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## The influence of fiscal freedom, government effectiveness and human development index on tax evasion in the European Union

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**Abstract.** *The fiscal behavior of taxpayers in a state that wants economic development is a subject of major importance. The tax system is one of the main tools by which a state exercises sovereignty through the collection, allocation and redistribution of revenues, in a given territory. This paper aims to highlight how the tax systems' characteristics, the human development and the effectiveness of the governmental actions affect the economic environment and hence taxpayers' behavior in the Member States of the European Union. To achieve this goal, indicators from the 28 Member States of the European Union and for the period 1999-2010 were used in the study. Starting with an analysis of panel data models, developed using a range of independent variables (fiscal freedom, government effectiveness, human development index) and tax evasion as a dependent variable, the study has 3 econometric models that analyze the influences implicated.*

**Keywords:** fiscal behavior, tax evasion, fiscal freedom, government effectiveness, human development.

**JEL Classification:** H30, H71.

## Introduction

Human behavior can be defined as the sum of mental, emotional, physical and social actions that a person has throughout life. This approach includes actions determined by culture, society, genetic and moral or religious values. Without a good understanding of human behavior, it is difficult to create and manage an organization, a company and ultimately a state, as all these entities are composed of individuals or citizens, personalities, attitudes, values, perceptions, motivations, aspirations and different skills. From this perspective, we can say that no two humans are identical, and consequently, theories and policies dealing with the population as a mass acting on the same principles and motivations have a reduced chance to achieve its objectives. By contrast, policies and economic theories that address the differences between people rather than similarities, and how these differences may affect the company, various organizations and, ultimately, individuals may have a greater chance of success.

Individual behavior, seen as a social being, but from an economic perspective, it is difficult to quantify and analyzed statistically. Empirical analyzes are in turn, difficult to achieve, given the complexity of the human being and that, unlike the sciences, the economy does not use or rarely use experiments that can be carried inside a laboratory. However, understanding the psychological factors that influence the behavior of economic agents is a very important scientific approach, both for those studying this field in terms of theory and those who are more interested in the application in real life of the eventual results of the research.

Decisions of individuals are influenced by factors such as social, psychological and emotional that sometimes prove to be more important than the rational ones. Thus, similar to decisions that have an immediate monetary component, decisions are taken similarly to emotional, general, everyday ones. Thus, exclusive analysis of economic factors does not help develop deeper understanding of decision-making, because psychological factors are at least as important as economic factors. An important consideration given the economic rationale is the desire of some of them to maximize their available income, calling for evading tax obligations.

Creating and developing the EU tax system is not only an economic process of great importance, but is equally a political process in which the sovereignty of the state, exercised by the Member States, plays a decisive role. In general, the tax system is based on institutions and instruments necessary for the implementation of fiscal policy in a given territory. The creation of a supranational fiscal infrastructure of the European Union is a complex process, favored by globalization trends manifested in the fiscal area, but also some reforms are hampered by existing differences between Member States, which are used to take independent decisions in this area.

The public financial system has always been on the borderline between political and economic aspects in the regional integration process. The tax system, in the European Union, is a reflection of the level of separation between economic integration emphasized by the existence of the single market and creation of a stronger political union. The coordination of tax systems has a very important role in ensuring the finality of the

integration process and it is absolutely necessary for the development of the Member States and society. In addition to the rules mentioned above, the tax system aims to create similar conditions in terms of tax competition between Member States and to redistribute budgetary funds to reduce interstate disparities (Talpoş and Enache, 2008).

There are significant differences between national tax systems and the tax system of the European Union. However, there are significant differences in terms of a domestic fiscal policy of the different Member States, which appeal to both local factors, and the willingness of states to take advantage of each other, including in this area. Based on these issues, fiscal harmonization within the European Union, still remains a goal, although in recent times there are significant advances.

Evaluation of different factors that contribute to economic growth has been and continues to be one of the most important concerns of economists everywhere. The role of fiscal policy in providing frameworks for economic development is also highly debated and the states are trying to find a balance between generating public revenues and stimulating growth, whereas the increase of tax rates has a negative effect on the profitability of investments.

With the beginning of the financial crisis, that became then an economic crisis, the role of the state in the economy, both in terms of regulating markets as in terms of its position as an active economic agent, was revived. EU Member States have established clear objectives for the policies, that would be applied in order to stimulate economic recovery and increase competitiveness. To achieve these objectives, management institutions at European level as well as national authorities, have undertaken to promote sustainable economic growth through fiscal policies and strategies on short and long term, quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies, level of education.

## 1. Econometric models

The economic field studies processes and phenomena, based on the idea that they are not carried out randomly, but based on their own laws, relatively stable and relatively repeatable, seeking to identify and, where possible, to influence. Starting from the basic idea that economic phenomena are most often measured (although there are situations where a quantitative analysis of a qualitative phenomenon can affect the results), the economy resorts to mathematics, statistics and econometrics, to show how certain factors influence the economic situation of a company, a region, a country or group of countries.

Econometric models are based on the regression method that establishes a statistical connection between the endogenous and exogenous variables (or influencing factors). The econometric modeling nowadays are increasingly using panel data, which have the advantage that they place equally temporal dimension and transverse dimension in the analysis variables. Form econometric models using panel data are of type:

$$Y_{it} = a + bX_{it} + \varepsilon_{it}, \quad (1)$$

where:

$i = 1, 2, 3, \dots, N$ ,  $N$  representing the number of elements of the panel (countries);

$t = 1, 2, 3, \dots, T$ ,  $T$  representing the number of periods.

A fixed effects model presupposes that the endogenous variable is influenced by the exogenous variable that changes over time. Therefore, analyzing the relationship between predictor variables and the variables within an entity (state, company, region, etc.), taking into account that some individual characteristics of the endogenous variables can have an impact on predictors.

Equation model with fixed effects is as follows:

$$Y_{it} = \beta X_{it} + \alpha_i + \varepsilon_{it}, \quad (2)$$

where:

$Y_{it}$  = dependent variable ( $i$  = entity,  $t$  = time);

$\beta$  = coefficient independent variable;

$X_{it}$  = independent variable;

$\alpha_i$  = constant;

$\mu_{it}$  = residual variable.

One of the main advantages of using random effects models is that they use for estimation variables that do not vary over time (varies only between different entities), variables which include models with fixed effects in the model constant. It is also important to note that random effect models presume that the standard error is not correlated with the regressors, and this allows to use even constant values as explanatory variables.

The general equation models with random effects is as follows:

$$Y_{it} = \beta X_{it} + \alpha_i + (\mu_{it} + \varepsilon_{it}), \quad (3)$$

Where:

$\mu_{it}$  = error between variables;

$\varepsilon_{it}$  = error within the same variables.

With use of the Stata program, version 14, for the data analysis, the error  $u_{it} = \alpha_i + \varepsilon_{it}$ , consider  $\alpha_i$  as a component of the error specific for the variable, corresponding to the element  $i$  and  $\varepsilon_{it}$  as random component of the error.

The introduction of time gaps (lags) considers that there is a possibility that qualitative factors exist between the explanatory variables of type  $X_i$ , whose modification is difficult to quantify. Therefore, we introduce a time delay, which aims to precisely consider the fact that the variation of  $X$  may influence the variation of  $Y$  over several time periods, subsequent to the moment when this variation occurred.

For reaching an optimum model it is necessary to perform a *Hausman-test* or a  $m$ -statistical to verify the hypothesis in terms of bias or inconsistency for some estimators. The test proposed by Jerry Hausman in 1978 aims to examine the hypotheses, that involve the use of estimators, specific for the models with fixed effects or with variable effects (if the value of  $p$  is less than 0.05, then it is not recommended to use a model with variable effects, but one

with fixed effects; if the value of  $p$  is greater than 0.05, it is recommended to use estimators for variable effects). Thus, according to the test, the specific estimator of the model with fixed effects, can be used also for the model with random effects, but it is effective only in the first one. Instead, the estimator specifically for the model with random effects cannot be used in the model with fixed effects (Kunst, 2013).

The main hypotheses for simple regression models are based on general assumptions of regression models, and are expressed as follows:

- 1) Defining (enunciation) the correct model.
- 2) Examining the accuracy of the data (data series are not affected by measurement errors).
- 3) Certifying that the residuals are zero mean random variables: for every  $i$ , the property shows that other unregistered factors, except the exogenous feature, have not a systematic influence on the average of the endogenous feature.
- 4) The variance of the residual variables is invariant in time or constant while defining property of homoscedasticity. The homoscedasticity assumption is restrictive in the developed model because the statistical panel data are obtained for a group of countries.
- 5) No autocorrelation of the residuals:  $cov(i, j) = 0, i \neq j$ .

## 2. Selection of variables

The econometric model proposed analyses the data in the 28 European Union Member States, in the period 1999-2010. The dependent variable is the amount of tax evasion as a percentage of GDP. The independent variables are: fiscal freedom, government effectiveness and the human development index. These variables are defined as follows:

**Tax evasion** (txe) is the illegal evasion of taxes by individuals, corporations, and trusts. Tax evasion, often entails taxpayers deliberately misrepresenting the true state of their affairs to the tax authorities to reduce their tax liability and includes dishonest tax reporting, such as declaring less income, profits or gains than the amounts actually earned, or overstating deductions.

**The fiscal freedom** (fiscf) component is a composite measure of the burden of taxes that reflects both marginal tax rates and the overall level of taxation, including direct and indirect taxes imposed by all levels of government, as a percentage of gross domestic product (GDP). The component score is derived from three quantitative sub-factors:

- The top marginal tax rate on individual income.
- The top marginal tax rate on corporate income.
- The total tax burden as a percentage of GDP.

$$\text{Fiscal Freedom}_{ij} = 100 - \alpha (\text{Factor}_{ij})^2$$

where:

Fiscal Freedom<sub>ij</sub> represents the fiscal freedom in country  $i$  for factor  $j$ ;

Factor<sub>ij</sub> represents the value (a percentage expressed on a scale of 0 to 100) in country  $i$  for factor  $j$ ;

and  $\alpha$  is a coefficient set equal to 0.03. The minimum score for each sub-factor is zero, which is not represented in the printed equation but was utilized because it means that no single high tax burden will make the other two sub-factors irrelevant.

**Government Effectiveness** (*guvef*) captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. The estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5.

**The Human Development Index** (*hdi*) is a summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and have a decent standard of living. The HDI is the geometric mean of normalized indices for each of the three dimensions. HDI has values between 0 and 1. The Human Development Index is greater as the indicator approaches 1.

The variables used were chosen based on empirical studies conducted by Schneider (2012), Schneider and Buehn (2012), Schneider and Lars (2010), Schneider and Williams (2013). Thus, they were selected as independent variables: fiscal freedom, government effectiveness and human development index to check the reverse influence on the dependent variable represented by tax evasion. The study aims to demonstrate that a high level of fiscal freedom, government effectiveness and a high human development index is associated with a low level of tax evasion in Member States of the European Union.

### 3. Data processing and results

In econometric research, we built three linear regression models to test the influence of the independent variables on the dependent variable.

**Model 1:** The influence of fiscal freedom on tax evasion.

Equation model:

$$txe = \alpha + \beta * fiscf + \varepsilon \quad (4)$$

**Model 2:** The influence of fiscal freedom and government effectiveness on tax evasion.

Equation model:

$$txe = \alpha + \beta * fiscf + \gamma * guvef + \varepsilon \quad (5)$$

**Model 3:** The influence of fiscal freedom, government effectiveness and the human development index on tax evasion.

Equation model:

$$txe = \alpha + \beta * fiscf + \gamma * guvef + \delta hdi + \varepsilon \quad (6)$$

Next we have done three econometric models:

- a model based on least squares (OLS);
- a model with fixed effects;
- a model with random effects.

### 3.1. Analysis of the research results in all the Member States of the European Union

The Table 1 exposes the results of running the 3 models above for all European Union countries (28 European Union member states generating 336 observations).

**Table 1.** *The influence of the fiscal freedom, government effectiveness and the human development index on tax evasion in the Member States of the European Union*

	M1			M2			M3			The expected sign
	OLS	Fixed effects	Random effects	OLS	Fixed effects	Random effects	OLS	Fixed effects	Random effects	
Fiscf	-0.21***	-0.22***	-0.2***	-0.007***	-0.021***	-0.019***	-0.01***	-0.004*	-0.007***	-
Guvef				-0.562***	-0.176**	-0.281***	-0.541***	-0.084	-0.174***	-
hdi							-0.78***	-1,256***	-1.018***	-
R <sup>2</sup>	0.15	0.32	0.32	0.34	0.34	0.33	0.36	0.58	0.57	
F	60.99	130.09		88.86	99.81		62.74	162.70		
N observations	336	336	336	336	336	336	336	336	336	
T. Hausman		P=0.000			P=0.000			P=0.000		

**Source:** Own processing in Stata 14.

In Table 1 we can observe a very good general relevance of the model in terms of elevated levels of the F-statistic and R<sup>2</sup>, which indicates that the model can be explained by the chosen variables.

As a result of the implementation of the Hausman test it was observed that in all the three models the fixed effects method has to be chosen at the expense of the random effects, because the probability obtained is below the level of significance of 0.05%.

The three models were run sequentially, by adding a new variable besides the existing ones in order to verify the correctness of the proposed model. As it can be seen the sign of coefficients does not change during the 3 models, checking their accuracy in their choosing.

The M1 model presents the influence on tax evasion of the fiscal freedom. The analysis results identify a negative correlation between the level of fiscal freedom and the percentage of tax evasion, increasing the fiscal freedom will reduce the tax evasion. The phenomenon could be explained by the fact that a higher degree of fiscal freedom reduces the taxpayers' perception in relation to the taxation level, alternatively, determines a higher level of compliance vis-à-vis the tax obligations to the state.

Enhancing the government effectiveness, quantified by providing quality public services, investments in strategic areas and transparency in public spending leads to reducing the levels of tax evasion. In this sense, we can say that taxpayers' perception of the quality of services provided by state influences attitudes about tax compliance.

A positive influence is observed in the model which examines the human development index on the independent variable. Thus a high degree of literacy increased life expectancy and a high quality of life are associated with improving tax collection. Schneider's empirical studies show higher levels of tax revenues in the developed countries in comparison with the countries that are ongoing development.

The results obtained should be interpreted with caution. The limits of the model are due to the size of the panel, thus it cannot be generalized in all the situations, the subjective data used in the model as the government effectiveness is measured subjectively as a perceptual feeling that the citizens have about certain aspects in the country.

### 3.2. Analysis of the research results in the Southern European Member States of the European Union

The Table 2 exposes the results of running the 3 models above for the Southern European countries Member States of the European Union (Italy, Spain, Portugal, Cyprus, Greece and Malta).

**Table 1.** *The influence of the fiscal freedom, government effectiveness and the human development index on tax evasion in the Southern European Member States of the European Union*

	M1			M2			M3			The expected sign
	OLS	Fixed effects	Random effects	OLS	Fixed effects	Random effects	OLS	Fixed effects	Random effects	
Fiscf	-0.057***	-0.025***	-0.018**	-0.057***	-0.03***	-0.022***	-0.511***	-0.005	-0.008	-
Guvef				-0.064	-0.212	-0.128	-0.229	-0.2**	-0.183**	-
hdi							-1.354***	-1.147***	-1.561***	-
R <sup>2</sup>	0.43	0.67	0.67	0.43	0.59	0.61	0.72	0.53	0.53	
F	53.73	86.58		26.57	88.76		60.94	162.70		
N observations	72	72	72	72	72	72	72	72	72	
T. Hausman		P=0.0034			P=0.001			P=0.3199		

**Source:** Own processing in Stata 14.

In Table 2 we can observe a very good general relevance of the model in terms of elevated levels of the F-statistic and R<sup>2</sup>, which indicates that the model can be explained by the chosen variables.

As a result of the implementation of the Hausman test there was observed that the first two models have the probability level of significance was below 0.05%, so the method chosen should be with fixed effects. For the M3 model the random effects should be chosen because the level of significance is 0.3199%.

The three models were run sequentially, by adding a new variable besides the existing ones in order to verify the correctness of the proposed model. As can be seen the sign of coefficients does not change during the 3 models, checking their accuracy in their choosing.

One model shows the effect of fiscal freedom on tax evasion in the Southern European states, namely Italy, Spain, Portugal, Cyprus, Greece and Malta. After analyzing the results of the model, we can see a negative correlation between tax evasion and fiscal freedom, the fiscal freedom increased by one leading to a decrease tax evasion with 0.025% in those states. This phenomenon can be explained by the fact that high tax burden and reduced tax rates on the taxpayer generate the raising of the level of tax compliance. This creates prerequisites for establishing a framework to enable an optimal level of taxes, so as to ensure growth in the tax base rather than increasing the percentage value of taxes.

The government effectiveness has a key role in the level of tax compliance. Quality of public services provided by the state, the policies formulated and implemented with precision and quality, and the credibility of the contributors to these policies has a strong impact on the behavior of the citizens. Thus, an increase in the governance effectiveness determines the rising of the tax collection that cause a decrease in tax evasion.

The independent variable is positively influenced by the human development index. A high degree of literacy and a high standard of living, occurred mainly in Spain, Italy and Portugal, causes a decrease in tax evasion explained by the superior utility of public spending (i.e. spending in health and education) perceived by citizens.

### 3.3. Analysis of the research results in the Northern European Member States of the European Union

The Table 3 exposed the results of running the 3 models above for the Northern European countries Member States of the European Union (Sweden, Denmark and Finland).

**Table 3.** The influence of the fiscal freedom, government effectiveness and the human development index on tax evasion in the Northern European Member States of the European Union

	M1			M2			M3			The expected sign
	OLS	Fixed effects	Random effects	OLS	Fixed effects	Random effects	OLS	Fixed effects	Random effects	
Fiscf	-0.037	-0.005	-0.003	-0.003	-0.002	-0.003	-0.005	-0.006*	-0.005	-
Guvef				-0.089*	-0.42	-0.538*	-0.623**	-0.108	-0.623**	-
hdi							-0.792**	-1.468***	-0.792**	-
R <sup>2</sup>	0.19	0.05	0.53	0.10	0.83	0.58	0.24	0.69	0.97	
F	0.67	3.58		1.89	2.65		3.44	30.4		
N observations	36	36	36	36	36	36	36	36	36	
T. Hausman		P=0.65			P=0.1537			P=0.000		

**Source:** Own processing in Stata 14.

In Table 3 we can observe a very good general relevance of the model in terms of elevated levels of R<sup>2</sup>, which indicates that the model can be explained by the chosen variables.

As a result of the implementation of the Hausman test there was observed that the first two models have the probability level of significance was above 0.05%, so the method chosen should be with random effects. For the M3 model the fixed effects should be chosen because the level of significance is 0.000%.

The three models were run sequentially, by adding a new variable besides the existing ones in order to verify the correctness of the proposed model. As can be seen the sign of coefficients does not change during the 3 models, checking their accuracy in their choosing.

The model analyzes the impact of the independent variables on tax evasion in the Nordic EU member states. The Northern States (Sweden, Denmark and Finland) have the most developed economies in Europe and the European Union, in terms of value of gross domestic product per capita. Northern Europe's economic structure is complex and

varied, being influenced by the current political developments, historical antecedents and socio-economic characteristics of the countries that compose it.

From the econometric modeling performed in the three states mentioned above, it appears that a reduction in tax rates and tax burdens on the taxpayers causes a reduction in tax evasion. One of the possible explanations is that, although the tax rates are high, the Nordic countries have a balanced economic system that determines a positive perception of the level of taxes and efficiency of public spending.

A high effectiveness of the governance process in the Nordic Member States of the European Union reduces tax evasion. Thus, improvements in public services, increasing transparency and credibility of government authorities can determine the efficiency of tax collection.

A positive influence is observed including the model, which examines the human development index on the independent variable. Thus, a high degree of literacy, increased life expectancy and a high quality of life are associated with improving tax revenue collection.

#### 3.4. Analysis of the research results in the Central-Eastern European Member States of the European Union

The Table 4 exposes the results of running the 3 models above for the Central-Eastern countries Member States of the European Union (Bulgaria, Croatia, Hungary, Romania, Latvia, Lithuania, Estonia, Czech Republic, Slovakia, Slovenia and Poland).

**Table 4.** The influence of the fiscal freedom, government effectiveness and the human development index on tax evasion in the Central-Eastern Member States of the European Union.

	M1			M2			M3			The expected sign
	OLS	Fixed effects	Random effects	OLS	Fixed effects	Random effects	OLS	Fixed effects	Random effects	
Fiscf	-0.011**	-0.027***	-0.027***	-0.013**	-0.025***	-0.024***	-0.009*	-0.004	-0.004	-
Guvef				-0.651***	-0.29**	-0.329**	-0.131*	-0.33**	-0.325**	-
hdi							-1.045***	-1.66***	-1.608**	-
R <sup>2</sup>	0.30	0.47	0.47	0.20	0.49	0.49	0.34	0.72	0.72	
F	5.36	86.1		16.99	71.94		22.07	116.14		
N observations	132	132	132	132	132	132	132	132	132	
T. Hausman		P=0.092			P=0.5316			P=0.994		

**Source:** Own processing in Stata 14.

In Table 4 we can observe a very good general relevance of the model in terms of elevated levels of the F-statistic and R<sup>2</sup>, which indicates that the model can be explained by the chosen variables.

As a result of the implementation of the Hausman test it was observed that all the three models have the probability level of significance was above 0.05%, so the method chosen should be with random effects.

The three models were run sequentially, by adding a new variable besides the existing ones in order to verify the correctness of the proposed model. As can be seen the sign of coefficients does not change during the 3 models, checking their accuracy in their choosing.

The models show the effect of fiscal freedom, human development index and government effectiveness on the level of tax evasion in the Central-Eastern state members of the European Union. Included in this area are Bulgaria, Croatia, Hungary, Romania, Latvia, Lithuania, Estonia, Czech Republic, Slovakia, Slovenia and Poland. 27 years since the transition to democracy and market economy, and 11 years after the biggest enlargement of the European Union, the countries of Central and Eastern Europe still faces problems of functioning institutions and they have to recover an important gap in comparison to the Western and Northern European countries. In this context, the Central-Eastern European Union Member States have faced a series of austerity measures (increases value added tax, cuts in public sector wages, etc.) which generated a wave of discontent among taxpayers.

The study shows that a reduction in tax rates and tax burdens levied by taxpayers result in a reduction of tax evasion, meaning that lowering the amount of taxes reduces the propensity of the tax payers to not fulfill tax obligations.

In developing countries in the Central-Eastern Europe the focus on streamlining the governance process, which involves increasing the quantity and especially the quality of public services and the credibility of the government system. Implementation of these actions results in a reduction of tax evasion recorded.

A positive influence is observed in the model which examines the human development index on the independent variable, high literacy, increased life expectancy and a high standard of living is associated with improving tax collection.

### 3.5. Analysis of the research results in the Western European Member States of the European Union

The Table 5 exposes the results of running the 3 models above for the Western European countries Member States of the European Union (France, Germany, Great Britain, Ireland, Luxembourg, Belgium, Netherlands, Austria).

**Table 5.** *The influence of the fiscal freedom, government effectiveness and the human development index on tax evasion in the Western European Member States of the European Union*

	M1			M2			M3			The expected sign
	OLS	Fixed effects	Random effects	OLS	Fixed effects	Random effects	OLS	Fixed effects	Random effects	
Fiscf	-0.004	-0.013***	-0.012***	-0.005**	-0.007***	-0.006***	-0.001	-0.004*	-0.006***	-
Guvef				0.562***	0.345***	0.359***	0.706***	0.3***	0.355***	-
hdi							-0.965***	-1.769***	-0.276	-
R <sup>2</sup>	0.20	0.35	0.47	0.15	0.47	0.47	0.43	0.52	0.48	
F	2.59	93.81		8.72	100.19		23.87	69.03		
N observations	96	96	96	96	96	96	96	96	96	
T. Hausman		P=0.000			P=0.36			P=0.025		

**Source:** Own processing in Stata 14.

In Table 5 we can observe a very good general relevance of the model in terms of elevated levels of the F-statistic and R<sup>2</sup>, which indicates that the model can be explained by the chosen variables.

As a result of the implementation of the Hausman test there was observed that the M1 and M3 models have the probability level of significance under 0.05%, so the method chosen should be with fixed effects. For the M2 model the variable effects should be chosen because the level of significance is 0.36%.

The three models were run sequentially, by adding a new variable besides the existing ones in order to verify the correctness of the proposed model. As can be seen the sign of coefficients does not change during the 3 models, checking their accuracy in their choosing.

Taxes on income from labor and social security contributions occupies the largest share in the total tax rate in the European Union, namely in the states of Western Europe (France, Germany, Great Britain, Ireland, Luxembourg, Belgium, Netherlands, Austria). Also, to pay these types of taxes and contributions, taxpayers allocate most of the time for tax compliance.

Increasing fiscal freedom is determined by reducing tax rates and tax burdens, which subsequently influences the likelihood of achieving the reduction of tax evasion recorded.

Unlike other groups of countries in Western Europe, enhancing the government effectiveness (providing quality public services, investments in strategic areas and transparency in public spending) increases the level of tax evasion. Thus, we can say that taxpayers' perception on the quality of services provided by the state, but also the socio-cultural influences of Western Europe tax payers attitude vis-a-vis the tax compliance in a manner that goes beyond the act of governmental effectiveness. The negative correlation identified in the econometric model can be explained by inclination pronounced by residents of Western states to the values of capitalism and toward free enterprise, involving a limited role of the state in the economy, namely the reduction of taxes. Hence, it can be concluded that an increased level of efficiency, which involves a high level of taxes an incentive to circumvent the tax legislation.

A positive influence is observed including predicting which examines the human development index on the independent variable. Thus, a high degree of literacy, increased life expectancy and a high quality of life is associated with improving tax collection.

The results obtained should be interpreted with caution. The limits of the model are due to the size of the panel that is reduced, thus cannot be generalized to the whole sample, the subjective data used in the model as the government effectiveness, which is measured as a subjective perception of the taxpayers.

## Conclusions

From reviewing the literature, it shows that the fiscal policies and the budget policies of a state have an important role in defining the characteristics of the economic environment and thus ensuring the citizens' behavior.

After analyzing the 3 econometric models we can say that there is a reverse connection between tax evasion and the 3 independent variables: fiscal freedom, government effectiveness and human development index.

Increasing fiscal freedom, which involves reducing the level of tax burden determine the reduction of tax evasion done by the taxpayers in the state by changing their behavior in a positive sense. Increasing government effectiveness perceived in a positive way by the taxpayer reduces the tax evasion by determining tax compliance. The human development index represents the increasing of the living standard registered in a State, which automatically influences the reduction of tax evasion made by taxpayers.

Changing the current course of the economy will not be easy to achieve, given the contemporary economic situation, but we can choose to reformulate the rules of structure and functioning of the economic system so that it satisfies the requirements and challenges of contemporary society. By doing this, we can restore the balance between the state, business, employees or taxpayers, to have an economy that works with the best results for everyone involved.

Tax systems must be reformed and the state should ensure the perspectives and priorities of various stakeholders are understood and taken into account when developing and implementing policies. Updating and harmonization of tax systems in Europe (and the world) is not an action easy to achieve, but continued use of mechanisms and tools whose effectiveness is lacking is not a viable long-term option.

However, our society today, in all its aspects, therefore, including economically or in terms of taxpayer behavior can not be limited to the statistical universe, no matter how well founded and complex it may be. Therefore, studies of the behavior of the taxpayer should be continued, with various approaches and methods in an attempt to achieve a description and, later, a standardization and / or a forecast closer to the reality.

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## **Limitation of ARIMA models in financial and monetary economics**

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**Abstract.** *Abandoning the classical econometric modeling approach which consists in using explanatory variables (suggested by economic theory for prediction), we choose instead to use a sophisticated method developed by Box and Jenkins (1970) based solely on the past behavior of the variable being modeled/forecast.*

*As we are in a data-rich environment and the economies and financial markets are more integrated than ever before, the quantitative methods in business and finance has increased substantially in recent years.*

*This paper investigates the limitation of autoregressive integrated moving average (ARIMA) models in financial and monetary economics using the behavior of BET Index and EUR/RON exchange rates, respectively. Two important features discovered in the analysis of financial time series in this paper are fat-tails (large losses or gains are coming at a higher probability than the normal distribution would suggest) and volatility clustering, these empirical properties can't be captured by integrated ARMA models, hence the limitation of these models.*

**Keywords:** Time Series Analysis, Autoregressive Integrated Moving Average, Forecast, BET Index, Exchange Rates, Box-Jenkins approach.

**JEL Classification:** C13, C22, C51, C52, C55, C58.

## 1. Introduction. Literature review

Unsurprisingly, Financial Economics represents the most empirical discipline of the economics/social science branches, showing a rapid increase of its usage in practice as well as stabilizing and facilitating growth of global economy. On the other hand, a strong economy is based on a well-established stock market, which is volatile by nature. Volatility affects, directly or indirectly, many factors such as: interest rates, currency exchange rates, imports, exports, GDP, and so forth. For example, a change in monetary policy leads to a change in the interest rates which affects the stock market return.

Also, risk managers are interested in forecasting the evolution of prices and risk factors. This can be done using only current and past observations which represents a key topic in time series analysis. Volatility as a phenomenon as well as a concept remains central to modern financial markets and academic research.

Researches regarding the predictability of exchange rates and financial asset returns have been under examination over the years and are still being studied stoutly:

It was shown by Akaike, H. (1976) that monetary approach can outperform the Random Walk model in an out-of-sample forecast exercise by incorporating a money demand function with a partial adjustment mechanism.

Starting with 1983 (Meese and Rogoff) forecasts of exchange rates using models based on Random Walk exceeded models based on the macroeconomic indicators, but this efficiency is lost when we are dealing with a time horizon that is extended by more than 12 months. It seems that empirical models used in seventies for exchange rates prediction fit well in sample, but we can't say the same thing if we consider an out-of-sample forecast.

Mark, N.C. (1995) presents evidence that long-horizon changes in the logarithm of spot exchange rates are predictable, motivated by a monetary model of exchange rate determination and is defined to be a linear combination of log relative money stocks and log relative real incomes. So, he found that the empirical exchange rate models were helpful in predicting long-horizons by investigating the movements of the U.S. Dollar price against four major currencies: the Canadian Dollar, Deutsche Mark, Swiss Franc, and the Japanese Yen, in a time period of 18 years (quarterly observations, from 1973:2 to 1991:4). In addition, subsequent works have questioned on whether exchange rates can be forecast at long-horizons, which leads to a weak consensus that models are not very helpful in predicting.

The economists Bellgard C. and Goldschmidt P. (1999) tried in nineties to forecast exchange rates using integrated *ARMA* models, but they have found these models are not suitable.

Weisang, G. and Awazu, Y. (2008) used integrated *ARMA* models for modeling USD/EUR exchange rate. They found that the series of monthly USD/EUR exchange rate for the period 1994:01 to 2007:10 was best modeled by a linear relationship between the current value and its preceding three values. They also lead to the conclusion that *ARIMA*(1,1,1) is the most adequate model for the prediction of the analyzed time series.

Finn, D. B. (2010) compares two monetary models: the flexible-price against rational-expectations, and conclude that the second one performs just as good as the Random Walk model. Another aspect presented in “Structural Time Series Model for the Analysis of exchange Rate of Naira” was about nominal exchange rate whose behavior was thought for long time to be described good by the Naïve Random-Walk (*NRW*) model. This leads to the conclusion of the inexistence of certain systematic economic forces in determining the foreign exchange rates.

Another example of a study using Box-Jenkins methodology is for instance the paper “Exchange-rates Forecasting: Exponential Smoothing Techniques and ARIMA Models”, in which the authors investigated the behavior of daily exchange rates of the RON versus the most important currencies in terms of international trade, namely the Euro, United States Dollar, British Pound, Japanese Yen, Chinese Renminbi and the Russian Ruble. (Făt and Dezsi, 2011).

Begu, L.S., Spătaru, S. and Marin, E. (2012) investigated the volatility of foreign exchange rates taking into account the daily RON/EUR exchange rates from 05.01.2009 to 12.10.2012. Trying to capture the key features of the analyzed data, they used several models: *ARCH*, *GARCH*, *EGARCH* and *TGARCH*. “The empirical results suggested that, for modeling the volatility of returns, the estimated *GARCH* models fit the sample data good enough. In practice, the *GARCH*(1,1) process generally seems to work reasonably well.” (Begu et al., 2012, pp. 38-39).

Another example of a study using the Box-Jenkins approach in forecasting exchange rates is “The prediction of exchange rates with the use of Auto-Regressive Integrated Moving Average models” in which Spiesová, D. (2014) confirms that to predict the conditional variance and then to estimate the future values of exchange rates (the Czech Koruna, Swedish Krona, British Pound, Polish Zloty, Hungarian Forint and the Romanian Leu vs. Euro), it is adequate to use the *ARIMA*(1,1,1) model without constant, or *ARIMA*[(1,7), 1, (1,7)] model, where in the long-term, the square root of the conditional variance inclines towards stable value. The author also concluded that using integrated *ARMA* models presented certain problems in estimating and validating the model and those models are more effective in interpretation of the medium-term value.

The same can be seen in researches regarding financial asset returns. According to Fama, E.F. (1965) all theories are based on the same assumption, the history of a time series data is rich in information – “History repeats itself in that “patterns” of past price behavior will tend to recur in the future.” (Fama, 1965, p. 34). He used daily prices, from 1957 to 1962:09:26 (the starting date varies from share to share from 1965:01 to 1958:04), for each of the 30 shares of the Dow-Jones Industrial Average Index, and pointed out an interesting characteristic given by the signs of the autocorrelation coefficients. For the daily differences, he finds out that 23 out of 30 first-order autocorrelations coefficients are positive, while for the four-day differences and nine, respectively, he finds that 21 of the autocorrelation coefficients and 24, respectively, are negative.

In his paper, Kon, S.J. (1984) explains fat-tails and positive skewness regarding daily returns of stocks and indexes making use of a discrete mixture of normal distribution. In financial theory the most important assumptions with respect to asset prices are the multivariate normal distribution and stationarity of the parameters. Moreover, the normality and stationarity represent required assumptions to most econometric models.

Lo, A.W. and MacKinlay, A.C. (1988) applying a test relied on variance estimators provide additional evidence regarding the Non-Random Walk evolution of the stock prices. Another interesting thing shown in the paper is given by the positive autocorrelation of the weekly returns on portfolios and the negative one for the individual securities.

Conrad, J., Kaul, G. and Nimalendran, M. (1991) show interest in some scheming properties of time series behavior of short-horizon asset returns and portfolios revealed in many papers regarding the positively autocorrelated portfolio returns and the negatively autocorrelated short-horizon individual asset returns. The first one implies that returns are foreseeable and the rank of the positive autocorrelation is inversely proportional to the size of the company.

Later on, Chang, K-P. and Ting, K.-S. (2000) applied the methodology of Lo and MacKinlay on the weekly Taiex Index (Taiwan composite value-weighted stock market index) for the period 1971-1996 and concluded the movements do not fit a Random Walk. It is likely that using the same methodology on more current data it can lead to different results since the Taiwan investment climate has changed a lot from 1971.

Cont, R. (2001) underlines some basic properties regarding the assets, price variations and other Financial Markets analysis. These properties are better shaped using volatility clustering, conditional heavy tails and linear autocorrelation. In this case, the abnormality of the residues shows that the traditional tools used in time series modeling (*ARMA* models) cannot be used to predict asset returns. In this case, nonlinear measures of dependence should be taken into account.

Christoffersen, P. (2003) also finds that the distribution of asset prices (returns) is characterized by fat-tails whose capture is decisive for a relevant analysis.

Unlike Chang and Ting's (2000) study upon Taiex Index, extending this study for the period 1996-2006, Lock, D.B. (2007) obtained that the weekly movements of Taiex Index from 1971 to 2006 follow a Random Walk. The gap in results may be thanks to the nature of the market, it being in its early stages till the 1980s and later reaching out maturity.

Tinca, A. (2013) highlights the underlying properties of financial markets using results like conditional heavy tails, negative asymmetry, the aggregational gaussianity is more pronounced for monthly returns compared to weekly returns, volatility clustering, negative correlation between volatility and returns, positive correlation between volatility and trading volume, low significance of the mean of the daily returns. Asset pricing models tend to fail when normality assumptions are taken into account.

## 2. Specification of the ARMA model

Time series represents a source of information for analysis and economic forecast, and reveals knowledge items which are useful for research or economic activity. We may consider time series as a raw material which processed by statistical or econometric methods can highlight recurring issues, analogies, conditionings or benchmarks. More specifically, time series passed through the filter of specific analysis/forecast methods can provide information on: the existence of a dominant evolutionary direction which applies particularly to conditions of normality of the process, appearance of systematic periodic oscillations with chances of repeating as effect and scale in the future, evolution's inertial character of some processes or relatively predictable appearance of the evolution of some processes as a response to some deviations from the past.

The dependence of the adjoining observations represents an inherent characteristic of time series and is of practical significance. Techniques for analyzing this dependence require "the development of stochastic and dynamic models for time series data and the use of such models in important areas of application" (Box et al., 2015, p. 7).

The analysis of time series can be divided in two types of methods, namely:

Spectral analysis, based on frequency components of a data series:

$$y_t = \mu + \sum_{i=1}^n [y_{1i} \cos(2\pi f_i t) + y_{2i} \sin(2\pi f_i t)] \quad (2.1)$$

where:

$y_1$  and  $y_2$  are uncorrelated random variables, having zero variance  $\sigma^2(f_i) = 0$ ;  
the set  $\{f_i\}_{i=1, \overline{T}}$  denotes the frequency at which  $y_t$  is evaluated.

The purpose of the analysis is to show at which frequencies the variable is active.

Time-domain analysis, based on the evolution of a variable with respect to time. It consists of modeling directly the relationships with delay of a series and its history.

The main aim of time series analysis is to evolve mathematical and statistical tools that reflect reality with respect to the analyzed sample data, thus providing plausible description for the population in cause.

Box and Jenkins, who developed in 1970 the technique for modeling time series known as the Box-Jenkins approach, stated that financial time series are not stationary since the mean changes over time, so they proceeded to differentiate the data in order to obtain stationarity. Thus, if the initial data was considered as being described by the random variable  $Y$ , the input for the Box-Jenkins technique would be described by the new variable  $Y^{BJ}$ . This model takes into consideration only the past values and past errors of the analyzed variable whose mathematical representation is as follow:

$$Y_t^{BJ} = f(Y_{t-1}^{BJ}, \dots, Y_{t-p}^{BJ}) + g(\varepsilon_{t-1}, \dots, \varepsilon_{t-q}) + \varepsilon_t \quad (2.2)$$

hence the difference from the traditional econometric model. The model above is the autoregressive integrated moving average process for  $Y$ , noted  $ARIMA(p, d, q)$ .

We start to describe mathematically the  $ARMA(p, q)$  model by introducing those two components,  $AR(p)$  process and  $MA(q)$  process, presented in “Financial Econometrics: From Basics to Advanced Modeling Techniques”.

An autoregressive process, noted as  $AR(p)$ , represents a process where the present value of a time series is described by a function of its  $p$  - past values. The mathematical representation of the  $AR(p)$  process is given by the following equation (the  $p$  -th order difference equation):

$$y_t = \alpha_1 y_{t-1} + \alpha_2 y_{t-2} + \dots + \alpha_p y_{t-p} + \varepsilon_t \quad (2.3)$$

where:

$y_t$  - the realisation of the dependent variable  $Y$  at time  $t$ ;

$y_{t-1}, y_{t-2}, \dots, y_{t-p}$  - the realisation of the lagged dependent variables;

$\alpha_1, \alpha_2, \dots, \alpha_p$  - the unknown parameters of the model,  $\alpha_1 \neq 0$ ;

$\varepsilon_t$  - the value of the disturbance term at time  $t$ , i.i.d.  $\varepsilon_t \sim N(0, \sigma^2)$ ;

$p$  - the number of lagged values of  $Y$  and represents the order of the process.

Consider  $L$  the lag operator, the equation of an  $AR(p)$  process is then:

$$(1 - \alpha_1 L - \alpha_2 L^2 - \dots - \alpha_p L^p) y_t = \varepsilon_t \quad (2.4)$$

or, equivalently

$$\alpha(L) y_t = \varepsilon_t \quad (2.5)$$

where:  $\alpha(L) = 1 - \alpha_1 L - \alpha_2 L^2 - \dots - \alpha_p L^p$  and represents the autoregressive polynomial.

A moving average process, noted as  $MA(q)$ , represents a process where the present value of a time series is described by a function of its current and  $q$  - past disturbances (lagged errors). The mathematical representation of the  $MA(q)$  process is given by the following equation:

$$y_t = \varepsilon_t + \beta_1 \varepsilon_{t-1} + \beta_2 \varepsilon_{t-2} + \dots + \beta_q \varepsilon_{t-q} \quad (2.6)$$

where:

$y_t$  - the realisation of the dependent variable  $Y$  at time  $t$ ;

$\varepsilon_{t-1}, \varepsilon_{t-2}, \dots, \varepsilon_{t-q}$  - the realisation of the lagged disturbances;

$\beta_1, \beta_2, \dots, \beta_q$  - the unknown parameters of the model,  $\beta_q \neq 0$ ;

$\varepsilon_t$  - the current value of the disturbance term, i.i.d.  $\varepsilon_t \sim N(0, \sigma^2)$ ;

$p$  - the number of lagged values of  $Y$  and represents the order of the process.

Without losing any generality, in the above representation of a  $MA(q)$  process, we assumed that the coefficient of  $\varepsilon_t$  equals 1. This restriction is important, otherwise being unable to identify the coefficient of  $\varepsilon_t$  or  $\sigma^2$ . Thus, if we assume  $\beta_0$  being the coefficient of  $\varepsilon_t$ , then it is required either restriction  $\beta_0 = 1$  or  $\sigma^2 = 1$ .

In the case of  $\beta_0 \neq 1$ , we can rewrite the following equation

$$y_t = \beta_0 \varepsilon_t + \beta_1 \varepsilon_{t-1} + \beta_2 \varepsilon_{t-2} + \dots + \beta_q \varepsilon_{t-q} \quad (2.7)$$

in terms of standardized disturbances as:

$$y_t = \sigma u_t + \beta_1 \sigma u_{t-1} + \dots + \beta_q \sigma u_{t-q}, \text{ with } \text{Var}(u_t) = 1, \quad (2.8)$$

where  $u_t = \frac{\varepsilon_t}{\sigma}$  and  $\text{Var}(\varepsilon_t) = \sigma^2$ .

Consider  $L$  the lag operator, the equation of a  $MA(q)$  process is then:

$$y_t = (\beta_0 + \beta_1 L + \beta_2 L^2 + \dots + \beta_q L^q) \varepsilon_t \quad (2.9)$$

or, equivalently

$$y_t = \beta(L) \varepsilon_t \quad (2.10)$$

where  $\beta(L) = \beta_0 + \beta_1 L + \beta_2 L^2 + \dots + \beta_q L^q$  and represents the moving average polynomial of degree  $q$  with  $b_0 \neq 0$ .

The two processes discussed above can be seen as particular cases of a mixed autoregressive moving average process, noted  $ARMA(p, q)$ , that represents the current value of a time series depending upon its past values and on the preceding residual values, given by the following equation:

$$y_t = \alpha_1 y_{t-1} + \alpha_2 y_{t-2} + \dots + \alpha_p y_{t-p} + \varepsilon_t + \beta_1 \varepsilon_{t-1} + \beta_2 \varepsilon_{t-2} + \dots + \beta_q \varepsilon_{t-q} \quad (2.11)$$

or it can be rewritten in terms of the autoregressive and moving average polynomials as:

$$\alpha(L) y_t = \beta(L) \varepsilon_t. \quad (2.12)$$

The benefit of choosing a mixed autoregressive moving average process instead of simple autoregressive process or moving average process arises from a thrifty model with few unknown parameters.

An autoregressive integrated moving average process, noted as  $ARIMA(p, d, q)$ , is an  $ARMA$  model where instead of  $Y_t$  we are dealing with the differenced series of  $Y_t$ , and it has the following general form:

$$\alpha(L) \Delta^d y_t = \beta(L) \varepsilon_t, \text{ with } \Delta^0 = 1 \quad (2.13)$$

where:

$\alpha(L)$ ,  $\beta(L)$ ,  $\varepsilon_t$  - have the meaning set out in this paper;

$\Delta^d y_t$  - the new time series obtained by differentiating the initial series  $\{y_t\}$   $d$  - times.

According to Kennedy (2008), the Box-Jenkins methodology for constructing  $ARIMA$  process has three main steps:

Step 1. Identification/model selection – one must determine the order of each component of  $ARIMA$  process i.e.,  $p, d, q$ .

Step 2. Estimation of the model parameters;

Step 3. Diagnostic checking or adequacy of the model. The most important and difficult step is given by the trial and error identification of the model based on correlogram. “In this respect the Box-Jenkins method is an art form, requiring considerable experience for a researcher to be able to select the correct model.” (Kennedy, 2008, p. 298).

### 3. Data and methodology

Given the growing importance of the current elements of uncertainty and stock exchanges, uncertainty reflected in both the volatility of financial instruments prices (shares, bonds, derivatives), and in interest rates and foreign exchange rates, this paper aims the following aspects:

- presenting the functionality of Box-Jenkins methodology in two case studies: Romanian *GDP* and weekly United States regular gasoline price, respectively;
- showing the limitation of *ARIMA* models in financial and monetary economics using on the one hand the BET Index analysis, and on the other hand the EUR/RON exchange rate analysis.

#### 3.1. The functionality of Box-Jenkins methodology

##### 3.1.1. Romanian GDP

The advantages of integrated *ARMA* models are presented in Stancu, S. (2011) where the analyzed time series is Romanian *GDP* from 2000 to 2010, quarterly data obtained from the official website of the National Institute of Statistics<sup>(1)</sup>.

To achieve the adequate *ARIMA(p, d, q)* model, the *GDP* series was tested for stationarity by applying the unit root tests: Augmented Dickey-Fuller (Dickey and Fuller, 1979) and Phillips-Perron (Phillips and Perron, 1988). Besides tests of stationarity, the chart series and correlogram also indicated that the *GDP* series is non-stationary and presents serial autocorrelation for the first fourteen lags.

**Table 1.** Augmented Dickey-Fuller (ADF) test with a constant and linear trend and Phillips-Perron (PP) test with a constant, respectively, applied on Romanian *GDP* series

Indicators		Unit root tests	
		PP Constant	ADF Constant, Linear Trend
t-Statistic (Prob.)		-1.215748 (0.6591)	-3.113834 (0.1174)
t-critical	1%	-3.592462	-4.211868
	5%	-2.931404	-3.529758
	10%	-2.603944	-3.196411

Source: Stancu, 2011.

Since the null hypothesis is not rejected and the *GDP* series is non-stationary, it is necessary to proceed to its transformation. After the first difference, the autocorrelation coefficients are close to zero which leads to the conclusion that this new series is stationary as can be seen from table below.

**Table 2.** Phillips-Perron (PP) test with a constant for the new *GDP* series (i.e., *DGDP*)

Indicators		Phillips-Perron unit root test	
		Constant	
t-Statistic (Prob.)		-15.90439 (0.0000)	
t-critical	1%	-3.596616	
	5%	-2.933158	
	10%	-2.604867	

Source: Stancu, 2011.

The output of Eviews for descriptive statistics presented in Table 3 shows that the stationary series is characterized by:  $mean = 3402.426$  million RON in current prices ( $GDP$  has evolved from one quarter to another, on average, by 3402.426 million RON in current prices), and we can say that the new series follows an approximately normal distribution, asymmetric and flatter.

**Table 3.** Descriptive Statistics of Romanian GDP

DGDP	
Mean	3402.426
Median	9998.200
Maximum	25922.10
Minimum	-64904.80
Std. Dev.	22367.52
Skewness	-1.597471
Kurtosis	4.727696

Source: Stancu, 2011.

DGDP	
Jarque-Bera	23.63671
Probability	0.000007
Sum	146304.3
Sum Sq. Dev.	2.10E+10
Observations	43

Next step consists in seasonality detection and its deseasonalisation using the moving average method. The result is a new time series,  $DGDPSA$ , that is the first difference of  $GDP$  seasonal adjustment.

Correlogram analysis reveals that the autocorrelation function ( $ACF$ ) has the first thirteen values greater than zero and decreasing, and the partial autocorrelation function ( $PACF$ ) has the first five values different from zero. So, the series has a moving average component with the number of lagged values at most equal to 13 and an autoregressive component with the number of lagged equal to 5.

The parameters of the autoregressive moving average model will be estimated using the stationary and seasonally adjusted series. Since "it is therefore recommended not to insist on unambiguous determination of the model order, but to try more models" (Spiesová, 2014, p. 31), using Eviews software were estimated nine models. After estimating the parameters of those nine equations, the output reveals that all the autoregressive models are statistically valid ( $F_{statistical} > F_{critical}$  and  $Prob(F_{critical}) < 0.05$ ).

In order to verify whether the model is adequate we proceed to test the residues. Since Durbin-Watson statistics are close to 2, it follows that residues are not serial correlated. Heteroskedasticity of residues is tested using White test, according with there are several valid models:  $AR(5)$ ,  $ARMA(4,2)$ ,  $ARMA(3,1)$ ,  $ARMA(3,2)$ ,  $ARMA(6,1)$ ,  $ARMA(5,3)$  and  $ARMA(1,1)$  as can be seen from the results presented in Table 4.

**Table 4.** Heteroskedasticity of residues using White test

Model	LM=Obs*R-squared	Heteroskedasticity of residues
$AR(5)$	$LM = 1.137 < \frac{2}{0.05,6} = 12.59$	Residues are homoscedastic.
$ARMA(4,2)$	$LM = 6.593 < \frac{2}{0.05,7} = 14.07$	Residues are homoscedastic.
$ARMA(3,1)$	$LM = 2.595 < \frac{2}{0.05,5} = 11.07$	Residues are homoscedastic.
$ARMA(3,2)$	$LM = 10.069 < \frac{2}{0.05,6} = 12.59$	Residues are homoscedastic.
$ARMA(6,1)$	$LM = 8.869 < \frac{2}{0.05,7} = 14.07$	Residues are homoscedastic.
$ARMA(5,3)$	$LM = 11.58 < \frac{2}{0.05,9} = 16.92$	Residues are homoscedastic.
$ARMA(1,1)$	$LM = 6.747 < \frac{2}{0.05,3} = 7.81$	Residues are homoscedastic.

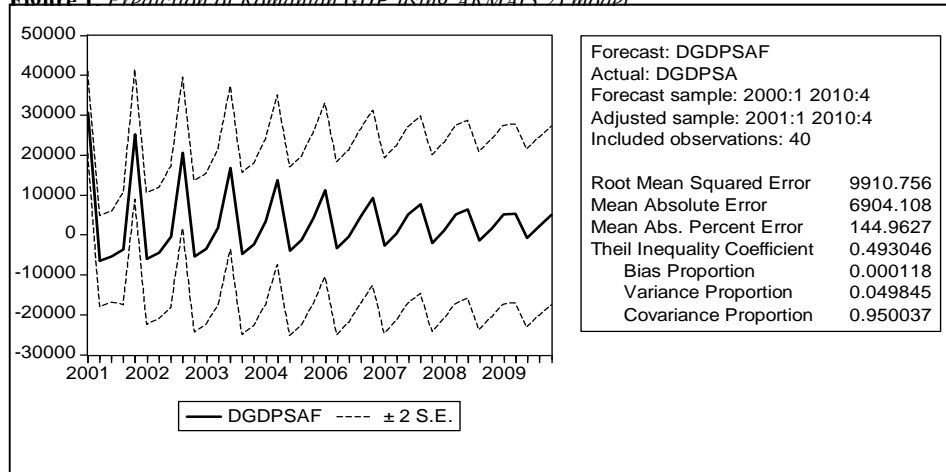
Source: Stancu, 2011.

In *Econometrie. Teorie și aplicații utilizând Eviews*, the Romanian quarterly GDP was predicted with the use of  $ARMA(3,2)$ , the selection of the best model being achieved based on the classical criteria (the greatest value of adjusted  $R$  – squared,  $\bar{R}^2 = 84.03\%$ ) and taking into account that all coefficients are significantly different from zero it is given by the following equation:

$$PIB_t = 2860.192 - 0,9635PIB_{t-1} - 0.94734PIB_{t-2} - 0.84796PIB_{t-3} + 1.156\varepsilon_t + 0.9999\varepsilon_{t-1} \quad (3.1.1)$$

The forecast range for Romanian GDP using  $ARMA(3,2)$  model, at a 95% interval, is exhibited in Figure 1.

**Figure 1** Prediction of Romanian GDP using  $ARMA(3,2)$  model



Source: Stancu, 2011.

### 3.1.2. Weekly US regular gasoline price

The weekly U.S. gasoline price (expressed as Dollars per Gallon) is investigated using R software in the paper “An Introduction to Analysis of Financial Data with R” and it is collected from data base of U.S. Energy Information Administration<sup>(2)</sup>. The study period is from January 06, 1997 to September 27, 2010.

Considering the price fluctuation, the analysis begins with the log price series. The time plot of the log price series indicates non-stationarity. After the first difference (logarithmic returns), the autocorrelation coefficients are close to zero which leads to the conclusion that this new series is weakly stationary.

Correlogram analysis reveals the partial autocorrelation function ( $PACF$ ) has the first five values different from zero that indicates an autoregressive component with the number of lags equal to 5. The fitted  $AR(5)$  model without the constant is given by the following equation in terms of the autoregressive polynomial:

$$(1 - 0.504L - 0.079L^2 - 0.122L^3 + 0.101L^5)y_t = \varepsilon_t. \quad (3.1.2.1)$$

Since model identification is specified empirically, an alternative is thinking about an  $ARMA(1, 3)$  model for the weekly growth rates of U.S. gasoline price. The equation of the fitted  $ARMA(1, 3)$  model, in terms of the autoregressive polynomial, is then:

$$(1 - 0.633L)y_t = (1 - 0.127L + 0.141L^3)\varepsilon_t. \quad (3.1.2.2)$$

Thus, there are two suitable models for the weekly growth rates of U.S. gasoline price,  $AR(5)$  and  $ARMA(1, 3)$ , respectively. Determining which model is kept for forecasting represents the final step of model fitting. The selection of the best model is achieved based on Akaike Info Criterion ( $AIC$ ). As  $AIC_{ARMA(1,3)} = -3704.6$  is bigger than  $AIC_{AR(5)} = -3704.96$ , the selected model for forecasting is the  $AR(5)$  model since having a model with a smaller error variance is better.

Therefore, the  $AR(5)$  model stands for predicting the U.S. gasoline price more than 10 days in advance. The results of out-of-sample forecast for the weekly growth rates of U.S. gasoline price, with the forecast origin on January 24, 2003, are presented below:

**Table 5.** Out-of-Sample Results using R software

Particulars	$AR(5)$ model
Root Mean Square Errors ( $RMSE$ )	0.02171
Mean Absolute Errors ( $MAE$ )	0.01538

Tsay, R.S. (2013). *An Introduction to Analysis of Financial Data with R.*, New Jersey: John Wiley & Sons, Inc., Hoboken.

## 3.2. Limitation of ARIMA models in financial and monetary economics

### 3.2.1. Application of Box-Jenkins methodology using BET Index

Our analysis takes into account Bucharest Exchange Trading Index (BET Index), daily quotations for the time period of September 22, 1997 to May 18, 2015, which involves investigating a time series of 4350 observations, and monthly quotations of the same index for the time period of September/1997 to April/2015 (211 observations). The data were collected from Bloomberg data base.

BET Index represents the benchmark index for the local capital market reflecting the evolution of ten most liquid companies listed on Bucharest Stock Exchange regulated market, except for financial investment companies (SIFs)<sup>(3)</sup>.

To achieve the adequate  $ARIMA(p, d, q)$  model, daily BET Index series was tested for stationarity through graphical representation, analyzing the behavior of autocorrelation and partial autocorrelation functions and also using the unit root tests (Augmented Dickey-Fuller and Phillips-Perron, respectively).

The evolution of daily BET Index prices from September 22, 1997 to May 18, 2015 is exhibited in Figure 2:

Figure 2. Daily BET Index prices from September 22, 1997 to May 18, 2015



Source: Bloomberg.

The evolution of daily BET Index prices indicates that the series has constant and trend (ascending, descending and then ascending again).

Daily BET Index prices correlogram reveals very high autocorrelations for the first two lags, 0.999 respectively, with values decreasing very slowly for the next lags, reaching a value of 0.971 at the 36<sup>th</sup> lag. This leads to the conclusion that the aforementioned series is non-stationary.

High Q-Stat test values together with *Prob.* < 5% to all lags confirms the presence of autocorrelation hence it is therefore a stochastic process without white noise in residues.

Non-stationarity is also highlighted by applying the Augmented Dickey-Fuller and Phillips-Perron tests, as can be seen from the table below:

Table 6. The results of Augmented Dickey-Fuller and Phillips-Perron tests for daily BET Index prices

Indicators		Daily BET Index prices		
		Constant	Constant, Linear Trend	None
ADF Test	t-Statistic (Prob.)	-0.871602 (0.7976)	-1.383817 (0.8658)	0.541844 (0.8331)
	t-critical	1%	-3.431670	-3.960149
		5%	-2.862008	-3.410838
	10%	-2.567062	-3.127218	
C	t-Statistic (Prob.)	1.421662 (0.1552)	0.735385 (0.4621)	
@TREND(1)			1.080134 (0.2801)	
PP Test	t-Statistic (Prob.)	-0.930643 (0.7790)	-1.470200 (0.8397)	0.446824 (0.8106)
	t-critical 1%	-3.431670	-3.960149	-2.565494

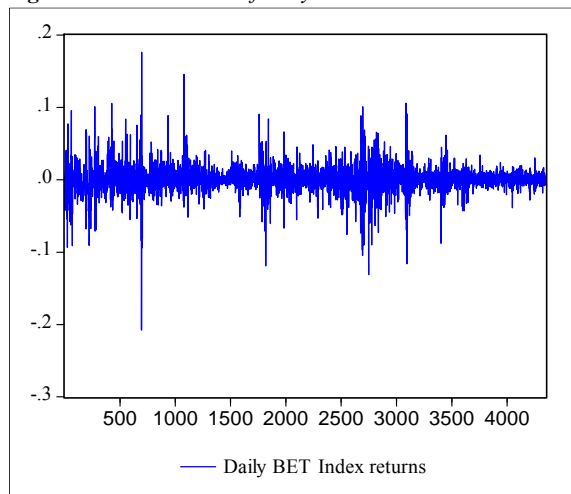
Indicators		Daily BET Index prices		
		Constant	Constant, Linear Trend	None
	5%	-2.862008	-3.410838	-1.940897
	10%	-2.567062	-3.127217	-1.616651
C	t-Statistic (Prob.)	1.410547 (0.1584)	0.753295 (0.4513)	
@TREND(1)			1.023191 (0.3063)	
Conclusions		The series is non-stationary and the intercept is not significant.	The series is non-stationary and both intercept and trend are not significant.	The series is non-stationary.

Source: Own calculations.

Since the null hypothesis  $H_0$ : "Series has a unit root" is not rejected for 1%, 5% and 10% significance level, the non-stationarity of the analyzed time series is removed by transforming it into continuously compounded returns (logarithmic yields). Decision to use daily returns was based on Strong N. (1992) approach according to which logarithmic returns have a good chance of being normally distributed. Likewise, empirical properties such as stationarity and ergodicity are owned by logarithmic returns and not by prices.

The evolution of daily BET Index returns from September 22, 1997 to May 18, 2015, exhibited in Figure 3, indicates that the logarithmic return series appears to be stationarity.

Figure 3. The evolution of daily BET Index returns



Source: Own calculations.

The *ACF* and *PACF* coefficients of daily returns series are close to zero at all lags, starting from 0.098 at lag 1, and decreasing quickly at lag 2 (0.038 and 0.029, respectively), which leads to the conclusion that the series of daily returns is generated by a Random Walk process. This is also confirmed by statistical *ADF* and *PP* tests. Table 7 exposes the findings of the *ADF* and *PP* tests which confirms that the return series of the BET Index is stationary for common levels of significance (1%, 5% and 10%, respectively) and  $Prob. < 0.05$ .

**Table 7.** The results of Augmented Dickey-Fuller and Phillips-Perron tests for daily BET Index returns

Indicators		Daily BET Index returns			
		Constant	Constant, Linear Trend	None	
ADF Test	t-Statistic (Prob.)	-59.73285 (0.0001)	-59.72600 (0.0000)	-59.70382 (0.0001)	
	t-critical	1%	-3.431670	-3.960149	-2.565494
		5%	-2.862008	-3.410838	-1.940897
		10%	-2.567062	-3.127218	-1.616651
C	t-Statistic (Prob.)	1.534739 (0.1249)	0.807145 (0.4196)		
@TREND(1)			-0.046275 (0.9631)		
PP Test	t-Statistic (Prob.)	-60.31756 (0.0001)	-60.31113 (0.0000)	-60.32571 (0.0001)	
	t-critical	1%	-3.431670	-3.960149	-2.565494
		5%	-2.862008	-3.410838	-1.940897
		10%	-2.567062	-3.127218	-1.616651
C	t-Statistic (Prob.)	1.534739 (0.1249)	0.807145 (0.4196)		
@TREND(1)			-0.046275 (0.9631)		
Conclusions		The time series of returns is stationary and the intercept is not significant.	The time series of returns is stationary, and both intercept and trend are not significant.	The time series of returns is stationary.	

Source: own calculations.

Table 8 points out descriptive statistics for the two time series, daily BET Index prices and returns. The conclusions drawn from the analysis of descriptive statistics for daily time series are as follows:

- distribution of daily price series reveals positive asymmetry (Skewness = 0.138582 > 0), while the distribution of daily returns shows negative asymmetry (Skewness = -0.227395 < 0);
- distribution of daily prices is platykurtic (Kurtosis = 1.877349 < 3), while the distribution of daily returns is leptokurtic (Kurtosis = 15.70472 > 3);
- Jarque-Bera statistics indicates that both series have abnormal distributions, the time series of returns presenting an extraordinarily high value (Jarque – Bera = 29286.28), and the probability of accepting the hypothesis of normality is zero in both cases.

**Table 8.** Descriptive Statistics of daily time series

Indicators	BET Index prices	BET Index returns
Skewness	0.138582	-0.227395
Kurtosis	1.877349	15.70472
Jarque-Bera	242.3053	29286.28
Probability	0.000000	0.000000

Source: own calculations.

It is worth noting that most of securities have such distributions as above and also the probability of occurring an extreme event into a leptokurtotic distribution is higher than the probability of occurrence in a normal distribution, and vice versa.

The analysis of BET Index returns correlogram reveals that we can try to estimate an ARMA model. Thus, the optimal values of  $p$  and  $q$  corresponding to  $AR(p)$  and  $MA(q)$  models is maximum 3 and we proceed to identify the ARMA model by trial-and-error. Using Eviews software five models are estimated:  $AR(1)$ ,  $MA(1)$ ,  $MA(2)$ ,  $ARMA(1, 1)$

and  $ARMA(1, 2)$ , followed by checking whether each model found is appropriate. This is done applying statistical tests for residues: absence of autocorrelation (residues correlogram, Q-statistics or LM test), homoskedasticity (White Heteroskedasticity test) and normality (Histogram – Normality test).

We predict daily BET Index using  $ARMA(1, 2)$ , the selection of the best model being achieved based on Akaike Info Criterion (we aim finding a model with a smaller error variance,  $AIC = -5.179848$ ), as can be seen from Table 9:

$$BET_t^{daily} = 0.000469 - 0.631639BET_{t-1}^{daily} + \varepsilon_t + 0.728061\varepsilon_{t-1} + 0.093907\varepsilon_{t-2} \quad (3.2.1.1)$$

**Table 9.** Selecting the best model for predicting daily BET Index

The estimated model	Adjusted R-squared	Akaike info criterion	Schwarz criterion	F-statistic (Prob)
$AR(1)$	0.009453	-5.178942	-5.176008	42.48333 (0.000000)
$MA(1)$	0.008819	-5.178365	-5.175432	39.68557 (0.000000)
$MA(2)$	0.010299	-5.179630	-5.175231	23.62318 (0.000000)
$ARMA(1,1)$	0.010050	-5.179315	-5.174915	23.06602 (0.0000)
$ARMA(1,2)$	0.010805	-5.179848	-5.173981	16.82781 (0.000000)

**Source:** own calculations.

We have found that for all analyzed models the normality assumption for residues is not fulfilled. According to specialized studies that happens often to residues of financial time series, hence the limitation of  $ARMA$  models. The next step is to extend the study of indices by applying models of  $GARCH$  family.

**Table 10.** Statistical tests for residues

The estimated model	LM Test		Normal distribution
	F-stat (Prob.)	Obs*R-squared (Prob.)	Jarque-Bera (Prob.)
$AR(1)$	2.584462 (0.075553)	5.167535 (0.075489)	36217.11 (0.000000)
$MA(1)$	4.223178 (0.014712)	8.437729 (0.014715)	35986.78 (0.000000)
$MA(2)$	0.791784 (0.453101)	1.584806 (0.452755)	34773.34 (0.000000)
$ARMA(1,1)$	3.335593 (0.035685)	6.668552 (0.035640)	35483.54 (0.000000)
$ARMA(1,2)$	1.423534 (0.240974)	2.849102 (0.240616)	34770.81 (0.000000)

**Source:** own calculations.

In an analogous way we proceeded to analyze monthly quotations and observed that conclusions outlined for daily series are also preserved for monthly series. Accordingly, we will make a brief presentation of the obtained results.

Monthly BET Index series is tested for stationarity through graphical representation, analyzing the behavior of autocorrelation and partial autocorrelation functions and also using the unit root tests (Augmented Dickey-Fuller and Phillips-Perron, respectively).

The evolution of monthly BET Index prices from September/1997 to April/2015 indicates that the series has constant and trend (ascending, descending and then ascending again), as can be seen in figure below:

**Figure 4.** The evolution of monthly BET Index prices

Source: Bloomberg.

Correlogram of monthly BET Index prices reveals very high autocorrelations for the first two lags, 0.983 respectively, with values decreasing very slowly for the next lags, reaching a value of 0.528 at the 20<sup>th</sup> lag. This leads to the conclusion that the aforementioned series is non-stationary.

Q-Stat test confirms the non-stationarity of the analyzed time series which is also highlighted by applying the Augmented Dickey-Fuller and Phillips-Perron tests:

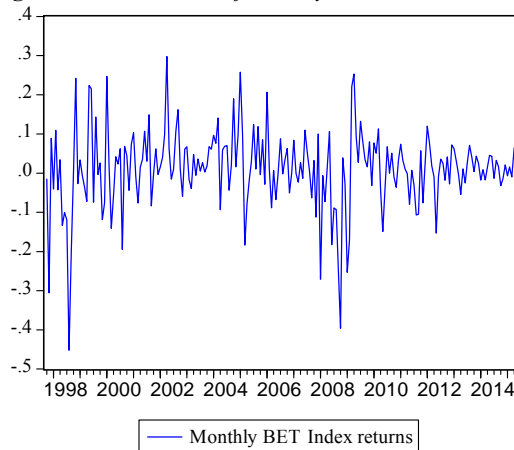
**Table 11.** The results of Augmented Dickey-Fuller and Phillips-Perron tests for monthly BET Index prices

Indicators		Monthly BET Index prices				
		Constant	Constant, Linear Trend	None		
ADF Test	t-Statistic (Prob.)	-0.941107 (0.7736)	-1.528782 (0.8168)	0.401635 (0.7986)		
	t-critical	1%	-3.461327	-4.002142	-2.575968	
		5%	-2.875062	-3.431265	-1.942338	
		10%	-2.574054	-3.139292	-1.615698	
PP Test	t-Statistic (Prob.)	-1.119303 (0.7083)	-1.827130 (0.6882)	0.173247 (0.7355)		
	t-critical	1%	-3.461327	-4.002142	-2.575968	
		5%	-2.875062	-3.431265	-1.942338	
		10%	-2.574054	-3.139292	-1.615698	
<b>Conclusion</b>		The series is non-stationary.				

Source: own calculations.

The non-stationarity of monthly BET Index prices is removed by converting into return series computed as continuously compounded returns. The evolution of monthly BET Index returns from September/1997 to April/2015 is exhibited in the figure below:

**Figure 5.** The evolution of monthly BET Index returns



**Source:** own calculations.

The *ACF* and *PACF* coefficients of monthly returns series are close to zero at all lags, starting from 0.205 at lag 1, and decreasing quickly at lag 2 (0.007 and -0.036, respectively), which leads to the conclusion that the series of monthly returns is generated, most likely, by a Random Walk process. This is confirmed by statistical *ADF* and *PP* tests. Table 12 exposes the findings of the *ADF* and *PP* tests and confirms that the return series of the BET Index is stationary, since the values of the tests are greater, in absolute value, than the critical values for common levels of significance (1%, 5% and 10%, respectively) and *Prob.* < 0.05.

**Table 12.** The results of Augmented Dickey-Fuller and Phillips-Perron tests for monthly BET Index returns

Indicators		Monthly BET Index returns			
		Constant	Constant, Linear Trend	None	
ADF Test	t-Statistic (Prob.)	-11.70085 (0.0000)	-11.67268 (0.0000)	-11.63434 (0.0000)	
	t-critical	1%	-3.461478	-4.002354	-2.576020
		5%	-2.875128	-3.431368	-1.942346
		10%	-2.574090	-3.139353	-1.615693
PP Test	t-Statistic (Prob.)	-11.74997 (0.0000)	-11.72206 (0.0000)	-11.72356 (0.0000)	
	t-critical	1%	-3.461478	-4.002354	-2.576020
		5%	-2.875128	-3.431368	-1.942346
		10%	-2.574090	-3.139353	-1.615693
Conclusion		The series is stationary.			

**Source:** own calculations.

Table 13 points out descriptive statistics for the two time series, monthly BET Index prices and returns. The conclusions that we can draw from the analysis of descriptive statistics for the monthly time series are:

- distribution of monthly prices reveals positive asymmetry (*Skewness* = 0.173164 > 0), while the distribution of monthly returns shows negative asymmetry (*Skewness* = -0.806950 < 0);
- distribution of monthly prices is platykurtic (*Kurtosis* = 1.869338 < 3), while the distribution of daily returns is leptokurtic (*Kurtosis* = 6.527186 > 3);

- Jarque-Bera statistics indicates that both series have abnormal distributions (*Jarque – Bera* = 12.35200 and 132.2769, respectively), and the probability of accepting the hypothesis of normality is close to zero in both cases.

**Table 13.** Descriptive Statistics for monthly BET Index prices and returns

Indicators	BET Index prices	BET Index returns
Skewness	0.173164	-0.806950
Kurtosis	1.869338	6.527186
Jarque-Bera	12.35200	132.2769
Probability	0.002079	0.000000

**Source:** own calculations.

We predict monthly BET Index using *ARMA(2,2)*. Selecting the best model using Akaike Info Criterion (*AIC* = -1.832137), we obtain the following equation:

$$BET_t^{monthly} = 0.010599 - 1.259707BET_{t-1}^{monthly} - 0.541348BET_{t-2}^{monthly} + \varepsilon_t + 1.503900\varepsilon_{t-1} + 0.783401\varepsilon_{t-2} \quad (3.2.1.2)$$

Based on BET Index returns correlogram, we estimated the following models: *AR(1)*, *MA(1)*, *ARMA(1,2)* and *ARMA(2,2)*, followed by checking whether each model found is appropriate. This is done applying statistical tests for residues: absence of autocorrelation (residues correlogram, Q-statistics or LM test), homoskedasticity (White Heteroskedasticity test) and normality (Histogram – Normality test).

**Table 14.** Selecting the best model for predicting monthly BET Index

The estimated model	Adjusted R-squared	Akaike Info Criterion	Schwarz Criterion	F-statistic (Prob.)
<i>AR(1)</i>	0.037605	-1.772704	-1.740826	9.166532 (0.002776)
<i>MA(1)</i>	0.039002	-1.778670	-1.746899	9.522923 (0.002304)
<i>ARMA(1,2)</i>	0.049836	-1.776109	-1.712354	4.654024 (0.003600)
<i>ARMA(2,2)</i>	0.066649	-1.832137	-1.752177	4.713224 (0.001169)

**Source:** own calculations.

We have found that for all analyzed models the normality assumption for residues is not fulfilled, hence the maintenance of the conclusions drawn for the daily series.

**Table 15.** Statistical tests for residues

The estimated model	LM Test		Normal distribution
	F-stat (Prob.)	Obs*R-squared (Prob.)	Jarque-Bera (Prob.)
<i>AR(1)</i>	1.262292 (0.285184)	2.542447 (0.280488)	88.54354 (0.000000)
<i>MA(1)</i>	0.018358 (0.981811)	0.037392 (0.981478)	92.43055 (0.000000)
<i>ARMA(1,2)</i>	0.967779 (0.381663)	1.941772 (0.378747)	75.54996 (0.000000)
<i>ARMA(2,2)</i>	0.488427 (0.614314)	0.992468 (0.608819)	126.6361 (0.000000)

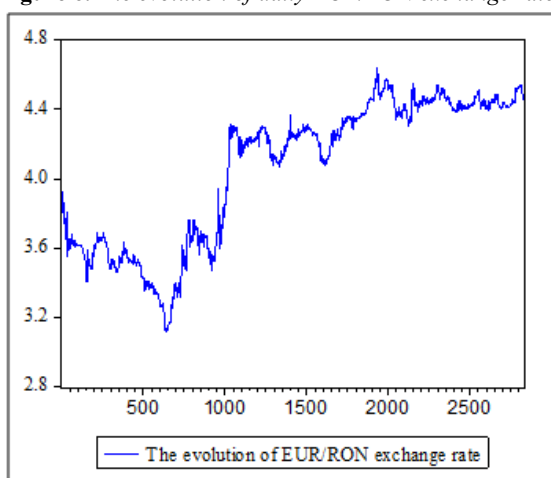
**Source:** own calculations.

### 3.2.2. Application of Box-Jenkins methodology using EUR/RON exchange rate

The paper aims to investigate the Box-Jenkins methodology using the EUR/RON exchange rate, daily quotations for the time period from January 03, 2005 to February 19, 2016, which involves investigating a time series of 2829 observations. The data were collected from the official website of the National Bank of Romania<sup>(4)</sup>.

The evolution of the daily EUR/RON exchange rate for the period January 03, 2005 - February 19, 2016 denotes that the series has constant and trend.

**Figure 6.** The evolution of daily EUR/RON exchange rate



Source: own calculations.

Likewise, the correlogram of daily EUR/RON exchange rate reveals very high autocorrelations for all lags, with values decreasing very slowly and reaching a value of 0.963 at the 36<sup>th</sup> lag. This leads together with High Q-Stat test values (*Prob.* < 0.05) to the conclusion that the aforementioned series is non-stationary.

Withal, the Augmented Dickey-Fuller and Phillips-Perron tests mark that the time series is non-stationary.

**Table 16.** The results of Augmented Dickey-Fuller and Phillips-Perron tests for daily EUR/RON exchange rate

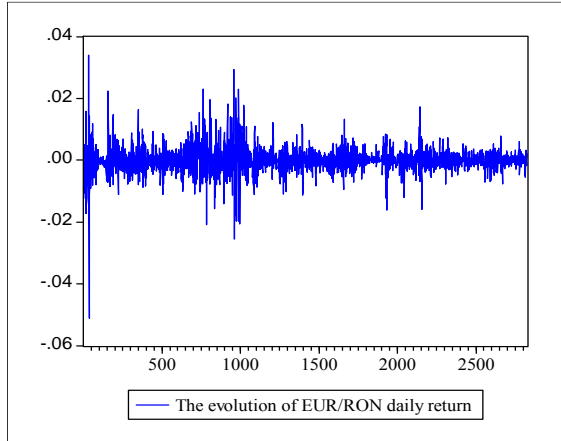
Indicators		Daily EUR/RON exchange rate			
		Constant	Constant, Linear Trend	None	
ADF Test	t-Statistic (Prob.)	-0.740810 (0.8345)	-2.473692 (0.3413)	0.670140 (0.8606)	
	t-critical	1%	-3.432474	-3.961291	-2.565781
		5%	-2.862364	-3.411398	-1.940936
		10%	-2.567253	-3.127549	-1.616624
PP Test	t-Statistic (Prob.)	-0.792774 (0.8205)	-2.713431 (0.2311)	0.554067 (0.8358)	
	t-critical	1%	-3.432471	-3.961287	-2.565780
		5%	-2.862363	-3.411396	-1.940936
		10%	-2.567253	-3.127548	-1.616624
Conclusion		The series is non-stationary.			

Source: own calculations.

The null hypothesis is not rejected, therefore we are trying to remove the non-stationarity using return series computed as the difference of the natural logarithm.

Daily EUR/RON return series for the period from January 03, 2005 to February 19, 2016 is exhibited below:

**Figure 7.** The evolution of daily EUR/RON return series



Source: own calculation.

The *ACF* and *PACF* coefficients of daily returns series are close to zero at all lags, starting from 0.177 at lag 1, and decreasing quickly at lag 2 (-0.109 and -0.145, respectively), which leads to the conclusion that the series of daily returns is generated, most likely, by a Random Walk process. Table 17 presents the findings of the *ADF* and *PP* tests and confirms that the series of EUR/RON returns is stationary.

**Table 17.** The results of Augmented Dickey-Fuller and Phillips-Perron tests for daily EUR/RON exchange rate returns

Indicators		Daily EUR/RON Returns			
		Constant	Constant, Linear Trend	None	
ADF Test	t-Statistic (Prob.)	-35.04889 (0.0000)	-35.04831 (0.0000)	-35.04506 (0.0000)	
	t-critical	1%	-3.432474	-3.961291	-2.565781
		5%	-2.862364	-3.411398	-1.940936
		10%	-2.567253	-3.127549	-1.616624
PP Test	t-Statistic (Prob.)	-43.85462 (0.0000)	-43.84877 (0.0000)	-43.87804 (0.0001)	
	t-critical	1%	-3.432472	-3.961289	-2.565780
		5%	-2.862363	-3.411397	-1.940936
		10%	-2.567253	-3.127549	-1.616624
Conclusion		The series is stationary.			

Source: own calculations.

Table 18 points out descriptive statistics for the two time series, daily EUR/RON exchange rates and returns. The conclusions that we can draw from the analysis of descriptive statistics for the daily time series are:

- negative asymmetry ( $Skewness = -0.586219 < 0$ ) for daily EUR/RON exchange rates and positive asymmetry ( $Skewness = 0.033855 > 0$ ) for returns;

- platykurtic distribution ( $Kurtosis = 1.797290 < 3$ ) for daily EUR/RON exchange rates and leptokurtic distribution ( $Kurtosis = 20.00848 > 3$ ) for returns and it presents fat-tails;
- non-normal distribution for both series ( $Jarque - Bera = 332.5394$  and  $34088.37$ , respectively, and the probability of accepting the hypothesis of normality is zero in both cases).

**Table 18.** Descriptive Statistics for daily EUR/RON series over the sample period

Indicators	Daily EUR/RON exchange rates	Daily EUR/RON returns
Skewness	-0.586219	0.033855
Kurtosis	1.797290	20.00848
Jarque-Bera	332.5394	34088.37
Probability	0.000000	0.000000

**Source:** own calculations.

Using Eviews software nine models are estimated based on the correlogram of daily EUR/RON returns and are statistically valid ( $F_{statistical} > F_{critical}$  and  $Prob.(F_{critical}) < 5\%$ ).

**Table 19.** Statistically valid models

The estimated model	Adjusted R-squared	Akaike info criterion	Schwarz criterion	F-statistic (Prob.)
$AR(1)$	0.030931	-8.215766	-8.211559	91.19959 (0.000000)
$AR(2)$	0.050647	-8.236318	-8.230005	76.35598 (0.000000)
$AR(3)$	0.059900	-8.245432	-8.237012	60.97838 (0.000000)
$MA(1)$	0.038720	-8.221706	-8.217500	114.8710 (0.000000)
$MA(2)$	0.041741	-8.224501	-8.218192	62.57165 (0.000000)
$MA(3)$	0.059250	-8.242588	-8.234176	60.34983 (0.000000)
$ARMA(1,2)$	0.050392	-8.235346	-8.226932	50.98838 (0.000000)
$ARMA(2,1)$	0.056591	-8.242245	-8.233828	57.48662 (0.000000)
$ARMA(2,2)$	0.059075	-8.244528	-8.234007	45.34107 (0.000000)

**Source:** own calculations.

In accordance with Akaike Info Criterion ( $minimum AIC = -8.245432$ ), we select the autoregressive model  $AR(3)$  to estimate the EUR/RON exchange rate. The equation of  $AR(3)$  model is given by:

$$Y_t = 0.0000498 + 0.186885Y_{t-1} - 0.124431Y_{t-2} - 0.100426Y_{t-3} + \varepsilon_t \quad (3.2.2)$$

As in the case of BET Index series, the EUR/RON exchange rate series also reveals the non-normality of residues, therefore the limitation of  $ARMA$  models in monetary economics.

**Table 20.** *Statistical tests for residues*

The estimated model	LM Test		Normal distribution
	F-stat (Prob.)	Obs*R-squared (Prob.)	Jarque-Bera (Prob.)
<i>AR(1)</i>	26.30613 (0.000000)	51.72285 (0.000000)	38145.28 (0.000000)
<i>AR(2)</i>	14.97831 (0.000000)	29.69439 (0.000000)	26570.70 (0.000000)
<i>AR(3)</i>	0.659732 (0.517070)	1.321653 (0.516424)	20539.52 (0.000000)
<i>MA(1)</i>	23.90158 (0.000000)	47.07397 (0.000000)	35406.99 (0.000000)
<i>MA(2)</i>	22.21396 (0.000000)	43.81702 (0.000000)	32554.97 (0.000000)
<i>MA(3)</i>	2.518329 (0.080775)	5.038309 (0.080528)	20948.62 (0.000000)
<i>ARMA(1,2)</i>	13.17244 (0.000002)	26.15661 (0.000002)	27507.68 (0.000000)
<i>ARMA(2,1)</i>	5.672717 (0.003478)	11.32401 (0.003476)	22873.36 (0.000000)
<i>ARMA(2,2)</i>	1.464084 (0.231466)	2.932391 (0.230802)	21177.67 (0.000000)

Source: own calculations.

#### 4. Results and conclusions

Usually in financial time series data we observe asymmetries, sudden outbreak at irregular time intervals and periods of high and low volatility. The exchange rate data strengthens the idea of this kind of behavior. Integrated *ARMA* models have definite limitations in counterfeiting these properties.

One of the most important features of the integrated *ARMA* models is the assumption of constant variance, most financial data exhibit changes in volatility and this feature of the data can't be fulfilled under this assumption. The symmetric joint distribution of the stationary *Gaussian ARMA* models does not fit data with strong asymmetry (as we can observe a strong negative asymmetry for daily EUR/RON exchange rate and positive asymmetry for returns).

Due to the assumption of normality, it is more suitable to use these models with data that have only a negligible probability of sudden burst of very large amplitude at irregular time epochs. These limitations of the integrated *ARMA* models lead us to models where we can retain the general *ARMA* framework, and allow the White Noise (innovations) to be non-Gaussian or abandon the linearity assumption.

Notwithstanding financial time series usually reveals more complex structures than those offered by *ARMA* processes, they may serve as a reference against more complex approaches by representing "a first starting point" (Rachev et al., 2007, p. 201). Since we have shown in this paper the limitation of *ARIMA* models for the analyzed time series, BET Index and EUR/RON exchange rate, respectively, the next step consists in extending the study by applying models of *GARCH* family.

On the other hand, predicting the future values of a variable based on past and current observations as we have pointed out in this paper in cases of Romanian *GDP* and United States regular gasoline price represents a key theme in time series analysis. One thing to keep in mind when we think about *ARMA* models is given by the great power to capture "very complex patters of temporal correlation" (Cochrane, 1997: 25).

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**Notes**


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- (1) See <http://www.inse.ro/cms/rw/pages/PIB-trim.ro.do;jsessionid=0a02458c30d550d7fda54cdc43fab67a95089cf660cf.e38QbxSahyTbi0Se0>
- (2) See <http://www.eia.gov/>
- (3) See <http://www.bvb.ro/FinancialInstruments/Indices/Overview#>
- (4) See <http://www.bnr.ro/Exchange-rates-1224.aspx>

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## **The Romania's challenges regarding the integration in the Euro Area**

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**Abstract.** *Considering the fact that Romania joining the euro area is a major country project, as was entering the European Union on January 1, 2007, this paper analyzes the way Romania currently meets the convergence criteria, the importance of their sustainability, the level of real convergence and further steps to be taken before adopting the euro. All these issues are meant to secure rigorous economic preparation, in order to reach a certain level of development, that can deal with competitiveness and which can ensure a relatively high level of convergence of income per capita.*

**Keywords:** Convergence criteria, GDP per capita, Regional gross domestic product, Euro area, Romania.

**JEL Classification:** E60, F15, F36, F43, O40.

## 1. Introduction

On January 1, 1999, the euro became the new official currency of 11 European Union member states, by replacing the old national currencies in two stages. During the first stage, starting January 1, 1999, the euro was introduced as a virtual currency for payment operations, which did not imply using bank notes and coins, while the old currencies continued to be used for making cash payments. The second stage began on January 1, 2002, when the euro was introduced as bank notes and coins.

Euro is the single currency, currently adopted by 19 of the 28 European Union member states, which form the Eurozone. The latest country to adopt the euro was Lithuania, on January 1, 2015.

Denmark and the UK chose „the opt-out clause”, while the other 7 member states, including Romania, committed to adopt the euro after meeting the convergence criteria provisioned in the Maastricht Treaty.

Before adopting the euro, any member state of the European Union (EU) must meet certain economic and legal criteria. The role of the economic convergence criteria is to guarantee the fact that the economy of the respective country is sufficiently well prepared to adopt the single currency and that it can easily integrate in the monetary regime of the euro area. The legal convergence refers to the compatibility of the national legislation to the provisions of the European Treaty, especially those related to the national central bank and currency issuance.

## 2. Nominal convergence criteria (Maastricht Criteria)

In order to adopt the single currency, each member state of the EU must meet the *nominal convergence criteria* set by the Maastricht Treaty, which refer to price stability, sustainability of the fiscal position, exchange rate stability and the long term convergence of interest rates.

For Romania, entering the euro area should represent a country project as important as joining the European Union.

Currently, Romania meets all 5 Maastricht criteria (Table 1).

*The medium annual inflation rate* in Romania, based on the harmonized index of consumer prices (HICP), is at -1.4% as of August 2016, thus ranking Romania among the top three EU member states with the lowest inflation.

For 2015, *the budget deficit* as a result of the ESA 2010 methodology was situated at 0.7% of GDP, under the 3% of GDP level provisioned in the Treaty.

According to EU methodology, *the government debt* was at 38.4% of GDP at the end of 2015, well under the 60% threshold provisioned in the Treaty, and lower than the level registered at the end of 2014 (39.9% of GDP).

As regards the exchange rate, the leu (Romania's national currency) has not yet entered ERM II (Exchange Rate Mechanism).

**Table 1.** *The Maastricht Criteria (Nominal Convergence Indicators)*

Nominal Convergence Indicators	Maastricht Criteria	Romania
Inflation rate (HICP) (percent, annual average)	≤1.5 pp above -1.43%* (average of the three best performing EU Member States)	-1.4 (August 2016)
Long-term interest rates (percent per annum, annual average)	≤ 2 pp above 3.02%* (average of the three best performing EU Member States in terms of price stability)	3.42 (August 2016)
Exchange rate vs. euro** (2 years maximum percentage change; appreciation(+)/depreciation(-))	±15 percent	+0.7/-2.6
General government deficit*** (percent of GDP)	below 3 percent	0.7 (2015)
Government debt*** (percent of GDP)	below 60 percent	38.4 (2015)

\* Cyprus, Romania, Bulgaria.

\*\* Maximum percentage deviations of the bilateral exchange rate against the euro from its August 2014 average level in September 2014 to August 2016 based on daily data at business frequency. An upward/downward deviation implies that the currency was stronger/weaker than the average exchange rate in August 2014.

\*\*\* According to ESA2010 methodology.

**Source:** Eurostat, National Institute of Statistics, Ministry of Public Finance.

For a sound integration in the euro area, it is not enough to meet the nominal convergence criteria, these criteria must also be sustainable. This cannot be reached without ensuring financial stability, fiscal balance and competitiveness (the durability and sustainability of the convergence are also provisioned in the Maastricht Treaty).

### 3. Where are we on real convergence?

Within the Maastricht Treaty, there is no reference to *the real convergence criteria*, necessary for creating a high degree of cohesion between the economic structures of the countries *en route* to joining the euro area with the existing ones. This omission may be due to the fact that, at the beginning of the European Union, it was formed by rich countries, with similar economic structures. Although real convergence has not been inserted in the association treaties signed when the euro area was created, both the European Commission and the ECB gave warning on the risks that may arise from the new EU member states joining the euro area, who only meet the nominal convergence criteria, but not the real convergence criteria, necessary for a sound economic integration.

Lacking clearly stipulated criteria, we may consider that the most important real convergence criteria are related to: the degree of economic openness, expressed as the weight of the total imports and exports in the GDP; the economic structure, as the weight of the large sectors in creating GDP – agriculture, industry, services – and the most synthetic criterion, GDP per capita, shown either as the nominal rate, or as the standard purchasing power parity (Isărescu, 2004, p. 6).

According to the *Theory of the Optimum Currency Area*, the states that are part of a group, or who join a group, may mutually benefit from owning a common currency only when their economic structures are similar and there is no risk that asymmetric shocks

can harm only some of them. Thus, the monetary policy elaborated by the European Central Bank is meant for a group of supposedly homogenous economies, it cannot and it must not address the particularities of each economy (Isărescu, 2004, p. 7).

For the moment, the countries from Central and Eastern Europe, with a weaker economy, cannot abandon their own monetary policy, as long as there is the risk of asymmetric shocks occurring as a result of the different economic structure. In order for these countries to enjoy the benefits of using the single European currency, they must first reach a high degree of nominal and real convergence, and then join the euro area.

The fact that real convergence is as important as nominal convergence must be taken into account.

In Romania, GDP per capita in 2015, expressed as the purchasing power standards (PPS), represented approx. 57 per cent of the European Union average (Table 2), 53 per cent of the eurozone countries average (Table 3), and well under the Baltic states who have adopted the euro, 69 per cent of the European Union average for Estonia in 2011, 62 percent for Latvia in 2013 and 75 per cent of Lithuania in 2014.

**Table 2.** *GDP per capita in PPS (percent of the EU average)*

GDP per capita in PPS Index (EU 28 countries = 100%)										
GEO/TIME	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Romania	38%	41%	48%	49%	50%	51%	54%	54%	55%	57%
Bulgaria	38%	42%	45%	46%	45%	45%	46%	46%	47%	46%
Czech Republic	81%	83%	81%	83%	81%	83%	82%	83%	84%	85%
Hungary	62%	61%	63%	64%	65%	65%	65%	66%	68%	68%
Poland	50%	53%	54%	59%	62%	64%	66%	67%	68%	69%
Croatia	58%	61%	63%	61%	59%	59%	60%	59%	59%	58%
Estonia	64%	68%	68%	62%	63%	69%	74%	75%	76%	74%
Latvia	55%	60%	60%	52%	52%	56%	60%	62%	64%	64%
Lithuania	56%	60%	63%	56%	60%	65%	70%	73%	75%	74%

Source: Eurostat (Last update: 11.10.2016).

**Table 3.** *GDP per capita in PPS (percent of the euro area average)*

GDP per capita in PPS Index (Euro area 19 countries = 100%)										
GEO/TIME	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Romania	35%	38%	44%	45%	46%	47%	50%	50%	52%	53%
Bulgaria	35%	38%	42%	43%	42%	42%	43%	43%	44%	43%
Czech Republic	74%	77%	75%	77%	75%	77%	76%	78%	80%	82%
Hungary	57%	56%	58%	60%	60%	61%	60%	62%	64%	64%
Poland	47%	49%	51%	55%	57%	60%	62%	63%	63%	64%
Croatia	54%	56%	58%	57%	54%	55%	56%	55%	55%	55%
Estonia	59%	63%	63%	58%	59%	64%	68%	70%	70%	69%
Latvia	51%	55%	55%	49%	48%	52%	56%	58%	60%	60%
Lithuania	51%	56%	58%	52%	56%	60%	65%	69%	70%	70%

Source: Eurostat (Last update: 11.10.2016).

**Table 4.** GDP per capita in PPS

GEO/TIME	GDP per capita in PPS									
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
EU*	24,700	26,000	26,100	24,500	25,400	26,100	26,600	26,700	27,500	28,800
Euro area*	26,600	28,100	28,100	26,300	27,500	28,200	28,500	28,600	29,400	30,600
Romania	9,300	10,700	12,500	11,900	12,600	13,300	14,300	14,400	15,200	16,300
Bulgaria	9,400	10,800	11,700	11,200	11,500	11,800	12,200	12,200	12,800	13,300
Czech Republic	19,800	21,600	21,100	20,200	20,600	21,600	21,800	22,300	23,500	25,000
Hungary	15,200	15,700	16,300	15,700	16,500	17,100	17,200	17,800	18,800	19,700
Poland	12,400	13,700	14,200	14,500	15,700	16,800	17,600	17,900	18,600	19,700
Croatia	14,300	15,800	16,400	15,000	14,900	15,500	15,900	15,800	16,100	16,700
Estonia	15,700	17,700	17,600	15,200	16,100	18,000	19,500	19,900	20,700	21,200
Latvia	13,500	15,500	15,500	12,800	13,300	14,700	16,000	16,700	17,500	18,500
Lithuania	13,600	15,600	16,200	13,800	15,300	17,000	18,500	19,600	20,700	21,300

\*EU 28 countries, euro area 19 countries.

Source: Eurostat (Last update: 11.10.2016).

From the experience of the latest states to join the euro area, it can be inferred that, for a sound integration, two years before adopting the single currency, the GDP per capita (PPS) should be at around 55-65 per cent of the European Union average.

2-3 years before joining the euro area, Latvia was in the same situation as Romania in 2015, i.e. with a GDP per capita (PPS) at 57 per cent of the European Union average. But, in Romania's case, there still is a large disparity between the 8 regions, as regards the GDP per capita.

#### 4. Analysis of intra-national disparities – Regional gross domestic product (PPS per inhabitant)

In Romania, only the Bucharest-Ilfov region is well ranked as regards GDP per capital (Table 5), as it economically surpasses certain developed areas of the European Union.

**Table 5.** Regional gross domestic product (PPS per inhabitant in % of the EU28 average) by NUTS 2 regions

geotime	2010	2011	2012	2013	2014
Inner London – West (England)	541	543	552	528	539
Luxembourg	254	263	258	264	266
Rég. Bruxelles (Belgium)	218	217	215	211	207
Hamburg (Germany)	204	207	205	204	206
Île de France (France)	181	177	177	181	178
Praha (Czech Republic)	175	174	171	173	173
Bucuresti – Ilfov (Romania)	121	131	126	127	129
Comunidad de Madrid (Spain)	130	127	126	124	125
Berlin (Germany)	115	121	119	118	119
Lazio (Italy)	128	126	121	116	114
Cataluña (Spain)	114	109	108	107	108
Vest (Romania)	56	56	58	56	58
Centru (Romania)	47	47	52	51	52
Sud-Est (Romania)	40	41	46	49	50
Nord-Vest (Romania)	44	44	47	47	48
Észak-Alföld (Hungary)	41	42	42	42	43
Sud – Muntenia (Romania)	41	42	41	43	43
geotime	2010	2011	2012	2013	2014
Sud-Vest Oltenia (Romania)	38	39	41	40	41
Severen tsentralen (Bulgaria)	29	30	32	32	34
Nord-Est (Romania)	30	30	34	34	34
Yuzhen tsentralen (Bulgaria)	31	32	33	32	32
Severozapaden (Bulgaria)	27	28	29	29	30

Source: Eurostat (Last update: 26.02.2016).

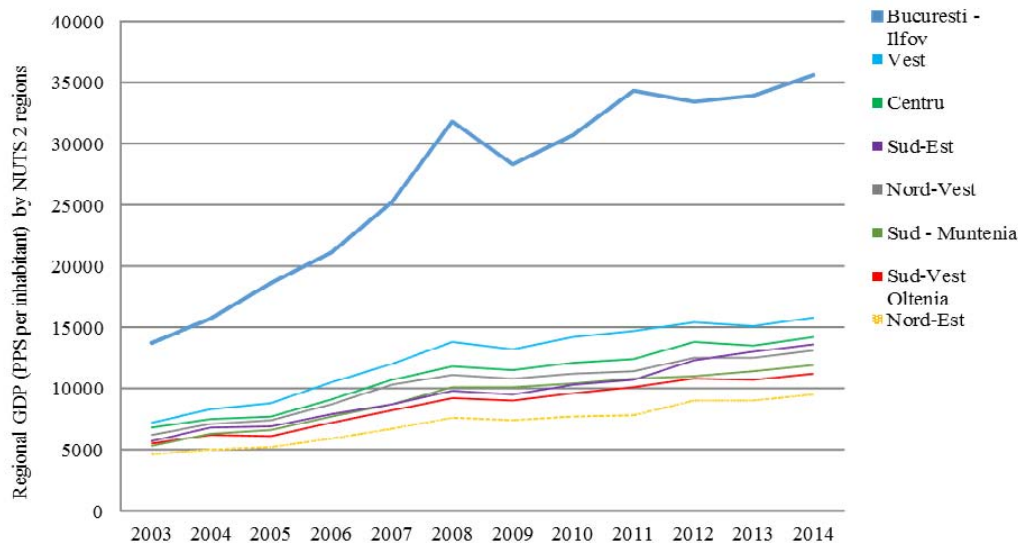
During 2003-2014, there was a rapid growth of the GDP per capita in the Bucharest-Ilfov region. This economic development did not follow this strong trend in the rest of the regions (Figure 1), only two of the seven regions managed to reach over 50% of European Union average in 2014, as regards the GDP per capita at PPS. The other five regions, inhabited by more than half of Romania's population, are at the bottom of European Union rankings as regards economic development.

**Table 6.** Regional gross domestic product (PPS per inhabitant) by NUTS 2 regions – Romania

geotime	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
București-Ilfov	13,700	15,700	18,600	21,100	25,200	31,800	28,300	30,700	34,300	33,400	33,900	35,600
Vest	7,200	8,300	8,800	10,500	12,000	13,800	13,200	14,200	14,700	15,400	15,100	15,800
Centru	6,800	7,500	7,700	9,100	10,700	11,800	11,500	12,100	12,400	13,800	13,500	14,200
Sud-Est	5,700	6,800	6,900	7,900	8,700	9,800	9,500	10,300	10,700	12,300	13,000	13,600
Nord-Vest	6,200	7,100	7,400	8,700	10,300	11,100	10,800	11,200	11,400	12,500	12,500	13,100
Sud Muntenia	5,300	6,300	6,600	7,700	8,700	10,100	10,100	10,400	10,800	11,000	11,400	11,900
Sud-Vest Oltenia	5,500	6,200	6,100	7,200	8,200	9,200	9,000	9,600	10,100	10,800	10,700	11,200
Nord-Est	4,600	5,000	5,200	5,900	6,700	7,600	7,400	7,700	7,800	9,000	9,000	9,500

Source: Eurostat (Last update: 26.02.2016).

**Figure 1.** Regional gross domestic product (PPS per inhabitant) by NUTS 2 regions – Romania



Source: Eurostat data, author's calculations.

The lack of infrastructure is one of the main causes leading to a low economic growth in most regions of the country, in some cases even to an economic stagnation, and to a very large gap between the economic development of Bucharest-Ilfov and the rest of the regions.

## 5. Steps to be taken for a sound integration in the Euro Area

Before Romania enters the euro area, a high level of convergence of the income per inhabitant – GDP per capita – must be reached, because in the absence of an independent monetary policy, a large gap in real convergence may lead to a more difficult management of economic cycles.

GDP per capita at PPS (purchasing power standards) is a real convergence indicator which must be improved; last year it was at only 53 per cent of the euro area average, and at 57 per cent of the European Union average (Tables 2 and 3).

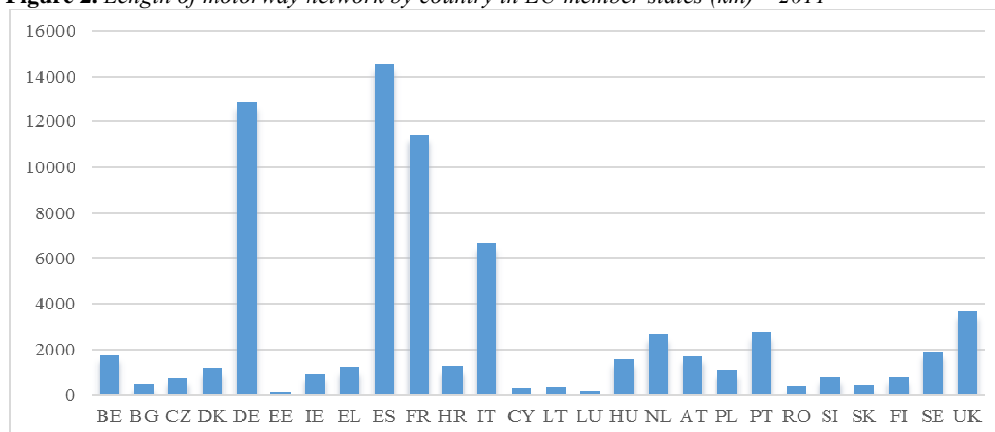
Without clearly defined criteria to indicate the sufficient real convergence in view of adopting the euro, we can use a common-sense benchmark for Romania: the minimum level of real convergence where another state joined the euro area, such as the aforementioned Latvia. However, besides this benchmark, we must also take the population of our country into account, which is much larger than that of Latvia, and the high disparities between the regions as regards the GDP per capita.

The very large gap between the Bucharest-Ilfov region and the rest of the regions regarding economic development (Table 6) could be substantially reduced, if all regions were interconnected through good quality transportation infrastructure, thus attracting new investors, creating new jobs and, as a result, increasing the standard of living.

Romania must cover the GDP per capita gap against the rest of the European Union countries, all the while keeping economic macro stability, and not insisting on a fast, short term growth, which could lead to macroeconomic disequilibrium.

A ranking made by the European Union Road Federation and shown in the „Yearbook 2014-2015”, on European level, ranked Romania in 2011 among the last countries as regards the total number of road kilometers linking regions, and also as regards the density of the total road network. At the end of 2011, Romania had a total of 84,053 public road kilometers, out of which only 350 kilometers were the highways, and it was surpassed by countries with a much smaller territory, such as Bulgaria with 459 highway km, Belgium with 1.763 km, Czech Republic with 745 km, Denmark with 1.143 km, Austria with 1.719 km etc. The highest ranking country in the European Union as regards the number of highway kilometers is Spain, with 14,554 kilometers, followed by Germany with 12,845 kilometers (Figure 2).

The National Statistics Institute, through their press release no. 101 from April 25, 2016, mention a total of 86,080 public road kilometers, out of which 747 are highway kilometers, registered as of December 31, 2015.

**Figure 2.** Length of motorway network by country in EU member states (km) – 2011

Source: Eurostat, EC, European Union Road Federation – Yearbook 2014-2015.

Romania has problems absorbing structural funds, which could significantly contribute to financing important investments.

According to the most recent data published by the Ministry of European Funds, at the end of September 2016, Romania had reached a 86.74% absorption rate (the amount collected from the European Commission, down payments included), from the financial framework 2007-2013, as opposed to 60%, which was the rate at the end of November 2015.

Out of the approximately 19 billion Euros in European funds allocated for Romania, it was only able to attract 14.4 billion Euros.

**Table 7.** The absorption stage of the Operational Programs 2007 – 2013, by Romania

Operational Program 2007-2013	EU Allocation 2007-2013	Down payments received from the EC	Statements of expenditure submitted to the EC (current absorption rate)		Reimbursements from EC (effective absorption rate)		Rate amounts collected from EC (with down payments)
			Amount	%	Amount	%	%
			3	4=(3/1)*100	5	6=(5/1)*100	7=[(2+5)/1]*100
	1	2					
SOPIEC	2,536,646,054	229,879,990	2,377,677,852	93.73	2,179,933,761	85.94	95.00
PO TA	170,237,790	15,321,401	193,092,021	113.42	146,404,499	86.00	95.00
SOP E	4,412,470,138	520,775,940	3,477,489,101	78.81	3,302,536,830	74.85	86.65
ROP	3,966,021,762	335,341,959	3,372,862,138	85.04	3,372,867,345	85.04	93.50
SOP DHR	3,476,144,996	451,898,849	2,347,894,037	67.54	2,243,811,890	64.55	77.55
SOP T	4,288,134,778	525,615,535	3,314,972,970	77.31	3,007,751,462	70.14	82.40
OP ACD	208,002,622	27,040,341	205,211,213	98.66	170,562,150	82.00	95.00
<b>TOTAL</b>	<b>19,057,658,140</b>	<b>2,105,874,015</b>	<b>15,289,199,332</b>	<b>80.23</b>	<b>14,423,867,938</b>	<b>75.69</b>	<b>86.74</b>

SOPIEC = Sectorial Operational Program Increase of Economic Competitiveness, PO TA = Operational Program Technical Assistance, SOP E = Sectorial Operational Program for Environment, ROP = Regional Operational Program, SOP DHR = Operational Program Development of Human Resources, SOP T = Sectorial Operational Program for Transport, OP ACD = Operational Program Administrative Capacity Development.

December 31, 2015: deadline for eligibility of expenditure incurred by beneficiaries.

Source: Ministry of European Funds (Last update: 30.09.2016).

There were significant delays in implementing EU financed programs, as a consequence of certain irregularities in the public acquisition procedures. These had a negative impact on the business environment and contributed to delays in investments in infrastructure.

The energy and transport infrastructure continue to stifle Romania's economic growth.

A brake on Romania's economic growth and development is represented by the energy infrastructure and the transport.

There were not created sufficient conditions for small and medium enterprises to have a easy access to finance.

Romania is among the top countries in the European Union as regards the number of people working without a legal contract, as over 1.5 million Romanians are undocumented workers.

Abiding the VAT legislation is among the lowest in the European Union, as the number of employers who use undocumented workers continues to be high, thus affecting budget income. This type of evasion prejudices the state budget by 4 billion Euros every year, as shown by the Fiscal Council. Working illegally is also not beneficial for the employees, as they cannot benefit from social security, health, unemployment and pension insurance, and from other legal provisions related to work accidents and occupational diseases.

Low quality education, which isn't correlated to the labor market, limited capacity of public administration, topped with an unstable fiscal policy, all have a negative effect on investments and export.

The rate of early school drop-out, calculated as a percentage of the total population of ages 18-24 was 19.1% in 2015, over the EU-28 average of 11%. Availability and access to education and care for preschoolers are limited, especially in the rural area. Lifelong learning is also far below EU average, and tertiary education graduation rate ranks Romania as second to last in the European Union, at 25.6% for individuals aged 30-34, ahead of Italy with 25.3%, and below EU-28 average of 38.7%.

In Romania, competitiveness should not only be based on low costs, but on other factors as well, such as innovation, timely delivery of goods and services, ensuring good quality service and creating own distribution networks. This way, high quality products and services, based on modern technologies, will become available on the market.

In 2015, the hourly cost of labor force in EU-28 was estimated at 25 Euros and at 29.5 Euros in the Eurozone. In Romania, there was the lowest cost of hourly labor, 5 Euros, ahead of the 4.1 Euros in Bulgaria. In 2015, Denmark had the highest hourly cost for labor force, namely 41.3 Euros.

Reducing the social security contributions paid by employers reduced the fiscal burden on the cost of labor, but it did not target workers with small and medium-sized income. The fiscal burden for individuals with small income is 40%, which continues to be high, compared to other European countries (European Commission, Country Report Romania 2015, pp. 57).

During this time, exports can be stimulated through the depreciation of the national currency, as a result of the much higher value of the contract currency, compared to the internal currency. After joining the euro area, this advantage will disappear, and the Romanian exporters will be interested in capitalizing better on productivity and efficiency, in order to be more competitive. Consequently, an increase in work productivity is necessary, which would increase economic efficiency, and which would, in turn, reflect in more competitive products on a larger market.

The Eurostat data show for Romania a level of hourly productivity at 5.6 Euros/hour in 2013, which represents 17.45% of the EU-28 average, and only 15% compared to the Eurozone average. Calculated based on PPS per working hour, the level of work productivity in Romania reaches 45.1% of the EU-28 average.

As regards the number of weekly working hours, the study undergone by Eurofund for 2012 ranks Romania in first place, at 41.2 hours. Other values: Germany (40.5 hours), Bulgaria (40.2 hours), Italy (38 hours), France (37.9 hours).

**Table 8.** Real labour productivity per hour worked (Euro per hour worked) in the EU member states

	2005	2006	2007	2008	2009	2010	2011	2012	2013
<b>Euro area (18 countries)</b>	34.8	35.5	36.0	35.9	35.5	36.3	36.7	37.0	37.3
<b>European Union (28 countries)</b>	30.2	30.9	31.3	31.2	30.7	31.4	31.8	31.9	32.1
<b>Luxembourg</b>	63.1	63.9	64.9	60.8	59.4	60.0	59.5	58.2	:
<b>Denmark</b>	51.4	51.9	52.2	51.1	49.8	52.4	52.5	52.6	53.4
<b>Ireland</b>	44.1	44.6	45.1	45.0	46.5	48.2	50.1	50.4	48.8
<b>Belgium</b>	45.4	45.8	46.2	46.0	45.3	45.9	45.8	45.7	45.9
<b>Netherlands</b>	44.7	45.5	46.2	46.2	45.1	46.0	46.1	45.6	45.8
<b>France</b>	43.6	44.9	44.9	44.4	44.2	44.7	45.3	45.4	45.6
<b>Sweden</b>	42.7	44.0	44.1	43.3	42.3	44.0	44.4	44.9	45.5
<b>Germany</b>	39.9	41.3	42.0	42.0	40.9	41.7	42.4	42.6	42.8
<b>Austria</b>	36.1	37.3	38.1	38.3	38.2	38.9	39.1	39.5	39.9
<b>Finland</b>	38.4	39.5	40.8	40.3	38.2	39.4	40.0	39.5	39.7
<b>United Kingdom</b>	38.9	39.7	40.8	40.3	39.3	39.8	40.0	39.3	39.2
<b>Italy</b>	32.4	32.5	32.6	32.4	31.7	32.5	32.5	32.2	32.2
<b>Spain</b>	27.9	28.1	28.5	28.7	29.4	30.0	30.4	31.5	32.1
<b>Cyprus</b>	20.1	20.4	20.8	21.2	21.0	21.3	21.2	21.5	21.6
<b>Slovenia</b>	18.2	19.3	20.1	20.1	20.1	20.6	21.4	21.3	21.4
<b>Greece</b>	19.8	20.8	21.5	22.2	21.1	20.4	19.9	20.2	20.2
<b>Portugal</b>	15.6	15.8	16.1	16.1	16.1	16.7	16.9	17.0	17.1
<b>Malta</b>	15.3	15.5	15.4	15.4	14.6	15.2	14.2	14.5	:
<b>Slovakia</b>	10.4	11.0	11.8	12.1	11.8	12.3	12.6	12.8	13.2
<b>Czech Republic</b>	11.7	12.4	13.0	13.0	12.8	13.0	13.3	13.2	13.1
<b>Hungary</b>	10.7	11.1	11.1	11.3	10.9	11.0	11.0	11.3	11.5
<b>Estonia</b>	9.2	9.7	10.3	10.0	10.3	10.9	10.8	11.2	11.4
<b>Poland</b>	8.4	8.6	8.8	9.0	9.1	9.8	10.2	10.4	10.6
<b>Lithuania</b>	7.7	8.2	8.7	8.8	8.3	9.4	10.1	10.3	10.6
<b>Latvia</b>	5.9	6.3	7.9	7.3	7.2	7.6	7.9	8.2	8.4
<b>Romania</b>	4.6	4.9	5.2	5.6	5.4	5.3	5.4	5.4	5.6
<b>Bulgaria</b>	4.0	4.1	4.3	4.3	4.3	4.5	4.7	4.8	4.9

: Not available.

Source: Eurostat.

Romania needs structural reforms that will ensure the sustainability of nominal convergence, by eliminating the sources of repressed inflation, such as the liberalization of the energy market or the gas market. On January 1, 2015, a small step was taken in regards to gas price liberalization when the non-household gas price liberalization entered into force. According to the first calculations, the final natural gas price dropped by 10% in the first 3 months after this measure was taken. Prices dropped because 40% of the contracts have been renegotiated, contracts which have been regulated in the past, and which passed into the free zone (Declaration Havrileț, president of ANRE, capital.ro – 05.03.2015). But the liberalization of energy prices for households was delayed.

The European Commission encourages national governments of the EU member states to liberalize basic services (energy, telecommunication, transport, postal services), so that consumers may eventually benefit from lower prices, new and more efficient services, and to be able to choose their own service providers, and so that European economy may become more competitive.

No reforms were yet made with regards to privatizing and restructuring state enterprises that generate losses and a series of measures that would improve the business environment.

Corporate governance may be an essential factor to make state entities perform. But so far, there has been no progress as regards corporate governance reform within the energy and transport state entities. There is still political interference in the current management of the entities, which does not secure a separation between the authorities' capacity as owners and their function as policy makers.

In the 2014 annual report drawn up by the Romanian Fiscal Council, the overdue payments accumulated at the end of 2014 by state companies, mostly organized as commercial entities or autonomously administrated entities, represented 20.7% of the total arrears registered on the entire economy; the arrears for state companies represented 3.7% of GDP. Their contribution to the total turnover in the economy was only 4% and their contribution to the gross added value economy was modest, only 9.9%.

Also in 2014, state companies recorded the best gross profit in the last few years, 3,568 million lei, which was mostly due to an increase in profitability of a small number of companies. If we deduct the profit of the most profitable 5 state companies in 2014 (ROMGAZ SA, HIDROELECTRICA SA, TRANSGAZ SA, Societatea Uzină Mecanică Cugir SA, CNADNR SA), the gross profit of state companies becomes negative, as loss increased from 387 million lei in 2013 to 957 million lei in 2014.

**Table 9.** *The evolution of some indicators of companies in Romania*

		2010	2011	2012	2013	2014
<b>Number of companies</b>	Total companies excluding financial sector	613,080	644,379	630,066	627,545	643,644
	The weight of the state companies in total	0.1%	0.2%	0.2%	0.2%	0.2%
<b>Gross added value (mil. lei)</b>	State companies (SC)	22,881	24,202	22,339	23,805	25,220
	Total companies excluding financial sector	195,849	196,151	197,392	227,615	255,957
	The weight of the state companies in total	11.7%	12.3%	11.3%	10.5%	9.9%
<b>Gross profit (mil. lei)</b>	<b>State companies (SC)</b>	<b>-2,101</b>	<b>1,372</b>	<b>-561</b>	<b>3,093</b>	<b>3,568</b>
	<b>SC, excluding the top five</b>	<b>-4,201.71</b>	<b>-2,449.37</b>	<b>-3,026.17</b>	<b>-386.80</b>	<b>-957.37</b>
	Private companies	27,934	10,421	15,623	23,856	27,479

		2010	2011	2012	2013	2014
<b>Arrears (mil. lei)</b>	State companies (SC)	28,012	26,251	25,363	26,187	24,369
	Private companies	69,193	88,882	91,536	90,358	93,508
	Total companies excluding financial sector	97,205	115,133	116,899	116,545	117,878
	<b>The weight of the state companies in total</b>	<b>28.8%</b>	<b>22.8%</b>	<b>21.7%</b>	<b>22.5%</b>	<b>20.7%</b>
		2010	2011	2012	2013	2014
<b>Arrears (% of GDP)</b>	<b>State companies (SC)</b>	<b>5.2%</b>	<b>4.6%</b>	<b>4.3%</b>	<b>4.1%</b>	<b>3.7%</b>
	Private companies	13.0%	15.7%	15.3%	14.2%	14.0%
	Total companies excluding financial sector	18.2%	20.4%	19.6%	18.3%	17.7%

Source: RA2014 – Fiscal Council, Ministry of Public Finance.

Romania has the largest part of the population in the European Union that owns small land areas, which can only be used for subsistence farming. The lack of infrastructure further contributes to an underperforming Romanian agriculture, as the rural areas suffer from unpaved roads and lack of sewerage. A lack of elementary infrastructure makes service development in rural areas problematic.

According to the National Institute of Statistics, in 2013, small farming areas of up to 1 hectare represented an important 54.5% of all farms in Romania (and they were using only 5% of the used farming area), while those smaller than 0.1 hectares represented 11% of the total farming areas.

The number of small farms, of up to 1 hectare, was diminished in 2013, compared to 2010, by 3%, i.e. by 76.000 ha of small farming areas. This reduction was mainly the result of the contribution of individuals using a farming area of up to 0.1 hectares.

In the European Union, there is a trend for a long term increase of farming areas, from small ones to medium and large ones, but this does not automatically mean that all small farms are inefficient.

Romania has made progress in regards to a growing independence and efficiency of the judicial system, as well as to combating corruption on all levels. Still, the level of actual carrying out of court rulings remains low, as well as preventing and combating small acts of corruption. All these political areas are the object of the mechanism for cooperation and verification.

Starting 2014, the corporate holding fiscal regime was regulated and Romania became as investor-friendly as Cyprus or the Netherlands. The corporate holding regime was regulated by the Fiscal Code for the first time.

The functioning of the holding regime was based on meeting two minimum conditions: tax exemptions on capital income and on dividends.

The tax relief provisioned in the new fiscal code may stimulate setting up holding companies in Romania. From now on, Romanian investors looking for more favorable jurisdictions for registering their business, in countries such as Cyprus or the Netherlands, will benefit from better conditions to start doing business in their own country. The fiscal changes target strategic development investments, not speculative ones. This is why most countries with a corporate holding regime impose minimum thresholds for shareholding percentage, in order to exempt dividends from tax. Romania chose a minimum of 10%

ownership of the share capital within a subsidiary that yields dividends, and set a minimum holding period of one year, as opposed to the Netherlands, who have a quota of 5%, and Cyprus, 1%.

## 6. Conclusions

Romania still has a lot more steps to take on the way to the Eurozone, as this is a complex process, which still requires many reforms for creating a developed, sustainable and competitive economy within all of the eight regions, which would generate benefits for the Romanian people. The process of adopting the euro must benefit from national consensus, untainted by the election cycle or by doctrinal differences.

Romania's accession to the euro area must represent a strong anchor for structural reforms, one that would lead to a better standard of living for Romanians, one closer to the European average.

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## **Does remittance drive economic growth in emerging economies: Evidence from FMOLS and Panel VECM**

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**Abstract.** *The study investigates the dynamic relationship among remittances, export, exchange rate and economic growth in emerging (Brazil, Russian Federation, India, China and South Africa) economies using balanced panel data ranging from 1994-2013. Data for all variables have been extracted from World Bank Indicators in terms of US\$. The Multivariate Panel Cointegration technique results demonstrate the existence of long run equilibrium relationships among observed variables. Employing the Fully Modified OLS Model (FMOLS), the study finds that remittances have significant negative impact on economic growth in Brazil, Russian Federation and India. However, remittances have significantly positive impact on economic growth in China. As a group FMOLS extends negative impact of remittances on economic growth across the selected emerging economies. Panel Vector Error Correction Model (PVECM) has been adopted to show the long run and short run causality among the variables across the countries. The PVECM result reveals that there is a long-run causal relationship running from export and remittances to economic growth.*

**Keywords:** Remittance, economic growth, FMOLS, co-integration, panel VECM.

**JEL Classification:** E3, F24, F43.

## 1. Introduction

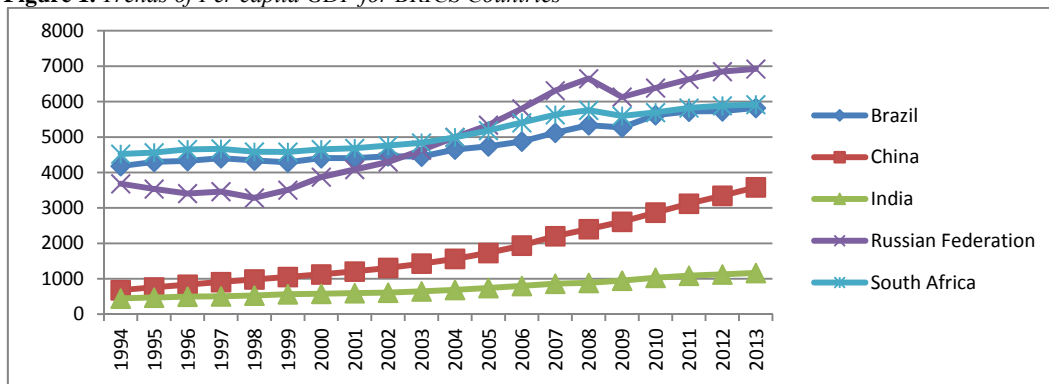
A long before there have been emerging debates on sources of economic growth of developing economies. Remittance is one of the major sources of economic growth that attracts academics, policy makers and researchers indicating their possible impacts on economic growth and development of developing countries. Many studies have made an attempt to show various sources of economic growth including the use of surplus labor, export rate, FDI and other external sources (Lewis, 1954; Myrdal, 1968; Harris-Todaro, 1970; Romer, 1986; Barro, 1991). Among all sources remittances have been considered as a major and consistent source of external income in developing countries. Primarily the role of remittances in the developing countries is to bridge the balance of payment (BOP) gap; and persistence of the better economic condition. Workers remittances have increased rapidly, growing more than FDI flows and Official Development Assistance in developing countries. Workers remittances in developing countries was US\$280.8billion in 2009 and reached around US\$400 billion in 2012 (World Bank, 2012). This paper tries to examine the short run and long run causality between remittances and economic growth in emerging (Brazil, Russian Federation, China and South Africa) countries. BRICS countries are major suppliers of migrant workers who are spread all over the world and contribute significantly their economic growth.

The study will be organized as follows the subsequent section provides the trends of remittances received, export rate, exchange rate and per capita GDP across the BRICS countries ranging from 1994 to 2013. In section 3, study discussed literature review on remittances and economic growth, section 4 reveals data sources sand variable description. Model specification, econometrics methodology and result are presented in section 5. Finally, conclusion and policy implication are presented in last section.

## 2. Trends of remittances, export rate, exchange rate and per capita GDP across BRICS

This section reports the trends of per capita GDP, export as percentage of GDP in US\$, remittance received as percentage of GDP in US\$ and exchange rate against US\$ across the BRICS countries ranging from 1994 to 2013.

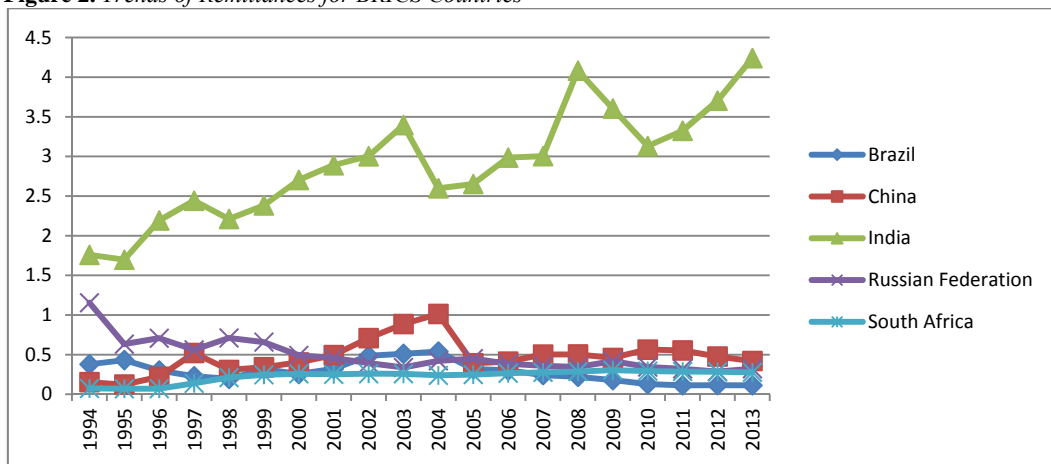
**Figure 1.** Trends of Per capita GDP for BRICS Countries



**Source:** Author's compilation using World Bank Data.

Figure 1 shows the per capita real GDP (US\$) for BRICS countries year ranging from 1994 to 2013. The following figure depicts that, the trends of the growth rates are negatively affected from the economic global crisis in 2008 and the Asian crisis 1997. Except India and China; Brazil, Russian Federation and South Africa are the most affected countries from global financial crisis in 2008. The trends reveal that the growth rate was -1.21%, -2.88% and -7.79% for Brazil, South Africa and Russian Federation respectively during the period of 2008-2009.

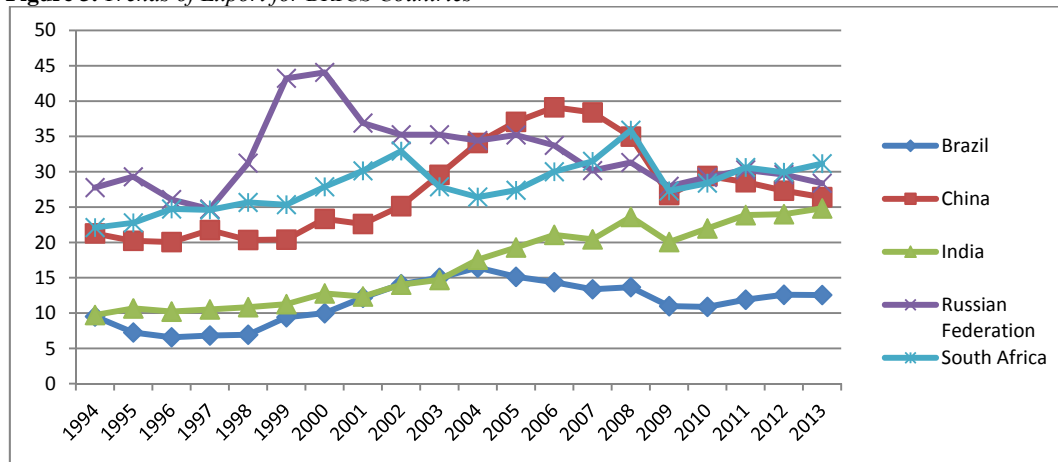
**Figure 2.** Trends of Remittances for BRICS Countries<sup>(1)</sup>



Source: Author’s compilation using World Bank Data.

Figure 2 presents the trends of remittances received as percentage of real GDP for BRICS countries. As per as World Bank data it is evident that there was significance contribution of remittance to the real GDP in India compared to her panel countries. The trend of remittances to the real GDP from 1994 to 2013 has increased from 1.175% to 4.25 % for India. However, contribution of remittances to the real GDP was less than 0.75% for Brazil, Russian Federation and South Africa. During the period from 2003 to 2004, contribution of remittances was 0.80% to 1.2% to the real GDP in China. It indicates that during these two years some deviation has been occurred in Chinese economy due to crunch of remittances towards economic growth

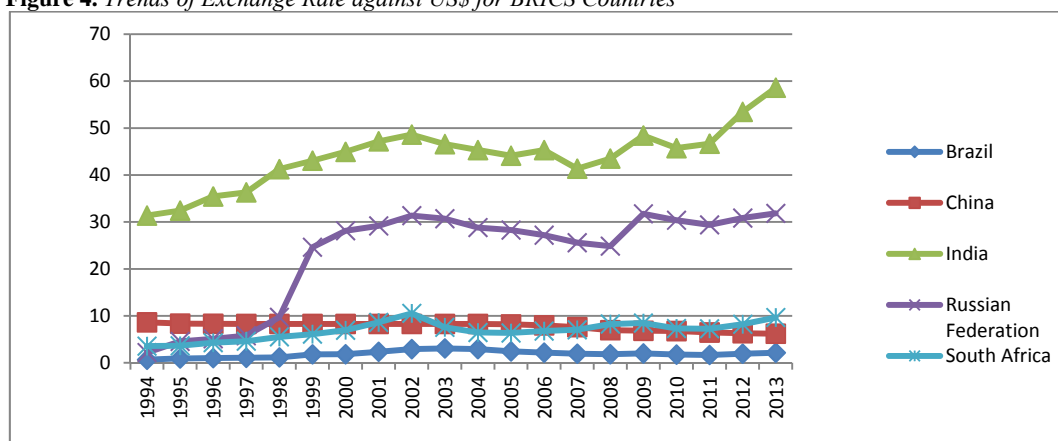
Figure 3 implies the contribution of export towards the real GDP across the BRICS countries. Having export as a sole indicator of economic growth as we observed from the Figure 3, each country’s export rate has increased along the period from 1994 to 2013. The contribution of export towards real GDP for Russian Federation was very high comparatively its panel countries during the first 10 years and is followed by South Africa. The contribution of export to the real GDP was 27.75% and 35.20% in 1994 and 2005 respectively for Russian Federation, and then it declined to 28.36% in 2013.

**Figure 3.** Trends of Export for BRICS Countries<sup>(2)</sup>

Source: Author's compilation using World Bank Data.

However, during the period of 2007, it was 38.39% which was highest share towards the GDP for China compared to its panel countries. During the period of 2008 contribution of export to real GDP growth rate fell down due to global economic crisis for all countries instead of India. This trend reports that there was no influential impact of global economic crisis on the Indian economy.

As we follow from Figure 4, it shows the exchange rate of BRICS countries against US\$ across BRICS countries. The trends show that the exchange rate against US\$ is very high for India. It was 31 units and 58 units of Indian currency against US\$ in 1994 and 2013 respectively. There is no deviation of Brazilian and Chinese currencies in terms of US\$. However, there was huge deviation in currency of Russian Federation. It was 9.70 and 31.83 units of Russian currencies against US\$ in 1994 and 2013 respectively. Expansion and contraction of currencies in terms of US\$ have influential impacts on trade practices and BOP of the country's leading to economic fluctuation in home countries and vice-versa.

**Figure 4.** Trends of Exchange Rate against US\$ for BRICS Countries<sup>(3)</sup>

Source: Author's compilation using World Bank Data.

### 3. Review of literature

#### 3.1. Theoretical background

In recent global economy, workers' remittances have been growing rapidly as one of the major source of external financing. Workers' remittances is the second largest source of external fiancé to many developing countries (World Bank, 2006), which tends to accelerate the pace of economic growth and development through enhancing domestic saving and investment in recipient countries. In this contrast another side of story confirms that workers' remittances are highly used for consumption purposes instead of investment and saving in recipient countries. We review both contrasting studies on the impact of remittances and economic growth as well.

Research on impacts of remittances on economic growth has been attempted by many researchers in recent era. Few empirical studies have investigated the role of remittances in consumption and poverty reduction (Lucas and Stark, 1985; Adams, 1991; Rapoport and Docquier, 2003; Sander, 2004; Azam and Gubert, 2005; Adam, 2006), where, these studies are based on household survey data from different countries. Primarily macroeconomic impacts of remittances may be segregated in two ways. From the theoretical stand point, workers' remittances are mainly used for consumption purposes; and it has negligible impact on saving and investment. The opposite case is that of migration is the leading to brain drain which creates more inequality in the sphere of human capital; globalization makes human capital scarcer where it is already scarce and more abundant where it is already abundant. (Docquire and Rapoport, 2006). For an instance, labor migration from Asian countries to European countries; it is evidence that former having less human capital abundance than latter. Stahl and Arnold (1986) report the use of remittances for consumption purposes which may have positive effect on economic growth. It happens due to possible multiplier effect. Moreover, many migrants invest their savings in small business, real estate or other related assets in their own countries because they have enough information about their local market than in their host countries in the picture of future market prospective. It is clearly observed (Owens, 1987; Kaufman and Mastruzzi, 2007) that impact of worker' remittance depends on many factors such as political freedom, political instability, political voice and accountability in terms of economic growth and development.

#### 3.2. Empirical background

It is very fascinating idea that every economy tries to grow at faster rate than earlier. Henceforth researchers have been interested in the rate at which the nation grows. To determine responsiveness of growth rate (per capita GDP has been taken as proxy for economic growth) to remittances and other sources of economic growth, such as percentage of export towards GDP, and variation in exchange rate, we first specify a simple double log-linear Cobb-Douglass production function as:

$$\ln PGDP_{it} = \beta_0 + \beta_1 \ln Rem_{it} + \beta_2 \ln Exp_{it} + \beta_3 \ln Exc_{it} + \varepsilon_{it}$$

Where,  $\ln PGDP_{it}$  is the natural log of Per capita GDP in US\$ and  $\ln Rem_{it}$  is natural log of percentage of remittances as real GDP. This variable is measured as investment in

human capital expected to have smoothly spurred on the economic growth of developing countries (Schultz, 1980; Romer, 1986; Lucas, 1988; Barro, 1990).

Where,  $LnExc_{it}$  indicates the natural log of exchange rate against US\$, expected result of impact of fluctuation in exchange rate on economic growth may be mixed (Berg et al., 2002; Edwards and Savastono, 2000; Kandi et al., 2007). It may be expansionary or contractionary that is depending on economic condition of the countries.

Where,  $LnExp_{it}$  indicates the natural log of percentage of export towards the real GDP, expected result of the impact of export revenue on economic growth would be positive (Giuliano and Ruiz-Arranz, 2005; Rajan, 2006).

There are several empirical studies that addresses the impact of remittances on economic growth in many countries to find out whether remittances promote economic growth or not. First we review the positive impact of remittances on economic growth. Workers' remittances have dual role in recipient countries, both enhancing economic growth and generating huge demand. It has been evident that workers' remittances have a positive impact on domestic saving, economic growth, productive investments and reducing poverty (Adams, 1992, 1998; Adams and Page, 2003; Giuliano and Arranz, 2005; Jongwanich, 2007; Taylor, 1992; Faini, 2001; Fayissa and Nsiah, 2010). A study finds that remittances have positive impact on economic growth in a 36 cross-sectional studies using a linear regression model (Pradhan et al., 2008). Aggarwal et al. (2006) find that remittances have positive effect on bank deposits and credit to GDP conducting a study of 99 countries ranging the period from 1975 to 2003. A study made an attempt to comprise the relation between remittances and GNP in Mexico; it has been found that every Mexican migrant send back the dollar to home country with them increasing Mexico's GNP (Taylor, 1999).

In this contrast some group of studies believe that remittances don't contribute to the economic growth instead it aggravates the economy as possible. The flows of remittances are used for expenditure on conspicuous consumption (Rahman et al. 2006; Stahl and Arnold, 1986; Chami et al., 2003) rather than minimal impact on saving and investment in productive assets. Although developing countries benefit from workers' remittances but countries suffers from the loss of skilled, educated workers, high labor force, which may have impact on output and revenue to the government. Reichat (1981) used a very technical term that 'Migrant Syndrome' to explain the negative impacts of remittance on the economic growth. It indicates that the loss of human capital against the compensatory transfers which called as 'Dutch Disease' that affects the production of goods and services in the home countries. There is no direct link between per capita GDP and remittances in developing countries (Spatafora, 2005). In this prospect one of the larger cross country survey conclude that remittances have negative effect on economic growth across a sample of 113 countries (Chami et al., 2003). Similarly various studies have concluded that the remittances have focused on the alleviation of poverty rather than overall economic growth (see, Stahl and Arnold, 1986; Chami et al., 2003; Adams and Page, 2003).

Some studies found the mixed result of the impact of remittances on economic growth, these are as follows. The impact of workers' remittances on economic growth is mixed in South and South East Asian countries (Habib and Nourin, 2006). The study posits that there

is negative relationship between migrant remittances and per capita GDP growth in Thailand, Sri Lanka, India and Indonesia. However, in case of Bangladesh, Pakistan and Philippines there is positive relationship between migrant remittances and per capita GDP.

#### 4. Data Source and Variable Description

The data used for this study to explore the long run relationship exists among the observed variables across BRICS Countries. Annual data on per capita real GDP in US\$, personal remittance received as percentage of real GDP, export of goods and services as percentage of real GDP and exchange rate against US\$ for BRICS countries have been extracted from the World Bank data base ranging from period 1994 to 2013. The data on per capita Gross Domestic Product has been taken at 2005 constant base price in US\$. Natural Logarithmic transformation has been made to normalise the data and further analysis been proceeded on the logarithmic transformed series. Per capita GDP at factor cost has been considered as proxy for economic growth across the BRICS countries in this present study. The variable remittances consists of all current transfers in cash or in kind made or received by resident households to or from non-resident households, However remittances includes income of border, seasonal and short term workers who are engaged in an economy where they are not residing and employed by non-residents (World Bank Classification). The variables description and their specification for empirical analysis are as follows:

- PGDP: Per capita Gross Domestic product (US\$).
- Rem: Remittances received as percentage of GDP.
- Exp: Export of goods and services as percentage of GDP.
- Exc: Exchange Rate against US\$ across BRICS.

#### 5. Model Specification and Econometric Applications

It is very interesting to see that every economy tries to grow at faster rate than earlier. Henceforth, researchers have been interested in the rate at which the nation grows. To determine responsiveness of growth rate (per capita GDP has been taken as proxy for economic growth) to remittances and other sources of economic growth, such as percentage of export of GDP, and variation in exchange rate, we first specify a Cobb-Douglas production function as follows:

$$Y_{it} = \alpha_i X_{it}^{\beta} u_{it} \quad \text{Where, } i = 1, 2, 3, \dots, N \text{ and } t = 1, 2, \dots, T.$$

Applying log transformation we can get the equation as follows:

$$y_{it} = \alpha_i + \beta' X_{it} + u_{it}, \quad \text{Where, } X \text{ is vector of explanatory variables and } \beta \text{ is vector of parameters.}$$

Now, we can apply such techniques for this present study taking double log linear model as follows:

$$\ln PGDP_{it} = \alpha_0 + \beta_1 \ln REMT_{it} + \beta_2 \ln EXPT_{it} + \beta_3 \ln EXRT_{it} + u_{it} \quad (1)$$

Where  $\ln PGDP$  is the natural log of Per capita GDP in US\$ and  $\ln REMT$  is natural log of percentage of remittances as real GDP. This variable is measured as investment in human capital expected to have smoothly spurred on the economic growth of developing countries (Schultz, 1980; Romer 1986; Lucas, 1988; Barro, 1990). Where  $\ln EXRT$  indicates the natural log of exchange rate against US\$, expected result of impact of fluctuation in exchange rate on economic growth may be mixed (Berg et al., 2002; Edwards and Savastono, 2000; Kandi et al., 2007). It may be expansionary and compression phase in the circumstances that is depending on economic condition of the countries. Where  $\ln EXPT$  indicates the natural log of percentage of export towards the real GDP, expected result of the impact of export revenue on economic growth would be positive (Giuliano and Ruiz-Arranz, 2005; Rajan, 2006).

### 5.1. Descriptive statistics

The descriptive statistics for all variables under the study named at PGDP Rem Exp Exc are presented in Table 1. The value of skewness and kurtosis indicate the symmetric nature in the distribution. In general if the value of skewness and kurtosis are 0 and 3 respectively, the observed distribution is said to be normally distributed. Moreover, if the skewness coefficient is more than unity it is considered fairly extreme and the low (high) kurtosis value indicates extreme platykurtic (extreme leptokurtic). From the table the result shows that the frequency distributions of observed variables are not normally distributed. The value of standard deviation indicates that deviation in the distribution.

**Table 1.** Descriptive Statistics Cross Sectional Units

Variables	Mean	SD	Min	Max	Skewness	Kurtosis	J-Bera
<b>Brazil</b>							
PGDP	4821.882	566.967	4181.670	5823.044	0.629	1.838	2.443
Rem	0.284	0.132	0.112	0.538	0.442	2.239	1.135
Exp	11.478	3.008	6.566	16.425	-0.265	1.973	1.113
Exc	1.883	0.677	0.664	3.077	-0.007	2.337	0.365
<b>Russia</b>							
PGDP	4988.318	1355.030	3282.790	6923.447	0.135	1.393	2.213
Rem	0.487	0.205	0.286	1.154	1.830	6.459	21.141
Exp	32.197	5.123	24.730	44.060	0.906	3.297	2.812
Exc	23.010	10.667	2.190	31.837	-1.074	2.389	4.162
<b>India</b>							
PGDP	738.458	233.901	444.483	1164.996	0.507	1.904	1.859
Rem	2.899	0.697	1.697	4.240	0.151	2.422	0.353
Exp	16.681	5.491	9.717	24.815	0.124	1.419	2.134
Exc	43.979	6.551	31.373	58.597	-0.081	3.207	0.057
<b>China</b>							
PGDP	1782.675	923.428	679.298	3583.376	0.599	2.039	1.967
Rem	0.472	0.216	0.122	1.013	0.770	3.760	2.460
Exp	27.334	6.423	20.053	39.126	0.548	2.018	1.806
Exc	7.7406	0.812	6.195	8.618	-0.847	2.045	3.155
<b>South Africa</b>							
PGDP	5118.642	529.858	4519.510	5916.463	0.316	1.395	2.480
Rem	0.229	0.076	0.069	0.303	-1.331	3.260	5.969
Exp	28.125	3.461	22.102	35.880	0.234	2.689	0.263
Exc	6.859	1.884	3.550	10.540	-0.114	2.499	0.252

**Source:** Calculated by authors taking data from World Bank Indicators.

## 5.2. Panel Unit Root Test

In order to test the panel cointegration among variables, the first step is to examine the unit roots properties of the data, because the variables must be integrated of the same order. In the present study we have used four unit roots methods viz. Levin-Lin-Chu (LLC et al., 2002), Im-Pesaran-Shin (Im et al., 2003), Fisher ADF and Fisher PP tests respectively. The null hypothesis of all these Panel unit roots tests have always consider non-stationary of the data in its null hypothesis. IPS combines information from the time series dimension with that from the cross section dimension, such that fewer time observations are required for the test to have power. Most of the researches have opined that IPS test have superior test power to analyze the long-run relationships in panel data and therefore, the present study have employed this procedure. IPS begins by specifying a separate ADF regression for each cross-section with individual effects and no time trend.

$$\Delta y_{it} = \alpha_i + \rho_i y_{i,t-1} + \sum_{j=1}^{p_i} \beta_{ij} \Delta Y_{i,t,j} + \varepsilon_{it} \quad (2)$$

Where  $i = 1, \dots, N$  and  $t = 1, \dots, T$ .

IPS use separate unit root tests for the  $N$  cross-section units. Their test is based on the Augmented Dickey-fuller (ADF) statistics averaged across groups. After estimating the separate ADF regressions, the average of the t-statistics for  $P_1$  from the individual ADF regressions  $t_{iT}(P_i)$ .

$$\bar{t}_{NT} = \frac{1}{N} \sum_{i=1}^N t_{iT}(P_i \beta_i) \quad (3)$$

Then the t-bar has been standardized and it converges to the standard normal distribution as  $N$  and  $T$  approaches towards infinity. IPS (1997) proposed that when  $N$  and  $T$  are small in the panel model the t-bar test performs better than other tests. In panel unit root estimation they proposed a cross-sectionally demeaned version of both test to be used in the case of errors of different regressions which contains a common time specific component.

The results of Table 2 presents both the Levin et al. (2002; LLC) and Im et al. (2003) confirm that all the series are non-stationary at their level instead of only LnRem. That indicates that we cannot reject the null hypothesis of non-stationarity, or the series contains a unit root. Hence, after the first order differentiation the test statistics show that we can reject the null hypothesis of non-stationarity for all the series at 1% level of significance.

**Table 2.** Panel Unit Root Test Result

Variables	Test Eqn.	At Level				At Difference				Order. Int.
		LCC	IPS	ADF	PP	LCC	IPS	ADF	PP	
LnPGDP	C	0.8	4.09	0.44	0.45	-4.6***	-3.71***	31.41***	31.2***	I(1)
LnPGDP	CT	-1.01	-0.45	11.21	4.33	-3.99***	-2.35***	21.73**	21.57***	
LnRem	C	-3.85	-1.81	20.05	17.47	-7.63***	-6.98***	58.31***	103.72***	I(1)
LnRem	CT	-2.98	-1.61	18.73	14.00	-3.22***	-3.87***	31.48***	56.27***	
LnExp	C	-0.5	0.11	9.12	7.86	-7.55***	-6.73***	56.32***	56.05***	I(1)
LnExp	CT	-0.94	-0.04	11.66	6.00	-5.37***	-5.11***	40.94***	45.79***	
LnExc	C	-1.48	-0.65	18.86	19.92*	-5.25***	-3.74***	31.05***	31.11***	I(1)
LnExc	CT	-0.43	1.13	5.29	4.95	-4.18***	-1.31*	17.6*	21.79**	

**Note:** Figures in parentheses are P-values. C refers to the specification with intercept; CT refers to the specification with intercept and trend. \*\*\*, \*\* and \* indicate 1%, 5% and 10% level of significance.

In conclusion, all series are stationary at their first order differences, or they are  $I(1)$  variables. All variables for the case of BRICS countries are integrated of order one. Since the variables are integrated of order of one for series, the Peronei's (1999, 2004) cointegration test will be applied to understanding the long-run equilibrium relationship among the variables. The Pedroni (1999, 2000) test of cointegration has been explained in below.

### 5.3. Panel cointegration tests

Pedroni (1997, 1999) has proposed a heterogeneous panel cointegration test, which has been used to estimate the cointegration among the variables in this present study. This test allows various cross sectional interdependence along with other different individual effects in order to establish the cointegration. He defines two kinds of test statistics where the first one is based on pooling residuals within the dimension of the panel. The tests are as follows:

Panel v Statistic:

$$T^2 N^{3/2} Z \hat{v}_{N,T} \equiv T^2 N^{3/2} [\sum_{i=1}^N \sum_{t=1}^T L^{-2} \hat{e}_{i,t}^2]^{-1} \quad (4)$$

Panel e statistic:

$$T\sqrt{N}Z\hat{p}_{N,T} \equiv T\sqrt{N} [\sum_{i=1}^N \sum_{t=1}^T \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^2]^{-1} \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{11i}^{-2} (\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i) \quad (5)$$

Panel t statistic (Non-parametric):

$$Z_{(N,T)} \equiv [\hat{\sigma}_{N,T}^2 \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^2]^{-1/2} \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{11i}^{-2} (\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i) \quad (6)$$

Panel t statistic (Parametric):

$$Z^* t_{N,T} \equiv [\hat{S}_{N,T}^{*2} \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{i,t-1}^{*2}]^{-1/2} \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{i,t-1}^{-2} (\hat{e}_{i,t-1}^* \Delta \hat{e}_{i,t}^*) \quad (7)$$

Group e statistic:

$$TN^{-1/2} \hat{Z} \hat{p}_{N,T-1} \equiv TN^{-1/2} \sum_{i=0}^N [\sum_{t=1}^T \hat{e}_{i,t-1}^2]^{-1} \sum_{t=1}^T [\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i] \quad (8)$$

Group t statistic (non-parametric):

$$N^{-1/2} \hat{Z}_{(N,T-1)} \equiv N^{-1/2} \sum_{i=1}^N [\hat{\sigma}_i^2 \sum_{t=1}^T \hat{e}_{i,t-1}^2]^{-1/2} \sum_{t=1}^T [\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i] \quad (9)$$

Group t statistic (parametric):

$$N^{-1/2} \hat{Z}_{(N,T)}^* \equiv N^{-1/2} \sum_{i=1}^N [\sum_{t=1}^T \hat{S}_i^{*2} \hat{e}_{i,t-1}^{*2}]^{-1/2} \sum_{t=1}^T [\hat{e}_{i,t-1}^* \Delta \hat{e}_{i,t}^*] \quad (10)$$

Table 3, Table 4 and Table 5 present the Pedroni's cointegration test; Kao test and Combined Fisher ADF test. Since all the variables are  $I(1)$ , Pedroni's cointegration test, Kao test and Fisher ADF test are employed to investigate the null hypothesis of no cointegrating relationship against the alternative hypothesis of the existence of cointegrating relationship.

The maximum test of statistics indicate that null hypothesis of no cointegrating relationship can be rejected at 1% , 5% or 10% level of significance for all BRICS countries. Hence all the six test statistics supports a panel cointegration relationship

among LnRem, LnExp, LnExc and LnPGDP at 1%, 5% or 10% level of significance. Panel V statistics shows cointegration at 1% and 10% level of significance. In case of Kao test the cointegration is significance at 5% level of significance.

**Table 3. Panel Cointegration Result**

Statistics	C	CT	NCT
<b>Within Dimension</b>			
Panel V-Statistics	1.42* (0.07)	6.00*** (0.00)	0.94 (0.17)
Panel rho-Statistics	-0.45 (0.32)	0.28 (0.61)	-1.21 (0.11)
Panel pp-Statistics	-5.55*** (0.00)	-2.26** (0.01)	-3.38*** (0.00)
Panel ADF-Statistics	-3.25*** (0.00)	-0.26 (0.39)	-1.45* (0.07)
<b>Between Dimension</b>			
Statistics	C	CT	NCT
Group pp-Statistics	0.81 (0.79)	1.22 (0.88)	0.64 (0.73)
Group rho-Statistics	-3.63*** (0.00)	-3.58*** (0.00)	-1.92** (0.02)
Group ADF-Statistics	-1.38* (0.08)	-0.78 (0.21)	-0.04 (0.48)

**Note:** Figures in Parentheses are p-values. C refers to the specification with intercept; CT refers to the specification with intercept and trend and NCT refers to the specification of without trend and intercept. \*\*\*, \*\* and \* indicate 1%, 5% and 10% level of significance.

**Table 4. Kao Test**

ADF	-1.98** (0.02)
Residual Variance	0.025
HAC Variance	0.027

**Note:** Figures in parentheses indicate the P value and \*\* indicates statistical significant at 5%.

**Table 5. Combined Fisher ADF Test**

No. of CE(s)	Trace Test	Prob.	Max-Eigen Value	Prob.
r=0	112.60	0.00	78.84	0.00
r>1	48.60	0.00	27.06	0.00
r>2	32.80	0.00	28.23	0.00
r>3	21.08	0.02	21.08	0.02

**Note:** Probabilities are computed using asymmetric Chi-square distribution.

**Table 6. Panel cointegration result across variables**

	Model-I	Model-II	Model-III
<b>Within Distribution</b>			
Panel V-Statistics	-1.68 (0.95)	-1.68 (0.95)	-1.45 (0.92)
Panel rho-Statistics	-0.86 (0.19)	-0.87 (0.19)	-0.45 (0.32)
Panel pp-Statistics	-1.88** (0.02)	-4.04*** (0.00)	-0.67 (0.25)
Panel ADF-Statistics	-1.66** (0.04)	-2.16** (0.01)	-1.52* (0.06)
<b>Between Distribution</b>			
Group pp-Statistics	0.98 (0.83)	1.24 (0.89)	0.98 (0.83)
Group rho-Statistics	-1.87** (0.03)	-2.50*** (0.00)	-0.43 (0.33)
Group ADF-Statistics	-1.96** (0.02)	-0.95 (0.17)	-1.01 (0.15)

**Note:** Model I indicate the cointegration between LnPDGP and LnRem, Model-II indicates the cointegration between LnPGDP and LnExc; and Model-III indicates the cointegration between LnPGDP and LnExp. Figures in parentheses indicate the P values and \*\*\*, \*\* and \* implies statistically significant at 1%, 5% and 10% respectively.

For the testing of long-run equilibrium in the panels Pedroni (1999) has proposed two types of residual-based tests that are i.e. without dimension tests (panel V static, panel e static, panel t statistic (non-parametric) and panel t statistic (parametric) and within dimension. Kao and combined Fisher ADF tests are also applied for the panel cointegration.

The combine Fisher-ADF test shows the existence of cointegrating relationship among variables such as remittances received (LnRem), export of goods and services to the real GDP(LnExp), exchange rate against US\$(LnExc) and per capita Gross Domestic Product(LnPGDP) as the trace statistics is greater than the maximum Eigen value which rejects null hypothesis of no cointegration. All the statics are statistically significant at 1% level, confirming overwhelming support in favor of panel cointegration. The cointegrating relationship does not speak about the long and short-run dynamics of the variables. For the sake of knowing the long run and short elasticities we have employed the Fully Modified Least Square. In case of fully modified least square the study estimates the long run elasticities of the variables.

#### 5.4. Fully modified least square

The fully modified least square estimation has been adopted from Christopoulos and Tsionas (2004) for estimating the asymptotically efficient consistent in panel series where the method takes in to consideration of non-exogeneity, serial correlation and heterogeneity (Pedroni, 1996). As all the explanatory variables are cointegrated with time trend, henceforth there is a existence of long-run equilibrium relationship among the variables through the panel unit root test (LLC, IPS, Fisher ADF and PP) and panel cointegration test (Pedroni, 1990). The study proceeds to estimate the Equation (1) by the method of fully modified OLS (FMOLS). The FMOLS allows consistent and efficient estimation of cointegration vector and at same time it addresses the problem of nonstationary regressors, as well as the problem of simultaneity biases in the heterogenous cointegrated panels. The OLS estimation is not as powerful as FMOLS and it yields biased results in regressors that are endogenously determined in the  $I(1)$  cases. The model can be written as:

$$Y_{it} = \alpha_{it} + x'_{it} \beta + \varepsilon_{it} \quad (11)$$

$$X_{it} = x_{i,t-1} + \varepsilon_{it}$$

Where  $\xi_{it} = [e_{it}, \varepsilon'_{it}]$  is the stationary with covariance matrix  $\Omega_i$ . The estimators will be consistent with the error process  $\omega_{it} + [e_{it}, \varepsilon'_{it}]$  statistics the assumption of cointegration between  $y_{it}$  and  $x_{it}$ . The limiting distribution of OLS estimator depends upon nuisance parameters. Following Phillips, and Hansen (1990), a semi-parametric correction can be made to the OLS estimators that elements the second order biases caused by the fact regressors are endogenous. Pedroni (1990 and 2000) follows the same principle in the panel data context, and allows for the heterogeneity in the short run dynamic and fixed effects. FMOLS Pedroni's estimator is constructed as follows

$$\hat{\beta}_{FM} \quad \beta = \sum_{i=1}^N \hat{\Omega}_{22}^{-2} \sum_{t=1}^T (x_{it} \hat{x}_i)^2 \sum_{i=1}^N \hat{\Omega}_{11}^{-1} \hat{\Omega}_{22}^{-1} \sum_{t=1}^T (x_{it} \bar{x}_i) e_{it} T \hat{\gamma}_i \quad (12)$$

$$\hat{e}_{it} = e_{it} \hat{\Omega}_{22}^{-1} \hat{\Omega}_{21i}, \quad \hat{\gamma}_i = \hat{T}_{22i} + \hat{\Omega}_{22i}^{-1} \hat{\Omega}_{21i} (\hat{T}_{22i} + \hat{\Omega}_{22i}^{-1}) \quad (13)$$

Where the covariance matrix can be decomposed as  $\hat{\Omega}_1 = \hat{\Omega}_1 + \hat{T}_i + \hat{T}_i$  where  $\Omega_i^0$  is the contemporaneous covariance matrix and  $\hat{T}_i$  is a weighted sum of autocovariance. The  $\hat{\Omega}_i^0$  represents an appropriate estimator of  $\hat{\Omega}_i^0$ .

This study has used panel group FMOLS test from Pedroni (1996, 2000). This test allows for greater flexibility in the presence of heterogeneity of the cointegrating vectors. The null hypothesis constructed for the test statistics of the panel group estimators is that  $H_0: \beta_i = \beta$  for all  $i$  against the alternative hypothesis  $H_A: \beta_i \neq \beta$ , so that the values for  $\beta_i$  are not constrained to be the same under the alternative hypothesis. This is clearly an advantage. Another advantage lies with the interpretation of the point estimates in the event that the true cointegrating vectors are heterogeneous. It can be interpreted as the mean value for the cointegrating vectors (Pedroni, 2001).

Table 7 shows the long run elasticities estimated by adopting FMOLS. The study estimates long run elasticities for all the individual BRICS countries along with panel group. Table 7 reports the results of individual and panel cointegrated cases for Eq. (1). Apart from South Africa all four countries have statistical significant impact of remittances on economic growth. The individual FMOLS results show that remittances inflow of China has positive impact on economic growth. The result shows that one percent increase in inflow of remittances in China has positive and statistical significance which increase 0.19percentage change in growth. However, Brazil, Russia and India show a negative relation between remittances received and economic growth where 1% changes in remittances received leads to 0.19%, 2.48% and 0.67% decline in economic growth respectively in long run. Panel FMOLS result reveals that there is 0.40% decline in economic growth due to 1%change in remittances inflow to the home country overall in long run. All countries have positive and statistical significant impacts of export rate on the economic growth. Individual FMOLS result shows that due to 1% change in rate of export there are 0.26%, 2.60%, 0.96%, 0.68% and 0.55% changes occur in economic growth in Brazil, Russia, India and South Africa, respectively.

**Table 7.** Long-run Elasticity coefficient of FMOLS

Country	LnRem	LnExp	Ln Exc
Brazil	-0.19(-14.23) ***	0.26(4.32)***	-0.03(-3.65)***
Russia	-2.48(-5.03)***	2.60(19.10)***	-0.84(-3.65)***
India	-0.67(-3.94)***	0.96 (7.70)***	1.22(17.85)***
China	0.19(4.87)***	0.68(8.27)***	-3.65(-24.50)
South Africa	0.08(1.13)	0.55(1.86)*	-0.12(-0.76)
Panel	-0.40(-4.71)***	0.59(4.07)***	-0.23(-2.93)***

**Note:** Figures in Parentheses indicate t statistics; and \*, \*\*and\*\*\* indicate statistically significant at 10%, 5% and 1% respectively.

There is 1% change in export towards real GDP increases growth by 0.55% in overall panel in the long run. Individual FMOLS result show that there are positive significant impact of exchange rate on economic growth. However, there are negative impacts of exchange rate on economic growth in Brazil and Russia. It is estimated that 1% change in exchange rate leads to 0.03% and 0.85% decline in growth rate in Brazil and Russia respectively in long run where 1%change in exchange rate it leads to 1.22%changes occur in growth rate in India. Overall panel result reveals that there is significant negative impact of exchange rate on economic growth. It shows that due to 1% change in exchange rate, 0.23% changes occur in economic growth in long run.

### 5.5. Panel Vector Error Correction Model (PVECM)

The study has applied Engle and Granger (1987) suggests two-step procedure in order to examine the short-run and long-run dynamic relationships between expenditure on education and economic growth. In the first step the long-run model specified in Eq. (1) is to be estimated and in the next step we have to define the lagged residual obtained as the error correction term (ECT). The estimation of dynamic vector error correction (VECM) model is as follow:

$$\begin{aligned} \Delta \text{LnRem}_{it} = & \theta_{1i} + \sum_{j=1}^q \theta_{1,1ij} \Delta \text{LnRem}_{it-j} + \sum_{j=1}^q \theta_{1,2ij} \Delta \text{LnPGDP}_{it-j} + \\ & + \sum_{j=1}^q \theta_{1,3ij} \Delta \text{LnEXC}_{it-j} + \sum_{j=1}^q \theta_{1,4ij} \Delta \text{LnEXP}_{it-j} + \lambda_{1i} \text{ECT}_{it-1} + \mu_{1it} \end{aligned} \quad (14)$$

$$\begin{aligned} \Delta \text{LnPGDP}_{it} = & \theta_{2i} + \sum_{j=1}^q \theta_{2,1ij} \Delta \text{LnRem}_{it-j} + \sum_{j=1}^q \theta_{2,2ij} \Delta \text{LnPGDP}_{it-j} + \\ & + \sum_{j=1}^q \theta_{2,3ij} \Delta \text{LnEXC}_{it-j} + \sum_{j=1}^q \theta_{2,4ij} \Delta \text{LnEXP}_{it-j} + \lambda_{2i} \text{ECT}_{it-1} + \mu_{2it} \end{aligned} \quad (15)$$

$$\begin{aligned} \Delta \text{LnExp}_{it} = & \theta_{3i} + \sum_{j=1}^q \theta_{3,1ij} \Delta \text{LnRem}_{it-j} + \sum_{j=1}^q \theta_{3,2ij} \Delta \text{LnPGDP}_{it-j} + \\ & + \sum_{j=1}^q \theta_{3,3ij} \Delta \text{LnEXC}_{it-j} + \sum_{j=1}^q \theta_{3,4ij} \Delta \text{LnEXP}_{it-j} + \lambda_{3i} \text{ECT}_{it-1} + \mu_{3it} \end{aligned} \quad (16)$$

$$\begin{aligned} \Delta \text{LnExc}_{it} = & \theta_{4i} + \sum_{j=1}^q \theta_{4,1ij} \Delta \text{LnRem}_{it-j} + \sum_{j=1}^q \theta_{4,2ij} \Delta \text{LnPGDP}_{it-j} + \\ & + \sum_{j=1}^q \theta_{4,3ij} \Delta \text{LnEXC}_{it-j} + \sum_{j=1}^q \theta_{4,4ij} \Delta \text{LnEXP}_{it-j} + \lambda_{4i} \text{ECT}_{it-1} + \mu_{4it} \end{aligned} \quad (17)$$

Where the ECT (Error correction term) is derived from the long-run FMOLS results from Eq. (1)

Table 8 shows the dynamics of remittances, export, and exchange rate on economic growth in BRICS countries both in short-run and long-run.

**Table 8.** Result of PVECM

Dependent Variables	Short-run				Long-run	
	$\Delta \text{LnPGDP}$	$\Delta \text{LnRem}$	$\Delta \text{LnExp}$	$\Delta \text{LnExc}$	ECT	JST
$\Delta \text{LnPGDP}$	-	-0.004 (0.76)	-0.38 (0.30)	0.06 (0.01)**	-0.00 (0.02)**	1.13 (0.34)
$\Delta \text{LnRem}$	-0.24 (0.90)	-	0.20 (0.41)	-0.02 (0.88)	-0.24 (0.00)***	0.17 (0.98)
$\Delta \text{LnExp}$	-0.74 (0.08)*	0.07 (0.48)	-	-0.09 (0.25)	0.03 (0.37)	0.83 (0.54)
$\Delta \text{LnExc}$	-5.64 (0.00)***	-0.05 (0.41)	0.30 (0.08)*	-	-0.02 (0.36)	2.02 (0.07)*

**Note:** Figures in Parentheses are P value and \*\*\*, \*\* and \* indicate significant level at 1%, 5% and 10% respectively. ECT indicates Error Correction Term and JST indicate Joint Significance Test.

From the panel vector error correction model the results are in favor of long-run causality among the variables; remittances, export rate, exchange rate and economic growth in all the countries where as there is no short run casual effect detected from remittances and export to economic growth. However, only short run causality detected from exchange rate to economic growth. It is evident that in long-run there only remittances and export rate have significant impact on economic growth generating infrastructure development, employment opportunities and capital formation in the countries. From the vector error correction long run causality detected from economic growth, export rate and exchange rate to remittances whereas no casualty has been fitted in short run and there is also no joint statistical significant among the variables. Another pair of panel VECM result reveals that there is short run causality detected from export to GDP while no joint statistical significant or long run causality detected among the observed variables in the BRICS countries.

Panel VECM result depicts that there is short run causality running from exchange rate and export to the economic growth. However, there is joint statistical significant satisfies among the variables. It implies casualty detected from export rate, exchange rate and economic growth; and vice versa.

From the above Panel Vector Error Correction Model, the result reveals that there is no short run causality depicted from remittances to economic growth, as we know amount of remittances received spends on conspicuous purposes, poverty reduction and luxury investment instead of saving and investment in productive assets (Lucas and Stark, 1985; Adams, 1991; Rapoport and Docquier, 2003; Sander, 2004; Azam and Gubert, 2005; Adam, 2006). Henceforth the result depicts that there is no short run causality between remittances and economic growth). It many have causal impacts in long run transferring remittances in to productive investments after full filling basic requirement and getting optimum luxuries consumption.

## **6. Policy implication and conclusion**

In this paper, study empirically investigates the effects of remittances as percentage of real GDP, export of goods and services as percentage of real GDP (US\$); and exchange rate on economic growth in BRICS (Brazil, Russian Federation, India, China and South Africa) countries period ranging from 1994 to 2013. In this panel data analysis technique, the study finds that there is a long-run equilibrium existence between remittances and growth rate in all BRICS countries. It is found that there is a negative long run impact of remittances on economic growth as PVECM result shows that 1% change in remittances that leads to 0.24% decline in GDP per capita income in the long run. To understand the short-run and long-run dynamics of the variables we have adopted the panel cointegration and panel vector error correction models with joint Significance test Statistics. Result finds that all the countries have long-run relationship with economic growth due to impact of remittances and exchange rate on per capita GDP across the BRICS countries. Joint significant test result reveals that causality depicted from exchange rate to other variables jointly across the countries sin the long run.

From the empirical result, it is found that remittances have negative impacts on economic growth across the countries in the long run. It could be interpreted that due to migration, countries experience loss of human capita which leads to low productivity in the home countries and it has negative impact on economic growth (Spatafora, 2005; Chami et al., 2003). However, it is technically called as Migrant Syndrome and Dutch disease effects of production of goods and services in sending and receiving countries (Reichart, 1981). The policy makers should put more emphasis on the emigration policies and its relevant application and dynamic use in modern economic growth by contributing high human capital in the countries.

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### Notes

- (1) Remittances as % of Real GDP for BRICS Countries.  
 (2) Export as percentage of Real GDP for BRICS Countries.  
 (3) Currencies against US\$ for BRICS Countries.

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## **Effectiveness of monetary policies in OECD countries**

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**Abstract.** *In this study, it was analysed whether monetary policies have an effect on stock price index in 13 OECD countries (Australia, Canada, Denmark, Iceland, Japan, Korea, New Zealand, Norway, Poland, Sweden, Switzerland, the United Kingdom and the United States) with High Income Level for the period after 2008 financial crisis (2010-2013). In the analysis results, it was determined that there is a unidirectional relationship from short term interest rates and M1 money supply towards stock price indexes; and a unidirectional relationship from stock price index towards interbank interest rates and M3 money supply. In this respect, it was concluded that effectiveness of monetary policies in 13 OECD countries with high-income level are weak after 2008 financial crisis.*

**Keywords:** stock price index, short term interest rates, interbank interest rates, m1 money supply, m3 money supply, dynamic panel data models.

**JEL Classification:** C50, E40, E44, E50.

## 1. Introduction

The relationship between monetary policy and stock market has attracted the attention of policy makers, academics and investors for a long time. In this context, whether stock prices could be used as an indicator or whether monetary policy decisions will be affected by the stock prices has always been a serious matter of discussion. In the literature, the relationship of monetary policy with respect to stock prices is addressed within the asset prices channel of monetary transfer mechanism.

Monetary transfer mechanism explains how changes in the nominal money stock or nominal interest rates warn real variables such as financial markets, employment, and total output. In the literature, there are two fundamental approaches explaining how the monetary transfer mechanism – also expressed as the compatibility process of money demand to money supply – works. These approaches are indirect transfer mechanisms proposed by Keynesian economists and direct transfer mechanisms proposed by Monetarist economists (Ireland, 2005: pp. 1). Determining through which channel is the monetary policy going to affect the economy is very vital in terms of the success of the monetary policy as much as the policies to be applied. Different views of Keynesian and Monetary economists on how monetary policy and, as a matter of fact, the money influences the economy, reveal themselves in the assessment related to the process of monetary transfer mechanisms.

According to Keynesian and Neo-classical (Wicksell) economists who defend indirect transfer mechanism, the transfer mechanism is actualized through interest rates. According to these streams of economy, the amount of money demanded in economy is susceptible to interest rates. According to Monetarist economists who defend indirect transfer mechanisms, the amount of money people want to hold is defined as a constant and non-changing steady size. Monetarists are more interested in price changes rather than the effects the monetary processes create in economic life. The changes the monetary processes create in relative prices also comprise the changes created in the income rates of capital and financial assets as well as changes in the prices of goods and services (Spencer, 1974: pp. 8).

Within the literature, the studies carried out by Rudebusch (1998), Rotondi and Vaciago (2003), Bernanke and Kuttner (2004), Ehrmann and Fratzscher (2004), Rigobon and Sack (2004), Caruana (2005), Lapodis (2006), Garg (2008), Kholodilin et al. (2008), Stoica and Diaconășu (2012) – all studied the relationship of stock prices and monetary policy – used short term interest rates as monetary policy tool in a way that supports Keynesian indirect transfer mechanisms. In the studies carried out by Wong (2005), Maskay (2007), Bennaceur et al. (2009), Demir and Yağcılar (2009), Castro and Sousa (2012) Money supply (M1, M2, M3) sizes are used as monetary policy tools in a way that supports the Monetarist point of view.

The aim of this study is to determine the relationship between stock prices index and monetary policies in 13 OECD countries with High Income Levels after the 2008 financial crisis (2010-2013) using the dynamic data analysis method. The study will make great contributions to the literature by putting forward whether monetary transfer

mechanism works in OECD countries with High Income Levels by testing the activities of monetary policies on asset market after the 2008 crisis period. The financial crisis of 2008 made a negative effect on OECD countries with high-income levels. The shrink in the size of these economies in this group made a reflection on developing countries. As a matter of fact, OECD countries with high-income levels have an inevitable role in the globalization of the crisis that started in the USA. Therefore, OECD countries with high-income levels were analysed in this study. The study is organized as follows: First section covers the literature review about the topic of paper; Second Section, comprises the variables used in this study as well as the methods and data used with these variables; Third Section, includes the empirical findings; Fourth section, contains the result and recommendation.

## 2. Literature review

Rudebusch (1998) who studied the reactions of the financial market against the monetary policy shocks in the United States of America (USA) through VAR analysis came to the conclusion that there is a very little correlation between the fund rates of futures and future financial market incomes for the period comprising 1988 to 1995. Deloda and Lippi (2000) – in their VAR model they created for five industrialized OECD countries (Germany, France, Italy, the United Kingdom and the United States of America) – came to the conclusion that real output levels of these countries got influenced by monetary policy shocks through price changes in the share market of the countries for the period between 1970 to 1993. Durham (2001) – in the Regression Model comprising 16 developed OECD countries for the period between 1956:Q4 to 2000:Q4 concluded that there is a negative and meaningful relationship between strict monetary policies and stock market performance.

Rigobon and Sack (2004) studied the relationship between monetary policy and stock prices for the USA from 1994:Q1 to 2001:Q3 using the time series analysis. According to the empirical findings of the study, it was expressed that while a change in the short term interest rate, which is used as policy interest, creates important effects on stock prices on one hand, on the other hand, changes in the long term market interest rates make a little effect on stock prices. In the study of Bernanke and Kuttner (2004) it was concluded that an unexpected 25 basis points decline in the USA Federal Fund Rates leads to 1% decline of the whole share market index. Moreover, findings were obtained related to the fact that such unexpected monetary policy shocks bring excessive income in the share market.

Wong et al. (2005) – in their study where a VAR model comprising the period from 1982:Q1 to 2002:Q3 for Singapore and the USA – found that there is a strong co-integration relationship between M1 money supply and stock prices before 1997 Asian crisis for Singapore and before 1987 financial crisis for the USA. That this relationship got weaker in the preceding periods is among the findings of the study. Maskay (2007) studies the relationship between money supply (M2) and stock prices for the USA from 1959:Q1 to 2006:Q3. In the study, where a two level Regression Model was deployed, it

was concluded that there is a positive relationship between money supply and stock prices.

In the analysis by Garg (2008) where he deployed Least Squares Method (LSM) model, findings were obtained suggesting that a 0.2 % change in the futures fund rates in the USA from 2001:Q4 to 2007:Q3 leads to a change of 1 % in the sector based stock index. Kholodilin et al. (2008) analysed the reactions of European Sector Share Market against the monetary policies of the European Central Bank using the Generalised Method of Moments (GMM) Model. In the study, a 0.2% - 0.3 % increase in the interest rates announced by the European Central Bank within the period causes a fall of 25 basis points in sector stock exchange index. Additionally, it was observed that an increase in the policy interest during the period causes a 1% decrease in the total stock level.

In the study by Bennaceur et al. (2009), the monetary policy and its relationship with stock prices in MENA countries was analysed using the VAR model for the period from 1990:Q4 to 2005:Q4. According to the empirical findings of the study, it was concluded that the monetary policy has an important effect on the stock incomes in Bahrain, Oman, Jordan and Saudi Arabia; that the monetary policy has no major effect on stock prices in Tunisia, Morocco and especially in Egypt; and that the reactions of monetary policy against the stock price changes are not homogenous in all these countries. In the study by Hayo et al. (2011), the monetary policy announcements as well as its relationship with asset prices were analysed using the GARCH model for the USA through the period data of 1998-2009. The result of the analysis revealed that extraordinary monetary policy precautions increase the fluctuations in asset prices.

In the study by Stoica and Diaconăşu (2012), the effect of monetary policy on stock market was analysed using the VAR model for 27 European Union countries through monthly data between January 2000 and February 2012. According to the empirical results of the study, a long-term relationship between policy interest and stock price index is in question only for The Netherlands, France, Finland and Italy for the period under focus. The reaction of stock price index against policy interest in these countries is strong and negative.

### **3. Data and methodology**

In this study, the relationship between stock price index and monetary policy of 13 OECD countries with High Income Level (Australia, Canada, Denmark, Iceland, Japan, Korea, New Zealand, Norway, Poland, Sweden, Switzerland, the United Kingdom and the United States) was tested for the period after 2008 financial crisis (2010-2013). The High Income Group classification is a classification that comprises an income of 12,615 USD of GDP or more for 2012, made by the World Bank. In the study, the definitions of M1 and M3 money supply – on behalf of monetary policy -, short-term interest rates, and interbank interest rates were used. The stock price index was used as dependant variable. The relationship among the variables was analysed making use of the monthly data between 2010-2013 within the scope of the study. The data of the study were obtained from OECD and electronic database. The data used in the study are as follows:

SP: Share Price Index (stock price index)

IIR: Interbank overnight interest rates

SIR: Short term interest rates

M1: M1 money supply (Index)

M3: M3 money supply (Index)

### 3.1. Panel unit root tests

In the study, the Pesaran et al. (2004)  $CD_{LM}$  test, Breusch-Pagan (1980)  $CD_{LM1}$  test and Pesaran et al. (2004)  $CD_{LM2}$  test were used in order to test whether the units making up the panel has cross-sectional dependence. According to other  $CD_{LM}$  tests in the APPENDIX, it was concluded that there is a cross-sectional dependence problem both for variables and for the model. Thereby, due to the fact that using methods discarding the cross-sectional dependence might return incorrect estimate results, methods taking cross-sectional dependence into consideration were used in the study. In the first place, the cross-sectionally Augmented Dickey-Fuller (CADF) test – developed by Pesaran (2007) – was used.

The CADF test uses the first differences of each series in ADF regression as well as delayed cross-sectional averages and assumes the fact that each cross-section that makes up the panel data gets influenced by time effects (Pesaran, 2007: p. 265). The CADF test supports the idea that real economic phenomena cannot be analysed with a single variable on general basis. With this respect, test regressions can be more efficient by creating finer inferences with the use of additional information in the unit root series (Constantini and Lupi, 2011: pp. 4). The CADF test created by Pesaran (2007) is as follows:

$$\Delta Y_{it} = \chi_i + \beta_i Y_{i,t-1} + \sum_{j=1}^{\rho j} c_{ij} \Delta Y_{i,t-j} + d_{it} + h_i \bar{Y} + \sum_{j=0}^{\rho j} \eta \Delta \bar{Y}_{i,t-j} + \varepsilon_{i,t} \quad (1)$$

$i = 1, 2, \dots, t$

In the equation above,  $\alpha_i$  is for the constant term while  $t$  is time,  $\Delta \bar{Y}$  is difference lags,  $\bar{Y}_{t-1}$  is a one term lag value of  $\bar{Y}$ . In this equation,  $\bar{Y}_t$  shows the average of  $N$  observations, which is included in the model, according to  $t$ . the CADF test expresses that the series are not stable under null hypothesis and that all units making up the panel are stable under alternative hypothesis. In the CADF test, the critical values are taken from Pesaran (2007). In the phase after the CADF regression is predicted, the averages of  $t$  statistics of lagged values (CADF) are taken in order to obtain CIPS statistics.

$$CIPS = \frac{1}{N} \sum_1^N CADF_i \quad (2)$$

In the CIPS test, the null hypothesis expresses that all units containing panel regression contain unit – namely series are not stable – and the alternative hypothesis expresses that all units making up the panel are stable.

### 3.2. Panel co-integration test

In order to determine whether there is cointegration relationship among the series in the study, the Durbin-Hausman panel co-integration test – developed by Joakim Westerlund (2008) was used. The Durbin-Hausman panel co-integration test – different from other panel co-integration tests – allows the independent variables to have different stability levels (Westerlund, 2008). In this method, it is mostly investigated whether one or more explanatory variables are endogenous in a regression model (Chmelarova, 2007: pp. 199). In the Durbin-Hausman test, two tests are calculated – panel and intragroup. While panel-wide inferences are made with panel statistics, inferences for the units making up the panel are made with the group statistics. The null hypothesis of the panel statistics is expressed as “There is no co-integration for all cross-sectional units” whereas the alternative hypothesis of the statistics is expressed as “There is co-integration for all cross-sectional units. The null hypothesis for the group statistics is known “to have no co-integration for all cross-sectional units”. The alternative hypothesis is expressed to have co-integration for some countries and no co-integration for some others.

### 3.3. Panel causality test

The model below is generally used in most of the standard causality tests: (Dumitrescu and Hurlin, 2012: p. 1451):

$$\gamma_{it} = \alpha_0 + \alpha_j \gamma_{i,t-1} + b_j \alpha_{i,t-1} + \int_i u_{i,t} \quad (3)$$

$$i = 1, 2, \dots, n$$

$\int_i$  indicates the constant effect. The constant effect can be eliminated by taking the first difference of the model above: When the difference of the model above is taken, the main model is as follows:

$$(\gamma_{it} - \gamma_{i,t-1}) = \alpha_j (\gamma_{it} - \gamma_{i,t-1}) + b_j (\gamma_{it} - \gamma_{i,t-1}) + (u_{i,t} - u_{i,t-1}) \quad (4)$$

Dumitrescu and Hurlin (2012) developed a causality test apart from heterogeneous panel data models. In this test, two variables that can be observed in T period at an amount of N are expressed as x and y. For each  $i = 1, 2, \dots, N$  and  $t = 1, 2, \dots, T$ , the lateral regression model is as follows (Dumitrescu and Hurlin, 2012: p. 1451):

$$\gamma_{it} = \alpha_i + \sum_k^K \gamma_i^{(k)} \gamma_{i,t-k} + \sum_{k=1}^K \beta_i^{(k)} \alpha_{i,t-k} + \varepsilon_{i,t} \quad (5)$$

In this equation,  $\beta_i = \beta_i^1, \beta_i^2, \beta_i^3, \dots, \beta_i^k$ . It is assumed that individual effects ( $\alpha_i$ ) are stable, that lag parameters  $\gamma_i^{(k)}$  are constant, and that  $\beta_i^{(k)}$  regression incline coefficients are changeable among the units. As a matter of fact, constant effects model is set up for the causality test carried out. The lag length mentioned here is identical to all cross-sectional units of K (Bozoklu and Yılançı, 2013: p. 176).

The null and alternative hypotheses of the model tested by making use of Equation (5) are as follows (Dumitrescu and Hurlin, 2012: p. 1453):

$$H_0 : \beta_i = 0 \rightarrow \forall_i = 1, 2, \dots, N$$

$$H_1 : \beta_i = 0 \rightarrow \forall_i = 1, 2, \dots, N$$

$$\beta_i \neq 0 \rightarrow \forall_i = N + 1, N + 2, \dots, N$$

The null hypothesis shows that all the individual vectors equal to zero, while the alternative hypothesis shows that some of the individual vectors equal to zero. The  $W_{N,T}^{HNC}$  mean statistics hypothesis is formulized as below:

$$W_{N,T}^{HNC} = \frac{1}{N} \sum_{i=1}^N W_{i,T} \quad (6)$$

Here,  $W_{i,T}$  stands for the individual Wald statistical values for cross-section units. The average statistic,  $W_{N,T}^{HNC}$ , which has asymptotic distribution, associated with the null HNC hypothesis, is defined as:

$$z_T^{HNC} = \sqrt{\frac{N}{2k}} (W_{N,T}^{HNC} - K), (T, N) \rightarrow \infty N(0, 1) \quad (7)$$

$$W_{i,T} = (T - 2K - 1) \begin{pmatrix} \tilde{\varepsilon}_i \theta_i \varepsilon_i \\ \tilde{\varepsilon}_i M_i \tilde{\varepsilon}_i \end{pmatrix} \rightarrow i = 1, \dots, N \quad (8)$$

The average statistic,  $W_{N,T}^{HNC}$ , which has semi-asymptotic distribution, associated with the null HNC hypothesis, is defined as:

$$z_N^{HNC} = \frac{\sqrt{N \left[ W_{N,T}^{HNC} - N^{-1} \sum_{i=1}^N E(W_{i,T}) \right]}}{\sqrt{N^{-1} \sum_{i=1}^N Var(W_{i,T})}} \quad (9)$$

Here,  $E(W_{i,T})$  is also  $Var(W_{i,T})$  and is the variant statistic of Equation (8). If there is cross-sectional dependency, 5% of the simulated critical values from 50.000 replications of the benchmark model and 5% of the approximated values are used. The biggest advantage of the panel causality test developed by Dumitrescu and Hurlin (2012) is that the Wald statistics, which are meanly standardized have standard asymptotic distribution and that the calculation is easy (Dumitrescu and Hurlin, 2012: p. 1459).

#### 4. Findings of the research

The  $CD_{LM}$  test results, also available in the Appendix section, show that there is cross-sectional dependency issue not only in all variables but also in the model. The fact that

there is cross-sectional dependency makes it possible to apply 2nd generation unit root tests on short-term interest rates and to obtain more relevant results.

**Table 1.** *The CADF Test Results in Countries with High Income Levels*

Countries	CADF-Stat				
	SIR	IIR	M1	M3	SP
Australia	-3.662**	-3.662**	-1.664	-1.693	-2.268
Canada	-4.222***	-4.222***	-1.180	-0.026	-1.264
Denmark	-5.636***	-5.636***	-2.286	-0.415	-1.407
Iceland	-3.566**	-3.566**	-0.827	-2.459	-2.391
Japan	-4.297***	-4.297***	-3.086*	0.736	-2.147
Korea	-5.638***	-5.638***	-2.117	-2.518	-1.401
New Zealand	-5.643***	-5.643***	-2.705	-1.722	-1.127
Norway	-3.672**	-3.672**	-1.114	-1.412	-2.197
Poland	-3.003*	-3.003*	-2.448	-2.335	-1.809
Sweden	-6.61***	-6.63***	-2.800	-2.863	-2.090
Switzerland	-4.303***	-4.303***	-1.461	-2.027	-1.948
The UK	-3.997***	-3.997***	-1.267	-2.170	-2.389
The USA	-4.283***	-4.283***	-0.247	-1.679	-1.686
CIPS-Stat	-4.498***	-2.24*	-1.785	-1.583	-1.856

\*\*\*, \*\*, \* shows that they are meaningful at a rate of 1%, 5%, and 10%, respectively. The critical values are -3.98%, -3.30% and -2.98% at 1%, 5% and 10% level respectively. The critical table values were obtained from Pesaran (2006) Case III Intercept and Trend. The critical table values for CIPS were obtained from Pesaran (2006) Table 2c Intercept and Trend.

According to the CADF unit root tests shown in Table 1, short term interest rate series are statistically meaningful at 1% level in Canada, Denmark, Japan, Korea, need Zeeland, Sweden, Switzerland, the United Kingdom, and the United States; at 5% level in Australia, Iceland, and Norway; and at 10% in Poland. Therefore, the alternative hypothesis is accepted by rejecting the Null Hypothesis for all of the countries. According to the results of the CIPS test that test whether the series contain root in the panel overall, short-term interest rate is meaningful at a level of 1%. Thus, it is understood that short-term interest rate series in 13 countries with High Level of Income are stable after the 2008 financial crisis period.

The interbank interest rate series is statistically meaningful at a level of 1% in Canada, Denmark, Japan, Korea, New Zealand, Sweden, Switzerland, the UK and the USA; at a level of 5% in Australia, Iceland, and Norway; at a level of 10% in Poland. Thus, the alternative hypothesis is accepted on one hand while the null hypothesis is rejected for the countries under discussion. The CIPS values are meaningful at a level of 10% when they are compared to the critical values presented in the study by Pesaran (2006) Table 2c (constant and trend). Therefore, it can be concluded that the interbank interest rate series have a stable structure after 2008 financial crisis in 13 OECD countries with High Level of Income.

The M1 series is only meaningful at a level of 10% in Japan. In the other countries making up the panel, the null hypothesis cannot be rejected due to the fact that the CADF test value is lower than the critical table values. The CIPS value for M1 series are not statistically meaningful. According to this, all the countries making up the panel contains root. It can be concluded that these countries has been in a non-stable process after the 2008 financial crisis.

According to CADF unit root test results for M3 series, the CADF test statistical value is lower than critical table values in the countries making up the panel. Thus, the null hypothesis cannot be rejected. The CIPS value for M3 series is not statistically meaningful. Therefore, it can be concluded that all the countries making up the panel has been in a non-stable process after 2008 financial crisis.

Finally, the CADF test results for stock price index show that the null hypothesis cannot be rejected in the countries making up the panel. Moreover, the CIPS test results – testing whether there is unit root on the overall panel – also confirm the fact that stock price index contains unit root. Thus, it can be concluded that 13 OECD countries with High Level of Income is in a non-stable process in terms of stock price index.

Whether there is cross-sectional dependency in the model must be analysed before analysing whether there is a long-term relationship among the series after the unit root test. The results of the cross-sectional dependency for the model are available in the appendix.  $CD_{LM}$  test results show that there is horizontal cross-sectional dependency issue for the model. Therefore, since using methods that do not take horizontal cross-sectional dependency into consideration may return erroneous results, panel co-integration test that takes horizontal cross-sectional dependency into consideration was used.

**Table 2.** *Durbin-Hausman Panel Co-Integration Test*

Dependent Variable	test	t-statistics	Probability value
Stock Price Index	$DH_g$	38.015	0.000
	$DH_p$	13.852	0.000

**Note:** All the tests were applied as constant and stable.  $DH_g$  stands for the group statistics, while  $DH_p$  stands for the panel statistics.

According to Durbin-Hausman test results in Table 2, both the panel statistics ( $H_p$ ) and the group statistics ( $H_g$ ) returned as meaningful for the period after 2008 financial crisis. Therefore, the null hypothesis expressing that there is no co-integration for both statistics is rejected. According to the panel statistics allowing inferring for the general panel, there is co-integration in cases where stock price index is dependent variable and short-term interest rate, interbank interest rate, M1 money supply, and M3 money supply are explanatory variable for the period between 2010-2013, a period also known as post-crisis period for 13 OECD countries with High Level of Income. Thus, it can be concluded that there is a long-term relationship among these variables. The group statistics ( $H_g$ ) that allows inference for each unit making up the panel also returned as meaningful statistically. According to this, the null hypothesis expressing that there is co-integration for some units and there is no co-integration for some others is accepted.

Following the panel co-integration test, whether there is causality relationship among the variables was analysed using the Dumitrescu-Hurlin Granger causality test.

**Table 3.** *The Causality Test Results*

Causality Direction	$W^{HNC}$	$Z_{NT}^{HNC}$	$Z_N^{HNC}$
SIR→SP	7.58E-07 (5.132849)	4.72008*** (5.647825)	2.04E-06 (4.936452)
SP→SIR	0.012970 (2.617687)	0.214609 (1.113552)	0.280543 (0.839156)
IIR→SP	2.74E-05 (4.378471)	4.06005 (4.2878509)	0.000413 (3.707540)
SP→IIR	0.000219 (3.875427)	0.001314*** (3.380974)	0.006162 (2.888062)
M1→SP	0.000134 (4.000546)	0.000598*** (3.606536)	0.003350 (3.091886)
SP→M1	0.013544 (2.601109)	0.221772 (1.083665)	0.286868 (0.812149)
M3→SP	0.006800 (2.853729)	0.122050 (1.539082)	0.188694 (1.223676)
SP→M3	0.000529 (3.640265)	0.005037*** (2.957030)	0.017311 (2.504975)

For all variables, 2 lag length were taken into consideration. \*\*\*, \*\*, and \* represent the meaning levels of 1%, 5%, and 10%, respectively. The values presented in parenthesis shows t-statistic values.

According to the panel causality test results in Table 3, the null hypothesis, which is expressed as “SIR is not the reason of SP’s granger causality”, is rejected. According to this result, there is a causality relationship from Short-term interest rates to Stock price index in 13 OECD countries after the 2008 financial crisis. The null hypothesis defined as “SP is not the cause of IIR granger” is rejected. In parallel to this, there is a unilateral causality relationship from stock price index to interbank interest rate in 13 OECD countries in the post-crisis period. When the causality relationship between stock price index and M1 money supply, the hypothesis of “M1 money supply is not the cause of SP granger” is rejected. According to this result, there is a unilateral causality relationship from M1 money supply to stock price index. As far as the causality relationship between stock price index and M3 money supply is concerned, the null hypothesis defined as “SP is not the cause of M3 money supply” is rejected. According to this result, there is a causality relationship discovered from stock price index to M3 money supply.

Throughout the Central banks of OECD countries with high level of income, Interbank overnight interest rates are used as a basic policy tool in signalling to the markets. Overnight interest rates that exist in interbank money market affect the interest rates, which are interpreted as the income curve of securities (stock, bond, bill, etc.) that have different risk and liquidity features, via money policy transfer mechanism. Although, a causality relationship could not be detected from this variable towards stock price index in the post 2008 financial crisis period. This result can be interpreted as a condition in which the financial markets do not respond to policy signals coming from the Central banks and in which the money authorities are not effective in providing financial stability. As widely known, there should not be any problems in the monetary transfer mechanism that makes monetary policy transfers or changes in the interest rate possible to transfer into real economy so that monetary policies can be used efficiently. Financial institutions and markets that function seamlessly are required so that monetary transfer mechanisms can function in the way it is expected. The problems in the process of financial

institutions and markets influence the process of monetary transfer mechanism, the monetary policy activity, and total demand and inflation level, as a result. With this respect, not being able to determine any causality relationship from interbank overnight interest rates towards stock price index in developed countries after post 2008 financial crisis period can be interpreted as the fact that monetary policy cannot function in the way it is expected.

A unilateral relationship from stock price index towards interbank interest rate in the post-crisis period can be interpreted as a case in which changes occurring in the stock price indexes influence overnight interest rates in the interbank money market and interbank interest rates have the qualification of an indicator that can predict stock price index.

The unilateral causality relationship from short-term interest rates and M1 money supply to stock price index in 13 OECD countries with high level of income during the post-crisis period shows that the central banks influence the stock price index by modifying short-term interest rate and M1. The unilateral causality relationship from stock price index to M3 money supply can be interpreted as a case in which stock price indexes have a qualification of indicator for Central Banks.

In the post-crisis period, another result that central banks of the countries can come to for the monetary policies is that the monetary policies are insufficient in preventing the crises, that price stability targets are not sufficient in achieving financial stability, and that banks should not ignore the risks and inflations in the asset prices in the markets.

#### **4. Result and policy recommendations**

A causality relationship from short-term interest rate to stock price index was determined in 13 OECD countries during post-2008 financial crisis period. These results show similarities with the results of the studies by Redebush (1998), Rigoban and Sack (2004), Bernanke and Kuttner (2004), Garg (2008), Kholodilin et al. (2008), Hoyo (2011) and Stoica and Diaconășu (2012). Another causality relationship that was determined in the study is from M1 money supply to stock price index. This result is in parallel to the studies of Wong (2005), Maskay (2007) and Castro and Sousa (2012). Moreover, a causality relationship from stock price index to interbank interest rate and M3 money supply was determined for the post-crisis period in the study. These interactions show that both interest rates and changes done in the money supply influence stock price index. At this point, it can be interpreted as the fact that Keynesian and Monetarist transfer mechanisms co-operate.

The central banks of the countries reached to the conclusion that providing price stability – following the crisis experience – is not the final destination but more like a tool to reach the purpose and that providing price stability – with this respect – is not equal to providing stability in real economic variables such as sustainable economic growth and employment. It was concluded that low and stable inflation rates alone are not sufficient in providing stable real economy and fast real economic growth. Because, the last global

financial crisis proved that primary result of central banks' focusing on price stability could be the ignored financial instability itself.

The findings obtained at the end of the study revealed the requirement that the central banking view, which targets price stability only while creating the new framework of the monetary policies, should be abandoned. With this respect, the indicator used by monetary policy authorities in developed countries in the post-crisis period showed that the performance of the interest rates is insufficient in providing financial stability. Yet, another inference is the obligation of the fact that more flexible monetary policy practices should be deployed so that financial stability and financial stability targets can be reached together except for traditional monetary policy practices. It is crucial to deploy non-traditional monetary policy tools with multiple monetary policy instruments instead of traditional short-term interest rate only, which is appointed to price stability target of monetary policy for central banks within this context.

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**Appendix 1. Cross Section Dependence Test Results for Variables**

Test	SIR	IR	M1	M3	Sp
CD <sub>LM1</sub>	(289.044) <sup>***</sup>	(111.487) <sup>***</sup>	(132.729) <sup>***</sup>	(93.552) <sup>***</sup>	(238.626) <sup>***</sup>
CD <sub>LM2</sub>	(16.897) <sup>***</sup>	(2.681) <sup>***</sup>	(4.382) <sup>***</sup>	(1.245) <sup>*</sup>	(12.860) <sup>***</sup>
CD <sub>LM</sub>	(-4.963) <sup>***</sup>	(-2.178)	(-3.659) <sup>***</sup>	(-1.818) <sup>**</sup>	(-1.119) <sup>*</sup>
Adjusted CD <sub>LM1</sub>	(21.400) <sup>***</sup>	(20.304) <sup>***</sup>	(8.772) <sup>***</sup>	(5.909) <sup>***</sup>	(7.985) <sup>***</sup>

<sup>\*\*\*</sup>, <sup>\*\*</sup>, <sup>\*</sup> indicate the significant level at 1%, 5% and 10% respectively.

**Appendix 2. Cross Section Dependence Test Results for models**

Test	t-statistical value	Probability value
CD <sub>LM1</sub>	504.161 <sup>***</sup>	0.000
CD <sub>LM2</sub>	34.120 <sup>***</sup>	0.000
CD <sub>LM</sub>	16.045 <sup>***</sup>	0.000
Adjusted CD <sub>LM1</sub>	38.032 <sup>***</sup>	0.000

<sup>\*\*\*</sup> indicates the significant level at 1%.

## Determinants of household loans

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**Abstract.** *Although, with the onset of the global financial and economic crisis, there have been significant changes in the activity of banks in Romania, the level of household indebtedness has remained high until today. This is why this paper analyzes the influence of unemployment rate and Consumer Price Index on household loans in Romania. The analysis is based on monthly time series data during 2008-2015 of loans to households, unemployment rate and Consumer Price Index. To study this dependence, we have opted for a model with an ARMA component, where the influence of unemployment rate and Consumer Price Index manifests itself with a delay (lag) and is expressed by a linear relationship. The model shows that these factors have a significant influence on household loans.*

**Keywords:** household loans, unemployment rate, Consumer Price Index, determinants of loans.

**JEL Classification:** E51, D14, C58.

## 1. Introduction

From 2007 until September 2008, along with the onset of the financial and economic crisis, the amount of household loans increased much to the detriment of the amount of public savings (kept in deposits) and this was accentuated over time during the period. Additionally, in the period between 2008 and 2015, household indebtedness was very high, reaching alarming levels in 2013, when 4.5 million individuals, that is about 50% of Romania's active population, had contracted about 6 million consumer loans and mortgage loans (Mihăițeanu, 2014). Starting with the Romanian economy's recession, public confidence in the economic situation declined and uncertainty about future incomes increased (Dumitru et al., 2011, p. 16). Therefore, households seek to reduce their indebtedness by placing their savings in deposits, despite deposit interest rates that continue to decrease. Other factors that have stimulated such behavior are: the improvement of the macro-economic environment, the increase of the average nominal wage net, the slight decrease in the unemployment rate, low inflation and the increasing payments to individuals from European funds (FGDB, 2014, p. 35).

In the Romanian specialty literature, there are not many studies that highlight factors influencing household loans. Muraru (2013) has shown that the Consumer Confidence Index, the absolute change calculated with the base chained in the interest rates of loans in Lei, the absolute change calculated with the base chained in the interest rates of loans in Euro and the absolute change calculated with the base chained in the exchange rate are factors affecting the demand for loans to households. Luca (2013) points out that among the factors that have influenced the restriction of the demand for loans, the important ones are: the decreased incomes, the uncertainty of job prospects and high interest rates. Luca (2014) shows that the global financial crises can change the borrowing plans of the population and the high levels of foreign currency loans are due to both banks supply and customer demand. Also, she adds that foreign currency loans were still preferred by households in 2010 in Romania, which was due to favorable interest rate and friendly loan terms for foreign currency loans compared with the local currency ones. Mitroi and Oproiu (2013) emphasize the dependence of the monthly variation of consumption loans on the monthly variation of household income, previous month variation of the loans value and eventually the previous month variation of the population income.

Among the scientific works in foreign literature reflecting on the issue of the article, we mention those that study: factors influencing household access to formal and informal credit in Malawi (Diagne, 1999), determinants of household loans in Spain (Nieto, 2007), determinants of household credit in Italy, separately analyzing credit market supply and demand (Magri, 2007), macroeconomic factors that influence the quality of loans to households in Italy in the last twenty years (Bofondi and Ropele, 2011), determinants of household credit in transition countries by a cross-country analysis (Kraft, 2007), determinants of non-performing loans in the Greek banking sector for consumer loans (Louzis et al., 2012), factors influencing borrowing by urban households in north-eastern Greece (Pastrapa and Apostolopoulos, 2009), determinants of formal and informal rural credit in Vietnam (Barslund and Tarp, 2008), factors affecting loans to households by analyzing a sample of 45 developed and developing countries (Beck et al., 2012), factors

influencing non-performing loans of the household sector by analyzing a sample of countries of the Euro area (Rinaldi and Sanchis-Arellano, 2006).

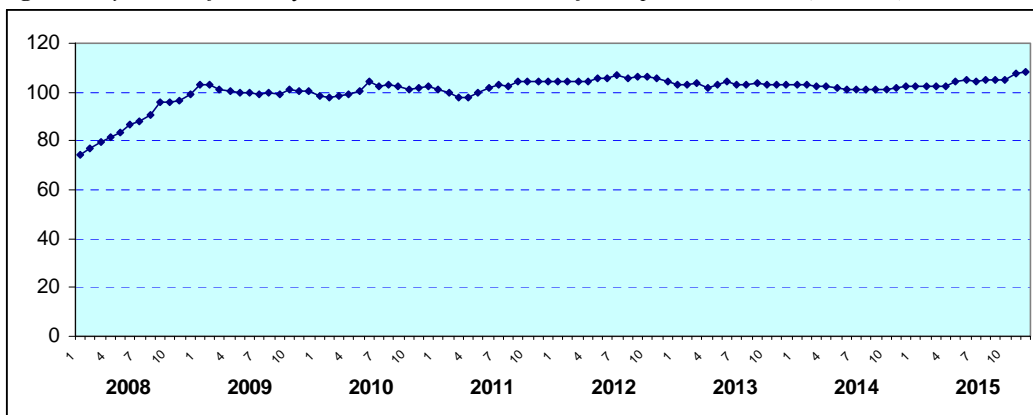
Rubaszek and Serwa (2012) use a life-cycle model with individual income uncertainty to investigate the factors influencing loans to households. They have shown that the determinants of loans are: real interest rate, GDP, interest rate spread (the difference between the lending rate and deposit rate), individual income uncertainty, individual productivity persistence (measured by the coefficient of AR (1) model followed by the logarithm of the idiosyncratic component of productivity) and the generosity of the pension system, and that the implications of the theoretical model are to some degree confirmed by the data for OECD and EU countries.

## 2. Testing time series stationarity

A time series is stationary if the properties of one section of the data are the same as those of any other section, i.e. if there is no systematic change in mean and variance, and strictly periodic variations have been removed (Chatfield, 2016, p. 13). If a time series is non-stationary, i.e. it exhibits a trend, in order to remove this trend, the difference operator is applied to the original time series to get a new time series (Montgomery et al., 2015, pp. 50-51). In order to study stationarity, the Augmented Dickey-Fuller and Phillips-Perron tests have been used. For data processing, Eviews 9.0 software has been used.

Time series of monthly household loans in Romania for the period 2008-2015 has generally fluctuated (Figure 1). If during January 2008-September 2008 loans to households had a permanent increase, from October 2008 to December 2015, periods of contraction alternated with periods of growth for these loans, period sizes and differences between extreme values being variables. This is due largely to the national and global economic situation (economic crisis, slight economic recovery), and the monetary policy, political factors etc.

**Figure 1.** Dynamics of monthly household loans in Romania for the period 2008-2015 (billion lei)



**Source:** prepared by the authors according to the data in Annex.

To test the stationarity of loans series (CRED), we use the Augmented Dickey-Fuller test that provides us the following information:

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-6.051247	0.0000
Test critical values:		
1% level	-3.500669	
5% level	-2.892200	
10% level	-2.583192	

\*MacKinnon (1996) one-sided p-values.

For the time series of monthly loans, the test value is less than the critical values corresponding to each of relevance levels of 1% , 5% and 10 % , which means that the series is stationary (with a probability greater than 0.99 ).

By using the Phillip-Perron test, we get the following information on the time series of monthly unemployment rate (R\_SOM):

Null Hypothesis: R\_SOM has a unit root  
Exogenous: Constant  
Bandwidth: 5 (Newey-West using Bartlett kernel)

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-1.797975	0.3795
Test critical values:		
1% level	-3.500669	
5% level	-2.892200	
10% level	-2.583192	

\*MacKinnon (1996) one-sided p-values.

As the probability for the Phillips-Perron test exceeds 5% (0.3795), the series of monthly unemployment rate R\_SOM is not stationary. Therefore, the stationarity of the DR\_SOM series obtained by its differencing will be tested. After applying the Phillips-Perron test, the software gives the following results:

Null Hypothesis: DR\_SOM has a unit root  
Exogenous: Constant  
Bandwidth: 2 (Newey-West using Bartlett kernel)

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-4.495764	0.0004
Test critical values:		
1% level	-3.501445	
5% level	-2.892536	
10% level	-2.583371	

\*MacKinnon (1996) one-sided p-values.

Hence, the first difference of the time series of unemployment rate is stationary.

To test the stationarity of the series of monthly Consumer Price Index in Romania for the period 2008-2015 (IPC), the Augmented Dickey-Fuller test is used, for which we obtain the following information:

Null Hypothesis: IPC has a unit root  
 Exogenous: Constant  
 Lag Length: 0 (Automatic based on SIC, MAXLAG=11)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.439118	0.0119
Test critical values:		
1% level	-3.500669	
5% level	-2.892200	
10% level	-2.583192	

\*MacKinnon (1996) one-sided p-values.

According to the output, the probability associated with this test is 0.0119, below the 0.05 threshold, which means that the series of the monthly Consumer Price Index is stationary.

### 3. The econometric model

It is believed that the volume of loans during a period (month) depends on the volume of loans during several periods in the recent past (several months earlier) and that dependence is linear, so we have an autoregressive process (AR). Also, the occurrence of sudden and unexpected changes in the external factors correlated with the resultative variable requires a moving average process (MA) to highlight the gradual assimilation of shocks (accidental deviations). Thus, the ARMA component of the model is emerging. An AR model would have been preferred, but the econometric tests and attempts have led to the more general version of this model, namely the ARMA model, whose parameters can be unstable, so it is used in forecasts with some reservations. At the same time, unemployment rate and Consumer Price Index during a period (month) influence the household loans during a subsequent period. As a result of the above, the model form is

$$CP_t = \alpha_0 + \sum_{i=1}^p \alpha_i CP_{t-i} + \gamma_1 IPC_{t-h_1} + \gamma_2 DRs_{t-h_2} + \varepsilon_t + \sum_{j=1}^q \beta_j \varepsilon_{t-j} \quad (1)$$

where:

$t$  = the time expressed in months;

$CP_t$  = the volume of household loans in month  $t$ ;

$IPC_t$  = the Consumer Price Index in month  $t$ ;

$DRs_t = Rs_t - Rs_{t-1}$ ;

$Rs_t$  = the unemployment rate in month  $t$ ;

$h_1$  = the delay (lag) in displaying the influence of the Consumer Price Index on household loans;

$h_2$  = the delay (lag) in displaying the influence of the difference between unemployment rates in two consecutive months on household loans;

$\alpha_i$  = the coefficients of the AR component of model that must be determined,  $i = 0, 1, \dots, p$ ;

$\beta_j$  = the coefficients of the MA component of model that must be determined,  $j = 1, 2, \dots, q$ ;

$\gamma_1$  = the coefficient of Consumer Price Index that must be determined;

$\gamma_2$  = the coefficient of the difference between unemployment rates in two consecutive months, that must be determined;

$\varepsilon_t$  = the residual variable that has a normal distribution with mean 0 and variance  $\sigma^2$ .

As we have seen before, the time series used in the model are stationary. After analyzing the autocorrelation coefficients and partial correlation coefficients have been identified several types of models. Next, the coefficients of these models have been estimated and tests have been performed on: significance of individual regression coefficients, overall significance of the regression model, autocorrelation in residuals, homoskedasticity, invertibility of ARMA component. Finally, in order to select the best model, the analysis criteria: adjusted R-square, Akaike and Schwartz information criteria have been used.

By proceeding this way, we have chosen a model that has  $p = 2$  (AR component order),  $q = 1$  (MA component order),  $h_1 = 5$  (lag of Consumer Price Index) and  $h_2 = 4$  (lag of difference between unemployment rates in two consecutive months):

$$CP_t = \alpha_0 + \alpha_1 CP_{t-1} + \alpha_2 CP_{t-2} + \gamma_1 IPC_{t-5} + \gamma_2 DRs_{t-4} + \varepsilon_t + \beta_1 \varepsilon_{t-1} \quad (2)$$

Estimation of econometric models coefficients is usually performed by the least squares method and the method of maximum likelihood. The model in this study has been estimated by the least squares method.

#### 4. Results and analyses

Using the above mentioned software, has been obtained the following information about the estimation of coefficients and the statistical tests for the model:

Dependent Variable: CRED  
 Method: Least Squares  
 Date: 05/10/16 Time: 22:52  
 Sample (adjusted): 6 96  
 Included observations: 91 after adjustments  
 Convergence achieved after 500 iterations  
 MA Backcast: 5

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3726991.	1302285.	2.861885	0.0053
DR_SOM(-4)	-278017.6	131409.2	-2.115664	0.0373
IPC(-5)	-3805.697	1936.872	-1.964868	0.0527
CRED(-1)	1.734667	0.054449	31.85866	0.0000
CRED(-2)	-0.766886	0.049616	-15.45642	0.0000
MA(1)	-0.980708	0.012754	-76.89603	0.0000
R-squared	0.908818	Mean dependent var		1.02E+08
Adjusted R-squared	0.903455	S.D. dependent var		3531662.
S.E. of regression	1097350.	Akaike info criterion		30.71835
Sum squared resid	1.02E+14	Schwarz criterion		30.88391
Log likelihood	-1391.685	Hannan-Quinn criter.		30.78514
F-statistic	169.4407	Durbin-Watson stat		1.826156
Prob(F-statistic)	0.000000			
Inverted MA Roots	.98			

By taking the estimates of the coefficients in the table above, we rewrite the equation (2) as follows:

$$\begin{aligned}
 CP_t = & 3726991 + 1.7347CP_{t-1} - 0.7669CP_{t-2} - 3805.697IPC_{t-5} - 278017.6DRs_{t-4} + \\
 & + \varepsilon_t - 0.9807\varepsilon_{t-1}
 \end{aligned} \tag{3}$$

Since only the probability associated with coefficient  $\hat{\gamma}_1 = -3805.697$  (Prob.) does not satisfy the condition of being less than 0.05, but this relevance threshold is exceeded slightly (0.0527), we can accept that the model parameters are significantly different from zero.

The coefficient of determination (R-squared), which has a high value (0.908818), indicates that 90.88% of the endogenous variable variation is determined by the factorial variables in the model, which shows that the factors taken into account are essential. The adjusted coefficient of determination (Adjusted R-squared), which has almost the same meaning, but penalizes the introduction of exogenous variables that have little influence on the endogenous variable (Ohtani, 2000), is also high (0.903455).

The calculated value of the Snedecor-Fisher test (F-statistic) is 169.4407, and the associated probability (Prob(F-statistic)) has a very low value, below the significance threshold of 0.01, so we reject the null hypothesis that all the regression coefficients are zero (excluding constant). Therefore, there is a statistically significant relationship between the endogenous variable and at least one of the exogenous variables.

Also, the ARMA component of the model is invertible, because the roots of the MA characteristic polynomial have modulus less than 1, as shown in the following information:

Inverse Roots of AR/MA Polynomial(s)  
 Specification: CRED C DR\_SOM(-4) IPC(-5) CRED(-1)  
 CRED(-2) MA(1)  
 Date: 05/10/16 Time: 22:55  
 Sample: 1 96  
 Included observations: 91

MA Root(s)	Modulus	Cycle
0.980708	0.980708	

No root lies outside the unit circle.  
 ARMA model is invertible.

We must also verify that there is no autocorrelation in the errors, and for this purpose we can use the LM test. The test output is the following:

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.358428	Prob. F(2,83)	0.6998
Obs*R-squared	0.608403	Prob. Chi-Square(2)	0.7377

Since the p-value of the chi-square statistic (Prob. Chi-Square) is 0.7377, higher than 0.05, we cannot reject the null hypothesis that there is no serial correlation, which means that no autocorrelation exists in the errors.

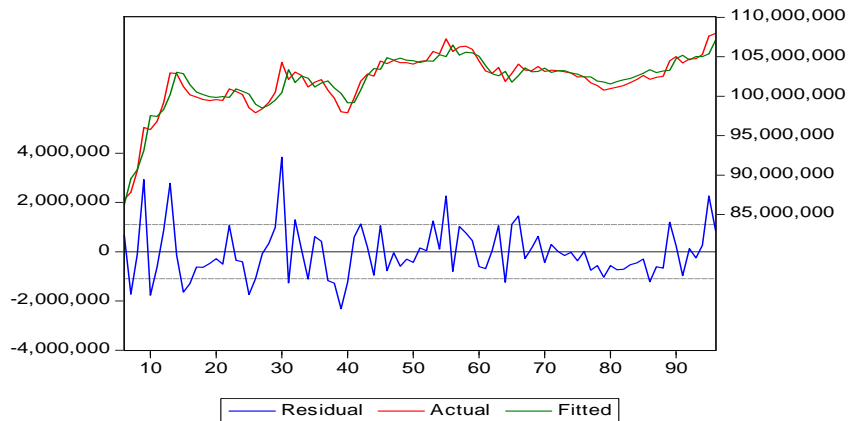
Finally, we must verify that the errors exhibit constant variance (homoskedasticity), and for this we will use the Breusch-Pagan-Godfrey test. The software gives us the following test output:

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	2.175959	Prob. F(4,86)	0.0784
Obs*R-squared	8.363430	Prob. Chi-Square(4)	0.0791
Scaled explained SS	12.57779	Prob. Chi-Square(4)	0.0135

Since the probability of F-statistic (Prob. F) is greater than 0.05 (0.0784), we cannot reject the null hypothesis of homoskedasticity, which means that errors manifest constant variance.

The actual and estimated values of monthly household loans as well as the residual variable values are represented in the figure below:



The statistical analysis performed validates the model and leads to its acceptance. The model shows that the volume of household loans in a month is determined, in a large proportion (over 90 %), by the variation of unemployment rate from 4 months ago, by the Consumer Price Index from 5 months ago and by the volumes of loans to households in the previous two months.

Coefficient estimates of the econometric model (3),  $\hat{\gamma}_1 = -3805.697$  and  $\hat{\gamma}_2 = -278017.6$ , show that there are inverse relationships with both factors, which means that increases in the Consumer Price Index and/or in the absolute change calculated with the base chained in the unemployment rate cause decreases in loans to households. Indeed, an increase in the Consumer Price Index means an increase in prices of the goods purchased and the tariffs for services used by the population, which, while the income remains the same or slightly increases, causes some restraint with regard to loans, in terms that once these loans have been contracted, there could be difficulty in paying the installments. In this situation, a decrease in the volume of loans to households is expected. Also, an increase in the absolute change calculated with the base chained in the unemployment rate means, at least on long-term, a rise in the unemployment rate, and in these circumstances, there is an increase in the number of unemployed, which makes these loans less affordable. Therefore, there is a decrease in the volume of loans to households.

The coefficient estimate of Consumer Price Index ( $\hat{\gamma}_1 = -3805.697$ ) shows that a 1% increase in this economic indicator, i.e. an increase in prices of goods and services consumed by the population by one percent in a month against the previous month, results in a decrease of 3,805,697 lei in loans to households in a month against the previous month, but this occurs with a delay of five months. The other estimate,  $\hat{\gamma}_2 = -278017.6$ , indicates that an increase of one percent in the monthly variation of the unemployment rate in a month against the previous month produces a decrease of 278,017,600 lei in loans to households in a month against the previous month, but it occurs with a delay of four months.

## 5. Conclusions

The model shows the dependence of loans to households on Consumer Price Index and the absolute change calculated with the base chained in the unemployment rate. The conditions for validating the correlation between household loans and factorial variables are satisfied: the equation as a whole is significant (the p-value of the F-statistic is very small), the model coefficients are significantly different from zero (only the significance level of a coefficient slightly exceeds the threshold of 0.05), a goodness of fit of the model (the adjusted coefficient of determination is 0.90), the ARMA component of the model is invertible, the errors are not autocorrelated (chi-square statistic probability is greater than 0.05), the error term has the same variance across all values of the independent variables (F-statistics probability is greater than 0.05).

The econometric model of the paper examines the influence of only two macroeconomic factors. To take into account a larger number of determinants of loans to households, one must take into consideration both banks supply and customer demand. A more complex model should also show, in addition to Consumer Price Index and unemployment rate, the influence of other factors, such as: population income (Mitroi and Oproiu, 2013), interest rates of loans in Lei, interest rates of loans in Euro, exchange rate (Muraru, 2013). There are also other influence factors that are harder to quantify, such as the conditions relating to good standing, the range of banking products and services. These issues are brought to our attention and will be the subject of future research.

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## Annex

**Monthly households loans, monthly unemployment rate and monthly Consumer Price Index  
in Romania for the period 2007-2015**

Period	Households loans (thousand lei)	Unemployment rate (%)	Consumer Price Index (%)
2008 - January	74,146,013.5	4.20	132.22
2008 - February	76,672,985.2	4.20	131.30
2008 - March	79,641,976.6	4.10	130.42
2008 - April	81,735,011.6	3.90	129.75
2008 - May	83,251,407.8	3.70	129.12
2008 - June	86,918,173.2	3.70	128.76
2008 - July	87,822,742.9	3.70	127.88
2008 - August	90,558,587.4	3.80	127.99
2008 - September	96,047,389.2	3.90	127.48
2008 - October	95,765,174.2	4.00	126.14
2008 - November	96,825,249.8	4.10	125.74
2008 - December	99,204,665.6	4.40	125.45
2009 - January	102,975,268.5	4.90	123.91
2009 - February	102,889,142.8	5.30	122.84
2009 - March	101,226,625.4	5.60	122.22
2009 - April	100,176,331.9	5.70	121.89
2009 - May	99,900,038.8	5.80	121.87
2009 - June	99,587,066.6	6.00	121.64
2009 - July	99,453,464.9	6.30	121.72
2009 - August	99,571,472.2	6.60	121.94
2009 - September	99,454,957.3	6.90	121.48
2009 - October	100,928,122.8	7.10	120.95
2009 - November	100,599,225.6	7.50	120.15
2009 - December	100,218,043.2	7.80	119.77
2010 - January	98,539,144.6	8.12	117.79
2010 - February	97,901,838.4	8.36	117.56
2010 - March	98,400,302.7	8.39	117.30
2010 - April	99,222,927.2	8.09	116.89
2010 - May	100,493,163.9	7.70	116.72
2010 - June	104,296,343.1	7.46	116.54
2010 - July	102,109,279.3	7.45	113.61
2010 - August	103,042,103.8	7.41	113.35
2010 - September	102,636,167.5	7.35	112.72
2010 - October	101,173,303.9	7.08	112.11
2010 - November	101,784,881.3	6.95	111.53
2010 - December	102,099,828.5	6.87	110.94
2011 - January	100,773,343.9	6.83	110.09
2011 - February	99,756,884.1	6.67	109.25
2011 - March	98,033,419.1	6.00	108.60
2011 - April	97,915,851.1	5.48	107.89

Period	Households loans (thousand lei)	Unemployment rate (%)	Consumer Price Index (%)
2011 - May	99,793,159.6	5.04	107.66
2011 - June	101,911,045.1	4.84	107.97
2011 - July	102,825,765.9	4.84	108.36
2011 - August	102,546,572.3	4.87	108.73
2011 - September	104,452,642.8	4.89	108.96
2011 - October	104,121,270.5	4.93	108.27
2011 - November	104,537,909.0	5.06	107.82
2011 - December	104,256,083.2	5.12	107.56
2012 - January	104,261,769.3	5.37	107.18
2012 - February	104,070,091.7	5.37	106.49
2012 - March	104,423,718.0	5.15	106.05
2012 - April	104,526,547.5	4.82	105.98
2012 - May	105,690,267.9	4.64	105.77
2012 - June	105,377,852.0	4.58	105.82
2012 - July	107,281,082.0	4.86	105.20
2012 - August	105,686,990.3	5.00	104.67
2012 - September	106,234,805.3	5.01	103.45
2012 - October	106,342,591.6	5.17	103.15
2012 - November	105,937,172.0	5.40	103.11
2012 - December	104,460,691.0	5.59	102.49
2013 - January	103,194,340.1	5.66	101.14
2013 - February	102,909,047.8	5.63	100.80
2013 - March	103,649,517.9	5.43	100.76
2013 - April	101,892,342.0	5.15	100.65
2013 - May	102,901,135.0	4.90	100.43
2013 - June	104,066,665.5	4.83	100.42
2013 - July	103,315,365.8	5.15	100.76
2013 - August	103,245,946.5	4.89	100.96
2013 - September	103,765,793.3	4.73	101.54
2013 - October	103,125,545.0	5.40	101.25
2013 - November	103,297,409.9	5.60	101.26
2013 - December	103,244,221.3	5.65	100.93
2014 - January	103,093,352.0	5.85	100.08
2014 - February	102,937,695.1	5.84	99.74
2014 - March	102,444,226.6	5.57	99.72
2014 - April	102,468,630.7	5.14	99.45
2014 - May	101,702,233.1	4.92	99.49
2014 - June	101,357,095.8	4.88	99.76
2014 - July	100,767,108.5	5.10	99.81
2014 - August	100,987,153.9	5.13	100.12
2014 - September	101,139,694.1	5.11	100.00
2014 - October	101,359,727.9	5.13	99.81
2014 - November	101,717,537.0	5.18	99.90

Period	Households loans (thousand lei)	Unemployment rate (%)	Consumer Price Index (%)
2014 - December	102,117,070.0	5.29	99.90
2015 - January	102,637,372.5	5.46	100.43
2015 - February	102,140,460.1	5.51	100.33
2015 - March	102,393,523.9	5.37	100.41
2015 - April	102,534,776.8	5.12	100.13
2015 - May	104,486,679.6	4.93	100.47
2015 - June	105,017,472.9	4.94	97.05
2015 - July	104,211,667.4	4.99	99.83
2015 - August	104,730,186.6	4.91	99.49
2015 - September	104,776,021.7	4.89	100.26
2015 - October	105,280,484.5	4.88	100.28
2015 - November	107,620,822.0	4.88	100.31
2015 - December	107,960,160.4	4.90	100.11

**Source:** National Institute of Statistics, <http://www.anofm.ro/statistican> and <http://www.bnr.ro/Credite-acordate-gospodariilor-populatiei-5771.aspx#>

## Tourism and economic structural change with endogenous wealth and human capital and elastic labor supply

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**Abstract.** *The purpose of this study is to introduce tourism to a small-open growth with endogenous wealth and human capital. We develop the model on the basis of the Solow-Uzawa growth model, Arrow's learning by doing, the literature of small-open economic growth models, and ideas from tourism economics. The economy consists of one service sector and one industrial sector. International tourists and domestic residents consume non-traded goods and services. We introduce endogenous land distribution between housing and supply of services. The production side is based on the traditional growth theories, while the household behavior is described by an alternative utility function proposed by Zhang (1993). We simulate the motion of the national economy and examine effects of changes in some parameters. The comparative dynamic analysis with regard to the rate of interest, the price elasticity of tourism, the global economic condition, the total productivities of the industrial and service sectors, the impact of tourism on human capital accumulation, and the propensity to save provides some important insights into the complexity of open economies with endogenous wealth and human capital.*

**Keywords:** tourism, price elasticity of tourism, wealth accumulation, endogenous human capital, elastic labor supply.

**JEL Classification:** E21, O41, O15.

## 1. Introduction

Tourism has played an increasingly important role in economic growth in many parts of the world. Tourism is different from what is called tradable goods in traditional trade theory. Tourism goods such as monuments of national heritage, historical sites, beaches, and hot springs, are not-tradable as one has to travel to the location in order to consume them. Hence, tourism converts non-traded goods into tradable ones. As reported by the World Tourism Organization (2008), over 903 million people travelled to a foreign country in 2007. The export income of international tourism is the fourth after fuels, chemicals, and automotive products. Tourism accounts for 6 per cent of global exports overall and thirty per cent of global exports of services (Copeland, 2012). According to the UNWTO World Tourism Barometer international tourist arrivals reached 1,087 million arrivals. Foreign tourism has become an important source of income and employment in many regions of the world. Tourism may interact with local economies in different ways. Tourism uses national resources such as labor, capital and housing and thus may make these resources less available for other sectors of the economy. Tourism also generates income which may be used to develop other economic activities. To properly address these interactions one needs a dynamic equilibrium framework. This study examines the dynamic interdependence in a general equilibrium framework. It should be noted that a static equilibrium framework with tourism is recently proposed by Zeng and Zhu (2011, see also, Corden and Neary, 1982; Copeland, 1991).

Tourism economics has increasingly become an important field in economics. There are many publications on tourism in the literature of economics (e.g., Sinclair and Stabler, 1997; Luzzi and Flückiger, 2003; Hazari and Sgro, 2004; Briedenhann and Wickens, 2004; Baum, 2007; Katircioglu, 2009; Hazari and Lin, 2011; Marta et al., 2014; and Ridderstaat et al., 2014). Nevertheless, as observed by Chao et al. (2009), the study of tourism has been largely limited to the static framework. Nevertheless, important issues related to tourism, for instance national economic growth and tourism, and national human capital accumulation and tourism, cannot be properly examined within static frameworks. A main purpose of this study is to introduce tourism to growth theory with endogenous wealth and human capital. We are also concerned with changes of economic structures and endogenous time distribution between work and leisure with tourism. It should be noted that empirical studies in the literature demonstrate an opposite relationship between a tourism boom and economic development (see, for instance, Balaguer and Cantavella-Jorda, 2002; Dritsakakis, 2004; Durberry, 2004; Oh, 2005; Kim et al. 2006). Hazari and Sgro (1995) develop a model to study the dynamic relationship among tourism, capital accumulation, per capita consumption and the terms of trade. According to their study an increase in the international demand for tourism leads to a positive effect on long-run economic growth. In another study by Chao et al. (2006), it is found that an expansion of tourism can result in capital decumulation in a two-sector dynamic model with a capital-generating externality. In order to fully understand possible effects of tourism on national economic development and economic structure, it is necessary to build a dynamic general equilibrium framework. Dwyer *et al.* (2004) discuss the need for dynamic general equilibrium modeling when studying tourism and its interaction with the rest economy. Blake et al. (2006) also address the issue. This study

studies tourism and economic growth on the basis of the Solow-Uzawa growth models and Arrow's learning by doing in context of a small-open economy.

Most of the models in the neoclassical growth theory model are extensions and generalizations of the pioneering works of Solow (1956). The Solow model has been extended and generalized in numerous directions (see, Burmeister and Dobell, 1970). An important extension was initiated by Uzawa (1961), who made an extension of Solow's one-sector economy by a breakdown of the productive system into two sectors using capital and labor, one of which produces industrial goods, the other consumption goods. Solow's one-sector growth model, Uzawa's two-sector growth model, and their various extensions and generalizations are fundamental for the development of new economic growth theories as well (see, for instance, Diamond, 1965; Stiglitz, 1967; Benhabib et al., 2000; Drugeon and Venditti, 2001; Ortigueira and Santos, 2002). But all these studies do not have tourism. This study structurally generalizes the Uzawa two-sector model to include tourism. As observed by Zeng and Zhu (2011), in the literature of tourism economics, almost all the models are based on a small open economy. We still follow this tradition in dealing with growth and capital accumulation within the analytical framework of small open economies. There is a large amount of the literature on economics of open economies (e.g., Obstfeld and Rogoff, 1996; Lane, 2001; Kollmann, 2001, 2002; Benigno and Benigno, 2003; Galí and Monacelli, 2005; Uya et al., 2013; Ilzetzki et al., 2013). We follow this tradition in modelling growth of small open economies.

Except introducing tourism into the neoclassical growth theory, we also take account of endogenous human capital and elastic labor supply in modeling economic growth. The literature on endogenous knowledge and economic growth has increasingly expanded since Romer (1986) re-examined issues of endogenous technological change and economic growth in his 1986's paper (see also Lucas, 1988; Chari and Hopenhayn, 1991; Grossman and Helpman, 1991; Aghion and Howitt, 1998; Martin and Ottaviano, 2001; Brecher et al., 2002; Nocco, 2005). It is well-known that Arrow (1962) first introduced learning-by-doing into the formal growth theory. In this study, we model the knowledge creation with Arrow's learning by doing. There are many applications of Arrow's idea to different issues in economic growth theory (e.g., Young, 1991, 1993; Martin and Rogers, 1997; Solow, 1997; Albelo and Manresa, 2005; Kitaura and Yakita, 2010; Shea, 2013). As Thrane (2008: 514) observe: "we know a lot about tourism consumption and its determinants and consequences. This is not the case for tourism consumption's flip side: tourism production. ... The study's theoretical rationale lies in the human capital framework as set forth in labor economics and sociology." This study also considers that tourism may have positive impact on human capital growth. Hence tourism makes contribution to the national economic growth not only by direct contribution such as consuming, but also through affecting human capital development.

There are a few dynamic economic models which deal with the interdependence between economic growth and tourism with micro-behavioral foundation. Nevertheless wealth and human capital accumulation is seldom modeled with land and land markets in the literature of tourism economics. This study also takes account land use. As far as the production side and international markets are concerned, our model follows the traditional modeling

framework. The model is an extension of a growth model with tourism by Zhang (2012) and Zhang's growth model with learning by dong (2014). The introduction of tourism to growth theory is influenced by Chao et al. (2006). A main different between our approach and the model by Chao *et al.* is that this study is based on an alternative utility function proposed by Zhang (1993). This model is different from Zhang's 2012 model is that this study introduce endogenous human capital and endogenous time distribution. Hence Zhang's 2012 model is a special case of the model in this study. Section 2 defines the basic model. Section 3 shows how we solve the dynamics and simulates the model. Section 4 examines effects of changes in some parameters on the economic system over time. Section 5 concludes the study. The appendix proves the main results in Section 3.

## 2. The growth model with tourism

This section develops a small open growth model with endogenous wealth and human capital. An open economy can import goods and borrow resources from the rest of the world or exports goods and lend resources abroad. Our model is a combination of the basic features of the well-known three models, the Solow growth model, the Uzawa two-sector growth model, and the growth models with tourism. There is a single good, called industrial good, in the world economy and the price of the industrial good is unity. Like in Chao et al. (2009) and Zhang (2012), we consider a small-open economy that produces two goods: an internationally traded good (called industrial good) and a non-traded good (called services). It should be noted that Brock (1988) also classifies economic activities similarly in a growth model of a small open economy. Brock divides goods and services into traded and non-traded and examines the dynamic adjustment of the relative price of non-traded and the current account following exogenous shocks, such as government purchases, changes in tax income or investment subsidy. This study emphasizes human capital accumulation and tourism with endogenous time. Domestic households consume both goods. We assume that foreign tourists consume only services. Capital depreciates at a constant exponential rate,  $\delta_k$ , which is independent of the manner of use. The households hold wealth and land and receive income from wages, land rent, and interest payments of wealth. Land is only for residential and service use. Technologies of the production sectors are described by the Cobb-Douglas production functions, which characterized of constant returns to scale. All markets are perfectly competitive and capital and labor are completely mobile between the two sectors. Capital is perfectly mobile in international market and we neglect possibility of emigration or/and immigration. We assume that labor is homogeneous and is fixed. We assume that the economy is too small to affect the interest rate in the world market.

We use  $\bar{N}$  to stand for the population. Let  $T(t)$  stand for the work time of the representative household and  $N(t)$  for the flow of labor services used at time  $t$  for production. We have  $N(t)$  as follows

$$N(t) = H^m(t)T(t)\bar{N}, \quad (1)$$

where  $H(t)$  is the level of human capital and  $m$  is the human capital utilization efficiency parameter. We call  $H^m(t)$  the level of effective human capital.

### Industrial sector

The industrial sector uses capital and labor as inputs. We use subscript index,  $i$  and  $s$ , to denote respectively the industrial and service sectors. Let  $K_j(t)$  and  $N_j(t)$  stand for the capital stocks and labor force employed by sector  $j$ ,  $j = i, s$ , at time  $t$ . We use  $F_j(t)$  to represent the output level of sector  $j$ . The production function of the industrial sector is

$$F_i(t) = A_i K_i^{\alpha_i}(t) N_i^{\beta_i}(t), \quad \alpha_i, \beta_i > 0, \quad \alpha_i + \beta_i = 1, \quad (2)$$

where  $A_i$ ,  $\alpha_i$ , and  $\beta_i$  are parameters. Markets are competitive; thus labor and capital earn their marginal products, and firms earn zero profits. The rate of interest,  $r^*$ , is fixed in international market. The wage rate,  $w(t)$ , is determined in domestic market. The marginal conditions are

$$r_\delta = \alpha_i A_i k_i^{-\beta_i}(t), \quad w(t) = \beta_i A_i k_i^{\alpha_i}(t), \quad (3)$$

where  $k_i(t) \equiv K_i(t)/N_i(t)$  and  $r_\delta \equiv r^* + \delta_k$ . As  $r^*$  is fixed, from (2) we have

$$k_i = \left( \frac{\alpha_i A_i}{r_\delta} \right)^{1/\beta_i}, \quad w = \beta_i A_i k_i^{\alpha_i}. \quad (4)$$

Hence, we can treat  $k_i$  and  $w$  as functions of  $r^*$ .

### Service sector

The service sector uses three inputs, capital  $K_s(t)$ , labor force  $N_s(t)$ , and land  $L_s(t)$ , to supply services. The production function of the service sector is

$$F_s(t) = A_s K_s^{\alpha_s}(t) N_s^{\beta_s}(t) L_s^{\gamma_s}(t), \quad \alpha_s, \beta_s, \gamma_s > 0, \quad \alpha_s + \beta_s + \gamma_s = 1, \quad (5)$$

where  $A_s$ ,  $\alpha_s$ ,  $\beta_s$ , and  $\gamma_s$  are parameters. Let  $p(t)$  and  $R(t)$  stand respectively for the price of the service and the land rent. In this study we assume that the prices are determined by market mechanism. In reality, for instance, land rent and price may be determined by different factors (Kanemoto, 1980). The marginal conditions for the service sector are

$$\frac{r_\delta}{\alpha_s A_s} = p(t) k_s^{\alpha_s-1}(t) l_s^{\gamma_s}(t), \quad \frac{w}{\beta_s A_s} = p(t) k_s^{\alpha_s}(t) l_s^{\gamma_s}(t), \quad R(t) = \gamma_s A_s p(t) k_s^{\alpha_s}(t) l_s^{\gamma_s-1}(t), \quad (6)$$

where

$$k_s(t) \equiv \frac{K_s(t)}{N_s(t)}, \quad l_s(t) \equiv \frac{L_s(t)}{N_s(t)}.$$

From (6) we solve

$$k_s = \frac{\alpha_s w}{\beta_s r_\delta}. \quad (7)$$

Hence, we treat  $k_s$  as a function of  $r^*$ .

### Full employment of capital and labor

The total capital stocks employed by the country,  $K(t)$ , is used by the two sectors. The capital stock is owned either by domestic residents and the rest of the world. As full employment of labor and capital is assumed, we have

$$K_i(t) + K_s(t) = K(t), \quad N_i(t) + N_s(t) = N(t),$$

where  $N(t)$  is the total labor force. We rewrite the above equations as

$$k_i N_i(t) + k_s N_s(t) = K(t), \quad N_i(t) + N_s(t) = N(t). \quad (8)$$

The capital intensities,  $k_i$  and  $k_s$ , are uniquely determined by the fixed rate of interest in international market. Solve (7)

$$N_i(t) = (K(t) - k_s N(t))k_0, \quad N_s(t) = (k_i N(t) - K(t))k_0, \quad (9)$$

where  $k_0 \equiv (k_i - k_s)^{-1}$ . We assume that  $k_0 \neq 0$ . The labor distribution is a unique function of the total labor supply and the total capital used by the country.

### Demand function of foreign tourists

Let  $y_f(t)$  stand for the disposable income of foreign countries. According to Schubert and Brida (2009), we assume the following iso-elastic tourism demand function

$$D_T(t) = a(t)y_f^\phi(t)p^{-\varepsilon}(t), \quad (10)$$

where  $\phi$  and  $\varepsilon$  are respectively the income and price elasticities of tourism demand. The variable,  $a(t)$ , is dependent on many conditions, such as infrastructures (airports and transportation systems) and environment (like criminal rates, pollutants and congestions), and cultural capital (e.g., Throsby, 1999; Beerli and Martin, 2004). We assume that tourists pay the same price in consumption as domestic people. In reality, tourism industry has many special features which have important effects on pricing (e.g., Marin-Pantelescu and Tigu, 2010; Stabler et al., 2010).

### Behavior of domestic households

We now model behavior of households. We use  $L$  and  $R(t)$  to denote the land and land rent. Each household gets income from land ownership, wealth and wage. Land properties may be distributed in multiple ways under various institutions. For instance, there two popular assumptions in the literature of urban economics. The first is the absentee landownership. The second is the public ownership. In the former, land is owned by absentee landlords who spend their land incomes outside the economic system. In the latter, for instance as accepted in Kanemoto (1980), the city government rents the land from the landowners at certain rent and sublets it to households at the market rent, using the net revenue to subsidize city residents equally. This study assumes that the land is equally owned by the population. This implies that the revenue from land is equally shared among the population. Consumers make decisions on choice of lot size, consumption levels of industrial goods and services as well as on how much to save. This study uses the approach to consumers' behavior proposed by Zhang (1993). The current income of the typical household is

$$y(t) = r^* \bar{k}(t) + H^m(t)T(t)w + \bar{r}(t), \quad (11)$$

where  $r^*k$  is the interest payment,  $H^m T w$  the wage total payment, and  $\bar{r}$  the land rent income. We call  $y(t)$  the current income in the sense that it comes from consumers' wages and current earnings from ownership of wealth. The sum of income that consumers are using for consuming and saving are not necessarily equal to the current income because consumers can sell wealth to pay, for instance, the current consumption if the current income is not sufficient for consuming. The total value of the wealth that a consumer can sell to purchase goods and to save is equal to  $p_i(t)\bar{k}(t)$ , with  $p_i(t) = 1$  at any  $t$ , where  $p_i(t)$  is the price of the industrial good. Here, we assume that selling and buying wealth can be conducted instantaneously without any transaction cost. The disposable income at any point of time is

$$\hat{y}(t) = y(t) + \bar{k}(t). \quad (12)$$

The disposable income is used for saving and consumption. At time  $t$  the consumer has the total amount of income equaling  $\hat{y}$  to distribute between consuming and saving. In the growth literature, for instance, in the Solow model, the saving is out of the current income,  $y$ , while in this study the saving is out of the disposable income, which is dependent both on the current income and wealth.

At each point of time, a consumer distributes the total available budget among the lot size, consumption of services, consumption of industrial goods, and saving. The budget constraint is

$$R(t)l(t) + p(t)c_s(t) + c_i(t) + s(t) = \hat{y}(t). \quad (13)$$

Equation (13) means that the consumption and saving exhaust the consumers' disposable personal income.

Let  $\bar{T}(t)$  stand for the leisure time at time  $t$ . The time constraint is

$$T(t) + \bar{T}(t) = T_0,$$

where  $T_0$  is the total available time for work and leisure. Substituting this function into (13) yields

$$H^m(t)\bar{T}(t)w + R(t)l(t) + p(t)c_s(t) + c_i(t) + s(t) = \bar{y}(t), \quad (14)$$

where

$$\bar{y}(t) \equiv (1 + r^*)\bar{k}(t) + H^m(t)T_0 w + \bar{r}(t).$$

The utility function  $U(t)$  is dependent on  $\bar{T}(t)$ ,  $l(t)$ ,  $c_s(t)$ ,  $c_i(t)$  and  $s(t)$  as follows

$$U(t) = \theta \bar{T}^{\sigma_0}(t) l^{\eta_0}(t) c_s^{\gamma_0}(t) c_i^{\xi_0}(t) s^{\lambda_0}(t), \quad \sigma_0, \eta_0, \gamma_0, \xi_0, \lambda_0 > 0,$$

in which  $\sigma_0$ ,  $\eta_0$ ,  $\gamma_0$ ,  $\xi_0$ , and  $\lambda_0$  are the representative household's elasticity of utility with regard to leisure time, lot size, services, industrial goods, and saving. We call  $\sigma_0$ ,  $\eta_0$ ,  $\gamma_0$ ,  $\xi_0$ , and  $\lambda_0$  propensities to consume the leisure time, to use the lot size, to consume services, to consume industrial goods, and to hold wealth, respectively. Maximizing  $U(t)$  subject to the budget constraint yields

$$\bar{T}(t) = \frac{\sigma \bar{y}(t)}{H^m(t)w}, \quad l(t) = \frac{\eta \bar{y}(t)}{R(t)}, \quad c_s(t) = \frac{\gamma \bar{y}(t)}{p(t)}, \quad c_i(t) = \xi \bar{y}(t), \quad s(t) = \lambda \bar{y}(t), \quad (15)$$

where

$$\sigma \equiv \rho \sigma_0, \quad \eta \equiv \rho \eta_0, \quad \gamma \equiv \rho \gamma_0, \quad \xi \equiv \rho \xi_0, \quad \lambda \equiv \rho \lambda_0, \quad \rho \equiv \frac{1}{\sigma_0 + \eta_0 + \gamma_0 + \xi_0 + \lambda_0}.$$

According to the definition of  $s(t)$ , the wealth accumulation for the household is

$$\dot{\bar{k}}(t) = s(t) - \bar{k}(t). \quad (16)$$

### Full use of land

Land is used for the residential use and service production

$$l(t)\bar{N} + L_s(t) = L. \quad (17)$$

### Demand and supply for services

The equilibrium condition for services is

$$c_s(t)\bar{N} + D_T(t) = F_s(t). \quad (18)$$

### Accumulation of human capital

In this study, we follow Arrow's learning by doing in modeling human capital accumulation (Arrow, 1962). We propose the following human capital accumulation equation (Zhang, 2014)

$$\dot{H}(t) = \frac{\nu_i D_T^{b_i}(t) (F_i(t) / \bar{N})^{a_i}}{H^{\pi_i}(t)} + \frac{\nu_s D_T^{b_s}(t) (F_s(t) / \bar{N})^{a_s}}{H^{\pi_s}(t)} - \delta_h H(t), \quad (19)$$

where  $\delta_h (> 0)$  is the depreciation rate of human capital,  $\nu_j, a_j, b_j$  and  $\pi_j$  are parameters. The term  $\nu_i D_T^{b_i}(F_i / \bar{N})^{a_i} / H^{\pi_i}$  is the industrial sector's contribution to human capital through learning by doing. Human capital rises in per capita output level of the industrial sector,  $F_i / \bar{N}$ . The term  $D_T^{b_i}$  stands for positive influences of foreign tourists on human capital. The term  $H^{\pi_i}$  indicates that as the level of human capital of the population increases, it may be more difficult (in the case of  $\pi_i$  being large) or easier (in the case of  $\pi_i$  being small) to accumulate more human capital through the industrial sector's learning by doing.

We have thus built the dynamic growth model with endogenous wealth, human capital, and tourism. The model is a synthesis of the well-known Solow-Uzawa growth and Arrow's learning-by-doing models for a small open economy with tourism.

### 3. The dynamics of the national economy

We now show that we can follow the motion of the economic system with two differential equations. The following lemma shows how we can determine the motion of all the variables in the dynamic system. We introduce a new variable as

#### Lemma

The variables,  $k_i, k_s,$  and  $w$  are uniquely determined as functions of  $r^*$ . The motion of the land rent and human capital is determine by

$$\begin{aligned} \dot{R}(t) &= \Omega_R(R(t), H(t)), \\ \dot{H}(t) &= \Omega_H(R(t), H(t)), \end{aligned} \quad (20)$$

where  $\Omega_R$  and  $\Omega_H$  are functions of  $R(t)$  and  $H(t)$  determine in the appendix. By the following procedure we can determine all the variables as functions of  $R(t)$  and  $H(t)$ :  $k_i$  and  $w$  by (4)  $\rightarrow k_s$  by (7)  $\rightarrow \bar{k}(t)$  and  $K(t)$  by (A15)  $\rightarrow N_i(t)$  and  $N_s(t)$  by (A13)  $\rightarrow K_i(t) = k_i N_i(t)$  and  $K_s(t) = k_s N_s(t) \rightarrow N(t)$  by (A12)  $\rightarrow p(t)$  by (A10)  $\rightarrow D_T(t)$

by (10)  $\rightarrow \bar{y}(t)$  by (A4)  $\rightarrow \bar{T}(t)$ ,  $l(t)$ ,  $c_i(t)$ ,  $c_s(t)$ ,  $s(t)$  by (15)  $\rightarrow T(t) = T_0 - \bar{T}(t)$   
 $\rightarrow L_s(t)$  by (17)  $\rightarrow F_i(t)$  by (A2)  $\rightarrow F_s(t)$  by (5).

The lemma implies that for a given rate of interest in the global market, the economic system at any point in time can be uniquely described as functions of the land rent and human capital. Hence, if we know the motion of the land rent and human capital, we can determine the motion of the whole system. It should be remarked that in the small open growth model by Turnovsky (1996), it is concluded that the equilibrium growth rates of domestic capital and consumption are determined largely independent. The former is determined by production conditions, the latter is determined primarily by tastes. The conclusion that growth rate of domestic capital is determined by production conditions is given also in some other models of small open economies with perfect capital mobility and perfect substitutability between home capital and foreign bonds (see, for instance, Zeira, 1987). In our model, the total output levels, the capital stocks employed by the economy, and economic production structure are not only determined by the production conditions and the international rate of interest, but also by tastes. Moreover, consumption is not only determined by preferences but also related to the rate of interest and the production conditions. As the expressions of the analytical result are tedious, it is difficult to get explicit conclusions. For interpretation, we simulate the model. We specify parameter values as follows

$$\begin{aligned} r^* &= 0.03, \delta_k = 0.05, N = 1.2, T_0 = 24, L = 20, A_i = 1, A_s = 1, \alpha_i = 0.3, \alpha_s = 0.2, \\ \beta_s &= 0.6, \lambda_0 = 0.7, \xi_0 = 0.15, \gamma_0 = 0.06, \eta_0 = 0.06, \sigma_0 = 0.12, a = 1, y_f = 4, \\ \phi &= 1.5, \varepsilon = 1.5, m = 0.5, \delta_h = 0.04, v_i = 2, y_s = 1.5, b_i = 0.05, b_s = 0.05, a_i = 0.3, \\ a_s &= 0.4, \pi_i = 0.3, \pi_s = 0.3. \end{aligned}$$

(21)

The rate of interest is fixed at 3 per cent and the population is 1.2. It should be remarked that although the specified values are not based on empirical observations, the choice does not seem to be unrealistic. For instance, some empirical studies on the US economy demonstrate that the value of the parameter,  $\alpha$ , in the Cobb-Douglas production is approximately equal to 0.3. Some empirical studies show that income elasticity of tourism demand is well above unity (Syriopoulos, 1995; Lanza et al., 2003). According to Lanza et al. (2003), the price elasticity is in the range between 1.03 and 1.82 and income elasticities are in the range between 1.75 and 7.36. Refer to, for instance, Gañin-Mūnos (2007) for other studies on elasticities. Following the lemma, we calculate the time-independent variables as follows

$$k_i = 6.61, k_s = 5.14, w = 1.23. \quad (22)$$

We specify the initial conditions as follows

$$H(0) = 140, R(0) = 13.$$

We plot the motion of the dynamic system in Figure 1. As their initial values are fixed lower than their long-term equilibrium values, the land rent and human capital the human capital rises over time. In association with rising land, the price of services is enhanced. Rising price reduces tourist demand. In association with rising human capital, the leisure time is also increased. The total labor supply falls slightly and then rises slightly. The GDP changes slightly over time. The output level of the industrial sector is reduced and that of the service sector is increased. The labor and capital inputs o the service sectors are increased and the labor and capital inputs are reduced. The national wealth rises over time and the capital stocks employed by the country falls. The household consumes more the two goods, owns more wealth, and has smaller lot size.

**Figure 1.** The Motion of the National Economy

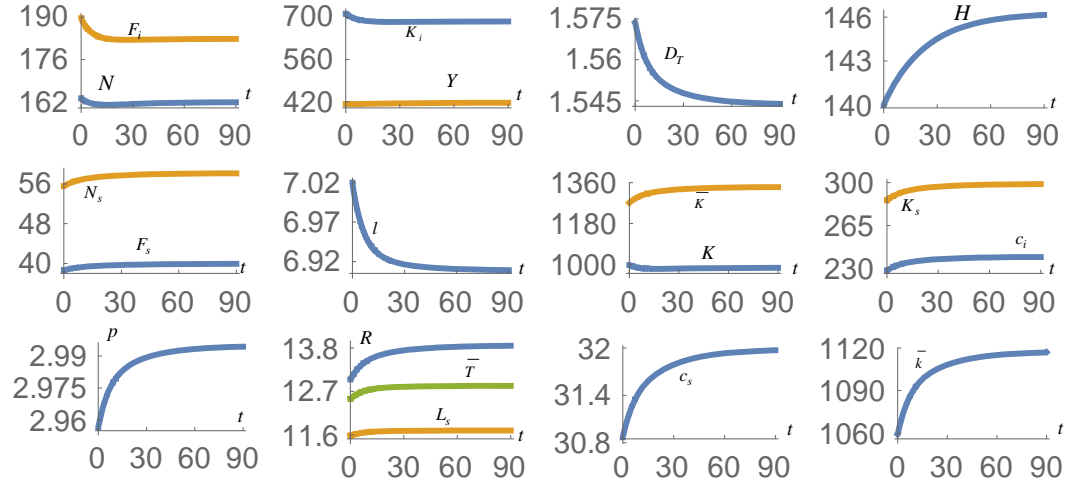


Figure 1 shows the motion of the variables over time. From the figure we observe that all the variables of the economic system tend to become stationary in the long term. This implies that the system approaches an equilibrium point. We identify the equilibrium values of the variables as follows

$$\begin{aligned}
 p &= 2.335, \quad R = 13.87, \quad Y = 417.39, \quad K = 984.64, \quad \bar{K} = 1341.18, \quad H = 146.3, \quad N = 162, \\
 DT &= 1.54, \quad N_i = 103.8, \quad N_s = 58.17, \quad K_i = 685.68, \quad K_s = 298.95, \quad L_s = 11.71, \\
 F_i &= 182.85, \quad F_s = 39.93, \quad \bar{T} = 12.84, \quad c_i = 239.5, \quad c_s = 31.99, \quad l = 6.91, \quad \bar{k} = 1117.65.
 \end{aligned}$$

The eigenvalues are

$$\{-0.159, -0.042\}.$$

This confirms that the unique equilibrium point is stable. This also guarantees the validity of comparative dynamic analysis in the next section.

#### 4. Comparative dynamic analysis

The previous section plots the motion of the variables. This section examines how changes in some parameters affect the national economy over time. As we have shown how to simulate the motion of the system, it is straightforward to make comparative dynamic analysis. We introduce a variable,  $\bar{\Delta}x(t)$ , to stand for the change rate of the variable,  $x(t)$ , in percentage due to changes in the parameter value.

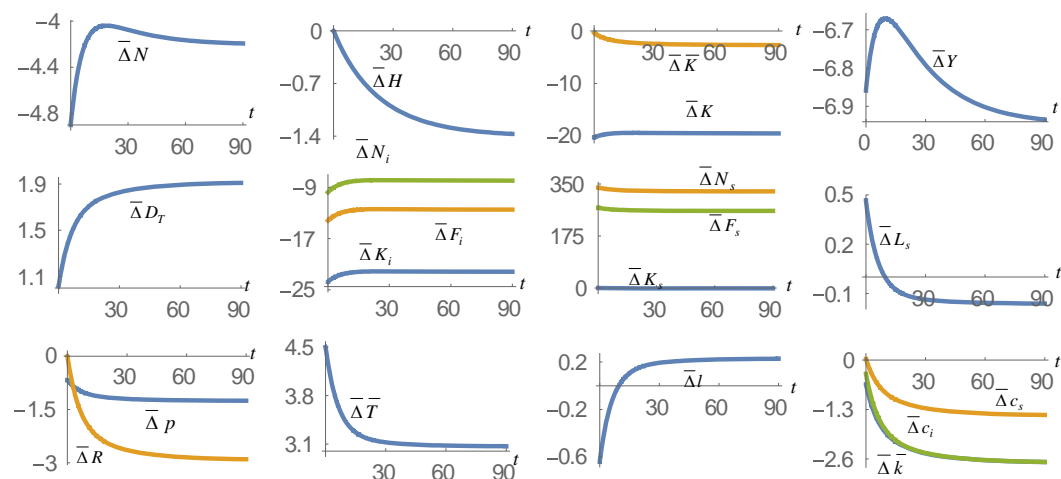
##### A rise in the rate of interest in the global market

First, we examine the case that all the parameters, except the rate of interest,  $r^*$ , are the same as in (21). We study what will happen to the dynamics of the economic system if the rate of interest is changed as follows:  $r^* = 0.03 \Rightarrow 0.04$ . It should be remarked that as we have explicitly solved the dynamics, we can also carry out comparative dynamic analysis by assuming that the rate of interest varies in time,  $r^*(t)$ . This is similarly true for other parameters. As the rate of interest rises from 3 percent to 4 percent in the international market, the capital intensities and wage rate are reduced as follows

$$\bar{\Delta}k_i = \bar{\Delta}k_s = -15.5, \quad \bar{\Delta}w = -4.9.$$

The cost of capital is increased, the capital intensities and wage rate are reduce. The changes in the time-dependent variables are plotted in Figure 2. The rise in the cost of capital causes the two sectors to use less capital. The capital stock employed by the national economy is thus reduced. The wealth owned by the country as well as the household are reduced. This results in the reduction in the wage rate, which is associated with reduction in the work hours. The human capital and total labor supply are decreased. The output level and two input factors of the industrial sector are reduced.

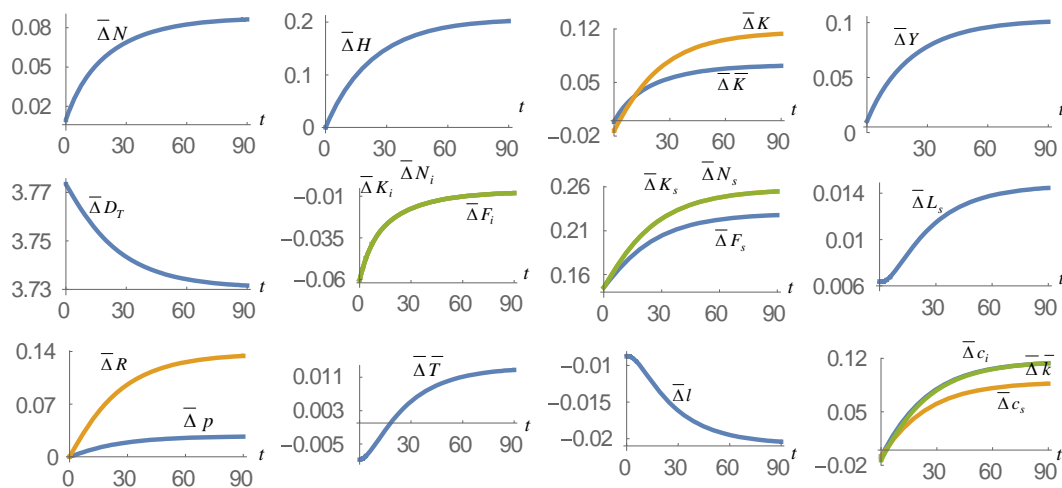
Figure 2. A Rise in the Rate of Interest



**Global economic conditions being improved**

As the country is under influences of global economies, it is important to examine what will happen when different conditions are changed in global markets. We analysed the effects of a rise in the rate of interest. We now study what will happen to the national economy when the foreign income is changed as follows:  $y_f = 4 \Rightarrow 4.1$ . The capital intensities and wage rate are not affected, that is,  $\bar{\Delta} k_i = \bar{\Delta} k_s = \bar{\Delta} w = 0$ . As foreign economic conditions are improved, more foreigners visit the economy. As more foreigners visit the country, the price of services and output of the service sector are increased. The service sector employs more labor and more capital. Human capital is increased as more tourists and higher output level of the service sector enable people accumulate more human capital. As the time distribution is slightly affected, higher human capital implies higher total labor. The land distribution is affected but very slightly. As the work hours is slightly affected and wage rate is invariant, the total wage income increased. The output and two input levels of the industrial sectors are slightly reduced. This occurs partly because the service sector serves more foreign visitors. The national resources are partly absorbed by the service sector. It should be also noted that the study by Chao *et al.* (2006) shows that an expansion of tourism can result in capital decumulation in a two-sector dynamic model with a capital-generating externality. Our simulation demonstrates the same conclusion with endogenous human capital. The consumption levels of goods and services, wealth level are all reduced initially but increased in the long time.

**Figure 3.** Global Economic Conditions Being Improved



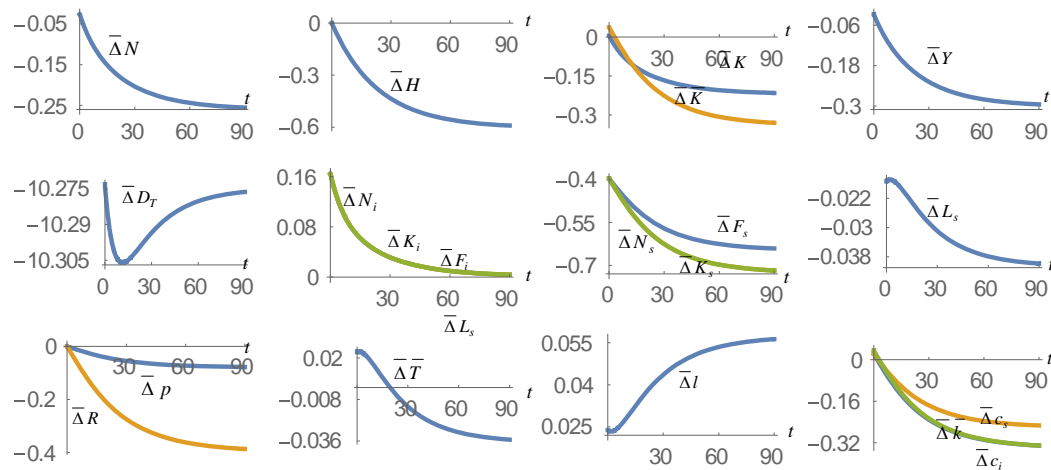
We see that an improvement in the global income reduces the living conditions and wealth of the domestic household in short term but improves these variables in the long term. It should be noted that according to Harzri and Sgro (1995) an increase in the international tourism leads to a positive effect on long-run economic growth. Our result shows that this conclusion is true in the long term, but not necessarily true in the short term. Similarly, their model shows that for a small open economy the growth in tourist consumption of services

increases the welfare. Our simulation demonstrates that this conclusion is valid in the long term, but not necessarily true in the short term. We get this “new insight” because our model explicitly shows transitional processes of the economic dynamics.

**The price elasticity of tourism being enhanced**

We now examine the impact of the following rise in the price elasticity of tourism:  $\varepsilon = 1.5 \Rightarrow 1.6$ . The capital intensities and wage rate are not affected,  $\bar{\Delta} k_i = \bar{\Delta} k_s = \bar{\Delta} w = 0$ . The changes in the other variables are plotted in Figure 4. A rise in the price elasticity reduces the tourist demand and the price of services. The output of the service sector is reduced as the demand falls. The human capital is reduced. The time distribution is slightly affected and the total labor supply is reduced. The total capital employed by the economy and the national product are decreased. The output of the industrial sector is increased. Some of labor force is shifted from the service sector to the industrial sector. The lot size rises, while the land input of the service sector is reduced. The consumption levels of the goods and services and wealth level are reduced in the long term.

**Figure 4.** *The Price Elasticity of Tourism Being Enhanced*

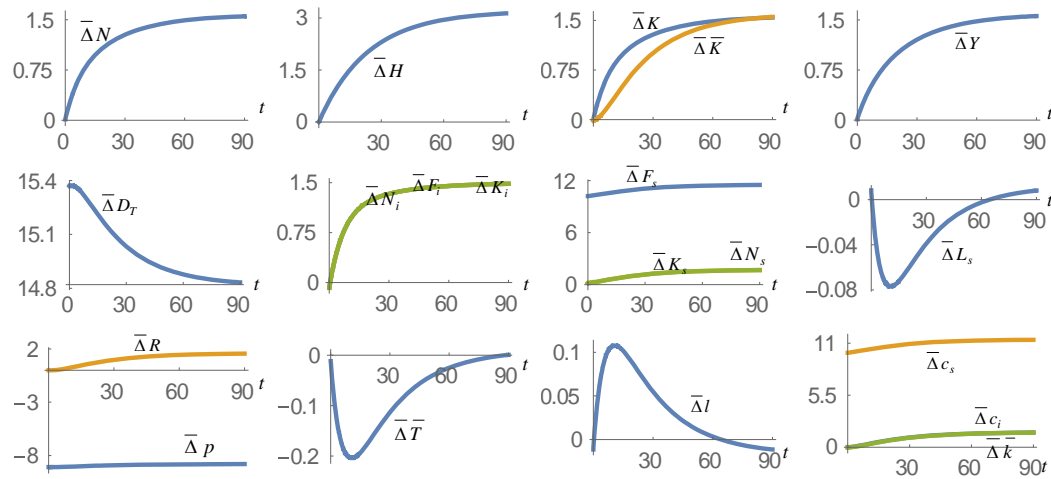


**A rise in the total productivity of the service sector**

We now examine the impact of the following change in the total productivity of the service sector:  $A_s = 1 \Rightarrow 1.1$ . The capital intensities and wage rate of the small open economy are not affected, that is,  $\bar{\Delta} k_i = \bar{\Delta} k_s = \bar{\Delta} w = 0$ . We plot the effects on the other variables are plotted in Figure 5. The increased productivity of the service sector raises the output and price level of services. More foreign tourists are attracted to the country. The output level and two inputs of each sector are augmented. The GDP rises over time. The land rent is increased. The lot size is increased initially and is reduced in the long term. The land input employed by the service sector is reduced initially and is reduced in the long term. The work hours is increased initially and is not affected in the long term. The human capital and

the total labor supply are increased. The country uses more capital stocks and owns more wealth. The household consumes more goods and services and owns more wealth.

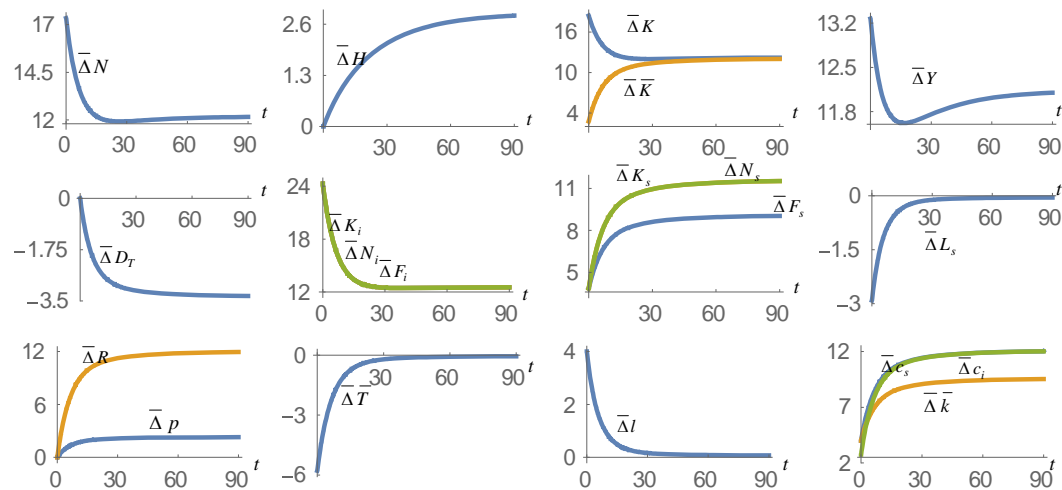
**Figure 5.** A Rise in the Total Productivity of the Service Sector



**An improvement in applying human capital**

We now examine what will happen to the national economy when the workers apply their human capital more effectively in the following way:  $m = 0.5 \Rightarrow 0.52$ . The capital intensities and wage rate are increased in the same rate. The changes in the other variables are plotted in Figure 6.

**Figure 6.** An Improvement in Applying Human Capital



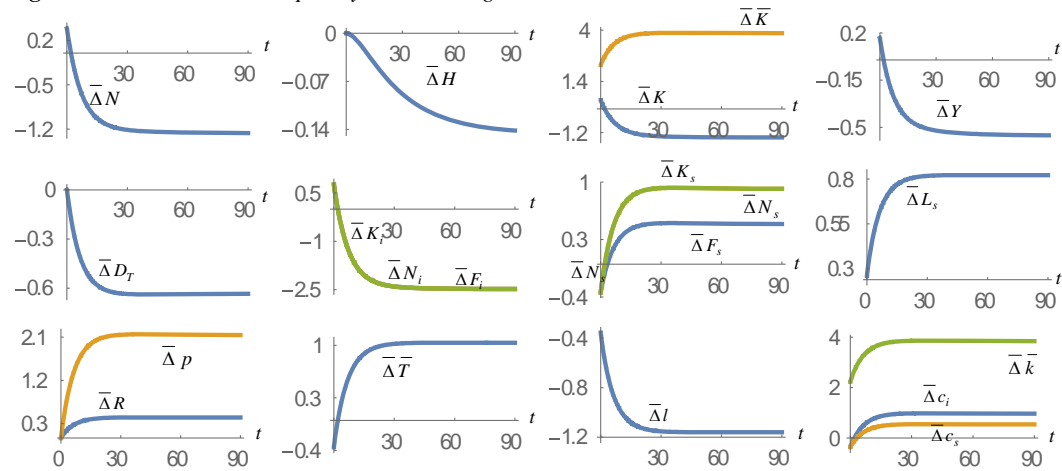
The total labor supply is increased. The GDP is increased. The price of services and the land rent are increased. The increased price reduces foreign tourists. The lot size is increased initially and is not affected in the long term. The land use of the service sector is reduced initially and is not affected in the long term. The work hours is increased initially and is not

affected in the long term. The human capital and the total labor supply are increased. The country uses more capital stocks and owns more wealth. The household consumes more goods and services and owns more wealth. Each sector increases their inputs and output level.

**The household's propensity to save being enhanced**

We now examine what will happen to the national economy when the propensity to save is increased as follows:  $\lambda_0 = 0.7 \Rightarrow 0.72$ . The capital intensities and wage rate are not affected,  $\bar{\Delta}k_i = \bar{\Delta}k_s = \bar{\Delta}w = 0$ . The changes in the other variables are plotted in Figure 7. The household's wealth and national wealth are increased. The leisure time is reduced initially and then is increased. The human capital is reduced. The total labor supply is augmented initially and then is reduced. The price of services and the land rent are increased. The household uses less lot sizes, consumes more services and industrial goods, and owns less wealth. The economy employs more capital initially and then uses less capital. The national output is increased and then is reduced. In association with price rising the country attracts less tourism. The two inputs and output level of the service sector are increased and the two inputs and output level of the industrial sector are lowered in the long term.

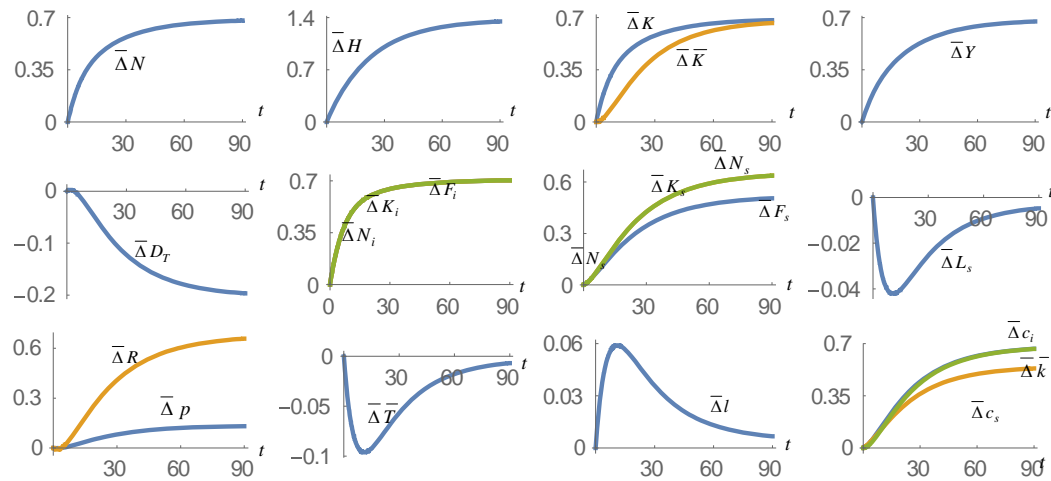
**Figure 7.** *The Household's Propensity to Save Being Enhanced*



**Tourism more strongly affecting human capital accumulation**

We now examine what will happen to the economy learns more effectively from tourism in the following way:  $b_s = 0.05 \Rightarrow 0$ . The capital intensities and wage rate not affected. The changes in the other variables are plotted in Figure 8. The human capital and the total labor supply are increased. The GDP is increased. The economy has more wealth and employs more physical capital. The price of services and the land rent are increased. Tourism is weakened as the price is increased. The land distribution is slightly affected. The work hours is slightly reduced. The household consumes more goods and services and owns more wealth. Each sector increases their inputs and output level.

**Figure 8.** *Tourism More Strongly Affecting Human Capital Accumulation*



## 5. Conclusions

This paper proposed an economic growth model of a small open economy with tourism and endogenous wealth and human capital in a perfectly competitive economy. The national economy consists of one service sector and one industrial sector. Following the traditional literature of small open economies, we assume that the rate of interest is fixed in international market. The production side is the same as in the neoclassical growth theory. We used a utility function, which determines saving, consumption and time distribution. The system has a unique stable equilibrium point. We simulated the motion of the model and examined effects of changes in the rate of interest, the price elasticity of tourism, the total productivities of the industrial and service sectors, the propensity to save, and the impact of tourism on human capital accumulation. The comparative dynamic analysis provides some important insights. For instance, when the price elasticity of tourism is increased, the tourist demand and the price of services are reduced; the output of the service sector is reduced; the human capital and the total labor supply are reduced; the time distribution is slightly affected; the total capital employed by the economy and the national product are decreased; the output of the industrial sector is increased; some of labor force is shifted from the service sector to the industrial sector; the lot size is increased and the land input of the service sector is reduced; and the consumption levels of the goods and services and wealth level are reduced in the long term. It should be noted that the model can be extended and generalized in different directions. For instance, it is important to study the economic dynamics when utility and production functions are taken on other functional forms. We do not consider possibilities that domestic households travel to other countries. This implies that it is important to deal with economies as an integrated whole (Clive et al., 2014). Monetary issues such as exchange rates and inflation policies are important for understanding trade issues. We also neglect tariffs and other taxes.

### Appendix. Proving Lemma 1

We already showed that  $k_i$ ,  $w$ , and  $k_s$  are determined as functions of  $r^*$ , which is fixed in the international market. From  $K_j = k_j N_j$  and (9), we have

$$K_i = (K - k_s N)k_0 k_i, \quad K_s = (k_i N - K)k_0 k_s, \quad (\text{A1})$$

where we omit time variable in expressions. From (6), we solve

$$R = \frac{w_s N_s}{L_s}, \quad (\text{A2})$$

where we also use  $l_s = L_s / N_s$  and  $w_s \equiv w \gamma_s / \beta_s$ . Insert (A2) in (15)

$$l \bar{N} + \frac{w_s N_s}{R} = L. \quad (\text{A3})$$

From the definition of  $\bar{y}$ , we have

$$\bar{y} = (1 + r^*)\bar{k} + H^m T_0 w + \frac{RL}{\bar{N}}. \quad (\text{A4})$$

From (A4) and  $l = \eta \bar{y} / R$  in (13)

$$l = \frac{(1 + r^*)\eta \bar{k} + H^m \eta T_0 w}{R} + \frac{\eta L}{\bar{N}}.$$

Insert this equation in (A3)

$$\bar{k} + \bar{w}_s N_s = m_0, \quad (\text{A5})$$

where

$$\bar{w}_s \equiv \frac{w_s}{(1 + r^*)\eta \bar{N}}, \quad m_0(R, H) \equiv \frac{(1 - \eta)LR}{(1 + r^*)\eta \bar{N}} - \frac{H^m T_0 w}{(1 + r^*)}.$$

From  $r^* + \delta_k = \alpha_s p F_s / K_s$  and (16) we have

$$c_s \bar{N} + D_T = \frac{r_\delta K_s}{\alpha_s p}. \quad (\text{A6})$$

Insert  $c_s = \gamma \bar{y} / p$  in (A6)

$$\gamma \bar{y} \bar{N} + p D_T = \frac{r_\delta K_s}{\alpha_s}. \quad (\text{A7})$$

Insert (A4) in (A7)

$$\left( (1+r^*)\bar{k} + H^m T_0 w + \frac{RL}{\bar{N}} \right) \gamma \bar{N} + a y_f^\phi p^{1-\varepsilon} = \frac{r_\delta K_s}{\alpha_s}, \quad (\text{A8})$$

where we also use (10). We now discuss two cases,  $\varepsilon = 1$  and  $\varepsilon \neq 1$ , separately. In the case  $\varepsilon = 1$ , (A8) becomes

$$\left( (1+r^*)\bar{k} + H^m T_0 w + \frac{RL}{\bar{N}} \right) \gamma \bar{N} + a y_f^\phi = \frac{r_\delta K_s}{\alpha_s}. \quad (\text{A9})$$

From (A5) and (A9), we delete  $R$  and get an equation which gives the relation between  $\bar{k}$ ,  $H$  and  $K$ . As discussed in the other case, we can determine two differential equations with  $K$  and  $H$  as variables.

We now examine  $\varepsilon \neq 1$ . From (6) we have

$$p = \frac{wR^{\gamma_s}}{\beta_s A_s k_s^{\alpha_s} w_s^{\gamma_s}}, \quad (\text{A10})$$

where we also use  $l_s = w_s / R$  from (A2). Insert (A10) in (A8)

$$\bar{k} + m_1 = \bar{r}_\delta (K - k_i N_i), \quad (\text{A11})$$

where we use  $K_s = K - K_i$ ,  $K_i = k_i N_i$  and

$$m_1(R, H) \equiv \frac{1}{(1+r^*)} \left[ H^m T_0 w + \frac{RL}{\bar{N}} + \frac{a y_f^\phi}{\gamma \bar{N}} \left( \frac{wR^{\gamma_s}}{\beta_s A_s k_s^{\alpha_s} w_s^{\gamma_s}} \right)^{1-\varepsilon} \right],$$

$$\bar{r}_\delta = \frac{r_\delta}{(1+r^*)\gamma \bar{N} \alpha_s}.$$

From (1), the time constrain and (15)

$$N = \left( (1-\sigma)T_0 H^m - \frac{(1+r^*)\sigma \bar{k}}{w} - \frac{\sigma RL}{w \bar{N}} \right) \bar{N}, \quad (\text{A12})$$

where we also use (A4). From (9) and (A12)

$$N_i = \left( \frac{K}{\bar{N}} + \frac{(1+r^*)k_s \sigma \bar{k}}{w} \right) k_0 \bar{N} + m_i, \quad N_s = m_s - \left( \frac{(1+r^*)k_i \sigma \bar{k}}{w} + \frac{K}{\bar{N}} \right) k_0 \bar{N}, \quad (\text{A13})$$

where

$$m_i(R, H) \equiv \left( \frac{R \sigma L}{w \bar{N}} - (1 - \sigma) T_0 H^m \right) k_s k_0 \bar{N},$$

$$m_s(R, H) \equiv \left( (1 - \sigma) T_0 H^m - \frac{\sigma R L}{w \bar{N}} \right) k_i k_0 \bar{N}.$$

Substitute (A13) into (A5) and (A11) yields

$$b_1 \bar{k} - K = \Phi_1,$$

$$b_2 \bar{k} + K = -\Phi_2,$$
(A14)

where

$$b_1 \equiv \left[ 1 - \frac{(1 + r^*) \bar{w}_s k_0 \bar{N} \sigma}{w} \right] \frac{1}{\bar{w}_s k_0 \bar{N}}, \quad \Phi_1(R, H) \equiv \frac{m_0 - \bar{w}_s m_s}{\bar{w}_s k_0 \bar{N}},$$

$$b_2 \equiv \left[ 1 + \frac{(1 + r^*) k_s \bar{r}_\delta k_i k_0 \bar{N} \sigma}{w} \right] \frac{1}{(k_i k_0 - 1) \bar{r}_\delta}, \quad \Phi_2(R, H) \equiv \frac{m_1 + \bar{r}_\delta k_i m_i}{(k_i k_0 - 1) \bar{r}_\delta}.$$

Solve

$$\bar{k} = \Lambda(R, H) \equiv \frac{\Phi_1 - \Phi_2}{b_1 + b_2},$$

$$K = \Psi(R, H) \equiv b_1 \Lambda - \Phi_1.$$
(A15)

By the following procedure we can determine all the variables as functions of  $R$  and  $H$ :  $k_i$  and  $w$  by (4)  $\rightarrow k_s$  by (7)  $\rightarrow \bar{k}$  and  $K$  by (A15)  $\rightarrow N_i$  and  $N_s$  by (A13)  $\rightarrow K_i = k_i N_i$  and  $K_s = k_s N_s \rightarrow N$  by (A12)  $\rightarrow p$  by (A10)  $\rightarrow D_T$  by (10)  $\rightarrow \bar{y}$  by (A4)  $\rightarrow \bar{T}$ ,  $l$ ,  $c_i$ ,  $c_s$ ,  $s$  by (15)  $\rightarrow T = T_0 - \bar{T} \rightarrow L_s$  by (17)  $\rightarrow F_i$  by (A2)  $\rightarrow F_s$  by (5).

From this procedure, (16) and (19), we have

$$\dot{\bar{k}} = \Omega_0(R, H) \equiv s - \bar{k},$$
(A16)

$$\dot{H} = \Omega_H(R, H) \equiv \frac{\nu_i D_T^{b_i} (F_i / \bar{N})^{a_i}}{H^{\pi_i}} + \frac{\nu_c D_T^{b_c} (F_c / \bar{N})^{a_c}}{H^{\pi_c}} - \delta_h H.$$
(A17)

Taking derivatives of the first equation in (A15) with respect to time yield

$$\dot{k} = \frac{\partial \Lambda}{\partial R} \dot{R} + \Omega_H \frac{\partial \Lambda}{\partial H}. \quad (\text{A18})$$

We do not provide the expressions in the above equation because it is tedious. Equal the right-hand sides of (A18) and (A16)

$$\dot{R} = \Omega_R(R, H) \equiv \left( \Omega_0 - \Omega_H \frac{\partial \Lambda}{\partial H} \right) \left( \frac{\partial \Lambda}{\partial R} \right)^{-1}. \quad (\text{A19})$$

We thus proved Lemma 1.

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## **Migration – trade nexus revisited: Empirical evidence from Turkish emigrants in OECD countries**

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**Abstract.** *In recent decades, economists seek to find the answers of two very fundamental questions “why has global trade grown, and what are the consequences of that growth?”. Two answers that come to mind immediately are trade liberalisation and falling transportation costs. Another possible explanation is that trade has grown because economies have converged in economic size. A fourth source may be increased outsourcing. And as another factor the international movement of people may play a significant role on international trade. The declining cost of travel and communications has lowered information barriers and encouraged migration across national borders.*

*The current paper aims at testing the impact of migration on bilateral trade in an augmented panel gravity model framework. To this end the relationship between Turkish emigrant stock in the 13 OECD countries and bilateral trade volume (imports and exports) for the years 2000-2012 was analysed. Economic size and geographical distance between trading partners were controlled. Empirical results show that there is a significant impact of migration on bilateral trade both in terms of imports and exports. On the other hand, as expected, economic size and distance have positive and negative effect respectively on trade.*

**Keywords:** Migration, trade, Turkey, OECD countries, panel gravity model.

**JEL Classification:** A13, B30, D01.

## 1. Introduction

Migration is a typical human activity; ever since developing into modern humans we have been on the move. Today about 3% of the world's population are migrants. This ratio has remained relatively stable over the past 50 years (Özden et al., 2011). According to UN report, in 2013, the number of international migrants worldwide reached 232 million, up from 175 million in 2000 and 154 million in 1990. Between 1990 and 2000, the international migrant stock grew by an average of 1.2 per cent per year whereas the annual growth rate accelerated over the following ten year, reaching 2.3 per cent (UN-DESA, 2013).

However, in parallel with the rapid globalization process and international trade expansion during the last decades, global migrant flows, either legal or illegal, gained more momentum as well. Over the period 1960 – 2010, for example, the share of total world exports over real-domestic product (GDP) has increased by 172%, whereas human migration more than doubled. This extraordinary growth in cross-country human migration and trade did not occur only intensively (i.e. over known migration corridors), but also extensively (i.e. over new migration corridors). Over the period of 1960-2000, the number of newly-created export channels between world countries exhibited a threefold increase, whereas number new migration corridors almost doubled (Fagiolo and Mastrorillo, 2014).

People leave their home country because of various reasons. Due to (ethnic or interstate) wars, environmental degradation and environmental disasters (flood, droughts) people are forced to migrate. Indeed, it can be described as a *push* and *pull* process. On the supply side, the main push factors include demographics and the lack of adequate employment opportunities at home. The pull factors include wage differences and associated labor productivity across markets, as well as perceived quality of life and a stream of income (UNCTAD, 2009).

International trade and international migration are two key facets of globalization, which are therefore likely interconnected. Since the pioneering work of Gould (1994) and Heid and Ries (1998), ample evidence have been found revealing that larger bilateral migration networks between countries are associated with larger trade flows. At the same time recent theories of international trade that provide the theoretical underpinnings to the analysis of trade flows in the context of a gravity equation, emphasize how factors affecting the variable and fixed costs of trade between two locations would affect the volume of trade (Peri and Requena, 2009). Migrant networks have the capacity to reduce the information, communication, transaction and contracting costs between locations, and hence to promote the international trade.

Emigration is an important issue for Turkey. Today, more than 5 million Turkish nationals live in tens of different countries all around the world most of whom are permanent migrants. OECD countries are the most favorite destinations for Turkish emigrants. Most of the OECD countries besides constitute foremost bilateral trade partners of Turkey. However, economic implications of the Turkish emigrants is not sufficiently studied and addressed in the related empirical literature. So, this paper is a

modest step towards to fill this gap by focusing on the Turkish emigrants in OECD countries.

The paper is organised as follows: In the next section theoretical background and implication of migrant-related international trade flows is given. The third section was devoted to historical information about Turkish migrant flows over five decades. As the international migrant flows gained considerable momentum in recent years the implications of international migration has been subject to vast literature both theoretically and empirically. There is a growing body of empirical works on the relationship between migration and trade as well. Some of them were cited in the fourth section. The structures of employed models and data used are described in the section five. Estimation results are also given therein. The paper ends with the conclusions.

## 2. Theoretical background

The economic implications of migration can appear in various channels for the host and home countries. The most prominent one is the effect on financial flows between host and home country in the form of remittances. Other phenomena are the foreign direct investment undertaken by migrants in their home countries either as part of their investment or through arrangements such as technological licensing and joint ventures (Wei and Balasubramanyam, 2006). Another possible effect is the migrants-related international trade flows.

Theoretical approaches to trade – migration nexus handle the subject either from the transaction costs or factor substitution point of view. In his seminal paper, Gould (1994) argued that trade between any two countries may be enhanced by stock of immigrants present in either countries and coming from the other one. Such a result is theoretically plausible because of both macro and micro considerations.

At the macro level, it can be argued that immigration-induced population growth increases aggregate demand and output, which – in turn – increases the demand for imports. Exports may increase as well if the presence of immigrants in export industries lowers unit production costs or if immigration enhances the international competitiveness of the host country more broadly (e.g. through greater labor mobility and lower prices). At the micro level, immigrants may be expected to have ongoing links with the home country that can help businesses in the host country to develop networks that can facilitate exporting to, or importing from, the migrant home country – *trade facilitation effect* (Genç et al., 2011). Immigrants also may well know the institutional and legal structure of their home country and their native language may help to easing communication in trading relationship. On the other hand, migrants often prefer their native goods (especially food items) from the homeland – *home preference effect*. Furthermore, they may play a significant role in marketing native goods in the host country. The gross impact of migrants on bilateral trade balance depends on the sum these two effects. Since the trade facilitation effect can affect both imports and exports, while the home preference effect only affects imports, under the assumption of *symmetric* trade facilitation effect, migrants would be more effective on imports in the host country.

Recent theoretical and empirical contributions to the trade literature have emphasized the existence of important fixed costs inherent to the process of exporting. Besides an ongoing debate on the components of those costs, negotiation costs, contracting costs or costs related to information barriers are likely to be an element (Jansen and Piermartini, 2009). Migrants may play a significant role in reducing such transactions costs due to their privileged position to provide necessary information on the host and their home country.

Another stream of theoretical approaches considers the factor mobility and tries to determine whether migration and trade are complements or substitutes. In a standard two goods, two factors trade model without trade costs, factor prices will equalize through goods trade. Hence, goods trade has the same effect as if factors could wander freely between countries. Immigration has the same impact on factor prices as trade. Hence, factor price differences between countries will trigger both trade and immigration flows, implying that trade and immigration are not statistically independent and therefore correlated (Heid, 2014). Mundell (1957) asserts that, in the Heckscher-Ohlin framework, any impediment to trade allows for factor movements across the borders and hence trade and migration are substitutes. This argument has support in the development literature where it is argued that under these circumstances sustained and equitable growth in migrant sending countries is the only effective strategy to cope with the migration pressure (Akkoyunlu and Siliverstovs, 2006).

Markusen (1983) shows that removing the original assumptions of the Heckscher-Ohlin model, trade and factor movements can be complements that is increase in the trade volume is accompanied by corresponding increase in labor mobility (Bettin and Lo Turco, 2009; Abdalla et al., 2007). In addition, there are also theoretical models which show that the relationship between migration and trade is ambiguous (Akkoyunlu and Siliverstovs, 2006). As Canavire-Bacarreza and Ehrlich (2006) pointed out, migration flows can also effect the composition of trade flows by introducing new product flows or amplifying product flows with historically low importance.

On the other hand, destination countries face a number of economic and social costs due to large migrant flows. Potential costs include; unemployment, lower wages, threats to national security, increasing cultural differences and challenges to the social peace. However, an economic analysis of migration suggests that rich countries overall benefit from immigration, including an increase and diversification of the work force. Incomes of indigenous population increase by 0.4% on average as a result (World Bank, 2006).

### **3. Turkish emigrant movements over recent decades**

Traditionally, Turkey has been known as a country of emigration. There has been, indeed, a Turkish migrant worker phenomenon long before World War II, but it was depended on individual decisions. If development of Turkish migrant labor flow is examined, depending on global economic dynamics, three separate but partially overlapped time periods can be distinguished, namely labor migration to Western Europe (from early-

1960s to late 1970s), to Arabian countries (from mid-1970s to early 1990s), and to Russia and other former Soviet republics (from early-1990s by now).

The beginning of the Turkish labor movements dates from the bilateral agreement concluded between the Federal Republic of Germany and Turkey in 1961 with main objective of assisting the reconstruction of post-war Germany with temporary unskilled labor, “guest workers”. It was expected that these workers would return to Turkey with new skills and help reorient the Turkish economy from rural agriculture to industry (Kirişçi, 2003). Destination countries have been multiplied in the course of time and over 2 million Turkish workers have migrated for employment to 30 countries. Today, Germany is still by far the most important host country for Turkish emigrants with some 2 million Turks, or just under two-third of the whole Turkish community abroad and is followed by France (Köksal, 2006).

After the mid-1970s, the economic downturn in Western Europe due to oil crisis of 1973 ended the recruitment of labor from Turkey. However, Europe’s recession coincided with an economic boom in the Middle East, allowing Turkish workers migrate to countries such as Libya, Saudi Arabia and Iraq. This emigration rarely involved entire families. The Turkish presence in Iraq (and to a lesser extent, other Arab countries) was reduced by the 1991 Gulf War. In the early 1990, meanwhile, after the collapse of the Soviet Union a new destination was arose for Turkish migrant workers.

The economic and political context in Turkey during the period of 1960-1980 is closely related with the trends in Turkish workers migration abroad. Although the first two of the Five Year Development Plans were reasonably successful to achieving their growth targets, they were less successful in bringing about basic structural transformation in the economy, or in distribution the gains from development to those most in need. Also, price stability was not achieved and employment generation was not sufficient (Aydaş et al., 2004). Because of these failures and in view of the inflow of savings and remittances, “export of surplus labor power” became an increasingly attractive policy to the government. The outflow of migrant workers was primarily determined by host country demand and so was subject to large fluctuations. Bilateral agreements shaped the initial stages of migratory flows. After then, migratory movements have gained their own dynamics and mechanisms quite independently.

İçduygu et al. (2001), by analyzing empirical data from Turkey, assert that a threshold of socio-economic development may lead to a higher level of migration. They also assert much has changed in Turkey since the early 1960s in both volume and type of migration, the heavy involvement of middle-level developed districts in migration continues to be significant.

In a final aspect of emigration, the last few years have witnessed an increase in the number of highly qualified professionals and university graduates moving to Europe or the CIS countries. Today, it is estimated that more than 5 million Turkish nationals living abroad, of whom about 4.5 million are in European countries, a substantial increase from 600 thousands in 1972 (Kirişçi, 2003).

#### 4. Review of the empirical literature

There is a growing empirical literature on the relationship between migration and trade which prompted by the rapid growth in the foreign-born population in many OECD countries in recent decades. Most of the studies have been devoted to investigate the trade implication of migration from less developed or developing countries to one or a number of developed countries<sup>(1)</sup>. The studies which aim to examine the impact of emigration on trade are rather rare. The concern and content of the studies can be classified in various aspects. Some studies cover differentiated products only or all products while others discuss immigration heterogeneity or business networks. Another distinction may be made in terms of the contents of the trade variable. Some studies devoted to exploring the impact of migration on cross-border trade while others restricting to the intra-industry flows.

The studies on migration impact on trade use the methodology of gravity that has been a popular approach for estimating trade flows in general. In previous studies, several specific explanatory factors have been added in addition to the standard gravity variables, namely GDP, per capita GDP, population and distance (Canavire-Bacarreza and Ehrlich, 2006).

Ghatak and Piperakis (2007) examined the impact of immigration from Eastern European countries on the volume of UK's bilateral trade flows. By using an augmented gravity model with immigration variables, they confirm the results of the previous studies about the positive link between immigration and trade, but only for imports. It appears that preference of immigrants for home country products is strong enough to influence aggregate imports. This confirms the pro-trade effect of immigration found in Gould (1994), Head and Ries (1998), and Dunlevy and Hutchinson (1999). On the other hand they failed to establish any export-enhancing effect from Eastern European countries.

Faustino and Leitao (2008a, 2008b) test the relation between immigration and Portuguese bilateral trade using static and dynamic panel gravity models. The results show that, the stock of immigrants has a positive effect on Portuguese exports, imports and bilateral intra-industry trade. The underlying assumption is that immigration contributes to decrease the costs of transactions, which in turn promotes trade flows. Their findings do not confirm the hypothesis of a negative effect of immigration on Portuguese exports. The results also suggest that when immigrants to Portugal come from a Latin partner-country, the effects on trade are stronger than in the case of immigrants from non-Latin countries.

The findings of Blanes (2005) also confirm that the stock of immigrants in a country has a positive effect on the share of its bilateral intra-industry trade (IIT). The paper links the literature about immigration and trade about IIT determinants. The key notion here is that immigration contributes to trade transaction costs reduction and this would benefit the trade in differentiated products, i.e. IIT, more than the trade in homogenous products, i.e. inter-industry trade. He tests this hypothesis using Spanish data and departing from the models developed by E. Helpman. His results are robust to different IIT measures, estimation methods and specifications.

Using a new dataset on stock of foreign-born individuals by skill class, Felbermayr and Toubal (2008) separately quantify two channels in which international migrants contribute to bilateral trade creation. They assume that improved information affects host countries' imports and exports symmetrically, while the preference channel matters for imports only. Their findings reveal that, in line with expectations, the trade cost channel (and hence the efficiency effect) is largest with differentiated goods and for high-skilled migrants.

In a trade model which extended in differentiated goods, Iranzo and Peri (2007) analyze the joint phenomena of migration and trade in a world where countries use different skill-specific technologies and workers have different skill levels (education). In this framework they match the features of the Western European countries (EU-15) and the new eastern European members of the EU. Then they simulate the effects of freer trade and higher labor mobility between the two regions. Their findings point out even in a freer trade regime the removal of the restrictions on labor movements would benefit Europe as a whole by increasing the GNP of Eastern and Western Europe.

The existing literature gives a certain importance to the role of time and integration within the host country ethnic network. Temporary migrants can be expected to be less integrated in the host country than permanent migrants. On the other hand, their knowledge of the home country can, in generally, be expected to be more up to date. Gould (1994) conducted one of the pioneering studies on trade and immigration relationship with a special emphasis on duration. He found that imports increase with immigrant volume at a decreasing rate over time, whereas for exports it takes several years to increase. Herander and Saavedra (2005) also found that the average length of stay of a migrant in the host country positively affects the exports. In a recent paper, Jansen and Piermartini (2009) investigated whether temporary migrants, like permanent migrants, have an impact on bilateral trade flows. Their empirical results show that temporary migrants have a role complementary to that of permanent migrants in promoting trade. They found that a 10 per cent increase in the number of temporary migrants from a country increases US exports to that country by 1 to 2.3 per cent and US imports from that country by 1 to 3.5 per cent. They also found that temporary migrants have a stronger impact than permanent migrants on both exports and imports and their results fall in the upper range of previous estimates on the impact of (permanent) migration on trade. Additionally, their findings confirm that temporary migrants have a more important role in reducing transaction costs for differentiated than for homogeneous goods.

The works in which migration – trade nexus has been handled for the case of Turkey are quite scarce. Karagöz (2010) studied this relationship for Turkish emigrants in a set of 24 countries for the period 2000 – 2005. Results of his analysis suggest that size of the host countries which denoted by GDP, population and per capita GDP separately, has an extending effect on bilateral trade volume whatever the trade indicator, *i.e.* exports, imports and total trade. Only exception is the effect of per capita GDP on total trade. Number of Turkish emigrants in sampled countries seems to have a positive impact on bilateral trade. In each model the coefficients are positive and statistically significant.

European countries are the main trade partners of Turkey and main migration destinations as well. In another study, İnel and Çakmak (2010) investigated the relation between emigration and bilateral trade, focusing on Turkey as a sending country and her main trading partners in Western Europe. Using fixed effects panel data model, they conclude that migration to the European countries increases the exports from and imports to Turkey, the results which indicate the validation of both the preferences and network channel hypotheses.

On the other hand, Parsons (2012) casts a suspicion on the strong trade enhancing effect of migration by focusing on unobserved factors which may be driving this relationship. He re-examines the trade-migration nexus using a panel spanning several decades, which comprises the majority of world trade and migration in every decade. First the findings common to the literature are reproduced. Then he uses country-pair fixed effects to account for unobserved bilateral factors, the implementation of which removes all of the positive impact of migration on trade. So, unobserved factors, a leading candidate for which it is argued is international bilateral ties, are on average strongly and positively correlated with migrant networks. At the end of the analysis, he concludes that the results demonstrate the large biases inherent in cross-sectional studies investigating the trade-migration nexus and highlight the extent to which previous results have been overstated.

## **5. Empirical analysis**

### **5.1. Variables, data and method**

To test the said relationship gravity model framework has been adopted which is considered to be one of the most successful models explaining trade flows between countries, as evidenced by its extensive using in the literature. It derives its success from the facts that it is well-founded on theoretical foundations, it is applicable to a wide range of specifications, it is robust over time, and since it can be derived from almost all plausible trade models, it can be used to illustrate the empirical patterns of bilateral trade (Abdalla et al., 2007).

As mentioned in the second section, since the impact of emigration on trade may differ in terms of import and export, it would be more convenient to investigate the relationship with regard to import and export separately. Therefore, following this way, we examined the impact of emigration on exports, imports and total foreign trade volume separately. To this end, the model has been augmented by adding the emigrant stock variable, besides the core variables of a gravity model like economic size and distance.

In order to represent the countries' economic size, abiding by the general application, GDP and population volume have been used. As an alternative measure per capita GDP, which is frequently used in gravity models, has been employed in a different model specification instead of GDP and population. The assumption behind this choice is that wealthy countries are more open to international trade and per capita income is better indicator for this purpose.

In the related literature, migration-trade nexus has been implemented in terms of both the emigrants (Min, 1990; Canavire-Bacarreza and Ehrlich, 2006; Karayil, 2007) and the immigrants (Ghatak ve Piperakis, 2007; Blanes, 2005; Lung, 2008; Girma ve Yu, 2002; Head ve Ries, 1998; Bruder, 2004; Tai, 2009). In this paper, the amount of the citizens of the Republic of Turkey which are abroad for various purposes is used to indicate the stock of emigrants.

Accordingly, the alternative models which are subject to estimation can be expressed as follows:

$$LEXP_{it} = \alpha_{10} + \alpha_{11}LGDP_{it} + \alpha_{12}LGDPT_{it} + \alpha_{13}LPOP_{it} + \alpha_{14}LPOPT_{it} + \alpha_{15}LDIST_{it} + \alpha_{16}LMS_{it} + \epsilon_{1it} \quad (1)$$

$$LEXP_{it} = \alpha_{20} + \alpha_{21}LPCGDP_{it} + \alpha_{22}LPCGDPT_{it} + \alpha_{23}LDIST_{it} + \alpha_{24}LMS_{it} + \epsilon_{2it} \quad (2)$$

$$LIMP_{it} = \beta_{10} + \beta_{11}LGDP_{it} + \beta_{12}LGDPT_{it} + \beta_{13}LPOP_{it} + \beta_{14}LPOPT_{it} + \beta_{15}LDIST_{it} + \beta_{16}LMS_{it} + \epsilon_{3it} \quad (3)$$

$$LIMP_{it} = \beta_{20} + \beta_{21}LPCGDP_{it} + \beta_{22}LPCGDPT_{it} + \beta_{23}LDIST_{it} + \beta_{24}LMS_{it} + \epsilon_{4it} \quad (4)$$

$$LTBT_{it} = \gamma_{10} + \gamma_{11}LGDP_{it} + \gamma_{12}LGDPT_{it} + \gamma_{13}LPOP_{it} + \gamma_{14}LPOPT_{it} + \gamma_{15}LDIST_{it} + \gamma_{16}LMS_{it} + \epsilon_{5it} \quad (5)$$

$$LTBT_{it} = \gamma_{20} + \gamma_{21}LPCGDP_{it} + \gamma_{22}LPCGDPT_{it} + \gamma_{23}LDIST_{it} + \gamma_{24}LMS_{it} + \epsilon_{6it} \quad (6)$$

where,  $EXP_{it}$  denotes the volume of exports from Turkey to country  $i$  in year  $t$  (million USD),

$IMP_{it}$  denotes the volume of imports from country  $i$  to Turkey in year  $t$  (million USD),

$TBT_{it}$  denotes the volume of total bilateral trade ( $EXP_{it} + IMP_{it}$ ) between Turkey and country  $i$  in year  $t$  (million USD),

$GDP_{it}$  denotes the GDP of country  $i$  in year  $t$  (million USD),

$GDPT_{it}$  denotes the GDP of Turkey across country  $i$  in year  $t$  (million USD),

$PCGDP_{it}$  denotes the per capita GDP of country  $i$  in year  $t$  (USD),

$PCGDPT_{it}$  denotes the per capita GDP of Turkey across country  $i$  in year  $t$  (USD)

$POP_{it}$  denotes the population of country  $i$  in year  $t$  (thousand person),

$POPT_{it}$  denotes the population of Turkey across country  $i$  in year  $t$  (thousand person)

$DIST_{it}$  denotes the population weighted distance between the capital of country  $i$  and the Turkey's capital Ankara (km)

$MS_{it}$  denotes the volume of Turkish migrant stock in country  $i$  in year  $t$  (thousand person)

$L$  denotes the logarithmic transformation

For the sake of convenience, we will call each of the models 1, 3 and 5 as long model (LM), whereas each of the models 2, 4 and 6 are called as short model (SM).

The set of explanatory variables included in the models is similar to the variables included in the previous literature using the gravity type trade model. Some augmenting covariates however have been excluded which control for shared colonial history, common language, religious similarity, cultural proximity so forth. This is because Turkey has no colonial history, and has no socio-cultural similarity with the sampled

countries which renders these variables irrelevant. So the only augmenting variable is Turkish emigrant stock.

As a result of linearization, all variables are used in their logarithmic form. For the 15 OECD countries in which the Turkish emigrants are settled down regardless of whether temporarily or permanently, data have been used for the years 2000-2012, *i.e.* 195 observations totally<sup>(2)</sup>. In the choice of the sampled countries data availability played a restrictive role. Migrant data cover the workers those settled down abroad permanently or temporarily as well as the Turkish citizens who are being abroad for other purposes (trade, education, official mission etc.). Necessary data have been derived from various databases. Trade statistics has been gathered from the Turkish Statistical Institution, GDP, per capita GDP and population data from the World Bank's WDI, and the migrant's data from OECD's online database. Weighted distances have been gathered from the CEPII<sup>(3)</sup>.

CEPII calculated two distance variables following the great circle formula, which use latitudes and longitudes of the most important cities (*dist*) and capitals cities (*distcap*). Furthermore, two other weighted measures of distance are also proposed to assess the geographic distribution of population (in 2004) inside each nation. The idea is to calculate distance between two countries based on bilateral distances between the biggest cities of those two countries, those inter-city distances being weighted by the share of the city in the overall country's population.

$$d_{ij} = \left( \sum_{k \in i} (pop_k / pop_i) \sum_{l \in j} (pop_l / pop_j) d_{kl}^\theta \right)^{1/\theta}$$

where,  $pop_k$  denotes the population of city  $k$  belonging to country  $i$ . The parameter  $\theta$  measures the sensitivity of trade flows to bilateral distance  $d_{kl}$  (Mayer and Zingano, 2006). For the weighted distance measure which used in this paper  $\theta$  is set to 1.

Due to theoretical considerations all coefficients are expected to have positive sign except the coefficients of *DIST* variable which are expected to be negative.

The relationship under consideration has been investigated in a panel data model framework. As Baltagi (2005) and Hsiao (1986) pointed out, when the number of cross-section units (countries) is greater than the length of time period (here the number of years), the sample does not cover the whole population, and a time-invariant variable like distance is used, the random effect model (REM) specification would be more convenient than fixed effect model (FEM). Since the above mentioned cases are valid here we employed the REM specification. However, the FEM estimations are also given for the purpose of comparison.

## 5.2. Empirical findings

In order to avoid any possible spurious regression relationship it is necessary to investigate the stationarity features of the variables used. Although we have a short panel, which reduce the possibility of the variables being nonstationary, we employed three

alternative unit-root tests to investigate whether the variables are stationary or not. In the related literature, panel unit-root tests are classified as Generation I and Generation II tests, with respect to independence of cross-sectional units. Since the countries in the sample does not depend each other, Generation I type tests are available in the unit-root search. The test results are given in Table 1 below. As seen from the table, all variables are stationary in their level, as indicated by at least two test methods. In this regard, population variables *LPOP* and *LPOPTr* have unit-root and hence are nonstationary<sup>(4)</sup>. These findings make it more plausible to regard the estimation of SM type equations.

**Table 1.** Results of panel unit-root tests.

Variable	ADF – Fisher $\chi^2$	PP – Fisher $\chi^2$	IPS - W
<i>LEXP</i>	<b>52.824 (0.0062)</b>	<b>91.843 (0.0000)</b>	<b>-2.845 (0.0022)</b>
<i>LIMP</i>	<b>55.648 (0.0030)</b>	34.782 (0.2507)	<b>-2.820 (0.0024)</b>
<i>LTBT</i>	<b>63.889 (0.0003)</b>	<b>50.243 (0.0117)</b>	<b>-3.861 (0.0001)</b>
<i>LGDP</i>	<b>54.166 (0.0044)</b>	<b>63.421 (0.0003)</b>	<b>-3.033 (0.0012)</b>
<i>LGDPTr</i>	<b>66.591 (0.0001)</b>	5.410 (1.0000)	<b>-4.174 (0.0000)</b>
<i>LPCGDP</i>	<b>56.686 (0.0023)</b>	<b>82.439 (0.0000)</b>	<b>-3.263 (0.0006)</b>
<i>LPCGDPTr</i>	<b>67.249 (0.0001)</b>	5.845 (1.0000)	<b>-4.225 (0.0000)</b>
<i>LPOP</i>	18.704 (0.9460)	9.240 (0.9999)	3.915 (1.0000)
<i>LPOPTr</i>	0.009 (1.0000)	<b>155.915 (0.0000)</b>	13.859 (1.0000)
<i>LMS</i>	<b>41.329 (0.0816)</b>	<b>92.435 (0.0000)</b>	-0.965 (0.1672)

**Notes:** i) Figures in ( ) are p-values. ii) Bold faced figures point to statistical significance at 10% level or below.

Since all variables (except population) are stationary in their level, needless to check the long-run relationship among them via a cointegration method. A level panel regression equation would be meaningful. Estimations of the panel data models those reflect the relationship between trade indicators (namely imports, exports and total foreign trade) and gravitational factors (size variables, migrant stocks, and distance) in line with the REM and FEM are given in Table 2 and 3 below respectively.

**Table 2.** Estimation of the models 1 – 6 based on cross-section random effect model.

	Dependent Variable					
	<i>LEXP</i>	<i>LEXP</i>	<i>LIMP</i>	<i>LIMP</i>	<i>LTBT</i>	<i>LTBT</i>
Constant	16.596 (14.009) [0.238]	<b>10.616</b> <b>(5.296)</b> <b>[0.046]</b>	- 7.243 (13.821) [0.601]	<b>13.127</b> <b>(5.708)</b> <b>[0.023]</b>	5.647 (8.528) [0.509]	<b>13.589</b> <b>(5.222)</b> <b>[0.010]</b>
<i>LGDP</i>	<b>1.206</b> <b>(0.175)</b> <b>[0.000]</b>	-	0.140 (0.198) [0.479]	-	<b>0.721</b> <b>(0.122)</b> <b>[0.000]</b>	-
<i>LGDPTr</i>	<b>0.457</b> <b>(0.176)</b> <b>[0.010]</b>	-	<b>0.833</b> <b>(0.180)</b> <b>[0.000]</b>	-	<b>0.605</b> <b>(0.111)</b> <b>[0.000]</b>	-
<i>LPOP</i>	- 0.033 (0.163) [0.842]	-	<b>0.942</b> <b>(0.211)</b> <b>[0.000]</b>	-	<b>0.382</b> <b>(0.130)</b> <b>[0.004]</b>	-
<i>LPOPTr</i>	— — 1.518 — (1. 408) — [0. 282]	-	0.146 (1.364) [0.915]	-	— — 0.638 — (0. 241) — [0. 449]	-
<i>LPCGDP</i>	-	<b>0.432</b> <b>(0.136)</b> <b>[0.002]</b>	-	0.038 (0.118) [0.747]	-	<b>0.184</b> <b>(0.077)</b> <b>[0.018]</b>

	Dependent Variable					
	<i>LEXP</i>	<i>LEXP</i>	<i>LIMP</i>	<i>LIMP</i>	<i>LTBT</i>	<i>LTBT</i>
<i>LPCGDPT<sub>r</sub></i>	–	<b>0.854</b> (0.098) [0.000]	–	<b>1.046</b> (0.085) [0.000]	–	<b>0.974</b> (0.055) [0.000]
<i>LDIST</i>	<b>– 0.962</b> (0.229) [0.000]	<b>– 1.419</b> (0.681) [0.039]	– 0.316 (0.389) [0.417]	<b>– 1.263</b> (0.736) [0.088]	<b>– 0.669</b> (0.241) [0.006]	<b>– 1.354</b> (0.675) [0.046]
<i>LMS</i>	0.012 (0.038) [0.743]	<b>0.196</b> (0.060) [0.001]	0.061 (0.050) [0.219]	<b>0.103</b> (0.056) [0.067]	0.044 (0.031) [0.156]	<b>0.091</b> (0.039) [0.019]
R <sup>2</sup>	0.822	0.655	0.745	0.682	0.891	0.839
F – statistic	144.657	90.114	91.783	101.749	254.996	247.503
<i>p</i> – value	0.000	0.000	0.000	0.000	0.000	0.000
Hausman $\chi^2$	16.270	13.053	10.992	18.287	5.805	18.214
<i>p</i> – value	0.006	0.005	0.052	0.000	0.326	0.000

**Notes:** i) Figures in ( ) denotes the standard errors while in [ ] are p-values. ii) Bold faced figures point to statistical significance at 10% level or below.

According to the REM estimations, size of the host countries which denoted by GDP and per capita GDP separately, has an extending impact on the bilateral trade volume when *EXP* and *TBT* are used as the trade indicator. Host country's GDP in LM and per capita GDP in SM seem to have no significant impact on import volume of Turkey from sampled countries. Population of the host country seems to have significant impact on import and total foreign trade of Turkey. On the other hand, population of Turkey does not have any significant impact on bilateral trade whatever the trade indicator. In terms of per capita GDP, the income elasticity of bilateral trade volume is higher for Turkey in compared with the host countries. Interestingly, Turkish migrant stocks in the host countries seem to have no meaningful impact on the bilateral trade volume in the LM specifications. But when the SM specification has been adopted its impact becomes statistically significant. This result may arise due to high correlation between the migrant stock and GDP and population variables. As it is known high degree of multicollinearity may cause to insignificant coefficients in regression equation.

Number of Turkish emigrants in sampled countries seems to have a positive impact on bilateral trade. In each model the coefficients, which can be called as *migration elasticity of trade*, are positive and statistically significant below 10% significance level. This result is in accordance with the case studies for other countries. According to the estimations, a 10% increase in Turkish migrant stock causes to 19.6% increase in exports, 10.3% increase in imports of Turkey and 9.1% increase in total bilateral trade volume. The significant (despite slightly asymmetric) effect of migration on imports and exports can be interpreted as that information extension about markets is effective as much as preferences in migration – trade interaction. The greater impact on exports, however, would imply that network affect prevails against preference affect, the case posited also by Gould (1994) and Girma and Yu (2002).

**Table 3.** Estimations of the models 1 – 6 based on cross-section fixed effect model.

	Dependent Variable					
	<i>LEXP</i>	<i>LEXP</i>	<i>LIMP</i>	<i>LIMP</i>	<i>LTBT</i>	<i>LTBT</i>
<i>Constant</i>	3.659 (15.272) [0.811]	0.547 (1.089) [0.616]	4.339 (14.787) [0.770]	<b>4.443</b> (0.944) [0.000]	7.251 (9.121) [0.428]	<b>3.655</b> (0.612) [0.000]
<i>LGDP</i>	<b>1.778</b> (0.226) [0.000]	–	– 0.058 (0.219) [0.790]	–	<b>0.706</b> (0.135) [0.000]	–
<i>LGDPTr</i>	0.131 (0.194) [0.502]	–	<b>0.948</b> (0.188) [0.000]	–	<b>0.614</b> (0.116) [0.000]	–
<i>LPOP</i>	0.707 (1.342) [0.599]	–	– 1.944 (1.299) [0.136]	–	– 1.064 (0.801) [0.186]	–
<i>LPOPTr</i>	– 1.926 (1.512) [0.204]	–	1.470 (1.464) [0.317]	–	0.002 (0.903) [0.999]	–
<i>LPCGDP</i>	–	<b>0.465</b> (0.138) [0.001]	–	0.044 (0.119) [0.716]	–	<b>0.188</b> (0.077) [0.016]
<i>LPCGDPTr</i>	–	<b>0.849</b> (0.099) [0.000]	–	<b>1.056</b> (0.086) [0.000]	–	<b>0.979</b> (0.056) [0.000]
<i>LMS</i>	0.018 (0.067) [0.785]	0.073 (0.074) [0.323]	– 0.022 (0.064) [0.738]	– 0.024 (0.064) [0.710]	0.010 (0.040) [0.800]	0.031 (0.042) [0.452]
R <sup>2</sup>	0.969	0.961	0.973	0.973	0.989	0.987
F - statistic	289.966	254.646	337.966	373.574	813.277	812.809
p - value	0.000	0.000	0.000	0.000	0.000	0.000

**Note:** i) Figures in ( ) denotes the standard errors while in [ ] are p-values. ii) Bold faced figures point to statistical significance at 10% level or below.

In parallel with theoretical expectations and previous studies, the distance variable has negative impact on bilateral trade flows, indicating that transportation and transaction costs are significant trade barriers. Its deterring effect is greater in export specifications in compare with import models which may be interpreted as importing motivation is stronger than exporting in Turkey or an indication of import-dependency of domestic production.

## 6. Conclusion

Two prominent features of globalization in recent decades are the remarkable increase in international trade and in migratory flows between developing and developed countries. Thus, the migration-trade nexus has received substantial interest in recent years from both theoretical and empirical researchers. Empirical findings reveal that in most cases amount of emigrants/immigrants has a positive impact on bilateral trade volume.

Emigration is an important issue for Turkey as well. Today, more than 5 million Turkish nationals live in tens of different countries all around the world most of whom are permanent migrants. OECD countries are the most favorite destinations for Turkish emigrants. Most of the OECD countries besides constitute foremost bilateral trade partners of Turkey. However, economic implications of the Turkish emigrants is not

sufficiently studied and addressed. So, this paper is a modest step towards to fill this gap by focusing on the Turkish emigrants in OECD countries. To this end we employed a battery of panel gravity models which are augmented by Turkish emigrant stock in 15 OECD countries. Results of the random effects panel data analysis are in accordance with the theoretical expectations and suggest that size of the host countries which denoted by GDP and population, and alternatively by per capita GDP, have an extending effect on bilateral trade volume in terms of Turkey's exports. As expected, distance has negative impact on bilateral trade flows, indicating that transportation and transaction costs are significant trade barriers. The stock of Turkish emigrants in sampled countries seems to have a positive impact on Turkey's exports, imports and overall bilateral trade. In each equation its coefficient, which can be regarded as migration elasticity of trade, is positive and statistically significant. The significant effect of migration on imports and exports (symmetric impact) can be interpreted as that information extension about markets is effective as much as preferences in migration – trade interaction.

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### Notes

- (1) A compilation and meta analysis of 48 empirical studies could be found in Genç et al. (2011).
- (2) The sample includes those countries: Germany, United Kingdom, Netherlands, Italy, Denmark, Spain, Norway, Sweden, Finland, Austria, Switzerland, Belgium, Hungary, Greece and Iceland.
- (3) Instead of the distance between the capitals, it is possible to use the distance between the countries' trade centers and Istanbul, but in the global scale it makes no significant difference.
- (4) Since the geographical distance is a time invariant measure, the variable LDIST was not tested.

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## **New pillars of the banking business model or a new model of doing banking?**

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**Abstract.** *In the first part of this paper we realise a brief introduction of the changes and challenges that transformed the society and the banking sector, eight years after the beginning of the financial and economical crisis. In the first part we emphasize some of the most relevant trends and their role and impact in shaping the banking industry, post financial crisis. Digitalisation, regulations, customers are changing the banking business model, creating also new opportunities for banks. The second part of the paper presents the main pillars of a new and sustainable banking model, providing valuable insight into the latest topics and questions from the industry. The society changed due or via the technological wave, we insist on the strategic importance of choosing a balanced mix of ingredients when designing and implementing a new banking model, in a sustainable manner.*

**Keywords:** banking model, digitalisation of financial services, credit deleveraging, NPLs, customer behaviour, regulations, Fintechs, communication systems.

**JEL Classification:** E51, F42, G01, G21, G23, G28, G38, M15.

## **I. Introduction**

Eight years from the beginning of the economical and financial crisis, eight years full of changes and challenges, eight years full of integration and disintegration in building a new vision in banking and financial services.

The financial crisis made bankers/regulators reflect and try to act better considering: short term and long term approach and consequences; simplicity of customers' needs and complexity/sophistication of banking and financial solutions/alternatives; mix of Human Capital and Technology; financial education that matters both for the staff of the banks and for the customers.

During those eight years a lot of efforts have been done for adaptation, adjustments in order to screen the new ingredients of a dynamic global society, in an interconnected world.

Trust remain the main challenge for a new but sustainable banking business model. Trust should be regained and consolidated.

The society as a whole is being transformed, so does the banking and financial industry. There are fundamental changes in the way the customers make payments, borrow money, design financial plans for their future, invest, make placement of their resources.

By learning and transferring into practice the lessons from the crisis, major changes can be performed.

Analysing the banking market, we may observe different business models, different types of banks, different interpretations and implementations of regulations (e.g. of Basel regulations).

We will reflect to the main trends, connected especially with the external world of a bank but also to several important pillars of a new banking model, connected especially with the organization of banking business, with the internal affairs of a bank.

We will explore the topics mainly from a European perspective.

## **II. New trends in banking and financial sector**

The main outputs of the financial crisis represent in fact trends changing the banking business models: 1) the digitalisation agenda, 2) the regulatory change, 3) change in customer behaviour, 4) credit deleveraging, 5) the development of alternative funding channels.

We will refer to this diverse mix of trends that is reshaping the banking model in a structural manner.

A key point within the digitalisation agenda is the customer, that is experiencing different devices for day-to-day business, and is willing to do the same also for banking operations. Distance banking services, applications and platforms offered via mobile and other smart devices, digital bank branches, card less ATMs, smart Customer Relationship Management systems connected and interconnected with different platforms, providing also behavioural analysis of the customers, online credit applications and processing, are

included within this technological trend, having a strong impact on banking business. All the relevant processes within a bank are changed, with accent on speed, reliability, access to interconnected platforms, availability 24/7/365, security.

The relationship management activity of the banking clientele requires innovation, creativity but also clear procedures and support systems to analyse relevant information about customers, competitors, markets, as banking is mainly, an information business. The dynamics in customer relationship management determines organisational and technological developments and changes (Rajola, 2012).

On the transactional and operations side, banks may buy or develop strategic partnerships with technology companies. Payment systems, banking transactions and operations are the main beneficiaries of digitalisation, determining reduction of costs and increase in transparency and tracking of data. Via cooperation, banks may develop and operate a common technological infrastructure where every participating bank may develop additional services, in order to define competitive advantages and to deliver financial solutions to the customers.

Mobility of the customers, the need to work and travel outside of their home countries, the global migration tendencies determines changes in payments and operations systems of the banks. Manuel Orozco (2013) reflected in his study on migration and remittances the existence of common patterns in behavior of the migrants. Regulations, economical developments within specific regions, dynamics in the home countries of the migrants are influencing as well the money transfer solutions, involving directly or indirectly the banking systems. Banks may plan strategically to benefit but also to support, via financial services, those migration trends, as remittances are representing important flows of capital. Another aspect to be considered is the average length of time, ranging from one to seven years during which migrants remit money, varying on the specific areas where they are working and sending money (Orozco, 2013).

Another significant trend is the regulatory frame, that involves a wide range of new regulations, starting in 2009, after the G20 meeting. From compliance, risk management, Know Your Customer to capital reserves of the banks, the regulatory trend implies deep reorganisation of the banking business: e.g. Solvency II, the resolution mechanisms introduced by the Bank Recovery and Resolution Directive (BRRD), Single Supervisory Mechanism (SSM), Single Resolution Mechanism (SRM), Capital Requirements Directive IV (CRD IV) and Capital Requirements Regulation (CRR), Minimum Requirement for own-funds and Eligible Liabilities (MREL). The reporting performed by the banks should be done quicker and is more complex. The organisation of bank's activity suffered changes, revealing a shift from sales/commercial towards compliance and risk. The changes are reflected differently for large, systemic banks and for small banks. In accordance with industry representatives, regulations trying to adjust "to big to fail" may induce "to small to survive". Throughout the world, the pressure to conserve capital to meet new regulatory requirements caused the structural changes of banking business models. For example universal banks abandon certain territories, asset classes and markets and design a new business model.

The trend that determines in fact the transformation of the banking industry is based on promoting innovation and access to new products and services. Security, data protection and high levels of customer protection are also parts of the new regulations frame. One frequent topic related to the regulations frame for banks and for non-bank competitors (e.g. financial technological companies called Fintechs), is represented by the condition to assure the same rules for the same service, for all players in the financial markets.

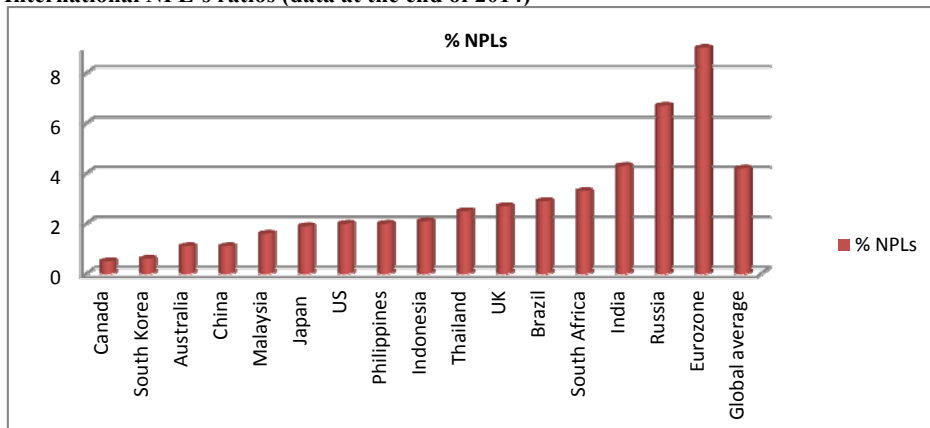
Regarding the trend represented by the change in customer behaviour, relevant consequences are increasing importance of customer satisfaction, the availability of financial services, the competition from other non-bank institutions. Customer satisfaction in banking should be considered more than a simple marketing policy, the bonuses of the staff being linked directly with customer satisfaction indexes, not with the amount of money that the bankers are „selling” via banking products and services. Relevant instruments and techniques from other sciences, such as psychology, sociology, economics are used more and more in banking industry. Behavioural analysis of the customers provides in-depth knowledge to support cooperation between the bank and the customer.

Blythe and Megicks (2010) analysed the complexity of the planning process regarding the customers and the importance to consider all sets of actions, reactions for a given set of circumstances, trends in order to converge with the customer expectations and to capitalise on them.

The information systems about the customer profile, the behaviour of the customer and the motives that drives the customer to make deposits, to invest money, to contract a mortgage loan in order to buy a house are relevant for the strategies of the banks, emphasizing that the customer took the lead in driving changes.

The dynamic global environment offers complex and difficult choices, especially when considering financial planning and financial resources, both for individuals and companies. Change in customer behaviour reflected the deviations of the customers from the standard models but also the limits of those models and the need to take also into consideration relevant emotional and social factors.

The deleveraging trend (identifying assets to hold, restructure or sell) is determined by banks that have been lowering their high pre-crisis leverage levels and are preparing for stricter regulatory capital requirements. Studies<sup>(1)</sup> on the deleveraging trend reflect basically three ways in which banks can deleverage: by raising capital, by reducing (risk – weighted assets), or restricting lending. The regulatory changes in Europe focus on the high levels<sup>(2)</sup> of Non-Performing Loans (NPL's) in the European Banking system. There are concerns that Non-Performing Loans keeps down credit growth, keeps down investors appetite for business perceiving non-realistic estimations, affects bank profitability and reduces overall economic recovery. At the global level, in 2014, Eurozone included the highest percent of NPL's, as reflected within the following graph. At the European level, a strong activity of selling portfolios of loans started in 2014 (as Eurozone had the highest percent of NPLs, around 9%) and increased significantly in 2015 (almost doubled) and 2016. UK, Italy, Ireland and Spain dominates the transactions<sup>(3)</sup> with NPL's.

**International NPL's ratios (data at the end of 2014)**

Source: The World Bank, PwC; published in The Banker, July 2016.

The trend represented by the development of alternative funding channels was generated by the shrinking of banking sector activity and the opportunity that new forms to take over the financial needs of the society. Relevant factors that favours this trend are related to the increased pressure from regulators, asking for more capital and inducing higher costs to comply, but also to the efforts to regain back the confidence from customers. Another driver for alternative providers of services is technology, that is changing the transactional banking and relationship banking models. Innovation is also favouring the development of alternative funding channels, new solutions such as Peer to Peer lending platforms, payments ecosystem, automated investment advice, crowdfunding models registering significant progress.

According to Andrew Haldane<sup>(4)</sup> of the Bank of England, Peer-to-Peer lending activity (e.g. equity crowdfunding, invoice trading, Peer to Peer consumer lending, Peer to Peer business lending, others) that was above 1 billion GBP in 2012 increased up to 3 billion GBP in 2014, as per the data at the end of 2014. This trend may contribute to increasing availability and convenience of finance, as well as reducing intermediation costs. As Haldane presented, the unit cost of US financial intermediation seems to be unchanged over a century, income from finance simply rises and falls with the value of assets, suggesting a huge amount of rent- extraction. Technology and innovation might contribute to reduce the costs but also transform the quality of lending, using “big data” support within the bank analysis processes.

Competition and cooperation are driving the alternative funding channels development. Non-bank and non-traditional actors, start-up technology companies, giant global companies (e.g. Apple, Google) are competing and/or cooperating with the banking sector. New developments (e.g. Bitcoin), e-commerce solutions (e.g. PayPal), induce a mix of threats and opportunities to the banking industry.

Global banking strategies have considered economies of scale and the combination of retail, investment and overseas banking as key drivers for their banking models. Technologies based on the principle of decentralization and block-chains and competition from other counterparties put pressure on banks to redesign their business models. Banks are

developing cooperation with Technological Laboratories, Business Accelerators, are creating venture capital funds in order to benefit of innovation and technological progress. From the Fintech companies, banks may expect competition but also cooperation.

The development of alternative funding channels may support financing different segments of banking clientele, such as Small and Medium Enterprises (SMEs). SMEs that typically do not get funding from banks, due to their specificities, may get funding from Fintechs. In some countries from the euro area, smaller firms find access to bank credit more restrictive than pre-crisis<sup>(5)</sup>. Considering the above mentioned innovative financing solutions, Fintechs may also contribute to making SMEs shares more tradable, developing the capital markets as well.

From a historical perspective, European financial system is “banco centric”. The structure and business culture of European societies are based on banking sectors. Post crisis evolutions, including the development of alternative funding channels, new forms of equity participation, new non-bank actors, new co-financing solutions, enable the system to change and become more sustainable.

### III. Pillars for a new banking business model

The main trends in banking and financial sector, derived from the external world of a bank, are influencing significantly the bank’s activity. We will also present several pillars, from the internal organisation of the bank, that could shape a new and sustainable banking model: a) *Personnel – Human Capital*; b) *ITC infrastructures*; c) *Internal procedures and work-flows*; d) *Communication policy and protocols*. The integration of these pillars within the activity of the bank based on a long term forward looking approach will enable further synergies for the banking business.

#### a) *Personnel – Human Capital*

The personnel of the bank should manage both traditional relationships and digital relationships with the customers.

The interaction between Human Capital and technology is changing considerably the way of doing banking. The engineering of a new banking model takes into consideration to mix, in a balanced manner, people, competencies, new functions, applications, technologies, blended platforms. Designing the right profiles and selecting the right people represent relevant aspects for a new a sustainable banking model. Banks are competing on talents with other industries that are developing very fast. A key point within a new banking business model are the clients: internal clients of a bank- the personnel and external clients of a bank – the customers.

Banks should transform the personnel into valuable assets, in order to create really meaning full relationships with customers. People that are working in a bank personalise the relationships with the customers, contribute to rebuilding trust. The answer to the question: “What is the value of creating openness via communication, technology, if we do not trust each other?” is not simple.

Within the new banking model, it is relevant that banks to struggle, do the research and answer to questions such as: “what are the real issues customers cares about?”. Due to the technological developments, staff of the banks see their customer less.

Inside the banks, the functional shift from controlling to collaborating will add value to the relationships between departments and people.

More and more banks are using hybrid models, both human advice and Robo advice, in accordance with the preference of the customer. Although the principal benefit of digitalization is cost, we believe that the real driver for a bank is human capital, “trained and transformed”, adapted to the new realities and prepared to serve and to build, in a creative and sustainable fashion, long term traditional and digital relationships with the customers.

#### *b) ITC infrastructures*

Banks have always used ITC infrastructures and systems to gather data from the customers, to analyse data and report, to provide services to customers, to make payments, to send encrypted messages, to process financial transactions.

Digitalisation, electrification of financial services are moving very fast, shaping the banking industry. Another strong component linked with the banking activity is the risk component, strong evolutions are especially on the cyber risks. Banks must develop risk management policies and tools, including the IT risk management framework, IT disaster recovery and business continuity planning, IT change management.

Among the key elements that contribute to a structural change in ITC infrastructures of the banks are: speed, security, availability and cost. Most of the world’s top 100 banks have been involved in pilot projects to implement new technologies, in order to secure communication, provide faster payments to the customers, use data mining in order to increase the quality of banking analysis.

The new ITC architecture involves deep changes for all the major activities within a bank, allowing knowledge to be distributed to all levels of the organization. The quality of the cooperation and the quality of the “translations” between the business/commercial, where the interaction with the customer is reflected and the support/the back office, where the data is processed represent a milestone for the new banking model. Answers to questions such as: what is the level of personnel necessary for the IT functions of a bank? or what can be externalized? gives valuable input for a new banking model that is willing to use technology in order to add value to the work of the people and to the customers.

Due to the low interest rates, banks should switch from incomes mainly from interests to incomes mainly from fees and this drives new changes for the business model, add additional services that need to be supported by the ITC systems.

The ITC architecture should be redesigned in order to insure integrity of data, to identify what are the assets that really matters, to ring fence them and protect them. The ITC infrastructure needs to be modular, to make sure that further developments, new platforms will be supported in this changing environment.

For example, in retail banking, a decade ago, a key word was prevention; nowadays in retail, a strategic aspect are recovery plans (e.g. „2h recovery plans”), resilience to cyber attacks; the entire banking organization should be built resilient.

A new and sustainable banking business model, considering all this developments, should separate customer data from all the production systems and all the communication systems. Regarding the contact/interaction with the customers, partners, the bank must sell all the products and services via all the possible channels.

*c) Internal procedures and work-flows*

Due to the external trends presented above, such as digitalisation, deep change in regulatory frame, change in customer behaviour, credit deleveraging, development of alternative funding channels, banks faced a huge amount of work after the financial crisis but also a huge amount of challenges. All the major banking models were affected by the crisis and changed by the post crisis new situations and trends: retail banking, corporate banking, investment banking<sup>(6)</sup>, private banking/wealth management.

The concern for reshaping internal activities in a bank involves new procedures and work-flows: for credit analysis, risk management, sales of banking products and services, payments systems of a bank, consultancy and advice to the customers (offered by bankers or by Robo-advisors), processing of financial transactions, Know Your Customer procedures etc.

Top aspects that need a special attention from the banking side, being part of the new banking model are: transition planning, better access to better data, quick operational programs to disburse resources, better tools to gather and filter information, customer due diligence. Banks should also share information about threats and should test the collective approach of a continuity plan.

The procedures and work-flows within a new and sustainable banking business model should define clear roles and responsibilities, flexible interdepartmental teams to address border line issues and to avoid building silo cultures, top-down responsibility and quick reaction/decision making processes. Within the business continuity plans, banks should include and sign protocols with strategic partners, in order to insure support in crisis situations. Banks may outsource some business functions but may not outsource the risks.

*d) Communication policy and protocols*

Communication in banking represents a strategic management tool, a critical one, it is no longer just a part of the marketing policy mix. A new banking business model should handle and insure a successful transition from traditional communication functions to real time communication via computers, other electronic systems, devices, techniques, that have changed everything in society, both banking and human relationships.

Banks benefit of large quantities of information and data, the concern is how to organise and use the data, making sure to communicate all the relevant actions to the customers and to capture their imagination.

Communication policy must be based on unity of command and coordination of all communication efforts.

A new communication strategy determines a reengineering for the entire banking organisation. The communication protocols include support and management of multiple systems: product driven system, distribution and channel system and the customer driven system.

Banks communicate with all the relevant stakeholders (authorities, regulators, customers, institutional partners and investors) and benefit, via technology of a continuous dialogue with the counterparties. Communication within the new banking business changes, instead of talking at the customers the banks should listen to the customers, earn the attention of the customers.

The crisis showed that it is far better for banks to initiate the „conversation” than to pick it up on it halfway through. Social media, social connected networks have given customers an influential tool to share information, to put pressure on banks in order to provide quality services.

The new banking business model should include crisis communication scenarios, to consider and test various variables, as catalysts for a crisis. Basically, all the alternative planning activities of a bank, business continuity activities must include also communication alternative scenarios, policies and protocols to enable a consistent and coherent reaction of a bank when a crisis situation occurs.

## Conclusions

The academic discussion over the banking sector business model is old and complex, but always generator for progress.

Relevant trends, such as digitalisation, change in regulations and customer behaviour, credit deleveraging, development of alternative funding channels, impacted the banking sector and the existing banking models: the need to integrate technology and to develop strategic digital relationships with the customers, the need to almost double the banks equity capital since the crisis, the need to adjust standard economical models with behavioural analysis and to consider the client as the main driver for change in banking, the restructure of bank's balance sheets by lowering the leverage levels, the need to redesign banking activity, to cut costs and to compete or cooperate with Fintechs, within the new realities of the financial world.

Transparency, authenticity, speed and delivery are rules for a new banking business model, in order to reset bad memories and regain trust. Via innovative technology, banks that are merging large relationship networks must communicate and be engaged in valuable dialogue with the customers.

Innovation/change is part of the new normality. The digitalisation of financial services is no longer optional, traditional patterns in customer behaviour, work-flows and processes have changed. Educational sales of banking products and services should be a permanent concern within the new banking business model.

A new and sustainable banking business model should mix Human Capital and technology, in order to do “real time” monitoring, learn, adapt and support the dynamic needs of the customers, at the highest standards. Risks, including cyber but also other asymmetric risks must

be clearly assessed, monitored and managed, within a new risk and resilience paradigm, including also detailed business continuity action plans and communication protocols.

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## Notes

- (1) As presented in “Bank deleveraging, the move from bank to market-based financing, and SME financing” by Gert Wehinger, senior economist in the Financial Affairs Division of the OECD Directorate for Financial and Enterprise Affairs.
- (2) According to the European Banking Authority, the levels of non performing exposure remains highly variable for across different countries, ranging in June 2015 from 49.6 % in Cyprus to 1 % in Sweden.
- (3) As reflected by the study “Deloitte Deleveraging Europe 2015-2016”, published by Deloitte.
- (4) See “Has the U.S. Finance Industry Become Less Efficient?”; Nesta (2012-2014); McKinsey by Haldane A., Phillipon, 2014.
- (5) See European Central Bank, “Survey on the access to finance of enterprises in the euro area, October 2014 to March 2015”, June 2015.
- (6) Goldman Sachs has started to offer online savings accounts that can be opened with a deposit of just \$1, with interest rates about 100 times better than those at big US retail banks like Wells Fargo or Bank of America; For almost 150 years, Goldman Sachs had prospered by getting close to people of power and influence: wealthy institutions, multinationals, rich families; as Ben McLannahan wrote in the Financial Times: „Goldman Sachs: a play for the 99%”.

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## Effects of R&D and innovation on income in EU countries: new generation panel cointegration and causality analysis

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**Abstract.** *The purpose of this study is to examine the effects of research-development expenditures and innovation on income using new generation panel data analysis for 11 EU countries. We found that that if research-development expenditures and innovation goes up by 1%, income, on average, raises by 0.19% and 4.05%, respectively.*

**Keywords:** R&D, Innovation, Panel Cointegration, Panel Causality.

**JEL Classification:** O31, O32, O47.

## 1. Introduction

Economic growth differences across countries occur for several reasons. They may be associated with large differences in literacy, infant mortality or life expectancy conditions. In addition to those, social standards, geography, culture and luck may also be fundamental causes of differences in economic performance across countries (Acemoglu, 2012). However, the key factor determining the differences in income across countries is related to the technological level in the contemporary world (Breznitz, 2007). Labor-based economic growth and natural resources-based economic growth are no longer valid in today's world. Advanced technology and productivity took the place of labor and natural resources-based growth (Potters, Ortega-Argilés and Vivarelli, 2011). At this point, the question of how developing countries can obtain advanced technology and arise their productivity.

The main objective of this study is to examine the effects of research and development (henceforth R&D) expenditures and innovation activities on income by new generation panel data analysis for the period of 1990-2011 for 11 Europe Union (EU) countries; Germany, Austria, Belgium, Denmark, Finland, France, Netherlands, UK, Spain, Sweden and Portugal. The findings show that if R&D expenditures and innovation goes up by 1%, income, on average, raises by 0.19% and 4.05%, respectively. The findings from this study are considered to be a guide for developing economies and countries that wait to join EU soon.

The remainder of the paper is organized as follows: The next section presents theoretical framework. Section 3 contains summary of the literature. The main empirical results are presented in section 4. Section 5 concludes.

## 2. Theoretical framework

In the existing literature, a number of explanations directly connected to this issue are developed. Krugman (1986) developed the technology gap model. This model suggests that a large part of the trade between industrialized countries is based on new goods. Filipovic, Devjak and Putnik (2012) states that innovative companies improving these production processes and patents and technical knowledge assured by intellectual property rights will accelerate the economic growth and monopoly profits of companies. In addition, the product life cycle hypothesis shows that industrialized countries owning a high degree of human capital and investing in R&D produce more technical innovations and new goods (Maksimovic and Phillips, 2008).

Besides that, according to the endogenous growth model developed by Romer (1986) and Lucas (1988), knowledge, R&D activities, human capital and technological progress are endogenous and significant contributors explaining growth and increased productivity. Additionally, Lucas (1988) includes technological progress and investment in the same model and focuses on the effects of R&D expenditures and human capital on technology. He finds that R&D and innovation activities play a substantial role in decreasing the technological gap and accelerating economic growth.

In recent years, labour force with knowledge and skill, experience and information, infrastructure of R&D, modern communication network, the effective use of information technology, productivity without sacrificing quality and wealth of product range are the main determinants of competitive capacity. This is because high value-added product competition has shifted to a competition of scientific and technology in developed countries. To do this, substantial funds are allocated for R&D and innovation in developed countries. For instance, in 2004, the public sector in the OECD countries spent approximately \$190 billion on R&D (OECD, 2007).

The number of patents which is an indicator of inventions carried out and demonstrates the capacity of country's R&D and number of R&D-based output are enormously crucial and shows the innovation potential of the country. This is because a design produced by R&D activities and the use of this design in production process decreases production costs and provides a competitive advantage for exporter companies in foreign trade (Amaghous and Ibourk, 2013).

Investments in knowledge and innovation also provide a basis for technological progress (OECD, 2007). The invention achieved through technological development and R&D activities can be considered as capital accumulation and innovation. In this way, available resources can be used more efficiently and countries can eventually have higher levels of production, consumption and standard of living (Kiper, 2004; Miroslav, Boris, Ivanova and Mitja, 2011). Thus, countries are required to allocate a higher proportion of national income for R&D and innovation in these countries. This is because sustainable economic growth in the long-run depends on technological progress and innovation (Bourgeois and LeBlanc, 2002: 33).

Legislative regulations protecting patent and intellectual property rights in countries have importance owing to the fact that these regulations can make a positive impact on companies' R&D expenditures (Wangwe, 2007). The reason is that knowledge produced by R&D and innovation activities is often also non-excludable. Due to the non-excludability of new knowledge, companies on free market may invest too little in R&D (Svensson, 2008).

Recently, R&D activities have become an element of productivity, economic growth and competitive advantage. Especially, the product life cycle has shortened in technology-intensive industries. This condition has forced companies to develop new products and innovation existing products. Companies not allocating sufficient resources for R&D and innovation have to pull out of the market. More than half of the economic growth in advanced economies in recent years is originated from R&D and innovation (OECD, 2007).

### 3. Literature

There are many studies in the literature which investigate the empirical aspects of the relationship between R&D, innovation and income. This section presents a selected empirical literature review on the impacts of R&D expenditures and innovation activities

on economic performance. Sylwester (2001) examine the association between R&D and the growth rate of output per capita. He found that there is weak positive relationship between R&D expenditures and the growth rate of output per capita for OECD economies. Osorio and Pose (2004) examine the relationship between R&D investment and innovation for the peripheral regions of Europe by cross-section OLS regression. The results indicate that R&D investment and higher education R&D investment is positively associated with innovation in these peripheral regions. Ulku (2004) investigate relationship between per capita GDP and R&D, innovation for 20 OECD economies and 10 non-OECD economies in 1981-1997 periods by panel data analysis. It is found that innovation and per capita GDP had strong and positive linkage in OECD and non-OECD countries. He also noted that innovations in OECD countries are supported by R&D investments. Torun and Cicekci (2007) examine the link between innovation and economic growth. They found that innovation makes a significant impact on growth and there are significant spillover between countries. Besides that, Estrada and Estrada (2009) develop the theoretical endogenous model for analyzing the impact of R&D investment on long term growth. They found that R&D shocks have a positive impact on economic activity. Yinsheng, Baomin and Die (2010) investigate the relationship between R&D investment and economic growth for the period 2000-2008. The results show that R&D investment has a positive impact on economic growth, although this impact decreases gradually. Kilic, Savrul and Ustaoglu (2011) examine the effects of technology and innovation on economic growth for Turkey. They found that there is a positive relationship between R&D expenditures and economic growth. Guloglu and Tekin (2012) investigate OECD countries for the period 1991-2007 by using GMM and Panel VAR methods. They suggest that technological change increases economic growth and technological change is the cause of R&D investment. Akinci and Sevinc (2013) examine the link between R&D expenditures and economic growth for Turkey for the period 1990-2011 by using the Granger Causality method. They found that there is a unidirectional causality from R&D investment and higher education R&D investment to economic growth. Bayarcelik and Tasel (2013) investigate the relationship between innovation and economic growth in Turkey by using the endogenous growth theory for the period 1998-2010. The results suggest that there is a positive and significant effect of R&D expenditures and the number of R&D employees on economic growth. Westmore (2013) examine effects of innovation specific policies across 19 OECD countries. The results suggest that innovation specific policies such as R&D tax incentives, direct government support of business R&D and patent rights encourages private sector innovative activity. Conversely, there is no direct effect of such policies on aggregate productivity growth.

#### 4. Empirical analysis

##### 4.1. Data and model specification

In this study, the effects of R&D expenditures and innovation activities on income are analyzed by new generation panel data analysis based on annual data for the period of 1990-2011 for 11 EU countries. The variables are: Gross National Product (2005=100)

(Y); R&D expenditures (2005=100) (R&D) and innovation (IN). Innovation is represented by the total number of patent applications previously used by Ulku (2004), Kilic et al. (2011), Guloglu and Tekin (2012).

Consider the following model used by Ho, Wong and Toh (2009)

$$Y_t = A RD_t^{\beta_1} K_t^{\alpha_1} L_t^{\alpha_2} e^{\mu t} \quad (1)$$

We begin by adding innovation as a variable to Eq. (1)

$$Y_t = A RD_t^{\beta_1} IN_t^{\beta_2} K_t^{\alpha_1} L_t^{\alpha_2} e^{\mu t} \quad (2)$$

Where  $Y$  equals real GDP,  $RD$  is the R&D capital stock,  $IN$  is the number of patents,  $L$  is labour input,  $K$  is capital input,  $A$  is a constant and  $\mu$  is a time trend which captures other trended influences. When we take the logarithm of both sides, we obtain

$$\text{Log}Y_t = \text{Log}A + \beta_1 \text{Log}RD_t + \beta_2 \text{Log}IN_t + \alpha_1 \text{Log}K_t + \alpha_2 \text{Log}L_t + \mu t \quad (3)$$

If the effect of labour and capital on income is represented by  $\beta_0$

$$\beta_0 = \text{Log}A + \alpha_1 \text{Log}K_t + \alpha_2 \text{Log}L_t + \mu t \quad (4)$$

This econometric model obtained in this study

$$\text{Log}Y_{it} = \beta_{i0} + \beta_1 \text{Log}RD_{it} + \beta_2 \text{Log}IN_{it} + \varepsilon_{it} \quad (5)$$

#### 4.2. Cross-sectional dependence tests

Taking into consideration cross-sectional dependence between countries makes a significant impact on the results of panel data analysis. For this reason, before we apply the analysis, the presence of cross-sectional dependence of model and variable needs to be tested. This is because unit root and cointegration tests should be chosen with respect to cross-sectional dependence results (Breusch and Pagan, 1980; Pesaran, 2004).

In this study, the presence of cross-sectional dependence is examined by the Adjusted Cross-Sectional Dependence Lagrange Multiplier ( $CDLM_{adj}$ ) developed by Pesaran, Ullah and Yamagata (2008). Test statistic is expressed as

$$CDLM_{adj} = \left( \frac{2}{N(N-1)} \right)^{1/2} \sum_{i=1}^{N-1} \sum_{j=i+1}^N \hat{\rho}_{ij}^2 \frac{(T-K-1)\hat{\rho}_{ij} - \hat{\mu}_{Tij}}{v_{Tij}} \sim N(0,1) \quad (6)$$

where  $\hat{\mu}_{Tij}$  is mean and  $v_{Tij}$  is variance. When we reject the null hypothesis, we say that there is a cross-sectional dependence between countries. The test statistic obtained from Equation (6) is normally distributed asymptotically (Pesaran et al. 2008). The results were presented in Table 1.

**Table 1.**  $CDLM_{adj}$  The Results of Cross-Sectional Dependence Test

Variables	t-statistics	p-value
GDP	84.332	0.007
R&D	5.909	0.000
IN	12.739	0.000
Model	101.844	0.000

According to results presented in Table 1, there is a strong cross-sectional dependence among these countries. It means that when R&D, innovation or income shocks occur in a country, these shocks affect the others. Thus, while countries determine their economic policy, they should take into consideration policies implemented by other countries and the shocks affecting these countries.

### 4.3. Panel unit root tests

In this study, stationarity of variables is examined by Hadri and Kuruzomi (2012) panel unit root test. These test takes into consideration not only cross-sectional dependence, but also unit root arising from common factors forming series. In order to remedy autocorrelation problem, it uses SPC (Sul-Phillips-Choi) method developed by Sul, Phillips and Choi (2005) and is based on the *SUR* (Seemingly Unrelated Regression) method using *AR* ( $p$ ) process. In this study,  $p$  optimal lag length was determined by Cross-Sectional Dependency Augmented Dickey Fuller (*CADF*) test. Consider the following model

$$y_{it} = z_t' \delta_i + f_t \gamma_i + \varepsilon_{it} \quad (7)$$

$$\varepsilon_{it} = \phi_1 \varepsilon_{it-1} + v_{it} \quad (8)$$

where  $f_t$  is common factor. To expand Eq. (7) in SPC method by *AR* ( $p$ ), we proceed as follows

$$y_{it} = z_t' \hat{\delta}_i + \hat{\phi}_{i1} y_{it-1} + \dots + \hat{\phi}_{ip} y_{it-p} + \hat{\psi}_{i0} \bar{y}_t + \dots + \hat{\psi}_{ip} \bar{y}_{t-p} + \hat{v}_{it} \quad (9)$$

By calculating variance in the long term ( $\hat{\sigma}_{vi}^2 = \frac{1}{T} \sum_{t=1}^T \hat{v}_{it}^2$ ) and SPC variance

( $\hat{\sigma}_{iSPC}^2 = \frac{\hat{\sigma}_{vi}^2}{(1-\hat{\phi}_i)^2}$ ) of estimation of Eq. (9) we can obtain the  $Z_A^{SPC}$  statistic

$$Z_A^{SPC} = \frac{1}{\hat{\sigma}_{iSPC}^2 T^2} \sum_{t=1}^T (S_{it}^w)^2 \quad (10)$$

To expand Equation (7) in *LA* method by *AR* ( $p+1$ ), we proceed as follows:

$$y_{it} = z_t' \tilde{\delta}_i + \tilde{\phi}_{i1} y_{it-1} + \dots + \tilde{\phi}_{ip} y_{it-p} + \tilde{\phi}_{ip+1} y_{it-p-1} + \tilde{\psi}_{i0} \bar{y}_t + \dots + \tilde{\psi}_{ip} \bar{y}_{t-p} + \tilde{v}_{it} \quad (11)$$

By calculating variance in the long term ( $\hat{\sigma}_{vi}^2 = \frac{1}{T} \sum_{t=1}^T \hat{v}_{it}^2$ ) and *LA* variance ( $\hat{\sigma}_{iLA}^2 = \frac{\hat{\sigma}_{vi}^2}{(1-\tilde{\phi}_{i1}-\dots-\tilde{\phi}_{ip})^2}$ ) of estimation of Equation (10) we can obtain  $Z_A^{LA}$  statistic is:

$$Z_A^{LA} = \frac{1}{\hat{\sigma}_{iLA}^2 T^2} \sum_{t=1}^T (S_{it}^w)^2 \quad (12)$$

The hypotheses are as follows

$H_0: \phi_i(1) \neq 0$  for all  $i$ , there is no unit root.

$H_j: \phi_i(1) = 0$  for some  $i$ , there is unit root.

The results were presented in Table 2.

**Table 2.** The Results of Hadri and Kuruzomi (2012) Panel Unit Root Test

Variables	Levels		First Difference	
	$Z_A^{SPC}$	$Z_A^{LA}$	$Z_A^{SPC}$	$Z_A^{LA}$
GDP	-2.2998	-2.6055	0.4574*	1.5767*
R&D	-2.3565	-2.6016	0.6036*	0.1238*
IV	3.0451	16.5601	-0.0365*	-0.4328*

Notes: \* denotes statistical significance at the 1% level of significance.

The results show that the level values of all series are non-stationary. Hence, all we have to do is to take the first difference of series. The first-differenced series are stationary; that is  $I(1)$ . Namely, series were non-stationary in level and they became stationary in the first difference.

#### 4.4. Homogeneity test for cointegration coefficients

The first studies to determine homogeneity of slope coefficients in cointegration equations were developed by Swamy (1970) and improved by Pesaran and Yamagata (2008). A cointegration equation is as follows:

$$Y_{it} = \alpha + \beta_i X_{it} + \varepsilon_{it} \quad (13)$$

where  $\varepsilon_{it}$  is an error term and where  $\beta_i$  is a slope coefficient. In this homogeneity test, we examine whether slope coefficients differ across cross-section units. The hypotheses are as follows

$H_0: \beta_i = \beta$  Slope coefficients have homogeneity

$H_j: \beta_i \neq \beta$  Slope coefficients have homogeneity

To test this, Pesaran and Yamagata (2008) developed two different test statistics:

$$\text{Large Samples: } \hat{\Delta} = \sqrt{N} \left( \frac{N^{-1}\bar{S} - k}{2k} \right) \sim \chi_k^2$$

$$\text{Small Samples: } \hat{\Delta}_{adj} = \sqrt{N} \left( \frac{N^{-1}\bar{S} - k}{v(T,k)} \right) \sim N(0,1)$$

where  $N$  is number of cross-section units,  $S$  is Swamy test statistics;  $k$  is number of explanatory variable and  $v(T, k)$  standard error. The results of slope homogeneity test are presented in Table 3.

**Table 3.** The Results Slope Homogeneity Test

	t-statistics	p-value
$\tilde{\Delta}$	0.127	0.450
$\tilde{\Delta}_{adj}$	0.139	0.445

The result shows that slope coefficient have homogeneity. In this case, we can interpret the panel cointegration coefficient.

#### 4.5. Panel cointegration test

The presence of a cointegration relationship between series is examined by the LM bootstrap panel cointegration test developed by Westerlund and Edgerton (2007). The main advantages of this method are: (i) it takes into consideration cross-sectional dependence, (ii) allows autocorrelation and heteroscedasticity in cointegration equation, (iii) produces effective results in small samples and (iv) prevents endogeneity problems by using Fully Modified Ordinary Least Square (FMOLS) method as an estimator (Westerlund and Edgerton, 2007). To understand this test, consider the following equation

$$y_{it} = \alpha_i + x'_{it}\beta_i + z_{it} \quad (14)$$

where  $z_{it} = u_{it} + \sum_{j=1}^t \eta_{ij}$  and  $\eta_{ij}$ ; is an independent and identically distributed process with zero mean and variance  $\text{var}(\eta_{ij}) = \sigma_i^2$ . The hypotheses are as follows

$H_0: \sigma_i^2 = 0$  for  $\forall i$ , there is a cointegration relationship between series

$H_1: \sigma_i^2 > 0$  for  $\exists i$ , there is no cointegration relationship between series

To test these hypotheses, Westerlund and Edgerton (2007) developed LM test statistic

$$LM_N^+ = \frac{1}{NT^2} \sum_{i=1}^N \sum_{t=1}^T \hat{w}_i^{-2} S_{it}^2 \quad (15)$$

where  $w_{it} = (u_{it}, \Delta x'_{it})'$  and  $S_{it}$  are sub-total values of error terms ( $\hat{z}_{it}$ ) of model estimated by FMOLS. LM test statistic and p-values are calculated by Bootstrap in the Westerlund and Edgerton (2007) Panel Cointegration Test.

**Table 4.** The results of Westerlund and Edgerton (2007) Panel Cointegration Test

Test statistic	p-value
1.586	0.685

**Notes:** Bootstrap critical values are obtained from 1000 replications

The findings show that there is a cointegration relationship between series. In other words, series tend to move together in the long run. Hence, the analysis with level values of series will not fall suspicious regression problem.

#### 4.6. Estimation of cointegration coefficients

Cointegration coefficients were estimated bias adjusted OLS estimator developed by Westerlund (2007). This method does not only take into consideration cross-sectional dependence between countries, but also considers endogeneity and common factors. In this respect, this method is considered superior to other estimators. The results of cointegration coefficients are presented in Table 5.

**Table 5.** Cointegration Coefficients

	Coefficient	t-statistics
R&D	0.19**	1.55
IN	4.05*	2.25

**Notes:** Autocorrelation and heteroscedasticity problems are fixed Newey-West method. \* and \*\* denote statistical significance at the 1% and 10% level of significance, respectively.

The results show that if R&D expenditures and innovation goes up by 1 percent, on average, economic growth goes up by approximately 0.19 percent and 4.05 percent, respectively.

#### 4.7. Panel Causality Tests

The causality relationship between series is analyzed by Panel Fisher test developed by Emirmahmutoglu and Kose (2011). This test employs level values of series and provides more knowledge about them. In addition to this, it includes  $I(0)$  and  $I(1)$  series in the model together. The test essentially involves two stages. The first stage determines the optimal lag length ( $p$ ) and the maximum order of integration ( $d_{max}$ ) of the variables in the system. The lag length,  $p$  is obtained in the process of the Vector Auto Regression (VAR) in levels among the variables in the system. We can express the level VAR model with ( $p + d_{max}$ ) as

$$X_{i,t} = \mu_i^x + \sum_{j=1}^{p_i+d_{max}} \alpha_{1ij} X_{i,t-j} + \sum_{j=1}^{p_i+d_{max}} \alpha_{2ij} Y_{i,t-j} + u_{i,t}^x \quad (16)$$

$$Y_{i,t} = \mu_i^y + \sum_{j=1}^{p_i+d_{max}} \beta_{1ij} Y_{i,t-j} + \sum_{j=1}^{p_i+d_{max}} \beta_{2ij} X_{i,t-j} + u_{i,t}^y \quad (17)$$

The second stage uses the modified Wald procedure to test the VAR ( $p + d_{max}$ ) model for causality.  $H_0$  hypothesis for Equation (16) indicates that there is no causality from  $Y$  to  $X$ . In this study, we applied Emirmahmutoglu and Kose (2011) Panel Fisher test and the results are presented in Table 6.

**Table 6.** The Results of Emirmahmutoglu and Kose (2011) Panel Fisher Causality Test

Causality	t-statistic	Decision
R&D=>GDP	37.77(0.019)**	There is bidirectional causality between R&D and GDP
GDP=>R&D	45.36(0.002)*	
IN=>GDP	50.72(0.00)*	There is bidirectional causality between IN and GDP
GDP=>IN	32.46(0.06)***	
R&D=>IN	44.95(0.002)*	There is unidirectional causality from R&D to innovation
IN=>R&D	29.10(0.14)	

**Notes:** Akaike Information Criteria was used to determine optimum lag lengths. The figures in the parentheses indicate p-values. \*, \*\* and \*\*\* denote statistical significance at the 1%, 5% and 10% level of significance, respectively.

According to the results, while there is bidirectional causality between R&D expenditures, innovation and income, there is unidirectional causality from R&D to innovation. This result is consistent with the theoretical expectations. Because an increase in R&D expenditures and innovation enhances product range and quality, competitiveness of country in the international arena by reducing costs and makes positive impact on income by affecting export. Conversely, increased income allows more resources to be transferred to R&D.

## 5. Conclusion

In this study, the effects of R&D expenditures and innovation activities on income were analyzed by new generation panel data analysis based on data for the period of 1990-2011 for 11 EU countries. First, the presence of cross-sectional dependence was tested by  $CDLM_{adj}$  developed by Pesaran (2008) and it is seen that there is cross-sectional dependence between countries. Secondly, stationarity of series was examined by the Hadri and Kuruzomi (2012) panel unit root test. The results show that while level values of all series is non-stationary, the first-differenced series is stationary. Thirdly, homogeneity of cointegration coefficients is analyzed by slope homogeneity test developed by Pesaran and Yamagata (2008). This finding suggests that cointegration coefficients were homogeneous between cross sections. Next, the presence of cointegration between series was analysed  $LM$  Bootstrap panel cointegration test developed by Westerlund and Edgerton (2007) and it is found that series is cointegrated. Then, cointegration coefficients were estimated by bias adjusted OLS estimator developed by Westerlund (2007). According to these results, if R&D expenditures and innovation rises by 1%, on average, income rises by 0.19% and when innovation rises by 1%, income rises by 4.05%. Consequently, the Panel Fisher causality test developed by Emirmahmutoglu and Köse (2011) was applied. These findings also show that there is bidirectional causality between R&D expenditures, innovation and income.

As a result, we can suggest that R&D expenditures and innovation have a positive and statistically significant impact on income. In this case, developing and least developed countries can have the opportunity to accelerate their income by investing R&D and innovation activities. For this reason, education system training of highly qualified labour force and collaboration of universities and industries are required in order to use resources efficiently in these countries. The incentives should be project-based and application-oriented.

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## **The major economic evolution of Romania by the middle of 2016**

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**Abstract.** *The purpose of this study is to examine the effects of research-development expenditures and innovation on income using new generation panel data analysis for 11 EU countries. We found that that if research-development expenditures and innovation goes up by 1%, income, on average, raises by 0.19% and 4.05%, respectively.*

**Keywords:** Gross Domestic Product, investments, income, inflation, unemployment, population, expenditures.

**JEL Classification:** O1, O11.

## Introduction

The indicator the most synthetic for Romania, concerning the outcomes recorded in 2010, is given by the Gross Domestic Product which counted for 513,640.8 million lei, expressed in the current prices of the year 2010. In 2011, the increase of GDP was some 1.1% as against 2010, which, adjusted at the level of 2011, reveals a value of 519,290.8 million lei.

In 2014, the evolution of GDP kept on increasing, if considering the current provisional, reaching a level of 103.1% as against 2013. In 2015, an increase of the Gross Domestic Product by 3.8% was recorded, and during the first six months of 2016 the increase was 5.2% as against the corresponding period of the previous year. The macroeconomic results indicators have recorded a negative evolution over the period January 2009 - January 2012 as a result of the effects of the economic and financial extended crisis, the lack of efficiency of the government activity and lack of a coherent anti-crisis program, based on pro-active steps.

Out of the data analysis we see, first of all, that for almost all the cases, the quarter to quarter evolution is a relatively positive one, both in respect of the comparison with the previous quarter and as against the corresponding quarter of the previous year, emphasizing an increase at the level of EU28. We notice that seven countries recorded slight, insignificant increases.

The rest of the countries, including Romania as well, are still facing in 2013 the effects of the crisis triggered by recession. If considering the European context, from the point of view of the recession phenomenon the situation is showing that there is only one country, i.e. Poland, managed to stay out of this condition, recording subsequent increases. Other 14 EU member countries, among which Germany (the engine of the European economy) with a noticeable increase in 2013-2015 too have recorded increases. Some of them, such as France, Holland, Slovakia, Denmark, have recorded consolidated increases during the two quarters, which forecasts a positive evolution expected at the level of the entire year 2016.

The situation occurring in this respect implies certain discussions, which, briefly, may resume to the following basic aspects:

- The imports decreased comparatively to the previous year. The imports kept on being profitable since, even if sometime an appreciation of the national currency against Euro and USD has been recorded, the wholesale and retail prices were not adjusted by cutting-off, the companies considering that they are a gained position which is not advisable to give up.
- On the other side, the exports increased during the period 2012-2015 and the first six months of the year 2016, because this fluctuation of the exchange rate against the two currencies of the foreign exchange panel of reference did stimulate the domestic production for export, this becoming much more profitable at export, the situation will maintain on the same trend in the following period.

- Normally, one country deficit, including the Romania one, is not alarming to the extent it makes part of a program of external loans, directed by projects, which do not harm the national wealth.
- In the context of the imports propensity towards the consumer goods, the situation can be evaluated as a negative one.

### Literature review

Anghelache (2008), Dodge (2006), Heiberger and Holland (2014) are reference works in the field of statistics, statistical analyses and statistical instruments. Anghelache (2014, 2015), Anghelache, Manole and Diaconu (2016) thoroughly describe the macroeconomic evolution of Romania in the respective years, on multiple topics. Pagliacci et al. (2016) develop an econometric approach on the analysis of Romanian international trade. Anghelache, Manole and Anghel (2016) develops on the evolution of agriculture, Anghelache, Soare and Popovici (2015) cover the influence of final consumption on Romania's GDP. Anghelache, Marinescu and Soare study the Romanian labor force market and population. A top-level analysis of the Gross Domestic Product is presented by Anghelache, Anghel and Sacală (2014). Cruceru and Anghelache (2014) are preoccupied by the evolution of investments. Anghel, Anghelache and Manole (2016) analyze the trend of inflation evolution. A key aspect considered in this paper is the population consumer prices, the work of Anghelache, Anghelache, Dumitrescu, Dragomir and Soare (2015) includes a study on this topic. Benjamin et al. (2010) approach the usefulness of econometric model in forecasting activities; Ghysels and Osborn (2001) cover the econometric tools as instruments for time series analyses. Bosq (2012) develops on statistics of stochastic processes. Corbore et al. (2006) focus on theoretical and practical aspects on econometrics.

### Methodology and data

- The GDP value in 2013 increased by 3.5%, reaching 617,565.4 million lei, in the context of the crisis, which, on both internal and international plan, continued to affect the economic evolution. Meantime, in 2014, the GDP reached a value of 668,143.6 million lei and in 2015 the level was 712,832.3 million lei. By 30.06.2016, the GDP value counted for 325,572.8 million lei.

#### Quarterly GDP evolution, over the period 2014-2016

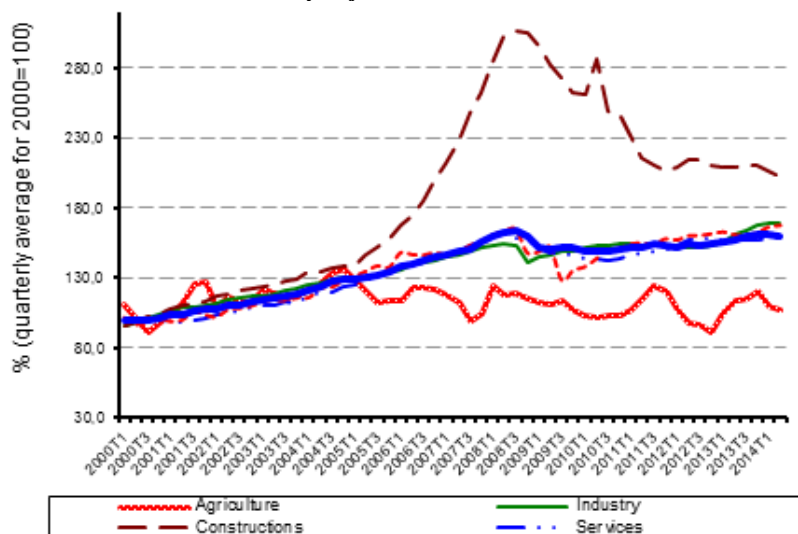
		1 <sup>st</sup> quarter	2 <sup>nd</sup> quarter	3 <sup>rd</sup> quarter	4 <sup>th</sup> quarter	Year
In % as against the corresponding period of the previous year						
Raw series	2014	104.3	101.7	103.2	102.8	103.0
	2015	104.3	103.4	103.6	103.8	103.8
	2016	104.3	106.0	-	-	-
In % as against the previous quarter						
Seasonally adjusted series	2014	100.1	100.1	101.6	100.9	-
	2015	101.2	99.9	101.6	101.2	-
	2016	101.5	101.5	-	-	-

**Data source:** National Institute of Statistics, press release no. 249/07.10.2015.

The analysis will get a more significant outline if we follow the way in which the GDP developed in 2015 and the first two quarters of 2016.

Thus, in Semester I 2016, GDP grew by 4.3% as gross series (3.8% adjusted series) and in the second trimester grew by 3.8% gross series (3,4% adjusted series) as against the corresponding quarter of the previous year.

#### The GDP evolution – seasonally adjusted



**Data source:** National Institute of Statistics, Press release no. 249/07.10.2016.

For the first semester of 2015, the total volume of GDP, in current prices, counted 351,181.2 million lei. In the same period of 2016, GDP in current prices was 325,572.9 million lei.

- In 2015, as well as during the first six months of 2016, the GDP has been achieved on the account of the activity carried out in the frame of the main branches of the national economy.

The contribution differed from the point of view of the gross added value recorded at the level of each branch.

The net taxes on product brought in the first semester of 2016 a positive contribution, representing some 11.7% out of the GDP, the constructions increased by 0.2%, while the industry recorded an increase of 0.25%.

In 2016, for the first six months, the same trends persisted, with the mention that agriculture marked a slight recoil.

For the first half of the year 2016, there is slight increase to be noted for the economy evolution.

The agriculture kept on maintaining within normal parameters of influence, recording a slim evolution.

- We find out that, from the point of view of the utilizations, the GDP formation has been achieved by the contribution of the following factors: gross forming of the fixed capital, final individual consumption of population with a decrease of -0.4%, which implies the following two conclusions:
  - From the point of view of utilizations, positive influences on the GDP achievement have been recorded by the final collective consumption of the public administration, stocks variation and net exports.
  - Negative influences on the GDP forming have been recorded by the by the final individual consumption of households, and the gross forming of fixed capital.

The survey on the economic evolution, considering the modifications of the GDP in the European Union countries, emphasizes the extremely critical situation existing on the European and, at a larger extent, international level.

What is really important is the fact that the weight of the private sector in the achievement of the gross added value by branches of the national economy and, eventually, to the GDP forming, kept on maintaining at a high level.

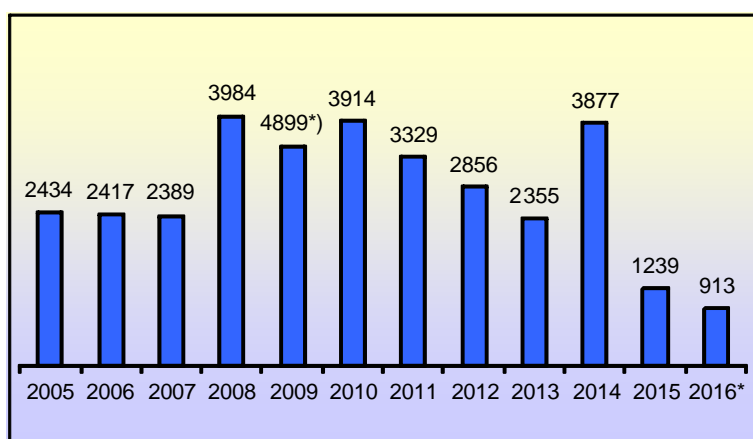
It is obvious that the privatization of other administrations or extending the privatization at the level of branches already privatized will have the targeted effect.

Here we have to underline the fact that such an analysis is not always pertinent since there will be and remain sectors of activity absolutely important for the national economy for which the state must keep its attributes of sole owner.

- The period 2015-June 2016 was one when a series of sectors of activity kept on getting privatized while those already privatized kept on increasing their patrimony (capitals) by attracting new autochthonous and foreign investments which, from the point of view of the effects on the national economy structure is an important aspect to consider.

#### Foreign direct investment in commercial companies

– million euro –



<sup>\*)</sup> data on seven months.

**Data source:** National Institute of Statistics, Statistical Bulletin no. 7/2016.

By the end of 2010, the direct investment of the Romanian residents abroad counted for 1,675 million euro, the contribution reaching 1,937 million euro in 2013, this being the contribution evaluated by the documentary system available in the country. In 2014 the attracted amount was 3,877.2 million euro, while in 2016, eight months, 913,887 million euro.

- An important element to consider when evaluating the economic evolution of a country over a period of time consists of the way the consumer prices developed, both on an overall basis and by groups of goods and services, as well as of the dual comparison with the planned, forecasted target and the outcomes of the previous year.

In the context of the steady concern as regards the adjustment of the system of the income collecting, based on the unique quota of taxation, as well as bringing the Fiscal Code to the level of correlative terms, in line with the actual situation of the country, in 2010-2016 there are a number of events occurring and worth to be outlined.

The essential phenomenon of the years 2010-2016 is given by the divergent evolution between the consumer price index, as an overall and in structure, in comparison with the evolution and appreciation of the national currency, the new leu, against the two currencies which are forming the foreign exchange basket, respectively Euro and USD. Since a couple of years, as a consequence of the policy run by the National Bank of Romania, which undertook the responsibility of targeting and fixing the inflation at certain levels, the foreign exchange evolution of the national currency followed a trajectory which, from an economic and financial point of view, proved to be a positive one but, meantime, generated a negative effect on the Romanian exports, or for those working abroad and those living in the country, being meantime non-conform with the actual economic situation of the country.

On this back-ground, during the period 2010-2016, we register also time intervals of slight appreciation of the national currency, in contradiction with the increase of the inflation rate, both on an overall basis and in structure by goods and services.

After 2013, a reverse trend of inflation evolution begins, kept under control, or decreased, due to the reduction of the Value Added Tax. Among the non-foodstuffs recording a high average increase there are the natural gas, the thermal energy, tobacco and cigarettes, electric energy, water – sewage – sanitation, hygiene and cosmetics, postal services, inter-urban transport.

#### Price increase in July 2016

– percent –

Indicators	Rise of consumer prices in July 2016, as against:			Monthly average rise of consumer prices during	
	June 2016	December 2015	July 2015	1.I- 31.VII. 2015	1.I- 31.VII. 2016
<b>Total</b>	<b>-0,2</b>	<b>-1,2</b>	<b>-0,8</b>	<b>-0,2</b>	<b>-0,2</b>
Foodstuff <sup>*)</sup>	0,0	0,3	1,3	-1,0	0,0
Non-foodstuff	-0,5	-2,0	-2,2	0,3	-0,1
Services	-0,1	-2,0	-0,9	0,2	0,0

<sup>\*)</sup> Including beverage.

**Data source:** National Institute of Statistics, Statistical Bulletin no. 7/2016.

At this point, there are a lot of other comments to be done but for a synthetic picture of the consumer price index we are holding present analysis only.

- On an overall basis, the industry kept on remaining on a positive position, meaning that it recorded a slight increase of the contribution to the GDP achievement during the period 2014-2016.

The privatization process could lead within the forthcoming periods to new decreases, both for the rhythm and the volume of the production of certain branches, but also of the total contribution which the industry might bring to the GDP achievement, by the obtained gross added value.

The labor productivity by an employee in the industrial field followed a slow increase trend over the period 2010-2016. In the first seven months of 2016, the resources of prime energy increased.

The evolution of the industrial production represents the sectors which have positively marked the evolution process during the period 2009-2016.

For 2014 and 2015, Romania recorded increases of the industrial production computed as seasonally adjusted series, a trend which was maintained in 2015 – June 2016 also.

If considering the distribution by large groups, the increase of the industrial production in Romania has been more marked for the group of the capital goods industry and significantly lower for the group of the current usage goods.

In 2012, 2013, 2014 and 2015 the industry followed a slightly growing trend.

However, these increases by groups have been counter-weighted the decreases recorded by the groups of current usage goods and durable goods.

The indices for the first half of 2016 have manifested increases in all months. The manufacturing industry, electric energy, gas and water, as major sections, on one side and the capital goods industry, the intermediary goods industry and the power industry on the other side, with important increases are responsible for the mentioned increases at the industry level.

The value indices of the new orders marked decreases in 2009, 2010, 2011 and 2012, and during the period 2013-2016 the trend reversed. In 2015 comparatively with 2014, the situation changed in respect of the new orders within the manufacturing industry from Romania, mainly in the situation of the manufacturing industry working on orders basis.

The labor productivity increased yearly over the period 2002 – July 2016, simultaneously with the decrease of the occupied population, so that during the first seven months of 2016, the productivity of labor grew by 2.3% (provisional data) per total industry.

- As well known, Romania is one of countries of the most pronounced agrarian profile from the European Union. Unfortunately, this character does not mean implicitly neither a corresponding contribution of the agriculture to the GDP forming, as already mentioned previously, nor a high level of efficiency as productivity level resulting

both out of the comparison of this sector with other sectors of our economy and, mainly, with the yields for various cultures and animal species recorded by the other European countries.

The same situation, if not even more underlined, is stated out when considering the yields for potatoes and rape, as well as for sun-flower, although the last one is not a significant culture for the other EU member states. Extremely significant are the statistics regarding the agricultural potential of the greatest agricultural producers from the EU, among which Romania is placed as well, considered from the point of view of the place and weight held within the total EU, as cultivated surfaces and production.

Thus, for wheat, Romania is holding the 4<sup>th</sup> place from the point of view of the cultivated surface, with a weight of 8.5% in total, accounting together with France, Germany and Poland, almost 50% of the total cultivated surface of the total EU.

But as far as the wheat production is concerned, Romania is holding the 7<sup>th</sup> place only, by three places lower than in the case of the surface, respectively with a weight of 3.7% of the total production of wheat of the EU. Together with France, Germany, Great Britain, Poland, Italy and Denmark, the weight in the production counts for over 75%. The corn production is by far more interesting, as Romania holds as surface, the 1<sup>st</sup> place with a weight of over a quarter (27.4%) in the total surface cultivated by the EU member states.

From the point of view of the corn production, we are holding the 2<sup>nd</sup> place only, after France, with 13.8%, whereof a gap as against the weight of over 50% in the cultivated surface.

A similar situation is stated out in respect of the animal effectives. Contrary to the situation in the past, when Romania counted among the first countries from Europe from the point of view of the effectives of bovines, porcine, ovine and goats, presently, with its about 2 million five hundred thousand bovine heads, Romania is slightly outrun by Belgium and in a significant manner, by France, Germany, Great Britain, Italy, Spain, Ireland, Poland and Holland. As to the porcine effectives, Romania is holding the 9<sup>th</sup> place only, after Germany, Spain and France. We manage to maintain ourselves on the 4<sup>th</sup> position of the top for ovine and goats only, after Spain, Great Britain and Greece.

The evolution of the agricultural branch in 2016 comparatively with 2015, is showing a stagnation, as a result of the increase of the same value recorded by the vegetal production, a little lower increase of the animal production and an increase of 2.7% of the agricultural services which, however, are not holding a significant weight.

On the other hand, splitting the land into small parcels and lack of any crop rotation whatsoever, lack of a proper quality seed as a general feature, are the factors counting as determinants for both the poor crops and their poor quality.

For those who, maybe, are not familiar with, we recall that ESU represents a unit of stable economic size at European level, through a relatively complex process of

estimating the value of different agricultural products (both vegetal and animal), namely an ESU equals to 1200 euro.

Counting for a very low number, of 0.1% only, the large agricultural exploitations of over 40 ESU per unit, generally agricultural exploitations with legal personality, are holding and utilizing over a quarter of the agricultural surface.

Another feature of the Romanian agricultural exploitations is given by carrying on combined activities of vegetal culture and animal breeding, their weight counting for about 20%.

- When analyzing the outcomes achieved by Romania in 2010 – June 2015, we find out that on an overall basis, the investment recorded a decrease as against the previous year, out of which the investment for equipment and conveyance means recorded the biggest reduction.

This means that through the imports the completion of the capital goods has been achieved, insuring thus the addition, by capitalization, of the companies' assets.

For all the three elements of the investments (works of new constructions, equipment and conveyance means and other expenditure) the trends are similar to that recorded for the overall picture, underlining however the fact that the construction works exceeded the trend recorded for equipment and conveyance means, for all the periods.

For the period 2014 – July 2016, the statistics are indicating a fluctuating evolution in respect of both the works categories (new constructions, capital repairs and current repairs), underlining the fact the overall dynamics is outrun by the new constructions, the types of constructions (residential buildings, non-residential, engineering constructions) where, similar to the previous years, a single type of constructions, i.e., residential buildings, is prevalently giving the production dimension.

The most significant decrease by semester has been recorded for the new construction works, as well as for the equipment and conveyance means. This development had repercussion on certain shifting which took place as regards the structure of the investments by branches.

A significant decrease of the weight has been recorded mainly as to the other branches of the national economy, excepting those already mentioned which, by its dimension, has annihilated the increase, some of them quite surprising, such as: construction branch.

- Comparatively to the year 2008, during the period 2009-2016, the indices of the market services supplied to the population, as well as the indices of the retail trade have recorded a decrease.

This decrease is generated by the domestic demand (an element of the GDP utilization), which recorded an underlined decrease generated by the income reduction.

Meantime, the services reached a significant weight in the GDP, out of which the retail trade only recorded a slow rhythm.

The services contribution to the GDP achievement by the gross added value achieved in the frame of this sector means a positive development which, at this stage of the integration, means a lot for Romania.

Out of the analysis of the structure of the carried out services activities, we note the fact that the retail trade recorded diminished rhythm of increase.

But, as from 2012 on, the services production showed a significant increase.

The dynamics of the services carried out to the population has been supported mainly by the activity of hotels and restaurants, which recorded no increase.

Briefly, 2015 is a significant year as far as the production of services is concerned, by the following major guide marks: the increase of the weight services hold as for the GDP achievement; the structural balancing of the services carried out to the population; differentiated decreases, for certain fields as already mentioned, quite significant, of the production of services spread on various zones, reflecting in fact the cynical effects of the economic crisis; the employment of a large number of persons in activities of carried out services, which tendency should mark a similar evolution during the forthcoming period; maintaining the quality of the services carried out to the population; diminishing of the hotel activity; exceeding a high weight of the contribution which the production of services brings to the GDP achievement; there has been a development of the financial and banking services as well as of capital market service, including thus a series of employees.

Another aspect concerning the analysis in the field of the production of services in our country is given by the volume of the turnover figure achieved by the wholesale and retail trade of auto-vehicles, the retail trade with fuel etc.

Generally speaking, the turnover figure decreased for all sectors of activity, as a consequence of the alarming cut off of the population income. In 2013, a slight upward trend is noticed, which becomes more stressed during 2014-2015 and the first six months of 2016.

The negative rhythm of departures has accentuated in 2011, 2012 and 2013, with a slight increasing rate in 2014, 2015 and the first six months of 2016.

The index of the net utilization of the accommodation places in July 2016 counted for 42.5% of the total structures of touristic accommodation, increasing by 4.1 percentage points as against the month of July 2015.

Out of the total number of benighted, the benighted of the Romanian tourists in the structures of touristic reception with accommodation functions represented, during the period 1.01-31.07.2016, 79.9% while the foreign tourists benighted represented 20.1%.

As far as the benighted of the foreign tourists in the structures of touristic reception, the bigger weight has been held by those originating in Europe (72.8% of the total foreign tourists), out of which 83.5% were coming from European Union countries.

The average duration of the sojourn during the period 1.01-31.07.2016 was of 2.4 days for the Romanian tourists and 2.0 days for the foreign tourists.

Higher indices of utilization for the accommodation places during the period 1.01-31.07.2016 have been recorded by hotels (33.6%), accommodation facilities on ships board (22.6%), touristic villas (20.1%) and hostels (19.6%).

The departures of the Romanian visitors abroad, registered at the *border points*, during the period 1.01-31.07.2016, counted for 8458.8 thousand, increasing comparatively with the period 1.01-31.07.2015.

- From the point of view of the weight of the main groups of goods out of the combined Classified List, in the overall export operations for active processing, the main weights went to: clothes articles made out of knitted and crocheted, textile materials, mechanical equipment and machinery, electric apparatus for recording and reproducing sound and images, shoes and similar items, conveyance means and materials, metallurgical products.

The commercial balance deficit (FOB/CIF) during the period 1.I – 31.VII.2016 counted for 4467.4 million lei, by 561.0 million euro bigger than the one recorded for the period 1.I – 31.VII.2014.

On an overall basis, we can appreciate that the foreign trade activity did develop negatively from the point of view of the volume but negatively as well as considering the two components, import and export.

Along with the effects of the economic and financial crisis, another element which generated a slower rhythm of evolution of the exports and imports, consists of the fact that the process of privatization and restructuring involved the closing-up of a number of companies or autonomous State supervised administrations, as well as of the fact that the quality of the manufactured products was not in the position to meet the foreign customers requirements.

The evolution of the number of exporters and importers during the period 2006-2015, a period which grasps the effect of the adhesion of Romania to the European Union, since January 2007 on, consisting of a significant increase of their number.

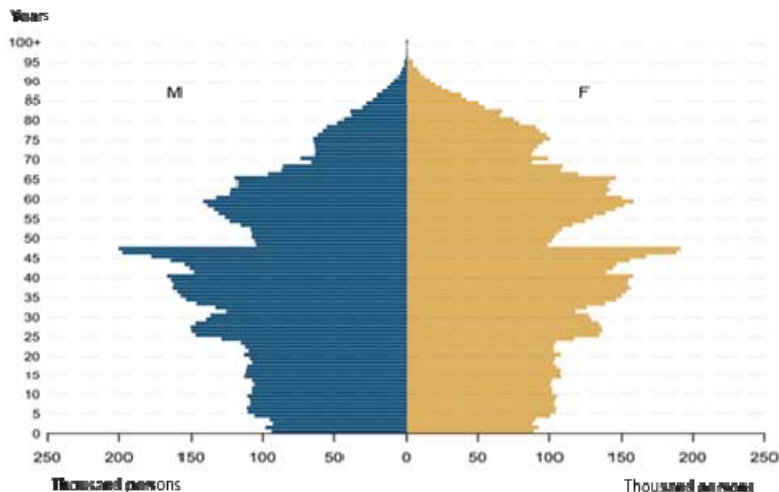
To note that the weight of the exports and imports of agro-alimentary products (including beverage and tobacco) in the total exports, respectively imports, has decreased during the first six months of 2016 by about 0.9% in the exports case and by about 2.0% in the case of imports.

In the case of the agro-alimentary products imports, beverage and tobacco the main commercial partners from the European Union are the following: Hungary, Germany, Bulgaria, Holland, Italy and Poland.

- The occupied population includes all persons – both employees and freelancers – who develop a productive activity within the production limits of the European Accounts System, and counted 8.53 millions of people by the end of 2015.

By January 1<sup>st</sup>, 2015, the resident population counted for 19,861 thousand persons, by 85.9 thousand persons less as against January 1<sup>st</sup>, 2014. The main cause of this decrease consists of the negative natural growth (- 69,522 persons).

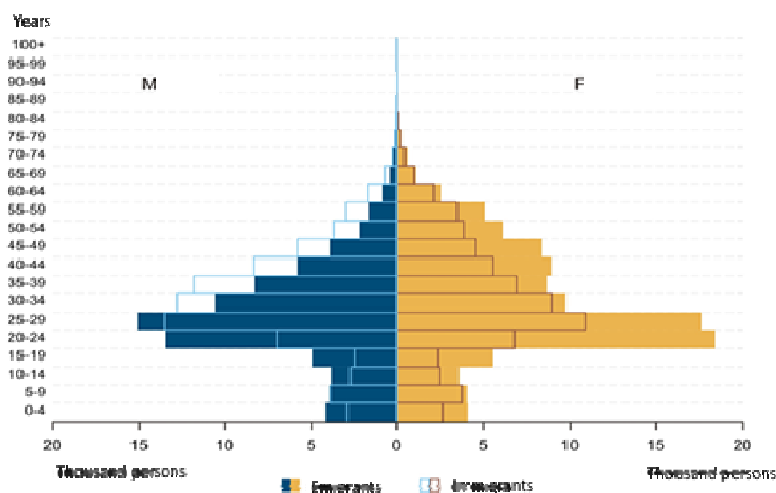
#### The resident population by sex and age, January 1<sup>st</sup>, 2015



Data source: National Institute of Statistics, Press release no. 249/07.10.2015.

Romania keeps on being a country of emigration. The sold of the international migration for the year 2014 was negative, the number of emigrants exceeding the number of immigrants with 42 thousand persons. During the year 2014, as well as in 2013, the female population emigrated at a higher proportion in comparison with the male population (56.8%). As to the immigrants, the male incomers were in a majority (55.1%).

#### The international temporary migration of long duration, by sexes and age groups, in the year 2015



Data source: National Institute of Statistics, Press release no. 249/07.10.2015.

This number differs significantly from the one of employees that is currently operated with. It includes the number of employees determined in compliance with the accounts, that take into consideration, both data sources used to determine the cost of labor force occupation, such as the Survey on labor force in households (AMIGO); the Inquiry regarding the cost of labor force (S3); Annual structural survey in enterprises (ASA); and also administrative data sources (information provided by the Ministry of Foreign Affairs, Ministry of Labor, Family and Equality of Chances, Ministry of Interior and Administrative Reform etc.); accounting situations of commercial companies. We state that the number of employees includes those working in the hidden economy, established according to the computation methodology.

Another category is represented by the independent workers (freelancers), they being the sole owners or co-owners of the entities without judicial personality they work in. In this category, can also be included: family workers, non-paid and home workers that manufacture for market; workers that exert, both individually and collectively, productive activities regarding exclusively the final consumption or formation of capital on their own account.

The occupied population, according to the SEC methodology, is the sole indicator that indicates the human potential of the occupied labor force that can be used to determine the social productivity of labor as a ratio between the GDP and the occupied population.

Real hourly productivity marks, in principle, the same evolution as the real productivity per occupied person.

In the analysis of the occupied population, it can be observed the percent evolution of the structure occupied regarding the great employees categories and individual entrepreneurs.

In this context, according to the European Account System edition 1995 also, the employees hold a weight of some 70% out of the occupied population.

The indicator occupied population of Romania compared to other countries proves a concerning discrepancy in negative way and where we think the attention of decisional factors must be focused. These statistics do not take into account the financing form, their purpose being to provide information on economic activities, according to CAEN Rev.2.

During the period 2010-2015 the number of employees decreased.

Also, declines in the effective of employees recorded in the public administration units can be found in the secondary activities developed by these entities: cultural, sport, and recreational activities, landscape design and services for buildings, agriculture, water supply, sanitation, waste management, de-contamination, constructions, transport and storage, production and supply of electrical and thermal energy, gases, hot water and air conditioning, lease and sub-lease of real estate goods etc.

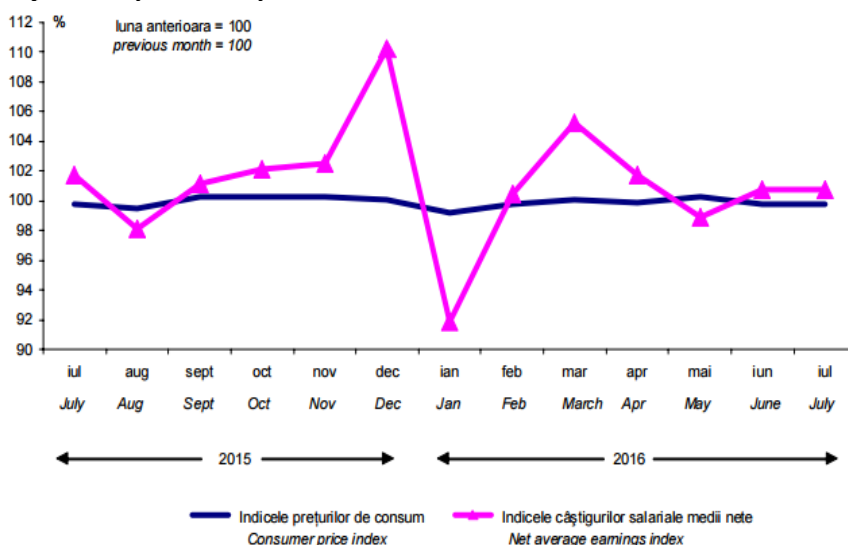
As for the evolution of average monthly net salary gains during the period 2009-2016, they were characterized, mainly, by declines from one month to another, excepting the months when annual and occasional premiums were granted, according to the national law, sums from other funds.

After October 2013, all the activities of the budgetary sector recorded wage increases due to the payment of the occasional premiums (inclusive the vacation bonuses), of the sums of other funds (inclusive for the previous periods), of the holding of a plurality of offices connected to the didactic personnel, as well as to the payment of the additional working time registered in some of the sanitary units.

Meantime, the increase of the wage gain has been influenced also by the dismissal of the personnel with low salaries from this sector.

Comparatively with October 1990, the index of the real salary gain counted for 140.1%, by 2.6 percent points higher than the one recorded for June 2016.

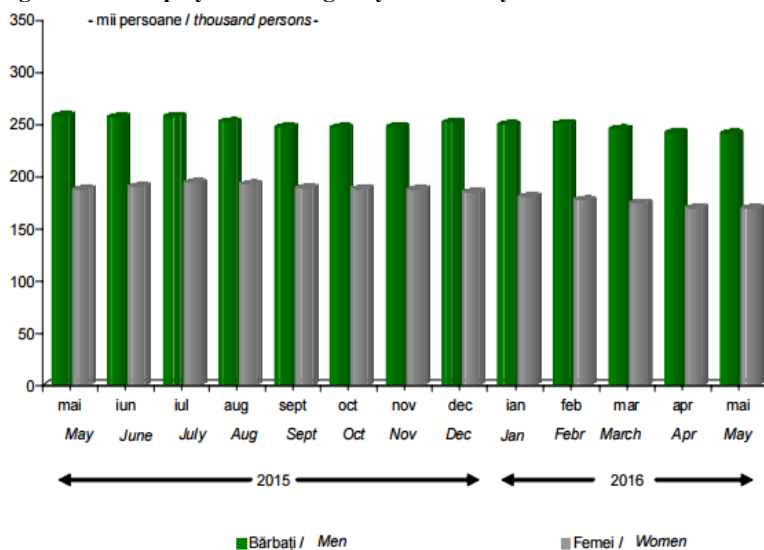
**The evolution of the consumer prices indices and of the indices of the average net salary gains, during the period July 2015 – July 2016**



**Data source:** National Institute of Statistics, Statistical Bulletin no. 7/2016.

In July 2016, for the majority of the activities of the economic sector, the level of the average net salary gain was higher than the one recorded for the previous month, as a consequence of the enforcement of the legal provisions as regards the setting up of the minimum basic gross salary, guaranteed for payment, of the granting of occasional premiums (inclusive bonuses for holydays and particular performances), of sums out of the net profit and other funds (inclusive meal tickets and gift tickets), but also a result of the production achievements or bigger receipts (depending on contracts).

In July 2016, the unemployment rate in its seasonally adjusted form counted for 4.1%. The unemployment rate in July 2015 kept the same level as that recorded for the previous month. The unemployment rate for men is exceeding by 1.2 percent points the one recorded for women.

**Registered unemployment during May 2015 – May 2016**

R – revised data, P – provisional data.

**Data source:** National Institute of Statistics, Statistical Bulletin no. 7/2016.

By sexes, the unemployment ratio for men is by 2.2 percentage points higher than the one for women (the values being 7.8% for men and 5.6% for women).

**Unemployment rate by sexes**

– % –

	2014						2015						
	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July
Total													
15-74 yrs	6.8	6.8	6.7	6.7	6.7	6.6	6.9	6.9	6.8	6.8	6.8	6.8	6.8
25-74 yrs	5.5	5.4	5.4	5.3	5.4	5.2	5.5	5.5	5.4	5.6	5.6	5.6	5.6
Men													
15-74 yrs	7.3	7.3	7.1	7.1	7.1	6.9	7.5	7.5	7.4	7.6	7.6	7.6	7.8
25-74 yrs	6.0	5.9	5.8	5.8	5.8	5.7	6.1	6.1	6.1	6.4	6.4	6.4	6.5
Women													
15-74 yrs	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.0	6.0	5.8	5.8	5.7	5.6
25-74 yrs	4.8	4.8	4.8	4.7	4.8	4.7	4.7	4.7	4.6	4.6	4.5	4.4	4.4

**Data source:** National Institute of Statistics, Statistical Bulletin no. 7/2015.

For adult persons (25-74 years), the unemployment rate was estimated as 5.6% for July 2015 (6.5% in the case of the men and 4.4% for women), out of the total number of unemployed estimated for July 2015.

The social security pensioners hold the majority (99.9%) of the total number of pensioners. The social security pensioners represent 88.2% of the total number of those of social security pension. By categories of pension, the number of the pensioners of age limit was preponderant (73.8%) in the frame of the category of the social security pensioners. The pensioners included in the categories – anticipated pension and partially anticipated – represented 2.1% only.

### Conclusions

In this paper, the authors have outlined the major evolutions recorded by the economy of Romania. The research followed the macroeconomic fields: Gross Domestic Product, investments, inflation and prices, foreign trade, evolutions in industry, agriculture, services, the population and labor force.

In the first semester of 2016, the main indicator of the Romanian economy has recorded increase on both gross and adjusted series. The upward trend was observed on the both trimesters of the semester. A significant and favorable contribution on the evolution of the Gross Domestic Product corresponds to the net taxes, while less major, but still positive influences were recorded for constructions and industry.

The weight of the private sector is still as an elevated level, even if the state, by virtue of its functions must maintain ownership on some economic branches and companies. From the viewpoint of foreign direct investments, the data on seven month published by the National Institute of Statistics of Romania present favorable ground to make optimistic forecasts for the entire year, as there can be expected a visible increase of this indicator.

The consumer prices were affected by the increase of the inflation main measurement indicator, which is the inflation rate, both as total indicator and calculated by goods and services, even if the Romanian leu has appreciated across the last years.

It is also a positive conclusion the fact that the industry has recorded increases in the recent years, together with the likewise positive influence of this branch on the Gross Domestic Product. The decline of occupied population was compensated by the increase in productivity.

The Romanian economy has a significant agricultural component, but this does not reflect in the contribution of the agriculture on the national GDP. The place our country holds from the viewpoint of resources is not matched by the positions occupied in the results-based hierarchies. The vegetal production was constant, but the agricultural services had a slight increase.

The share of services in the Gross Domestic Products emphasizes the importance of this sector on the economy of Romania and offers good perspectives for future evolutions. However, a less positive dynamic was recorded in the case of services-related turnover, with decreases both on aggregated level and by sectors, in correlation with the decrease of population incomes.

The foreign trade activities recorded negative indicators for the analyzed period, outlined at first by the deficit of commercial balance, greater than the level reach for the previous period. In the last ten years, the number of exporters and importers increased.

As mentioned before, the labor force indicator that measures the occupied population decreased. A phenomenon that is found among the causes of this negative trend is the international migration of Romanian workers. A significant share of occupied population is represented by freelancers. During the first half of 2016, the net average earnings index experienced an oscillatory trend, with a major peak in March and a sizable decrease in May (without considering the comparison between January and December 2015).

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## Foreign aid, macroeconomic policies and economic growth nexus in India: An ARDL bounds testing approach

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**Abstract.** *The purpose of this paper is to examine the effectiveness of foreign aid on economic growth in Indian economy using annual data from 1970 to 2014. The co-integration test confirms a long run relationship between real GDP per capita and foreign aid for India. The study finds a positive and significant impact of foreign aid on economic growth in India both in long run and in short run. Our results provide strong evidence that effectiveness of foreign aid on economic growth is contingent on macroeconomic policy environment in India. The VECM results confirm short-run and long run unidirectional causality running from foreign aid, government expenditure and trade openness to economic growth in India. Further, the results of the variance decomposition approach indicate that economic growth in India mostly explained by foreign aid. Further, the impulse response function result indicates that there is positive response in economic growth due to shock stemming in foreign aid. The findings and the results are useful guidelines for major stakeholders, including donors and the government of recipient countries for designing framework for aid effectiveness.*

**Keywords:** Foreign Aid, Economic growth, India, ARDL, VECM.

**JEL Classification:** C01, C51, E13, F03, F35.

## 1. Introduction

Developing countries are no doubt characterized as capital resource constraint economies. This much needed capital to boost economic growth and welfare is largely inadequate domestically, which consequently deserves the need for external capital. Foreign aid is a significant source of external income to developing countries. Foreign aid has a potential to play a key role in promoting developing countries' economic growth. It has emerged as a dominant strategy for alleviating poverty in developing nations. Yet it seems that the developing countries of the world continue to suffer from economic hardship, raising questions of whether foreign aid is a worthwhile and effective approach to boost growth and development in recipient economies. This question has attracted the attention of many scholars over several decades.

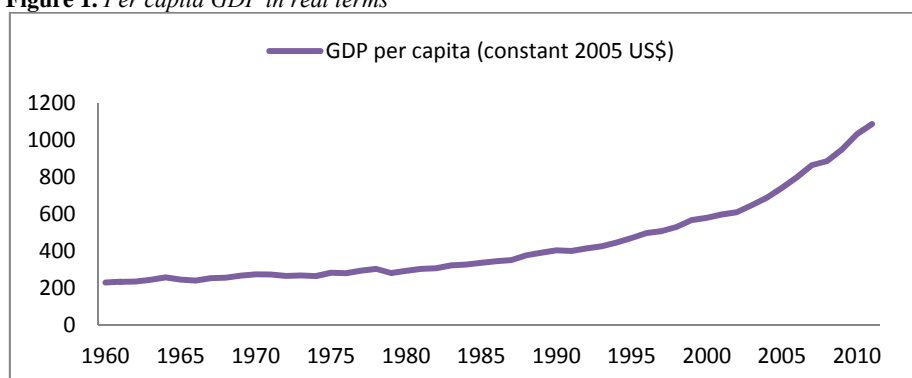
As Morrissey (2001) points out (a) aid increases investment, in physical and human capital; (b) aid increases the capacity to import capital goods or technology; (c) aid does not have indirect effects that reduce investment or savings rates; and aid is associated with technology transfer that increases the productivity of capital and promotes endogenous technical change. According to McGillivray et al. (2006), four main alternative views on the effectiveness of aid, namely; (a) aid has decreasing returns, (b) aid effectiveness is influenced by external and climatic conditions, (c) aid effectiveness is influenced by political conditions, and (d) aid effectiveness depends on institutional quality.

The empirical evidence on the role of foreign aid in the growth process of developing countries obtained from extensive studies has been mixed. For example (Papanek, 1973; Levy, 1988; Islam, 1992; Hansen and Tarp, 2000; Burnside and Dollar, 2000; Gomanee et al., 2003; Dalgaard et al., 2004; Karras, 2006) find evidence for positive impact of foreign aid on growth, (Easterly, 1999; Burnside and Dollar, 2000; Brautigam and Knack, 2004) find evidence for negative impact of foreign aid and growth, while (Mosley, 1980; Mosley et al., 1987; Boone, 1996; Jensen and Paldam, 2003; Rajan and Subramaniam, 2005; Williamson, 2008) find evidence to suggest that aid has no impact on growth. It should be noted that, although Burnside and Dollar (2000) concluded that foreign aid has positive effects, this conclusion applies only to economies in which it is combined with good fiscal, monetary, and trade policies. A study by Doucouliagos and Paldam (2009), using the meta-analysis covering 68 papers containing a total of 543 direct estimates, it is found that the effect of aid on growth estimates scatter considerably and add up to a small positive, but insignificant, effect on growth. By and large, the relation between aid and economic growth remains inconclusive.

Foreign aid takes many forms. The most important in terms of its size and influence is Official development assistance (ODA) provided by the Development Assistance Committee (DAC) of the Organization for Economic Cooperation and Development (OECD). ODA is calculated as the sum of grants and loans to aid recipients' countries that; (a) are undertaken by the official sector of the donor country; (b) have the main objective of promotion of economic development and welfare in recipient countries; and (c) are on concessional financial terms (i.e., with a grant element equal to at least 25 per cent of the total). In addition to these financial flows, technical co-operation costs are also

included in ODA. The items that are not included in ODA are: grants, loans and credits for military purposes, transfer payments to private individuals, donations from the public, commercial loans and foreign direct investment (FDI). India's widely seen success stories of globalization, has significantly accelerated its economic growth since the inception of economic reforms in 1991 (Basu, 2008; Panagariya, 2010). The country is one of the fastest growing economies in the world and hosts some of the largest foreign investment inflows in recent years (UNCTAD, 2010). Figure 1 shows that per capita GDP has remained almost constant ranging between the periods 1960 to 1980. After that, real per capita GDP shows an upward trend over the rest of the period.

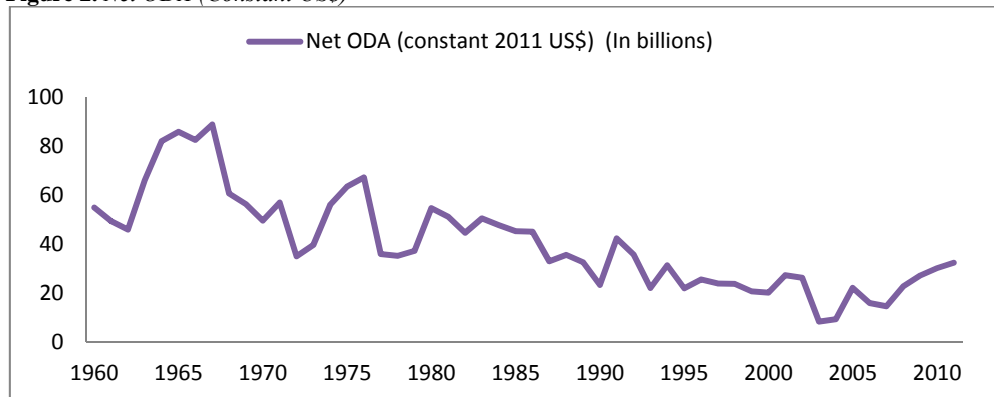
**Figure 1.** *Per capita GDP in real terms*



**Source:** World Bank, database.

It is not surprising to note that despite its rapid economic growth in recent years, India still receives development aid. Among developing countries, India continues to be one of the largest recipients of foreign aid. In 2009, the total net ODA, received by India from all donor countries was about US\$ 2.502 billion, of which US\$ 1.578 billion was in the form of net bilateral aid flows from countries organized in the Development Assistance Committee (DAC) (OECD, 2012). At US\$ 630 million, India is still the single largest recipient of development aid from the United Kingdom (OECD, 2012). Moreover, India also receives a substantial amount of aid from international NGOs. For example, in 2010, the Bill & Melinda Gates Foundation committed US\$ 100 million to India (OECD, 2012).

Figure 2 shows that ODA to India has been fairly sporadic with dips in contributions over the period under consideration. The peak from 1965 - 1980 was a response to India's economic problems mostly due to Indo - Pak war and its consequences which resulted in a request to the IMF for a greater ODA. Subsequently, ODA has been relatively constant since the early 1980s. The average annual disbursement of aid to India in the first half of the 1990s was close to 2.9 billion dollars. After the introduction of the economic reforms period spanning from 1992 onwards there has been decrease in ODA till 2003-2004 followed by a rise and then another fall in 2006 and 2007. Again, it has increased due to the financial crisis that has also affected the Indian economy, which required further assistance from the external sector.

**Figure 2.** Net ODA (Constant US\$)

Source: World Bank, database.

Unsurprisingly the top five government donor's total contributions over the last 11 years have been from UK, Japan, EU, Germany and the United States (US), the five donors with bilateral programmes from 2003. Even before the decision was taken to limit bilateral aid the UK funded a considerable proportion of aid to India, for example 18% in 2002. This proportion rose to 46% and 43% in 2003 and 2004 respectively before settling at figures between 22% and 31% over the next six years. Over the period 2000 to 2010 the UK has given 23% of all aid. In 2010 however, Japan gave the largest amount of aid to India, US\$939.3 million (more than US\$300 million more than the UK) representing 34% of the total for that year.

**Table 1.** Top three donors of India's official development assistance (ODA), 2000-2010

Top three donors	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
1 UK	265.0	232.3	427.5	365.8	356.7	551.5	318.8	416.0	536.7	630.3	636.7	4737.3
UK %	14	9	18	46	43	27	22	31	26	25	23	23%
2 Japan	383.2	629.2	613.9	381.1	-90.7	81.5	35.9	123.8	658.6	517.0	939.3	4272.7
Japan %	21	25	26	48	-11	4	2	9	32	21	34	21%
3 EU	108.1	152.4	164.0	84.2	172.4	226.2	245.4	93.9	119.2	98.9	98.3	1562.9
EU %	6	6	7	11	21	11	17	7	6	4	4	8%

Source: OECD DAC, constant 2009 prices, excluding debt relief, in US\$ million and as a proportion of ODA from all donors.

There is no significant study regarding the aid effectiveness on economic growth by using modern econometrics technique for India. Specifically, no known study has used the autoregressive distributed lag (ARDL) approach to examine this relationship. There is a need to fill this gap in literature. Hence, the objective of this paper is to shed light on the issue by using ARDL approach to investigate the linkage among foreign aid, macroeconomic policies and economic growth in the context of India. The aim of the paper is to examine the effectiveness of foreign aid (or more explicitly ODA) on economic growth in India. More specifically, an attempt is made to ascertain whether effectiveness of foreign aid on economic growth is contingent on macroeconomic policy environment in India. The outcome of the study will provide useful insights into the role of foreign aid,

macroeconomic policies and will help the policy makers to address the issue of aid effectiveness in developing countries like India.

The remainder of the paper is structured as follows; Section 2 presents the theoretical perspectives and review of empirical literature. Section 3 outlines the model specification, data issues, econometric methodology used in the study. Section 4 analyses the empirical results of the study and Section 5 presents the concluding remarks and policy implications.

## 2. Literature review on aid-growth relationship

### 2.1 Theoretical perspective

The earlier work on the relationship between foreign aid and economic growth were persuaded by the early growth theories, which suggested that aid is considered to be the driving force for economic growth through capital accumulation in the recipient country. Conventionally, the most important limitation to the economic growth of developing countries despite having surplus labour, there is lack of savings which is crucial for investment. Additionally, low per capita income limits the capacity to generate saving for developing economies. The original Harrod-Domar model was expanded in the “two-gap” model of Chenery and Strout (1966). This model suggested that the first gap is between the amount of investment necessary to attain a certain rate of economic growth and the available domestic saving, whereas the second gap is between import requirements for a given level of production and foreign exchange earnings (Easterley, 2003). The developing countries cannot overcome the shortage of saving and foreign exchange earnings from their own resources. Thus, foreign aid could be used to promote the growth in developing countries by reducing saving-investment and export-import gap and eradicating the constraints of the original Harrod-Domar model (Papanek 1972, Newlyn 1973).

Bacha (1990) added a third gap (in addition to savings and foreign exchange gaps) – the fiscal gap to this model of aid-growth. The basic argument argued that all aid was used as a net increment to the capital stock. Another group of economists, Rahman (1967), Griffin (1970), Griffin and Enos (1970) and Weisskopf (1972) argued that that if the cost of foreign resources (in the form of concessional loan and grant aid) is lower than the marginal rate of return, then only these resources would be preferred substitutes for domestic resources (savings).

Further, in recent years, literature on aid effectiveness on the stable macroeconomic policies of the recipient countries has been stressed to make aid more effective for economic growth. The World Bank also stressed on supportive macroeconomic framework for successful structural adjustment. It can be viewed that macroeconomic stability and fewer distortions make capital inflow more effective. Distortionary macroeconomic policies reduce the efficiency of capital investment and the rate of economic growth (World Bank, 1990). Hudson and Mosley (2001) mentioned two reasons for the inclusions of policy variables in the original model. Firstly, there is a possibility that countries with good policy environment would grow faster, regardless of

the changes in the factors of production. Secondly, there is a possibility that in the presence of a good policy environment, credit is transmitted into investment. Hence, empirical investigations are required to establish the foreign aid-economic growth nexus taking into account macroeconomic policies in recipient developing countries.

## 2.2. An overview of empirical literature

There seems to be extensive work examining the direction between aid and growth. As earlier mentioned, the results from these various studies are mixed. On the one side, World Bank research finds that aid effectiveness is contingent on the macroeconomic policy environment of the recipient. Aid is effective at spurring growth in countries with good policies but has little impact in countries with poor policies. This view was supported by: Burnside and Dollar, 2000; Collier and Dollar, 2002; Collier and Dehn, 2001; Collier and Hoeffler, 2002. On the other side of the debate, researchers argue that aid works irrespective of the policy environment (Hansen and Tarp, 2001; Lensink and Morrisse, 2000; Guillaumont and Chauvet, 2001; Dalgaard and Hansen, 2001; Hudson and Mosley, 2001; Lu and Ram, 2001). Implicit, in the debate is the issue of aid selectivity. Advocates of the World Bank research argue for a re-allocation of aid in favor of countries with good policies and a policy of selectivity is currently being embraced by many bilateral and multilateral aid donors. However, a policy of selectivity is unfounded and unnecessary if aid works irrespective of the policy environment. The debate has been driven by the results from cross-country regression analysis.

Hansen and Tarp (2000) reviewed 72 studies that estimated aid-growth relationship. 40 out of those 72 studies showed a positive relationship between foreign aid and economic growth while 31 studies did not find any significant impact. Only one study showed a negative aid-growth nexus. They also claimed that such positive impact of aid came through increased savings. Thus, it can be argued that foreign aid helps to increase economic growth in developing countries by relieving the savings constraint. A study conducted by McGillivray (2005) demonstrates how aid to African countries not only increases growth but also reduces poverty. He points out the important fact that continuously growing poverty, mainly in sub-Saharan African countries, compromises the MDGs (Millennium Development Goals) main target of dropping the percentage of people living in extreme poverty to half the 1990 level by 2015. His research econometrically analyzes empirical, time series data for 1968-1999, concluded that the policy regimes of each country, such as inflation and trade openness, influence the amounts of aid received.

Addison et al. (2005) examine trends in official aid to Africa over the period 1960 to 2002. The authors largely emphasize the tremendous decrease in aid over the last decade, which will have an impact on Africans living in poverty and the African economy as a whole. This paper concludes that aid promotes growth and reduces poverty. It also positively impacts public sector aggregates, contributing to higher public spending and to lower domestic borrowing. Gomanee et al. (2005) address directly the mechanisms via which aid impacts growth. Using a sample of 25 Sub-Saharan African countries over the period 1970 to 1997, the authors determined that foreign aid has a significant positive effect on economic growth. Furthermore, they identified investment as the most

significant transmission mechanism. This paper concludes that on average, each one of percentage point increase in the aid/GNP ratio contributes one-quarter of one percentage point to the growth rate. Karras (2006) investigates the correlation between foreign aid and growth in per capita GDP using annual data from the 1960 to 1997 for a sample of 71 aid-receiving developing countries. This paper concludes that the effect of foreign aid on economic growth is positive, permanent, and statistically significant.

By using a simultaneous-equation model, Burke and Ahmadi-Esfahani (2006) did not find sufficient evidence to conclude that aid had a significant effect on the economic growth in Thailand, Indonesia and the Philippines during 1970 to 2000. A study by Doucouliagos and Paldam (2009), using the meta-analysis covering 68 papers containing a total of 543 direct estimates, found that the effect of aid on growth estimates scatter considerably and add up to a small positive, but insignificant, effect on growth. Mallik (2008) predicted negative effect of aid on economic growth while investigating long run and short run relationship between foreign aid and log of real GDP per capita in 6 Sub-Saharan countries using cointegration technique 5 out of 6 countries had a significant and negative long run effect of aid on economic growth. In the short run, foreign aid seemed to have no significant impact on growth of real GDP per capita in most of these Sub-Saharan economies except Nigeria.

While a large set of literature attempts to identify the aid-growth relationship, very few examine this issue for South Asian countries. Dhakal et al. (1996) examined three South Asian countries: India, Nepal and Pakistan, applying Granger Causality test in these countries for the period 1960 to 1990. Growth effect of aid was found to be positive and significant in India and Pakistan. Otim (1996), however, implicitly observed a positive relationship between aid and growth through government fiscal behavior in three South Asian countries: Pakistan, India and Sri Lanka. The apparent failure for observing any clear link between aid and growth may be attributed to several factors including small set of sample and mis-specified model that limit the effectiveness of these studies. Hence, inconclusive results on aid-growth relationship in South Asia demand for further investigation. A paper by Asteriou (2009) used a panel data set for five South Asian countries to investigate the aid-growth relationship for a period ranging from 1975 to 2002. Using both panel Mean Group (MG) and Pooled Mean Group (PMG) approaches, Asteriou found a positive aid-growth relationship in this region.

The debate so far has been driven by the results from cross-country regression analysis. Surprisingly very few studies have investigated the issue of aid effectiveness for individual aid recipients using time series data. This is surprising since the impact of aid is likely to be recipient country specific.

By using time series data from 1972 to 1988, Islam (1992) suggested a weak positive relationship between aid and growth in Bangladesh. Although grants and food aid were found to be more effective than community and project aid; however, in general, foreign resources seemed to have less impact on growth compared to domestic resources. This conclusion deserves careful consideration for two reasons. First, the period in Islam's study was short for time series analysis and second, Islam himself mentioned that estimated coefficients suffered from collinearity and specification problem. Khan and

Rahim (1993) focused on the effectiveness of aid in increasing GNP growth in Pakistan from 1960 to 1988. Although aid did not have immediate impact on GNP growth; one year lagged value of aid variable produced positive and significant growth impact. These results contradicted with Shabbir and Mohammed (1992) who earlier found a positive aid-growth relationship in Pakistan. According to Mahmood (1993), insignificant results of Khan and Rahim (1993) might be due to mis-specification of their model.

Gounder (2001) investigate the effectiveness of foreign aid for the case of Fiji for the period 1968 to 1996. He used Autoregressive Distributed Lag approach to co-integration to estimate the models. The results show that total aid flows and its various forms i.e., bilateral aid, grant aid and technical cooperation grant aid, has a significant impact on economic growth in Fiji. Lloyd et al. (2001) investigate the effectiveness of foreign aid for the case of Ghana for the period 1970 to 1997. The study finds that aid contributes to long-run growth in private consumption and that policy reform enhanced the effectiveness of aid. Quartey (2005) focuses on innovative ways of making financial aid effective in Ghana. The author concluded that mainly multi-donor budgetary support could be successful, but only if the government of Ghana and its partners plan better and coordinate their efforts.

Mavrotas (2002) focused on the effectiveness of aid on growth for India. He derived a reduced form growth equation for the period 1970 to 1992. He found that policies have an impact on aid effectiveness in India. The study supported the finding that aid contributes to long-run growth in private consumption and that policy reform enhanced the effectiveness of aid. Ouattara (2006) analyzes the effects of aid flows on key fiscal aggregates in Senegal for the period of 1970-2000. The author determined three main outcomes of his study. Firstly, a large portion of aid flows, approximately 41%, was used to finance Senegal's debt and 20% of the government's resources are devoted to debt servicing. Secondly, the impact of aid flows on domestic expenditures is statistically insignificant, and thirdly debt servicing has a significant negative effect on domestic expenditure.

While there is mounting evidence that aid does contribute to growth, there is some dispute as to whether good policy is a necessary condition for aid effectiveness. To enhance our understanding of aid effectiveness, it is desirable to conduct study to assess the impact of aid on growth in a developing country like India by taking into account the policy variables.

### 3. Methodology and data

#### 3.1 Model specification and data issues

The main focus of the study is the issue of whether aid works better in the presence of good policy environment. In order to capture the effectiveness of aid inflow on growth in the presence of good policy, we incorporate the aid-policy interactive term in the growth model. The model specified for estimating the impact of foreign aid on economic growth

identifies capital and other key determinants of economic growth as commonly suggested in the growth-literature Kargbo (2012).

Following the underlying theory, to examine the role of aid on economic growth, we employ both time series estimation procedure by employing ARDL approach to co-integration.

The empirical model framed for aid-growth linkage is specified as:

$$LPGDP_t = \beta_0 + \beta_1 LODA_t + \beta_2 LPI + \beta_3 LGFCE + \beta_4 INF + \beta_5 LTOP + \varepsilon_t \quad (1)$$

Where, LPGDP represents the economic performance of an economy. It is defined by per capita gross domestic product. LODA is aid denotes foreign aid (ODA) as a share of GDP. LPI constitutes the summation of ratio of gross capital formation to GDP (GCF) and private sector credit to GDP (Kargbo, 2012), it represents the private capital domestic sources which is crucial source of capital in addition to aid to encourage economic growth.

Apart from these the variables the study makes use of three control variables, (1) government final consumption expenditure (GFCE) (Easterly and Rebelo, 1993) to include the effect of the fiscal policy; (2) consumer price index (CPI, base year = 2005); inflation (Fischer 1993) to capture the impact of monetary policy and (3) trade openness, which is (imports + exports)/GDP (Fenny 2005). Openness to trade is often hypothesized to raise growth through several channels, such as access to advanced technology from abroad, greater access to variety of inputs for production, and also broader markets that raise the efficiency of domestic production through increased specialization (Durberry et al., 2006). Edward (1998), for instance, uses a series of openness indicator of trade policy. In the present context, the ratio of total trade to GDP ratio is used as variable named (TOP) to proxy the trade openness in India.

In the present context, the study uses the annual data for the period 1970 to 2014. L implies that the variables have been transformed in natural logs. The data sources are; International Financial Statistics Yearbooks published by the IMF and World Bank Statistical Yearbooks.

### 3.2. Co-integration with ARDL

To empirically analyze the long run relationship and dynamic interaction, the model has been estimated by Auto regressive distributed lag (ARDL) co-integration procedure developed by Pesaran et al. (2001). The procedure is adopted for following reasons. First, the bound test is simple as opposed to other multivariate co-integration technique such as Johansen and Juselius (1990), it allows co-integrating relationship to be estimated by OLS once the lag order is selected. Second, the bound test procedure does not require the pre testing of the variables included in the model for unit root unlike other techniques, such as Engle and Granger (1987). These approaches require that all the variables to be integrated of the same order (I(1)). Otherwise, the predictive power will be lost (Kim et al., 2004; Perron, 1989, 1997). However, ARDL technique is applicable irrespective of whether regressor in the model is I (0) or I (1). The procedure will however crash in the presence of I (2) series. Third, the test is relatively more efficient in small sample data sizes as is the case of this study. Fourth the error correction method integrates the short

run dynamics with long run equilibrium without losing long run information. The inclusion of dynamics helps in the correction of endogeneity bias (Pesaran and Pesaran, 1997). This methodology is the appropriate one, as foreign aid has been largely argued to be endogenous. The unrestricted error correction model (UECM) of ARDL model is used to examine the long run & short run relationship take the following form.

$$\begin{aligned} \Delta LPGDP_t = & \delta_0 + \delta_1 C + \delta_2 LODA_{t-1} + \delta_3 LPI_{t-1} + \delta_4 LINF_{t-1} + \delta_5 LGFCE_{t-1} + \delta_6 LTOP_{t-1} + \\ & \sum_{i=1}^q \alpha_i \Delta LODA_{t-i} + \sum_{i=1}^q \beta_i \Delta LPI_{t-i} + \sum_{i=1}^q \mu_i \Delta LINF_{t-i} + \sum_{i=1}^q \sigma_i \Delta LGFCE_{t-i} + \\ & \sum_{i=1}^q \omega_i \Delta LTOP_{t-i} + \varepsilon_t \end{aligned} \quad (2)$$

Where the series are as defined earlier and C is constant term and L implies that the variables have been transformed in natural logs. The first part of the equation (2) with  $\delta_2, \delta_3, \delta_4, \delta_5$  and  $\delta_6$  refer to the long run coefficients and the second part with  $\alpha, \beta, \mu, \sigma, \omega$  refers to the short run coefficients. The null hypothesis of no c0-integration  $H_0: \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = 0$  and the alternative hypothesis  $H_1: \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq \delta_6 \neq 0$  implies co-integration among the series (equation 2).

### 3.3. ARDL bound test procedure

The first step in the ARDL test is to estimate equation (2) by OLS in order to test for existence of a long run relationship among variables by conducting an F-test for the joint significance of the coefficients of the lagged levels of variables i.e.  $H_0$  (null hypothesis) as against  $H_1$  (alternative hypothesis) as stated earlier. Two asymptotic critical values bound provide a test for co-integration when the independent variables are I(d) where ( $0 \leq d \leq 1$ ); a lower value assuming the regressors are I(0) and an upper value assuming purely I(1) regressors of the F- statistics is above the upper critical values, the null hypothesis of no long run relationship can be rejected. Conversely, if the test statistics fall between the lower and the upper bound of critical values, the null hypothesis cannot be rejected. Further, if the calculated values lie between lower and upper bounds, the decision about the co-integration is inconclusive (Pesaran et al., 2001). In the second step, once the co-integration is established the conditional ARDL long run model for  $LPGDP_t$  can be estimated as:

$$\begin{aligned} \Delta LPGDP_t = & \alpha_0 + \sum_{i=1}^q \delta_1 LPGDP_{t-i} + \sum_{i=1}^q \delta_2 LODA_{t-i} + \sum_{i=1}^q \delta_3 LPI_{t-i} + \\ & \sum_{i=1}^q \delta_4 LINF_{t-i} + \sum_{i=1}^q \delta_5 LGFCE_{t-i} + \sum_{i=1}^q \delta_6 LTOP_{t-i} + \varepsilon_t \end{aligned} \quad (3)$$

This involves selecting the orders of ARDL ( $q, q_1, q_2, q_3, q_4$ ) models using SIC. The third and final step, we obtain the short run dynamic parameters by estimating an error correction model with the long run estimates. This is specified as below:

$$\begin{aligned} \Delta LPGDP_t = & \mu + \sum_{i=1}^{q_1} \alpha_i \Delta LPGDP_{t-i} + \sum_{i=1}^{q_2} \beta_i \Delta LODA_{t-i} + \sum_{i=1}^{q_3} \mu_i \Delta LPI_{t-i} + \\ & \sum_{i=1}^{q_4} \sigma_i \Delta LINF_{t-i} + \sum_{i=1}^{q_5} \omega_i \Delta LGFCE_{t-i} + \sum_{i=1}^{q_6} \gamma_i \Delta LTOP_{t-i} + \phi ECM_{t-1} + \varepsilon_t \end{aligned} \quad (4)$$

Where  $\alpha, \beta, \mu, \sigma, \omega, \gamma$  are short run dynamic coefficient to equilibrium and  $\phi$  is the speed adjustment coefficient.

To ascertain the goodness of fit of the ARDL model, diagnostic and stability tests are conducted. The diagnostic test examines the serial correlation, functional form, normality, and heteroscedasticity associated with the model. The structural stability test is conducted by employing the cumulative residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ).

### 3.4. Granger causality test

The direction of causality between foreign aid, economic growth, private investment, inflation, trade openness and government final consumption expenditure is investigated by applying the VECM Granger causality approach after confirming the presence of cointegration between the above mentioned variables. On the same line Granger (1969) argued that vector error correction model (VECM) is more appropriate to examine the causality between the series at I(1). The VECM is restricted form of unrestricted VAR and restriction is levied on the presence of long run relationship between the series. The system of error correction model (ECM) uses all the series endogenously. This system allows the predicted variables to explain itself both by its own lags and lags of forcing variables as well as the lags of the error correction term and by residual term. The VECM equations are modeled as follows:

$$\begin{pmatrix} \Delta LPGDP_t \\ \Delta LODA_t \\ \Delta LPI_t \\ \Delta LINF_t \\ \Delta LGFCE_t \\ \Delta LTOP_t \end{pmatrix} = \begin{pmatrix} C1 \\ C2 \\ C3 \\ C4 \\ C5 \\ C6 \end{pmatrix} + \sum_{i=1}^p \begin{bmatrix} \beta_{11i} & \beta_{12i} & \beta_{13i} & \beta_{14i} & \beta_{15i} & \beta_{16i} \\ \beta_{21i} & \beta_{22i} & \beta_{23i} & \beta_{24i} & \beta_{25i} & \beta_{26i} \\ \beta_{31i} & \beta_{32i} & \beta_{33i} & \beta_{34i} & \beta_{35i} & \beta_{36i} \\ \beta_{41i} & \beta_{42i} & \beta_{43i} & \beta_{44i} & \beta_{45i} & \beta_{46i} \\ \beta_{51i} & \beta_{52i} & \beta_{53i} & \beta_{54i} & \beta_{55i} & \beta_{56i} \\ \beta_{61i} & \beta_{62i} & \beta_{63i} & \beta_{64i} & \beta_{65i} & \beta_{66i} \end{bmatrix} X \begin{pmatrix} \Delta LPGDP_{t-i} \\ \Delta LODA_{t-i} \\ \Delta LPI_{t-i} \\ \Delta LINF_{t-i} \\ \Delta LGFCE_{t-i} \\ \Delta LTOP_{t-i} \end{pmatrix} + \begin{pmatrix} \gamma_1 \\ \gamma_2 \\ \gamma_3 \\ \gamma_4 \\ \gamma_5 \\ \gamma_6 \end{pmatrix} ECM_{t-1} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \\ \varepsilon_{6t} \end{pmatrix} \tag{5}$$

Where  $\varepsilon_{it}$  are random term and supposed to be normally distributed with zero mean and constant variance. The C's,  $\beta$ 's and  $\gamma$ 's are the parameters to be estimated.  $ECM_{t-1}$  represents the one period lagged error-term derived from the cointegration vector. From the Equation (5) given the use of a VAR structure, all variables are treated as endogenous variables. The F test is applied here to examine the direction of any causal relationship between the variables. The foreign aid (ODA) does not Granger cause economic growth (PGDP) in the short run, if and only if all the coefficients of  $\beta_{12i}$ 's are not significantly different from zero in Equation (5). Similarly, the economic growth do not Granger cause energy in the short run if and only if all the coefficients  $\beta_{21i}$ 's are not significantly different from zero in the Equation (5). There are referred to as the short-run Granger causality test. The t-statistics of the estimate of lagged term i.e.  $ECM_{t-1}$  with negative sign is used to test the long run causal relation. The short-run and long-run Granger causality results are reported below in Table 7.

## 4. Empirical analysis

### 4.1. Stationarity test

To determine the order of integration, the study uses two sets of unit root tests; (1) ADF, DF-GLS and KPSS tests and (2) Ng-Perron unit root tests at levels and first differences. The vital statistics are presented in Table 2. The results show that all the variables except LINF and LTOP are non-stationary at levels. Having found that some variables are not stationary at levels, and some variables are stationary at level, the next step is to difference the variables once in order to perform stationarity tests on differenced variables. The results reported in Table 2 show that after differencing the variables once, all the variables expect LINF and LTOP were confirmed to be stationary. It is, therefore, worth concluding that the variable LODA, LPGDP, LPI and LGFCE variables used in this study are integrated of order one  $I(1)$  and the variable, LINF and LTOP are integrated of order  $I(0)$ . Therefore, the study uses autoregressive distributed lag (ARDL) approach to co-integration. In addition, it is also important to ascertain that the optimal lag order of the model is chosen appropriately so that the error terms of the equations are not serially correlated. Consequently, the lag order should be high enough so that the conditional ECM is not subject to over parameterization problems (Narayan, 2005; Pesaran, 2001). The results of these tests are presented in Table 3.

**Table 2.** Stationarity Test of Variables

	Classical Unit Root Tests			Ng-Perron Unit Root Tests			
	ADF	DF-GLS	KPSS	MZa	MZt	MSB	MPT
LPGDP	3.8783	-0.4475	0.2135	0.22111	0.1108	0.5015	61.5671
LODA	-2.3546	-1.7010	0.2211	-6.82040	-1.7493	0.2564	13.4422
LPI	-1.2194	-1.2429	0.1064	-4.46842	-1.4778	0.3307	20.2527
LINF	-4.9281	-4.0056	0.1019	-14.6215	-2.6995	0.1846	6.25752
LGFCE	-1.5596	-1.6561	0.1394	-4.30412	-1.4042	0.3262	20.5841
LTOP	-3.5139	-3.2009	0.0535	-77.7963	-6.1818	0.0794	1.39930
$\Delta$ LPGDP	-5.6488	-5.6652	0.0770	-18.8942	-3.0591	0.1619	4.91037
$\Delta$ LODA	-6.522	-3.2697	0.1775	-10.4374	-2.2589	0.2164	8.85069
$\Delta$ LPI	4.0905	-3.7904	0.1245	-4.13432	-1.4237	0.3443	21.8879
$\Delta$ LINF	-5.6064	-5.5036	0.3648	-6.69517	-1.8038	0.2694	13.6248
$\Delta$ LGFCE	-3.6167	-3.6029	0.0972	-19.7304	-3.1280	0.1585	4.69647
$\Delta$ LTOP	-3.3851	-3.3220	0.0797	-17.3970	-2.9399	0.1689	5.29472

**Note:** the lag length of ADF test is determined by the Akaike information criterion (AIC) and Schwartz Bayesian Criterion (SBC) values.

**Table 3.** Lag Length Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	157.6116	NA	2.02e-10	-10.9722	-10.7819	-10.9140
1	267.6116	180.714	2.49e-13	-18.6865*	-16.7349*	-17.3956
2	275.6525	10.9126	4.75e-13	-17.1180	-15.4052	-16.5944
3	311.9226	38.8608*	1.38e-13	-17.5659	-16.0918	-17.8095*

\* indicates lag order selected by the criterion.

LR: sequential modified LR test statistic (each test at 5% level).

FPE: final prediction error.

AIC: Akaike information criterion.

SIC: Schwarz information criterion.

HQ: Hannan-Quinn information criterion.

## 4.2. ARDL estimation results

After determining the order of integration, the study employs ARDL approach to co-integration in order to determine the long run relationship among the variables. The result of bound testing approach is presented in Table 4. The bound test evidence confirms the long run relationship because the calculated F-statistics is greater than critical values of upper level of the bound at 5% level of significance.

**Table 4.** ARDL Bounds test

Panel 1: Bound testing to co-integration:

Estimated Equation :  $LPGDP = F(LODA, LPI, LINF, LGFCE, LTOP)$   
 Optimal lag : 1  
 F – Statistics : 4.6263

Panel 2: Diagnostic Tests:

Normality J-B value: 2.2955 (0.3173)  
 Breusch-Godfrey Serial Correlation LM Test : 0.9418 (0.4083)  
 Heteroscedasticity Test (ARCH) : 0.6062 (0.5522)  
 Ramsey Reset Test : 0.0290 (0.9714)

Next step is to estimate the long run and short run coefficients of ARDL model. The long estimates of the model specifications are presented in Table 5. The results indicate that LODA is having a positive and significant impact on the economic growth of India. The ODA coefficient is significant at 1%. This implies that foreign aid contribute to economic growth in India. This result is supported by findings obtained by Gounder (2001, 2002), Mohammed (1993), Ouattara (2006) and Feeny (2005). However, the result contradicts the findings of Chowdhury and Das (2011), Islam (1992) and Kahn and Rahim (1993).

Further, the private investment (PI: constitutes of both the ratio of gross capital formation to GDP and the ratio of private sector credit to GDP) is found to have insignificant impact on the economic growth in India. Again, monetary policy variable proxied by inflation comes out with negative and insignificant impact while determining the long run economic growth of the country. However, the coefficient of fiscal policy variable (GFCE) is significant at 1% level. This implies that level of government expenditure is an important factor in determining long run economic growth of the country. This finding is supported by the results of Kargbo (2012). The coefficient of the trade openness variable is found to be positive and significant at 2%. This finding supports the notion that growth in India is determined by output and export of the major sectors. Further, trade openness encourages the skilled labor force to contribute more to the growth with the help of technology and R&D imports. This result supports the findings by Kargbo (2012) and Feeny (2005).

**Table 5.** Estimated Long Run Coefficients using ARDL Approach (Dependent variable: LPGDP)

Regressors	ARDL(1,0,0,0,1)		
	Coefficient	t-value	Probability
LODA	0.9673	2.7576	[0.009]
LPI	0.33345	0.6705	[0.507]
LINF	-0.0266	-0.3237	[0.507]
LGFCE	1.3028	4.6830	[0.00]
LTOP	0.7578	2.2351	[0.026]
CONS	-9.0958	-3.4341	[0.002]

*Robustness Indicators*

R <sup>2</sup>	0.99708	
Adjusted R <sup>2</sup>	0.99646	
F Statistics	1611.0	[0.000]
D.W. Stat	2.1548	
Serial Correlation,	F = 0.3008	[0.588]
Heteroscedasticity,	F=0.79659	[0.378]
Ramsey Test	F=0.6984	[0.410]

**Note:** (1) The lag order of model is based on Schwarz Bayesian Criterion (SBC).

The short run estimates are also relevant in the estimation of aid-growth relationship. According to De Boef (2000), the short run change is necessary to maintain the long run relationship. The short run estimates (Table 6) are very much in consonance with the long run estimates as the foreign aid is found to have positive and significant coefficient in the short run also. However, the coefficient is significant at 5% level in the short run. Further, in the short run, the private investment variable (PI) also insignificant in influencing economic growth. However, all the macro-economic policy parameters, except GFCE, have not emerged to contribute the economic growth in the short run. This may not be surprising as the usual aim of macroeconomic policy is to influence the long run growth of the economy. Surprisingly government final consumption expenditure comes out with positive and significant coefficient in the short run as well. This may imply that public expenditure increase creates incentives in the process of short run economic growth in the country.

The ECM mentions the degree to which the equilibrium behavior drives the short run dynamics. Thus, the ECM term is of importance in co-integration analysis. The coefficient of the ECM term ( $ECM_{t-1}$ ) which signifies the speed of adjustment of the model to equilibrium in the event of external shocks shows 20% of disequilibrium errors are corrected. The ECM term is found to be negative as was expected and also significant further confirming the existence of a long run relationship between foreign aid and economic growth in India.

**Table 6.** Error Correction representation for the selected ARDL Model (Dependent variable: LPGDP)

Regressors	ARDL(1,0,0,0,0,1)		
	Coefficient	t-value	Probability
$\Delta LODA$	0.4208	1.9507	[0.059]
$\Delta LPI$	0.0682	0.6691	[0.508]
$\Delta LINF$	-0.00523	-0.3133	[0.756]
$\Delta LGFCE$	0.2656	2.3266	[0.026]
$\Delta LTOP$	-0.1257	-0.9316	[0.358]
CONS	-1.8546	-2.2773	[0.029]
$ECM_{t-1}$	-0.2039	-2.4309	[0.200]
<i>Robustness Indicators</i>			
R <sup>2</sup>	0.4888		
Adjusted R <sup>2</sup>	0.3804		
D.W. Stat	2.1548		
SE regression	0.0253		
RSS	0.02118		
F-stat.	5.2598	[0.001]	

**Note:** The lag order of model is based on Schwarz Bayesian Criterion (SBC).

### 4.3. Granger causality test results

The panel short run and long run Granger causality results are reported below in Table 7. The findings in Table 7 indicate that short-run unidirectional causality running from foreign aid, government expenditure and trade openness to economic growth in India. It has been found that the error correction terms are statistically significant for the specification with LODA as the dependent variables which indicate that there exists a long-run relationship among the variables in the form of Equation (1) which also confirm the results of ARDL bounds test.

**Table 7.** VECM Based Granger F-Test Results

	<i>Sources of Causation</i>						<i>ECM (t Value)</i>
	$\Delta$ LPGDP	$\Delta$ LODA	$\Delta$ LPI	$\Delta$ LINF	$\Delta$ LGFCF	$\Delta$ LTOP	
$\Delta$ LPGDP	--	3.0030*	1.7294	1.3764	2.2653**	2.8207**	-1.8534**
$\Delta$ LODA	0.3712	--	0.2706	0.3157	2.3871	1.0992	-0.7188
$\Delta$ LPI	3.9829	2.9682	--	2.8475	2.8438	4.1198	2.3834
$\Delta$ LINF	7.6047	7.396	7.7448	--	7.5893	7.3175	3.82543
$\Delta$ LGFCF	0.1040	1.3332	0.1786	0.8994	--	1.5891	-0.3534
$\Delta$ LTOP	1.9227	1.6045	1.2362	1.9227	0.3517	--	0.7823

It is argued in the economic literature that the Granger causality approaches such as the VECM granger causality test has some limitations. The causality test cannot capture relative strength of causal relation between the variables beyond the selected period. This weakens the reliability of causality results by the VECM approach. To solve this issue, the study applied variance decomposition method.

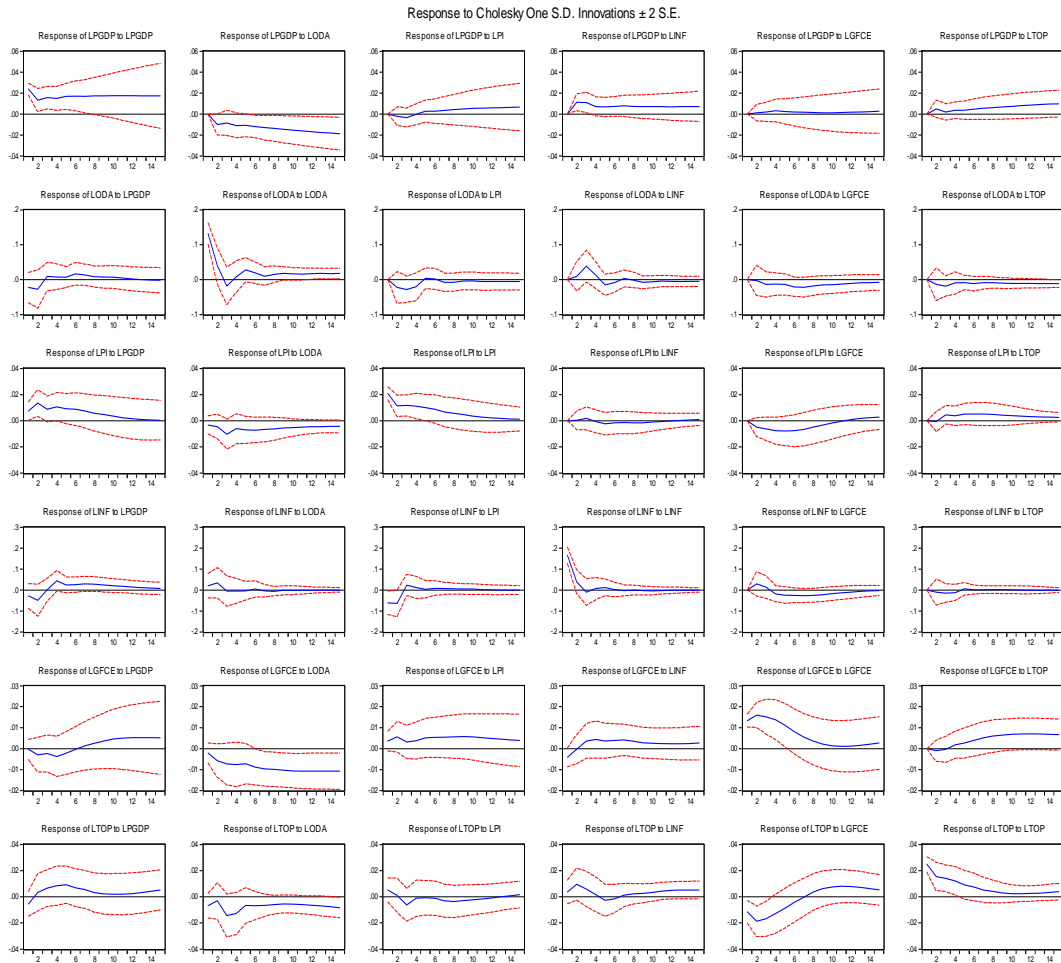
It is pointed out by Pesaran and Shin (2001) that the variance decomposition method shows the contribution in one variable due to innovative shocks stemming in other variables. The main advantage of this approach is that it is insensitive with ordering of the variables because ordering of the variables is uniquely determined by VAR system. The results of the variance decomposition approach are presented in Table 8. The empirical evidence indicates that a 48.61% of economic growth is contributed by its own innovative shocks. Further, Shock in foreign aid explains economic growth by 31.43%. Inflation contributes to economic growth by 9.18% and trade openness contributes 6.94%. The share of other variables in economic growth is very minimal.

**Table 8.** Variance Decomposition of LPGDP

Period	S.E.	LPGDP	LODA	LPI	LINF	LGFCF	LTOP
1	0.02381	100.0000	0.00000	0.00000	0.00000	0.00000	0.00000
2	0.03160	74.37799	10.1661	0.46066	12.4474	0.12641	2.42137
3	0.03815	67.81587	12.0056	1.12246	16.7612	0.37261	1.92214
4	0.04325	64.55940	15.7408	0.87952	15.7814	0.86296	2.17579
5	0.04841	63.66395	17.5518	1.03079	14.5185	0.95352	2.28133
6	0.05353	62.36604	19.3132	1.08598	13.7338	0.89560	2.60523
7	0.05852	60.48706	21.1577	1.24788	13.2129	0.82301	3.07137
8	0.06340	58.93987	22.7276	1.47413	12.5810	0.75075	3.52651
9	0.06825	57.34294	24.2657	1.76831	11.9121	0.68410	4.02676
10	0.07307	55.82216	25.6465	2.07088	11.3069	0.62546	4.52796
11	0.07781	54.31698	26.9424	2.34992	10.7682	0.58144	5.04090
12	0.08248	52.84010	28.1598	2.61283	10.2894	0.55390	5.54396
13	0.08709	51.40128	29.3089	2.84951	9.86689	0.54377	6.02957
14	0.09165	49.98976	30.3994	3.06087	9.49936	0.55241	6.49813
15	0.09616	48.61366	31.4300	3.24821	9.18112	0.58048	6.94653

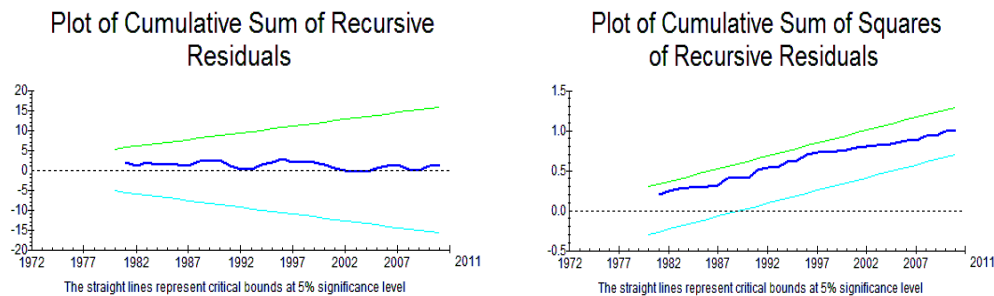
The impulse response function is alternative of variance decomposition approach and shows the reaction in one variable due to shocks stemming in other variables. The output is presented in Figure 3. The results indicate that there is positive response in economic growth due to shock stemming in foreign aid.

**Figure 3. Impulse Response Function**



#### 4.4. Stability test results

Finally, the CUSUM and CUSUMSQ are estimated and plotted to check the structural stability of the long run parameters together with the short run movements. The test suggests that if the plots of the CUSUM and CUSUMSQ residuals stay within the critical bounds of 5% level of significance, all the coefficients in the given regression are stable. Examination of the plots in Figure 4 shows that CUSUM and CUSUMSQ statistics are well within the 5% critical bounds implying that short run and long run coefficients in the ARDL models are stable.

**Figure 4.** Plot of CUSUM and CUSUMSQ (Stability Test)

## 5. Concluding remarks and policy implications

Foreign aid in the form of ODA is an important source of public expenditure in many developing countries in the world. Its impact on economic growth and development has been debated for many multi-country cases over the year. However, the aid effectiveness analyses for single country case are few. Further, in a country like India where aid effectiveness is yet to be examined in recent years, this study will fill this gap by providing the empirical evidence as a basis for policy consideration. To do so, we estimated the foreign aid-economic growth relationship by using ARDL bound test approach and VECM techniques for India over the period 1970 to 2014.

The empirical findings of the study reveal that there exist a long run co-integrating relationship between foreign aid, macroeconomic policy parameters and economic growth in India. The ARDL test result shows significant positive impact on real GDP per capita growth in the country. Further, Trade Openness (measured as total trade/GDP) seems to have positive and long run relationship with real GDP per capita growth in India. The fiscal policy parameter (measured by government final consumption expenditure) is found to have positive and significant impact on the long run growth of the economy. This implies that the level of government expenditure and trade is an important factor in determining long run economic growth of the country. Further, the study found that due to one percent deviation from the long run equilibrium, the growth rate of the real GDP per capita is corrected within the period of 4-5 years in India. The short run estimates are very much in consonance with the long run estimates as the foreign aid is found to have positive and insignificant coefficient in the short run also. The findings of the VECM estimates indicate that short-run unidirectional causality running from foreign aid, government expenditure and trade openness to economic growth in India. Further, the error correction terms are statistically significant for the specification with LODA as the dependent variables which indicate that there exists a long-run relationship among the variables in the model. The results of the variance decomposition approach indicate that economic growth in India mostly explained by foreign aid. Further, the impulse response function result indicates that there is positive response in economic growth due to shock stemming in foreign aid.

Our results provide strong evidence that effectiveness of foreign aid on economic growth is contingent on macroeconomic policy environment supporting the findings of Mavrotas

(2002); Fenny (2005); Karras (2006) and Kargbo (2012). The relationship among foreign aid, macroeconomic policy variables and economic growth indicate that foreign aid and appropriate macroeconomic policy change can be used as an important tool in achieving desired rate of growth in India in par with the findings of Mavrotas (2002). We also found that private investment is not a significant determinant in boosting economic growth in India. However, we found that government expenditure, and trade openness augments the economic growth of the country in the short run as well as in the long run. Our findings suggest that sound economic management policy in terms of low inflation, trade openness and supplementing public expenditures is crucial for aid effectiveness. There is need to implement appropriate policy measures, in order to achieve the positive impact of foreign aid on economic growth through lower inflation, higher public expenditures and trade openness in the Indian economy.

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## Human nature in the economic behavior based on the neoclassical economic model

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**Abstract.** *We will approach in this article the question of human nature in economics. The traditional homo oeconomicus, as presented in mainstream economics, seems to represent the model of a perfect economic individual. We will question whether the fundamental coordinates of homo oeconomicus, rationality, self-interest and selfishness, capture the essence of human beings and if there is an universal human nature. We propose a more flexible portrait of the economic individual, with insights from recent psychological research, and we suggest that it is society which shapes human nature and character. There is no fixed or inherited human nature. An environment of inequalities makes the individual act in a selfish and utilitarian way, while a more fair social organization would make individuals altruistic and more cooperative. Values are also missing from the traditional portrait of homo oeconomicus. Human beings do not simply and always pursuit optimization, but choose often guided by ethical considerations beyond utility calculus.*

**Keywords:** neoclassical economics, human nature, homo oeconomicus, inequality, values.

**JEL Classification:** A13, B30, D01.

## Introduction

We will approach in this article several questions: how well does *homo oeconomicus* describes the essence of human nature and which is the distinctive trait of the economic individual-*homo oeconomicus* – is it competition or cooperation? Is the economic individual rational or emotional? Does the traditional portrait of *homo oeconomicus* – self-interested, insatiable, rational, competitive correspond to a real person or is just a creation which allowed the mathematization of economic theories?

The purpose of this article is to raise the question whether *homo oeconomicus* actually depicts the essence of human nature. Did economic theory succeed to surprise the essence of human behavior or *homo oeconomicus* merely serves as a simplifying abstraction, which starts from a portrait generally valid, reduced to a couple of schematic traits, which do not encompass the essence of humankind, proposing only a modality to schematize and to mathematize. Does it really exist a human nature? Philosophers offer contradictory answers when it comes to define what human nature actually is. Some philosophers tend to say that our fundamental trait is thinking, while others say that the man is a social being, a cultural being or *homo faber*.

Other theories of human nature consider that the human nature can not be known, we can only have access to the human condition, that is that human nature which is deformed by culture. Human nature, in order to preserve its characteristic to remain in the background, to remain invariant and uniform, is like a *das Ding an sich*. The cognoscible objectivity, that is the phenomenon, associated to the human nature, is the human condition (Dinga, 2015).

In the economic theory, from Adam Smith until this day, the concept of self-interest seems to define the all-pervasive *homo oeconomicus*. The pursuit of self-interest seems to represent a trait so intrinsically and closely connected to human character, that economic theory seems unable to conceive a more eloquent theory to explain behaviors. Although it was questioned and it was proved that it is not in accordance with reality, the image of *homo oeconomicus* is still dominant. The explanation is related to the fact that it allows an elegant mathematical interpretation, which gives the impression of exactness and rigor. Econometric models based on these presuppositions come also to strengthen the image of economy as a science which functions like natural sciences, following fixed rules.

The portrait of *homo oeconomicus*, characterized by an elementary psychology and a mercantile behavior, allows neoclassical economic theory to yield precise analyses, following the model of exact sciences. The behavior of *homo oeconomicus* can be expressed in equations and can be measured using indifference curves, or using functions of profit or utility maximization. A fixed human nature and characterized by unchanged laws allows economists to propose a model of behavior which is predictable and is defined by some fundamental coordinates. Economic individual is animated by the satisfaction of self-interest and he searches in any situation to maximize his utility. We consider that the mathematization of economy is responsible for this type of behavior characterized by the search of the optimal in any situation.

This homo oeconomicus is in the first place a rational agent. To pursue the quantitative analyses, neoclassical theory needed a man reduced to a couple of essential traits, because it was easier to work with fewer variables than with more. This agent is always behaving in a maximizing manner, has a rational behavior and in every situation he will choose the best alternative for him, the one which is maximizing utility and based on the rule of self-interest. Such a behavior characterizes both individual agents and also the market as a whole, because the individual is representative for the whole society. The differences between individuals reside in their history only, because if individuals were put in the same situation and with the same background, they would make the same choices (maximizing personal utility). This homo oeconomicus has become the dominant image used by economists to explain economic phenomena, but we do not have an author and a fixed bibliography for homo oeconomicus. His image prevails nonetheless from all the works concerned with equilibrium, optimal, theory of games or the maximization of production or consumption functions (Pohoată 2011).

We think that human nature is not something fixed and which does not change. It depends very much on social institutions and on social beliefs and also on human emotions. There is no nature fundamentally selfish or fundamentally altruistic and oriented towards cooperation. We have in society examples belonging to both types of behavior.

We have no reason to deduce that the actual majoritarian behavior based on self-interest and selfishness is an inevitable consequence of human nature. We have proofs – like the statistics from the book *Animal Spirits* that within an unequal society people have the tendency to behave in a selfish manner. An environment of inequalities influences the development of human nature. So, the main cause why people become more aggressive and selfish is the inequality from the society and not human nature.

We return to the classical philosophical discussion whether the society influenced positively or not the development of human nature. Some philosophers, like Rousseau, claimed that man was truly fulfilled in the natural state and living in society only brought about harms to human beings. We adhere to the opinion that it is very important for the individual to find an environment/group where predominate ethical and just principles. For if the individual lives in a society where the values adopted are profit and accumulation, and clear rules for rewarding or sanctioning unjust conducts lack, then the individual will act based on the principles prevalent in the social group to which he belongs. So, it is not human nature to blame for certain behaviors, but it is the society which is unable to create norms and rules for a fair behavior.

### State of art

John Stuart Mill defines economics as treating human being solely as a being who desires to possess wealth, and who is capable of judging the comparative efficiency of means for obtaining that end (Mill, 1836). He does not treat human nature as modified by the social situation. Mill proposes a vision of homo oeconomicus following a strategy of simplification. These kind of conceptions served to the creation of homo oeconomicus, a rational being whose sole occupation is optimization.

William Stanley Jevons (1871) describes homo oeconomicus as a consumer who calculates and whose actions and motives are defined in psychological terms. Jevons reached these conclusions starting from the utilitarian philosophy and its economic and moral principles. The portrait Jevons makes for the economic nature of the individual combines calculus and psychology. The true search of homo oeconomicus is in fact his pleasure – he searches to maximize utility from consumption. Jevons comes with a graphical representation of a chart of the goods and the associated sensations of pleasure. Each individual gains a certain utility from the consumption of a certain good, and this pleasure or utility gain is decreasing when more units from the respective good are consumed. We have here the action of the psychological principle of saturation.

Jevons proposes not only a graphical representation of subjective sensations but also their mathematical expression. Both feelings and sensations of consumers and also the decisions of homo oeconomicus can be expressed in mathematical language.

By adopting mathematical conceptions and methods from mechanics – using calculus in order to describe the total quantity of utility obtained from consumption – and the final degree due to the infinitesimal changes in utility as a result of the decisions of consumption, Jevons succeeded to offer an exact expression for the economic behavior.

Not only that the economic theories were expressed in mathematical language, but it is supposed that the individual makes such calculus for himself, that is his brain function mathematically when he takes economic decisions by comparing or weighting the different options and by choosing that alternative which will maximize utility. When he must choose between the consumption of two different goods, the individual compares mentally the utility he will obtain from the consumption of successive units (Jevons, 1871).

Jevons defines utility not as a quality within goods, but as “a circumstance of things arising from their relation to man’s requirements” (1871, p. 105), like a relation between goods and man, so that to calculate the utility of a person is not possible to be observed or measured. This means that the behaviour of a person is known only to the subject, it is an internal feeling and appreciation. We return to the philosophical question of how we can have access to others’ subjectivity and mind.

This process of mathematizing the utility helped Jevons create a new portrait of the economic man. Homo oeconomicus is taken into a mathematical world and his behavior can be expressed in terms of mathematical and precise laws. This turn to mathematics is an important step taken at the time by economists. Economic man becomes thus a person who can be studied in the laboratory and his behavior can be expressed using mathematical laws.

It is the recurrent use and need of mathematical and physical language which prompted economists to describe the essence of human being as similar to that of an automata who calculates and searches for satisfactions or utility increases. Francis Edgeworth believed that “at least the conception of Man as a pleasure machine may justify and facilitate the employment of mechanical terms and Mathematical reasoning in social science” (Edgeworth, 1881).

Frank Knight added to the portrait of the economic man a new dimension, that of access to full information. His idea was that homo oeconomicus who is performing calculus as his fundamental activity, needs also to be endowed with complete information about all the states of the world. The individual needs in order to perform the calculus necessary for appreciating exactly what actions to perform on the market full information about everything that happens in the economy. This individual has also foresight capacities. At the level of the individual we have perfect knowledge and information about all the situations in the economy, and if we translate this situation at the market level, everything takes place with necessity and in a perfect manner on the competitive market. The competitive and self-regulating market is created and is made possible by the cumulated action of these independent individuals, each pursuing his self-interest and each trying to get maximum satisfaction (Knight, 1921).

Thus, marginal and neoclassical economists such as Knight exaggerated certain characteristics of the economic man - his calculating ability and perfect information in order to produce the portrait of a more idealized model of homo oeconomicus. These types of idealizations were indeed necessary in order to apply mathematical theory to the human action. Only depicting individuals like „pleasure machines”, their behavior could have been expressed by mathematical laws and principles.

### Neoclassical paradigm and the methodology of exact sciences

The intrusion of exact sciences in economics has appeared with the construction of simplifying models, with the risk of not surprising the real human character and nature. Producers and consumers were reduced to fewer behavioral variables; the market was characterized by perfect equilibrium, all these serving the ideal of building axiomatic theories.

The neoclassical economic paradigm was build based on a false analogy with the physical phenomena. While the causality intrinsic to physical phenomena is necessary, in economy the causal chain is unpredictable, due to the intervention of the human factor and its liberty. Despite all these, we consider that there is a dominance in the neoclassical economic theory of determinism and of the predictability of events using relations of type cause-effect.

Neoclassical theory was deeply influenced by the example of Newtonian physics, for which systems are made up of atoms, being infinitely divisible and subject to mechanical laws with universal applicability. Newtonian physics in its turn was profoundly marked by the rationalist philosophy of Descartes. The rationalism of Descartes started from the supposition that reality can be known and explained through causal mechanisms, being an intelligible system in so far we can identify the laws governing action and existence. The principles of rationality and causality are universal and the reality is accessible through knowledge.

The theory of physics was based on these assumptions trying to identify universal laws which describe the behavior of natural phenomenon. The possibility of knowledge

implies also the possibility to foresee the evolution of processes. The determinism of this conception is obvious – any event is the product of a cause which we can identify and which produces in turn an effect which is also identifiable. Everything takes place with necessity within these physical laws.

Because the universe works perfectly causal and rational, everything is measurable, because the universe is made up from independent and autonomous parts, it is supposed that their characteristics and the relations between them remain unchanged. The equilibrium of the system is static and systems are characterized by reversibility, we can remake the causal chain until we return to a previous state specific for the system.

Neoclassical economists have developed economic theory in accordance with these principles. Neoclassical economic systems are mechanistic, and the characteristics of the individual atoms which make up the economic system and the relations between them are constant and governed by fixed laws. Economic systems are characterized by equilibrium.

Neoclassical economists apply the principle of methodological individualism and they reduce the macroeconomic system to the action of individuals which act based on the same rational principles (the concept of homo oeconomicus considered as a representative agent). From marginal utilities to the prices established through the mechanism of supply and demand everything can be expressed using numerical formula. These offer to economics an aura of scientificity, in analogy with exact sciences.

The method of mathematical modeling and of quantitative analyses was introduced in the economic discipline by the representatives of marginalism. Leon Walras introduced the notion of general static equilibrium. Jevons analysed the consumer behavior in terms of marginal utility, using mathematical instruments in economic analyses. Edgeworth introduced the idea of indifference curves and uses of the infinitesimal calculus. First reactions appeared through the Austrian School, from Carl Menger, who claimed that mathematical language was not appropriate in order to express the economic phenomenon and individual subjectivity.

The concern for formal, numerical modeling became inseparable from economic analysis. Even if there are concerns for qualitative developments – related to development or welfare, all these tended to be measured by quantitative indicators. The need for quantitative expression of economic phenomenon shows an obvious lack of realism – how can we measure for instance the values or how can we measure economic behaviors?

So, neoclassical model was developed starting from the model of theoretical physics and applied the principles of a mechanistic philosophy, which describe the behavior of natural phenomenon, to the economic action and behavior. Starting from these theoretical premises, one has modeled a consumer and producer which acts based on a perfectly rational calculus and who takes decisions by analyzing and evaluating all available alternatives. The human individual was conceived as an automat who acts in a mechanical manner. The extension of principles applicable in the world of natural phenomenon deformed economic analysis, producing completely unrealistic effects and producing a completely mechanized conception of human nature.

### Homo oeconomicus or about human nature

In the context of optimality, human nature is considered as fixed and given. There is no place for novelty or for free choice because individual is deemed to perfect knowledge and to acting in a predictable manner. He has no other choice but to be consistent with his own preferences, and to choose more for less. The individual knows in every situation what is best for him. There is no place here for improvement and for revising convictions in accordance with Bayes rules.

Usually individuals learn and revise older convictions depending on the new information received. This is not the case for homo oeconomicus. He does not need to revise anything, because his choices and information are perfect. This could be called rather a static state, and nothing new can emerge. The world made up from economic individuals seems rather a place without novelties or events.

This theory had known such a widespread acceptance mainly from its power of simplification, being based on the postulate of a fixed human nature and certain eternal principles of this nature, as well as on a profound commitment to simplicity and elegance as overriding criteria of an adequate explanation (Blaug, 1980).

Neoclassical economic theory considers that individuals maximize utility and firms are maximizing profits. The main assumptions of neoclassical theory are that individuals are selfish and possessive. The natural tendency of human nature is to increase personal welfare and this will result in the maximization of general welfare of the society as well. The references to morality or ethics play no role in the psychology of homo oeconomicus,

The human behavior is reduced by neoclassical theory to two main hypostases – the pursuit of satisfaction for the consumer and the search for profit from the producer. Even if there are many more aspects related to human behavior in reality, these two outlined are considered fundamental. All the other characteristics which define human beings seem to be exterior to the real nature of the economic individual. Through a chirurgical operation, the individual is extracted from his imaginative and cognitive environment and he is send to act and maximize in an environment consonant with his narrow hedonism – the market with perfect competition (Pohoață, 2011).

If homo oeconomicus in the works of Smith or Say still preserved the traits of an antreprenur, in the works of Jevons, Walras or Galiani he is subject to an over-simplification in order to be turned into a perfect economic robot, capable to perform hedonistic calculus. This is totally a quantitative vision of the human nature. Individuals have no feelings, no history and no relations. They live only to perform utilitarian analyses and to calculate. They are perfect rational machines and will choose in every situation the best alternative. The human being thus depicted has no spiritual side; there is only the taste for utility and accumulation. This rational robot is capable of calculus and of choosing the profit, always more for less, and pleasure instead of loss.

This individual becomes through aggregation the guarantee of a market where everything takes place in equilibrium. Methodological individualism postulates that the behavior of a single rational individual translates to the scale of the whole society/humankind. All

social and macroeconomic phenomena are explained and composed from movements of these atoms. These individuals are considered identical, provided that they act under the same circumstances.

The idea behind this representative agent is that of a common human nature, and more than that, of a predictable behavior. If individuals are in the same situation they will do the same actions. The actual and real difference between individuals is coming from their history, but not from their nature. Such an image of the human nature proposes a portrait which enhances similarities between individuals and postulates we all are identical, inheriting a common nature.

### Homo oeconomicus and the axiom of rationality

Homo oeconomicus, afterwards replaced with the representative agent, acts in applying the principle of rationality. The rationality of homo oeconomicus, which is manifested by choosing from a set of alternatives of the alternative which is maximizing utility, based on a set of predefined preferences, supposes that the economic agent is endowed with an unlimited capacity to process information to which he has access and to take the best decisions in any situation.

Rational behaviour is usually defined as choosing more instead of less and as making proof of consistency in the case of choices. When consumer has to choose between two bundles of goods, the hypothesis of decreasing marginal substitutions states that consumers will chose packages of goods which contain bigger quantities from anything, all other things being equal (Buchanan and Tullock, 2010).

This perfect rationality will always materialize in the best decisions, that is he will choose the optimal alternative, which is maximizing utility, and at the market level this kind of behavior will reflect in the action of markets characterized by perfect competition, which arrive in an equilibrium state through the action of universal economic laws.

Rationality as utility maximization means that the economic agent always chooses based on his own set of preferences. These preferences must fulfill simultaneously several conditions. The first condition is that the relation of preference is characterized by completeness (either  $x \leq y$  or  $y \geq x$  or both, for all the packages  $x$  and  $y$ ), which means that any packages are comparable. The second axiom supposes the condition of reflexivity  $x \leq x$  for any  $x$ . In accordance with this hypothesis, any package is desired in the same measure as itself. The third condition supposes to respect the condition of transitivity, that is if  $x \geq y$  and  $y \geq z$ , then it follows that  $x \geq z$ . This function of utility attaches to each package of goods a real number. This utility function represents the relation of preference in the following manner  $u(x) \geq u(y)$  if and only if  $x \geq y$ .

The maximization of long term utility, without any concern except for personal welfare, is a distinctive trait of homo oeconomicus. The economic activities relying on the postulate of optimizing rationality follow only a growth without limits of profit by increasing production and increasing consumption. The maximizing rational behavior is considered an efficient behavior.

The neoclassical economics assumes decisions of homo oeconomicus are always the result of optimizing calculation. The optimization means here trying to reach the highest preference curve. The individual is also conceived as being independent from other people, the relations play no role in the neoclassic model, because the individual is considered self-sufficient.

There have been many critiques of such an image of the economic individual. Many economists from the Austrian school, Thorstein Veblen, John Maynard Keynes or Herbert Simon formulated the critics that homo oeconomicus is an actor who has too many foresight and forecasting in the making of his decisions. The knowledge of the economic individual is much too perfect and also the access to full information is very implausible. Experience shows that individuals take decisions under conditions of stress and uncertainty and that bounded rationality or irrationality is a distinctive trait of our human nature. There can be never such a thing as a perfect knowledge of all circumstances, which means that individuals always take risky and non-cert decisions. Moreover, it seems that emotions play an important role in the process of decision-making. Rationality is not such a spread trait of human psyche as neoclassical economists seem to believe.

The neoclassical economic model proposes a vision about human nature which is very unrealistic; homo oeconomicus is described very rigid and very far from the image we get from psychological research. Human behavior is proven not to be uttermost and mostly rational. This rationality trait explains only in part human behavior. In reality individuals have more characteristics than the rational ones. Not only profit and the search with any price of utility maximization motivate economic behavior.

According to Keynes, the economy is not governed only by rationality, which is supposed to solve any transaction through the mechanism of the invisible hand to the beneficial reciprocal advantage of participants in transactions. An important part of the economic activity is governed by „animal spirits“. People have reasons outside the economic sphere, and they are not always rational when they follow their own interests. For Keynes the animal spirits are the main reason why such economic fluctuations take place. They also represent the main cause of voluntary unemployment. So, as the indivisible hand of Smith is the key element of classical economics, the animal spirits are the main element in a different vision of the economy, a vision that could explain the fundamental instabilities of capitalism (Akerlof and Shiller, 2010).

### Other economic visions of human nature

All these conceptions about human nature were questioned by several economists who studied economic behavior and phenomena. They all had in common the rejection of traditional visions about human nature, characterized by self-interest, utility maximization and rationality. These critics showed that actually people behave differently from the economic theory prescriptions.

This kind of conceptions about human nature were investigated by Karl Polanyi from the prospect of economic anthropology. Anthropological research shows that the primitive societies were not based on self-interest and that the notion of profit was developed mainly starting from Adam Smith, since the 19<sup>th</sup> century. Reciprocity and obligations were the main dominant in primitive societies; community was taking care of poorer people while richness was redistributed through certain ceremonies of gift giving (Polanyi, 2001).

Economic anthropologists' research has shown that primitive or traditional societies exhibited different patterns of behavior. Such systems had a viable gift economy but not a market economy. In those societies people were not pursuing the self-interest and reciprocity was dominant. We could envisage such a human nature, where cooperation and not competition and the pursuit of sheer self-interest is the fundamental trait of individuals.

More recently critics came from behavioral economics. Daniel Kahneman put into question the idea that individuals are behaving in a rational and consistent manner. Kahneman also showed that the assumption of rationality is strongly related to liberalist conceptions. The supposition that individuals are rational offers the rational foundation for the libertarian approach of public policies – we must not interfere with the right of the individual to choose, only if these choices harm others. Libertarian policies are also related to the admiration for the market efficiency in allocating goods in accordance with the laws of supply and demand.

According to Kahneman, people have at their disposal two systems to take decisions – one is made from fast thinking, through which we resort to heuristics, taking decisions on grounds somehow irrational, and another is the slow thinking which we use much less often. Using experiments Kahneman showed that individuals have an irrational behavior. (Kahneman, 2012).

The founder of experimental economics, Vernon Smith, says that the most fundamental trait of human character is the capacity to evolve in exchange relations. It is not the self-interest which promoted economic growth, but exchange is considered to promise gains that humans search. According to Smith, the division of labor is not originally the effect of any human wisdom, which foresees and intends the general opulence to which it gives occasion. It is the necessary, though very slow and gradual, consequence of a certain propensity in human nature which has in view no such extensive utility; the propensity to truck, barter and exchange one thing for another.

From an economist's point of view, the most compelling feature of human nature is sociality. It has been our species capacity for social exchange that has enabled task specialization and the production above bare subsistence that has supported investment in the creation and utilization of knowledge (Vernon, Smith, 2004).

Critics of the traditional representation of human nature as it appears in the neoclassical economic theory are focusing on the fact that the image *homo oeconomicus* gives us is rather partial. Human nature can not be reduced to the character of an automata, who is trying in every possible situation to maximize utility and who chooses only based on self-

interest and optimization. People take seldom rational decisions, they are capable of altruism and they do not live a life based solely on utility gains or profits.

The neoclassical representation of human nature seems very incomplete. People do not make a rule of taking decisions based on an analysis of costs and benefits and they do not evaluate always the marginal cost and the utility of decisions. Neoclassical theory concentrates only on the utilitarian side of human behaviour, and favors only activities which can be evaluated from the prospect of utility or pleasure gain. But people are guided by many other values than a simple quest for pleasure. Man is not a robot maximizing under every conceivable situation his pleasure or utility.

### Conclusions

All these representations on the human nature of homo oeconomicus focus on its side of an automata who maximizes in any situation utility gains from satisfaction of preferences. But this view on preferences is rather narrow. Simply satisficing preferences says nothing about them, which of these preferences are good and which are bad, which are to be preferred over others and which are to be avoided. Here we have to reintroduce values in the discourse. For homo oeconomicus values seem to be absent, as his only concern is optimization. His only and sole purpose in this life is to optimize and the economic individual is unable to see beyond these limits.

Political philosophers have shown that the man can be fulfilled only in the search and achievement of values. Thus, social progress is a process of formation and modification of the human intellect in which our values and desires continually change (Hayek, 1960).

From their earliest origins, men and women appear to have allocated a considerable portion of their time to the pursuit of truth, beauty, justice, liberty, community, friendship, love, salvation, and so on, activities best described not as labor or work, but as striving—a term that precisely intimates the lack of a reliable relation between effort and result. A means-end or cost-benefit calculus is impossible under the circumstances (Hirschman, 1984).

The distinction between satisfaction (simple preferences) and values (meta-preferences) implies the consideration of ethics and motivation. The higher values (rather than preferences) might be gained through deliberation upon choices. If we introduce values in the discourse, we have a behavior build on ethical principles, very far from the traditional image of an individual who calculates and maximizes pleasure.

Our research should be oriented in the direction of ethics and values of this homo oeconomicus, in order to add a new dimension to the traditional portrait of the economic individual, for which the only value is profit and utility. Also, further research should clarify the question of the universality of human nature – is there an innate, unique human nature which all of us inherit or this human nature is a creation and depends very much on social norms and institutions?

Probably the influence of society of shaping human nature is the most important thing to be taken into consideration. As research has shown, a society where inequality dominates makes selfish individuals, while a society where more egalitarian rules exist can produce more altruistic and cooperative individuals. An extensive study of how society shapes human nature is therefore a key to question the actual image of homo oeconomicus, which represents still an important benchmark when taking into consideration the evolution of human nature.

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## Determinants of nonperforming assets-bank-specific and macroeconomic factors: A panel data analysis of different group of commercial banks operating in India

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**Abstract.** *This paper examines the relationship between the Net Nonperforming Assets (NNPAs) and the factors influencing them (bank specific and macroeconomic) for different group of Indian commercial banks (State Bank of India and its associates, nationalised banks, private Banks, foreign banks) in a panel data framework. From the macroeconomic variables, two principal component series have been created; one is from the group of variables having positive correlation with the NNPA's and the other from the group of variables having negative correlation, for different type of banks. The linear and the dynamic panel regressions and further Impulse Response analysis have been carried out to check the linkages between the NNPA's with its determinants. The result shows that the impact of determinants on NNPA's varies for different group of banks as the banking practices and regulations vary among themselves. Indian banks got influenced more in comparison to the foreign banks with the change in macroeconomic conditions.*

**Keywords:** scheduled commercial banks, determinants, nonperforming assets, NPAs, bank specific, macroeconomic parameters, principal components, panel data models, India.

**JEL Classification:** C33, E44, G21.

## 1. Introduction

The financial strength of any bank depends upon the performance of its own assets. The degradation in the assets quality results in accretion of nonperforming assets. The continual rise in nonperforming assets<sup>(1)</sup> (NPAs) leads to worsening of the banking industry functions. NPAs result from the nonpayment of loans by borrowers to lenders/banks. It not only reduces the earnings of the banks but also affects the capital base of the banks leading to banking crisis, and then economic downturn. Presently, the news of increase in the NPAs among banks is one of the alarming findings in the Indian financial system which has worried each concerned controlling bodies; starting from each bank's board of directors to Reserve Bank of India (RBI). It posed a concern for the banks in India, as one of the nationalised banks, namely United Bank of India has been forced by the regulator to put cap on amount of lending to a single borrower due to frequent rise in its NPAs. Particularly, the public sector banks in India have started to show decline in profits and even losses in their financial results because of piling up of bad assets. The growth of NPAs has two side effects on the profits of the banks. On the one side, it stops interest earnings from those stressed assets, and on the other, it leads to the making of more compulsory provisions for those NPAs out of earned profits. Furthermore, the capital base of the bank depends upon the accumulated profits and banks need to maintain the minimum required capital as a percentage to their risk weighted assets. Thus, when profit does not rise or starts to fall, banks become standstill and cannot lend further as they become unable to meet the eligible capital requirement. In that case, these banks are forced to stop their business or finally government supports them by infusing capital.

The performance of any bank's loans depends upon the progress of the operating economy, its own management practices and earning capacity of the financing firms. In other words, apart from macroeconomic fundamentals, banks internal management's decisions, such as targeting return on assets (ROA), maintenance of capital adequacy ratio (CAR), and amount of provisioning also strongly influence in the progress of banks' business. There have been several studies that analysed the relationship between the nonperforming loans with the bank specific and the macroeconomic variables by the researchers and academicians (Castro, 2012; Erding and Abazi, 2014; Louzis et al., 2012; Pestova and Mamonov, 2012; Tanaskovic and Jandric, 2014). The rise of NPAs is considered to be the representation of rise in credit risk. The credit risk is considered to be the major risk for banks as most of the assets remains in the form of loans. The increase in nonperforming loans leads to credit default and worsening of the credit risk ratios for the banks (Samad, 2012). Many research had also been done in explaining the NPAs of Indian banks, but further, the analysis for different group of banks will be novel in this direction for the present time (Arora, 2013; Das and Ghosh, 2007; Dhar and Bakshi, 2015; Dwivedi, 2012; Ghosh et al., 2014).

With this background, the paper tries to build up the empirical relation of nonperforming loans with the bank-specific and macroeconomic parameters for different categories of commercial banks operating in India. For this study, 58 commercial banks<sup>(2)</sup> are considered in different groups with an intention to examine how the impacts of the

determinants vary across the groups as each has their own banking practice and regulation. The major share of State Bank of India (SBI) and its associates and nationalised banks are owned by the government, whereas shares of private banks are owned by their private owners, and the foreign banks have their ownership outside India. The government owned banks are controlled by the government representatives and are modeled to work for the benefit of all sections of people by lending to priority sectors like agriculture, weaker sections, education, farmers etc. However, the private banks work for profit with high priority. The foreign banks do limited business like credit card facilities, credit guarantee loans and act as a representative bank between banks in India and their parent bank. From the trend of lending by the commercial banks, it is observed that, public sector banks burn their hand by lending to risky agricultural sector as compared to private and foreign banks. The last 10 years' average share of lending to agricultural sector by SBI and its associates, nationalised banks works out to be 12 percentages to 13 percentages, whereas for the private banks it is 7 percentages, and for the foreign banks it is even less than 2 percentage of their total lending. This is considered to be one of the reasons for accumulation of more bad assets for the public sector banks. The other reasons may be the style of banking practices and the dependence on macro fundamentals of the country. Further, the bank's behavior plays important role for controlling the non performing loans (NPLs), the state run banks are generally bailed out by Government while they got burdened with bad assets and need of capital. The attitude that state will protect us leads to further deterioration of assets base of publicly owned banks. Zhang et al. (2016) examined the impact of bank behavior on bad assets in China and observed that Chinese banks exhibit moral hazard manner in taking the lending decisions as they add more risky loans to reduce their NPLs ratios and end up with more stressed assets.

The bank specific parameters are taken into consideration for each bank separately for different groups of banks, whereas the macroeconomic parameters are common for all the banks. The common macroeconomic parameters are grouped into two types for each category of banks depending whether they have positive or negative correlation with the NNPA of the groups of banks. For nationalised and private banks, the macroeconomic parameters like unemployment rate, fiscal deficit, and weighted average lending rate (WALR) are kept under the first group having the positive correlation with NNPA, and the rest of the parameters like gross domestic product (GDP), wholesale price index (WPI), index of industrial production (IIP), exchange rate and scheduled commercial banks' (SCBs) credit growth rate belonged to the second group of parameters having negative correlation. The group consisting of SBI and its associates has positive correlation with unemployment rate, fiscal deficit, WALR and exchange rate with their NNPA and has negative correlation with rest of the macroeconomic parameters. Similarly, for the foreign banks operating in India, the macro parameters like unemployment rate, fiscal deficit, WALR and SCBs credit growth rate are kept under first group while the rest are put under the second group.

Following this, the Principal Component Analysis (PCA) technique is used for common macroeconomic parameters to generate one single component vector for each correlated group, that is, group having positive correlation and negative correlation with the NNPA. Further, it leads to the creation of two variables for each category of banks. They

are named as positively correlated macro principal component (PCMPC) and negatively correlated macro principal component (NCMPC), derived from positively and negatively correlated macro variable group with the NNPA's respectively. Then, different type of panel regressions such as fixed effect, random effect, and dynamic panel models are estimated for each category of banks by using NNPA's as the dependent variable and bank specific parameters such as return on assets (ROA), capital adequacy ratio (CAR), provisions and two principal component macro variables groups (PCMPC and NCMPC) as the independent variables. The Hausman specification and Breusch-Pagan LM tests are also been conducted to check suitability of random effects model over the fixed effect model. Moreover, the impulse response analysis has also been carried out to check the linkages between the NPA's and its determinants in a Panel Vector Autoregressive (PVAR) model which helps to find out the response of NNPA's due to standard shocks in their determinants.

The rest of the article goes as follows. Section 2 discusses the existing literature on the nonperforming loans and its determinants. In Section 3, the data and methodology used for this paper is discussed. The estimated empirical results are analysed in Section 4, and Section 5 concludes the paper.

## 2. Literature review

Several studies exist that explore the determinants of credit risk - both theoretical and empirical in nature to explain the factors influencing the nonperforming loans. The performance of bank's loan depends upon repayment capacity of the borrowers, which again depends upon running of their business and economic condition of the operating country. It is generally a trend that in the booming phase of economy NPA's decline as the repayment capacity of the people increases and then the trend changes when the recession steps in. The present study may be linked to the famous financial accelerator theory of macroeconomics, which explains that, the adverse shocks to the economy are amplified by worsening financial market conditions. Specifically, adverse conditions in the real economy and in financial markets propagate the financial and macroeconomic downturn. Bernanke et al. (1996) studied the US economy where the lenders got affected due to macroeconomic shocks in the economy. With the fall in macro fundamentals, the firms in the economy loose loan repayment capacity due to rising cost in the market and declining demand for their products at the same time. It leads to non-payment of loans and then leading to rise in NNPA's ratio. It can also be linked with that of Merton Framework of Macro financial risks where the problems in the macro financial setup lead to credit failure in the economy. Gray et al. (2007) analysed the inter linkages between the external shocks and asset liability mismatch (ALM) of the enterprises.

The importance of studies on credit risk can be seen worldwide. People across the globe have studied the determinants of the nonperforming loans. Tanaskovic and Jandric (2014) studied the determinants of nonperforming loans (NPLs) in Central and Eastern and South-Eastern Europe (CESEE) countries and observed that the increase in NPLs are positively related with the GDP growth, level of foreign currency loans and foreign

exchange rates. Erding and Abazi (2014) had also analysed the NPLs of the emerging European countries and their empirical study shows that among the macroeconomic factors, the growth of NPLs are prone to real GDP growth, inflation and credit growth rate, and among the bank specific factors, profitability and interest rate charged by banks stand important. Furthermore, Beck et al. (2015) studied NPAs of 75 countries and found that growth rate of real GDP, movement of share prices, exchange rate, and lending interest rates play an important role in influencing the NPL ratio. Similarly, Castro (2012) had studied the credit risk in the countries like Greece, Ireland, Portugal, Spain and Italy (GIPSI) by using the dynamic panel models and found that GDP growth and share price movement are inversely related to the NPLs rise, whereas unemployment and interest rate are positively related. Moreover, Ahmad and Ariff (2007) compared the credit risk determinants of both developed and emerging economies and observed that the two to four macroeconomic factors influence the credit risk of both these type of countries to a significant extent. They also opined that the emerging economies have more credit risk as compared to developed ones because of bank specific factors. Furthermore, Ahmad et. al. (2008) mentioned about the determinants of bank capital ratios in case of developing economies. According to them, there is a strong relationship between regulatory capital and bank's internal risk taking decision. They also declined the opinion that earnings and capital within a bank are positively linked.

Apart from cross country analysis, empirical researches on credit risk have also been carried out for different countries separately. The nonperforming loans of Greek banks are mainly explained by the macroeconomic variables and management quality (Louzis et al., 2012). Pestova and Mamonov (2013) had studied the Russian banks credit risk through macroeconomic and bank specific parameters by the use of single equation panel data models and noted that the macroeconomic factors, basically the rise in interest rates accelerate the growth of bad assets. Furthermore, Ghosh (2015) studied the banking industry specific and regional economic parameters as the determinants of US banks stressed assets and observed that greater capitalization, liquidity risks, poor credit quality, greater cost inefficiency and banking industry size positively impact NPLs, while profits of the bank and economic parameters like real GDP, real personal income and housing price index lowers the bad assets of these banks. Samad (2012a) had also studied the credit risk variables of the US bank failure and noted that credit loss provision and loan loss allowance to non-current loans are the responsible factors for the banking failure in the US. Similarly, Festic et al. (2010) had studied the systematic macroeconomic sources of credit risk in the European States and found that the slowdown in economy leads to growth of NPLs.

The credit risk determinants are also being studied in the developing countries. Garr (2013) studied the credit risk of Ghana banking industry and found out that the credit risk is influenced by the management efficiency, per capita domestic product, government borrowing and the financial sector development. Furthermore, Washington (2014) had analysed the impact of macroeconomic parameters on the nonperforming loans in Kenyan banking sector and found that the macroeconomic parameters strongly influences the nonperforming loans and also found that the lending to private sector is negatively related to the rise of bad loans. Additionally, some models are being analysed to verify how

effectively credit risk can be measured. Manab et al. (2015) had studied the earnings management and credit default forecast of Malaysia and established the result that the liquidity ratios, productivity ratio, and profitability ratio are significant factors in determining credit risk.

Similarly, Podpiera and Otker (2010) indentified that the business models, earnings potential and economic uncertainty are the determinants of credit default in European Large Complex Financial Institutions (LCFIs). The cost of the commercial banks depends upon the nonperforming assets and probability of failure in assets helps to predict the cost structure (Maggi and Guida, 2011). Nishikawa (2002) tried to predict the credit risk for business units and emphasized that credit rating models helps to identify the bank's risk and enables the bankers to determine the fair interest rate based on business unit ratings.

The credit risk profile varies across the countries depending upon the policy setup and regulatory control. Ali and Daly (2010) studied the credit default rates across the countries, and they observed that the defaults are influenced by the macroeconomic parameters and concluded that the responsiveness of factors affecting the defaults varies across the countries; as the US is more prone to macro shocks than the Australia. In India, case studies for credit risk determinants are also been done by academicians and policy makers. Dhar and Bakshi (2015) had studied the NPAs of 27 public sector banks during the period of 2001-2005 and opined that bank specific parameters such as net interest margin and return on assets play major roles in influencing the piling up of bad assets. Ghosh et al. (2014) studied the NPAs of public sector banks and opined that GDP and market conditions have a direct relationship with the NPAs of public sector banks. In the similar line, Das and Ghosh (2007) studied the credit risk of Indian banks and observed that the rapid growth in credit and decline in the capital adequacy ratio (CAR) of banks is the early indicator of the financial downturns of the banks. Furthermore, Bittu and Dwivedi (2012) had studied the Indian banking industry and found that the variations in the fresh slippages of loans are affected by the change in the business growth and maintenance of CAR. They also studied the causal relation between the stressed assets and the macro parameters and noted that there is causal relation from GDP to slippages, however no reverse causation, from slippages to GDP.

In India, the risk profile varies from bank to bank depending upon the management goal and compliance requirement of banks. Arora (2013) had studied the credit risk management practices of public and private sector banks and observed that credit worthiness analysis and collateral requirements are major risk control tools and also pointed out that the risk management practices differ among public and private sector banks.

### 3. Data and methodology

The year wise data on bank specific parameters such as capital adequacy ratio (CAR), return on assets (ROA) and provisions have been captured from a set of 58 banks. It has been compiled from Centre for Monitoring Indian Economy (CMIE) data base and annual reports of the individual commercial banks separately for the period of 1999-2015. As per the RBI's classification based on shareholding strength, the covered 58 banks operating in

India have been broadly categorized into four different groups, namely SBI and its associates, nationalised banks, private banks and foreign banks. Furthermore, the factors outside the banking system (macroeconomic parameters) such as GDP, IIP, WPI, SCBs credit growth, exchange rate, unemployment rate, fiscal deficit and WALR data are taken year wise from CMIE and RBI data base for the same time period. Bank specific parameters are unique for each bank, whereas the macro parameters are common for all the banks. The macro parameters are classified into two groups, one having positive correlation with the NNPA's and the other having negative correlation, for different type of banks separately.

The details of the parameters used in this study and their descriptions are presented in Table 1.

**Table 1.** Variables included in the analysis

No.	Variable Name	Description
1	Net nonperforming assets(NNPAs)	Ratio of total net nonperforming assets to net advances
2	Capital Adequacy Ratio (CAR)	Ratio of total risk weighted assets to total capital funds
3	Return on Assets (ROA)	Ratio of average earnings to total average assets
4	Provisions	Provision amount kept by the bank for risk weighted assets as per the statutory audit
5	Gross Domestic Product(GDP)	Measures the growth percentage of national income and output.
6	Index of Industrial Production (IIP)	Measures the growth rate of total industrial output.
7	Wholesale Price Index (WPI)	Measures the growth rate of wholesale price level.
8	Weighted Average Lending Rate (WALR)	Weighted average lending rate (WALR) of banks in India. The weights are given according the total outstanding of the bank.
9	Exchange Rate	Exchange rate of the US Dollar and the Indian Rupee
10	Fiscal Deficit	Fiscal Deficit (difference between the government's expenditures and its revenues) as a percentage of its gross domestic product (GDP).
11	Unemployment Rate in India	No of people actively looking for job as a percentage of total labour force
12	Scheduled Commercial Banks(SCBs) credit growth rate	Credit growth of all the Scheduled Commercial Banks.

Group wise common principal components have been constructed through the PCA technique for macroeconomic parameters. The PCA helps to address the problem of correlation among the macro economic variables and generates the principal component which is used as a single factor for estimating the panel regressions. The panel regressions are done by using the bank specific parameters and the two principal components of the macro variables groups with NNPA's. Besides, the impulse response analysis has also been carried out to check the linkages between the NPAs and its determinants in Panel Vector Autoregressive (PVAR) model. A brief summary of the tests and estimated methods used for this paper are discussed as follows.

### 3.1. Principal component analysis

The principal component analysis (PCA) is a statistical technique used for data analysis, wherein large complex group of variables which are correlated with each other are converted into small and simple group of variables (components) which are not related among them. It keeps the maximum amount of data variation and makes the data easy to operate. PCA can also be defined as the linear combination of its basis factors which is expressed as

$$P = XY \quad (1)$$

where,  $X$  and  $Y$  are  $m \times n$  matrices related to each other with a transformation  $P$ ,  $X$  is the original data set taken for analysis and  $Y$  is the resultant component data set. From the set of components, the first component is generally selected as the representative principal component as it explains the maximum proportion of the total variance. Once the group wise principal components are formed, they are used for following panel regressions.

### 3.2. Panel data models

For this study we have used the famous fixed and random effect panel data models and they are being tested through Hausman specification and Breusch-Pagan Lagrangian multiplier (LM) test to check which model is appropriate – fixed or random effect model. Additionally, the Blundell-Bond (1998) linear dynamic panel model is also used for panel regressions.

#### 3.2.1. The fixed effects model

The fixed effect model explains the relationship between explanatory variable and dependent variable where each individual entity has significant role in predicting the outcome in the system. The fixed effect model can be written as

$$Y_{it} = \beta_1 X_{it} + \alpha_i + U_{it} \quad (2)$$

where,  $\alpha_i$  is the unknown intercept and  $i = 1, \dots, N$ ,  $Y_{it}$  is the dependent variable,  $t$  is the time variable and  $i$  is the entity level variable.  $X_{it}$  is the independent variables and  $\beta_1$  is the coefficient for this independent variables and  $U_{it}$  is the error term.

#### 3.2.2. The random effects model

The random effect model differs from the fixed effects model as the variation across entities is assumed to be random and uncorrelated with the independent variables included in the model. The random effect model can be written as

$$Y_{it} = \beta_1 X_{it} + \alpha + U_{it} + \varepsilon_{it} \quad (3)$$

where, the  $\alpha$ , as intercept remains fixed and  $\varepsilon_{it}$  is the error term, within entity.

#### 3.2.3. Hausman Specification and Breusch-Pagan LM test

The Hausman specification and Breusch-Pagan LM tests are being conducted to check which one is better, fixed or random effect model, depending upon the significance of the test results. The random effect model is chosen over fixed effect model if the Hausman specification test is found to be statistically insignificant. But this is reverse in case of Breusch-Pagan LM test, which indicates that the random effect model is better if the test result is found to be statistically significant.

#### 3.2.4. Blundell-Bond linear dynamic panel model

The linear dynamic panel model takes into account the lags of the dependent variable as explanatory variable and also includes the unobserved panel-level effects, fixed or random. Arellano and Bond (1991) derived a consistent generalized method of moments (GMM), dynamic panel regression model which is useful for the datasets with many

panels and few periods. Further, Blundell–Bond in 1998 had developed extended dynamic panel model which is superior to existing non-linear dynamic panel models.

The Blundell–Bond linear dynamic panel-data model can be written as

$$y_{it} = \sum_{j=1}^p \alpha_j y_{i,t-j} + x_{it} \beta_1 + w_{it} \beta_2 + v_i + \varepsilon_{it}, i = 1, \dots, N; t = 1, \dots, T. \quad (4)$$

Where,  $\alpha_j$  are the  $p$  parameters to be estimated,

$x_{it}$  are the independent variables and  $\beta_1$  are the coefficient for the same,  $w_{it}$  are the predetermined variables and  $\beta_2$  are their coefficients.,  $v_i$  are the panel level effects and  $\varepsilon_{it}$  is the identically independently distributed (i.i.d.) for the whole sample with variance  $\sigma^2_\varepsilon$ .

### 3.2.5. Panel Vector Auto regression (PVAR) Analysis

In Vector Auto regression (VAR) model all the variables are treated as endogenous and interdependent among each other. The Panel VAR model is calculated in a panel data set and allows individual heterogeneity and it can be written as

$$y_{it} = \alpha_0 + A_1 y_{it} + \mu_{it} + \varepsilon_{it}, i = 1, \dots, N, \quad (5)$$

where  $y_{it}$ , is the vector of endogenous variables and  $\mu_{it}$  is the parameter that explains the unobserved bank specific parameters and  $\varepsilon_{it}$  represents the idiosyncratic error terms.

In the panel VAR model, impulse response is a technique used to analyse the response of the variables due to shocks in their endogenous variables. The impulse response basically shows the reaction of any external shock to the system and how the variables got affected due to change in the other variables.

## 4. Empirical results

The empirical results found in this paper are as follows. The trend and descriptive statistics of NNPA's of different group of banks operating in India are shown as per Tables 2 and 3 respectively.

**Table 2.** Trend of NNPA's in Indian Banks

Year	Public Sector Banks	Private Banks	Foreign Banks
1996-97	17.84	8.48	4.29
1997-98	16.02	8.67	6.38
1998-99	15.89	10.81	7.59
1999-00	14.02	8.47	6.99
2000-01	12.39	8.54	6.85
2001-02	11.09	9.65	5.49
2002-03	9.36	8.08	5.34
2003-04	7.79	5.83	4.81
2004-05	5.37	3.9	2.99
2005-06	3.65	2.46	2.12
2006-07	2.66	2.19	1.88
2007-08	2.23	2.47	1.9
2008-09	1.97	2.91	4.3
2009-10	2.19	2.73	4.24
2010-11	2.23	2.24	2.56
2011-12	2.98	1.89	2.68
2012-13	3.61	1.79	2.98
2013-14	4.36	1.78	3.86
2014-15	4.96	2.09	3.20

The above trend shows that the percentage of NPAs has been continuously rising in past three years for all the type of banks; however, the government owned banks have observed higher rate of growth in accumulation of bad assets since the financial year 2009-10. This may due to ill health of the domestic economy and compulsory regulation for lending to the priority sectors of the economy for the public sector banks.

**Table 3.** Descriptive Statistics of NNPA's of different group of banks

	Public Sector Banks	Private Banks	Foreign Banks
Mean	7.40	5.00	4.23
Standard Error	1.26	0.75	0.41
Median	4.96	2.91	4.24
Standard Deviation	5.49	3.28	1.80
Sample Variance	30.09	10.76	3.25
Kurtosis	-1.02	-1.59	-0.95
Skewness	0.73	0.50	0.44
Range	15.87	9.03	5.71
Minimum	1.97	1.78	1.88
Maximum	17.84	10.81	7.59

The descriptive statistics shows that the average bad assets percentage is highest for the public sector banks and it is lowest for the foreign banks operating in India. The positive skewness is observed to be highest in case of public sector banks and lowest for the foreign banks indicating that the NPAs are the major problem for the public sector banks. The standard deviation result shows that the private banks have highest volatility in their percentage of NPAs to total loans.

#### 4.1. Correlation analysis

The correlation matrix<sup>(3)</sup> is formed to determine the group having positive and negative correlation with the NNPA's of different type of banks. From the set of macroeconomic variables - GDP, WALR, WPI, fiscal deficit, IIP, exchange rate, unemployment, SCBs credit growth - two groups have been formed on the basis of correlation matrix, one having positive correlation and the other having negative correlation with the NNPA's of that particular type of banks. It is observed that, both nationalised and private banks' NNPA's are correlated with the same set of macro parameters both positively and negatively.

For SBI and its associates - NNPA's; WALR, unemployment rate, exchange rate and fiscal deficit are grouped under the first group having positive correlation and others under the second group, whereas for foreign banks, NNPA's; WALR, unemployment rate, fiscal deficit and SCBs credit growth are grouped under the first group and the rest of the variables are grouped under the second group.

The groupings of macro parameters based on the sign of correlation as presented in the correlation matrix for different type of banks is detailed in the Table 4.

**Table 4.** Grouping of variables based on the Correlation with NNPA's

Type of Bank	Positively correlated macro variables group	Negatively correlated macro variables
Nationalised Banks	WALR, unemployment rate, fiscal deficit	GDP, WPI, IIP, exchange rate, SCBs credit growth
Private Banks	WALR, unemployment rate, fiscal deficit	GDP, WPI, IIP, exchange rate, SCBs credit growth
SBI and its Associates	WALR, unemployment rate, exchange rate, fiscal deficit	GDP, WPI, IIP, SCBs credit growth
Foreign Banks	WALR, unemployment rate, fiscal deficit, SCBs credit growth	GDP, WPI, IIP, exchange rate

Based on the above categorisation, two principal components have been formed for each correlated groups and for each category of banks. It is observed that fall in exchange rates leads to rise of NNPA's of SBI and its associates, however the relationship is reverse in case of other group of banks. The SCBs credit growth is positively correlated with the NNPA's of foreign banks indicating that NPAs of foreign banks rises when there is growth in SCBs credit and for other banks the NPAs percentage falls with the rise in credit in the system.

#### 4.2. Panel regressions

Once the principal components have been formed, the panel data models have been estimated for different type of banks separately. The different type of linear panel regressions such as fixed effect; random effect and Blundell–Bond dynamic panel model have been estimated to see the impact of both bank specific and macroeconomic determinants on NNPA's. The panel regressions have been constructed as per the following equation:

$$NNPA_t = \alpha_1 + \beta_1 CAR + \beta_2 ROA + \beta_3 Provisions + \beta_4 PCMPC + \beta_5 NCMPC + u_{it} \quad (6)$$

The Hausman specification and Breusch-Pagan LM tests have also been carried out to check suitability of random effects model over the fixed effect model.

##### 4.2.1. Panel regressions for nationalised banks

The nineteen nationalised banks data have been taken for this panel estimation. Bank specific parameters like CAR, ROA, and provisions are taken as explanatory variables, besides, the two constructed principal components (PCMPC and NCMPC) which are also included as independent variables and NNPA's is taken as the dependent variable for regression analysis.

**Table 5.** Results of fixed effect, random effect and Blundell–Bond dynamic panel estimations for different group of banks

Regressors	Fixed-effects Coefficients	Random-effects Coefficients	Blundell–Bond dynamic panel estimation Coefficients
(1) Nationalised Banks			
NNPA(1)			0.67 (0.00)
CAR	-0.53 (0.00)	-0.53 (0.00)	-0.15 (0.00)
ROA	-1.91 (0.00)	-2.04 (0.00)	-1.06 (0.00)
PROVISIONS	0.000042 (0.07)	0.000023 (0.25)	0.000045 (0.97)
PCMPC	1.49 (0.00)	1.41 (0.00)	0.18 (0.02)
NCMPC	-0.09 (0.27)	-0.12 (0.14)	-0.19 (0.00)
Constant	10.38 (0.00)	11.03 (0.00)	3.55 (0.00)
Wald chi square		570.95	1956.14
Hausman specification test, P value- 0.655			
Breusch Pagan LM Test, P value- 0.0001			
(2) Private Banks			
NNPA(1)			0.64 (0.00)

Regressors	Fixed-effects Coefficients	Random-effects Coefficients	Blundell–Bond dynamic panel estimation Coefficients
CAR	-0.03 (0.39)	-0.02 (0.38)	0.01 (0.70)
ROA	-0.25 (0.27)	-0.61 (0.00)	-0.35 (0.02)
PROVISIONS	0.00010 (0.00)	0.000031 (0.19)	0.000073 (0.78)
PCMPC	1.52 (0.00)	1.44 (0.00)	0.41 (0.00)
NCMPC	-0.08 (0.23)	-0.13 (0.06)	-0.20 (0.00)
Constant	3.09 (0.00)	3.61 (0.00)	1.01 (0.01)
Wald chi square		252.00	636.98
Hausman specification test, P value- 0.00			
Breusch Pagan LM Test, P value- 0.00			
(3) SBI and its associates			
NNPA(1)			0.34 (0.00)
CAR	-0.00026 (0.00)	-0.00017 (0.05)	-0.00048 (0.01)
ROA	-0.79 (0.11)	-1.02 (0.05)	-2.36 (0.02)
PROVISIONS	0.0000735 (0.71)	0.00000367 (0.81)	0.00000251 (0.83)
PCMPC	0.98 (0.00)	0.98 (0.00)	0.83 (0.00)
NCMPC	-0.77 (0.00)	-0.76 (0.06)	-0.52 (0.00)
Constant	3.83 (0.00)	3.96 (0.00)	4.51 (0.01)
Wald chi square		39.64	266.08
Hausman specification test, P value- 0.00			
Breusch Pagan LM Test, P value- 1.00			
(4) Foreign Banks			
NNPA(1)			0.25 (0.00)
CAR	-0.02 (0.69)	0.06 (0.06)	0.07 (0.09)
ROA	-0.63 (0.04)	-0.75 (0.01)	-0.67 (0.02)
PROVISIONS	0.000019 (0.88)	0.0000023 (0.99)	-0.0000015 (0.99)
PCMPC	0.50 (0.09)	0.52 (0.08)	1.01 (0.02)
NCMPC	-0.34 (0.16)	-0.30 (0.22)	-0.36 (0.18)
Constant	3.30 (0.00)	2.76 (0.02)	1.83 (0.07)
Wald chi square		15.74	42.66
Hausman specification test, P value- 0.1469			
Breusch Pagan LM Test, P value- 0.0001			

#### P Value in the parentheses

The suitability of fixed and random effect model has also been tested through Hausman specification and Breusch Pagan LM tests. The null hypothesis of the Hausman specification test says that the random effect models are appropriate which is accepted as

per the above p-value in the model and confirms that the random effect model is better in this case. In case of the Breusch Pagan LM test, the null hypothesis tells that the pooled effect models are appropriate over the random effect model and the p-value rejects the null hypothesis and confirms the same as concluded by Hausman specification test (see Table 5 (1)).

The regression results show that all the bank specific and macro parameters are significant in affecting the NNPA's except the provisions in case of nationalised banks indicating that the amount of provisions kept by these banks have no significant impact on the rise of NNPA's as the provisioning varies from year to year and amount of provisioning being altered by restructuring the asset classification. On the other hand, return on assets play a major role in reducing the NNPA's. The positively correlated macro principal component (PCMPC) which is the constituent of the WALR, unemployment rate, and fiscal deficit also determines the NNPA's growth to a larger extent showing that both monetary and fiscal parameters impact in the performance of assets. The results of the dynamic panel model also reveal the same thing. Besides, it shows that the past trend of NNPA's is significant determinant of the movement of NNPA's.

#### 4.2.2. Panel regressions for private banks

The selected nineteen private banks data have been captured for the panel estimation where the NNPA's as the dependent variable depends upon both the bank specific and macro specific factors.

For the private banks, the results of Hausman specification and Breusch-Pagan LM tests give opposite results. The first test indicates that random effect model is not appropriate, whereas the second test confirms the superiority of the random effects model. However, both the fixed and random effect model show that return on assets and PCMPC play major roles in determining the movement of NNPA's for private banks. The dynamic panel shows that all the parameters significantly influence the NNPA's except the provisions and capital adequacy ratio (CAR). These banks are known to be maintaining higher capital adequacy ratio, as they add more profit every year to their balance sheets and hence, the CAR does not have significant influence in determining the movement of NNPA's. Apart from the bank specific parameters, the private banks get influenced by the monetary and fiscal forces too (see Table 5 (2)).

#### 4.2.3. Panel regressions for SBI and its associates

The SBI and its associates cover the largest share of the Indian banking business. The captured seven banks' NNPA's determinants have been estimated by both the micro and macro specific parameters. The PCMPC have been constructed from WALR, unemployment rate, exchange rate and fiscal deficit and NCMPC has been created from other macroeconomic variables.

The results of Hausman specification and Breusch-Pagan LM tests imply that the fixed effect regression is better in case of SBI and its associate group as each entity has significant role in explaining the group behavior. The regression output resulting from the

fixed effect model shows that the CAR, PCMPC, and NCMPC are statistically significant factors which play a lead role in influencing the NNPA of SBI and its associates. The dynamic panel estimation shows that all the factors are significant in affecting the NNPA except the provisions, among which ROA and PCMPC play foremost role. The amount of provisioning is being done for the bad loan accounts and the banks always try to provide less provision amount by restructuring the loan account from NPAs to standard assets. The macroeconomic parameters influence the NNPA of SBI and its associates significantly as the performance of these banks depends much on the stability of the economic situation of the country (see Table 5 (3)).

#### 4.2.4. Panel regressions for foreign banks

The foreign banks have their parent operation in their domestic country and in India they do selected business activities and mainly act as an agent banker. They generally deal with businesses like providing credit cards, export finances and non-fund based credit facilities which generate more fees based income and are profitable in nature. The thirteen foreign banks have been captured to calculate the determinants of NNPA.

The results of Hausman specification and Breusch-Pagan LM test imply that the random effect regression is better in case of foreign banks operating in India. Regression result shows that in case of fixed and random effect models the growth of NNPA is not significantly influenced by any of the factors in the model except return on assets (ROA). Similarly, the dynamic panel model also shows that all the estimators have insignificant coefficients except ROA and PCMPC (see Table 5 (4)).

In a nutshell, it is observed that for all the type of banks the provisions have insignificant impact, however the ROA and PCMPC, that is, factors like WALR, unemployment rate, and fiscal deficit play major roles in influencing the level of NNPA. In addition to these macro variables, in case of SBI and associates, the exchange rate and for foreign banks the credit growths in the industry play significant roles in determining the level of NNPA.

### 4.3. Impulse response analysis in Panel Vector Auto regression (PVAR) framework

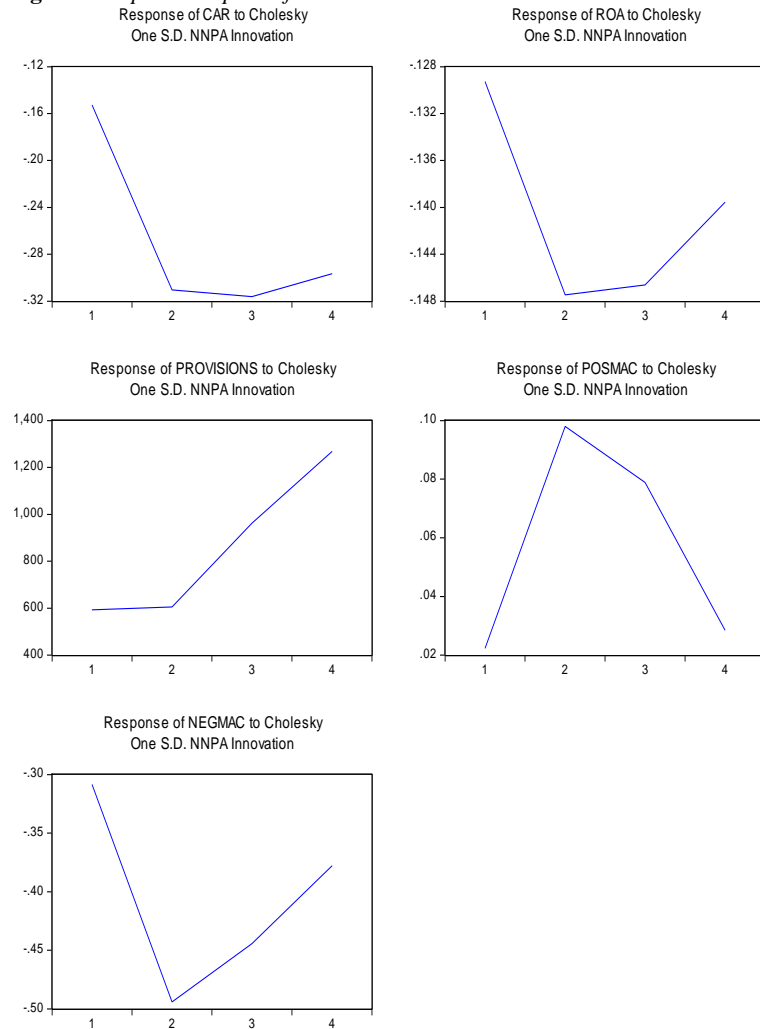
The impulse response function tries to analyse the dynamic effects of the system when the model receives any external shock in the system. In the present PVAR model the impulse response analysis has been carried out for different type of banks separately. The impulse responses here measure that how much the NNPA get responded to what magnitude due to the one standard deviation (S.D.) shock in the explanatory variables of the panel data set for different type of banks. The result clearly shows that macroeconomic shocks affect the NNPA differently for different type of banks.

For different type of banks, group wise impulse response has been carried out as follows.

#### 4.3.1. Impulse response analysis for nationalised banks

The result of the impulse response shows that, in case of the nationalised banks, one positive S.D. shock in CAR and ROA impacts the NNPA positively as the NNPA show downward trend.

**Figure 1. Impulse Response for nationalised banks**



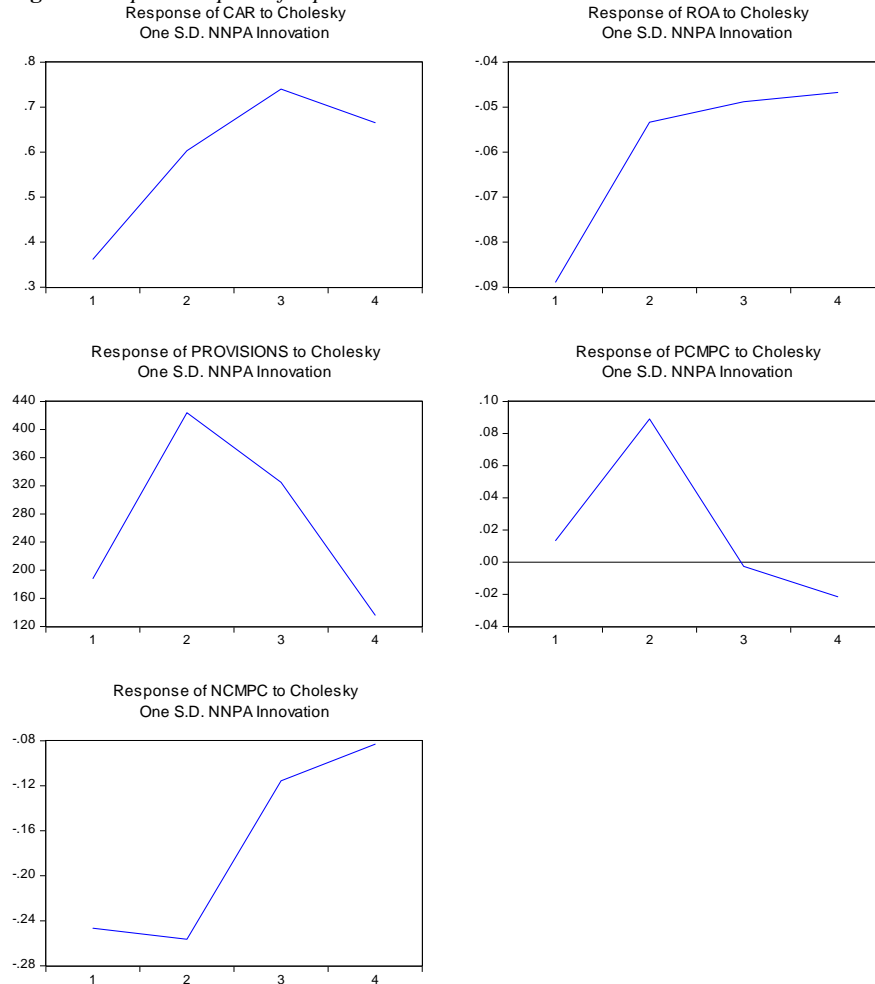
It means when the CAR and ROA rises it leads to fall in the NPAs for these banks. The shocks in PCMPC and NCMPC have strong impact on the NNPA as it shows there is straight rise and fall in the NNPA due to positive shocks in PCMPC and NCMPC respectively. The shocks in the provisioning amount have no impact initially however it leads to rise in NNPA as time passes (see Figure 1).

**4.3.2. Impulse response analysis for private banks**

Private banks behave differently as compared to the nationalised banks in India. One positive S.D. shock in CAR and ROA leads to rise in the NNPA for the banks. The shock in the amount of provisioning has direct impact on the NNPA. Shocks in positively correlated macroeconomic group have direct relationship with the NNPA indicating the percentage of NPAs increases due to any positive shocks in PCMPC. The shocks in NCMPC have negative impact on NNPA although the impact is less as

compared to other bank groups indicates that, private banks NNPA's do not decline much when there is positive shock in NCMPC (see Figure 2).

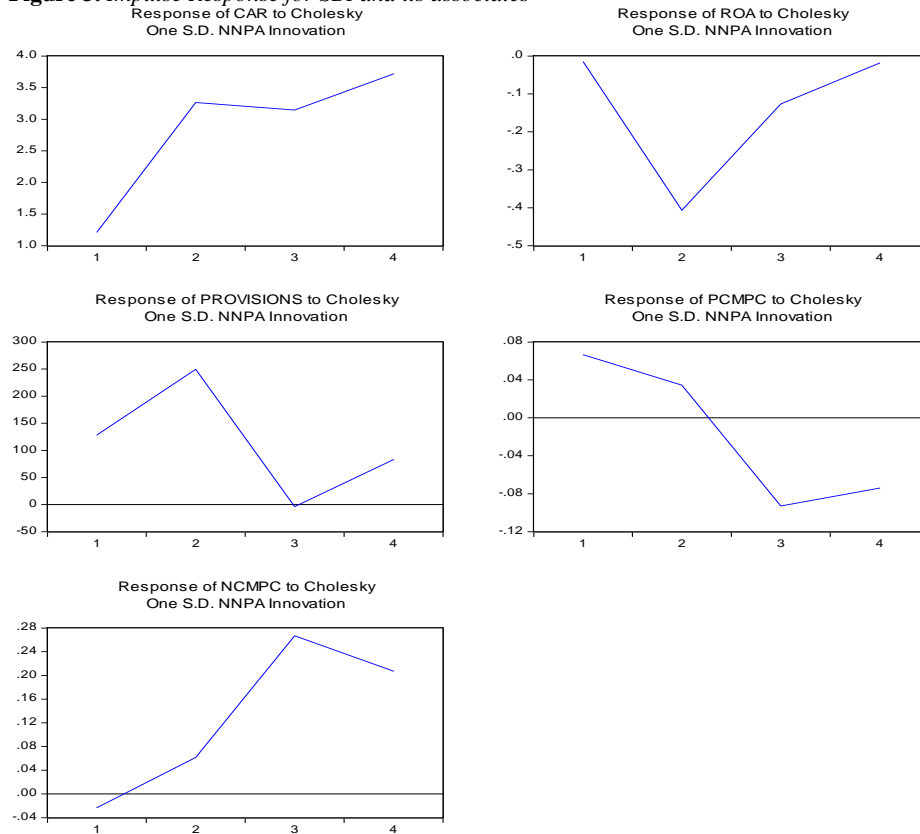
**Figure 2.** Impulse response for private banks



#### 4.3.3. Impulse response analysis for SBI and its associates

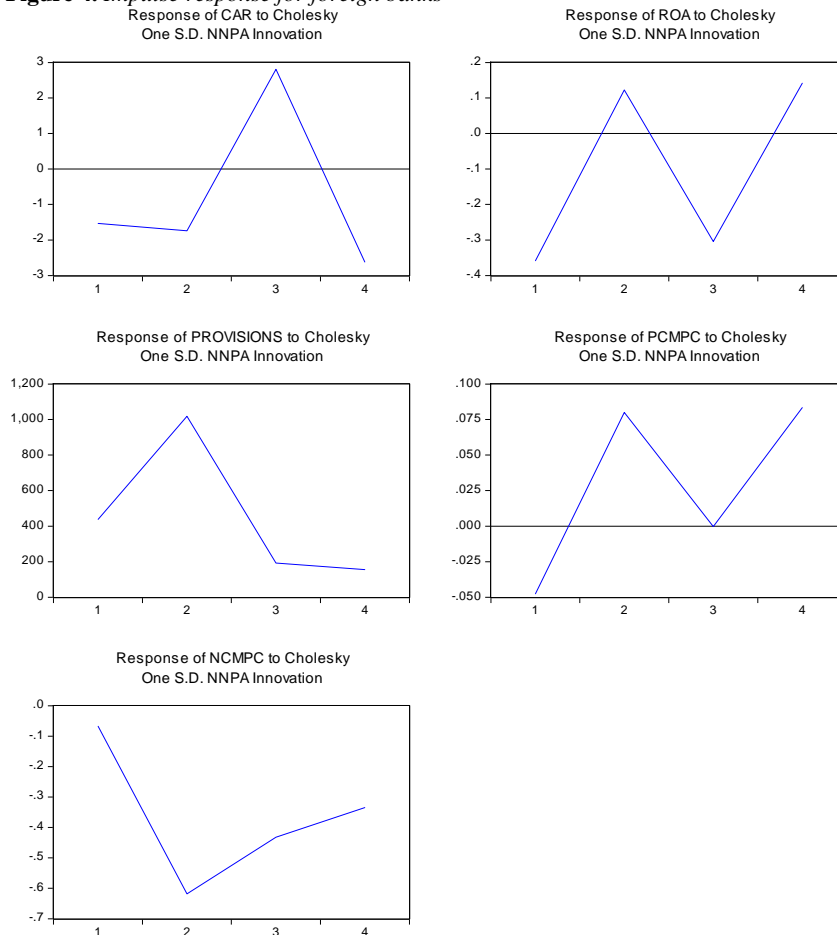
The NNPA's of SBI and its associates got influenced in the same way as that of nationalised banks due to shocks in the positively correlated macroeconomic determinants. The positive shocks in PCMPC and NCMPC lead to rise and fall in the NNPA's respectively. However, to the shocks in bank specific parameters the NNPA's behave as per the private banks. It shows that SBI and its associates are able to catch up the management practices of the private banks whereas the nationalised banks lack behind (see Figure 3).

**Figure 3. Impulse Response for SBI and its associates**



**4.3.4. Impulse response analysis for foreign banks**

Foreign banks NNPA's moves in the opposite direction in comparison to all other type of banks with the shocks in macroeconomic determinants indicating that, when there will be macroeconomic trouble in India, the foreign banks assets will not be impacted negatively, however at the same time Indian banks will face problem of accretion of bad assets. The NNPA's got affected significantly due to positive shocks in the returns on their assets showing that the rise in returns leads to fall in NNPA's (see Figure 4).

**Figure 4.** *Impulse response for foreign banks*

By and large, it is perceived that the shocks in bank-specific and macro specific parameters have different type of impacts for different type of banks. The trend of the impulse response shows that the nationalised banks and SBI and its associates are prone to behave equally to the macroeconomic shocks, whereas for the private banks any shock leads to upward movement for NNPA. It shows that NNPA for the private banks increases due to any external shocks in the bank specific and macro parameters. The trouble in macro fundamentals is not a problem for foreign banks earning assets.

## 5. Conclusion

The panel data approach to study the credit risk of different type of banks in India gives us an idea to determine how nonperforming loans are being affected by change in its determinants. In general, it is implied that both macro and bank specific factors play significant roles in influencing the occurrence of NNPA. The NNPA of different type of banks behave differently towards the change in the macroeconomic determinants as they

follow multiple banking practices and regulations. SBI and its associates and nationalised banks are controlled by the government bodies and specifically designed for providing banking facility to all sections of people, whereas the private banks are owned by the private owners and their main aim is profit maximisation. There is target for lending toward priority sectors like agriculture, weaker sections, education, farmers etc. for government owned banks, however these rules are not strict for the private sector and foreign banks. The public sector banks got influenced more by the changes in monetary and fiscal norms of the country. Overall, the bank specific parameters also influence the NNPA. From the set of bank specific parameters; CAR, ROA play key function, whereas the amount of provisioning has less important in influencing the NNPA. The impulse response analysis through panel VAR technique also shows that the shocks of the macro and bank specific parameters have diverse type of effect for different type of banks. The nationalised and SBI and its associates are influenced in the similar way due to changes in the macro parameters. The private banks are more sensitive to shocks in both macro and bank specific parameters. The foreign banks behave completely opposite with the other banks in the presence of shocks in macro determinants. So, the present problem of NNPA in Indian banking industry is more of a problem posing for Indian banks rather than for the foreign banks operating in India. It may be suggested that banks management should cautiously follow the macro fundamentals, the regulators policy announcements, and their own management decisions to control the NNPA.

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## Notes

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- <sup>(1)</sup> Nonperforming assets (NPAs) is one of the classification criteria used by banks and financial institutions for categorisation of the loans where the borrower does not pay neither the principal nor the interest for a period of 90 days. As per the Reserve Bank of India (RBI) guidelines, an asset is called NPA when it stops generating income for the banks; both interest and/or installment remain overdue for 90 days.
- <sup>(2)</sup> Banks in India are broadly classified into Scheduled commercial banks and Scheduled cooperative banks as per the Reserve Bank of India Act-1934. Furthermore, Scheduled commercial banks are categorised into five types such as SBI and its associates, nationalised banks, private sector banks, foreign banks and Regional Rural Banks (RRBs). The 58 important banks are captured from the first four groups. RRBs have been excluded from the present study due to improper data base and small size of its business. The detailed names of different group of banks covered are presented in Appendix I.
- <sup>(3)</sup> The correlation matrix tells us how strongly the different macro parameters are correlated to the NNPA of different group of commercial banks. Depending upon the sign of correlation coefficients (positive and negative) the macro variables are grouped under two categories. Please refer Appendix II for the correlation matrix.

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**Appendix I. Names of banks considered for this study**

Nationalised banks	Private Banks	SBI and its Associates	Foreign Banks
Allahabad Bank	Axis Bank Ltd.	State Bank Of Bikaner and Jaipur	Abu Dhabi Commercial Bank
Andhra Bank	Catholic Syrian Bank Ltd.	State Bank Of Hyderabad	Antwerp Diamond Bank N V
Bank Of Baroda	City Union Bank Ltd.	State Bank Of India	Bank Of Bahrain and Kuwait Bsc
Bank Of India	D C B Bank Ltd.	State Bank Of Mauritius Ltd.	Bank Of Ceylon
Bank Of Maharashtra	Dhanlaxmi Bank Ltd.	State Bank Of Mysore	Bank Of Nova Scotia
Canara Bank	Federal Bank Ltd.	State Bank Of Patiala	Barclays Bank Plc
Central Bank Of India	H D F C Bank Ltd.	State Bank Of Travancore	Citibank N A
Corporation Bank	I C I C I Bank Ltd.		D B S Bank Ltd.
Dena Bank	I D B I Bank Ltd.		Deutsche Bank A G
Indian Bank	I N G Vysya Bank Ltd.		Hongkongand Shanghai Banking Corpn. Ltd.
Indian Overseas Bank	Indusind Bank Ltd.		Mizuho Bank Ltd.
Oriental Bank Of Commerce	Jammu and Kashmir Bank Ltd.		Royal Bank Of Scotland N V
Punjab and Sind Bank	Karnataka Bank Ltd.		Standard Chartered Bank - India Branches
Punjab National Bank	KarurVysya Bank Ltd.		
Syndicate Bank	Lakshmi Vilas Bank Ltd.		
Uco Bank	Ratnakar Bank Ltd.		
Union Bank Of India	South Indian Bank Ltd.		
United Bank Of India	Tamilnad Mercantile Bank Ltd.		
Vijaya Bank	Yes Bank Ltd.		

**Appendix II. Correlation matrix**

Parameters	GDP	WALR	WPI	Fiscal Deficit	IIP	ER	Unemployment	SCBS credit Growth	NNPA
Correlation for Nationalised banks									
NNPA	-0.38	0.69	-0.29	0.44	-0.22	-0.08	0.34	-0.27	1.00
Correlation for Private Banks									
NNPA	-0.31	0.62	-0.33	0.45	-0.14	-0.21	0.39	-0.15	1.00
Correlation for SBI and its Associates:									
NNPA	-0.46	0.42	-0.23	0.34	-0.25	0.09	0.25	-0.23	1.00
Correlation for Foreign Banks:									
NNPA	-0.15	0.19	-0.23	0.23	-0.06	-0.06	0.20	0.01	1.00

## Gradualistic strategy of transition to market economy

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**Abstract.** *Following the collapse of the Soviet Union, post-Soviet countries started transition to the market economy, giving birth to various economic theories. The article presents review of Gradualistic theory of transition to the market economy and empirical research based on the economic indicators of China. In the model percentage values of savings and total investments are taken as variables indicating to the financial capabilities of the State. Empirical research demonstrated that norm for total investments and savings has direct growing relationship with the Gross Domestic Product, which is a logical outcome. Moreover, factors of government reform activities and government support have also direct growing relationship with the growth in Gross Domestic Product. Received outcomes are adequate to the theoretical model and indicate to the efficiency of Gradualistic strategy.*

**Keywords:** Shock Therapy, Gradualist Transformation, gross domestic product, government force.

**JEL Classification:** P20, P31, P40, P52.

## Introduction

World wars, unification of the Federal Republic of Germany and the Democratic Republic of Germany, great depression etc. belong to the events of the particular significance of the twentieth century. Breakdown of the Soviet Union also belongs to such events, creating new challenges for the economic science. Socialist economic system, so called Grand Experiment of twentieth century, ended with the collapse. Economic growth rate of socialist countries was reducing periodically, and in 1990-ies the growth terminated. Under the initiative of and support from the world organizations and developed countries the transformation of economic system of socialist countries to the market economy started (Papava, 2011, pp. 84-85; Nikolaeva, 2001, pp. 17-18).

Based on the wide theoretical and empirical research, it became possible to establish two approaches to post-communist transformation process: so called "Shock Therapy" and Gradualist Transformation. It has to be noted that the latter can be further classified as gradualism and extreme gradualism, latter referred to as the third approach. In the twentieth century International Monetary Fund was the supporter of Shock Therapy; it was providing financial support to post-Soviet countries within the framework of application of the above strategy; the countries, themselves capable to implement reforms and finance such reforms, were considered as supporters of Gradualist approach (Papava, 2011, pp. 84-85; Kisiliová, 1996, p. 113; Kolodko, 2000, pp. 41-42).

### Gradualistic Way of Transition to Market Economy (based on the example of Chinese Economy)

Gradualistic strategy for transition to the market economy considers gradual transformation of economy into the market economy. The necessary and significant pre-conditions for implementation of the above mentioned strategy are: 1) Implementation of reforms in the country, considering high level support from the government. 2) Existence of financial resources for financing the reforms (Papava, 2011, pp. 87-88). Shock therapy significantly differs from Gradualistic strategy; the shock therapy considers maximizing the number of radical transformations in the shortest period of time. For the implementation of above policy, it is necessary to liquidate budgetary deficit and to carry out strict monetary policy (control over the cash funds or exchange rate). In case, if above mentioned policy also considers regulation of revenues and prices, then it is referred to as orthodox scenario (Papava, 2011, p. 85).

The present article will discuss Gradualistic theory, based on which it is possible to develop the following type of general logical scheme, i.e. textual model:

$$\text{Gross Domestic Product (GDP)} = \text{Financial Support} + \text{Government Support and Implementation of Reforms} \quad (1)$$

In order to get to the statistical formulation of model 1 and demonstrate it in a formalized manner, it can be transformed as follows:

$$\text{GDPpercchange}_t = b_0 + b_1 \times \text{savingpercchange}_t + b_2 \times \text{investperc}_t + b_3 \times \text{governmentforce}_t + U_t \quad (2)$$

Where:

GDP perc change<sub>t</sub> is the rate of chain type growth of Gross Domestic Product;

saving perc change<sub>t</sub> – percentage value of savings;

invest perc<sub>t</sub>– percentage share of total investments in the Gross Domestic Product;

and government force<sub>t</sub> – fictitious variable for government support and reform activities;

$b_k$ -regression coefficients;  $U_t$ -error term.

In the model 2 percentage values for savings and total investments are considered as variables indicating on the financial capabilities of the state. We can characterize financial capabilities of the country (certainly, partially and not in full) via application of savings and total investments. Empirical data of the model 2 have been reviewed for the period of 1980-2014 years. The rate of chain growth in the Gross Domestic Product is considered as a resulting variable, and percentage growth of investments and savings – are represented by percentage values of mentioned variables.

For the characterization of reforms implemented and government support, fictitious variable - *government force<sub>t</sub>* is introduced in the model 2 (Ananiashvili, 2010, pp. 249-266; Wooldridge, 2009, pp. 353-354). For the calculation of values of the above variable, we shall review the highest rank leaders of China during the period of 1980-2014 years (see the Table 1):

**Table 1.** *Reform activities of presidents of China*

The President of China	Reform Activities	Leadership Years	Variable Index
Ye Jianying		1978-1983	0
Li Xiannian	X	1983-1988	1
Yang Shangkun		1988-1993	0
Jiang Zemin	X	1993-2003	1
Hu Jintao		2003-2013	0
Xi Jinping		2013-to date	0

**Source:** BBC, China historic profile.

Fictitious values of variable are determined in accordance with the years of governance of reformer presidents; not only their power is used in defining of values of variable, but also the existence of reformism.

For the empirical realization of an image it is important to check the time series for statistical stationarity. Via the unit root test it is determined that percentage values of total investments are an integrating process of first line, and the percentage increase of gross domestic product (GDP) and percentage values of savings represent the stationary lines. Through transferring to the first line differences of percentage values of total investments and determining the trend from percentage increase of gross domestic product and percentage values of savings, it is possible to build up the linear regression, which will have the following form:

$$\text{GDP perc change det}_t = 0.448 \times \text{saving perc change det}_t + 0.6 \times \text{dif invest perc}_t + 1.768 \times \text{government force}_t + U_t \quad (3)$$

Where:

GDP perc change  $det_t$  is de-trended value of chain growth rate of gross domestic product;

dif invest perc $_t$  – the first line differences of percentage share of investment in the gross domestic product;

government force $_t$  – the fictitious variable of reformism and support of Chinese leaders.

The estimated values of relevant criteria for evaluation of represented model 2 are given below:

**Table 2. Regression results of model (2)**

Dependent Variable: GDP\_PER\_CH\_DETR

Method: Least Squares

Date: 01/15/16 Time: 13:41

Sample (adjusted): 1981 2014

Included observations: 34 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DINV_PROC	0.600540	0.167288	3.589852	0.0011
SOC	1.176784	0.546974	2.151443	0.0393
SAVING_DETR	0.447887	0.127902	3.501800	0.0014
R-squared	0.486837	Mean dependent var		0.055647
Adjusted R-squared	0.453730	S.D. dependent var		2.743772
S.E. of regression	2.027924	Akaike info criterion		4.336000
Sum squared resid	127.4868	Schwarz criterion		4.470679
Log likelihood	-70.71200	Hannan-Quinn criterion		4.381929
Durbin-Watson stat	1.261949			

During empirical realization of presented model 3, it is determined that, statistically, free member is not significant, and significance level for the rest of ratios is 5% and the model is valid in statistical terms.

The residual members are normally distributed in the image and, in accordance with 1% significance level of White's test, the heteroscedasticity problem is not observed. In this case, the Durbin Watson's test cannot be used for checking the autocorrelation, since the model does not contain the free member, which represents one of the assumptions for use of test. In addition, in accordance with the Breusch-Godfrey test, for the residual members zero hypothesis ( $H_0$ ) on non-existence of autocorrelation is applied (Breusch, 1978, pp. 334-355; Godfrey, 1978, pp. 1293-1301; Ananiashvili, 2014, pp. 9-18).

It is possible to make conclusions of theoretical and practical nature based on the mentioned outcomes:

- Based on the example of Chinese economy, gradualist approach is effective that is demonstrated by usefulness of the model.

- It is desirable to include other factorial variables, in line with values of determination and corrected determination ( $R^2=0.49$ ,  $R_{cor}^2=0.45$ ) in the model, which are not determined under the present model.
- Total investments and savings norm are in growing relationship with gross domestic product, which is logical outcome. Total investments and savings norms represent the source for financial support, which has been mentioned prior to model development. The government reform activities and support factors are also in growing relationship with growth in gross domestic product. The results are adequate to the theoretical model and indicate to the efficiency of gradualist strategy.

Not so high determination ratio ( $R^2=0.49$ ) of a model can be conditioned by an attempt of imaging of variables of theoretical model (by using of substitute variables), or by non-inclusion of important (essential) factors in the model.

### Conclusions

Our research has defined that the gradualist strategy of transition to the market economy is efficient based on the example of China. In particular, reforms and strong financial support give an opportunity to the country to pursue the way of transition to the market economy under the conditions of macroeconomic stability.

The strategy of Shock Therapy could also fit Chinese economy, which would also bring effective outcomes. However, the clear argument on which strategy had to be chosen by the country, does not exist. In addition, it is worth to note the following fact of principle significance: in the event of application of gradualist approach the country does not face the drastic changes and macroeconomic fluctuations, as it is typical during implementation of shock therapy. Taking into consideration the above mentioned, we consider the gradualist theory for transition to the market economy as preferential approach.

It should be noted that the research conducted for the example of China did not enable us to make straightforward conclusions, whether the model would work based on the example of other gradualist countries and how efficient was the strategy chosen by those countries. It is necessary to conduct additional empirical researches in this direction, which would be based on the specific characteristics of each country, in order to reveal the correctness and preference of the choice.

It is theoretically as well as practically expedient and interesting to empirically analyze the strategies of post-Soviet gradualist countries and to compare the results with China, which could generate new theories and new directions of the research. It is also important to conduct empirical research of economies of those countries, which have chosen the Shock Therapy.

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## **Financial liberalization and economic growth: Evidence from Tunisia**

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**Abstract.** *The objective of this paper is to build an index of financial liberalization in Tunisia using the Principal Component Analysis method over a period of 36 years from 1980 to 2015. In addition, this paper also includes econometric estimates terms of cointegration and causality between financial liberalization policy and economic growth in Tunisia. To do this, we adopt a methodology which is based on an analysis in terms of causality. This approach requires passing through three stages. The first step is to check the properties of time series (stationary and integration order) of the financial liberalization index and economic growth through the use of unit root Dickey-Fuller tests. The second step seeks to examine the long-term relationship between the two variables by using a multivariate analysis Johansen. Finally, the third step seeks to determine the direction of causality between the financial liberalization index and economic growth by applying a vector error correction model. The results show that the two series are integrated of order one ( $I(1)$ ), the existence of a long-term relationship between the financial liberalization index and economic growth and the presence of causality Granger unidirectional of financial liberalization index to economic growth.*

**Keywords:** financial liberalization index, economic growth, Principal Component Analysis, causality, cointegration.

**JEL Classification:** C43, E65, G23, O16.

## 1. Introduction

The process of financial liberalization in Tunisia began in 1987. Since then, various liberalization measures have been implemented to broaden and deepen the financial system. Some instruments were designed to increase competition and efficiency in the financial market. These instruments included the removal of barriers to entry, the commercial banks and the privatization of public banks. The monetary policy instruments such as the deregulation of interest rates, reducing reserve requirements and the change in the position of direct or indirect monetary policy were implemented. Similarly, the introduction of prudential norms, the establishment of finance companies and investment Banking revision of laws and the enactment of the law of debt collection aimed at ensuring the integrity of banks and maintaining Tunisian financial system stability. All these instruments were expected to achieve the overall objectives of the competition and the functioning of money markets and capital.

Financial liberalization is adopted worldwide through several elements reflecting the variety of restrictions has been previously taxed.

The most important are:

- Elimination of the interest rate and other price controls,
- The privatization of state-owned intermediaries and reducing management

Administrative appropriations by public agencies,

- The administration of new entrants in all service industries financial and removal of legal protection for the cartel of financial markets,
- Reductions in trade regulations on intermediate financial and
- The tax reduction, explicit and implicit financial intermediaries.

The remaining of the paper is organized in the following way. Section 1 presents the methodology adopted for the construction of financial liberalization index. Section 2 dwells the empirical literature review. Section 3 presents the econometric methodology, contains empirical results and discussion, and finally, concludes are drawn in section 4.

## 2. Construction of financial liberalization index

Financial liberalization is a process that involves the implementation of a number of policies as dictated above. To show the degree or level of financial liberalization at any given time, a financial liberalization index (FLI) for Tunisia is constructed according to the method of principal components.

Bandiera et al. (2000) and Laeven (2000) constructed an index of financial liberalization for eight developing countries including eight major components of financial liberalization in their index, which are (1) interest rates, (2) measures competitiveness, (3) reserve requirements, (4) credit control, (5) ownership of banks, (6) prudential regulation, (7) the financial market stock, and (8) the international financial liberalization.

Laeven (2000) constructed a similar index for 13 developing countries. It takes six financial liberalization measures but does not take measures related to stock markets and the external sector in its index.

Previously, Demetriades and Luintel (1997) constructed an index of financial repression for India using the method of principal components. They include nine different political repressions in their index.

Referring to the same optical Laurenceson and Chai (2003) constructed an index of financial repression similar to China.

With reference to our work, we build an index for Tunisia fiscal policy. In addition, we check the relationship between financial development indicators and the index. This variable is used as a proxy for financial liberalization. The calculation of this index is a qualitative exercise based on the type and year of liberalization. Thus, the construction of our index includes six different elements used in the process of financial liberalization, which are:

- Liberalization of interest rates;
- Introduction of mandatory reserves;
- Establishment of prudential regulation;
- Removal of barriers to entry in the banking and financial system;
- Remove the sectoral allocation of credit;
- Privatization of state banks.

The following table shows for the Tunisian banking and financial system the sequence of enforcement.

**Table 1.** *The sequence of financial liberalization in Tunisia*

Year of measurement	1980	1987	1989	1992	1993	1996	1997
Interest rate		x					
Barrier to entry						x	
Reserve requirements			x				
Credit control					x		
Privatization							x
Prudential regulation				x			
<b>Total measures implemented</b>	0	1	2	3	4	5	6

**Source:** IMF various reports and working papers, various reports of the World Bank, working papers and debate papers, Demirguc-Kunt and Detragiache (1998) and Laeven (2000).

This table shows the sequence of financial liberalization with respect to each of six different measures. The crosses in the boxes indicate the year and the type of liberalization measures in question happens to effect. The number 2 indicates the implementation of two measures in 1989, and when we reach the number six (6) indicates that six (6) steps.

To take the index of financial liberalization, some arbitrary value is assigned to each financial liberalization policy (Table 2). Each liberalization variable can have a value between 0 and 6. When a sector is fully liberalized, this variable takes a value of 1 and when the sector is regulated, it takes a value of 0.

The description of the variables used in the construction of financial liberalization index and the date of implementation are presented below.

DTI: Deregulation of Interest Rates - 1987.

SBE: Removing Barriers to Entry - 1993.

RRR: reduction in compulsory reserve requirements - 1989.

RCC Relaxation in credit checks - 1993.

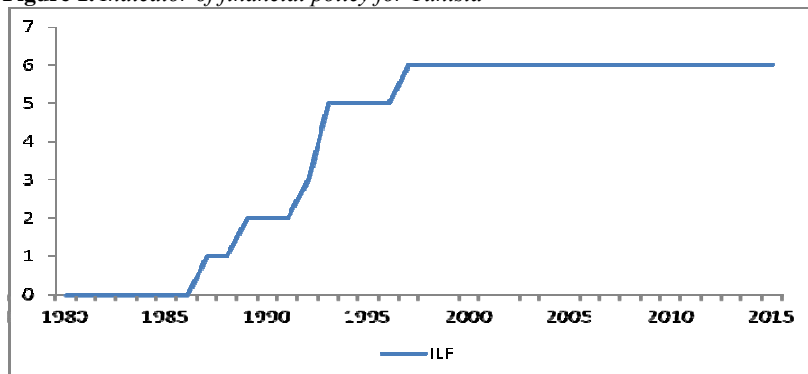
RBS: Regulation and Banking Supervision - 1992.

PSB: Privatization of State-owned Banks - 1997.

**Table 2.** *Standard financial liberalization index*

Years	DTI	SBE	RRR	RCC	RBS	PSB	FLI
1980	0	0	0	0	0	0	0
1981	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0
1987	1	0	0	0	0	0	1
1988	1	0	0	0	0	0	1
1989	1	0	1	0	0	0	2
1990	1	0	1	0	0	0	2
1991	1	0	1	0	0	0	2
1992	1	0	1	0	1	0	3
1993	1	1	1	1	1	0	5
1994	1	1	1	1	1	0	5
1995	1	1	1	1	1	0	5
1996	1	1	1	1	1	0	5
1997	1	1	1	1	1	1	6
1998	1	1	1	1	1	1	6
1999	1	1	1	1	1	1	6
2000	1	1	1	1	1	1	6
2001	1	1	1	1	1	1	6
2002	1	1	1	1	1	1	6
2003	1	1	1	1	1	1	6
2004	1	1	1	1	1	1	6
2005	1	1	1	1	1	1	6
2006	1	1	1	1	1	1	6
2007	1	1	1	1	1	1	6
2008	1	1	1	1	1	1	6
2009	1	1	1	1	1	1	6
2010	1	1	1	1	1	1	6
2011	1	1	1	1	1	1	6
2012	1	1	1	1	1	1	6
2013	1	1	1	1	1	1	6
2014	1	1	1	1	1	1	6
2015	1	1	1	1	1	1	6

**Figure 1.** Indicator of financial policy for Tunisia



Whereas some weaknesses of this indicator of fiscal policy, including zero for the years before the implementation of the financial reform values, it is necessary to improve the quality of this indicator and to better capture the effect on performance economic Tunisia. I therefore propose that the difference in our work (2003), an improved fiscal policy index.

From the values shown in Table 1, the financial liberalization index (FLI) for Tunisia is achieved. For this purpose, the weight of each component is calculated using the method of principal components. The ILF of the composition can be expressed as follows:

$$FLI_t = \alpha_1 DTI_t + \alpha_2 SBE_t + \alpha_3 RRR_t + \alpha_4 RCC_t + \alpha_5 RBS_t + \alpha_6 PSB_t \tag{1}$$

In the above equation,  $\alpha_i$  is the weight of the component given by the eigenvector corresponding to the selected main component. The eigenvalues and eigenvectors of the correlation matrix of the variables of financial liberalization policy are:

**Table 3.** Principal Component Analysis Results  
Matrix components

	Component 1
RCC	,961
DTI	,801
PSB	,826
RRR	,888
RBS	,957
SBE	,961

Total variance explained						
Components	Initial values			Extraction Sums of squares of the factors identified		
	Total	% of the variance	% cumulative	Total	% of the variance	% cumulative
1	4,875	81,251	81,251	4,875	81,251	81,251
2	,643	10,711	91,963			
3	,285	4,744	96,707			
4	,130	2,173	98,880			
5	,067	1,120	100,000			
6	-1,322E-16	-2,203E-15	100,000			

Extraction Method: Principal Component Analysis.

Take the first principal component which accounts for 80 percent of the total variance in all financial variables. Thus, the FLI is given by the following equation:

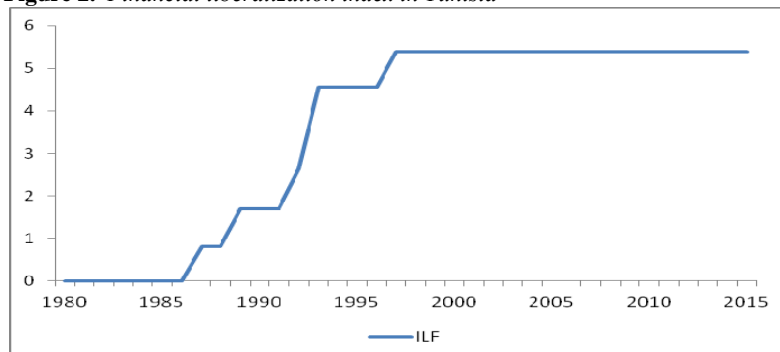
$$FLI_t = 0.796 DTI_t + 0.959 SBE_t + 0.884 RRR_t + 0.959 RCC_t + 0.955 RBS_t + 0.816 PSB_t \quad (2)$$

The index for the individual components of the financial liberalization policy is calculated by substituting the values  $DTI_t$ ,  $RCC_t$ ,  $PSB_t$ ,  $RRR_t$ ,  $RBS_t$  and  $SBE_t$  equation (2) in Table 2 and multiplying by the respective values of  $\alpha_i$ . The financial liberalization index for each year is calculated by adding the calculated values of all elements of the policy for the year concerned. The individual and total index is calculated and presented in Table 4.

**Table 4.** *Improved financial liberalization index for Tunisia*

Years	DTI	SBE	RRR	RCC	RBS	PSB	FLI
1980	0	0	0	0	0	0	0
1981	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0
1987	0	0,801	0	0	0	0	0,801
1988	0	0,801	0	0	0	0	0,801
1989	0	0,801	0	0,888	0	0	1,689
1990	0	0,801	0	0,888	0	0	1,689
1991	0	0,801	0	0,888	0	0	1,689
1992	0	0,801	0	0,888	0,957	0	2,646
1993	0,961	0,801	0	0,888	0,957	0,961	4,568
1994	0,961	0,801	0	0,888	0,957	0,961	4,568
1995	0,961	0,801	0	0,888	0,957	0,961	4,568
1996	0,961	0,801	0	0,888	0,957	0,961	4,568
1997	0,961	0,801	0,826	0,888	0,957	0,961	5,394
1998	0,961	0,801	0,826	0,888	0,957	0,961	5,394
1999	0,961	0,801	0,826	0,888	0,957	0,961	5,394
2000	0,961	0,801	0,826	0,888	0,957	0,961	5,394
2001	0,961	0,801	0,826	0,888	0,957	0,961	5,394
2002	0,961	0,801	0,826	0,888	0,957	0,961	5,394
2003	0,961	0,801	0,826	0,888	0,957	0,961	5,394
2004	0,961	0,801	0,826	0,888	0,957	0,961	5,394
2005	0,961	0,801	0,826	0,888	0,957	0,961	5,394
2006	0,961	0,801	0,826	0,888	0,957	0,961	5,394
2007	0,961	0,801	0,826	0,888	0,957	0,961	5,394
2008	0,961	0,801	0,826	0,888	0,957	0,961	5,394
2009	0,961	0,801	0,826	0,888	0,957	0,961	5,394
2010	0,961	0,801	0,826	0,888	0,957	0,961	5,394
2011	0,961	0,801	0,826	0,888	0,957	0,961	5,394
2012	0,961	0,801	0,826	0,888	0,957	0,961	5,394
2013	0,961	0,801	0,826	0,888	0,957	0,961	5,394
2014	0,961	0,801	0,826	0,888	0,957	0,961	5,394
2015	0,961	0,801	0,826	0,888	0,957	0,961	5,394

The figure of the financial liberalization index (FLI) given in the last column of the table above is shown in Figure 2.

**Figure 2.** *Financial liberalization index in Tunisia*

The improved financial liberalization index is a composite index calculated from the regression of financial and monetary reforms, including the interest rates, reserve requirements, credit control, the bank privatization, elimination of barriers to entry and prudential regulation it is less interested in its value at its trend over time. The FLI is interpreted as follows: when the financial system is subject to measures of financial policy given the index of financial liberalization has a downward trend. By cons, when monetary authorities put in place a policy of financial liberalization, the trend of the FLI will be on the rise.

The chart above shows the index of financial liberalization evolution. Two main conclusions emerge: first, the evolution of the ILF reflects the impact of measures implemented by the monetary authorities. Indeed, over the period 1980-1986, the evolution of the index corresponds to the years during which the Tunisian monetary authorities pursued a policy of funding administered. Then, the level has risen since 1987, the year when the first financial liberalization measures were applied in Tunisia.

## 2. Financial sector and economic growth: empirical approach

Through recent studies, a large divergence persists on the importance of the financial sector and the policies adopted in terms of economic growth. This situation is rather inexplicable because empirical evidence, from several studies is available in favor of the thesis of the positive impact exerted finance on economic growth.

Due to the multitude of this work and the inability to realize a complete way, we will present the synthesis of some studies that seem most interesting in terms of results and conclusions. The objective of this work is mainly to interpret the empirical results obtained in this chapter.

### Financial variables and economic growth: an ambiguous relationship

Empirical studies on the links between the financial sphere and the real economy experienced a rise in the years 1980 and 1990. These studies are part of the research perspective of long-term determinants of economic growth.

The importance of the findings of the work, with the objective to determine the role of financial variables in all of the factors behind economic growth comes from the methodology used by the authors of this research. Thus, the authors of this work monitor the impact of each factor in the influence of other factors on economic growth.

Criticism of the work De Gregorio and Guidotti by Laroche et al. show that “*the tested econometric relationships almost always raise economic growth as a variable explained by financial variables. However, the conventional linear specification of these models, although it translates assumptions about the direction of causality studied, allows to show that the correlations between financial development and growth*” (Laroche et al. 1995, p. 46). For this reason, Laroche et al. offer a dual approach to seize the links between finance and growth. The first proceeds by applying Granger causality tests; while the second uses data from R. Barro and his approach to study the type of relationships between financial indicators and the pace of economic growth.

The Granger causality test is performed to see the profile of existing relationships between real variables, which are the investment rate (I), the GDP growth rate noted g, and a set of twelve financial variables denoted generically f. “*The countries considered mainly belong to the OECD and the study period is 1976-1992. The results show that causality does exist and that are conducted primarily in the sense  $\rightarrow$  finance growth. Reverse causality is found for some countries, but much more rarely*” (Laroche et al., 1995, p. 39). Also, sometimes no link is established between the two phenomena. Table 5 summarizes some results obtained by Laroche et al.

**Table 5.** Some results of causality tests

Growth rate of real GDP (g) and financial development variables (f)							
	Japan	USA	Italy	France	Spain	South Korea	Mexico
$\Delta$ Credit/GDP <sub>t</sub>	f→g	f→g			g→f	f→g	
Credit/GDP <sub>t</sub>	f→g	f→g		g→f	g→f	g→f	
Real interest rate		f→g	g→f	g→f	g→f	f→g	g→f
Investment rate (I) and financial development variables (f)							
$\Delta$ Credit/GDP <sub>t</sub>		f→I		f→I	f→I		
Credit/GDP <sub>t</sub>	I→f		f→I		f→I		
Real interest rate	f→I	f→I	f→I				f→I

→: because Granger at the 5%.

**Source:** A. Laroche et al. (1995), pp. 55-56.

From these results, it appears that there are “*causal links in the short term, but with significant regional differences, and some ambiguity in the direction of causality*” (Laroche et al., 1995, p. 54).

According to Leahy et al. (2001), “*the OECD studies have failed to find a significant relationship between financial development and economic growth*” (Leahy et al., 2001, p. 15). According to these authors, “*the uses of methods similar to those used in previous studies for a large sample of countries do not provide evidence concerning the finance contribution to economic growth*” (Leahy et al., 2001, p. 15). A likely explanation for the failure of empirical studies to detect links between the financial sector and economic growth is the fact that the opening of financial markets, on top of each other, in developed countries disconnects economic growth of financial development in each country. This,

perhaps, overshadowed the positive contribution of finance to economic growth. Despite this obstacle, other studies have provided results that show the positive contribution of finance on economic growth.

The main results obtained by Rajan and Zingales (1998), and Berthélemy and Varoudakis (1996), Thornton and Darrat (1999) aim to broaden the scope of empirical studies considered to establish lessons relevant.

For his part, Darrat (1999) sought in its contribution to sit empirically the different hypotheses about the relationship between financial development and economic growth. The author starts with the distinction proposed by Patrick H. (1966) between the hypothesis of growth driven by the supply of financial services (supply leading) and that where it is simply the result of incentives from the real sector (Following demand). The author aims to see how is the situation in three countries are Saudi Arabia, United Arab Emirates and Turkey. He believes the level of financial deepening by two indicators. The first is the relationship between fiat money and the stock of narrow money,  $M_1$  and nominal GDP,  $M_1/GDP$ . The second indicator is the ratio between the stock of broad money and nominal GDP,  $M_2/GDP$ . The first indicator is supposed to capture the level of sophistication of the domestic financial sector, while the second captures the size or financial depth of the economy. The real sector is represented by a single indicator which is the annual GDP growth rate noted  $g$ . The available data cover the period from 1964 to 1993.

The author aims to check the direction of the existing causality between financial deepening and economic growth by using an error correction model (ECM) that can analyze the short and long term relationship between two phenomena. To do this, he performed in advance, the ADF tests, the PP and WS to determine the order of integration of the series. In addition, it introduced inflation as an explanatory variable to make its multivariate model. The table below summarizes the results it has achieved.

**Table 6.** *The short and long-term causality between finance and growth*

		Supply-leading		Demand-following	
		$M_1/GDP \rightarrow g$	$M_2/GDP \rightarrow g$	$g \rightarrow M_1/GDP$	$g \rightarrow M_2/GDP$
Turkey	Short-term Relationship	No	Yes	No	No
	Long-term Relationship	Yes	Yes	No	No
United Arab Emirates	Short-term Relationship	No	Yes	No	No
	Long-term Relationship	No	No	Yes	No
Saudi Arabia	Short-term Relationship	No	No	No	No
	Long-term Relationship	Yes	No	Yes	No

Yes: indicates that there is a causal relationship and no: means that this relationship does not hold.

**Source:** Darrat (1999), the author presented his findings in a more formalized way, this presentation was preferred as it allows better illustrate.

Thus, „the calculations provide evidence to support the hypothesis of the leading supply even if their strength and clarity vary between countries” (Darrat, 1999, p. 31). In fact, of the seven cases where a relationship is identified between financial variables and the rate of economic growth, five are in favor of the hypothesis of leading supply and two in favor of the hypothesis of demand Following.

As M.S. Habibullah, F.A. Darrat and J. Thornton aims to study the direction of causality between financial deepening and economic growth in a sample of Asian countries. It uses, for this, the technique uses the cointegration and Granger causality test to see if relationships exist and which way between the two phenomena. Two indicators are used to measure the degree of financial deepening:  $M_2/GDP$  and total deposits to nominal GDP. The author uses the real rate of economic growth as the proxy variable for characterizing the real sector.

The results obtained show that the real GDP growth rate and financial deepening, measured by two indicators used are not cointegrated, and that in all the sample countries. Thus, no long-term relationship is established between the two phenomena. Regarding the short-term bonds, “the results of Granger causality tests suggest that financial deepening has little economic growth. Unidirectional causality from financial deepening to economic growth is found in only three cases of nine” (Thornton, 1994, p. 47). The following table summarizes the results of the author as regards the short term of causality.

**Table 7.** *Causal results between financial development and economic growth*

	Unidirectional relationship of financial development to growth	Unidirectional relationship of growth to financial development	Bidirectional Relationship	No causal
India	No	No	No	Yes
South Korea	No	Yes	No	No
Malaysia	No	No	Yes	No
Myanmar	No	Yes	No	No
Nepal	Yes	No	No	No
Philippines	Yes	No	No	No
Singapore	No	No	No	Yes
Sri Lanka	No	Yes	No	No
Thailand	Yes	No	No	No

Yes: there causality Granger short term and no: means that this relationship does not hold.

**Source:** Thornton (1994), p. 49.

These results obtained by different empirical studies are important but they are not systematic. Thus, to better understand the type of links between the financial sector and the real sector, it is to present further results that are likely to illuminate other aspects of the relationship between the two sectors.

Before reviewing the work that examined the empirical assessment of the impact of financial liberalization policies on economic growth, it is first of all to present the results of the fundamental work A. Levine and Zervos (1998). The latter two authors used data from a panel of 47 countries and a 18-year period (1976-1993). Their goal is to „assess empirically whether the indicators of the activity of banks and financial markets, both at once, robustly correlated with current and future economic growth rates, capital accumulation rate, the rate of productivity growth and private savings rate” (Levine and Zervos, 1998, p. 538). Both authors took into consideration „control by the impact of other economic and political factors that may influence growth” (Levine and Zervos, 1998, p. 539) and three dependent variables.

It follows from the last work that the indicators of liquidity and the size of the stock market are positively and significantly correlated with current and future rates of economic growth, capital accumulation and productivity improvement. Furthermore, the level of banking development, measured by the share of bank credits to the private sector in GDP positively affects the growth, accumulation and productivity growth. Further, the two authors show that indicators capturing the level of development of banking and trading activities simultaneously and positively affect economic growth, capital accumulation and productivity improvement.

Finally, the study developed by Levine and Zervos (1998) shows that none of the financial indicators is closely linked with the saving rate. They also found that stock market volatility is a non-correlated significantly with economic growth, capital accumulation and productivity improvement.

#### Financial liberalization and economic growth: some empirical results

After more than three decades of the first experiences of financial liberalization and the accumulation of empirical literature increasingly rigorous empirically to place the relevance of studies, several evidences have been informed. Thus, it appears that „the paradigm of financial liberalization is a kernel of truth and a vast exaggeration” (Dornbusch and Reynoso, 1989, p. 205). The empirical literature focusing on assessing the impact of financial liberalization policies made it possible to review the content of its recommendations and the conditions under which they positively affect economic growth.

In this sense, J. Morisset (1993) tried to test one of the basic assumptions of the paradigm of financial liberalization. For this reason, the heart of its contribution consists of a structural investment model in which are introduced the „factors can influence the relationship between real interest rates, the domestic credit supply and private investment” (p. 133). In this sense, ingenuity model J. Morisset stems from the fact that it introduces multiple interactions that better reflect the complexity of reality and the real impact of financial liberalization policies.

„The model is simulated for Argentina for the period 1961-1982 that the country has been subject to different interest rate policy” (Morisset, 1993, p. 134). One of the main results emerged is that „the increase in real interest rates do not necessarily induces a positive effect on private investment” (Morisset, 1993, p. 134). Furthermore, the positive effect of the increase in domestic credit, as suggested by McKinnon and Shaw, cannot take place because of the substitution of the acquisition of productive assets by the monetary and financial assets.

Regarding the impact of financial liberalization on public sector financing needs from the domestic banking system, it appears that these requirements are increasing limited funds available for the private sector. The author shows, moreover, that „the effect of the policies of interest rates on demand for capital goods is low although the overall impact may be higher on the quality of the investment on its quantity” (Morisset, 1993, p. 148).

Overall, Morisset (1993) concluded that the competent authorities must ensure three conditions to ensure that the increase in real interest rates affect private investment positively. Indeed, „bank deposits to be close substitutes for nonperforming assets (cash, gold, etc.) and external assets as capital goods, the financial sector should ensure an efficient allocation of domestic credit and domestic credit flows should not be absorbed by the public sector needs” (Morisset, 1993, pp. 148-149).

The contribution of N. Roubini and Sala-i-Martin X. fits, such as Morisset J., as part of work trying to empirically test the assumptions of neoliberal theory of financial liberalization. Both authors developed a model of financial repression, inflationary finance and endogenous growth to detect the impact exerted by the financial liberalization policies on growth and other real variables. The data relate to 60 countries and a period from 1960 to 1985.

„Roubini and Sala-i-Martin resumed remedial Barro equations tested by maintaining the same explanatory variables of growth and adding financial variables. Financial repression is quite summarily represented by a dummy variable when the real interest rate means the estimation period is negative, or the rate of compulsory reserves. The coefficients on variables prove significant and negative, leading to the conclusion that the country is exerted financial repression generally grow more slowly than others” (Amable and Chatelain, 1995b, p. 121). The results of these two authors show that „countries that repress their financial systems tend to grow less quickly than others; This result holds even after controlling for other determinants of economic growth” (Roubini and Sala-i-Martin, 1992, p. 7).

According to Khan A. and Hasan L. (1998), „the essential message of the thesis of McKinnon and Shaw is as low or negative interest rates discourage savings and, consequently, reduce the loanable funds available at the investment which negatively affects the economic growth rate „ (p. 582). In this context, financial liberalization policies induce an increase in the level of investment in two ways. The first results from the increased volume of domestic credit distributed following the increase in intermediated savings stimulated by encouraging earnings reflected high interest rates. The second path is constituted by the duct effect McKinnon. Indeed, it states that due to the indivisibility of investment projects and the predominance of internal financing of projects, the creation of money balances is a prerequisite for the realization of such projects. This reasoning shows the positive relationship between the accumulation of monetary balances and the investment rate.

The working Khan A. and Hasan L. (1998) deal with the Pakistanis cases using data covering the period 1959-1995. The objective of the authors is to test the basic relationships of the paradigm of financial repression. To do this, they took care to study the stochastic properties of the variables before testing cointegration – static formulation of long-term between the variables. After this step, they estimated an error correction model, if its validation, in order to capture the dynamic relationships between variables.

The tests show the existence of cointegration relationships in favor of McKinnon complementarity hypothesis. Moreover, „the coefficients attached to savings of S/GDP

rate in the money demand function  $M/P$ , and real money balances in the savings function, are statistically significant. This result remains valid when the currency and savings demand functions are estimated as part of a static formulation of long-term -relation cointegration- or in a dynamic formulation using an error correction model” (Khan A. and Hasan L. 1998, p. 116).

In the same context, MS Habibullah (1999) wanted to test the hypothesis led growth finance in the early stages of economic development as foreseen by H. Patrick. He used as A. Khan and L. Hasan, techniques provided by the co-integration and error correction models. In addition, the technique adopted by the author allows him to decide on the direction of causality between the financial sector and the real sector without any prior restriction. This work concerns the data for seven Asian countries and takes as indicators of financial development the  $M_2/GDP$  ratio and the monetary indicator Divisia. As for the real sector, the author uses as an indicator the real GDP level.

After studying the stationary series using the DF and ADF tests, the author wanted to test whether long-term relationships are not checked between financial variables and real GDP in each of the seven countries. The cointegration test between financial development and economic growth rate was made by adopting the two-step procedure of Engel and Granger of testing the null hypothesis of no cointegration. In cases where cointegration holds, then the deviation where the error term is added to the regression used for the test of causation to account for long-term bonds. Finally, this model becomes error correction is estimated to see the links that are established between each of the two financial variables and level of economic development. Table 8 summarizes the results obtained by M.S. Habibullah for the seven Asian countries.

**Table 8.** *The results of the working MS Habibullah*

Countries	M <sub>2</sub> /GDP			Divisia Monetary Indicator		
	Supply leading DF→GY	Demand following GY→DF	Bidirectional DF↔GY	Supply leading DF→GY	Demand following GY→DF	Bi-directional DF↔GY
Indonesia	No	No	Yes	No	No	Yes
Malaysia	No	Yes	No	No	Yes	No
Myanmar	No	Yes	No	No	Yes	No
Nepal	No	Yes	No	No	Yes	No
Philippine	Yes	No	No	oui	No	No
Sri Lanka	No	No	Yes	No	No	Yes
Thailand	No	No	No	No	No	Yes

**Note:** DF and GY represent financial development and economic growth.

Yes: means the existence of causality and no: means no causation.

**Source:** Habibullah (1999), „Financial development and economic growth in Asian countries: testing the financial-led growth hypothesis”, *Saving and development*, t. XXIII, No. 3, p. 286.

### 3. Financial liberalization and Economic Growth in Tunisia: Empirical Evidence

Before causality test Granger (1969), it is necessary to carry out preliminary tests. These are stationary test variables and no cointegration between the variables in pairs to avoid spurious regression. The presence of a cointegration relationship between the variables leads us to estimate the vector error correction model dedicated to adjust the estimation bias induced by the cointegrating relationship.

### Stationary series and order of integration

The stationarity of the series is an underlying assumption for the operation, for statistical inference needs, estimators (Student t, Fisher statistics, etc.). However, the majority of macroeconomic series are not stationary. For this reason, it is essential to conduct the study of stochastic properties of the series.

A time series  $X_t$  is called stationary if the following three conditions are satisfied:

1.  $E(X_t) = \mu$
2.  $Var(X_t) = \sigma^2$
3.  $Cov(X_{t-s}, X_t) = \gamma_s$

These conditions stipulate that the first two moments of the variable and its covariance with its past values are invariant with respect to time. When a series checks these properties, it is said to be integrated of order 0 and we note that:  $X_t \sim I(0)$

A series that is not  $I(0)$ , that is to say not checking 1, 2 and 3, is called non-stationary. Granger C. (1969) has shown that any set may be stationary if it is differentiated a sufficient number of times. Thus, when it is necessary to differentiate  $d$  times to make  $I(0)$ , then this series is said integrated sequence of order  $d$  that can be written  $X_t \sim I(d)$ . Econometricians have a set of instruments to check whether a series is stationary or not and determine, where appropriate, the order of integration.

The test most commonly used to determine the stationary or not a series  $X_t$  is the Augmented Dickey and Fuller test (ADF). This test is based on the estimation of the following regression:

$$\Delta X_t = \beta_0 + \beta_1 T + \beta_2 X_{t-1} + \sum_{i=1}^k \theta_i \Delta X_{t-i} + \varepsilon_t \quad (3)$$

In this equation:  $\Delta$  is the first difference operator,  $T$  is the trend and  $\varepsilon_t$  is a normally distributed error term. If no difference  $X_t$  is introduced into the right side of the equation (4-2), then this is the test of Dickey and Fuller (DF) is used. Otherwise, its enhanced version is used. In equation (3), the null hypothesis  $H_0: \beta_1 = 0$ ; it is tested against the alternative hypothesis  $H_1: \beta_1 \neq 0$ . If the t-ratio calculated is less than the critical value of  $t$ , then the null hypothesis of the existence of unit roots is rejected. In this case the time-series level is  $I(0)$ . In this work, we will use the ADF test to determine the nature of the series used and their integration orders.

From the table below, it emerges that for degrees of significance 99%, 95% and 90% of financial liberalization and economic growth are non-stationary in level in some countries (the null hypothesis is accepted). Thus, it is necessary to stationarize both series by a differentiation process.

The use of the ADF test, we found that the calculated values of the ADF statistics, in almost all are below the critical values for the first differences of the variables (the null hypothesis is rejected). Therefore, the two variables (FLI and LNGDP) become stationary in the first difference.

The first step is to check the stationarity properties of our series with this test. The results are reported in the following table. These results below assume that all variables used in the estimates, in particular, GDP and ILF are stationary in first difference.

The results of the stationarity test are summarized in the table below.

**Table 9.** Stationarity tests (ADF): 1980-2014

Country	Variables	Constant	Trend	ADF test value	Critical Value 5%	Decision
Tunisia	GDP	No	No	3.830	-1.951	-
	DGDP	No	No	-1.912	-1.610	I(1)
	ILF	No	No	0.603	-1.951	-
	DILF	No	No	-3.192	-1.951	I(1)
	GDP	Yes	Yes	-2.757	-3.552	-
	DGDP	Yes	Yes	-3.857	-3.557	I(1)
	ILF	Yes	Yes	-0.814	-3.552	-
	DILF	Yes	Yes	-4.053	-3.557	I(1)
	GDP	Yes	No	0.732	-2.954	-
	DGDP	Yes	No	-3.931	-2.957	I(1)
ILF	Yes	No	-1.500	-2.954	-	
DILF	Yes	No	-3.710	-2.957	I(1)	

Source: Our calculations.

In general, results of the ADF tests indicate that the two time series are not stationary in level. However, the ADF test applied to the first differences reject the null hypothesis of unit root. Thus, LNGDP and FLI variables were included in the order one (I (1)), which is an important first step for the application of the approach VAR and cointegration tests.

Before estimating the model, we had to determine the optimal number of delay. To do this we used the method information criterion because of its accessibility on Eviews. We selected the number of late that minimizes information criteria, is 1.

**Table 10.** Choice of number VAR lags

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-46.99158	NA	0.089851	3.266106	3.359519	3.295989
1	<b>56.28884</b>	<b>185.9048*</b>	<b>0.000120*</b>	<b>-3.352590*</b>	<b>-3.072350*</b>	<b>-3.262939*</b>
2	57.73210	2.405424	0.000143	-3.182140	-2.715074	-3.032722
3	60.68534	4.528305	0.000155	-3.112356	-2.458464	-2.903170
4	61.35337	0.935239	0.000198	-2.890225	-2.049506	-2.621272
5	67.30664	7.540806	0.000180	-3.020442	-1.992898	-2.691722
* indicates lag order selected by the criterion						
LR: sequential modified LR test statistic (each test at 5% level)						
FPE: Final prediction error						
AIC: Akaike information criterion						
SC: Schwarz information criterion						

### 3.1. Cointegration and Error Correction Model

If we find unit roots in  $X_t$  and  $Y_t$  then the causal relationship between the two variables will be estimated in adequate delays levels and not to remove their non-stationary character. Relating the levels of the two series, in turn, will be investigated by the technique of cointegration. This reasoning stems from a simple observation. Thus, two economic phenomena may diverge in the short term and long term converges. This means

that the forces binding the long term with the possibility of removal of the equilibrium path in the short term.

$X_t$  and  $Y_t$  are cointegrated say if they are integrated of the same order and the residue obtained from their co-integration equation is stationary. The stationarity is tested using the test DF increased called ADF test. In cases where the residue is stationary, then the two sets are called cointegrated. According to the representation of Engel's theorem and Granger (1987), error correction models (ECM) possible to capture with a single specification of the long-term and short-term bonds that exist between the two variables.

However, the representation of Engel and Granger (1987) is restrictive because it identifies only one cointegration relationship. Also it has been criticized especially at the results found (biased). So, to avoid problems in terms of our results, we apply the Johansen method.

Table 11 presents the cointegration test indicates a long-term equilibrium relationship between the index of financial liberalization and economic growth.

**Table 11.** Johansen Cointegration Test

Unrestricted Cointegration Rank Test (Trace)				
Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**	
0.465004	24.96637	20.26184	0.0104	
0.122836	4.325012	9.164546	0.3659	
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.465004	20.64136	15.89210	0.0083
At most 1	0.122836	4.325012	9.164546	0.3659

**Source:** Our calculations.

The normalized relationship is:

$$DLNGDP = -0,156DFLI - 7,722$$

This model means that a 1% increase in the index of financial liberalization in Tunisia generate long-term 0.15% decrease in real GDP per capita.

At the end of this table, the hypothesis of no cointegration between economic growth (LNGDP) and financial liberalization (FLI) is accepted for Tunisia. In other words, the analysis of the trace and the maximum eigenvalue leaves appear a cointegration relationship in the confidence interval of 5% of probability test.

The existence of the cointegration relationship justifies the adoption of an error correction model according to the following representation of the model:

$$\Delta \ln pib_t = \beta_1 \Delta ilf_t + \beta_2 (\ln pib_{t-1} - ilf_{t-1}) \quad (4)$$

The coefficient means the force of a return to equilibrium which must be negative and significant to accept the specification of the Vector Model Error Correction (VECM) presented, from our calculations, in the following table.

**Table 12.** *Estimated VECM model*

<b>Cointegrating Eq:</b>	<b>CointEq1</b>	
LNGDP(-1)	1.000000	
FLI(-1)	-0.191019 (0.03627) [-5.26725]	
<b>C</b>	-7.165830	
<b>Error Correction:</b>	<b>D(LNGDP)</b>	<b>D(FLI)</b>
CointEq1	-0.047256 (0.01755) [-2.69323]	0.319134 (0.31848) [1.00204]
D(LNGDP(-1))	-0.168489 (0.17309) [-0.97340]	0.299180 (3.14187) [0.09522]
D(FLI(-1))	-0.010774 (0.01007) [-1.07021]	0.195958 (0.18273) [1.07242]
<b>C</b>	0.027713 (0.00592) [4.67788]	0.124697 (0.10753) [1.15960]
<b>R-squared</b>	0.210238	0.060825
<b>Adj. R-squared</b>	0.128539	-0.036331
<b>Sum sq. resids</b>	0.016649	5.485419
<b>S.E. equation</b>	0.023961	0.434917
<b>F-statistic</b>	2.573314	0.626058
<b>Log likelihood</b>	78.44140	-17.21714
<b>Akaike AIC</b>	-4.511600	1.285887
<b>Schwarz SC</b>	-4.330205	1.467282
<b>Mean dependent</b>	0.022163	0.163455
<b>S.D. dependent</b>	0.025667	0.427225
<b>Determinant resid covariance (dof adj.)</b>		0.000105
<b>Determinant resid covariance</b>		8.08E-05
<b>Log likelihood</b>		61.84345
<b>Akaike information criterion</b>		-3.142027
<b>Schwarz criterion</b>		-2.688540

Moreover, in our study and in the estimation of economic growth on the composite index of financial liberalization, it seems that the coefficient of the restoring force was very negative, which allows relatively confirm the validity of the model vector error correction. It is noted that in case of short-term imbalance, economic growth in Tunisia fits with convergence rate of 4.7%.

### 3.2. Determination of Granger causality

In its contribution in 1969, C. Granger developed the idea of the causal concept by using the criterion of predictability. So, if you have two time series  $X_t$  and  $Y_t$ , then  $X_t$  cause  $Y_t$  because if the future values of the latter are better predicted from past values of  $X_t$ . The criterion chosen to decide the quality of the forecast is the variance of the squared error associated with the regression of  $Y_t$  on  $X_t$ . Causality from  $Y_t$  to  $X_t$  is defined in a similar manner.

Practically, C. Granger proposes to compare the quality of the forecast  $X_t$  taking only its own past values and that when we introduce past values of  $Y_t$  next to those of  $X_t$ . In this work, we will try to see the causality between real variables and financial variables which makes that every time  $X_t$  and  $Y_t$  are a real variable (economic growth) and a financial

variable (financial liberalization). VAR representation used to test the causality between financial liberalization index (FLI) and economic growth (LNGDP<sub>t</sub>) is as follows:

$$FLI_t = \sum_{i=1}^n \alpha_i FLI_{t-i} + \sum_{i=1}^n \beta_i LNGDP_{t-i} + \varepsilon_{1t} \quad (5)$$

$$LNGDP_t = \sum_{i=1}^n \lambda_i FLI_{t-i} + \sum_{i=1}^n \theta_i LNGDP_{t-i} + \varepsilon_{2t} \quad (6)$$

n: the number of lags

With  $\varepsilon_{1t}$  and  $\varepsilon_{2t}$ : uncorrelated white noise. The test of the null hypothesis  $H_0: = 0$  for  $j = 0, 1, 2, \dots, n$ , against the alternative hypothesis  $H_1: 0$  for at least some values of (i) is evidence of some causality between the series  $X_t$  and  $Y_t$  series.

Granger causality test assumes stationarity  $X_t$  and  $Y_t$ . No stationarity of the series, when not corrected, will lead to spurious regressions as demonstrated by *Granger and Newbold (1974)*. Another more serious problem of the non-stationary series is the irrelevance of t-Student statistics, t-Fisher and  $R^2$  for statistical inference needs. For both these reasons, if the series are not stationary, ie contain unit roots, it is necessary to determine the order of integration and use an appropriate filter to make them stationary.

The corresponding results are given in Table 13. Reading this table shows that the causality between financial liberalization and domestic production is not systematic. First, the results of this test reveal the one hand, an unambiguous causal link between FLI and LNGDP variables.

In 1966 Patrick are two of a country economic development phases. In the first phase, the development of the financial sector promotes and influences economic activity. That said, we are in the presence of a phenomenon „resulting supply” (supply leading) where financial deepening moves the resources of a traditional sector into a modern and dynamic sector (*Schumpeter, 1912*). In the second phase, when the financial markets become more liquid and less risky, then the direction of causality is reversed and it is made of production to finance (Gurley and Shaw, 1960). That said, we are in the presence of a phenomenon „demand driven” (Following demand). Tunisia is in the first phase and the direction of causality is realized the financial sector to the real sector.

**Table 13.** Causality test results with one lag, 1980-2014

Null Hypothesis:	Obs.	F-Statistic	Prob.
FLI does not Granger Cause LNGDP	34	4.67514	0.0384
LNGDP does not Granger Cause FLI		0.63553	0.4314

**Source:** Our calculations.

Thus, the direction of causality between the real economy and the financial sphere depends on the structure and specificity of the studied economies. The tests show that for some countries the causal relationship is non-existent, this is explained by a rudimentary financial system, administered and suffers from embryonic and almost missing the stock market. These results can be explained by the fact that the mechanisms of current financial systems are still unable to direct and allocate savings into efficient and profitable investments.

#### 4. Conclusion

In this study, we sought to examine the causal relationship between financial liberalization and economic growth in Tunisia during the period 1980-2014 and on the basis of data from the World Bank, the causality test Granger has been done. Indeed, the starting point that guided our research was to verify whether there is a causal link between financial liberalization and economic growth and expiring case whether this causality is unidirectional or bidirectional. To do this, the index of financial liberalization in Tunisia was built in six steps involving different policies implemented during the liberalization process. The liberalization index is based on the factorial method. . The financial liberalization index in Tunisia shows that the 1987-1997 decade was the period in which most of the financial liberalization measures were implemented in Tunisia.

Exploring this thread led us to ask the assumptions that there would be a causal relationship between the two spheres; it would go to one direction or both directions between pairs of variables.

To achieve the objective of our research, three types of tests are performed in order to investigate the causal sources. This is the stationarity test, cointegration test of Johansen, and Granger causality tests.

The main results of our research are:

- Both variables (LNGDP and FLI) are stationary in first differences;
- For Tunisia, the pair of variables (LNGDP and FLI) is cointegrated; it evolves together and therefore shows a long-term relationship at least in one direction;
- We estimated the correction model  $d4\text{erreur}$  which aims to account in the same equation of a possible deviation from a long-term balance and short-term adjustment process that balance;
- The Johansen cointegration test reveals that long-term financial liberalization has a negative impact on economic growth in Tunisia, showing that a 1% increase in the index of financial liberalization would lead to a reduction in growth of 0.15 %;
- In the case of Tunisia, the Granger causality test indicates a unidirectional causality between the pair of variables (the financial liberalization index and real GDP per capita).

The causality test in the error correction model, mainly in Tunisia shows that the financial sector “causes” the real sector.

Ultimately, the relative predominance of as casual relationship from financial liberalization on growth „supply leading” in the terminology of Patrick is partly explained by the fact that the Tunisian banking system is still underdeveloped, unable to meet requirements of financial intermediation and the preponderance of informal financial mechanisms.

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## **Public target space as key factor for public policy implementation**

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**Abstract.** *The present study focuses on reducing the potential failures met while implementing a new public policy .A determining element for the success of implementing a new public policy, as we are going to demonstrate in this study, is the compatibility between the model of the proposed public policy and the target public space, characterized by a high degree of inertia and manifest tendencies when maintaining the status quo.*

*How could there be a compatibility, on the one hand between a public policy whose vision is based on the changing of institutions, organisations and people, and on the other hand the unreformed public space, aligned to obsolete guidelines?*

*Which are the necessary approaches to achieve compatibility between the models of policies and the target space? What strategies must be chosen?*

*How must efforts and the resources in the public space be calibrated and oriented so that they become compatible with the model chosen by the policy-makers?*

*The answers to these questions constitute the main objectives of this study, and the approach initiated to accomplish that meant, firstly, configuring a link between the strategic thinking on which elaborating a public policy is based, the different typologies of the target public space and the calibration of the efforts and resources pegged to them.*

**Keywords:** target public space, policy process, adaptive organizational, culture of target public space.

**JEL Classification:** O2, O3.

### 1. Target public space and public policy model

The chosen policy elaboration model and the target public space. This can either mean that technical solution proposed by researchers to be applied within the target space are totally unrealistic or that within the target space there are areas of confusion, instability, unpredictability where the model chosen by policy makers cannot be applied. In these terms *the swamp* represents the reality of complex and uncertain situations. Ron Amann says that within this *swamp* areas of *solid ground* can be identified in which *serious actions* of supporting both policy elaboration modernizing and policy implementation *can take place* (Parsons, p. 41). We see the solid ground described by Ron Amann as representative for the simple and uncertain issues.

Public policies are bearers of values which emerge from the political management's vision on future evolutions of the target public space. Public management is responsible with formalizing, disseminating and creating the climate in which the vision and values will be agreed upon by all actors part of the target space.

Assuming such a behavior by the political management shall positively influence the chosen model for the policy elaboration (see Figure 1).

Within the current context, exigencies aim at democratizing and opening the public policies process; this involves eliminating distortions and testing perceptions and hypotheses by debates, arguments and talks. In other words, elaborating public policies should turn into a public learning process.

Figure 1. Strategic concepts of public policies



Source: Popescu, 2005.

This hypothesis leads to the rational model formulated by H. Simon (1945), adequate to a target space in which issues are linear, simple and certain and which is compatible with traditional bureaucratic structures (see Figure 2a).

The trends of using the rational model have been limited as it became more and more obvious that real world phenomena and events do not follow a linear pattern and therefore, disassembling and reassembling them is no valid solution for an ever changing world.

In this case, strategic thinking imposes the intuitive model, fundamented just on the experience, hunch and intuition of the deciding parties and not on exact analyses (see Figure 2b). Intuitive decisions are taken on the basis of proofs and lessons learned *from*

*the previous successes/mistakes*; this represents a return to the past despite the „new” and „modern” rhetoric (into a past where a better policy elaboration means elaborating policies on the basis of improving the instrumental rationality). This is the proof-based approach on policies, for which knowledge is the means to control unstable, high-risk situations. From this perspective, the intuitive strategic approach underlines not just a step forward but especially *the best way to what works*.

The 'what works' philosophy is a real opportunity for social sciences to influence the public policies process after a long period in which they were seen as irrelevant (Parsons, 2002, p. 42).

Making the proof-based policy elaboration model compatible with the target space involves strategic approaches oriented towards:

- *academic research*. The challenge consists of influencing *the production of relevant knowledge* so that it can be reproduced in a shape that can be used by policy makers. The proof-based approach trend is, by excellence, a quantitative approach.
- *professional and organizational expertise*. Focusing efforts and resources is meant to contribute to the development of both the system which can facilitate a better learning management and to the governmental- and departmental-level knowledge.

The common characteristic of the two management types is that they are likely to be explicit and encoded. Proof can be aggregated and disseminated within the whole target space. Starting with a certain level this means, on one hand, that structures and procedures are created so that the institutional modes of „knowing what works” and of „learning” can be extracted, stored, found and communicated and, on the other hand, that academic research has to be produced and disseminated according to clear specifications (Parsons, 2002, p. 46).

Speaking about the proof-based approach, W. Parsons thinks that its opportunity to contribute to the improvement of governing is pretty slim, its contribution consisting, in fact, in making relationships between *knowledge* and *policy making* even more confuse.

We can draw the attention, in supporting this point of view, to the existence of leveling risk, simultaneously with the almost complete neglect of the creativity- and innovation-oriented undertakings (Miroiu and Andreescu, 2010).

Thus, the center of gravity in the proof-based health policy is represented by illness and standard procedures for treating the respective illness. The center of gravity of the health policy in fact should be the patient (and not the illness) whose reactions cannot always be standardized. Every patient has his own representation of the way he feels the state of illness. Another example is that of education; imposed regulations and standards tend to level the educational process.

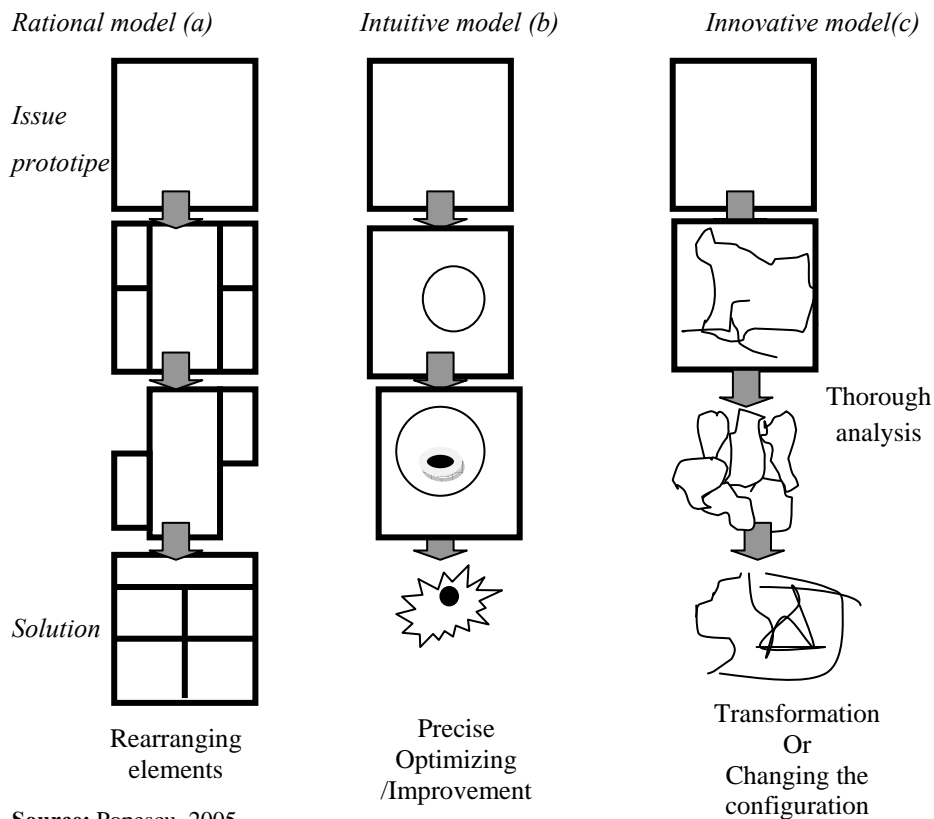
In conclusion, we can say that, aside for certain undisputed contributions, the proof-based approach negatively affects innovation, creativity and, by default, competitiveness. The policy should not be guided by „dogma” but by the knowledge of „what works and why”. All proof/knowledge are necessary to policy makers „in order to allow them to measure the effect of A over B.”

On the other hand, the advantages of proof-based approach consist of rapid change implementation which is to positively influence other areas. The relatively fast change potential, visible and measurable impact have been the main criteria in choosing the transformational areas. There are good practice examples and successful institutional or managerial models both in Romania and in the region that can serve as a model. Poland, for instance, is a very good model in many fields, starting with the way it solved the issues of its state enterprise sector up to the way it attracts and implements investment projects financed by European funds.

Without minimizing the contribution of this type of approach, we think it is important to underline the fact that *the what works only approach* is not of nature to ensure the success of the implementation process, especially in the case of uncertain and complex situations, most frequent in the world we live in.

We appreciate we can compare the swamp Schon refers to with this ever changing reality facing complex and uncertain issues for whose solving scenarios have to be imagined different from the ones existing. In these conditions, exigencies deriving from current imperatives lead to the reconfiguration of the target space in a way meant to stimulate innovative thinking (see Figure 2c)

**Figure 2.** Strategic public policy elaboration models



In a 2014 Financial Times interview, Nobel laureate Edmund Phelps stressed that, aside from the financial crisis, Europe's issue consists of the fact that politicians blocked innovation or reduced bonuses for those willing to innovate. After a major slowdown in dynamism in the 60s, the productivity increase rhythm dropped in almost all Western states, halved in the US in the 70s and almost stopped in France, Germany and the UK in the end of the 90s.

Politicians introduced regulations repressing competition – presided over interest groups, diverting advantageous contracts towards them. They have blocked innovation or cut down incentives for those eager to innovate. Thus, despite a more and more pregnant need of innovative models, the officials' answer is still long in coming. The success of implementing new innovative models in the target public space involves, according to the supposition from the beginning of this chapter, the *increase* of the target space up to the level it can answer to as higher a number of challenges (cognitive, informational, resource limitation, behavioral and cultural) as possible, associated to the initial innovative policies. The risk of an implementation failure is determined by directing resources and efforts to other directions than those appropriate to surmount challenges. In other words, neglecting or ignoring the compatibilization of the target space with the new introduced by the public policy initiated leads to major malfunctions that can go all the way to totally compromising the public policy project. Out of the plethora of challenges we underline culture, that is the values of the target public space, which, in our opinion, are the most difficult to get consistent. According to Lasswell's theory, values represent the essence of a public policy. More than that, he sees values as true obstacles that can affect the objectivity of the perspective on what works (Lasswell, 1951).

## 2. Target public space: from culture to action

In order to grasp all the implications we will analyze the essential aspects of the target space.

An organization is not only a conglomerate of people and resources. It is a set of values and hypotheses determining its own climate and organizational culture. Moreover, the maturity of an organization positively reflects upon the organizational culture.

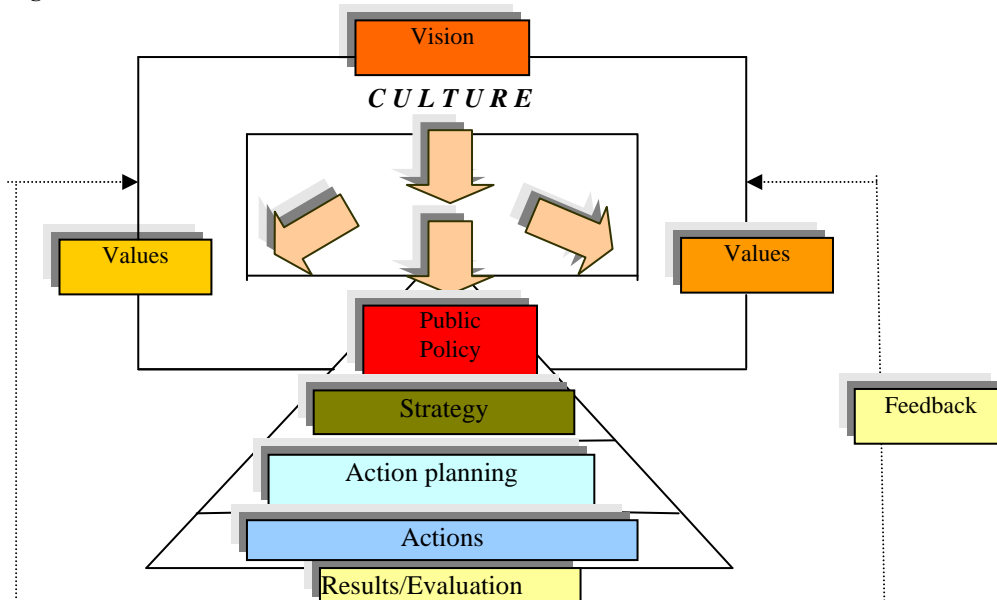
Irrespective of the way they are structured, organizations are not lifeless machines. The people involved, their experience in the organization's past, their own beliefs and values system, all contribute to the liveliness of the organization. As it gathers knowledge and manages to solve the complex issues it faces, the organization matures. *Culture beareres* can likewise be change drivers or elements of maintaining *the status quo*, function of the values they explicit by their manifest behavior (and not by the values they publicly state they support). We underline the fact that the success of any type of public policy is strictly conditioned by changing the culture of the target public space, in the sense of political socialization. Culture is the way members of a group communicate both among them and with other groups within the society. Behaviors, habits, practices, values, beliefs and common visions of the future are emphasized in the progress of the

communication process. The target space culture reflects and becomes palpable if initiated policies are turned into actions.

The importance of a new culture, formulated together with the transformation targeted by implementing a public policy, consists of the facets of the change project. Sequential implementation of just those new practices seeming more useful or with a higher degree of suitability, can have remarkable short-term effects. Fragmented effects cannot however support long-term performance. For instance, consumer protection policies can only be successful on the short term, with the lack of a solid consumer culture.

The result of completing the concepts illustrated in Figure 1 with these considerations appears in Figure 3. Just the organizational environments compatible with the public policies – these promoters of the new and of change – are capable or acknowledging the importance of the newly promoted values.

**Figure 3.** *From culture to action*



**Source:** Popescu, 2005.

From this perspective, the organizational analysis brings forth *the adaptive organization*, characterized by:

- sophistication and maturity; flexibility and not rigid bureaucracy;
- proactively;
- motivational mechanisms promoting openness and engagement towards the organization;
- cooperation climate favoring teamwork;
- interest for being open towards the community;
- decisional transparency;

- Constant preoccupation for the development of the organization so that it can be capable of permanent changes.

Efforts and resources have to be therefore assigned towards the development of the target space, including from a cultural perspective.

### 3. Cultural diversity of target public space

The public space culture, defined as a conglomerate of cultures belonging to the actors involved (public organizations, business organizations, civic organizations, local communities' and societal ones interested in a certain public policy), has to be harmonized with the values and ethics that the public policy promotes while making way through the Scylla of goodwill and Charybda of bureaucracy. This is a difficult process in need of a strong culture.

The force of a culture resides in its real contents and the adequacy of the solutions found for the public policies' issues. A strong culture assumes the consent of actors on the way a public policy has to be elaborated, implemented and evaluated.

A strong culture does not mean unconditional acceptance but consensus on values and attitudes. Building such a culture involves time and substantial efforts for its learning and consolidation. Target public space is a complex structure, network type, composed of all the actors that defined it and are involved in the implementation process. We will call this structure, meta-organization.

In other words, meta-organization is a conglomerate of private and public organizations, national, international and transnational. Its culture is the common place of cultural diversity that should provide coherence and consistence to the complex structure it defines. Public and private, national, international, transnational NGOs are accepted into the complex, network-like structure characteristic for public policies.

Despite the fact that one does not attempt to level these cultures, it is necessary for a certain compatibility to exist. It involves the engagement of entities, component of the meta-organization, into intense efforts directed to creating a new value - and beliefs-based culture, adequate to the success of the public policy projects.

Diminishing societal performance is a result of the difference between the environment opportunities and the ability to promote public projects that capitalize these opportunities. The improvement of public projects' quality, of future evolutions and real-time risk-taking forecasts represent the ability to eliminate this disparity.

In these conditions, the mechanist cultural model, characteristic for the bureaucracy, is totally outdated. The cultural model of the organic organization is the one towards which all the initiatives of changing the organizational culture of meta-organization members should be directed to.

For an overwhelming majority, the only answer of the bureaucracies to the various and serious issues they face is to create new institutions and elaborate new projects in the hope of overcoming challenges and solve issues.

Such an approach does not, most often, offer the expected satisfaction, due to erroneous circumstances on which answers are initiated – that is one attempts to solve a behavioral issue by a structural solution. Cases are frequent when institutions wait for the replacement of existing programs with new ones; unfortunately, in their implementation the same routines are used, favoring the “same clientele”.

While responsible bureaucracies, the so-called *learning organizations* are preoccupied by the value they add to the processes they develop, the above-mentioned organizations only become active when signals appear referring to the necessity of giving up satisfying the “clientele”.

The public policies' responsible have not only to quickly accumulate innovative and creative capabilities necessary for the definition of new horizons, but also to facilitate turning them into practice. In other words, one has to give up the old paradigms and total engagement, in spirit and action, within a long-term-defined change process, in the sense of complex systems' management exigencies.

The situations in which no differences appear between the cultures of actors participating in the implementation of a policy are desirable and coincide with the situation in which the entities have a common corporate past. Certitudes, aspirations and behavior are specific and reflect the activities undergoing within the entity, but preserve the general features identical with the culture of the meta-organization. It is essential that between the base culture and the cultures of the actors should not appear too considerable differences or irreconcilable conflicts. In the absence of solid arguments the cultural leveling attempt is a source of conflicts.

Sometimes, considerable cultural differences among entities obstruct communication and cooperation among them or with various expert groups participating in the public policies project. Public policies management favors this kind of cultural diversity as long as it does not affect the implementation (Popescu, 2005, pp. 269-271).

Dedicated surveys have proven that public organizations that benefit from an adaptive culture experience a remarkable growth from the perspective of the development of the public policies process they take part in, if compared to the institutions that do not enjoy such a culture.

Any meta-organizational culture is formed of, as previously mentioned, the cultures of those participating entities in public policies. A meta-organization culture may become superimposed on the cultures of participating entities in public policies when those entities share a mutual past. Beliefs, aspirations and behaviour are then characteristic and reflect the activities carried on within the respective entity by keeping up with general features that are identical to the meta-organization culture. What's essential is that no major discrepancies or irreconcilable conflicts occur between the basic culture and the cultures of the players.

Huge cultural differences between entities may sometimes impede communication and cooperation among them or with different expert groups who take part in the public policy project. Public policy management favors such cultural diversity kinds, as long as they do not have any effect on the best development of the public policy process.

Any attempt to achieve cultural uniformity without appealing to sound arguments is a source that generates conflict. It is necessary to give up the old paradigms and to assume total commitment, in spirit and deed, as part of a long-term process of change, which means to meet the demands of a complex system management.

Against the background of a strong organizational culture, the team players of a public organization give up their old mentalities exclusively defined as their expectancy for material incentives and rewards, and favor new mentalities where personal expansion is prevalent.

Relationship developed under these conditions is far stronger than associations exclusively based on material reward. Moreover, this type of connecting tends to create true networks within the organization. If this networking is subject to pressures from driving forces, the effect will be the expected one, i.e. will entail change of the organizational culture.

The relevance of the new culture consists in the implications that arise from implementing the change project. Sequence implementation of those new practices that seem best fit, more useful and with a higher degree of appropriateness, can have outstanding short-term effects. Disjointed efforts cannot sustain long-term performance.

To this end, total commitment is needed in approaching the new public management, which will favor reduction of cultural differences and ultimately the growth of a new culture to substantially contribute to achieving performance expertise, and increased institutional capacity towards the development of new effective public policies.

#### **4. Conclusion**

By this study we tried to bring to attention the implementing barriers caused by a target public space stuck in a time warp, and which refuses to accept the new thing represented by the public policy.

More than that, the values, whose vectors are represented by the public policies, are considered a real obstacle that might affect the objectivity of the perspective on what functions, because the new characteristics which should be taken into consideration when elaborating policies necessarily implies changes at the level of the actors composing the target space.

These new requirements focus on the democratization and opening of the process of public policy, which means eliminating distortions and testing perceptions and hypotheses through debates in the public arena

In other words, formulating public policies should turn into a process of public learning. Fulfilling these requirements raises a new issue that is whether the vectors of change (organisations, authorities and officials) are able to pressure for changing and adapting to the present context, more and more precarious and less predictable.

In conclusion, the vectors of change must be able not only to transform their organisations as a reaction to changes confronting our modern world, but also to create and develop organisations as real learning systems that are able to continue to transform.

To this purpose, total engagement in the approaches of the new own public management is necessary, which will favour the diminishing of cultural differences, and lastly the development of a new culture that will contribute substantially to achieving professionalism, performance, to increasing institutional capacities in order to develop national policies at a level similar to the European/international one.

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## The relationships among the returns of investment instruments: a vector autoregressive approach for Turkey

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**Abstract.** *This paper that uses monthly data from 2003:M01 to 2016:M07 investigates the relationships among monthly real rates of return of stocks, USD, one-month deposits, and gold in Turkey by employing vector autoregressive (VAR) analysis. The findings of the paper indicate that while stocks seem to be a good investment instrument against USD and gold, USD is a good investment instrument against stocks and one-month deposits. Besides, gold is a plausible investment instrument against one-month deposits. Therefore, the paper yields that only stocks and USD are good investments instruments against each other in Turkey. In conclusion, the paper reveals that financial market participants in Turkey do not consider short-term fluctuations of returns of assets very much and that they may be interested in the long-run return of an asset.*

**Keywords:** Financial and non-financial assets, return of financial investment instruments, vector autoregressive analysis.

**JEL Classification:** C32, G11, G23.

## 1. Introduction

Financial markets experience a rapid change in today's world. Within this scope, financial markets and the variety of financial assets in these markets continuously develop. As is known, economic actors whose incomes are greater than expenditures invest in financial markets in order to make use of their savings. Investors in financial markets may invest in more than one investment instruments to utilize returns of different investment instruments and to decrease investment risks. In other words, they may diversify their portfolios. In developed countries, stocks take place on the top among these instruments as investors can invest in many firms' stocks from different sectors in stock markets (Yildiz, 2014). However, stock markets are considered as mixed and risky markets. Short and long-term interest rates on bank deposits present interest incomes to their investors. Investors who desire relatively safe return prefer deposits in financial markets. One of the basic investment instruments in financial markets is gold. Gold is seen as a safe harbor and is especially preferred by investors when there exist uncertainty and crises. Investors can also make money by investing in different currencies.

Movements in prices and yields of financial instruments affect both current incomes and future financial decisions of investors. Within this scope, an increase in interest rates may decrease investments in foreign exchanges and stock markets (Senturk and Ducan, 2014). Besides, some investors who want safety usually invest in bonds and/or deposits. On the other hand, some financial market participants invest in gold to decrease risk and to defence themselves against volatility in financial markets.

This paper aims at examining the relationships among monthly returns of stocks, USD, one-month deposits, and gold over the period 2003-2016 for Turkey. The remainder of the paper is structured as follows: Section 2 gives empirical literature. Data are introduced in Section 3. Section 4 presents estimation methodology. Estimation results are reported in Section 5. Section 6 concludes the paper.

## 2. Brief literature

When one examines the empirical literature on the returns of investment instruments, he/she will observe that many papers have been conducted so far. He/she will also observe that these papers have focused on the relationships among stocks, deposits, foreign exchange, and gold.

Najand and Noronha (1998), using data over the period 1977-1994 for Japan, examine the causal relationships among return of stocks, inflation, interest rates, and industrial production. They yield that inflation Granger causes return of stocks in Japan. Gjerde and Saettem (1994) examine the macroeconomic variables that affect return of stocks for the period 1974-1994 for Norway through a vector autoregressive (VAR) analysis. They find that return of stocks is negatively related to interest rates and is positively related to industrial production. Koch and Saporoschenko (2011) investigate the relationships among return of stocks, interest rates, and exchange rates over the period 1986-1992 for Japan by performing a generalized autoregressive conditional heteroscedasticity (GARCH) model. According to the findings of the paper, an increase in interest rates

negatively affects return of stocks. Rapach et al. (2005) consider the predictability of return of stocks in 12 industrialised countries for the period 1970-1990 using some macroeconomic variables, such as interest rates, inflation rates, industrial production index, money stock, and unemployment rates. They yield that all these variables can be employed to forecast return of stocks. Abugri (2008) examines the effects of exchange rates, interest rates, industrial production, and money supply on return of stocks for the period 1986-2001 in four Latin American countries (Argentina, Brazil, Chile, and Mexico) by conducting VAR analysis. The findings of the paper reveal that all variables have effects on return of stocks.

In addition to these papers, several studies have been conducted in order to examine the relationships among returns of investment instruments in Turkey. The papers mentioned in the rest of this section have focused on Turkish financial markets. For instance, Karaca (2005), who uses data covering the period 1990-2005 and employs ARDL method, examines the relationships between interest rates and exchange rates and finds out that there is a weak and positive relationship between these variables only for the period 2001-2005. Kasman et al. (2011) explore the effects of interest rates and exchange rates on return of stocks of Turkish banks for the period 1999-2009 by employing ordinary least squares (OLS) and GARCH. They yield that return of stocks is negatively related to interest rates and exchange rates. Aksoy and Topcu (2013), using data over the period 2003-2011, analyse the relationships among return of stocks, government bonds, and gold and find out that return of stocks is negatively related to return of gold. Yildiz (2014) investigates the relationships among stock prices, interest rates, exchange rates, and gold prices using data over the period 2001-2013 by way of VAR analysis. They yield that stock prices are negatively related to interest rates and exchange rates. Senturk and Ducan (2014), who use data for the period 1997-2013 and perform VAR analysis and Granger causality test, examine the relationships among interest rates, exchange rates, and return of stocks. The findings of the paper indicate that i) return of stocks is negatively related to interest rates and exchange rates, ii) interest rates are negatively related to return of stocks and exchange rates, iii) exchange rates are negatively related to return of stocks and positively related to interest rates. The findings also show that there is unidirectional causality running from exchange rates to return of stocks and from interest rates to exchange rates. Oncu et al. (2015) examine the relationships among stock prices, gold prices, and exchange rates using data that covering the period 2002-2013. They yield that i) exchange rates Granger cause stock prices and ii) gold prices Granger cause stock prices and exchange rates.

### 3. Data

This paper performs a time series analysis for Turkey using monthly data from 2003:M01 to 2016:M07 in order to examine the relationships among monthly rates of return of some financial and non-financial assets (%). While financial assets are stocks, US Dollar, and one-month bank deposits, the non-financial asset is gold in this paper. BIST100, USD, DEPOSIT, and GOLD represent the monthly real rates of return of stocks, US Dollar, one-month deposits, and gold, respectively. Thereby all rates of return are adjusted for changes in consumer prices. All data are extracted from Turkish Statistical Institute.

**Table 1.** Descriptive statistics and correlation matrix

	BIST100	USD	DEPOSIT	GOLD
Descriptive statistics				
Mean	0.742	-0.247	0.604	0.346
Median	0.600	0.480	0.410	-0.170
Maximum	44.900	23.400	16.200	27.300
Minimum	-34.400	-20.200	-3.800	-12.090
Std. deviation	10.540	4.101	1.695	5.005
Observations	163	163	163	163
Correlation matrix				
BIST100	-	-0.312	0.035	-0.305
USD	-0.312	-	-0.205	0.601
DEPOSIT	0.035	-0.205	-	-0.019
GOLD	-0.305	0.601	-0.019	-

Table 1 reports descriptive statistics and correlation matrix for variables. One notes that all descriptive statistics of BIST100 except for minimum are greater than those of other variables. One notes, as well, BIST100 is negatively correlated to USD and GOLD and is positively correlated to DEPOSIT while USD is negatively correlated to DEPOSIT and is positively correlated to GOLD. Finally, he/she notes that DEPOSIT is negatively correlated to GOLD. Descriptive statistics and correlation matrix can provide one with some initial inspection, but one should consider some statistical methodologies to obtain more efficient estimations.

#### 4. Methodology

##### 4.1. Unit root tests

Specifying the order of integration of variables is the first step in time series analyses since one may experience spurious regression problem when analyses employ conventional ordinary least squares (OLS) estimations.

Unit root tests developed by Dickey and Fuller (1981, hereafter ADF) and Phillips and Perron (1988, hereafter PP) are commonly utilized in econometrics literature. The main shortcoming of these tests is that they do not take into account possible structural breaks in series. However, it should be considered that series may have structural breaks before a long-term relationship among variables is investigated.

Narayan and Popp (2010) propound a unit root test with two structural breaks endogenously determined. They propose two models allowing for two structural breaks. The first model, namely M1, allows for two structural breaks in intercept while the second model, namely M2, allows for two structural breaks in intercept as well as trend.

The data-generating process of a time series  $y_t = d_t + u_t$  that Narayan and Popp (2010) define has two components, a deterministic component ( $d_t$ ) and a stochastic component ( $u_t$ ) where  $u_t$  exhibits an AR (1) process. Models are demonstrated as follows:

$$d_t^{M1} = \alpha + \beta t + \Psi^*(L)(\theta_1 DU'_{1,t} + \theta_2 DU'_{2,t}) \quad (1)$$

$$d_t^{M2} = \alpha + \beta t + \Psi^*(L)(\theta_1 DU'_{1,t} + \theta_2 DU'_{2,t} + \gamma_1 DT'_{1,t} + \gamma_2 DT'_{2,t}) \quad (2)$$

where  $DU'_{i,t} = 1(t > T'_{B,i})$ ,  $DT'_{i,t} = 1(t > T'_{B,i})(t - T'_{B,i})$ ,  $i=1,2$ .

Here,  $T'_{B,i}$ ,  $i = 1,2$  denotes the true break dates. The parameters  $\theta_i$  and  $\gamma_i$  stand for the magnitude of the intercept and trend breaks, respectively. Narayan and Popp (2010) remark that the inclusion of  $\Psi^*(L)$  allows breaks to happen slowly over time. Therefore, the proposed model is an innovative outlier class of models since it is based on the idea that the series responds to shocks to the trend function in a similar way as it responds to shocks to the innovation process,  $e_t$ .

The test regressions are the reduced forms of the corresponding structural model. They are showed as follows:

$$y_t^{M1} = \rho y_{t-1} + \alpha_1 + \beta^* t + \theta_1 D(T'_{B})_{1,t} + \theta_2 D(T'_{B})_{2,t} + \delta_1 DU'_{1,t-1} + \delta_2 DU'_{2,t-1} + \sum_{j=1}^k \beta_j \Delta y_{t-j} + e_t \tag{3}$$

$$y_t^{M2} = \rho y_{t-1} + \alpha^* + \beta^* t + \Omega_1 D(T'_{B})_{1,t} + \Omega_2 D(T'_{B})_{2,t} + \delta_1^* DU'_{1,t-1} + \delta_2^* DU'_{2,t-1} + \gamma_1^* DT'_{1,t-1} + \gamma_2^* DT'_{2,t-1} + \sum_{j=1}^k \beta_j \Delta y_{t-j} + e_t \tag{4}$$

The break dates are determined using a sequential procedure (see Narayan and Popp (2010) for the details of this procedure). The null hypothesis of a unit root of  $\rho = 1$  is tested against the alternative hypothesis of  $\rho < 1$ , and t-statistics of  $\hat{\rho}$  in Equations 3 and 4 are used. Critical values are generated through Monte Carlo simulations and depicted in Table 3 in Narayan and Popp (2010). If calculated test statistics are greater than critical values, the null hypothesis of a unit root is rejected.

#### 4.2. VAR analysis

VAR models suggested by Sims (1980) are commonly employed to forecast systems of interrelated time series and to analyse the dynamic impact of random disturbances on variables. Every endogenous variable in the system is a function of the lagged values of all endogenous variables.

A VAR model can be expressed in matrix notations as the following (Maddala, 1992):

$$y_t = A_1 y_{t-1} + \dots + A_p y_{t-p} + m + \varepsilon_t \tag{5}$$

where  $y_t$  is a  $k \times 1$  vector of endogenous variables,  $m$  is a  $k \times 1$  vector of constants,  $A_1, \dots, A_p$  are  $k \times k$  matrices of coefficients to be estimated, and  $\varepsilon_t$  is a  $k \times 1$  vector of white noise process.

If it is assumed that  $k = 2$  and  $p = 1$ , the VAR model is expressed as follows (Johnston and Dinardo, 1997):

$$y_t = \begin{bmatrix} y_{1t} \\ y_{2t} \end{bmatrix} = \begin{bmatrix} m_1 \\ m_2 \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} y_{1,t-1} \\ y_{2,t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} = m + A y_{t-1} + \varepsilon_t \tag{6}$$

This model can be expressed via equations as below:

$$y_{1t} = m_1 + a_{11} y_{1,t-1} + a_{12} y_{2,t-1} + \varepsilon_{1t} \tag{7}$$

$$y_{2t} = m_2 + a_{21} y_{1,t-1} + a_{22} y_{2,t-1} + \varepsilon_{2t} \tag{8}$$

Hence, in all VAR models, each variable is stated as a linear combination of lagged values of itself and of all other variables in the system.

Johnston and Dinardo (1997) explain impulse-response functions obtained through the estimation of the VAR models. Accordingly, a shock in  $\varepsilon_{1t}$  has an instant effect on  $y_{1t}$ , but no effect on  $y_{2t}$ . In period  $t+1$ , this shock in  $y_{1t}$  affects  $y_{1,t+1}$  via the first equation and also affects  $y_{2,t+1}$  via the second equation. These effects continue to period  $t+2$ , and so forth. Thus a shock in the VAR model starts a chain reaction over time in all variables in the VAR system. Hence these chain reactions are calculated by impulse-response functions.

## 5. Findings

Table 2 depicts the results of ADF and PP unit root tests. As is seen from the table, the null hypothesis of a unit root can be rejected for variables. In other words, all variables are stationary.

**Table 2.** ADF and PP unit root tests

Variable	ADF test statistic		PP test statistic	
	Intercept	Intercept and trend	Intercept	Intercept and trend
BIST100	-10.388*	-10.503*	-10.451*	-10.534*
USD	-8.697*	-9.088*	-9.097*	-9.163*
DEPOSIT	-10.211*	-12.113*	-10.685*	-12.102*
GOLD	-9.653*	-9.644*	-9.579*	-9.569*
Critical values	1%	-3.470	-3.470	-4.015
	5%	-2.879	-3.437	-2.879
	10%	-2.576	-3.143	-2.576

**Note:** \* indicates the rejection of the null hypothesis at 1% level of significance.

Table 3 presents Narayan and Popp (2010) unit root test's results. Accordingly, all variables are stationary with regard to both models of the test. Break dates obtained from Narayan and Popp (2010) unit root test correspond to some considerable periods for the Turkish economy. Accordingly, the financial turbulence in Turkey in May 2006 may account for the break in 2006. The global financial crisis in 2008-2009 may account for the breaks detected for 2008 and 2009. The sovereign debt crisis in Euro Area might account for the breaks detected for 2011.

**Table 3.** Narayan and Popp (2010) unit root test

Variable	Test statistics and break dates	
	M1	M2
BIST100	-6.656* (Sep. 2008, Mar. 2009)	-6.846* (Sep. 2008, Mar. 2009)
USD	-10.760* (May 2006, Sep. 2008)	-10.520* (May 2006, Sep. 2008)
DEPOSIT	-12.720* (Sep. 2009, Sep. 2011)	-12.560* (May 2011, Sep. 2011)
GOLD	-9.962* (Sep. 2008, Jun. 2011)	-10.800* (Jul. 2008, Jul. 2011)
Critical values	1%	-4.958
	5%	-4.316
	10%	-3.980

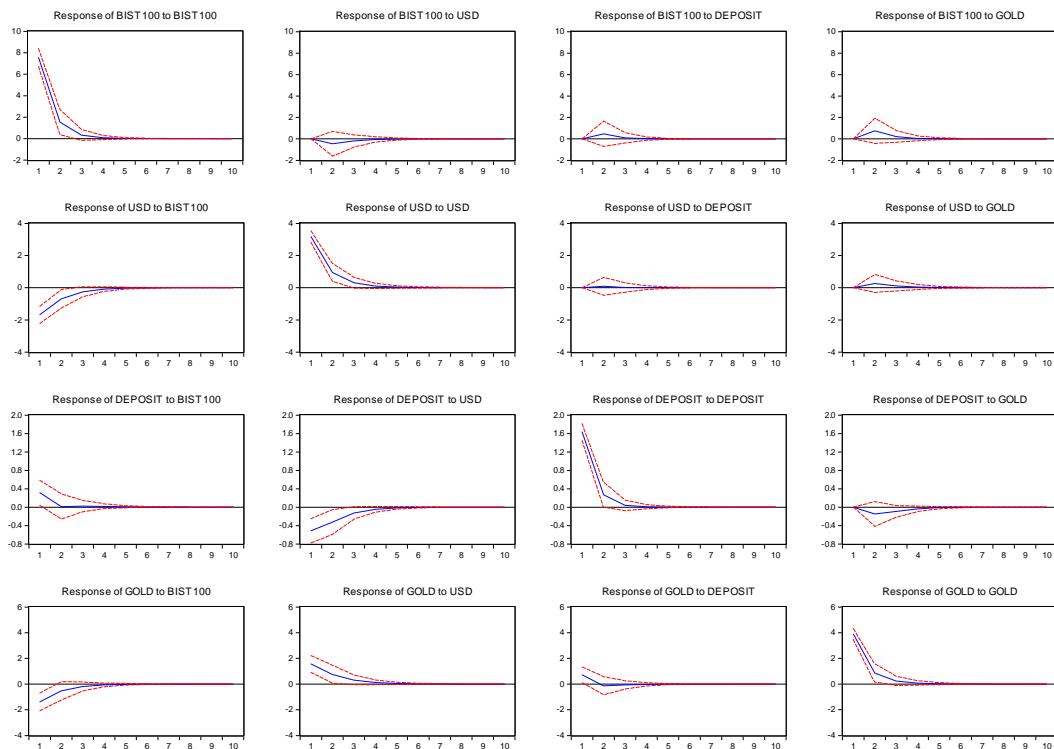
**Notes:** Break dates are showed in parentheses. Critical values are received from Narayan and Popp (2010).

\* indicates the rejection of the null hypothesis at 1% level of significance.

Figure 2 shows the graphical presentations of impulse-response functions. First, a one-unit standard deviation shock to BIST100 leads to a decrease in USD and GOLD while it induces an increase in DEPOSIT. Hence one may argue that BIST100 is a good investment instrument against USD and GOLD. Second, a one-unit standard deviation shock to USD causes a decrease in BIST100 and DEPOSIT while it leads to an increase in GOLD. Thereby USD seems to be a good investment instrument BIST100 and

DEPOSIT. Third, a one-unit standard deviation shock to DEPOSIT induces an increase in BIST100 and GOLD while it does not have significant effects on USD. Fourth, a one-unit standard deviation shock to GOLD leads to an increase in BIST100 and USD while it induces a decrease in DEPOSIT. For this reason, GOLD appears to be a plausible investment instrument against DEPOSIT. These findings indicate that that BIST100 and USD are good investment instruments against each other in Turkey.

**Figure 1.** Graphical presentations of impulse-response functions obtained from VAR analysis  
Response to Cholesky One S.D. Innovations  $\pm 2$  S.E.



**Notes:** The optimal lag length is 1 with regard to Akaike Information Criterion, and there are not serial correlation and heteroskedasticity problems for this lag length.

## 6. Conclusion

This paper examines the relationships among monthly real rates of return of stocks, USD, one-month deposits, and gold in Turkey by utilizing monthly data covering the period 2003:M01-2016:M07. After conducting unit root tests and determining all variables are stationary, the paper conducts VAR analysis and impulse-response functions. According to the findings, (i) stocks appear to be a good investment instrument against USD and gold, (ii) USD is a good investment instrument against stocks and one-month deposits, and (iii) gold is a plausible investment instrument against one-month deposits. Based on these findings, the paper explores that only stocks and USD are good investment instruments against each other in Turkey.

One may expect that financial market participants invest in an asset when the return of this asset increases. As a result of this behaviour, other assets' prices and returns may decrease.

The findings of the paper do not support this event since we yield that an increase in the return of an asset leads to an increase in returns of other assets in most of the impulse response functions. Hence the findings of the paper indicate that financial market participants in Turkey do not consider short-term fluctuations of returns of assets very much. Thereby the paper explores that they may be interested in the long-run return of an asset.

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## Current account sustainability in SAARC economies: Evidence from combined cointegration approach

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**Abstract.** *Majority of the South Asian economies are experiencing continuous deficits in their current account along with high external borrowing. This may question the sustainability of their external obligation in the long run. Therefore, this study examines the long run sustainability of current account imbalances of Seven South Asian economies for the period 1980 to 2014. By applying the recently developed econometric methods, we found that the current account of Maldives and Sri Lanka is sustainable in the long run, while for the rest of the South Asian economies the current account is not sustainable. This results have important policy implications. In particular, the South Asian economies should increase their cooperation with each other in terms of trade and investment to minimize the external sector imbalances and to achieve an increasing growth momentum in the future.*

**Keywords:** Current account deficit; Intertemporal budget constraint; Sustainability; South Asian Economies.

**JEL Classification:** F30, F32, Q56.

## 1. Introduction

Trade is considered as an engine of growth in developing economies (Lewis, 1980; Riedel, 1984). In the process of trade, an economy may incur deficit in its current account<sup>(1)</sup> which can mainly occur due to increasing domestic consumption and investment demand. Such deficit can be financed by the external borrowing or by cutting down the foreign exchange reserves in the short run. However, if the deficit continues for the longer period of time it may question the ability of an economy to finance it. In this case it is important to test whether such deficit is sustainable in the long run or not. As explained by Lanzafame (2014), “sustainable hypothesis” defines the condition that current account dynamics are consistent with a country’s intertemporal budget constraint (IBC), in the sense that this can be met in the long run without the need for drastic correction.

The South Asian economies, also called as SAARC (South Asian Association for Regional Cooperation), consist of eight south Asian nations such as Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka. All these economies, except Bangladesh and Nepal, are facing continuous deficits in their current account for a long period of time. Though the deficits of majority of such economies has decreased in the recent years, still the economy like Bhutan is facing a deficit of more than 20 per cent of its GDP. Recently, the Indian economy also faced serious problems in its external sector balances when its current account deficit (CAD) increased from 0.65 per cent of GDP in 2006-2007 to 4.84 per cent of GDP in 2012-13. This led to sharp depreciation of Indian rupee and rising domestic inflation.

After several years of relative stability the price of oil declined steeply in 2014. Since then oil importing economies including the South Asian economies have been enjoying the fruits of plummeting crude oil prices globally. This can help in restoring their external sector balances and moderate inflation as the prices of goods and services do not increase because of lower energy prices and transportation cost. Moreover, a reduction in the oil prices can reduce the import bills for these economies, which will have a favourable impact on the trade and current account balances. Falling oil prices also can help to reduce the subsidy burden of the government and thereby lead to cutting down the fiscal deficit, as oil is subsidised in developing economies. Thus, this episode of decline in oil prices raises two important questions. First, whether the effects of falling oil prices are temporary or permanent. Second, if it is temporary, can any long term macroeconomic policy help in mitigating the cyclical effects which gets transmitted globally due to fluctuations in oil prices?

One of the major objective of formation of SAARC forum was to accelerate the process of economic and social development in the member states (Jain and Singh, 2009). Slowly, trade promotion was given major priority for economic co-operation. Still, all the south Asian economies, except Nepal and Bangladesh, are facing persistent deficits in their current account. Countries such as Bhutan, Maldives and Sri Lanka are having a high CAD as per cent of GDP of 24.69, 4.07 and 2.56, while Pakistan, India and Bangladesh are having a deficit of 1.45, 1.34 and 0.97 in 2014, respectively. On the other hand, only Nepal is having a surplus of 2.47 in the same year. At present, the intra-SAARC trade is

also found to be quite low as compared with that of other regional forums such as European Union (EU) and Association of South East Asian Nations (ASEAN). Therefore, an important question arises regarding the long run sustainability of the current account imbalances in the SAARC economies.

Given the above background, the rest of the paper is structured as follows. Section 2 reviews the literature. Section 3 explains the over view of the SAARC economies. Section 4 describes the model, data and methodology. Section 5 presents the results and discussion. Section 6 concludes with policy prescriptions.

## 2. Literature review

The intertemporal approach, developed by Sachs (1981) and latter extended by Obstfeld and Rogoff (1996), has been considered as an important theoretical development to explain whether disequilibrium in an economy's current account is sustainable in the long run or not. This approach is based on the assumptions of perfect capital mobility and the consumption-smoothing behaviour. The "sustainability hypothesis" as elucidated in intertemporal approach defines the condition under which the current account imbalances are consistent with a country's intertemporal budget constraint (IBC), which can be met in the long run without any drastic corrections (Lanzafame, 2014). While non-stationary current account does not necessarily violate the IBC (Quintos, 1995; Bohn, 2007), stationarity can be considered as the sufficient condition for the sustainability of the current account.

A number of studies have attempted to examine the issue of the sustainability of the current account both at the individual country level (Karunaratne, 2010; Apergis et al., 2000; Stilianos and Wu, 1999) as well as for a cross section of countries (Gnimassoun and Coulibaly, 2014; Baharumshah et al., 2005; Kim et al., 2009). Plethora of studies have argued that a stationary current account balance can be considered as sustainable (Christopoulos and León-Ledesma, 2010; Chen, 2011). This is because a stationary current account is consistent with the accumulation and sustainability of external debts (indicating that there is less probability of a country defaulting its debts) as well as an indicator of potential exchange rate realignment (Richard and Tiwari, 2014). Further, the stationarity of current account concurs with the implication of the modern intertemporal model of current account, and hence supports its validity (Obstfeld and Rogoff, 1996). However, Bohn (2007) argues that the stationarity of current account balance is sufficient but not the necessary condition for the sustainability of external debt. In this case the long run equilibrium relationship between exports and imports are nonetheless more informative. In this regard, Husted (1992) shows that under the null hypothesis that the economy satisfies its inter-temporal budget constraint, we expect exports and imports have a cointegrating relationship with cointegrating vector (1, -1), granted that they are  $I(1)$ . Thus, the existence of the long run relationship between exports and imports of an economy is a necessary condition to be satisfied for balancing an economy's intertemporal budget constraint.

While there is a bulk of studies available to explain the current account sustainability in the developed economies, the literature in the case of developing economies are sparse. To the best of our knowledge, there is no study to have a comparative analysis of the current account sustainability in the SAARC economies. As the majority of these economies are facing the problems of large CAD along with high external debt, this study is an attempt to examine the long run sustainability of the current account imbalances in the South Asian economies for the period of 1980 to 2014.

### 3. Overview of the SAARC economies

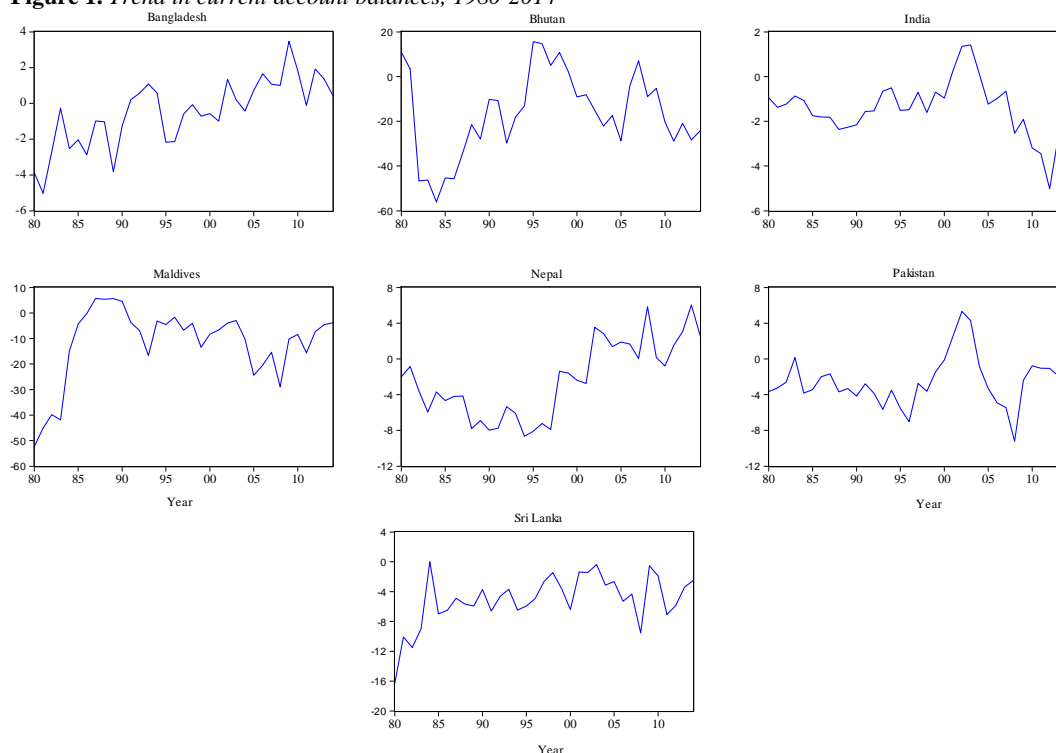
The South Asian region (as defined by SAARC) constitutes about 23 per cent of the world's population and has 15 per cent of the world's arable land, but only 6.0 per cent of purposing power parity (PPP) based global gross domestic product (GDP) and account for around 2.0 percent of world goods trade, and around 3.0 per cent of world foreign direct investment (Jain and Singh, 2009). The south Asian economies are highly diverse in terms of country size, geography, social and political system, culture and language. While some countries like Afghanistan, Nepal and Bhutan are landlocked and mountainous; the other such as Sri Lanka is an island whereas the Maldives is an archipelago of low-lying coral islands in the Indian Ocean.

The SAARC region which was considered as the slowest growing region during the 1960s and the 1970s, became the fastest growing region after 1980. The growth performance of such region is considerably robust over the time among the low income countries. The average GDP growth of the SAARC economies which was lower than the world output growth before 1980s, it significantly improved and crossed the global growth after 1980s (see Appendix A). Although the average GDP growth rate of all the member countries of SAARC improved after 1990s, it further deteriorated for most of the economies except Bangladesh, Nepal and Sri Lanka during the recent years. On the other hand, the average growth of the Bangladesh, Nepal and Sri Lanka improved significantly during the post crisis period. Further, the overall growth rate of the South Asian region which was sustained at an average of 5.36 per cent during 1981-2000, it improved to an average of 7.23 per cent during 2001-2007 and further slightly deteriorated to 6.06 per cent during 2008-2014.

Though, there is a significant improvement in the savings and investment in the SAARC region in recent years, still some of the economies of the region, *viz.*, Afghanistan, Nepal, Bhutan and Bangladesh still depend on the foreign savings/aid for financing their resource gap (Jain and Singh, 2009). In terms of the fiscal position, all the South Asian economies are incurring fiscal deficit (FD) which is a great challenge for most of the economies in this region for the long run fiscal and growth sustainability. Further, majority of these economies are sensitive to the external and natural shocks. For instance, Maldives got severely affected by the 2004 tsunami which put huge pressure on the government for the reconstruction and development of the economy. The countries like India, Pakistan and Afghanistan are having continuous cross border problems with each other as well as with their neighbouring countries. This makes them to spend large

resources on the imports of defence equipment and thereby creating burden on the government by raising FD (Dash et al., 2016). Though the FD of Sri Lanka increased after the 2008 Global financial crisis, in recent years it reduced due to modernisation of the revenue administration and thereby broadening of the tax base.

**Figure 1.** Trend in current account balances, 1980-2014



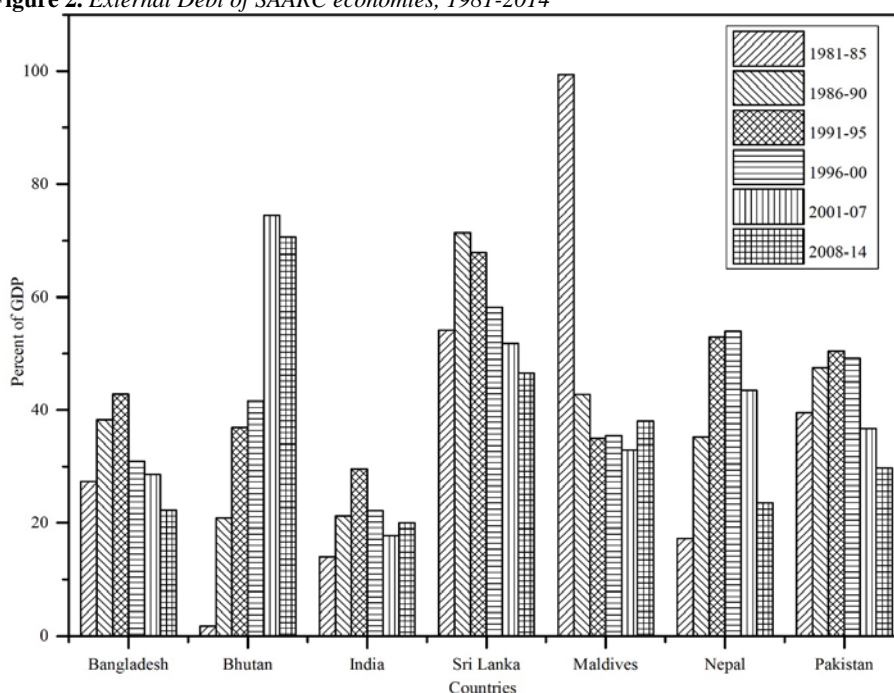
**Source:** World Development Indicators (WDI) of World Bank.

All the South Asian economies, except Nepal and Bangladesh, have been incurring large CAD over the years. Figure 1 presents the trend in the current account for the South Asian economies. This shows that for Maldives the CAD as a ratio to GDP is the highest in the region. A major portion of such deficit is being financed by the net surplus in the services trade, which mostly comes from the tourism. Further it also can be seen that all the South Asian economies experienced a sharp deterioration in their current account after the Global financial crisis. Recently, due to the lower international crude oil prices, the current account of these economies are seen to be improved. The CAD of Bhutan decreased from 28.91 per cent of GDP in 2011 to 24.14 per cent of GDP in 2014. The external sector balance of Sri Lanka also got affected badly after the global financial crisis due to the widening trade deficit and sharp fall in the remittances inflows. The CAD increased from 0.37 per cent of GDP in 2003 to 9.54 per cent of GDP in 2008, though during the latter period it decreased to 2.48 per cent of GDP in 2014. In case of Maldives also the CAD significantly reduced from 15.65 per cent of GDP in 2011 to a lower level of 3.85 per cent of GDP in 2014. In India the increasing trade deficit during 2008-09 was mostly offset by a steady remittance inflows and a rising surplus in the net service

exports. Due to the rising imports, CAD increased to around 5 per cent during 2012-13 though it fell to a 1.34 per cent of GDP during 2014-15. Further, in the past few years the current account of Nepal and Bangladesh is showing surplus which is mainly because of the narrowing trade deficit and higher remittances inflows.

The rising CAD in the South Asian economies is mainly financed through net surplus in the service exports, remittances inflows and external debt. The average trend in the external debt of these economies is presented in the Figure 2. This shows that all the South Asian economies are the net borrowers in the international market.

**Figure 2.** External Debt of SAARC economies, 1981-2014



**Source:** World Development Indicators (WDI) of World Bank.

In Maldives, there is a significant improvement in the external debt situation as compared to the early 1980s. The average external debt which was 99.41 per cent of GDP during 1981-1985 sharply deteriorated to 32.92 per cent of GDP during 2001-2007, although it further increased after the Global financial crisis to 38 per cent of GDP during 2008-2014. This shows that in the recent years there is a significant reduction in the external debt burden on the Maldives government as compared to the early 1980s. In Bhutan, the average external debt burden increased from 1.76 per cent of GDP in 1981-85 to 70.70 per cent of GDP in 2008-14. The major proportion of the external debt utilised for the growth oriented investment purpose, such as the rapidly expanding power sector. India is considered as the largest trading partner for Bhutan and rupee debt constitutes 61 per cent of external debt of Bhutan (IMF, 2014). For all other South Asian economies like Bangladesh, India, Sri Lanka, Nepal and Pakistan the average external debt has decreased

significantly after 1990s. Further, although the average external debt of all the SAARC economies reduced significantly during the post Global financial crisis periods, for India and Maldives it increased from 17.78 and 32.92 per cent of GDP during 2001-07 to 20.05 and 38.00 per cent of GDP during 2008-14, respectively.

Although a number of measures are being under taken for the economic growth and development of the South Asian region, still the per capita income is very low which is a matter of concern. In the field of infrastructure, social provisions and working of the institutional set up the region is lagging behind. Among all the South Asian economies, the Sri Lankan economy is quite exceptional not only in the SAARC region but also in the developing world in terms of education, health and other social development. It has achieved high literacy and low infant and adult mortality rates and continues to provide universal health and education coverage and in its commitment to gender equality and social development (Jain and Singh, 2009). Its current levels of human development indicators are comparable to those of the high income countries (Srinivasan, 2004).

#### 4. Model, data and methodology

##### 4.1. The model

Assessing the sustainability of current account has been a debatable issue in literature (Holman, 2001; Mann, 2002). Widely employed tests exploit the recent developments in time series econometrics for testing the sustainability hypothesis. These tests rely on stationarity of current account which has implications for the intertemporal approach. According to the intertemporal approach, current account acts as a buffer to smooth consumption implying that typically it behaves like a stationary variable. However, employing conventional unit root test have yielded non-stationarity of current account in its level (Shibata and Shintani, 1998) and the lack of power of conventional tests for stationarity is well known (Shiller and Perron, 1985). Husted (1992) proves that the mean reversion in current account can be explained by examining the cointegration properties between exports and imports, and that current account is sustainable if exports and imports are cointegrated with the cointegrating vector being (1,-1). This enables us to examine the long run relationships between the variables using the most recent test of combined cointegration of Bayer and Hanck (B-H) (2013). We follow Husted (1992) to determine the sustainability of current account in the South Asian economies. This approach uses a model of budget constraint at an individual level, which can be extended to an economy. We discuss the approach below:

The current period budget constraint for an economy can be expressed as

$$C_0 = Y_0 + B_0 - I_0 - (1 + ir_0)B_{-1} \quad (1)$$

Where  $C_0$  denotes current consumption,  $Y_0$  current output,  $I_0$  is investment expenditure,  $ir_0$  is world interest rate  $B_0$  is international borrowing and  $(1 + ir_0)B_{-1}$  is external debt. As equation (1) must hold good for every time period intertemporal budget constraint

(IBC) can be arrived as the summation of period by period budget constraint, which can be expressed as equation (2).

$$B_0 = \sum_{t=1}^{\infty} \delta_t TB + \lim_{n \rightarrow \infty} \delta_n B_n \quad (2)$$

Where  $TB_t = X_t - M_t = Y_t - C_t - I_t$  which is the trade balance in period  $t$ , that is, income-absorption.  $X_t$  and  $M_t$  are exports and imports, respectively and  $\delta_t$  is the discount factor. The last term in Equation 2 implies that when limit term equals zero the amount a country borrows is equal to the present value of future trade surpluses. Assuming that the world interest rate is stationary with unconditional mean  $ir$ , equation (1) can be expressed as

$$Z_t + (1+ir)B_{t-1} = X_t + B_t \quad (3)$$

Where  $Z_t = M_t + (ir_t - ir)B_{t-1}$

Solving Equation (3), Husted (1992) arrives at

$$M_t + ir_t B_{t-1} = X_t + \sum_{j=0}^{\infty} \phi^{j-1} (\Delta X_{t+j} - \Delta Z_{t+j}) + \lim_{j \rightarrow \infty} \phi^{t+j} B_{t+j} \quad (4)$$

Where  $\phi = 1/(1+r)$  and  $\Delta$  is the first difference operator. It can be seen from equation (4) that payments on imports as well as interests on foreign debt is represented on the left hand side. To arrive at the current account of an economy we subtract  $X_t$  from both sides of equation (4) and multiply the result by  $(-1)$ . In order to convert Equation 4 to a regression model we assume that the limit term is zero and a residual term is added. This yields the following equation:

$$X_t = a + bM_t^* + \mu_t \quad (5)$$

It should be noted that  $M_t^*$  measures imports of goods and services plus unilateral transfers. In order to satisfy IBC the necessary condition is the existence of a stationary error structure. This implies that  $\mu_t$  in equation (5) should be an I(0) process. The necessary and sufficient condition for IBC is the existence of a vector  $(a, b)$  such that  $(a, b) = (0, 1)$  and the process is stationary. Two intuitive implications can be arrived from equation (5). First, Failure to detect co-movements between exports and imports implies that the economy fails to satisfy its budget constraint resulting in default of its debt. Second, if exports and imports are cointegrated with a vector  $\beta = (1, -1)$  then the economy satisfies IBC in the long run and the two series would never drift too far apart. We use the above framework for testing the sustainability of current account of the South Asian economies.

## 4.2. Data

Following the earlier literature (such as Kalyoncu and Ozturk, 2010; Husted, 1992)<sup>(2)</sup> on testing current account sustainability, we use annual data for exports of goods and services (as percent of GDP) and imports of goods and services plus interest payments on the external debt (as percentage of GDP) for seven SAARC economies, such as, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka. We have not included Afghanistan in our study due to unavailability of data for most of the study periods. Further, Afghanistan is also a new member of SAARC and it joined recently in 2005. The data are sourced from the World Bank's World Development Indicators (WDI) database. The study period consists of from 1980 to 2014.

The summary statistics of the variables for all the countries are presented in Table 1. This shows that in all the South Asian economies the average of imports is higher than the average of exports. This implies that the South Asian economies are the net importers of goods and services in the international market. The average gap between the exports and imports is found to be higher for Bhutan, Nepal and Sri Lanka which is more than 10, as compared to the other member nations of SAARC. Further, one of the interesting result we can find that while for all the economies the correlation between the exports and imports is positive implying exports and imports move in the same direction, in the case of Pakistan, the correlation is found to be negative. This may indicate that Pakistan's rising import demand as well as huge burden of external debt may lead to fall in its efficiency to exports.

**Table 1.** Descriptive statistics and correlation matrix

Country	Variables	Mean	S.D.	Min.	Max.	Correlation	
						Exports	Imports
Bangladesh	Exports	10.91	5.17	3.4	20.16	1	
	Imports	17.89	4.74	12.43	28.15	0.93	1
Bhutan	Exports	30.97	11.17	12.06	54.97	1	
	Imports	51.41	10.14	31.41	73.31	0.59	1
India	Exports	12.85	6.82	5.11	25.16	1	
	Imports	15.88	7.87	7.72	31.64	0.99	1
Maldives	Exports	88.38	29.01	43.27	166.36	1	
	Imports	90.74	41.69	50.67	214.2	0.90	1
Nepal	Exports	14.93	5.09	8.9	26.33	1	
	Imports	29.07	6.47	18.99	41.48	0.44	1
Pakistan	Exports	14.11	2.03	9.95	17.36	1	
	Imports	21.39	2.85	15.41	25.69	-0.35	1
Sri Lanka	Exports	28.99	6.57	15.47	39.02	1	
	Imports	40.82	7.24	24.33	56.93	0.84	1

**Note:** Exports imply the exports of goods and services as percentage of GDP; Imports imply imports of goods and services plus the interest payments on the external debt as percentage of GDP. Both the variables have taken as percentage of GDP.

## 4.3. The Bayer-Hanck cointegration approach

For testing the sustainability hypothesis we apply the combined cointegration test developed by Bayer and Hanck (2013). There are several tests that have been developed to examine the long run relationship among variables. The residual based test of Engle and Granger (1987), the system based test of Johansen (1988) and the error correction based test of Boswijk (1994) and Banerjee et al. (1998) are the most commonly used.

Engle-Granger test involves a two-step testing procedure. The major limitation of this test is that if an error arises in the first step it carries over and feeds into the second step and ultimately gives biased results. Further, the results of the long run regression may provide inefficient estimates if the residuals are not normally distributed. However, Engle and Yoo (1991) cointegration test solved the issues of Engle and Granger (1987) test by providing efficient results even if the distribution of estimators from the cointegrating vector is not normally distributed.

Johansen and Juselius (1990) developed the maximum likelihood cointegration test which can be applied to examine cointegration between variables when the variables are non-stationary at levels but integrated of the same order. However, this is a single equation model and is not applicable when the variables are integrated of mixed order. The results are also sensitive to the incorporation of exogenous and endogenous variables in the model. While the test indicates the presence of cointegration among the variables or not, it does not give any information about the short run dynamics. Further, Pesaran et al. (2001) suggested a bounds testing cointegration approach using an autoregressive distributed lag (ARDL) model which can deal with some of the issues arising out of the Johansen and Juselius (1990) approach. This approach is applicable even if the series are  $I(0)$ ,  $I(1)$  or a mix of  $I(0)/I(1)$ . Unlike Johansen and Juselius (1990) cointegration test, the ARDL model shows both the short run and the long run relationship between the variables. The demerit of this method is that, it is not applicable if any of the variable is integrated of order two [ $I(2)$ ] Pesaran et al. (2001).

As discussed above there exists various methods to test long run relationship between a set of variables. However, in practice it is possible that different methods may give different results making it difficult to conclude whether the series are cointegrated or not. In order to overcome this, Bayer and Hanck (2013) developed a new dynamic cointegration technique by combining several popular tests such as Engle and Granger (1987), Johansen (1988), Boswijk (1994) and Banerjee et al. (1998) to obtain uniform and reliable results. This test gives efficient estimates by ignoring the nature of multiple testing procedure which gives robust and better results as compared to the individual t-test or the system based test.

The B-H cointegration test follows Fisher's (1932) critical tabulated values formula to combine the statistical significance level i.e. p-values of single cointegration test. Following Shahbaz et al. (2016), the formula is given below:

$$EG - JOH = -2[\ln(P_{EG}) + \ln(P_{JOH})] \quad (6)$$

$$EG - JOH - BO - BDM = -2[\ln(P_{EG}) + \ln(P_{JOH}) + \ln(P_{BO}) + \ln(P_{BDM})] \quad (7)$$

The notations such as  $P_{EG}$ ,  $P_{JOH}$ ,  $P_{BO}$  and  $P_{BDM}$  represent the probability values for the individual cointegration tests such as Engle and Granger (1987), Johansen (1991), Boswijk (1994) and Banerjee et al. (1998), respectively. We follow the critical values of Fisher (1932) to decide whether there is cointegration between the variables or not by rejecting the null hypothesis of no cointegration when the calculated Fisher (1932) statistic value is greater than the critical values generated by B-H (2013).

## 5. Empirical results and discussions

Testing of the unit root properties of the variables is considered as the necessary precondition for examining the cointegrating relationship among them. We use the Ng and Perron (N-P) (2001) unit root test to investigate the order of integration of the variables. This test is preferred over the other unit root tests because it is suitable and also gives efficient results for the small sample case. Further, as compared to the ADF, PP and DF-GLS unit root tests, the N-P (2001) test is more preferable due to its explanatory power. The results are reported in Table 2, which indicate that for all the countries, both exports and imports have unit root problem, while both of them are stationary at first difference. However, in the case of Sri Lanka, the exports is stationary at level or I(0) while the imports is stationary at first difference or I(1).

**Table 2.** Ng and Perron (2001) unit root test results

Countries	Variables	MZa	MZt	MSb	MPT
Bangladesh	Exports	0.616	0.418	0.679	33.223
	Imports	-1.447	-0.630	0.435	12.353
	$\Delta$ Exports	-16.414*	-2.854	0.174	1.532
	$\Delta$ Imports	-15.350*	-2.770	0.180	1.596
Bhutan	Exports	-1.711	-0.836	0.488	12.940
	Imports	-12.849	-2.518	0.196	7.184
	$\Delta$ Exports	-15.321*	-2.712	0.177	1.805
	$\Delta$ Imports	-29.893*	-3.860	0.129	3.084
India	Exports	0.884	0.744	0.842	50.097
	Imports	0.283	0.216	0.765	37.731
	$\Delta$ Exports	-7.304***	-1.764	0.242	3.862
	$\Delta$ Imports	-15.894*	-2.732	0.172	1.861
Maldives	Exports	-3.246	-1.273	0.392	7.546
	Imports	-1.493	-0.800	0.536	15.049
	$\Delta$ Exports	-15.481*	-2.782	0.180	1.583
	$\Delta$ Imports	-16.752*	-2.893	0.173	1.466
Nepal	Exports	-2.462	-1.095	0.445	9.870
	Imports	0.647	0.322	0.497	21.092
	$\Delta$ Exports	-16.318*	-2.855	0.175	1.508
	$\Delta$ Imports	-15.945*	-2.750	0.172	1.808
Pakistan	Exports	-4.1273	-1.412	0.342	5.966
	Imports	-5.995	-1.644	0.274	4.353
	$\Delta$ Exports	-16.477*	-2.844	0.173	1.583
	$\Delta$ Imports	-15.476*	-2.777	0.179	1.600
Sri Lanka	Exports	-39.024*	-4.366	0.112	2.607
	Imports	-4.833	-4.741	0.105	2.040
	$\Delta$ Exports	-45.019*	-1.171	0.405	8.383
	$\Delta$ Imports	-15.525*	-2.785	0.179	5.878

The lag length is shown in parentheses. For details of these notations including MZa, MZt, MSB and MPT, please see the study by Ng and Perron (2001).

\*, \*\* and \*\*\* represent significance at 1%, 5% and 10% levels, respectively.

The N-P (2001) unit root test provides biased results in the presence of any structural break in the data (Shahbaz et al., 2016). For this reason, we employed Zivot and Andrews (ZA) (1992) structural break test. The ZA (1992) unit root test accommodates the information about the single structural break present in the data. The results of ZA test are reported in Table 3. The results indicate that both the exports and imports for all the South Asian economies are non-stationary at their levels in the presence of a single

structural break and stationary at first difference. In other words, all the variables are integrated of  $I(1)$ .

**Table 3.** Zivot and Andrews (1992) unit root test

Countries	Variable	Level			1st difference		
		T-statistic	Time break	Decision	T-statistic	Time break	Decision
Bangladesh	Exports	-4.427 (0)	2005	Unit root	-6.386* (0)	2005	Stationary
	Imports	-3.829 (0)	2003	Unit root	-6.655* (0)	2009	Stationary
Bhutan	Exports	-3.089 (1)	1992	Unit root	-4.409** (0)	2007	Stationary
	Imports	-4.490 (0)	1991	Unit root	-6.396* (1)	2009	Stationary
India	Exports	-4.742 (1)	2004	Unit root	-9.008* (0)	2009	Stationary
	Imports	-2.265 (0)	1987	Unit root	-6.354* (0)	2009	Stationary
Maldives	Exports	-3.092 (0)	2007	Unit root	-5.899* (0)	1986	Stationary
	Imports	-4.067 (1)	2004	Unit root	-6.153* (0)	1986	Stationary
Nepal	Exports	-3.745 (2)	1992	Unit root	-7.852* (0)	1998	Stationary
	Imports	-3.195 (0)	2002	Unit root	-6.374* (0)	1998	Stationary
Pakistan	Exports	-3.279 (0)	1987	Unit root	-8.028* (0)	2005	Stationary
	Imports	-3.821 (0)	2002	Unit root	-7.543* (0)	2007	Stationary
Sri Lanka	Exports	-3.240 (4)	2005	Unit root	-10.223* (1)	2009	Stationary
	Imports	-4.532 (0)	2009	Unit root	-7.161* (0)	1991	Stationary

Lag order is shown in parenthesis.

\*, \*\* and \*\*\* represent significance at 1%, 5% and 10% levels, respectively.

From the unit root test results as we found that both exports and imports are integrated of the same order i.e.  $I(1)$ , in such case the B-H (2013) combined cointegration approach is a suitable empirical method to test the cointegrating relationship among the variables. The B-H (2013) cointegration test is sensitive to the lag order selection (Satti et al., 2014) which implies that appropriate lag length selection is necessary before applying this test. Therefore, we used the Akaike information criterion to select an appropriate lag length. The results are reported in Appendix B. Given the lag length we applied the B-H (2013) combined cointegration approach to our data and the results are reported in Table 4.

**Table 4.** The results of Bayer and Hanck (2013) cointegration analysis.

Country	Estimated Models	EG - JOH	EG - JOH - BO - BDM	Lag	Cointegration
Bangladesh	$Ex = f(Im)$	1.926	2.403	1	NO
	$Im = f(Ex)$	1.586	3.205	1	NO
Bhutan	$Ex = f(Im)$	4.406	7.474	1	NO
	$Im = f(Ex)$	4.730	11.264	1	NO
India	$Ex = f(Im)$	5.569	7.866	3	NO
	$Im = f(Ex)$	5.843	14.764	3	NO
Maldives	$Ex = f(Im)$	56.483**	61.053**	3	YES
	$Im = f(Ex)$	57.877**	168.401**	3	YES
Nepal	$Ex = f(Im)$	2.568	3.342	3	NO
	$Im = f(Ex)$	2.225	3.619	3	NO
Pakistan	$Ex = f(Im)$	0.707	1.964	1	NO
	$Im = f(Ex)$	1.106	3.570	1	NO
Sri Lanka	$Ex = f(Im)$	12.385**	27.919**	3	YES
	$Im = f(Ex)$	17.636**	54.477**	3	YES

Critical values at 5% level are 11.229 (EG-JOH) and 21.931 (EG-JOH-BO-BDM), respectively. Lag length is based on minimum value of AIC.

\*\* Represents significance at 5% level.

We find that Fisher statistics for EG-JOH and EG-JOH-BO-BDM tests exceeds the critical values at 5% level of significance for Maldives and Sri Lanka when exports was

used as the dependent variable and import was used as the independent variable, and vice versa. On the other hand, for the all other economies it fails below the critical values. This implies that while two cointegrating vectors found between exports and imports for Maldives and Sri Lanka, no cointegrating relationship found between the variables for rest of the South Asian economies. This indicates that, except Maldives and Sri Lanka, there is no long run equilibrium relationship between exports and imports for the South Asian Economies during 1980 to 2014.

Though the B-H (2013) approach gives efficient results, at the same time it does not accommodate structural breaks in the model (Shahbaz et al., 2016). Therefore, for the robustness of our results we further applied the ARDL bounds testing cointegrating approach developed by Pesaran et al. (2001)<sup>(3)</sup> to accommodate the structural break in the model. As it is well known that the ARDL approach is sensitive to the lag length selection in the model, we use the Akaike Information Criteria (AIC) to select the appropriate lag length. As reported by Lütkepohl (2006) the dynamic link between the series can be well captured with the appropriate selection of the lag length. The optimum lags are given in the column 2 of Table 5. For testing the existence of cointegration in different models, we used Narayan (2005) critical values. The results show that, except Maldives and Sri Lanka, the null hypothesis of no cointegration cannot be rejected for both the models. Further, while for Maldives we reject the null hypothesis of no cointegration as both exports and imports were used as dependent variables, for Sri Lanka we can only reject the null hypothesis only for the model where imports is used as the dependent variable. This shows the presence of two cointegrating vectors for Maldives and one cointegrating vector for Sri Lanka which validate the existence of long run equilibrium relationship between exports and imports for both the economies.

**Table 5.** Results of ARDL model

Bound testing approach to cointegration					Diagnostic tests			
1	2	3	4	5	6	7	8	9
Country	Equation	Optimal lag	Structural break	F-statistics	$\chi^2_{Normal}$	$\chi^2_{ARCH}$	$\chi^2_{RESET}$	$\chi^2_{SERIAL}$
Bangladesh	Ex = f(lm)	(1,1)	2005	1.794	3.005	2.817	0.038	1.520
	lm = f(Ex)	(6,6)	2003	2.679	0.278	0.986	1.149	1.706
Bhutan	Ex = f(lm)	(2,4)	1992	4.878	0.492	0.334	0.877	0.512
	lm = f(Ex)	(1,0)	1991	3.657	0.636	0.997	1.961	1.102
India	Ex = f(lm)	(5,1)	2004	1.331	0.183	1.490	0.078	1.264
	lm = f(Ex)	(5,1)	1987	4.943	0.673	0.798	1.159	0.202
Maldives	Ex = f(lm)	(1,1)	2007	5.427***	17.31	0.053	0.051	0.279
	lm = f(Ex)	(1,2)	2004	5.616***	2.412	0.029	4.024	1.119
Nepal	Ex = f(lm)	(1,1)	1992	0.469	4.041	0.195	1.344	1.664
	lm = f(Ex)	(1,2)	2002	1.308	1.039	2.648	0.974	2.870
Pakistan	Ex = f(lm)	(1,0)	1987	2.739	1.177	0.228	2.198	0.102
	lm = f(Ex)	(1,0)	2002	4.268	0.728	0.003	1.780	1.184
Sri Lanka	Ex = f(lm)	(1,0)	2005	2.563	0.476	0.718	0.877	0.157
	lm = f(Ex)	(2,0)	2009	10.694*	2.284	0.126	0.971	0.136
		Critical values (T = 35) <sup>a</sup>						
		Lower bound I(0)	Upper bound I(1)					
		7.870	8.960					
		5.290	6.175					
		4.225	5.050					

The optimal lag length is determined by AIC.  $T$  is the total number of observations used in the empirical analysis. \*, \*\*, and \*\*\* denote significance at 1%, 5% and 10% levels, respectively.

<sup>a</sup> Critical lower and upper bounds values are collected from Narayan (2005) including unrestricted intercept and no trend.

The results of both the B-H (2013) and ARDL bounds testing approaches showed that only in the case of Maldives and Sri Lanka the exports and imports are cointegrated, while in case of the other South Asian economies we did not get any cointegration between the variables. Given the studies of Husted (1992) and Kalyoncu and Ozturk (2010), our results confirm the sustainability of the current account of Maldives and Sri Lanka. On the other hand, for the other South Asian economies such as Bangladesh, Bhutan, India, Nepal and Pakistan, the current account was found to be unsustainable in the long run.

## 6. Conclusion and policy implications

An economy, due to increasing domestic consumption and investment demand, may incur deficit in its current account. Such deficit can be financed by external borrowing in the short run. However, if the deficit continues for the longer time period it may question the ability of an economy to service such obligations. In this case it is very much important to test the sustainability of such deficit in the long run.

This study investigated the long run sustainability of the current account imbalances in the South Asian economies by using the annual data for the period of 1980 to 2014. Based on the studies of Husted (1992) and Kalyoncu and Ozturk (2010), we examine the sustainability of the current account imbalances by testing the long run equilibrium relationship between exports of goods and services, and imports of goods and services plus interest payments of the respective economies.

The recently developed Bayer and Hanck (2013) cointegration test is employed to test the long run equilibrium relationship between the variables. The integrating properties of the variables are tested using the Ng and Perron (2001) and Zivot and Andrews (1992) unit root tests. While the former test does not control for the possible structural breaks in the model, the latter test controls for a single unknown structural break in the model. The results of both the models are consistent and also shows that all the variables under study are integrated of order one or  $I(1)$ . We further applied the autoregressive and distributed lag (ARDL) bounds testing approach of Pesaran et al. (2001) by accommodating single structural break in the model to test the robustness of our long run estimates. The long run estimates obtained from both B-H (2013) and Pesaran et al. (2001) bounds test approach showed that there exist long run equilibrium relationship between exports and imports only for Maldives and Sri Lanka, while we did not get any cointegration between the variables for the other South Asian economies. Therefore, we concluded that the current account imbalances of all the South Asian economies, except Maldives and Sri Lanka, is unsustainable in the long run. In other words, in the case of the Maldives and Sri Lanka, the intertemporal budget constraint is not violated, while for the rest of the economies it is violated. This results indicate that for most of the economies in the SAARC region the

international indebtedness may not be sustainable, and over time the discrepancy between the exports and imports as a share of GDP would grow without bounds.

Overall, the findings of this paper conveys some important messages. It found that majority of the south Asian economies are running deficit in their current account and this deficit is not sustainable in the long run. As these economies are depending on the external borrowings to finance such deficits, a sharp rise in the CAD may put the economies into debt trap in the long run. Further, the intra-SAARC trade is also found to be quite low as compared with that of regional forums such as European Union (EU) and Association of South East Asian Nations (ASEAN). So policies are needed to increase the trade cooperation among these economies which can be helpful in improving their external sector positions. Though in the recent years due to the fall in the global crude oil prices there is a temporary significant improvement in the current account position in the regions, there exists an imperative to increase the exports of goods and services through raising the productivity and gaining competitive advantage. In the long run this can be helpful to bridge the gap between the exports and the imports and will push the current account towards sustainable region in the South Asian economies.

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## Notes

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- (1) Current account is the sum of net exports of goods and services, net primary income and net secondary income. It can also be defined as the difference between exports and imports or saving and investment of an economy Sachs (1981).
- (2) Kalyoncu and Ozturk (2010) and Husted (1992) showed that in the presence of the cointegrating relationship between exports and imports, the CAD of an economy can be considered as sustainable in the long run.
- (3) The ARDL model is chosen over the alternative traditional models such Engel and Granger (1987) and Johansen and Juselius (1990) because of the superiority over the others; (i) the ARDL model can be applied even if the variables are mixed order integrated; (ii) It also produces robust results even if the sample size is small. Further, we use the critical values of Narayan (2005) which is specially created for sample size ranging from 30 to 80; (iii) the ARDL technique also solves the issue of endogeneity in the model estimation due to the incorporation of lagged values of the dependent variable in the model.

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**Appendix A. Annual GDP growth of SAARC and world economy, 1971-2014**

GDP Growth	1971-1980	1981-1990	1991-2000	2001-2007	2008-2014
World	3.814	3.18	2.784	3.237	1.901
SAARC	2.975	5.568	5.148	7.233	6.06
Afghanistan	-0.059	-1.453	-3.191	15.007	7.835
Bangladesh	1.041	3.851	4.726	5.782	6.172
Bhutan	4.094	10.441	5.417	9.203	6.233
India	3.062	5.868	5.493	7.714	6.348
Maldives	6.272	11.742	7.560	8.986	5.965
Nepal	2.111	4.789	5.015	3.519	4.693
Pakistan	4.802	6.190	3.956	5.157	3.489
Sri Lanka	4.335	4.244	5.250	4.963	6.678

**Source:** World Development Indicators (WDI) of World Bank.

**Appendix B. AIC lag selection results for B-H (2013) test**

Country	LAG	AIC
Bangladesh	1	5.5933 <sup>b</sup>
Bhutan	1	12.6459 <sup>b</sup>
India	3	5.8988 <sup>b</sup>
Maldives	3	15.1075 <sup>b</sup>
Nepal	3	8.5923 <sup>b</sup>
Pakistan	1	7.3063 <sup>b</sup>
Sri Lanka	3	8.7992 <sup>b</sup>

AIC: Akaike Information Criteria.

<sup>b</sup> Indicates lag order selected by the criterion.

## Information asymmetry and technical efficiency: Case of a panel of Tunisian insurance companies

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**Abstract.** *The problem of the information asymmetry affects all the insurance sectors namely the one that exists in Tunisia. This problem of asymmetry entails essentially two major problems, such as the adverse selection and the moral hazard. These problems of adverse selection and moral hazard cause perverse effects on the productivity of the insurance companies and consequently on their productive efficiency. The objective of this research work is, on the one hand, to theoretically analyze the effects of the information asymmetry on the insurance functioning and, on the other hand, to estimate the technical efficiency of the Tunisian companies while taking account this problem which remains up to now unsolved.*

**Keywords:** information asymmetric, technical efficiency, insurance companies, parametric approach.

**JEL Classification:** D82, D24, G22, C14.

## 1. Introduction

Several research studies analyzed the performance of financial institutions and mainly that of the assurance companies, because of their importance in the economy. In fact, the insurance sector is one of the driving forces of development and takes part directly or indirectly in the economic, social and financial development.

The insurance transaction involves two operators: the insurer and the insured. On concluding a contract, the insured must pay a premium, which is the price of the risk that the insurer assumes when purchasing an insurance policy. Therefore, in case of a disaster, the insurer grants a compensation to the affected policyholders. It should be noted that there the inverted production cycle, which is an insurance specificity, raises a problem of fixing the cost price considered an enigma for the insurer. Price is an information vector the main function of which is to notify us about the economic scarcity of a resource, namely its quality which is also complex information. However, an ambiguity appears in the insurance market since the information is not quite a property as the others. It is essentially an experience price, in other words, the information can be known only after being obtained.

Moreover, the information problems were a major focus in the economic analysis. The new microeconomic theory set forth recent studies which dealt in a relevant way with the debates related to the staff information problems in a contracting environment. The carried out studies showed that this problem arises when the available information is asymmetrically distributed between the contracting parties. Therefore, such an exchange seems difficult between two unequal parties. Such a problem may entail a cost for either of the two parties and even for both.

This information asymmetry leads to adverse selection and moral hazard problems. These latter ones start from a situation characterized by the information asymmetry. The difference between these two similar concepts is of a temporal nature. Adverse selection starts from a situation before the contract signing. This is to make the choice between goods or agents that will remain the same after signing the contract but don't reveal their true nature after the signature. In fact, the moral hazard occurs after signing such a contract. This situation is characterized by the fact that the agents can change their behavior after the signature of the contract. As a result, the insurer is called on to undertake the necessary measures to counterbalance these two phenomena of adverse selection and moral hazard, which can affect the firm's productive efficiency.

It is therefore interesting to study the productivity and efficiency of the insurance companies and analyze the impact of the information asymmetry on them. However, in recent years, several studies have been conducted about the insurance companies' productivity. These studies focused first on the estimation of the scale and scope economies and technical efficiency.

The aim of this research work is, on the one hand, to theoretically analyze the effects of the information asymmetry on the functioning of the insurance markets and, on the other hand, to estimate the technical efficiency of the Tunisian companies by taking into account this problem which remains unsolved up to now.

## 2. Theoretical framework

Studies about the information problems in the field of economics started in the early 1960s. The two most well known problems are the moral hazard and the adverse selection. Akerlof (1970) was the first author to deal with the problem of adverse selection which is sometimes referred to as anti-selection. According to this author, this concept refers to a situation where the goods buyers can observe only the average quality of the property. The sellers of a good quality property feel insufficiently rewarded through an average price and therefore, they withdraw from the market. In fact, only poor quality goods remain in the market that Akerlof calls "lemons". He gives, among other things, the example of the used car market and thus explains the price difference between new and used cars. For Akerlof, informational asymmetry leads to the exclusion of the 'good' and in an extreme case the disappearance of the market. Akerlof demonstrated how this phenomenon can impede the functioning of the market. In this case, the insured provides better information on the risk that the insurer is committed to cover.

In an article dealing with the insurance sector for medical care, Arrow (1963) showed that the volume of medical care depends on the number of people who have health insurance. In other words, after the contract signature, people who signed contracts are more likely to consult their physicians, given the absence of costs of such an operation. Adverse selection and moral hazard are problematic for a decision maker. The latter might not know if he has chosen the good agents in the first situation and if the selected agents will change their behavior in the second situation. Therefore, most authors concluded that the information problems cause significant distortions in the economy. However, in some markets, effective mechanisms have been developed to reduce these distortions. These latter ones are more intense at the anti-selection level, which is explained by the fact that anti-selection is related to exogenous characteristics, whereas the moral hazard is explained by endogenous actions that can be modified at any time. For this reason, the present paper will be limited to the anti-selection problem.

Rothschild and Stiglitz (1976) examined the balance in a competitive market and showed that poor-risk individuals choose the same type of contract as the one chosen by low risk individuals. However, the premiums paid by the various groups are the same. The presence of this type of problem can prevent the low-risk insured from ensuring, or at least, he will be obliged to reduce his insurance purchases. This will certainly have an impact on the insurer's portfolio, who in turn, will attempt to raise the fares so as to compensate for the loss due to the departure of potential clients, which will cause a new start. Rothschild and Stiglitz made a bright analysis of the functioning of competitive insurance markets in the asymmetric information. Instead of offering a single insurance contract for all the individuals, the insurers offer a list of insurance contracts which organize a form of risk selection in the market. If the proportion of high-risk individuals is relatively high, a separator equilibrium is established and characterized by a full coverage of high and partial coverage of low risk. If the proportion of high-risk individuals goes beyond a certain threshold, there is no more equilibrium.

This theoretical prediction gave rise to many subsequent developments. Thus, a discussion was ensued about the possibility of a pooling equilibrium (mixing balance).

Wilson (1977) showed that the equilibrium is mixing when the proportion of high risk is relatively low. Other contributions focused on refinements of the equilibrium concept of the insurance markets (Riley, 1979; Miyazaki, 1977 and Spence, 1978).

These approaches, which may take into account or not, depending on the circumstances, the possibility of cross subsidies between the classes of risk, provide a very strong substantiation of the insurance deductibles. Indeed, the latter ones urge the insured individuals to get self-selected: high risk frequency agents prefer low or zero franchises, whereas low loss frequency agents accept high franchises. The insurance franchise is therefore a very relevant mechanism in the management of the risks subject to the anti-selection phenomenon. (Riahi and Pannequin, 2004). Therefore, it can be seen that if anti-selection can threaten the functioning of the insurance markets, insurers can, in some cases, overcome the barrier caused by the information asymmetry. They can get policyholders to reveal their risk level by offering contracts that can be distinguished by the amount of insurance.

As a result, the insurer is called to take the necessary measures to deal with this phenomenon of information asymmetry that can affect the firm's productive efficiency. In recent years, there have been several research studies dealing with the insurance productivity. These studies focused first on the estimation of economies of scale and scope and technical efficiency. Furthermore, several studies focused on the study of the insurance sector to assess its productive performance. In this context, we can mention the work of Fecher et al. (1993), Gardner and Grace (1993, 1998), Cummins and Zi (1997) and Cummins, Weiss and Tennyson (1999) and many others.

Cummins and Weiss (1993) presented an overview of the literature on research the efficiency and productivity of the insurance industry. These authors published several articles about the American insurance industry. Actually, he conducted some analyses in terms of allocative efficiency, at scale etc. Fecher et al. (1993) drew the same conclusion for the French industry. He explained this result by a heterogeneous and segmented market: firms are highly specialized and have specific customers to counteract the adverse selection. Furthermore, the prices paid by the insured depend on his characteristics; therefore, production technology may change from one company to another.

In another comparative study of fifteen countries of the OECD, Donni and Fécher (1997) showed that the productivity growth observed in all the surveyed countries is essentially attributed to technical progress. They also showed that both reinsurance and the monopolized share market have a positive effect on the level of efficiency. In fact, economic and financial liberalization will lead to more intense competition. As a consequence, the insurers are expected to improve their productive performance.

On the other hand, to measure performance, several approaches have been developed in the literature among the best known of them are those based on the ratios of total productivity (TFP) and the ratio of the partial productivity factors (PPF). These two ratios assume that firms operate on their production/cost border, which implies that these firms are efficient and that any productivity improvement is conceived as an improvement of

the observed output. Nishimizu and Page (1982) showed that this improvement can be twofold: the technical progress on the one hand, and the change of efficiency, on the other hand. From here, it is clear that efficiency is a notable component that contributes to TFP growth. This suggests that this component may be considered as a performance indicator. Although they are of an undeniable value, these ratios (PTF, PPF) have become obsolete giving way to new techniques of performance measurement, such as mathematical programming techniques or non-parametric methods and econometric and parametric techniques or methods. For this reason, the major objective assigned to this work is to understand the productive efficiency of the different insurance companies by adopting technical efficiency as a performance criterion.

## 2.1. Information asymmetric in the insurance market: an anti-selection case

### 2.1.1. *Insurance market equilibrium with anti-selection*

Actually, in the model of Rothschild and Stiglitz, the game is a two-step procedure: in the first stage, and in the absence of information on the type of consumer, the insurance companies offer one or several contracts simultaneously and anticipate the characteristics of their customers by considering the rival companies as an input. In the second stage, the consumers make a choice among these contracts and reveal the type the ones specific to them.

The characteristics of the balance therefore depend on the reaction of an insurance company to the shares of its rivals. In a competitive environment, the retained equilibrium concept is the Nash equilibrium, which corresponds to a situation where each insurance company considers the other company's strategy as a parameter and does not anticipate the reaction of the rival insurers to the change of its own strategy. The insurance contracts available in the equilibrium will not be in deficit. Moreover, a contract cannot achieve positive profits because when an insurance company offers a profitable contract, another company will offer a less interesting contract, which increases the usefulness of the agent. Competition between companies generates void profits at equilibrium. The definition of RS equilibrium is as follows: "An RS equilibrium is a set of contracts defined in two dimensions (price, quantity) such as when different categories of consumers choose a particular contract so as to maximize their utility, each contract has a non-negative profit and there are no other contracts outside this equilibrium which, if offered, would realize a profit."

According to this definition, when there is perfect information, the competitive equilibrium is defined by the maximization of the utility function of each type under constraint of void profits. In the case of imperfect information, the insurance contracts of perfect information cannot be fulfilled; therefore, the insurers should take into account the behavior of this anti-selection in order not to suffer deficits. Therefore, two types of contracts correspond to the definition of RS equilibrium:

- Separator contracts (both types self-select and sign differentiated contracts),
- Pooling contract (a single contract is underwritten by both types of individuals).

Rothschild and Stiglitz (1976) showed that, in general, Nash equilibrium may not exist between insurance companies in competition when they use, as informative actions, a

package of price and quantities. When there is no RS equilibrium, Wilson and Grossman (1979) showed preferred that the pooling equilibrium preferred by the low risks emerges, therefore, they proposed the following new definition for the equilibrium:

*An equilibrium is a group of contracts, such as when the various categories of consumers choose a particular contract so as to maximize their usefulness, each contract has a non-negative profit and there are no other offered contracts which achieve a positive profit even when the existing initial contracts on the market are withdrawn.*

According to Wilson and Grossman, the insurer has to anticipate the reaction of his competitors after his entry into the market and therefore should drop loss-making contracts. These expectations, at Wilson and ' the Grossman's way, helped the same equilibrium to emerge where the RS equilibrium did not exist. Rothschild and Stiglitz finally presented a more realistic view of the relationship between the insurer and the insured. By expressing their desires, the insured peoples reveal their risk level. Using this information, the insurer may deny a person to sign a contract intended for him.

Spence (1978) and Myazaki (1977) developed the analysis of Wilson (1977) and showed the possibility of the existence of stable equilibrium when the insurance company subsidized an insurance policy with the profits of another policy.

*An equilibrium of Miyasaki-Spence-Wilson many contracts that globally realize a non-negative profit in the way that where different categories of consumers choose a particular contract so as to maximize their utility. There are no other offered contracts that achieve a positive profit even when the initial existing contracts on the market are removed.*

Spence and Myazaki showed that an equilibrium contract for low risk individuals is identified by maximizing their expected utility under the following two constraints:

The insurer's expected profit is nil

- The members of the high risk group have no incentive to choose the contract offered to the low-risk group.

Finally, it should be noted that Wilson's equilibrium is sometimes called in the economic literature the Spence-Myazak's equilibrium. Wilson's equilibrium has the same characteristics as that of Nash. Actually, among both contract parties, the low-risk individuals are the ones who always suffer from the information asymmetry and who do not pay the premium corresponding to their real class of risk.

A new concept of the insurance market equilibrium, which is called "reactive equilibrium", was proposed by Riley (1979). After studying the model of Rothschild and Stiglitz (1976) and Wilson (1977), Riley distinguished two types of informational equilibrium:

- A series of informational contracts in which the company offers different contracts for each risk group. In such cases, the insurer may distinguish between the different types of individuals but the truth is a dominant strategy for at least the individuals of the high risk group.
- A group of low informational contracts in which a single contract is offered to all the risk groups. In this case, the discrimination between the different types of individuals

is therefore impossible and the truth is not the only dominant strategy for both groups of risks.

Riley showed that:

- The Nash's equilibrium satisfies, in general, neither the first set (Riley: 1979), nor the second set (Riley: 1979).
- Wilson's equilibrium satisfies the first set when two discriminating contracts are proposed and the second set when a uniform contract is proposed for both groups.

Therefore, compared with Wilson's equilibrium, the insurance companies have a "much more aggressive" behavior through a 'reactive equilibrium'. In fact, when the insurance companies are in a 'reactive equilibrium, no company has interest to react by offering a more advantageous contract on the market. If there is a reaction, the company will be a loser and may disappear from the market.

After presenting an overview of the information asymmetry in the insurance market and in particular on the presence of the anti-selection market, it can be concluded that if anti-selection threatens a priori the functioning of the insurance markets, insurers may, in certain circumstances, overcome the difficulty posed by the asymmetry of information. By offering contracts that differ by the amount of insurance, they bring the insured to disclose their risk level and they can quote actuarial premiums.

Therefore, the insurer has to take the necessary measures to counteract this information asymmetry that can affect the firm's productive efficiency. It therefore seems interesting to study the productivity and efficiency of the insurance companies and analyze the impact of information asymmetric on them.

## 2.2. Productivity and efficiency of the insurance companies

### 2.2.1. *Productive performance concept*

Productivity became a hot topic that unanimously interested the economists, the econometricians and the policy makers. Productivity for managers and economists is a means of improving competitiveness, production, revenues etc. Hence, it can, at the macro level, affect the quality of the provided services and can generate more resources.

Policyholders are increasingly seeking new ways of managing the risks they face. It is therefore appropriate to find, when necessary, unconventional solutions. In this respect, what distinguishes the insurers is the quality of their services. Actually, the offered services differentiate similar insurers. On the supply side, the insurer has to get adapted mainly to his customers' needs.

Both approaches seem to answer the measurement of production efficiency, namely, the traditional and the recent approaches. By referring to the firm's traditional economic theory on the evaluation of the productive performance, we have to look at the measurement of the partial and/or total factor productivity. Therefore, productivity connects production and the production factors which are necessarily used to achieve a certain level of production.

The various measures brought in by the traditional economic theory (partial labor productivity (PPL), total factor productivity (TFP)) are applicable to the field of insurance companies. Bernstein (1998) used the concept of total factor productivity when he studied the Canadian life insurance. Moreover, to carry out an analysis of the insurance companies' performance, the decision makers often opt for a calculation of the accounting or financial ratios.

Although these performance measures are the source of the evaluation of the productive performance of insurance companies, they have some limitations. First, these ratios do not take into account the quality of the services, besides they give only a facet of the companies' performance. In fact, a company can benefit from a solid financial structure; however, it may be technically inefficient. Moreover, these ratios do not enable us to conduct comparative analyzes at the international level. Similarly, these used accounting ratios are specific to each company, even within the insurance companies where the insurers do not adopt the same performance indicators.

However, with the rapid development of the recent methodologies of the efficiency frontiers, the traditional measures became obsolete. In fact, these methodologies represent, if it needs to be said, a multidimensional index through which the insurance companies' complex activities can be dealt with.

To cover the shortfalls caused by the traditional approaches in terms of the measurement of the firms' productive performance, some approaches have recently been developed. These approaches brought in some indicators of considerable importance because they can be applied to all the economic activities in any market structure (Pestieau and Picard, 1993).

The underlying logic of the frontier methodology helps measure the firms' performance in relation to a "Best practice" firm. Actually, every observed firm will be compared to firms operating in the same sector. In this context, several studies about the insurance companies' performance were conducted on the basis of a productive performance indicator, namely, technical efficiency. Besides technical efficiency, other indicators show the degree of the insurance companies' efficiency from another angle to find out allocative and scale efficiency.

### ***2.2.1. The estimation techniques of productive efficiency***

In a perspective of the efficiency analysis, the production function is not only interpreted as a relationship between the inputs and the outputs, but also as a frontier that has several production possibilities. For a company located on the border, this corresponds to the maximum amount that can be obtained from a given input vector, or in an equivalent manner the minimal amount of input required to achieve the level of the produced output. Each production activity belonging to the production frontier is defined as being efficient. Nevertheless, all the other firms located below the frontier are said to be inefficient.

Thus, the inefficiency level is measured by the distance that separates a firm of its efficiency frontier. In general, the production frontier is unknown, but it can be estimated from information about the companies' inputs and outputs which form all the selected production possibilities.

The most adopted techniques for the measurement of the degree of inefficiency are found in two main approaches:

- The nonparametric approaches, which are the “Data Envelopment Analysis” (DEA) and the “Free Disposal Hull” (FDH) methods.
- Parametric or econometric approach, which consists in estimating a production or distance function.

The focus on the nonparametric methods in estimating the production frontier lies in their capacity in several domains to take into account the specificity of the different sectors.

On the other hand, with the development of econometric tools, there was therefore the emergence of parametric techniques to measure the degree of inefficiency in most sectors. These techniques emerged mainly to correct the defects revealed by nonparametric techniques (non consideration of hazards, the need for a well defined functional form about the production technology etc.).

While the nonparametric approach builds the frontier using linear programming, the parametric approach builds the frontier using an econometric model. The main difference between the two approaches is that the second imposes a precise functional form on the specification of the frontier, whereas the first approach does not require this hypothesis.

Measuring the insurance output seems to be an enigma and actually raises several problems. If we resume the different insurance functions, we can conclude that it is an abstract product. In fact, the insurer sells security and protection that meet the need for security expressed by the insured. This feeling of security can be measured by the price that the insured is willing to pay. Therefore, measuring the output is a very difficult task. Furthermore, the offered services cause substantial difficulties when determining an aggregate measure for the firm’s production. This topic has been widely debated by researchers. Besides, there are several studies dealing with the efficiency of insurance companies, although there is no consensus on a precise definition of measurement of the insurance output. Certainly, identifying the inputs and outputs is essential for the studying of the productive performance of insurance companies.

In fact, the various approaches developed in the recent literature to measure the productive efficiency and mainly the technical efficiency are the non parametric DEA and the parametric methods. In the third section, these estimation techniques and the different already developed models are used to assess the performance of the Tunisian insurance companies.

### 3. Estimation technical efficiency of the Tunisian insurance companies

#### 3.1. Data and variables

The available data are collected about 10 insurance companies observed over a 14 year period (1990-2003). Among the 22 companies resident, we have retained only 10 companies about which there is exhaustive information. For each company, the information is only available about the quantities of inputs (labor, physical and financial capital) and the quantity of outputs (claims paid out). The used database was developed

from the balance sheets and the profit and loss accounts published by these companies. In order to estimate technical efficiency, we adopted the parametric approach by estimating a stochastic production function of translog type.

### 3.2. Estimation of technical efficiency using the parametric method

In the literature, there are two types of frontiers, a deterministic parametric frontier, which interprets any distance from the border as an indicator of inefficiency, and a stochastic frontier, which includes two types of errors, an asymmetrical one, which is used to capture inefficiency, and another symmetric or a common error term, which is assumed to be beyond the firm's control. Given the size of the temporal dimension of our sample (14 years), it seemed interesting to work on models that take into account the temporal variability of technical inefficiency (i.e., the model of Battese, 1992); Cornwell et al. (CSS, 1990); Lee and Schmidt, 1990 etc.). However, in this research study, our interest will be simply paid to the flexible functional form advanced by CSS, (1990). Moreover, we will take into account two types of stochastic frontiers with and without information asymmetry. In fact, the first is a standard stochastic production frontier without asymmetry, whereas the second tries to build a production frontier that incorporates the terms of the information asymmetry through two proxy variables, namely, the loss and reinsurance ratios.

#### ▪ *The loss ratio:*

This ratio is the proportion of the sinister charges (payable claims + provisions for ongoing risk) to premiums. Nevertheless, it enables us to understand the proportion of the payable claims in the total of the net premiums received. However, this ratio gives us some information about the amount refunded in case of disaster. In practical terms, the policyholders' compensation is not done instantaneously, but it can, for several reasons (legal, administrative etc.), spread over a longer period. In this case, to ensure his future and present commitments to policyholders and beneficiaries of contracts, the insurer must set up provision funds for outstanding claims.

#### ▪ *The reinsurance ratio:*

This ratio is calculated on the basis of the ratio of the ceded reinsurance and the deducted premiums. In fact, it reflects the level of uncertainty regarding some sold insurance policies. This implies that the insurer is unable either to adequately grasp the incurred risk regarding some insurance policies (e.g. automobile), or is unable to escape the problems related to the information asymmetry that represents the cornerstone in our research work. For this reason, sometimes the insurer chooses to insure himself to an insurance company to counteract any possible informational problems.

### **3.2.1. Estimation of the stochastic frontier without asymmetry**

#### **3.2.1.1. Selection of the functional form**

Among the problems that arise in the context of the parameter estimates is the choice of the functional form. The question is to identify the most appropriate form which describes best the considered industry technology. However, we do not claim to study several functional forms, but we shall confine ourselves only to the Cobb-Douglas and translog production

functions. However, our goal is to choose one among these two technologies. For this reason, we will conduct a Fisher test to choose the function which will be retained.

▪ **The Cobb-Douglas form**

The Cobb-Douglas function can be written as follows:

$$\log y = \alpha_0 + \alpha_1 \log L + \alpha_2 \log K$$

▪ **The Translog form**

The translog function can be written as follows:

$$\log (Y_t) = \alpha_0 + \alpha_1 \log (K_t) + \beta_1 \log (L_t) + \alpha_2 \log (K_t)^2 + \beta_2 \log (L_t)^2 + \gamma \log (K_t) \log (L_t)$$

It can be seen that these two models are nested. Indeed, if the  $\beta_{ij}$  ( $i=j=1,2$ ) are nil, then the Cobb-Douglas form will be obtained. On this basis, a hypothesis test can be made on a subset of coefficients, which is in fact a Fisher's test.

As a consequence, our hypothesis can be formulated as follows

$$\left\{ \begin{array}{l} H_0: \beta_{12} = \beta_{11} = \beta_{22} = 0 \\ H_1: \beta_{ij} (i = j = 1, 2) \neq 0 \end{array} \right. \quad \left\{ \begin{array}{l} H_0: \text{Cobb-Douglas} \\ H_1: \text{Translog} \end{array} \right.$$

The easiest and most appropriate method to carry out this test is to apply Fisher's test. Hence, the test statistics is defined as follows:

$$LR = \frac{(\text{SCR}(\text{constrained model}) - (\text{SCR}(\text{non constrained model})) / (\text{dl}(H_0) - \text{dl}(H_1)))}{\text{SCR}(\text{non constrained model}) / \text{dl}(H_1)}$$

With,

SCR: is the sum of the residual squares;

dl ( $H_0$ ): is the degree of freedom under  $H_0$ ;

dl ( $H_1$ ): is the degree of freedom under  $H_1$ .

Table 1 shows the results of the conducted test:

**Table 1.** The various test statistics

	constrained model	non constrained model
SCR ( $H_0$ )	23.58	.....
DL ( $H_0$ )	136	.....
SCR ( $H_1$ )	.....	19.445
DL ( $H_1$ )	.....	130
$F_c$	4.609	.....
$F^T (5\%)$	2.10	.....

From Table 1, it can be seen that Fisher's calculated statistics is higher than that of the table. This makes us conclude that the null hypothesis  $H_0$  can be rejected. In other words, the Cobb-Douglas functional form is rejected in favor of the Translog functional one. On the basis of this test, the technology of the Tunisian insurance industry can be represented by a Translog functional form, which will be retained later.

**3.2.1.2. The model of Cornwell, Schmidt and Sickles: CSS**

To assess the variability of technical efficiency over time, the specification proposed by CSS (1990) will be used. This choice can be validated using Fisher's test.

▪ **Hypothesis test**

In the same vein, a statistical test will be carried out to justify the rejection of the deterministic fixed effect model in favor of the CSS model which describes the variability of technical efficiency. First of all, it should be noted that under the  $H_0$  null hypothesis, the CSS model is equivalent to the deterministic fixed effect model. Hence, we have:

$$\begin{cases} H_0: \theta_{1i} = \theta_{2i} = 0 \\ H_1: \theta_{ji} \text{ (j = 1, 2) are different from zero} \end{cases}$$

▪ **The test results**

The different test statistics are given in Table 2 below:

**Table 2.** The various test statistics

	constrained model	non constrained model
SCR ( $H_0$ )	7.822	.....
DL ( $H_0$ )	130	.....
SCR ( $H_1$ )	.....	4.6627
DL ( $H_1$ )	.....	110
$F^c$	3.7268	.....
$F^T$ (5%)	1.75	.....

Therefore, the performed Fisher's test shows that  $H_0$  is rejected in favor of  $H_1$  hypothesis. As a result, this test rejects the constant efficiency model in favor of the variable efficiency model.

However, Cornwell, Schmidt and Sickles took a quadratic functional form which depends on time for efficiency.

This form can be written as:

$$U_{it} = \theta_{0i} + \theta_{1i}t + \theta_{2i}t^2$$

The type of translog production function is written as follows:

$$\log y_{it} = \beta_1 \log K_{1it} + \beta_2 \log K_{2it} + \beta_3 \log L_{it} + \beta_{11it} (\log K_{1it})^2 + \beta_{22} (\log K_{2it})^2 + \beta_{33} (\log L_{it})^2 + \beta_{12} \log K_{1it} \log K_{2it} + \beta_{13} \log K_{1it} \log L_{it} + \beta_{23} \log K_{2it} \log L_{it} + \epsilon_{it} + V_{it}$$

To estimate this model, we can also build dummy variables.

In fact, this model will be estimated by means of the so-called two-step method, which can be illustrated as follows:

- Estimate the production function by the OLS method.
- Recover the residues. ( $\hat{\epsilon}_{it}$ ).
- Regress the residues ( $\hat{\epsilon}_{it}$ ) on the  $V_{it}$  and  $\theta_{0i} + \theta_{1i}t + \theta_{2i}t^2$ , otherwise, the following model must be estimated by the OLS method.

Estimating the production function by the means of the OLS method

- Retrieve the residues ( $\hat{\epsilon}_{it}$ ).

Regress the ( $\hat{\epsilon}_{it}$ ) residues on  $V_{it}$  and  $\theta_{0i} + \theta_{1i}t + \theta_{2i}t^2$ , in other words, the following model should be estimated using the OLS approach:

$$\hat{\epsilon}_{it} = \theta_{0i} + \theta_{1i}t + \theta_{2i}t^2 + V_{it}$$

Moreover, this estimation enables us to obtain the different elements of technical inefficiency  $\theta_{ji}$  ( $j = 1, 2, 3$ ), and therefore we can estimate the technical efficiency of the different companies. The efficiency scores can be obtained as follows:

$$TE = \exp(\hat{\theta}_{0i} + \hat{\theta}_{1i,t} + \hat{\theta}_{2i,t^2} - \max(\hat{\theta}_{0i} + \hat{\theta}_{1i,t} + \hat{\theta}_{2i,t^2}))$$

$i = 1, \dots, 10$  et  $t = 1, \dots, 14$ .

The following table shows the different technical efficiency scores obtained using this method.

**Table 3.** The different technical efficiency scores obtained by the means of the CSS model (without asymmetry)

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
90	0.6643	1	0.3388	0.3243	0.4311	0.6035	0.8337	0.9775	0.8961	0.6867
91	0.609	1	0.3486	0.394	0.4032	0.5984	0.7169	0.9609	0.7282	0.6751
92	0.5677	1	0.3587	0.4655	0.3813	0.5938	0.6308	0.9437	0.6073	0.6632
93	0.5379	1	0.369	0.5349	0.3645	0.5899	0.568	0.926	0.5196	0.6509
94	0.5182	1	0.3796	0.5977	0.3524	0.5864	0.5233	0.9076	0.4563	0.6383
95	0.5076	1	0.3904	0.6495	0.3445	0.5835	0.4933	0.8888	0.4111	0.6255
96	0.5054	1	0.4014	0.6864	0.3405	0.5812	0.4758	0.8695	0.3801	0.6124
97	0.5116	1	0.4126	0.7055	0.3403	0.5793	0.4696	0.8498	0.3606	0.5991
98	0.5265	1	0.4241	0.7051	0.3439	0.578	0.4743	0.8298	0.351	0.5857
99	0.5509	1	0.4358	0.6854	0.3514	0.5772	0.4901	0.8094	0.3506	0.572
00	0.586	1	0.4478	0.6478	0.363	0.5769	0.5183	0.7888	0.3594	0.5582
01	0.6337	1	0.4601	0.5955	0.3792	0.5771	0.5608	0.768	0.378	0.5443
02	0.6968	1	0.4725	0.5324	0.4005	0.5778	0.6209	0.747	0.408	0.5303
03	0.7788	1	0.4853	0.4629	0.4278	0.5791	0.7034	0.7258	0.4518	0.5163
Moy	0.5853	1	0.4089	0.5705	0.3731	0.5844	0.5771	0.8566	0.4756	0.6041
Rang	4	1	9	7	10	5	6	2	8	3
Min	0.5054	1	0.3388	0.3243	0.3403	0.5769	0.4696	0.7258	0.3506	0.5163
Max	0.7788	1	0.4853	0.7055	0.4311	0.6035	0.8337	0.9775	0.8961	0.6867

By looking at Table 3, it can be noticed that on the basis the different scores, a ranking of the different companies could be achieved. In the first group, we find companies C2, C8 and C10 which are classified respectively in the 1st, 2nd and 3rd place, with respective technical efficiency scores of the order of 1; 0.8566 and 0.6041. A second group includes companies C1, C6, C7 and C4 the efficiency scores of which are too close to one another, that is 0.5853; 0.5844; 0.5771 and 0.5705. Finally, a third group consists of C9, C3 and C5 companies which have low efficiency scores, that is 0.4756; 0.4089 and 0.3731.

Besides, on the basis of the various obtained scores, it can be concluded that C3 company recorded an efficiency improved over the 1990-2003 period, whereas C8 company knew a decline of efficiency over the whole studied period. The same applies to company 9, except for the last two years.

### 3.2.2. Estimation of a stochastic frontier with asymmetry

In this section, the information asymmetry will be taken account for its contribution to the production frontier since it could hamper the functioning of the insurance market or even threaten its existence. In fact, in the face of an insurer who, due the lack of sufficient information on the risk of its customers, practices uniform rates, only the individuals who anticipate high costs (high risk) will be interested in ensuring themselves, which results in an incomplete coverage of low risk and a deficit for the insurer. In practice, this anti-selection phenomenon consists of the insurers' strategies in selecting the low risks so

much so that, unlike the theoretical predictions of adverse selection, in systems where a real competition between insurers prevails, there is rather a difficulty of high risks that should be ensured (Henriet and Rochet, 1998; Couffinal, 2000). This incentive to the high risk selection is so high for the insurers that it is more immediately profitable and much easier to implement than the risk management. Risk management can be defined as the insurer's ability to create incentives towards the policyholders seeking a greater productive efficiency.

In this section, there is an attempt to build a production frontier that incorporates the terms of the information asymmetry through two proxy variables, which are the loss and the reinsurance ratios. Actually, a Fisher's test will be conducted to justify the introduction of the terms of the information asymmetry in the production function. Then, the temporal variability of technical efficiency will be tested in the presence of both ratios. Finally, an estimation of the technical efficiency of different companies could be achieved.

▪ **The test results**

The various test statistics are presented in Table 4 below:

**Table 4.** *The various test statistics*

	constrained model	non constrained model
SCR (H <sub>0</sub> )	19.4459	.....
DL (H <sub>0</sub> )	130	.....
SCR (H <sub>1</sub> )	.....	115.8228
DL (H <sub>1</sub> )	.....	27
F <sup>c</sup>	120.5229	.....
F <sup>T</sup> (5%)	2.67	.....

On the basis of this table, it can be noticed that the calculated Fisher's statistics is greater than that of the table. This makes us conclude that the null H<sub>0</sub> hypothesis is rejected in favor of H<sub>1</sub> hypothesis. As a consequence, this test shows the relevance of the introduction of the information asymmetry terms in the production function.

The translog production function is written as follows:

$$\log y_{it} = \beta_1 \log K_{1it} + \beta_2 \log K_{2it} + \beta_3 \log L_{it} + \beta_{11it} (\log K_{1it})^2 + \beta_{22} (\log K_{2it})^2 + \beta_{33} (\log L_{it})^2 + \beta_{12} \log K_{1it} \log K_{2it} + \beta_{13} \log K_{1it} \log L_{it} + \beta_{23} \log K_{2it} \log L_{it} + \varepsilon_{it} + V_{it} + \delta_1 \text{Sinisit}_{it} + \delta_2 \text{Réass}_{it}.$$

Table 5 shows the results of the conducted test:

**Table 5.** *The various test statistics*

	constrained model	non constrained model
SCR (H <sub>0</sub> )	3.2818	.....
DL (H <sub>0</sub> )	110	.....
SCR (H <sub>1</sub> )	.....	2.2292
DL (H <sub>1</sub> )	.....	130
F <sup>c</sup>	2.59726	.....
F <sup>T</sup> (5%)	1.67	.....

Therefore, the performed Fisher's test shows that hypothesis H<sub>0</sub> should be rejected in favor of H<sub>1</sub>. As a result, this test rejects the model of constant efficiency in favor of that of the variable efficiency.

The following table shows the different technical efficiency scores obtained in the case of the information asymmetry.

**Table 6.** *The different technical efficiency scores obtained using the CSS model (with asymmetry)*

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
90	0.4252	0.7488	0.7151	0.9352	0.6802	0.4912	0.4912	0.7936	1	0.8533
91	0.3726	0.6387	0.8333	0.9891	0.2745	0.3502	0.8266	0.9603	1	0.819
92	0.4742	0.7423	0.6895	1	0.2863	0.4285	0.6083	0.6855	0.969	0.6273
93	0.6373	0.3842	0.5367	1	0.2539	0.3845	0.5055	0.528	0.8788	0.5535
94	0.3226	0.4041	0.5044	1	0.316	0.3306	0.6603	0.5457	0.8939	0.5196
95	0.357	0.3973	0.6267	1	0.2561	0.2618	0.5506	0.2626	0.8014	0.2761
96	0.6266	0.3832	0.3326	1	0.2767	0.2391	0.4175	0.2525	0.6359	0.2365
97	0.8582	0.4982	0.5753	1	0.5584	0.3189	0.5382	0.5283	0.8093	0.3305
98	0.7904	0.4547	0.5184	1	0.416	0.2826	0.363	0.4554	0.6329	0.3073
99	0.8791	0.7633	1	0.7002	0.6877	0.4632	0.7333	0.6625	0.9635	0.4256
00	0.8062	0.802	0.7994	1	0.7269	0.4289	0.688	0.7202	0.9142	0.4737
01	0.6461	0.827	0.5075	0.8932	0.51	0.5018	0.7429	0.8081	1	0.5126
02	0.5069	0.6147	0.4582	1	0.3845	0.3901	0.5307	0.6034	0.703	0.3661
03	0.2922	0.4797	0.3678	1	0.28	0.2727	0.4256	0.3775	0.5075	0.2981
Moy	0.5710	0.5813	0.6046	0.9655	0.4219	0.3674	0.5773	0.5845	0.8364	0.4714
Rang	7	5	3	1	9	10	6	4	2	8
Min	0.2922	0.3832	0.3326	0.7002	0.2539	0.2391	0.363	0.2525	0.5075	0.2365
Max	0.8791	0.827	1	1	0.7269	0.5018	0.8266	0.9603	1	0.8533

By referring to the table, we can draw the following results:

A first group includes C4, C9 and C3 companies classified respectively in the 1st, 2nd and 3rd place and which have respective technical efficiency scores of 0.9655; 0.8364 and 0.6046. A second group includes C8, C2, C1 and C7 companies which have efficiency scores too close to one another, that is, 0.5845; 0.5813; 0.5773 and 0.5710. Finally, a third group includes C10, C5 and C6 companies which have somewhat low efficiency scores, that is, 0.4714; 0.4219 and 0.3674.

Furthermore, from the obtained different scores, it can be concluded that the C4 company recorded an efficiency improvement of 0.9352 in 1990 to 1 in 2003, whereas C2 company saw a decline of its efficiency score which passes from 0.7488 in 1990 to 0.5813 in 2003. On the basis of this table, it can be noticed that the different efficiency scores for most insurance companies recorded a development compared to the technical efficiency scores achieved when the information asymmetry is not taken into account. Therefore, it can be concluded from this analysis that, when insurance companies take into account the information asymmetry, their efficiency scores generally improve. This implies that these companies need to better manage risk so as to overcome the problem of the information asymmetry.

## Conclusion

To analyze the technical efficiency of the Tunisian insurance companies, we applied in this work the parametric approach embodied in the translog stochastic frontier production. The main obtained results firstly lead, through the model of Cornwell, Schmidt and Sickles (CSS), to the determination of technical efficiency scores, while ignoring the problem of the information asymmetry, as well as companies' classification, and secondly to the determinations of the efficiency scores while taking into account the problem of the information asymmetry. These results show that the different technical efficiency scores for most of the

insurance companies recorded an improvement compared to the technical efficiency scores recorded by these companies when the information asymmetry is not taken into account. However, the new companies' classification obtained from the estimation of a production frontier with asymmetry shows that on average, most of the companies recorded greater efficiency scores when taking into account the information asymmetry. Finally, the Tunisian insurance companies are required to take into account the information asymmetry to improve their productive performance.

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## FDI and export spillovers using Heckman's two step approach: Evidence from Turkish manufacturing data

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**Abstract.** *This paper examines the impact of horizontal and vertical spillovers from foreign direct investment on a firm's decision to export, and on export share. Using Heckman selection models, the export spillover hypothesis is tested using firm-level data from Turkish manufacturing firms. The empirical evidence reveals that domestic firms seem to benefit only in a limited way from export spillovers. Except for backward spillovers to exporters with adequate absorptive capacity, there is no evidence of forward and horizontal spillovers to domestic exporting firms, even when they increase their absorptive capacity. However, the findings also suggest that increases in absorptive capacity will first increase but eventually reduce the export share of domestic firms. Furthermore, the results reveal negative horizontal spillovers and no evidence of vertical spillovers to non-exporters. This may well indicate negative competition effects resulting from entry of foreign firms into domestic markets, and high sunk entry costs to export markets.*

**Keywords:** Foreign Direct Investment (FDI), export spillovers, absorptive capacity, horizontal linkage, vertical linkage.

**JEL Classification:** F13, F21, F23.

## 1. Introduction

Foreign direct investment (FDI) is viewed as a powerful force for the integration of developing countries into the global economy (UNCTAD, 2000). This is due to the argument that FDI has a significant effect on the host country's macroeconomic performance, and is an important form of technology transfer from developed countries to developing countries. Therefore policymakers and governments across the world design policies to stimulate inward flows (see e.g. Aitken et al. 1997; Gorg and Greenaway, 2004; Bwalya, 2006; Girma and Wakelin, 2007; Bitzer et al. 2008). Compared to domestic firms, foreign firms have more advanced technology, employ higher numbers of highly skilled workers, and spend more on R&D, and it is possible that such assets may leak out to domestic firms (so-called spillover effects), which in turn has a beneficial effect on domestic firms' productivity (Caves, 1996). Spillover effects arise from a number of sources including the horizontal (intra-industry) and vertical (inter-industry) production linkages formed between domestic and foreign-owned firms. Following this line of reasoning, since the pioneering study of Caves (1974), the productivity spillovers from FDI have been widely investigated in the literature, although the empirical evidence is mixed (see Meyer, 2003 and Greenaway et al., 2004 for the literature survey).

However, a new strand of literature suggests that the interaction of domestic firms with foreign firms can also affect the export decision (export participation) and export share (export intensity) of domestic firms, i.e. create export spillovers resulting from information, imitation and competition effects (see Blomstrom and Kokko, 2003; Gorg and Greenaway, 2004; Greenaway and Kneller, 2004; Ruane and Sutherland, 2004; Kneller and Pisu, 2007; Bajgar and Javorcik, 2013 among others).

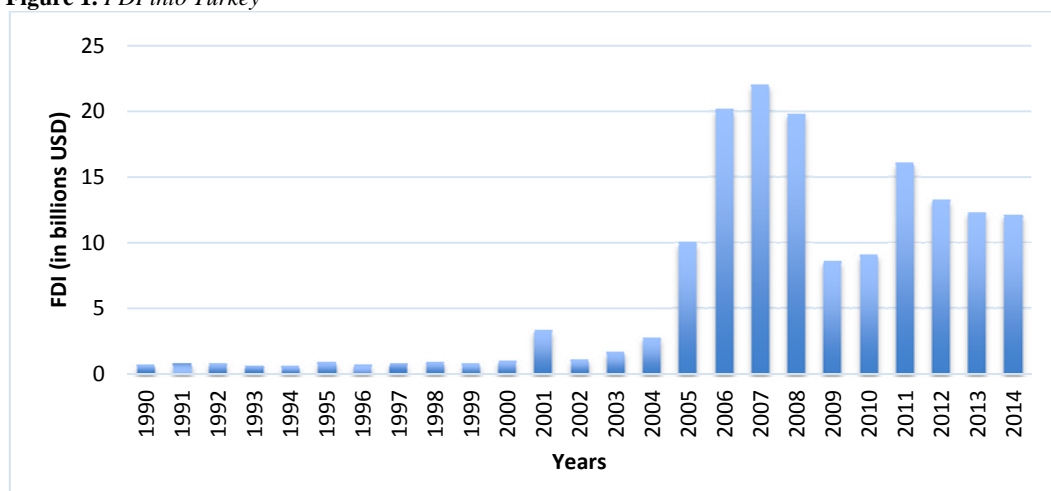
The issue of export spillovers is important, because strong export performance is widely believed to be one of the crucial factors in enhancing economic growth. Since exporting firms must improve their productivity in order to overcome trade barriers, and the higher levels of competition in international markets, and have to address different consumer tastes, exports are generally regarded as boosting a firm's productivity. Furthermore, exporting firms might be alerted to potential innovations abroad, which they may adapt in order to improve their position in foreign markets (Barrios et al. 2003, Greenaway and Kneller 2007). This would encourage firms to obtain the appropriate knowledge and advance their technological capability (Jongwanich and Kohpaiboon, 2008).

This paper contributes to this debate by focusing on Turkey, a country that has attracted significant FDI since the early 1990s, but especially in the last decade. Until 1980, the total foreign investment allowed into Turkey was less than \$250m. With the switch to an export-oriented trade policy, the history of FDI in Turkey accelerated in the early 1980s (Mercul, 2001). Following reforms to the existing investment law, Turkey experienced a considerable increase in foreign capital investments. Particularly, thanks to economic and political stability, over the past decade, Turkey made notable progress and sustained a confident economic environment, and in this context, FDI inflows to the country increased dramatically.

As shown in Figure 1, in 2001, FDI reached the highest level up to then, at \$3.35 billion (with an increase of 240% compared to 2000, in which FDI was about \$980 million) due to the second installment payment made by an Italian company that bought a GSM license in Turkey in 2000. Although FDI decreased substantially to \$1 billion in 2002 and \$1.7 billion in 2003, \$2.8 billion foreign capital entered the country in 2004, and this amount jumped remarkably to \$20 billion in 2006 and \$22 billion in 2007, as a result of privatization rather than new investments. However, with the arrival of the global crisis, FDI dropped to \$19.9 billion in 2008 and the real impact was felt the following year, when FDI dropped sharply to \$8.6 billion. The figure rose to \$9 billion in 2010 and then *soared to \$16 billion* in 2011. This upward movement, however, did not last: *FDI declined* to \$13.3 billion in 2012, \$12.4 billion in 2013 and \$12.1 in 2014.

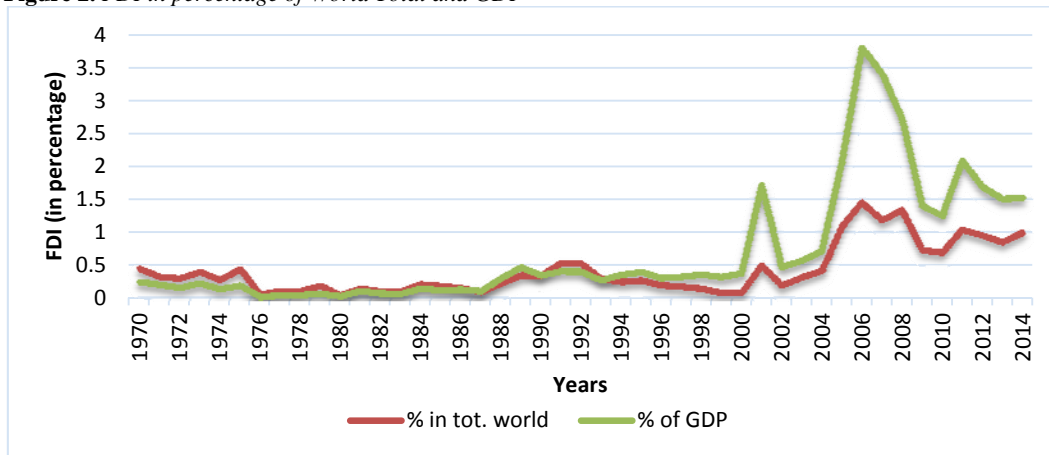
Overall, while the country attracted only about USD 15bn. in FDI through 2002, FDI inflows totalled to USD 155bn. in the period 2003-2015. The number of companies with foreign capital, which was only 6700 in 2003, rose to 44000 by 2015. According to the 2015 World Investment Report of the United Nations Conference of Trade and Development (UNCTAD), FDI inflows into Turkey were \$12.1 billion in 2014, making the country the 22nd most popular spot for investors in the world, 12th among emerging countries, and first in the Western Asia region.

**Figure 1.** FDI into Turkey



Source: UNCTAD.

Turkey's performance at attracting FDI can also be evaluated by examining FDI shares with respect to GDP, and by comparing FDI inflows to the world total. As Figure 2 shows, FDI, as a percentage of GDP and world total, increased dramatically after 2000, while the highest shares are recorded in years after 2004. Although the financial crisis of 2008 slowed down the country's performance, the figures in the following years indicate recovery.

**Figure 2.** FDI in percentage of World Total and GDP

Source: UNCTAD.

While some existing studies have considered the impact of FDI on productivity, economic growth and exports (see, Aslanoglu, 2000; Yılmaz and Ozler, 2004; Lenger and Taymaz, 2006; Pamukcu and Taymaz, 2009 among others), to the best of our knowledge, none of the available studies has considered the impact of FDI-related industrial linkages on export spillovers in Turkey. Therefore, in the present paper, considering a firm's ability to absorb spillovers, we try to provide some empirical evidence for the impact of horizontal and vertical linkages between domestic and foreign firms on (i) the decision of domestic firms to export (export participation) and (b) the export share of domestic firms (export intensity). By means of Heckman selection models, we test for the export spillover hypothesis using a firm-level dataset of manufacturing industries.

The rest of the paper is organized as follows. Section two contains a review of the literature pertaining to the impact of FDI on export performance. Section three presents the research methodology, including data collection and model specification, and a list of variables. Section four presents the results, and finally section five concludes the paper.

## 2. Literature Review

The literature on export spillovers from foreign multinationals is limited, while there is a large amount of empirical literature that investigates the impact of FDI and FDI-linked spillovers on productivity, and on technology transfer to domestic firms (Gorg and Greenaway, 2004; Kneller and Pisu, 2007). Furthermore, the studies that have considered the effect of FDI on export performance have mainly focused on horizontal linkages (see Blomstrom, 1986; Blomstrom and Kokko, 2001; Liu and Wang, 2003; Gorg and Hijzen, 2004; Girma, Gorg, and Pisu, 2008; Liu, 2008; and Blalock and Simon, 2009 among others). This is despite the fact that foreign presence might clearly affect the export activities of domestic firms through horizontal and vertical linkages (Rodriguez-Clare, 1996; Aitken et al., 1997).

The evidence on export spillovers is mixed. While Aitken et al. (1997), Greenaway et al. (2004), Kneller and Pisu (2007), Greenaway and Kneller (2008), and Koenig et al. (2010) find relatively positive export spillovers, Barrios et al. (2003), Bernard and Jensen (2004), and Ruane and Sutherland (2005) find insignificant or even negative results. The contradictory results are not surprising, since the impact of FDI-related industrial linkages on export performance depends on the characteristics of domestic firms, industries and indeed the host country, i.e. size of a country's stock of human capital, financial market development, and technology gap between domestic and foreign firms (Anwar and Nguyen, 2011; Kneller and Pisu, 2007). However, there are only a few studies, such as Keller (2004), Girma and Gorg (2005), and Girma (2005), that examine the role of the absorptive capacity of domestic firms, which enable them to capture spillovers from FDI, but these studies mostly focus on the spillovers from FDI to productivity growth rather than to export performance (Kim, 2013).

Furthermore, Alvarez and Lopez (2008) argue that the sunk-entry costs to export markets tend to lower the overall size of the export spillover effect, meaning that the net effect on export performance will be positive only if the export spillover effects can more than compensate for the sunk-entry cost (Anwar and Nguyen, 2011). Before beginning to export, domestic firms must face significant sunk costs, which might include setting up international networks, development of new products for global markets, and establishment of distribution channels (Kneller and Pisu, 2007). On the one hand, foreign firms can act as a natural source of such information that would reduce sunk costs associated with export market participation and facilitate export market participation of domestic firms (Aitken et al., 1997) since, as Ruane and Sutherland (2004) discuss, such information can have public-good characteristics, and domestic firms are able to obtain new information associated with exporting activity from foreign enterprises, i.e. knowledge spillovers. These knowledge spillovers can occur between firms in the same industry (intra-industry or horizontal spillovers) and between firms in different industries (inter-industry or vertical spillovers).

On the other hand, the entry of foreign multinationals boosts the level of competition, which forces domestic firms to become more productive in order to remain in the market, which in turn can positively influence the likelihood of entering export markets. This is due to the fact that, as discussed in Kneller and Pisu (2007), only highly productive firms that can meet the sunk costs associated with export activity, gain positive profit from export market participation, and continue to export (see also Melitz, 2003; Helpman, Melitz, and Yeaple, 2004; and Bernard et al., 2003). Furthermore, the presence of foreign firms can affect the productivity of domestic firms through industrial production linkages (horizontal and vertical) (see Gorg and Greenaway, 2004; and Javorcik, 2004 for rationales for production linkage spillovers), and therefore affect the export behavior of domestic firms. However, Aitken et al. (1999) argue that there is a possibility of productivity reductions due to lower production and higher average cost of production, since foreign firms are more competitive and may steal market demand from domestic firms. This tends to decrease the export intensity of domestic firms and force some domestic firms, which are not able to compete with foreign firms, to exit the market (Kim, 2013).

One of the first and key empirical studies on the issue of export spillovers (Aitken et al. 1997) investigates the role of geographic and multinational spillovers on the export decisions of local firms, using plant-level data from the Mexican manufacturing industry between 1986 and 1990. They find evidence of export spillovers from multinational enterprises (MNEs), and they conclude that proximity to multinational activity reduces the cost of access to foreign markets, and the probability of domestically-owned firms being exporters is positively associated with a high concentration of exporting activity by MNEs in the same industry and region.

Kokko et al. (2001), employing cross section data from Uruguayan manufacturing in 1998, investigate the existence of spillovers from foreign firms on the export decisions of domestic firms. The empirical evidence suggests that the likelihood of exporting of domestic firms is positively associated with a relatively high presence of foreign firms established in the outward-oriented period in Uruguay (after 1973), whereas there is no evidence of export spillovers from multinationals established in the inward-oriented period (before 1973) (Kneller and Pisu, 2007). “This suggests that the type of trade regime within which multinationals operate may determine their potential for generating positive export spillovers” (Gorg and Greenaway, 2004).

Barrios et al. (2003), using firm-level panel data for Spanish manufacturing for 1990-98, emphasize the importance of export spillovers from R&D expenditure and export activity of both domestic firms and MNEs. They estimate a probit model to explain why firms export, and a Tobit model to estimate what determines the firm’s export ratio. Their results do not provide any significant evidence for export spillovers from either R&D or export activities of MNEs in the same industry, although they find spillovers from both types of activity on other foreign-owned firms. However, the Tobit estimations suggest that the R&D expenditures of MNEs have positive spillover effects on the export ratio of domestic firms.

Utilizing firm-level panel data for the United Kingdom for 1992-96, Greenaway et al. (2004) extend the model utilized by Aitken et al. (1997) by introducing demonstration and competition effects in addition to information spillovers. They identify possible transmission mechanisms for export spillovers and test for their existence. They show that the presence of foreign firms has a positive effect on both the likelihood of exporting, and the export share of domestic firms.

Ruane and Sutherland (2005), using data from Irish manufacturing industry during the period 1991-1998, investigate export spillovers from foreign firms on the export decision and export intensity of domestic firms in an export platform economy. The empirical evidence suggests that the export decision and export intensity of domestic firms is positively associated with the presence of foreign enterprises, whereas the export share of foreign-owned firms is negatively associated with the export decision and export intensity of domestic firms. The negative effect is explained by the concentration of US-owned firms in Ireland using the country as an export platform to produce and distribute products to the EU. They argue that export spillovers are unlikely where the country is an export platform, in which competition with domestic firms in local markets is limited.

Using a firm-level dataset of the United Kingdom manufacturing industries from 1992 to 1999, Kneller and Pisu (2007) assess the extent of both horizontal and vertical spillovers from FDI towards domestic firms. Utilizing a Heckman selection process, they show that there are significant export spillovers from foreign firms. They also find positive and significant horizontal and regional export spillovers on the export decision of firms, which results from the fact that, as they argue, foreign presence leads to information spillovers which reduces the sunk costs of exporting of domestic firms. With regard to vertical spillovers, they find significant backward spillovers on the export intensity only.

Anwar and Nguyen (2011), using a Heckman sample selection model estimated over firm-level data in Vietnam, examine the effect of the horizontal and vertical linkages on the export decision and export intensity of domestic firms. The empirical results suggest that the presence of foreign firms in Vietnam, through horizontal and forward linkages, significantly affects the export decision and export share of domestic firms. This result continues to hold when (a) level of technology of domestic firms, (b) ownership structure of domestic firms, (c) orientation of foreign firms and (d) geographical proximity to foreign firms are taken into account.

Nguyen and Sun (2012), utilizing firm-level data from Vietnam in 2003 and 2004, investigate the export behavior of manufacturing firms in Vietnam. Their empirical analysis is based on a Heckman selection model and their results reveal that firm-specific characteristics have a significant effect on the export behavior of firms, and they find significant evidence of export spillovers from FDI to domestic firms. On the other hand, their results suggest that spillovers are heterogeneous and depend on firm characteristics.

In the context of Turkey, the literature mainly focuses on the impact of FDI and FDI-linked spillovers on productivity of domestic firms, and the empirical evidence provides contradictory results. Aslanoglu (2000), using survey data from 1993 on the largest 500 firms collected by the Istanbul Chamber of Commerce (ISO), finds no evidence of horizontal spillover effects from FDI to the average labor productivity of domestic firms. Similarly, Lenger and Taymaz (2006) find that there is no contribution of FDI on the productivity of Turkish firms.

Pamukçu & Taymaz (2009) use Turkish plant-level data over the period of 1983-2001 and show that there are negative horizontal spillovers from foreign-owned firms. Koymen and Sayek (2010) use unbalanced panel data of Turkish manufacturing firms over the period of 1990-2001 and focus on the role of human capital in horizontal and vertical spillovers from FDI. Their results indicate that only the firms that have a share of skilled employees above a certain threshold are able to benefit from horizontal spillovers. They also show that firms' human capital does not play any role as a limiting absorptive capacity when it comes to the realization of vertical linkages.

### 3. Data and Estimation Strategy

For our purpose in this study, we use a recent enterprise-level dataset on Turkish manufacturing firms over the period of 2003-2013. In the database, "enterprise" is the

statistical unit and defined as “the smallest combination of legal units that is an organizational unit producing goods and services, which benefits from a certain degree of autonomy in decision making, especially for the allocation of its current resources. An enterprise carries out one or more activities at one or more locations” (We will use the terms “firm” and “enterprise” interchangeably in this paper). This unbalanced panel dataset is based on two different sources of data collected by the Turkish State Institute of Statistics (TURKSTAT): The Annual Industry and Service Statistics (AISS) and the Foreign Trade Statistics (FTS). The datasets are available under a confidential agreement by which all the computations can only be conducted at the Microdata Research Centre of TURKSTAT.

AISS contains data on output, revenues, value added, intermediate input costs, and employment, along with capital ownership structure over the period 2003-2013. It is a census for the whole population of firms with more than 19 employees whereas it is a representative survey for firms with less than 20 employees. FTS, on the other hand, relies on customs declarations and provides information on the export and import activities of the entire population of firms engaged in export/import activities together with the information on the origin/destination countries and physical quantity of trade flows for the period 2002-2013.

In 2010, economic industry classification was changed from NACE Rev.1.1 to NACE Rev.2 and accordingly the dataset was reclassified using NACE Rev.2, so that NACE Rev.1.1 standard codes are not available after 2009, while NACE Rev.2 standard codes are available for most of the firms over the whole period. However, for the sake of employing I-O table (2002), in which firms are classified by NACE Rev.1.1, in order to calculate spillover variables, we opted to convert the industry codes of firms over the period 2010-2013, for which we only observe a NACE Rev.2 code, to NACE Rev.1.1. To do so, we simply used the most recent code. Although a 4-digit code is available, we mostly rely on 2-digit (or slightly more aggregated) industry classifications for practical implementation (spillover variables estimation for example). The list of the industries by NACE Rev.1.1 can be found in Table 1 in the appendix. We should note that, industries 16, 30, and 37 are excluded from the analysis due to very small number of observations in these industries.

Our estimation sample is limited to firms operating in the manufacturing industry with more than 19 employees. This is motivated by the fact that, as we mentioned above, AISS is a census for the whole population of firms with more than 19 employees whereas it is a representative survey for firms with less than 20 employees. Furthermore, we also impose the restriction of at least 4 consecutive time-series observations for each firm, with the number of years of observations on each firm varying between 4 and 11. This is mainly motivated by the initial capital stock estimation method we employ in this paper, which is based on Harberger (1978), who uses three-year growth averages to construct a more stable initial capital stock for firms (see the appendix for the calculation of capital stock series). Therefore, this produces an unbalanced sample of manufacturing firms, which mitigates possible selection and survivor bias, as Levinsohn and Petrin (1999) argue, by allowing for both entry and exit. All nominal values are deflated using 2-digit NACE

price indices with the base year of 2010. For capital goods, we use an aggregate investment deflator provided by the Ministry of Development. In this study, foreign firms are defined as those firms in which the equity share held by a foreign investor is at least 10 per cent in accordance with the definitions of the OECD and the IMF.

In this paper, for our purposes, we investigate two aspects of export spillovers, which are i) the decision to export (export participation) and ii) how much to export (export intensity). Therefore, the econometric analysis involves a two-stage decision process, as at the first stage, firms decide whether to export or not, and at the second stage, firms decide how much to export (Kneller and Pisu, 2007). The export intensity is restricted to the subset of firms that do export, since not every firm exports. If functions of export participation decision and export intensity decision of a firm are estimated separately, the problem of selection bias arises. The reasoning behind this is that, as Greenaway et al. (2004) discuss, the presence of foreign firms affects the export decision of all domestic firms, not only domestic exporting firms. The sample selection bias can be avoided using a Heckman selection model, which jointly estimates the export participation and export intensity functions. The model consists of two equations as follows:

$$EXD_{ijt} = \alpha + \beta_1 EXP_{ijt-1} + \beta_2 X_{ijt} + \beta_3 Y_{jt} + \beta_4 Z_{jt} + u_{ijt} \quad (1)$$

$$EXI_{ijt} = \mu + \delta_1 X_{ijt} + \delta_2 Y_{jt} + \delta_3 Z_{jt} + v_{ijt} \quad (2)$$

where Equations (3.1) and (3.2) are export market participation decision and export share decision (export intensity) equations, respectively. Here,  $i$  represents firm  $i$ , while  $j$  represents industry  $j$ , and time is represented by  $t$ .  $EXD_{ijt}$  is a binary variable equal to 1 if the firm was exporting at time  $t$  and zero otherwise.  $EXI_{ijt}$  is a firm's export intensity and is defined as the ratio of exports to total sales.  $EXP_{ijt-1}$  is the lagged export status of the firm and it is 1 if the firm was exporting at time  $t-1$  and zero otherwise. This variable is considered to be relevant for current export decisions. Kneller and Pisu (2007) argue that, as discussed in Bernard and Jensen (2004), this variable captures the importance of past experience in export markets, and if it is positive and significant, it is usually interpreted as evidence of fixed costs of entry to export market.

$X_{ijt}$  and  $Y_{jt}$  capture the characteristics of firm  $i$  and industry  $j$  at time  $t$ , respectively. Meanwhile,  $Z_{jt}$  captures the channels of export spillover from foreign firms.

We estimate our equations using a Heckman model with a maximum likelihood estimation method, since it is more efficient and more appropriate than the two-step estimation method (Kneller and Pisu, 2007). The method involves estimation of the inverse Mill's ratio, and the coefficients in the two equations, by using a full maximum likelihood procedure.

### 3.1. Variables

As discussed earlier, FDI spillovers can occur through both horizontal and vertical linkages between domestic and foreign firms. Following Javorcik (2004), Kneller and Pisu (2007) among others, we construct spillover variables using the firm-level panel and Turkish input/output table (I/O table) for 2002 prepared by TURKSTAT. Specifically, the

horizontal spillover variable ( $H_{jt}$ ) is the share of total output of foreign-affiliated plants operating in Turkey ( $Y_{jt}^f$ ) in industry  $j$  at time  $t$  in total output of industry  $j$  ( $Y_{jt}$ ), and captures the intra-industry spillovers from foreign multinationals to domestic firms in the same industry.  $H_{jt}$  is calculated as:

$$H_{jt} = \frac{\sum_{i \in j} (f_{ijt} * Q_{ijt})}{\sum_{i \in j} Q_{ijt}} = \frac{Y_{jt}^f}{Y_{jt}} \quad (3)$$

where  $f_{jt}$  denotes the foreign ownership share of firm  $i$  in industry  $j$  at time  $t$  and is represented by a variable whose value is either 0 or 1, where zero implies a fully-domestically-owned firm, and 1 depicts a fully-foreign-owned firm. Plants with at least 10% foreign ownership shares are defined as foreign-affiliated firms.  $Q_{ijt}$  is the total output of firm  $i$  in industry  $j$  at time  $t$ .

Vertical linkages can be divided into forward or backward categories. The variable for backward spillovers ( $B_{jt}$ ) captures the spillovers from foreign firm operating in downstream industry to domestic firm operating in upstream industry (the domestic firm is an input supplier of the foreign firm).  $B_{jt}$  is calculated as:

$$B_{jt} = \sum_{m \text{ if } m \neq j} \alpha_{jm} H_{mt} \quad (4)$$

where  $\alpha_{jm}$  is the share of industry  $j$ 's output supplied to industry  $m$  in total output of industry  $j$ .

The forward variable ( $F_{jt}$ ) captures the spillovers from foreign firm operating in upstream industry to domestic firm operating in downstream industry (the foreign firm is an input supplier of the domestic firm).  $F_{jt}$  is calculated as:

$$F_{jt} = \sum_{n \text{ if } n \neq j} \beta_{jn} H_{nt} \quad (5)$$

where  $\beta_{jn}$  denotes the share of material inputs purchased by industry  $j$  from industry  $n$  in total inputs sourced by industry  $j$ .

We derive both the coefficients  $\alpha_{jm}$  and  $\beta_{jn}$  following Javorcik (2004). The calculation of these coefficients require an integration with the Input-Output (I/O) table, which is available only for 2002 and at the 2-digit International Industrial Classification (ISIC) level.

The Herfindahl index captures the concentration level in an industry. Blomstrom and Kokko (1998), as referred to by Javorcik (2004), argue that the entry of multinational firms results in more severe competition and forces domestic firms to use their resources more efficiently or to search for new technologies, which may both the probability of exporting, and export intensity. The Herfindahl index is defined as the squared sum of the market shares of the largest 50 firms, and may be written as follows, where  $x_{ijt}$  is the sales of the firm  $i$  in industry  $j$  at time  $t$  and  $X_{jt}$  is the total sales of industry  $j$ .

$$HERF_{jt} = \sum_{i=1}^{50} \left( \frac{x_{ijt}}{X_{jt}} \right)^2 = \sum_{i \in j} s_i^2 \quad i = 1, 2, \dots, 50 \quad (6)$$

where  $s_i$  is a market share of a firm  $i$  in industry  $j$  and  $X_{jt} = \sum x_{ijt}$

Based on the arguments of Roberts and Tybout (1997), and Bernard and Jensen (2004), affirmed in most of the evolutionary economics literature, firms with better quality labor are expected to produce better quality products and higher levels of efficiency and, hence, the quality of workers may affect export performance. Following Bernard and Jensen (2004), and Kneller and Pisu (2007) among others, we use the average level of wages of the firm as a proxy for this export-performance-enhancing effect of quality workers.

In our specification, we also control for the export experience of firms. Export experience is represented by a dummy variable set to 1 if a domestic firm has already engaged in exporting in the past, and 0 otherwise. As in Kneller and Pisu (2007), Sun (2009), Nyugen and Sun (2012), this variable is included only in the export participation equation, due to the fact that the selection equation should contain at least one variable that is not in the outcome equation (see Baum, 2006 and De Luca and Perotti, 2011). Furthermore, Kneller and Pisu (2007) argue that, as discussed in Bernard and Jensen (2004), this variable captures the importance of past experience in export markets, and if it is positive and significant, it is usually interpreted as evidence of sunk costs of exporting. As Sun (2009) discusses, it is reasonable to exclude the export dummy from the export intensity equation since any fixed export cost should not affect the export share of firm, as it has been already paid.

Similar to Franco and Sasidharan (2009), who proxy the firm size by the ratio of each firm's sales to average sales in the industry, firm size is proxied by the share of each firm's output in average output in the industry. Although Narjoko (2009) points out that the variables, such as output, sales or profits, are not appropriate because they tend to be more sensitive to the changes in the business cycle, the term, relative output, should mitigate this type of concern.

Capital intensity is defined as a firm's fixed assets per employee, which is used to control for the impact of comparative advantage disparity across firms on their export performance (Chen et al., 2013). The capital intensity is considered to be positively related both to the decision to export and to the export intensity in developed countries, because it embodies accumulated technological knowledge (Wakelin, 1998). However, the capital intensity coefficient may turn out to be negative or insignificant in the case of developing countries because they are capital scarce (Franco and Sasidharan, 2010). Since the capital stock series of firms are not available from the database, the series are calculated using a perpetual inventory method (See Appendix B for the details of the capital stock estimation method).

Industry export share is defined as the share of exports in each industry in total manufacturing exports. This variable is included in the specification due to the fact that it captures the importance of each industry in the export structure of the manufacturing industry and controls for the possibility that firms operating in more export-oriented industries are more likely to export. On the other hand, it also controls for the fact that foreign affiliates may tend to locate in industries with higher export ratios, which if not controlled for may lead to an endogeneity problem (Nguyen and Sun, 2012).

Total factor productivity (TFP) is a measurement of efficiency in the production process and is often considered to be a proxy for the quality of management. According to Melitz (2003), more productive groups of firms can cover the sunk costs associated with trade, so that they are more likely to export. On the other hand, Greenaway and Kneller (2004), among others, find that productivity increases the probability of exporting, and export intensity. TFP is estimated by using a semi-parametric regression method constructed by Levinsohn and Petrin (2003), which takes account of unobserved firm-specific productivity.

The earlier literature investigating the spillover effects from FDI estimated the production function using traditional methods, i.e. by applying ordinary least squares (OLS) to a panel of (continuing) firms. However, OLS estimation of TFP create several methodological issues. The OLS technique assumes that production inputs are uncorrelated with omitted unobservable variables even though productivity and input choices are likely to be correlated. Hence, OLS estimation of firm-level production functions introduces a simultaneity or endogeneity problem and thereby results in inconsistent and biased estimates of production function. Moreover, selection bias will emerge if no allowance is made for entry and exit (Van Beveren, 2010).

In response to these methodological issues, several estimators have been proposed in the literature. The main contributions to measuring firm level TFP are by Olley and Pakes (1996) and Levinsohn and Petrin (2003). The key difference between the two methods is that Olley and Pakes (1996) use investment whereas Levinsohn and Petrin (2003) introduce material inputs as a proxy into the estimation procedure.

Levinsohn and Petrin (2003) point to the evidence from firm-level datasets that there are substantial adjustment costs related to investment. They argue that it is less costly to adjust material inputs than to adjust investment in response to the productivity shocks. If this is the case, the investment proxy may not smoothly respond to the productivity shock, violating the consistency condition. Moreover, firms generally report positive material inputs whereas large number of zero observations in investment series are observed (Petrin et al., 2004).

In this paper we use the Levinsohn and Petrin (2003) methodology to estimate firm level production functions. Specifically, we estimate a Cobb-Douglas production function by expressing value added as a function of capital and labor costs, using materials and energy usage as proxies for unobserved productivity shocks:

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \beta_e e_{it} + \omega_{it} + \eta_{it} \quad (7)$$

where  $y_t$  is the logarithm of value added;  $l_{it}$ ,  $m_{it}$  and  $e_{it}$  are the logarithm of labor, materials and energy usage respectively;  $k_t$  is the logarithm of the state variable, capital,  $\omega_{it}$  denotes the productivity of the firm, and  $\eta_{it}$  stands for measurement error in output, which is uncorrelated with input choices. Levinsohn and Petrin (2003) give a detailed description of the estimation procedure and the derivation of the TFP.

We also control for industry size, defined as the share of revenues of each industry in total manufacturing revenues. Including industry size into the specifications allows for

possible general spillovers not directly associated with export activity (Franco and Sasidharan, 2010).

Year and industry dummy variables are also included in both specifications to account for macroeconomic shocks and cross-industry disparities that are not captured by other control variables. The definition of the variables can also be found in Table 4 presented below.

As discussed earlier, spillover effects have also been shown to depend on the absorptive capacity of the firm. In our alternative estimation, we account for this fact, and we add interaction terms between the absorptive capacity variable and spillover variables into our specification. We define absorptive capacity as the technology gap between firms and the industry leaders, which are predominantly foreign firms (Griffith, Redding, and Simpson, 2002; Girma, 2005):

$$abs\_cap_{it} = \frac{TFP_{it}}{\max_{industry}(TFP_{jt})} \quad (8)$$

that is, firm  $i$ 's TFP relative to the maximum TFP in the two-digit industry (the "industry leader").

In the literature, the technology gap between foreign and domestic firms has been identified as one of the key mediating factors for FDI spillovers (Kokko 1994; Kokko, Tansini, and Zejan 1996). However, regarding its role for spillovers from FDI, empirical research provides conflicting results. While some studies such as Findlay (1978), Wang and Blomstrom (1992), and Smeets (2008) find that a large technology gap is beneficial for local firms since their catching-up potential increases, others such as Blalock and Gertler (2009) argue that, if the technology gap between the multinational and local producers is too big or too small, local firms might not be able to absorb positive FDI spillovers (Farole and Winkler, 2012).

Table 1 presents the definition of the variables, whereas the descriptive and summary statistics of domestic firms and foreign multinationals are presented in Tables 2 and 3. Foreign firms are, not surprisingly, on average, superior to domestic firms in all aspects. For example, they are larger, more productive, more capital intensive, and pay higher wages.

The distribution of firms by NACE Rev.1.1 is presented in Table 4. Foreign firms are, not surprisingly, mostly concentrated in high-tech and capital intensive industries, such as 24 (chemicals), 23 (coke and refined petroleum), 34 (motor vehicles, trailers and half trailers), and 33 (medical, precision, optical instruments). On the other hand, they appear less in low-tech and labor intensive industries, such as 17 (textile products), 18 (wearing apparel), and 19 (dressing of leather).

**Table 1.** Definition of Variables

Variables	Definition
Export Intensity	the ratio of exports to total revenue
Export Participation	expar=1 if the firm has exported during the year; 0 otherwise
Capital Intensity	a firm's fixed assets per employee
Industry Size	the share of revenues of each industry in total manufacturing revenues
Firm Size	the share of each firm's output in average output in the industry.
Herfindahl Index	the concentration level in an industry (the squared sum of the market shares of the largest 50 firms)
Average Wage	wage per employee per year in Turkish Lira
TFP	estimated by using the semi-parametric regression method constructed by Levinsohn and Petrin (2003)
Industry Export Share	the share of exports in each industry in total manufacturing exports
Horizontal Linkage	the linkage between domestic firm and foreign firm when both are in the same industry
Backward Linkage	the linkage between domestic firm and foreign firm when the domestic firm is the input supplier of the foreign firm
Forward Linkage	the linkage between domestic firm and foreign firm when the foreign firm is the input supplier of the domestic firm
Export Experience	a dummy variable taking 1 if a domestic firm has already engaged in exporting in the past and 0 otherwise

**Sources:** TURKSTAT (The Annual Industry and Service Statistics and the Foreign Trade Statistics).

**Table 2.** Descriptive Statistics of Key Variables (All Firms)

Variables	Obs.	Mean	Min	Max
Export Intensity	146830	0.105	0	1
Export Participation	146830	0.535	0	1
Capital Intensity	146830	424384	26.260	150000000
ln(CAP_INT)	146830	11.796	3.268	18.824
Industry Size	146830	0.068	0.002	0.170
Firm Size	146830	0.372	0.062	11.990
Herfindahl Index	146830	0.022	0.002	0.959
Average Wage	146830	12543.9	84.621	237327.8
ln(wage)	146830	9.272	4.438	12.377
TFP	146830	694	1.066	28135.68
ln(TFP)	146830	6.180	0.064	10.245
Industry Export Share	146830	0.062	0.0001	0.766
Horizontal Linkage	146830	0.179	0.0000	0.966
Backward Linkage	146830	0.107	0.0110	0.361
Forward Linkage	146830	0.138	0.0003	0.848
Export Experience	128297	0.556	0	1

**Sources:** TURKSTAT (AISS and FTS).

**Table 3.** Summary Statistics of Key Variables (Foreign vs. Domestic)

Variables	Foreign Firms		Domestic Firms	
	Obs.	Mean	Obs.	Mean
Export Intensity	6333	0.225	140497	0.100
Export Participation	6333	0.849	140497	0.521
ln(CAP_INT)	6333	11.990	140497	11.788
Industry Size	6333	0.070	140497	0.068
Firm Size	6333	0.495	140497	0.367
Herfindahl Index	6333	0.029	140497	0.022
ln(wage)	6333	10.105	140497	9.235
ln(TFP)	6333	6.987	140497	6.143
Industry Export Share	6333	0.075	140497	0.061
Horizontal Linkage	6333	0.279	140497	0.175
Backward Linkage	6333	0.118	140497	0.107
Forward Linkage	6333	0.192	140497	0.135
Export Experience	5670	0.880	122627	0.541

**Sources:** TURKSTAT (AISS and FTS).

**Table 4.** *Distribution of Firms by Industry*

NACE	INDUSTRY	Domestic	Foreign	All	% Foreign
15	Food products and beverages	1835	113	1948	0.058
17	Textile products	2884	69	2953	0.023
18	Wearing apparel	2883	77	2960	0.026
19	Dressing of leather	484	3	487	0.006
20	Wood products, excepts furniture	303	6	309	0.019
21	Paper and paper products	384	43	427	0.101
22	Publishing and printing	415	15	430	0.035
23	Coke and refined petroleum	47	9	56	0.161
24	Chemicals	518	128	646	0.198
25	Rubber and plastic products	1098	83	1181	0.07
26	Non-metalic products	1277	67	1344	0.05
27	Basic metal industry	653	25	678	0.037
28	Metal products, except machinery	1581	79	1660	0.048
29	Machinery and equipment, n.e.c.	1716	79	1795	0.044
31	Elect. machinery and apparatus, n.e.c.	546	50	596	0.084
32	Radio, tv, communication eq. and app.	93	10	103	0.097
33	Medical, precision, optical instruments	170	19	189	0.101
34	Motor vehicles, trailers and half trailers	712	86	798	0.108
35	Other transport equipment	419	25	444	0.056
36	Furniture, n.e.c.	1097	37	1134	0.033
Total		19115	1023	20138	0.051

**Note:** Sector 16, 30 and 37 are not included in the study.

#### 4. Empirical Results

The two export equations of the Heckman selection model are estimated jointly by the maximum likelihood technique, and Tables 5 - 7 report the estimation results. The Wald tests for overall significance of the models indicate the coefficients of the regressors are highly jointly significant. On the other hand, the null hypothesis of no correlation between the error terms (i.e.  $\rho = 0$ ) is rejected at the 1% level by the LR test, which suggests the interdependence between the export participation and export intensity equations, and hence validates the choice of the Heckman selection model.

Table 5 shows the estimation results without considering absorptive capacity of domestic firms, whereas Table 6 presents the results of estimation for domestic firms with the full set of explanatory variables including the interaction terms between each spillover variable and absorptive capacity variable. Table 7 shows the results from the model with a quadratic specification, in which we allow for a non-linear relationship between spillover variables and the absorptive capacity of domestic firms. The results of each specification for all countries are also reported in the appendix. We note that the results are very similar across both samples.

As shown in Table 5, when absorptive capacity is not taken into account in the model, there exist no spillover effects from horizontal and backward linkages, while the export decision and export intensity of domestic firms seem to be (although only at the 10 per cent significance levels) associated with the presence of foreign firms in downstream industries. The effect is positive in the export intensity equation, whereas it is negative in the export decision equation. If we suppose that exporting firms are more productive, and

the access to quality intermediate inputs less costly, which eventually reduces the production costs of domestic firms and improves the quality of their products, this may enable domestic firms to increase their export share. On the other hand, domestic firms with low absorptive capacity may not be able to use complex intermediate inputs supplied by multinationals, and are unlikely to capture positive spillovers from foreign firms. Therefore, they are unlikely to start exporting due to high sunk costs of exporting. On the other hand, the intermediate inputs supplied by foreign firms may be mostly international-market-oriented, which favors already exporting firms, but not non-exporting firms.

Furthermore, the export participation decision of domestic firms appears to depend on a firm's previous export experience, confirming the proposition that firms involved in exporting in the past are more likely to continue exporting, since they have already incurred the sunk costs of market entry (Kneller and Pisu, 2007; Sun, 2009; Nguyen and Sun, 2012). The degree of industry concentration (HHI), as we expect, has a negative and significant effect on the export intensity of firms, but a positive but insignificant effect on the export decision of firms.

**Table 5.** Estimation Results w/out Considering Absorptive Capacity of Firms (Domestic Firms)

VARIABLES		Export Participation		Export Intensity	
		Coeff.	Std. Err.	Coeff.	Std. Err.
Capital Intensity		0.040***	0.004	-0.002***	0.001
Industry Size		0.112	0.940	-0.264	0.189
Firm Size		-0.008	0.047	-0.009	0.009
Herfindahl Index		0.543	0.567	-0.355***	0.106
Average Wage		0.088***	0.013	0.002	0.002
TFP		0.192***	0.008	-0.008***	0.002
Industry Export Share		-0.467***	0.149	0.108***	0.034
Horizontal Linkage		0.234	0.179	-0.042	0.034
Backward Linkage		1.235	0.785	-0.114	0.156
Forward Linkage		-0.548*	0.326	0.095*	0.057
Export Experience		2.201***	0.009	Not included	Not included
Constant		-3.607***	0.188	0.352***	0.037
No. of Observations	122627				
Rho	-0.393				
Sigma	0.233				
Lambda	-0.092				
LR test of indep. Eqns. (rho=0)	2593.9				
Wald's Test for the Overall Significance of the Model	3776				
Log pseudo-likelihood	-41577				

**Notes:** \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%; regressions include time and industry dummies.

The results in Table 5 also indicate that capital intensity is significant and negative in the export intensity equation, while it is positive and significant with regard to the export decision of firms. Franco and Sasidharan (2009) find a negative effect of capital intensity for both equations and argue that in an emerging country the role played by capital is secondary in favouring exporting activities. However, our results show that, although the effect is negative for the export intensity of domestic firms, capital intensity favors the likelihood of exporting of domestic firms. This supports the idea that an increase in

capital intensity increases the scale of production and increases the likelihood that domestic firms will enter the export market (Anwar and Nguyen, 2011).

Furthermore, Table 5 shows that the likelihood of exporting increases in the wage per employee. Kneller and Pisu (2007) argues that this may reflect the fact that firms with high skilled workers (and therefore higher wages) are more likely to be able to compete successfully in international markets. The coefficient for the productivity variable (TFP) is, surprisingly, negative and significant in the export intensity equation but positive and significant in export participation equation. This implies that more productive firms are more likely to enter international markets, but they export less. This may be due to the fact that, in the case of Turkey, local firms are more domestic-oriented; even as they export and as they become more productive, they interact and compete with foreign firms more intensely in domestic market, which makes them to cut their exports and to be more oriented in domestic market. The result, on the other hand, may be related to the export destinations of domestic firms. If domestic firms mostly export to low-income destinations, increasing productivity may lower the export intensity. In a representative sample of Italian manufacturing firms, Crino and Epifani (2009) find a negative correlation between productivity (however measured) and sales to low-income destinations.

Industry export share has a positive and significant effect on the export intensity equation; however, the coefficient turns out to be negative in the export participation equation. This suggests that firms operating in more export-intensive industries are more likely to export a larger share of their output, while they are less likely to participate in the export market, which may result from high fixed costs of entry to export markets. Moreover, as Table 5 indicates, the size of the industries and firms do not play any roles in the export volume and export decisions of domestic firms, as the coefficients are insignificant. This is in contrast with the literature (see Wakelin, 1998; Bleaney and Wakelin, 1999; Barrios et al., 2003; Greenaway and Kneller, 2004 among others), who argue that larger firms may be more financially capable of competing successfully in the international market.

When the absorptive capacity of firms is considered in the model, the results in Table 6 show that the interaction terms between absorptive capacity and backward spillover variables become significant and positive in the export intensity equation. It is negative but insignificant in the export participation decision equation. This result signifies backward spillovers on the decision about how much to export; as Kneller and Pisu (2007) discuss, these are likely to capture general information externalities that improve the firm's ability to compete in international markets as domestic firms improve their productivity. However, these general information externalities do not affect the firms' likelihood of exporting.

With regard to horizontal spillovers, Table 6 shows that, as the firms become more productive and close the technology gap, the likelihood of exporting decreases (albeit the coefficient is significant at a 10 per cent significance level). This may be due to the fact that horizontal linkages are more likely to result in both information and competition effects (Kneller and Pisu, 2007). Girma and Gorg (2005) argue that domestic firms with

low absorptive capacity levels are unlikely to be in direct competition with foreign firms due to their relative backwardness, and are not able to benefit from positive spillovers. As they improve their productivity and close the technology gap, they start competing with foreign firms and thus begin to be exposed to the negative competition effect in the domestic market. Therefore, they may be less willingly to start exporting.

**Table 6.** Estimation Results Accounting for Absorptive Capacity of Firms (Domestic Firms)

VARIABLES		Export Participation		Export Intensity	
		Coeff.	Std. Err.	Coeff.	Std. Err.
Capital Intensity		0.041***	0.004	-0.003***	0.001
Industry Size		0.116	0.940	-0.244	0.189
Firm Size		-0.011	0.047	-0.008	0.009
Herfindahl Index		0.468	0.567	-0.341***	0.106
Average Wage		0.095***	0.013	0.0001	0.002
TFP		0.213***	0.009	-0.015***	0.106
Industry Export Share		-0.466***	0.149	0.112***	0.034
Horizontal Linkage		0.299	0.184	-0.040	0.035
Horizontal_abs.cap		-1.379*	0.824	-0.002	0.137
Backward Linkage		1.376*	0.787	-0.195	0.156
Backward_abs.cap		-2.229	1.378	1.430***	0.244
Forward Linkage		-0.534	0.327	0.097*	0.058
Forward_abs.cap		-0.525	0.868	-0.074	0.135
Export Experience		2.201***	0.009	Not included	Not included
Constant		-3.823***	0.195	0.415***	0.038
Number of Observations	122627				
Rho	-0.394				
Sigma	0.233				
Lambda	-0.092				
LR test of indep. Eqns. (rho=0)	2603.4				
Wald's Test for the Overall Significance of the Model	3830.3				
Log pseudo-likelihood	-41544				

**Notes:** \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%; regressions include time and industry dummies.

We find no evidence of export spillovers from forward linkages, resulting from increasing absorptive capacity of domestic firms. This implies that as the firms become more productive, the foreign presence in upstream industries does not affect the export activity of domestic firms. This may be due to the fact that intermediate supplier foreign firms may be mostly export oriented. Regarding the other control variables, the results are similar to the one without the interaction terms of absorptive capacity with spillover variables.

Finally, Table 7 shows the results from the model with a quadratic specification, in which we allow for a non-linear relationship between spillover variables and the absorptive capacity of domestic firms. The results for domestic firms, as shown in Table 7, indicate a concave (inverted u-shape) relationship for the interaction of absorptive capacity with backward linkages in the export intensity equation. Hence, an increase in absorptive capacity will first increase, but eventually reduce the export share of the firms. This implies that, if technology gap between domestic firms and multinationals is too small, there is a negative effect of backward linkage on the export share of the domestic firm.

**Table 7.** Estimation Results Accounting for Nonlinearity between FDI and *abs\_cap* Term (Domestic Firms)

VARIABLES		Export Participation		Export Intensity	
		Coeff.	Std. Err.	Coeff.	Std. Err.
Capital Intensity		0.042***	0.004	-0.003***	0.001
Industry Size		0.069	0.940	-0.256	0.189
Firm Size		-0.009	0.047	-0.008	0.009
Herfindahl Index		0.515	0.568	-0.334***	0.106
Average Wage		0.090***	0.013	-0.002	0.002
TFP		0.204***	0.010	-0.019***	0.002
Industry Export Share		-0.476***	0.150	0.111***	0.034
Horizontal Linkage		0.223	0.187	-0.062*	0.035
Horizontal_ <i>abs.cap</i>		0.610	1.269	0.485**	0.228
Horizontal_ ( <i>abs.cap</i> <sup>2</sup> )		-4.283	2.826	-0.896	0.575
Backward Linkage		1.301*	0.789	-0.241	0.157
Backward_ <i>abs.cap</i>		-0.240	2.164	2.449***	0.413
Backward_ ( <i>abs.cap</i> <sup>2</sup> )		-4.888	5.073	-2.910***	1.123
Forward Linkage		-0.536	0.328	0.093	0.058
Forward_ <i>abs.cap</i>		-0.803	1.329	-0.026	0.222
Forward_ ( <i>abs.cap</i> <sup>2</sup> )		0.888	2.856	-0.092	0.556
Export Experience		2.200***	0.009	Not included	Not included
Constant		-3.711***	0.199	0.466***	0.039
Number of Observations	122627				
Rho	-0.394				
Sigma	0.233				
Lambda	-0.092				
LR test of indep. Eqns. (rho=0)	2603.1				
Wald's Test for the Overall Significance of the Model	3876.1				
Log pseudo-likelihood	-41515				

**Notes:** \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%; regressions include time and industry dummies.

## 5. Conclusion

This paper examines the impact of horizontal and vertical spillovers from FDI on i) the export participation decision and ii) the export intensity of domestic firms utilizing firm level data of Turkey's manufacturing industries for the period of 2003 – 2013. The empirical analysis is based on Heckman's maximum likelihood estimation strategy to control for selection bias.

The empirical evidence reveals that, when absorptive capacity is not considered in the model, there exists no spillover effects from FDI through horizontal and backward linkages on the export intensity and the export participation decision of domestic firms. On the other hand, the export decision of firms is weakly significantly and negatively associated with the presence of foreign firms in the upstream industries whereas there is a little evidence of positive forward effects on the export share of domestic firms.

When the absorptive capacity of firms is accounted for, domestic firms seem to benefit only in a limited way from export spillovers. With reference to horizontal spillovers, we found negative export spillovers to non-exporters. This may result from the negative competition effects of foreign firms. Domestic firms with low absorptive capacity levels are unlikely to be in direct competition with foreign firms due to their relative

backwardness. As they increase their absorptive capacity and close the technology gap, they begin to be exposed to the negative competition effect in the domestic market. Therefore, they may be less willingly to start exporting (Girma and Gorg, 2005).

With regard to vertical spillovers, the results reveals an evidence of backward spillovers to only exporters, we find no evidence of backward spillovers to non-exporters and no evidence of forward spillovers to both exporters and non-exporters. These findings suggest that, even if domestic firms increase their absorptive capacity, they are not be able to benefit from export spillovers through forward linkages. This might due to that foreign firms that are input suppliers are mostly export-oriented firms and they do not affect export behavior of domestic firms. On the other hand, domestic exporters may benefit from backward spillovers as they improve their capacity. This may suggest general information externalities that improve the firm's ability to compete in international markets and increase their export share, as domestic firms improve their productivity. However, our findings also imply that increases in absorptive capacity will first increase but eventually reduce the export share of exporters.

Overall, domestic firms seem to benefit only in a limited way from export spillovers. The export participation and export intensity decision of domestic firms does not seem to be affected by contacts they may have with multinational enterprises. Except for backward spillovers to exporters with adequate absorptive capacity, we did not find any evidence of forward and horizontal spillovers to domestic exporting firms even they increase their absorptive capacity. However, our findings also suggest that that increases in absorptive capacity will first increase but eventually reduce the export share of domestic firms. Furthermore, our results reveal negative horizontal spillovers and no evidence of vertical spillovers to non-exporters. This may well indicate negative competition effects resulting from entry of foreign firms into domestic markets and high sunk entry costs to export markets.

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## Appendix A. Tables

**Table 8.** Estimation Results without Considering Absorptive Capacity of Firms (All Firms)

VARIABLES		Export Participation		Export Intensity	
		Coeff.	Std. Err.	Coeff.	Std. Err.
Capital Intensity		0.038***	0.004	-0.004***	0.001
Industry Size		0.116	0.923	-0.240	0.185
Firm Size		-0.011	0.046	-0.009	0.009
Herfindahl Index		0.414	0.560	-0.364***	0.104
Average Wage		0.118***	0.012	0.008***	0.002
TFP		0.188***	0.008	-0.011***	0.002
Industry Export Share		-0.627***	0.138	0.102***	0.032
Horizontal Linkage		0.210	0.175	-0.041	0.033
Backward Linkage		1.546**	0.765	-0.114	0.152
Forward Linkage		-0.537*	0.317	0.090	0.055
Export Experience		2.215***	0.009	Not included	Not included
Constant		-3.797***	0.182	0.346***	0.035
Number of Observations	128297				
Rho	-0.395				
Sigma	0.238				
Lambda	-0.094				
LR test of indep. Eqns. (rho=0)	2716.42				
Wald's Test for the Overall Significance of the Model	3910				
Log pseudo-likelihood	-43963.53				

**Notes:** \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%; regressions include time and industry dummies.

**Table 9.** Estimation Results Accounting for Absorptive Capacity of Firms (All Firms)

VARIABLES		Export Participation		Export Intensity	
		Coeff.	Std. Err.	Coeff.	Std. Err.
Capital Intensity		0.039***	0.004	-0.004***	0.001
Industry Size		0.124	0.923	-0.224	0.185
Firm Size		-0.012	0.046	-0.008	0.009
Herfindahl Index		0.361	0.560	-0.354***	0.104
Average Wage		0.124***	0.013	0.006***	0.002
TFP		0.204***	0.009	-0.017***	0.002
Industry Export Share		-0.629***	0.139	0.105***	0.032
Horizontal Linkage		0.245	0.179	-0.035	0.033
Horizontal_abs.cap		-0.731	0.746	-0.082	0.114
Backward Linkage		1.668**	0.767	-0.191	0.152
Backward_abs.cap		-1.803	1.279	1.250873	0.206
Forward Linkage		-0.519	0.318	0.093*	0.055
Forward_abs.cap		-0.522	0.792	-0.071	0.116
Export Experience		2.215***	0.009	Not included	Not included
Constant		-3.967***	0.190	0.398***	0.037
Number of Observations	128297				
Rho	-0.396				
Sigma	0.238				
Lambda	-0.094				
LR test of indep. Eqns. (rho=0)	2724.21				
Wald's Test for the Overall Significance of the Model	3959.88				
Log pseudo-likelihood	-43935.21				

**Notes:** \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%; regressions include time and industry dummies.

**Table 10.** Estimation Results Accounting for Non-linearity between FDI and *abs\_cap* Term (All Firms)

VARIABLES		Export Participation		Export Intensity	
		Coeff.	Std. Err.	Coeff.	Std. Err.
Capital Intensity		0.039***	0.004	-0.004***	0.001
Industry Size		0.070	0.924	-0.236	0.185
Firm Size		-0.010	0.046	-0.008	0.009
Herfindahl Index		0.410	0.561	-0.346***	0.104
Average Wage		0.118***	0.013	0.004	0.002
TFP		0.194***	0.009	-0.022***	0.002
Industry Export Share		-0.645***	0.139	0.106***	0.032
Horizontal Linkage		0.159	0.182	-0.055	0.034
Horizontal_abs.cap		1.571	1.162	0.338*	0.198
Horizontal_abs.cap2		-5.385**	2.648	-0.730	0.503
Backward Linkage		1.598**	0.768	-0.251*	0.153
Backward_abs.cap		0.191	1.989	2.609***	0.356
Backward_abs.cap2		-4.308	4.389	-3.516***	0.876
Forward Linkage		-0.516	0.319	0.095*	0.056
Forward_abs.cap		-0.960	1.213	-0.167	0.194
Forward_abs.cap2		1.397	2.523	0.324	0.456
Export Experience		2.213***	0.009	Not included	Not included
Constant		-3.839***	0.193	0.454***	0.038
Number of Observations	128297				
Rho	-0.396				
Sigma	0.238				
Lambda	-0.094				
LR test of indep. Eqns. (rho=0)	2725.25				
Wald's Test for the Overall Significance of the Model	4019.33				
Log pseudo-likelihood	-43896.21				

**Notes:** \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%; regressions include time and industry dummies.

## Appendix B. Capital Stock Estimation

### Capital Stock Estimation

The perpetual inventory method is a simple method of producing a capital stock series from data on investment flows. The capital stock in period  $t$  is equal to the capital stock in the previous period after accounting for depreciation plus new additions to the capital stock in terms of net-investment.

$$K_t = (1 - \delta)K_{t-1} + I_t \quad (\text{A.1})$$

where  $K_t$  represents the capital stock at time  $t$ ,  $\delta$  the geometric depreciation rate, and  $I_t$  is investment.

In order to be able to apply the Perpetual Inventory Method to calculate the current capital stock, we need (i) a time series of investment data, (ii) information on the initial capital stock at the time when the investment time series starts, and (iii) information on the rate of depreciation of the existing capital stock.

#### (i) time series of investment data

The basic ingredient to the perpetual inventory method is the investment information provided in the AISS. The AISS distinguishes between 4 types of investment:

1. Machinery and equipment
2. Buildings and civil engineering structures
3. Other tangible goods
4. Computer software

After calculating capital stock series for each one of these asset types, these series are aggregated to obtain the total capital stock series of the firm.

#### (ii) initial capital stock

The implementation of the perpetual inventory method varies with respect to the way the initial capital stock is constructed. In this paper we employ the steady state approach to estimate the initial capital stock, which is based on the neoclassical growth theory whereby the economy is assumed to be at its balanced growth path (Harberger, 1978). This translates into firms operating at their steady state at a micro level. Hence, output grows at the same rate as the capital stock which implies constant capital-output over the long run. Therefore, denoting the initial year of the firm with "0", considering  $K_0$  as initial capital stock of firm  $i$  and  $\delta$  as depreciation rate, initial capital stock is constructed as follows:

$$K_{i1} = (1 - \delta)K_{i0} + I_{i0} \quad (\text{A.2})$$

Dividing both sides of equation with  $K_{i0}$ , we get

$$\frac{K_{i1}}{K_{i0}} = (1 - \delta) + \frac{I_{i0}}{K_{i0}} \quad (\text{A.3})$$

Since we assume that firms are at their balanced growth path

$$\frac{K_{i1}}{K_{i0}} = \frac{Y_{i1}}{Y_{i0}} = 1 + g_i \quad (\text{A.4})$$

so

$$1 + g_i = (1 - \delta) + \frac{I_{i0}}{K_{i0}} \quad (\text{A.5})$$

then

$$K_0 = \frac{I_0}{g_i + \delta} \quad (\text{A.6})$$

where  $g$  is the growth rate of the firm and calculated as growth of deflated production value.

An obvious problem of the Steady State Approach is that the estimate of the initial capital stock depends crucially on the investments and the growth rate of output in a single year. While this is unproblematic if the economy under consideration is in fact in equilibrium, a short-term investment shock in the first period of the available time-series of investments would lead to a strongly biased initial capital stock estimate. To counter this problem, Harberger (1978) uses three year averages to construct a more stable and reliable initial capital stock for firms (Berlemann and Wesselhoft, 2012). As a rendition to this, we use average investment and average growth rate of output of firms that appear in at least four years to construct our initial capital stock.

The steady state approach can generate negative value for initial capital stock if the average growth rate in output is negative and greater than the depreciation rate. This method can also generate zero value for initial capital stock in case the firms report zero investment for the first year they appear in the dataset. For firms that report zero investment at their initial year, it is assumed that they cannot be producing without capital. Therefore, initial capital stock is calculated at the year that they report positive investment and this amount is iterated back to the beginning year by dividing each type of capital stock by  $(1-\delta)$  for each former year.

(iii) the rate of depreciation of the existing capital stock.

Ozler & Yılmaz (2007), utilizing Turkish micro level data from 1983-1996, assumed depreciation rates of 5%, 10%, 20% and 30% for building and structure, machinery and equipment, transportation equipment and computer and programming respectively. However, these depreciation rates are quite high compared to those in the literature. Furthermore, the methodology of the data covering the period 2003-2013 is quite different from the previous years. Therefore, motivating from the literature, we assume the following depreciation rates: 2.5 percent for building and civil engineering structures; 5 percent for transportation vehicle, machinery and equipment, and computers; 10 percent for other tangible goods; and 15 percent for computer software.

Given the initial capital and depreciation rates, perpetual inventory method is used for following years where we assume that capital stock is predetermined and evolves according to,

$$K_t = (1 - \delta)K_{t-1} + I_t \quad (\text{A.7})$$