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The role of fiscal policy in the financial crisis. Challenges and solutions

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Abstract. *Since the financial crisis was an economic shock with a considerable unfavorable fiscal component, the prospect of maintaining the sustainability of public finances was a challenge for each country. This study aims to examine the extent to which Central and Eastern European (CEE) countries have been able to acquire or maintain a sustainable fiscal stance both before and during the crisis by empirically estimating three fiscal reaction functions (FRF). Thus, the nature of the fiscal policy promoted within the CEE states, the degree of fiscal sustainability, the persistence of the promoted fiscal behavior and the degree of fiscal discretionism are identified. The results confirm statistically relevant parameters for all three FRFs estimated, indicating the sustainability of public finances in CEE countries, despite the developments implied by the economic crisis.*

Keywords: fiscal reaction function, fiscal policy, panel regression, fiscal sustainability, Central and Eastern European countries.

JEL Classification: C23, E62, H61, H62.

Introduction

Fiscal policy is a constant topic of debate in the European Union (EU), its importance being underpinned in the fiscal criteria promoted by the Maastricht Treaty, as well as the Stability and Growth Pact (SGP). In the current context, defined by important restrictions associated with the implementation of fiscal policies, particularly in CEE countries, and the need for fiscal consolidation, assessing how fiscal authorities adjust their reactions is of particular importance, suggesting their expected future response.

Therefore, the present paper aims to investigate the sustainability of public finances at the level of the selected group of CEE states, as well as to highlight the role of fiscal behavior in the divergent performance observed in this countries in the context of the financial crisis through an empirical analysis using FRF as a tool. Thus, the nature of the fiscal policy promoted within the CEE states, the degree of fiscal sustainability, the persistence of the promoted fiscal behavior and the degree of fiscal discretionism are identified, in line with the approach proposed by Dinu et al. (2011).

The dependent variables of the three panel FRF specifications, expression of the fiscal stance, are the actual primary balance (pb) expressed as a percentage of GDP, the cyclically adjusted primary balance (capb), indicating the discretionary fiscal policy measures, and the cyclical component of the budget balance (cbb), the latter being a measure of automatic stabilizers, in view of the fact that it is directly influenced by the cyclical fluctuations of the economy.

The study is structured as follows: the first section provides a review of the literature on assessing fiscal sustainability through FRF, the second section is dedicated to describing the econometric specifications, the methods and the data used, highlighting the importance of using the FRF. The empirical results are presented in the third section, and the concluding observations of the study are presented in the last section of this paper.

1. Literature review

Fiscal sustainability has known a detailed research into the literature of the past two decades, its importance being underlined by the fact that the fiscal policy is confined by the need to finance the deficit, governments facing limits associated with the extent to which they can borrow.

The sustainability of public finances implies, in general, that governments serve their current and future obligations in line with the inter-temporal budgetary constraint (IBC), which requires that the net present value of future primary balances ought to be sufficient to repay the initial level of debt, and the transversality condition, which implies that the net present value of the future debt will fall to zero over time, which implies that the debt-to-GDP ratio should not increase at a rate superior to the difference between the interest rate and the growth rate (Afonso et al ., 2005).

Given that the definition of fiscal sustainability is based on the IBC, the analysis in the literature was based mainly on its empirical form:

$$G_t + (1 + i_{t-1}) \times D_{t-1} = T_t + D_t$$

According to which the total government revenue, including tax revenue (T_t) and loans (D_t) of the current period, should be equal to the total government expenditure (G_t) plus debt service (including the principal of the previous period (D_{t-1}) and the interest expenses ($i_{t-1} \times D_{t-1}$).

Bohn (1998), however, simplified this relation in the form of an equation exploring the link between public debt (D_t), primary balance (Pb_t), defined as budget revenues minus public expenditure, less interest, and the interest rate (R_{t-1}).

$$D_{t-1} = (D_t - Pb_t) \times (1 + R_{t-1})$$

A direction of the literature on fiscal sustainability uses the FRF as the main tool of empirical analysis, i.e. an equation describing the behavior of a fiscal variable of interest, taking into account current fiscal, macroeconomic and political conditions, through its estimation being provided a valid method for assessing fiscal sustainability. The origin of the fiscal reaction function is found in the IBC equation, which is reiterated in order to determine different FRFs, in accordance with the specific research terms and objectives of the authors.

The literature based on the empirical approach was initiated by influential study of Bohn (1998) on the fiscal policy pursued by the US in the period 1916-1995, in which he used the following FRF:

$$ps_t = \alpha \times d_t + \beta \times Z_t + \varepsilon_t = \alpha \times d_t + \mu_t$$

where

$$\mu_t = a \times Z_t + \varepsilon_t$$

In this equation, ps_t and d_t represent the ratio of the primary balance to GDP and the government debt as a share of GDP, α denotes the ps_t reaction's capacity relative to the d_t level, Z_t contains a set of various other determinants of the primary balance (economic, institutional, *et cetera*), and the errors and random shocks are captured by the error term ε_t.

Bohn (1998) finds that the authorities reacted to a positive debt dynamics with an increase in the primary deficit, reflected by a positive and statistically significant reaction coefficient associated to the government debt, which would indicate reliable information on the sustainability of the fiscal stance, regardless of how the interest rate and the GDP growth rate are compared. This argument is justified by the author in view of the fact that a positive and significant debt coefficient (α) is a sufficient condition to ensure fiscal sustainability, denoting that a country is committed to systematically reduce or maintain stable government debt ratios in GDP, conditioned by the existence of a set of other factors, by adjusting the primary budget balance with the increase in public debt. In other words, more resources are made available for debt servicing.

Such a condition, however, clearly implies a retrospective approach to the extent that only reveals the public debt feedback in the estimation sample, so that such an approach can not predict the future fiscal reaction of a government and, therefore, whether the latter will repay the public debt (Baldi and Staehr, 2015).

A significant number of studies engage in the methodology used by Bohn (1998). Thus, the studies based on the FRF tend to find evidence of a positive and significant fiscal reaction to debt growth, with an important variability, however, depending on the country and the time sample considered. Following a relatively extensive literature review, Checherita-Westphal and Ždarek (2015) found that the intensity of the fiscal response to the debt generally ranges between 0.01 and 0.10. Moreover, the studies using panel data focusing on the EU/EA find this coefficient to be between 0.03 (European Commission, 2011) and 0.10 (Baldi and Staehr, 2015).

2. Research methodology

2.1. The econometric specification

In order to identify the nature of the fiscal policy promoted within the CEE states, the degree of fiscal sustainability, the persistence of the promoted fiscal behavior and the degree of fiscal discretionism, three FRFs models will be used in line with the approach proposed by Dinu et al. (2011).

The dependent variables of the three panel FRF specifications, expression of the fiscal stance, are the actual primary balance (pb) expressed as a percentage of GDP, the cyclically adjusted primary balance (capb) and the cyclical component of the budget balance (cbb), expressed as a share of potential GDP, according to the definition. Given that interest is largely the result of previous decisions on debt accumulation, it is justified to consider the reaction to the actual primary balance and the cyclically adjusted primary balance to various explanatory variables.

Thus, in order to extend the research to incorporate the cyclical behavior of the fiscal policy, the actual primary balance is decomposed according to the following relationship:

$$pb_t = capb_t + cbb_t$$

where the cyclically adjusted primary balance indicates the discretionary fiscal policy measures, this indicator not being directly affected by the economic cycle, and the cyclical component of the primary budget balance provides a measure of automatic stabilizers, given that it is influenced directly by the cyclical fluctuations of the economy. Specifically, automatic stabilizers refer to the fiscal categories that react automatically to the economic cycle without any intervention from fiscal policy authorities.

The actual primary balance model (PB)

Within this model, the FRF engaged aims at examining the influence of the macroeconomic and institutional factors on the fiscal stance, thus explaining the behavior of the fiscal policy in the CEE states, distinguishing the nature of the fiscal policy, as well as its stabilizing impact. This model has as reference the studies elaborated by Bohn (1998), Khalid et al. (2007) and Nguyen (2013).

According to the literature, the panel FRF's general specification is:

$$sbp_{i;t} = \alpha_0 + \alpha_1 \times sbp_{i;t-1} + \alpha_2 \times dat_{i;t-1} + \alpha_3 \times gap_{i;t} + \alpha_4 \times expg_{i;t} +$$
$$+ \alpha_5 \times fri_{i;t} + \alpha_6 \times ri_{i;t} + \alpha_7 \times crisis_{it} + \varepsilon_{it}$$

where $sbp_{i;t-1}$ represents the primary balance of the previous period in country i; $dat_{i;t-1}$ denotes the stock of debt in current year; $gap_{i;t}$ represents the output gap; $expg_{i;t}$ expresses unexpected government spending; $ri_{i;t}$ is the rate of inflation; $fri_{i;t}$ quantifies the Fiscal Rules Index (FRI) computed by the European Commission (EC). Also, a dummy variable was introduced to capture the negative impact of the financial crisis on the primary balance ($crisis_{i;t}$). Measurement errors, as well as random shocks, are captured by the error term ($\varepsilon_{i;t}$), while the constant term of the model (α_0) captures the changes in the dependent variable, which could not be explained by the chosen explanatory variables.

The variables were expressed as a ratio of GDP, except for the output gap, which, according to the definition, was expressed as a ratio of potential GDP. The FRI and inflation rate were expressed as indices.

The Cyclically Adjusted Primary Balance Model (CAPB)

The CAPB model is commonly used in studies that examine the discretionary response of the fiscal policy to business cycle, thus investigating the existence of an output stabilizing reason in fiscal policy making, given that this indicator is easier to control by the authorities concerned.

Therefore, the econometric specification used in this model, having as reference the studies developed by Gali and Perotti (2003), CE (2011) and Turrini (2008), is as follows:

$$sbpac_{i;t} = \beta_0 + \beta_1 \times sbpac_{i;t-1} + \beta_2 \times dat_{i;t-1} + \beta_3 \times gap_{i;t} + \beta_4 \times expg_{i;t} +$$
$$+ \beta_5 \times fri_{i;t} + \beta_6 \times euro_{i;t} + \beta_7 \times pf_{i;t} + \varepsilon_{i;t}$$

where $sbpac_{i;t-1}$ is the cyclically adjusted primary balance of the previous period in country i; $dat_{i;t-1}$ denotes the stock of debt in current year; $gap_{i;t}$ represents the output gap; $expg_{i;t}$ expresses unexpected government spending; $fri_{i;t}$ quantifies the FRI computed by the EC. Two dummy variables were used in order to allow for changes in the fiscal policy behavior, namely to quantify the structural changes implied by the euro area membership ($euro_{i;t}$) and the adoption of a specific fiscal program in the context of the request for international financial assistance ($pf_{i;t}$). Measurement errors, as well as random shocks, are captured by the error term ($\varepsilon_{i;t}$), while the constant of the model (β_0) captures the changes of the endogenous variable, which could not be quantified through the chosen explanatory variables.

The sbpac and gap variables were expressed as ratio to potential GDP, according to the definition, while dat and expg variables were specified as a share of GDP.

In this case, the inflation rate and the dummy variable associated with the crisis were excluded from the panel because they did not show statistical significance.

The cyclical budget balance model (CBB)

The "cyclical" or "non-discretionary" balance is defined as the component of the primary budget balance, whose variations are attributable, at least in the short term, to causes beyond the direct control of the fiscal authorities, i.e. business cycle fluctuations. Specifically, the cyclical component of the primary balance may be affected by fluctuations in the cyclical position of the economy through observable variations in unemployment, which implies a corresponding change in social assistance expenditure, as well as the fluctuations in the macroeconomic bases specific to the different categories of taxes, these variations being interpreted as changes in government revenue.

Thus, this model emphasizes the influence of cyclical fluctuations on the fiscal position, given the fact that the dependent variable approximates a measure of the automatic stabilizers, according to the approach proposed by Dinu et al. (2011). In order to highlight the characteristics of this model, the variable associated with the public debt stock was excluded from the model.

Thus, the econometric specification of this model is:

$$sbc_{i;t} = \gamma_0 + \gamma_1 \times sbc_{i;t-1} + \gamma_3 \times gap_{i;t} + \gamma_4 \times gap_{i;t-1} + \varepsilon_{i;t}$$

where $sbc_{i;t-1}$ represents the cyclical balance of the previous period in country i; $gap_{i;t}$ denotes the current output gap; $gap_{i;t-1}$ quantifies the output gap of the previous period. Measurement errors, as well as random shocks are quantified by the error term ($\varepsilon_{i;t}$), while the constant of the model (γ_0) explains changes in the endogenous variable, which could not be captured by the chosen explanatory variables.

The variables were expressed as a percentage of potential GDP, according to the definition.

2.2. Description of the data

The sample used in this analysis includes ten CEE countries, namely emerging economies, former countries in transition and current members of the EU: Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. This delimitation is based on two criteria, namely the geographical position and the economic structure of the states.

Given the limited availability of the data for CEE states, the estimation of individual FRFs is not feasible, thus FRFs being estimated in a panel analysis. Although the panel used in this research is unbalanced, relatively few observations are missing, the panel's time dimension being at most 22 years (where the starting year is 1995). Thus, 2016 represents the final year of observation of the sample, while the starting year varies according to the availability of the data.

In order to examine the fiscal sustainability hypothesis in the selected CEE countries, the data used in this study, except for the FRI, which was taken from the EC's fiscal rules database, was extracted from AMECO, this implying the advantage that the collected data set is determined using a uniform methodology, i.e. the ESA 2010 accounting standard, which is particularly important in a panel analysis.

The expenditure gap is defined as the deviation of the primary expenses from the trend. Thus, in this paper the indicator concerned was computed using the following formula:

$$expg_{i;t} = \frac{\left(primary\ expenditure_{i;t} - trend_{i;t}\right)}{trend_{i;t}} \times 100$$

2.3. Estimation methods

The estimation of the three FRFs encounters two possible problems, namely heterogeneity and endogenity, which are especially important in case of panel analyzes, in which a common FRF is engaged. Thus, heterogeneity is associated to the specific features of each country which could not be explained by the specification of the models. The literature offers some approaches to overcome this problem. The standard approach implies the inclusion of country-specific fixed effects to capture all country-specific factors that are not explicitly controlled by the model's constant, assuming, in parallel, homogeneous coefficients of the explanatory variables.

Endogenicity issues(1) with regard to the specifications of the three models need to be addressed. Specifically, the output gap should be somewhat correlated with the dependent variable, both determining the fiscal position and being determined by fiscal policy, as a result of the effect of fiscal multipliers, while government debt may be correlated with the model's residuals, given the fact that a country effective in generating high primary balances due to unobservable factors, captured by residuals, will tend to have a lower public debt (Medeiros, 2012).

Initially, the three FRFs are estimated using FE OLS. Considering the possibility of a correlation relation between the explanatory variables and the error term due to non-linearity and more complex interactions between variables, the paper also presents FRFs estimated by means of the methods FE TSLS and FE GMM. Thus, using a variety of modeling techniques this paper assures the robustness of the results and explores different aspects of the data.

That being said, the results of this paper should be viewed with caution, especially in terms of typical estimation problems for panel sets with a small sample size, as is the case with this research.

3. Main results of the research

Table 1. *The actual primary balance model results*

	FE OLS	FE TSLS	FE GMM
C	-2,78***	-3,40***	-3,40***
Primary balance t-1	0,23***	0,23***	0,23***
Stock of public debt	0,07***	0,08***	0,08***
Output gap	-0,07*	-0,09**	-0,09**
Expenditure gap	-0,25***	-0,29***	-0,29***
Inflation rate	0,02**	0,05*	0,05*
Fiscal Rules Index	0,51***	0,50***	0,50***
Crisis dummy	-1,22***	-1,03***	-1,03***
Number of observations	190	140	140
R^2	75,4%	77,4%	77,4%
Adjusted R^2	73,1%	74,5%	74,5%
S.E. of regression	1,39	1,27	1,27
Durbin-Watson statistic	1,56	1,62	1,62
F-statistic probability	0,0%	0,0%	-

***p < 0,01; **p < 0,05; *p < 0,1.
Source: Authors' estimations.

The coefficient α_1 reflects the degree of stability of the fiscal policy promoted. Thus, a negative value recorded by the α_1 coefficient signals the consolidation of the current fiscal position relative to the previous developments of this indicator, given that a decrease of the primary balance during the year t-1 should be followed by an increase of the budgetary balance during the year t, in order to compensate for the accumulation of deficit in the previous period.

The primary balance appears to have a high degree of persistence over time, given that the dependent variable from the previous period always has a positive and very significant value, regardless of the method used. Thus, the promotion of an expansionary policy, which triggered the increase of the budget deficit by 1% of GDP, will cause the latter increase by 0.23% of GDP in the following year, regardless of the method considered, the consolidation of the fiscal position regarding the deficit accumulation in the previous period not being pursued within the CEE countries. On the contrary, we can see the manifestation of a process of accumulation of deficits, which may imply a broad process of fiscal consolidation in the future, as was the case with several CEE countries, namely Latvia, Romania and Hungary. It is possible, however, that after the crisis changes have occurred regarding this behavior, but this argument can not be investigated due to the small size of the post-crisis data.

The persistence of the fiscal position may be due to a series of structural and institutional attributes, including information delays, policy constraints and implementation gaps. A high degree of persistence may suggest difficulties associated with changing the level of spending or taxation.

The coefficient α2 quantifies the size of the fiscal consolidation in response to the level of the stock of public debt. In other words, the coefficient α2 assesses the satisfaction of the government debt sustainability condition, a positive value of this coefficient indicating that fiscal policy can be considered prudent or sustainable, given that an increase in the stock of debt generated by different macroeconomic and financial conditions is followed by an increase in the primary balance, with more resources being made available to debt servicing. In this way, fiscal policy, on average, seems to adjust to meet IBC. In the present case, the government debt sustainability condition is met, with the primary balance improving by 0.07-0.08% of GDP at each 1% of GDP growth in the debt stock. This result is in line with those reported in the Baldi and Staehr (2015) and EC (2016).

The coefficient α_3 represents the total response of the primary budget balance to cyclical conditions, being generated by a combination of discretionary fiscal actions and automatic stabilizers. If this coefficient is positive, fiscal policy can be considered anti-cyclical, given that favorable (unfavorable) economic developments would lead to an improvement (deterioration) of the country's budgetary position. Thus, in the context of a negative (positive) output gap, the budget balance will decrease (increase) as a result of promoting an expansionary (restrictive) fiscal policy. However, if the parameter in question exhibits a negative value, then fiscal policy can be characterized as pro-cyclic, contributing to the amplification of cyclical fluctuations. Instead, a statistically insignificant coefficient indicates that the fiscal policy is neutral.

The sensitivity of the dependent variable to the cyclical fluctuations is -0.07% of GDP for OLS and -0.09% of GDP for TSLS and GMM, reflecting the promotion of a pro-cyclical fiscal policy within the CEE countries. Thus, an output gap of 1% of GDP will imply the reduction of the primary balance by 0.07-0.09% of GDP, emphasizing the promotion of an expansionary fiscal policy, cyclical fluctuations being amplified in this context. These findings are similar to those highlighted in the research conducted by EC (2016) on FRFs associated to the CEE states.

The coefficient α_4 confirms the impact of unexpected expenditure on the primary budget balance. In particular, an increase of 1% of GDP in terms of expg involves a contraction of the primary balance of 0.25% of GDP for OLS and 0.29% of GDP for TSLS and GMM. This development is justified, as an increase in expg is implicitly associated with an increase in government expenditure.

In response to the adverse developments regarding the fiscal position involved by the financial crisis, European countries have consolidated the set of fiscal rules aimed at limiting public debt and fiscal imbalances. In this paper, including a measure of the institutional guarantees for fiscal discipline proves to have a favorable impact on the primary balance, namely 0.50-0.51% of GDP. The finding of efficiency in improving the fiscal position resulting from the existence of stronger tax rules is in line with the findings of Afonso and Hauptmeier (2009), EC (2011, 2016) and Debrun et al. (2008). Specifically, fiscal rules imply an increased predictability of the fiscal policy, contributing to strengthening its credibility.

The impact of inflation on the fiscal position is quantified by the coefficient α_6. Thus, a 1% increase in the inflation rate results in an increase in the actual primary balance of 0.02% of GDP for OLS and 0.05% of GDP for TSLS and GMM. The positive influence of the inflation rate can be justified by the reasoning that the increase in government revenues may be due to a higher inflation rate. This argument, however, requires the investigation of the specific indexing mechanisms.

The dummy variable aiming at investigating the implications of the crisis on the fiscal policy has a high significance irrespective of the estimation technique used, indicating a fundamental change in the fiscal behavior. Specifically, the dummy variable in question reveals a behavior of limiting primary budget surpluses in CEE countries after 2009, this finding being associated to a strong deterioration of 1.22% of GDP for OLS and 1.03% of GDP for TSLS and GMM. This result is justified, given that the recession was an economic shock with a considerable adverse fiscal component, maintaining the sustainability of public finances being a challenge for each country.

Table 2. *The cyclically adjusted primary balance model results*

	FE OLS	FE TSLS	FE GMM
C	-2,40***	-2,58***	-2,58***
Cyclically adjusted primary balance t-1	0,27***	0,21***	0,21***
Stock of public debt	0,05***	0,06***	0,06***
Output gap	-0,35***	-0,42***	-0,42***
Expenditure gap	-0,22***	-0,28***	-0,28***
Fiscal Rules Index	0,20	0,53***	0,53***
Euro adoption dummy	-1,06**	-1,56***	-1,56***
Fiscal programme dummy	-1,07***	-1,49**	-1,49**
Number of observations	185	137	137
R^2	71,5%	74,4%	74,4%
Adjusted R^2	68,8%	71,0%	71,0%
S.E. of regression	1,42	1,30	1,30
Durbin-Watson statistic	1,58	1,71	1,71
F-statistic probability	0,0%	0,0%	-

***p < 0,01; **p < 0,05; *p < 0,1.
Source: Authors' estimations.

The coefficient β_1, which corresponds to the degree of persistence regarding the discretionary fiscal position, recorded a value of 0.27% of GDP for OLS and 0.21% of GDP for TSLS and GMM, suggesting that the stability condition of public finances is not met for the primary discretionary balance, as well, periods that witnessed the promotion of an expansionary discretionary policy not being alternated by periods when governments have behaved more restrictively. Thus, the increase of the deficit in the previous year by 1% of GDP will lead to an increase of this indicator by 0.21-0.27% of GDP in the current year, suggesting that the fiscal authorities do not consider the developments associated with the discretionary fiscal position in the previous period in the decision-making process.

The results indicate that, at all conventional levels of significance, the coefficient β_2, indicating the discretionary fiscal response with respect to the government debt is different from zero and positive, thus confirming the validity of the public finance sustainability hypothesis. In particular, an increase in the debt stock by 1% of GDP will result in a fiscal contraction of 0.05-0.06% of GDP, measured by the increase in the cyclically-adjusted primary balance, respectively the reduction of the deficit recorded by the latter. Such a reaction is sufficient for ensuring the long-term compliance with IBC, implying that the group of countries is unlikely to become insolvent in the long run.

The coefficient β_3, highlights the response generated by means of fiscal discretionary actions with respect to the cyclical fluctuations, the influence of the automatic stabilizers being excluded from this model. Thus, according to the CAPB model, the discretionary fiscal policy promoted by the ECE group was strongly pro-cyclical, the existence of an output gap of 1% of GDP resulting in a significant decrease in capb, i.e. by 0.35-0.42% of GDP, highlighting the promotion of an expansionary fiscal policy. We can therefore argue that fiscal authorities did not act to stabilize the cyclical fluctuations recorded at the level of the economy, but rather to amplify them, the fiscal position not being consolidated during the favorable economic periods, which may imply a constraint in promoting anti-cyclical expansionary policies in adverse economic times, as has been the case for many CEE countries, this group of countries being forced to implement a restrictive fiscal policy in order to achieve structural adjustments, thus continuing to promote the amplification of the cyclical fluctuations and deteriorating the structural fiscal positions.

The explanations of pro-cyclicality in bad times lie in the compromise faced by fiscal authorities concerning the implementation of an impulse on aggregate demand for cyclical stabilization instead of pursuing to maintain fiscal discipline.

Also in this case, the increase of public expenditure deviation from the long-term trend implies a negative response from the dependent variable, reflected by the coefficient β_4. Therefore, under the conditions of an increase by 1% of GDP of this indicator, the discretionary position records a contraction of 0.22% of GDP for OLS and 0.28% of GDP for TSLS and GMM.

Fiscal rules are again considered to be effective, being associated with an improvement of capb by 0.20% of GDP for OLS and 0.53% of GDP for TSLS and GMM.

The influence of the dummy variable associated with the euro area membership is significant, implying a deterioration of capb by 1.06% of GDP for OLS and 1.56% of GDP for TSLS and GMM, starting with the year the CEE country has adopted the euro. A downward trend in the primary surpluses is therefore highlighted in this period, which indicates a weaker answer from capb after joining the euro area. This result is of particular relevance, especially as fiscal policy is one of the few instruments available for macroeconomic stabilization in the framework of a monetary union, in the chosen sample this being the case of Estonia, Latvia, Lithuania, Slovakia and Slovenia. Moreover, these estimates confirm the result that the SGP restricts the fiscal policy in the euro area more than in the CEE countries which have not joined yet to the monetary union, given that fiscal discipline is strengthened under a common monetary policy. In other words, inside a monetary union, awareness of fiscal sustainability issues is high, an economic crisis induced by the individual Member State's deficit having an immediate effect on all other members through a change in the value of the common currency. In addition, the risk of contagion increases with a higher degree of integration. Therefore, promoting and maintaining individual fiscal discipline within the monetary union represents a moral hazard.

Also, the years that witnessed the implementation of a certain fiscal programme associated with the request for international financial assistance were characterized by the significant decrease of the capb, quantified by the coefficient β_7, respectively by 1.07% of GDP for OLS and 1.49% GDP for TSLS and GMM. This development can be explained in the light of the commitments made with regard to the fiscal conduct to be adopted in order to consolidate public finances and correct the existing imbalances in the context of the external financial assistance programme.

Table 3. *The cyclical budget balance model results*

	FE OLS	FE TSLS	FE GMM
C	0,00	0,00	0,00
Cyclical budget balance t-1	0,61***	0,83***	0,83***
Output gap	0,40***	0,41***	0,41***
Output gap t-1	-0,24***	-0,34***	-0,34***
Number of observations	197	137	137
R^2	98,6%	99,3%	99,3%
Adjusted R^2	98,5%	99,2%	99,2%
S.E. of regression	0,19	0,15	0,15
Durbin-Watson statistic	1,82	1,89	1,89
F-statistic probability	0,0%	0,0%	-

***p < 0.01; **p < 0,05; *p < 0,1.
Source: Authors' estimations.

The cyclical component of the budget balance shows a high degree of persistence over time, as measured by the coefficient γ_1, which has a positive and very significant value. Specifically, the increase of the cyclical deficit by 1% over the previous period, in response to the cyclical conditions, will imply an increase in the current cyclical deficit by 0.61% of GDP for OLS and 0.83% of GDP for TSLS and GMM.

This paper assumes not only that the current level recorded by the output gap is important in terms of cyclical balance adjustment, but a major contribution to the evolution of this indicator lies also in the output gap of the previous period.

Thus, the coefficients γ_2 and γ_3 provide information on the reaction of the fiscal position to the current and previous cyclical variations, approximating only the answer recorded through the action of the automatic stabilizers, the influence of the discretionary measures not being quantified. Thus, in the context of a contemporaneous output gap of 1% of

GDP, the cyclical budget balance will increase by 0.40-0.41% of GDP, involving a pro-cyclical effect, while the cyclical fiscal response to an output gap of 1% recorded in the previous period will imply a cyclical reduction of 0.24% for OLS and 0.34% for TSLS and GMM, reflecting an anti-cyclical response. It can be noticed, therefore, the destabilizing action of the automatic budgetary reaction to cyclical developments recorded in the previous period.

It should be noted that the intensity of automatic stabilizers identified by this paper is very close to the conventional one, i.e. of 0.5%, mentioned in the economic literature and used as a convention on the impact of automatic stabilizers on the budget balance in the European economy.

Moreover, the analysis on cyclical balance sensitivity in terms of fluctuations in the output gap is not only useful in quantifying the size of automatic stabilizers, but is extremely important for European countries, especially for those participating in the monetary union, as it highlights the size of the available margin of maneuver, subject to the limits imposed by the SGP.

4. Conclusions and recommendations

The analysis shows a moderate influence of the cyclical conditions on the behavior of fiscal authorities in CEE countries, implying a reduction of 0.07-0.09% of GDP in the primary balance at each increase by 1% in the output gap, thus reflecting the promotion of pro-cyclical fiscal policies. However, as previously noted in this paper, the primary balance responds to the cyclical fluctuations both through discretionary stabilization actions and through the action of automatic stabilizers. Thus, the assessment of the fiscal policy by means of the capb's response reveals a pro-cyclical discretionary policy, the cyclical sensitivity coefficient in this case amounting to -0.35% of GDP for OLS and -0.42% of GDP for TSLS and GMM. The study also confirms the role of automatic stabilizers, their influence in stabilizing the cyclical fluctuations in CEE countries being 0.41-0.42% of GDP, relatively close to the value recorded by the discretionary sensitivity coefficient to the economic cycle.

Thus, we assume that the pro-cyclical properties of the primary balance adjustments regarding the contemporaneous output gap are induced by the effects implied by the policy makers' actions. This finding is of great importance, given that a higher influence of the automatic stabilizers reduces the need for discretionary measures during economic recessions. A justification for the observed pro-cyclicality is that fiscal authorities may want to engage in promoting an anti-cyclical fiscal policy, but they don't have adequate information on the current cyclical conditions, given that real-time estimation of indicators associated with the economic cycle is subject to significant uncertainty, mainly due to revisions concerning the potential GDP estimates. Thus, the pro-cyclicality of fiscal policy may result *ex post*, although the intention of the fiscal authorities was to promote a counter-cyclical fiscal stance.

This finding highlights the need to shift the response burden to automatic stabilizers to a greater extent, this reasoning implying the elimination of decision and implementation gaps that are characteristic for the discretionary actions.

Moreover, the results confirm a positive reaction of the fiscal position regarding the changes in the debt stock, but this response needs to be assessed in parallel with the fiscal reaction capacity associated with the cyclical developments.

The estimates for the first model indicate a pro-cyclical response associated with primary surpluses (-0.07% of GDP for OLS and -0.09% of GDP for TSLS and GMM) close to the consolidation reaction to the stock of debt (0.07-0.08% of GDP), which indicates that, as a whole, the primary balance adjustment pursues both stabilization and consolidation objectives. The results of the second model, however, highlight the fact that the fiscal authorities attach a greater importance to stabilization objectives through discretionary actions (-0.35% of GDP for OLS and -0.42% of GDP for TSLS and GMM) compared to the consolidation aims (0.05-0.06% of GDP). This finding is in contradiction with the results obtained by Ballabriga and Martinez-Mongay (2002), arguing that within the EU fiscal authorities are pursuing fiscal consolidation to a higher degree than cyclical stabilization objectives. This behavior could be justified by the relatively low level of government debt in CEE states.

Moreover, the estimates of the three models highlight that the condition of stability for public finances is not fulfilled, the coefficient associated with the fiscal position of the previous period being positive, thus indicating a high degree of persistence. Specifically, an increase of the primary deficit by 1% of GDP over the previous year determines a primary deficit of 0.23% of GDP in the current year. The cyclical fiscal position (0.61% of GDP for OLS and 0.83% of GDP for TSLS and GMM) shows a persistence above the discretionary one (0.27% of GDP for OLS and 0.21% of GDP for TSLS and GMM), suggesting that the primary balance is adjusting more slowly to cyclical developments, while the previous discretionary deficits are absorbed more rapidly. These observations are of considerable importance in the annual budgeting process.

The results confirm statistically relevant parameters for all three FRFs estimated, indicating the sustainability of public finances in CEE countries, despite the developments implied by the economic crisis. Moreover, comparing the obtained results of the methods engaged in this paper, at least in statistical terms, we can argue that the estimates do not differ substantially, the variables having an increased statistical significance. Also, the signs of the estimated coefficients are consistent and in line with the initial expectations, as can be seen in Tables 1, 2 and 3. Therefore, the coefficients are considered robust.

Note

(1) In econometrics, endogenity is defined as the situation where an explanatory variable is correlated with the error term. Common causes of endogenity are represented by the existence of an uncontrolled variable that determines both the evolution of the dependent variable and the explanatory variables in the model, respectively the existence of a causal relationship between the dependent and independent variables in the model.

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Using the input-output model in macroeconomic analysis and forecasting studies

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Abstract. *In this article the authors present the main aspects of a country's macroeconomic system. It shows that it is a complex structured economic sectors (pure sectors). Also it makes reference to the free market, placing the problem of identifying the interaction of market forces. Inside the national economy there is an intermediate consumption that is showing the amount consumed by branch "c" from all other branches. Input fields are used in this respect in order to show that at a macroeconomic level the model is complex, on the basis of the model calculation and analysis of economic is performed. On the basis of coefficients the existence and intensity of links between branches of national economy is determined. It is important to establish the how aggregation of branches is taking place. The number of branches and the concentration degree are subordinate requirements of study links and proportions that are performed in an economic activity. Aggregation of activities in order to establish the branches used for creating input-output tables is made according to several criteria such as: product identification, common destination of the finished product, similarity raw materials consumed or technological processes and likeness of quantitative structure cost price of production.*
The branches for the balance should be homogeneous and represent a grouping of homogeneous production units.

Keywords: forecasting, production, intermediary consumption, technology, coefficient, matrix.

JEL Classification: C82, E60.

Introduction

The macro-level analysis can be performed by using the input-output table model. The summary table contains all the data necessary for obtaining the coefficients for direct expenditure (a_{ij}) or total (A_{ij}). In order to use this model it is necessary to clarify some issues regarding: homogenous branch, system for classification of activities, sizing of the final product or of the final demand, the calculation of the direct costs for material coefficient, determination of gross production, determination of the variables on which the model is based on. The homogeneous branch produces only goods and services specified in the classification and when difficult elements appear we should consider criteria for classification in this system. By using the International Standard Classification of activities and using the system of national accounts and classifications made by the Statistical Office, we find solutions for this input-output model in order to be used not only for analysis but also for analyzing internal and international comparability. Currently, the system used is CAEN 2 which assures a classification of the branches and national economic activities. The input-output system includes a number of tables, but the bottom line is the summary table of this model divided into four quadrants, each with significance that helps economic analysis of production, analysis of economic results, and the unitary calculation of the domestic product per branch and for the total national economy. This model is particularly formalized even though it appears quite complex, offers a perspective to have data and information to ensure effective and efficient management of resources.

In Romania it is also used, by completing this input-output system that gives an opportunity to review and study the national economy. In this article, we will limit ourselves to presenting the main theoretical aspects involved using input-output tables in ***macroeconomic*** analysis.

1. Literature review

Anghelache and Capanu (2003), Anghelache and Capanu (2004), Anghelache et al., (2013), Anghelache (coord.), 2007). Anghelache et al. (2007) present thorough statistical analyses on the system of national accounts of Romania, more research on economic statistics was presented by Anghelache (2008), Anghelache and Anghel (2016). The work of Jones (2011) is dedicated to the study of correlations existing between economic growth, on one hand, and input-output economics, on the other. Christiano, Eichenbaum and Rebelo (2011) and Woodford (2011) develop on the government spending multiplier as economic policy instrument. Close by, the work of Barro and Redlick (2011) measures the macroeconomic effects of public policies in the fields of taxation and purchases. A detailed analysis of uncertainty and its impact is presented by Bloom (2009). Macroeconomic forecasting is approached by Pesaran, Pick and Pranovich (2013). Anica-Popa and Motofei (2010) are preoccupied with forecasting the infrastructure and constructions – related indicators in Romania, they follow a project-oriented approach. The input-output instruments are presented by Miller and Blair (2009), while

Hendrickson, Lave and Matthews (2006) focus on goods and services environmental cycle assessment. Parker (2011) and Romer and Romer (2010) research the results of fiscal policies' enforcement in particular cases of economic environment conditions, Auerbach and Gorodnichenko (2012) analyze the feedback to fiscal policies. Păunică (2014) focuses on indicators regarding the forecast of infrastructure indicators in a specific region of Romania. The modeling is an important instrument of macroeconomic analysis, the tools of modeling are presented by Anghelache and Anghel (2014) and Anghelache et al. (2016).

2. Research methodology and data

The connections between branches characterize and measure dependencies between various branches of the national economy; for this purpose, using functional dependencies between production volume and production costs.

For it is of great importance, the coefficients of direct material expenses, noted with aij that show how industry and production is consumed in order to produce one unit of projected output in industry branch j. It is calculated as the ratio between the intermediate consumption products and overall consumption or crude intermediate and the branches consuming, the formula is shown below:

$$a_{ij} = \frac{x_{ij}}{X_j} \tag{1}$$

It is assumed that part of the sector for production and the productive use in industry j is directly proportional to the output of branch j, namely:

$$x_{ij} = a_{ij} \bullet X_j \tag{2}$$

The a_{ij} coefficients are identified herein with *specific consumptions*. Their size depends on the technical level and technological level of production, which is why they are named *technological coefficients*. The a_{ij} coefficients form a square matrix named A which has an essential role in all the applications of the balance.

Based on the balance model we can calculate the distribution coefficients of production branch i consumed in a productive brank j and the overall product of the production branch, meaning:

$$h_{ij} = \frac{x_{ij}}{X_i} \tag{3}$$

Between coefficients a_{ij} coefficients h_{ij} there is a close linked, a mutual dependency as shown below:

$$h_{ij} = \frac{x_{ij}}{X_i} = \frac{a_{ij} \bullet X_j}{X_i} = a_{ij} \bullet \frac{X_j}{X_i} \tag{4}$$

The A matrix is characterizes the structure of social production, the division of its branches and links between branches. From such considerations the A matrix content is called *structural matrix.* The elements of A matrix as shown by their contents have only positive or zero values, they cannot have negative values.

The equation:

$$x_{ij} = a_{ij} \bullet X_j \tag{5}$$

shows the between the consumption of a branch and its total there are constant relations. Equations of sharing production gains following form:

$$Xi = \sum a_{ij} + X_i + Y_i, j = \overline{1,n} \tag{6}$$

From this relationship we can determine the expression of the product or of the final demand:

$$Xi - \sum a_{ij} \bullet X_j = Y_i \tag{7}$$

The equations system of production sharing is a static model of the connection balance between the branches; it is a linear system with n equations and 2n unknowns. This model allows to find *n* variables if we give *n* values to the final product or the final branches. When required to calculate the overall product it is for the overall product design. To this end it is necessary to *determine the coefficients of total material costs noted with A_{ij}*, showing the production of each branch must provide the national economy to achieve a final product unit for a certain branch. These rates include all direct material costs and indirect costs. Direct expenses relate the connection between two adjacent products from two adjacent technological branches. Indirect costs express the same kind of occurrence in all sectors that contribute to achieving the concerned product.

The coefficients of total material costs, can only be sized with the help of branches; starting from the static model of the balance in matrix form that can be written as follows:

$$X = A * X + Y, \tag{8}$$

from where we can deduce that:

$$X = (E - A)^{-1} * Y \tag{9}$$

The expression $(E - A)^{-1}$ give value to the *coefficients of total material costs.* The A_{ij} coefficients make a square matrix. The model assumes the following form:

$$X_i = \sum A_{ij} \bullet Y_j \tag{10}$$

The static model of the branches reflects the relationship between the overall product or profit of each branch and the end product of all branches, points out that the final product of a branch can start a change in the chain in all branches of the national economy and not only in the sectors concerned.

One of the main purposes for making the table is to create a basis for improving the methods of macroeconomic analysis.

With the help of statistical data are collected according to the model adopted that allow widening and deepening analyzes on the processes of production, distribution and use of the final product. Developing this tool leads to the discovery of inaccuracies and gaps in the statistics of a country, contributing to the improvement of statistical indicators used and computational techniques or the improvement of statistics as a tool of knowledge.

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The input-output table allowed for the first time, introducing in the economic activity "analysis of inputs and outputs" based on the use of mathematical models and the electronic techniques of calculation.

The amount of data that it provides makes the systematic nature of this information table to have a broad and effective use in economic analysis and forecasting calculations.

The table data are of great importance for the calculation of indicators that allow the study of: economic structure, the proportion of economic development, the interdependence of economic sectors; participation of different sectors in the setting output for final consumption.

The indicators included in the table - gross output, value added of the end product - computed for each branch included in the classification used, analyzed, allow characterization of deeper, more complete structure of the national economy.

For this purpose calculated and analyzed the proportion of the gross production, the final product in terms of GDP and the added value in each branch related to the total.

$$\frac{P_{bi}}{\sum P_{bi}};\frac{V_{ai}}{\sum V_{ai}};\frac{P_{fi}}{\sum P_{fi}} \qquad (11)$$

P_b represents the raw production of a branch;
V_a the added value of a branch;
P_f represents the final product of a branch;
i represents 1,2,..., n.

These sizes which expresses the contribution of each branch to the formation of gross production, the final product (expressed in GDP) or the value added, have a special significance for studying the structure of the economy. It can also calculate the indicators expressing the proportion of various elements of the value added or the final product (household consumption, government consumption, investment, exports) of each branch to the size of these elements in the national economy. Studying these proportions for a longer period of time makes clearer the changes that have taken place in the economy of the country.

In order to analyze the economic structure, the branches of the classification, as was shown in the previous paragraph, can be concentrated according to certain criteria.

They can be grouped into: the main branches which provides the raw material (mining and agriculture), which is the primary sector; industries that process agricultural products and mining industry, which is the secondary sector; and branches providing services, tertiary sector.

Calculating the ratio of these three sectors Gross final product, or value added, we get a series of indicators that allow to draw conclusions about the structure of the economy and its character.

If the specific gravity of the branches of the primary sector is high, the economy of that country is a rudimentary economy, and if the secondary branches sector have a share in the formation of the indicators listed, the economy of that country is a developed economy. Increasing the share of secondary sector and tertiary gross national product size, final product and added value indicates economic development.

The data from the input-output table also allows to calculate indicators characterizing the distribution of employment, time worked by industry and industry groups, calculating the proportion of the population employed, and the time spent in each branch from the total. To know some aspects of the effectiveness of each branch, these indicators are correlated with the added value of each branch, and its proportion in total.

The indicators listed above, calculated based on table data, compared in time revealed aspects of changes that have taken place in the structure of the national economy and its development compared to other countries reveals similarities or differences between the structures of their economy.

The data from the input-output table underlying the characterization and analysis of interdependencies between economic sectors.

As was shown in the input-output activity each branch is shown under double aspect: as a branch supplying and consuming. In this case, the product flows shown in the table shows dependency output of a branch the size of production at other branches. Thus, entries for each branch power delivery express what products and how much should be produced in other branches to get a certain amount of production in the branch.

Production of a branch does not depend only on its direct relations with suppliers branches, but also the production branches not directly supplying products, but are linked indirectly through the direct relationship they have branches supplying them. These direct and indirect links between branches make some change in the output of a branch to determine changes in many sectors of the economy. Economic dependence on a branch other branches can be measured by expense coefficients.

One of the main results of processing of the input branches is the obtained coefficients costs - direct costs coefficients (a_{ij}) and total expenditure coefficients (A_{ij}).

Coefficients of direct expenses – express expenses of a product to obtain other products or spending of a branch to obtain a value of production units from other branches; e.g. coal consumption for electricity production; consumption of metal to obtain tools; the production of metal per 1 000, 10 000 or 100 000 RON or the production of construction equipment for oil extraction etc.

The coefficients of total expenditure is calculated by inverting the matrix coefficients of direct expenses and expresses besides direct costs and expenditure on other products involved in obtaining the corresponding production. So coefficients of total expenditure show direct and indirect costs of a product to obtain a unit of another product. For example, to determine the total costs for coal for the production of machine tools have taken into account not only the expenses incurred by the companies that produce machine tools, but also coal consumption in other companies that supply products to obtain machine tools, such as coal consumption in establishments producing metal, electricity etc. So, it is necessary to consider all inputs of carbon held in all its technological links in the production of the machine tools.

In preparing input-output table, firstly it is calculated the table of direct expenses (matrix a_{ij}).

A_{ij} coefficients are obtained by dividing the total amount spent for certain products from the total production of these products:

$$\left(\boldsymbol{a}_{\boldsymbol{ij}=\frac{x_{ij}}{X_j}}\right) \tag{12}$$

Coefficients of direct expenses actually express the branch structure of material consumption per unit output value of a certain branch.

Analyzes of the coefficients of direct costs allows to highlight branches (products) that have a decisive role in the productive consumption of each sector and their impact on various branches of the changes that occur in the output of other branches.

Matrix **(a_{ij})** represents a milestone in the development and analysis of the links between branches. This allows characterization of direct links between branches and is of great importance for economic analysis and planning of the national economy.

On the basis of the matrix **(a_{ij})** it is calculated the coefficients **A_{ij}** (total costs coefficients). They are linked to the coefficients of direct expenditure - intermediate consumption and final consumption structure.

Total expenditure coefficients **A_{ij}** used to determine the various branches of production required 5

$$V_J - \sum_{i=1}^{n} N_{ij} + I_{mj} = A_j + I_{nj}^{ind} + VNA_j + VIP_j \tag{13}$$

Summing gross value added of all branches to obtain GDP at market prices, according to:

$$\sum_{j=1}^{n}(VP_j - N_{ij} - I_{mj}) = \sum_{j=1}^{n}\left(A_j + I_{nj}^{ind} + VNA_j + VIP_j\right) = PIB_{PP} \quad (14)$$

Since VNAj + VIPj represent the income arising from domestic production factors:

$$\sum_{j=1}^{n}\left(A_j + VF_j + I_j^{ind} + +S_j\right) = PIB_{PP} \quad (15)$$

Eliminating depreciation of fixed capital from ***GDPpp*** results in ***NDPpp***.

If you add up all the components in square II, we obtain GDP at market prices calculated by the method of end-use, namely:

$$\sum_{i=1}^{n}\left(CP_i + CST_i + I_i^b + E_{si} + I_{mi}\right) = PIB \quad (16)$$

Starting from the main objective pursued by constructing input-output tables - highlighting interdependencies between production branches - there are some deviations from the results obtained from macroeconomic calculations. While the determination of indicators in the national accounts does not take account of deliveries between companies (intermediate production), in case of the table these deliveries are taken into account if these deliveries are referring to those that occur between units within the same branch.

To meet the needs of management forecasting of the input branches (BLR) is developed as forecast balance for the period. The starting point is the statistical balance. Development of the balance forecast period involves the following operations:

- **Sizing final product or final demand**

Final demand is determined exogenously off balance model. The national economy, the demand should be designed and structured based on the following elements: analysis of the existing level and structure of final demand based on statistical balance; research and evaluation of the factors influencing the growth of final demand, the correlation between the accumulation fund consumer replacement fund; developing hypotheses prediction on the relationship between the accumulation fund and the consumption fund in the foundation of the hypothesis prediction on the relationship between the accumulation fund and the consumption fund by labor productivity and training in the production resources of labor, changes in accumulation of productive efficiency and the factors conditioning increasing material wealth; development forecasts on the development of each branch of production taking into account the prospects of foreign economic relations.

- **Calculating the coefficients of direct material costs and updating them**

Coefficients of direct material costs is usually calculated based on the static balance of the links between branches; however, these rates cannot be mechanically extrapolated for the forecast period, those coefficients should be updated conditions of the projection period as a result of changes produced in the national economy. Main factors influencing coefficients are direct material costs: mutual substitution of various energy sources; substituting natural raw materials, synthetic materials and products tend to shift towards more complex, higher processed; general increase in consumption of industrially processed products and service consumption; the downward trend in manufacturing of material consumption.

- **Calculation of the total material cost coefficients**

The coefficients of total material costs are determined based on the updated matrix of technological coefficients. For the calculation of the total material costs coefficients to following operations are followed: calculating the difference matrix (E - A) and its determinant; writing and calculation transposed its association; the inverse matrix calculation $(E - A)^{-1}$.

- **Determination of the gross or overall product of the branches**

This operation is of special importance for establishing proportions and balancing the economy; the balance allows establishing net consumer demand and the gross product of each branch so as to completely cover the requirements of the final product. Final products are coordinated global and balanced each other. The product of the branch is based to the needs of internal and external market and technical and productive potential. Overall product is calculated by the relationship:

$$X_i = \sum A_{ij} \bullet Y_i \qquad (17)$$

- **The link between the necessary volume with the possible volume of the global product and establishing the retained indicator as an objective**

The required volume of global product resulting from the calculations of balance and the possible volume is established outside the balance, depending on production capacities and their use, the possibilities to ensure the necessary raw materials, energy and labor, the financial and currency. The ideal situation would be that amount must be equal to the feasible volume. In reality there are differences between the two variables.

- **Determining the variables from quadrant III:**

Depreciation of fixed capital, total material costs, net value added structured on elements, gross value added and imports.

Depreciation on branches (Z_i) is calculated by multiplying the depreciation coefficients (z_i) with the overall product:

$$Z_i = z_i \bullet X_i \qquad (18)$$

The depreciation coefficients are calculated based on the synthetic balance of the ties between the Z branches, as shown:

$$z_i = \frac{Z_i}{X_i} \qquad (19)$$

and are updated for the condition of the period according to the forecast of the factors that have a influences on the action of increase or decrease. On the economy, fund amortization is calculated by adding depreciation branches:

$$Z = \sum Z_i = Z_1 + Z_2 + \ldots + Z_i + \ldots + Z_n = z_1 \cdot X_1 + z_2 \cdot X_2 + \ldots + z_i \cdot X_i + \ldots + z_n \cdot X_n = \sum z_i \cdot X_i \quad (20)$$

The costs of total material of the branches consumption is calculated by adding the intermediate columns included in quadrant I associated with the corresponding depreciation. Use the following relationships:

$$CM_i = x_{1i} + x_{2i} + \ldots + x_{ji} + \ldots + x_{ni} + Z_i = \sum x_{ji} + Z_i \quad (21)$$

$$CM_i = a_{1i} \cdot X_i + a_{2i} \cdot X_i + \ldots + a_{ji} \cdot X_i + \ldots + a_{ni} \cdot X_i + Z_i = \sum a_{ji} \cdot x_i + Z_i \quad (22)$$

On the hole of the national economy, expenses for material are is added together by branches:

$$CM = \sum CM_i = \sum \sum x_{ji} + \sum Z_i = \sum \sum a_{ji} \cdot x_i + \sum Z_i \quad (23)$$

The net value added by industry is calculated as the difference between the overall product and material expenses:

$$VAN_i = X_i - CM_i \quad (24)$$

The gross value added is calculated by adding the fixed capital depreciation:

$$VAB_i = VAN_i + Z_i \quad (25).$$

Imports associated with each branch is established in the preparatory works that serve to determine the main indices of the national economy closely correlated with exports so that the two flows of foreign trade to offset each other.

Total Resources (R) are established by branch and on the national economy. They consist of global product respectively gross global product and import. Balancing of the input branches must ensure equality between total resources and total uses (U) consisting of intermediate consumption and final demand or final consumption.

After going through all these steps to we prepare the total BLR for the forecast period.

Conclusions

From the results presented in this article resulted a number of conclusions highlighting the complexity and usefulness of input-output tables in the calculation of macroeconomic indicators and their use in macroeconomic forecasts. Using the input-output model involves clarifying issues regarding aggregation branches, branches achieve homogeneity and identifying the established connections between them. The synthetic input-output table is accompanied by balance expressing links that are established between these branches of the national economy. We paid attention to building of synthetic model input-output to highlight the need to have reliable data to identify correlations that are established based on these connections, by establishing the algorithm, then we can proceed to calculate technology coefficients, intermediate consumption, final results, import and export role in the calculation of macroeconomic indicators. Being a complex model of the economy, for example it could use a limited number of branches to present practically the indicators that are calculated and the expressiveness of their planned tests. The tables can be developed for a deep and useful role of macroeconomics. The authors were limited to synthesize as much as possible, the most significant theoretical to suggest the possibility of using this macro model analysis. Of course, the presentation of such a model can be other important elements, but the purpose of this article is to highlight the most commonly used elements.

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Panel causality analysis between exchange rates and stock indexes for fragile five*

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Abstract. *Having become too dependent on foreign capital inflows to finance their economies can be expressed for the fragile five countries. The purpose of this study is to determine the existence and direction of casual relationship between stock indexes and exchange rates for the fragile five. According to Dumitrescu-Hurlin's panel causality test for fragile five countries, bidirectional Granger causality relation is detected for overall data, except before mortgage crisis term, from exchange rate to stock indexes. Dumitrescu-Hurlin's test and a modified type of sequential panel selection methodology are also conducted for searching the determiners of the casual relationship for each time interval.*

Keywords: causality relation, fragile five, exchange rates, stock markets, panel data.

JEL Classification: G15, F31, C33.

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1. Introduction

The countries that have liberalized their economies and deregulated their financial markets have become more integrated with the world economy since 1980s. This process provided a significant opportunity for some of these countries to improve the level of their development. However, the macroeconomic variables of these countries have become more volatile because of increasing capital flows. Due to these developments, the international capital flows to these countries have been risen sharply. As a result of this, the volatility of exchange rates and degree of the risks involved in investments increased. So that, the more flexible exchange rate regimes and the portfolio diversification issues have become more important in the late 1980s' and 1990s for academics, individual/institutional investors and the policy makers. In this context, lots of studies have focused on to the relationship between the foreign exchange rates (ER) and the stock indexes (SI).

However, there is no previous study observed in the related literature on the relationship between SI and ER for fragile five countries, makes this study original. In 2013, Morgan Stanley declared some emerging markets, namely Brazil, Indonesia, South Africa, India, and Turkey as fragile five. According to Morgan Stanley, these countries have some important problems in common. Firstly, their currencies are under the pressure against the US dollar, and secondly each of these countries has a significant and rising current account deficits that make them more dependent on foreign capital flows. So that, it is important to investigate the evidence of relationship between the ER and SI. The aim of this study is to investigate the relationship between the ER and SI by applying the panel causality analysis for fragile five countries. For this purpose, the daily data of ER and SI of the fragile five countries are obtained and formed in to panel data for the fragile five countries and Dumitrescu and Hurlin (2012)'s panel causality test is applied for the period of January 3, 2002 and March 3, 2016. The post hoc test results of Granger causality via Dumitrescu and Hurlin's test and a modified type of sequential panel selection methodology also conducted for searching the determiners of the casual relationship between ER and SI. Up to mortgage crisis (MC), all analyses repeated also for three terms, before MC, during MC and after MC for investigating the existence and/or direction of the causality relationship.

2. Relationship between the exchange rate and stock markets

The economic theory on this relationship suggests two alternative approaches (Granger et al., 2000); "flow" and "stock" oriented approaches. According to the flow oriented or known as traditional approach, the real exchange rate affects the international competitiveness, the general economic activity, the balance of trade position, the macroeconomic variables and consequently the real output of the economy (Dornbusch and Fischer, 1980; Aggarwal, 1981). In other words a depreciation in the value of domestic currency influences the country's external competitiveness and hence its income, trade balance and economic welfare. To this approach increasing stock returns would be associated with the decreasing value of domestic currency. Decreasing value of domestic currency affects the stock prices of the firms regarding to its indirect influence that increases the earnings, profitability and the current and expected cash flows of the firms.

Stock oriented approach that based on portfolio balance model (Branson et al., 1977; Frankel 1983) suggests that the ER are determined by market mechanism. An expected increase in stock prices attracts the foreign investors and hence the foreign capital flows increase the demand for the country's currency and vice versa. Increasing (decreasing) stock returns will increase (decrease) the domestic wealth and the net demand to the domestic currency and its value (Gavin, 1989). According to this equilibrium, the movements in SI may affect the demand and the value of currencies and the value of ER. Especially during the time of a financial crises, it is more significant to maintain this equilibrium in developing countries because of the sudden changes in the behavior of investors. If they lose their confidence in the economic and political stability, they want to get out of the risky countries. Therefore, the demand to the assets of these countries may decrease as the demand to the foreign currencies may increase rapidly. So that for the countries like that, the capital account dynamics have an important role in determining the ER.

In the academic literature, there are many studies on the relationship between ER and SI, and most of them have focused on developed countries. According to some of these studies (Solnik, 1987; Jorion, 1990; Bernard and Galati, 2000; Nieh and Lee, 2001; Griffin and Stulz, 2001) there may be no evidence of any relation observed between ER and SI, while some of them found unidirectional causality from ER to SI and bi-directional or two-way causality between SI and ER (Aggarwal, 1981; Adler and Dumas, 1984; Ma and Kao, 1990; Roll, 1992; Chow et al., 1997; Doukas et al., 1999; Patro et al., 2002; Grambovas, 2003). There are a few studies about the relations between ER and SI (Fang and Miller 2002; Mishra, 2004; Venkateshwarlu and Tiwari, 2005; Wu, 2005; Aquino, 2005; Narayan and Smyth, 2005; Pekkaya and Bayramoğlu, 2008; Kumar, 2009; Rahman and Uddin, 2009) in developing countries.

Ajayi et al. (1998) examined the relation for advanced and Asian emerging markets, and find that in advanced economies there is a relation from SI to ER. Aggarwal (1981)'s study is an example of unicausality from ER to SI. For the period of 1974-1978 in US, Aggrawal (1981) finds that there is an influence from ER to SI. In other words, there is a positive correlation between ER and SI. There are some studies that have the same results for different countries (Donnelly and Sheey, 1996; Glaum et al., 2000; Abdalla and Murinde, 1997; Granger et al., 2000; Pan et al., 2007).

Another group of studies are concerning the unidirectional relation from SI to ER. Granger et al. (2000) found relation from SI to ER for some Asian countries. Ajayi et al. (1998) find that in emerging economies there is a relation from SI to ER. Some of studies found a bi-directional relation between ER and SI. Tabak (2006) found a relation from SI to ER and vice versa that based on Granger causality model. According to this study there is a linear relation from SI to ER and a nonlinear relation from ER to SI.

3. A panel causality analysis for fragile five

The purpose of this study to determine the existence and direction of casualty relation between ER and SE with taking attention on the periods of MC in 2008. In application, the fragile five countries are selected for the sake of homogeneity and much alike properties of them, and also not have been studied before. The names of the fragile five countries, their SI and their ER with their abbreviations are listed in Table 1. The SI of the fragile five countries for the analysis are selected with respect to the index representation of the countries' stock prices and conversant structure of the index. The ER is taken into account as USD over the currencies of that country. The daily market prices of the fragile five as data, are acquired from finance.yahoo.com (18.03.2016) for SI and www.exchangerate.com (18.03.2016) for ER.

Table 1. *Names, abbreviations of fragile five countries, their stock indexes and currencies*

Countries	Brasilia, Br	Indonesia, Id	South Africa, So	India, In	Turkey, Tr
Stock Index, SI	BVSP	JKSE	FTSE/JSE	SENSEX	BIST100
Exchange rate (with US $), ER	$/Brazilian Real, BR	$/Indonesian Rupiah, Id	$/South African Rand, SR	$/Indian Rupee, InR	$/Turkish Lira, TL

After synchronizing the data in terms of time by deleting the other countries' observations of the missing one, logarithmic returns of all over the time series calculated separately. Then, overall five double time series has 3038 daily return observations, from January 3, 2002 to March 1, 2016 (03.01.02-02.03.16).

The stationarity of data set is an important problem for time series and panel data. Depending on the data set structure, many tests can be used to examine the stationary characteristics of the series. In this study, we use Im et al. (2003) and Maddala and Wu (1999) panel unit root test to examine the stationarity characteristics of the data. The results (Table 2) show that both SI and ER are stationary at level. So, we can use the return series in the causality analysis.

Table 2. *Panel unit root tests of fragile five series*

	Maddala and Wu		Im, Pesaran and Shin	
	Intercept	Intercept and Trend	Intercept	Intercept and Trend
SI	414.817 (0.000)	429.356 (0.000)	-2.9173 (0.000)	-21.5244 (0.000)
ER	456.361 (0.000)	491.362 (0.000)	-22.3544 (0.000)	-23.3863 (0.000)

Note: Numbers in parentheses show the p- values.

To test the existence and direction of the Granger causality between SI and ER, we employ the panel causality test which introduced by Dumitrescu and Hurlin (2012). They explained that their test statistic is based on the individual Wald statistics of Granger non causality averaged across the cross-section units. Dumitrescu and Hurlin (2012) reveal lots of advantages of their test, and main advantages can be summarized as follows; (1) it is very simple to implement. (2) Monte Carlo simulations show that their panel statistics lead to substantial increase in the power of the Granger non-causality tests even for samples with very small T and N dimensions. (3) Their test statistics do not require any particular panel estimation. (4) The test can be easily implemented in unbalanced panels and/or panels with different lag order K for each individual. Accordingly, even in the condition of determining the wrong lag length, their test statistics is quite reliable. Dumitrescu and Hurlin test statistic can be computed as following (2012:1459):

$$\tilde{Z}_N^{Hnc} = \frac{\sqrt{N}\left[W_{N,T}^{Hnc} - N^{-1}\sum_{i=1}^{N} E(W_{i,T})\right]}{\sqrt{N^{-1}\sum_{i=1}^{N} Var(\tilde{W}_{i,T})}} = \frac{\sqrt{N}\left[W_{N,T}^{Hnc} - N^{-1}\sum_{i=1}^{N} K_i \cdot \frac{T_i - 2K_i - 1}{T_i - 2K_i - 3}\right]}{\sqrt{N^{-1}\sum_{i=1}^{N} 2K_i \cdot \frac{(T_i - 2K_i - 1)^2 \cdot (T_i - 2K_i - 3)}{(T_i - 2K_i - 3)^2 \cdot (T_i - 2K_i - 5)}}} \quad (1)$$

Where $W_{N,T}^{Hnc} = \frac{\sum_{i=1}^{N} W_{i,T}}{N}$; $W_{i,T}$ denotes the individual Wald statistics for the ith cross-section unit corresponding to the individual test of $H0{:}B_i=0$, and $T_i>5+2K_i$.

We implement Dumitrescu and Hurlin (2012)'s panel Granger causality test for the lags of 1, 2 and 3 in this study. The test results are reported in Table 3 show that there is a bi-directional Granger causality between SI and ER variables for the fragile five.

Table 3. *Granger causality relations of Fragile 5 (3038x5 observations, 03.01.02-02-03.16)*

Lags	ER↛SI			SI↛ER		
	W-Stat.	Zbar-Stat.	Prob.	W-Stat.	Zbar-Stat.	Prob.
1	6.7216	9.0352	.0000	19.2130	28.7629	.0000
2	9.0977	7.9235	.0000	21.4787	21.7477	.0000
3	15.5603	11.4471	.0000	23.6810	18.8492	.0000

Note: Prob. values are calculated from statistics of Dumitrescu and Hurlin's Panel Granger causality test. Symbol of ↛ stands for the causality tests's Null hypothesis of "ER↛SI; ER does not homogeneously cause SI".

In order to determine the reason behind the Granger causality relation, a modified type of sequential panel selection methodology is taken into consideration as a post hoc test. In our study, sequential panel selection methodology which is applied to panel unit root tests by Chortareas and Kapetanios (2009) explained as "a sequence of panel unit tests on a reducing dataset where the reduction is carried out by dropping series for which there is evidence of stationarity", is also inversely adapted to panel causality analysis. First, ordinary Granger causality tests of each paired series are conducted for first three lags, their F statistics and p-values are reported in Table 4. Since Dumitrescu and Hurlin panel causality test are conducted for first three lags and we are searching which countries have the determiner of this relation, ordinary Granger causality tests are conducted for the same lags. Orderly, paired series which has highest F statistics, may have the highest impact on determination of the Granger causality relation of Dumitrescu and Hurlin test. Thus, by orderly dropping the paired series of the country which has highest F statistics until the p-value of Dumitrescu and Hurlin test become statistically nonsignificant at .05 level. Table 5 shows the results of this procedure. According to results in Table 5, among fragile five countries, as Br, So, Tr have Granger causality relation from ER to SI but no significant relation detected in that direction for In. As Br, Id, In have Granger causality relation from SI to ER but no significant relation detected in that direction for So.

Table 4. *F statistics (prob. values) of Granger causality relations (03.01.02-02-03.16)*

Lags	Br, ER↛SI		Id, ER↛SI		So, ER↛SI		In, ER↛SI		Tr, ER↛SI	
1	4.0672	(.0438)	3.0798	(.0794)	3.9127	(.0480)	2.6896	(.1011)	19.8588	(.0000)
2	5.9352	(.0027)	1.5978	(.2025)	1.9335	(.1448)	2.5383	(.0792)	1.7395	(.0000)
3	5.7577	(.0006)	5.2154	(.0014)	3.1293	(.0247)	4.5062	(.0037)	7.3253	(.0001)
	Br, SI↛ER		Id, SI↛ER		So, SI↛ER		In, SI↛ER		Tr, SI↛ER	
1	57.6556	(.0000)	22.3973	(.0000)	5.2217	(.0224)	9.7748	(.0018)	1.0153	(.3137)
2	28.6425	(.0000)	15.2013	(.0000)	2.5808	(.0759)	6.7087	(.0012)	.5636	(.5692)
3	19.8391	(.0000)	13.1474	(.0000)	1.7507	(.1545)	4.3082	(.0049)	.4230	(.7366)

Note: Prob. values are calculated from statistics of ordinary Granger causality test. Symbol of ↛ stands for the causality tests's Null hypothesis of "ER↛SI; ER does not cause SI".

Table 5. *Sequential panel selection prob. values (03.01.02-02.03.16)*

Causality test		Id, So, In, Tr	Br, Id, So, In	So, In, Tr	So, Tr	So, In	In, Tr	Id, In	Id, Tr
1 lag,	ER↛SI	.0000	.0006	.0000	.0000	.0000	.0216	.0598	.0000
2 lags,	ER↛SI	.0000	.0000	.0000	.0000	.0000	.0811	.1317	.0000
3 lags,	ER↛SI	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
1 lag,	SI↛ER	.0000	.0000	.0000	.0344	.0000	.0000	.0000	.0000
2 lags,	SI↛ER	.0000	.0000	.0000	.4196	.0002	.0000	.0000	.0000
3 lags,	SI↛ER	.0000	.0000	.0140	.8815	.0182	.0005	.0000	.0000

Note: Prob. values are calculated from statistics of Dumitrescu and Hurlin's Panel Granger causality test. No unit root is detected statistically at .01 level according to the panel unit root tests of Im et al. (2003) and Maddala and Wu (1999) for all sub groups.

Taking into consideration of "Mortgage Crises" (MC) which is experienced firstly in USA then expand to almost all over the world, we thought that there may be some variations occur in the existence or/and direction of the Granger causality relations. Göçer (2012) stated the beginning date of MC as 15.09.08 when the bankruptcy of Lehman Brothers that is accepted as one of the great financial intuition in USA/world. The impact of the MC may go on even in the beginning of 2010s, for the fragile five countries we accepted that the main effects of MC are detected form 15.09.08 to beginning of 2010. Therefore, the data is split into three parts in terms of time, namely Before MC (03.01.02-14.09.08), during MC (15.09.08-30.12.09) and after MC (04.01.09-02-03.16). The same analyses carried out for these three set of panel data. Results of panel unit root tests, ordinary Granger causality tests and Dumitrescu and Hurlin test are reported in tables of Appendixes 1-7. The summary of inferred results' are presented in Table 6.

Table 6. *Inferences from Dumitrescu and Hurlin causality tests*

Causality relation	Fragile 5	Br	Id	So	In	Tr
ER→SI, 03.01.02-02-03.16	Exists	Exists		Exists	Not Exists	Exists
SI→ER, 03.01.02-02-03.16	Exists	Exists	Exists	Not Exists	Exists	
ER→SI, Before MC	Not Exists					
SI→ER, Before MC	Exists	Exists	Exists	Exists	Not Exists	Not Exists
ER→SI, During MC	Exists	Exists	Exists		Not Exists	Exists
SI→ER, During MC	Exists		Exists	Not Exists		Not Exists
ER→SI, After MC	Exists		Not Exists	Exists	Not Exists	Exists
SI→ER, After MC	Exists	Exists	Exists	Not Exists		Not Exists

Note: MC is mortgage crises between 15.09.08-30.12.09 (265 observations). General results are inferenced from Dumitrescu and Hurlin's Panel Granger causality tests. Individual results are inferenced from Dumitrescu and Hurlin's Panel Granger causality tests and a type of sequential panel selection strategy. The blanks in the table means that no clear evidence has observed in decisions /inferences for that period/direction.

According to inferences from Dumitrescu and Hurlin causality tests as in Table 6, ER and SI have bidirectional Granger causality relationship except before MC. Before MC, SI does Granger cause of ER but not vice versa. During and after the MC, both variables does Granger cause of each other. This results show that, SI and ER prices may effect each other for fragile five countries. However, before MC, there is no evidence found from the panel data about "ER does Granger cause SI for the fragile five". For Br and Id, this interaction is more powerful than the So, In and Tr. For So and Tr, the direction of this Granger causally relation is usually from ER to SI and not vice versa. Different Granger cause feature is realized for In, results that there is almost no durable causality is detected for In, among the fragile five countries.

4. Conclusion

The purpose of this study is to determine the existence and direction of casualty relation of the variances between SI and ER for the fragile five countries. According to Dumitrescu and Hurlin's panel causality tests, bi-directional Granger causality relation is observed between ER and SI.

The results obtained from this study are consistent with the theory. They show that there are unidirectional and bi-directional causalities from ER to SI and vice versa for all countries in general. However, considering the different periods the results may vary. For fragile five countries there is no causality observed from ER to SI before mortgage crises. This is a period of rapid growth for the world economy, especially for developing countries. In this period most of the firms used their profits for new investments with the idea that growth process will continue, and the dividend payout ratios are affected from this. Decreasing dividend payout ratios, the long term expected returns from the new investments and increasing interests in real estates may reduce the preferences for stocks. As a result of these, many of investors may decrease the ratio of the stock assets in their portfolios, then from the beginning of mortgage crises, market revised to its ordinary conditions which exist bidirectional causality.

During the Mortgage Crises, while there is a bi-directional causality between ER and SI for Indonesia, there are unidirectional causality from ER to SI for Turkey and Brazil, and causality from SI to ER for Indonesia. After the period of mortgage crises, there are unidirectional causalities from ER to SI for South Africa and Turkey and from SI to ER for Brazil and Indonesia.

The results are similar for the same periods for some countries which can be classified together, for example Turkey and South Africa, Brazil and Indonesia. However, India is distinguished from these countries and seems to be in a different structure. There may be several opportunities for researchers to investigate and for investors to get more and attractive profits according to the causality relations between ER and SI. Also these results are an indicator for policy makers to decide the fiscal and economic policies and the regulations for financial markets. Additionally, the Morgan Stanley's suggestions argued for exchange rates and deficit may be true for the fragile five countries, but it cannot be said that all of the fragile five countries have similar characteristics in terms of the relationship between exchange rates and stock markets.

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Appendix 1. *Panel unit root tests of Fragile 5 for intercepts*

		Before MC		During MC		After MC	
		03.01.02-14.09.08		15.09.08-30.12.09		04.01.09-02-03.16	
		Statistic	Prob.	Statistic	Prob.	Statistic	Prob.
SI	Im, Pesaran and Shin W	-17.9301	.0000	-6.79616	.0000	-19.3552	.0000
SI	Maddala Wu Chi-square	325.945	.0000	72.5710	.0000	364.665	.0000
ER	Im, Pesaran and Shin W	-16.1877	.0000	-13.5732	.0000	-37.0052	.0000
ER	Maddala Wu Chi-square	28.824	.0000	203.705	.0000	529.329	.0000

Note: All the panel series of sub groups are researches for unit root tests of Im et al. (2003) and Maddala and Wu (1999). Results of these unit root tests are not reported since there is no unit root detected in .99 confidence level.

Appendix 2. *F statistics (prob. values) of Granger causality relations (1435 observations, 03.01.02-14.09.08)*

Lags	Br, ER↛SI		Id, ER↛SI		So, ER↛SI		In, ER↛SI		Tr, ER↛SI	
1	1.1689	(.2798)	2.6816	(.1017)	1.2862	(.2569)	4.2988	(.0383)	.1969	(.6573)
2	.9514	(.3864)	1.6952	(.1839)	.6807	(.5064)	4.1428	(.0161)	.1360	(.8728)
3	2.3953	(.0667)	1.5684	(.1952)	.7684	(.5117)	2.9444	(.0319)	.1202	(.9483)
	Br, SI↛ER		Id, SI↛ER		So, SI↛ER		In, SI↛ER		Tr, SI↛ER	
1	52.4084	(.0000)	3.5471	(.0599)	3.6602	(.0559)	1.9432	(.1635)	3.4562	(.0632)
2	27.8021	(.0000)	2.9668	(.0518)	2.4270	(.0887)	.9674	(.3803)	1.9730	(.1394)
3	18.5727	(.0000)	3.5574	(.0139)	1.7503	(.1548)	.8301	(.4773)	1.3284	(.2635)

Appendix 3. *Sequential panel selection prob. values (Before MC, 15.09.08-30.12.09)*

Causality test		Fragile 5	Id, So, In, Tr	Br, Id, So, Tr	In, So, Tr	Id, So, Tr	So, Tr	Id, So
1 lag,	ER↛SI	.1445	.1159	.6395	.2580	.7955	.6365	.3270
2 lags,	ER↛SI	.2464	.1866	.7868	.2603	.4029	.7768	.7925
3 lags,	ER↛SI	.1277	.3942	.6053	.5591	.3361	.6997	.7731
1 lag,	SI↛ER	.0000	.0024	.0000	.0137	.0108	.0018	.0094
2 lags,	SI↛ER	.0000	.0309	.0000	.1736	.0910	.0120	.0168
3 lags,	SI↛ER	.0000	.0346	.0000	.5237	.3530	.0105	.0043

Note: Prob. values are calculated from statistics of Dumitrescu and Hurlin's Panel Granger causality test.

Appendix 4. *F statistics (prob. values) of Granger causality relations (265 observations, 15.09.08-30.12.09)*

Lags	Br, ER↛SI		Id, ER↛SI		So, ER↛SI		In, ER↛SI		Tr, ER↛SI	
1	6.2045	(.0134)	6.2658	(.0129)	3.6562	(.0570)	.4618	(.4974)	15.4264	(.0001)
2	4.4349	(.0128)	3.4308	(.0338)	1.8353	(.1616)	.5074	(.6027)	9.0014	(.0002)
3	3.8526	(.0101)	3.4525	(.0172)	3.3755	(.0190)	2.0870	(.1024)	6.9672	(.0002)
	Br, SI↛ER		Id, SI↛ER		So, SI↛ER		In, SI↛ER		Tr, SI↛ER	
1	1.5059	(.2209)	9.6373	(.0021)	2.3796	(.1241)	3.7792	(.0530)	1.5846	(.2092)
2	2.3283	(.0995)	3.9838	(.0198)	1.2097	(.3000)	1.8942	(.1525)	1.3238	(.2679)
3	2.6379	(.0501)	4.0488	(.0078)	1.2849	(.2800)	1.5053	(.2136)	.9358	(.4239)

Appendix 5. *Sequential panel selection prob. values (During MC, 15.09.08-30.12.09)*

Causality test		Fragile 5	Br, So, In, Tr	Br, Id, So, In	So, In, Tr	Id, So, In	Br, So, In	Id, In	So, In	In, Tr
1 lag,	ER↛SI	.0000	.0000	.0000	.0000	.0030	.0033	.0201	.2997	.0000
2 lags,	ER↛SI	.0000	.0000	.0024	.0000	.1180	.0328	.1807	.8199	.0000
3 lags,	ER↛SI	.0000	.0000	.0000	.0000	.0000	.0000	.0027	.0034	.0000
1 lag,	SI↛ER	.0000	.0687	.0000	.0573	.0000	.0616	.0000	.0410	.0986
2 lags,	SI↛ER	.0121	.1798	.0080	.4247	.0209	.1709	.0072	.4487	.4025
3 lags,	SI↛ER	.0038	.1606	.0011	.6257	.0080	.0949	.0026	.5100	.7175

Appendix 6. *F statistics (prob. values) of Granger causality relations (1338 observations, 04.01.09-02.03.16)*

Lags	Br, ER↛SI		Id, ER↛SI		So, ER↛SI		In, ER↛SI		Tr, ER↛SI	
1	2.1419	(.1436)	3.3929	(.0657)	6.3265	(.0120)	1.2450	(.2647)	16.2505	(.0001)
2	2.3548	(.0953)	1.6990	(.1833)	3.6048	(.0275)	.6601	(.5169)	7.5352	(.0006)
3	2.6562	(.0471)	3.4405	(.0163)	3.0253	(.0287)	1.8710	(.1326)	6.0409	(.0004)
	Br, SI↛ER		Id, SI↛ER		So, SI↛ER		In, SI↛ER		Tr, SI↛ER	
1	15.6510	(.0001)	3.9171	(.0480)	.9754	(.3235)	3.0163	(.0827)	1.0458	(.3067)
2	8.0964	(.0003)	7.4872	(.0006)	1.4612	(.2323)	2.8041	(.0609)	.8953	(.4087)
3	5.4913	(.0009)	4.7556	(.0027)	1.0380	(.3747)	1.7617	(.1526)	.6252	(.5988)

Appendix 7. *Sequential panel selection prob. values (After MC, 04.01.09-02.03.16)*

Causality test		Fragile 5	Br, Id, So, In	Id, So, In, Tr	Br, Id, In	Id, So, In	So, In, Tr	So, In	Id, In	Br, Id
1 lag,	ER↛SI	.0000	.0013	.0000	.1242	.0012	.0000	.0055	.1889	.0782
2 lags,	ER↛SI	.0000	.0316	.0000	.3251	.0885	.0000	.1108	.0890	.1482
3 lags,	ER↛SI	.0000	.0000	.0000	.0005	.0002	.0000	.0091	.0043	.0004
1 lag,	SI↛ER	.0000	.0000	.0810	.0000	.0458	.4078	.3213	.0139	.0000
2 lags,	SI↛ER	.0000	.0000	.0000	.0000	.0000	.2146	.1107	.0001	.0000
3 lags,	SI↛ER	.0000	.0000	.0108	.0000	.0013	.7670	.2887	.0001	.0000

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Modeling of stock indices with HMM-SV models

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Abstract. *The use of volatility models to conduct volatility forecasting is gaining momentum in empirical literature. The performance of volatility persistence, as indicated by the estimated parameter ϕ, in Stochastic Volatility (SV) model is typically high. Since future values in SV models are based on the estimation of the parameters, this may lead to poor volatility forecasts. Furthermore, this high persistence, according to some research scientists, is due to the structure changes (e.g. shift of volatility levels) in the volatility processes, which SV model cannot capture. Hidden Markov Models (HMMs) allow for periods with different volatility levels characterized by the hidden states. This work deals with the problem by bringing in the SV model based on Hidden Markov Models (HMMs), called HMM-SV model. Via hidden states, HMMs allow for periods with different volatility levels characterized by the hidden states. Within each state, SV model is applied to model conditional volatility. Empirical analysis using the proposed HMM-SV models does not only address the structure changes, but also, provides better volatility forecasts and establishes an efficient forecasting structure for volatility modeling.*

Keywords: forecasting, hidden Markov model, stochastic volatility, stock exchange.

JEL Classification: C13, C15, C18.

1. Introduction

A great deal of attention has been paid in finance, as well as in empirical literature for practically measuring risk to modeling and forecasting the volatility of stock market indices via stochastic volatility (SV) model. No doubt, forecasting the volatility of stock indices is an important aspect of many financial decisions. For instance, investment managers, option traders and the financial managerial bodies are all interested in volatility forecasts in order to either construct less risky portfolios or obtain higher profits (Panait and Slăvescu, 2012).

Various volatility models have been recommended to describe the statistical features of financial time series. Sources of the market volatility have been presented by Shiller (1993). The most common models among these are the SV models. Other volatility models include, but not limited to, the autoregressive conditional heteroskedasticity (ARCH) models by Engle (1982) and extended to generalized ARCH (GARCH) by Bollerslev et al. (1995). Their success lies in their ability to capture some stylized facts of financial time series, such as time-varying volatility and volatility clustering.

SV modeling has been applied to time varying volatility (Taylor, 1982, 1986). For example, SV models can be used to model the variance as an unobserved component that follows a particular stochastic process. In SV models, time-varying variance is not restricted to a fixed process. In SV models, it is usual to model volatility as a logarithmic first order autoregressive process. SV models represent a discrete time approach to the diffusion process used in the option pricing literature (Hull and White, 1987).

This model, though theoretically attractive, is empirically challenging as the unobserved volatility process enters the model in a non-linear fashion which leads to the likelihood function depending upon high-dimensional integrals.

In this paper, we propose a solution to the problem of of high volatility persistence in SV model by bringing in HMM to allow for different volatility states (periods with different volatility levels) in time series. Also, within each state, we allow SV model to model the conditional variance. The ensuing HMM-SV model indeed yields better volatility forecast compared to SV models for artificial data and real financial data, in-sample as well as out-of-sample.

2. Related literature

A number of varied approaches can be used to estimate the SV model. Two recent studies that compare the usefulness of the SV model with GARCH models in applied forecasting situations can be seen in So et al. (1999) and Yu (2002). So et al. (1999) ascertained that in modeling and forecasting foreign exchange rates, the SV model estimated as a state space model does not outperform GARCH model. Yu (2002), on his own part, used the SV model to forecast daily stock market volatility for New Zealand. By means of forecast accuracy tests, he discovered that the SV model surpasses performance of GARCH models. The mixed results from these two papers suggest the need for further research on the relative merits of SV models in applied forecasting situations. Although standard SV models improve the in-sample fit a lot compared with constant variance models, numerous studies find that SV models give unsatisfactory forecasting performances (Figlewski, 1997).

Xiong-Fei and Lai-Wan (2004) argued that the usually overstated volatility persistence in SV models may be the cause of poor forecasting performances. For Lamoureux (1990), this well-known high persistence may originate from the structure changes in the volatility processes, which SV models cannot capture. Lamoureux demonstrated that any shift in the structure of financial time series (e.g. the shift of unconditional variance) is likely to lead to misestimating of the SV parameters in such a way that they entail too high a volatility persistence.

Nelson (1991) and Glosten et al. (1993) have used the GARCH model to compute the difference, which has effects of negative and positive shocks on volatility. Kim et al. (1998), in recent times, applied Hidden Markov model (HMM), instead of ARCH, to handle the effects in economic data. The difference between the HMM and ARCH is the unconditional variance. If there are sequential changes in regime, some researchers advise that some more intuitive approaches need to be considered, and using different regimes may contribute to the return-generating process in the market.

Hamilton and Susmel (1994) apprehended that the long run variance could obey regime shift; they suggested an ARCH process. The effect will vanish if they use weekly data, because sparse time point makes the dependence weaker. It is rational to examine the price of stock market by using HMM. In using HMM, Chu et al. (1996) chose a two-stage process to represent the return behavior in the stock market. They first considered the return behavior in stock market as a Markov process. Then, the different return regimes derived from the first stage were utilized to estimate the volatility. Lastly, they found that the negative deviations in returns can have larger increase in volatility than the positive one. Accordingly, they think the return and volatility are not linearly but asymmetrically.

HMMs have been applied for at least three decades in signal-processing applications, especially in automatic speech recognition. Now, this theory and application has expanded to other fields. A HMM (see Rabiner, 1989) includes two stochastic processes of which one is an underlying stochastic process that is not observable and, the other process is the observation sequence.

2. HMM-SV model

2.1. Hidden Markov model

Although originally introduced and studied in 1957 and early 1970's, the contemporary reputation of statistical methods of HMM is not in question. A HMM is a bivariate discrete-time process $\{X_k, Y_k\}_{k\geq 0}$ where $\{X_k\}_{k\geq 0}$ is an homogeneous Markov chain which is not directly observed but can only be observed through $\{Y_k\}_{k\geq 0}$ that produce the sequence of observation. $\{Y_k\}_{k\geq 0}$ is a sequence of independent random variables such that the conditional distribution of Y_k only depends on X_k .The underlying Markov chain $\{X_k\}_{k\geq 0}$ is called the state.

HMM are defined through a functional representation known as state space model. The state space model (Doucet and Johansen, 2009) of a HMM is represented by the following two equations:

(State equation) $$x_t = f(x_{t-1}) + w_t \quad (1)$$

(Observation equation) $$y_t = g(x_t) + v_t \quad (2)$$

where f and g are either linear or nonlinear functions, while w_t and v_t are error term. Models represented by (1) - (2) are referred to as state space model and this comprises a class of HMMs with non-linear Gaussian state-space model, for instance, stochastic volatility (SV) model.

2.2. Stochastic volatility model

Stochastic volatility models (Shephard (1996)) are a variant of the general state space approach presented here. SV model belong to class of Hidden Markov model with non-linear Gaussian state-space model and they take the volatility of the data into account. The SV model due to Taylor (1982) can be expressed as an autoregressive (AR) process:

$$x_t = \phi x_{t-1} + w_t \quad (3)$$

$$r_t = \beta \exp\left(\frac{x_t}{2}\right) v_t \quad (4)$$

where $w_t \sim N(0,\tau), x_0 \sim N(\mu_0, \sigma_0^2), v_t \sim N(0,1)$, $\{r_t\}_{t\geq 0}$ is the log-returns on day t, ,we call β the constant scaling factor, so that $\{x_t\}_{t\geq 0}$ represents the log of volatility of the data, $\log(\sigma_t^2)$ where $\sigma_t^2 = \mathrm{var}(r_t)$ .In order to ensure stationarity of r_t , it is assume that $|\phi| < 1$. By taking the logarithm of the squared returns of equation (4), results in a linear equation (5),

$$y_t = \alpha + x_t + z_t \quad (5)$$

Equations (3) and (5) form the version of the SV model which can be modified in many ways; together they form a linear, non-Gaussian, state-space model for which (5) is the observation equation and (9) is the state equation.

2.2.1. Stochastic volatility with heavy – tailed distribution

The standard form of the SV model is given in equations (3) and (4). In equation (4) v_t follows a normal distribution. Various authors have argued that real data may have heavier tails than can be captured by the standard SV model.

An extension of the linearized version of the SV model (see equation (3) and (5), wherein it is assumed that the observational noise process, z_t is a student-t distribution is considered. The model, first presented in Shumway and Stoffer (2006), retains the state equation for the volatility as:

$$x_t = \phi x_{t-1} + w_t$$

but the proposed student-t distribution with degrees of freedom, v, for the observation error term, z_t, effects a change in the observation equation:

$$y_t = \alpha + x_t + z_t \qquad z_t \sim t_v , t = 1, \cdots, n, \tag{6}$$

For the parameter estimates of the proposed SV model with student-t, the likelihood functions have been maximized by using the Sequential Monte Carlo Expectation Maximization algorithm (Nkemnole et al., 2015) in the MATLAB optimization routines.

2.3. HMM with stochastic volatility model

Our model is a blend of the original SV model and HMMs. To start with, we use HMMs to divide the entire time series into regimes with different volatility levels. The return of the time series is assumed to be modeled by a mixture of probability densities and each density function corresponds to a hidden state with its mean and variance. In the HMMs, SMCEM algorithm is employed in finding the state sequence in the time series. Subsequently we get the subsets of original time series corresponding to different states (volatility levels). Afterwards, within each regimes, we allow SV model with different parameter sets to model the conditional variance as:

$$x_t = \phi^i x_{t-1} + w_t , \; w_t \sim N(0, \tau)$$

$$y_t = \alpha^i + x_t + z_t$$

where i denotes the state of the time series at time t. ϕ^i, τ^i, and α^i are the parameter sets of the SV model related to state i.

Then, for the volatility forecast σ_t^2 , $(\{x_t\}_{t\geq 0}$ represents the log of volatility of the data, $\log(\sigma_t^2)$ where $\sigma_t^2 = \mathrm{var}(r_t))$ of the global model, there is need for us to predict the state i of time series at time $t+1$ (next state).

After the next state i at time $t+1$ has been determined, we choose the corresponding SV model with parameter sets ϕ^i, τ^i, and α^i to make volatility forecast.

Criteria for assessing the accuracy of the models to predict which includes MAE, MSE, MAPE are listed on pages 13 and 14. SPSS and MATLAB were used to analyse the data to produce figures and results of the models.

2.4. Sequential Monte Carlo Expectation Maximization (SMCEM) Algorithm Analysis

Estimation procedures

The entire estimation procedure consists of three main steps: filtering, smoothing, and estimation. With the output of filtering and smoothing step an approximate expected likelihood is calculated. $\{\phi, \tau, \alpha\}$ are estimated to model the changing volatility.

2.4.1. Filtering step

The algorithm for the filtering and smoothing steps shows an extension of Godsill et al. (2004) and Kim and Stoffer (2008). From here M samples from $f(x_t, | Y_t)$ for each t were obtained.

i) Generate $f_0^{(i)} \sim N(\mu_0, \sigma_0^2)$

For $t = 1, \cdots, n$

ii) Generate a random number $w_t^{(i)} \sim N(0, \tau), \quad j = 1, \cdots, M$

iii) Compute $p_t^{(i)} = \phi^{\,i} f_{t-1}^{(i)} + w_t^{(i)}$

a. Compute $w_t^{(i)} = p(y_t \mid p_t^{(i)},) \propto e^{-\frac{x_t}{2}} \left(1 + \dfrac{y_t^2 e^{-x_t}}{v-2}\right)^{-\frac{v+1}{2}}$

b. Generate $f_t^{(i)}$ by resampling with weights, $w_t^{(j)}$.

2.4.2. Smoothing step

In the smoothing step, particle smoothers that are needed to get the expected likelihood in the expectation step of the EM algorithm were gotten:

Suppose that equally weighted particles $\{f_t^{(i)}\}, i = 1, \cdots, M$ from $f(x_t, | Y_t)$ are available for $t = 1, \cdots, n$ from the filtering step.

i) Choose $[s_n^{(i)}] = [f_n^{(j)}]$ with probability $\dfrac{1}{M}$.

For $n-1$ to 0

Calculate

$$w_{t|t+1}^{(i)} \propto f(s_{t+1}^{(i)} \mid f_t^{(j)}) \propto \exp\left(-\frac{(s_{t+1}^{(i)} - \phi\, f_t^{(j)})^2}{2\tau}\right) \frac{1}{\sqrt{\pi(v-2)}} \frac{\Gamma\left[\dfrac{v+1}{2}\right]}{\Gamma \dfrac{v}{2}} \exp^{-\frac{\tilde{s}_{t+1}}{2}} \left(1 + \frac{y_t^2 e^{-\tilde{s}_{t+1}^{(j)}}}{v-2}\right)^{-\frac{v+1}{2}}$$

for each j

ii) Choose $[s_t^{(i)}] = [f_t^{(j)}]$ with probability $w_{t|t+1}^{j}$.

$(s_{0:n}^{(i)}) = \{(s_0^{(i)}, \cdots, s_n^{(i)})\}$ is the random sample from $f(x_0, \cdots, x_n \mid Y_n)$

iii) Repeat i-iii, for $i = 1, \cdots, M$ and calculate

$$\hat{x}_t^n = \frac{\sum_{i=1}^{M} s_t^{(i)}}{M}, \hat{p}_t^n = \frac{\sum_{i=1}^{M} (s_t^{(i)} - \hat{x}_t^n)^2}{M-1}, \hat{p}_{t,t-1}^n = \frac{\sum_{i=1}^{M} (s_t^{(i)} - \hat{x}_t^n)(s_{t-1}^{(i)} - \hat{x}_{t-1}^n)}{M},$$

$$E\left[1 + \frac{y_t^2 e^{x_t}}{v-2}\right]^{-\frac{v+1}{2}} = \frac{n(v-2)}{(v+1)\sum_{t=1}^{n} y_t^2 e^{-y_t + v_t}\left[1 + \frac{y_t^2 e^{x_t}}{v-2}\right]^{-1}}$$

2.4.3. Estimation step

This step consists of obtaining parameter estimates by setting the derivative of the expected likelihood, of the complete data $\{x_0, \cdots, x_n, y_1, \cdots, y_n\}$ given $\{x_0, \cdots, x_n\}$, with respect to each parameter to zero and solving for $\hat{\phi}$, $\hat{\tau}$, and $\hat{\alpha}$.

The complete likelihood of $\{x_0, x_1, \cdots, x_n, y_1, \cdots, y_n\}$ is

$$\log f(X,Y) = \log \frac{1}{\sqrt{2\pi}} \frac{1}{\sigma_0} + \log \exp\left(-\frac{(x_0 - \mu_0)^2}{2\sigma_0^2}\right) + \log \prod_{t=1}^{n} \frac{1}{\sqrt{2\pi\tau}} \exp\left(\frac{-(x_t - \phi x_{t-1})^2}{2\tau}\right)$$
$$+ \log \prod_{t=1}^{n} \frac{1}{\sqrt{\pi(v-2)}} \frac{\Gamma\left(\frac{v+1}{2}\right)}{\Gamma\left(\frac{v}{2}\right)} e^{-\frac{(y_t - \alpha - v_t)}{2}} \left(1 + \frac{y_t^2 e^{-(y_t - \alpha - v_t}}{v-2}\right)^{-\frac{v+1}{2}} \tag{7}$$

By the above method, we got the following estimates

$$\hat{\phi} = \frac{S_{10}}{S_{00}}, \qquad \hat{\tau} = \frac{1}{n}\left[S_{11} - \frac{S_{10}^2}{S_{00}}\right] \tag{8}$$

$$\hat{\alpha} = \log \frac{n(v-2)}{(v+1)\sum_{t=1}^{n} y_t^2 e^{-y_t + v_t}\left[1 + \frac{y_t^2 e^{x_t}}{v-2}\right]^{-1}} \tag{9}$$

$$\hat{\alpha} = \left[n \sum_{t=1}^{n} (y_t - v_t)^{v-1}\right]^{\frac{1}{v-1}} \tag{10}$$

where

$$S_{00} = \sum_{t=1}^{n} (x_{t-1}^{n})^2 + p_{t-1}^{n} \ ,$$

$$S_{11} = \sum_{t=1}^{n} (x_{t}^{n})^2 - p_{t}^{n} \ ,$$

$$S_{10} = \sum_{t=1}^{n} x_{t}^{n} x_{t-1}^{n} + p_{t,t-1}^{n}$$

3. Volatility forecast evaluation and comparison

3.1. Data and methodology

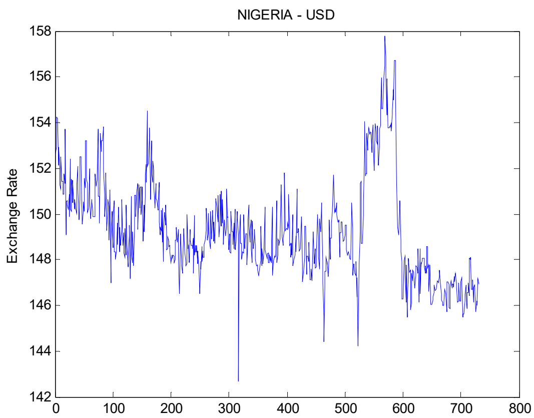
Both simulated data sets and real financial data sets were utilized in the volatility forecast experiments. Also, the in-sample and the out-of-sample forecasting performances were considered. To start with, we used simulated data set to verify if the proposed model solves the problems of excessive persistence in SV model; we generated more than 11000 observations and discarded the initial 10000 samples.

Then, we employed the use of real financial data sets in our experiments to establish the viability of the proposed model. The real financial data sets consist of the daily exchange rate series of the Nigerian Naira, Ghana Cedi, British Pound and Euro, all against the US Dollars (from January 2, 2010 to December 31, 2014).

3.1.1. Jarque-Bera statistics

Jarque-Bera statistics is applied to examine the non-normality of the exchange rate series.

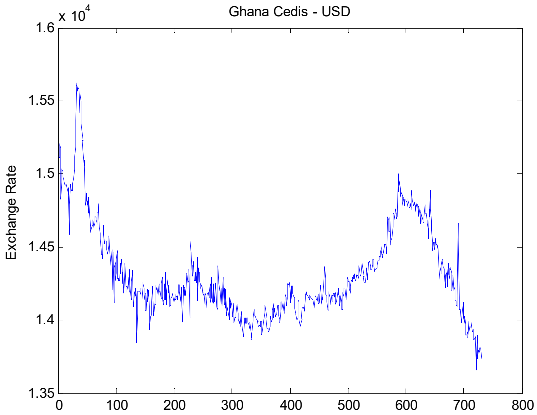
Figure 1. *Naira/dollar exchange rate index summary statistics*



Statistics	Naira/Dollar rate
Mean	36.28380
Std. Dev.	64.67169
Skewness	1.220108
Kurtosis	3.489442
Jarque-Bera	194.4878
Probability	0.000000

Figure 1 shows a positive skewness, 1.220108, and a high positive kurtosis, 3.489442. With reference to the Jarque-Bera statistics, Naira/dollar exchange rate index is non-normal at the confidence interval of 99%, since probability is 0.000000, which is less than 0.01. Consequently, there is need to convert the Naira/dollar exchange rate index series into the return series.

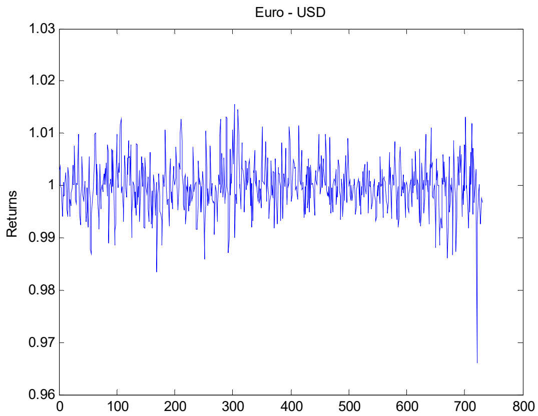
Figure 2. *Cedi/dollar exchange rate index summary statistics*



Statistics	Cedi/Dollar
Mean	0.345512
Std. Dev.	0.615862
Skewness	1.220410
Kurtosis	3.490659
Jarque-Bera	194.5413
Probability	0.000000

Figure 2 shows a positive skewness, 1.220410 as well as a positive kurtosis, 3.490659. As indicated by Jarque-Bera statistics, the Cedi/dollar exchange rate index is non-normal at the confidence interval of 99%, since probability is 0.0000, which is less than 0.01. So the need also arises to convert the Cedi/dollar exchange rate index series into the return series.

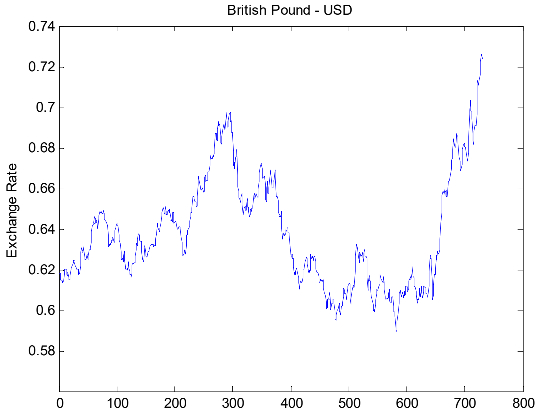
Figure 3. *Euro/dollar exchange rate index summary statistics*



Statistics	Euro/Dollar
Mean	0.180556
Std. Dev.	0.322022
Skewness	1.224487
Kurtosis	3.506883
Jarque-Bera	195.2801
Probability	0.000000

Figure 3 shows a positive skewness, 1.224487, and a positive kurtosis, 3.506883. As indicated by the Jarque-Bera statistics, Euro/dollar exchange rate index is non-normal at the confidence interval of 99%, since probability is 0.0000 which is less than 0.01; hence the need to convert the Euro/dollar exchange rate index series into the return series.

Figure 4. *Pound/dollar exchange rate index summary statistics*



Statistics	Pound/Dollar
Mean	0.152918
Std. Dev.	0.272588
Skewness	1.220855
Kurtosis	2.492430
Jarque-Bera	194.6209
Probability	0.000000

Figure 4 shows a positive skewness, 1.220855, and a positive kurtosis, 2.492430. As indicated by the Jarque-Bera statistics, Euro/dollar exchange rate index is non-normal at the confidence interval of 99%, since probability is 0.0000 which is less than 0.01; hence the need to convert the Euro/dollar exchange rate index series into the return series.

3.1.2. Transformation of the exchange rate index series of the Nigerian Naira, Ghana Cedi, British Pound and Euro

On the whole, the movements of the stock indices series are non-stationary, and therefore, not suitable for the study purpose. The stock indices series are transformed into their returns so that we get stationary series. The transformation is:

$$r_t = 100 \ln \frac{p_t}{p_{t-1}} \tag{11}$$

where r_t , p_t is the exchange rate at time index t, p_{t-1} the exchange rate just prior to the time t.

3.1.3. Augmented Dickey-Fuller (ADF) Test and Phillips-Perron (PP) Test on Naira/Dollar, Cedi/Dollar, Pound/Dollar and Euro/Dollar exchange rates index Returns Series

Both the ADF and PP tests are used to obtain verification regarding whether Naira/Dollar, Cedi/Dollar, Pound/Dollar and Euro/Dollar exchange rates return series is stationary or not.

Table 1. *ADF test on Naira/Dollar, Cedi/Dollar, Pound/Dollar and Euro/Dollar exchange rates returns*

			t-Statistic		
		Naira/Dollar index	Cedi/Dollar index	Pound/Dollar index	Euro/Dollar index
ADF test statistic		-43.12567	-45.56412	-47.34789	-46.78622
	1% level	-3.331562	-3.33253	-3.331562	-3.33253
	5% level	-2.751341	-2.751341	-2.751341	-2.751341
Test critical values	10% level	-2.456200	-2.456200	-2.456200	-2.456200
Prob.		0.0001	0.0001	0.0001	0.0001

Table 1 shows that the values of ADF test statistic, -43.12567, is less than its test critical value, -2.751341, at 5%, level of significance which implies that the Naira/Dollar exchange rates return series is stationary. The result of ADF test also demonstrates that the Cedi/Dollar, Pound/Dollar and Euro/Dollar return series are stationary, as the values of ADF test statistic is less than its test critical value.

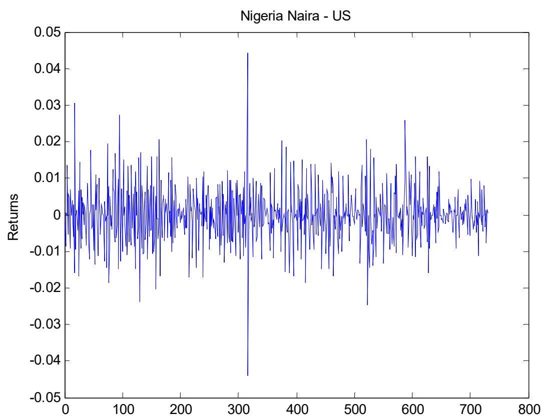
Table 2. *PP test on Naira/Dollar, Cedi/Dollar, Pound/Dollar and Euro/Dollar exchange rates returns*

			t-Statistic		
		Naira/Dollar index	Cedi/Dollar index	Pound/Dollar index	Euro/Dollar index
PP test statistic		-43.32035	-45.80403	-47.34789	-46.78622
	1% level	-3.331562	-3.33253	-3.331562	-3.33253
	5% level	-2.751341	-2.751341	-2.751341	-2.751341
Test critical values	10% level	-2.456200	-2.456200	-2.456200	-2.456200
Prob.		0.0001	0.0001	0.0001	0.0001

Table 2 illustrates the results of the PP test and proves that the Naira/Dollar index returns series is stationary, as the values of PP test statistic, -43.32035, is less than its test critical value, -2.751341, at the level of significance of 5%. The outcome of the PP test equally shows that the Cedi/Dollar, Pound/Dollar and Euro/Dollar exchange rates returns series are stationary, since the values of PP test statistic is less than its test critical value.

3.2. Summary Statistics of the Naira/Dollar, Cedi/Dollar, Pound/Dollar and Euro/Dollar exchange rates returns

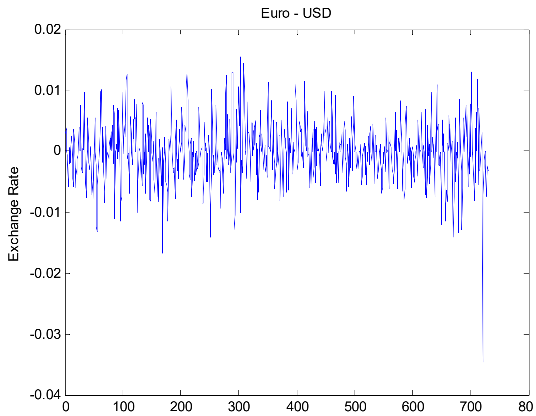
Figure 5. *Naira/dollar exchange rate index returns summary statistics*



Statistics	Naira/Dollar rate
Mean	-0.001385
Std. Dev.	0.708650
Skewness	-0.074139
Kurtosis	8.805879
Jarque-Bera	735.0376
Probability	0.000000

Figure 5 reveals a negative skewness, -0.074139, and a positive kurtosis, 8.805879. As indicated by the Jarque-Bera statistics, the Naira/dollar exchange rate index returns series is non-normal at 95% confidence level, since probability is 0.0000, which is less than 0.05.

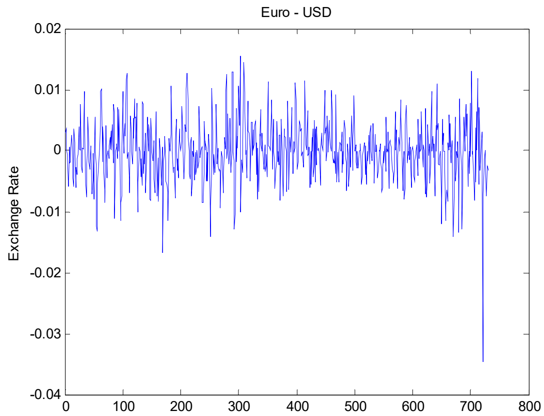
Figure 6. *Cedi/dollar exchange rate index returns summary statistics*



Statistics	Cedi/Dollar
Mean	0.006258
Std. Dev.	0.536507
Skewness	-0.096923
Kurtosis	13.11769
Jarque-Bera	2312.255
Probability	0.000000

Figure 6 also reveals a negative skewness, -0.096923, and a positive kurtosis, 13.11769. Based on the Jarque-Bera statistics, the Cedi/dollar exchange rate index returns series is non-normal at 5% level of significance, because the probability, 0.0000, is less than 0.05.

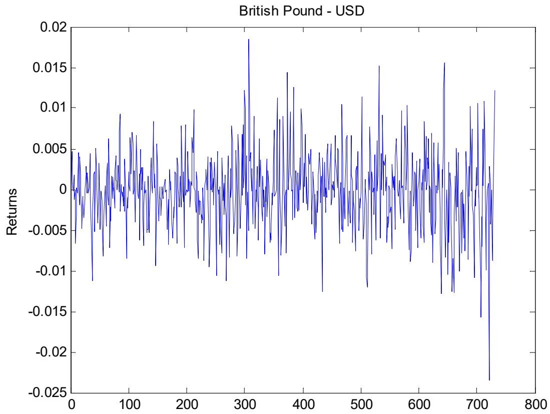
Figure 7. *Euro/dollar exchange rate index returns summary statistics*



Statistics	Euro/Dollar
Mean	0.001676
Std. Dev.	0.488392
Skewness	-0.434943
Kurtosis	7.993814
Jarque-Bera	559.9343
Probability	0.000000

Figure 7 also reveals a negative skewness, -0.434943, and a positive kurtosis, 7.993814. Based on the Jarque-Bera statistics, the Euro/dollar exchange rate index returns series is non-normal at 5% level of significance, because the probability, 0.0000, is less than 0.05.

Figure 8. *Pound/dollar exchange rate index summary statistics*



Statistics	Pound/Dollar
Mean	0.020803
Std. Dev.	0.506541
Skewness	-0.022958
Kurtosis	4.262290
Jarque-Bera	34.76827
Probability	0.000000

Figure 8 also reveals a negative skewness, -0.022958, and a positive kurtosis, 4.262290. Based on the Jarque-Bera statistics, the Pound/dollar exchange rate index returns series is non-normal at 5% level of significance, because the probability, 0.0000, is less than 0.05.

4. Empirical results and evaluation

As the actual volatility at time t is not observable, there is need for some measures of volatility to assess the forecasting performance. In this paper we apply the standard approach suggested by Pagan and Schwert, (1990). A proxy for the actual volatility $\hat{\sigma}_t^2$ is given by

$$\hat{\sigma}_t^2 = (r_t - \bar{r})^2 \qquad (12)$$

where $\bar{r}$ is the mean of the time series over the sample period. The statistical performance measures Mean Squared Error (MSE), Mean Absolute Error (MAE), and Mean Absolute Percentage Error (MAPE), are applied to select the best performing model both in the in-sample and the out-of-sample data set independently in this study:

$$\text{MSE} = \frac{\sum_{t=1}^{n} (\hat{\sigma}_t^2 - \sigma_t^2)^2}{n} \qquad (13)$$

$$\text{MAE} = \frac{1}{n}\sum_{t=1}^{n} |\hat{\sigma}_t^2 - \sigma_t^2| \qquad (14)$$

$$\text{MAPE} = \frac{\sum_{t=1}^{n} |\hat{\sigma}_t^2 - \sigma_t^2| / \sigma_t^2}{n} \qquad (15)$$

where $\hat{\sigma}^2$ is the forecasted variance and σ^2 the actual variance time period t and n is the number of forecasts.

4.1. Statistical performance

The evaluation results are shown in Tables 3 and 4 below. A two-state HMM-SV model was used in our experiments. In both tables, t-v represents true value, HSV stands for HMM-SV model and SV stands for SV model. s_1 and s_2 designate the two states with low and high volatility levels, respectively. MSE_1, MAE_1 and $MAPE_1$ are the in-sample MSE, MAE and MAPE while MSE_2 MAE_2 and $MAPE_2$ are the out-of-sample MSE, MAE and MAPE.

Table 3. *Statistical performance results for the simulated data set and the true parameter sets compared with those obtained from HMM-SV and SV models*

Models	ϕ	τ	α	MSE_1	MAE_1	$MAPE_1$	MSE_2	MAE_2	$MAPE_2$
t-v S_1 S_2	0.41 0.62	0.7417 1.1445	2.0461 2.0854						
SV	0.72	0.8416	2.2761	0.0402	0.1001	0.2325	0.1010	0.1776	0.2641
HMMSV S_1	0.57	1.2454	2.0445						
S_2	0.75	1.3534	2.1034	0.0321	0.0623	0.1224	0.0161	0.0562	0.1684

Table 4. *Statistical performance results for the stock return data sets and the parameter sets obtained from HMM-SV and SV models*

Stock Exchange	Models	ϕ	τ	α	MSE_1	MAE_1	$MAPE_1$	MSE_2	MAE_2	$MAPE_2$
Naira/Dollar	SV	0.8485	4.0273	4.3205	0.3401	0.3211	0.2334	0.2401	0.2211	0.3334
	HMMSV S_1	0.7875	3.4771	6.9980						
	S_2	0.0685	1.2341	3.8746	0.1021	0.1743	0.2534	0.0021	0.0743	0.2424
Cedi/Dollar	SV	0.9869	4.1936	5.3824	0.1370	0.1716	0.2265	0.1360	0.1706	0.2255
	HMMSV S_1	0.8127	4.2368	4.7144						
	S_2	0.0712	3.1134	2.1345	0.0210	0.0595	0.1473	0.0110	0.0495	0.1464
Pound/Dollar	SV	0.9770	2.1311	0.7654	0.1783	0.0928	0.1922	0.1773	0.0718	0.1812
	HMMSV S_1	0.9050	1.3136	0.9883						
	S_2	0.0805	1.2136	0.8564	0.0516	0.0783	0.0452	0.0416	0.0783	0.1112
Euro/Dollar	SV	0.9754	2.3108	0.7627	0.1706	0.2601	0.5784	0.0502	0.1402	0.5138
	HMMSV S_1	0.8871	1.4605	1.2590						
	S_2	0.0762	1.3605	1.1590	0.0956	0.1943	0.3578	0.0144	0.0943	0.4548

The above results are indicative that that HMM-SV model capture the volatility structure changes processes between two different volatility regimes with different volatility persistence ϕ . Nonetheless, the SV model cannot capture such volatility structure changes and always show very high volatility persistence. Consequently, HMM-SV model offers better volatility forecasts as the MSE (MAE) of HMM-SV model is considerably smaller than the SV models most of the time.

5. Conclusion

The volatility persistence of widely-used SV model is usually too high leading to poor volatility forecasts. The root for this excessive persistence seems to be the structure changes (e.g. shift of volatility levels) in the volatility processes, which the SV model cannot capture.

As we developed our HMM-SV model to allow for both different volatility states in time series and state specific SV model within each state, the empirical results for both artificial data and real financial data not only takes care of the structure changes (hence giving better volatility forecasts), but also helps to establish an proficient forecasting structure for volatility models.

Accordingly, the results for both in-sample and out-of-sample evaluation forecasting performance confirm that our model outperforms widely-used SV model, Hence, the results suggest that it is promising to deepen the study of volatility persistence, the hidden regime-switching mechanisms inclusive. On long run, this will improve volatility forecasts in future research.

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The impact of private sector credit on income inequalities in European Union (15 member states)

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Abstract. *This paper aims to provide a comprehensive analysis on the income inequalities recorded in the EU-15 in the 1995-2014 period and to estimate the impact of private sector credit on income disparities. In order to estimate the impact, I used the panel data technique with 15 cross-sections for the first 15 Member States of the European Union, applying generalized error correction model.*

Keywords: credit, error correction model, European Union, income inequality, panel.

JEL Classification: C33, D63, E51.

1. Introduction

The financial crisis has questioned the financial sector's role in the development and growth process and its impact on income distribution. National governments considered that the banking system is too big to fail and, finally, guaranteed for the banking sector debt with government bonds to save it, subsequently transforming private debt into public debt. Indeed, the world could not pass through this stage without as policymakers choosing a compromise between the financial and the social one. Most of the research papers developed in this area have demonstrated that national governments opted for a compromise that has deepened the social imbalances in the world. The theory says that an exaggerated level of lending has the ability to increase the economy's vulnerability to shocks and to cause imbalances on the distribution of credit, which may affect the income gap, as individuals with low income will not benefit from the same opportunities as those of individuals with high income.

In 2014, the private sector credit - expressed as a share of gross domestic product (GDP) - from the first 15 European Union member states (EU-15) increased by 58.22% compared to the level recorded in 1995, while Gini index (relevant indicator for income inequality) fell by 0.32% on the same timeframe. Although, on average, income inequality is considerably lower in 2014 than it level from 1995, this indicator had an extremely heterogeneous evolution in the EU-15 Member States, its evolution being influenced by other factors, which were integrated into the research.

The trend of income inequality is considered a result of the indicators evolution related to economic growth, social, education and health spending, financialisation, corruption and national institutional features, unemployment, investment, tax burden, economic openness, technological progress, price level, as well as energy capture by human activity and information processing.

The motivation for choosing this theme lies in the academic interest for income inequality area and its constant presence in the agenda of economic debates, respectively the social discontent against the capitalist system reforms.

The main goal of the paper is to estimate the impact of private sector lending on income inequalities, it following to be achieved by reaching three specific objectives:
- identifying the impact of private sector lending and other relevant factors that have the ability to impact the income inequality;
- testing the Gauss-Markov theorem hypotheses;
- performing the economic analysis of the obtained results.

2. Literature review

The results of researches whose goal consisted in estimating the impact of financial development on income inequality, are quite ambiguous and often contradictory. Galor and Moav (2004) proved that credit growth leads to a decrease in income inequalities level, given the fact that credit growth give the opportunity to the lower class to borrow and start new projects, which can reduce the income gap. On the other hand, Rajan and Zingales (2003) showed that in countries with weak institutions, there is a positive relationship between financial development and income inequality, considering that individuals with high incomes have a privileged position in terms of access to finance. According to Law et al. (2014), financial development could represent a driver force of income inequalities reduction, in the case of prevailing strong institutions, which allows individuals of the lower-class to invest in human capital.

Clarke et al. (2006) and Beck et al. (2007) identified a positive relationship between financial development and the gap between incomes, while Jauch and Watzka (2012) found a positive impact of credit growth on income inequality, using a panel data with fixed effects for 138 countries.

Jaumotte et al. (2013) analysed the concept of income inequality as a consequence of financial and trade globalization. The analysis included private lending as a share of GDP on the control variables list, the corresponding coefficient for this variable being positive and statistically significant. Dabla-Norris et al. (2015) analysed the financial development and its overwhelming influence on increasing income disparities in the 1980-2012 period in 97 states and have reached similar conclusions.

According to Piketty (2014), financial expansion can lead to an increase in income inequality because of its statistical association with wealth increase, the last one being distributed more unevenly than the incomes. Also, Li and Yu (2014) estimated the impact of lending as a share of GDP on income inequality (expressed in Gini indicator), identifying a significant and positive coefficient of it. Moreover, Denk and Cournède (2015) analysed a sample of 33 OECD countries and proved that the existence of a high degree of financialisation coincides with a situation where income disparities prevailing the national state. According to them, the expansion of financial creates the premises of income inequalities increase, given that economic entities with high profits can receive larger loans than the ones of individuals or economic entities with low incomes, leading to a higher return on investment for high profits economic operators, which leads to wage increases. Furthermore, de Haan and Sturm (2016) identified a positive impact of financial development, financial liberalization and banking crises on income inequality, the effect being conditioned by the features of political institutions.

The selection of the private sector credit as a relevant variable to capture the impact of finances on income inequality came from the hypothesis demonstrated by Naceur and Zhang (2016), according to which its effect is manifested mainly through the banking sector, but not through the stock market capitalization.

Testing the relationship between credit and income inequality has raised new questions concerning the manifestation of the endogeneity between inequality and lending. Most of the existing research in this field, such as those of Rajan (2010) or Kumhof (2015) showed that loan growth may be a consequence of the growing gap between incomes, taking into consideration the fact that individuals who get low incomes start borrowing to avoid consumerist disparities against the upper class. Also, Gu and Huang (2014) confirmed this hypothesis. Van Treeck (2014) found that the financial crisis in the United States (2007-2008) was caused by the increase of the income gap, following the same economic foundation mentioned above. On the other hand, the literature review provides conflicting views of the authors too. Atkinson and Morelli (2011), respectively Bordo and Meissner (2012) did not identify any significant impact of income inequality on the credit cycle. However, the literature is not conclusive on the assumption of this hypothesis. Most of the papers from this field examined the relationship between financial liberalization and income inequality, as well as that of Claessens and Perotti (2007) saying that extractive institutions continue to favor a rent-seeking behavior.

3. Methodology

The main objective of the paper is to estimate the impact of private sector lending on income inequalities in the EU-15. In this context, I used the quantitative approach, deductive method and certain specific econometric techniques.

In order to investigate the stated objective, I estimated the impact of private sector lending growth and other control variables (listed in Annex 1) on income inequalities – in Eviews 9.0 software – using panel technique and generalized error correction model, implicitly the Generalized Least Squares method (the estimation being weighted with the Cross-Section SUR option).

Data series were extracted on yearly basis, covering the 1995-2014 period for the first 15 Member States of the European Union. I chose this representation of the panel data, because these countries were member states of the European Union on the entire period of analysis, thereby, the research not being affected by the adhesion of other countries to the union. Statistical database used did not cover the entire time horizon analysed for the Gini coefficient and lending to the private sector (expressed as a percentage of GDP), which made it necessary running the linear interpolation tool of Eviews, in order to estimate the missing data from the analysis (Annex 2 and Annex 3).

Following the verification of the stationarity and of the residuals, it has resulted the use of error correction model as the most accurate method for estimation. In order to confirm the econometric method used, I checked the stationarity test using the Summary window, a technique that provides results for each of the 5 tests applied for unit root[(1)] assumption and Hadri, in exceptional cases. However, the impact analysis of the exogenous variables on a single endogenous variables and the non-stationary nature of the initial variables (becoming stationary after performing the first difference) indicated selecting error correction model as the most appropriate estimation method, eliminating the vector error correction model from the possible alternatives. The selected method requires adding the error term lagged by 1 time-series frequency (resulting from the estimated model using the initial variables), its specific coefficient having the role to estimate the speed of adjustment. Error correction model can be applied only if the error term is stationary, a situation that indicates a long-term relationship between regressors and regressand.

Even if the panel is considered a more effective technique because it increases the number of degrees of freedom and the estimation efficiency, it can also bring new challenges, regarding the autocorrelation between cross-sections. In this respect, I used Cross-Section SUR option to correct, ex-ante, the possible inconveniences of the model.

After including the interpolated data, the first differences of the variables and the appropriate lag in the model, it has resulted 270 observations of the 300 initial observations (15 cross-sections). Regarding the selection of the appropriate lag, I used the Schwarz information criterion for each of the first four lags (Schwarz has the smallest value for lag 1, concluding that choosing lag 1 is appropriate).

Identifying the optimal lag, the differentiation level, and the estimation method, has made it possible the estimation of the following model:

$$D(Gini) = \alpha_0 + \alpha_1 D(Gini_{t-1}) + \alpha_2 D(creditp_{t-1}) + \alpha_3 D(he_{t-1}) +$$
$$+ \alpha_4 D(ed_{t-1}) + \alpha_5 D(un_{t-1}) + \alpha_6 D(tax_{t-1}) + \alpha_7 D(CPI) +$$
$$+ \alpha_8 D(openness) + \alpha_9 D(gfcf) + \alpha_{10}(UT_{t-1}) + \varepsilon_t \qquad (1)$$

where:
$D(Gini)$ and $D(Gini_{t-1})$ catch the first difference of Gini coefficient and the first difference of its auto-regressive term, while $D(creditp_{t-1})$, $D(he_{t-1})$, $D(ed_{t-1})$, $D(un_{t-1})$, $D(tax_{t-1})$ represents the first difference of the following variables lagged by one year: private sector credit as a share of GDP, government health expenditures as a share of GDP, government education expenditures as a share of GDP, unemployment rate, respectively total tax burden as a share of GDP (including imputed social security contributions). On the other hand, $D(CPI)$, $D(openness)$and $D(gfcf)$ correspond to the dynamic of the corruption perception index, trade openness and gross fixed capital formation. Finally, the last component of the model is UT_{t-1} – the error term laged by one year – respectively ε_t, this series being estimated in order to indicate the residuals distribution.

After estimating the model, I checked the assumptions of the Gauss-Markov theorem to confirm or reject that the estimators are best linear unbiased estimators. Thereby, I used the verification of the following hypotheses by the methods mentioned-below at a significance threshold of 5%:

- linearity of the model;

- the confirmation of the significance of the parameters and non-zero dispersion for each regressor (T-test and standard error);
- the existence of a number of observations greater than the number of coefficients;
- the absence of the multicolinearity, the test being performed by using Klein criterion - the absence of the multicolinearity is confirmed when the correlation coefficient between two exogenous variables is less than the coefficient of determination;
- the absence of correlation between regressors and residuals (Pearson correlation);
- the confirmation of the errors features, according to which their average is null and the residuals are normally distributed (Jarque-Bera test and histogram of the residuals);
- the confirmation of the errors features, according to which their variance is constant (the existence of the homoskedasticity – White test);
- the absence of cross-sections dependence (Breusch-Pagan and Pesaran test);
- the confirmation of the hypothesis, according to which conditional average of the errors is null (Residuals plot).

4. Results and interpretations

This section examines the impact of private sector credit on the evolution of income inequality, as well as investigates the validity of the model.

Initially, I checked the stationarity of the variables using the tests mentioned in methodology to identify the appropriate procedure for estimating the model. The tests performed indicated the non-stationary character of the variables, these becoming stationary after processing the first difference (Table 1).

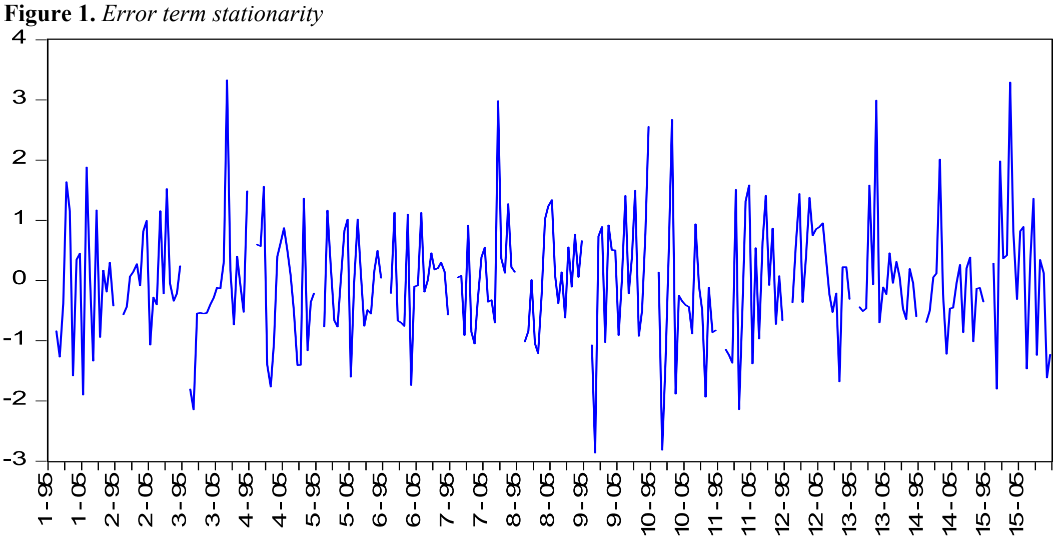
Table 1. *Stationarity tests – Summary window*

Variable	Number of tests rejecting I(0) unit root hypothesis (α = 5%)			Number of tests rejecting I(1) unit root hypothesis (α = 5%)		
	Individual intercept	Individual intercept and trend	None	Individual intercept	Individual intercept and trend	None
Gini*	1 of 4	5 of 5	0 of 3	4 of 4	5 of 5	3 of 3
Gini(-1)*	1 of 4	4 of 5	0 of 3	4 of 4	5 of 5	3 of 3
creditp(-1)*	3 of 4	2 of 5	0 of 3	4 of 4	4 of 5	3 of 3
he(-1)	0 of 4	2 of 5	0 of 3	4 of 4	5 of 5	3 of 3
ed(-1)	1 of 4	2 of 5	0 of 3	4 of 4	5 of 5	3 of 3
un(-1)	2 of 4	0 of 5	0 of 3	4 of 4	5 of 5	3 of 3
tax(-1)	0 of 4	0 of 5	0 of 3	4 of 4	5 of 5	3 of 3
CPI*	2 of 4	3 of 5	0 of 3	4 of 4	5 of 5	3 of 3
openness*	1 of 4	5 of 5	0 of 3	4 of 4	5 of 5	3 of 3
gfcf	0 of 4	1 of 5	0 of 3	4 of 4	5 of 5	3 of 3

*Hadri test rejects the stationarity hypothesis at level and accepts it after processing the first difference.
Source: Own calculations using Eviews 9.0

The use of error correction model involves adding in the regression the variables specific to first differences, as well as of the error term, this process being conditioned of its stationary character. In this respect, I checked and confirmed the error term stationarity using the same procedure mentioned above (Figure 1).

Figure 1. *Error term stationarity*



Source: Own calculations using Eviews 9.0

Next, I estimated the model by the Generalized Least Squares method (Cross-Section SUR option), the obtained results being attached in the Annex 4. Their analysis indicates a coefficient of determination of 0.8093, confirming the linearity of the regression and the proper selection of the regressors, given that the exogenous variables evolution explains 80.93% of the fluctuation of the regressand. Also, the probability of the F-test (0%) confirmed the validity of the model in statistical terms. Following that, I analysed the impact of the regressors, respecting the „ceteris paribus" assumption.

According to the results attached in Annex 4, the increase of autoregresive term with 1 deviation point led to an increase in the dynamic of the Gini coefficient with 0.899 points. The impact can be caused by the ability of the savings to generate new additional revenues for the population that records high-incomes, which may increase the spread between wage incomes.

Regarding the subject of interest of the paper, the model has estimated an impact of 0.005 points on the dynamics of Gini index at an increase with 1 percentage point of credit to private sector as a share of GDP – lagged by one year in the EU-15. This effect results from approving, in particular, of loans to companies with high turnovers, this type of loan being less risky. Subsequently, these economic entities increase their profits by adopting and applying certain development strategies (as a result of accessing the credited amounts), which can lead to an increase in wages, increasing the disparities between employees working in a company with low profits and low access to credit and those who operate in a company with high profits and high access to credit. Another explanation lies in the effect of the credit growth on the rise of asset prices, implicitly on investors wealth.

The control variables used have contributed significantly to the fluctuation of income inequality. The increase by 1 percentage point in the dynamics of government spending on health (as % of GDP) and government spending on education (as % of GDP) – variables lagged by one year – reduced the dynamic of Gini coefficient with 0.104 and 0.139 points, the explanation of the phenomenon being given by the theory of human capital. On the other hand, the 1 percentage point growth in the dynamics of unemployment rate from the previous year has led to an increase in the dynamic of income disparities from the current year with 0.063 points, this relationship being argued by the impact of reducing the number of employees in the economy (implicitly that of the transition from wages to income from unemployment benefits - which are lower than wage incomes) on income gap. Regarding the impact of the tax burden on Gini index, an increase in its dynamics (variable lagged by 1 year) by 1 percentage point grew the spread between incomes with 0.045 points.

The variables included in the model that are impacting the Gini coefficient on short term (corresponding to the situation where there is no lag) are the level of corruption, openness of the economy and gross fixed capital formation. In this respect, the increase of the dynamic of corruption perception index by 1 deviation point (which shows a decrease in the level of corruption, considering the reverse scaling of the indicator) had an effect of –0.029 on the dynamics of Gini index, influence that could be argued by multiple channels of impact, such as: the impact of corruption on economic growth and, implicitly on income inequality, the impact of corruption on tax evasion, ineffective tax administration and on the deductions through social groups benefits disproportionately, the effect of corruption on reducing the efficiency of social programs or the impact of corporate lobbies on the policymaking process, due to the high concentration of property assets in the economy. Regarding the impact of the openness of the economy on the income inequalities, the increase of the dynamic of the trade openness by 1 percentage point led to a decrease of income inequality dynamics with 0.019 points, the effect having the ability to manifest through the influence of trade on economic growth channel, which reduce the Gini coefficient, as well as that of the impact of trade openness on the expansion of certain market sectors.

On the other hand, the increase of gross fixed capital formation dynamic with 1 percentage point increase the dynamic of Gini index with 0.081 deviation points.

If all the variables are constant, the dynamic of the gap between incomes feels a growth with 0.060 points. Taking into account the long-run relationship between regressors and regressand, I have found that the annual speed of adjustment of the disequilibriums was 1.122%, this coefficient being statistically valid, given that it satisfies the condition of the negative sign and its statistically significant coefficient.

The estimated coefficients for each exogenous variable are significant at a significance threshold of 1%, excepting the first differences of government spending on education coefficient, a variable that is statistically significant for the 5% threshold, but not for the

1%. Also, the standard errors of the estimators is non-zero, but close to 0, which confirms the second hypothesis of the Gauss-Markov theorem, while relatively high population size (the third hypothesis) creates the premises for a proper representation of the residuals.

Table 2 shows that there is no multicolinearity between the regressors used in the analysis, taking into account that the coefficient of determination is higher than the statistical correlation coefficient between the exogenous variables.

Table 2. *Klein criterion – testing multicollinearity*

Correlation matrix of 1st difference	Gini*	cred*	he*	ed*	un*	tax*	CPI	open	gfcf
Gini*	1.00	0.03	0.01	0.02	-0.03	0.00	0.02	-0.06	0.00
cred*	0.03	1.00	0.14	0.11	-0.09	-0.02	-0.04	-0.06	-0.08
he*	0.01	0.14	1.00	0.45	0.14	-0.18	0.05	-0.08	-0.24
ed*	0.02	0.11	0.45	1.00	0.23	-0.03	0.04	-0.07	-0.23
un*	-0.03	-0.09	0.14	0.23	1.00	0.01	0.02	0.14	-0.40
tax*	0.00	-0.02	-0.18	-0.03	0.01	1.00	0.05	0.02	0.18
CPI	0.02	-0.04	0.05	0.04	0.02	0.05	1.00	0.07	0.03
open	-0.06	-0.06	-0.08	0.07	0.14	0.02	0.07	1.00	0.16
gfcf	0.00	-0.08	-0.24	-0.23	-0.40	0.18	0.03	0.16	1.00

R-squared = 0.8093; open is openness and cred is creditp; * are the regressors lagged by 1 year.
Source: Own calculations using Eviews 9.0

On the other hand, the Table 3 confirms the hypothesis concerning the absence of correlation between regressors and residuals, which validates other two hypothesis of Gauss-Markov theorem.

Table 3. *Correlation matrix between residuals and regressors*

Correlation matrix*	Gini**	cred**	he**	ed**	un**	tax**	CPI	open	gfcf
Residuals	-0.06	0.01	0.01	-0.02	-0.02	0.01	-0.01	0.00	-0.01

*Regressors are expressed in 1st difference form; ** are the regressors lagged by 1 year.
Source: Own calculations using Eviews 9.0

According to the result of Jarque-Bera test (Table 4), there are no arguments to reject the hypothesis related to normal distribution of errors, since its probability-value (0.186) is above the threshold of 5% used. At the same time, the average of the residuals is null, making it possible the investigation of the following hypotheses. After using White test, I have accepted the hypothesis that the model is homoskedastic, given that the product of the number of observations and R-squared (218.515) is lower than Chi-square statistic (296.466) for 258 degrees of freedom. Also, Breusch-Pagan LM (1.000) and Pesaran CD (0.863) tests confirm the absence of cross-sections dependence, since their probability is higher than the significance threshold of 5%.

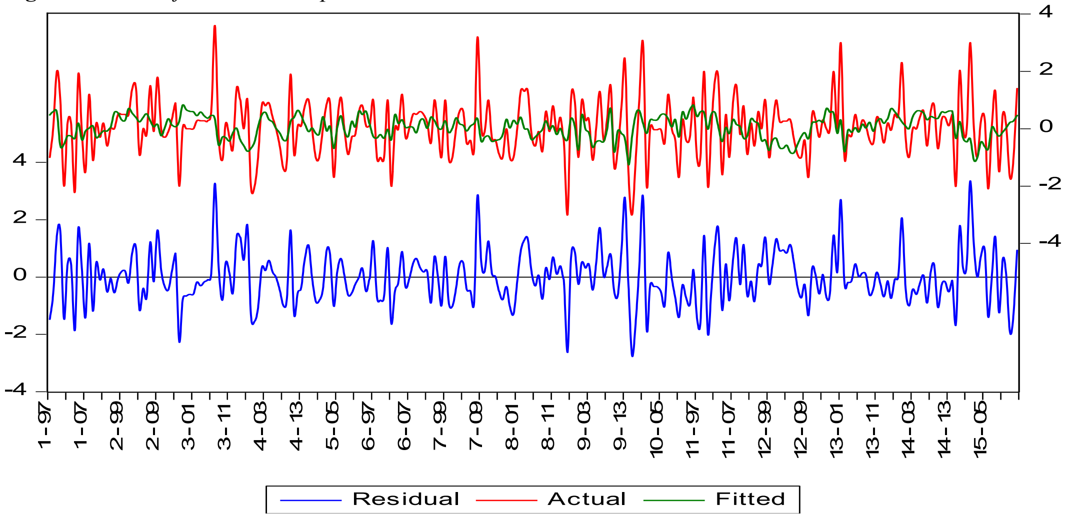
Table 4. *Residuals hypothesis*

Hypothesis	Method	Result
Normal distribution of residuals	Jarque-Bera	0.186
Homoskedasticity	White-test	218.515
Cross-section dependence absence	Breusch-Pagan LM	1.000
Cross-section dependence absence	Pesaran CD	0.863

Source: Own calculations using Eviews 9.0

Regarding the verification of the zero conditional mean of the errors, I used the Residuals plot to check the constancy of residuals. Figure 2 demonstrates the constant evolution of the residuals (blue line), around 0. Thereby, I have accepted the hypothesis related to zero conditional mean of the errors and afterwards, I have validated the model - the estimators being characterised by maximum verisimilitude.

Figure 2. *Actual, fitted, residual plot*



Source: Own calculations using Eviews 9.0

In other words, the model has fulfilled all the conditions for a correct statistical representation and its expected effects can be considered very close to the current reality.

5. Conclusions

This paper estimated a positive impact of private sector credit growth on income inequality, this being caused by the existence of disequilibriums in the distribution of the credit. The coefficient is statistically significant and the model meets all Gauss-Markov theorem assumptions, necessary to the validation of the maximum verisimilitude of the estimators. Moreover, there is a long-run relationship between the exogenous variables of the model and the Gini coefficient. Also, this research demonstrated that the income inequality has a historical cause. The proper conduct of macro-prudential policy can provide a solution in terms of moderating the impact of excessive lending to the private sector on the income inequalities.

Note

(1) See Levin, Lin and Chu (i), Breitung (ii), Im, Pesaran and Shin (iii), ADF-Fisher (iv), PP-Fisher (v).

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Annex 1. *Data used*

Indicators	Source
GINI coefficient	Eurostat and OECD
Private sector credit (as a % of GDP)	World Bank
Health government expenditures (as a % of GDP)	Eurostat
Education government expenditures (as a % of GDP)	Eurostat
Unemployment rate (%)	International Monetary Fund
Total tax burden including imputed social security contributions - total economy (as a % of GDP)	AMECO
Corruption perception index	Transparency International
Total trade (as a % of GDP) - openness index	Eurostat
Fixed gross capital formation (as a % of GDP)	Eurostat

Source: Own processing.

Annex 2. *Gini coefficient interpolated data*

Country	Interpolated data for Gini coefficient (years)	Gini coefficient values
Austria	2002	25.70
Belgium	2002	28.15
Denmark	1996, 1998, 2000, 2002	20.00, 20.50, 21.50, 23.40
Finland	2003	25.75
France	2003	27.60
Germany	2002, 2003, 2004	25.28, 25.55, 25.83
Greece	2002	33.85
Ireland	2002	29.80
Italy	2002, 2003	30.30, 31.60
Luxembourg	2002	27.30
Netherlands	2003, 2004	26.97, 27.93
Portugal	2002, 2003	37.27, 37.53
Spain	2003	31.00
Sweden	2003	23.00
United Kingdom	2004	34.30

Source: Own calculations using Eviews 9.0

Annex 3. *Domestic credit to private sector (% of GDP) interpolated data*

Country	Interpolated data for credit to private sector (years)	Credit to private sector (% of GDP) values
Austria	1998, 1999, 2000	97.61, 95.04.92.46
Belgium	1998, 1999, 2000	72.01, 69.99, 67.96
Denmark	No data missing	No data missing
Finland	1999, 2000	51.14, 51.93
France	1998, 1999, 2000	79.02, 78.23, 77.45
Germany	1999, 2000	112.87, 112.46
Greece	No data missing	No data missing
Ireland	1999, 2000	80.90, 76.39
Italy	1999, 2000	57.32, 58.96
Luxembourg	1998, 1999, 2000	86.03, 83.91, 81.77
Netherlands	1998, 1999, 2000	101.47, 104.87, 108.27
Portugal	1999, 2000	97.27, 106.12
Spain	1999, 2000	86.99, 91.06
Sweden	No data missing	No data missing
United Kingdom	No data missing	No data missing

Source: Own calculations using Eviews 9.0

Annex 4. *Model estimation*

Dependent Variable: D(GINI)
Method: Panel EGLS (Cross-section SUR)
Sample (adjusted): 1997 2014
Periods included: 18
Cross-sections included: 15
Total panel (balanced) observations: 270
Linear estimation after one-step weighting matrix

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GINI(-1))	0.898591	0.051850	17.33047	0.0000
D(CREDITP(-1))	0.004989	0.001123	4.441531	0.0000
D(HE(-1))	-0.104071	0.034091	-3.052751	0.0025
D(ED(-1))	-0.139070	0.057220	-2.430437	0.0158
D(UN(-1))	0.062590	0.013065	4.790733	0.0000
D(TAX(-1))	0.044759	0.012317	3.633950	0.0003
D(CPI)	-0.028655	0.004364	-6.566117	0.0000
D(OPENNESS)	-0.019471	0.001453	-13.40060	0.0000
D(GFCF)	0.081449	0.010434	7.806441	0.0000
C	0.060178	0.012139	4.957532	0.0000
UT(-1)	-1.121507	0.063090	-17.77616	0.0000

Weighted Statistics

R-squared	0.809313	Mean dependent var	0.217654
Adjusted R-squared	0.801951	S.D. dependent var	2.283226
S.E. of regression	1.000950	Sum squared resid	259.4922
F-statistic	109.9247	Durbin-Watson stat	1.893735
Prob(F-statistic)	0.000000		

Source: Own calculations using Eviews 9.0

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Economic freedom, economic growth and international tourism for post-communist (transition) countries: A panel causality analysis

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Abstract. *This paper examines the causal relationship between economic freedom and foreign tourist arrivals for 17 post-socialist transition countries during the period from 1996 to 2012. We employ the recently introduced panel Granger causality approach that is flexible enough to take account of both cross-country correlation and heterogeneity across the countries. The empirical results support the evidence on (i) the neutrality between economic freedom-economic growth and between economic growth-international tourism with few exceptions and (ii) the causality from economic freedom to tourism in six out of seventeen transition economies.*
Post-socialist countries are still in the process of integrating into the market economic system and also the global system; and consequently, the results of the current study are heavily shaped by the historical backgrounds and also the infancy of the transition process of these nations.

Keywords: economic freedom, foreign tourism, economic growth, transition countries, panel causality.

JEL Classification: Z32, C33, P24, O47.

Introduction

Since the conclusion of the Second World War, the economic and political landscape has dramatically changed in a rather discrete manner but the frequency and the speed with which the landscape has shifted have been tremendous, particularly after the 1990s. Globalization encompasses all dimensions of our lives, where there has been a broadening, deepening and speeding up of worldwide interconnectedness, from cultural to economic, from financial to religious, from entertainment to politics, from cuisine to international trade and, finally, from tourism to the environment. In today's global world, tourism's (particularly foreign tourism's) contribution to the overall economy is one or a combination of these three mechanisms: direct, indirect and induced. The sector's contribution in the form of favorable externalities may be even stronger than the primary direct effects. Due to these primary and secondary effects, we have witnessed government incentive schemes with a variety of forms and specific policy measures to fuel the growth of the tourism sector in a large number of countries. Because of these endogenous government policies and also the transformation originating from the globalization process, international tourism has gained substantial momentum, mostly in the last two decades.

Given the importance of tourism in both economic growth and sustainable development, special attention, on the one hand, is paid to the causal dynamics between economic growth and tourism. Empirical studies with the aim of uncovering the causal link between economic growth and foreign tourism yielded conflicting results. Some studies found evidence supporting the causality from tourism to economic growth (inter alias; Schubert et al., 2011; Brida et al., 2010; Zorturk, 2009; Kim et al., 2006; Gunduz and Hatemi, 2005), yet some other studies found evidence on the causality from economic growth to tourism (inter alias, Oh, 2005; Narayan, 2004). Bidirectional causality was detected by (inter alias, Mallick et al., 2016; Chen and Chiou-Wei, 2009; Cortes-Jimenez et al., 2009; Dritsakis, 2004; Durbarry, 2004 and Lee and Chang, 2008) whereas some studies failed to find statistically significant evidence about causality in any direction between two variables (inter alias, Eugenio-Martin et al., 2004; Katircioglu, 2009; Figini and Vici, 2010)(1). On the other hand, many scholar have paid keen interest in the causal links between foreign tourism and a variety of variables, including international trade (inter alias, Kulendran and Wilson, 2000; Khan et al., 2005 and Kadir and Jusoff, 2010), regional convergence (inter alias, Cortés-Jiménez, 2010 and Soukiazis and Proenca, 2008) and political (in) stability (inter alias, Algieri, 2006 and Narayan et al., 2010). One of the prominent explanations behind the conflicting results on the causality between tourism and the variety of economic aggregates is the differences in institutional structure amongst countries. According to Landes (1998), cultural norms and institutions are often believed to explain why certain countries grow rich and others remain poor.

Over the past few decades, the world has undergone a remarkable transformation. During this era, the transformation concerned increasing levels of economic and technological integration in the world system and resulted in new patterns of social, economic, cultural and political alignments, including extensive liberalization policies (particularly in developing nations in the economic, political and financial areas), the end of the Cold War, growth in international tourism, and creation of a global culture, etc. The pattern of transformation in the global system is also related to our research questions in two interconnected points: (1) during the same era, a significant growth trend in international tourism has been observed, and the tendency has become more pronounced for developing nations, and (2) the same era also coincides with the end of the Cold War and beginning of transformation struggles for some countries, known as post-socialist states.

Since the onset of transition at the end of the 1980s, a large number of countries in the Euro-Asia region have implemented a set of reforms intended to develop market based institutions involving almost all aspects of economic, social and democratic context. Up to early 1990s, these post-communist countries had centralized “command” economy which is incompatible with international tourism (see for example, Hall, 1991 and 2001), and therefore, it may be misleading to assume that these countries completed the necessary fundamentals for successful international tourism development. These transition countries had different initial conditions, and each of these nations employed different transition models; therefore, the process of the transition from planned economic system to market economy displays significant differences among these nations. Related to the differences in transition process, the important point is about the fact that international tourism is very vibrant, and their relationship with economic growth and also with economic freedom is extremely complex. In this dynamic and vibrant process, the places, namely tourist destinations, are endlessly (re)invented, (re)produced, (re)captured and (re)created by the simultaneous coexistence of global and local forces (Milne and Ateljevic, 2001).

In the early 1990s, the total factor productivity in the value added process in the post-communist transition countries was significantly lower than that of countries with similar per capita income level. The productivity gaps, in general, stemmed from the inherited capital and production structures as well as ineffective institutions supporting economic activity (European Bank for Reconstruction and Development, 2013). The major reforms in price liberalization, small-scale privatization and the opening-up of trade and foreign exchange markets were mostly implemented by the end of the 1990s. Because of the favorable impact of these reforms on production, consumption and investment, we observe that by the mid-2000s, the productivity gap between these (at least majority of) transition countries and other emerging economies with similar GDP per capita level was almost fully closed.

The institutional economic literature states perfectly that well designed and enforced institutions may significantly improve efficiency for almost all the sectors, including tourism. Acemoglu et al. (2001) ask whether the quality of economic institutions (economic freedom) may play some role in augmenting or hampering the influence of international tourism over economic growth or vice-versa. The tourism-led-growth hypothesis may be more relevant if we consider institutional factors; that is, some nations can exploit the opportunities accrued from foreign tourism to boost macroeconomic performances if they possess good institutions inherited from the complex and dynamic procedures. In addition to this motivation from the view of political economy, the important motivation in examining the causal linkages among economic freedom, economic growth and tourism is that the transition process is associated with the increase in income level and most of the transition countries possess an attractive tourist destinations. However, we have not encountered any studies in the literature that have investigated the *causality* for these three variables (or other variables consistent with institutional economic theory) referencing post-communist countries that offer a remarkable "controlled" experiment because of their unique resemblance in political, social, economical and cultural stance in the early 1990s. Investigating these causal linkages provides insights to better understand the role of transition process because all post-communist nations began the transition process with similar backgrounds (centralized command-economy, price control, limited or no private property, large state monopoly industries and so on). Moreover, in comparison with other developing countries, all these post-communist nations began the transition process with relatively large stocks of human capital (that is, the neoclassic model of endogenous growth model via human capital is accounted for) and therefore the differences in human capital should not play a decisive role explaining differences in growth rates among these countries. In addition to these factors, since the transition path pursued by each these post-communist state has been quite different, this represents a particularly good source of data for engaging meaningful statistical analysis.

This study aims at investigating casual relationships among international tourism, economic growth and economic freedom utilizing a panel Granger causality framework for 17 post-socialist countries (Albania, Armenia, Belarus, Bulgaria, Croatia, the Czech Republic, Georgia, Hungary, Latvia, Lithuania, Moldova, Poland, Romania, Russia, Slovakia, Slovenia and Ukraine) for the period of 1996-2012. The panel results indicate the lack of causal link between economic growth-tourism arrivals, economic growth-economic freedom, and finally economic freedom-foreign tourist arrivals. Besides, given the importance of heterogeneity with respect to level of development and economic freedom as well as share of tourism in economic structure, we find clear evidence on the heterogeneity across-countries for the causal linkages between economic freedom and tourism arrivals.

The next section is devoted to a literature review. In section 3 and section 4, the data set and the methodological devices utilized in the study are explained at length, respectively. The results are reported in section 5, which is followed by conclusions.

Background and literature review

Scholars have long had interest in addressing whether “tourism” is the elusive quest for growth. The importance and the relevancy of foreign or international tourism on this quest, however, are relatively new. In the past two decades, quite a large number of empirical studies have been devoted to examining the causality and/or correlation between international tourism and other economic and social variables. One of the most attractive research questions has been the statistical correlation and also causality between foreign tourism and economic growth (inter alias, Sequerira and Nunes, 2008; Brida and Pulina, 2010; Narayan et al., 2010; and Ivanov and Webster, 2013). These empirical studies have utilized different empirical tools, different time spans and different sets of countries and yielded conflicting results. Based on the inconsistencies in results, four different alternative hypotheses have been proposed: (1) the tourism-led-growth (TLEG, henceforth) hypothesis(2), (2) the growth-driven-tourism (GDT, henceforth) hypothesis, (3) bidirectional causality and (4) no-causality.

Although there is substantial literature on this topic for a large number of countries, the large share of these studies is devoted to the OECD countries and particularly countries with globally famous tourism backgrounds (for example, Greece, Spain and Turkey). The empirical studies limiting their focus to transition countries (particularly to the post-communist countries) hardly exist. Chen and Chiou-Wie (2009) examines two Asian countries, S. Korea and Taiwan. Chen and Chiou-Wie (2009) employed the VAR-method (to examine the causality) and to control the uncertainty they employed the EGARCH method by utilizing data covering 1975Q1-2007Q1. They reported that TLEG is more in tune with Taiwan, whereas bidirectional causality was detected for S. Korea. Oh (2005) conducted an empirical study for S. Korea with a data set covering 1975-2001 by utilizing a Granger-causality test based on the VAR framework and failed to find evidence supporting the TLEG hypothesis. Kim et al. (2006) undertook a similar study on Taiwan in the period between 1971 and 2003 and used a two different set of data-spans: both quarterly (1971–2003) and annual (1956-2002). They found strong evidence supporting bidirectional causality for each case.

Three studies (Payne and Mervar, 2010; Surugiu and Surugiu, 2013 and Chou, 2013) with a specific focus in post-socialist countries deserve some attention. Payne and Mervar (2010) examined the relevancy of TLEG hypothesis for Croatia using quarterly data covering from 2000Q1-2008Q3. They employed Toda–Yamamoto causality tests and reported that the causality run from real GDP to international tourism revenue. Surugiu and Surugiu (2013) and Chou (2013) address the long-run causal relationships between tourism growth (in particular tourism spending) and economic growth. Surugiu and Surugiu (2013) employ Granger causality analysis based on the vector error correction model (VECM) and impulse functions for Romania by employing data set covering from 1988 to 2009 and reported evidence supporting TLEG hypothesis. Chou (2013) uses panel causality test for 10 transition countries (Bulgaria, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Poland, Romania, Slovakia and Slovenia) and find that (ii)

TLEG is supported for Cyprus, Latvia and Slovakia; (ii) the GDT hypothesis is more appropriate for the Czech Republic and Poland; (iii) the feedback mechanism is more appropriate for Estonia and Hungary; and finally, (iv) the neutrality hypothesis (neither tourism development nor economic growth is sensitive with the other) was detected for Bulgaria, Romania and Slovenia.

Growth theory asserts that in addition to factors in standard neoclassic production function, high quality formal institutions play an important role in economic growth process. North (1990) and Landes (1998) postulate that there exist strong links between economic institutions and economic growth. The intuition derived from the conventional institutional approach exclusively assumes that the causality runs from institutions to economic development, and therefore, the theory ignores an important possibility that economic growth may also stimulate better economic institutions. Acemoglu and Robinson (2013) argue that economic institutions that enforce property rights, create a level playing field, and encourage investments in new technologies and skills are conducive to economic growth. According to Berggren (2003: 194), economic freedom is a composite arrangement that attempts to characterize the degree to which an economy is a market economy, that is, the degree to which it entails the possibility of entering into voluntary contracts within the framework of a stable and predictable rules of law that uphold contracts and protect private property, with a limited degree of interventionism in the form of government ownership, regulations, and taxes. The freedom is, therefore, related to freedom of individuals to work, to produce, to consume, and to invest in any way they please, and the freedom is both protected by the state and unconstrained by the state (Beach and Kane, 2008).

In the applied works, economic freedom indexes (or economic freedom indicators) are generally considered as the degree of compatibility of a country's institutional structure with a market economic system. This hypothesis has been tested for many countries and with different methodological tools in the empirical literature. Studies by Barro (1996), Keefer and Knack (1997), Hall and Jones (1999), Acemoglu et al. (2001) and many others explored the positive link between the institutional environment and economic performance for a large number of developing and developed countries.[(3)] In the empirical literature, contrary to the main argument of conventional institutional theory, some studies produce strong evidences showing that the existence of formal economic institutions may not lead to economic prosperity in the former socialist economies since they often lack compatibility with post-communist economic systems or prevalent informal norms.[(4)] According to Tamilina and Tamilina (2012), the lack of strong political contexts is believed to restrain these countries from further improving their formal institutions, and as a result, institutional reforms usually end up promoting only the redistribution of economic or political power without entraining any substantial change in economic growth

In the literature, the number of empirical studies that share similar scientific enterprise with ours for these post-socialist countries is relatively small: We have encountered only five studies examining the causality/correlation between economic growth and economic freedom for transition states. Paakkonen (2010) engages regression/correlation analysis for post-socialist countries by employing both the standard growth accounting variables (inter alias, capital formation including FDI, human capital, R&D) and also institutional variables. He reports that the favorable role played by institutional variables is relatively small; and in some cases, even not significant. However, Seputiene and Skuncikiene (2011) and Prochniak (2011) utilize standard regression method and run a battery of regressions with alternating variables, and they demonstrate that in addition to standard variables in growth accounting literature (i.e., physical capital, human capital, etc.), variables in accordance with institutional theory (including economic freedom) generally have a positive contribution to economic growth. Other econometric studies with formal causality tests, for example, Peev and Mueller (2012) and Piatek et al. (2013), provide some evidence that economic freedom matters in achieving better growth performance. However, Piatek et al. (2013) use a composite index rather than country specific data and the causality results reported by Peev and Mueller (2012) are based on panel regression.

For the relationship between economic freedom and international tourism, the institutional economic theory postulates institutions may play important role in improving efficiency for almost all the sectors, including tourism (Acemoglu et al., 2001). The collapse of socialism in the late 1980s led to multifaceted and deep changes and challenges in the political, economic, social, and cultural systems in these countries; and in this respect, free market formal institutions (both legal framework and also enforcement mechanisms) are not expected to be fully operative and functioning in these transition countries. The institutional economics is a subfield in political economy and in terms of both theoretical and empirical dimensions it is a very active field of research. However, political tourism economics is a relatively new subfield within the tourism discipline. Because the field is relatively new and still evolving, we have not encountered any studies examining the correlation or causality issues among variables that may be located around the intersection between political economy and tourism economy. In addition to this, international tourism is also relatively a new phenomenon and therefore, difficult to connect with the role played by formal institutions in fueling the contribution of the tourism industry to economic performance. Having only a relatively short history for both domains, the topics seem to be very fertile ground for academic research. At the same time, however, given the relative infancy of institutional domains in transition countries and also the relative infancy of widespread international tourism from the global perspective, the research questions the current study is aimed at examining are crucial to better understand the causal linkages between foreign tourism and economic freedom.

Data

In this paper, economic freedom is measured by the economic freedom index (EFI) constructed by the Heritage Foundation. The index consists of ten freedom indicators (business freedom, trade freedom, monetary freedom, freedom from government, fiscal freedom, property rights, investment freedom, financial freedom, freedom from corruption and labor freedom). These freedom indicators are averaged equally into the economic freedom index and scaled from 0 to 100 with 100 representing the maximum freedom. Economic growth is measured by real GDP per capita in 2005 constant US dollars (RY), and the data are collected from the World Development Indicators (WDI) on-line database. The total number of international tourist arrivals (ITA) is employed as a proxy for tourism growth, and the data are retrieved from the database of the WDI and United Nations World Tourism Organization (UNWTO). In empirical analysis, the variables are utilized in natural logarithmic form. Based on data availability, we employ annual data for the period from 1996 to 2012 for seventeen transition economies – Albania, Armenia, Belarus, Bulgaria, Croatia, the Czech Republic, Georgia, Hungary, Latvia, Lithuania, Moldova, Poland, Romania, Russia, Slovakia, Slovenia, and the Ukraine.

The descriptive statistics are reported in Table 1. At first glance, the data shows that the mean of the economic freedom in the transition economics is close to 60, implying that the countries in the sample appear not to have high levels of economic freedom. This, in fact, is not surprising because economic freedom requires structural changes in the business environment, trade, the monetary-fiscal-financial system, property rights, corruption and labor markets that require a long-term perspective. The divergence between the maximum (72.4) and minimum (35.4) degrees of the economic freedom index may imply a high level of heterogeneity in the transition economies. A similar inference can be drawn for income level and tourism arrivals. The coefficient of variation as a simple indicator for volatility indicates that tourism arrivals to the transition economies have the highest volatility compared with economic growth and economic freedom. However, the economic freedom index has the smallest variability, as is expected because economic freedom, first of all, requires institutional changes, and once the quality of such institutions reach a certain stage, it is not likely the system would reverse. The transition countries that the current study focuses on possess different attractiveness-capacity (involving historical, natural-attraction and cultural elements and proximity to main trading routes, etc.); therefore, we observe notable variability in tourism arrivals.

The correlation coefficients in Table 1 indicate a positive linear association between economic freedom and economic growth, economic freedom and international tourism arrivals, and economic growth and international tourism arrivals. It appears that economic freedom and economic growth are highly correlated, implying that economic freedom (economic growth) facilitates economic growth (economic freedom) in the transition economies. The linear association between economic growth and international tourist arrivals is as strong as the correlation between economic freedom and international tourism arrivals. However, the correlation is not necessarily translated into causality; and therefore, instead of simple descriptive and graphical analyses, an appropriate way to determine presence/absence of causal link among variable of interest requires application of formal statistical procedures (Nazlioglu, 2011).

Table 1. *Descriptive statistics and correlations*

Descriptive statistics	EFI	Growth	ITA
Mean	58.44	6183.76	5,824,551
Maximum	72.40	20706.67	28,177,000
Minimum	35.40	570.024	7,000
Std. Dev.	8.34	4667.88	6,550,563
Coefficient of variation	0.14	0.75	1.124
Observations	289	289	289
Correlation matrix			
EFI	1		
Growth	0.83	1	
ITA	0.65	0.59	1

Methodology

To determine the direction of causality between the variables of interest, we employ the panel data framework because panel methods increase the power of tests in hypothesis testing. In examining causal linkages within the panel framework, two issues play a key role for selecting the appropriate causality tool. The first issue is to control for cross-sectional dependence across the members of the panel because a shock affecting one country may also affect other countries through the high degree of globalization and also international trade and financial integration. The Monte Carlo experiment conducted by Pesaran (2006) demonstrates the importance of testing for cross-sectional dependence in a panel data study and also illustrates the substantial bias and size distortions when cross-sectional dependence is ignored in the estimates (Pesaran, 2006). The second issue is to consider whether the data can be pooled across countries or whether panel estimates account for country specific heterogeneity (Pesaran and Smith, 1995; Luintel and Khan, 2004). First of all, the assumption that the slope coefficients are homogeneous is unlikely to hold because countries differ in their stages of development (Luintel and Khan, 2009). Furthermore, in a panel causality analysis, imposing the joint restriction for the whole panel is the strong null hypothesis (Granger, 2003) and assumes that homogeneity may mask the country specific characteristics (Breitung, 2005).

Therefore, testing for cross-sectional dependence and slope homogeneity in a panel causality analysis is a crucial step. We hereby begin by investigating whether there is cross-sectional dependence and heterogeneity across the transition economies. In what follows, we outline the preliminary tests for cross-section dependence and slope homogeneity tests, before providing the details of the panel Granger causality test.

Preliminary tests

To test for cross-sectional dependency, one well-known test is the Lagrange multiplier (hereafter, LM) test developed by Breusch and Pagan (1980). The procedure to compute the LM test requires the estimation of the following panel data model:

$$y_{it} = \alpha_i + \beta_i' x_{it} + \varepsilon_{it} \text{ for } i = 1, 2, ..., N \; ; \; t = 1, 2, ..., T \tag{1}$$

where i is the cross section dimension, t is the time dimension, y_{it} is the dependent variable (ITA), x_{it} is the vector of explanatory variables (i.e., EFI and RY), α_i and β_i are respectively the individual intercepts and slope coefficients that are allowed to vary across cross-section(5). The null hypothesis of no cross-sectional dependence- $H_0 : Cov(\varepsilon_{it}, \varepsilon_{jt}) = 0$ for all t *and* $i \neq j$ - is tested against the alternative hypothesis of cross-section dependence- $H_1 : Cov(\varepsilon_{it}, \varepsilon_{jt}) \neq 0$ - for at least one pair of $i \neq j$. The LM test is calculated by

$$LM = T \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij}^2 \sim \chi^2_{N(N-1)/2} \tag{2}$$

where $\hat{\rho}_{ij}$ is the sample estimate of the pair-wise correlation of the residuals from the individual ordinary least squares (OLS) estimation of the equation (1) for each i. The LM test is valid for panels in which N is relatively small and T is sufficiently large. For large panels where $T \to \infty$ first and then $N \to \infty$, Pesaran (2004) proposed the scaled version of the *LM* test as follows:

$$CD_{lm} = \left(\frac{1}{N(N-1)} \right)^{1/2} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} (T \hat{\rho}_{ij}^2 - 1) \sim N(0,1) \tag{3}$$

The CD_{lm} test is subject to substantial size distortions when N is large and T is small. Pesaran (2004) developed a more general cross-sectional dependency test that is valid for panels where T→∞ and N→∞ in any order. The new test is calculated as follows:

$$CD = \sqrt{\left(\frac{2T}{N(N-1)} \right)} \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij} \right) \sim N(0,1) \tag{4}$$

Pesaran (2004) demonstrates that the *CD* test has a mean of zero for fixed T and N and is robust for heterogeneous dynamic models, including multiple breaks in slope coefficients and/or error variances, so as long as the unconditional means of the dependent and independent variables are time-invariant and their innovations have symmetric distributions. However, the *CD* test will lack power in certain situations where the population average pair-wise correlations are zero, but the underlying individual population pair-wise correlations are non-zero (Pesaran et al., 2008, p. 106). For large panels when first T→∞ and then N→∞, Pesaran et al. (2008) propose a bias-adjusted test which is a modified version of the LM test by utilizing the exact mean and variance of the LM statistic. The bias-adjusted LM test is

$$LM_{adj} = \sqrt{\left(\frac{2}{N(N-1)}\right)} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \frac{(T-k)\hat{\rho}_{ij}^2 - \mu_{Tij}}{\sqrt{\nu_{Tij}^2}} \sim N(0,1) \tag{5}$$

where k is the number of regressors, μ_{Tij} and ν_{Tij}^2 are, respectively, the exact mean and variance of $(T-k)\hat{\rho}_{ij}^2$ that are provided in Pesaran et al. (2008, p. 108).

With respect to testing for slope homogeneity, Pesaran and Yamagata (2008) proposed the so-called delta ($\tilde{\Delta}$) test for the null hypothesis of homogeneity - $H_0 : \beta_i = \beta$ for all *i*- against the alternative hypothesis heterogeneity- $H_1 : \beta_i \neq \beta_j$ for a non-zero fraction of pair-wise slopes for $i \neq j$ -. The $\tilde{\Delta}$ test is valid as $(N,T) \to \infty$ without any restrictions on the relative expansion rates of N and T when the error terms are normally distributed. In the $\tilde{\Delta}$ test approach, the first step is to compute the following modified version of the Swamy test:

$$\tilde{S} = \sum_{i=1}^{N} \left(\hat{\beta}_i - \tilde{\beta}_{WFE}\right)' \frac{x_i' M_\tau x_i}{\tilde{\sigma}_i^2} \left(\hat{\beta}_i - \tilde{\beta}_{WFE}\right) \tag{6}$$

where $\hat{\beta}_i$ is the pooled OLS and $\tilde{\beta}_{WFE}$ is the weighted fixed effect estimation of equation (1), M_τ is an identity matrix of order T, and $\tilde{\sigma}_i^2$ is the estimator of σ_i^2 .(6) The test statistic is defined as

$$\tilde{\Delta} = \sqrt{N} \left(\frac{N^{-1}\tilde{S} - k}{\sqrt{2k(T-k-1)/T+1}} \right) \sim N(0,1) \tag{7}$$

The results reported in Table 2 indicate that the null hypothesis of no cross-sectional dependence is rejected at the 1 percent level of significance. This finding implies that a shock that occurs in one transition country may be transmitted to other countries. Table 2 also shows the results of two tests of the slope homogeneity. As observed, the null hypothesis of slope homogeneity is rejected at 1% level of significance by both tests which therefore support country specific heterogeneity. In sum, we can therefore conclude that the policy implications driven from the causality approach that considers cross-sectional dependency appear to be more appropriate for designing sound policies.

Table 2. *Cross-section dependency and homogeneity tests*

Cross-Sectional Dependency			
	Test	Statistic	p-value
Breusch and Pagan (1980)	LM	230.24***	0.000
Pesaran (2004)	CD_{LM}	5.71***	0.000
	CD	3.04***	0.000
Pesaran et al. (2008)	LM_{adj}	16.21***	0.000
Slope Homogeneity			
Pesaran and Yamagata (2008)	$\tilde{\Delta}$	19.71***	0.000

*** denotes statistical significance at 1 percent.

Panel Granger causality test

Testing causality in a panel framework has attracted interest during the last decade, and different approaches have been developed to examine the direction of causality in a panel data context. One attempt is based on estimating a panel vector autoregressive or vector error correction model by means of a generalized method of moments (GMM) estimator. This approach is, however, not able to consider either cross-sectional dependence or heterogeneity. GMM estimators, furthermore, can produce inconsistent and misleading parameters unless slope coefficients are, in fact, homogeneous (Pesaran et al., 1999).

The second approach proposed by Konya (2006) is sufficient to account for cross-sectional dependency and heterogeneity across cross-sections. This approach employs the seemingly unrelated regressions (SUR) estimation method developed by Zellner (1962) to control for contemporaneous correlations (cross-sectional dependency) and produces bootstrap critical values to make results robust irrespective of unit root and co-integration properties. Although Konya's testing procedure has attracted much interest in empirical applications, this approach includes a drawback for the panel data sets if the number of cross-sections (N) is not reasonably smaller than time periods (T) because the SUR estimator is only feasible for panels with large T and small N (Pesaran et al., 1999).

The third approach proposed by Dumitrescu and Hurlin (2012) is based on averaging standard individual Wald statistics of Granger tests under the assumption of cross-section independency. This approach, thereby, controls for heterogeneity but it is not able to account for cross-sectional dependence. The individual Granger causality analysis requires estimating vector autoregressive (VAR) models with stationary variables. The presence of non-stationary variables in VAR models may cause a nonstandard asymptotic distribution of Wald statistics based on unit root and co-integration properties where these nonstandard asymptotic properties arise from the singularity of the asymptotic distributions of the estimators (Lütkepohl, 2004, p. 148). To overcome this problem, Toda and Yamamoto (1995) developed an intuitive causality approach by augmenting the VAR model with the maximum integration degree of variables, which leads to valid Wald tests with asymptotic distribution irrespective of whether variables are non-stationary or co-integrated. Emirmahmutoglu and Kose (2011) extended the Toda-Yamamoto approach to Granger causality in time series data for panel data sets in a simple way. This approach to panel causality thereby accounts for cross-country heterogeneity irrespective of whether the variables of interest are non-stationary or co-integrated. In addition to this flexibility, because the critical values for panel statistics are derived from bootstrap distributions, it also considers the cross-section dependency.

In the Emirmahmutoglu-Kose approach, the following VAR model is estimated for each cross-section:

$$y_{it} = \mu_i + A_{1i} y_{i(t-1)} + \cdots + A_{p_i} y_{i(t-p_i)} + \cdots + A_{(p+d)i} y_{i(t-p_i-d_i)} + \varepsilon_{it}. \tag{8}$$

where y_{it} is vector of endogenous variables (ITA, RY, EFI), $\boldsymbol{\mu_i}$ denotes the p dimensional vector of fixed effects, p_i is the optimal lag(s) and d_i is the maximum integration degree of the variables. The null hypothesis of no-Granger causality against the alternative hypothesis of Granger causality is tested by imposing zero restriction on the first p parameters. The so-called modified Wald statistic has the asymptotic chi-square distribution with p degrees of freedom. To test the Granger non-causality hypothesis for the panel, the Fisher statistic is developed that defined as:

$$\lambda = -2\sum_{i=1}^{N} \ln(\pi_i) \tag{9}$$

where π_i is the probability corresponding to the individual modified Wald statistic. The Fisher statistic has an asymptotic chi-square distribution with *2N* degrees of freedom. However, the limit distribution of the Fisher test statistic is no longer valid in the presence of cross-section dependency. To accommodate for cross-section dependency in the panel, Emirmahmutoglu and Kose (2011) suggest obtaining an empirical distribution of the panel statistic using the bootstrap method[(7)].

Empirical results

The results for the panel causality analysis[(8)] between economic growth and foreign tourism are presented in Table 3. The country specific results indicate that there is a unidirectional causality from economic growth to tourism in Georgia and Romania in which per capita income provides us with predictive power for tourism arrivals. The opposite unidirectional causality from tourism to economic growth is detected only for Moldova where higher per capita income is associated with higher tourism arrivals. The neutrality hypothesis is in tune with 14 countries: Albania, Armenia, Belarus, Bulgaria, Croatia, the Czech Republic, Hungary, Latvia, Lithuania, Poland, Russia, Slovakia, Slovenia and Ukraine. The panel results demonstrate that the null hypothesis of non-causality from economic growth to tourism is rejected at the 1-percent level of significance because the panel Fisher statistic exceeds the bootstrap critical values. However, the null hypothesis of non-causality from tourism to economic growth cannot be rejected at any percentage level of significance because the panel Fisher statistic cannot exceed the bootstrap critical values. It is important to note here that the panel results for the causality from economic growth to tourism should be interpreted with caution because the Fisher statistic may be affected by a very high individual Wald statistic (thereby, very smaller p-value) for the case of Romania.

Our empirical results support the neutrality hypothesis for most of the transition economies, indicating that neither increase in foreign tourist arrivals nor economic growth is cause to each other. In the literature, some empirical studies (among others, Adamou and Chlorides, 2010; Holzner, 2011; Narayan et al., 2010; Sequeira and Nunes, 2008) show that the more a country is specialized in tourism, the greater the effect tourism growth has on GDP growth. Given this, our result of neutrality is, in fact, not surprising in transition countries because tourism makes a relatively small contribution to income level in these countries. Annual country reports published by World Travel and Tourism Council-WTTC (2011) exhibit that except Albania, Croatia, Georgia and Hungary the share of tourism sector in overall GDP for the remaining 13 countries is extremely low which is around 0,5 to 2 percent. These numbers are well below European and World averages of 3 percent.(9)

Table 3. *Causality between economic growth and tourism*

		Growth ≠> Tourism		Tourism ≠> Growth	
Country	Lag(s)	Statistic	p-value	Statistic	p-value
Albania	2	1.763	0.414	0.033	0.984
Armenia	1	0.010	0.922	0.212	0.645
Belarus	1	0.003	0.958	0.219	0.640
Bulgaria	2	0.082	0.960	0.089	0.957
Croatia	2	0.465	0.793	1.437	0.487
Czech Republic	1	0.090	0.764	0.255	0.614
Georgia	2	4.959*	0.084	4.456	0.108
Hungary	2	0.167	0.920	2.969	0.227
Latvia	1	1.461	0.227	0.129	0.719
Lithuania	2	4.139	0.126	4.108	0.128
Moldova	2	0.677	0.713	4.995*	0.082
Poland	2	2.692	0.260	1.542	0.463
Romania	2	62.416***	0.000	1.435	0.488
Russia	2	0.565	0.754	1.667	0.435
Slovakia	2	2.792	0.248	2.256	0.324
Slovenia	1	0.351	0.554	0.687	0.407
Ukraine	2	0.255	0.880	3.257	0.196
			Bootstrap critical values		
Panel results		Fisher stat.	10%	5%	1%
Growth ≠> Tourism		85.907***	83.625	84.583	85.279
Tourism ≠> Growth		33.445	90.746	91.799	92.721

Notes: ≠> denotes non-Granger causality hypothesis. The optimal lag(s) are selected by Schwarz information criterion by setting maximum lags to 3 in VAR model. The bootstrap critical values are based on 1000 bootstrap replications. *, ** and *** respectively denote statistical significance at 10, 5 and 1 percent.

In Table 4, we present the results from the causality analysis between economic freedom and economic growth. The country specific analysis demonstrates that only in the case of Poland, there is unidirectional causality from economic growth to economic freedom. For the case of sixteen countries, the null hypothesis of non-causality between economic growth and economic freedom cannot be rejected. Consistent with the country specific results, the panel results demonstrate that the hypothesis of non-causality cannot be rejected. We therefore find strong evidence on the neutrality between growth and economic freedom in transition countries. The neutrality between economic freedom and economic growth in transition countries can be attributed to the fact that these countries are still in the process of transition, and therefore, the relationship between economic freedom and economic performance may not be as strong as in countries where the transition process started long ago, such as in developed countries and emerging markets.

Table 4. *Causality between economic freedom and economic growth*

		EFI ≠> Growth		Growth ≠> EFI	
Country	Lag(s)	Statistic	p-value	Statistic	p-value
Albania	2	0.017	0.992	2.815	0.245
Armenia	1	0.118	0.732	0.001	0.980
Belarus	1	0.869	0.351	0.371	0.542
Bulgaria	2	1.004	0.605	1.051	0.591
Croatia	2	2.774	0.250	3.749	0.153
Czech Republic	1	0.683	0.409	0.190	0.663
Georgia	2	3.580	0.167	0.712	0.701
Hungary	2	2.879	0.237	2.368	0.306
Latvia	1	0.528	0.467	1.406	0.236
Lithuania	2	1.960	0.375	3.683	0.159
Moldova	2	3.978	0.137	1.327	0.515
Poland	2	1.932	0.381	5.630*	0.060
Romania	2	1.123	0.570	0.791	0.673
Russia	2	3.394	0.183	1.382	0.501
Slovakia	2	4.169	0.124	1.539	0.463
Slovenia	1	0.177	0.674	1.731	0.188
Ukraine	2	4.535	0.104	4.576	0.101
			Bootstrap critical values		
Panel results		Fisher stat.	10%	5%	1%
EFI ≠> Growth		38.160	69.711	70.637	71.327
Growth ≠> EFI		37.941	86.897	87.815	88.582

Notes: ≠> denotes non-Granger causality hypothesis. The optimal lag(s) are selected by and Schwarz information criterion by setting maximum lags to 3 in VAR model. The bootstrap critical values are based on 1000 bootstrap replications. *, ** and *** respectively denote statistical significance at 10, 5 and 1 percent.

Table 5 reports the results for causality between economic freedom and foreign tourist arrivals. The country specific results indicate that the hypothesis of non-causality from economic freedom to tourist arrivals is rejected in the case of Albania, Croatia, the Czech Republic, Georgia, Lithuania, and Romania. The null hypothesis of non-causality from tourism to economic freedom is rejected only in two cases –Belarus and the Ukraine. For the case of eight countries, the null hypothesis of non-causality neither from economic freedom to tourism nor from tourism to economic freedom can be rejected, implying the evidence on neutrality between these two variables that economic freedom and tourism do not have predictive power on each other. The panel results show that the null hypothesis from economic freedom to tourism and from tourism to economic freedom cannot be rejected because the Fisher statistics do not exceed the bootstrap critical values.

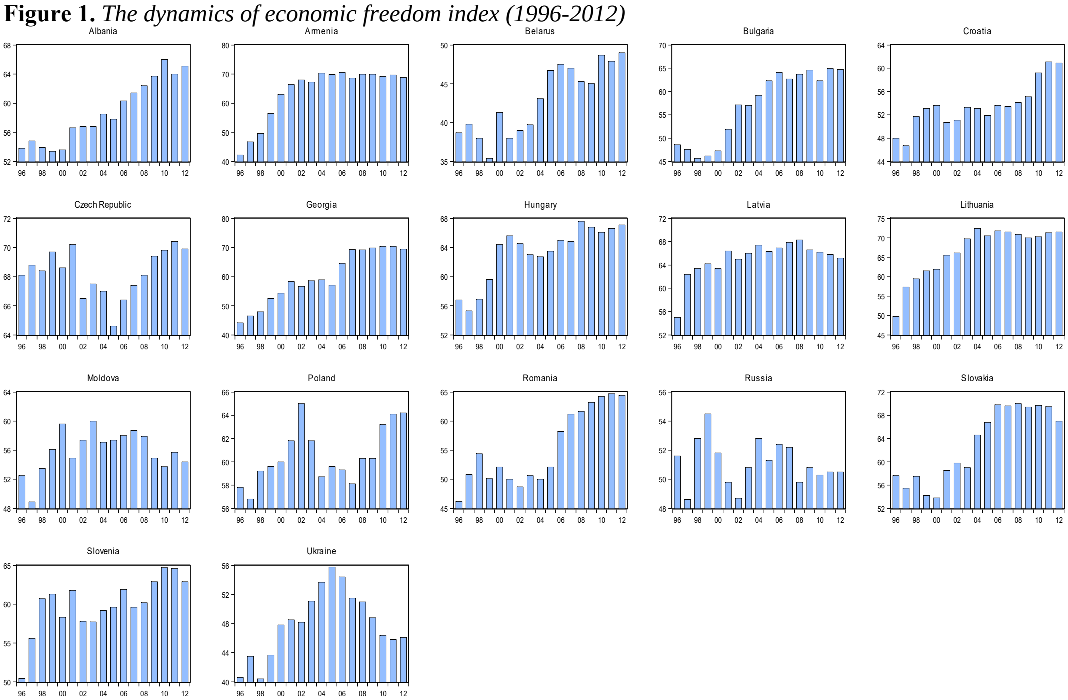
Table 5. *Causality between economic freedom and tourism*

		EFI ≠> Tourism		Tourism ≠> EFI	
Country	Lag(s)	Statistic	p-value	Statistic	p-value
Albania	2	6.538**	0.038	1.559	0.459
Armenia	1	0.209	0.648	0.717	0.397
Belarus	1	1.015	0.314	2.789*	0.095
Bulgaria	2	1.635	0.442	2.252	0.324
Croatia	2	5.422*	0.066	3.559	0.169
Czech Republic	1	17.980***	0.000	1.391	0.238
Georgia	2	9.619***	0.008	1.704	0.426
Hungary	2	0.241	0.887	0.833	0.659
Latvia	1	0.020	0.887	0.005	0.941
Lithuania	2	8.555**	0.014	2.805	0.246
Moldova	2	0.154	0.926	0.122	0.941
Poland	2	0.930	0.628	4.554	0.103
Romania	2	11.848***	0.003	0.078	0.962
Russia	2	0.783	0.676	1.726	0.422
Slovakia	2	2.389	0.303	1.805	0.405
Slovenia	1	0.097	0.756	0.753	0.386
Ukraine	2	0.407	0.816	8.046**	0.018
			Bootstrap critical values		
Panel results		Fisher stat.	10%	5%	1%
EFI ≠> Tourism		73.927	143.675	144.78	145.663
Tourism ≠> EFI		40.498	84.802	85.674	86.368

Notes: ≠> denotes non-Granger causality hypothesis. The optimal lag(s) are selected by and Schwarz information criterion by setting maximum lags to 3 in VAR model. The bootstrap critical values are based on 1000 bootstrap replications. *, ** and *** respectively denote statistical significance at 10, 5 and 1 percent.

If one considers the country specific and panel results together, there is clear evidence on the heterogeneity across-countries. This heterogeneity in causality between economic freedom and tourism can be attributed to the diversified level of economic freedom in transition countries. At this point, visual inspection for freedom index can be performed to have further intuition about the causality from economic freedom to tourism arrivals. The yearly value of freedom index is shown in Figure 1. A closer look at the figure shows first that Czech Republic and Lithuania have the highest economic freedom level(10). Uninterrupted favorable trend in economic freedom is clearly a case for Albania, Bulgaria, Georgia, Hungary and Lithuania. Armenia and Croatia also have clear upward trend but in the early 2000s the indexes for these countries display some stagnation-like pattern. Although institutional variables in developed western countries do not display large swings, the figure indicates that there are clear up-and-down movements in economic freedom indicators for the Czech Republic, Moldova, Poland, Romania, Russia, Slovakia and Ukraine.

Figure 1. *The dynamics of economic freedom index (1996-2012)*



Discussion

In the above sections, a formal causality test was applied to examine the causal linkages between economic freedom (the reform process), economic growth, and international tourism for transition countries. The tourism sector's contribution to economic growth requires strong backward and forward linkages. However, the strength of the backward and forward linkages depends strongly on behaviors of actors in both demand and supply side of the market as well as the structure of the markets. On the demand side, for example, both the length of stay and also average expenditure per foreign tourist are well below the European average(11). In addition to and also parallel to this point, post-communist restructuring seems to stimulate regional cross-border mobility (Hall, 2001). For example, according to OECD report on Bulgarian tourism(12): of Bulgaria's 5 million visitor arrivals at frontiers in 2005 with average stay of 2.2 days, and moreover, according to Hall (2001) almost 75% of total arrivals are from neighboring countries and suggesting significant local cross-border activity. In the supply side, there are also some problems. In order to flourish international tourism, the pursuit of sound and steady government policies are required. The government incentives may cover a large spectrum of areas including (but not limited to) a well-developed infrastructure (including roads, airports, railroads), adequate human capital compatible with tourism sector's needs, state supported advertisement campaigns, attracting FDI (particularly from renowned international hotel chains). However, with the post-communist reduction of the role of the state, we have observed that the most state governments in these transition countries, despite various incentives and policy statements, have shown an unwillingness or inability to invest significantly in the tourism industry or to secure significant international funding for it (Hall, 2001). Due to adverse features related to both supply and demand sides, the size of international tourism in overall economy is very small and if the governments do not implement some vigorous measures to stimulate the sector, the international tourism may keep its low profile. In sum, the neutrality hypothesis uncovered in this study is mainly due to insignificant share of the foreign tourism's contribution in overall economy for the majority of transition countries.

As touched above, we have observed that economic reform has stagnated in the majority of transition countries since the mid-2000s, even in countries that are still far from reaching the transition frontier. A comparison of economic freedom indicators as well as democratic freedom indicators from 1996 to 2012 is carried in a study titled "Transition Report 2013" prepared by European Bank. According to the report, Poland, Lithuania, the Slovak Republic, Slovenia, Croatia, Georgia, the Czech Republic and Romania has displayed somewhat superior dynamic performance in either economic or democratic (or both) indicators than the other countries in the transition region. In our study, the causal links working from economic freedom to foreign tourist arrivals are detected for Albania, Croatia, the Czech Republic, Georgia, Lithuania and Romania. High quality democratic institutions are prerequisites in achieving desired benefits accrued from implementing other reforms (including reforms in economic freedom). However, today none of the former Soviet Union countries has even moderately strong democratic institutions – with the exception of the three Baltic States, Estonia, Latvia and Lithuania (Peev and Mueller, 2012). Therefore, taken together, the majority of these transition countries may not have reached to a critical threshold point in their transition frontier curve; and therefore, the progress and depth of both economic institutions and the level of international tourism are not sufficient to generate intended gains.

Countries located in Central and Eastern Europe and Central Asia started a complex transition process just approximately 25 years ago. During these 25 years, these countries have implemented set of reforms involving almost all aspects of their systems, including political, economic, legal, administrative and societal. Therefore, the institutional configuration and its evolution for these nations should be assessed by considering the historical backgrounds of these nations. In particular, due to social, cultural and other forms of rigidities, democratic deadlocks and many other problems, the extensive transformation with this magnitude (switching from a socialist system to a market economic system) may require more time than 25 years. Related to the 25 years of transition process experiences for these nations, we need to enumerate three important points: (1) the structural transformation has not been fully completed for a large spectrum of domains, (2) the paths and the growth pace in the reform process display significant heterogeneous and volatile pattern among these nations, and (3) some transition countries have been more successful in the transformation process than others. These three points imply that the specific numeral value assigned as the economic freedom score may be indicative but may not be absolute.

7. Conclusion

This paper examines the causal links among economic freedom, foreign tourism arrivals and economic growth for 17 post—socialist transition countries by applying panel-Granger-causality tests over the data set from 1996 to 2012. Causality analysis provides predictive power for a variable based on knowledge of past values of another variable. The current study examines three sets of causality nexus: (1) economic growth and foreign tourist arrivals, (2) economic growth and economic freedom, and (3) economic freedom and foreign tourist arrivals. The empirical results support evidence favoring the neutrality hypothesis for all these three nexus. The lack of causality among these three nexus has some mechanical and also some interpretive implications. In a mechanical way, the neutrality between tourism and economic growth implies that increases in tourism arrivals to transition economies do not boost income levels directly or the increase in economic growth does not have meaningful effects in attracting more tourists. The same intuition can also be applied to the remaining two nexus. However, the advantages and multidimensionality of the tourism sector will make it remain crucial in the transition process over time. Given the historical, economic and political backgrounds of these transition countries, the lack of causality among these variables should be interpreted by considering these points.

Notes

(1) To see an extensive survey for the issue, see, for example, Brida and Pulina (2010).

(2) We refer an interested reader to Pablo-Romero and Molina (2013) for a very extensive review about the hypotheses.

(3) An extensive survey can be found in Seputiene (2007) and Doucouliagos and Ulubasoglu (2006).

(4) See Tamilina and Tamilina (2012, p. 5).

(5) In our case, we estimate the panel regression model by employing real income as the dependent variable and foreign tourism and economic freedom as the explanatory variables.

(6) In order to save space, we refer readers to Pesaran and Yamagata (2008) for details of Swamy's test and the estimators described in equation (7).

(7) In order to save space, the details of bootstrapping method is not outlined here. An interested reader is referred to Konya (2006) and Emirmahmutoglu and Kose (2011).

(8) The causality procedure employed here first requires determining the maximum integration degree (d) of the series. Following Emirmahmutoglu and Kose (2011), we investigate the time series properties of the variables by means of the unit root test by Dickey and Fuller (1981) and find out that d is equal to one for each country in our panel. In order to save space, we do not report the results from the unit root analysis here but are available upon request.

(9) According to the country reports by World Travel and Tourism Council, the shares of these four countries are: Albania (4.8%); Croatia (12.2%); Georgia (6.2%) and Hungary (4.1%).

(10) The mean of the economic freedom index in the Czech Republic and Lithuania was, respectively, 68.28 and 66.55 for 1996-2012.

(11) Based on country reports by World Travel and Tourism Council (2011), we calculate that the average spending per foreign tourist in these transition countries in our sample is about 400-500 US$ while the average spending for Spain, Greece and Turkey is around 800-1000US$.

(12) See OECD report: http://www.oecd.org/industry/tourism/40239491.pdf

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The main correlations between the monetary-banking indicators

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Abstract. *At the level of national economy, the essential problem is that of the use of financial resources. Of course, every society has its own resources, but that they are not always sufficient. To operate in a free market economy appears very often need to turn to the Bank's resources in the form of loans. Credit implies the existence of credit resources on the part of the banking system but, at the same time, it raises the question of the relationship between monetary mass in circulation and monetary mass necessary to ensure market equilibrium required.*

The banking system is defined and represented in the two sub-sectors, namely: monetary authorities that it is a country's National Bank and the system of commercial banks. Great economists have noted that the imbalance between the monetary mass necessary and the monetary mass in circulation may be, at some point, a problematic leading to financial crisis and broader financial and economic crisis.

In this article we try to make an analysis based on data sources that stand available to any researcher. Thus, as a first idea, we discuss about the Central Bank's balance sheet, one that offers the possibility of calculating the balance of equilibrium equation which shows a series of correlations are established on the market. The second source of analysis and interpretation of this market is the aggregate balance sheet of commercial banks. Based on this balance sheet is

calculated the balance sheet equation which can give an accurate picture on the ratio between the requirements and possibilities.
Also, in the article we referred to the monetary situation, especially consolidated monetary situation, one who has existing monetary mass market in passive, and international reserves and net domestic assets, in assets which are and must be in balance, i.e. the two indicators of assets must equal monetary mass so that no imbalances.
In the article, we refer to the main correlations between monetary aggregates to embrace the situation at a given time and to be able to conclude that evolution can be perspective in this area.

Keywords: monetary mass, correlation, balance sheet, the monetary aggregate, the monetary balance.

JEL Classification: E52, G17, G20.

Introduction

Monetary and banking statistics recorded an ascent over the past decades, together with the understanding and recognition of the monetary aspects of the four major imbalances: inflation, unemployment, the budget deficit and the balance of payments deficit. Monetary data analysis aims to evaluate the financial situation of the country in a way that makes it possible to assess financing options for national authorities, in line with the development of the real economy. Although there are still significant differences in terms of currency intervention on various manifestations of economic instability, outstanding advances have been achieved in the quantification of the various aggregates that allow the distinction of macroeconomic trends, connections between economic variables, financial and monetary.

The banking system is limited and assigned into two sub-sectors, namely monetary authorities (Central Bank) and commercial banks.

Statistical information of financial nature presents a few major advantages: they are available in a short period of time after the end of the reference period, shall be submitted for an itemized bill and contain a high degree of truthfulness.

By aggregating and consolidated accounts of banking institutions (at various levels) to obtain information the monetary issue, the monetary base, monetary mass, domestic credit and international reserves, allowing also make the connections with macroeconomic aggregates results, indicators of national public budget and balance of external payments. Thus, at the level of Central Bank analyzed monetary issue and the monetary base, while at the level of commercial banks is the process of creating a currency account (scriptural). Next, by aggregating the information provided at the level of the Central Bank and commercial banks, it follows what is called the „Monetary Situation", which outlines the volume and structure of monetary, credit and foreign exchange reserves of the country.

1. Literature review

Andrei and Bourbonais (2008), Anghelache and Anghel (2016) develop on the use of econometric instruments in economic analyses. Angelini et al. (2014) approach the correlation between capital requirements and monetary policy, Angeloni and Faia (2013) further develop on the case of fragile banks. Anghelache and Anghel (2016, 2015), Anghelache et al. (2013), Anghelache and Capanu (2004), Anghelache (2008), Anghelache (2007), are reference works in macroeconomic statistics. Anghel (2015) studies the structure of monetary mass that characterizes the Romanian economy since gaining the EU membership. Anghelache and Manole (2016) apply regression to study the relation between monetary situation and payments balance. Anghelache et al., (2016) present a model for financial and monetary studies. Anghel (2015) studies the principles and instruments of financial-monetary analysis. Anghelache et al. (2016), Anghelache (2011) describe the economic modeling, from theoretical and practical viewpoint. Barro and Ursua (2008) realize a historical analysis of macroeconomic crises from 1870 on. Mankiw (2016) is an in-depth study on macroeconomics. Păunică (2014) presents the financial indicators related to projects developed for infrastructure in Romania. Smets (2014) evaluates the intensity of the correlation between financial stability and monetary policy. Taylor and Williams (2010) present a set of recommendation for the monetary policies. Anghelache et al. (2015) analyze some aspects of the macroeconomic monetary situation of Romania. Curdia and Woodford (2010) study the correlation between credit spreads and monetary policy. Blake and Kirsanova (2011) develop on the impact of inflation conservatism and policy in monetary and financial areas. Eichenbaum et al. (2017) evaluate the predictable character of nominal exchange rate, corroborated with monetary policy. Anica-Popa and Motofei (2010) study the indicators correlated to infrastructure and construction projects. Fuster et al. (2010) analyze the fluctuations at the macroeconomic level. Further aspects on monetary policies and their impact are presented by Gertler and Karadi (2015), Quint and Rabanal (2014), Van der Ghote (2016). Savor and Wilson (2013) research the investor’s awareness and attitude towards the risk occurring at the macroeconomic level. Ilzetzki et al. (2013) analyze the magnitude of the fiscal multipliers. Gilbert (2011) studies the informational aspects of macroeconomic announcements. Svensson (2014) is preoccupied with inflation targeting.

2. Research methodology and data

In the analysis of the main connections between data sources and the monetary and banking, we use synthetic synthetic documents established in the Central Bank and commercial banks. These are included in the balance sheet of the Central Bank, on the one hand and the aggregated balance sheet of commercial banks, on the other hand. In the structure of these two balances, compared with consolidated monetary situation, extract elements of mathematical formalization of the correlation (using existing interconnections).

3. Central Bank balance sheet

Monetary issue (EB) and the monetary base (BM) are monetary aggregates which are determined at the level of monetary authorities (Central Bank), with the Bank's balance sheet data source. Through the function of broadcast and, implicitly, by the lending of the economy, the Central Bank has a primary role and mostly in monetary creation process with direct and indirect implications on important economic objectives: full use of labor force growth, inflation, and economic stability.

Synthetically, the Central Bank balance sheet is presented as follows:

Assets	Liabilities
1 Foreign assets -AE$_E$ **2 Domestic assets -AI$_E$** **A Government loans - CGe** **B. Loans to commercial banks -CB**	1. **Foreign liabilities - PE$_E$** 2. **Domestic liabilities - PI$_E$** A. **Monetary** Base **- BM** **- Monetary issue -N** **= Cash population –N** **= Cash in cash offices of commercial banks -C** **- Reserves of commercial banks at the central bank -R** B. **Public deposits (government) -DG$_E$** C. Other liabilities **(net) -APN$_E$**

Balance sheet equation is:

$$AE_E + CG_E + CB = PE_E + N + C + R + DG_E + APN_E \quad (1)$$

This balance sheet presents a collection of the main monetary authorities accounts, regrouping required for submission of further information and the construction of the monetary situation.

- Assets part contains three main ways that the central bank creates money.
– Foreign assets (AE_E) include assets to which the non-resident trader is final debtor: reserve of gold, foreign currencies, foreign currency deposits held abroad, special drawing rights, the reserve position at the IMF. The foreign assets represents, in general, international reserves established and administered by the Bank of issue in order to ensure that national monetary authorities ' reaction to actual or potential imbalances in the field of foreign payments and the stability of the exchange rate through intervention on the foreign exchange market.
– Government loans (CGE) granted by the Bank of issue are made up of direct financial obligations of the Central Administration of the monetary authorities in the form of bills, certificates, Treasury effects, loans and advances to the State Treasury.
– Loans to commercial banks (CB) aimed at ensuring the necessary liquidity at the level of the latter, through the process of rediscount. The counterpart of this post of a Central Bank in aggregate balance sheet of commercial banks, as liabilities (credits received from the Central Bank or refinancing loans).

- In the liabilities of the Central Bank's balance sheet included positions regrouping commitments (obligations of) monetary authorities and expressing the size and distribution of the primary currency holders. The main passive post is (BM) which includes monetary issue (EB) and compulsory reserve of commercial banks to issue Bank (R).

BM = EB + R.

The Bank's monetary or primary currency is therefore a currency issued and controlled by the Central Bank through which supplies banking system so that commercial banks can repay (banknotes) amounts deposited into the accounts of economic operators and of the population.

- Foreign liabilities (PE) include all monetary obligations to nonresidents (deposits created from external loans).
- Public Deposits (DGE) on the bank of issue are obligations of the monetary authority to the central government (availability of extra-budgetary funds and existing at a time).
- Other liabilities (net) is a residual post.

In conclusion, the monetary base is the most important counterparty post of the total net assets of the bank of issue:

BM = Amount Assets - Liabilities Amount included in BM.

That any changes in the assets and liabilities of the bank of issue can indirectly influence monetary base dimensions. Thus, any asset growth leads to increased BM, while increasing liabilities involves lowering BM. The last relation can be written as:

$$BM = (AE_E - PE_E) + (CG_E - DG_E) + CB - APN_E = AEN_E + CGN_E + CB - APN_E \quad (2)$$

It explains the three determining causes of currency issue:

- increase of net foreign assets (AEN_E); n this way, monetary issue is caused by increased foreign reserves by foreign loans and purchase of foreign exchange by the central bank;
- increase of net government credit (CGN_E); it appears to cover the budget deficit resulted from the existence of a time lag between budget expenditures and revenues at risk; generally, financial situations materialized by the budgetary imbalance (DB) is a prerequisite imbalance monetary causal relationship can be expressed by the relation:

$$DB = CB - VB = \Delta BM + \Delta DP, \quad (3)$$

where:
CB – budgetary expenditure;
VB – budget revenues;
ΔBM – monetary base growth;
ΔDP – public debt growth.

- growth of loans to commercial banks by the central bank (CB) in order to meet liquidity demands arising from banks holders of debit balance in its relations with other banks in the money market.

Through monetary base, the central bank controls the monetary creation process in the banking system, process quantified by reserve money multiplier (m).

$$m = \frac{M_2}{BM} \quad (4)$$

BM multiplier expressed the growth of the monetary mass in the broad sense (M2) to increase by 1 leu BM.

4. Aggregated balance sheet of commercial banks

Commercial banks also have, in addition to the bank of issue, a consideration in money creation, which are banks creating scriptural money or account. Commercial banks are characterized by basic operations represented by the formation of deposits (monetary resource mobilization) and their use in order to grant loans. It creates so, scriptural money (or account) through a multiplication process credit playing a very important role in saving-investment relationship, relationship decisive for growth.

Synthetically, the aggregated balance sheet of commercial banks is presented as follows:

Assets	Liabilities
1. Foreign assets - AEc 2. Domestic assets - Ale A. Non-government loans - CNG - to companies - to households - other loans B. Government loans - CGc C. Reserves of commercial banks at the central bank - R D. Cash in cash offices of commercial banks - C	1. Foreign liabilities-PEc 2. Domestic liabilities - Pic A. Sight deposits - DV B. Savings population - EP C. Term deposits – DI D. Residents' Foreign currency deposits -V E. Public deposits - DGc F. Loans from Central Bank - CB G. Other liabilities (net) - APNc

Balance sheet equation is:

$$AE_C + CNG + CG_c + R + C = PE_C + DV + EP + DT + V + DG_C + CB + APN_C \quad (5)$$

The balance presents a consolidated situation of accounts in commercial banks. The most numerous posts in the table pose no need for additional statements, having a content similar to posts of monetary authorities. As passive operations we can enumerate deposits, and own capital, and as active operations we outline the governmental credits.

5. Monetary situation

Monetary situation (SM) shows how the economy, starting from the monetary base procure means of payment, which constitutes what is called "money". This makes it appear to the financial relationships between the Group of banking institutions (Central Bank, commercial banks), which provides the means of payment in the economy and the other economic subjects (businesses, public institutions, population). The major purpose of the SM is to allow analysis of the monetary aggregates, including inter-sectorial funding and links appearing in dealing with other macroeconomic aggregates.

The indicators are obtained from MS by aggregating and consolidation of information contained in the Central Bank's balance sheet and in the aggregate balance sheet of commercial banks.

$$AE_E + CG_E + CB = PE_E + N + C + R + DG_E + APN_E \quad (6)$$

$AE_C + CNG + CG_C + R + C = PE_C + DV + EP + DT + V + DG_C + CB + APN_C +$

$AE_E + AE_C + CG_E - DG_E + CG - DG_C + CNG =$

$PE_E + PE_C + N + DV + EP + DT + V + APN_E + APN_C$ (7)

or

$AE + CI = PE + M2 + APN$ (8)

The following is presented schematically SM, built so that interbank flows have been eliminated.

Assets	Liabilities
Foreign assets **- AE** Domestic assets **– AI** - domestic credit **-CI** **= non-governmental credit -CNG** **= government credit - CGN**	Foreign liabilities **- PE** Domestic liabilities **- PI** **-monetary mass - M2** **= Narrow monetary mass - M1** **cash outside the banking system -N** * **Available funds -DV** * **= quasi-currency – QM** * **population savings –EP** * **term deposits –DT** * Residents' Foreign currency deposits **-V** - Other liabilities **(net) -APN**

It is noted that the monetary mass is presented as a heterogeneous size consisting of all assets that can be used to purchase goods and services and for the payment of debts. In other words, monetary mass is all the means of payment, respectively liquidity, existing at some point in the economy. It includes:

- narrow monetary mass – M1, i.e. cash outside the banking system (fiduciary currency) and availability, they exhibit a high degree of liquidity;
- quasi-currency – QM, which includes the population's savings, time deposits, foreign currency deposits of non-residents, they exhibit a low degree, as they are not directly usable as a means of payment, but can be relatively easily converted into currency by their keepers.

In practice, it builds, also, strengthened monetary situation (SMC), which is as follows:

Strengthened monetary situation

Assets	Liabilities
Net international reserves -RIN **Net domestic assets -AIN** **- domestic credit -CI** = net **government credit -CGN** **= non-governmental credit –CNG** **- other assets (net)-AAN**	**Monetary mass -M2**

Identity obtained describes the steady state in the banking system:

$M2 = RIN + AIN.$ (9)

Net international reserves currency means that a country has to support its balance of payments, either via direct funding or by means of intervention aimed at influencing the exchange rate of the national currency. Net international reserves are simply no difference between foreign assets and liabilities. They represent the difference between foreign reserve assets, immediately available in case of need and short-term foreign currency liabilities.

Domestic credit includes all loans of the banking system to the government, economic agents, population. All loans that banks allow them to other banks (for example, credit is granted by the Central Bank to commercial banks) disappear in the consolidation process.

Government credit is likely net so it is the difference between government credit and public deposits. Therefore, when the governmental credit net is negative, it appears that the Government is the lender and otherwise, net debtor. This treatment makes it easy to measure the impact of government operations on the Central liquidity in the economy, which is reflected in the structure of Government credit net public by measuring public debt, budgetary surpluses and deficits of the (State budget, local budgets, social insurance budget) and net deposits of extra-budget funds.

6. The connection between monetary situation strengthened (SNIC) and balance of payments (BP)

We have shown the connection between the report saving/investment, on the one hand, the current account balance of the BP (net external debt), on the other hand.

$$VND - ABS = EN - FNC = SCC = - SF = - \Delta DEN. \qquad (10)$$

The increase in net foreign debt ***(ΔDEN)*** has the effect of either increasing net indebtedness to non-banking sectors (private and government sector) - $\Delta DEN_{PG,}$ modification of net international reserves of the banking sector. Accordingly:

$$\Delta DEN = \Delta DEN_{PG} - \Delta RIN. \qquad (11)$$

The identity of expressing the steady state in the banking system (M2 = RIN + SID) transferred to the dynamic ($\Delta M2 = \Delta RIN + \Delta AIN$) and replaced the previous relation leads to an equation that can be identified by the approach of the balance of payments monetary.

$$\mathit{VND\text{-}ABS{=}\text{-}\Delta DEN{=}\Delta ARIN}\text{-}\ \Delta DEN_{PG} = \Delta M2\text{-}\Delta AIN\text{-}\ \Delta DEN_{PG}, \qquad (12)$$

or

$$VND + \Delta DEN_{PG} - ABS = \Delta M2 - \Delta AIN = \Delta RIN,$$

This latter relationship indicates that any excess of the expansion of domestic credit (which forms the largest part of net domestic assets) than increasing dizer currency will dissipate in excess of absorption (consumption) over national disposable income and foreign loans granted system nonbank, leading to a reduction in net international reserves. This approach emphasizes the key role of domestic credit creation in the interpretation of the balance of payments.

However, the relationship clearly shows the main sources of financial support for growth: domestic loans, foreign reserves of the state and foreign loans.

7. The main correlations between monetary aggregates

Major monetary correlations must ensure at the same time the increase of GDP growth in real terms, monetary mass and credit, reducing inflation and stabilizing the exchange rate in relative terms.

- The faster growth of monetary mass, compared to the annual inflation rate confirms the real growth of the money stock and continuing re-monetization of the economy process. This trend has the effect of increasing savings and domestic credit, thus supporting economic recovery and growth process.
- The faster growth of population savings than monetary mass and non-governmental credit. This correlation has the effect of maintaining confidence in the national currency, thus showing that forcing credit and monetary mass leads to inflation deviations.
- Growth in broad monetary mass (M2), faster than the narrow monetary mass (Ml) and than the monetary base as quasi-money (especially population savings) have an inflationary character.
- Keeping interest rates to levels higher than the inflation rate and the depreciation of the national currency (real positive interest), so be discouraged keeping currency. Of the fundamental macroeconomic variables, the monetary mass correlate primarily with GDP.

Milton Friedman, studying the evolution of monetary circulation in the U.S., over a period of nearly a century, consisted of the long-term existence of the objective of a stable correlation between size of Gross Domestic Product and the size of the monetary mass. Accordingly, in order to ensure a harmonious development of economic life, Friedman recommends ensuring an average annual growth of the monetary circulation rate (5-6% in conditions). This increase should be applied on a permanent basis without taking into account certain cyclical developments. The action of this long-term growth rates, coupled with the trend of economic growth, is provided basic monetarist concept of ensuring monetary equilibrium.

However, short-term correlation between money supply growth (RM) and the growth rate of gross domestic product (RPIB) have completed at least one variable (change in average interest rate -ΔRD) so that:

$$\mathrm{RM_n} = \mathrm{f}(\mathrm{RPIB_n}, \frac{1}{\Delta \mathrm{RD}}), \quad (14)$$

where:

$\mathrm{RM_n}$ – the growth rate of nominal monetary mass;

$\mathrm{RPIB_n}$ – the nominal growth rate of GDP.

In other words, monetary mass grows with nominal GDP growth and interest rate decrease. In real terms, the correlation becomes:

$$\mathrm{RM_r} = \mathrm{f}(\mathrm{RPIB_r}, \mathrm{RI}, \frac{1}{\Delta \mathrm{RD}}), \quad (15)$$

where:

$\mathrm{RM_r}$ – the growth rate of real monetary mass (calculated using the GDP deflator);

RPIBr – the growth rate of real GDP;
RI= the inflation rate, calculated on the basis of GDP deflator.

8. Conclusion

From the way in which we presented the data in this article, it appears clear that between the money and needed at the level of national economy there is a close interconnection.

The correlations established between the two money and banking elements lead to the conclusion that macroeconomic Central Bank should have a leading role and to pursue through the levers at its disposal to obtain and achieve equilibrium. Correlations help to identify if certain circumstances arise imbalances and based on them to provide measures to achieve macroeconomic balance. Article has a theoretical content, but of course can be extended through an analysis using data provided by the National Bank which will give certain sizes of indicators which reflect the correlations between monetary mass or, better said, of the macro-economic monetary aggregates. For a more extensive analysis, these connections and correlations are determined will be synthesized into a model of analysis of the main connections that exist at the macroeconomic level in the field of monetary aggregates.

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Impact of governance on budget deficit in developing countries

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Abstract. *Since 1980s, many fundamental changes have been experienced in many areas especially in economy and politics. Financial administration was also affected by this change. In this regard, traditional administration mentality was re-interpreted as a transparent, accountable and participant manner based on rule of law. Studies on the political determinants of budget deficits are heavily focused on political behaviours. There is a gap in the literature in the issue of relationship between budget deficits and governance which represents an administration approach based on specific principles as different from political behaviours. This study analyzes the relationship between budget deficits and governance through panel data analysis in 123 developing countries for 2002-2014 periods.*

Keywords: governance, budget deficit, institutions, developing countries, panel data.

JEL Classification: H11, H62, H68, H87.

1. Introduction

Budget deficit is one of the most important macroeconomic problems which have been debated in academic and political platform since 1970s. Budget deficits which gradually increase in many countries, especially in developed countries, are regarded as a problem which restrict the efficiency of economic policies of governments in their struggle against such macroeconomic problems as unemployment and inflation.

It is seen that studies on budget deficits and its determinants have been focused on macroeconomic indicators until 1990s. After some authors such as Roubini and Sachs (1989a, 1989b) and Alesina et al. (1989) supports the idea that macroeconomic indicators are not solely adequate in order to explain budget deficits, the interest towards the impact of political and institutional factors on budget deficits. In this regard, Roubini and Sachs (1989a, 1989b), Alesina and Drazen (1991) and Spolaore (1993) analyzed the impact of single-party governments and coalition governments on budget deficits. In addition to the studies on the relationship between political, opportunist, partisan behaviours and budget deficits, the number of studies on the relationship between budget deficits and political factors such as political stability, ideology of government parties and the number of authorities, which are effective in financial decisions, has been increasing.

It is seen that analyses on budget deficits are focused on various political behaviours. Moreover, there is an outstanding gap in the issue of analyzing the impact of existing administration/governance mentality as independent from political behaviours. There has been a change in governance mentality in almost every area from company management to state government in 1980s in some developed countries and commonly in early 1990s. This change suggests that administration will turn into a mutual process where the relevant stakeholders are included, instead of a traditional, unilateral and hierarchical structure. This fundamental change in administration mentality has also been reflected on fiscal administration and economy administration.

This study analyzes the impact of governance on budget deficits. Firstly, models which analyze political and institutional determinants that are effective in budget deficits have been handled; empirical studies have been analyzed and literature abstract has been included. Application phase of the study analyzes the relationship between budget deficits and governance regarding 123 countries which are accepted by IMF as developing countries for 2002-2012 period through panel data analysis method.

2. Political and institutional factors determining budget deficits

Budget deficit subject has been considered as one of the most important macroeconomic problems since 1970s. Therefore, it has been the subject of numerous studies. A significant part of these studies focused on political and institutional determinants of budget deficit and various models have been developed. These models have briefly been mentioned.

2.1. Tax smoothing model

Tax smoothing model[(1)], which was developed by Barron (1979) and Lucas and Stockey (1983), is assumed as an optimization process that minimizes tax collection costs by smoothing government's marginal tax rates intertemporally (Bohn, 1998: 951). In this context, to perform the level of expenditure targeted by the government is possible by fixing the tax rates, preventing expenses shocks and optimal financing. Since financial optimization protects the budget balance, budget deficit reveals only in unforeseen expense or income cases or when faced with temporary shocks (Franzase, 2001: 5). Barro (1986 and 1987), suggests that tax smoothing model is not only normative but it also has a positive side that explains the fiscal policy (Alesina and Perotti, 1994: 4). However, different from other political models this model accepts budget deficits as a normative assessment (Pinho, 2004: 4).

Tax smoothing model that makes a distinction between permanent and temporary effects of public expenditures and economic activities has been tested with various empirical studies. Bohn (1990) suggested that tax smoothing model cannot be rejected according to the trend that taxes followed in the US after World War II; Huang and Lin (1993) suggested the existence of tax smoothing hypothesis for the period between 1929 and 1988. Ghosh (1995) concluded that there is a clear relationship between intertemporal tax smoothing model and the trend of budget surplus and expected public expenditures for Canada (the period 1962-1988) and the USA (the period 1961-1988). Adler (2006) concluded that tax smoothing model cannot be rejected in Sweden for the period 1952-1999 whereas it is invalid for the period 1970-1996. Roubini and Sachs (1989a) stated that tax smoothing model does not take differences in the size of budget deficits in OECD countries into account and it is insufficient to explain the steady increase in tax rates in these countries. For Australia, Kingston and Layton (1986), who address the 1964-1995 period, support the hypothesis while Olekalns (1997), who examines the same period, stated that economy is too unstable for tax smoothing model to be valid. Roche (2001) rejected the hypothesis in Brazil for the period 1970-1994.

2.2. Models based on government structure

Roubini and Sachs (1989a), who examined the impact of the government structure in the budget deficit, developed index of political dispersion to measure the type of government in power. This index divides the type of government into three. The first one is bipartisan parliamentary government or presidential government where there are different parties under the control of the executive and legislative; the second one is parliamentary government with three or more coalition partners; the third one is minority parliamentary governments. According to Roubini and Sachs (1989a), relatively weak governments lead to more budget deficit. In contrast, single-party majority governments are strong government structures that can control parliament in the face of opposition on budget policies subject. In theoretical model proposed by Hahm (1996), different from Roubini and Sachs (1989a), political systems are examined in three units as presidential government, stable parliamentary (one-party government) and unstable parliamentary (coalition government). Roubini-Sachs approach is valid in unstable parliamentary systems but in a stable parliamentary system, government power does not have a systematic impact on the budget deficit (De Haan et al., 1999: 166).

Alesina and Drazen (1991) developed “war of attrition model” for coalition governments. According to the model, there are impacts of policies on income distribution, that are implemented to prevent budget deficit and government partners show a resistance not costs of policies implemented to reflect on their grassroots. Thus, the stabilization process turns into a “war of attrition” in which each partner finds it rational to leave the other out. Stability can be achieved when a group imposes the burden of financial regulations on others (Alesina and Drazen, 1991: 1). In this respect, Roubini and Sachs (1989), support the weak government model. Spolaore (1993) approached political systems as majority systems that there is only one party who has veto power and coalition systems that all parties have veto power. It is emphasized that (Pinho, 2004: 19-20) there may be a trade-off between relative inaction of coalition governments for implementation of stability programs to correct budget deficit and partisan overreaction of single-party governments.

2.3. Opportunistic political behaviour models

Opportunistic behaviour models developed under public choice theory are based on the assumption that politicians prioritize political benefits rather than social benefits and voters are myopic. Opportunistic political cyclical periods model is based on Northaus’s studies. According to Northaus (1975: 174), during their term of office, ruling parties prefer policies that maximize their majority in the next elections. Until 1970s, it has been discussed that unintentional decisions of well-intentioned politicians caused macroeconomic fluctuations and it has been suggested that budget deficit was used by governments on purpose in order to ensure political supremacy in the short term (Bakırtaş, 1998: 48).

Opportunistic political model that was developed with adaptive expectations assumption was reconsidered to include rational expectations in the late 1980s by such authors as Cukierman and Meltzer (1986), Rogoff and Sibert (1988), Persson and Tabellini (1990) and rational opportunistic models have been developed. These studies accept that the basic motivation of politicians is to remain in power. Politicians implement policies of budget deficits to be re-elected especially in pre-election period.

2.4. Partisan political behaviour models

Some authors assume that politicians consider their political and ideological objectives in a strategic manner while making decisions on taxation, expenditures and monetary expansion (Edwards, 1994: 236). According to basic hypothesis of Hibbs (1977) on partisan behaviours of politicians, parties competing for votes take the priorities of those they represent and support them into account, if elected (Brauninger, 2005: 409). According to Hibbs, while left parties that socialist groups or working class support give priority to full employment in economic policies, parties that appeal centres and conservative base give place to price stability as a priority in economic policies. The reason of this is that supporters of left parties consist of mid-low income group (labour groups) who pays the cost of unemployment in the most painful way. Supporters of right-wing government are high-income class (business focused/ capital owner groups) who feels cost of inflation even worse (Farah, 2010: 158).

Based on assumptions of partisan models, “rational partisan model” including rational expectations has been developed by Alesina (1987, 1988), Chappel and Keech (1986). According to rational partisan models, political cycle causes unemployment and fluctuations in inflation if there are uncertainties regarding the outcome of future elections while wage contracts are renewed at regular intervals (Alesina, 1987; Alesina et al., 1992). In both models of Chappell-Keech and Alesina uncertainties related to elections may cause temporary fluctuations in unemployment in the presence of long-term wage contracts (Veiga and Chappell, 2002: 263-264).

2.5. Models related with budget authority

Studies focused on the effects of behaviours of politicians and voters on budget deficits have been suggested to be insufficient for explaining the differences of budget deficits between the countries and periods. This insufficiency has been tried to be covered by models that examine the impact of budget institutions (Pinho, 2004: 21). Budget institutions cover all the rules and regulations for planning, approval and implementation of the budget. In general, there are two types of budget institutions: laws stipulating numerical targets for budget and procedural rules (Farah, 2010: 158). These institutions vary from one country to other. Therefore, budget institutions may be the potential explanatory for budget deficits and the difference of debts between the countries (Alesina and Perotti, 1994: 34-35).

De Haan et al. (2013: 424) argued that effects arising from the conflict between the parties and partisan behaviours on budget deficits could be prevented through budget institutions. Budget institutions may contribute to the success of fiscal policy through ensuring fiscal discipline and determination of the rules of the game. Hallerberg et al. (2007) stated that different approaches (the contract and delegation approach) for different types of government may be preferred concerning the budget institutions. Shepsle (1979) mentioned that structures that were made by some procedural institutions might help in solving the problem of Arrow deadlock that emerged in legislation.

2.6. Models based on the strategic use of loan

According to Persson and Svensson (1989: 325) the ruling parties may use loan as a strategic tool, if they foresee that they will lose elections and a new government with different goals will be established. The ruling party tends to loan by taking the level of debt that future government will take over into account and increase the budget deficit. Thus, as a result of increased interest payments of future public debt and aims to reduce the amount of public revenue dedicated to the provision of public goods.

According to Tabellini and Alesina (1990: 37), a social choice between the current and future power problem occurs through the reduction in support for the ruling party. Time inconsistency caused by this problem determines the size of the budget deficit or surplus. If future power demonstrates different choices, policies required by current majority cannot be executed in the future. This situation encourages current majority to select a loan policy that is not optimal for whole society. Deviation from optimality may reveal as excessive budget deficit or surplus.

Although loan is a financing tool that is used to cover public expenditures, it is also a fiscal policy tool that makes economic intervention possible for the state (Çiçek et al., 2010: 142). Governments that stipulate to lose elections may seek to strategically increase budget deficit to restrict the economic opportunities of future government or resources that can be used for undesired policies. This situation shows that economic intervention will be possible through budget deficit even in the future.

2.7. Intergenerational income distribution related models

Cukierman and Meltzer (1989: 713) focused on the effects of public loan on income distribution through budget deficit and surplus by stating that public expenditures have functions of provision of public goods and redistribution of income. They divided the society into two sections as riches and poors and assumed that there are differences between the policies of governments that both sides support. While riches are indifferent about loan, poors support loan and thus budget deficit policies. If the majority of society is composed of poors or a government supported by poors is in power, budget deficit may increase because public expenditures will be financed with more loans (Güvel and Koç, 2011: 239).

According to Alesina and Perotti (1995b), the fact that next generation does not have a choice has an extremely powerful effect in the implementation of public debt that transfer income from next generation to the current generation. Tabellini (1991: 340) stated that budget deficit is not only a tool of between generations; it is also an income transfer tool from the rich to the poor. In budget deficit policies (in financing transfer expenditures through loans) that increase social transfers and applied by politicians supported by poors, income transfer is carried out both between generations and from the rich to the poor.

3. Budget deficits and governance

There has been a rapid and fundamental change in many areas, especially in economy and politics in the world since the 1980s. This change has led to the emergence of new discussions on the role of government, economic policies and public financial administration systems (Eroğlu, 2013: 141). It has been raised to restructure the hierarchical only one-way structure of the current government approach from top to down as double-sided based on reciprocity. In the early 1980s new insights for the public administration and governance reform have been adopted, which is known as "new public management" especially in Australia, New Zealand, UK, USA and some other countries (Rondinelli, 2007: 4). In this regard, as a model that the citizens, private sector and civil society organizations are all included in the traditional decision-making process, the public sector is more efficient, transparent and is open to inspection, governance approach has gained acceptance in many countries. With this approach, it has attempted to develop a governance approach that sections affected by public decisions are incorporated into the decision-making process and the quality of public services increased by improving productivity.

The concept of governance as it has its scope today started to be treated as a popular issue in entire world by being in the agenda first in northern Europe (Gaudin, 1998: 47) and then by the World Bank (1989) 's report. In Sub-Saharan African countries report(2), World Bank showed a new development approach which is based on the idea that economic development cannot be achieved unless governance, rule of law and democracy did not reach a certain level (Bovaird and Löffler, 2009: 216). After World Bank identified the current situation in Africa as a "governance crisis", the term "governance" has become a part of development policies especially in the least developed countries (Pagdem, 1998: 7).

Politicians and academics broadly discuss governance concept and there is not a specific definition for that on which there is a strong a consensus (Kaufmann et. al., 2011: 222). Despite the lack of generally accepted definition of the governance concept, some principles are determined to measure and strengthen governance. In this context, the most commonly used principles are participation, rule of law, transparency and openness in decision-making, accountability, predictability or consistency and effectiveness. International organizations are united in the idea that these are the principles for the basis of sustainable development (Caluser and Salagean, 2007: 12). In addition, governance indices have been developed by various international organizations for measurement of governance, monitoring the development of it and making comparisons between countries. In this study, Global Governance Indicators indexes, which have been developed by World Bank, are used. These indicators are very attractive for researchers since they are prepared extremely carefully and meticulously, have global coverage area and achieved with maximum precision (Thomas, 2010: 33).

Worldwide governance indicators consist of six indexes. Voice and accountability index covers perceptions on such as freely participating of citizens in political elections in a country without exposing to pressure, citizen’s freedom of expression and association and freedom of the press. Political stability and absence of violence index measures the perceptions on some possibilities, such as destabilization of the government in power through unconstitutional means or terrorism and/or violent means. In the scope of government effectiveness index, some data are combined, related to the subjects such as the quality of public service delivery and bureaucracy, the quality of the civil service and independence of these services from political pressures and confidence in the policy that the government commits. Regulatory quality index measures the ability of government to develop and implement healthy policies and regulations that allow and encourage the development of private sector. Rule of law index shows the perceptions on subjects, such as confidence of citizens in society rules, implementation quality of contracts, property rights, the quality of the police and the courts and possibility of crime and violence. Control of corruption index shows the perceptions on subjects, such as the use of public power to ensure private interests from the biggest to the smallest form of corruption and the use of state possibilities for elites and special interest groups (Kaufmann et al., 2004: 2; Kaufmann et al., 2011: 223).

Governance is also used as a special term that explains the change in the nature and role of the state by reforms carried out in public (Bevir, 2009: 3). With this aspect, as a management approach that shapes political behaviors beyond the political motivation, it is an issue that concerns public policies deeply. While economy political analysis made on budget deficits are focusing on political behaviors, an important lack of effect of governance reflects in the literature.

It is observed that empirical studies examining the relationship between governance indicators and economic performance focused especially on the subjects, such as economic growth (Barro, 1996; Gani, 2011; Yarrabati and Hawkes, 2015; Omoteso and Mobolaji, 2014; Olson et al. 2014; Alfaro et al. 2008; Huynh and Chavez, 2009; Butkiewicz and Yenikkaya, 2006), development (Bulte et al. 2005; Swapoop and Rajkumar, 2002), foreign trade (Baier and Bergstrand, 2007), direct foreign investments (Globerman and Shapiro, 2003; Jansen, 2003; Lambsdorff, 2003), domestic investments (Aysan et al., 2006; Aysan et al., 2007; Tanzi and Davodi, 1997) and income distribution (Alesina and Perotti, 1996; Belletini, 1998). The studies that examine the relationship between these indicators and budget deficits are very limited.

4. Summary of literature

In recent years, there has been a widespread opinion in the literature on budget deficits that political and institutional determinants should also be taken into consideration and included in the analysis besides the economic determinants of budget deficit. Political economy theories suggest that political and institutional factors may be important for budget deficits.

Authors start with Roubini and Sachs (1989a) and Grilli et al. (1991) and the followings examined the relationships between political variables and budget deficits (Romer, 2006: 598). These are considered as the pioneer works in this area. Some of the empirical studies carried out on the political and institutional determinants of budget deficits are covered in the appendix of this study. In these studies, such subjects have been examined as government structure with budget deficits, power time, the ideology of the ruling party, the presence of opportunistic and partisan political cyclical waves. Unlike before, the effect of management approach on budget deficits has been examined in this study. This study is expected to contribute to fill the conspicuous gap in the literature on the relationship between governance and budget deficits. A summary of the literature on empirical studies on political and institutional determinants of budget deficits is presented in the Table 1.

Table 1. *Empirical studies related with political and institutional determinants of budget deficits*

Author	Publication Year	Basic Results
Roubini and Sachs	1989a	Political factors affect budget deficits. Budget deficits are smaller in powerful governments while they are bigger in weak governments (short-lived and coalition governments).
Roubini and Sachs	1989b	The size of the public deficits is related with economic and political characteristics of the countries. Political consensus is required to reduce public deficits. Debt/GDP ratio is increasing much faster in countries with coalition governments.
Grilli, Masciandaro and Tabellini	1991	Proportional electoral system and short government terms have effect on fiscal indiscipline. There is a higher public debt stock in the countries with minority governments and coalition governments.
Edwards and Tabellini	1991	Unstable political environment (seigniorage) were determined to be more prone to inflation tax. No evidence could be found relating to the same conclusion about weak governments. Political instability is one of the reasons of public deficit.

Author	Publication Year	Basic Results
Cukierman, Edwards and Tabellini	1991	Political instability is one of the most important factors affecting seigniorage income. Seigniorage income of governments increases as political instability increases.
Crain and Tollison	1993	Political instability has negative impact on variability (volatility) of budget balance. The volatility of public deficit is higher in provinces with a greater change frequency of governments. As a result political stability is important for fiscal policy.
Edwards	1994	Ideological differences may have significant effects on economic policy in developing countries. Political budget cycle is valid in Chile in the analysed period.
De Haan and Sturm	1994	Increase in public debt is positively related with the frequency of government changes whereas it is negatively related with strong budget procedures. Besides, increase in public expenditures wave higher during leftist governments in these countries.
Alesina and Perotti	1995a	Single-party governments are more successful than coalition governments in the area of financial regulations.
Alesina and Perotti	1995b	Government types show different degrees of success in financial compliance applications and coalition governments are their most unsuccessful ones. There is no difference between the right and left parties in single-party governments in terms of the success of financial regulations.
Haan, Sturm and Beekhuis	1999	The number of political parties in government (coalition government) affects the increase in public debt. No effect of political variables on budget deficits was encountered.
Kontopoulos and Perotti	1999	While the number of parties in the government increases a looser fiscal policy is applied. There is a significant presence of relationship between the number of parties in the coalition and budget deficits & expenditures.
Schuknecht	2000	Weak institutional structures in developing countries facilitate the election-oriented fiscal policies. To prevent opportunistic policies toward elections, discretionary spending policies and institutional mechanisms strengthening financial control are important.
Bussiere and Mulder	2000	Political stability has a strong influence on economic fragility in countries with weak economic fundamentals and low reserves. Coalition governments are less successful than single-party governments in achieving desired financial reforms due to long duration of reconciliation between partners.
Tutar and Tansel	2000	According to annual data: - Budget deficit increases as the number of parties in the coalition and financial authorities increases. - There is no impact of the elections. - Coalitions, military coups, oil crisis, the Cyprus Peace Operation and the fight against terrorism has significant and negative impact on budget deficits According to quarterly data. - Elections, the number of parties in the coalition and the number of fiscal authorities partly affect budget deficits. According to monthly data. Elections have a significant and negative effect on budget deficits (all budget lines except investment).
Telatar	2000	Manipulative (opportunist) and political surf hypothesis have not been confirmed. This is shown as because data used by the peculiar structure of Turkey's economy are chosen as policy objectives (inflation target) and not including in the analysis the variables that governments can directly control such as public expenditures, transfer expenditures.
Freitag and Sciarini	2001	A very small part of the political and institutional factors affect the budgetary performance of the EU countries in this period. There is a strong correlation between political stability (the number of government changes) and budget deficits.
Bradbury and Crain	2001	The lower parliament volume has an increasing effect on public expenditures whereas the higher parliament volume has a decreasing effect on it.
Acosta and Coppedge	2001	Governments tend to increase public deficits in election years. Political institutions have an impact on economic performance.
Tepe	2001	Ricardian equivalence hypothesis was rejected due to missing money markets, liquidity constraints and differential loan rates.
Acemoglu et al.	2002	Politicians eye unsustainable policies with the interests of different groups to stay in power in societies with weak institutions and economic problems emerge as a result of these policies.
Keefer and Knack	2002	Social polarization decreases country's creditworthiness (credibility). Increase in income inequality among groups (ethnic or social) living in the country may lead to face difficulties in payment of debts.

Author	Publication Year	Basic Results
Annett	2002	The electoral system / method, legislation and degree of fragmentation in government and governmental stability has a strong influence on fiscal policy. There is a clear relationship between political system and expenditures & taxation preferences.
Mulas-Granados	2003	Besides economic conditions, coalition governments (divided decision makers), the ideology of the government party and the proximity in the elections have effect on adaptation strategies if usually fiscal policy is in particular.
Woo	2003	Financial depth, income inequality, assassinations, cabinet size and centralization of authority in budget decisions are important and robust determinants of public deficits. Public deficits tend to increase in countries with frequent government changes. This positive relationship between government changes and budget deficits supports political business cycle hypothesis. Social and political instabilities have a very strong impact on budget deficits. Budget and government institutions have effect on fiscal discipline generally.
Baldacci et al.	2004	Fiscal consolidations based on expenditure cuts increase the possibility of providing financial sustainability. The possibility of fiscal consolidation to be implemented decisively decreases in election years. IMF-supported fiscal consolidation programs are more likely to be successful.
Asutay	2004	In order to increase their votes to be re-elected (through monetary and fiscal policy), governments in power in Turkey constitute political business cycles.
Akçaoğlu and Yurdakul	2004	It is observed that there is an increase in budget deficits in Turkey in general elections period. Election periods have no significant impact on inflation and economic growth. Opportunistic model was verified for Turkey while partisan model was rejected. The fact that parties forming the government represent different ideologies (of being on the right or left wing) has no significant effect on budget deficit (growth and inflation).
Lavigne	2006	Political factors has a significant impact on the success and sustainability of economic and financial regulations.
Sezgin	2007	In order to maximize their votes, political parties in Turkey manipulate the economy during the election periods.
Aslan and Bilge	2009	Deviations occurring in budget expenditures in the coalition periods of Turkey are significantly greater than the periods of single-party and this is not supposed to be random but systematic.
Hatunoğlu and Tekeli	2013	Governments implement policies of increasing expenditures in pre-election periods in order to be re-elected.
Karakaş	2013	Political cyclical fluctuations are apparently valid for Turkey. Politicians in Turkey manipulate economy through financial instruments before elections and they try to fix the economy by applying strict fiscal policies after the election period.
Altun	2014	Political cyclical fluctuations are valid in Turkey. Opportunistic and partisan behaviour models for the political parties in power in Turkey between 1950 and 2000 are valid.

5. Data set

Data with annual frequency that belongs to 123 countries which are agreed by IMF that they are developing countries in 2002-2012 periods is used in the study. Governance indicators, of which effect on budget deficit was examined and World Bank has been publishing since 1996, was published every two years until 2002 and annually for the following years. Therefore, 2002 has been chosen as starting year in that governance indicators started to be published annually. The end year is 2014 based on the scope of the latest release of worldwide governance indicators.

In the analysis in which it is aimed at measuring the impact of worldwide governance indicators on budget deficits, economic growth and inflation (consumer price index) variables were used as control variables since they are likely to affect budget deficits. Since they have a direct and indirect effect on budget deficits independent from governance, these variables are widely used in analysis of budget deficits in the literature. Data sets that belong to the variables used in the study were obtained from database of World Bank and IMF. Explanations for these variables are presented in Table 1. Worldwide governance indicators consist of six sub-indexes. These are; voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, control of corruption. These indexes are comprised of values between -2.5 and +2.5 points. When the score of a country on the related index is close to -2.5 it shows that it fails whereas it shows that it is more successful when it is close to + 2.5.

Table 2. *Variables used in the model*

Variables		*	Definition		Source
Budget Balance	BB		General government net	%	IMF
Ekonomik Büyüme	G	+	GDP growth (annual)	%	WB
Enflasyon	INF	-	Inflation, average consumer prices	%	IMF
Voice and accountability	VA	+	Worldwide governance indicators (WGI)	index	WB
Political stability and absence of	PS	+	WGI	index	WB
Government effectiveness	GE	+	WGI	index	WB
Regulatory quality	RQ	+	WGI	index	WB
Rule of law	RL	+	WGI	index	WB
Control of corruption	CC	+	WGI	index	WB

* Estimate of relationship between budget deficit and variables.

Budget deficit, which is used as the dependent variable in the model, is represented as a ratio of public net debt-receivable balance to GDP. This ratio shows the budget balance. Percentage change in real GDP is used as an indicator of economic growth. Annual inflation rate is also included in the analysis.

6. Econometric method

Panel data analysis method was used in the study. Panel data analysis is a method that estimates economic relations by using section (horizontal or vertical) data that has time dimension (Pazarlıoğlu and Gürler, 2007: 37). Panel data analysis is widely used in recent years in studies regarding economic variables. Panel data analysis is a method that estimates economic relations by using section (horizontal or vertical) data that has time dimension (Pazarlıoğlu and Gürler, 2007: 37). Therefore in this method a data set is generated which covers both dimensions by using both time series and horizontal section data.

6.1. Panel unit root test

Since data used in panel data analysis has time series, stability must be determined. If the series is stable it means that average and variance are constant over time and common variance between two periods depend on only the length between the two periods, not on the period that this common variance is calculated. If the series are not stable, t, F, and chi-square limitations and similar traditional test processes remain questionable (Gujarati, 1999: 708, 713). One of the widely used methods for this is panel unit root tests. Following the studies of Levin and Lin (1992, 1993), unit root tests started to be used quite widely in the studies that panel data method is used (Maddala and Wo, 1999: 631). Also in the literature, panel unit root tests, which are recommended by Im, Pesaran and Shin (IPS) (2003), Maddala and Wu (MW) (1999) and Hadri (2000) are used.

6.2. Panel regression models

In general, linear panel data model with panel data, which is generated by dealing N number of units and T number of observations for each unit together:

$$Y_{it} = \beta_{0it} + \beta_{1it}X_{1it} + \beta_{2it}X_{1it} + \cdots + \beta_{kit}X_{kit} + u_{it} \qquad (1)$$

i =1, 2, 3,..., N, t = 1, 2, 3,…, T
can be as expressed. Among the sub-indices in equation (1), i represents section dimension, such units as household, individuals, countries; t represents time dimension, such as month, year., shows value of dependent variable for i unit at time t; β_{0it}, constant term; β_{kit}, Kx1 dimension parameters vector; X_{kit}, value of explanatory variable k at time t for i unit.

In the model expressed by equation (1) in panel data analysis, coefficients β take different values for different units in different periods. Therefore, some assumptions related to constant term of model, slope coefficients and error term are made while the model is estimated. These models obtained with these assumptions are "fixed effects" and "random effects" models. Both in fixed effects and random effects models, error terms u_{it} are assumed to distribute independent and as N $(0,\sigma_e^2)$ for all periods and all individuals (Tatoğlu, 2013: 37).

6.3. Fixed effects models

One of the panel regression models is fixed effect model. This is a model that slope coefficients are equal ($\boldsymbol{\beta_1 = \beta}$) for time and section units whereas constant coefficient varies based on horizontal cross-sectional units because it has unit effect (Greene, 1993:466). Constant term takes different values for each horizontal section unit; differences between units are expressed by differences in the constant term. Also in this model, unit effect and independent variables are allowed to be correlated by assuming that independent variable has no correlation with error term. When a general panel data model is addressed (Tatoğlu, 2013: 80):

$$\boldsymbol{Y_{it} = \beta_0 + \beta_1 X_{1it} + \beta_2 X_{2it} + \cdots + \beta_k X_{kit} + v_{it}} \qquad (2)$$

In fixed effect model:

$$\beta_{0it} = \beta_{0i} = \overline{\beta} + \mathrm{e}\mu_i \,;\ \beta_{1it} = \beta_1 \qquad \beta_{2it} = \beta_2, \ldots\ldots\ldots, \beta_{kit} = \beta_k$$

is assumed. β_{0it} represents constant term including unit effect, μ_i unit effects; u_{it} error term. Slope parameters are assumed to remain constant depending on units and time. In the model, constant term varies depending on units but constant that is generated for units is fixed through time. Therefore, time effect on constant term is considered as invalid (Gujarati, 1999).

6.4. Random effects models

In panel data usage, individual effects that cannot be observed in each unit may emerge. If these individual effects are treated as a random variable like error term, these are “random effects”, if they are treated as a parameter that is estimated for each horizontal cross-section observation, these are “fixed effects” (Tatoğlu, 2013: 79).

In random effects model the differences in horizontal section unit are assumed to be random like error term (Greene, 1993: 469). In these models, changes that occur in horizontal section units or based on units and time are included in the model as a component of error term. The most important reason for that is to prevent loss of freedom degree experienced in fixed effects model (Baltagi, 2005: 13).

$$Y_{it} = \beta_0 + \beta_1 X_{1it} + \beta_2 X_{2it} + \cdots + \beta_k X_{kit} + v_{it} \quad (3)$$

When a panel data model as in Equation 3 is discussed, it is not included in constant parameter because unit effect is not constant in random effects model. It is included in error term because it is random (Tatoğlu, 2013: 104). So here error term can be represented as below;

$$v_{it} = u_{it} + \mu_i$$

u_{it} now represents errors, μ_i is unit error that represents unit differences and the variations between units by time.

7. Analysis model

The model that examines the impacts of worldwide governance indicators on budget deficits was formed on the basis of Roubin and Sachs (1989a) model which is considered the basis of the studies done on the political and institutional determinants of budget deficits.

$$BB_{it} = \beta_0 + \beta_1 G_{it} + \beta_2 INF + \beta_3 VA_{it} + \beta_4 PS_{it} + \beta_5 GE_{it} + \beta_6 RQ_{it} +$$
$$+\beta_7 RL_{it} + \beta_8 CC_{it} + u_{it} \quad (4)$$

The dependent variable used in the model is BB_{it}, which represents budget deficit of country i in year t as a share of GDP. Of the independent variables used as economic variables G_{it}, represents economic growth of country i in year t, GGD_{it} represents inflation rate of country i in year t. Of the global governance indicators in the model, VA_{it} represents voice and accountability index of country i in year t, PS_{it} represents the index of political stability and absence of violence of country i in year t, GE_{it} represents government effectiveness index of country i in year t, RQ_{it} represents regulatory quality index of country i in year t, RL_{it} represents rule of law index of country i in year t and CC_{it} represents the control of corruption index of country i in year t. u_{it} is error term. Estimates have been made for this model and research findings are given in the following chapter.

8. Analysis results

For the data set of this study, panel unit root test which was developed by Breitung (2000) was applied. The main reason to prefer this test is its success in small samples. Breitung (2000) showed with Monte Carlo Experiences that in small samples this test is more powerful than the other panel unit root tests (Tatoğlu, 2013: 207).

H_0: Panels contain unit roots.

H_A: Panels are stable.

Breitung unit root test results, of which test hypothesis mentioned above are presented in Table 2. Looking at these results, it is seen that null hypothesis was rejected for all series so that the series are stable in level.

Table 3. *Breitung panel unit root test results*

Variables	t	p
LB	-8.7156*	0.0000
G	-11.5616*	0.0000
INF	-9.0331*	0.0000
VA	-1.3470***	0.0857
PS	-2.5991*	0.0047
GE	-1.9403**	0.0262
RQ	-1.7212**	0.0336
RL	-1.4263***	0.0765
CC	-1.3834***	0.0883

Note: *, **, *** show that null hypothesis was rejected for significance levels 1%, 5% and 10%, respectively.

ANOVA F test results that were proposed by Moulton and Randolph (1989) were examined to test the presence of individual effects that could not be observed in the early stages of analysis. Null hypothesis that all individual effects are equal to zero (H_0: μ_i=0) was rejected. (see Table 3). This result indicates that data vary according to individuals so the classical model (pooled LS-Least Squares) is not valid. In addition, likelihood ratio test (Likelihood Ratio: LR) is used to test the classic model against random effects model. H_0 hypothesis is "The classic model is correct". According to test results H_0 is rejected, so it is understood that the classical model where there are unit effects is not appropriate. The presence of individual effects was tested with Breusch- Pagan (1980) test. The hypothesis that variances of unit effects are equal to zero (H_0: $\sigma_{\mu}^2 = 0$) was tested with this test. According to results H_0 hypothesis is rejected and it is seen that the classical model is not appropriate (Table 3).

Hausman test was used for the selection of estimator. The main hypothesis of the test is "there is no correlation between the explanatory variables and individual effects". In this case, estimator of both the fixed effects and random effects is consistent. Thus, the difference among the estimators will be very small. The alternative hypothesis is "there is a correlation between explanatory variables and individual effects". In this case, random effects estimator is biased whereas fixed effects estimator is consistent. Hausman test results applied to the model are presented in Table 3. According to Chi-square statistics obtained, null hypothesis cannot be rejected. In summary, dependent variables and individual effects are not correlated and random effects GLS estimator is active. However, autocorrelation and heteroscedasticity problems should be tested.

To test the presence of autocorrelation, Durbin-Watson test, which was proposed by Bhargava, Franzini and Narendranathan, and local best invariant test statistics, which was proposed by Baltagi-Wu were used. A comment is made that autocorrelation is significant if test statistics are less than two (Tatoğlu, 2013: 214). Test statistics belong to both tests and presented in Table 3 are less than two. These results indicate that there is an autocorrelation problem. In addition, Lagrange (LM), and adjusted lagrange multipliers (ALM) tests were used to test for the presence of autocorrelation in random effects model. The null hypothesis of these tests are autocorrelation coefficient (lambda) is equal to zero. In both tests the null hypothesis were rejected, so there's autocorrelation.

Heteroscedasticity problem in econometric analyses is encountered when working with horizontal sectional data rather than with time series. Therefore, tests of Levene, Brown and Forsythe's were used to test the presence of heteroscedasticity in random effects model. Null hypothesis "variances of the units are equal" was rejected, so there is heteroscedasticity. White correction was made in model estimation to obtain resistant standard errors in the presence of heteroskedasticity and autocorrelation. F-statistic values (Table 3) show that model is significant as a whole.

According to the results of the analysis presented in Table 3, of the global governance indicators they are statistically significant with significance levels for voice and accountability (VA) 1%, political stability (PS) 5% and regulatory quality (RQ) 10% whereas government effectiveness (GE), rule of law (RL) and control of corruption (CC) variables are statistically insignificant. Of the economic variables used in the model, they are statistically significant with significance levels for the increase in real GDP, means economic growth (G) 1% and inflation 5%.

Table 4. *Panel regression estimations (random effects GLS estimator, dependent variable: BB)*

Variables	Coefficient	t-Statistic	P Statistic
G	0.273*	(5,73)	0,000
INF	0.086**	(1,98)	0,048
VA	-2.964*	(-3,19)	0,001
PS	1.836**	(2.27)	0,023
GE	-1.148	(-1,37)	0,170
RQ	1.794***	(1,87)	0,062
RL	-0.558	(0.37)	0,711
CC	0.888	(1.01)	0,310
C (sabit)	-3.200	(-5,79)	0.000
Test Results			
ANOVA F	7.97		Prob (0.000)
Hausman	12.71		Prob (0.122)
W0 (Levene/BrownForsythe)	6.326		Prob (0.000)
Breusch-Pagan	1092.80		Prob (0.000)
Likelihood-ratio	423.81		Prob (0.000)
Durbin-Watson	1.585		
Baltagi-Wu	1.698		
LM (lambda = 0)	424.62		Prob (0.000)
ALM (lambda = 0)	68.99		Prob (0.000)
R^2	0.0861		
F	39.44		Prob (0.000)
Number of obs.	1599		

Note: *, **, ***, show that estimated coefficients are statistically significant for significance levels 1%, 5% and 10%, respectively.

According to findings of panel regression analysis, one unit increase in political stability (PS) index increases budget balance 1.83 points. One unit increase in Regulatory Quality (RQ) index has positive effect of 1.79 points on budget balance. On the other hand, increase in voice and accountability (VA) index in the countries included in the analysis has negative effect on budget balance. Budget balance that was used in the analysis to represent budget deficits shows the ratio of budget deficit to GDP. Recovery or increase of budget balance means a decrease in budget deficit.

9. Conclusions

Budget deficit is one of the major economic problems of many developed and developing countries. While budget deficit is used as a fiscal policy tool, it may cause various economic problems in some cases, especially inflation. With this aspect, it is a subject that sometimes limits governments and affects their economic decisions.

Many theoretical and empirical studies have been made on the causes of budget deficit since 1970s. An important part of these studies focused on political and institutional determinants of budget deficits. In these studies, subjects such as opportunistic and partisan political behaviors, government structure and term of office have been examined. In this study, different from political behaviors, effect of management approach on budget deficits was examined.

Since the late 1980s, the traditional management approach has undergone some criticism. It was defended that realization of a management that has a single-way hierarchical structure to a certain extent in a mutual manner between relevant stakeholders will be more effective. Therefore, some principles such as transparency, accountability, rule of law, voice and accountability were determined and recognized as the important elements of management. There is a conspicuous gap in the literature for effect of governance on budget deficit. In this study, the effect of governance on budget deficit in 123 emerging countries in the period 2002-2014 period was examined. World Governance Indicators (WGI) which was developed by World Bank, consisting of six indexes and often preferred in academic studies were used as governance indicators. Also independent from these indexes, economic growth and inflation rates which has relationship with budget deficit were included in the analysis as control variables.

According to analysis results, of the global governance indicators voice and accountability, political stability and regulatory quality have statistically significant relationship with budget deficits. Improvements in political stability and regulatory quality indexes lead to a certain decrease in budget deficits. In contrast, it was concluded that the increase in voice and accountability index increases budget deficits. A significant relation could not be determined between government effectiveness, rule of law, control of corruption and budget deficits. There is a significant relationship between budget deficits and increase in real GDP (growth) and inflation, which are included in the analysis as control variables.

In the countries that budget deficit is an important problem and fighting with it, providing some political improvements besides implemented economic measures will increase the success of policies. Therefore, it is important to ensure political stability first in terms of budget balance. In addition, the economic and political regulations, which encourage the development of private sector, protect property rights and entrepreneurship, are expected to have a positive impact on policies applied for budget deficits.

Notes

(1) For detail information about Tax Smoothing Hypothesis see: Alesina and Perotti (1994), Karakas, M., Taner, T. and Yanikkaya, H. (2014).

(2) World Bank (1989), *Sub-Saharan Africa; From Crisis to Sustainable Development*, The World Bank Publication, Washington, D.C.

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Private equity market developments in central and Eastern Europe

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Abstract. *This paper discusses the current state of the private equity industry in terms of size of investment, funds raised, disinvestment mechanisms practiced and their trends in the CEE region in comparison with other European countries. The low level and limited success in developing venture capital industry in Europe, particularly in the Central and Eastern European countries raises concerns, given the numerous evidences, which show the positive role of venture capital investment in supporting innovation. We believe that the lack of supply of venture capital is one of the hampering factors to demand of funds came from entrepreneurs in the CEE states, including in Romania, which we show to be one of the countries with a systemic lack of venture capital funding in early-stages of business.*

Keywords: venture capital, private equity, Central and Eastern Europe (CEE), Romania.

JEL Classification: G23, G24, M13.

1. Introduction

Private equity funds fill the gap between internal financing and "traditional" market sources (public equity and bank loans). There are two main types of private equity (PE) funds. Venture capital (VC) funds refer to equity investments made for the launch, early development, or expansion of business and they tend to be provided to young and start up companies with high growth potential. Buyout funds specialize in acquiring large public firms, restructuring and reselling them in a relatively short period of time. The distinctive feature of these funds is their active involvement in monitoring, the development strategy of firms they finance related to research activities, product development and commercialization, as well as assisting divestments, mergers and acquisitions.

Although the need of funding is lower in early-stages (seed and start-up) of firms than in the following ones, the former are critical for the business development. Many challenges make attracting of "traditional" funds to be difficult. Uncertainty that characterize innovative firms in seed and start-up stages, the lack of records and assets secured, limited ability to highlight the potential market for new products or services, high rates of obsolescence of their goods produced (mainly developed in the fields of science-intensive sectors), along with the issues associated with information asymmetry can lead to a higher perceived risk in firms, thus increasing the opportunity costs of their investments that often become prohibitive to their funding on the capital markets.

The value of innovative firm relies on its growing potential in the long-run, incorporating scientific knowledge, skills and intellectual property. Generally, these characteristics are associated with distinct patterns of cash inflows in firms such as their uncertainty and volatility, and long-term payback periods. In this context, "traditional" financing methods are irrelevant particularly for start-up firms, that confront themselves with investments in early-stages of life cycles, the low capacity to honour debt service and uncertainty associated with untested business models and business success.

Innovative firms raise many issues and uncertainties. In addressing informational problems, specialized firms introduce various mechanisms that appear critical for boosting innovation. It is known that early participation of specialized firms (venture capitalists) to the financing of firms, including monitoring and in shaping the managerial teams can support innovation and successful activities in the long-run.

Many benefits in the economy have been identified in the literature related to firms backed by venture capital. For instance, Kortum and Lerner (2000) show that venture capital has a strong positive impact in boosting inventions. Diffusing of technologies in the economy enhances, in turn, increased productivity and returns. Gottschalk et al. (2007) show that German firms that obtained funds from private investors, including from specialized firms registered higher growth rate, spent more funds in research and development, were more inventive and diffused technologies than other firms. Achleitner and Klöckner (2005) conclude that the average rate of employment is higher in firms backed by venture capital. Venture capital has been attracted much attention in practice and in the literature, given its positive impact on high growing potential firms that innovate by producing new technologies, being associated with growing sales, industrial development and better employment. Governments recognise the importance of funds raised and invested in high risk activities, admitting that firms' access to funding can be crucial for their research activities, obtaining profit and commercialization capacity. The low equity levels, including venture capital investments can be viewed as problematic, taking into account their important role in boosting innovation.

We discuss the current state of the private equity industry in terms of size of investment, funds raised, disinvestment mechanisms practiced and their trends in the CEE region in comparison with other European countries. CEE comprises the countries of Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Moldova, Montenegro, Poland, Romania, Serbia, Slovakia, Slovenia and Ukraine. The statistics we use are based solely on the "market approach", wherein information is compiled to show activity in a particular country, regardless of the origin or location of private equity fund managers. The analysis shows that additional sources of risk capital may be necessary to induce firms to carry out R&D activities and innovate. Some countries, including Romania, reveal a large equity-funding gap. This gap arises as a result of underdeveloped stock markets in the region, insufficient human capital which limit the flow of private equity funding into the region as well as reducing of public and private R&D spending.

Our paper is organised as follows: Section 2 unfolds a brief history of private equity market in CEE countries, in Section 3 we analyse the trend in fundraising and investment activities, as well as divestment mechanisms performed in the CEE countries in Section 4. One of the largest gaps in terms of private equity investments, mainly venture capital investments, displays Romania, in which recent private market developments are analysed in Section 5 and Section 6 concludes.

2. Brief history of private equity markets in the cee countries

Some articles analysed the development of PE markets in Europe, including in the CEE states. In this respect, a part of them focused on the role of specialised firms in privatizing state owned companies (e.g. Filatotchev et al., 199; Karsai et al., 1998, 1999), reflecting various investments decision making of regional investors in comparison with other investors that were operating on the global markets. Other studies analysed the features of the markets in the CEE area and the main obstacles to catching up with the developed markets. Although some similarities in investments practices are identified, the greater risk of the region is considered in explaining the investments trends and that the market development requires higher quality of projects and broader opportunities for divestment.

Iliev (2006) underlines the very small number of firms receiving financing in early stages, which can be explained by the low number of quality projects and the lack of infrastructure for related transactions. Another obstacle in early-stages firms trying to attract funds is identified by the low number of informal investors (Szerb et al., 2007). The total R&D intensity is found to be the main determinant of the venture capital invested in Romania, impacting both the supply and the demand of funds (Diaconu, 2012).

Focusing on the supply of funds from limited partners, Groh and Liechtenstein (2009) studied the attractiveness of the CEE countries for risk capital investors. Their study is based on questionnaires addressed to institutional investors, asking them about the importance of several emerging markets investment criteria, leading to a ranking of emerging countries' attractiveness for private equity investors. In this respect, the authors show that the CEE countries are less attractive than the EU-15 average. In this region, investors are attracted to a lower tax rate on corporate income, but they are discouraged by the low liquidity on the national capital markets.

Another attractiveness index of private equity by country is also published by EBRD (2014, p. 79), containing details of six different indicators measuring how far each country is from the United States in terms of attractiveness for equity financing. It is showed that the transition region is a long way from catching up with more developed economies. The lack of developed stock markets, the paucity of opportunities for initial public offerings and mergers and acquisitions, and the immature credit markets all serve to discourage PE/VC funds, for which viable exit strategies are crucial in order to realise financial returns. The region also scores less favourably in terms of its human and social environment, indicating that it does not have sufficient human capital to attract PE/VC investors. In addition, there is room for improvement both in terms of the ease of doing business and corporate R&D spending (in order to boost entrepreneurial opportunities) and in terms of investor protection and corporate governance rules. On a more positive note, the region's taxation system compares favourably with developed economies.

The EBRD (2006) study shows that the development of the private equity markets in the CEE states can be divided into four stages. The first stage lasts from the beginning of the transition period to the middle of the 1990s. During this period, country funds dominated and the typical sizes of funds were around USD 50 million, as the funds managers did not have much investment experience in the region yet. The investments derived from privatization had a major role among the business deals. They were mainly involved in the restructuring of the industry. In fact, in the 90', the private equity industry was characterized by significant growth in the region. However, the modest levels of investments in R&D were poor linked to commercial applications. A large number of firms were privatized. In firms sold to foreign strategic investors, the new owners took their responsibility to align governance, managerial and profitability practices to the global standards, but it was not always respected. In other cases, the property was transferred to employees or managers of enterprises, eventually through mass privatization programs, but firms were in excessive debt, having old technology and the lack of experience and capital for renewing their technologies and production to export. Specialised firms of risk capital that usually provide both expertise and financial resources for restructuring offered some solutions to those problems.

The second stage had finished by the end of the 1990s and it was characterised mainly by the regional fundraising. The typical fund size grew to USD 100-200 million and the financing of expansion stages became typical. According to EBRD (2006) study, the consolidation of the private equity market of the region had started.

The third stage had finishes by the end of the 2000' and it was characterised by a fast expansion. In this stage the regional funds still dominated, and the financing of technology became the focus of the investments. The typical size of capital managed by funds increased to the level of USD 250-300 million. The regional specialised investors, institutional investors as well as the investors operating at the Europe level were all present on the private equity market at that time. Venture capital investments to early-stage firms showed up, but the financing of expansion-stage firms maintained. Technology, IT and media were the main area of financing.

The fourth and last development stage lasted from 2001 till 2006, and it was characterised by the consolidation and rationalisation of the market. Only the successful fund managers were able to survive. Beside the regional and country funds, the specialised investors were also present in the market. The financing area already included buyouts.

The financial crisis started in the second half of 2007 focused the attention of VC&PE investors to the importance of their portfolios' diversification. Due to the economic slowdown and the increased levels of regulators pressure experienced in the developed markets, the VC&PE investors were looking for new geographical target areas, mainly the CEE region viewed less risky after joining the EU, which experienced relatively fast growing rates and was less influenced by the effects of the financial crisis in the short run. The CEE region became one of the focusing areas of the investors, the fundraising grew rapidly, and in 2007 and 2008 the fundraised were exceeding € 1 billion. The regional funds, which raised more and more capital from a growing group of investors, faced competition from other global and Pan-European funds that tried to compensate the lack of their local experience, by hiring the fund managers of the regional funds with comprehensive local market knowledge. The high growth rate of GDP, growing consumption, developing infrastructure, the possibility of regional expansion of local high-growth firms, the divisions of the consolidating conglomerates available for buyouts, were all promising attractive returns to the investors.

There have been considerable improvements in the private equity industry in CEE in recent years, as shown by easier exits from investments and higher returns. The industry has moved increasingly towards larger funds. Returns from investments dating back to the early 1990s have outperformed equivalent investments on the London Stock Exchange and have exceeded the average for private equity investments in Western Europe. Although the opportunities for private equity funds to exit from their investments have improved – due to the development of domestic stock markets and better access to foreign stock markets – the presence of a co-investor has helped funds to exit from some less successful investments.

Considerable challenges remain for the CEE countries. Despite rapid financial development, most firms in the region still rely on internally generated funds and contributions through informal channels – for example, loans from friends and relatives of the owner/entrepreneur. A large number of firms, even in some of the most developed CEE countries, have no link whatsoever to the formal financial system. Improving access to financial resources for these enterprises and for new businesses is still a fundamental challenge in the region.

3. Fundraising and investment activities in the CEE region

A large number of firms operate in the CEE countries and some of them are relatively recently established. Unfortunately, over the past decade, the CEE region has seen only modest levels of PE/VC financing, which has tended to remain focused on the Western Europe. Most specialized firms have started to focus on buyout and restructuring operations, having minor contributions in early stages of business. In general, institutional capital used in most OECD countries is not present or has reduced involvement in the CEE markets, and many active specialised companies in the region have been foreign subsidiaries. Viewed as a whole, the funds raised and invested in CEE show a similar trend to other countries in the European area, but the capital sizes have been much lower. In fact, the private equity (and venture capital) industry is still a young one in this area, knowing a continuous development from its formation to date.

The total amount of funds raised in the period 2000-2015 was the most significant in 2007 when it reached € 4.034 billion, followed by a massive reduction in the subsequent periods recording the lowest values in 2009 (€ 450 million) and 2013 (€ 409 million). According to EVCA (2015) data, both the annual levels of funds raised in 2015 (€ 418 million) and investments in 2009-2015 failed to reach the 2007 levels.

The CEE region accounted for less than 2% of all private equity fundraising in Europe in 2015, reflecting a year with a limited number of fund managers in the market, especially from the region's larger firms. The government agencies remained the main source of financing in 2015, including national, regional or local government agencies, and continue to be the leading source of capital for CEE. Their participation, along with other institution for developing (such as European Bank for Reconstructing and Development and European Investment Fund) was 42% in 2014 and 36% in 2015. The high proportion of the total funds raised in 2014 was due to the public funds came from

China. In absolute terms, the volume of funds from the government agencies increased more than three times in 2014 compared with 2013, and 2015 marked the forth consecutive year in which the government agencies were the main source of funds in CEE according to EVCA (2014, 2015). Compared to the rest of the European space, CEE has characteristics in fundraisings, in which the sovereign wealth funds represented the second major source of capital, 16%, followed by the pension funds, 11% etc.

The investment activity in the CEE region manifested also particularities concretised in a growth trend until 2009, but annual oscillations can be observed as well, registering in the period 2000-2015 maximal levels in 2008 and 2009 (€ 2.43 billiards). The private equity investments made grew since 2013, registering € 1.63 billiards in 2015.

Four countries (Serbia, Czech Republic, Poland and Romania) made investments that represented 80% of total investments made in the CEE space in 2014 (EVCA, 2014). Also, the main destinations of private equity financing in the CEE region in 2015 were Poland (54% of total value), Serbia (14% of total), Hungary (10% of total) and Romania (9% of total). These four countries made up 85% of total CEE investments by value in 2015 (EVCA, 2015).

Table 1 depicts the investment activity in some selected countries of CEE. As we can observe, the private equity investments manifested also large oscillations from one year to another in all countries. The investments made in 2015 increased in many countries, except Baltic countries, Czech Republic, Hungary etc.

Table 1. *Annual private equity investments in the CEE countries, 2007-2015, € millions*

	2007	2008	2009	2010	2011	2012	2013	2014	2015
Baltic countries	216.98	88.00	6.69	33.47	53.40	29.55	65.38	112.72	102.32
Bulgaria	178.98	91.63	185.17	82.24	7.22	84.17	11.10	2.33	28.04
Czech Republic	181.07	422.98	1.357.98	22.84	143.93	105.87	134.44	299.45	13.83
Hungary	222.72	464.03	213.64	65.05	194.84	102.95	56.27	169.93	158.30
Poland	434.19	635.72	274.57	652.69	678.44	473.02	380.03	250.92	803.51
Romania	212.44	293.96	220.87	119.14	65.92	27.61	70.35	77.97	144.29
Other CEE*	163.75	82.48	128.29	47.43	28.86	138.01	49.35	393.27	261.51

*States from ex-Yugoslavia space and Slovakia comprise this group.

Source: European Private Equity Activity Data.

Poland incorporates one of the largest private equity markets in CEE. Moreover, the total number of Polish firms backed by venture capital (78 out of 290) was the largest in CEE in 2014. By number of companies financed, Poland, Hungary, the three Baltic countries and Slovakia made up 91% of the total companies receiving private equity financing in 2015.

Czech Republic, Hungary and Serbia also performed significant transactions in the region. However, Serbia recorded the highest level of investment activity in CEE in 2014 (€ 326 million) as a result of large buyout transactions (99% of total CEE investments in 2014). Buyouts account for most of the private equity investment in CEE in 2015, registering € 1.3 billion. Buyouts comprised 78% of total private equity investments in CEE, similar to the 77% level seen across all of Europe in 2015.

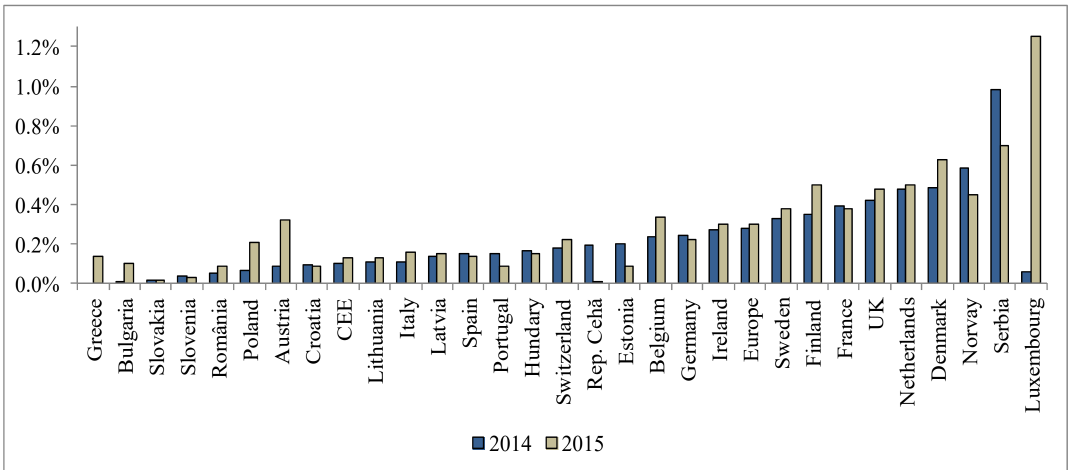
The private equity investments increased in Romania since 2012. However, the Romanian private equity investments remain modest since 2011, including the number of firms financed.

CEE private equity investment measured as a percentage of GDP was 0.127% on average for the region in 2015 and remained below the European average of 0.302%. 2015 was the third year of increased private equity intensity since 2013 (0.063%). However, private equity investments continued to be much lower in CEE than in the European average (0.277% – 2014; 0.302% – 2015). In other words, the private equity investments as a percentage of GDP was, on average, lower in CEE than 40% of the level in the European area, indicating underinvestment in the CEE region and a significant gap.

The gap continued to be significant, despite the impressive investment made in CEE in 2015. Notably, Serbia again ranked near the top end of Europe in this measure, reaching 0.696% of GDP invested, again driven by one large transaction in that market.

The gap between the CEE region and other European countries concerning the total private equity intensity is illustrated in Figure 1. It can be noted that while the equity capital intensity was increased in some CEE countries, most of them have the ratio under the regional average.

Figure 1. *Private equity investments in CEE, 2014-2015, % of GDP*



Source: EVCA (2014, 2015).

By sector, the energy and environment sector was the leading area of CEE investments in 2015, making up 32% of the total. This was followed by consumer goods and retail that comprised 29% of total investments. Communications, historically a leading sector in the region, made up only 5% of total investments in 2015. The main annual investment areas vary. For instance, communications sector was preferred to investment in 2014. Investments in computer and consumer electronics were ranked lower by their dimensions, attracting 19% of the total investments. The funds invested in energy and environment, as well as in consumer services reached 9% of the total investment, and 7% comprised life sciences and related fields in 2014.

Venture investments in CEE totalled € 84 million in 2015, some 16% below 2014, mainly because of less activity in the later-stage venture segment. The CEE share of total European venture investment value was 2.2% in 2015 compared with 2.7% in 2014. Meanwhile, the CEE region accounted for 7.8% of total European firms receiving venture capital financing in 2014 versus 6.5% the previous year.

According to EVCA (2015), the venture capital sector accounted for 5% of the CEE region's total private equity investments by value and 72% by number of firms. The average venture capital investment per company in CEE was €0.38 million in 2015. For comparison, the average venture capital investment per company across the whole of Europe in 2015 was €1.3 million. Start-up investments continued to make up the largest part of the CEE venture market in 2015, comprising 55% of investment value and 57% of companies financed in the total venture segment.

Data in Table 2 show the amount of venture capital invested by country in CEE. High variability of venture capital investments can be observed, having a strong rebound in 2009 in many countries. In some states, increased levels in the later years have not reached the higher level of investments made in 2007-2008 (except the Baltic countries and Hungary). Hungary and Poland are leaders in these investment segments, concentrating together 55% of the early stages investments made in CEE, registering the biggest increase in 2014. The most active venture market in CEE continued to be Hungary (attracting 30% of venture capital investments in 2015) and Poland (attracted € 20 million or 23% of the total). These two countries marked up also over half of the region's venture financed firms during 2015.

Table 2. *Annual venture capital investments in CEE, 2007-2015, € millions*

	2007	2008	2009	2010	2011	2012	2013	2014	215
Baltic countries	15.27	12.82	2,89	6.32	7.81	11.77	16.58	17.46	20.21
Bulgaria	3.32	8.32	4,04	1.33	0.42	0.09	5.10	2.33	1.10
Czech Republic	4.19	31.83	28,25	23.05	10.52	5.23	2.88	9.07	1.67
Hungary	10.50	12.84	1,26	17.90	40.02	65.49	16.71	32.15	24.95
Poland	39.11	50.44	1,15	3.31	26.46	9.08	15.63	22.01	19.58
Romania	33.79	41.99	4,17	5.09	4.00	3.06	2.98	5.31	1.83
Other CEE*	24.37	9.37	2,03	3.50	7.93	4.30	10.50	7.50	11.91

*States from ex-Yugoslavia space and Slovakia comprise this group.

Source: European Private Equity Activity Data.

The success of venture capital financing is ultimately subject to the way of exit. That is adjusted to the nature of investment, of which the method and timing is already planned by the investors at the time of investment. Apart from carefully selecting firms to be included in the portfolio, profit to be realized greatly depends upon choosing the time and method of divestments. PE investors always participate in the financing of selected firms for a temporary period. Profits realized during exits basically influence the investors' potentials for future fundraising.

4. Divestment mechanisms performed in the CEE countries

Divestment activity in the CEE region showed also significant oscillation in the period 2000-2015. In this sense, the values of exits were the highest starting with 2011. The structure of divestment mechanisms in the last years shows similar patterns in other European states. The table below shows the amounts resulting from practicing various divestment mechanisms and the percentages of the total funds obtained, with regard to the states of Europe as a whole and in the CEE countries:

Table 3. *Divestments in CEE, 2014-2015, € millions*

Divestment mechanisms (*exit*)	Total CEE	% CEE	Total Europe	% Europe	Year
Divestment by trade sale	634,198	51.28	11,607,727	28.70	2015
	367,598	29.00	10,157,303	26.30	2014
Divestment by public offering	205,813	16.64	9,359,003	7.50	2015
	67,852	5.40	7,129,297	18.40	2014
- Divestment on flotation (IPO)	34,273	2.78	2,681,158	6.60	2015
	48,422	3.80	3,330,562	9.80	2014
- Sale of quoted equity	171,540	13.87	6,677,845	16.50	2015
	19,430	1.5	3,798,735	9.80	2014
Divestment by write-off	7,050	0.57	1,838,994	4.50	2015
	104.746	8.30	2,709,244	7.00	2014
Repayment of silent partnerships	0	0	201,271	0.50	2015
	0	0	131,143	0.30	2014
Repayment of principal loans	6,414	0.52	1,671,537	4.10	2015
	25.441	2.00	3,04,665	7.90	2014
Sale to another private equity house	278,005	22.48	10,797,626	26.70	2015
	271.746	21.40	9,273,950	24.00	2014
Sale to financial institution	37,084	3.00	4,092,767	10.10	2015
	337,685	26.70	2,455,911	6.40	2014
Sale to management (MBO)	16,623	1.34	642,462	1.60	2015
	61,010	4.80	1,249,393	3.20	2014
Divestment by other means	51,438	4.16	247,367	0.60	2015
	30,964	2.40	2.517.818	6.60	2014
Total 2015	1,236,625	100.00	40,458,754	100,00	2015
Total 2014	1,267,043	100.00	38,667,725	100.00	2014
Total 2013	958,430	-	34.392.893	-	-

Source: EVCA (2014, 2015), investment costs.

Divestment by trade sale was the most prominent route, particularly for venture capital invested in early stages in CEE, totalising 60% of the funds obtained through divestments from these stages in 2014. 51% of total divestment value (at historical cost) was performed through trade sales in 2015, and they were also the leading exit route across all of Europe but accounted for just 29% of total divestments.

Although it is not common on the CEE markets (bit more practiced in other European countries), sale to another private equity house (the so-called “secondary” sale) was the second most used exit route in CEE, with 22% of total divestment value in 2015 and 21% in 2014 at historical cost. Together with trade sale, the two exit routes accounted for more than 50% of the total divestment funds.

Generally, divestments by public offering are not largely practiced in the CEE countries. For instance, divestments by public offering accounted only 5.4% of exits in 2014, compared to the level (19%) obtained in all European states. The amounts resulted were lower than expected, despite of the use of divestment by public offering practiced by some funds administrators. Public market exits made a strong showing across CEE in 2015, comprising 17% of total exit value at cost, a significant increase from the levels seen in prior years in the region.

The amounts resulting from sales to various financial institutions showed a significant and untypical percentage for CEE, 27% of the region's disinvestment funds in 2014, as opposed to the total registered in other European countries (5%). The preference of specialised firms for this divestment mechanism is often influenced by the amount of capital to be unlocked; for example, only one source of capital resulting from divestment totalised 62% of the funds obtained from sale to financial institutions in 2014 (EVCA, 2014).

5. Private equity market developments in Romania

The private equity market in Romania shows similar aspects found on the entire regional CEE market, but also has particularities in terms of investments levels made and their structure as well.

The structure of private equity investments by stage is depicted in Table 4. In this framework, private equity investments concentrated toward growth and buyouts which characterise the Romanian market in the period 2000-2014 can be observed. Also, the investments made in early stages were sporadic and maintained at low levels (0-5% of the total investment, 15% being registered in 2002). Venture capitals were not invested in seed stage (except the small amount registered in 2015), and the financing of other early stages was extremely modest (in years in which they were practiced). Since 2008, venture capital investments in seed and start-up were insignificant. Firms in those stages were adversely affected by the lack of funds in innovation processes as a result of the absence of (visible) market segment of individual investors (business angels) and venture capital invested by specialised firms.

Table 4. *Annual private equity investments in Romania, 2007-2015, € millions*

	2007	2008	2009	2010	2011	2012	2013	2014	2015
Seed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.46
Start-up	32.46	5.43	4.17	1.91	0.00	0.00	0.00	1.83	0.00
Later stage venture	1.33	36.56	0.00	3.18	4.00	3.06	2.98	3.48	1.37
Total venture	33.79	41.99	4.17	5.09	4.00	3.06	2.98	5.31	1.82
Growth	52.36	49.66	89.93	52.05	31.76	7.85	10.08	22.43	2.66
Rescue/Turnaround	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.06	0.00
Replacement capital	14.50	5.00	22.04	12.00	18.50	0.00	9.46	0.00	0.00
Buyout	111.80	197.31	104.73	50.00	11.65	16.70	47.84	49.18	140.20
Total investments	212.44	293.96	220.87	119.14	65.92	27.61	70.35	77.97	144.29

Source: European Private Equity Activity Data.

The percentages of investments made in growth and buyouts are the highest, but irregular evolution of the amounts invested and their volatile character are maintained. Investments made mainly in growth and buyouts demonstrate higher returns obtained for investors at a lower risk in these stages than in early stages of businesses. The low levels of all private equity, while allocating the largest percentage of funds to the latest stages, and their volatile character determined irregular annual concentration of investments.

Table 5 display the percentage of private equity investments in Romania by sector. In the period 2007-2015, we can observe that domains such as communications, computer goods and retail, and life sciences were the main beneficiaries of funds invested. Other significant investments were concentrated in consumer services and energy and environment in certain years. In those domains specialised firms are oriented as well, not only in Romania, but in the entire space of CEE. However, the Romanian market differs from the whole CEE market by investing large amounts of funds to financial services (between 2007 and 2011), which are not of much interest to the economy. In the CEE space, the investments made in financial services did not exceed 6% of the total equity investments in 2007-20015. At the same time, the high-tech domains registered sporadic and insignificant investments compared to the total investments made in the CEE region, reflecting effects of industrial structure in Romania. Also, funds invested to industrial production ate quasi-inexistent.

Table 5. *Private equity investments in Romania by sector (%)*

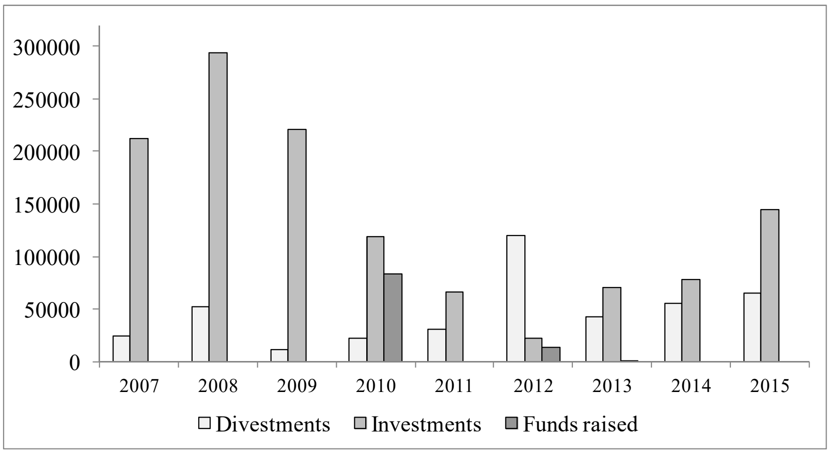
Domain	2007	2008	2009	2010	2011	2012	2013	2014	2015
Agriculture	0.0	6.8	0.0	7.8	0.0	0.0	3.6	0.0	0.0
Business & ind. products	8.2	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Business & ind. services	8.2	5.4	1.2	2.5	7.8	0.9	0.7	0.5	0.0
Chemicals & materials	0.0	15.8	2.8	0.6	3.9	3.2	17.8	0.0	0.0
Communications	21.2	0.4	2.0	11.7	0.0	14.3	17.1	7.3	18.2
Computer goods & retail	0.5	0.0	11.6	0.0	6.1	0.0	6.6	18.8	36.4
Construction	1.7	13.2	1.0	2.6	11.5	7.0	1.2	0.9	0.0
Consumer goods & retail	1.7	5.4	29.9	5.3	15.2	1.1	0.3	1.4	18.2
Consumer services	21.7	3.4	10.0	0.0	28.1	0.0	2.9	23.4	9.1
Energy & environment	0.0	0.8	7.8	14.2	9.0	72.4	21.1	15.0	0.0
Financial services	8.5	6.5	8.4	10.6	13.9	1.0	0.0	1.4	9.1
Life sciences	11.3	29.3	24.8	33.6	0.0	0.0	0.0	9.0	9.1
Real estate	16.9	11.3	0.6	2.7	0.0	0.0	0.0	0.0	0.0
Transportation	0.0	0.0	0.0	8.4	4.6	0.0	28.8	22.4	0.0
Unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total investments	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Subtotal high-tech	0.0	2.3	2.7	0.0	16.7	0.0	9.5	0.4	18.2

Source: European Private Equity Activity Data.

Venture capitals invested were extremely low and they were made in a few domains only, according with European Private Equity Activity Data (% of venture investments): real estates (96.1%), computer goods and retail (3.3%), consumer goods and retail (0.6%) in 2007; real estate (77.6%), business and industrial services (9.5%), energy and environment (5.7%), business and industrial products (4.7%), communications (2.5%) in 2008; communications (73.6%), real estate (13.8%), energy and environment (12.6%) in 2009; real estate (62.6%), communications (37.4%) in 2010; computer goods and retail (100%) in 2011; communications (100%) in 2012; communications (100%) in 2013; consumer goods and retail (51.2%), communications (24.3%), consumer goods and retail (18.9%) in 2014; communications (50%), computer goods and retail (25%%), consumer goods and retail (25%) in 2015. Often, the percentages associated to a particular domain correspond to the capitals invested at the level of one firm, and the annual number of early-stage backed firms was between 1 and 4 in the period 2007-2015.

The funds raised (incremental amounts raised during the year) were also low in the years in which they were collected (in 2010 and 2011 only) in the period 2007-2015. Total investments and funds obtained by divestments were modest, and all shaped annual large variations (Figure 2), highlighting the fragility of the private equity market in Romania, particularly in the venture capital segment, which cannot be developed in an environment of low share of small and medium sized innovative firms. This feature is also evident when we analyse the source of funds raised in the period 2006-2015. Over 90% of the funds raised came from the external government agencies, while the pension funds, funds of funds, insurance companies and banks were all missing investors in the area of capital suppliers. Among others, this is the consequence of insufficient regulatory framework adapted to perform high-risk investments (Diaconu, 2012).

Figure 2. *Private equity investments, funds raised and divestments in Romania, € thousands*



Source: European Private Equity Activity Data.

Exits are mainly performed by sales to another private equity house and sales to financial institutions and not by public offering which is the form considered of success (via obtainable returns) for specialised firms. In the period 2007-2015, exits by public offering were practiced in 2007 and 2011by sales of quoted equity (over 50%).

The yield obtainable at the end of the investment process, and the stock market development are factors that can affect investment decision, the time of investment and the disinvestment mechanism practiced by specialized firms.

6. Discussion

The development of private equity market in the CEE countries is far away from its potential. That can be reflected starting with the lower level of private equity investments than in developed market economies. To some extent, this is due to a number of constraints, which are specific to the CEE region, particularly the lack of local investors, high risk perceived by foreign investors and insufficient loan finance for private equity transactions. The shortage of experienced local management teams is also an obstacle. Legal, regulatory and tax issues pose further difficulties. Investors often complain about slow legal and regulatory processes, an inexperienced and understaffed judiciary and bureaucracy.

The common impediments that prevent domestic capital from investing in private equity funds are bureaucracy, lack of market opportunities, a weak bankruptcy framework and obstacles to starting a business. In some countries, this list also includes predatory officials, shareholder abuse, weak licensing and uncertain law enforcement. Policymakers across the region still need to pay more attention to the specific needs of the private equity industry and to address barriers to its further development (EBRD, 2006).

The magnitude of these constraints varies across the CEE countries. Romania is one of the countries with the lowest level of private equity investments, particularly in early stages. The modest proportion of innovative SMEs, the reduced R&D spending both in the private and public sector, the market dominance by stabilized companies affect all the demand for venture capital which, in turn, decreases the capital supply. Also, the absence of individual investors and favourable disinvestment opportunities affect de supply of funds.

Bank financing remains the dominant source of external capital for firms across CEE. Additional sources of risk capital are necessary to induce firms to carry out R&D. In particular, private equity and venture capital industries reveal a large equity-funding gap. This gap arises as a result of underdeveloped stock markets in the region, as well as insufficient human capital, which limit the flow of private equity funding into the region.

Financial systems across the CEE region continue to be dominated by banks, with little public or private equity available. To what extent can financing by these banks help firms to innovate? The EBRD (2014) study shows that where banks ease credit constraints, firms tend to innovate more by introducing products and processes that have not previously been available in their local or national markets. However, there is little evidence that bank credit also stimulates in-house research and development. This suggests that while banks can facilitate the spread of technology within the markets, their role in pushing back the technological frontier remains limited.

Funding constraints may limit the adoption of technology, as external inventions are costly to integrate into a firm's production structure. Firms therefore need sufficient financial resources to properly adapt external technologies, products and processes to their local circumstances. If insufficient funding is available, businesses may be unable to fully exploit the easy option of R&D that has been carried out elsewhere. Such firms remain stuck in low-productivity activities, and this may, at country level, contribute to the persistence of divergent growth patterns around the world.

Firm-level innovation – and private-sector dynamism more generally – may pose challenges to banks and other financial intermediaries that need to decide which entrepreneurs deserve funding and which do not. The more quickly technologies evolve, the more difficult it is for banks to distinguish between creditworthy loan applicants and firms that are too risky. To some extent, this is simply because business plans that involve new and untested products or processes are more difficult to evaluate. It may also be complicated to value collateral that involves new technologies. Consequently, if they are to continue lending to innovative firms, banks will have to constantly update their screening processes.

The future of private equity market in CEE is determined by the extent in which the individual investors and institutions will consent to assume the risk of their investments on the market.

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Public-Private Partnerships for clean energy investment in developing and emerging economies: Allocating risks and sharing rewards

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Abstract. *Clean energy investment such as geothermal and hydropower projects tend to be large, capital intensive and with long repayment periods. These projects are challenging, especially in developing and emerging market countries that are in transition and sometimes characterized by a changing and unpredictable political situation and unfavorable business environments. Public-Private Partnerships (PPPs) enable pooling of public, private and donor funds for clean energy investment in developing and emerging market economies. Those economies are also eligible for support from international financial institutions (IFIs) such as the World Bank Group and regional development banks*[(1)]*. A well designed PPP can be a venue for scaling up funding for clean energy internationally and thus contribute to the battle against climate change. The focus of this article is on PPPs; potential benefits and challenges for host governments and various partners (including the private sector, bilateral donors, multilateral institutions), allocation of risks as well as sharing of rewards. When disputes occur between the private sector and host governments International Financial Institutions can play an important role in resolving disputes and help ensure the fair sharing of the risks and the rewards of the PPP for all the parties involved.*

Keywords: clean energy projects, public-private partnerships, international financial institutions.

JEL Classification: F30, G22, P18, Q40.

Introduction

Clean energy investment such as geothermal and hydropower projects tend to be large, capital intensive and with long repayment periods. These projects are challenging, especially in developing and emerging countries that are in transition and sometimes characterized by a changing and unpredictable political situation and unfavorable business environments.

For geothermal projects, several models can be used to mobilize capital and cover the resource risks. These include, for example: (i) an enterprise in public ownership, (ii) a private company developer and (iii) a public-private partnership (PPP). In the first model, a public sector company would typically undertake the whole project, including the resource risks. This could be a combination of national and municipal authorities such as in the case of Iceland. In the second model a private sector developer might be a large company with a strong balance sheet as in the case of Chevron in the Philippines. In this case the private company has the financial capacity to undertake the whole project. In the third model the public and private sectors work in partnership, i.e. a public-private partnership (PPP).

PPPs enable pooling of public, private and donor funds for clean energy investment in developing and emerging economies. Those economies are also eligible for support from IFIs, such as the World Bank Group and regional development banks. A well designed PPP can be a venue for scaling up funding for clean energy internationally and thus contribute to the battle against climate change. Thus a potential global benefit exists in using this arrangement. The focus of this article is on PPPs: potential benefits and challenges, host government cooperation with the private sector, allocation of risks as well as sharing of rewards.

Among the sources of evidence used for analysis in this article is secondary data, including analytical reports and scholarly literature. Direct observation also plays a role as the authors draws on his home countries experience, Iceland, that has made a transition to clean energy for space heating and electricity production utilizing geothermal as well as hydropower energy. The author also draws from his experience as a staff member at the World Bank from for 12 years working in three continents, Africa, Asia and Europe. Furthermore, the author has also for several years as professor interviewed various staff of the World Bank as well as regional development banks on the challenges of clean energy projects in developing and emerging countries.

Public-Private Partnerships – some definitions

What exactly is a public private partnership? Many different definitions are used for PPPs by different individuals and institutions. One definition is “any public sector service provided partially or wholly by the private sector” (Delmon, 2009, p. 601). Another definition is “co-operative institutional arrangements between public and private sector actors” (Hodge and Greve, 2009, p. 33). The World Bank has defined PPPs as “the transfer to the private sector of investment projects that traditionally have been executed or financed by the public sector" (World Bank, 2008, p. 93). The Organization for Economic Co-operation and Development has defined PPPs as "long term contractual arrangements between the government and a private partner whereby the latter delivers and funds public services using a capital asset, sharing the associated risks" (OECD 2012, p. 18). Notably, the Organization for Economic Co-operation and Development and World Bank definitions mention capital investment by the private sector. The other definitions are more general, highlighting service and cooperation.

Possible benefits from using public-private partnerships in developing and emerging countries

Why would governments of developing and emerging market economies want to cooperate with the private sector under a PPP arrangement? The answer is: for several reasons. A PPP can be a feasible option for governments because in most developing and many emerging countries the government has limited capacity to mobilize funds. This means that a partnership with the private sector can help the government obtain much-needed long term capital. The private sector may also possess technical knowledge that the public sector does not have and be a more efficient operator of power plants. In this case a public-private partnership can be formed to allow for a sharing of the risks and rewards from the project.

PPP can be a favored model in developing and emerging markets and be beneficial if well designed and if risks and rewards are shared fairly. However, little point exists in forming PPPs if, for example, the private sector partner captures most or all the benefits, or if the government keeps changing the rules of the game resulting in a non-viable project.

With pressure on physical infrastructure and limited resources, governments of developing and emerging countries may want to cooperate with the private sector via a PPP to help finance, build, and/or operate public projects. While doing so, the government could at least in theory: (1) utilize the better skills and better management from the private sector that may lead to increased efficiency for the project in a competitive environment, (2) access private sector funds to undertake more projects than would be possible with public funds alone – this can contribute to fiscal stabilization, and increase investment and growth, (3) provide more affordable and better services to end-users, and (4) share risks with the private sector (see, for example, Leruth, 2009; de Palma et al., 2009; Estache, 2005).

Developing and emerging economies on the one hand and high-income economies on the other may have different reasons for participating in public private partnerships. As Hart points out, "Policy makers frequently argue that PPPs are good because the private sector is a cheaper source of financing or insurance than the public sector." Furthermore, he emphasizes that "This thinking is strange for an economist since it is hard to imagine an agent that is more able to borrow or to provide insurance than the government (with its enormous powers of taxation)" (Hart, 2003, p. c75). Leruth also argues "the government is often able to borrow at [an] almost risk-free rate (no credit risk), which gives it an advantage" (Leruth, 2009, p. 230).

These arguments may well be true in countries that enjoy strong creditworthiness (e.g., via AAA or other high credit rating status). The countries discussed in this article, however, are developing and emerging countries. They often have large unutilized energy resources and strong medium- or long-term demand for energy, but their creditworthiness is limited. Their nationals often have limited ability to pay for the services rendered to them and the government has weak capacity to force them to do so through taxation. Such governments can be risky partners for the private sector in a PPP. In this situation, efficient and effective risk allocation is the key to success, and the international community can play a constructive role, for example, through participation by IFIs, which can involve a variety of funding and mitigation instruments as well as technical assistance.

When discussing green infrastructure finance, the World Bank states that “the international community has recognized that the majority of new investment financing will need to come from private sources” (World Bank, 2012, p. 16). The World Bank’s focus is on developing and emerging markets. This means that some sort of public-private partnerships will need to be formed for a large share of clean energy investment in those markets in transition. This is a major challenge not only for the private sector, but also for participating developing and emerging countries. Moreover, as the World Bank has stated, “developing a framework for improved collaboration between public and private sectors could greatly benefit green infrastructure financing mechanisms” (World Bank, 2012, p. 6).

Interest in PPPs is growing among Asian countries, including a notably prominent market in China. The Association of Southeast Asian Nations (ASEAN) for example recently stated that “PPPs are seen to be beneficial in meeting ASEAN infrastructure needs, estimated by the Asian Development Bank at USD 60 billion per annum. Private participation in infrastructure provision can enhance existing public capacity in providing economic (e.g. transport, telecommunication, power, water and sanitation) and social (e.g. health and education) infrastructures” (ASEAN, 2014). Great need is also present in other developing and emerging regions such as Africa and Latin America.

Some challenges using public-private partnerships in developing and emerging countries

According to the Public-Private Infrastructure Advisory Facility(2) countries using the PPP model need to have: strong institutions, legal systems and rule of law, high standards of public and corporate governance, transparency, competition, protection of investments, enforcement of laws, and dispute resolution mechanisms (World Bank, 2015). This is an impressive list, but some would argue that it is unrealistic even for developed high income countries. If international financial institutions insisted that those criteria be satisfied before an investment could take place using the PPP model, very few places in the world would receive any private finance. This would especially be a challenge in developing Africa.

Because of this challenge, key international organizations such as ASEAN, the European Union, the International Monetary Fund, the United Nations, and the World Bank have formulated and displayed substantial policy documents on PPPs. A recent paper on PPPs shows that international organizations use roughly the same categories and conceptions of stages for what is needed to establish effective PPPs (Greve, 2015).

Multilateral as well as bilateral financial organizations can at least in theory be a catalyst in supporting PPP projects, including in the clean energy sector. Institutions such as the World Bank Group and regional development banks can, via their policy dialogue, assist governments when undertaking reforms needed for effective use of the PPP model. IFI support can be important because developing and emerging countries often have limited capacity to negotiate with multinational enterprises. Since the Public-Private Infrastructure Advisory Facility is a multi-donor technical assistance facility, financed by 17 multilateral and bilateral donors, it can play an important role here.

But, as mentioned before, using the PPP model and working in partnership with IFIs and bilateral development institutions can also come at a cost. A recent book published by the World Bank, entitled "Public Private Partnerships in Europe and Central Asia – Designing Crisis-Resilient Strategies and Bankable Projects", comments very cautiously that "working with these institutions may also lengthen the project development process, given specific requirements in terms of environmental and social safeguards requirements and stringent procurement procedures" (Cuttaree and Mandri-Perrott, 2011, p. 59). Another book also published by the World Bank entitled: "Doing a dam better: the Lao People's Democratic Republic and the story of Nam Theun 2 (NT2)", is more critical when discussing World Bank cooperation with the private sector. The authors simply state that: "The bad news is that the World Bank is seen as a high-cost/high-hassle partner of last resort. There is therefore a critical need to reduce the costs the private sector incurs for doing business with the World Bank. Doing so will require the World Bank to better understand the constraints under which the private sector works" (Porter and Shivakumar, 2010, p. 22). These comments are especially notable given that the authors have both served as World Bank country directors. Shivakumar, for example, played an important role in enabling the Nam Theun 2 hydropower project in Lao.

The challenges of host government cooperation with the private sector

PPPs are not only a challenge for the private sector. Cooperating with private enterprise can also be a serious challenge for host governments in developing and emerging market economies, especially during times of economic and financial crisis. In their book, *Making Foreign Investment Safe – Property Rights and National Sovereignty*, Wells and Ahmed (2007) document a dramatic dispute between CalEnergy, an entity founded as a consulting and service company for geothermal power in North America, and the Indonesian government. This dispute resulted in a claim under official political risk insurance filed by CalEnergy and paid by the US government agency, the Overseas Private Investment Corporation. Less dramatic, but still consequential, was the dispute between Enron, then a private power developer, and the Indonesian government, that ended with the Multilateral Investment Guarantee Agency (MIGA), the insurance agency of the World Bank Group, paying out its first claim ever.

As Wells and Ahmed state: “The Indonesian experience with official political risk insurance has not been the only one that has made developing countries a bit wary. From the point of view of host countries, the new property rights system was not being very constructive. The moral hazard associated with the insurance surely had encouraged some investors to avoid renegotiation when economic crisis hit Indonesia and other countries. And Indonesians saw themselves as having few rights when CalEnergy filed a claim with [the Overseas Private Investment Corporation] or when [the Overseas Private Investment Corporation] sought reimbursement from Indonesia” (Wells and Ahmed, 2007, p. 246). Insurance can thus under certain conditions put the host government in a very difficult position vis-à-vis a private sector investor who is insured, in this case with the powerful US agency Overseas Private Investment Corporation. Moreover, Wells and Ahmed also criticize the public agencies providing guarantees as follows: “Further, and unlike many private insurers, public agencies appear to pay little attention to actual or potential moral hazards. If [the Overseas Private Investment Corporation] would insure only a smaller percentage of the equity, forcing more of the risk onto the investor, one aspect of moral hazard ought to decline. Second, allowing [the Overseas Private Investment Corporation] to seek something less than full reimbursement from host countries would reduce the perception that it faces no loss if it decides to pay claims” (Wells and Ahmed, 2007, p. 246).

In the case of the Enron dispute in Indonesia, MIGA paid Enron in the end. MIGA then demanded reimbursement from the government of Indonesia and got it. A good relationship with the World Bank Group, which MIGA is part of, must also have been considered important for the government of Indonesia because of other projects and programs that could be jeopardized in the event of an unresolved dispute. It is, however, questionable whether the World Bank Group should use its leverage in this way.

While the tensions between the government of Indonesia and MIGA did not run as high as in the case of the Overseas Private Investment Corporation, both were costly for the government of Indonesia in terms of money and international relations. In their concluding chapter, Wells and Ahmed raise doubts about whether the international system of property rights can accomplish its goal of encouraging foreign investment that is helpful for the host country. Nevertheless, and in spite of the serious problems that a host government can experience, they recognize the need for public private partnerships when they state that “Meeting the huge infrastructure needs for development will surely require a mix of private investment, state investment, multilateral lending, hybrid arrangements, and very substantial aid money” (Wells and Ahmed, 2007, p. 283).

IFIs are well placed to mitigate risks at competitive prices. As Wells says, “official insurance can be priced low, since the threat of sanctions by the organizations backing the insurance sharply reduce the chances of the events being insured against occurring” (Wells, 2005, p. 91).

Regional and global economic crises, such as those that struck Asia in 1997/98, Argentina in 2001, and the whole world in 2008/09, can pose significant threats to the international investment regime. As Salacus (2010) states, “Countries under great stress, faced with potential social and political upheaval as a result of rapidly declining standards of living, often seek radical solutions and are impatient with international investment rules that may restrict their latitude of action. For example, during times of economic crisis, governments may be unwilling to grant national treatment to foreign investors, to avoid changing regulations in the name of "fair and equitable treatment," and to refrain from seizing vital national resources held by foreigners simply because they have made treaty promises not to expropriate. Thus Argentina, to cope with one the most serious economic and financial crisis in its history in 2001-2002, took a series of measures that foreign investors believed violated their legal rights and economic interests, resulting in the initiation of numerous investor-state arbitration claims" (Salacuse, 2010, p. 471). International financial institutions can play an important role in resolving disputes between host governments and foreign investors during economic and financial crises and they should make efforts to facilitate settlements that are fair for all parties involved. It should be a last resort action to pay out a claim to the private investor and then use the leverage of the IFI to force reimbursement from the host government.

Public-Private Partnerships – allocating risks and sharing rewards

In spite of the many potential problems and issues that can be associated with public-private cooperation and in operating public-private partnerships, PPPs can be a feasible platform to fund infrastructure development and to increase the efficiency of public sector service delivery in developing and emerging economies. The PPP becomes a venue for the public and private sectors to cooperate on a project that would traditionally have been in the public domain. Infrastructure projects in the clean energy sector are often large, capital intensive and long term. Repayment periods are also often long. It can take a private investor 10 to 30 years to recover the investment and project returns. It is often challenging to maintain a good working relationship within a PPP for such a long time, while the local, regional and global environment may change dramatically during this period.

The private sector has for years been recognized as a significant financing source for meeting developing country investment requirements. However, financial markets remain largely untapped for this purpose and have yet to live up to their potential (Asian Development Bank, 2006). PPPs are one platform worth considering for the private sector to engage in infrastructure projects, including geothermal and hydropower projects. Private capital, bilateral and multilateral donor support, including IFIs, and public funds can be combined in a PPP project. A well designed policy and institutional framework for PPPs offers the opportunity to leverage and combine all three sources of financing and expertise without crowding out private investment. By forming a PPP both public and private sectors can share the risks and rewards of infrastructure projects.

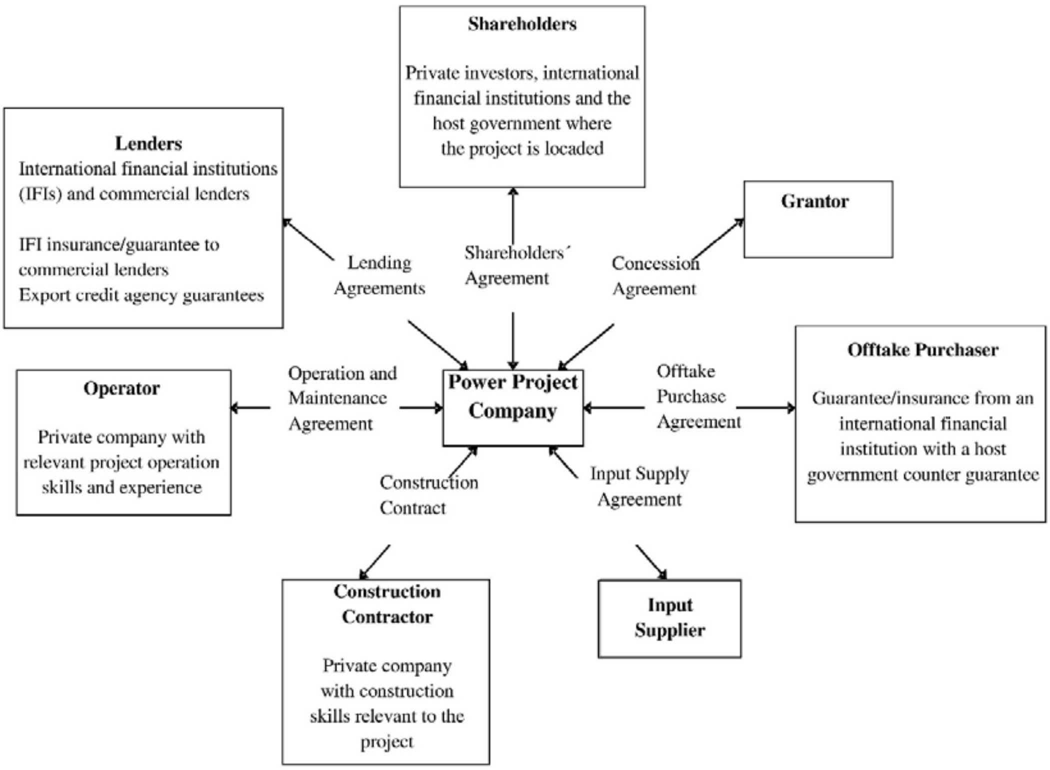
Private sector funding and participation in clean energy projects is a challenge for various reasons. Among them is that the host government is often the only buyer of the electricity or hot water produced i.e. it is the so called offtake purchaser[(3)]. Many developing and emerging countries with large clean energy potential have limited creditworthiness. They have low per capita income and are often going through economic and political transition.

Developing and emerging countries can also be vulnerable during regional and global crises. In such cases the sponsors(4) of a project may hesitate to inject funding because of uncertainty with the income stream from the investment. Lenders, including commercial investment banks, would also often hesitate to provide loans to such projects because of uncertainty whether the project company, whose income stream is at risk, can service its loans. Sponsors may also hesitate to provide equity capital.

To engage in cooperation, the public and private sectors can employ several different schemes(5) including the so called BOT, i.e. Build-Operate-Transfer (International Monetary Fund, 2004). In BOT projects the private sector is responsible for financing, constructing and operating the project. Under this arrangement the host country grants a concession(6), i.e. the right for a private firm to undertake a public sector project and operate it over an agreed period. When the concession expires the ownership of the project is transferred back to the party granting the concession.(7)

The partners typically involved in a BOT project are: the project company that undertakes the project, the host government (that can also be the offtake/power purchaser and guarantor), the shareholders, the lenders, the grantor, the construction contractor, the operator, the offtake purchaser/power purchaser, and the input supplier. Figure 1 below shows a typical PPP BOT contractual structure.

Figure 1. *Typical PPP BOT contractual structure*



Source: Constructed by the author.

The project company uses the income stream from the project to service its debt and to pay returns to its investors.[8] The lenders to a BOT project might, for example, be commercial investment banks, IFIs and bilateral agencies. The IFIs could also serve as guarantors e.g. for payment to the lenders, including commercial investment banks. National institutions such as export credit agencies, which support trade finance (goods and services), can also play a constructive role in reducing the risks taken by private sector investors see e.g. Dinh and Hilmarsson (2012a, 2012b, 2012c and 2013).

The lenders would typically be keen to manage their risks[9] and would receive a fixed margin on their loan whereas the shareholders[10] maximize the profits on their equity investment. In addition to obtaining funding for the project, the project company procures the design and coordinates the construction and operation of the project in line with the requirements of the concession agreement. Project company shareholders often include firms with construction and operation experience, and with offtake purchase capabilities (Delmon, 2009, p. 98).

The offtake purchase agreement secures the project payment stream. The offtake purchaser will be looking for guaranteed long term output from the project. The credit risk associated with the offtake purchaser will be of particular concern to the project company and the lenders. This is where guarantees from host governments or IFIs, including the World Bank, become important.

Critical to the design of PPPs is the way risks are allocated between the partners in the PPP. In fact, effective risk allocation is key to success in any PPP. A general principle is that risk should fall on the party that is abler to do something about it. Risks in PPPs tend to be allocated on the basis of commercial and negotiating strength. The stronger party will allocate risk that it does not want to bear to the weaker party. Efficient allocation of risk will generally result in a more successful and profitable project and will benefit each of the parties involved (Delmon, 2009).

In order to minimize the market risk from the project company and the project lenders, an offtake purchase agreement, or in the case of a power project, a power purchase agreement, may be made. This is to create a secure payment stream which will be an important basis for financing the project. The offtake purchaser may also be the grantor, or a government entity such as a public utility, in which case the offtake purchase agreement and the concession agreement may be one and the same document (Delmon, 2009).

The lenders will want project risks to be allocated to project participants, i.e. the construction contractor and the operator but not the project company, which is their debtor. The project company will enter into a contract with the construction contractor in order to divest its obligations to the grantor to design, build, test, and commission the project. Completion risk for the project should be allocated to the construction contractor. In the case of a turnkey project, completion and performance risk should fall on the construction contractor.

If the main risks are associated with poor management of the service, shifting the risk to the operator could provide the right incentives to ensure that the project delivers. If risks are related to changes in policies, then the government should bear the risk. This is because the project company will not generally be able to manage political risk. The project company will ask the government to bear those risks, not necessarily to claim compensation at a future date but to pressure the government to avoid such risks and to minimize the probability that such risk events will occur.

Sharing the risks and the rewards in a fair and sustainable manner is important for the success of a PPP that may be operating for a few decades. During this time economic and financial crisis can hit. This risk should be factored into the project. In turn, this can result in demands for higher returns for private sector participants. Crises in East Asia as well as in Latin America can teach valuable lessons to the private and public sectors, as well as to bilateral and multilateral providers of loans, equity and guarantees.

Reducing the risk of failure through efficient project company operations as well as good government policies is important for all parties involved. Shifting the risk to a weaker party is, however, questionable (e.g. if an insured private sector participant files a claim against the host government of a developing country without trying to resolve issues and then an insurer such as an IFI files a reclaim against the host government without making credible efforts to resolve the dispute).

PPPs place a strong demand on host government capacity to communicate and negotiate both with private participants and IFIs when these are involved. Low government capacity is an obstacle when using the PPP framework, but one must keep in mind that a weak government is also less likely to be able to run a project with 100 percent public ownership efficiently. When disputes occur between the private sector and host governments, IFIs can, and should, play an important role in resolving disputes and help ensure the fair sharing of the risks and the rewards of the PPP for all the parties involved.

Conclusions

Clean energy investments such as geothermal and hydropower projects tend to be large, capital intensive and with long repayment periods. These projects are challenging, especially in developing and emerging countries that are in transition and sometimes characterized by a changing and unpredictable political situation and unfavorable business environments. PPPs enable pooling of public, private and donor funds for clean energy investment in developing and emerging market economies. Those economies are also eligible for support from IFIs. A well designed PPP can be a venue for scaling up funding for clean energy investment internationally and thus contribute to the battle against climate change. Thus a potential global benefit exists in using this arrangement.

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Notes

(1) Such as the African Development Bank, the Asian Development Bank, European Bank for Reconstruction and Development and the Inter-American Development Bank.

(2) The Public-Private Infrastructure Advisory Facility was created in 1999 to act as a catalyst to increase private sector participation in emerging markets. It provides technical assistance to governments to support creation of a sound enabling environment for the provision of basic infrastructure services by the private sector. According to the Public-Private Infrastructure Advisory Facility a sound business-enabling environment consists of strong institutions, legal systems and rule of law, high standards of public and corporate governance, transparency, competition, protection of investments, enforcement of laws, and dispute resolution mechanisms. The Public-Private Infrastructure Advisory Facility is a multi-donor technical assistance facility, financed by 17 multilateral and bilateral donors: the Asian Development Bank, Australia, Austria, Canada, the European Bank for Reconstruction and Development, France, Germany, the International Finance Corporation, Italy, Japan, the Millennium Challenge Corporation, the Netherlands, Sweden, Switzerland, the United Kingdom, the United States, and the World Bank. Public-Private Infrastructure Advisory Facility funds are untied and grants are provided on a demand-driven basis, see further: http://www.ppiaf.org/node/23#What%20is%20PPIAF?

(3) An offtake purchaser is a purchaser of the product produced by a project. In the case of a power project the product produced is the electricity generated.

(4) A sponsor of a project is a party wishing to develop or undertake a project. A sponsor would normally provide financial support for the project e.g. early equity capital.

(5) PPP schemes and modalities other than Build-Operate-Transfer (BOT) include for example: Build-Own-Operate-Transfer (BOOT), Build-Rent-Own-Transfer (BROT), Build-Lease-Operate-Transfer (BLOT), Build-Transfer-Operate (BTO).

(6) A concession is the right granted by the host government for a private company to undertake a public sector project and operate it over an agreed period.

(7) For a comprehensive discussion on BOTs see, for example, Jeffrey Delmon's outstanding book on Private Sector Investment in Infrastructure (Delmon, 2009).

(8) i.e., equity contributors to the project company.

(9) i.e., they would only take measurable and measured risks.

(10) i.e., equity holders in the project company.

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Science is measurement, yet not all sciences can be evaluated using the same measurement

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Abstract. *The purpose of this paper is to investigate if in Economics may take place the same type of "Darwinian Competition" that occurs in Natural Sciences and through which theories are permanently removed. Starting from how measurement, tool development and the establishment of the experiment as a research method, led to significant progress in natural science we demonstrate that the same assumptions for reducing the complexity of reality and the ontological universalism hypothesis cannot be used in Economics. The consequence of not being able to use the same methodological tools is that economics has to be content with the use of statistical laws, which merely allow the prediction of "empirical regularities" in comparison with the precision of natural sciences laws.*

Keywords: equilibrium, experiment, measurement, ontological universalism, Darwinian Competition.

JEL Classification: B41, C62, N01.

Introduction

For most of us, the word science is associated with that kind of knowledge, which although it is subject to the ethos vagaries, it remains objective and that objectivity is arising from rational argumentation. The kind of knowledge that explains the relationships between things, objects or people and not the thing itself or even less the individual itself. Although when it comes to relational knowledge, in a representational meaning it can be subjective. The current scientific paradigm is concerned only with that kind of knowledge that can be repeated and transmitted to others beyond the sensory or mental perceptions of each individual. Also, we are looking at the accuracy with which scientists succeed in explaining these relations, the causal relationships among phenomenon and try to explain which is the cause and which is the effect. Finally, we come to classify or better said, to give value to a science by its ability to explain, using theories through an abstract model, the reality. And this inevitably leads us to divide the science into narrower domains. Even if the dream of any great scientist is to find the unifying theory and even if the studied issues can easily cross the artificial boundaries that we have imposed to each field, the method of partial explanation of reality had and still has a heuristic value. But what happens if theories which partly explain reality are not compatible with each other? According to this situation, one may question our capacity to select the relevant facts required for the phenomenon explanation.

This very specific problem can be observed even in Physics, the most organized factual science. Physics is currently explaining reality using two totally different and incompatible theories. General relativity explains the order at a cosmic level and quantum mechanics explains the disorder at the subatomic level. Both explain very well what is happening in their field of study (Macroscopic World and Microscopic World), however the functions of spatial geometry of general relativity theory collapses when observed for extremely small distances because of the violent fluctuations of the particles (which are explained through quantum theory). How can that be? How can there be order at macroscopic level and chaos at microscopic level and how can order be generated from disorder? How can both theories be “true” and should antinomy exist in a theoretical science?

This paper has a more humble purpose than that of finding a unifying theory of physics. In this paper, I will try to explain the difference of measurement performed in social and natural sciences. I will explain in what sense, social sciences are more complex than natural sciences and therefore would require a more sophisticated epistemology. This complexity is mainly due to exogenous variables as well as descriptors of general logic with which every explanatory model operates. At the same time, I will demonstrate how the tools development, at a higher pace in natural sciences, has brought significant progress in comparison with the social sciences. Tools development and more accurate observation of the phenomenon are the main causes for the *Darwinian Competition* between theories in natural sciences. This type of competition is a major source of progress for the theory of knowledge. On the other hand, identical competition in social science does not exist only because of inadequacy or insufficiency of instruments but mainly because of the specificity of the studied subject, which contains by nature, indeterminist elements such as free will, motivation, value judgments and all of these represent primary causes of human action, making some theories to become immortal.

Literature review

Any article that aims to make explicit the role of different measurements and how they are used according to scientific fields must start from a theorizing model. The model that could lead to the Darwinian competition and that natural science uses to enrich the theory of knowledge is the critical rationalism proposed by Karl Popper and also used by Goodman and Snyder (1993, pp. 338-350). This way of theorizing divides scientific claims into two categories. The first category is constituted from theories with empirical content, which may therefore be subject to falsifications by observation and measurement. If the theories withstand the tests, they will still be maintained and if they are counterfeit they will be repudiated. The second category is that of non-falsifiable theories, non-empirical theories, which cannot be tested. Economic science has theories contained in both categories. Into the non-testable theories category fall most of the normative theories. Normative theories are determined primarily, and this is a great deficiency in terms of measurement, by the link with the past and to what is socially acceptable in the current period. History, tradition, culture and even religion in many societies play an important role in the formulation of normative theories. How can we measure, for example, if a country is democratic or not? Moreover, how can we measure the optimum to which the individual freedoms or the constraints imposed by the government should extend?

The search for precision in measurement and the transpose of certain statements such as *"a single number has more real and permanent value than a vast library of hypotheses"* Robert Mayer(1) (Georgescu-Roegen, 2009, p. 15) have pushed economics to the belief that everything can be measured. The fascination exerted on the intellect by the number can be traced back in time to the ancient Greeks; it is not easy to overcome even today. This is the fascination that has produced the ***ordinal illusion*** and whether there are numbers, there must be "more" and "less" and therefore ***Quantity.*** This type of reasoning has driven some authors, such as Stanley Jevons to assert that *"since the Economics deals with quantity, it must be a mechanic of utility and self-interest."* (Jevons, 1965, p. 50). Those economists have built a bridge between physics and economics and began adopting the methodological tools, in terms of measuring variables, with the risk of eliminating certain important assumptions. This toolkit also eliminates a second very important part of establishing scientific knowledge in physics, namely experiment.

Economics cannot perform controlled experiments, and when they perform them, the subjects do not behave in the way they would behave when they are not observed (the same problem appears in quantum physics). I will return to the issue of the experiment and the place it should occupy in Economics and also to the differences between precision laws and statistical laws. One of the most important assumptions that Physics makes when performing measurements on Earth and which, Economics have borrowed (which leads to erroneous generalizations and economic policies) is the ***Ontological Universalism***.

The Ontological Universalism hypothesis and the Social Constructs

This assumption plays a crucial role in determining a theory generality degree. Following Popperian criteria, a theory is more valuable as it forbids more effects to take place. In this case a theory is most valuable if it does not allow exceptions from the general rule. In Physics a theory that explains the physical world in which we live, must be valid for any place and time on Earth. An oxygen atom will have the same behavior in a rich country in Northern Europe as well as in a poor country in Central Africa. By contrast, human societies differ in space and time. The main categories that we can find in the literature for classifying the human societies are as follow: primitive collectivism, feudalism, capitalism and communism. Economics must use some domain specific assumptions in conjuring with the ones used by Physics (to determine the factors that create these different types of societies). If we assume that the key factors in shaping social relations are institutions and technology, and these types of societies have different technologies and institutions, we will need a theory relating to each type of society. Economics call for Ontological universalism leads in most cases to paralogism and errors characteristic of inductive logic, a recent and well argued case are austerity policies (Blyth, 2015).

Identification of observable variables is not an easy task for Economics, but one that requires a measurability criterion. Such a criterion was proposed by the philosopher John Searle (1995, pp. 35-56); propositions about facts can be classified into two categories: Ontological and cognitive and each category can be either objective or subjective. Sentences that relate to physical objects are ontologically objectives and those relating to mental constructs are ontologically subjective. Moreover, sentences about things that have meaning independent of the observer (or do not need a point of view) fall into the category of cognitive objectives, and those who need an observer (a particular point of view) in order to make sense, fall into the category of subjective cognitive. In Economics sentences that fall into the category of cognitive objective are positive, while those that fall within the cognitive subjective are normative. We can now create a matrix of measurability that can frame any sentence and it will have two meanings; one will be ontological and the other will be cognitive.

Different types of reality matrix based on the classification criterion of John Searle

Ontological	**Cognitive**	
	Objective (positive)	**Subjective (Normative)**
Objective (physical)	(1) This paper has a width of 2 millimeters	(2) I don't like thin paper
Subjective (mental construct)	(3) The money supply has increased	(4) I like money

Measuring a piece of paper is both ontological and cognitive objective therefore should be placed in box no. 1 of this matrix, but someone's feelings on the paper thickness should be placed in box no. 2. On the other hand, money (paper) is ontologically subjective because they are socially constructed and are socially accepted as a mean of exchange. At the same time money is cognitively objective, is not required a viewpoint of someone to recognize a 5 euro bill, so it should be put in box no. 3. Sentences that describe our feelings about money will be both ontological and cognitive subjective and will fit in box no. 4.

Physics and Biology are using as observable variables only those that fall in box no. 1. Economics is using such variables as well; take for example, the agricultural or industrial production. Beside this category, Economics is using observable variables that should fit in box no. 3; a good example would be "the money supply has grown in the last year". Because Economics is using social constructs, the complexity of the variables is increasing. We didn't chose money for example by chance, but because there are different types of notes and not every one of them are accepted in any country in the world. Not everyone can recognize a 5 RON bill. More people can recognize the 5 euro bill, but anyone can recognize that measures of the paper on which the banknotes are printed.

In these circumstances we can conclude that much of the progress of the natural sciences is due to the facts and variables used in measurements. Another portion of the progress is due to the innovation in measuring instrument. Microscopes, telescopes, spectroscopes, all have registered accelerated progress. We can argue that major paradigm shift in physics were made by instruments. New tools have led to new observations which overthrew the previous paradigm. This assumption is contrary to that proposed by Thomas Kuhn (2008, p. 61), who argues that the main reasons for paradigm shifts are new social and political ideas. Moreover, we must understand the shortcomings of observations in Economics. Data which economists typically use in their predictions are either official government statistics or data from surveys applied to the companies or households. In this situation a problem may arise regarding the objectivity of such data, a problem generated by the *self-interest.* If we admit the assumption of Adam Smith, who ranks self-interest as the main stimulus for human action, then we must admit that this self-interest is maintained by firms and households when providing information. In producing a public good such as information, incentives to households or firms are not in favor of the production of "true" information in the sense of objective, but rather inclined to produce "correct" information in terms of political or cultural. In the case of government, if we accept the assumption that argues that the government primary interest is to maximize the number of votes, we have even a more acute problem than for households or firms. Motivation is again changed from producing the "true" information in producing the "politically correct" information that has the greatest potential to attract votes.

The role of the experiment as a research method and the differences between precision laws and statistical laws

It is important to understand that theorizing in both natural and social sciences is consistent with the mainstream worldview. Until recently the undisputed mainstream worldview, starting with Galileo and Newton was that of mechanical physics. Nowadays the mainstream is challenged by the vision of quantum physics. We can say that we are at a crossroads of paradigms. What I want to emphasize is that "scientific objectivity" cannot escape the contextual chains and in the context of mechanics, the veracity of a theory is given by the ability to pass the test of falsification. The falsification is usually tried through experiment and often in couple with mathematics. Even the greatest philosophers have failed to escape the chains of context, and in this respect we can see even I. Kant sinning when he said that *"in any field of the natural sciences there is only that much science as much as mathematics is included in it"* (Kant, 2004, p. 6). Kant believed that the criterion of science is mathematics and eventually all the natural sciences will take a mathematical form. Even if this belief led many of his followers to an overvaluation of mathematics, some even to panmatematism, Kant's belief was invalidated by the history of science, at least until today. However, from these beliefs some questions have arisen and these questions need answers:

1. Can the experiment be used as a research method for testing theories in social sciences?
2. Can we inquire the empirical observations using the same type of laws (precision) used in the natural science?

First, in order to use the experiment as a research method it is mandatory to operate some complexity reductions. For the natural sciences there are several categories upon which such reductions must be used, as argued by Lucian Blaga (1998, pp. 218-219):

a) External conditions.
b) Conditions related to the experimental equipment.
c) Conditions related to the observation process of the phenomenon regarding the experimenter.

One will ignore both external conditions of the phenomenon and the intrinsic conditions of the equipment because by their nature they are considered to be "constants". The same applies to conditions pertaining to the observer because it is considered that his influence on the experiment is negligible. Experiments of mechanical physics conducted under the light of these reductions have greatly contributed to the theory of knowledge. On the other hand, experiments subject to these reductions cannot occur in quantum physics. The main reason for which these reductions cannot take place is the order of magnitude, which is similar to the size of the observed variables. Just by observing the phenomena, the observer will have a significant influence on the observed variables; in most cases he will alter their behavior.

Regarding social sciences and especially economics, using the experiment as a method of testing the theory, will require the use of an auxiliary reduction beside those mentioned earlier. It is considered that the behavior of the observed subjects (humans) is rational. This hypothesis gives birth to a series of problems. Firstly, there is no consensus regarding the concept of rational behavior. Rationality can be defined as the behavior that leads to the objective in the most efficient manner (i.e., economic rationality, efficient use of resources). In Economics we often encounter rationality defined as a set of preferences or decisions that are inwardly non-contradictory and mutually consistent. But for these assumptions widely applied in economic theory, psychologist Daniel Kahneman, Nobel Prize winner in Economics sounded the alarm saying that *"Defining rationality as consistency is too restrictive; it calls for an adherence to the rules of logic that a finite mind is not able to apply"* (Kaneman, 2012, p. 637). Moreover, this "straitjacket" imposed by rationality consistency should not be worn again, because goals can change depending on the emergence of new information, as Keynes argued in the past century.

Thus, decisions to achieve new goals may be inconsistent with decisions taken to achieve the initial objective.

To answer the above questions one must understand that experiment, as a research method, unfold by deterministic laws (the experiment is by definition a controlled process). This very process control enables us to isolate the phenomenon we wish to study. By isolating the phenomenon under laboratory conditions it is understood, that in the natural sciences, the initial conditions can be reproduced. This is possible because of the "inanimate matter" that those sciences are studying. The experiment results will be identical; the process through which one can go from cause to effect will be the same, if we submit the studied object to the same initial conditions, thus allowing us to extract some **precision laws.** Using the experiment as a research method leads to a conclusion regarding empiricism and has an epistemic consequence, namely, **it is transforming the empirical observation into the ultimate source of scientific knowledge**. On the other hand, this phenomenon isolation and reproduction of the initial conditions cannot be operated in the social sciences. First because the subject of study (human) who can act or react differently under identical conditions. Secondly, there is only one sense of the knowledge accumulation which makes it impossible to reproduce the initial conditions and deems useless the historical comparison, so although we say that history repeats itself, it is merely an approximation, we have no historical laws, a good argumentation of this idea can be found in *The poverty of historicism* by Karl Popper. Moreover, there is a certain degree of indeterminism in an evolutionary process. History is contingent mainly because innovation which disrupts systemic regularities and assures us that the world is non-ergodic, that *"it is more than a statistical shadow of the past"* (North, 2005, pp. 44-45).

We should now have a pretty clear picture of the position of the experiment in Economics and that social reality does not support precision laws. The only laws that the experiment can justify are **statistical** or otherwise, **empirical regularities**. We must be very cautious with respect to the dangers that the experiment method can pose. One that commonly occurs is that in the absence of additional explanations "empirical regularities" create false certainties. Most economic crises are based on an erroneous assessment of risks caused by these false certainties.

The evolutionary process and the logic of scientific research

Before we explain how the evolutionary process works (or doesn't) in Economics, we have to define the framework within which this science operates, namely the society. To characterize a system as static, dynamic and evolving we have to look at how the equilibrium is achieved in that system:

- Static equilibrium assumes repeating the same values of endogenous variable, period after period, as long as the values of exogenous variables remain the same.
- Dynamic equilibrium assumes a particular path in time for the endogenous variable as long as the values of the exogenous variables remain the same.

An evolutionary process, be it an economic process, assume that equilibrium values of endogenous variables cannot be repeated indefinitely, sooner or later this iteration will be interrupted. This interruption will move the system into a new process which differs qualitatively from the old process. A good example of such a process would be a society in dynamic equilibrium in which the total income increases, but also the inequalities. As this process is repeated, the degree of inequality worsens to such an extent that it reaches a boiling point; it produces a social crisis, which historically leads to violent redistributive processes, i.e. revolution. Economic theories assume evolutionary processes; only through them the qualitative changes of society can be explained.

Even if we admit the existence of evolutionary processes in Economics we should further investigate whether this leads to the "Darwinian Competition". In the natural sciences this investigation is done according to the Popperian criteria of falsification, propositions are tested empirically. This criterion is not enough for social science, implicitly nor for Economics, because many assertions cannot be directly empirically tested. Thus we need an additional criterion, such as the one proposed by Nicholas Georgescu-Roegen (2009, p. 56).

By logical sorting, assertions can be divided into two categories:
1. Any β proposition is a logical consequence of an α proposition.
2. No α proposition flows from another α proposition.

An α sentence should not be directly observable or tautological, but at the same time it should allow logical derivation of β sentences, which in turn are observable and therefore testable. In other words, α proposition is the theory and β propositions are the theories' testable predictions. If no β propositions can be logically derived from a "theory" then that is not a scientific theory. This method proposed by Georgescu-Roegen is very important due to the fact that it establish causal relationships between variables. The variables are not intrinsically endogenous or exogenous; they are classified in those two categories only in the light of scientific theories. Moreover, in Economics the same variable can be considered as endogenous in one explanatory model and as exogenous in other explanatory model. We must admit that Economics is a science of aggregates, a science dealing with the society and not the individual, in short is a science of averages or at least that's what the representative agent does. In these circumstances testing and falsifying theories is done via statistical methods. It should not surprise us that Economics operates with empirical regularities, even so, one must inquire the consequences of this procedure.

Adolfo Figueroa argues that a theory is composed from a family of models. *"To derive a β proposition from an economic theory we need a* "social situation" *in which the social context and the constraints under which the social actors operate are determined"* (Figueroa, 2016, pp. 55-57). But to create this context, in order for theories to be operational, it is required to introduce some auxiliary hypotheses. Since there are different social contexts, and for each context a different set of auxiliary assumptions is used, we will end up by having a model for each context. All possible models (the number of different social situation must be finite), are composing the theory. Testing the theory is done now indirectly, by testing each model. If a model of that family is falsified, then the model is rejected, but not the theory. The process moves to the next model and the theory will be rejected only when all the models of that family will be falsified. On the one hand I must stress that this method proposed by Adolfo Figueroa is prone to the so-called Duhem-Quine problem, who claim that using auxiliary hypotheses creates a kind of protective ring around theories so they are saved from falsification. On the other hand, this method explains quite well how theories which are composed by empirically falsified models are returning again as “fashionable”.

Conclusion

As the article demonstrates the particularities of the studied subject of Economics require the adoption of looser hypotheses, which involves giving up many of the exaggerated claims about forecast of human behavior. Tools that can quantify elements so important to increase the accuracy of the forecasts were not invented. Elements such as: will, judgment, motivation, etc. are impulse – causes of human action. All of them are components of the human nature and can vary from individual to individual.

The most important conclusion that emerges from this article is that, beyond the objectivity of scientific theories we must always remain aware that they operate with humans endowed with free will. Using Searle's matrix, one can observe that most economic theories fall within the ontological subjective. The consequence of this is that theories responding to psychological needs will always get a *veto* on those theories that do not answer such needs. This is the main reason why theories such Austerity or Trickle-Down Economics still exist even though they had most of their models empirically refuted. This is the textbook demonstration of what Mark Blyth (2015, p. 46) claims as *“facts never contradict a good ideology”* and the main reason why we can’t have that type of “Darwinian Competition” in Economics.

Theories such as Marxism or the self-regulated free markets proposed by the *“Chicago School”* for Latin America have not been falsified because the model could not be built respecting the hypothesis form the textbook. The main reason why they were not respected is that they could not be imposed on the population that would have to bear the model (not even in a totalitarian regime, not to mention in a democratic regime, where these assumptions are utopian or better said dystopian).

Therefore, a question remains open: In this context, should Economics, through its so-called scientific objectivity, raise claims over those accepted in a democratic manner? In my opinion, we are walking on a dangerous road if we are ready to accept and impose theories to human subjects justified only by using the same theoretical framework we use in natural sciences.

Note

(1) The statement is out of context; Robert Mayer was speaking to a group of physicists and he didn't need to add further the condition that that number must correctly express the reality.

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The effects of real exchange rates and income on the trade balance: A second generation panel data analysis for transition economies and Turkey

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Abstract. *In this study, effects of real exchange rate, domestic and foreign income on the external trade balance has been analysed in the framework of the extended Marshall-Lerner condition and J-curve phenomenon using 1995:Q1-2015:Q4 period data for fourteen transition economy and Turkey by means of panel cointegration analysis with multiple structural breaks under cross-sectional dependency.*
Cross-sectional dependence has been analysed with the bias-adjusted cross-section dependence Lagrange multiplier developed by Pesaran et al. (2008) and cross-section dependency has been observed among the countries. Stationary of the series has been tested with the panel unit root test with multiple structural breaks developed by Carrion-i-Silvestre et al. (2005) and it has been found that series are non-stationary in level. The existence of a cointegration relationship between series has been tested with the panel cointegration test with multiple structural breaks developed by Basher and Westerlund (2009) and a cointegration relationship has been observed between the series. Cointegration coefficients have been estimated with the Pesaran (2006) Common Correlated Effects method. According to the analysis result we found evidence that support the extended Marshall-Lerner condition in Belarus, Bulgaria, Croatia, Hungary, Latvia, Poland, Romania, Russia, Slovakia, Slovenia and Turkey. Furthermore, the J-curve phenomenon is valid in Belarus, Romania and Slovenia.

Keywords: trade balance, real exchange rates, cross-sectional dependence, panel data analysis, transition economies.

JEL Classification: C33, F31, O24.

Introduction

In the 1980s, with the beginning of the transition process to the market economy and globalisation, economies have made more dependent on each other and more sensitive to external events. Therefore, relationship between foreign exchange policies and the external trade performances of countries has become a common subject of research (Thirlwall and Gibson, 1986; Taylor and Sarno, 1998; Hook and Boon, 2000). Understanding the relationship between the terms of exchange rates and the trade balance is the key to a successful trade policy (Bahmani-Oskooee and Ratha, 2004).

The relationship between exchange rate policies and a country's trade balance is traditionally analysed by examining Marshall-Lerner condition(1). The condition suggests that real currency depreciation improves a country's trade balance in the long run if export and import volumes are sufficiently elastic with respect to the real exchange rate. In order to take place the Marshall-Lerner condition as econometric, the coefficient of the real exchange rate variable should be positive in the long run (Gocer and Elmas, 2013). After real currency depreciation, a country's trade balance worsens immediately and begins to improve later, its figure looks like the J letter, and therefore is called the "J-curve" (Krugman and Obstfeld, 1997). Dynamic impacts of the exchange rate on the trade balance are known as the J-curve phenomenon. In order for this hypothesis to econometrically take place, the coefficient of the real exchange rate variable should be negative in the short run and positive in the long run (Gocer and Elmas, 2013).

In studies recently, it is reported that explaining the effects of changes in exchange rates on foreign trade balance with the elasticities calculated by just observing changes in the price and the amount of goods is not sufficient and income effects should also be involved in the model Bahmani-Oskooee ve Niroomand, 1998; Fan et al., 2004; Gomez and Ude, 2006; Sastre, 2012). Therefore, Marshall-Lerner condition was extended with domestic and foreign income by following Ahmad and Yang (2004), Gocer and Elmas (2013) and many other studies, we adopt the following specification:

$$BT_{it} = \beta_{0i} + \beta_1 REXR_{it} + \beta_2 Y_{it}^d + \beta_3 Y_{it}^f + \varepsilon_{it} \tag{1}$$

where *BT, REXR,* Y^d, Y^f and ε_{it} express respectively trade balance, real exchange rate, domestic income, foreign income and error term. Note that estimate of β_1 is expected to be positive to fulfil the extend Marshall-Lerner condition. Because, a real exchange depreciation improves the foreign trade deficit. Estimate of β_2 is expected to be negative, for usually an increase in domestic income stimulates to higher imports. If an increase in the foreign income leads to higher exports yielding a positive estimate for β_3. Therefore, foreign trade balances of countries are determined depending on the real exchange rate, the domestic income and foreign income levels. In this study, in order to observe the effects of transition countries' membership to European Union on foreign trade balance, the EU dummy variable was also added and the following model was obtained:

$$BT_{it} = \beta_{0i} + \beta_1 REXR_{it} + \beta_2 Y_{it}^f + \beta_3 Y_{it}^d + \beta_4 D_{EU} + \varepsilon_{it} \tag{2}$$

Several studies have been carried out analysing the relationship between the real foreign exchange rate and the trade balance and different results have been obtained depending on the countries and periods used within the analysis.

This study was divided two sections. In the second part following the introduction, an abstract of literature will be given, in the third part empirical analysis will be presented and the study will be completed with conclusions and evaluation at the end. It is evaluated that this study will a contribute to the literature with the subject matter and the used analysis methods.

1. Literature review

Arize (1994) has researched the relationship between the real exchange rate and the trade balance with 1973-1991 period data for nine Asian countries. He reported that there is a positive and significant relationship between the trade balance and the real effective exchange rate in these countries and the Marshall-Lerner condition is valid in these countries. Bahmani-Oskooee and Niroomand (1998) have reported the elasticity condition using 1960-1992 period data and as certained that the elasticity condition is supported in many countries.

Wilson (2001) tested the relationship between the real exchange rate and the trade balance of Singapore, Korea and Malaysia with the USA and Japan and it was found no evidence supporting the J-Curve phenomenon in Singapure and Malaysia. Baharumshah (2001) has researched the effects of macroeconomic factors on the trade balance of the USA, Japan, Thailand and Malaysia using the 1980-1996 period data and concluded that the real exchange rate is a crucial variable affecting the trade balance in the long run Fan et al. (2004) tested extended Marshall-Lerner condition for China and found sum absolute values of export and import elasticities 1.93. Therefore, they reported that extended Marshall-Lerner condition is satisfied in China. Narayan (2004) analysed the relationship between the real exchange rate and the trade balance with the cointegration method using the 1970-2000 period data of New Zealand's economy. However, he has not obtained any support about the cointegration relationship between the real exchange rate and the trade balance of New Zealand, although he has reported that the J-curve phenomenon is valid.

Gianella and Chanteloup (2006), have researched the effects of increases in the real exchange rate on imports and exports with the 1995-2004 period data for OECD countries. He found that price elasticities are 0.6 for imports and 0.7 for exports and the Marshall-Lerner condition is supported. Yazici (2008) reported the response of exchange rate changes on Turkish trade balances for 1986-1998 periods. He found that after domestic currency depreciation, the trade balance first improves, then deteriorates and then improves again. Matesanz and Fugarolas (2009) checked the J-curve phenomenon for Argentina by means of impulse-response functions and were unable to derive a conclusion to support a J-curve phenomenon pattern in the short run. Bahmani-Oskooee and Kutan (2009) analysed the validity of the J-curve phenomenon in the Bulgaria, Croatia, Cyprus, Czech Republic, Hungary, Poland, Romania, Russia, Slovakia, Turkey and Ukraine economies with the limit test methods and determined that this effect is valid in Bulgaria, Croatia and Russia.

Yazici and Klasra (2010) investigated how the response of trade balance to devaluation is affected in J-curve framework using the generalised impulse response function analysis for the manufacturing and mining sectors of the Turkish economy. The obtained results indicate that the J-curve phenomenon is valid in neither sector. Hsing (2010) tested whether the Marshall-Lerner condition is valid for eight Asian countries and confirmed that the Marshall-Lerner condition holds for India, Korea, Japan and Pakistan, it is valid for Hong Kong, Singapore and Thailand using relative CPI, but cannot be confirmed for Malaysia. Wen (2011) reported that the Marshall-Lerner condition is not supported in China's economy. Jamilov (2011) analysed the validity of the J-curve phenomenon for Azerbaijan's economy and observed that an actual depreciation of the domestic currency would cause a decline in the trade balance in the short run and an increase in the long run hence indicating that the J-curve phenomenon is valid. Bahmani-Oskooee and Hegerty (2011) investigated the effects of the North American Free Trade Agreement (NAFTA) on US-Mexico trade and was unable to find any support for the J-curve phenomenon. Sastre (2012) tested the Marshall-Lerner condition under the assumption that the GDP is independent from the exchange rate and the foreign trade flow to GDP ratio is high and found that the Marshall-Lerner condition is not supported. Hsiao et al. (2012) stated that the Marshall-Lerner condition is valid in Chinese trade with Japan and the J-curve phenomenon is also valid in its trade with EU countries.

Gocer and Elmas (2013) analysed the relationship between the trade balance and the exchange rate with the panel cointegration with multiple structural breaks under cross-sectional dependence method by using the 1980-2011 period data of Bulgaria, Hungary, Poland and Romania. They determined Marshall-Lerner condition works for Bulgaria, Hungary and whole panel. Additionally they found that J-curve phenomenon is valid in Hungary, Poland, Romania, Turkey and whole panel. Mwito et al. (2015) investigated the Marshall-Lerner condition in Kenya's bilateral trade using the Extended Trade Balance Model. The findings indicated that the Marshall-Lerner condition was only fulfilled for trade between Kenya and China, UAE, India and South Africa. Bandyopadhyay (2016) tested the Marshall-Lerner condition for India in the pre-reform (1962-1990) and post-reform interlude (1991-2013) period and concludes that the Marshall- Lerner condition is satisfied in the pre-reform and the post-reform period in India, but there has been decline in the numerical terms.

2. Econometric analysis

2.1. Data set

Variables of the study are Trade balance (*BT*), Real Exchange Rate (*REXR*), Domestic Income (Y^d) and Foreign Income (Y^f).The quarterly data 1995:Q1-2015:Q4 periods for fifteen countries[(2)] has been used. Fifteen countries in the study have got similar economic characteristics in terms of transition to market economy and most of their exports to EU-27 countries. Most of them recently gained full membership to the EU and Turkey recently initiated full membership negotiations. The trade balance data has been obtained by dividing the exports of goods and services to the imports of goods and services. GDP of USA was used as proxy variable of foreign income. The data set was obtained from the World Development Indicators (World Bank, 2016) and International Financial Statistics (IMF, 2016). The Gauss 9.0 and codes for this software have been used for this analysis.

2.2. Testing the cross-section dependency

Before proceeding with further steps, the adjusted Lagrange Multiplier (LM_{adj}) test has been employed in order to test for cross section dependency (*CD*), which was firstly proposed by Breusch-Pagan (1980) but developed by Pesaran et al. (2008) who eliminated or adjusted for deviation in the classical *LM* test. In the absence of investigating cross section dependency, results might not be robust but might be biased and inconsistent (Breusch and Pagan, 1980; Pesaran, 2004). Therefore, the existence of cross-section dependency in the series and the cointegration equation should be tested before the other further analyses.

The first developed test for cross-section dependency is Breusch-Pagan (1980) *LM*. This was followed by Pesaran (2004) *CD* and Pesaran et al. (2008) the bias-adjusted *LM* test (LM_{adj}) test. LM_{adj} test was used in this study. The first form of *LM* test statistics is as the following:

$$LM = T\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}^{2} \sim \chi^{2}_{\frac{N(N-1)}{2}} \tag{3}$$

Equation (3) can be rewritten with the following with the adjustment:

$$LM_{adj} = \left(\frac{2}{N(N-1)}\right)^{1/2}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}^{2}\frac{(T-K-1)\hat{\rho}_{ij}-\hat{\mu}_{Tij}}{\upsilon_{Tij}} \sim N(0,1) \tag{4}$$

where $\hat{\mu}_{Tij}$ represents the avarage, υ_{Tij} represents the variance. The test statistics to be obtained here show a standard normal distribution as asymptotic. The null hypothesis of the LM_{adj} test is that of no cross-sectional dependency (Pesaran et al., 2008). The LM_{adj} test has been used and results are presented in Table 1.

Table 1. *Cross-sectional dependency test (LM_{adj}) results*

	LM	*CD*	LM_{adj}
BT	521.360*** (0.000)	28.732*** (0.000)	48.071*** (0.000)
REXR	724.450*** (0.000)	42.746*** (0.000)	13.866*** (0.000)
Y^d	805.603*** (0.000)	48.346*** (0.000)	86.478*** (0.000)
Y^f	456.201*** (0.000)	42.205*** (0.000)	45.369*** (0.000)
Cointegration Equation	838.072*** (0.000)	50.587*** (0.000)	17.392*** (0.000)

Note: *p*-values were computed 1000 bootstrap replications. In the parentheses are probability values. *** indicates the presence of cross-sectional dependency at level of 1%.

According to the results in Table 1, the null hypothesis has been strongly rejected. It has been inferred that there is cross-section dependency in the series and cointegration equation. Therefore, a trade and real exchange rate shock experienced by one of the countries affects the others. For that reason, countries should consider the other countries' external trade balance and real exchange rate policies. In addition, cross-section dependency should be taken into consideration while choosing the next test methods.

2.3. Panel unit root test with multiple structural breaks

Panel unit root tests are regarded as stronger than the time series unit root tests because of for using both the time and the cross-section dimension information (Choi, 2001). Not considering the existence of cross-sectional dependency among the countries, which are forming the panel, is an important problem. Panel unit root tests here are divided two parts as first and second generation tests. The first generation includes Fisher-type test of Maddala and Wu (1999), Hadri (2000), developed Fisher-type test of Choi (2001), Levin, Lin and Chu (2002), Im, Pesaran and Shin (2003) and Breitung (2005).

First generation unit root tests are based on all countries are affected equally from incoming shocks. But, it isn't a realistic approach when countries so different. In order to overcome this problem, new generation unit root tests have been developed. Main second generation unit root tests are Taylor and Sarno, (1998), Bai and Ng (2001), Breuer, Mcknown and Wallace (2002), Phillips and Sul (2003), Moon and Perron (2004), Pesaran (2003), Chang (2004) and Pesaran, (2006).

However, these methods were insufficient with the presence of structural breaks in series and give biased results (Charemza and Deadman, 1997). Carrion-i-Silvestre et al. (2005) developed PANKPSS (Panel Kwiatkowski-Phillips-Schmidt-Shin), which is one of the second-generation unit root tests. PANKPSS takes the cross-section dependency and the structural breaks in series into consideration while testing for unit roots. Through PANKPSS, the average of the series and in the case of the existence of the structural breaks, the stationary of the series in their trends can be tested. It also allows the occurrence of structural breaks in different numbers and dates in each cross-section unit in the panel. Therefore, the stationary of the series can also be estimated respectively for overall panel and each cross-section (Carrion-i-Silvestre et al., 2005). The model of the test is as follows:

$$Y_{i,t} = \alpha_{i,t} + \beta_{i,t}t + \varepsilon_{i,t} \qquad i = 1, 2, \ldots\ldots, N \text{ and } t = 1, 2, \ldots\ldots, T \tag{5}$$

where

$$\alpha_{i,t} = \sum_{k=1}^{m_1} \theta_{i,k} D_{1i,t} + \sum_{k=1}^{m_1} \gamma_{i,k} D_{2i,t} + \alpha_{i,t-1} + u_{i,t}$$

$$\beta_{i,t} = \sum_{k=1}^{n_1} \varphi_{i,k} D_{1i,t} + \sum_{k=1}^{n_1} \gamma_{i,k} D_{2i,t} + \beta_{i,t-1} + v_{i,t}$$

D_1 and D_2 above are dummy variables and can be defined as:

$$D_1 = \begin{cases} 1, & t = T_B + 1 \\ 0, & t \neq T_B + 1 \end{cases}$$

$$D_2 = \begin{cases} 1, & t > T_B + 1 \\ 0, & t \leq T_B + 1 \end{cases}$$

Where T_B expresses the breakpoint and allows m structural break in constant term and n structural break in trend. Carrion-i-Silvestre et al. (2005) test considers up to five structural breaks. This test, following Bai and Perron (1998), determines structural break points where residual sum of squares are at minimum. The general expression for the test statistic is:

$$LM(\lambda) = N^{-1} \sum_{i=1}^{N} \left(\widehat{\omega}^{-2} T^{-2} \sum_{t=1}^{T} S_{i,t}^2 \right) \tag{6}$$

where

$$S_{i,t} = \sum_{j=1}^{t} \hat{\varepsilon}_{i,j}$$

denotes the partial sum process that is obtained using the estimated OLS residuals of (5), with

$$\widehat{\omega}^2 = N^{-1} \sum_{i=1}^{N} \widehat{\omega}_i^2$$

where $\widehat{\omega}^2$ is a consistent estimate of the long-run variance of $\varepsilon_{i,t}$ and

$$\omega_i^2 = \lim_{T \to \infty} T^{-1} S_{i,T}^2 \qquad i = \{1,2, \dots, N\}$$

The null hypothesis denotes that series are stationary under multiple structural breaks. PANKPSS test was applied and results are presented in Table 2.

Table 2. *PANKPSS panel unit root test*

	BT		***ΔBT***	***REXR***		***ΔREXR***	Y^d		ΔY^d	Y^f		ΔY^f
	Test Stat.	Break Dates	Test Stat.	Test Stat	Break Dates	Test Stat.	Test Stat	Break Dates	Test Stat.	Test Stat	Break Dates	Test Stat.
Belarus	0.073 (0.037)	2008Q1	0.046* (0.537)	0.057 (0.054)	1996Q3; 1997Q4; 2000Q4; 2004Q1	0.112* (0.513)	0.121 (0.039)	2004Q1; 2007Q1	0.107* (0.468)	0.268 (0.197)	2004Q1	0.111 (0.433)
Bulgaria	0,061 (0.041)	1998Q2; 2000Q2 2005Q1; 2008Q4; 2010Q2	0.056* (0.499)	0.241 (0.178)	1997Q4; 2001Q4; 2007Q1; 2008Q4	0.105* (0.464)	0.258 (0.159)	2003Q1; 2007Q1	0.389* (0.429)	0.268 (0.197)	2004Q1	0.111 (0.433)
Croatia	0.045 (0.031)	1996Q4; 1998Q2; 2001Q4; 2008Q4	0.365* (0.472)	0.134 (0.026)	2004Q1; 2007Q1	0.098* (0.444)	0.211 (0.157)	2003Q1; 2006Q1	0.297* (0.443)	0.268 (0.197)	2004Q1	0.111 (0.433)
Czech Rep.	0.046 (0.041)	1997Q4; 2003Q4; 2008Q4	0.048* (0.294)	0.225 (0.076)	1997Q1; 2001Q4; 2005Q1; 2007Q4	0.308* (0.486)	0.283 (0.160)	2003Q1; 2007Q1	0.383* (0.449)	0.268 (0.197)	2004Q1	0.111 (0.433)

	BT		*ΔBT*	*REXR*		*ΔREXR*	Y^d		ΔY^d	Y^f		ΔY^f
	Test Stat.	Break Dates	Test Stat.	Test Stat	Break Dates	Test Stat.	Test Stat	Break Dates	Test Stat.	Test Stat	Break Dates	Test Stat.
Estonia	0.051 (0.047)	1996Q2; 1998Q4; 2008Q3	0.056* (0.639)	0.043 (0.036)	1996Q2; 2003Q1; 2005Q2; 2007Q1	0.418* (0.462)	0.407 (0.164)	2003Q1; 2006Q1	0.272* (0.438)	0.268 (0.197)	2004Q1	0.111 (0.433)
Hungary	0.052 (0.032)	1999Q3; 2001Q1; 2004Q4; 2008Q4	0.038* (0.253)	0.106 (0.044)	2000Q2; 2001Q4; 2004Q1; 2007Q1; 2008Q4	0.258* (0.502)	0.214 (0.163)	2002Q1; 2004Q1	0.373* (0.442)	0.268 (0.197)	2004Q1	0.111 (0.433)
Latvia	0.035 (0.029)	1996Q2; 2003Q1; 2008Q3	0.028* (0.478)	0.045 (0.044)	1996Q2; 2005Q3; 2007Q1; 2009Q3	0.210* (0.481)	0.203 (0.226)	1998Q1; 2003Q1; 2006Q1	0.307* (0.433)	0.268 (0.197)	2004Q1	0.111 (0.433)
Lithuania	0.046 (0.035)	1996Q4; 1999Q3; 2005Q4; 2008Q4; 2010Q2	0.070* (0.172)	0.098 (0.094)	1996Q2; 1998Q1; 2003Q1; 2006Q1; 2009Q4	0.304* (0.492)	0.276 (0.208)	1997Q1; 2003Q1; 2006Q1	0.416* (0.448)	0.268 (0.197)	2004Q1	0.111 (0.433)
Poland	0.089 (0.065)	1996Q2; 2000Q2; 2004Q2; 2007Q1; 2008Q4	0.395* (0.485)	0.056 (0.050)	1996Q2; 2000Q4; 2002Q3; 2007Q1; 2008Q4	0.113* (0.489)	0.397 (0.189)	2004Q1; 2007Q1	0.721* (0.448)	0.268 (0.197)	2004Q1	0.111 (0.433)
Romania	0.088 (0.074)	1998Q4; 2000Q2; 2003Q2; 2006Q1; 2008Q4	0.206* (0.486)	0.049 (0.032)	1997Q4; 1999Q4; 2005Q1; 2007Q1; 2008Q4	0.118* (0.486)	0.378 (0.163)	2003Q1; 2006Q1	0.191* (0.449)	0.268 (0.197)	2004Q1	0.111 (0.433)
Russia	0.088 (0.074)	1998Q4; 2000Q4; 2006Q4	0.056* (0.223)	0.061 (0.032)	1996Q2; 1998Q3; 2001Q1; 2005Q1; 2007Q1	0.136* (0.491)	0.181 (0.166)	2003Q1; 2006Q1	0.161* (0.448)	0.268 (0.197)	2004Q1	0.111 (0.433)
Slovakia	0.027 (0.019)	1996Q2; 1998Q4; 2000Q4; 2002Q4; 2008Q4	0.345* (0.590)	0.032 (0.030)	1996Q4; 2003Q1; 2005Q1; 2007Q1; 2008Q4	0.614* (0.459)	0.224 (0.164)	2003Q1; 2007Q1	0.196* (0.441)	0.268 (0.197)	2004Q1	0.111 (0.433)
Slovenia	0.228 (0.036)	1998Q4; 2000Q4; 2005Q2; 2007Q2; 2008Q4	0.170* (0.475)	0.267 (0.052)	1996Q3; 2008Q1	0.425* (0.463)	0.150 (0.125)	2004Q1; 2007Q1	0.425* (0.438)	0.268 (0.197)	2004Q1	0.111 (0.433)
Turkey	0.040 (0.034)	2003Q4; 2010Q2	0.118* (0.509)	0.047 (0.027)	1998Q4; 2000Q4; 2005Q1; 2010Q2	0.120* (0.476)	0.274 (0.183)	2005Q1	0.157* (0.434)	0.268 (0.197)	2004Q1	0.111 (0.433)
Ukraine	0.052 (0.028)	1999Q1; 2005Q2	0.070* (0.519)	0.071 (0.046)	1996Q2; 1998Q3	0.217* (0.476)	0.130 (0.040)	2004Q1; 2006Q1	0.085* (0.454)	0.268 (0.197)	2004Q1	0.111 (0.433)
Panel	1.946 (1.474)	-	0.194* (5.501)	5.505 (5.193)	-	1.529* (5.561)	17.739 (7.621)	-	3.252* (7.451)	13.219 (8.131)	-	2.629 (6.927)

Note: Critical values were computed 1000 bootstrap replications. *; expresses that the series is stationary in the 10% significance level. The model allowing the structural break in constant and trend has been chosen as a test model. *Δ*; shows the first difference.

According to results in Table 2 series are stationary in first differences, *I(1)*. Because of the series are integrated of the same order, cointegration tests can be applied.

2.4. Panel cointegration test with multiple structural breaks

Cointegration theory based on Engle and Granger (1987). Panel cointegration tests started with Pedroni (1999). Panel cointegration tests here are divided two parts as first and second generation tests. Main first generation panel cointegration tests are Pedroni (1999), Pedroni (2004), Kao (1999) and a Fisher-type test using an underlying Johansen methodology (Maddala and Wu 1999). These tests aren't considering cross-sectional dependence. Mainly second-generation cointegration tests are O'Connel (1998), Westerlund (2005), Gengenbach, Palm and Urbain (2006), Westerlund and Edgerton (2007, 2008) and Basher and Westerlund (2009).

Basher and Westerlund (2009) cointegration test can considers the cross-section dependence and multiple structural breaks structural breaks in the cointegration equation. This test allows the breaks in the constant term and trend. The test statistic is computed as:

$$Z(M) = \frac{1}{N}\sum_{i=1}^{N}\sum_{J=1}^{M_i+1}\sum_{t=T_{ij-1}+1}^{T_{ij}}\left[\frac{S_{it}^2}{(T_{ij}-T_{ij-1})^2\hat{\sigma}_i^2}\right] \quad (7)$$

where

$$S_{it} = \sum_{s=T_{ij-1}+1}^{t} \widehat{W}_{st}$$

However, $\widehat{W}_{st}$ is the regression residual obtained by using any efficient estimator of the cointegration vector such as the fully modified least squares estimator. $\hat{\sigma}_i^2$ is the usual Newey and West (1994) long-run variance estimator based on $\widehat{W}_{st}$. *Z(M)* becomes the following when it is abbreviated by taking their cross-sectional averages.

$$Z(M) = \sum_{t=T_{ij-1}+1}^{T_{ij}} \frac{S_{it}^2}{(T_{ij}-T_{ij-1})^2\hat{\sigma}_i^2} \sim N(0,1) \quad (8)$$

Null hypothesis is cointegration. The Basher and Westerlund (2009) cointegration test was applied and results are presented in Table 5.

Table 3. *Panel cointegration test results*

	Test Statistics	*p-Value*	*Decision*
No Break in Constant	12.85**	0.020	No Cointegration
No Break in Constant and trend	12.669***	0.000	No Cointegration
Break in Constant	2.760*	0.070	Cointegration
Break in Constant and trend	9.763	0.130	Cointegration

Note: *p*-values were computed with 1000 bootstrap replications. *, ** and *** indicate the presence of cointegration at level of 10%, 5% and 1% respectively.

Results presented in Table 3 indicate that; the decision regarding the presence of cointegration relationship is highly affected depending on whether or not the cross-section dependency and structural breaks are considered. Here, it is decided that there is a cointegration relationship between the series in the panel when the structural breaks and cross-section dependency are taken into consideration in the cointegration equations. Obtained structural break dates from cointegration test presented in Table 4.

Table 4. *Break dates in the cointegration equation*

Country	1th Break	2nd Break	3rd Break
Belarus	2000Q4	2004Q4	2008Q3
Bulgaria	1998Q1	2001Q4	-
Croatia	1998Q1	2003Q4	-
Czech Rep.	1998Q1	2001Q2	2004Q3
Estonia	1998Q3	2008Q2	
Hungary	1999Q4	2003Q1	2008Q3
Latvia	1998Q2	2005Q2	2008Q3
Lithuania	2005Q2	2008Q3	-
Poland	1998Q4	2002Q1	-
Romania	1998Q4	2008Q3	-
Russia	1999Q1	2002Q3	2006Q3
Slovakia	1998Q4	2002Q3	-
Slovenia	1999Q1	2002Q4	2007Q2
Turkey	1998Q1	2008Q3	-
Ukraine	2000Q2	2004Q1	2007Q2

Note: Structural break dates obtained from model with level and trend. In this study, maximum break point is taken three.

The test method has successfully determined the structural break dates in countries. 1998 and 2008 indicate the Russia economic crisis and the global economic crisis.

2.5. The estimation of long run cointegration coefficients

The long run cointegration coefficients can estimate with the Common Correlated Effects (CCE) method developed by (Pesaran, 2006) for each countries. In this analysis, the structural break points that are obtained from the cointegration analysis have been added to the analysis with dummy variables. Long run cointegration coefficients of panel were calculated with the Common Correlated Effects Mean Group (CCEMG) method of (Pesaran, 2006). CCE and CCEMG methods were used in this study and results were presented in Table 5.

$$BT_{it} = \beta_{0i} + \beta_{1i} REXR_{it} + \beta_{2i} Y_{it}^{d} + \beta_{3i} Y_{it}^{f} + \beta_{4i} D_{EU_{it}} + \beta_{5i} D_{1_{it}} + \beta_{6i} D_{2_{it}} + \varepsilon_i \qquad (9)$$

Table 5. *The long run cointegration coefficients*

Country	***REXR***	Y^d	Y^f	D_{EU}	D_1	D_2
Belarus	0.24**[1.75]	-0.001[-1.18]	0.0001[1.10]	0.004[0.051]	8.55[0.001]	1.05***[2.36]
Bulgaria	0.48**[2.21]	-0.007**[-2.1]	0.1278[0.15]	49.58*[1.56]	-4.23[-0.001]	3.01***[45.21]
Croatia	0.16***[2.54]	-0.003[-0.004]	-0.001[-1.01]	-3.22[-1.02]	1.13[0.001]	-0.02***[-3.2]
Czech R.	1.65[0.72]	0.007[0.025]	0.002**[2.15]	59.22***[7.45]	2.01[0.001]	-2.85***[-8.1]
Estonia	-0.10[-0.75]	-0.09***[-3.5]	-0.04[-0.25]	-1.45[-0.002]	0.39***[10.12]	3.015[1.02]
Hungary	0.22***[2.72]	-0.01**[-1.72]	-0.03*[-1.51]	-7.47**[-2.15]	-1.38[-0.15]	7.18**[1.65]

Country	***REXR***	***Y^d^***	***Y^f^***	***D~EU~***	***D~1~***	***D~2~***
Latvia	0.17***[3.15]	-0.05***[-2.3]	-0.001*[-1.41]	33.44***[6.12]	-2.09[-0.001]	-0.15***[-2.5]
Lithuania	0.14[1.02]	-0.009[-0.17]	0.003***[3.11]	84.15***[4.17]	-0.57[-1.14]	3.12[0.12]
Poland	0.25*[1.43]	0.001[0.45]	0.001*[1.55]	40.18***[2.35]	-1.64***[-3.5]	1.25***[3.01]
Romania	0.07***[3.12]	-0.007[-0.41]	0.001**[2.11]	76.38[0.025]	-1.74***[2.41]	4.23***[7.56]
Russia	1.20*[1.43]	-0.02***[-3.2]	0.23***[5.11]	-4.36[-0.001]	7.71***[2.76]	2.12**[2.05]
Slovakia	0.21***[2.91]	-0.004[-0.54]	-0.001*[-1.58]	43.26***[4.65]	9.01***[3.12]	7.41**[1.86]
Slovenia	0.02***[5.74]	-0.021[-1.15]	0.001[0.17]	-1.16[-0.85]	1.25[0.001]	0.015[0.127]
Turkey	0.15**[1.87]	-0.01**[-1.89]	0.001***[3.15]	0.003**[1.91]	8.25**[1.65]	3.45**[2.04]
Ukraine	0.24[1.21]	0.001[0.25]	-0.02**[-2.01]	0.012***[4.32]	-2.2[-0.12]	7.64***[3.05]
Panel	0.34***[1.81]	-0.004[-1.08]	0.0011*[1.45]	24.74***[3.3]	1.63[0.17]	2.75[1.25]

Note: *, ** and *** indicate the significance of coefficients at level of 10%, 5% and 1% respectively. Autocorrelation and heteroscedasticity problems were adjusted with the Newey-West method. [ ]; shows *t* statistics.

According to Table 5, increases in the real exchange rates in all countries positively affect the trade balance. This effect is statistically significant and extended Marshall-Lerner condition is valid in Belarus, Bulgaria, Croatia, Hungary, Latvia, Poland, Romania, Russia, Slovakia, Slovenia, Turkey and panel. Domestic income has got negative effect on trade balance and foreign income positive in line expectations. EU membership has got positive and statistically significant effect on these countries' trade balances.

2.6. Estimation of the short run coefficients

At this stage of the analysis, individual coefficients have been estimated with the CCE method and the panels' coefficient has been estimated with the CCEMG method using following error correction model:

$$\Delta BT_{it} = \beta_{0i} + \beta_{1i} ECT_{i,t-1} + \beta_{2i} \Delta REXR_{it} + \beta_{3i} \Delta Y_{it}^{d} + \beta_{4i} \Delta Y_{it}^{f} + \varepsilon_{it} \quad (10)$$

ECT_{t-1} is error correction term and which is one period lagged error terms of the long-run analysis. Equation (10) was estimated and results were presented in Table 6.

Table 6. *The short run coefficients*

Country	ECT_{t-1}	$\Delta REXR$	ΔY^d	ΔY^f
Belarus	-0.022***[-4.74]	-0.32**[-2.12]	-0.002[-1.06]	0.02***[10.01]
Bulgaria	0.001[0.007]	0.27[0.41]	-0.003***[-7.46]	0.02[0.001]
Croatia	-0.001[-0.0001]	0.012**[1.86]	-0.001[-0.50]	-2.063[-1.01]
Czech Rep.	-0.001[-1.19]	-0.36*[-1.51]	0.0001[0.001]	-0.32[-0.01]
Estonia	-0.001[-0.001]	-0.084[-0.76]	-0.0001[-0.004]	0.001[1.15]
Hungary	-0.001[-0.54]	0.46***[4.10]	-0.001[-0.42]	1.78***[5.17]
Latvia	0.005[0.0001]	0.58[0.11]	-0.002[-0.001]	0.001[1.01]
Lithuania	-0.001[-0.016]	-0.19[-0.70]	-0.001[-0.002]	2.0[1.05]
Poland	-0.062***[-6.19]	0.22[0.41]	0.001[0.001]	7.81***[15.41]
Romania	-0.004[-0.4]	-1.48***[-5.15]	0.001[0.15]	0.719***[7.15]
Russia	-0.001[-0.05]	-1.32[-0.001]	0.001[0.001]	-7.02[-0.001]
Slovakia	-0.017[-0.054]	2.27[1.05]	0.001[0.002]	1.48[0.90]
Slovenia	0.02[0.013]	-1.25**[-1.65]	-0.001[-0.50]	0.001[0.07]
Turkey	-0.09[-0.01]	-0.65[-0.001]	-0.001[-0.25]	-3.22**[-2.15]
Ukraine	0.015***[3.01]	-1.12*[-1.35]	-0.001[-0.063]	0.825[0.14]
Panel	-0.01*[-1.62]	-0.19[-0.80]	-0.0006***[-2.56]	0.13[0.007]

Note: *, ** and *** indicate the significance of coefficients at level of 10%, 5% and 1% respectively. Autocorrelation and heteroscedasticity were adjusted with the Newey-West method. Values in brackets are *t* statistics.

When the results in Table 6 are examined, it can be seen that increases in the real exchange rates in Belarus, Romania, Slovenia and panel affect the trade balance negatively in the short run and the *J*-curve phenomenon is valid in these countries. Also, error correction term is negative and statistically significant in Belarus, Poland and panel. In the other words, the short run deviations converge to the long run balance level in these counties.

Conclusion and evaluation

In this study, effects of the real exchange rates, domestic and foreign income on the balance of external trade has been analysed in the framework of the extended Marshall-Lerner condition and J-curve phenomenon using 1995-2015 period quarterly data for fourteen transition economy and Turkey by means of panel cointegration analysis with multiple structural breaks under cross-sectional dependency.

The existence of cross-section dependency among the countries in the panel has been analysed with the LM_{adj} test and it has been concluded that cross-section dependence exists among these countries. The fact that all of these countries have most of their exports to EU countries is considered to be influential in this dependence. Since cross-section dependence exists among these countries, a real exchange rate or foreign trade crises experienced in one of these countries may affect the others. Therefore, countries should also take into consideration events in related countries.

The stationarity of the series has been analysed with the Carrion-i-Silvestre et al. (2005) method, which considers the multiple structural breaks in series. It has been found that series are non-stationary in level and they become stationary when their first differences are taken.

The existence of a cointegration relationship between series has been analysed with the Basher and Westerlund (2009) test, which considers the cross-section dependency and the multiple structural breaks. It has been observed that when the structural breaks in series are not considered, there is no cointegration relationship, although there is a cointegration relationship when the structural breaks are considered.

The long run individual cointegration coefficients have been estimated with the CCE method developed by Pesaran (2006), which considers the cross-section dependency. The long run panel cointegration coefficients have been estimated with CCEMG and it has been found that increases in real exchange rates positively effects the trade balance of the countries. In addition, it has been identified that the Marshall-Lerner condition is valid in Belarus, Bulgaria, Croatia, Hungary, Latvia, Poland, Romania, Russia, Slovakia, Slovenia and Turkey. The short run coefficients have also been estimated with the CCE and CCEMG methods again. According to short run analysis, the J-curve phenomenon is supported and there is proof that the J-curve phenomenon is valid for only Belarus, Romania and Slovenia.

As a result, it can be said that depreciation of the domestic currency can be used as a policy instrument to achieve an improvement in the trade balance and a decrease in the current account deficit for Belarus, Bulgaria, Croatia, Hungary, Latvia, Poland, Romania, Russia, Slovakia, Slovenia and Turkey. In order to ensure trade balance exchange rates it is an effective policy instrument in these countries. Real exchange rate increases have a positive effect on the trade balance in the Croatia and Hungary economy in the short run. Therefore it is indicated that policy makers of these countries can use the real exchange rate is an effective policy instrument.

In addition to these findings in study, in considering cross-sectional dependency and multiple structural breaks, differs from former studies and improves on the empirical literature concerning effects of the real exchange rates, domestic and foreign income on the trade balance. For this reason, in this paper we fill an important gap in the literature by studying the impact of the real exchange rate changes on the trade balance in the 13 East emerging European economies and Turkey.

Notes

(1) However, Marshall-Lerner condition implicitly assumes that the GDP is independent from the exchange rate. But this assumption is not sustained (Sastre, 2012).

(2) Belarus, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Russia, Slovakia, Slovenia, Turkey and Ukraine.

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Child policy changes and estimation of income distribution effects

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Abstract. *The paper explores the household income distribution effects of recent changes in social benefit policy for families with children in Romania. The particular changes we examine are the amount growth of the main social benefit for children – the universal state allowance for children – and the increase of income threshold and benefit amount for the support allowance for families with children, an important means-tested social benefit. Our approach relies on ex-post impact evaluation of policy changes through income simulation using microdata at household level. We studied the effects within specific groups of families based on number of children, but we also estimated the effects on single-parent families. The results show that recent changes have contributed to the reduction of income inequalities in general by increasing the income level at the bottom and median of the income distribution. Larger families experience higher relative income growth, as the benefits are linked with family size and their pre-reform income levels are lower.*

Keywords: income distribution, family benefits, tax-benefit system, microsimulation, households.

JEL Classification: C63, D31, H31, I32.

1. Introduction

The wellbeing of children and their families is one the most relevant social policy goals in any country. The life of the children, present and future, is substantially influenced by the welfare provision during childhood: health care, education, social services and social benefits. But not only the child is influenced by the lack of resources, but also the society as a whole (Esping-Andersen, 2002). In most of the cases, children are more exposed to poverty than the population overall; this being the case of Romania as well, where more than one third of the children live in poverty, while less than one quarter of the population has a precarious material condition. An important policy instrument for welfare provision for families with children is the social benefit system. Family or children related benefits are a form of support in cash or kind for families, directly related to children, in order to cover costs for pregnancy, childbirth, adoption and bringing-up children (Esspros Manual and User Guidelines, 2016). Children related benefits could be contributory or non-contributory, means-tested or non-means-tested.

In this paper, we have examined the changes of the amounts and eligibility rules for two children related benefits. The universal state allowance for children, a non-contributory and non-means tested benefit, being granted to all children up to the age of 18 years, has doubled its amount since 2015. On the other hand, the family support allowance, a means-tested and non-contributory benefit for families with children, has been modified in order to raise its upper income-testing threshold by 43%, while its amount has increased by 64 to 127% depending on the number of children. The interventions are definitely significant; however we aimed at estimating the importance of these changes in the overall disposable income of families with children. To do so, we assessed the ex-post impact of social benefit changes upon the income distribution through the microsimulation of income components. In order to compare the income distribution between the pre and post reform moments, alongside of isolating the policy effects from any other developments, which could affect income levels, we built a counterfactual scenario to frame a picture for what would have happened if the policies had not changed. The indicator that we monitor in order to estimate policy effects is the average disposable income, detailed by income deciles. We used the household equivalised income (OECD equivalence scale) to account for household size and age composition. The microdata we employ is national representative survey data from the EU-SILC (European Union Survey on Income and Living Conditions) and we use the EUROMOD tax-benefit microsimulation model for the simulation of income components.

The paper is organized as follows. The next section reviews the relevant literature on the welfare effects of child policy changes. Section 3 describes the child policies analysed, the methodology and data. Section 4 discusses the main findings and the paper ends with some concluding remarks.

2. Welfare effects of social benefits for children – A review of the literature

There is a significant range of studies focused on exploring the link between social benefit provision for children or families with children and their welfare and showing the importance of these transfers in poverty alleviation among children (Matsaganis et al., 2006; Levy et al., 2007; Immervol et al., 2000; Corak, 2005; Forster and Toth, 2011; Van Mechelen and Bradshaw, 2013; Tarki, 2010; Chzhen and Bradshaw, 2012).

Several studies have examined the distributional impact of income transfers to families with children, such as Matsaganis et al. (2006), who has concluded on data from southern EU countries that the effects are positive, though weak and dependent on the size of transfers. Levy et al. (2007, 2013) explored on the distributional implications of a child basic income operated at EU level and found out that it would be quite effective in reducing both incidence and depth of poverty in poorer member states. That is because the relative size of the transfers is more significant in poorer countries. However, not only the size, but also the design of the family benefits influences the effectiveness of a country's policies in child poverty reduction (Salanauskaite and Verbist, 2013; Immervol, 2000). The demographic characteristics of the targeted population should be taken into consideration at policy design, as there definitely is an interaction between family policies and population characteristics, but also between these two and the wider tax-benefit system (Avram and Militaru, 2016).

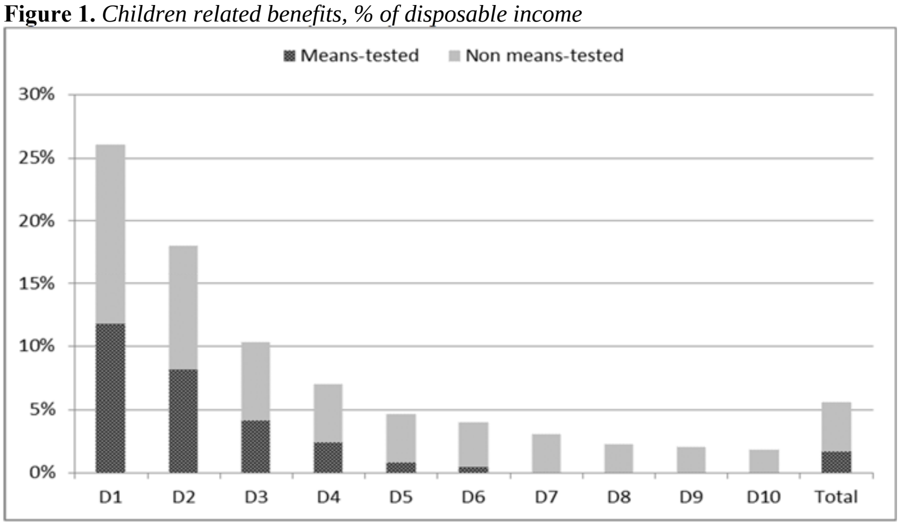
The type of the benefits (universal or means-tested) does matter in poverty reduction effectiveness and income redistribution, as it is revealed by several studies (Corak, 2005; Van Mechelen and Bradshaw, 2013; Figari et al., 2011; Van Lancker and Van Mechelen, 2015) who point out that a combination between universal child benefits and targeted benefits for low income families with children could be more effective. Moreover, others (Bradshaw, 2012; Marx et al., 2016) promote the idea that means-tested family benefits only are inefficient both vertically and horizontally. On the other hand, there could be a significant non take-up issue when dealing with means-tested benefits (Gassman and Notten, 2008) and also associated administrative costs, targeting errors and possible work incentives (Coady et al., 2003; Van Oorschot, 2002). In general, but more specifically when dealing with universal child benefits, there is a convergence of the opinions towards the idea that the size of the transfers matters the most (Gassman and Notten, 2008; Matsaganis et al., 2006), but no general agreement on the design of the social benefit system for families with children. Also, the paradox of redistribution has been put forward by many authors since Korpi and Palme (1998), meaning that very strong pro-poor targeting does not necessarily lead to income inequality reduction (Marx et al., 2016). In general, targeted, means-tested benefits influence vertical equity, universal child benefits relate to horizontal equity (Verbist and Van Lancker, 2016).

As such, the researches have pointed out that regarding the impact of children related benefits, the size, the design of the benefits, as well as the population characteristics and the wider tax-benefit system play significant roles. In our work, we did not disentangle between these factors, instead we attempted to estimate the overall income distribution effects of significant policy changes aimed at improving the material condition of families with children. However, we tried to detect the effects by specific family types, in order to account for demographic characteristics, such as the number of children and the number of adults raising the children. Even though children related benefits are explicitly linked with the number of children, the poverty incidence among large families is the highest, especially because the adults in the household have a weak attachment with the labour market (TÁRKI, 2010) or because the children live in single parent a families which have a much higher risk to be poor (Chzhen and Bradshaw, 2012). Moreover, there are few studies that address the distributional impact and poverty reduction effectiveness of the child benefit system in Romania (Avram and Militaru, 2016), some of them in a cross country comparative perspective (TÁRKI, 2010), but there is no evidence so far on ex-post impact assessment in policy changes related to families with children, thus our exercise could open up a new path for researches.

3. Methodology and data

Our methodology relies on the extensive use of microsimulation methods for income components based on a counterfactual scenario, which attempts to answer the "what…. if" question: "What would have been the income distribution parameters if the children related policies had not change?". So, on one hand, we have the income distribution after the policy change and, on the other hand, we have the income distribution before the policy change, but we do not know how the distribution would have looked like if the policies had not change. For this, we have built the counterfactual scenario departing from the final situation, with the policy change, and, on the same population and market incomes, we have simulated the old tax-benefit system, without the changes in the children related policies. Practically, following this approach, we have separated out the policy effect on incomes from any other effect, which could have occurred in the meantime (Bargain and Callan, 2010). To discuss on the effectiveness of policy changes, we have estimated the household disposable income in both situation, pre and post reform, and compared between averages overall and by deciles. Specific family types have been in our view, such as families with one child, two children, three and more children, but also single parent families. Children are defined according to the Romania legal frame, as being individuals up to the age of 18 years old. The household disposable income has been calculated as market income plus social benefits minus direct taxes on income and social contributions, and has been equivalised to account for household composition and size. We used the dichotomy between means-tested and non means-tested benefits, as the policy changes have envisaged both dimensions. As earlier said, we have estimated the ex-post impact of a change in the following social benefits for children: (1) universal child allowance, which is a non-means-tested benefit, accounting overall for 4% of the average household disposable income and (2) family support allowance, which is means-tested and depends on the number of children, also granting differentiated amounts for single parent families and making up on average merely 2% of the equivalised disposable income of all households. As it can be seen in the figure below (Figure 1), the generosity of these schemes is relatively higher in lower income households, in the poorest decile the two benefits account for almost 26% of the household disposable income, while in the second poorest decile, the benefits constitute around 18% of the disposable income at household level.

Figure 1. *Children related benefits, % of disposable income*



Source: authors' own calculations based on EU-SILC data and EUROMOD ver. G.1.4

Our simulations made use of the EUROMOD tax-benefit microsimulation model (Sutherland and Figari, 2014), through which tax liabilities and social benefit entitlements can be estimated for the EU countries, based on EU-SILC (European Union – Survey on Income and Living Conditions). In the case of Romania, the social and fiscal policies are implemented for 2007-2016, but for our work we used the 2014 and 2015 tax-benefit systems, as the changes have occurred in 2015. The microdata we used were collected in 2014 (with 2013 income levels), so there is a discrepancy between the policy year when the changes took place (2015) and the income reference year (2013). We have overcome this drawback by updating income levels from 2013 to 2015 by detailed income source, based on official statistics from other sources.

We must mention as a caveat that the behavioural changes following a policy reform have not been taken into consideration in our estimations, our aim being that of examining the static, direct, first-order effects of social policy changes.

4. Main findings

The policy changes are progressive as one would expect, because poorer households benefit more as the family support allowance is targeted based on means-testing, while the universal child allowance depends on the number of children which is higher in poorer families. Overall, the household disposable income increases by 2.1%, meaning that the material condition of household in Romania has been positively affected by the children related policy changes in 2015. The income changes by income decile can be viewed below (Table 1), where also the changes in the amounts of means-tested and non means-tested benefits, respectively are presented. The deciles have been constructed based on the equivalised disposable income of household. So, in the first decile, households benefit of 11% increase of disposable income, while the second decile display a 9.7% higher income than in the initial situation, and so on, higher the decile lower the effects. These evolutions clearly indicate that the income distribution has shifted to a more egalitarian one.

Table 1. *Household disposable income changes as a result of children related policy reform, % of initial disposable income*

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	Total
Disposable income	11.0	9.7	6.1	4.5	3.1	1.7	1.6	0.7	0.7	0.5	2.1
Means-tested benefits	6.4	5.7	3.4	1.6	2.1	1.4	1.3	0.6	0.5	0.1	1.4
Non means-tested benefits	1.4	2.7	3.0	2.2	2.1	0.5	0.5	0.1	0.1	0.1	0.7

Source: authors' own calculations based on EU-SILC data and EUROMOD ver. G.1.4

We have separated the effects by income components, namely means-tested benefits and non-means-tested benefits in order to investigate the contribution of each to the overall impact (see Table 1). The amount of means-tested benefits increases as a result of policy measures by 1.4% of initial disposable income, which actually means 50% of the initial amount of means-tested benefits. This is the direct effect of the increase of amount and income testing threshold for the family support allowance. As for the non-means tested benefits, multiplying the amount of the universal state allowance for children is conducive to less than 1% increase of the total amount of non-means tested benefits at household level as share of initial disposable income and around 19% increase as share of the total non-means tested benefits. As expected, the changes are differentiated by deciles, clearly progressive for the means-tested benefits and inverted U-shaped for the non-means tested benefits. Strong effects are noted in the bottom deciles (up to the third decile), while in the richer deciles the impact is almost null. The U-shape induced by the change in the universal child allowance can be explained by the decile distribution of families with children.

As also said earlier, we tried to detect the effects upon specific family types, in order to account for demographic characteristics, such as the number of children and the number of parents raising the children. We focused on families with one child, families with two children, families with three or more children, and on single parent families, respectively. The results are shown below (Table 2).

Table 2. *Household disposable income changes as a result of children related policy reform, % of initial disposable income, by family types*

Disposable income	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	Total
Families with one child	12.1	10.5	5.2	5.1	3.6	1.8	1.3	0.6	0.9	0.6	2.5
Families with two children	14.6	11.0	6.0	3.8	2.9	1.3	2.6	0.9	1.2	0.8	5.6
Families with three children +	15.8	10.0	4.8	2.8	0.4	-1.1	1.2	3.5	0	0	15.0
Single-parent families	13.2	10.7	-1.2	3.4	1.5	-0.8	2.0	1.9	1.7	1.5	6.5

Source: authors' own calculations based on EU-SILC data and EUROMOD ver. G.1.4

We find that families with three or more children benefit mostly of the policy reform, as they experience almost 15% average increases of their disposable income. The effects are also visible for single parent families (6.5% increase in disposable income), families with two children (5.6% increase in disposable income) and less for families with one child (2.5%). The distribution of results by deciles of income show the same progressive pattern with large effects in the bottom deciles (1st and 2nd) and decreasing impact at the middle, while almost null influences in the richer half of the income distribution.

The estimated effects cover the interaction between tax-benefit elements, such as an increase in the level of a non means-tested benefit could lead to the loss (or amount reduction) of a means-tested benefit. In our case, it is possible that the doubling of the universal child allowance to cause the loss of eligibility for family support allowance. As it can be seen in Table 2, there are a couple of negative effects which could be either result of benefit loss or could simply mean that families have moved between deciles. Practically, the deciles do not consist of the same families between the two moments.

We separated the effects between means-tested and non means-tested benefits, as it can be seen in the table below (Table 3).

Table 2. *Household disposable income changes as a result of children related policy reform, % of initial disposable income, by family types*

Means-tested benefits	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	Total
Families with one child	-0.1	2.1	3.3	2.9	1.7	0.5	0.4	0	0	0	0.7
Families with two children	6.2	6.3	5.4	3.7	6.7	2.8	1.3	0	0	0	2.1
Families with three children+	7.4	7.5	7.7	12.1	5.7	2.3	3.1	0	0	0	5.5
Single-parent families	5.9	-0.7	8.2	6.6	5.5	3.1	1.4	0	0	0	2.6
Non means-tested benefits											
Families with one child	6.2	4.5	3.3	2.5	2.3	1.8	1.6	1.3	1.1	0.8	1.7
Families with two children	12.1	8.6	5.3	4.5	3.7	3.2	2.4	1.9	2.0	1.3	3.5
Families with three children+	14.1	12.9	9.1	7.0	5.8	2.4	4.2	3.5	0	0	9.6
Single-parent families	10.7	8.8	3.9	3.9	5.4	3.1	2.2	1.9	1.4	1.5	3.9

Source: authors' own calculations based on EU-SILC data and EUROMOD ver. G.1.4

The following findings have emerged. For families with one child, the effects are around 1% for both benefit types; it seems that some of the families in the first decile lose some very small share of the family support allowance as their income from other benefits increases. We note slightly more significant effects for the 2nd and 3rd deciles, determined by the income testing threshold increase. For families with two children the effects are more pronounced, on the average, the amounts from means tested benefits increase by 2%, and those from non-means tested benefits by 3.5%. Again, the same pattern of increased effects towards the 3rd to 5th deciles as a result of family allowance income testing threshold increase is visible. On the other hand, the effects on the non means tested benefits are strictly decreasing by deciles, with the first deciles benefiting the most. As one had expected, larger families with low income levels would be mostly influenced by the child policy reforms. But, not only poor families benefit, but also middle income families, such as placed in the 4th decile, which experience the highest means-tested income increase (12% of the initial disposable income). The change of the family support allowance has widened the mass of the beneficiaries through the broadening of the income testing threshold. This can be noted also for single-parent families.

To sum up, our results show that the child policy reform that took place in 2015 has been beneficial for families with children, whose disposable income has increased progressively, more in the poorer deciles and less or at all in the richer deciles, more for larger families and single parent families and less for families with one child. Also, on the whole, the income distribution has become slightly less unequal, following these changes.

5. Conclusions

In this paper we attempted to examine the income distribution implications of child policy changes. The reform under analysis took place in 2015 and consisted of two major decisions: the universal child benefit was doubled in amount and the family support allowance was broadened as threshold for income testing and enlarged in amount. We used income microsimulation techniques on national representative household data and built a counterfactual scenario in order to separate out the child policy effect on incomes from any other effect which could have occurred in the same period of time.

The effectiveness of policy changes has been assessed by estimating the pre and post reform household disposable income, calculating average changes between the two situations, overall and by deciles. We have separated the effects by benefit types: means-tested and non means-tested. Also, specific family types have been considered for the analysis, such as families with one child, two children, three and more children, but also single parent families. The results have clearly pointed out that the reform has been in favour of poor families with two, three or more children, but also single-parent families have improved their disposable income quite significantly. The most important changes in the income distribution were due to the reform of family support allowance which is targeted to poor families and has a supplement for single parent families. In addition, the overall income distribution has become more egalitarian as a result of child policy changes.

Though, we must mention as a caveat that the behavioural changes following a policy reform have not been taken into consideration in our estimations, our aim being that of examining the static, direct, first-order effects of social policy changes. Also, there was a discrepancy between the policy year when the changes took place and the income reference year of survey data, which has been overcome through the updating of income levels by detailed income component, based on official statistics from other sources.

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An enquiry into the dynamics of real oil prices: A state space approach

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Abstract. *This paper empirically investigates the nature of the underlying stochastic processes characterizing real oil prices using a Structural Time Series Model for the period 1960 to 2016. Based on the state space framework the STM decomposes the data into separate stochastic components by the maximum likelihood via the Kalman Filter. In contrast to the extant literature, this approach obviates the need to attain stationarity. Instead, it explicitly represents the non-stationarity properties of real oil prices through time varying structures and incorporation of structural breaks.*
The results establish that real oil prices are a composite of a long term trend, effect of shocks and short term fluctuations. The trend exhibits stochastic evolution and is punctuated by distinctive breaks triggered by unpredictable and significant events. Short term fluctuations are driven by transitory market influence and result in mean reverting patterns. Overall, the model captures, in a nonstructural framework, oil price movements and allows generation of forecasts based on the concrete implications of data characteristics.

Keywords: cycle, oil resources, real prices, structural time series model, trend.

JEL Classification: Q30, Q32, C51.

1. Introduction

Oil is widely recognized to be one of the most significant energy resources worldwide and is known for frequent price swings in times of shortage or oversupply. It has substantial influence on global economic activities. An increase in oil prices results in rising inflation and is detrimental for oil-importing countries while a decrease can lead to economic recession and political instability in oil-exporting countries due to curtailment of economic development. Besides absolute price levels oil price volatility can also translate into severe economic losses.

There have been abundant theoretical and empirical attempts to analysis and forecast crude oil price.(1) Empirical approaches can broadly be segregated into structure models and data-driven methods (Zhang et al., 2008). The former aim to define and analyze oil price movements in terms of a supply and demand framework (e.g. Huntington, 1994 and Yang et al., 2002). This approach is useful in highlighting and quantifying the mechanisms of price determination. However, it integrates a high degree of complexity and is constrained due to the scanty availability of related data. Moreover, in spite of using a fully specified model, irrespective of the number of explanatory variables included, the variability of the series will only be partly accounted for. Data based methods popularly utilize linear approaches where price is assumed to follow some kind of autoregressive specification (such as Autoregressive Moving Average and Autoregressive Conditional Heteroscedasticity). Under this framework the primary issue of contention is to test for the presence of unit roots to determine whether oil prices demonstrate trend or difference stationarity.(2) In the context of unit root testing Perron (1988) pointed out that it is crucial to select an appropriate specification for the trend function. If the data contain a unit root than application of the least squares method will result in severe size distortions. Similarly, if the data are generated by a trend stationary process but modeled as difference stationary the tests will be inefficient and lack power relative to the trend stationary process (Perron and Yabu, 2009). Another major complication arises if the series is impacted by structural breaks. The exclusion of breaks in a trend stationary process can lead to the spurious confirmation of unit root (Perron, 1989) and in a difference stationary process it can incorrectly confirm stationarity (Leybourne et al., 1998). Though several recent studies incorporate structural breaks in standard unit root tests these tests provide negligible information concerning the existence and number of breaks. Testing whether a series is characterized by a trend break is further complicated as the nature of persistence in the errors is generally unidentified. Notably results of existing studies are agnostic on this specific issue and display a perceptible lack of conformity. Implicitly assuming trend stationarity, Slade (1982) concludes that the evolution of eleven resource prices, including oil, follow a U-shaped time path. Slade (1988) shows that the data are non-stationary and proposes that the series are characterized by uncertainty not captured by deterministic models. Berck and Roberts (1996) update the same data to 1990 and apply the Lagrange-Multiplier and Dickey-Fuller tests to find that resource prices are non-stationary. Still with the same series, Ahrens and Sharma (1997) use multiple unit root tests to conclude that five series are non-stationary while six are trend stationary. Lee et al. (2006) incorporate two endogenously determined structural breaks and contradict non-stationarity and support trend stationarity. In contrast to unit root tests, an innovative dimension to understanding price movements was provided by Pindyck (1999). Firstly, the study went beyond unit root testing and applied a state space approach and the Kalman Filter to establish that the prices of energy products (oil, gas and coal) fluctuate around a stochastic long-term trend over the period 1870 to 1996. Secondly, the study explicitly related its empirical findings to standard resource economic framework and showed that they are consistent with a basic model of exhaustible resource production.

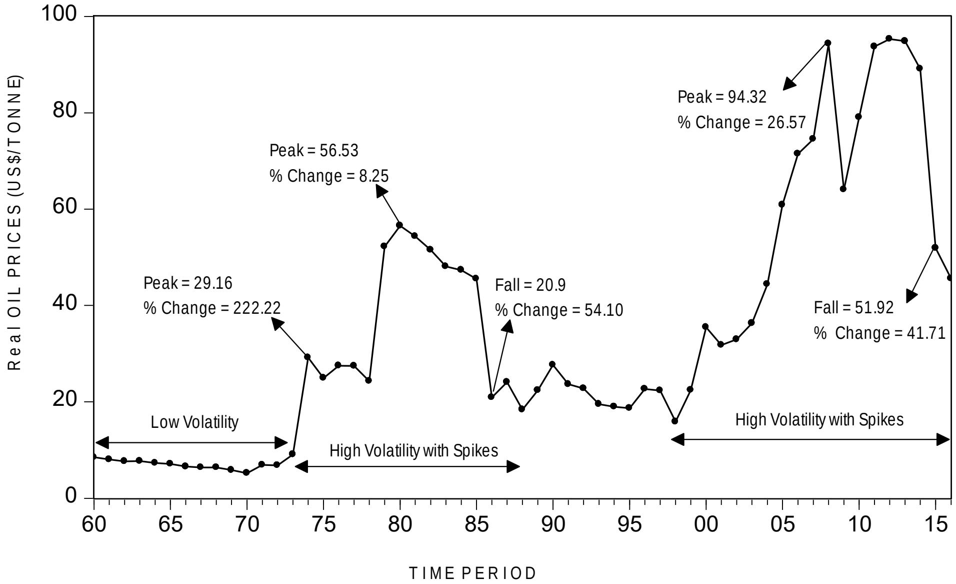
Motivated by the above mentioned considerations the present study seeks to complement the existing literature by using a state space approach to obtain a comprehensive derivation of oil price movements. To this end, it applies the Structural Time Series Model (STM) to categorize the separate stochastic components defining oil prices over the period 1960 to 2016. Additionally it allows integration of structural breaks and additive outliers in the form of intervention analysis and generates forecasts. Based on the state space framework and estimated using the Kalman Filter, this class of model has been successfully applied to metals (Alagidede, 2009) and agricultural commodity (Rezitis et al., 2015) price movements. However, their utilization in the context of energy modelling is somewhat limited. Furthermore understanding the characteristics of the data is mandatory to determine the admissibility of related theoretical frameworks. For example, though it is not explicit most studies on resource prices are based on Hotelling's (1931) principal which states that the net price of an exhaustible resource will increase in accordance to the interest rate in competitive market equilibrium yielding a rising price trajectory over the long term. Modifications of the basic Hotelling model propose that the price could initially decline, as reserve accumulation or technical advancement cause the marginal extraction cost to fall, but over the long term the depletion effect will offset the impact of technological change causing price to rise. Building on these Hotelling style deterministic models several tests establish increasing or U-shaped price paths to highlight the depletion effect of resource use (Krautkraemer, 1998) while others settle to conduct unit root tests. However when analyzing whether a resource is growing increasingly scarce, based on trend evaluation, it is necessary to select the correct specification for the trend function. If the data surface in stochastic patterns (for example due to demand shifts or reserves growth) then the standard Hotelling framework and its implication will not be applicable. The situation is further complicated due to the possibility of unaccounted structural breaks, arising in response to market disruptions (for example the oil price shock of the 1970s). On the other hand, if the data demonstrate a tendency for short run deviation testing for long term growth will be inefficient and will lack power to explain high price runs. In this context, the STM analyzes the data generation process without the mandate of unit root pretesting and its empirical results facilitate easy economic interpretation. Several key results surface from the present research. Estimates from the STM indicate that the long term trend is best captured by a stochastic rather than deterministic specification. The trend is rather characterized by two breaks. These are both statistically significant and are of economic importance for explaining price behaviour. The findings also document the frequency and duration of oil price cycles. This result can be utilized for formulating policies to regularize trade shocks and its resultant macroeconomic effects arising due to price disruptions as well as to design counter cyclical policies to manage price fluctuations. Finally the model performs well in forecasts. Section 2 commences with a descriptive analysis of the data and discusses the methodology applied in the present research. Section 3 outlines the empirical results derived from estimating the Structural Time Series Model. Section 4 provides a discussion of the results and concludes.

2. Data and modeling approach

The data set utilized in the present study consists of annual average spot price of Brent, Dubai and West Texas Intermediate which are assigned equal weights for the duration of 1960 to 2016. It is measured in US dollars per barrel ($/bbl) and obtained from the World Bank. Following the literature the series is deflated using the Wholesale Price Index for all commodities and is expressed in 2010 constant terms. Notably, while several studies utilize long period data sets the present analysis is limited to six and a half decades of data mainly because a stochastic modelling approach increases the likelihood of data snooping, i.e. for a long duration time series a single or more structural changes will be detected that might not have any empirical significance and explanation to its occurrence.

The logarithm of real oil prices over the complete sample period is exhibited in Figure 1. The graph clearly manifests that the series is characterized by several specific features. First, a visual examination is adequate to indicate that the data does not demonstrate a deterministic trend. Prices were generally declining until 1970, after which there is no clear trend. Another wave of falling prices was observed post the mid-1980s and was succeeded by a rising trend. Prices declined in 2008-2009 and then more recently in 2014, representing one of the most dramatic fall in oil prices over the sample period. Second, there is a strong suggestion of changes in the trend line in the early 1970s (around the time of the first oil shock) and mid-1980s (around the time of the oil glut) and the occurrence of occasional spikes indicates the possibility of outliers. Third, the data displays a high degree of fluctuations with possible trend reversions.

Figure 1. *Evolution of Real Oil Prices, 1960-2016*



2.1. The structural time series model

The Structural Time Series Model is a rich and flexible class of models which is popularly utilized to decompose a dependent variable into separate latent components of trend, seasonal, cyclical and irregular terms. These terms are defined through stochastic evolution over time and their segregation allows direct economic interpretation (Harvey and Shepard, 1993). The formulating rationale behind the STM is that the unobserved level component is the true value which is subject to a disturbance captured by a noise component resulting in the observed value. So, the different terms represent the true values that can be examined conditional to the addition of noise. The STM is highly suitable for data that integrate stochastic structures that frequently appear in observed series as the underlying data-generating processes (Harvey, 1989). Its application to real oil prices can serve to shed light on both long and short term movements. Being a special case of state space models STM is estimated by the maximum likelihood via the Kalman Filter and specified as follows:

$$y_t = \mu_t + \gamma_t + \psi_t + \sum_{j=1}^{i} \lambda_j d_{j,t} + \varepsilon_t \qquad \varepsilon_t \sim NID\ (0, \sigma_\varepsilon^2) \quad t = 1, 2, \dots, T \tag{1}$$

Where y_t is the real oil price, μ_t is the trend, γ_t and ψ_t are the cyclical terms, $d_{j,t}$ is the dummy variable and ε_t is the irregular component. The trend represents the long-term growth of the response series and can include level and/or slope. A level denotes the definite value while the slope captures the integral tendencies of the data. The latter is included if the data demonstrates a constant growth pattern. The trend can be modelled as a Random Walk Model (RWM) or Local Level Trend (LLT) model. The former is suitable for flat and slow turning series and is specified as follows:

$$\mu_t = \mu_{t-1} + \eta_t \qquad \text{where } \eta_t \sim NIID(0, \sigma_\eta^2) \tag{2}$$

Inclusion of the slope in the RWM yields the LLT consisting of a stochastic level and slope.

$$\mu_t = \mu_{t-1} + \beta_{t-1} + \eta_t \qquad \eta_t \sim NIID(0, \sigma_\eta^2) \tag{3}$$

$$\beta_t = \beta_{t-1} + \xi_t \qquad \xi_t \sim NIID(0, \sigma_\xi^2) \tag{4}$$

Restrictions can be imposed on equations 3 and 4 to derive specific cases. If $\sigma_\eta^2 = 0$ the trend is smooth and the model converts to a Smooth Trend Model (SMTM), if $\sigma_\xi^2 = 0$ the trend displays a fixed slope and if $\sigma_\eta^2 = \sigma_\xi^2 = 0$ it becomes deterministic. A cycle component captures the short term movements in the data series which can be modelled to arrest complex periodic patterns of varying periods and amplitudes. Each cycle is characterized by a combination of sine and cosine waves.

$$\begin{bmatrix} \psi_t \\ \psi_t^* \end{bmatrix} = \rho \begin{bmatrix} cos\lambda & sin\lambda \\ -sin\lambda & cos\lambda \end{bmatrix} \begin{bmatrix} \psi_{t-1} \\ \psi_{t-1}^* \end{bmatrix} + \begin{bmatrix} v_t \\ v_t^* \end{bmatrix} \tag{5}$$

Where $v_t\ and\ v_t^*$ are independently distributed as $N(0, \sigma_v^2)$ and the damping factor $(0 < \rho < 1)$ is included to display the pace at which fluctuations dampen. The fourth term in equation 1 is the irregular component. It reflects unexplained variation in the data and is assumed to be Gaussian white noise.

2.2. Intervention tests

Considering the potential presence of intertemporal changes in the characteristics of the data, structural breaks (SB) and additive outliers (AO) are identified and included in the analysis. The former occur in response to a permanent shift (upwards or downward) in the series while the latter represent an abnormal value in real oil prices. The de Jong and Penzer (1998) approach is applied to identify both SB and AO. Once identified these are included using dummy variables in the specified STM.

According to the de Jong and Penzer (1998) approach the fitted model is considered to be the null and any value and structural breaks that are not adequately accounted for by it are recognized as outliers. To appropriately represent the data generation process it is specified as follows:

$$y = (y_1^{'}, \dots, y_n^{'})' \tag{6}$$

Equation 6 specifies the null model and states that y has mean **0** and covariance matrix $\sigma^2\sum$**.** The objective is to test for the existence of deviations from the null model by the inclusion of an intervention variable given as follows:

$$D = (D_1^{'}, \dots, D_n^{'})' \tag{7}$$

The alternative hypothesis is specified as

$$y \sim (D\delta, \sigma^2\sum) \tag{8}$$

Equation 8 reduces to the null hypothesis in the situation where $\delta = 0$. Notably in the case of a univariate series (like the present study) with δ, $\mathbf{D}$ specifies a column vector called the intervention signature. The intervention can be a measurement intervention that captures a single outlying data point (modelled through impulse intervention), a structural break that causes the level of the series to shift over the long term (modelled through step intervention) or a switch intervention which represents the presence of extreme values on either side of the current level of the series (modelled through step intervention). Notably the graph in Figure 1 is highly suggestive of both outliers and structural breaks.

Given $\boldsymbol{D}$ and $\sum$ the Generalized Least Squares is utilized to approximate the intervention parameter δ.

$$\hat{\delta} = S^{-1}s, cov(\hat{\delta}) = \sigma^2 S^{-1}, \tag{9}$$

$$\text{Where } s = \boldsymbol{D}'\textstyle\sum^{-1}\boldsymbol{y}, \qquad S = \boldsymbol{D}'\textstyle\sum^{-1}\boldsymbol{D}, \tag{10}$$

Where s is the intervention contrast. The test of the hypothesis of no shock i.e. $\delta = 0$ is founded on the following.

$$\hat{\delta}'\{cov(\hat{\delta})\}^{-1}\hat{\delta} = \sigma^{-2}s'S^{-1}s \tag{11}$$

σ^2 can also be replaced by normal based maximum likelihood estimate where

$$\hat{\sigma}^2 = (y'\textstyle\sum^{-1}\boldsymbol{y})/n, \tag{12}$$

Equation 12 yields the test statistic

$$\tau^2 = \hat{\sigma}^{-2}s'S^{-1}s \tag{13}$$

The estimate σ^2 can be modified to include the intervention as follows

$$\hat{\sigma}^2 = n^{-1}(\boldsymbol{y}'\textstyle\sum^{-1}\boldsymbol{y} - \boldsymbol{s}'\boldsymbol{S}^{-1}\boldsymbol{s}) \tag{14}$$

The statistic τ^2 has an approximately χ_p^2 distribution, where p denotes the rank of $\boldsymbol{S}$. Dividing each component of $\hat{\delta}$ by its estimated standard error provides τ the analog of the usual regression *t* statistic. Finally neither D nor $\sum$ is known. In general $\sum$ **is** a function of hyperparameters estimated under the null. The presence of shocks may distort these estimates and thus affect the test statistics.

The above method provides an efficient way to judge the abnormality of a data point in the tested series by computing SB and AO regression coefficients and their standard errors. Table 1 presents the results of the de Jong and Penzer (1998) intervention test for real oil prices.

Table 1. *Structural breaks and additive outliers in real oil prices*

S. No.	Date	Break type	Estimate	Chi-square
1	1974	Structural break	0.96839*	15.83
2	1986	Structural break	-0.69258*	11.271
3	1978	Additive Outlier	-0.42599*	8.651

*Significant at the 5% level.

3. Results

In this section the results of the Structural Time Series model are presented. This methodology comprises of interpretable components, such as trends, cycles, irregular and intervention terms, which are specified as stochastic progressions dependent on normally distributed disturbances. The output parameters of the STM consist of variances of the disturbance terms, damping coefficients and cycle frequencies. Estimation of equations 1 to 5 is carried out in a step wise procedure where first the variance hyperparameters are attained and then the trend and cyclical terms are extracted based on the smoothing algorithm contained in Koopman et al. (2009).

The parameters are provided in Table 2. Summing up the variances of all the components allows to derive variation in real oil prices (σ_y^2). The level is deterministic while the variance of the slope is different from zero. This result somewhat contradicts the findings obtained by several earlier studies which establish a deterministic trend (overall rising or U-shaped) for oil prices (e.g. Slade 1982). With reference to the cyclical components, the short cycle (Cycle-1) has a variance of 0.01722 while the longer cycle (Cycle-2) displays an insignificant variance. Clearly Cycle-1 is stochastic while Cycle-2 evolves in a deterministic pattern. Interpretively, the cycles in oil prices arise due to a multitude of demand and supply influences, geopolitical events, technological advances, and changes in market structure. These incidences involve a high measure of arbitrariness causing the timing, periodicity and amplitude of the cycles to exhibit stochastic properties. Cycle-1 lasts for the duration of 9.44 years while Cycle-2 displays a period of 25.87 years. The duration of Cycle-1 corresponds with the length of a typical business cycle. The interval of Cycle-2 is quite long but can be attributed to capital intensity, long gestation period, and uncertainties prevailing in upstream oil investment projects. In addition, both cycles are persistent, with a damping factor of around 0.58 for Cycle-1 and 1 for Cycle-2. For validation, full sample estimates are provided in the right column and are reasonably similar.

The q-ratios are calculated and reported in Table 2. They are defined as the ratio of each variance to the largest and are effective is estimating the relative contribution of separate components to the data. Results show that majority of the variation in oil prices is attributable to Cycle-1 followed by the slope. The q-ratio of the irregular component is close to zero confirming that the other included components account for all the movement in the data.

The regression estimates of the trend parameters and intervention variables are displayed in the last panel of Table 3. The long term trend is punctuated by two structural breaks and a single outlier (see results in Table 1). All three interventions are statistically significant as evaluated by the reported statistics and capture major economic events. Break-1974 arrests the Arab oil embargo by the Organization of Petroleum Exporting Countries (OPEC) and was accompanied by the stock market crash. This episode represents the most striking rise in real oil price of modern history where the nominal price rose fourfold over the course of half a year. Post 1974 oil prices remained relatively low and when adjusted for inflation they present a moderate decline. Outlier-1978 reflects this decline when many economists considered that oil prices were unsustainably low (Gately. 1986) prior to the Iranian revolution. Finally, Level-1986 captures the popular oil glut. Post 1980 there was global decline in demand for oil due to overproduction resulting in global surplus. Oil price continuously declined for a period of six years culminating in a 46 percent price drop in 1986 (Gately, 1986) and almost equaling its level prior to 1973.

Table 2. *Estimation results for real oil prices*

Hyperparameters	In sample period (1960-2009)	Full sample period (1960-2016)
Level (σ_η^2)	0 (0)	0 (0)
Slope (σ_ξ^2)	0.00000613* (0.00036)	0.00002056* (0.001408)
Cycle (σ_γ^2)	0.01722* (1)	0.01430* (1)
Cycle (σ_ψ^2)	1.957648E-7 (1.14E-05)	1.44E-07 (9.99E-06)
Irregular (σ_ε^2)	1.03727E-10 (6.02E-09)	1.259804E-8 (8.81E-07)
Cycle-1		
Duration ($2\pi/\lambda$)	9.40794*	6.77887*
Damping Factor (ρ)	0.58144*	0.59991*
Frequency (λ_C)	0.66786	0.92688
Variance (σ_ψ^2)	0.02602	0.02234
Cycle-2		
Duration ($2\pi/\lambda$)	25.87982*	25.66335*
Damping Factor (ρ)	1.00000*	0.99357
Frequency (λ_C)	0.24278	0.24483
Variance (σ_ψ^2)	0.06324	0.11202
Coefficients of final state		
Level (μ_t)	3.690881*	3.976540*
Slope (β_t)	0.042684	0.038561
Level-1974	1.00431*	0.96780*
Level-1986	-0.77938*	-0.77981*
Outlier-1978	-0.43265*	-0.43202*

Notes: q-ratios are reported in parentheses.
*Significant at the 5% level.

Figure 2 shows the decomposition of real oil price. The first graph in the upper panel illustrates that the long-run slope component of the trend is stochastic with a small growth rate. The second graph shows the long-run trend along with the intervention effects. For clarity, the actual data points are also included. It is evident that Level-1974 led to a dramatic upward shift in the trend and Level-1986 caused it to move downwards. The smoothed cyclical components are displayed in the lower panel. Cycle-2 displays a large amplitude causing the data to deviate from its long-run trend.

Considering a cycle to be composed of a period from peak to trough and trough to peak there is evidence of one complete and 2 half cycles. The amplitude of Cycle-1 remains within the range of -0.25 to 0.25 but rises towards the end of the sample period. This result is consistent with the literature which proposes that price volatility increased in the mid-2000s. Oil prices surged in mid-2000 reaching a record high in 2008 fuelled by high demand relative to supply. A decline occurred in 2009 with the onset of the global financial crises but a strong recovery in global oil demand combined with slower supply growth soon revived oil prices. From 2011 to mid-2014 oil prices remained stable but then declined to reflect one of the most dramatic falls till date. Notably this period was characterized by the influence of market specific factors such as positive oil supply shocks, increased production in non-OPEC countries, sustained production levels by OPEC and declining demand. This recent price decline is broadly comparable to the magnitude of price fall in 1986 (when OPEC reversed production cuts) and 2008-2009 (due to the global financial crisis). The former was primarily supply driven and the latter was mostly influenced by breakdown in demand. In contrast, the recent fall in oil price appears to be a mix of the two. These observations combine to cast a doubt on whether the data would have demonstrated an increasing trend, since the mid-1970s, in the absence of the included intervention variables and cyclical movements.

Figure 2. *Decomposition of oil prices*

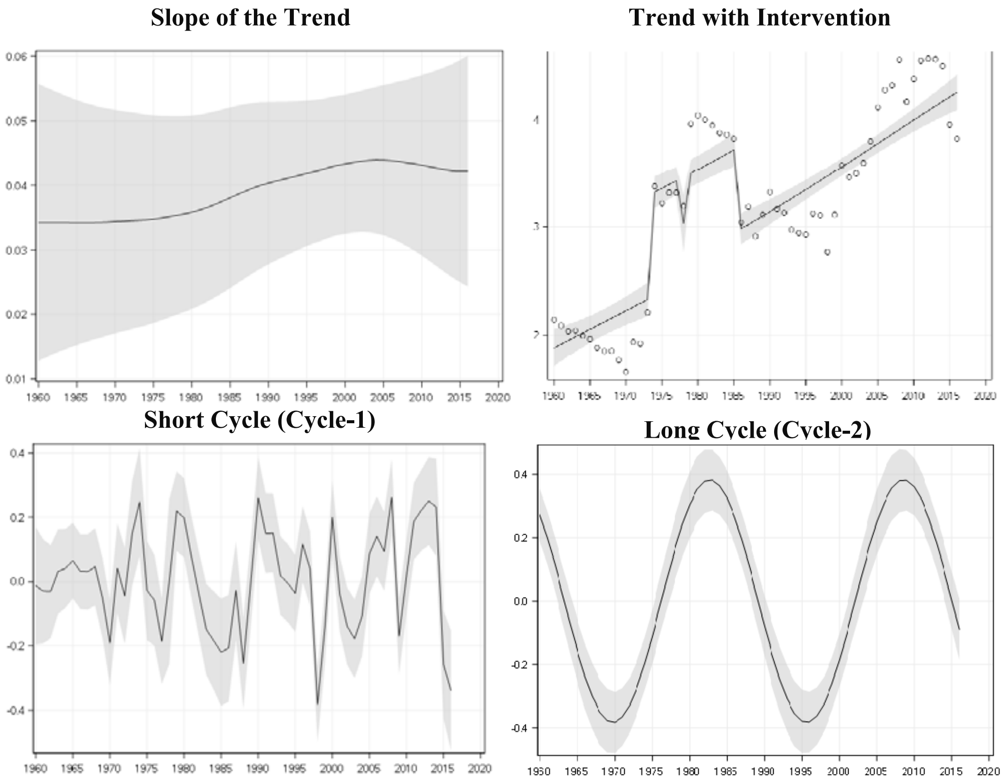


Table 3 presents the diagnostics and goodness-of-fit statistics for the estimated model. These include the mean squared error, the root mean squared error, the mean absolute percentage error, the maximum percentage error, the adjusted R^2 and R^2. The adjusted R^2 and R^2 show a reasonable fit and the statistics presented in Table 3 do not indicate any deficiencies in the estimated model.

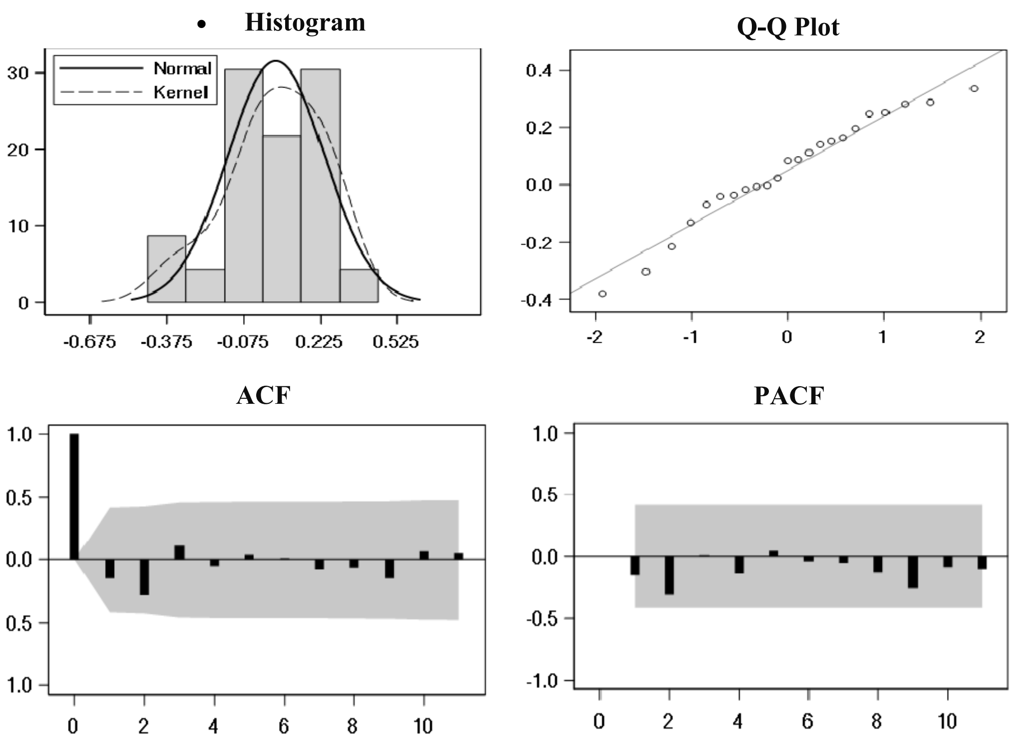
Table 3. *Fit statistics based on residuals for real oil prices*

Statistics	In sample period (1960-2009)	Full sample period (1960-2016)
Mean Squared Error	0.03674	0.03894
Root Mean Squared Error	0.19168	0.19733
Mean Absolute Percentage Error	4.52741	4.67147
Maximum Percentage Error	9.43231	9.24999
Adjusted R^2	0.79189	0.85696
R^2	0.85811	0.89149

Note: Number of non-missing residuals used for computing the fit statistics = 23.

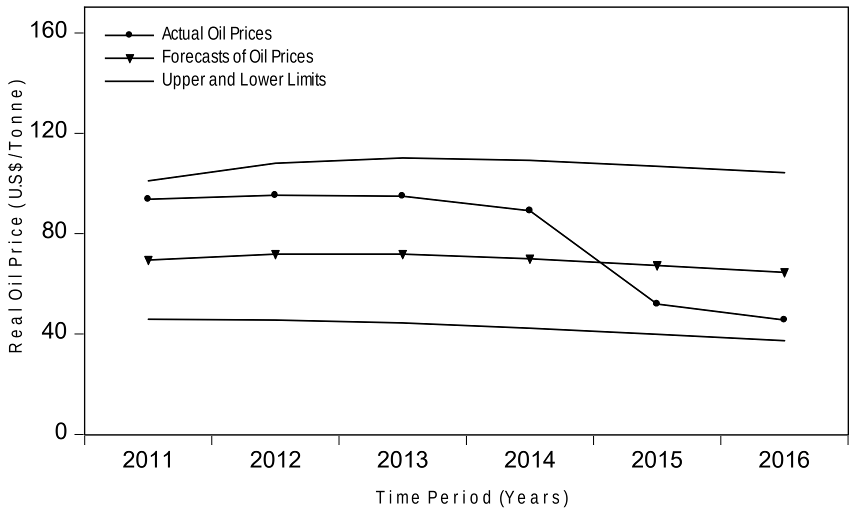
Figure 3 displays the residuals based on the standardized one-step-ahead prediction errors as defined in Koopman et al. (2009). For an accurately specified model these are normally and independently distributed. The histogram and Q-Q plot displayed in the top panel do not exhibit any violation of normality. The lower panel confirms that the autocorrelation and partial autocorrelation functions do not violate the assumption of whiteness. The statistics (Table 3) and graphs (Figure 3) are the means of checking the validity of the model and suggest that it is robust.

Figure 3. *Residual diagnostics*



Generation of forecasts is an important part of modeling time series patterns and gauging its statistical adequacy as it provides the means of projecting the past into the future by attaching suitable weights to the past and current observations. STMs are formulated directly in terms of unobserved components and are effective not only for capturing the salient features of the data but also for forecasting. The model in the present section is estimated with the first 50 data points and the last six years are reserved for out-of-sample forecasts. The actual values, forecasts and 95% confidence bands are illustrated in Figure 4. The forecast seem to be generally satisfactory and do not deviate more than two standard errors, even in the case of recent price descent, from the observed value establishing that the estimated model is accurate. This result validates that for oil prices a stochastic trend model with cycles and structural breaks provides an adequate and flexible account of the data. Notably identifying the stochastic process is instrumental in determining reasonable forecasts which play an important role in macro economy policy making and are important for investment decisions. Moreover, the trend specification of the estimated STM is close in spirit to the model proposed and estimated by Pindyck (1999) which also utilized annual data but for a longer time span.

Figure 4. *Real oil price forecasts (2009 to 2014)*



4. Discussion and conclusions

Oil is a classic case of an exhaustible resource and its price has significant theoretical implications which govern its utilization. Trends in oil prices have always been an important research area for economists, not only because of its non-renewability but also due to its significant impact on the world economy. An important task for researchers is to relate findings of empirical tests to the existing theory. As emphasized in Section 1, multiple research works focus on the behavior of oil price but don't facilitate drawing theoretical inferences from their results. Specifically the popularly applied autoregressive model based tests are unequipped in this regard. The present study seeks to contribute in this direction by accounting for separate structural components inherent in real oil prices and shedding light on its theoretical implications.

One of the most widely cited and referred work is Hotelling's (1931) theoretical model of exhaustible resources. In its basic form it states that the net price of an exhaustible resource, which is an economic measure of resource scarcity, should grow at the rate of interest. This prediction is referred to as the Hotelling rule (Krautkraemer, 1998). Under a perfectly competitive market the rule implies that the market price minus marginal costs will grow at the rate of interest therefore the natural resource price should be increasing over time. Extensions to the model also establish a U-shaped long-run price trajectory (e.g. Pindyck, 1978 and Slade, 1982). Based on this fundamental rationale of a long term deterministic growth several studies analyze price trends of natural resources, such as oil, assuming trend stationarity or conduct unit root tests. Both these approaches are less informative about the underlying data generation process and rely on mechanical procedures with the possibility of spurious results. Furthermore, though Hotelling's theory and its extensions are elegant, observed oil price data over the past decades suggests that is evolves in patterns more complex than either deterministic trends or unit root processes. For example real oil prices exhibit a steady declining trend in the beginning of the 1960s and sharp fall between 1982 and 1986 while a rising trend prevailed during 1970s and post 2000. These periods also exhibited the impact of high fluctuations and multiple spikes.

The key innovation in this paper is the use of structural time series model to overcome the problems inherent in extant studies. It builds on the conception that oil prices are characterized by complex behavioral patterns that can be represented appropriately within a state space framework. The STM is set up to consist of a stochastic trend, cycle and irregular components which are extracted by the state-space smoothing algorithm. This approach yields several interesting facts about real oil prices. Firstly, oil prices have not shown a persistent increase over the past decades rather the long term trend is stochastic and impacted by three significant interventions. By modeling the trend with interventions it was observed that oil price is sensitive to market disruptions resulting in trend shifts. These disruptions occur due to some unusual and significant events in oil markets such as political issues or decisions of oil exporting countries. This result for the long term trend contradicts some of the earlier studies which establish deterministic price paths (for example Slade 1982) but is largely in agreement with Pindyck's (1999) who suggested that over the long term price trajectory will be time varying to reflect the impact of demand shifts, reserves growth and technical change. Moreover, the discovery of breaks corroborates the findings derived by Lee et al. (2006). Notably omission to discover structural breaks can lead to erroneous and inaccurate interpretation of trends resulting in unwarranted policies that may raise issues associated with oil price fluctuations. Secondly, the analysis presents substantiation of persistent cyclical movements and documents their frequency and duration. The first cycle spans a duration of 9.4 years while the second one is for 25.8 years. The speed with which oil price cycles rise and fall are quite persistent and estimated to average 0.79 for both cycles. This cyclical behaviour is an aspect that is not reflected in the Hotelling's theory and unaccounted for in most empirical tests which tend to focus primarily on the trend component of oil prices. However, oil prices present high volatility implying a lack of steadiness that cannot be explained by trend analysis. For example, oil prices post mid-1970s and mid-2000s present periods of high volatility that are effectively explained by the existence and persistence of cycles. Moreover the validation of cyclical behaviour holds major significance for related policies concerning stabilization, consumption and income of both producer and consumer economics. The above results cast a doubt on Hotelling style deterministic trends in oil prices. A general conclusion of this study is that oil price developments tend to be more complex than captured by the assumption of exponentially increasing prices. While several tests in the literature propose that prices increase in the long run yet the more superior fit of oil prices is the one that accounts for the underlying stochastic processes in oil prices. This approach captures the multiple influence of long term variables (such as demand shifts, technological change, reserves growth and site development) and small fluctuations in the short term (primarily due to supply-demand disequilibrium) and structural breaks (significant market disruptions) which Hotelling, and associated tests, do not account for. The STM class of model also provides a favorable vehicle for forecasting.

In conclusion the promise of the above applied approach derives largely from the fact that it captures in a nonstructural framework what basic theory tells us should be driving price movements. The framework presented here can effectively be extended to other nonrenewable resources while accounting for market specific interventions.

Notes

(1) While the literature on oil prices is extensive (see Hamilton, 2008) the present study focuses on the strand that seeks to test Hotelling theory of exhaustible resources utilizing real prices.

(2) A series is defined to be strictly stationary when its joint probability distribution does not vary over time periods. Weak stationarity is defined when its mean and variance are constant and the autocovariance depends only on the length of the lag (Hamilton, 1994).

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Wage inequalities in Romania under successive adjustments in minimum wage levels

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Abstract. *In this paper we aim to identify some of the most relevant wage determinants observable at micro level and try to explain wage inequalities through the use of Mincer equations. The case of Romania is discussed for the year 2014. Because of data availability issues, the methodological framework relied on ordered logit models. Moreover, because of the two successive increases in the minimum wage levels, the paper analyses the changes occurring quarterly during Q1 2014 – Q4 2014 upon the individuals odds of moving forward to a higher decile of the wage distribution. Both social-demographic and economic characteristics are investigated.*

Keywords: wage inequalities, ordered logit model, micro-datasets, socio-demographic factors, economic factors.

JEL Classification: J31, C82.

1. Introduction

The aim of this paper consists in studying the changes in wage inequalities in Romania under a certain period of time that was intensively affected by several minimum wage adjustments. Because of data availability reasons, the reference period considered referred to the year 2014, for which the minimum wage registered two successive adjustments, as follows: a first change occurred in January 2014 when the gross minimum wage rate increased from 800 to 850 lei, followed by a second adjustment up to the level of 900 lei in July 2014.

Although assessing the net impact of the minimum wage levels upon the Romanian labour market in general, and wage inequalities in particular, cannot be estimated unless microdata is used and microsimulation techniques are properly applied, the current paper will focus explicitly on wage inequalities and their short-term dynamic under two successive adjustments in the statutory minimum wage level.

Thus, the paper will aim to identify some of the most relevant wage determinants that are observable at individual level and try to explain wage inequalities through the use of Mincer earnings equations. Moreover, because of the two successive increases in the minimum wage levels, the paper will investigate the changes occurring quarterly during Q1 2014 - Q4 2014 upon the individuals odds of moving forward to a higher decile of the wage distribution. This is mostly because we assume that the wage distribution is normally affected by the minimum wage increases.

The quarterly AMIGO database provided by the National Institute of Statistics was used in the current research in order to investigate the main changes in wage distribution over the period Q1 2014-Q4 2014. Regarding the information on individuals' wages, the database is limited to only the corresponding net wage decile for each person, instead of offering further information on the gross average wage, social benefits or tax burden at micro level. Under these data availability restrictions, there were a limited number of factors included in the Mincer earnings models.

According to the economic literature review, the Mincer model (1958, 1974) can be an effective tool in explaining the rate of return on education and work experience. The Mincer model captures not only how labour market rewards depend on attributes such as years of schooling or work experience, but also on the rate of return on schooling, which can be interpreted as an interest rate for investing in human capital. Although there are studies that have focused on determining the rate of return on schooling, such as those by Ashenfelter and Krueger (1994) or Ashenfelter and Rouse (1998), recent studies no longer provide valid estimates for this indicator.

In general, there are two main methodological approaches used at international level to explain wage differentials. On the one hand, there are studies applying OLS regressions for quantifying average wage inequalities, while on the other hand there are quantile regressions, which also allow for unobservable factors to be considered in order to explain each individual's position in the wage distribution.

Based on quantile regressions, Pereira and Martins (2000) studied the impact of education on wage inequality in 15 European countries (Austria, Denmark, France, Finland, Germany, Greece, Italy, Ireland, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom), during 1980-1995 and concluded that in most countries the dispersion of wage inequalities increases with schooling.

Several other studies used quantile regressions when studying wage inequalities (see Buckinsky, 2001; Tansel and Bircan, 2011). In terms of main earnings inequality factors Fournier and Koske (2012) studied the effects of the following factors on a group of 32 countries: the number of hours worked, the gender, the age and the highest degree of education obtained. They found that women have less employment opportunities than men, and those who work earn less than men. Moreover, policies aimed at increasing the graduation rate for upper secondary education tend to reduce wage inequalities.

At national level, the literature review on the topic of wage inequalities is less vast. Some have studied the main determinants of wages (Andreica et al., 2010; Vasilescu et al., 2010, 2014; Militaru et al., 2011). Others have focused on wage inequalities between the public and the private sectors (Voinea and Mihăescu, 2011). In this sense, Zaman and Stănculescu (2007) argued that wage increases in the Romanian public sector have not yet been correlated to the productivity growth rate, as compared to the private sector, which represents a major political concern in mitigating wage disparities.

Based on the literature review in the field, it can be concluded that identifying the main determinants of wage inequalities plays an extremely important role, providing support to policy makers in order to reduce wage inequalities.

This paper is organized as follows: Section 2 briefly presents the data and the methodological framework used for this study, Section 3 describes the main findings of the analysis, while the last section concludes.

2. Data description and the methodological framework

In order to identify the main determinants of wage inequalities, the current study relied entirely on the AMIGO database and built up several Mincer earnings equations corresponding to the four quarters of the year 2014, when the minimum wage policy is assumed to have had several implications on the national wage distribution.

The AMIGO database provides national representative data collected through identical questionnaires applied on quarterly bases. The questionnaire is divided into two parts: one addressed to the household and a second one addressed to each individual aged over 15 regarding their professional status, work, occupation, main and secondary activity, hours worked or desire to have another job.

Our study was conducted over the period Q1 2014 – Q4 2014 and only focused on employed persons. Therefore, from the initial database all unemployed persons, as well as self-employed persons were excluded. The resulted final sample sizes were the following: 15372 individuals for the first quarter, 15631 for second quarter, 15718 for third quarter and 15523 individuals for the fourth quarter of the year 2014.

Based on the database specificity and due to econometric reasons the following types of information at individual level were considered in the study through the form of categorical variables:

- Socio-demographic characteristics, such as: age (*age15_24, age25_44, age45_64, age 65+)*, gender (*Male* and *Female*) residence area (*Urban* and *Rural*) and the levels of education (*ISCED 0, ISCED 1-2, ISCED 3-4* and *ISCED 5-8*).
- Economic variables: economic sectors (*Industry, Constructions, Agriculture, Private services, public services and other sectors)* and major occupations *(GM1, GM2, GM3, GM4, GM5, GM6, GM7, GM8* and *GM9).*

Dummy variables were then built for each variable's category. Thus, for the age variable there were four dummy variables built corresponding to the following age sub-groups: 15-24 years old, 25-44 years old, 45-64 years old and over 65 years old. The youth group (*15-24 years*) was considered as a reference base and was therefore excluded from the estimation.

Regarding the level of education, other four dummy variables were created, as follows: ISCED 0 for no education, ISCED 1-2 corresponding to primary or lower secondary education level, ISCED 3-4 for secondary or non-tertiary secondary education level and ISCED 5-8 for higher education level. Variable *ISCED 5-8* was considered as reference base.

Regarding gender, the dummy variable *Female* was considered the reference base, while when considering the residence area, the *Rural* variable was left aside from the estimation for comparison reasons.

Further data processing was required in order to build the dummy variables corresponding to the economic sectors. Because of methodological limitations, we regrouped the initial economic sectors intro the following main dummy variables: *Industry, Constructions, Agriculture, Private services* (G – Wholesale and retail trade; repair of motor vehicles and motorcycles, H – Transportation and storage, I – Accommodation and food service activities, J – Information and communication, K – Financial and insurance activities, L – Real estate activities, M – Professional, scientific and technical activities, N – Administrative and support service activities were included here), *Public services* (O – Public administration and defence; compulsory social security, P – Education, Q – Human health and social work activities, as well as R – Arts, entertainment and recreation were included here), and *other sectors* (S – Other service activities, T – Activities of households as employers; undifferentiated goods and services producing activities of households for own use, as well as U – Activities of extraterritorial organisations and bodies were included here) which was considered the reference base.

Finally, although the occupations were available in the database at 3 digits codes, for the current study's purpose we regrouped the information into the main major groups of occupations and considered *GM9 – Unskilled worker group of occupations* as the reference base.

Although most empirical studies on wage inequalities typically use simple OLS regression or quantile regression, in the current study there was a distinct approach proposed because of data availability reasons. Thus, since the database only provides information on the decile each individual's net earnings belong to, ordered logit models had to be applied using micro data.

Therefore, the dependent variable is a categorical one, taking values from 1 to 10 according to the correspondent decile. Under these circumstances, an ordered logit model had to be estimated so to quantify the importance of these factors upon the odds of getting higher earnings and moving towards a higher wage decile.

The logit model is a one-period classification model for which estimates are based on a maximum likelihood function in order to determine the conditional probability of an individual belonging to a category according to certain independent variables. Thus, the logit model describes a relation between the binary variable Y, which takes values 1 or 0, and k explanatory variables $x_1, x_2, ..., x_k$.

Starting from a linear probability model such as: $\Pr(y = 1|x) = x\beta + \varepsilon$, if we restrict probabilities to the interval [0,1] we get $\Omega(x) = \frac{Pr(y = 1|x)}{Pr(y = 0|x)} = \frac{Pr(y = 1|x)}{1-Pr(y = 1|x)}$. The logit model results by applying the natural logarithm to these probabilities, reaching the following general form: $ln\Omega(x) = \beta_0 + \sum_{j=1}^{k} \beta_i x_{i,j}$.

This equation is called the logit form of the model, where $ln\Omega(x)$ is the logarithm of the probability that an individual belongs to one category or another in relation to the explanatory variables $x_{i,1}, x_{i,2},..,x_{i,k}$. In the case of the ordered logit model, the probability of an individual belonging to a category versus a smaller or a larger category is estimated, since the values of the dependent variable are ordered: $\Omega_{\leq m|>m}(x) = \frac{Pr(y \leq m|x)}{Pr(y > m|x)}$ (Hosmer et al., 2013).

Thus, one of the characteristics of the ordered logit model consists in the fact that the values of the dependent variable are assumed to be equally spaced and that the ordering makes sense. This hypothesis is called the hypothesis of proportional chances (or the hypothesis of parallel regression) which generates a set of estimated coefficients for the logistic model.

3. Main findings

To evaluate the inequality of earnings, we estimated four ordered logit models corresponding to each quarter of the year 2014. The main estimation results are summarized in Table 1, from where we notice that all coefficients are statistically significant.

The model is valid and although the Pseudo R^2 test value is rather small in all four cases, we accept such biases due to the current data limitations.

Regarding wage inequalities, the most notable result corresponds to the case of the second quarter of the year 2014, when according to the estimated odd ratios, male employees have 2.4 times higher chances of earning more and move forward to a higher wage decile of the distribution than female employees. This is by far the highest value of wage inequalities registered among the period Q1 2014 – Q4 2014.

The second most relevant indicator of wage inequality was noticed in the first quarter of the year 2014, when the logistic estimation suggested the fact that male employees have 1.97 times higher chances of moving forward to a higher wage decile than females.

Table 1. *Ordered logit models for the period Q1 2014 – Q4 2014*

		Q1 2014		Q2 2014		Q3 2014		Q4 2014	
	Variables	**Odd ratio**	**P-value**	**Odd ratio**	**P-value**	**Odd ratios**	**P-value**	**Odd ratios**	**P-value**
Gender	Male	1.97	0.00	2.41	0.00	1.92	0.00	1.92	0.00
Residence area	Urban	1.34	0.00	1.34	0.00	1.28	0.00	1.22	0.00
Level of education	ISCED 0	0.27	0.014	0.15	0.007	0.03	0.004	0.20	0.036
	ISCED 1-2	0.30	0.00	0.35	0.00	0.38	0.00	0.37	0.00
	ISCED 3-4	0.54	0.00	0.56	0.00	0.62	0.00	0.56	0.00
Age structure	age25_44	1.62	0.00	1.41	0.00	1.65	0.00	1.63	0.00
	age45_64	1.87	0.00	1.65	0.00	1.90	0.00	1.92	0.00
	age65plus	2.13	0.03	1.28	0.474	1.79	0.083	1.84	0.022
Economic sector	Industry	0.13	0.00	0.08	0.00	0.09	0.00	0.07	0.00
	Constructions	0.12	0.00	0.08	0.00	0.12	0.00	0.08	0.00
	Private services	0.10	0.00	0.06	0.00	0.08	0.00	0.06	0.00
	Public services	0.09	0.00	0.06	0.00	0.08	0.00	0.05	0.00
	Agriculture	0.09	0.00	0.05	0.00	0.08	0.00	0.05	0.00
Major occupation	GM0	7.94	0.00	9.57	0.00	9.07	0.00	10.68	0.00
	GM1	9.48	0.00	9.48	0.00	9.25	0.00	10.38	0.00
	GM2	8.13	0.00	7.92	0.00	8.62	0.00	8.78	0.00
	GM3	6.03	0.00	5.96	0.00	5.74	0.00	6.19	0.00
	GM4	4.50	0.00	4.07	0.00	4.26	0.00	5.11	0.00
	GM5	1.81	0.00	1.77	0.00	1.77	0.00	1.80	0.00
	GM6	6.64	0.00	4.32	0.00	3.89	0.00	5.70	0.00
	GM7	2.60	0.00	2.44	0.00	2.51	0.00	2.75	0.00
	GM8	3.32	0.00	3.20	0.00	3.23	0.00	3.25	0.00
Main test statistics	No. of obs. =	15372		15631		15718		15523	
	LR chi2(22) =	3922.7		4109.4		3692.8		3749.7	
	Prob. > chi2 =	0.00		0.00		0.00		0.00	
	Pseudo R2 =	0.0558		0.0574		0.0511		0.0526	

Source: authors' own calculation.

Among the other socio-demographic characteristics, the comparative age sub-groups analysis highlighted that the chances of moving from one decile to a higher one are positively correlated to age. This is especially notable for the age sub-groups 25-44 and 45-64 years old as compared to youth employees (the 15-24 years old sub-group). For instance in the first quarter, the chances of the individuals between 25 to 44 years old are 1.6 times higher than youth employees, while the chances increase for those between 45 and 64 to a 1.87 times higher than young employees. However, even in case of the age group of over 65 years old, positive chances are registered as compared to youth employees as well. As a peculiarity, the highest chances are registered in the first quarter of the year 2014 when individuals over 65 years old have 2.13 times chances more than young employees to move forward on the wage distribution.

Regarding the residence area, the results indicate that higher chances in moving to a higher wage decile correspond to those living in urban areas as compared to rural residents, although the chances tend to drop slightly from 1.34 times more to 1.28 times more over the year 2014.

Regarding the level of education, the logistic outputs confirm the human capital theory suggesting that education contributes to better labour remuneration. In this case the lowest chances in having higher earnings correspond to those with no education (ISCED 0), for which the chances to move to a higher decile are actually 73% lower than those with higher education level in the first quarter of 2014. Surprisingly, chances decrease even more in the following two quarters and only improve in the last quarter of 2014, when reaching 5 times lower than those with higher education (ISCED 5-8).

The chances are still low for graduates of primary or lower secondary education level (ISCED 1-2), being of approximately 70% less in comparison to highly educated employees in the first quarter of 2014 and tending to increase in the following quarters. A rather similar tendency is registered for the graduates of secondary or non-tertiary secondary education (ISCED 3-4), for which the chances in the first quarter were this time only 46% less than highly educated employees.

Among the economic determining factors of wage increases, quite notable for all quarters of the year 2014 are the influences of the major groups of occupations. More precisely, in comparison to the case of GM9 – *Unskilled worker group* all other major groups of occupations tend to bring higher chances to the employees to move to a higher decile. These results are in accordance to the capital theory, suggesting that specialization and qualification contribute to higher labour rewards. The comparison at quarterly level indicates an increasing tendency of the chances of the employees belonging to GM0 (Armed Forces Occupations) and also for GM1 (Legislative body members) to earn more as compared to unskilled workers. More precisely, chances increase for GM0 from 7.9 to 10.7 times higher than GM9, while for GM1 from 9.5 to 10.4 times more than GM9.

When considering the main economic sectors, the logistic models suggest that there are lower chances for the employees working in Industry, Construction, Private and Public services, as well as in Agriculture to move to a higher decile as compared to other economic sectors. Based on first quarter estimation, for instance, employees in the Industry sector have 87% chances less in moving to a higher decile as compared to those working in other sectors. As a peculiarity however, it is worth mentioning the fact that chances tend to drop even further in the following quarters as compared to first quarter, and seasonality might also be present, especially in the Construction sector, where chances tend to drop more significantly in the last quarter as compared to the previous one. Moreover, it is notable that the highest chances are registered in the first and the third quarter, corresponding to the periods of minimum wage adjustments.

4. Conclusions

In this paper we aimed to identify some of the most relevant wage determinants that are observable at individual level and try to explain wage inequalities through the use of Mincer earnings equations. The case of Romania was discussed for the year 2014 and because of data availability issues, the methodological framework relied entirely on ordered logit models. Moreover, because of the two successive increases in the minimum wage levels, the paper conducted a comparative analysis of the quarterly changes occurring during Q1 2014 – Q4 2014 upon the individuals' odds of moving forward to a higher decile of the wage distribution. Both social-demographic and economic characteristics were investigated and the results were consistent to the human capital theory.

In general, employees living in urban areas tend to have higher odds of moving to a higher decile. Moreover, the return on education was also found to be positive and higher chances to earn more were estimated for those with higher education level. The odds are also expected to increase with age, while wage inequality was present, with the highest degree registered in the second quarter of 2014, when the odds of male employees to move to a higher wage decile were 2.4 times higher than female employees.

Regarding the economic factors, all major occupation groups tend to generate higher earnings compared to unskilled workers, while employees in Industry, Construction, Agriculture, Private or Public sectors tend to have lower chances to move to a higher decile than those working in other sectors.

Even though we are aware of the methodological limitations of our study implied by data availability issues that prevent us from providing net impact assessment results of the minimum wage policies, we believe that this paper brings valuable insights on the short-term changes on employees' odds of moving from one wage decile to another one under a period of intense adjustments of the minimum wage level.

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An examination of bilateral J-curve: Evidence from Turkey and her 20 major trading partners

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Abstract. *There are two methods to determine the impact of real exchange rate on balance of foreign trade. While previous studies, which aim to uncover the nexus between foreign balance and real exchange rate, use foreign trade statistics to measure the volume of foreign trade, some other recent studies utilize bilateral trade statistics. By following current literature, this study draws from the model of Rose and Yellen (1989) and analyzes the relationship between the volume of bilateral foreign trade and bilateral real exchange rate in Turkey and her 20 major trading partners for the period from 1995 to 2015. To this purpose, the presence of cross-sectional dependence among the countries was investigated, and long-term coefficients for each country were obtained with the Mean Group Estimator (MG) method developed by Pesaran and Smith (1995). In conclusion, the findings revealed that bilateral real exchange rate has a statistically significant negative effect on the bilateral foreign trade balance in 10 out of 20 countries in the panel. This negative relationship means that depreciation of the Turkish Lira (TL) against the currency of trading partners improves bilateral foreign balance, and thus, the J-curve effect in these countries is verified. Moreover, Canning and Pedroni (2008) panel causality test results indicate that bilateral real exchange rates cause bilateral foreign trade balance in Turkey with her 14 trading partners.*

Keywords: bilateral J-curve, bilateral foreign trade, bilateral real exchange rate, panel co-integration, Canning and Pedroni (2008) panel causality test.

JEL Classification: F14, F31, C33, F41.

Introduction

The exchange rate system in a country informs us about the economic agents that determine the value of the national currency against foreign currencies. Exchange rates are determined by economic actors in flexible exchange rate system and determined by monetary authorities in fixed exchange rate system. However, despite the flexible exchange rate system, it is observed an intervention in the foreign exchange market to prevent fluctuations and to assure stability. The value of national currency affects many of the main economic variables such as income level, interest rate, unemployment rate and foreign trade balance. Especially, the response of foreign trade balance to exchange rates is one of the most researched economic relationships by both scholars and policy makers.

In outward-oriented economies, import and export potential of a country are among the indicative parameters of national income and domestic output level. In this respect, while setting targets for a country's national income and trade volume, it is of importance to analyze how the changes in exchange rates may respond to trade balance. However, it cannot be said that there is consensus on the long-term effects that the changes in exchange rates can create (Hacker and Hatemi-J, 2004: 778). Depreciation of the national currency against foreign currencies makes the imported goods more expensive and the domestically-produced goods cheaper for foreigners. As a result of depreciation, import decreases and export increases, and thus, a recovery in the foreign trade balance is expected. However, there are several factors prevent simultaneous effect of exchange rate change on the foreign trade balance. The reaction of economic actors to price changes, the exchange rate system in a country and foreign trade policy, the composition of the foreign trade, and the treaties among stakeholders may prevent the emergence of the expected improvement in the foreign trade balance in the short term (Lal and Lowinger, 2002: 400-401). Thus, depreciation or devaluation lead to a further deterioration in the foreign trade balance in the short term, and the expected recovery effect on foreign balance is to be observed in the long-run. In time, the balance of foreign trade follows a path that is similar to the letter J, so it is known as J curve effect (Krugman and Obstfeld, 2003: 464).

Two different methods have so far been used in the empirical studies that have been conducted to examine the validity of Marshall-Lerner condition and J-curve, which shed light on the relationship between real exchange rate and foreign trade balance. Although some of these studies make use of the aggregate data on foreign trade to measure foreign trade balance, more recent studies benefit from the international bilateral foreign trade data. This study followed the most current literature by using the Rose and Yellen (1989) model and conducted an econometric analysis of bilateral foreign trade and bilateral real exchange rate data of Turkey's 20 trading partners. The 20 countries in the study constitute 70% of total import and 60% of total export in Turkey since 2015. Total export and import figures of these countries are given in Table 1 to show their importance in Turkey's foreign trade:

Table 1. *Turkey's trade with major trading partners in 2015 (millions of US dollars)*

Trading partner	Imports	Exports	Trading partner	Imports	Exports
Austria	1,568	1,025	Japan	3,140	335
Belgium	3,147	2,558	Korea	7,058	569
China	24,874	2,415	Netherlands	2,915	3,155
Egypt	1,216	3,125	Poland	2,978	2,329
France	7,598	5,850	Russia	20,402	3,589
Germany	21,352	13,418	Spain	5,589	4,743
India	5,614	650	Switzerland	2,445	5,681
Iran	6,096	3,664	UAE	3,448	4,681
Israel	1,673	2,698	United Kingdom	5,541	10,556
Italy	10,642	6,888	United States	11,128	6,408

Source: Direction of Trade Statistics (DOTS) 2015, IMF; TURKSTAT Foreign Trade Statistics 2015.

This study examines the effect of bilateral foreign exchange rates on bilateral foreign trade balance of Turkey's most important 20 trading partners. In other words, the validity of J-curve effect is investigated focusing specifically on Turkey. To this end, first, the presence of cross-sectional dependence among the countries was investigated. As the findings showed cross-sectional independence, the presence of a long-term relationship was examined with the Pedroni (1999) and Kao (1999) first-generation co-integration tests, and long-term coefficients were obtained with Pesaran and Smith (1995) MG parameter estimator. Finally, causality relationships among the variables were determined using the Canning and Pedroni (2008) panel causality test.

1. Theoretical framework on the relationship between foreign trade balance and real exchange rate

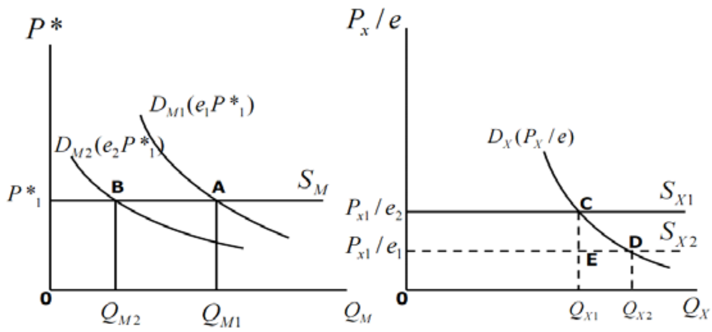
Import and export are the most important commercial activities that provide the connection between country and the rest of the world. On the condition that domestic and foreign prices are fixed, a country's total import volume is positively correlated with country's income level, while it is negatively correlated with the real exchange rate. On the other hand, there is a positive relationship between a country's total export, and the income level of trading partners and real exchange rate. In this respect, the balance of foreign trade which emerges due to the difference between total export and import has a strong relationship with the real exchange rate. An upward movement in the real exchange rate, or in other words, depreciation of the national currency increases export and competitiveness of the country and import is affected negatively (Bocutoğlu, 2014: 421-428).

Increase or decrease in exchange rates may have different definitions based on the exchange rate system used in the country. In a country where the flexible exchange rate system is adopted, an increase in exchange rate is named as depreciation, while in country using the fixed exchange rate system, such an implementation by an administrative decision is named as devaluation. On the other hand, when exchange rates decrease in flexible exchange rate system, the situation is considered as appreciation. When fixed exchange rate system is adopted with the exchange rates declining, the situation is named as revaluation (Bekaert and Hodrick, 2012: 61-62). No matter which exchange rate system is used, the reaction of the balance of foreign trade to depreciation is investigated within the framework of Marshall-Lerner analysis named after Alfred Marshall and Abba Lerner, who first revealed this interaction (Krugman and Obstfeld, 2003: 477).

Alfred Marshall and Abba Lerner based their explanations regarding how the increase and decrease in exchange rates can recreate foreign trade balance on the price elasticity of imported and exported goods. Graph 1 shows the effect of exchange rate changes on import supply and demand and tries to make the issue clearer.

The left and right sections of Graph 1 display drawings regarding import and export functions, respectively. (P^*) in the vertical axis of the first graph that shows import supply and demand represents the price of the imported good in terms of foreign currency, while (Q_M) in the horizontal axis represents the quantity of import. The reason why the S_M line, which shows import supply, is parallel to the horizontal axis is that in this model foreign countries' meeting of the demand constantly at a specified price $(P_1^*\ in\ the\ graph)$, in other words, supply elasticity is infinite. D_M curve, which is a negatively sloped curve, indicates that an increase in the price of foreign goods decreases import. An increase in exchange rate when the price of the imported goods in terms of foreign currency is fixed means that the relevant good will be more expensive in national currency; thus, import demand curve will shift to the left, and the quantity of import will decrease. When import demand decreases because of the increase in exchange rate, the amount of import will drop from Q_{M1} to Q_{M2}.

Graph 1. *The effect of real exchange rate movement on balance of foreign trade*



Source: Ünsal, 2005: 572.

(P_X/e) in the vertical axis of the graph on the right which displays export supply and demand functions show the price of the exported good in foreign currency, and (Q_X) in the horizontal axis illustrates the amount of export. Similar to import supply function, export supply function (S_X) has infinite elasticity as manufacturers continually meet foreign demand at a specified price. Negatively sloped export demand curve (D_X) indicates that a decrease in the price of the exported good in foreign currency increases the amount of export. Any incidence that leads to an increase in the exchange rate is to make the price of domestic goods cheaper compared to foreign competitors, and the price will drop to P_{X1}/e_1, while the amount of export will increase from Q_{X1} to Q_{X2} (Ünsal, 2005: 573-575).

These explanations indicate that in an economy with flexible exchange rate system, two effects, namely price effect and volume effect, emerge on export revenue as a result of depreciation of the national currency. As an increase in the exchange rate is to make the foreign goods cheaper for foreigners due to the new exchange rate, an increase in foreign demand is expected. Likewise, as increasing exchange rate is to make the foreign goods expensive keeping the initial prices fixed, foreign demand will decrease, and import volume will reduce. When the amount of import decreases and export volume increases, foreign trade balance is improved, and thus positive volume effect is observed (Krugman and Obstfeld, 2003: 436).

Despite this positive effect on the amount, the total export revenue of the country will decrease as the price of the exported goods becomes cheaper in terms of foreign currency as a result of the increase in exchange rates. In this case, the time path of foreign trade balance will depend on the reaction that foreigners will give to the increasing exchange rate, in other words, on the price elasticity of demand for exported goods. If the decrease in the price of the exported good in foreign currency due to the increasing exchange rate leads to a further amount increase in foreign demand, in other words, if the demand elasticity of the exported good is higher than 1, the depreciation is to affect foreign trade balance positively. When the demand elasticity of the exported good is low, foreign trade balance may again be affected positively if the price elasticity of the imported goods is higher than 1. In this case, an increase in the price of the imported goods reduces import more than export, and so, foreign trade balance will be improved (Ünsal, 2005: 575).

When the volume and price effects that yield contradictory results are examined together, it can be said that it is impossible to make a deduction about the effect of increasing exchange rates on a country's foreign exchange reserves. Although foreign exchange revenue of a country will decrease as a result of the positive volume effect created by the increasing exchange rate, it may be impossible to reach a definite conclusion about the country's foreign exchange revenue as the result of price effect is not known exactly (Seyidoğlu, 2015: 494). To improve foreign trade balance, the sum of coefficients of domestic demand elasticity of imported goods and foreign demand elasticity of exported goods must be higher than 1 with the assumption that supply elasticity of imported and exported goods is infinite:

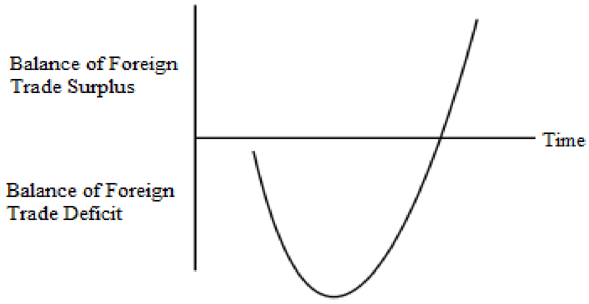
$$\eta_x + \eta_M > 1$$

In the equation, η_x represents foreign demand elasticity of exported goods, while η_M represents domestic demand elasticity of imported goods (Karluk, 2013: 662-663). According to this criterion known as Marshall-Lerner condition, the higher the sum of foreign demand elasticity of exported goods and domestic demand elasticity of imported goods is than 1, improvement of foreign trade balance will be. However, to maintain the validity of this condition, supply elasticity must be infinite; in other words, there must be no flaws in the production of imported and exported goods (Rose and Yellen, 1989: 67; Seyidoğlu, 2015: 488).

2. Foreign trade balance after the changes in exchange rates and the J-curve

When the findings of the empirical studies conducted to test the validity of Marshall-Lerner condition are examined, it is seen that foreign balance deteriorate following currency devaluation in the short term instead of getting better but improve only after a period. The graph of the foreign trade balance following the depreciation in the national currency resembles the letter J, and thus, it is known as J-curve (Krugman and Obstfeld, 2003: 464). According to J curve analysis, improvement in foreign trade balance after depreciation of national currency can only be observed after a certain delay (Gandolfo, 2002: 126-127).

Graph 2. *The effect of currency depreciation on the trade balance and J-curve effect*



Source: Ünsal, 2005: 577.

As opposed to the prediction that Marshall-Lerner made based on elasticity coefficients, the unexpected effect on foreign trade balance may be associated with the fact that short-term elasticity coefficients are generally smaller than the long-term ones (Bahmani-Oskooee and Ratha, 2004: 1377). The reason behind the deterioration in the foreign trade balance in a short-term following the depreciation of national currency was explored by Magee (1973), who mainly drew attention to the importance of delayed effects. In his study, Magee (1973) highlights that it takes a time to adjust import and export to the new exchange rate; and thus, foreign balance is initially affected negatively as producers and consumers react slowly to the changes in exchange rates.

As Magee (1973) states, this deterioration that is observed in the foreign balance in the short term can be explained regarding both demand and supply. Despite the changes in real exchange rates, purchase price, sale price and the payments will continue to be made according to the rates due to the contracts signed before the changes (Magee, 1973: 305-306). Economic actors have to consider possible future values of exchange rates or the increase or decrease in exchange rates in contracts in order not to lose income in foreign trade. The exporter chooses to receive payment when her currency gains value, while it is more advantageous for the importer to make payment when her currency loses value. Thus, based on the bargaining power of trading partners, the exchange rate is fixed through the contracts signed before the trade not to be affected by the changes in exchange rate. In this case, the changes in exchange rate, economic activities are maintained according to the ex-rate specified in the contract, and thus, in the short term the increase in the exchange rates deteriorate foreign trade balance rather than improve it

(Bahmani-Oskooee and Ratha, 2004: 1378). Over time, new contracts begin to dominate, and it can be seen an improvement in the balance of trade. In this situation which is called pass-through effect by Magee (1973), a devaluation of national currency increases the domestic prices of imported goods, while the demand is the same. Likewise, although this situation makes export even cheaper in the trading partner country, the amount of demand will not change, and inflow of foreign currency will reduce. This adverse effect observed in import and export prices because it takes time to make adjustments over import and export volumes due to the rigidities in short-term supply and demand is the second reason behind the deterioration in the foreign trade balance in the short term (Gandolfo, 2002: 126-127).

When the change in the prices of imported and exported goods is the same depreciation rate of the national currency, the pass-through effect will be full. On the other hand, when the change in prices is lower than exchange rate change, the pass-through effect will be partial (Seyidoğlu, 2015: 489). Following the short term pass-through effect in prices in which demand is inelastic, the elasticity condition of the Marshall-Lerner will be met, and foreign trade balance will be improved in time. There has not yet been consensus on how long it takes for the expected positive effect of depreciation of national currency on foreign balance to emerge. This period depends on the exchange rate system and foreign trade policy in the country, the reaction that economic actors will give to price changes, and the term of the contract (Lal and Lowinger, 2002: 411). However, empirical studies have shown that balance of foreign trade worsens almost two years after depreciation and the positive effect will be observed only after this period (Seyidoğlu, 2015: 490-491).

Junz and Rhomberg (1973) point to five possible lags in addition to those specified by Magee (1973). One of these, recognition lag, emerges when it takes time for buyers and sellers to realize the changing competition conditions. As dissemination of information changes based on language and distance, the delay time may be longer in international trade. Moreover, in connection with the establishment of new business networks and the placement of new orders, delivery lag is also expected in addition to the decision lag. Purchasing of new materials and equipment (replacement lag) and production lag are other delay types (Junz and Rhomberg, 1973: 413).

3. Literature review

Most of the empirical research in the past, the validity of Marshall-Lerner condition was tested by calculating the sum of price elasticities of import and export. When the literature is examined, it is seen that in addition to these studies based on elasticities, there is also a significant number of studies that deal with the real exchange rate and foreign trade balance. The table below provides a summary of studies that focused on the relationship between the volume of the bilateral foreign trade between Turkey and her trading partners and bilateral exchange rate.

Table 2. *Studies in the literature and the main findings*

Authors	Country group	Time period	Method	Findings
Kimbugwe (2006)	Turkey and her 9 trading partners	1960-2000	ARDL, Johansen Co-integration	Although the results obtained using aggregate data show that Marshall-Lerner condition is valid, the Bilateral J-curve hypothesis was not verified.
Neyaptı, Taşkın and Üngör (2007)	Turkey and her 150 trading partners	1980-2001	Panel regression	Following the Customs Union process, the effect of real exchange rate on Turkey's export volume has increased even further. Appreciation of Turkish Lira leads to increase in import particularly from EU countries.
Halıcıoğlu (2008)	Turkey and her 13 trading partners	1985.1-2005-4	ARDL	None of the trading partners experienced J-curve effect.
Uz (2010)	Turkey's most significant 13 trading partners	1982.2-2007.4	OLS, FMOLS, DOLS, ARDL, Johansen(1988) multivariate maximum-likelihood methods	Appreciation or depreciation of Turkish Lira has a limited effect on the trade balance. The Marshall-Lerner condition is valid for only Canada, South Korea and the UK among 13 countries.
Demirtaş (2014)	Bilateral trade between Turkey and Germany	2002M01-2012M08	ARDL	Depreciation of Turkish Lira affects trade with Germany positively in both the short and the long run. While these findings confirm that J-curve effect is valid in the long term, it is not compatible with the effect expected in the short-run.
Çulha and Kalafatçılar (2014)	81 countries (7 from the Eurozone, 17 from the Middle East Africa region, 16 developed and 31 developing countries)	2003.1-2013.2	VAR analysis	While the demand conditions are the determinant factors in Turkey's export with developed countries, mostly the changes in real exchange rates are influential on the export to the Middle East and Africa.
Aydın, Başkaya and Demiroğlu (2015)	Turkey and her 91 trading partners	1994-2012	Panel regression	1% of appreciation in the currencies of trading partners increases the rate of export to import from 0.94% to 1.45%.

4. Variables and data sources used in econometric applications

This study analyzes how the foreign trade balance between Turkey and her most important 20 trading partners changes with the exchange rate movements. To this end, econometric analyses were conducted with Eviews 8 and Gauss 10 software programs using data for the period between 1995 and 2015. The study sample is composed of Austria, Belgium, China, Egypt, France, Germany, India, Iran, Israel, Italy, Japan, South Korea, the Netherlands, Poland, Russia, Spain, Switzerland, United Arab Emirates, the United Kingdom and the USA. To determine the bilateral exchange rate changes on bilateral trade of Turkey with her 20 trading partners, empirical model was followed in the studies of Rose and Yellen (1989: 55), Lal and Lowinger (2002: 402), Bahmani-Oskooee, Economidou and Goswami (2006), and Bahmani-Oskooee and Wang (2006: 326). The model to be estimated is given in Equation 1:

$$logTB_{j,t} = \alpha_0 + \alpha_1 logY_{t,t} + \alpha_2 logYF_{j,t} + \alpha_3 logRER_{j,t} + u_t \quad (1)$$

In this equation, α_0 represents the constant term, $\alpha_1, \alpha_2, \alpha_3$, indicate long-term coefficient for each variable and u_t shows the error term. All the variables were subjected to logarithmic transformation and estimations were done with the logarithmic model.

Although foreign trade balance is the difference between export and import volumes of the country, another calculation is used to make unit-free measure bilateral trade balance and to make a logarithmic transformation. As in the studies of Rose and Yellen (1989), Lal and Lowinger (2002), Bahmani-Oskooee, Economidou and Goswami (2006) Bahmani-Oskooee and Wang (2006), Bahmani-Oskooee and Goswami (2003), Halıcıoğlu (2008) and Kimbugwe (2006), this variable which is often used in the recent literature represents the ratio of the import from country j to country t to the export to country j from country t.

$logTB_{j,t}$ variable in Eq. (1) represents bilateral trade balance between Turkey and her foreign trade partner country j. To calculate this variable, the volume of import from country j to Turkey was proportioned to the volume of export from Turkey to country j. In addition to trade balance variable, $logY_{t,t}$ in Eq. (1) represents Turkey's real GDP level and $logYF_{j,t}$ show the real GDP level of foreign trade partner country j.

Table 3. *Definition of the variables and data sources*

Variable	Definition of the Variables	Data Source
$logTB_{j,t}$	Balance of bilateral foreign trade: the ratio of the import from country j to Turkey to the export to country j from Turkey $(M/X)_{j,t}$	The Direction of Trade Statistics (DOTS), International Monetary Fund.
$logY_{t,t}$	GDP in Turkey (constant 2010 US$)	World Bank, WDI.
$logYF_{j,t}$	GDP level of trading partner country j (constant 2010 US$)	World Bank, Global Economic Monitor (GEM) and IMF, International Financial Statistics.
$logRER_{j,t}$	Bilateral Real Effective Exchange Rate between Turkey and trading partner's currency: $logRER_{j,t}$ was calculated as $[(P_t * NER)/P_j]$ where P_t is CPI in Turkey, P_j is CPI in country j and NER bilateral nominal exchange rate of Turkey with trading partner j)	This variable was constructed by using World Bank Global Economic Monitor (GEM) and CBRT (The Central Bank of the Republic of Turkey) exchange rate statistics.

As import of the country is to rise with the increase in income level, α_1 coefficient of $logY_{t,t}$ is expected to be positive. However, GDP level of the country may have negative effect on import, if it supports import substitution industrialization and thus imported goods start to be produced at home. Likewise, α_2 coefficient of $logY_{j,t}$, which represents the GDP level of the trading partner can also be negative or positive (Bahmani- Oskooee and Wang, 2006: 326). $logRER_{j,t}$ represents bilateral real exchange rate between Turkish Lira and foreign currency of trading partner country j. Since $logTB_{j,t}$ is calculated by the ratio of import from trading partner country j to Turkey and export to the same country from Turkey, negative coefficient of α_3 indicates that the increase in the bilateral real exchange rate improves the bilateral foreign balance (Lal and Lowinger, 2002: 408).

5. Methodology and empirical findings

The presence of cross-sectional dependence among the countries in the panel has great importance in choosing the methods to be used in an econometric analysis. The findings that do not into consideration presence of cross-sectional dependence will be spurious regressions. Another pre-test that needs to be carried out in addition to cross-sectional dependence in panel data analysis is homogeneity test. To this end, Pesaran, Ullah and Yamagata (2008) bias-adjusted CD test was used to determine the presence of cross-sectional dependence among 20 countries for the period between 1995 and 2015, and Pesaran and Yamagata (2008) Delta test ($\tilde{\Delta}$) was used to check the homogeneity structure of the panel.

Pesaran, Ullah and Yamagata (2008) developed the bias-adjusted CD test to determine whether a shock in a country will affect other countries. This method can be used in large panels where there is no limitation on time dimension and cross-sectional dimension and where both take high values. The calculation regarding this method is made through the equation given in Eq. (2) (Pesaran et al., 2008: 108).

$$LM_{adj} = \sqrt{\frac{2}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \frac{(T-k)\hat{\rho}_{ij}^2 - \mu_{Tij}}{\vartheta_{Tij}} \tag{2}$$

Another pre-test that needs to be conducted before the panel data analysis, Pesaran and Yamagata (2008) delta test ($\tilde{\Delta}$), determines whether the panel has a homogeneous or a heterogeneous structure. When the number of countries in the panel is high, $\tilde{\Delta}$ statistics, and when the number is few, $\tilde{\Delta}_{adj.}$ statistics yield more meaningful results. When the probability value of $\tilde{\Delta}$, which is calculated with Eq. (3) or $\tilde{\Delta}_{adj.}$ calculated with Eq. (4) is at 95% significance level and higher than 0.05, it means that slope coefficients of the panel are homogeneous; in other words, the countries in the panel have similar structures.

$$\hat{\Delta} = \sqrt{N}\left(\frac{N^{-1}\tilde{S} - k}{\sqrt{2k}}\right) \tag{3}$$

$$\tilde{\Delta}_{adj.} = \sqrt{N}\left(\frac{N^{-1}\tilde{S} - E(\tilde{Z}_{iT}}{\sqrt{var\tilde{Z}_{iT}}}\right) \tag{4}$$

Table 4 shows the homogeneity and cross-sectional dependence test results of the sample in this study. Probability statistics must be higher than 0.05 at 95% significance level to be able to accept the null hypothesis in the bias-adjusted CD test and to determine that there is no cross-sectional dependence among the countries in the panel. The findings in Table 4 indicate that the null hypothesis is accepted and there is cross-sectional independence among the countries in this study. Pesaran and Yamagata (2008) $\tilde{\Delta}$ and $\tilde{\Delta}_{adj.}$ statistics have shown that the null hypothesis will be accepted and the panel has a similar structure. According to these results, in the following stages of the study, analyses continued with first generation methods, which take homogeneous structure into account and which function under cross-sectional independence.

Table 4. *Cross-sectional dependency test results*

	Statistics	Probability
Bias-adjusted CD test (Pesaran, Ullah and Yamagata , 2008)	-1.202	0.88
$\tilde{\Delta}$ (Pesaran and Yamagata, 2008)	-3.724	0.99
$\tilde{\Delta}_{adj.}$ (Pesaran and Yamagata, 2008)	-4.236	0.99

While some of the first generation panel unit root methods take homogeneity of coefficients of countries, some yield results for the panel with a heterogeneous structure.

As the Pesaran and Yamagata (2008) Delta test results of this study indicated that the countries in the panel have homogeneous structure, unit root test for the variables was done with Levin, Lin and Chu (2002), Breitung (2000) and Hadri (2000) tests, which propose a hypothesis on homogeneity. Levin, Lin and Chu (2002) and Breitung (2000) unit root tests suggest that in the null hypothesis series include unit root, while Hadri (2000) unit root test puts forward that in the null hypothesis the series is stationary. Thus, to determine that a series is stationary according to Levin, Lin and Chu (2002) and Breitung (2000) methods, the probability value of the variable must be lower than 0.01 at 99% significance level. According to Hadri (2000) method, on the other hand, this value must be higher than 0.01.

Table 5. *Unit root tests results*

Variable	Levin, Lin and Chu (2002)		Breitung (2000)		Hadri (2000)	
	Level	First Diff.	Level	First Diff.	Level	First Diff.
$logTB$	-1.12 (0.12)	-5.27 (0.00)	-2.56 (0.01)	-4.43(0.00)	6.48 (0.00)	0.27 (0.39)
$logY$	1.80 (0.96)	-4.82 (0.00)	-9.47 (0.00)	-8.59 (0.00)	13.96 (0.00)	-3.31 (0.99)
$logYF$	-2.95 (0.01)	-7.54 (0.00)	0.82 (0.79)	-6.56 (0.00)	8.63 (0.00)	3.48 (0.01)
$logRER$	-9.92 (0.00)	-5.26 (0.00)	-1.14 (0.12)	-8.33 (0.00)	10.31 (0.00)	1.01 (0.15)

Note: The values in parentheses show probability values. Estimations are made with the inclusion of constant and trend.

Unit root test results for the variables in the long-term equation in Eq. (1) are given in Table 5. According to these results, while bilateral foreign balance $logTB$ and $logYF$ which represents the GDP of trading partner country have unit root at a level value at 99% significance level according to all three methods, they are stationary when the first difference is taken. Although $logY$ which represents the GDP level of Turkey, has unit root at a level according to Levin, Lin and Chu (2002) and Hadri (2000) methods, it is stationary at a level according to Breitung (2000) method. Although $logRER$ which represents bilateral real exchange rate, has unit root at a level according to Breitung (2000) and Hadri (2000) methods, it is stationary at a level according to Levin, Lin and Chu (2002) method. Based on these results it was determined that although each variable has unit root at a level according to at least two of the three methods, they are stationary when the first difference is taken.

To test the presence of a long-term relationship among the variables, Pedroni (1999) and Kao (1999) co-integration methods under cross-sectional independence were used. In Pedroni method, the pre-condition is that each variable must be stationary at first difference; in other words, they must be I(1). The unit root tests revealed that all the variables in the study are stationary at first difference according to at least two of the three methods. This method checks that according to the null hypothesis, there is not a long-term relationship between variables, while the alternative hypothesis suggests the opposite. Pedroni (1999) calculates seven statistics with standard normal distribution, four of which are within dimension (panel v, panel p, panel PP and panel ADF-statistic) and three of which are between dimension (Group rho, Group PP and Group ADF).

Table 6. *Pedroni and Kao co-integration tests results*

	Constant		Constant and trend	
	Statistics	Probability	Statistics	Probability
Pedroni(1999)				
Panel v	3.64	0.00	1.98	0.02
Panel rho	-0.00	0.49	2.30	0.98
Panel pp	-3.68	0.00	-2.73	0.00
Panel adf	-4.26	0.00	-4.37	0.00
Group rho	0.23	0.59	2.77	0.99
Group pp	-9.43	0.00	-7.31	0.00
Group adf	-4.54	0.00	-3.34	0.00
Kao (1999)				
ADF Statistics	-3.13	0.00		

Table 6 presents the Pedroni (1999) and Kao (1999) co-integration test results of the constant and constant-trend model. The findings from Pedroni (1999) co-integration analysis show that both constant and constant-trend model rejects the null hypothesis compared to five statistics except for panel-rho and group-rho statistics. The rejection of the null hypothesis suggesting that there is no long-term relationship among the variables verifies that the variables in the long-term equation are co-integrated. Similarly, Kao (1999) co-integration test also shows that the null hypothesis which suggests that no co-integration relationship exists among $logTB$, $logY, logYF$ ve $logRER$ variables at 99% significance level is rejected.

Long-term coefficients of variables in Eq. (1) are obtained with Mean Group Estimator (MG) developed by Pesaran and Smith (1995). According to the results of the whole panel and achieved through this model, bilateral real exchange rates affect bilateral foreign trade balance negatively at 1% significance level. This result indicates that depreciation of Turkish Lira has negative effect on the bilateral foreign trade balance, which is calculated as the ratio between import and export (M/X). The negative coefficient of $logTB$ can be interpreted that depreciation in Turkish Lira affects import negatively; export and foreign balance are influenced positively. When coefficients for each country are examined, it is seen that while the bilateral real exchange rate is negative for 16 countries among the 20 countries in the panel, the results are statistically significant for ten countries. The appreciation of currencies of Belgium, Egypt, Germany, India, Israel, Italy, Japan, Russia, Switzerland and the United Kingdom compared to Turkish Lira reflects positively to Turkey's foreign trade balance with these countries in a statistically significant. Only in the bilateral foreign trade with China, appreciation of Turkish Lira has a positive and meaningful effect.

Table 7. *Panel mean group estimation results for 20 countries*

Country	$logY$	$logYF$	$logRER$
Austria	0.787	-3.326*	-0.029
Belgium	-0.823**	2.179	-0.276***
China	11.62***	-5.435***	0.436**
Egypt	1.589	-2.278	-0.561***
France	0.678*	-4.523**	-0.113
Germany	1.275***	-2.600***	-0.111***
India	-4.517**	2.553**	-0.644***
Iran	-1.777	0.521	-0.072
Israel	-3.101***	5.178***	-0.365***
Italy	-0.104	-5.064***	-0.221***

Country	$logY$	$logYF$	$logRER$
Japan	0.039*	-3.248	-0.167*
Korea	3.104	-5.499**	0.084
Netherlands	-0.138	0.742	-0.145
Poland	-0.835	1.780	-0.085
Russia	-4.533***	3.918***	-0.810***
Spain	0.779**	-2.700***	-0.157
Switzerland	-1.508	-2.354	-0.756**
UAE	4.759	-2.557	0.092
United Kingdom	0.142	-3.053**	-0.185***
USA	4.461***	-7.471	0.078
PANEL	*0.594*	*-1.662***	*-0.200****

Note: *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

The effect of Turkey's income level on bilateral foreign balance, which is calculated as the import-export ratio is given in the second column of Table 7. The increase in Turkey's income level affects bilateral foreign balance negatively in 4 of the 20 countries in the sample, while it affects the bilateral foreign balance positively in 5 countries in a statistically significant. The positive results mean that the increase in GDP of Turkey enhances the import from the other country, and foreign balance calculated as import-export ratio increases as well. Thus, the positive relationship between $logY$ and $logTB$ variables indicates that the growth in Turkey's income level worsens the bilateral foreign balance between Turkey and her trading partners. The results in Table 7 reveals that the increase in Turkey's income level leads to more import from China, France, Germany, Japan, Spain and the USA than export to them.

The third column in Table 7 displays coefficients of the relationship between the $logYF$ representing the income level of Turkey's trading partners and the bilateral trade balance. According to these results, the income level of trading partners has a significant negative effect on foreign balance variable in 8 of the 20 countries in the sample, while it has a significant positive effect on three countries. The negative relationship indicates that the increase in the income level of trading partners also increases Turkey's export and bilateral foreign balance calculated as import-export ratio worsens.

After obtaining the long-term parameter coefficients for each country, causality analysis was conducted to search for the presence of causality relationship among the variables. Possible causality relationships from bilateral real exchange rate to bilateral foreign balance and from bilateral foreign balance to bilateral real exchange rate were investigated using Canning and Pedroni (2008) causality test. Results for each country are given in Table 8.

Table 8. *Canning and Pedroni (2008) causality test results*

Country	$logRER \rightarrow logTB$	Probability	$logTB \rightarrow logRER$	Probability
Austria	-1.89**	0.03	2.40*	0.09
Belgium	-1.39*	0.07	0.77	0.34
China	-1.39**	0.01	0.48*	0.10
Egypt	-1.36**	0.01	0.40**	0.05
France	-1.48***	0.00	1.01	0.14
Germany	-0.90**	0.01	1.30**	0.04
India	-1.01**	0.05	0.05	0.73
Iran	-0.61	0.22	0.32	0.57
Israel	-0.52	0.26	0.13	0.73

Country	$logRER \rightarrow logTB$	Probability	$logTB \rightarrow logRER$	Probability
Italy	-0.57**	0.05	0.16	0.49
Japan	-0.66	0.13	0.36	0.43
Korea	-0.46	0.19	0.05	0.78
Netherlands	-0.58**	0.03	0.12	0.66
Poland	-1.52***	0.00	070**	0.04
Russia	-0.89	0.03	0.17	0.58
Spain	-0.60**	0.04	0.31	0.16
Switzerland	-0.67*	0.10	-0.08	0.41
UAE	-0.34	0.23	0.11	0.28
United Kingdom	-1.02*	0.09	-0.33	0.62
USA	-0.24**	0.05	0.18*	0.10

Note: ***, ** and * determine significance at 1%, 5% and 10% level respectively.

According to the Lambda-Pearson statistics obtained from the Canning and Pedroni (2008) causality test, to reach causality from the independent variable to the dependent variable, probability values must be lower than 0.01, 0.05 and 0.10 at 99, 95 and 90% significance level, respectively. In this respect, based on the results in Table 8, it can be stated that bilateral real exchange rate cause bilateral foreign trade balance in 14 of 20 trading partners of Turkey. It is seen that causality relationship is at 99% significance level in France and Poland; at 95% significance level in Austria, China, Egypt, Germany, India, Italy, the Netherlands, Spain, and the USA; and at 90% significance level in Belgium, Switzerland, and the United Kingdom.

When the results obtained based on the hypothesis that the causality relationship is from bilateral foreign balance to bilateral real exchange rate are evaluated, it was observed that there is causality relationship in 5 of the 20 countries in the sample. Bilateral foreign trade causes bilateral real exchange rate in Germany, Egypt and Poland at 95% significance level, and in Austria, the USA and China at 90% significance level.

Conclusion

The exchange rate system in a country informs us about the economic actors that will determine the value of a national currency against other foreign currencies. While governments make this task in the fixed rate system, exchange rates are determined by the market forces in the presence of a floating exchange rate system. However, despite the floating exchange rate system, it is observed that in practice there are occasional interventions in the foreign exchange market to ensure stability. Moreover, excessive depreciation or appreciation of the national currency against foreign currencies affects country's foreign trade balance as well.

This study examines the validity of J-curve by searching for the relationship between bilateral foreign trade balance and bilateral real exchange rates within the context of Turkey and her 20 trading partners. In this respect, it was first investigated whether a shock in one country in the panel affects the other countries via the cross-sectional dependence test. Accordingly, based on the results obtained, unit root, co-integration, coefficient estimator and causality methods were determined. As the cross-sectional dependence test results show that there is cross-sectional independence among the countries in the panel, the presence of a long-term relationship among the variables was investigated through the first generation Pedroni and Kao co-integration methods. All the results obtained from these methods revealed that there is a long-term relationship among the variables, and long-term coefficients for each country were obtained with the Mean Group Estimator (MG) method developed by Pesaran and Smith (1995). The results from the Mean Group Estimator method indicate that bilateral real exchange rate has a statistically significant negative effect on 10 of the 20 countries in the panel. This negative interaction means that the depreciation of Turkish Lira against the currency of the trading partner affects bilateral foreign balance calculated as import-export ratio positively, and thus, J-curve hypothesis is accepted in these countries. On the other hand, the results of the Canning and Pedroni (2008) causality test, which is conducted to determine the causality relationship among the variables, show that one-way causality exists from bilateral real exchange rate to bilateral foreign trade balance in 14 trading partners of Turkey.

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Do military expenditures converge in NATO countries? Linear and nonlinear unit root test evidence

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Abstract. *It is a public service that states defend their countries against internal and external threats. Military expenditures are made to this end. Although military expenditures contribute to economy, a safe environment is important for economic development. Military expenditures hold an important place within overall expenditures of countries. Although military expenditures and their share within GDP differ, they hold an important place within total public expenditures of countries. However, there aren't many studies on military expenditures in literature. We tested the convergence hypothesis of military expenditures for NATO countries covering a period from 1953 to 2014 by using linear and nonlinear unit root tests. According to the findings, the conclusion is that the military expenditures of Germany, Greece, Portugal, the UK and Luxembourg converge to the NATO mean whereas the convergence hypothesis does not hold true for other NATO countries.*

Keywords: military expenditures, convergence, NATO countries, linearity tests, linear and nonlinear unit root tests.

JEL Classification: C12, C22, H5.

1. Introduction

When we examine the last 30 years, we see that there is significant work on countries' defense services and expenditures. While there is increase in military expenditures of many relatively developed countries, there is decrease in military expenditures of small developing countries for financial reasons. Reasons such as financial structure, internal and external threats, the legitimacy of state etc. are the issues that still make military expenditures important.

In general terms, defense planning is the process of establishing a defense policy for a state and pursuing relevant objectives through the involvement of the military on the international and/or internal arena, the distribution of defense resources, and the development of domestic interinstitutional systems of cooperation. This system is very important due to its impact on the role and tasks of armed forces or, more precisely, on their insertion into overall governing principles and practices. (Maior and Matei, 2003, pp. 60-61). Countries need to attach importance to defense planning in order to ensure that there is democracy and good administration. Therefore, military expenditures, how such expenditures are to be made and the share of military expenditures within GDP are important issues.

Military expenditures are generally viewed as public investment while others view it as a socially costly enterprise that displaces investment in social welfare. When available resources are no longer sufficient to meet public program demands, the program competes for budgetary allocations. The trade-off relationship among health, education, and military expenditures and the major components of government budgets cause one program to win and the others to lose. (Lin et al., 2015, p. 33).

Table 1. *NATO countries economic and defence expenditure data*

Explanation	2011	2012	2013	2014	Average / 2010-2014
Defence Expenditure of NATO Countries (US Dollars- Current Prices)	1044470	996595	968585	942915	993254
Defence Expenditure of NATO Countries (US Dollars- 2010 Prices)	1011615	965443	919486	883606	958771
Gross Domestic Product per capita in US Dollars (Deflated by PPP)	38415	39240	40083	41256	39206.2
Gross Domestic Product per capita in US Dollars (2010 Prices and Exchange Rates)	37443	37615	37892	38427	37667
Defence Expenditure per capita in US Dollars (2010 Prices and Exchange Rates)	1116	1060	1004	960	1052.8
Armed Forces - Military (Thousands)	3497	3423	3397	3322	3442.2
Defence Expenditures as a Percentage of Gross Domestic Product (Current Prices)	3	2.8	2.7	2.5	2.8
Defence Expenditures as a Percentage of Gross Domestic Product (2010 Prices)	3	2.8	2.7	2.5	2.8
Armed Forces - Military and Civilian Personnel as a Percentage of Labour Force	1.1	1.1	1.1	1	1.08

Source: NATO Website, Public Diplomacy Division, NATO Publishes Defence Expenditures Data for 2014 and Estimates for 2015, June 2015.

Table 1 shows the data on the total economic and defence expenditures of NATO countries. When one examines the table, it can be seen that there is decrease in the military expenditures of NATO countries. Likewise, the share of defence expenditures within GDP is also in decline. The table also shows that although per capita GDP values have increased over the course of years, per capita defence expenditures have decreased. The table also shows that there is decrease in the number of military forces in recent years.

Doctrine transformation and the behavior of NATO as an international alliance known as the response of NATO members have been examined through changes in defence expenditures. The distribution of defence expenditures among NATO members varies and thus raises questions about each nation's role in the collective defense effort that is the raison d'être of a military alliance. Since its establishment in 1949, NATO has adopted three distinct defense doctrines, namely Mutually Assured Destruction (MAD), Flexible Response, and Crisis Management. These distinct defense strategies should have had an impact on the level and distribution of contributions to the common defense. (Amara, 2008, pp. 449-450).

There are only a few studies on military expenditures in literature. One of the most important reasons for this is the fact that it is difficult to have access to defense data. There are empirical studies on the relationship between military expenditures and economic growth in literature. However, there are also empirical studies using linear and nonlinear methods to examine the convergence of military expenditures of the NATO established for the purpose of military alliance and defense.

The convergence hypothesis that has been the subject of numerous studies especially since 1980s is one of the important outcomes of the neoclassic growth theory and advocates that it will rule out income differences in general and that relatively poorer countries will converge to richer countries.

The neoclassical growth model, introduced by Solow (1956), has had a profound impact on the way in which economists define and conceptualize long-run interrelationships between macroeconomies. Economic growth is attributed to the joint impact of exogenous technical change and capital deepening on an economy with concave short-run production opportunities and thus the neoclassical model makes very strong predictions concerning the behavior of economies over time. In particular, given a microeconomic specification of technologies and preferences, per capita output in an economy will converge to the same level regardless of initial capital endowments. When different economies are compared, this means that differences in per capita output for economies with identical technologies and preferences will be transitory (Bernard and Durlauf, 1996, pp. 161-162).

The concept of convergence can be classified in general as beta (β) and sigma (σ) convergence. There are also concepts such as conditional and unconditional convergence, global or regional convergence, deterministic or scholastic convergence, total factor efficiency or income convergences in literature. All of these different concepts of convergence were not apparent from the very beginning at all. Research on convergence went through several stages, and it is only with time that these different definitions emerged and gained credit. Convergence research has also seen the use of different methodologies, which may be classified broadly. These methodologies are informal cross-section approach, formal cross-section approach, panel approach, time-series approach, and distribution approach. (Islam, 2003, p. 312). Among the abovementioned methods, the linear and nonlinear time series technique is the one used most commonly.

The use of linear and nonlinear time series methods or parallel data methods recently in convergence analysis has led to differentiation between deterministic and stochastic convergence. Stochastic convergence investigates whether there is a relationship between the permanent actions taken in a country's per capita production level and the permanent actions taken in another country's per capita production level (Bernard and Durlauf, 1991). Unit root tests are often used to test stochastic convergence analysis empirically.

Lau, Demir and Bilgin (2016) analyzed the convergence of military expenditures for 37 countries in their study. According to the results of the analysis made using nonlinear panel unit root test, 53 percent of the countries converge to the global mean of military expenditures, 39 percent converge to the military expenditures of Germany, 33 percent to the military expenditures of China, 22 percent to the military expenditures of the USA and 11 percent to the military expenditures of Russia.

The basic purpose of the study is to contribute to literature by carrying out an empirical analysis on the military expenditures of NATO countries since such a study does not exist and since the purpose is to identify discrepancies. The goal of the study is to make recommendations to the countries in which there is no convergence to change their economic policies. The basic problem encountered in the unit root tests frequently used in convergence analyses is to choose the right test. In this respect, the unit root test the structure of which is suitable will be chosen in order not to obtain any deviating results. The test introduced by Harvey et al. (2008) to literature will be used to examine the linearity or nonlinearity of series. The reason why this test is preferred is because it offers the basic advantage that variables are not influenced by their level of stationarity. Once the structure of relevant series is identified, relevant unit root tests will be applied to investigate the existence of convergence.

The methodology and the data set to be used in the empirical part of the study is going to be introduced in the second part and the third part is going to concentrate on the empirical results of the military expenditure convergence. The conclusion and the policy proposals are going to constitute the last part.

2. Data and methodology

The data used in this study that investigates the convergence of military expenditures among NATO countries are the annual data covering the years 1953-2014. The data used in this study were obtained from the database of the Stockholm International Peace Research Institute (Sipri). The data to be used after the studies investigating stochastic convergence were calculated as $\overline{y}_{it} = \ln(me_{i,t} / me_{j,t})$. In this study, $\overline{y}_{it}$ indicates military expenditure between relevant country and that country's mean, $me_{i,t}$ indicates *i*. country's military expenditure and $me_{j,t}$ indicates total military expenditure.

In the 20th century, linear models have been the focus of mostly theoretical and applied econometrics. It was only starting from 1990s that nonlinear models were greatly developed, also under the stimulus of economic theory that frequently suggested nonlinear relationships between variables. Consequently emerged the interest in testing whether or not a single or a group of economic series could be generated by a linear model against the alternative that they were nonlinearly related instead.

Linear models have the advantage of being undoubtedly simple and intuitive. However, they also have several limitations, some of which can be overcome via nonlinear modeling. These limitations are as follows: linear models cannot allow for strong asymmetries in data, they are not suitable for data characterized by sudden and irregular jumps, they neglect nonlinear dependence, they are useful for prediction and they are not suitable for series which are not time reversible. In addition, a failure to recognize and deal with the presence of nonlinearity in generating a mechanism of a time series can often lead to poor parameter estimates and to models which miss important serial dependencies altogether (Bisaglia and Gerolimetto, 2014, p. 1). Therefore, linear and nonlinear structure should be investigated for the corresponding time series.

In theoretical and empirical econometric studies, investigating linearity is one of the crucial issues. McLeod-Li (1983), Keenan (1985), Tsay (1986), Brock, Dechert and Scheinkman (1987) and Harvey and Leybourne (2007) are those who developed linearity tests in the last 30 years. The classic linearity tests are based upon the assumption that the variables are $I(0)$ or $I(1)$ processes. This issue is especially problematic in empirical studies. Therefore, the recent contribution by Harvey et al. (2008) proposes a new linearity test which can be applied either to $I(0)$ or $I(1)$ processes. This study proposes a Wald test when the order of integration is unknown, which is a weighted average of the Wald tests for the null of linearity when the variable is known to have a unit root and when it is known to be stationary (Cuestas et al., 2012, p. 9).

Harvey et al. (2008), at first, is a nonlinear AR(1) model for the I(0) series y_t, $t = 1,...,T$ where T is the sample size and the following y_t time series is estimated:

$$y_t = \mu + u_t$$

$$u_t = \rho u_{t-1} + \delta f(u_{t-1}, \theta) u_{t-1} + \varepsilon_t \tag{1}$$

where ρ, δ and using function $f(.,\theta)$ are chosen such that u_t is globally stationary. In (1), ε_t is a zero mean *iid* white noise process. The function $f(.,\theta)$ is assumed to admit a Taylor series expansion around $\theta = 0$, thus model (1) is approximated to the second order by

$$u_t = \delta_1 u_{t-1} + \delta_2 u_{t-1}^2 + \delta_3 u_{t-1}^3 + \varepsilon_t \tag{2}$$

Model (2), the null hypothesis of linearity and alternative hypothesis of nonlinearity, can be represented respectively as

$H_{0,0}: \delta_2 = \delta_3 = 0$

$H_{1,0}: \delta_2 \neq 0 \;\; and \, / \, or \;\; \delta_3 \neq 0$

where $H_{1,0}$ indicates a hypothesis under the assumption of y_t being $I(0)$. Under these conditions y_t becomes

$$y_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 y_{t-1}^2 + \beta_3 y_{t-1}^3 + \varepsilon_t \tag{3}$$

In this case, the null hypothesis and alternative hypothesis are as follows:

$H_{0,0}: \beta_2 = \beta_3 = 0$

$H_{1,0}: \beta_2 \neq 0 \;\; and \, / \, or \;\; \beta_3 \neq 0$

Under these restrictions, the standard Wald statistics for testing are as follows:

$$W_0 = T\left(\frac{RSS_0^r}{RSS_0^u} - 1\right)$$

where RSS_0^u denotes the residual sum of squares from the unrestricted OLS regression in (3) and RSS_0^r is a restricted ordinary least square(OLS) regression imposing $\beta_2 = \beta_3 = 0$ in (3), then

$$y_t = \beta_0 + \beta_1 y_{t-1} + \varepsilon_t \tag{4}$$

W_0 will follow an asymptotically χ^2 distribution under the null $H_{0,0}$.

The nonlinear AR(1) model for an $I(1)$ series admits the following first differences of y_t,

$$y_t = \mu + u_t$$

$$\Delta u_t = \phi \Delta u_{t-1} + \lambda f(\Delta u_{t-1}, \theta) \Delta u_{t-1} + \varepsilon_t \tag{5}$$

in which ϕ, λ and the function $f(.,\theta)$ are again chosen such that Δu_t is globally stationary. The function again allows for a Taylor series expansion around $\theta = 0$, the model (5) can be approximated to the second order by

$$\Delta u_t = \lambda_1 \Delta u_{t-1} + \lambda_2 (\Delta u_{t-1})^2 + \lambda_3 (\Delta u_{t-1})^3 + \varepsilon_t \tag{6}$$

Model (6), the null hypothesis of linearity and alternative hypothesis of nonlinearity, can be represented respectively as:

$H_{0,1}: \lambda_2 = \lambda_3 = 0$

$H_{1,1}: \lambda_2 \neq 0 \;\; and/or \;\; \lambda_3 \neq 0$

where $H_{.,1}$ indicates a hypothesis under the assumption of y_t being $I(1)$. Under these conditions with $\Delta y_t = \Delta u_t$, y_t becomes

$$\Delta y_t = \lambda_1 \Delta y_{t-1} + \lambda_2 (\Delta y_{t-1})^2 + \lambda_3 (\Delta y_{t-1})^3 + \varepsilon_t \tag{7}$$

The corresponding Wald statistics for (7) is

$$W_1 = T\left(\frac{RSS_1^r}{RSS_1^u} - 1\right)$$

where RSS_1^u denotes the residual sum of squares from the unrestricted OLS regression in (7) and RSS_1^r is a restricted OLS regression imposing $\lambda_2 = \lambda_3 = 0$ in (7). W_1 follows an asymptotically χ^2 distribution under the null $H_{0,1}$.

Harvey et al. (2008) offers a weighted average of W_0 and W_1 statistics:

$$W_\lambda = \{1-\lambda\} W_0 + W_1 \; . \tag{8}$$

In (8), λ is a function that converges in probability to zero when y_t is $I(0)$ and to one when y_t is $I(1)$. W_λ is asymptotically distributed as χ_2^2. Harvey et al. (2008) investigate the finite sample size and power behavior of this linearity test by using the Monte Carlo simulation. The Monte Carlo simulation shows clearly W_λ that the tests with finite sample properties (size and power) are the best performing and favorable tests.

The KSS test is based on the assumption that mean reversion is symmetrical. This assumption means that negative and positive deviations have got the same impact. Sollis (2009) further extended the scope of this assumption and developed a new test procedure that allows for symmetrical or asymmetrical nonlinear adjustments. In this test, the speed of mean reversion will be different depending on the sign of the shock, not only the size (Cuestas and Ramlogan-Dobson 2013). The model to be used for the test advocated by Sollis (2009) is as follows;

$$\Delta y_t = G(\gamma_1, y_{t-1})\{S_t(\gamma_2, y_{t-1})\rho_1 + (1 - S_t(\gamma_2, y_{t-1}))\rho_2\} y_{t-1} +$$
$$+ \sum_{i=1}^{k} k_i \Delta y_{t-i} + \varepsilon_i \tag{9}$$

Here $G(\gamma_1, y_{t-1}) = 1 - \exp(-\gamma_1(y_{t-1}^2))$ with $\gamma_1 \geq 0$ and $S_t(\gamma_2, y_{t-1}) = \{1 + \exp(-\gamma_2 y_{t-1})\}^{-1}$ with $\gamma_2 \geq 0$. As it is the case in the Sollis (2009) KSS test, the model is going to look as follows by using the Taylor approximations.

$$\Delta y_t = a(\rho_2^* - \rho_1^*)\gamma_1\gamma_2 y_{t-1}^4 + \rho_2^*\gamma_1 y_{t-1}^3 + \eta_i \tag{10}$$

Where ρ_1^* ve ρ_2^* are linear functions of ρ_1 and ρ_2. Where $a = 1/4$, which can be written as:

$$\Delta y_t = \phi_1 y_{t-1}^3 + \phi_2 y_{t-1}^4 + \eta_i \tag{11}$$

Where $\phi_1 = \rho_2^* \gamma_1$ and $\phi_2 = a(\rho_2^* - \rho_1^*)\gamma_1\gamma_2$. An augmented version is

$$\Delta y_t = \phi_1 y_{t-1}^3 + \phi_2 y_{t-1}^4 + \sum_{i=1}^{k} k_i \Delta y_{t-i} + \eta_i \tag{12}$$

Where y_t, similar to the KSS test, is raw, demeaned or detrended data. The null hypothesis of nonstationarity is $H_0: \phi_1 = \phi_2 = 0$. Sollis (2009) derives the asymptotic distribution of an F test of $H_0: \phi_1 = \phi_2 = 0$ showing it to be a nonstandard function of Brownian motions. The test statistic can be written as follows:

$$F = \left(R\hat{\beta} - r\right)' [\hat{\sigma}^2 R\{\textstyle\sum_t x_t x_t'\}^{-1} R']^{-1} \left(R\hat{\beta} - r\right)/m \tag{13}$$

The critical values of F statistics are tabulated by Sollis (2009). When the null hypothesis is rejected, the null hypothesis of symmetric ESTAR, $H_0: \phi_2 = 0$, can be tested against the alternative of asymmetric ESTAR, $H_0: \phi_2 \neq 0$, by means of a standard hypothesis test. For standard F critical values to be applicable for this test, $\phi_1 < 0$, so that the series is stationary under the null being tested (Sollis, 2009).

In empirical econometrics studies, researchers developed structural unit root tests with different specifications to investigate the presence of unit root. Perron (1989) firstly generated exogenous structural unit root tests. Many other different structural unit root tests have been developed in time. In literature various structural unit root tests suffer from severe spurious rejections in finite samples when a break is present under the null hypothesis(1) (Narayan and Popp, 2010:1426).

Narayan and Popp (2010) developed a new unit root test with two structural breaks. Narayan and Popp (2010) unit root test generalizes the unit root test with one break by Popp (2008). The Innovational Outlier (IO) type test allows for structural breaks under the null and alternative hypothesis and is applicable for all model specifications (Narayan and Popp, 2013: 723).

Narayan and Popp (2010) test has got two different specifications for both of the trending data. While one of them allows for two breaks in level (M1), the other allows for two breaks in level as well as slope (M2). The specifications of M1 and M2 models differ from one another in how the deterministic component, d_t, is defined,

$$d_t^{M1} = \alpha + \beta t + \Psi^*(L)(\theta_1 DU_{1,t}^{'} + \theta_2 DU_{2,t}^{'})$$

$$d_t^{M2} = \alpha + \beta t + \Psi^*(L)(\theta_1 DU_{1,t}^{'} + \theta_2 DU_{2,t}^{'} + \gamma_1 DT_{1,t}^{'} + \gamma_2 DT_{2,t}^{'}) \tag{14}$$

$$DU_{i,t}^{'} = 1(t > T_{B,i}^{'}), \qquad DT_{i,t}^{'} = 1(t > T_{B,i}^{'})(t - T_{B,i}^{'}), \qquad i = 1, 2.$$

where $T_{B,i}^{'}, i = 1, 2$ denote the true break dates. θ_i and γ_i indicate the magnitude of the level and slope breaks, respectively. The IO-type test equation for M1 model is as follows:

$$y_t^{M1} = \rho y_{t-1} + \alpha_1 + \beta^* t + \theta_1 D(T_B')_{1,t} + \theta_2 D(T_B')_{2,t} + \delta_1 DU_{1,t-1}' +$$
$$+ \delta_2 DU_{2,t-1}' + \sum_{j=1}^{k} \beta_j \Delta y_{t-j} + e_t \quad (15)$$

with $\alpha_1 = \Psi^*(1)^{-1}[(1-\rho)\alpha + \rho\beta] + \Psi^{*'}(1)^{-1}(1-\rho)\beta$, $\Psi^*(1)^{-1}$ being the mean lag, $\beta^* = \Psi^*(1)^{-1}(1-\rho)\beta$, $\phi = \rho - 1$, $\delta_i = -\phi\theta_i$ and $D(T_B')_{i,t} = 1(t = T_{B,i}' + 1), i = 1,2$. $DU_{1,t}' = 1(t > T_{B,i}')$, $DT_{1,t}' = 1(t > T_{B,i}')(t - T_{B,i}')$, i=1,2. The IO-type test equation for M2 model is as follows:

$$y_t^{M2} = \rho y_{t-1} + \alpha^* + \beta^* t + \kappa_1 D(T_B')_{1,t} + \kappa_2 D(T_B')_{2,t} + \delta_1^* DU_{1,t-1}' +$$
$$+ \delta_2^* DU_{2,t-1}' + \gamma_1^* DT_{1,t-1}' + \gamma_2^* DT_{2,t-1}' + \sum_{j=1}^{k} \beta_j \Delta y_{t-j} + e_t \quad (16)$$

In this equation, κ_i=$(\theta_i + \gamma_i)$, $\delta_i^* = (\gamma_i - \phi\theta_i)$ and $\gamma_i^* = -\phi\gamma_i$ i = 1, 2. In order to test the unit root null hypothesis of $\rho = 1$ against the alternative hypothesis of $\rho < 1$, the t-statistics of $\hat{\rho}$ denote $t_{\hat{\rho}}$. The break dates are selected using the sequential procedure proposed by the Narayan and Popp (2010) test and appropriate critical values as provided in the Narayan and Popp (2010) paper are used to test the hypothesis for unit root (Salisu and Mobolaji, 2013, p. 172). Narayan and Popp (2010) tabulated their test critical values for M1 and M2 models.

Narayan and Popp (2013) compares the Lumsdaine and Papell (1997), Lee and Strazicich (2003) and Narayan Popp (2010) two structural break unit roots test. Their study shows that the Narayan Popp (2010) test has good size and stable power, and identifies the structural breaks accurately in finite samples by using Monte Carlo simulations. According to the findings in their study, Narayan and Popp (2010) test is significantly superior to Lumsdaine and Papell (1997) and Lee and Strazicich (2003) two structural break unit root tests.

3. Empirical results

In the first part of this study that investigates military expenditures in NATO countries, the test developed by Harvey et al. (2008) that offers the basic advantage of not being influenced by the stationarity levels of variables was used and the results are tabulated in Table 2.

Table 2. *Linearity tests results*

Country	Harvey Stat	Country	Harvey Stat
Canada	0.15	Italy	0.78
USA	4.11	Luxembourg	3.3
Belgium	10.52*	Netherlands	4.26
Denmark	1.81	Norway	7.52**
France	3.7	Portugal	5.41***
Germany	38.7*	Turkey	5.05***
Greece	6.21**	UK	9.58*

Note: The symbols *, ** and *** mean rejection of the null hypothesis of linearity at the 1%, 5% and 10% respectively. Harvey et al. (2008) test critical values, 9.21, 5.99 and 4.60 respectively.

According to the linearity test results in Table 2, Belgium, Germany, Greece, Norway, Portugal, Turkey and the UK series display nonlinear characteristics. The unit root test advocated in the study by Sollis (2009) was used for these countries and the results are given in Table 3.

Table 3. *Nonlinear unit root tests results*

Country	k	$Ho:\phi_1=\phi_2=0$	$Ho:\phi_2=0$
Belgium	2	1.419173	0.05876
Germany	3	21.03265*	4.30529**
Greece	1	4.595211***	1.41139
Norway	2	2.811195	0.60443
Portugal	1	12.64718*	3.92743***
Turkey	1	1.254721	0.01659
UK	1	4.843415***	0.38328

Note: The symbols *, ** and *** mean rejection of the null hypothesis of unit root at the 1%, 5% and 10%, respectively.

According to the Sollis (2009) nonlinear unit root test result provided in Table 3, the results indicate stationarity for Germany, Greece, Portugal and the UK, in other words military expenditures converge to the mean. The presence of the impact of asymmetry for these countries the unit root null hypothesis for which was rejected could be tested by $Ho:\phi_2=0$. As the table indicates, the symmetrical ESTAR nonlinearity was rejected for Germany and Portugal under the null hypothesis. Therefore, there is asymmetrical ESTAR nonlinearity in these countries.

The unit root test with structural break introduced into literature by the Narayan and Popp (2013) study was used for Canada, the USA, Denmark, France, Italy, Luxembourg and the Netherlands, in other words the countries the linearity of which has been identified and the results are tabulated in Table 4.

Table 4. *Linear unit root tests results with two options*

Country	Model 1: Two Breaks in Level			
	k	t-statistic	TB1	TB2
Canada	1	-2.921	1965	1982
USA	1	-2.535	1965	1991
Denmark	4	-3.108	1965	1969
France	1	-2.111	1965	1990
Italy	4	0.2438	1990	1995
Luxembourg	0	-4.239***	1966	2000
Netherlands	0	-1.989	1965	1983

Note: The symbols *, ** and *** mean rejection of the null hypothesis of unit root at the 1%, 5% and 10%, respectively.

According to the results of the Narayan and Popp (2013) unit root test with structural break, only the military expenditures of Luxembourg converge to the mean.

4. Conclusions

The nonlinearity test developed by Harvey et al. (2008) was used in the first part of this study that investigates the convergence of the military expenditures of the NATO countries between 1953-2014. The nonlinearity of Belgium, Germany, Greece, Norway, Portugal, Turkey and the UK series were identified by using this test and the Sollis (2009) test was used to test the validity of the convergence hypothesis. According to the findings of this test, the military expenditures of Germany, Greece, Portugal and the UK converge to the NATO mean. The convergence hypothesis was tested using the Narayan and Popp (2013) test for Canada, the USA, Denmark, France, Italy, Luxembourg and the Netherlands the linearity of which were identified. These findings show that the military expenditure policies of the countries for which the convergence hypothesis does not apply should be reviewed.

Note

(1) See the Perron (1989), Zivot and Andrews (1992), Lumsdaine and Papell (1997) structural break unit root tests.

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Impact of GDP and tax revenue on health care financing: An empirical investigation from Indian states

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Abstract. *This paper examines the long run effects of GDP and tax revenue on public health expenditure for sixteen major states of India over the period 1980-2014. We apply panel long run cointegrating estimator (FMOLS and DOLS) and panel VECM techniques for the empirical analysis. This study is more relevant for financial progress towards universal health coverage of India because Indian states are heterogeneous in terms of public health expenditure, associated with low tax revenue and low level of GDP growth. The empirical result shows that there is a positive and significant impact of per capita GDP and per capita tax revenue on growth of public health expenditure while the elasticity of public health expenditure is less than one. Further, there is a long run causality from the growth of per capita GDP and per capita tax revenue to the growth of per capita public health expenditure. These results have policy implications for universal health coverage by improving alternative tax revenue in Indian states.*

Keywords: public health expenditure; Indian states; GDP; tax revenue.

JEL Classification: H51, H2, H75.

1. Introduction

The health care financing is a key building block of the health system[(1)] functions framework and plays an influential role in attainment of universal health coverage goals (Kutzin, 2013). Mathauer and Guy (2011) have systematically designed health care financing performance indicators for low income countries in order to achieve universal health coverage[(2)] (UHC). Some of the relevant indicators are per capita government health expenditure, government health expenditure as percentage of gross domestic product (GDP), government expenditure as percentage of gross domestic product (fiscal space) and government health expenditure as percentage of total government expenditure (fiscal space for health) etc. These indicators are measured by the country's income level and financial affordability of the government. Reeves et al. (2015) explains the health financing mechanism for the low and middle income countries to achieve the breadth-depth-height of health system coverage. It has taken government health expenditure as one of the indicators of UHC denoted as dependent variables, tax revenue and GDP taken as independent variables to measure the progress towards UHC. The challenge for many low and middle income countries is how to increase public health care expenditure in order to achieve UHC because these countries heavily rely on out-of-pocket health care expenditure (Mathauer and Guy, 2011).

India is not an exception in health system challenge and also suffers huge shortage of finance in public health care. As a consequence of this, the public health care delivery system suffers from inadequate health care services, severe staff shortage, lower quality of infrastructure and catastrophic out-of-pocket expenditure (Kurian, 2015). Choudhury (2014) says that the level of public health expenditure as percentage of gross state domestic product (GSDP) is around one percent in most of the poor performing states in India due to low budgetary space[(3)]. Duran et al. (2014) explains that fiscal space for health shifted only from 4.6 percent to 4.8 percent during the period 2007-08 to 2012-13; it suggests that India requires a health system for financing in UHC and requires more emphasis primarily on general tax revenues by generating more income.

The main motivation of this study starts from the state's role in financing health care for the implementation of Universal Health Coverage (UHC) in India. Because, health is a state subject in India and financing for public health care is solely depends on the budgetary space of the state government. The budgetary space for spending is driven by the income and tax revenue of the government and it is also one of the objective for achieving universal health coverage. Beside the above supply side factors, other demand side factor such as per capita income, demographic structure, morbidity pattern etc. also affects the nature and type of heath care expenditure. The important point here is to see the position of the state government in financing public health care from its own budgetary space as income level and tax revenue to mitigate health demands of the people without help of the central government assistance. So, this study has taken into consideration income level and own tax revenue of the state government to measure the level of health care expenditure.

1.1. Past literature

There is a growing literature on the nexus between public health expenditures and GDP, which can be broadly grouped into three different lines of inquiry. The first strand of literature examines the elasticity of public health expenditure with respect to GDP in the short run as well as in the long run. The literature deals with short run estimator of health expenditure studies such as Sen (2005); Wang (2009); Baltagi and Francesco (2010); Cantarero and Lago Penas (2010); Farag et al. (2012); Fan and Savedoff (2014); Reeves et al. (2015); and the literature deals with the long run estimators of health expenditure such as Narayan et al. (2010); Khan et al. (2015); Wang (2011); Tamakoshi and Shigeyuki (2014). These studies find per capita GDP to be the most important determinant of per capita public health expenditure. The economic interpretation of these findings is that, the elasticity of public health expenditure with respect to GDP is equal to or greater than one, leading to the conclusion that health care is a luxury rather than a necessity. When elasticity is less than unity, health care is closer to being a necessity than a luxury. Whether health care is a luxury or a necessity, it has an implication on the link between public health expenditure and economic well-being. The second strand of literature (Gerdtham and Mickael, 2000; Herwartz and Bernd, 2003; MacDonald and Sandra, 2002; McCoskey and Thomas, 1998; Wang, 2011; Dreger and Hans, 2005; Tamakoshi and Shigeyuki, 2015) deals with investigating evidence for a long run (cointegrating) relationship between public heath expenditure and GDP. The third strand of literature (Devlin and Paul, 2001; Erdil and Yetkiner, 2009; Hartwig, 2010; Wang, 2011; Amiri and Venetelou, 2012) examines the causality between public health expenditure and GDP in the short-run as well as long-run. There are two types of causality between public health expenditure and GDP; it could be either unidirectional (that is, public health expenditure as a function of GDP or GDP as function of public health expenditure) or bidirectional (that is, both public health expenditure and GDP causing each other). The direction of causality is important, as the health policy implications are vastly different for each possible direction. The unidirectional causality from public health expenditure to GDP (reverse causality) indicates that the public health expenditure has both direct and indirect effects on economic growth (Hartwig, 2010). The theoretical argument is that public health expenditure can be considered as an investment in human capital and leads to healthier workforce. Hence as a factor of production, an increase in the efficiency helps augmenting the economic growth (Devlin and Paul, 2001). On the other hand, the unidirectional causality from GDP to public health expenditure is a general phenomenon in almost all countries. But the implication of increasing public health expenditure is that, it reflects the intention of economic development, and exhibits the improvement in the quality of life of people (Wang, 2011). The presence of bidirectional causality between public health expenditure and GDP implies that public health expenditure and economic growth are jointly affected by shocks and conservative health policies may have an adverse effect on income and vice versa (Amiri and Venetelou, 2012).

Regarding studies on India, there is limited work on the nexus between public health expenditure and GDP. Bhat and Nishant (2006); Rahman (2008); Hooda (2015), examined the relationship between GDP and public health expenditure among the Indian states, found that per capita GSDP affects positively to the growth public health expenditure. These studies use random effect regression model to estimate the short run impact of income on the growth of health care expenditure. The result shows that the value of income elasticity of public health expenditure varies between 0.47-0.68, which implies that health care is not a luxury good among the Indian states. These studies have overlooked the long run relationships between GDP and public health expenditure in the state level. The literature relating to the long run impact assessment of per capita GDP on per capita public health expenditure are scarce in the state level of India, except the recent study of Behera and Dash (2016). They argued that public health expenditure and GDP are cointegrated in the long run and found positive relationship between them. But it ignores the role of state's per capita tax revenue in order to finance health care because the literature argues that tax revenue is most contributing factor for the growth of public health expenditure (Reeves et al., 2015; Cantarero and Santiago, 2010; Fan and Savedoff, 2014). The studies like Reeves et al. (2015) and Cantarero and Santiago (2010) have taken tax revenue as the one of the explanatory variables for explain the growth of public health expenditure. These studies found that tax revenue affects positively to the growth of public health expenditure in the short run, while the long run impact assessment of tax revenue on growth of public health expenditure is very rare in literature. The studies such as Reeves et al. (2015) and Fan and Savedoff (2014) have argued that mobilization of funds through domestic tax revenue is the sustainable sources of financing for health care and implement health policies.

The contribution of this paper may be described as follows: First, we examine the long run effects of per capita GSDP and per capita tax revenue on per capita public health expenditure using long run estimator techniques such as FMOLS for heterogeneous cointegrated panel proposed by Pedroni (2000) and DOLS techniques proposed by Kao and Chiang (2000). Second, we examine the causal relationships between per capita public health expenditure, per capita GSDP and per capita tax revenue using the panel vector error correction model (VECM) econometric model that combines short-run and long-run dynamics. Our result shows that there is a positive and significant impact of per capita GDP and per capita tax revenue on growth of per capita public health expenditure while the elasticity of per capita public health expenditure is less than one. Further, there is a long run causality from the growth of per capita GDP and per capita tax revenue to the growth of per capita public health expenditure. These research findings would serve as effective policy instruments to understand the financial progress towards universal health coverage of Indian states.

Based on the background information mentioned above, the objective of this paper is to examine the long run impact of GDP and tax revenue on public health expenditure for sixteen major states of India over the period 1980-2014. The remainder of this paper is organised as follows. Section 2 presents a brief overview of public health expenditure scenario of the states of India. Section 3 describes the data and methodology. Section 4 presents the results from empirical analysis and Section 5 is the conclusion.

2. A brief overview of public health care expenditure trends of Indian states

Our objective in this section is twofold. The first objective is to provide a comparison of public health expenditure trends as percent of GSDP vis-à-vis trends of tax revenue as percent of GSDP of sixteen Indian states over the three time periods i.e. 1980-1989;

1990-1999; and 2000-2014. The second objective is to show how heterogeneous the sixteen states are with respect to per capita public health expenditure vis-à-vis per capita GSDP and per capita tax revenue during the period 2000-2014.

Table 1. *Trends of public health expenditure and tax revenue (Average)*

	Public health expenditure as percent of GSDP			State's own tax revenue as percent of GSDP		
Major states of India	1980-1989	1990-1999	2000-2014	1980-1989	1990-1999	2000-2014
Andhra Pradesh (AP)	1.94	1.34	1.23	11.96	10.18	12.75
Assam (ASM)	1.16	0.94	1.04	2.75	3.20	5.08
Bihar (BIH)	1.52	1.60	1.07	5.12	5.93	4.79
Gujarat (GUJ)	0.94	0.69	0.55	6.61	7.03	6.77
Haryana (HAR)	0.96	0.55	0.46	6.67	6.56	7.18
Himachal Pradesh (HP)	2.77	1.86	1.47	3.86	4.32	5.52
Karnataka (KAR)	1.03	0.84	0.73	7.17	7.76	9.32
Kerala (KER)	1.32	0.92	0.83	6.42	7.13	7.82
Madhya Pradesh (MP)	1.47	1.01	0.84	6.40	6.71	7.27
Maharashtra (MAH)	1.05	0.57	0.50	7.02	6.48	7.14
Odisha (ODI)	1.15	0.90	0.76	3.28	3.82	5.56
Punjab (PUN)	0.93	0.74	0.65	6.77	6.09	7.22
Rajasthan (RAJ)	0.10	1.00	0.92	4.65	4.88	6.40
Tamil Nadu (TN)	1.21	0.85	0.67	7.23	7.56	8.53
Uttar Pradesh (UP)	1.09	0.93	1.02	4.33	4.75	6.59
West Bengal (WB)	1.09	0.90	0.75	4.86	4.88	4.57
All States	1.11	0.80	0.75	5.33	5.48	6.63

Source: State finance of budget and handbook of statistics on the Indian Economy, RBI.

We begin with Table 1, where we report the trends of public health expenditure over the period 1980-2014. Two messages are worth noting here. First, for India as a whole (All States), public health expenditure as percent of GSDP reduced from 1.11 percent over the period 1980-1989 to 0.75 percent of GSDP in the period 2000-2014. The second message is that, for the majority of the states, public health expenditure as percent of GSDP has decreased in the period 2000-2014 compared to the 1980-1989 period. Similarly, from the trend analysis of tax revenue of Indian states over the period 1980-2014, we found two observations. First, the growth of tax revenue as percent of GSDP of India (All States) has increased from 5.33 percent in the period 1980-1989 to 6.63 percent in the period 2000-2014. Second, majority of Indian states have increased revenue productivity (tax revenue as percent of GSDP) over the period 2000-2014 than the period 1980-1989.

From our simple trend analysis of the data, it is clear that states are heterogeneous in terms of average public health expenditure. To further measure the degree of heterogeneity, Figure 1 is shown the scatter plots of the growth of per capita public health expenditure with respect to changes in per capita GSDP over the period 2000-2014. Figure 1 shows that the states such as Karnataka, Punjab, Tamil Nadu, Gujarat, Maharashtra and Haryana are having higher per capita income and showing lower level of per capita public health expenditure. Similarly, the states such as Uttar Pradesh, Madhya Pradesh, Odisha, West Bengal and Bihar are having lower per capita income but having lower level of per capita public health expenditure. While the states namely Andhra

Pradesh, Kerala and Himachal Pradesh are exhibits higher level of per capita public health expenditure with respect to higher level of per capita income.

Figure 1. *GSDP and public health expenditure trends of Indian states (Avg. 2000-2014)*

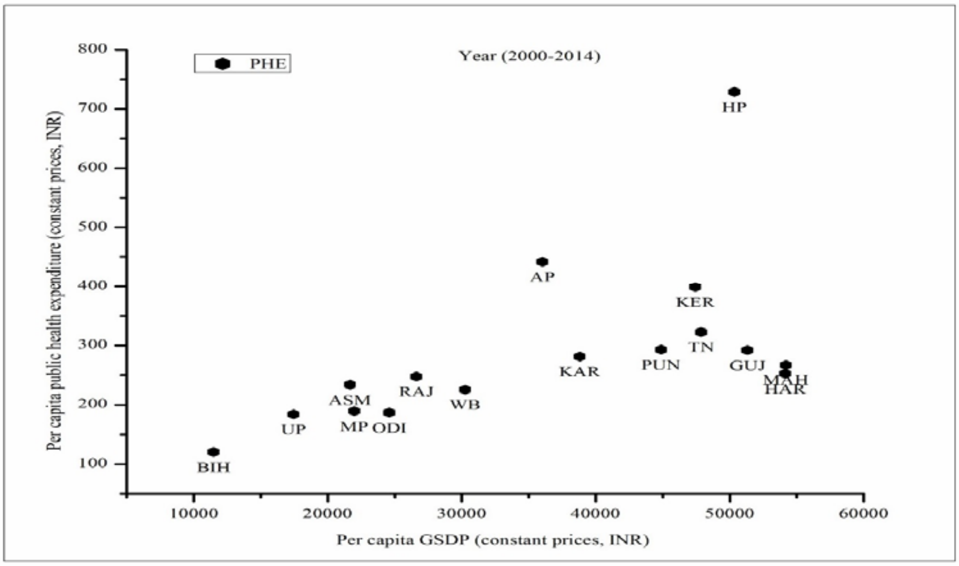
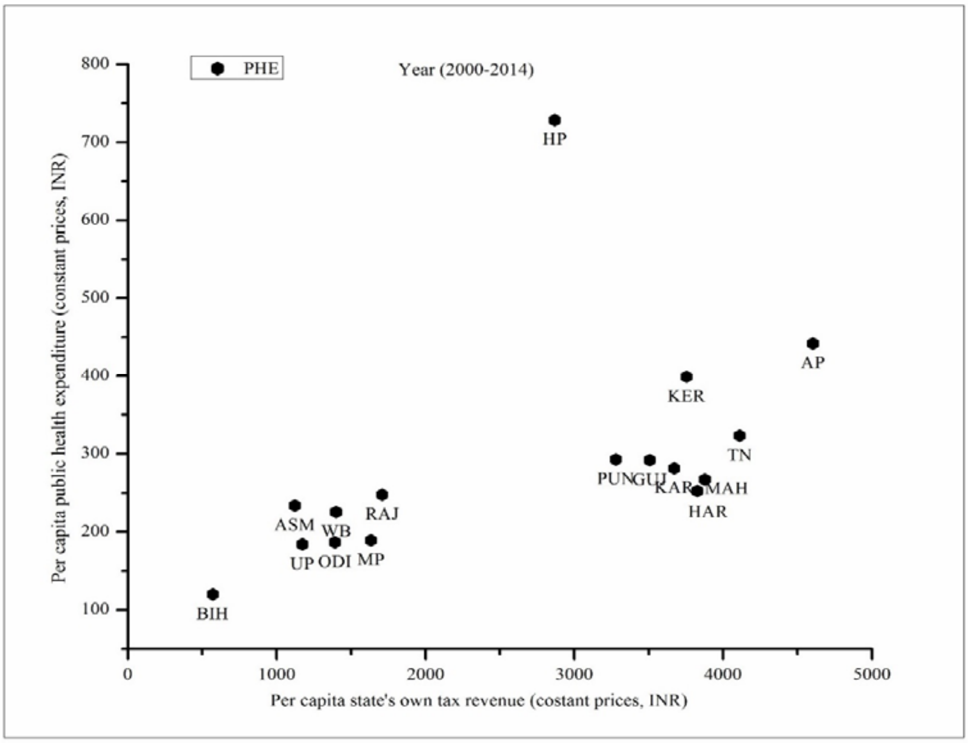


Figure 2. *Tax revenue and public health expenditure trends of Indian states (Avg. 2000-2014)*



In Figure 2, we presents the scatter plot analysis of per capita public health expenditure with respect to per capita tax revenue of Indian states over the period 2000-2014. We notice that the state's namely Punjab, Gujarat, Karnataka, Maharashtra, Haryana and Tamil Nadu are having higher per capita tax revenue associated with lower level of per capita public health expenditure. Similarly, the state's namely Uttar Pradesh, Odisha, Madhya Pradesh and Bihar are having lower per capita tax revenue associated with lower level of per capita public health expenditure. While the states namely Andhra Pradesh, Kerala and Himachal Pradesh are having higher level of per capita public health expenditure associated with higher level of per capita tax revenue.

Overall trends analysis concludes that there is a huge variation in the growth of per capita public health expenditure among the states of India. Further, lower income states are not able to mobilise more resources towards public health expenditure due to lower level of revenue growth. On the contrary, higher income states are also fails to mobilise more resources towards public health expenditure despite higher level of revenue growth.

3. Data and methodology

3.1. Data description

The selection of the period from 1980-81 to 2014-15 is based on the availability of the required data on public health expenditure and relevance of the time period. This period is of great significance as it captures the period of two and a half decade of economic reform/liberalization and also includes the impact of national health policies. It allows us to study the changing pattern and trend of health expenditure in various states of India. We have considered for our analysis, the sixteen major states, covering 93 percent of the population and accounting for 95 percent of the total income of the country. The expenditure and population data are drawn from state finance budget report and handbook of statistics on the Indian economy published by the Reserve Bank of India. The study uses one dependent variables namely, real per capita public health care expenditure (PCPHE) and two independent variables namely, real per capita gross state domestic product (PCGSDP) and real per capita tax revenue (PCTREV). Since price deflators series are not available at the state level, the national level Price Index for all commodities at constant (2004-2005=100) prices has been used to convert the nominal values into real (constant) values. Finally, we convert all the variables used in the empirical model into natural logarithm.

Table 2. *Results of descriptive statistics*

Variables	Description	Mean	Std. Dev.	Maximum	Minimum	Observations
PCPHE	Per Capita Public Health Expenditure	229.07	141.81	1158.02	70.98	560
PCGSDP	Per Capita Gross State Domestic Product	25172.32	15685.35	81981.42	5930.92	560
PCTREV	Per capita State's own tax revenue	1732.76	1373.05	6743.64	271.84	560

Note: All variables are in real constant 2004-05 prices (INR: Indian Rupees).

The Table 2 presents descriptive statistics of the variables for the states in our empirical analysis during the study period. The result shows that variable PCPHE has a minimum value of INR 70.98 and a maximum value an INR 1158.02 with a mean value of Rupees 229.07. So, there is high degree variation in per capita public health expenditure among the Indian states. Also, it shows that all the variables PCPHE, PCGSDP, PCTREV reveal a considerable degree of standard deviation with huge difference in minimum and maximum values.

3.2. Empirical methods

First, we examine the long run effects of per capita GSDP and per capita tax revenue on per capita public health expenditure using long run estimator techniques such as FMOLS for heterogeneous cointegrated panel proposed by Pedroni (2000) and DOLS techniques proposed by Kao and Chiang (2000). The simple panel OLS regression equation as follows:

$$Y_{it} = \alpha_i + \beta_i X_{it} + \mu_{it} \tag{1}$$

In Eq. (1), Y_{it} and X_{it} are cointegrated with slopes β_i which may or may not be homogeneous across i. In this case, the null hypothesis is $H_0 : \beta_i = 1$ for all i. Let $\varepsilon it == \left(\hat{\mu}_{it}, \Delta X_{it}\right)'$ be a stationary vector consisting of the estimated residuals from the cointegrating regression and difference in X_{it}. Let $\Omega_i \equiv \lim_{T\to\infty} E\left[T^{-1}\left(\Sigma_{t=1}^{T}\varepsilon_{it}\right)\left(\Sigma_{t=1}^{T}\varepsilon'_{it}\right)\right]$ be the long-run covariance matrix and it can be decomposed as $\Omega i = \Omega_i^0 + \Gamma_i + \Gamma'_i$, where Ω_i^0 is the contemporaneous covariance and Γ_i is a weighted sum of autocovariances. Using this notation, the panel FMOLS estimator is given as:

$$\hat{\beta}^*_{GFM} = N^{-1} \sum_{i=1}^{N} \left(\sum_{t=1}^{T} \left(X_{it} - \bar{X}_i\right)^2 \right)^{-1} \times \left(\sum_{t=1}^{T} \left(X_{it} - \bar{X}_i\right) Y^*_{it} - T\hat{\tau}_i \right) \tag{2}$$

Where,

$$Y^*_{it} = (Y_{it} - \bar{Y}_i) - \frac{\hat{\Omega}_{21i}}{\hat{\Omega}_{22i}} \Delta X_{it},$$

$$\hat{\tau}_i = \hat{\Gamma}_{21i} + \hat{\Omega}^o_{21i} - \frac{\hat{\Omega}_{21i}}{\hat{\Omega}_{22i}} (\hat{\Gamma}22i + \hat{\Omega}^o_{22i}).$$

In a similar fashion, the panel DOLS regression equation becomes:

$$Y_{it} = \alpha_{it} + \beta_i X_{it} + \sum_{k=-K_i}^{K_i} \gamma_{ik} \Delta X_{it-k} + \mu_{it} \tag{3}$$

From Eq. (3), we construct the panel DOLS estimator, mentioned as below:

$$\hat{\beta}^*_{GD} = N^{-1} \sum_{i=1}^{N} \left(\sum_{t=1}^{T} z_{it} z'_{it} \right)^{-1} \times \left(\sum_{t=1}^{T} z_{it} \tilde{Y}_{it} \right) \tag{4}$$

Where, $\hat{\beta}_{GD}$ is group mean distributer of panel dynamic OLS,

$Z_{it} = \left(X_{it} - \bar{X}_i, \Delta X_{it-K}, ..., \Delta X_{it+K} \right), \tilde{Y}_{it} = Y_{it} - \bar{Y}_i$ and Z_{it} is the $2(K+1)^*1$ vector of regressors.

Second, we examine the causal relationships between per capita public health expenditure, per capita GSDP and per capita tax revenue using the panel vector error correction model (VECM) econometric model that combines short run and long run dynamics. VECM can be developed as follows:

Model – 1 (5)

$$\Delta \ln PCPHE_{it} = \beta_{1g} + \sum_p \beta_{11ip} \Delta \ln PCPHE_{it-p} + \sum_p \beta_{12ip} \Delta \ln PCGSDP_{it-p} + \psi_{1i} ECT_{t-1}$$

$$\Delta \ln PCGSDP_{it} = \beta_{2g} + \sum_p \beta_{21ip} \Delta \ln PCGSDP_{it-p} + \sum_p \beta_{22ip} \Delta \ln PCPHE_{it-p} + \psi_{2i} ECT_{t-1}$$

Model – 2 (6)

$$\Delta PCPHE_{it} = \beta_{1g} + \sum_p \beta_{11ip} \Delta PCPHE_{it-p} + \sum_p \beta_{12ip} \Delta \ln PCTREV_{it-p} + \psi_{1i} ECT_{t-1}$$

$$\Delta \ln PCTREV_{it} = \beta_{2g} + \sum_p \beta_{21ip} \Delta \ln PCTREV_{it-p} + \sum_p \beta_{22ip} \Delta PCPHE_{it-p} + \psi_{2i} ECT_{t-1}$$

Where

Δ -denotes the first difference of the variables, p denotes the lag length and ECT_{t-1} denotes the lagged error correction term, found from the long run cointegrating equations. The long run causality can be obtained in the VECM model by looking at the significance of the estimated coefficient on lagged error correction term. The joint χ^2 (Chi-square) statistics of Wald test is used to investigate the direction of short-run causality between the variables. If the p parameter of β_{12ip} are jointly significant then $PCGSDP$ Granger cause $PCPHE$ in Model 1 and $PCTREV$ Granger cause $PCPHE$ in Model 2. Similarly, if the p parameter of β_{22ip} are jointly significant then $PCPHE$ cause $PCGSDP$ in Model 1 while $PCPHE$ cause $PCTREV$ in Model 2.

4. Empirical procedure and results

The empirical analyses of panel data in this study comprise the following four steps. First, we test for a panel unit root test to ascertain the order of integration of the variables. Second, we test for cointegration among panel data employing the panel cointegration test developed by Pedroni (1999, 2004) and Kao (1999) and a combined Johansen Fisher-type test (Maddala and Wu, 1999). Third, the long run equilibrium relationship is estimated using fully modified ordinary least square (FMOLS) and dynamic ordinary least squares (DOLS) techniques for heterogeneous cointegrated panels (Pedroni, 2000). Fourth, once the panel cointegration is established, we apply a panel-type VECM in order to test the causality between PCPHE, PCGSDP and PCTREV as well as the impact direction.

4.1. The Panel unit root test

To avoid any spurious and harmful interpretation of the findings, first we have to test the stationarity property of the variables in the data series. In this paper, we applied Levin et al. (2002), Breitung (2000), Im et al. (2003) and Maddala and Wu (1999) unit root test. Results from panel unit root tests are reported in Table 3. The results indicate that the null hypothesis of the existence of unit root could not be rejected for all of the variables at the selected level. However, the unit root null hypothesis for all of the variables at the first difference could almost be completely rejected at the 1 percent level.

Table 3. *Results of panel unit root tests*

Statistical Tests	LLC	Breitung	IPS	ADF - Fisher	PP - Fisher
Level					
PCPHE	2.194	5.802	4.270	10.655	6.226
PCGSDP	-0.082	5.273	4.163	15.661	22.458
PCTREV	2.612	3.806	4.061	11.434	12.627
First Difference					
PCPHE	-19.999*	-6.804*	-18.092*	300.784*	717.780*
PCGSDP	-22.587*	-5.421*	-23.250*	516.480*	853.691*
PCTREV	-14.959*	-6.835*	-16.860*	270.090*	544.313*

Notes: 1) LLC and IPS represent the panel unit root tests of Levin et al. (2002) and Im et al. (2003), respectively; Fisher-ADF and Fisher-PP represent the Maddala and Wu (1999) Fisher-ADF and Fisher-PP panel unit root tests, respectively. 2) The Schwarz information criterion (SIC) is used to select the lag length; the bandwidth is selected using the Newey–West method. Bartlett is used as the spectral estimation method. 3) All variables are formed in natural logarithm (ln) and estimation are made with individual intercept and linear trend. 4) * Statistical significant at 1 percent level.

4.2. The panel cointegration tests

As the results of the panel unit root tests indicate that the variables contain a panel unit root, we can proceed to examine whether there is a long run relationship among the variables using three types of cointegration tests: Pedroni (1999, 2004), Kao (1999), and Fisher-type testing using Johansen methodology (Maddala and Wu, 1999). The Pedroni and Kao tests are based on the Engle and Granger (1987) two step (residual-based) cointegration test. Pedroni (1999, 2004) proposes seven test statistics for cointegration that permit for heterogeneous intercept and linear trend coefficients across cross sections. The Kao (1999) test follows the same basic approach as the Pedroni test but lays down cross section specific intercepts and homogenous coefficients in the first stage regressors. Maddala and Wu (1999) use Fisher (1932) cointegration approach by combining tests from individual cross sections to obtain a test statistics for the entire panel.

We conducted panel cointegration test between per capita public health expenditure, per capita GSDP and per capita tax revenue indicators separately such as Model 1 (lnPCPHE and lnPCGSDP) and Model 2 (lnPCPHE and lnPCTREV). The Table 4 presents the results from the panel cointegration tests. The result has shown in ten test statistics such as panel v-statistics, panel rho-statistics, panel pp-statistics, panel-ADF statistics, group rho-statistics, group pp-statistics, group ADF-statistics, Kao statistics, max-eigenvalue statistics and trace statistics. The Model 1 explains that real per capita public health expenditure is a function of real per capita GSDP. The result shows that the null of no panel cointegration is rejected in all test statistics in Model 1. It implies that there exists a long run relationship between real per capita public health expenditure and real per capita GSDP in India at the aggregate level (national). The Model 2 explains that real per capita public health expenditure is a function of real per capita tax revenue. The result shows that the null of no panel cointegration is rejected in all test statistics in Model 2. It implies that there exists a long run relationship between real per capita public health expenditure and real per capita tax revenue in India at the aggregate level (national).

There are at least two possible reasons that may help support the strong association. First, the share of public health expenditure as a ratio of GDP has increased during the period 2000-2014. This might be happened due to increase the budgetary space of the state governments of India in order to mobilise more finance for health sector because state's own tax revenue capacity as a ratio state's GDP shown increment during the period 2000-2014 (Table 1). Second, growth of per capita income and per capita tax revenue have increased dramatically during the period (Figure 1 and Figure 2). So, it is evident that real per capita public health expenditure and real per capita GSDP are moving together in the long run.

Table 4. *Result of panel co-integration test*

Test statistics			In(PCPHE) and In(PCGSDP)	In(PCPHE) and In(PCTREV)
Padroni test				
panel v-statistics			2.964*	3.595*
panel rho-statistics			-4.641*	-3.034*
panel pp-statistics			-4.531*	-3.578*
panel ADF-statistics			-4.298*	-3.834*
group rho-statistics			-2.854*	-0.302
group pp-statistics			-4.357*	-3.471*
group ADF-statistics			-3.618*	-3.882*
Kao test			-3.661*	-3.092*
Johansen Fisher test	Hypothesized no. of CE(s)	None	78.48*	76.06*
Test trace statistics		At most 1	39.50	53.19**
Johansen Fisher test	Hypothesized no. of CE(s)	None	76.78*	66.65*
Test max-eigenvalue statistics		At most 1	39.50	53.19**

Notes: : 1) The Pedroni (1999) statistics are asymptotically distributed as normal. 2) In Johansen Fisher Panel Cointegration test, the hypothesized no. of cointegrating equations represented in trace and max-eigenvalue test statistics. 3) * Statistical significant at 1 percent level, ** Statistical significant at 5 percent level.

4.3. Long run effects of GDP and tax revenue on public health expenditure

Based on the evidence of cointegration, we estimate long run effects of per capita public health expenditure with respect to per capita GSDP and per capita tax revenue by using the panel FMOLS and DOLS estimators. The results of both FMOLS and DOLS estimators shows that per capita GSDP and per capita tax revenue are positively affects to the growth of per capita public health expenditure. The long run coefficient of PCGSDP suggests that at 1 percent increase in per capita income translates to 0.42 percent increment in per capita public health expenditure. Similarly, the long run coefficient of PCTREV suggests that at 1 percent increase in per capita tax revenue translates to 0.14-0.15 percent increment in per capita public health expenditure (Table 5: columns 3 and 6). After controlling tax revenue in both regression models, we found that the elasticity of PCPHE with respect to PCGSDP is 0.53 percent. It implies that the elasticity of income with respect to health expenditure is less than one and indicates that public health expenditure is not a luxury good in India. The similar finding are those of Behera and Dash (2016); Narayan et al. (2010); Khan et al. (2015); and Wang (2011) etc., which shows per capita income is the main determinant of the growth of per capita public health expenditure in long run and regression coefficient is less than one. The studies such as Reeves et al. (2016); Cantarero and Santiago (2010); and Fan and Savedoff (2014) have found tax revenue as one of determinants to the growth of public health expenditure but these studies have not estimated the long run effects of tax revenue on the growth of public health expenditure. After controlling PCGSDP in both regression models, we found that tax revenue is positively affects to the growth per capita public health expenditure in the long run. It implies that at 1 percent increase in tax revenue translates to 0.72 percent of increment in per capita public health expenditure. So, mobilization of tax revenue through economic growth is the important strategy in order to financing health care in India.

Table 5. *Result of the long run estimator of public health expenditure; Dep: ln (PCPHE)*

Variables	Fully modified ordinary least square (FMOLS)			Dynamic ordinary least square (DOLS)		
	1	2	3	4	5	6
ln(PCGSDP)	0.532* (0.002)		0.426* (0.045)	0.530* (0.003)		0.423* (0.043)
ln(PCTREV)		0.735* (0.004)	0.148** (0.063)		0.739* (0.005)	0.152** (0.062)
R-squared	0.528	0.279	0.538	0.781	0.624	0.819

Notes: 1) Figures in parenthesis are standard error values. 2) ln: natural logarithms. 3) * Statistical significant at 1 percent level, ** Statistical significant at 5 percent level.

4.4. Panel VECM Granger causality results

After conformation of the cointegration relationships between public health expenditure and GSDP (Model 1); and public health expenditure and tax revenue (Model 2), the Table 6 reports the results of Vector Error Correction Model (VECM) panel Granger causality of two models. We use the AIC value to determine the lagged period ρ that is most suitable for the model.

As shown in Table 6, there is an evidence of unidirectional Granger causality running from per capita GSDP to per capita PHE in Model 1. The long result has shown in long run error correction term (ECM_{it-1}) which is negative and significant. In other words, there has no Granger causality running from per capita PHE to per capita GSDP in long run. Our finding are line with the earlier studies like Pradhan and Bagchi (2012); Wang (2011); Khan et al. (2015); Amiri and Ventelou (2012); and Erdil and Yetkiner (2009) found long-run causality from economic growth to public health expenditure growth. Further, there is an existence of bidirectional Granger causality between per capita GSDP and per capita PHE in the short run. Our findings are thus in line with that of Pradhan and Bagchi (2012); Wang (2011); Khan et al. (2015); Amiri and Ventelou (2012); and Erkan and Yetkiner (2009) which had reported short-run bi-directional causality between increase in health expenditure and increase in economic growth. As the best of my knowledge, there has no studies estimate the Granger causality relationships between per capita tax revenue and per capita public health expenditure. Our result finds that per capita tax revenue causes to the growth of per capita public health expenditure in both short run as well as long run. While, the growth of per capita public health expenditure is not causing the growth of state's tax revenue in both short run as well as long run.

Our findings on long run causality from economic growth and tax revenue to the growth of public health expenditure have the policy implication for the sustainable health financing in India. Further, the short run bidirectional causality between public health expenditure and economic growth result implies that more investment in health sector would cause economic growth in the long run.

Table 6. *Results of VECM Granger Causality test*

	Model 1		Model 2	
Equation	Δln(PCPHE)	Δln(PCGSDP)	Δln(PCPHE)	Δln(PCTREV)
Δln(PCPHE)		0.364[a] [17.213][b] (0.004)[c*]		-0.044 [11.047] (0.026)**
Δln(PCGSDP)	-0.154 [50.404] (0.000)*			
Δln(PCTREV)			-0.025 [4.356] (0.359)	
ECM_{it-1}	0.026 [4.894] (0.000)*	-0.001 [-2.449] (0.014)**	0.001 [0.177] (0.858)	-0.070 [-6.291] (0.000)*

Notes: 1) [a], [b] and [c] denote the sum of coefficients, statistics value, and p-value, respectively. 2) Chi-square statistics testing for short run causality through the joint significance of Wald test, and t-statistics testing for long run causality through the error-correction adjustment coefficient. 3) * Statistical significant at 1 percent level, ** Statistical significant at 5 percent level.

4. Conclusion

In this paper we examines the long run effect of GDP and tax revenue on the public health expenditure for sixteen major Indian states over the period 1980 to 2014. The main motivation of our study had based on the argument that whether the budgetary space (per capita GSDP and per capita tax revenue) of the state governments is enough for financing health care for achieving universal health coverage. We applied panel long run cointegrating estimator (FMOLS and DOLS) and panel VECM techniques for the empirical analysis.

Overall trends analysis concludes that there is a huge variation in the growth of per capita public health expenditure among the states of India. Further, lower income states are not able to mobilise more resources towards public health expenditure due to lower level of revenue growth. On the contrary higher income states are also fails to mobilise more resources towards public health expenditure despite higher level of revenue growth.

Overall, empirical analysis concludes that public health expenditure has long run relationships with the growth of per capita GSDP and per capita tax revenue. It shows that the elasticity of public health expenditure with respect to GSDP and tax revenue has less than one in the long run, exhibits health is not a luxury good in India. Further, per capita GSDP and per capita tax revenue have caused to the growth of per capita public health expenditure in the long run. While, per capita public health expenditure has not caused to the growth of per capita GSDP and per capita tax revenue in the long run. Our findings on long run causality from economic growth and tax revenue to the growth of public health expenditure have the policy implication for the sustainable health financing in India. Further, the short run bidirectional causality between public health expenditure and economic growth result implies that more investment in health sector would cause economic growth in the long run.

The policy implication would be growth is certainly important for spending in health but it requires enough revenue for transforming growth to health and vice-versa. The health sector is having huge requirement of financial resources to mitigate health related infrastructure. The state's budgetary space may not be sufficient to full fill the gap between supply and demand of the public health care. The state government should initiate the alternative source of finance such as proper utilization of central grants, generate more tax and non-tax revenue, increase tax base, reducing tax evasion and avoidance. The study has not taken into consideration the non-income determinants of the growth of public health expenditure; second, impact of alternative sources of revenue on public health expenditure also ignored. These limitations would be our future research analysis.

Notes

(1) Health system include all the activities whose primary purpose is to promote, restore or maintain health. In precisely health systems are not just concerned with improving people's health but with protecting them against the financial costs of illness. The challenge facing governments in low income countries is to reduce the regressive burden of OOP payment for health by expanding prepayment schemes, which spread financial risk and reduce the spectra of catastrophic health care expenditures (World health report, 2010).

(2) UHC provides assurance of health services to all needy people under three objectives such as equity in access, quality of health services and ensuring financial risk protection (World health report, 2010).

(3) Budgetary space (fiscal space) of a country refers to the government's ability and willingness to mobilize public revenues, which in turn allows it to spend money on public services and programs, including health. The necessity of the creation of fiscal space for the financing health care is that, the greater the fiscal space of a country, the greater the potential for public expenditure on health (Mclntyre and Kutzin, 2016).

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Appendix

Table A1. Lag length criteria for VECM Granger Causality

Lag order	LogL	LR	FPE	AIC	SC	HQ
Model 1						
0	-489.622	NA	0.028533	2.119061	2.136906	2.126086
1	1084.451	3127.792	3.28e-05	-4.6485	-4.59496	-4.62742
2	1118.571	67.50519	2.88e-05	-4.77832	-4.689102*	-4.7432
3	1123.974	10.64296	2.87e-05	-4.78437	-4.65946	-4.7352
4	1142.168	35.68253	2.70e-05	-4.84555	-4.68495	-4.78234
5	1153.688	22.49364*	2.61e-05*	-4.877967*	-4.68168	-4.800701*
6	1157.124	6.678933	2.62e-05	-4.87553	-4.64356	-4.78422
Model 2						
0	-651.935	NA	0.057437	2.818684	2.836528	2.825708
1	880.2060	3044.469	7.92e-05	-3.76813	-3.714596*	-3.747057*
2	881.6377	2.832699	8.01e-05	-3.75706	-3.66784	-3.72194
3	888.6449	13.80293	7.90e-05	-3.77002	-3.64511	-3.72085
4	897.3908	17.15258*	7.74e-05*	-3.790478*	-3.62988	-3.72726
5	898.4888	2.143878	7.84e-05	-3.77797	-3.58168	-3.7007
6	900.5181	3.944866	7.91e-05	-3.76948	-3.5375	-3.67816

Notes: 1) * indicates lag order selection by the criterion. 2) LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion.

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The relation between foreign direct investments and some economic indicators. The case of Romanian economy

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Abstract. *Foreign direct investments (FDI) are a force that shapes the world economy. Stocks and flows of FDI (inward and outward) are indicators followed with great attention by national and international entities and they are correlated with other macroeconomic indicators to detect trends at regional, national and international levels and to determine the degree of development of a country. The dramatically changes that occurred in world economy in the last 30 years have generated major changes on the motivations of foreign investors, the emergence of new types of economic agents that generate foreign direct investments and new international regulations regarding FDI. In this article, the authors analyzed the relations between FDI, import, export and GDP for Romania economy for the period 1990-2014. The research methodology applied is based on the Augmented Dickey-Fuller statistic test and the Granger causality test, the datasets for the variables included in the study have been drawn from official data sources, the UNCTAD database and the National Statistics Institute of Romania's database (TEMPO). To present their results, the authors have used graphical and table-based instruments, which provides better understanding of the research outputs. Also, the study is placed within the context and historical landmarks of the Romanian economy, the results and conclusions emphasize the effects of certain actions and events on the indicators and correlations analyzed.*

Keywords: foreign direct investment, transnational corporations; import, export and GDP.

JEL Classification: F1, F2.

Introduction

In international scientific literature, there are many studies on the relationship between FDI, exports and economic growth. The experts have demonstrated the complementary relation between FDI and export:

- on the one hand, certain international flows of goods are replaced by FDI flows, because some foreign markets are no longer accessed via exports, but through the relocation of the production in the economy of that country
- on the other hand, the subsidiaries of transnational companies have a significant contribution on exports of the host country, because they deserves less domestic and more the international market; these are resources seeking FDI or efficiency seeking and less market seeking FDI.

The impact of FDI on the balance of payments is more complex given the multiple influences on certain accounts such as those generated by exports of foreign subsidiaries, their imports of raw materials or equipment, repatriation of profits.

Literature review

At the beginning of 90`s, more and more developing countries and countries in transition to market economy have allowed the access of foreign investors to national economies, in advance of the expected positive effects like technology transfer (Sood, 2016), employment of local work force, the boost of export due to integration into global production chains, substantial contributions to state budget, improvement of local competitiveness of firms, restructuring and privatization of state owned companies (Matei, 2004; Iacovoiu, 2007), the use of advanced technical methods (Lipsey, 2004), the development of local industry (Markusen and Venables, 1999). In addition, FDI is an important source of capital, complementary to domestic investment – in the case of privatization of large state owned companies, the foreign capital was the only viable solution because of the existence of modest financial funds in host countries. Alfaro et al. (2004) have approached the role of local financial markets in the scope of the correlation between foreign direct investments and growth. Alin (2010) presented the effects that the ongoing crisis had on the economy, at the global level. Granger (1969) develops on the use of econometric tools in the study of causal type relations. Lazăr and Lazăr (2009) focus on the sustainable development's progress measurement through quantitative indicators. Lazăr and Lazăr (2012) is a thorough study on the analysis of economy through statistic methods, the work covers both microeconomic and macroeconomic statistics. Sima and Gheorghe (2008) have analyzed the types of profiles corresponding to the Romanian entrepreneurial ventures. Stancu and Iacovoiu (2015) applied econometric techniques to study the correlation between net outward investment position and innovation capabilities, by using specific indicators. Raluca (2012) is preoccupied with measuring the competitiveness, through the use of the Global Competitiveness Index. Anghelache et al. (2015) use multiple regression to study the impact of gross investments and final consumption on Romania's GDP, a previous work by Anghelache et al. (2013)

covers a statistical analysis of GDP and foreign direct investments for Romania. Anghel et al. (2016) analyze the influence of import on foreign direct investments.

Many studies have demonstrated the positive potential of FDI on host economies, but reality, and subsequent literature, marked the negative effects of FDI on employment (lay-offs), transfer of technology(in some cases, outdated technology are relocated in developing countries and there are negative effects on corruption or balance of payments (Matei, 2004, Iacovoiu, 2009, Radulescu 2012), a previous work by Radulescu (2003) approached the counter-corruption actions and efforts at the international level. Another trend can be observed in international literature: there are many scientific studies that highlight the different effects of FDI in host countries depending on some variables like the characteristics of the recipient countries (Alfaro and Charlton, 2007), the implantation method or the field of activity specific to transnational corporations (Lipsey and Sjöholm, 2005).

Despite the negative effects recorded by some studies, the general opinion is that FDI have significant consequences on economic growth through multiple channels such as technology transfer, capital formation and human capital (Acaravci and Ozturk, 2012). But the researchers draw attention to the fact that the impact of FDI on economic growth depends on the level of human capital available in the host economy. In addition, FDI is considered a vehicle for the adoption of new technologies in the host Economies, so the FDI has effects on human capital accumulation (Borensztein et al., 1998).

On one hand, FDI flows are attracted by the development`s level of host countries, on the other hand, they contribute directly, and indirectly through generated spillover effects on economic growth of the host countries Some studies realized for former communist countries indicated the importance of FDI as an engine of economic growth, hence the importance of promoting these countries as a location for subsidiaries of transnational corporations, which however require the public authorities to improve the financial system, infrastructure quality, human capital and tax system (Acaravci and Ozturk, 2012) and a sectorial approach in order to register a consolidation of FDI in productive sectors allowing the potentiation of their impact on sustainable development (Anghelache et al., 2014).

Methodology

In this study, we will explore the causality relation between inward and outward flows of FDI, imports, exports and GDP in the case of Romania. First, we will do the unit root test using the Augmented Dickey-Fuller statistic test, then, we will make a Granger causality test to determine the causality between the variables

The variables used for this study are:

- Inward flow of foreign direct investments for the period 1990-2014 extracted from UNCTAD (INW_F).
- Outward flow of foreign direct investments for the period 1990-2014 extracted from UNCTAD (OUT_F).

- Gross domestic product for the period 1990-2014 extracted from UNCTAD (GDP).
- Imports CIF for the period 1991-2014 extracted from INS-Tempo (IMP).
- Exports FOB for the period 1991-2014 extracted from INS-Tempo (EXP).

Unit root test

Before we proceed to the Granger causality test, we will test the variables for unit root using the Augmented Dickey –Fuller (ADF) test.

Null hypothesis is that the variable has a unit root. In order to do the calculation we will be using the ADF test, Schwarz Info criterion to determine the lag length and a maximum number of 5 lags.

The math behind the ADF test can be shortly explained by using the next algorithm.

We start from the basics of a unit root test and consider a simple autoregressive AR(1) process (Eviews):

$$y_t = \rho y_{t-1} + x_t' \delta + \epsilon_t \tag{1}$$

where: x_t – optional repressors, constant or trend;
$\rho$and δ – parameters;
ϵ_t – white noise.

If $|\rho| \geq 1$, y is a nonstationary series and the variance of $y$increases with time and approaches infinity. If $|\rho| < 1$, y is a stationary series.

The standard DF test starts from equation [1] and subtracty_{t-1} from both sides:

$$\Delta y_t = \alpha y_{t-1} + x_t' \delta + \epsilon_t \tag{2}$$

where $\alpha = \rho - 1$.

The null and alternative hypotheses are written as:

$$\begin{aligned} H_0&: \propto = 0 \\ H_1&: \propto < 0 \end{aligned} \tag{3}$$

and evaluated using the conventional t-ratio for α:

$$t_{\propto} = \widehat{\propto}/(se(\widehat{\propto})). \tag{4}$$

where $\widehat{\propto}$ is the estimate of $\propto$, and $se(\widehat{\propto})$ is the coefficient standard error.

Dickey and Fuller (1979) demonstrated that if the hypothesis of the unit root is null, the statistic stops following a Student t-distribution and they simulate critical values for different test and sample size. MacKinnon (1996) further develop the simulations for a larger set of simulations.

Because the simple DF unit root is valid only for AR(1) process series the ADF was developed which added a parametric correction for higher-order correlation by assuming that the y series follows and AR(p) process by adding p lagged difference terms of the dependent variable y to the right-hand side of the regression:

$$\Delta y_t = \alpha y_{t-1} + x_t' \delta + \beta_1 \Delta y_{t-1} + \beta_2 \Delta y_{t-2} + \cdots + \beta_p \Delta y_{t-p} + v_t. \tag{5}$$

This augmented equation is used to test [4] using the t-ratio [3]. The important aspect obtained is that the asymptotic distribution of the t-ratio for $\propto$ is independent of the number of lagged first differences included in the ADF regression. Even though the assumption that y follows and AR process may seem restrictive, Said and Dickey(1984) demonstrates that the ADF test is asymptotically valid in the presence of a moving average component if sufficient lagged difference terms are included in the test regression.

Granger causality test

Granger (1969) questioned how much of y can be deduced by the past values of $y$and afterwards he questioned whether if by adding lagged values of x can get a better deduction of y. A variable y is Granger-caused by x when x improves the prediction of y, or when the coefficients of the lagged x are statistically significant. We have to acknowledge that a two-way causation is a frequent case in which x Granger causes y and y Granger causes x.

In order to make a Granger causality test, we have to specify the lag length l. Usually is best to have more lags to catch the relevant information from the past. In our study, we tested for Granger causality by using different lag lengths from 2 to 6 lags to establish what the lag period is where more causality interaction between variables happens.

After establishing the lag length l we run a bivariate regression of the form:

$$y_t = \alpha_0 + \alpha_1 y_{t+1} + \cdots + \alpha_l y_{t-l} + \beta_1 x_{t+1} + \cdots + \beta_l x_{t-l} + \varepsilon_t. \tag{6}$$

$$x_t = \alpha_0 + \alpha_1 x_{t+1} + \cdots + \alpha_l x_{t-l} + \beta_1 y_{t+1} + \cdots + \beta_l y_{t-l} + \mu_t. \tag{7}$$

for each possible pair of (x, y) series of the group. The F-statistics reported are the Wald statistics for the joint hypothesis:

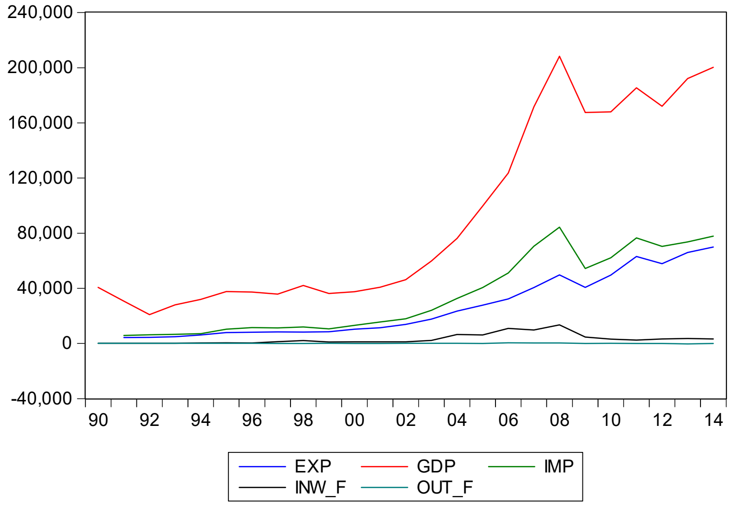
$$\beta_1 = \beta_2 = \cdots = \beta_l = 0. \tag{8}$$

for each equation. The null Hypothesis is that $x$does not Granger-cause$y$in the first regression and$y$does not Granger-cause x in the second regression.

Results and discussions

We start our investigation by analyzing the graphical evolution of the variables. As we can see from Fig.1 the evolutions of the GDP, imports, exports and inward flow of foreign direct investments registered a positive trend until 2008 when the effect of the international financial crisis determined a decrease of the above mentioned variables After the shock of 2008 the GDP and imports had an oscillate evolution and, until 2014 they didn't reach the 2008 levels. The exports were influenced less than exports by the financial crisis and even if the shock was obvious they recover quicker and started engaged on a faint ascending trend.

Figure 1. *Evolution of variables in the period 1990-2014 (million USD)*



Source: authors calculations based on data from UNCTAD and INS.

The inward flow of foreign direct investments remained at a low level from 13 491 million USD in 2008 to around 3 000 million USD. The outward flow of foreign direct investments was very low in the analyzed period in comparison with the inward flow of foreign direct investments, characterized by small spikes of outward investments in some years.

Table 1. *Correlation table*

	OUT_F	INW_F	IMP	GDP	EXP
OUT_F	1.000000	0.661853	0.090063	0.039804	-0.114798
INW_F	0.661853	1.000000	0.676228	0.643187	0.499121
IMP	0.090063	0.676228	1.000000	0.992722	0.969395
GDP	0.039804	0.643187	0.992722	1.000000	0.970106
EXP	-0.114798	0.499121	0.969395	0.970106	1.000000

Source: author's calculations.

In Table 1, we explore the correlation between the analyzed variables and we consider the next intervals adequate for our analyze: 0 – ±0.3 no correlation; ±0.3 – ±0.7 moderate correlation; ±0.7 – ±1 strong correlation (Fassil, 2009).

According to these intervals we observe that there is a very strong positive correlation between exports and imports of 0.97, GDP and imports of 0.99 and GDP and exports of 0.97. there is a moderate positive correlation between inward flow and outward flow of FDI of 0.66, imports and inward flow of FDI of 0.68, GDP and inward flow FDI of 0.64, exports and inward flow of FDI of 0.50 and GDP and outward flow of FDI of 0,40. There is no correlation between imports and outward flow of FDI and exports of 0.09 and outward flow of FDI of –0.12.

Forward we test the variables for unit root. We used the ADF test with Schwarz Info criterion to determine the lag length and a maximum number of 5 lags.

Table 2. *Unit root test*

Variable	Test for unit root in	Lag length	t-statistic	Prob.*
EXP	level	0	2.792126	0.9977
	1st difference	2	-0.792047	0.3602
	2nd difference	1	-10.07623	**0.0000**
GDP	level	0	1.581388	0.9682
	1st difference	0	-3.498139	**0.0013**
	2nd difference			
IMP	level	0	0.990008	0.9093
	1st difference	0	-4.405980	**0.0001**
	2nd difference			
INW_F	level	0	-1.158958	0.2176
	1st difference	0	-5.644362	**0.0000**
	2nd difference			
OUT_F	level	0	-2.825215	**0.0068**
	1st difference			
	2nd difference			

*MacKinnon (1996) one-sided p-values.
Source: author's calculations.

As we can see from Table 2, only the outward flow of foreign direct investments was stationary and the rest of the variables had to be differenced at level 1 or 2. GDP, imports and inward flow of foreign direct investments became stationary at 1st difference, exports became stationary at 2nd difference.

After achieving stationary variables we can proceed with the Granger causality test. In Tables 3, 4 and 5 we can see the results of the test for a number of lags from 2 to 6.

In Table 3 we have the results for the Granger causality tests between the next pairs of variables: inward flow of FDI – outward flow of FDI, imports – outward flow of FDI, GDP – outward flow of FDI and exports – outward flow of FDI.

The first pair of variables shows us that there is Granger causality on both ways statistically significant on almost all lags lengths and we can see that the highest probability is registered in the lag length of 2 for the inward flow of FDI that Granger cause outward flow of FDI and lag length 3 for outward flow of FDI that Granger cause the inward flow of FDI. The second pair show us that there is imports does not Granger cause outward flow of FDI for lag length of 2, 3, 4 and 5 but it does for lag length 6. Outward flow of FDI does Granger cause imports for lag lengths of 3, 4, 5 and 6 but not for a lag length of 2. The third pair shows us that the GDP does not Granger cause outward flow of FDI for all the length lags while outward flow of FDI does Granger cause GDP for lag lengths of 3, 4, 5 and 6 but not for a lag length of 2. The fourth pair show us that exports does not Granger cause outward flow of FDI for all lag lengths, while outward flow of FDI Granger cause exports for a lag length of 4, 5 and 6 and not for lag lengths of 2 and 3.

Table 3. *Granger causality test results 1*

Lag level \ Null Hypothesis		INW_F does not Granger Cause OUT_F	OUT_F does not Granger Cause INW_F	IMP does not Granger Cause OUT_F	OUT_F does not Granger Cause IMP	GDP does not Granger Cause OUT_F	OUT_F does not Granger Cause GDP	EXP does not Granger Cause OUT_F	OUT_F does not Granger Cause EXP
2	Obs.	22		21		22		20	
	F-Statistic	5.8938	2.007	0.2704	0.5974	0.6049	0.8266	0.3710	0.2538
	Prob.	*0.011*	0.165	0.766	0.562	0.557	0.454	0.696	0.779
3	Obs.	21		20		21		19	
	F-Statistic	3.7959	6.5256	0.9546	5.6628	1.9030	9.2619	1.1834	1.5475
	Prob.	*0.035*	**0.006**	0.443	*0.011*	0.176	**0.001**	0.357	0.253
4	Obs.	20		19		20		18	
	F-Statistic	4.2919	5.4747	1.4780	14.267	1.8415	7.6089	0.8362	4.6292
	Prob.	*0.025*	*0.011*	0.280	**0.000**	0.191	**0.003**	0.535	*0.026*
5	Obs.	19		18		19		17	
	F-Statistic	5.4409	5.2200	3.2827	25.327	1.3833	9.4155	0.8374	6.6271
	Prob.	*0.018*	*0.020*	0.076	**0.000**	0.325	**0.003**	0.568	*0.020*
6	Obs.	18		17		18		16	
	F-Statistic	3.9442	4.2363	10.537	16.31	4.3900	7.2289	1.6308	26.955
	Prob.	0.077	0.067	*0.020*	**0.009**	0.063	*0.023*	0.369	*0.011*

5% statistical significance; 1% statistical significance.
Source: author's calculations.

In Table 4 we have the results for the Granger causality tests between the next pairs of variables: imports – inward flow of FDI, GDP – inward flow of FDI and exports – inward flow of FDI.

Table 4. *Granger causality test results 2*

Lag level \ Null Hypothesis		IMP does not Granger Cause INW_F	INW_F does not Granger Cause IMP	GDP does not Granger Cause INW_F	INW_F does not Granger Cause GDP	EXP does not Granger Cause INW_F	INW_F does not Granger Cause EXP
2	Obs.	21		22		20	
	F-Statistic	3.85515	2.43049	6.15952	1.01166	0.62457	1.04388
	Prob.	*0.043*	0.120	**0.010**	0.385	0.549	0.376
3	Obs.	20		21		19	
	F-Statistic	2.82692	1.36277	3.22166	1.30934	1.0003	0.42858
	Prob.	0.080	0.298	0.055	0.311	0.426	0.736
4	Obs.	19		20		18	
	F-Statistic	3.96557	1.54463	2.32834	0.40041	0.89308	1.12914
	Prob.	0.035	0.263	0.121	0.805	0.506	0.402
5	Obs.	18		19		17	
	F-Statistic	3.7858	3.89844	2.17027	1.29385	4.082	4.74014
	Prob.	0.056	0.052	0.158	0.355	0.058	*0.042*
6	Obs.	17		18		16	
	F-Statistic	1.71604	2.1342	0.85433	0.87428	1.61273	4.98629
	Prob.	0.313	0.242	0.580	0.570	0.373	0.108

5% statistical significance; 1% statistical significance.
Source: author's calculations.

The first pair shows us that imports Granger cause inward flow of FDI only in lag length of 2 and does not for lag lengths of 3, 4, 5 and 6, while inward flow of FDI does not Granger cause imports for all lag lengths analyzed. The second pair show us that GDP Granger cause inward flow of FDI only in lag length of 2 and does not for lag lengths of 3, 4, 5 and 6, while inward flow of FDI does not Granger cause GDP for all lag lengths analyzed The third pair show us that exports does not Granger cause inward flow of FDI for all lag lengths analyzed, while inward flow of FDI Granger cause exports only in lag length of 5 and does not for lag lengths of 2, 3, 4 and 6.

In Table 4 we have the results for the Granger causality tests between the next pairs of variables: GDP – imports, exports – imports and GDP – exports.

Table 5. *Granger causality test results 3*

Lag level	Null Hypothesis	GDP does not Granger Cause IMP	IMP does not Granger Cause GDP	EXP does not Granger Cause IMP	IMP does not Granger Cause EXP	EXP does not Granger Cause GDP	GDP does not Granger Cause EXP
	Obs.	21		20		20	
	F-Statistic	0.14494	0.12197	1.63693	6.04294	3.30138	2.67487
2	Prob.	0.866	0.886	0.228	*0.012*	0.065	0.102
	Obs.	20		19		19	
	F-Statistic	0.15278	0.55878	2.4473	5.7404	1.71351	3.16423
3	Prob.	0.926	0.652	0.114	*0.011*	0.217	0.064
	Obs.	19		18		18	
	F-Statistic	0.29072	0.23003	2.91719	2.86778	0.49156	1.34977
4	Prob.	0.877	0.915	0.084	0.087	0.743	0.324
	Obs.	18		17		17	
	F-Statistic	0.70096	0.46832	4.27559	2.61231	1.55252	1.74556
5	Prob.	0.640	0.790	0.053	0.137	0.302	0.258
	Obs.	17		16		16	
	F-Statistic	0.56426	0.34997	3.19364	1.96062	0.77571	1.59032
6	Prob.	0.747	0.879	0.184	0.310	0.639	0.378

5% statistical significance; 1% statistical significance.
Source: author's calculations.

The first pair shows us that GDP does not Granger cause imports for all lag lengths analyzed and imports does not Granger cause GDP for all lag lengths analyzed. The second pair shows us exports does not Granger cause imports for all lag lengths analyzed while exports Granger cause imports for lag lengths of 2 and 3 and does not for lag lengths of 4, 5 and 6. The third pair shows us that exports does not Granger cause GDP for all lag lengths analyzed and GDP does not Granger cause exports for all lag lengths analyzed.

The relations between the analyzed variables show us that there is a complex interconnection between them. Results show us that there is a strong causality relation between inward and outward flow of FDI, which can be explained by the fact that as Romania received inward FDI, domestic companies learn from foreign companies new managerial and technological skills which in turn allow them to invest abroad. On the other hand, as Romanian companies realize investments abroad spread information about the level of development of home country making it interesting for potential foreign investors.

The fact that the level of outward flow of FDI Granger cause imports and GDP show us that as a country starts to invest abroad, its level of development is increasing generating an increase of imports in order to sustain that development.

Another important result is that outward flow of FDI Granger cause exports is in line with other researchers' results (Dunning and Lundan, 2008), as outward FDI tend to replace exports. As outward flow of FDI increases, the level of exports tends to decrease because the companies that were exporting moved their production in the country or the region where it was exporting before.

Imports Granger cause inward flow only for a lag length of 2, which means that a spike on the imports may generate an inward flow of FDI in the next period, but as time passes this is not true anymore. As the theory say (Dunning and Lundan, 2008; Narula and Pineli, 2016), foreign investors search for the right time for an investment, which will bring them the highest return. The same can be said for the influence of GDP on inward flow of FDI, but in this case, the development of a country may determine the decision of a foreign investor to start a new investment.

In the case of Romania, we must acknowledge that the evolutions of the analyzed variables were influenced by the different policies and events that happened in the research period. Firstly, we must take into account that at the start of the analyzed period Romania was in the process of transition from communism to capitalism, which generated a lot of distortions in the economy (Zaman et al., 2011). Also, we have to acknowledge that until the year 2000, Romania had a positive discrimination treatment for foreign investors which, even if it is not a policy anymore tend to be present this days too.

Conclusions

FDI is probably the most complex package of economic activity because they involve financial, management, material, technological and know-how flows. For this reason, their impact on host economies is much diversified. The main contribution is financially, this becomes especially important for countries in the developing world where the rate of domestic investment is reduced and official assistance fell mostly in relative expression to the total financial flows perceived. Moreover, in the case of the privatization of large state enterprises, the foreign investors are the only bidders because the local companies do not have sufficient financial resources to sustain such transactions.

By spillover effects, FDI contributes to the development of local firms, generating additional demand in upstream sectors and providing products and services for downstream sectors. So FDI generates domestic investment. In addition, FDI has important contributions on human capital development, technology transfer, restructuring, foreign trade and competitiveness of the host country. It should pay attention to the fact that there are situations where FDI has effects negative. Sometimes dissatisfied with quality of local products, foreign affiliates may waive local suppliers, preferring imports of certain goods.

The impact of FDI on the Romanian economy depends on numerous factors such as investment type, method of implantation (greenfield investment or taking over local companies, including the participation to the privatization process), supply of local or foreign factors of production, orientation to local/foreign markets, scope, strategy adopted by transnational corporations. FDI and domestic investment are complementary, both contributing to GDP growth by specific influences and impacts. Besides the relation of them, there is a certain level of saturation, in time, of the national economy to FDI. This is determined by:

- the capacity to absorb FDI by the national economy;
- the business peculiarities - bureaucracy, corruption, high taxes, unpredictability of the legal system;
- the foreign investors' behavior (after they have recovered the investment in the host country, they enjoy the freedom to leave, to withdraw when faced with some efficiency problems);
- the repatriated profits of foreign subsidiaries are typically higher that the reinvested profit in host countries (Zaman et al., 2011).

This saturation tendency opposes the increasing internationalization and globalization and underutilized economic potential of our country.

Foreign direct investments have very complex relations with different indicators of the host country as well as with the source country economy. As the level of development of a country is more advanced so is the complexity of the relations. In our endeavor to try to find causality relations between the above presented variables we must acknowledge a few drawbacks like a reduced number of observations that can be used to generate suitable results, but with a larger number of observations the results may be more robust, different policies and events that influenced the data in the analyzed period.

In our study, we were able to observe a few effects that are in line with the results of other researchers like the relation between inward and outward flow of FDI, the effect of outward flow of FDI on imports and exports.

We also had some results that are contradictory with the theory of FDI and the most puzzling one is that we couldn't find a causality relation between inward flow of FDI and GDP. This has been observed by other researchers (Narula and Driffield, 2012; Zanfei, 2012) in other studies and it means that the host country didn't transfer the influx of technology and managerial skills of foreign companies to domestic companies. This means that Romania didn't benefit of the full potential of inward FDI effects. This situation could be explained by the fact that the main part of FDI is concentrated in medium and low tech level branches (Zaman, 2012). So, the Romanian authorities must search for a suitable policy to access this resource that may spur future development for its companies and citizens. For example, a selective approach must be used in order to attract FDI in high tech level sectors by using differential incentives in order to increase the high technology transfer and generation.

Regarding the influence of FDI on Romanian foreign trade, according with the data released by the Romanian National Bank for the last years, the foreign affiliated that operated in Romania have an important impact on exports and imports (60-70%). That demonstrate a strong control exercised by foreign subsidiaries on the foreign trade of our country and consequently on the national economy. The main problem is that foreign affiliates have a negative impact on trade balance because the value of import is bigger that the value of exports realized by these entities.

In addition, the Romanian specialists (Zaman and Geamănu, 2010) have mentioned the consistent contributions of some transnational companies like Renault, OMV and Sidex Mittal to Romanian exports and GDP. Because the main part of FDI attracted by Romanian economy are located in non-tradable and services sectors (Zaman, 2012; Anghelache et al., 2015), their contribution to the increase of export is limited.

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Economic freedom and foreign direct investment in South Asian countries

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Abstract. *The risk related to any overseas investment is polygonal which reflects numerous features that are appropriate for investor, such as rule of law, transparency, governance, level of international trade, business and financial conditions etc. All such components combine to form domestic investment climate of an economy, which influence the inflows of foreign capital in a country. This study analyzed the role of domestic investment climate (measured by Heritage Foundation economic freedom index) along with other macroeconomic variables in attracting FDI in South Asia covering 20 years from 1995 to 2014 by applying panel data techniques. Results revealed that overall economic freedom is an important determinant of FDI. Disaggregated analysis of economic freedom suggests that only fiscal and trade freedom has statistically significant influence on FDI. Therefore, Study recommends south Asian Nations to improve domestic investment environment to attract more foreign capital.*

Keywords: economic freedom, foreign direct investment.

JEL Classification: O170, F210.

1. Introduction

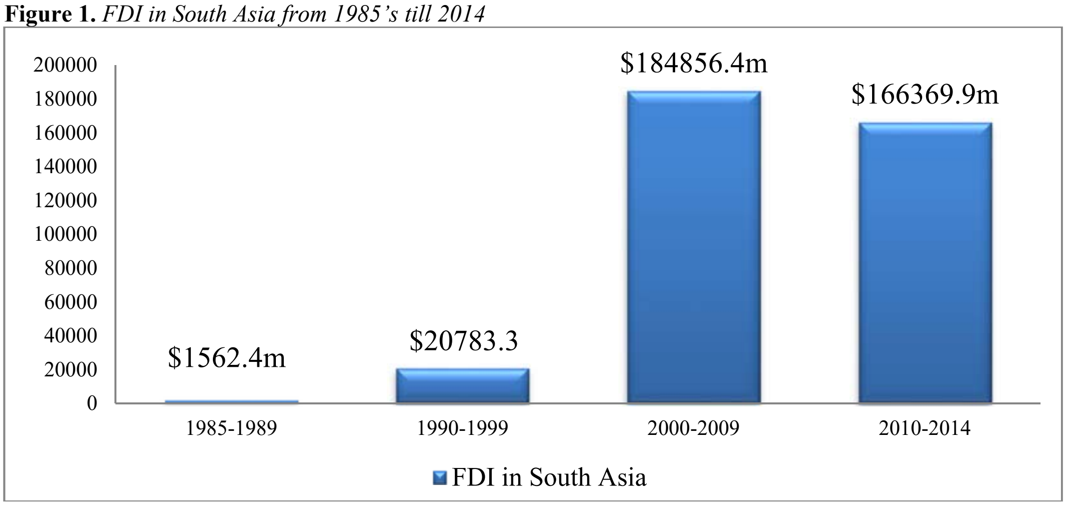
Foreign direct investment has been recognized as one of the key source of financing long term sustainable economic progression in developing countries. FDI plays a critical role in the development of recipient countries by helping nations to improve their economic performance, through Technological development, capital accumulation, improving resource allocation and strengthening financial capital. Considering the benefits derived from FDI, firms usually have different motives behind attaining FDI which are described by Dunning (1997) OLI Model (ownership-specific factors, location-specific factors and internalization advantages). It is also observed that along with macroeconomic determinants other factors like institutions of the host country also play important role in attracting foreign direct investment. A well-developed institutional framework also comprising better investment climate, allows firms greater discretion in the choice of their strategies. Market-supporting and investment friendly institutional environment facilitates foreign investors by reducing unnecessary hurdles in business operations and maintaining such activities in host countries. Macro-level institutions in a nation influence transactions costs within that economy. Empirical findings suggested that strong institutions of a country will make it an attractive destination for FDI for three reasons. First, it decreases transaction costs (Bevan and Estrin, 2004) secondly, a well-developed institutional framework allows firms greater discretion in the choice of their strategies (Delios and Beamish, 1999). Finally, it will reduce risks related with transactions by decreasing information asymmetries (Tong et al., 2008).

Domestic investment environment of a country can be captured by “Economic Freedom” prevailing in a nation. Freedom implies no restriction, pressure or obligation in choice or exchange or transfer of personal assets which have achieved legally. Gwartney (2009) proposed that main constituents to Economic Freedom comprise protection of individual as well as property, freedom to compete, and voluntary exchange. In an economically free society, individuals are free to work, produce, consume and invest in any way they please and government permits free movement of labor, capital and goods. Economic Freedom is a composite measure of different aspect of domestic investment climate including freedom in selection and supplying resources, competition in business activities and freely trade with others. According to Heritage Foundation Index, economic freedom is the amalgamation of ten subcomponents namely property right freedom, freedom from corruption, labor freedom, fiscal freedom, business freedom, monetary freedom, trade freedom, government spending, investment freedom and financial freedom. Hence, Economic freedom provides better investment climate which is very important for the foreign firms. MNCs while allocating resources mainly consider the environment provided by host country for investment because it will affects the decision of allocation. Nations having improved environment for investment are able to attract more MNCs as it is easy for them to work in investment friendly climate. The importance of domestic environment in attracting foreign capital motivates us to analyze this relationship along with other influential aspects of FDI in five South Asian economies, Pakistan, Bangladesh, India, Nepal and Sri Lanka, over a 20-year time frame from 1995 to 2014.

2. Trend analysis of FDI in South Asian economies from 1985-2014

Flow of foreign investment to the developing economies of South Asia is raised substantially since 1980's with some fluctuations. Data highlighted that in 1985's foreign investment to South Asian nations was low while 1990s there is a gradual rise due to liberalized policies adopted by the nations. Figure 1 reveals that FDI has increased substantially in 2000s and extended up to $184856.4 million. According to UNCTAD (2011) huge decline has been noticed after 2008 global financial crisis.

Figure 1. *FDI in South Asia from 1985's till 2014*



Source: Index Mundi (2016).

The bifurcation of FDI in the region is shown in Table 1. It is noted that India has kept up higher FDI in the region throughout the period trailed by Pakistan. Similarly Indian economy was able to attain highest inflows of FDI till 2014. India is one among the emerging economies of the world which is also providing better investment climate to foreign firms. In South Asia, India is the dominant recipient of inflows in automotive industry and during 2013-2014; Indian was able to get 12 projects larger than $100 million. According to the World Investment Report (2015) India has jumped to the ninth rank in 2014 with a 22% rise in the FDI inflows where it was in the fifteenth position in the previous two years. For Nepal, volume of FDI remains negligible over three decades. During 1985-1989, flows on foreign capital were minimal or even negative in Nepal, with an average of $4.31 million. However, there was a distinct acceleration during the 1990s, although total amount of flows remained insignificant during 1990-2000. Nepal does not work well in attracting foreign investment as compared with the rest of developing economies of South Asia. Increase in FDI may be attributed by the experts as a result of investment boom. Moreover, FDI incorporates the economic strategies which interns enhance efficiency of capital and labor.

Table 1. *Bifurcation of FDI in South Asia*

Country	1985-1989 (million dollars)	1990-1999 (million dollars)	2000-2009 (million dollars)	2010-2014 (million dollars)
Bangladesh	7.727	558.073m	5226.208m	8484.125m
India	779.49	15060.64m	156290.2m	149915.7m
Nepal	4.31	79.352m	83.087m	353.835m
Pakistan	763.588	5008.599m	23006m	7318m
Sri Lanka	7.373	76.639m	250.951m	298.322m

India was able to acquire 30% share of FDI inflows in 2000-2013 in south Asian Countries. According to a survey report of UNCTAD, during 2010-2012 it has been noticed that the second most important FDI destination after China was India for MNCs. There has been a tremendous up surge in the economic development of the country. However, the sectors in which inflows of foreign investment were increased included: services, construction activities, telecommunication, computer software and hardware industry while the UK, US, Singapore and Mauritius were among the leading sources of foreign investment flows. Moreover, Pakistan captured 27% of the total foreign capital followed by Sri Lanka (24%) and Bangladesh (15%) during 2000-2013. In South Asian economies Nepal, being a least developed nation, has equipped for drawing the least amount of inflows (4%). In the underlying years of its liberalization, Nepal's share was very insignificant and minute.

3. Literature review

Existing Foreign direct literature is fundamentally aimed to explore different determinants of FDI and their impact on the economy. Economic environment of a nation is an important factor in stimulating FDI. It is the product of interaction among a number of normative, regulative and cultural cognitive institutional components. North (1991) defines institutions as "perceived confinements that structure financial and socio political cooperation". They include both informal aspects (culture and traditions) and formal aspects (laws and regulations). On the bases of North's work institutional economists argue that "the policy and institutional environment is an essential factor of economic growth because sound institutions inspire productive actions and depress predatory behavior" (Gwartney, 2009). As indicated by this perspective, availability as well as productivity of resources is influenced by the quality of an economy's institutions. There has been a significant surge in empirical and theoretical work in the recent years, using the institutional approach in international business research. Khanna and Palepu (2000) have claimed that the absence of developed institutions make unrelated diversification an attractive strategy in developing economies. It has also been noted that in institutionally distant nations, subsidiaries have enhanced survival chances but there should be more ownership of foreign firms (Gaur and Lu, 2007). In this regard, transparency in financial approaches is a fundamental issue for foreign investors. If financial environment is not in favor of foreign investors, it can impose additional expenses on firms which give negative impression about nations.

Many researchers used Economic freedom to capture the institutional environment prevailing in the nation. Gwartney et al. (1996) stated that: “individuals have economic freedom when (a) the property attain is without the use of theft, fraud or force and protected from physical invasions by others and (b) they are free to exchange, use or give away their property as long as their activities do not violate the identical rights of others.” It is described by Heritage Foundation Index as “the absence of government constraint or coercion on the production, distribution, consumption of goods and services beyond the extent necessary for citizens to protect liberty”. So, economic freedom reflects investment climate prevailing in domestic economy which helpful in efficient allocation of resources.

Economic freedom is taken as an indicator of the domestic investment climate in the literature. For instance, Quazi (2007) revealed that lucrative investment climate prevailed in East Asian countries attracted significant foreign investment. Furthermore, large market size, higher return on capital and greater information about the location where investment will be allocated will improve the flow of foreign capital. Similarly, Zghidi et al. (2016) empirical analysis found economic freedom is an important element for economic progression. In this regard market-supporting and investment friendly institutional environment also facilitates foreign investors by reducing unnecessary hurdles in business operations and maintaining such activities in host countries (Wei, 2000). Foreign entrants are likely to maximize profits and eliminate transaction costs in the presence of well-functioning regulatory frameworks and market supporting policies (Hoskisson et al., 2000). However, an efficient and favorable market-supporting institutional regime lessens investment related costs of foreign investors in uncertain business environments and does not hinder access to essential organizational capabilities.

Foreman (2007) illustrated that changing certain components of economic freedom like reducing government intervention, increasing property rights protections and lowering barriers to capital flows are likely to raise FDI. Similarly, Bengoa and Robles (2003) illustrated that economic freedom in the host nation has a positive impact on FDI while Nasir and Hassan (2011) explored the association among economic freedom, market size and FDI in South Asian countries from 1995-2008 and found that the association between market size and FDI is significant which is quite reasonable because markets which are large have more potential for attracting foreign direct investment.

Aggregate impact of economic freedom can be different from its subcomponents effect. The property rights protection in terms of reducing government intervention and efficient enforcement of contracts is considered to be an essential institutional determinant of FDI (Cotton and Ramachandran, 2001; Fabro and Aixala, 2012). Foreign investors are keen in the appropriate enforcement of lawful contracts to guarantee continuous business transactions. Secondly, corruption can drastically influence the effectiveness of FDI. It arises from the misuse of discretionary authority, endorsed or unchecked by weak legal frameworks in host nations. The presence of corruption is widely believed to influence business activities through raising the operating charges of foreign investors (Jain, 2001; Mudambi et al., 2013; Ajide and Eregha, 2014). Dima (2008) showed that overall a higher level of the components of economic freedoms (mainly security of property rights) tends to be associated with a better capacity of the host countries to attract FDI.

Similarly, Beheshtitabar and Irgaliyev (2008) explored that only investment freedom and trade freedom have significantly positive impact in receiving FDI. Which indicates that reducing trade barriers (both tariff and non-tariff barriers) and improving environment for investment are positive indicators for FDI. While, Hassan (2015) found that the countries with lower tax burden, corruption-free operating environment and business friendly regulation impose a positive influence on international relocation decision of the investors. Similarly government size being one of the subcomponents of economic freedom is negatively associated with FDI. Bellos and Subasat, (2012) implies that FDI is encouraged by a decline in government size. However business regulations that ease operations can be significant influencing aspect of FDI. Another aspect of economic freedom is effective liberalization in the services sector. The impact of openness to trade was examined by Kandiero and Chitiga (2014). Increasing openness in the whole economy while reducing tariff and nontariff barriers such as licensing will enhance FDI inflows in a country. The greater imposition of direct as well as indirect taxes raises the transaction costs of establishing and maintaining businesses in foreign nations (De Mooij and Ederveen, 2003). Similarly, on the effects of corporate income taxation, most EU based studies find a negative association of higher tax rates on FDI. Like, Bellak and Leibrecht (2009) revealed negative relationship with corporate taxation on FDI.

Where, Sambharya and Rasheed (2015) indicated that better economic management (monetary policy, fiscal burden and banking and finance), less government participation in the economy in terms of government size and absence of wage and price control leads to higher FDI. Julio et al. (2013) found that reducing corruption, lessening restrictions on investment, higher protection of private property, the independence of the financial system and labor freedom will enhance FDI streams. So, better level of economic freedom not only attains greater amount of foreign capital but also permits host nations to take full advantage from foreign investments. The literature highlights the fact that with regard to the role of economic freedom in determining FDI, previously few studies were conducted on South Asia. However, along with other determinants of foreign direct investment, this study will going to investigate the role of economic freedom and it’s subcomponents in determining FDI in the South Asian region.

4. Data and methodology

By implying panel regression method this study empirically explores the role of economic freedom in attracting FDI in selected South Asian countries during 1995-2014.To analyzed the heterogeneity among the panel data researcher can either apply fixed or random effect model. Fixed effect determine whether intercept varies across time or across group while random effect check differences in error variance over period of time or across group. Hausman specification test (Hausman, 1978) equates whether a random effect model is applicable or fixed effect. Its null hypothesis is that the individual effects are not correlated with the other regressors, when this null it is rejected; a fixed effect model is favored over its random effect model. This study assumes a positive association between Economic Freedom and FDI stocks.

The econometric model specification is as follows:

$$(FDI)_{it} = \beta_{0i} + \beta_1 (EF)_{it} + \beta_2 (MS)_{it} + \beta_3 (HC)_{it} + \beta_4 (TRA)_{it} + \\ + \beta_5 (QOI)_{it} + \beta_6 (NR)_{it} + \varepsilon_{it}$$

In above model, FDI stock is dependent variable of country i at time t , while independent variables are Economic freedom (EF), Market size (MS), Human capital(HC), Trade (TRA), Quality of infrastructure (QOI) and Natural resource (NR).Current study used Heritage Foundation Economic freedom Index which ranges from 0-100, where 0 is minimum and 100 implies maximum economic freedom. Data of FDI Stock & Natural resources (ores and metals export as percentage of merchandise export) is extracted from ESCAP online Statistical database 2016 while market size (measured by GDP per capita), Human Capita(Gross secondary school enrolment ratio) and total trade as percent of GDP is taken from World Development Indicator 2016.

5. Results discussion

Correlation analysis is conducted before applying panel regression in order to detect strength of linear association among the variables. Result in Table 2 revealed that economic freedom has a strong positive association with FDI in south Asian countries. Correlation of all independent variable is less than 0.80 which indicate that there is no multicollinearity among the independent variables. In our study, the VIF values for independent and control variables used in regression analysis also less than 10. So any potential collinearity is not expected to influence the results of panel regression analysis.

Table 2. *Correlation analysis*

	FDI	EF	HC	MS	NR	QOI	TRA
FDI	1.000						
EF	0.686***	1.000					
HC	0.413***	0.519***	1.000				
MS	0.783***	0.618***	0.784***	1.000			
NR	-0.218**	-0.434***	-0.194*	-0.222**	1.000		
QOI	0.125	-0.156	0.028	0.120	0.736***	1.000	
TRA	0.299***	0.697***	0.676***	0.414***	-0.338***	-0.202**	1.000

Table 3 displays the panel regression analysis for role of economic freedom in FDI. Hausman test is performed to choose between fixed and random effect model. This test looks at whether the individual impacts are uncorrelated with different regresses in the model. If the null hypothesis is rejected, a fixed effect model is applied. However, after applying Hausman test it is revealed that fixed effect is appropriate for this model.

Table 3. *Impact of economic freedom on foreign direct investment*

Independent Variables	MODEL 1	MODEL 2	MODEL 3
Economic Freedom	0.161* (0.068)	0.137** (0.035)	0.117* (0.044)
Market Size	0.005*** (0.001)	0.006*** (0.001)	0.004*** (0.001)
Human Capital	0.054** (0.013)	0.046** (0.014)	0.031** (0.007)
Trade	0.083*** (0.017)	0.079*** (0.016)	0.045* (0.017)
Natural Resources		0.138 (0.138)	0.051 (0.284)
Quality of Infrastructure			3.96E-05** (1.3E-06)
Constant	-12.15** (4.151)	-11.39*** (4.012)	-6.859* (2.855)
Diagnostic Tests			
observations	99	95	95
R^2	0.641	0.665	0.692
Adj. R^2	0.625	0.629	0.670
F-Stats.	24.79	33.72	31.42
F (p-value)	0.000	0.000	0.000
Hausman (p-value)	0.000	0.000	0.000

Standard error in parenthesis, ***, ** and * represent the level of significance at 0.01, 0.05 and 0.10 percent, respectively.

Table 3 represents estimation results of three models in which FDI stock is dependent variable. The coefficient of Economic Freedom is positive and statistically significant in all models at varying level of significance. It shows that increase in Economic Freedom leads to increase FDI in South Asia. The rationale for this positive relationship is that higher economic freedom implies improved domestic investment environment prevailing in the country. This will provide better rule of law, regulatory efficiency with open market economy, which encourages foreign investors to bring more investment. This positive relationship between Economic freedom and FDI is supported backed by Pourshahabi et al. (2011), Ajide and Eregha (2014), Sambharya and Rasheed (2015).

Market size which is measured by GDP per capita demonstrates a positive and statistically significant relationship with FDI in all models. As large market size would seems as an attractive factor for investors who are seeking higher demand for their products. Investors can get benefit from efficient allocation of resources and economies of scale. This implies that investors are appealed to host economies having sizeable markets. Our results are in line with Laabas and Abdmoulah (2009), Mohamed and

Sidiropoulos (2010), Pourshahabi et al. (2011), Amendolagine et al. (2013), Bannaga et al. (2013) and Ajide and Eregha (2014).

Study also included human capital, which has positive and significant relationship with FDI. It is a worthy signal indicating that availability of a skilled workforce is a significant factor and plays important part in attracting FDI stock. While Jimenez (2011) recommended that higher rates of enrolment in education is an indicator for an accessible more productive and qualified workforce trained to adapt more swiftly to advance technologies and knowledge. Hakro and Omezzine (2011) found the similar results. Trade is also included as an independent variable and its coefficient value is positive and statistically significant. However, markets that are more open are having better chances to have significant economic welfare gains with the help of more efficient allocation of resources as compared to the markets that are less open. Thus, foreign investors prefer investing in nations with substantial volume of trade. Our trade results are consistent with Elfakhani and Matar (2007) and Abderrezak (2008).

Model 2 includes natural resources, which are measured by ores and metal export in South Asia. Literature highlights the fact that natural resource is one of the important variables for gaining FDI. Whereas, our study results indicate statistically insignificant relationship of natural resources and FDI. While quality of infrastructure, which is measured by mobile subscription (per 1000 people), is incorporated in model 3 along with natural resources as independent variable. Estimation results reveal that it has positive and significant impact on FDI; a good infrastructure attracts more FDI. However, this value is very small but it is statistically significant. Availability of better infrastructure reduces transaction costs by permitting entrepreneurs to easily connect with their customers and suppliers. Infrastructure provision, like highways, roads, ports, electricity, communication networks would generally increase productivity and thereby attract higher levels of FDI. The positive association between FDI and quality of infrastructure is consistent with Asiedu (2002), Khadaroo and Seetanah (2007) and Benacek et al. (2014).

Results depict that economic freedom, market size, human capital, trade and quality of infrastructure have positive and statistically significant influence on FDI, while natural resources have positive and statistically insignificant impact in current study. The explanatory power of all the statistical models of the study is good because R^2 is (64.1, 66.5 and 69.2) percent respectively. Probability of F-statistics is below 0.01 percent in all models which represent the correctness of model. It is also important to mention that along with doing the regression analysis for the aggregate economic score, we have also divided the economic freedom index into sub-components in order to perform detailed analysis as well as observe difference/similarities between these sub-categories of economic freedom in attracting FDI.

Economic Freedom has ten subcomponents described by *Heritage Foundation Index*(1). In current study we only display fixed effect results of those subcomponents whose coefficient is statistically significant in different models. It is shown that fiscal freedom is positive and significant in all the three models. Fiscal freedom measures the burden of direct as well as indirect taxes on conducting businesses in the host countries. However, in model 3 by including quality of infrastructure as independent variable fiscal freedom coefficient value is increased to 0.62 units. Reducing tax burden will cause in reduction of cost associated with business. So it has substantial impact on the location choices by foreign investors in the South Asia. This result is consistent with Hassan (2015).

Second component is trade freedom as it measures the absence of obstacles known as tariff plus non-tariff barriers that affect export and import of goods and services. Trade freedom is significantly positive only in model 1 and 2. This positive association is consistent with Beheshtitabar and Irgaliyev (2008). While remaining subcomponents of economic freedom including property right freedom, freedom of corruption, government spending, business freedom, labor freedom, monetary freedom, investment freedom and financial freedom are insignificant indicating that, they are not playing important role in attracting FDI in the South Asian region.

Table 4. *Impact of subcomponents of economic freedom on FDI*

Models	Model 1		Model 2		Model 3
Independent variable	Fiscal freedom	Trade freedom	Fiscal freedom	Trade freedom	Fiscal freedom
Sub component of Economic Freedom	0.057*** (0.011)	0.022* (0.009)	0.057*** (0.011)	0.023* (0.009)	0.062*** (0.011)
Market Size	0.004** (0.001)	0.004*** (0.000)	0.005** (0.00132)	0.005*** (0.0008)	0.003** (0.001)
Human Capital	0.047*** (0.009)	0.041** (0.013)	0.042** (0.011)	0.036*** (0.007)	0.024** (0.005)
Trade	0.109** (0.025)	0.098*** (0.019)	0.099** (0.023)	0.088*** (0.017)	0.056* (0.022)
Natural Resources			0.049 (0.275)	0.082 (0.298)	-0.033 (0.286)
Quality of Infrastructure					4.0E-05** (1.3E-06)
Constant	-8.389*** (1.329)	-4.297* (1.662)	-8.561*** (1.326)	-4.519** (1.317)	-4.849** (1.499)
Diagnostic tests					
observations	99	99	95	95	95
R^2	0.642	0.63	0.673	0.662	0.708
Adj. R^2	0.609	0.597	0.626	0.626	0.688
F Stats.	40.29	38.35	34.99	33.31	33.97
F (p-value)	0.000	0.000	0.000	0.000	0.000
Hausman (p-value)	0.000	0.000	0.000	0.000	0.000

Standard error in parenthesis, ***, ** and * represent the level of significance at 1, 5 and 10 percent levels, respectively.

6. Conclusion

This study empirically explore the role of domestic business environment measured by Heritage foundation economic freedom index in attracting FDI in selected South Asian countries (Pakistan, Bangladesh, India, Nepal and Sri Lanka) covering the time frame of 20 years from 1995 to 2014. The Panel Fixed Effect estimation results revealed that economic freedom has positive relationship with FDI in Selected south Asian

Countries. Results demonstrate that the institutional climate of a country, matters in encouraging or inhibiting the flow of foreign capital into a country. Economic freedom plays vital role in attracting FDI. Host economy's domestic market is also important aspect for drawing market seeking FDI. Large sized market represents greater domestic demand so it is an attractive factor for investors seeking higher demand for their products. However large market size will help in economies of scale, efficient allocation of resources, cost reduction and maximize profit. There occur a significant investment by MNEs in the field of research and development like for the development of advance technologies. So, there must be a certain degree of human capital availability in the host economy that is able to work and understand with advance technology brought by MNEs. Consequently, skilled, well-educated and trained labor force can be a key feature in acquiring foreign capital flows.

It has been noticed that improving economic openness by relaxing barriers and obstacles to trade would attract better volume of foreign investment in the region. Relaxing barriers would encourage foreign investors as highlighted by literature. Empirical results indicate that infrastructure availability will promote FDI by reducing operational cost which will decrease the cost of doing business for foreign enterprises which will ultimately leads them towards profit maximization. This will also increase access to local and global markets which encourage FDI. Considering the empirical evidence, a higher degree of overall fiscal freedom in a host country is expected to decrease the cost associated to business by reducing taxes imposed by the government and there occur upsurge in profit, ultimately higher will be the likelihood of FDI being located there.

Based on empirical analysis this study recommendations are:

- Economic Freedom measuring domestic investment climate matters in terms of attraction of foreign direct investment. Policy makers should focus on betterment of investment climate by raising its level through transparent policies, eliminating corruption, reducing tax burden and stable economy.
- By reducing tax burden through effective policies can result in a higher degree of fiscal freedom in a host country by reducing the cost associated to business. Furthermore, it will result in raising the profit, ultimately increasing the likelihood of FDI being located there.

Note

(1) For details, see Heritage Foundation Economic Freedom Index.

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New software for identification and evaluation of environmental and waste management in the companies

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Abstract. *Reducing environmental pollution by finding optimal solutions for waste management is an ongoing concern both within companies and in landfills. The need to develop waste management integrated systems should have the effect of reducing the impact on the environment in the context of a sustainable development. This paper proposes a solution for waste management, which is already applied in a warehouse that collects non-hazardous types of waste in three major cities: Campina, Ploiesti and Boldesti-Scaieni. Using the software application called "mediu.conturweb" provides a comprehensive framework for monitoring the total amount of waste stored and recycled, for monitoring environmental factors like CH4 and CO2 emissions. The application achieved its goal of reducing emissions back in 2015, when it was first implemented, for a huge amount of waste of approximately 131,909.36 t to the values of 384 tons/year for CH4 and of 998 tons/year for CO2.*

Keywords: waste, smart waste management, software, emission.

JEL Classification: Q53, Q56.

Introduction

Environmental impact assessment (EIA) is a process that identifies and predicts the effects that a certain socio-economic activity (initiated, designed, developed and put into operation, see Andrei et al., 2014; Bel and Fageda, 2010; Bombos et al., 2016a; Bombos et al. 2016b; Cristea et al., 2015; Matei, 2013; Merrild et al., 2012; Panaitescu et al. 2015; Panaitescu and Bucuroiu, 2014; Panaitescu and Onutu, 2013) might have on the environment as well as on the human health and the well-being of the population. The most effective way of preventing unnecessary amounts of new waste used by all systems is called “smart waste management”. Product reusing, separating or selling may reduce the amount of waste to be disposed of in landfills. Waste production minimisation features a set of possibilities which leads to waste production prevention or reduction straight from the production phase, all the way to goods consumption, also including storage and distribution (Bel and Fageda, 2010; Merrild et al., 2012; Panaitescu and Bucuroiu, 2014; Panaitescu and Onutu, 2013). Identification and assessment of environmental issues is an environmental management tool. In this sense, this step must be quantified in the activity of each company that has or may have an impact on the environment in the future.

All the studies presented in literature identified a direct relationship between waste management programs and the quality of the environment (Anghelache, 2011; Panaitescu and Bucuroiu, 2014; Panaitescu and Onutu, 2013). Most of these studies used models or methods that are taken from other related areas, namely water and soil quality protection, the management of sludge coming from wastewater treatment plants (Anghelache et al., 2013; Bombos et al., 2016a; Bombos et al., 2016b; Buzoianu et al., 2016; Cristea et al., 2015; Panaitescu et al., 2016a; Panaitescu et al., 2016b; Panaitescu et al. 2015; Panaitescu et al., 2016; Panaitescu and Stoica, 2016; Panaitescu, 2016; Păunică et al., 2009; Strătulă et al., 2005).

The present study proposes a solution for waste management by monitoring the quality and quantity of waste. The ecological landfill where this method was applied has the main activity collecting only non-hazardous waste. The software used for monitoring and managing of this ecological landfill was developed with the help of a company called WEB SC Contur LTD and is called “mediu.conturweb”. The application has been designed so that it can be used by any company that wants an advanced waste management system that minimizes its impact on the environment.

Literature review

Panaitescu and Bucuroiu (2014) have studied the composition of waste at municipal level for the urban areas in Prahova. Anghelache (2011) analyzes the management of environmental risk. Panaitescu and Onutu (2013) have approach the quality monitoring process for sludge drawn following the treatment of waste water. Bel and Fageda (2010) present an analysis on the Galicia (Spain) case of cost for solid management waste. Merrild et al. (2012) have evaluated the dilemma of waste recycling vs. incineration. Bombos et al. (2016a) have studied the impact of wastewater’s oxidation with nanostructured catalysts. Cristea et al. (2015) have approached the treatment of sunflower oil over Co-Mo catalyst, while Bombos et al. (2016b) studied the Ru-Sn catalyst in water denitrification. Panaitescu et al. (2015) study the reduction of hexavalent chromium, Panaitescu and Stoica (2015) contribute to the enhancement of COD treatment in the case of refinery wastewater plant. Stratula et al. (2005) analyze some characteristics of the fraction reaction on 1,2 – dicloropropanate. Panaitescu (2016) describes a new method used to separate ethylenediamine; Panaitescu, Jinescu and Mares (2016) approach the ethylenediamine separation from wastewater in textile industry waste recycling. Panaitescu et al. (2016a) have studied the stabilization of dolomite aqueous suspension, Panaitescu et al. (2016b) analyze the decrease of demand for biological oxygen during wastewater purification. Buzoianu et al. (2016) consider the increase in efficiency for aeration reactors. Bucuroiu et al. (2016) approach the treatment of oil wastewater by using polymeric agents. Anghelache et al. focus on the usefulness of time-series in analyses. Păunică et al. (2009) develop on the application of business intelligence systems. Andrei, Panait and Ene (2014) focus on three factors that influence the companies' attitude towards the protection of environment, a previous study by Matei (2013) develops on the connection between corporate social responsibility and the sustainable development of Romania.

Materials and methods

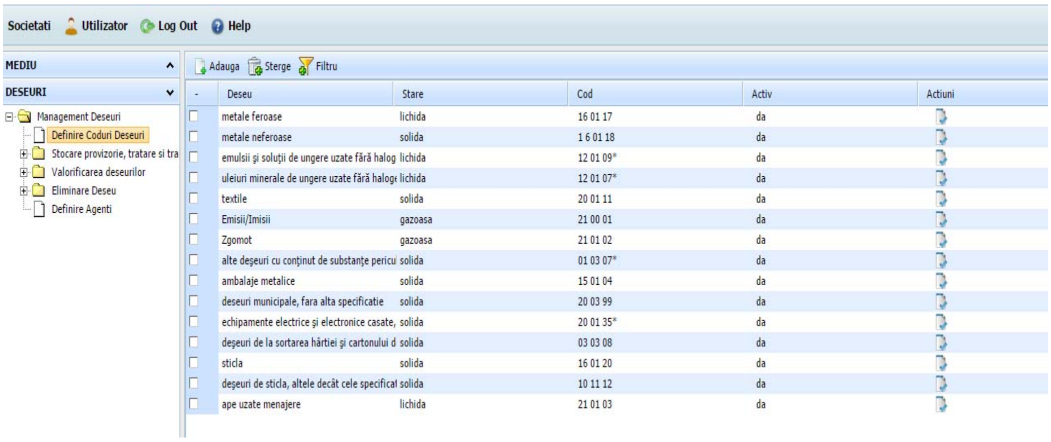
The application used for monitoring and managing the landfill has been designed to fit the official regulations provided by Law 211/2011. The application "mediu.conturweb" was conceived in the Romanian language. The hardware requirements are minimal, the software requires a minimum of 10GB of space for running the application in optimal conditions.

The data base, on which the information collected from the landfill and its influence on the environment are evaluated, is called "previous modules of software".

The nature of these requirements is:

- the type of waste;
- the waste's code;
- the source of origin;
- the date on which the waste was delivered;
- the date on rejected shipments;
- the date on any waste mixing;
- the amount produced;
- the date of waste evacuation;
- the storage mode;
- the data on recycling: volume, recycling methods, usage areas of waste recycled.
- Choosing the type of waste is done according to code GD 856/ 2002 (Figure 1).

Figure 1. *Choosing the type of waste*



Note: the English equivalents for the labels in the above interface (in Romanian) are presented below: *Societati:* Societies; *Utilizator*: User; *Mediu*: Environment; *Deseuri*: Waste; *Adauga*: Add; *Sterge*: Delete; *Filtru*: Filter; *Stare*: Status; *Cod*: Code; *Activ*: Active; *Actiuni*: Actions; *Lichida*: Liquid; *Solida*: Solid; *Management deseuri*: Waste Management; *Definire coduri deseuri*: Define waste code; *Stocare provizorie, tratare*: Provisional storage, treatment; *Valorificarea deseurilor*: Capitalization of waste; *Eliminare deseu*: Waste disposal; *Definire agenti:* Define agents; *Metale feroase*: ferrous metals, *Metale neferoase*: Non-ferrous metals, *Emulsii si solutii de ungere uzate fara halogen*: Emulsions and waste lubricant solutions without halogen; *Uleiuri minerale de ungere uzate fara halogen*: Waste lubricant mineral oils without halogen; *Textile*: Textiles; *Emisii/Imisii*: Emissions/Ambient emissions; Zgomot: *Noise;* Alte deseuri cu continut de substante periculoase: *Other waste containing dangerous substances*; Ambalaje metalice: *Metallic wrappings*; Deseuri municipale, fara alta specificatie: Municipal waste, without other specification; *Echipamente electrice si electronice, casate*: Electrical and electronical equipments, cashiered; *Deseuri de la sortarea hartiei si cartonului*: Waste from sorting paper and carton; *Sticla*: Glass; *Deseuri de sticla, altele decat cele specificate*: Glass waste, other than specified; *Ape uzate menajere*: Domestic wastewater.

The landfill should have minimal impact on the environment. In order to achieve this purpose it is necessary:

- to monitor the quality of the environment;
- to monitor the exploitation of the deposit.

Following the waste's disposal, emissions result. Their amount has to be kept under control. The main emissions arising and whose concentrations are influenced directly and in a short time by the quantity and quality of stored waste are the warehouse gasses (Bucuroiu et al., 2016). Emissions sources from the warehouse location are a free open source. During the operation, the warehouse compartments represent the source and will be a trigger of unguided surface emissions. The main constituents of warehouse gas are: CH_4, CO_2, N_2, traces of H_2S and small amounts of non-methane organic compounds (COVnm).

Based on the waste quantities, the calculation of CH_4 and CO_2 amounts emitted by the warehouse were made using the APM method for 2010-2015 [1]. This period of time was chosen because the waste management was implemented starting with 2015. Emission values of 2015 were compared with values from previous years.

Determination of the amount of methane emitted between 2014 and 2015 was done using the following equation 1:

$$CH_{4\ (tons/year)} = [\ (\ TWG_T \times TWS_F \times G_o\ ) - RM\ ] \times\ (1 - F_{OX}) \quad (1)$$

where:

TWG_T represents the total quantity of generated wastes (tons/year);

TWS_F – the waste fraction cleared to warehouse;

G_o – the generating potential of methane (tons C/tons DMS) which depends on the morphological composition of wastes;

RM – the methane recovered in inventory year (tons/year) = 0 (the default value is recommended, assuming that methane is not collected and is burned).

F_{OX} – the oxidation factor with 0.1 fractional value for well equipped warehouses.

The generating potential of methane is calculated using equation 2:

$$G_{o\ (tons\ C/\ tons\ DMS)} = [MCF \times DOC \times DOC_F \times F \times 16/12] \quad (2)$$

where:

MCF – the correction factor for methane, usually equals 1 because of the administrated amplasament for year 2015 and 0.6 for year 2014;

DOC – degradable organic carbon (tons C/ tons DMS);

DOC_F – DOC fraction = 0.55 for year 2015 and 0.6 for year 2014;

F – the methane fraction in biogas (by volume) with a recommended value of 0,5, at a national level;

16/12 – the conversion factor of carbon (C) into methane for year 2015.

Degradable organic carbon value (DOC) is calculated using equation 3:

$$DOC\ (tons\ C/\ tons\ DMS) = (0.4 \times u) + (0.17 \times v) + (0{,}15 \times y) + (0{,}3 \times z) \quad (3)$$

where:

u –DMS fraction represented by paper and textiles;

v – DMS fraction represented by garden waste, parks and other biodegradable organic waste (except food);

y – DMS fraction represented by food waste;

z – DMS fraction represented by wood and straw waste.

The ecological warehouse management and its influence on the reduction of the amount of waste at source and/or its recycling should be based on the recycling rate "U" (equation 4):

$$U = \frac{total\ waste\ recycled}{total\ waste\ stored}. \quad (4)$$

Results and discussions

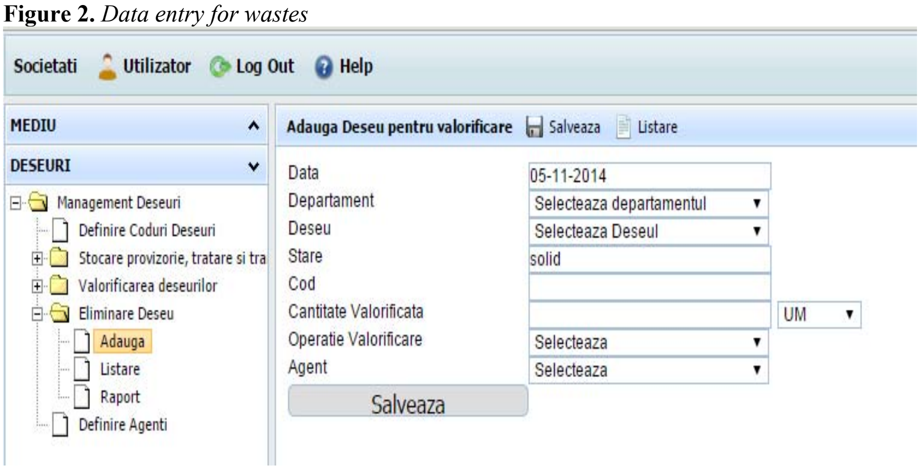
After the Environmental Issues folder is accessed, a window opens where the environmental issues identified in the respective structure can be selected (the waste code must also be inserted if applicable) according to conducted activities. If environmental issues which are not in the program database are identified, they can also be easily added. The waste report folder contains all the information on the stock, capitalised amount, real-time eliminated quantities and the waste record sheet (according to GD 856:2002). Taking into consideration that within an organisation waste reporting is centralized, the program cumulates all the waste quantities generated by the entire organisational structure as they are introduced into the system.

Annual quantities of waste stored in the ecological landfill from 2013 until 2015 used as the database for the "mediu.conturweb" software (Figure 2). They are presented in Table 1.

The Report folder contains information relating to wastes stock, amounts capitalized and amounts cleared and also the Record of evidence of waste (according to HG 856: 2002).

Because, within an organization, waste reporting is a centralized process, the program accumulates whole quantities of waste generated by the organization's structures, as they are entered into the system (Figure 2).

Figure 2. *Data entry for wastes*



Note: the English equivalents for the labels in the above interface (in Romanian) are presented below. *Societati:* Societies; *Utilizator*: User; *Mediu*: Environment; *Deseuri*: Waste; *Management deseuri*: Waste Management; *Definire coduri deseuri*: Define waste code; *Stocare provizorie, tratare*: Provisional storage, treatment; *Valorificarea deseurilor*: Capitalization of waste; *Eliminare deseu*: Waste disposal; *Adauga*: Add; *Listare*: Print; *Raport*: Report; *Definire agenti:* Define agents; *Adauga deseu pentru valorificare*: Add waste for capitalization; *Data*: Date; *Departament*: Department; *Selecteaza departamentul*: Select department; *Deseu:* Waste; *Selecteaza Deseul*: Select waste; *Stare*: State; Cod: Code; *Cantitate valorificata*: Capitalized quantity; *Operatie valorificare*: Capitalization operation; *Selecteaza*: Select; *Salveaza*: Save.

Table 1. *Waste storage situation*

Year	Total Waste	Domestic waste	Inert Waste	Street waste	Construction waste
2012	141109.55	56158.88	22108.45	16453.32	46388.90
2013	102042.05	55241.74	8610.62	18383.51	19806.18
2014	112263.12	63271.72	13165.36	16694.98	19131.06
2015	135094.56	75909.58	21377.26	18363.30	19444.42

The analysis of the data presented that the annual average of waste brought to the warehouse in 2015 was about 131909.36 t of urban solid domestic waste, representing the total amount of domestic waste produced in three main towns and belonging to the following cities: Campina, Ploiesti and Boldesti-Scaieni.

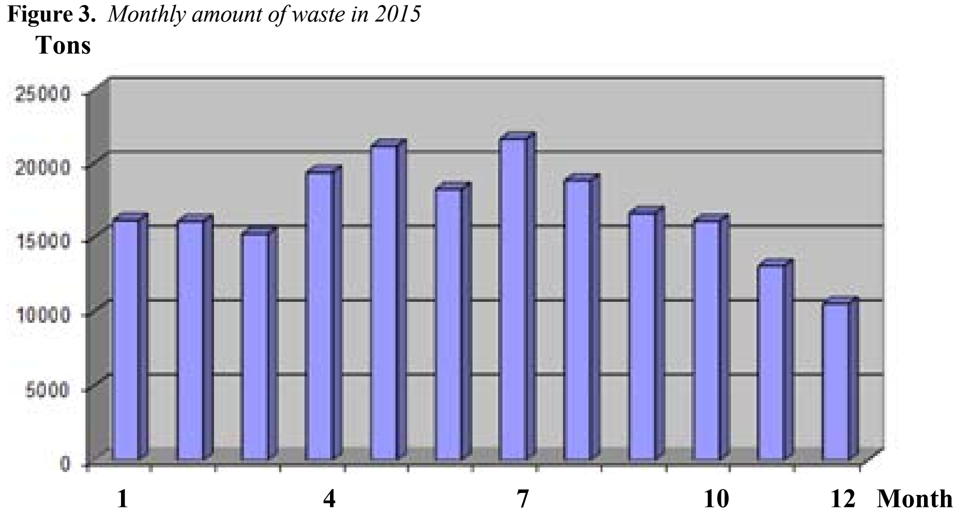
Waste from offices and resulting from operational activities of the target are cleared directly on warehouse, their amount being insignificant in relation to the warehouse capacity.

Is it estimated that it should be:

0.5 kg/person/day x 16 persons x 365 days = 2.920 kg/year ≅ 3 tons/year

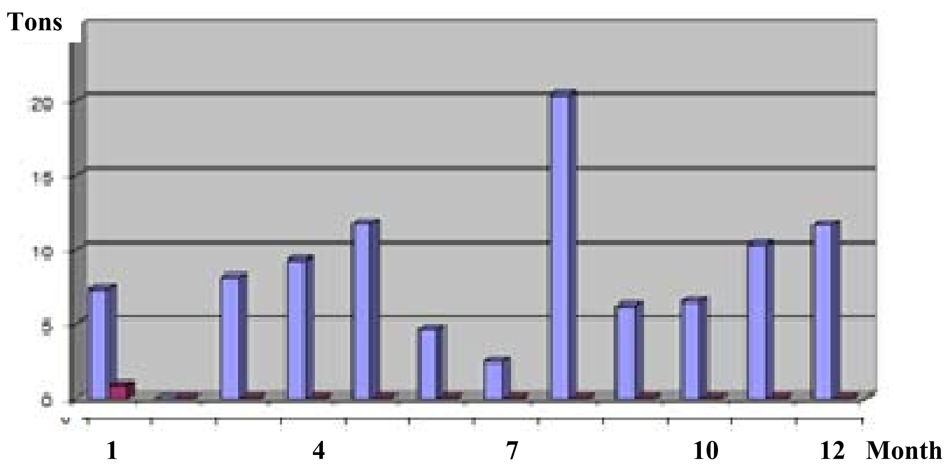
“Mediu.conturweb” application offers the possibility of a monthly representation of total amount of waste as is shown in Figure 3.

Figure 3. *Monthly amount of waste in 2015*



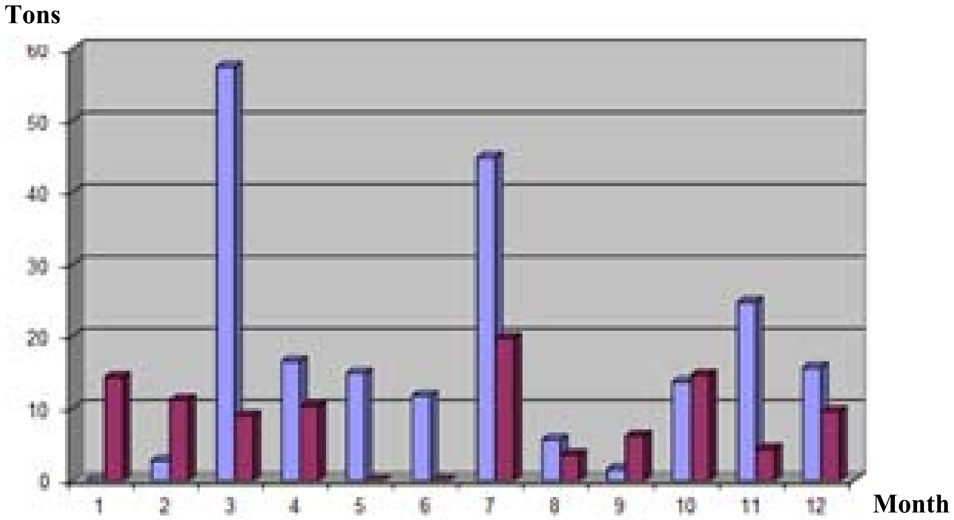
Depending on the category of waste, quantities are distributed differently every month. Monthly distribution of the categories of waste is represented in Figures 4, 5 and 6.

Figure 4. *Monitoring the stored amount of waste from wood prelucration during January-December 2015*



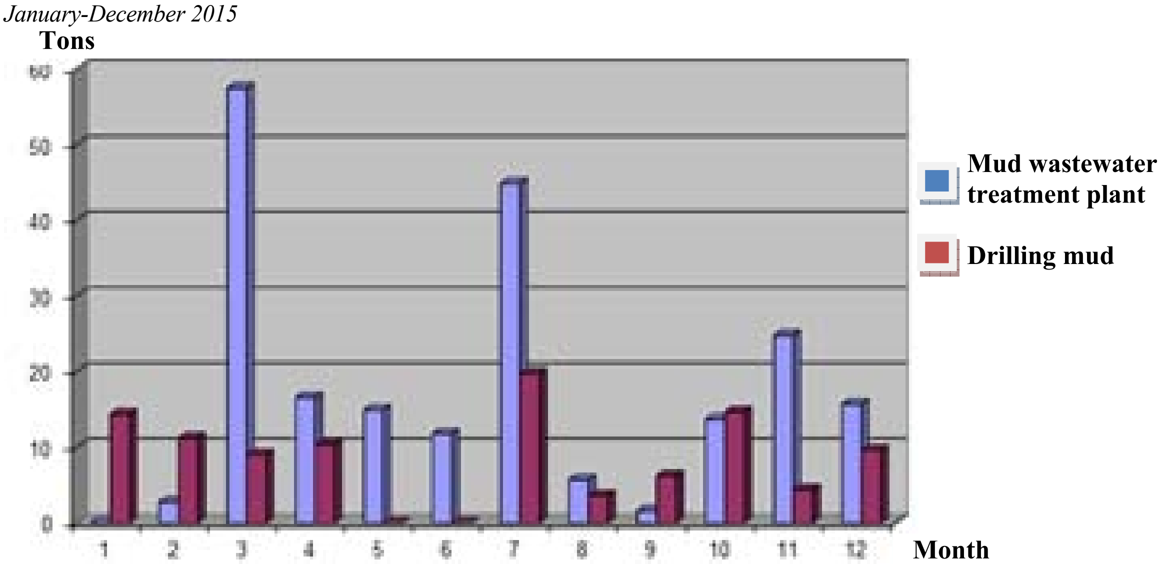
For instance, the chart in Figure 4 reveals the stored amount of waste resulting from wood processing for each month of the year 2015. There can be observed that the highest amount was measured in August, with values slightly over the half of maximum in May and December. A sizable amount of waste was also recorded in April and November.

Figure 5. *Monitoring the stored amount of mud waste from wastewater treatment plants during January-December 2015*



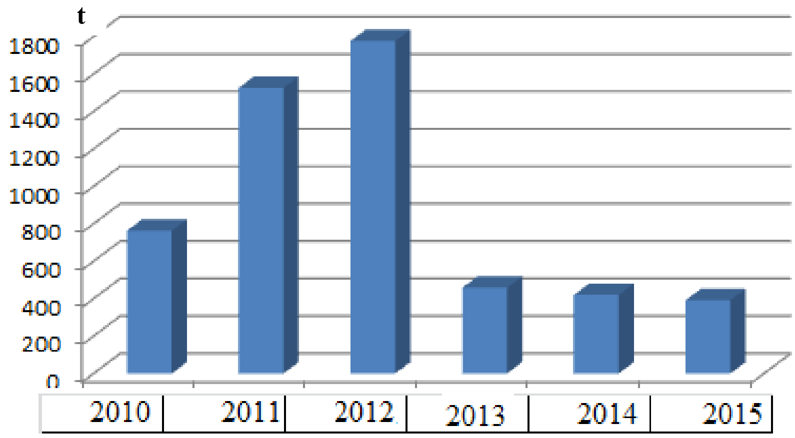
This type of chart allows the observation of mud waste obtained during the processes run by wastewater treatment plants. Like the previous figure, the data are measured for each month (in 2015). The highest amount of mud waste was recorded in March, with July, November and December following with lower values.

Figure 6. *Monitoring the stored amount of mud from wastewater treatment plant and drilling mud during January-December 2015*



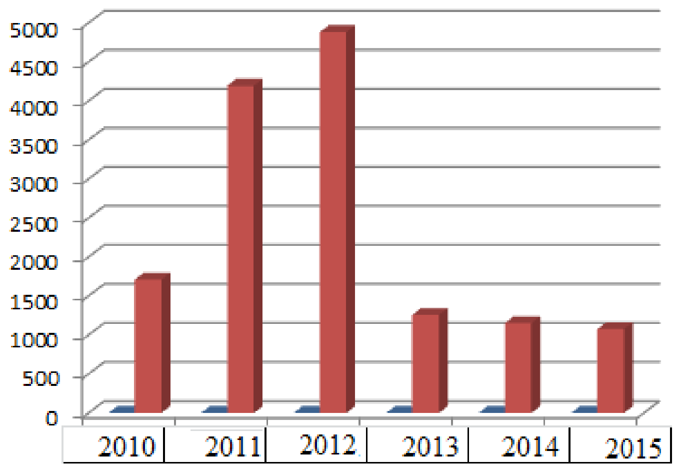
The emissions quantities between 2010 and 2015 generated by the software and based on the calculation model presented above. The same results are generated in the form of graphs presented in Figures 7 and 8.

Figure 7. *Annual quantity of methane emissions*



Analyzing the data we can observe that there was a peak of CH_4 emissions in 2012 which corresponded to a maximum of 141109.55 tons of waste. From the maximum value of CH_4 – 1789 tons we reached in 2015 – the year when "mediu.conturweb" software was implemented – to the amount of 384 tons/year.

Figure 8. *Annual quantity of CO_2 emissions*



The amount of CO_2 emissions recorded the same variation, namely: decreased from the value of 4650 tons/year in 2012 to the value of 998 tons /year in 2015. Establishing the recycling rate and variation of quantity / quality of waste are correlated parameters by the "mediu.contur.web" software with the amount of annual emissions. Analyzing the data presented in Figures 7 and 8 shows that alongside with an increase in the recycling rate at the value of 5 for a larger amount of waste, the annual quantity of emissions decreases.

Conclusions

The need to reduce the amount of waste in the context of its growth and considering the enlargement of its diversity required a new approach of waste management in companies and landfills. Waste management should be done both at the source and in the transfer and storage areas. This paper proposes waste management solutions based on both the storage/recycling component and also on the economic component as well. Developing an application based on the data collected could offer real-time solutions. The application "mediu.conturweb", besides offering an efficient monitoring of the amount of waste recycled, also finds solutions depending on the nature, origin and final destination of the recycled products. Emission's monitoring in waste disposal sites is one of the current legal requirements. The influence the amount of waste disposed/recycled is directly seen in close relation with the amount of emissions. The application "mediu.conturweb" implemented in 2015 resulted in a decrease of emissions to the value of 384 tons/year for CH_4 and of 998 tons/year for CO_2, thus allowing us to obtain an optimal value depending on the waste component which considers recycling rate 5.

Note

(1) See http://www.anpm.ro/anpm_resources/migrated_content/files/APM%20BRASOV/2013/Inventar%202012/Ordin-emisiiAnexa1-partea1.pdf

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An analysis of the effect of monetary policy changes on macroeconomic factors

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Abstract. *One important role of the Reserve Bank of India (RBI) or any central bank is to ensure economic stability in the country. For the purpose, the central bank adopts various measures to ensure that the inflation rates, GDP, interest rates, exchange rates, money supply and other target macroeconomic parameters remain under control. It uses reserve ratios like Cash Reserve Ratio and interest rates like Repo rates to control liquidity and inflation in the country. The effectiveness of such policies and monetary rates in ensuring economic stability needs to be verified and tested. The decision maker needs to understand the effect of these changes on the affected (targeted) variable. This research is an attempt to test and verify the effectiveness of the changes in monetary and policy rates on the desired critical variables. What is the effect and how much is the effect? Can these effects help in better policy making? These are some of the questions aimed to be addressed in the research.*

The research uses basic statistical tools such as correlation, regression and advance statistical tools such co-integration and Vector Auto Regression to study the variables and draws conclusion based on the results. The data used is from Indian economy and the time period used is 2011-2014. Monthly and quarterly data has been used as required. The research is aimed to provide information to decision makers in formulating policies and to contribute to the existing literature on the subject.

Keywords: macroeconomy, monetary policy, policy rates, central bank.

JEL Classification: G21, E1, E5.

1. Introduction

'The biggest challenge facing the conduct of fiscal and monetary policy in India is to continue the accelerated growth process while maintaining price and financial stability', Rakesh Mohan (2008).

Hutchison et al. (2012) focused on accumulation of international reserves and sterilization by the RBI using quarterly data from 1996 to 2009. Their analysis confirm that an increase in financial integration has changed the policy trade-offs facing emerging market economies like India. Mohan (2008) in his paper focuses on the role of fiscal and monetary policies in the evolution of the Indian economy over the years, with particular attention being given to the reforms undertaken in these policies since the early 1990s. He argues that monetary policy aims to maintain a judicious balance between price stability and economic growth. Palakkeel (2007) argues that apart from interest rate spread and financial deregulation, income, previous period's financial savings and inflation rate can affect compositional variation of financial assets. Gottschalk and Moore (2001) studied the efficacy of inflation targeting regime for Poland and argued that inflation targeting regime could be successful in Poland with understanding of the linkages between monetary policy and inflation outcomes with a focus on prerequisites. Khatkhate (2006) asserted that inflation targeting might be good policy framework for India as RBI always has to be on alert to maintain its credibility and authority in controlling inflation although source may often be non-monetary. The interest rate pass through process is one in which bank interest rates respond to changes in monetary policy rates. This process is simply the rate or process at which the official interest rate is transmitted to other interest rates (Kovanen, 2011). A weak and incomplete interest rate pass-through is an indication of an unhealthy financial system (Aydim, 2007) and the failure of monetary policy to stabilize macroeconomic shocks (Marotta, 2009). In order to tighten liquidity in the market, central bank interest rates are increased which further cuts back on investments by increasing cost of borrowing for banks as well as consumers. It is imperative to study the degree and speed of this change amongst interest rates. In the study conducted by Sander and Kleimerier (2006), it was found that there exists a greater response to anticipated monetary policy changes measures rather than to unanticipated changes. Aziakpono, Wilson and Manuel (2007) found market interest rates to respond quickly to monetary policy rates, the study conducted by Aziakpono and Wilson (2010) found that commercial bank's lending rates are more rigid in response to positive shocks in monetary policy official rate in South Africa. In one of the latest study by Kelulime (2014), a similar data set, as this study, was used where monthly data was used for time period 2007-2012 for regression analysis on macroeconomic factors. Suthar (2008) observed that the monetary policy intentions depicted by the bank rate of the RBI, the short-term and long-term domestic interest differentials and interest yield differentials, and the rate of change of foreign exchange reserves have a significant impact on the monthly average of the exchange rate between the rupee and the dollar indicating that the exchange rates are affected by monetary policy rates. Mishra (2013) attempted to evaluate the independence of monetary policy in India from all the possible spheres and concludes that the inflation targeting framework may be amended and targeting inflation band rather than inflation point would be a better option for RBI.

2. Methodology and discussion

The general objective of the research is to understand the interrelationship amongst selected macroeconomic variables, specifically, in the banking sector, for effective monetary policy making. The specific objective is to understand the dynamics between monetary policy rates and ratios with inflation, liquidity and foreign exchange as the three key functions of the Reserve Bank of India (RBI) are controlling inflation, liquidity management and stabilizing foreign exchange rate. RBI has been using the policy rates such as Repurchase rate (Repo), Reverse Repurchase rate (Reverse Repo), Bank Rate and statutory ratios such as Cash Reserve Ratio (CRR) and Statutory Liquidity Ratio (SLR) to tame inflation and control liquidity in the economy but the effectiveness of this policy needs to be studied. This paper tries to understand the dynamics between monetary policy, inflation and liquidity by working on mathematical models and drawing conclusions based on the analysis.

Interest rate pass through process has been highlighted in previous researches indicating the effect of one rate over another in an economic system (Kovanen, 2011; Kelilume, 2014). References were found for and against, both, in using the level data (Ahmad and Rao, 2006) or first difference of data for analysis (Kelilume, 2014) and this given study uses first difference of data for all time series. Quarterly data for GDP has been used in the study as this data set is available from RBI (Prabheesh et al., 2006). This study also used quarterly data for GDP and related variables.

The data used in the research is for the time period January, 2011 to December, 2013. The raw data was retrieved from the RBI database. The variables used in the study are given below along with a brief description of the same. The terms in bracket indicate the acronym used in equations and SPSS analysis. Also 'Gretl' software was used as an additional tool for analysis.

Table 1. *List of variables used along with their descriptions*

1. Cash Reserve Ratio (CRR): The percent of deposits which banks have to keep with RBI as cash.
2. Repo rates (Repo): The rate of interest at which banks borrow from RBI.
3. Exchange Rate of one US Dollar in Indian rupees (USD/INR).
4. Consumer Price Index (CPI): The measure of inflation applicable on consumer prices.
5. Banking credit (Credit): The level of credit extended by banks.
6. Statutory Liquidity Ratio (SLR): The percent of deposits, which the banks are required to invest in liquid assets, excluding CRR.
7. Reverse Repo Rate (ReRepo): The rate at which the banks park their money with RBI.
8. Bank Rate (BnkRate): The long term reference rate as decided by RBI.
9. Velocity of Money (VoM): Calculated as a percentage of GDP over Broad money supply.
10. GDP: The economic dependent of the country taken as current price at base 2011-2112.

The variables used have been categorized as:

- *Independent variables*: Cash Reserve Ratio (CRR), Statutory Liquidity Ratio (SLR), Repo rates, Reverse Repo rates and Bank Rates.

- *Dependent variables*: Foreign Exchange Rate, Consumer Price Index (CPI), Banking credit, GDP, Velocity of Money.

The units of various parameters were different for different variables, varying from percentages to absolute values to index numbers. For the convenience of effective analysis, data of all the variables was worked upon for uniformity. All the variables were converted into index numbers with their initial value of the time period made as the base value at 100 and the subsequent values were converted into index number at this base. Thus, the size effect anomaly in data was eliminated by use of index numbers. These index numbers were then used to calculate monthly averages, which were subsequently used for analysis. Different variables changed in different dates thus making it difficult to compare. This anomaly of difference in dates was eliminated by calculating monthly averages. *Thus the data series for all the variables was converted into a monthly time series*. Since GDP data is available on quarterly basis, for some variables the monthly series has been further converted into quarterly series for analysis.

After the initial analysis it was observed that size anomaly is not significant and that absolute and index numbers are giving the same result. Thus subsequent analysis was done using absolute values only.

The research uses basic statistical tools such as correlation, regression and advance statistical tools such co-integration to study the effect and draws conclusion based on the results. The data used is from Indian economy and the time period used is 2011-2014. Monthly and quarterly data has been used as required. Basic statistics of monthly averages for each of the parameter is calculated. Correlation analysis is done amongst selected variables. Linear Regression analysis is done amongst few of the variables based on the research objectives considering multicollinearity. Bivariate and Multivariate regression analysis was done using level data as well as data at first difference to account for stationary and autocorrelation in regression. Here, Durbin-Watson (D-W) statistic is used to understand autocorrelations. The D-W statistic is a number that tests for autocorrelation in the residuals from a statistical regression analysis. The Durbin-Watson statistic is always between 0 and 4. A value of 2 means that there is no autocorrelation in the sample. Co-integration is found by looking at the time series graphs of the residuals of respective regressions. Cointegration analysis was done to study the relation amongst time series of variables and finally Vector Auto Regression (VAR) was done on selected variables to understand the dynamics of macroeconomic variables further including the Impulse Response Function (IRF) and Forecast Error Variance Decomposition (FEVD) analysis using log values of Credit, Inflation, CRR and Repo. To understand the lag effect of five macroeconomic variables for India (Inflation, GDP, Exchange rate, Interest rates and FDI), VAR methodology is followed based on Sims (1980). Thus, VAR systems were analyzed at different lags and the best VAR system was selected based on Akaike Information Criterion (AIC) based on Akaike (1981).

Correlations

Analyzing variables from Table 2, the correlation was found to be high and negative for CRR with Inflation and CRR with Credit off take of commercial banks which clearly indicates towards the 'double edged sword' which a central bank faces. If CRR is reduced, it will increase the credit off take and liquidity in the market but on the other hand it will also increase the inflation level. The correlation between Repo rates and bank borrowings from central bank was negative but medium, indicating that although reducing repo would encourage banks to borrow and increasing liquidity but the effect is not high. Bank rate and call money rates were found to be low on correlation. Bank rate and Deposits with banks were correlated on the higher side indicating that if bank rate is increased, it will increase the deposit rates which will encourage deposits with banks.

Table 2. *Correlations of selected variables using absolute data, monthly series*

	CPI	Credit	USD.INR
CRR	-0.913	-0.950	-0.681
SLR	-0.877	-0.856	-0.583
Repo	-0.643	-0.645	-0.762
ReRepo	-0.658	-0.660	-0.762
BankRate	0.731	0.776	0.502

Source: author's calculation.

Table 3 indicates some interesting correlations about the policy rates. The GDP was found to be negatively correlated with CRR, SLR (High) and repo rates indicating that any increase in these rates by the central bank would negatively affect the economic growth of the country. Also, GDP was found to be highly positive correlated with credit levels and money demand, which is a technically and logically correct phenomenon.

Table 3. *Correlations of selected variables using absolute data, quarterly series*

	GDP	CRR	SLR	Repo	BankRate	Credit	VoM
GDP	1.000	-0.891	-0.858	-0.306	0.758	0.951	0.408
CRR	-0.891	1.000	0.908	0.477	-0.902	-0.959	-0.072
SLR	-0.858	0.908	1.000	0.551	-0.710	-0.894	-0.123
Repo	-0.306	0.477	0.551	1.000	-0.248	-0.476	0.411
BankRate	0.758	-0.902	-0.710	-0.248	1.000	0.829	0.076
Credit	0.951	-0.959	-0.894	-0.476	0.829	1.000	0.114
VoM	0.408	-0.072	-0.123	0.411	0.076	0.114	1.000

Source: author's calculation.

Regressions

The regression analysis was done in bi-variable and multivariate mode using monthly and quarterly time series data at level and at first difference. The regression equations are also given in brackets.

Regression 1: Inflation (CPI) over Cash Reserve Ratio (CRR) at first differences

The R-squared and DW statistic was found to be 0.035 and 0.68 at first difference data. ($CPI\_d = 1.11+0.84 \times CRR\_d$). The two series were found to be not co-integrated.

Regression 2: Bank Credit over Cash Reserve Ratio

The R-squared and DW statistic was found to be 0.17 and 2.47 at first difference data. (Credit_d= 490 -1466.6 × CRR_d). The two series were found to be co-integrated at first difference.

Regression 3: Foreign exchange rate over CRR

The R-squared and DW statistic was found to be 0.0238 and 1.6 at first difference data. (ExRate_d = 0.545 + 1.61 × CRR_d).

The two series are co-integrated at first difference.

Regression 4: Inflation with CRR, SLR, Repo, Re-Repo and Bank Rate

Multicollinearity was expected to effect the regression because of high correlation between CRR and SLR (0.862). CRR and Bank rate (-0.869) and between Repo and Re-repo rates (0.999).

Thus, SLR, Re-repo and Bank rate were reduced from the equation to counter multicollinearity.

At Level: CPI = 187.14 -8.92 × CRR -2.72 × Repo

At first difference: CPI_d= 1.1 + 0.71 CRR_d + 0.44 Repo_d

The Rsquared was found to be 0.843 with DW statistic of 0.23 at level. The Rsquared was found to be 0.046 with improved DW statistic at 0.68 at first difference. The series were not co-integrated at level or at first difference.

Regression of quarterly time series

Regression 5: GDP over Credit

At level: GDP = 2702 + 0.44 × Credit

The Rsquared was found to be 0.9 and DW statistic was found to be 2.13 at level.

At first difference, the Rsquared was found to be 0.0003 and DW statistic was 2.15 with almost no autocorrelation. The series were co-integrated at first difference but low Rsquared is a concern.

Regression 6: GDP over CRR

At level: GDP = 38670 - 2889 × CRR

The Rsquared was found to be 0.793 at level and 0.014 at first difference. The DW statistic was 1.56 at level and 2.1 at first difference indicating almost no autocorrelation in the regression. The series are also found to be co-integrated at first difference but with a very low Rsquared value.

Regression 7: GDP over Repo

At level: GDP = 40990 - 2082 × Repo

The Rsquared was found to be 0.093 at level and 0.29 at first difference. The DW statistic was found to be 0.53 at level and 1.8 at first difference with almost no autocorrelation. The two series were found to be co-integrated at first difference. The series can be said to be a good fit at first difference with 29% explained variance and low autocorrelation.

Regression 8: GDP over CRR and Repo

At level: GDP = 31561 -3128 × CRR + 1052 × Repo

The Rsquared was found to be 0.811 at level and 0.3 at first difference. The DW statistic was found to be 1.34 at level and 1.78 at first difference with almost no autocorrelation. The two series were found to be co-integrated at first difference. The series can be said to be a good fit at first difference with 30% explained variance and low autocorrelation.

Regression 9: Velocity of Money over CRR

At level: VoM = 131 -0.001 × CRR

The Rsquared was found to be very low at 0.005 at level and 0.06 at first difference. Although, the DW statistic was encouraging with 2.1 at level and 2.25 at first difference but with almost no autocorrelation the series were found to be co-integrated at first difference.

Regression 10: Velocity of Money over Repo

At level: VoM = 0.22 + 0.012 Repo

The Rsquared was found to be at 0.16 at level and 0.31 at first difference. The DW was 2.04 at level and 2.02 at first difference with no autocorrelation at level or at first difference. The two series were found to be co-integrated at first difference.

Regression 11: Velocity of Money over CRR and Repo

At level: VoM = 0.20 -0.004 × CRR + 0.016 × Repo

The Rsquared was found to be 0.26 at level and 0.32 at first difference. The DW statistic was found to be 2.19 at level and 2.02 at first difference with no autocorrelation. The two series were found to be co-integrated at first difference.

Vector Auto Regression (VAR) Models

Many VAR systems could be analyzed based on the dependent and independent variables but considering the research objective, two VAR based models are analyzed as given below.

VAR system 1: Inflation, CRR and Repo

VAR system 2: Credit, CRR and Repo

VAR system 1

The Akaike Information Criteria (AIC) was used to select the optimum lag for the system, which had a minimum value of -18.59 at lag 2. Thus, the VAR system was analyzed at lag 2. Three models were formulated as a part of this VAR system with the three variables as dependent variables, each at a time. The variables were used at first difference.

Table 4. *(Equation 1) Inflation (CPI) as the dependent variable*

	Coefficient	p-value
Const	0.202	0.44
l_CPI_1	1.492	0.00
l_CPI_2	−0.518	0.01
l_CRR_1	−0.014	0.68
l_CRR_2	0.006	0.88
l_Repo_1	−0.049	0.48
l_Repo_2	0.022	0.72

R-squared	0.997		Durbin-Watson	1.75

Table 5. *(Equation 2) CRR as dependent variable*

	Coefficient	p-value
Const	2.873	0.057
l_CPI_1	−0.538	0.64
l_CPI_2	0.069	0.95
l_CRR_1	1.381	0.00
l_CRR_2	−0.580	0.01
l_Repo_1	0.216	0.58
l_Repo_2	−0.368	0.28

R-squared	0.985		Durbin-Watson	1.75

Table 6. *(Equation 3) Repo rate as dependent variable*

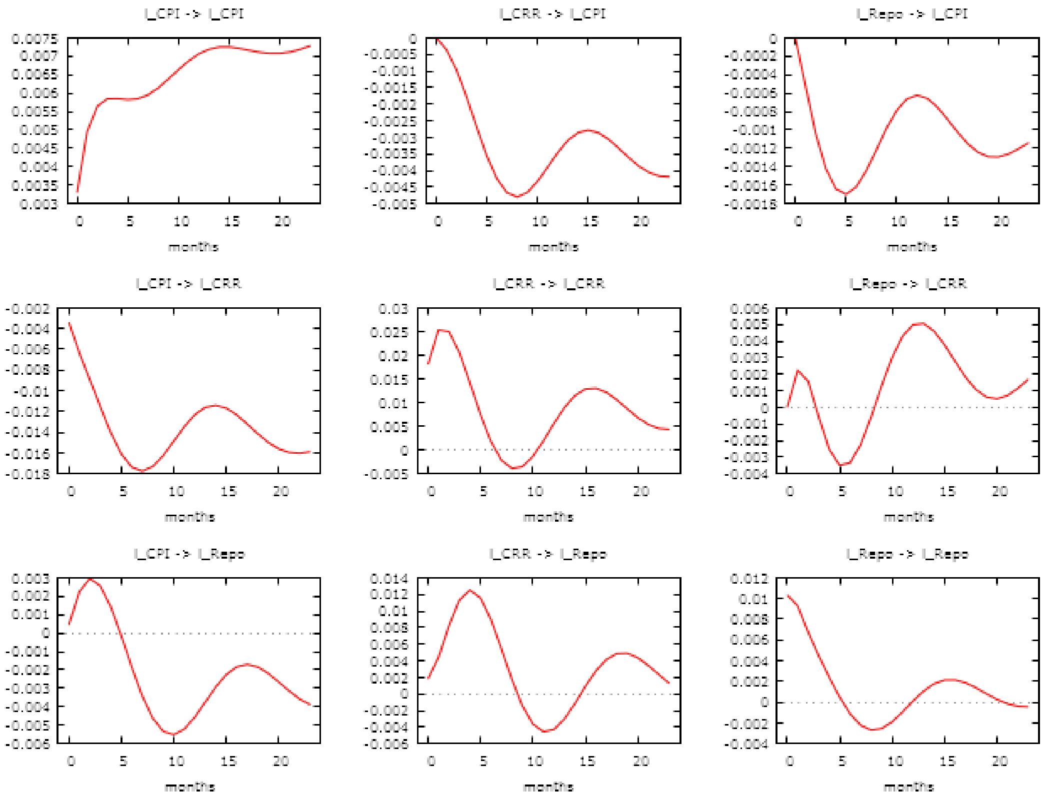
	Coefficient	p-value
Const	−1.208	0.15
l_CPI_1	0.716	0.28
l_CPI_2	−0.422	0.49
l_CRR_1	0.152	0.17
l_CRR_2	0.053	0.66
l_Repo_1	0.898	0.00
l_Repo_2	−0.153	0.43

R-squared	0.958		Durbin-Watson	1.81

Testing for auto correlation separately, no auto correlation was found in all the three equations, which is evident from the DW statistic also.

Testing for ARCH effect, the null hypothesis of NO ARCH effect was accepted for all the three equations.

Chart 1. *The Impulse Response Functions (IRF) for all the equations in VAR 1*



Each graph in Chart 1 is indicated for two variables where the first variable indicates the response of one shock (positive standard deviation) from second variable over 20 months. From response of Inflation to CRR, it can be observed that initially the inflation comes down till seventh month but again it goes up and stabilizes. Similarly, for response to Repo, the inflation initially goes up for three months and then it comes down and stabilizes.

Analyzing Table 7, it can be interpreted that Inflation forecast for one quarter is totally dependent on itself (100% explained variance) but as we forecast for long term, it is also dependent on Repo rate and CRR. In Table 8, the variation in Repo rates can be observed as largely dependent on Inflation and CRR in long term and according to Table 9, CRR largely depends on Inflation in long term.

Table 7. *Forecast error variance decomposition for CPI (Equation 1, VAR 1)*

period	l_CPI	l_Repo	l_CRR
1	100	0.0	0.0
2	98.92	0.9	0.18
3	96.58	2.49	0.94
4	93.04	4.26	2.69
5	88.54	5.87	5.59
6	83.64	7.02	9.33
7	79.09	7.64	13.26
8	75.46	7.78	16.75
9	73.03	7.59	19.38
10	71.76	7.22	21.02
11	71.48	6.77	21.75
12	71.89	6.34	21.78
13	72.71	5.94	21.35
14	73.70	5.62	20.68
15	74.68	5.36	19.95
16	75.53	5.19	19.28
17	76.18	5.08	18.7
18	76.62	5.04	18.34
19	76.82	5.05	18.12
20	76.85	5.08	18.07
21	76.74	5.12	18.14
22	76.57	5.14	18.29
23	76.38	5.14	18.47
24	76.25	5.12	18.63

Table 8. *Forecast error variance decomposition for Repo (Equation 2, VAR 1)*

period	l_CPI	l_Repo	l_CRR
1	0.18	99.81	0.0
2	2.37	94.31	3.31
3	4.07	79.78	16.15
4	4.11	63.09	32.80
5	3.38	50.56	46.05
6	2.82	42.82	54.36
7	2.94	38.71	58.34
8	4.06	36.96	58.98
9	6.17	36.32	57.52
10	8.80	35.73	55.47
11	11.32	34.71	53.97
12	13.29	33.43	53.27
13	14.68	32.31	53.02
14	15.58	31.65	52.77
15	16.14	31.49	52.36
16	16.43	31.65	51.92
17	16.49	31.80	51.70
18	16.41	31.72	51.86
19	16.31	31.38	52.31
20	16.31	30.87	52.82
21	16.53	30.33	53.14
22	17.01	29.85	53.14
23	17.73	29.44	52.83
24	18.63	29.08	52.29

Table 9. *Forecast error variance decomposition for CRR (Equation 3, VAR 1)*

period	l_CPI	l_Repo	l_CRR
1	3.43	2.92	93.66
2	5.09	5.21	89.68
3	7.65	5.08	87.26
4	11.64	4.24	84.11
5	17.26	3.61	79.14
6	23.98	3.37	72.65
7	30.78	3.31	65.91
8	36.66	3.20	60.13
9	41.29	2.98	55.71
10	44.81	2.80	52.39
11	47.42	2.82	49.76
12	49.23	3.14	47.63
13	50.24	3.72	46.05
14	50.51	4.37	45.11
15	50.28	4.93	44.79
16	49.89	5.27	44.84
17	49.69	5.39	44.92
18	49.89	5.36	44.75
19	50.55	5.23	44.22
20	51.59	5.07	43.33
21	52.88	4.91	42.21
22	54.26	4.76	40.97
23	55.61	4.64	39.75
24	56.84	4.55	38.60

VAR system 2

The Akaike Information Criteria (AIC) was used to select the optimum lag for the system which had a minimum value of -16.69 at lag 2. Thus, the VAR system was analyzed at lag 2. Three models were formulated as a part of this VAR system with the three variables as dependent variables, one by one. The three variables were used at first difference.

Table 10. *(Equation 1) Credit as the dependent variable*

	Coefficient	p-value
Const	−0.647	0.51
l_Credit_1	0.710	0.003
l_Credit_2	0.347	0.13
l_CRR_1	−0.182	0.06
l_CRR_2	0.233	0.02
l_Repo_1	−0.045	0.78
l_Repo_2	0.024	0.84

R-squared	0.993		Durbin-Watson	1.85

Table 11. *(Equation 2) CRR as the dependent variable*

	Coefficient	p-value
Const	4.643	0.037
l_Credit_1	0.010	0.98
l_Credit_2	−0.375	0.45
l_CRR_1	1.354	0.00
l_CRR_2	−0.583	0.01
l_Repo_1	−0.049	0.89
l_Repo_2	−0.120	0.67

R-squared	0.98		Durbin-Watson	1.64

Table 12. *(Equation 3) Repo rate as the dependent variable*

	Coefficient	p-value
Const	−0.446	0.73
l_Credit_1	−0.235	0.43
l_Credit_2	0.311	0.31
l_CRR_1	0.078	0.54
l_CRR_2	0.053	0.69
l_Repo_1	1.101	0.00
l_Repo_2	−0.378	0.04

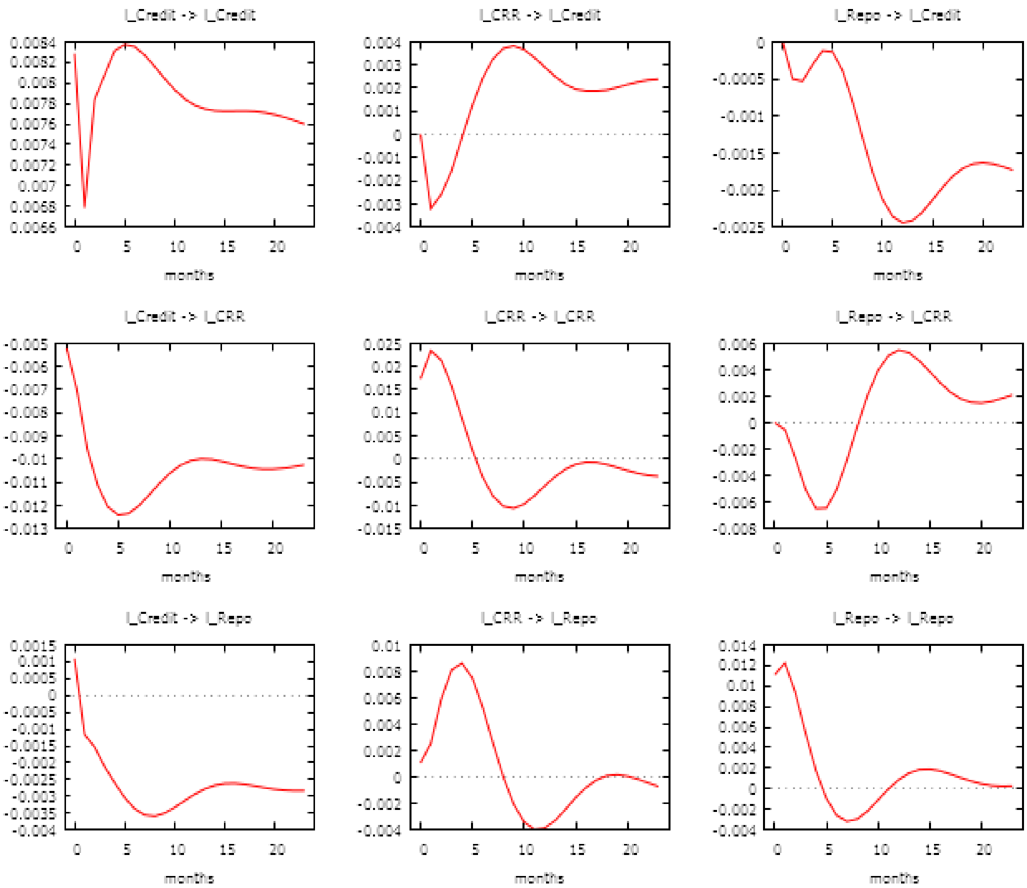
R-squared	0.95		Durbin-Watson	1.97

Testing for autocorrelation with a null hypothesis of NO autocorrelation, the hypothesis was rejected for equation 1 but accepted for equation 2 and equation 3 at 5% confidence indicating that autocorrelation was found in equation 1 only.

Testing for ARCH effect, the null hypothesis of NO ARCH effect was accepted for all the three equations indicating that no ARCH effect was found in all the three equations.

Each graph in Chart 2 is indicated for two variables where the first variable indicates the response of one shock (positive standard deviation) from second variable over 20 months. The response of credit to CRR can be interpreted as if CRR is increased, the Credit comes down for five months and then it rises a little bit and stabilizes. Similarly the response of Repo rates on Credit is very interesting and logical. As Repo rate is increased, Credit comes down drastically till seventh month and stays below zero level till 20 months.

Chart 2. *The Impulse Response Functions (IRF) for all the equations in VAR 2*



According to Table 13, the fluctuation in variance for forecasted Credit is observed to be more effected by CRR rather than Repo rates, which goes up to 10.32% for 13th quarter and vice versa for variance in CRR (Table 14). The variance in Repo can be explained by both Credit and CRR in long term (Table 15).

Table 13. *Forecast error variance decomposition for 1_Credit (Equation 1, VAR 2)*

period	l_Credit	l_CRR	l_Repo
1	100	0.0	0.0
2	91.59	8.2	0.20
3	90.96	8.76	0.27
4	92.31	7.44	0.24
5	93.91	5.89	0.19
6	94.61	5.22	0.16
7	94.21	5.62	0.17
8	93.02	6.71	0.26
9	91.49	8.0	0.49
10	90.00	9.12	0.87
11	88.78	9.87	1.35
12	87.89	10.24	1.86
13	87.34	10.32	2.34
14	87.05	10.21	2.74
15	86.97	9.99	3.05
16	87.01	9.73	3.26
17	87.13	9.47	3.39
18	87.27	9.25	3.48
19	87.41	9.07	3.52
20	87.51	8.94	3.55
21	87.58	8.85	3.57
22	87.61	8.80	3.59
23	87.60	8.78	3.62
24	87.58	8.77	3.65

Table 14. *Forecast error variance decomposition for 1_CRR (Equation 2, VAR 2)*

period	l_Credit	l_CRR	l_Repo
1	8.27	91.73	0.0
2	8.25	91.72	0.03
3	11.37	88.12	0.51
4	15.57	82.66	1.77
5	20.44	76.04	3.52
6	25.28	69.71	4.99
7	29.38	64.98	5.63
8	32.32	62.19	5.48
9	34.22	60.73	5.05
10	35.46	59.73	4.81
11	36.43	58.62	4.95
12	37.38	57.22	5.39
13	38.43	55.63	5.94
14	39.57	53.99	6.43
15	40.80	52.43	6.77
16	42.08	50.99	6.93
17	43.39	49.65	6.96
18	44.69	48.40	6.89
19	45.97	47.23	6.79
20	47.18	46.14	6.68
21	48.30	45.13	6.56
22	49.33	44.22	6.45
23	50.25	43.38	6.36
24	51.09	42.61	6.29

Table 15. *Forecast error variance decomposition for 1_Repo (Equation 3, VAR 2)*

period	l_Credit	l_CRR	l_Repo
1	0.94	0.93	98.13
2	0.89	2.70	96.39
3	1.21	10.47	88.31
4	1.86	21.35	76.79
5	2.74	30.87	66.39
6	3.88	36.32	59.80
7	5.24	37.92	56.84
8	6.76	37.31	55.92
9	8.28	36.25	55.46
10	9.64	35.80	54.55
11	10.75	36.18	53.07
12	11.61	36.96	51.43
13	12.30	37.66	50.04
14	12.89	37.99	49.11
15	13.46	37.96	48.57
16	14.03	37.69	48.27
17	14.63	37.32	48.05
18	15.24	36.96	47.79
19	15.88	36.62	47.48
20	16.55	36.31	47.13
21	17.24	35.99	46.76
22	17.93	35.69	46.37
23	18.62	35.41	45.98
24	19.28	35.14	45.57

Conclusion

The effect of monetary policy changes was observable and was observed in the research but no ‘confident’ conclusive evidence was found, although, the results can be used to understand the direction and quantum of effect of monetary policy in limited constraints. Most of the time series were found to be co-integrated at first difference and with no autocorrelation indicating good fit for forecasting. However, the unexplained variance was a concern in many such cases which needed to be further explored. For most of the regressions, when autocorrelations were removed, the R-squared values came down. The problem of low R-squared was eliminated by using VAR models where R-squared values increased and the models also improved on autocorrelation and ARCH effect. The Impulse response functions (IRF) were very helpful in understanding the responses of Inflation and Credit to CRR and Repo. It was observed that the effect of policy rates (CRR and Repo) affects Inflation and Credit till five to ten months and then the affect subsides.

An analysis of basic statistics of the variables indicated that CRR and Bank rate emerged as two most widely used rates by the central bank, RBI, as Coefficient of Variation for the two were found to be highest amongst the five policy and monetary rates, also including Repo, Reverse Repo and SLR.

The best fit was found between Velocity of Money over Repo and CRR indicating the direct effect of rates and reserves upon Money supply and GDP. Interpretation of the correlation and regression results from the research enhances the understanding of the macroeconomic variables and policy rates and would surely assist in policy making and further research on the subject.

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The costs of Brexit for UK economy

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Abstract. *Leaving the EU without a deal in place for future trading agreements would be the worst-case scenario for British economy. In the long-run Brexit is expected to reduce UK living standards due to the declines in trade and foreign direct investments. The British economy will suffer from the losses implied in the export sectors due to the fact that 45% of its exports are destined to EU members. The potential loss of importance for the City of London will generate a fragmented European financial market that will reduce systemic risk. On the other hand, market participants could face a dual regulation on financial markets, increased uncertainties and frictional costs. The plan to design a Capital Market Union will create a strong competition for London, while Frankfurt and Paris are eager to absorb the financial services lost by British economy.*

Keywords: banking union, financial markets, financial services, trade policy.

JEL Classification: E44, E66, G20.

Introduction

The Brexit vote was a hard response from the left behind voters to the political class and European Union. The EU immigration policy strongly backed by Germany proved to extend the existing divergences between member states. After the sovereign debt crisis, there were a lot of contradictory perspectives in the European model regarding the design of the Banking Union (North-South collision), the immigration policy, the austerity policies imposed by the European Commission or the foreign policy towards Russia. Brexit demonstrated that EU lack of legitimacy on different problems created a strong sense of frustration at national level in several member states. The negotiation between EU and Great Britain would be a real challenge due to the short timeline (since the trigger of Article 50, the deal between the two parties has to be agreed in two years) and the multitude of subjects in discussion. The paper raises the problem of the costs implied by Brexit from an economic perspective, taking into account the dimension of the export sectors of Britain and the role of London as the main financial center of Europe. It is clear that both sides in the negotiation process will try to minimize the costs and increase the benefits. UK negotiation position comprises two alternatives; either it will battle to remain a part of the Single Market, in which case it will have to offer some concessions, or it will trade under WTO rules and fight for the its companies passporting rights to operate in EU.

Literature review

The negotiation process that started after the invocation of Article 50 will be a short and tight one. There are a multitude of problems to agree on, from trade policy to the Single Market or the "Brexit bill" that has to be assumed by British economy. Great Britain position is awkwardly unclear at this moment, even if all the economists agree that in the negotiation process EU has a clear advantage. As Sampson (2016) emphasized UK position is weaker due to the fact that *it did not participate in trade negotiations for the past 40 years, and currently has very little negotiating capacity. Nonetheless, it needs diplomatic expertise to provide information on the objectives and strategies of its negotiating partners*. In order to sum up a list of potential costs for the British economy, the problem was approached from different standpoints. The timeline of 2 years is rather short and it will be very hard to reach an agreement due to the fact that Germany elections are at the end of 2017 and no clear direction in the negotiation process can be achieved in EU without its approval.

For elaborating a proper image of the trade potential losses, Dhingra et al. (2016a) reveal that the negative impact of Brexit would be only marginally offset through bilateral trade agreements with US, Canada or Southeast Asia. The gravity model equations imply an overall income reduction estimated between 1.3% and 2.6%, and once they include the long-run effects on productivity, the national income loss increases to a figure between

6.3% and 9.5%. The commercial relations with EU will become more complicated and expensive, resulting in a trade diversion away from EU.

Kohl, Brakman and Garretsen (2017) emphasize that the GDP reduction implied by Brexit is estimated between 1% and 6%, depending on the variables used in the equations and the benefits generated by the long-run trade policies of British authorities. Prior to the UK joining the European Economic Community (EEC) in 1973, around one third of UK trade was related to this region. In 2014, the 27 other EU members accounted for 45% of the UK's exports and 53% of imports, while EU exports comprised 13% of UK GDP. The integration in the EU Single Market provided higher trade benefits for UK consumers through reduced prices in goods and services. The export sectors benefited from better opportunities that led to increased sales and profits for British companies.

Terzi (2016) emphasized that *the core of the single market is focused in the concept of Schumpeterian creative destruction: once countries open their borders to European competition, some firms (the most unproductive) will exit the market, allowing for a redistribution of resources to the most competitive.* Unfortunately, this process creates losers and winners, while some discretional national policies result in long-term unemployment or permanent migration. The huge difference between the core and the periphery in the European model cannot be ignored and the overall regional policy of EU (for the period 2014-2020 regional policy was allotted 0.4% of EU GDP per year) was merely a disappointment.

Brexit proved that the leave behind voters are a force that cannot be neglected. The impact of globalization, the structural changes in the economies after WWII and the technology revolution created an entire segment of population that can be perceived as permanent losers. Unfortunately, EU failed to integrate the unreformed labor markets with the skill-bias of technology shocks. The deal between the two sides has to limit the mutual damage, because if it flops, Brexit will transform a political problem into an economic one.

Methodology

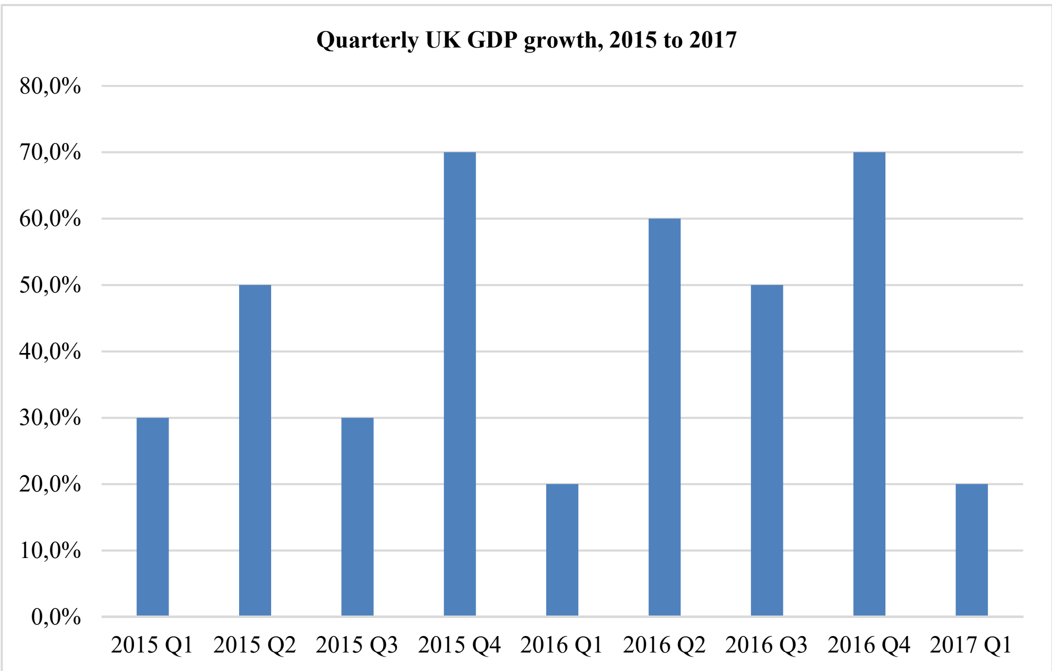
The paper analyzes the implications of the Brexit process to the economy, and especially to the export and financial sector. The most urgent challenge after the trigger of Article 50 would be to secure a new trade agreement with EU, while trying to limit the number of protectionist measures by both sides. As Sampson (2016) emphasized it is very important to know *whether the reference point for UK-EU negotiation is membership of the Single Market or trade under WTO rules.* Analyzing the impact in the financial services, it is evident that UK should struggle to secure tariff-free access to EU markets or passport rights for financial services. Any of these concessions from EU will imply negotiation costs for UK, such as: a “Brexit bill” as high as 60 billion euro (UK contributions to EU budget until 2020) or guaranteeing the “four freedoms” integrated in the Single Market.

Analyzing the GDP growth figures, there are clear signs of weakness derived from investors perceptions regarding the economy. The investment component of the economy will be affected because the negotiation process will imply rising uncertainty over different sectors regulation.

It is evident that since the beginning, the negotiation process will shape the perspective of a soft or hard Brexit. The study of other states experience in the European Free Trade Association provides a clear image of the trade-offs that Britain will have to exceed in order to smooth the negative impact on its economy. Trade negotiations will imply a bargain of competing objectives between the two sides, an idea also embodied in the reciprocity principle that guides WTO rounds of negotiation.

Analysis

Brexit implications started to appear in UK economy since the first quarter of 2017. The GDP growth rate started to decrease due to a reduced level of private investments and a loss of financial services business. The perspective that EU will take the opportunity to impose trade barriers to UK services exports scared companies and led to future plans of production delocalization. Protectionist regulation from EU will determine an increase in consumer prices, higher costs for imported inputs and capital goods and important price distortions in the business supply chains.



At the end of April 2017, the sterling was 13% lower against US dollar and 9% lower against Euro, than on the day of the referendum. This signifies that the investors expectations for the economy have weakened, while the costs of the imported goods and services increased sharply. The figures of the inflation for the first quarter of 2017 (2.7%) support this conclusion, on the medium term the consumption component of the GDP being directly affected. Great Britain holds almost 7% of the global stock of foreign direct investment (over 1 trillion Euro), being on the second place after United States. Half of the direct investments comes from EU member states, so a "hard Brexit" could signify potential large disinvestments and a huge loss for UK economy. British research firms could be excluded from EU 80 billion Horizon 2020 fund, creating negative effects for innovation and technological progress.

The ability of Britain to design its own financial framework post-Brexit will be counterbalanced by the need of market participants to trade in Europe. The European financial system will become less integrated and more unstable. The outcomes of the Banking Union will create additional vulnerabilities, because the entire set of regulations described in (Hrebenciuc, 2017) will be put under a question mark: *The new configuration of the European Banking Union will include a set of measures focused on ensuring stability in the system:*

- *Single Supervisory Mechanism performed by ECB.*
- *National Deposit guarantee schemes.*
- *Single Resolution Mechanism.*
- *Direct recapitalization through the European Stability Mechanism.*

A further potential danger could be a vicious feed-back loop (Danielsson et al., 2016a) that could end with a depreciated sterling, rising inflation and falling bond prices. In this case the long-term sustainability of the pension funds would be put under risk affecting the entire British financial system. The probability that the European authorities will try to increase the roles of Frankfurt and Paris in the European financial markets is high. In order to achieve this objective, the entire regulation will have to be designed in order to attract the clearing house business and to move the focus of the capital markets investors away from London.

The potential design of the Capital Markets Union will not include Great Britain and the integration of the European financial markets will create a strong competition for London. As described by (Danielsson et al., 2016b) Britain and EU had different approaches to regulation. British regulation is based on common law, transparency and self-regulation (assumes that rules should be applied only where a clear need is demonstrated), while the European approach is constructed on civil law and tries to regulate in a prescriptive way. Due to these evident differences, the separation of the British financial market from Europe will potentially create additional loses for investors and companies. In the meantime, the City of London might lose its major financial center status, while many financial market participants will operate under dual regulation of EU and UK.

The Brexit will increase fragmentation, it is known that highly integrated systems with unified rules and reduced frictional costs have many vulnerabilities and encourage the creation of too-big-to-fail institutions. While fragmentation is not efficient from this perspective, it also derives benefits from a reduced systemic risk for the financial system.

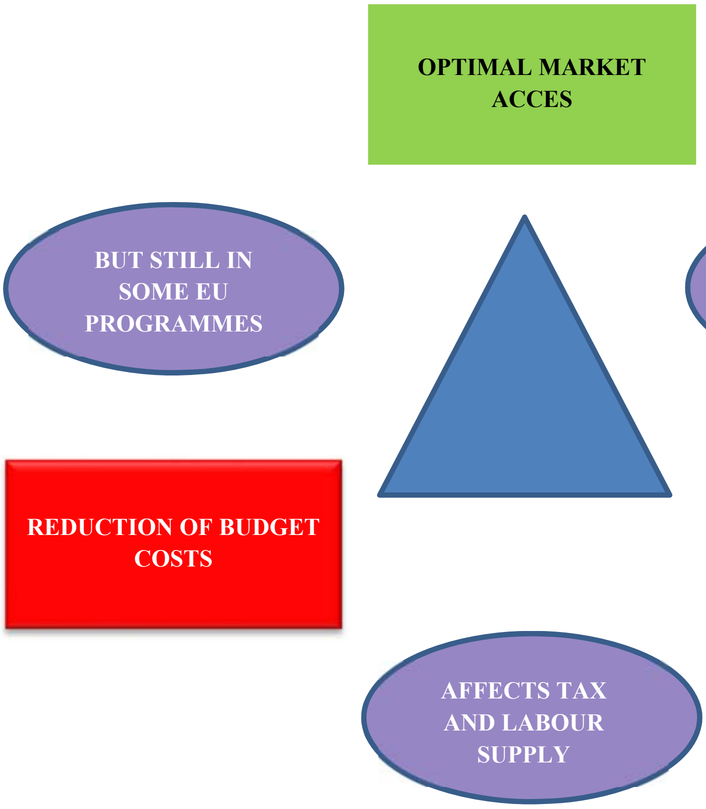
Analyzing from a financial perspective UK contributions could remain close to its membership dues. The Brexit bill imposed by the departure from the European Union is comprised from three main elements:

1. British commitments to the 2014-2020 EU budget framework, an amount estimated at roughly 30 billion euro.
2. Investment commitments to the cohesion policy of EU (ex. Motorways construction in Poland), UK share could total 17 billion euro.
3. EU Pensions Scheme, in 2016 the unfunded pension sums all over EU totalized 60 billion Euro. UK may be prepared to cover its own nationals, but European officials insist that all liabilities are a joint responsibility, as Eurocrats work for EU, not for their national governments. The figures estimated for this commitment should stand around 10 billion euro.

These costs are problematic for UK economy which failed to properly reform its labor market. Analyzing the income inequality through Gini coefficient, the rise from 0.32 in 1986 to 0.36 in 2014 is rather big. As a comparison, in 2014 Germany had a Gini coefficient of 0.29, while Greece registered 0.34, both smaller than UK. The potential losses implied by trade disintegration and UK possibility of no longer be a part of European supply chains creates the premises for an even worse Gini coefficient in the future. As Iain Begg (2017) stated, *it is very hard to manage trade disintegration and capture the costs at this moment. UK trilemma tries to accomplish a perfect equilibrium state that involves three components: an optimal access to the Single Market, an efficient curb on free movement (that will imply protectionist measures from UK side in order to satisfy the leave behind voters) and a reduction of budget costs that could create additional space to maneuver for social policies.*

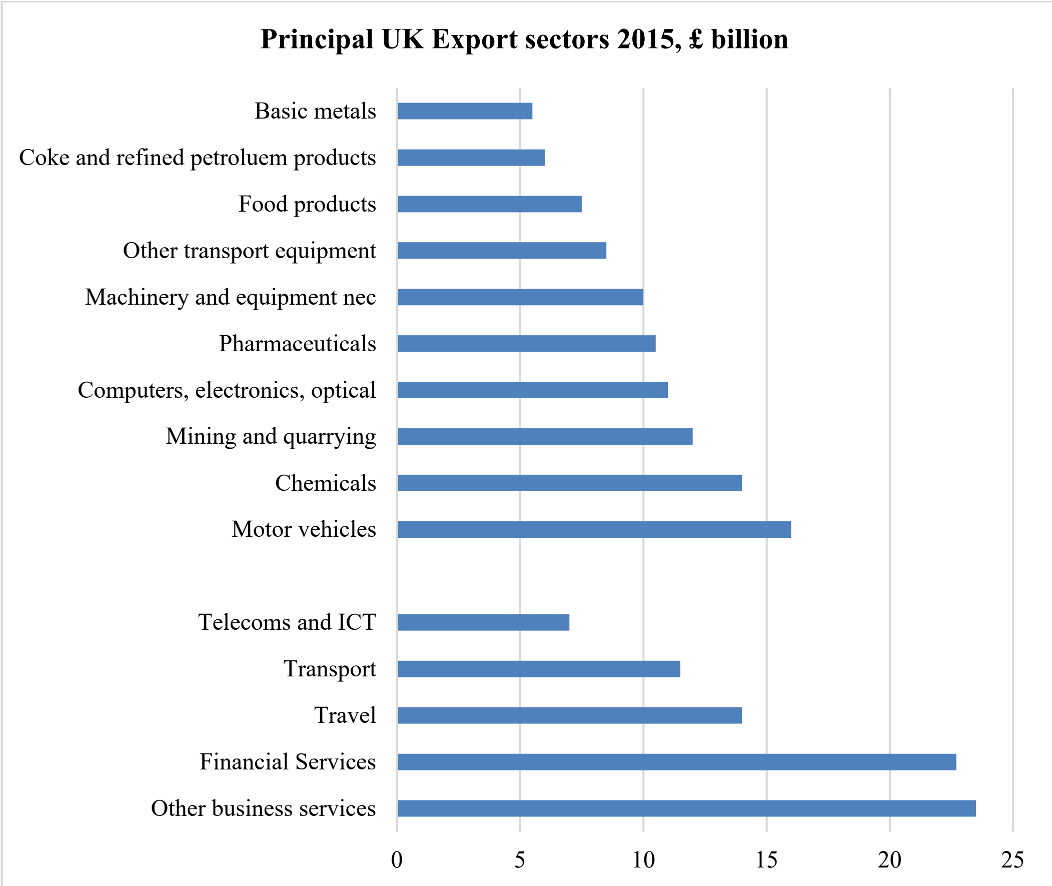
The potential benefits of Brexit could be: better regulation in UK (the common perception is that Bruxelles over-regulates and creates little space of maneuver in different sectors), opportunities for better trade deals with other partners (Southeast Asia, US, Canada) and avoidance of EU budget contributions until 2020 (hard to achieve if UK wants to benefit from the Single Market or passporting rights to operate in EU). In order to achieve a successful Brexit for both sides, the negotiation process has to start very quickly, without national remorse from several members and the perception that UK has to be punished for the national vote. From EU perspective, only three states have a share of exports going to UK larger than 8% (Ireland 14%, Netherlands 9.5% and Belgium 9.2%) and none of them are a dominating force in Bruxelles decision.

Trilemma of what UK wants



Source: Begg (2017).

Analyzing the principal UK export sectors, calculations reveal that financial services and other business services have over 45 billion sterling exposure to EU market. This figure reaches 2.4% of GDP in 2015 and a tougher regulation in these sectors could potentially provide large negative effects for British economy. The eventuality of "hard Brexit" could rapidly affect travel, financial services, other business services or motor vehicles sectors. The total exposure of these sectors represent over 4% of UK GDP. Taking into account some restrictive policies for immigration in order to please Brexit voters, the impact on the British pension funds sustainability is not negligible. In the EU labor markets, UK has been a net beneficiary of highly-skilled workers that brought comparative advantages in the services and financial sectors.



Conclusion

Brexit may signify a political absurdity transformed in an economic problem. The clear vote against globalization and UK inability to cope with global competition and technology revolution creates several problems for British authorities. UK will have to decide in the near future if it wants to further benefit from the Single Market or trade under WTO rules. Both perspectives may provide benefits, but surely imply costs that are hard to measure precisely at this moment. In order to achieve a "soft Brexit", politicians have to study the examples of Switzerland, Norway, Iceland or Liechtenstein. Apparently, Switzerland has the best position in this group, but Britain will have to face tough questions about what it means to preserve sovereignty when EU is making rules over which it will have no say. The desire to escape the authority of the European Court of Justice or to curb the immigration policies in its favor will be hard to achieve if it wants to preserve access to the Single Market and passporting rights to operate in EU. Companies doing business in the Single Market must abide EU competition rules, as recent examples of Microsoft and Google proved.

UK export sectors are much largely exposed to EU than vice-versa. Until now, the City of London was by far the most important financial center in Europe, a fact that could be changed in the eventuality of a "hard Brexit". Studies reveal that the negative economic impact could be large, and the GDP figures from the first quarter in 2017 seem to provide evidence in supporting this thesis. The stock of foreign direct investments from EU which stand at around 500 billion Euros could suffer a depreciation, especially in the sectors that are easy to displace. It is evident that the perfect equilibrium of UK trilemma will be hard to achieve.

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