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Crowding-out, home bias and financial stability in the aftermath of the sovereign debt crisis

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Abstract. *Crowding-out is the phenomenon in which government spending in one sector of the economy crowds out the private sector. This paper calibrates a DSGE model for Romania and then estimates a VAR model for Romania, the Czech Republic, Poland, and Hungary. From this broad perspective, it can be ascertained that risk stemming from unsustainable debt levels is attributed to the entire macro-financial framework and not just to the fiscal sector. The analysis focuses on the period around the sovereign debt crisis, when the crowding-out effect held a pivotal position in the dynamic interplay between public sector borrowing and private investment.*

Keywords: sovereign debt, investment, sovereign-bank nexus, financial crisis, macro-financial linkages.

JEL Classification: C32, E22, H63.

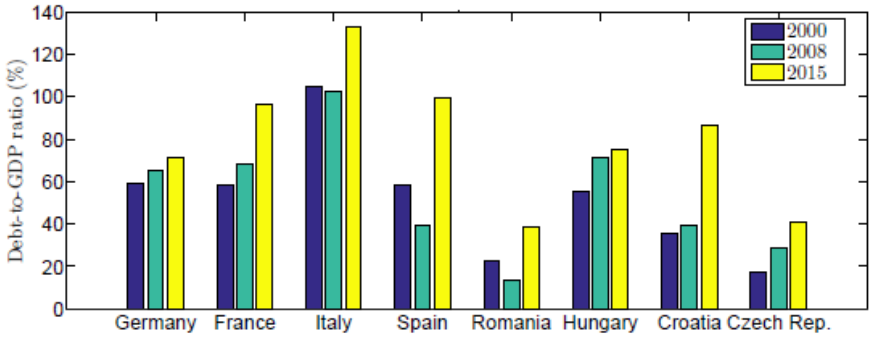
1. Introduction

The Global Financial Crisis and the Sovereign Debt Crisis have brought into discussion the topic of sovereign risk, as a result of the difficulties registered by some EU member states following an increase in the levels of public debt which can no longer be considered risk-free. In the context of expansionary fiscal policies, a crowding-out phenomenon can potentially lead to muted or even negative effects on aggregate output and private sector investment. The channels through which public borrowing can crowd-out public investment are various and there is still no general consensus on the aggregate impact on economic growth. According to Keynesian theory, increasing sovereign debt, financed through tax cuts or raising deficit, contribute to economic growth in the short term, but can lead to a reduction in public saving. In this case, if private sector activity is not able to offset the additional government borrowing, interest rates will rise, and investment will be crowded-out. Furthermore, the impact of crowding-out depends on the state of the economy, meaning that if the economy is operating below its potential, with an investment surplus, an increase in government spending via deficit widening will not induce a negative effect on the private sector.

Given the fact that the financial system is the main financing source for governments at a global level, there are opinions according to which, in the event of a shock occurrence, the significant exposures of banks and insurance companies may affect the balance-sheet positions of these institutions, which might lead to the damaging of investors' perceptions on the capacity of the issuing state in servicing its financial obligations towards its creditors. The substantial exposures of the banking system can be explained by the liquidity of public debt instruments (Krishnamurthy and Vissing-Jorgensen, 2012, pp. 233-267). Both the Global Financial Crisis and the Sovereign Debt Crisis have highlighted that holdings of the government bonds can bear significant solvency risk, with potential systemic repercussions if the effects are transmitted through contagion channels.

The existing literature identifies two main reasons for which banks do not dispense of their sovereign debt exposures. First of all, the losses incurred as a result of sovereign debt exposures materialise only when they are sold, if the instruments are held until their maturity (banking book). Brunnermeier and Pedersen (2009, pp. 2201-2238) provide an argument in favour of holding such portfolios, in cases of illiquidity spirals, in times of stress at a system-wide level, when massive selling might lead to significant adjustments in bond prices, amplifying the solvability issues of selling credit institutions. Moreover, high sovereign holdings owned by the banking sector do not amplify systemic risk in a significant manner, considering the fact that, in the case of a sovereign default, many financial institutions are likely to fail. Figure 1 illustrates the debt-to-GDP ratio for the selected CEE countries and a set of developed European Economies, for comparison.

Figure 1. *Euro vs. Non-euro Area countries Debt-to-GDP ratio evolution*



Source: Eurostat.

The concept of the crowding-out effect holds a pivotal position in discussions surrounding sovereign debt crises, especially as it pertains to the dynamic interplay between public sector borrowing and private investment. During a sovereign debt crisis, the government's increased need to borrow in order to finance its deficit can lead to a rise in interest rates. Theoretically, this escalation of interest rates is a reaction to the heightened demand for credit. As the government competes for a finite pool of investable funds, it crowds-out private borrowers. This phenomenon can stifle economic growth as businesses and consumers, faced with more expensive loan conditions, may reduce investment and spending. Furthermore, the increased cost of borrowing can lead to a depreciation of the currency, which might fuel inflationary pressures, further dampening economic activity by eroding the purchasing power of consumers.

In economies heavily reliant on external financing, the crowding out effect can also impact the balance of payments, making it costlier to service foreign debt and potentially leading to a vicious cycle of increasing debt and interest rates. This can diminish the country's economic resilience, making it more susceptible to external shocks and reducing its ability to implement countercyclical fiscal policies during economic downturns. Moreover, the crowding out effect also has implications for the equity market. As government borrowing requirements swell, it can lead to a reallocation of capital from equities to bonds, potentially depressing stock prices and further limiting companies' ability to raise funds through equity financing. This shift can have a long-term impact on corporate investment decisions, innovation, and growth prospects, which are crucial for the recovery from a debt crisis.

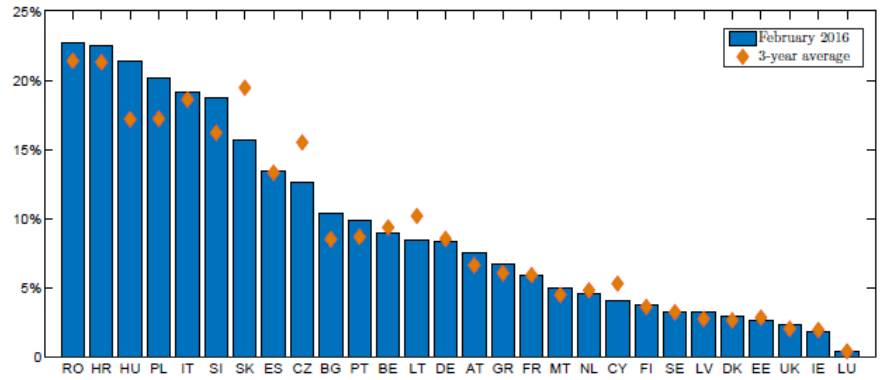
Understanding the crowding out effect is essential for policymakers, as it underlines the need for balanced fiscal management and prudent debt levels. Ignoring the implications of crowding out can result in suboptimal allocation of resources, hindered private sector development, and ultimately, a more prolonged and deeper economic crisis. Hence, it's imperative to adopt a holistic approach that considers the ramifications of fiscal policy on the broader economy, ensuring that interventions aimed at resolving a sovereign debt crisis

do not inadvertently stifle the very growth needed for recovery. In this context, the current paper focuses on studying the effects of government expenditure and investment on the dynamics of investments and on quantifying the effects of public investment on the real economy and private investment via the public financing and infrastructure channels in selected CEE countries, namely Romania, Poland, the Czech Republic, and Hungary.

2. Literature Review

The effects of public financing on private sector credit dynamics have been exhaustively analysed in numerous studies. The European Systemic Risk Board report on the regulatory treatment of sovereign exposures (ESRB, 2015) argues that public financing needs can affect private sector financing through the increase in competition for the access of funds, leading to a generalized increase in financing costs at a banking sector level. Nonetheless, the impact of this transmission channel varies according to a series of exogenous factors, as the negative effects of the recent financial crisis on the economy constitute, in all likelihood, the factors3 which explain the financial deleveraging process observed in the past years. Furthermore, the ESRB report on sovereign exposures (2015) deals with concentration risk identified in some EU member states, highlighting at the same time a common tendency of credit institutions to acquire government bonds issued by their respective home countries, a phenomenon which has intensified in recent years (Figure 2).

Figure 2. *MFI loans extended to general government*



Notes: Credit extended by MFIs excluding the ESCB to domestic general government. Credit comprises granted loans and holdings of debt securities issued. Total assets exclude remaining assets. For some countries, such as Italy and France, government-owned agencies mandated to finance primarily public administrations are listed as MFIs.

Source: ECB.

Furthermore, the opinions of some analysts indicate that high exposure of the banking system on sovereign debt can be ascribed to the crowding-out effect. In such a scenario, the expansion of the public sector is based on self-financing, instead of financing private investments and the private sector. A series of recent papers redefine the context of the crowding-out phenomenon, considering that high exposures over the private sector describe a new normality. In this sense, recent literature avoids associating the high exposure of the private sector on public funding with the crowding-out phenomenon, using the concept of home bias instead. Moreover, contrary to existing opinions, Asonuma et al. (2015) and Cornand, et al. (2016, pp. 445-469) show that, in the short term, the home bias phenomenon has positive effects for public debt sustainability. On the other hand, Reinhart and Tashiro (2013, pp. 1-43) highlight the need for developing the concept pertaining to the crowding-out phenomenon. As such, the authors show that, in time, crowding-out can be reached by means of important contributions given by the home bias phenomenon and capital outflows. However, Reinhart and Tashiro (2013, pp. 1-43) stress on the fact that while the aforementioned two factors are important in the emergence of the crowding-out phenomenon, the latter is not solely determined by them. Moreover, Asonuma et al. (2015) and Cornand et al. (2016, pp. 445-469) do not offer a clear direction for the medium and long term effects of the home bias phenomenon. Horváth, et al. (2015) find evidence of partially voluntary and involuntary sovereign debt home bias among large European banks. The authors show that the bias is stronger if the sovereign is risky and shareholder rights are strong, or the government has a positive ownership in the bank.

Consequently, the high exposure of the private sector on public financing should be regarded from a different perspective, other than that of its immediate association with the crowding out phenomenon and the related externalities. Another series of opinions underline an increase in the risks associated with the private sector, as result of the home bias phenomenon. In this regard, a series of arguments contravening to these opinions may be invoked, arguments which belong to the range of conclusions formulated by Asonuma et al. (2015) and Cornand et al. (2016, pp. 445-469).

3. Study case: was private investment crowded-out by public debt in Romania?

Another extensively debated topic in the existing literature focuses on identifying the factors which determined the massive credit contraction in the aftermath of the global financial crisis and on identifying the causes which acted on the demand and supply of loans at an aggregate level. In this case, the results of the studies are divided, some authors advocating that shocks on the supply-side of credit had a greater impact than those generated by demand-side shocks. Other researchers (Bell and Young, 2010, pp. 311-320) have identified an equally weighted contribution for the two types of shocks on newly granted loans.

For non-euro area countries, data stemming from surveys performed by central banks on loan granting to non-financial companies and population denote a major contraction of the population's demand on credit products (Figure 3). The tendency has also been observed in similar surveys conducted by other European central banks (ECB, Bank of England and others). In this sense, it has been somewhat established that demand-side shocks have had a major role in the downturn of loan granting in the period following the onset of the financial crisis.

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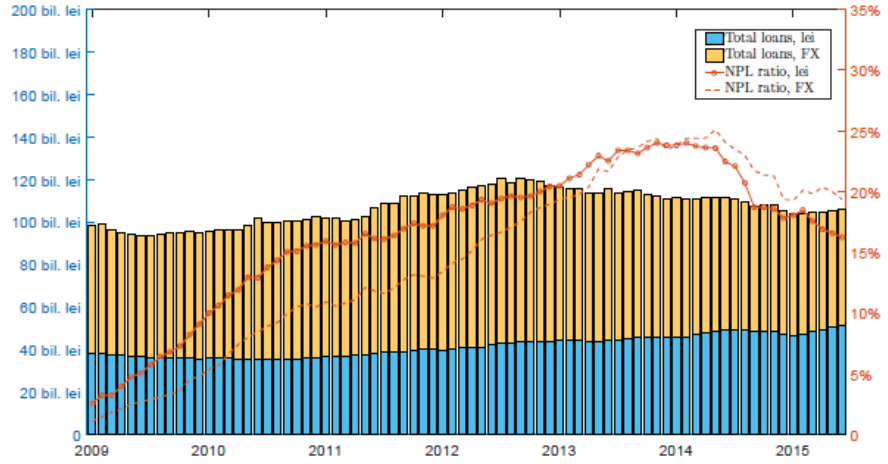
Figure 3. *Loan demand dynamics in Romania, by sector*

Source: Bank Lending Survey, NBR.

Several empirical studies which estimate thresholds for sustainable levels of public debt, under a general equilibrium framework, taking into account the economic and financial context, find that excessive growth of public debt can negatively affect the private sector. The aforementioned phenomenon can lead to second round effects on the public sector, amplifying the fiscal imbalance and raising the future cost of borrowing, through an increase of the sovereign risk premium. On the other hand, reaching an unsustainable debt level can lead to negative consequences through the expectations channel by amplifying short-term yield volatility, with spillovers across the entire maturity spectrum. From this

broad perspective, it can be ascertained that risk stemming from unsustainable debt levels is attributed to the entire macro-financial framework and not just to the fiscal sector. This type of scenario can be applied to situations in which sovereign debt rises as a consequence of unanticipated fiscal shocks. Moreover, in the presence of other types of shocks that generate negative spillovers, sovereign exposures will become even riskier as risks associated with other types of investments will increase further. Specifically, a flight-to-quality phenomenon can arise in such uncertain macro-financial conditions, where investors prefer to reallocate capital towards low-risk assets and economies (Figure 4). With the exception of severe scenarios, standard shocks maintain a balance between the risks associated with sovereign exposures and other types of assets.

Figure 4. *Non-performing loans of the Romanian banking system, by currency*



Source: NBR.

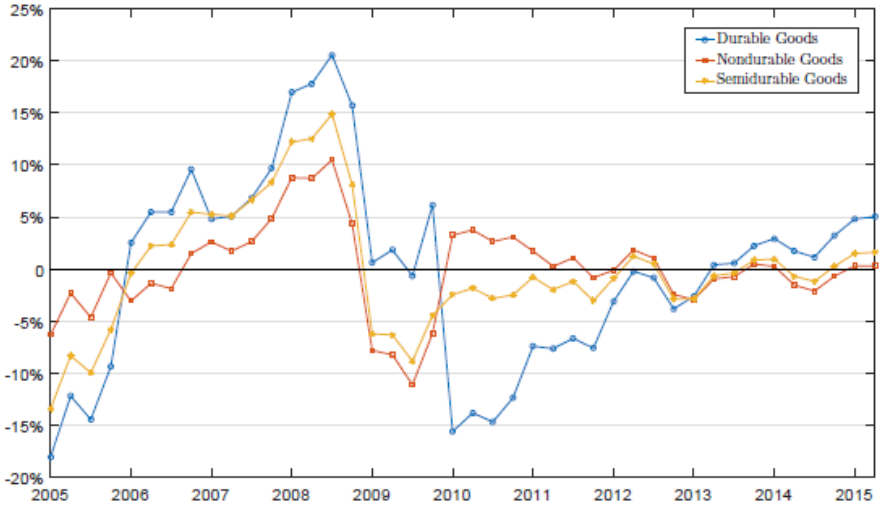
Regarding the home-bias phenomenon from a micro-macro perspective, financial institutions preference for government bonds, in contractionary phases, is natural given the current financial architecture. Prior to arguing this point of view, the typical behaviour of emerging economies in periods of contraction will be described. Adverse supply and demand-side shocks lead to a GDP contraction, accompanied by a rise in risk premia and capital outflows, negatively affecting private investment. Furthermore, the current account deficit transit to surplus is achieved simultaneously with a reverse trend of the capital account. In this context, supply sector contraction and local currency depreciation significantly contribute to the increase in non-performing loan rates which, in turn, negatively affect financial sector stability. Conversely, a reduction in consumption of durable goods (Figure 5) naturally implies a credit demand contraction.

Conversely, rapid banking sector growth can lead to significant risks for sovereign debt, through higher fiscal costs related to crisis management i.e. bank bailouts. The impact

depends on the characteristics of each system, although the IMF finds that the overall costs are higher in countries with large and leveraged banking systems. The authors show that while home bias can help reduce financing costs, especially during crisis episodes, it can also foster a potentially unsustainable rise in public debt, ultimately leading to an increase in sovereign risk.

Public debt growth has led to significant changes in financial institutions investment strategies, taking into account the abrupt reversals in risk premia observed after the outbreak of the financial crisis. In the aftermath of the global financial turmoil, banking sector capital was eroded by increasing NPL ratios and by the negative dynamics of financial results, determining a reorientation towards alternative investment instruments with a better risk-return profile, compared to classical loan products.

Figure 5. *Consumption cycle dynamics, separated by types of goods*



Note: The cyclical component was obtained by applying the Hodrick-Prescott filter, using a smoothing parameter of 1600 (recommended by the authors in the case of quarterly data).

Source: Eurostat, own calculations

3.1. A macro-financial model to describe the crowding-out transmission mechanism

The classical framework for quantitative macro research offers a simple and intuitive way to investigate the effects of increases in public debt on other key variables. For this purpose, we resort the approach of Ball et al (1998, pp. 699–720) in order to understand the framework, at least theoretically, which could facilitate the raising of crowding out. The two authors in fact used a classical Ramsey model designed in such a way to refute the

Ricardian equivalence. The model of Ball et al (1998, pp. 699–720) is described by the following relations:

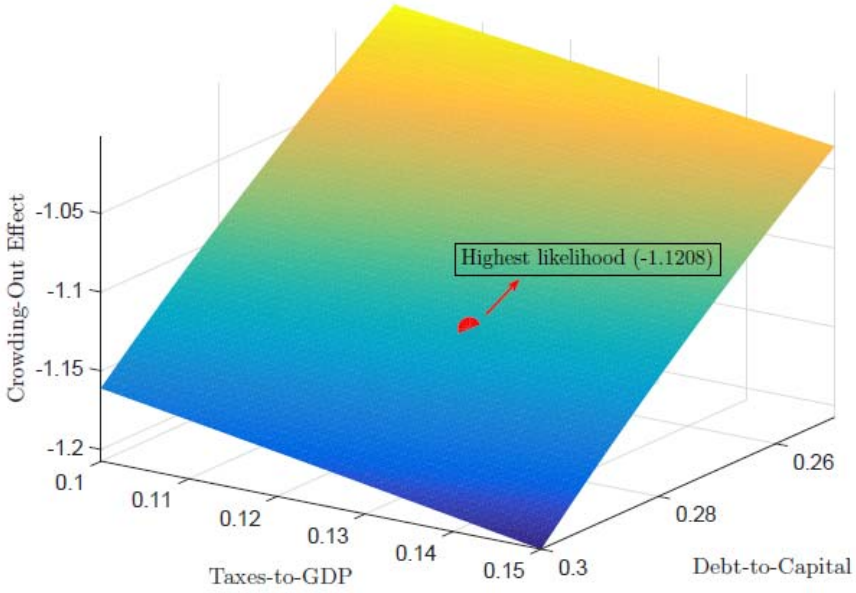
$$\begin{aligned} Y &= f(L) \\ TY &= r \times D + G \\ r &= f'(K) \\ \rho &= (1-\tau) \times r \\ f(K) &= K^{\alpha} - \delta \times (K) \end{aligned} \tag{1}$$

The above relations define the steady-state of the Ramsey model with fiscal sector. The first relation denotes the production function, in this paper being use a specification with capital depreciation, as compared with the benchmark form of the Ball et al (1998, pp. 699–720). The second related introduce the fiscal sector, where the taxes, as a share of production, equalize the debt servicing plus the government consumption. The third relation represents the marginal product of capital, while the last relation show that subjective time preference is defined by the after taxes interest rate. In this model, the crowding out is measured by the effects on capital generated by an increase in debt. In order to obtain a relationship for this purpose, a total differentiation of the capital in respect with debt is taken:

$$\frac{\partial K}{\partial D} = \left\{ \left[\tau - \left(\frac{D}{K} \frac{\alpha \times (\alpha - 1) \times K^{\alpha-1}}{\alpha \times K^{\alpha-1} - \delta} \right) \right] - (1-\tau) \times (K^{\alpha} - \delta \times K) \times \left(\frac{\alpha \times (\alpha - 1) \times K^{\alpha-2}}{(\alpha \times K^{\alpha-1} - \delta)^2} \right) \right\}^{-1} \tag{2}$$

To investigate the crowding out effects, the above model was calibrated on Romanian macro data. According with other studies on Romanian economy as well as based on empirical observation, the output elasticity of was calibrated at 0.4, the depreciation factor at 0.025, the taxes-to-GDP ratio at 0.13, while the debt-to-capital ratio was set at 0.2814. Given the high volatility observed in data, we constructed a grid for taxes-to-GDP and debt-to-capital ratios. The above plot shows the effects of crowding out generated by increase in government debt. In the highest likelihood scenario, emphasized by the red dot, the crowding out effect is around -1.1208 (Figure 6). This means that for an additional leu increase in the government debt, the steady state capital will decrease with a little bit more than a leu. The obtained results for different simultaneous scenarios of taxes-to-GDP and debt-to-capital ratios emphasize a much higher sensitivity of the crowding out in respect with the debt-to-capital ratio. Therefore, in times of crisis, when the debt is expected to raise, the crowding out effects will be larger. On the other hand, a counter-cyclical behaviour of the fiscal management could balance such effects.

Figure 6. *Grid plot for assessing crowding-out effects as a function of taxes-to-GDP and debt-to-capital ratios*



Source: own estimations.

We reiterate that our previous experiment was a simple and intuitive one used to describe a general framework that could facilitate the raising of crowding out effects. More than that, our econometric experiment refuted the predictions provided by the model of Ball et al. (1998, pp. 699–720). Given these, we decided to investigate further the problem in hand in order to obtain a better understanding of the crowding out phenomena in Romanian economy. For this reason, we used a DSGE model with a similar mechanism as in Traum and Yang (2015, pp. 24–45). More exactly, we decided to investigate if the crowding out phenomena depends on the size of the debt and not on the source use of government expenditures. Our DSGE model represents a version of the basic model used by Alupoaiei (2015, pp. 217-226), Cespedes et al (2004, pp. 1183-1193), containing also external and banking sector, as compared with the model of Traum and Yang (2015, pp. 24–45). The fiscal sector was introduced according with Gali et al (2007, pp. 227-270), while the government expenditures were split-up in government consumption and investments. In this regard, the production function is affected by the evolution of government investments. Other important specifications of this model are (i) the utility function contains an external habit, (ii) the risk premium is expressed as a fragility condition, (iii) while the specification of relatively small domestic economy in respect with foreign economy is set as in Justiniano and Preston (2010, pp. 93-128). The model was calibrated for Romanian economy.

The obtained impulse-response functions emphasized the same results as in Traum and Yang (2015, pp. 24–45): the increase of government expenditure due to consumption

determines a decrease in Tobins Q and investment (Impulse response plots can be found in the Appendix). Instead, when the government allocates its results for investments, investment and related Tobins Q record an opposite reaction. Another interesting result is that government investment produces a raise in credit as the increase investments have to be financed. This observation is very important to understand how the use of government expenditure could affect the real dynamics.

3.2. Empirical modelling of crowding-out phenomenon

3.2.1. Estimating crowding-out effects of public investment

The first part of the empirical analysis is aimed at quantifying the effects of public investment on private investment and the real economy, relying on the theoretical model which implies that public investment growth can affect private sector investment through the following channels:

- **Financing channel** – a higher demand for public spending can entail raising taxes or accessing capital markets, causing interest rates to rise. The effect is transmitted to private sector savings via a decrease in expected rate of return on private capital, consequently leading to a crowding-out effect.
- **Infrastructure channel** – on the other hand, investing in infrastructure projects can provide a sustainable basis for productivity growth in the private sector, resulting in an overall positive impact on private investment (crowding-in effect).

In order to assess the impact of public investment in a quantitative framework, we have chosen to follow Afonso and Aubyn (2008), by estimating a small VAR model for 4 CEE economies (Romania, Czech Republic, Poland and Hungary) using an annual dataset spanning between 1995-2016.

Given the limited availability of macroeconomic time series for CEE countries, we extract the following variables from the AMECO database: real GDP growth, real public and private investment and real taxes. The authors include a measure for the long-term interest rate as the last variable in the model, which is unavailable on such a long timeframe for CEE economies, due to the limited financial market development and restricted access to market based financing of the economy.

The model can be written as:

$$X_t = c + \sum_{i=1}^{p} A_i \times X_{t-i} + \varepsilon_i \tag{3}$$

where X_t is the vector containing the endogenous variables, c represents the intercept of the equation, A is the matrix of autoregressive coefficients and ε, the vector of random disturbances.

Identification of orthogonal shocks η_t is imposed via a set of restrictions, by applying a Choleski decomposition of the matrix of covariances of the residuals:

$$\eta_t = B \times \varepsilon_t$$

where

$$B^{-1} = D = \begin{pmatrix} d_{11} & 0 & 0 & 0 \\ d_{21} & d_{22} & 0 & 0 \\ d_{31} & d_{32} & d_{33} & 0 \\ d_{41} & d_{42} & d_{43} & d_{44} \end{pmatrix} \quad (4)$$

Consequently, the variables are ordered from most to least exogenous, with public investment placed at the top of the vector, with the purpose of obtaining instantaneous effects of public investment shocks in the other macroeconomic variables included in the VAR model. In turn, the ordering implies that all the other variables have a lagged effect on public investment, which is consistent with the hypothesis of a relatively slower government investment strategy allocation process. Additionally, private investment responds contemporaneously to public investment shocks, as economic agents can base their investment strategies on government allocation of funds aimed at certain public infrastructure projects.

The VAR model is estimated in first differences, as we do not expect any long-term cointegrating relations between the macroeconomic variables (Afonso and Aubyn, 2008). Lag selection was based on lag length criteria testing, considering the relatively limited data availability for the aforementioned countries. Consequently, one lag is used for all four estimated models, after running serial residual correlation and normality tests to ascertain that the statistical foundations of the models are sound. The results of the testing procedures, as well as the Augmented Dickey-Fuller test results can be found in the Appendix.

Finally, in order to assess the crowding out effects of public debt, we compute several measures of long-run elasticity based on Pereira (2000, pp. 513-518). Using accumulated impulse response functions for the VAR model estimation (Figure 7), we can measure long-term marginal productivity of private and public investment in the following manner:

$$MPI_{ipub} = \frac{\Delta Y}{\Delta I_{pub}} = \varepsilon_{ipub} \times \frac{Y}{I_{pub}}, MPI_{ipriv} = \frac{\Delta Y}{\Delta I_{priv}} = \varepsilon_{ipriv} \times \frac{Y}{I_{priv}}, \quad (5)$$

where (6)

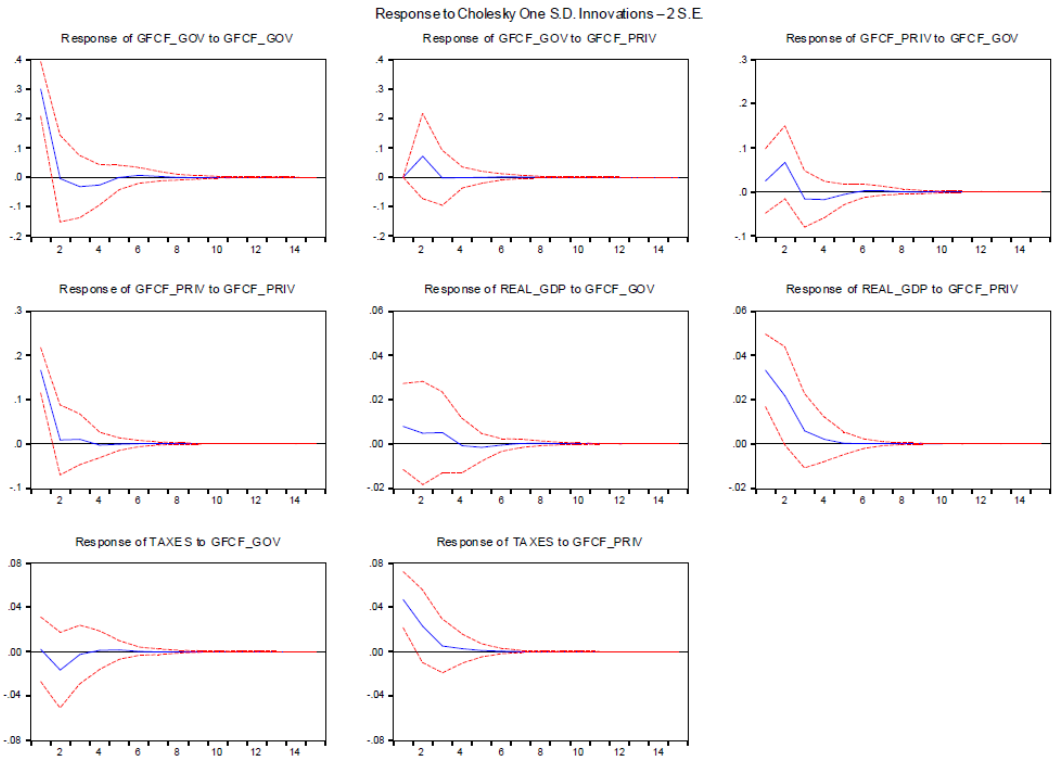
$$\varepsilon_{i\text{pub}} = \frac{\Delta \log Y}{\Delta \log I_{\text{pub}}}, \varepsilon_{i\text{priv}} = \frac{\Delta \log Y}{\Delta \log I_{\text{priv}}}$$

Furthermore, crowding-out effects of public investment can be derived from the marginal effects on private investment, derived from:

$$\frac{\Delta I_{\text{priv}}}{\Delta I_{\text{pub}}} = \frac{\varepsilon_{i\text{pub}} \times I_{\text{priv}}}{\varepsilon_{i\text{priv}} \times I_{\text{pub}}} \quad (7)$$

Broadly speaking, we expect that a positive ratio between private and public investment elasticities can indicate a crowding-in effect, whereas a negate value could entail a crowding-out effect on private sector investment.

Figure 7. *Orthogonal impulse response functions to private (GFCF_priv) and public (GFCF_gov) sector investment for the Romanian Economy*



Source: own estimations.

3.2.2. Results

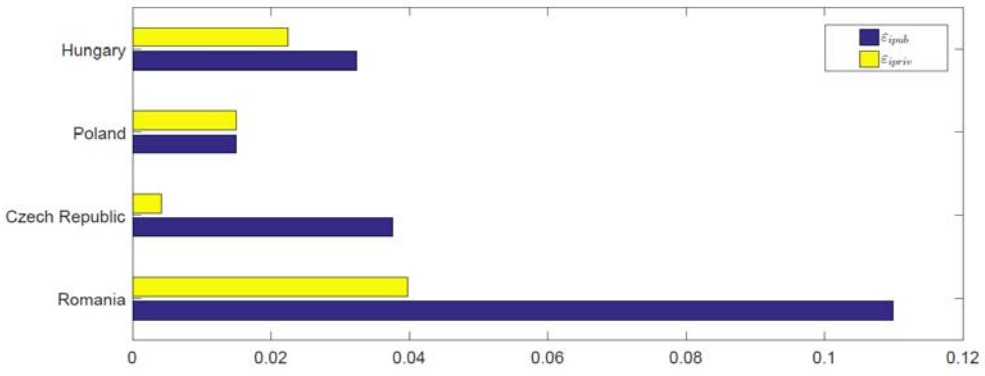
After assessing the statistical relevance of the results, we plot the orthogonal impulse response functions for private and public investment, on a 15-period horizon, and draw several conclusions. First of all, the estimated signs are in accordance with macroeconomic theory, highlighting a strong theoretical underpinning of the econometric specification.

In all four cases, we find that private investment growth has a positive effect on real GDP growth and is associated with a higher impact than public investment growth. One possible explanation could reside in the fact that public investment efficiency is still an unresolved issue in the analysed CEE countries and that private investment projects generate more added value than government development. Similarly, a rise in private gross fixed capital formation leads to a positive impact on tax collection, highlighting once again the importance of investment in attaining sustainable economic growth.

Estimating long-run elasticities of public and private investment reveals the fact that, in all cases, private investment generates more added value, and that while Hungary and Poland exhibit similar elasticities for public and private investment, the Czech Republic and Romania have much higher elasticity ratios for private investment (Figure 8).

A significant difference between private and public elasticity ratios is consistent with the results of Afonso and Aubyn (2008), as the authors generally find that private investment generates significantly higher accumulated responses in GDP growth. Quantifying crowding-in effects via impulse response analysis can prove to be a rather difficult task, although it seems that generally the impact of public investment growth tends to be positive for all the analysed countries. For this reason, we chose to compute long-run elasticities, derived from accumulated responses.

Figure 8. *Estimated long-run elasticities for public and private investment*



Source: own estimations.

The results are summarized in the Table 1. The results reveal the fact that public investment generates a crowding-in effect on private investment in all the CEE countries included in the sample, while generating expansionary effects in output. While there are some differences between the estimated elasticity of private to public investment, ranging from 2 22 percentage points, the overall conclusion is that public investment has generated positive effects on private sector investment and output.

Table 1. *Long-run elasticities and estimated crowding in/out effects*

Romania	ε_{ipub}	0.039	Y/I_{pub}	27.896	MPI_{ipub}	1.109
	ε_{ipriv}	0.109	Y/I_{priv}	5.002	MPI_{ipriv}	0.549
	Crowding in/out					6.49%
Czech Republic	ε_{ipub}	0.004	Y/I_{pub}	22.395	MPI_{ipub}	0.092
	ε_{ipriv}	0.037	Y/I_{priv}	4.231	MPI_{ipriv}	0.158
	Crowding in/out					2.08%
Poland	ε_{ipub}	0.014	Y/I_{pub}	28.021	MPI_{ipub}	0.419
	ε_{ipriv}	0.014	Y/I_{priv}	6.105	MPI_{ipriv}	0.091
	Crowding in/out					21.77%
Hungary	ε_{ipub}	0.022	Y/I_{pub}	32.671	MPI_{ipub}	0.732
	ε_{ipriv}	0.032	Y/I_{priv}	5.421	MPI_{ipriv}	0.175
	Crowding in/out					11.50%

Source: own estimations.

4. Conclusions and policy options to reduce sovereign-bank nexus

Regarding the home-bias phenomenon from a micro-macro perspective, financial institutions preference for government bonds, in contractionary phases, is natural given the current financial architecture. In the presence of other types of shocks that generate negative spillovers, a flight-to-quality phenomenon can arise in such uncertain macro-financial conditions, where investors prefer to reallocate capital towards low-risk assets and economies. From this broad perspective, it can be ascertained that risk stemming from unsustainable debt levels is attributed to the entire macro-financial framework and not just to the fiscal sector per se.

The EU debt crisis has sparked a series of policy initiatives aimed at eliminating the negative feedback loops established between sovereign debt instruments and credit institutions. The most widely discussed options are related to imposing non-zero risk weights when computing the RWA indicator for individual institutions or setting maximum exposure limits towards the government, in a similar manner to EU legislation treatment of large exposures. While several empirical studies have shown the benefits of imposing tighter regulatory standards in increasing the resilience of the banking sector (for example, see ESM Discussion paper no. 1, March 2016), the fiscal costs for implementing these types of measures could prove to be challenging, in terms of pricing as well as market liquidity.

Additionally, other researchers have argued that the policy option of imposing tighter prudential rules on banks' sovereign exposures is viable in a steady state, but complex in a crisis situation (Angelini et al., 2014). Setting aside the fact that there is a common agreement amongst policymakers regarding the need for a gradual implementation of such prudential measures in order to preserve sovereign debt markets stability, there are still other concerns regarding the viability of implementing these measures. For instance, Andritzky et al. (2016) argue that in the presence of large exposure limits, banks could be forced to sell their sovereign exposures if their capital contracts in a crisis episode. This procyclical effect could lead to an increase government financing costs and hamper countercyclical fiscal policy.

First of all, Angelini et al. (2014) raise a question related to the functioning of such provisions in the case of monetary unions, in which monetary policy is coordinated at aggregate level and where policy makers do not have the option of trading-off sovereign default risk for inflation risk. Secondly, imposing different weights on sovereign debt requires an objective evaluation regarding the level of risk entailed by each type of instrument and relying on extern credit ratings could undermine the gradual reliance decrease on rating agencies (G20 and FSB). Finally, designing an efficient prudential framework for sovereign debt risk requires considering interactions with all the other policy requirements regarding liquidity, collateral eligibility and others. In conclusion, while there is still no clear direction on the optimal policy framework to address the sovereign-bank nexus, it is clear that increasing financial sector resilience and designing anticyclical fiscal policy measures, as part of an overarching macroprudential policy framework, will lead to lowering the probability of future financial crises and ultimately pave the way for a sustainable contribution of the financial sector to economic growth.

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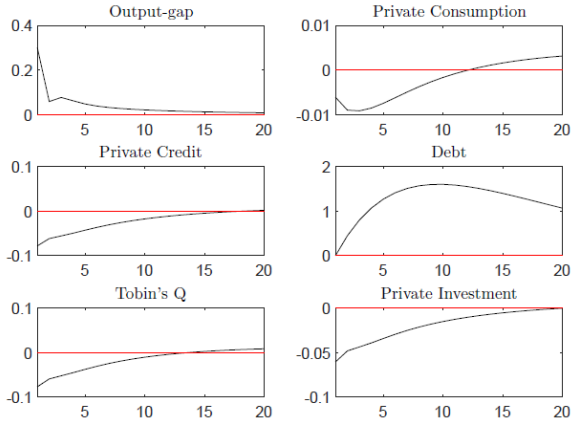
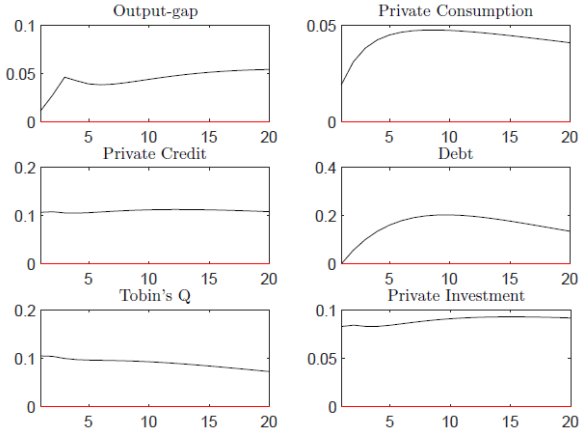
Appendix

Figure A.1. *IRFs for a shock in government expenditure*



Source: own estimations.

Figure A.2. *IRFs for a shock in government investment*



Source: own estimations.

Table A.1. *ADF results for the variables included in the VAR model*

		Real GDP	GFCF gov	GFCF priv	Taxes
Romania	t-stat	-2.82628	-4.2478	-3.99968	-3.16783
	critical value	-2.6467**	-3.79264	-3.79264	-3.01412*
Czech Republic	t-stat	-3.51584	-6.58803	-5.12072	-3.40571
	critical value	-3.01412*	-3.79264	-3.79264	-3.01412*
Poland	t-stat	-3.42152	-4.69961	-2.68692	-3.51585
	critical value	-3.01412*	-3.79264	-2.6467**	-3.01412*
Hungary	t-stat	-3.20094	-5.58788	-3.39629	-3.42571
	critical value	-3.01412*	-3.79264	-3.01412*	-3.01412*

Note: critical values are for 1% statistical significance
** Denotes statistical significance at 10%
* Denotes statistical significance at 5%
Source: own estimations.

Table A.2. *Multivariate residual serial correlation LM test results*

	Lags	LM-stat	Probability
Romania	1	26.74462	0.0444
	2	19.83172	0.2279
Czech Republic	1	11.39414	0.7845
	2	6.338204	0.984
Poland	1	17.68224	0.3428
	2	16.28143	0.4335
Hungary	1	9.679919	0.8828
	2	11.76789	0.7598

Note: Probabilities obtained from chi-square distribution with 16 degrees of freedom.
Source: own estimations.

Table A.3. *Multivariate Jarque-Bera residual normality test results*

	Chi-square	Probability
Romania	2.096245	0.7181
Czech Republic	3.536151	0.4724
Poland	2.819803	0.5884
Hungary	5.316973	0.2563

Note: Probabilities obtained from chi-square distribution with 4 degrees of freedom.
Source: own estimations.

Figure A.3. *Orthogonal impulse response functions to private (GFCF priv) and public (GFCF gov) sector investment for the Czech Republic*

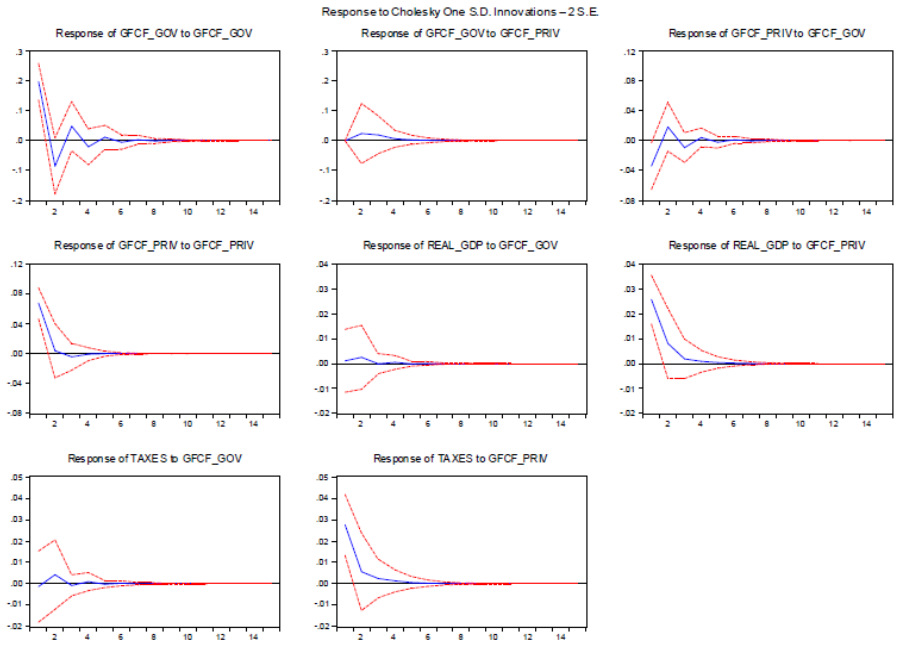
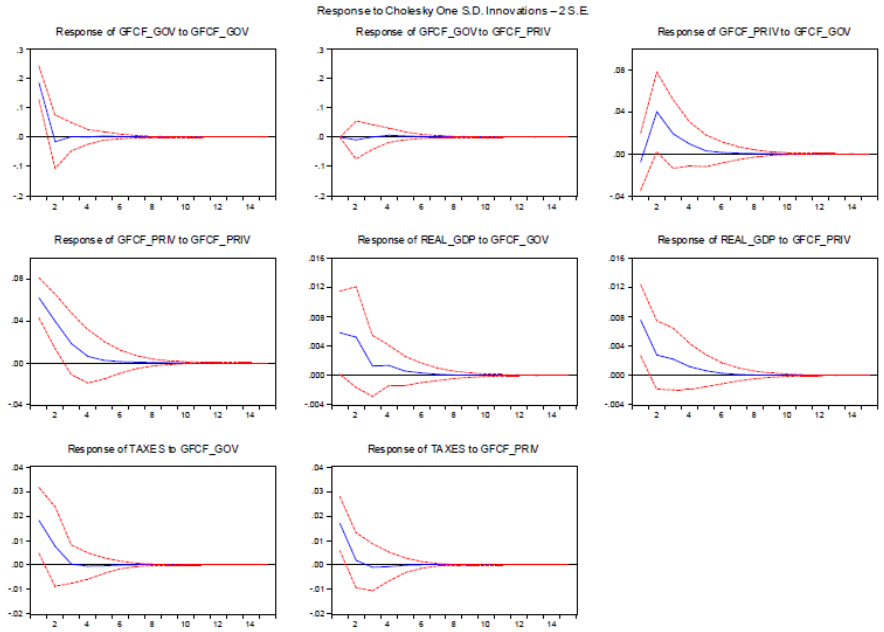
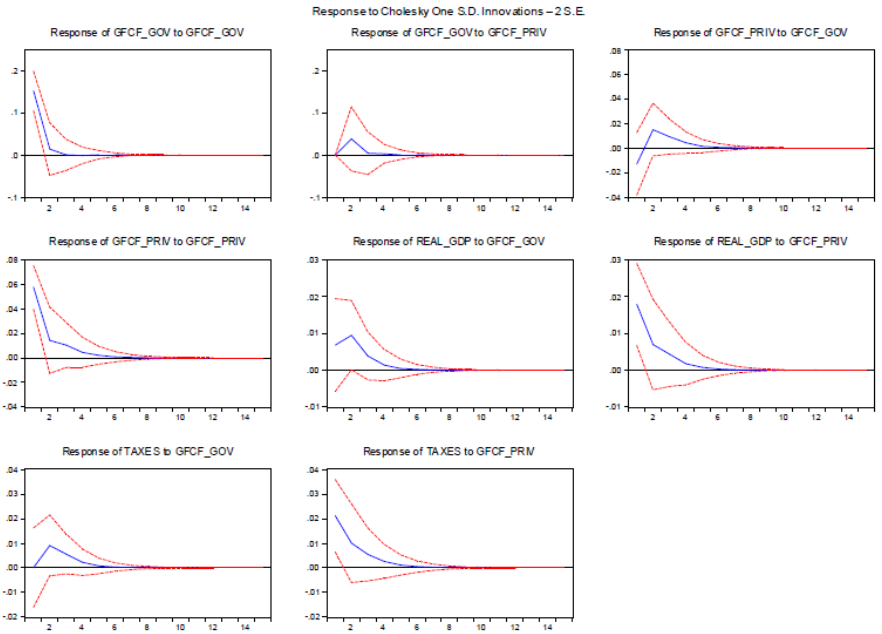


Figure A.4. *Orthogonal impulse response functions to private (GFCF priv) and public (GFCF gov) sector investment for Poland*



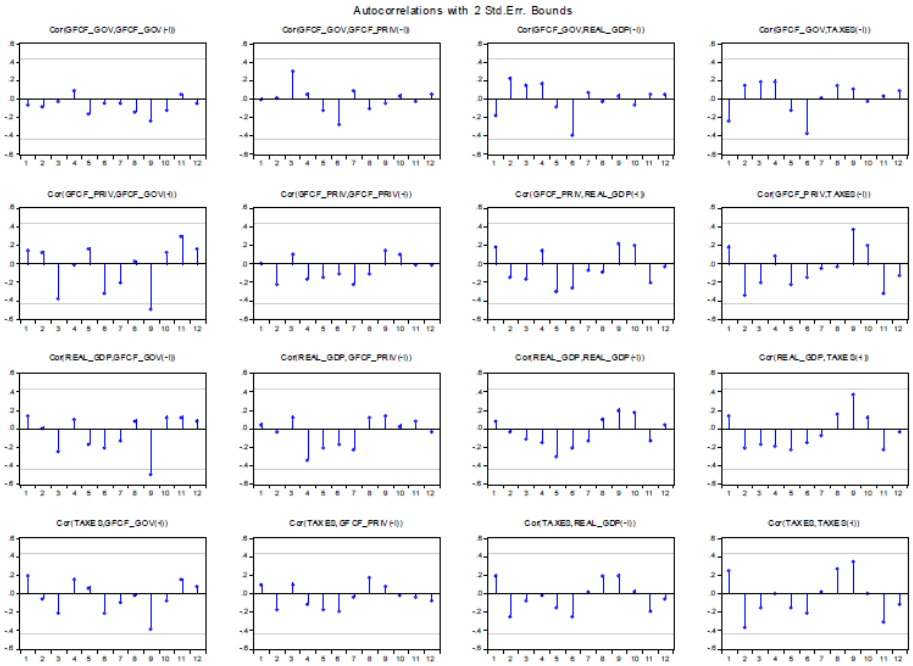
Source: own estimations.

Figure A.5. *Orthogonal impulse response functions to private (GFCF priv) and public (GFCF gov) sector investment for Hungary*



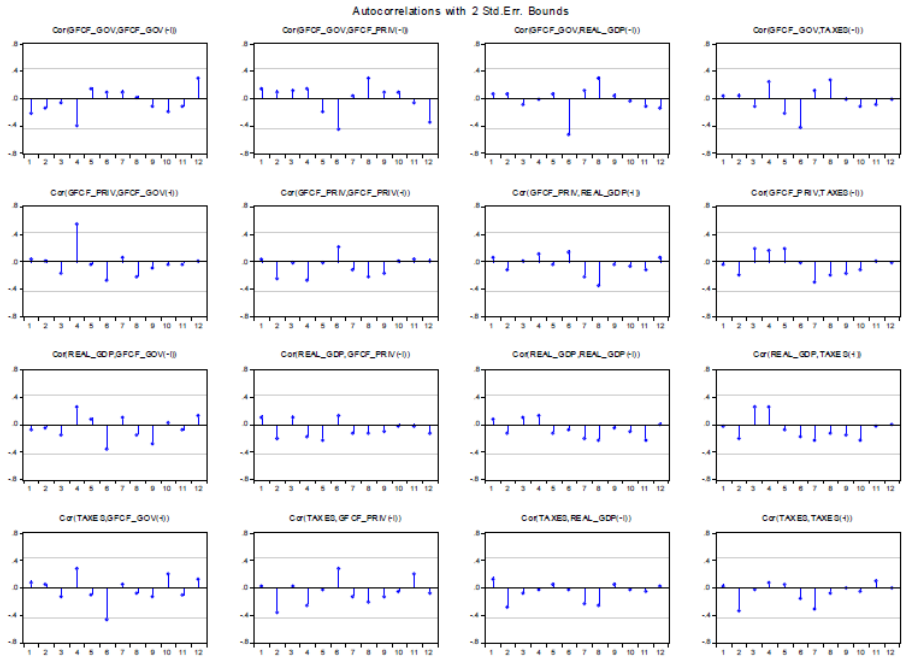
Source: own estimations.

Figure A.6. *Correlogram analysis for Romania*



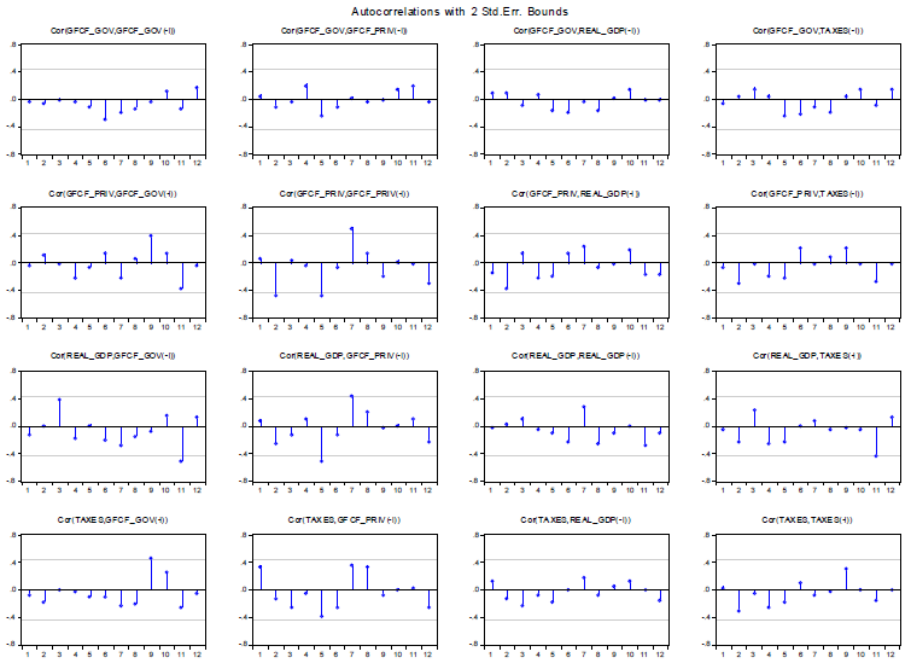
Source: own estimations.

Figure A.7. *Correlogram analysis for the Czech Republic*



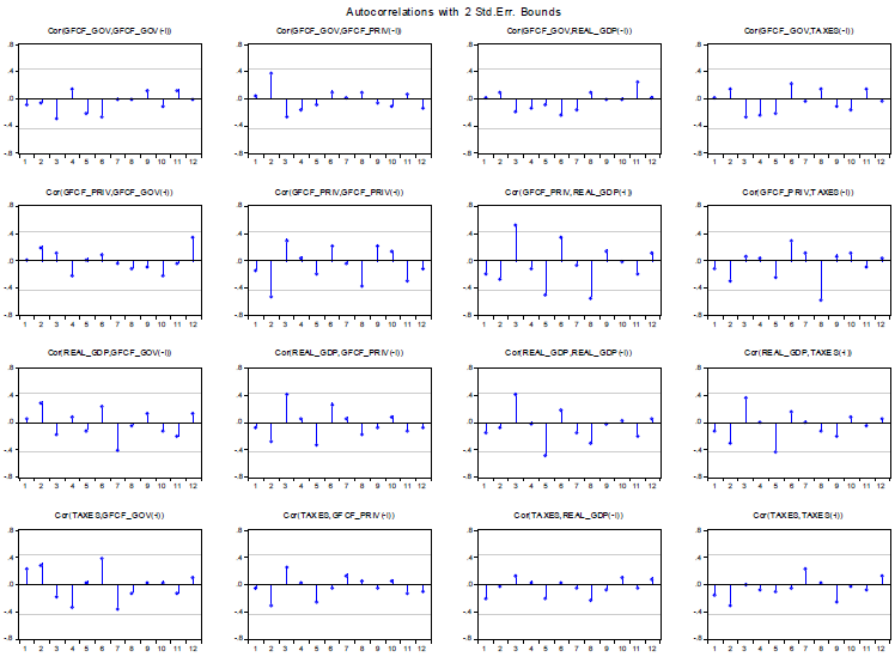
Source: own estimations.

Figure A.8. *Correlogram analysis for Poland*



Source: own estimations.

Figure A.7. *Correlogram analysis for Hungary*



Source: own estimations.