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South East European Journal of Economics and Business
Volume 18 (1) 2023, 194-210
DOI: 10.2478/jeb-2023-0013

ECONOMIC CONSEQUENCES OF THE COST OF GOVERNMENT BORROWING IN EUROPEAN TRANSITION ECONOMIES

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Abstract

Given the need of transition economies to fund the investments necessary for development partly through borrowing, this paper investigates empirically the economic consequences of the government cost of borrowing for European transition economies during the period 2003-2016. The investigation analyses the impact of sovereign borrowing costs, in turn, on interest rates on loans to businesses and households, on the growth rates of investment and consumption, and, ultimately, on general economic activity. By utilizing a panel VAR technique our results indicate that consequent upon a positive shock to the cost of sovereign borrowing, the cost of borrowing for loans to both Non-Financial Corporations (NFCs) and households increases. We find that the price transmission from government borrowing costs to the private sector is at play with respect not only to borrowing rates but also to macroeconomic activity at large. Following an increase in sovereign borrowing costs, we observe substantial negative responses in the growth rates of investment, household consumption, and GDP growth. Also, while a price of borrowing increase for NFCs is found to negatively affect investment, household consumption is unaffected by an increase in household borrowing rates. These findings have valuable policy implications for policymakers and stakeholders in transition economies. Specifically, the results suggest that efforts to reduce the cost of sovereign borrowing could have a positive impact on the economy by lowering borrowing costs for households and businesses, promoting investment and consumption, and ultimately boosting economic growth.

Keywords: *Government bonds, risk transmission, lending rates, sovereign debt.*

JEL classification: *C32, C33, E43, E52, G21*

1. Introduction

In recent years, public finances and their nexus with other sectors of the economy have undergone thorough scrutiny in both policies as well as academic discussions. This increased interest in government fiscal stance and its long- and short-term sustainability was motivated by at least two major moments that characterized the recent period. First, the recent global financial crisis and the following European sovereign debt crisis transmitted negative effects through multiple channels simultaneously onto the economy. And secondly, the discussion around the most effective public policy response to the deteriorating output, increasing unemployment rates, weaker financial system, and, ultimately, the decline in living standards as

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a consequence of the financial and sovereign debt crisis (Neri and Ropele 2015).

As the crisis unfolded, especially the European sovereign debt crisis, divergence emerged at the EU country level and also the regional level with regard to the dynamics of key fiscal and macroeconomic indicators (Eller and Reininger 2016). Given the differences among countries in Europe in their fiscal and macroeconomic developments, significant differences were also observed with regard to sovereign bond yields, this coming after a slow convergence that was observed in the run-up to the crisis period. The deteriorated macroeconomic environment and the induced pressures on the public finances, together with the rise in the public cost of borrowing in the countries of the less-developed European "periphery" (including those in "transition"), increased even further the stock of public debt, which consequently gave rise to uncertainties with regards to government creditworthiness and the associated sovereign credit risks. The increased uncertainties regarding sovereign credit risk during the crisis periods adversely affected banks' funding conditions to a level close to the deterioration of the creditworthiness of the sovereign (CGFS 2011).

With these macroeconomic and fiscal developments at play affecting sovereign creditworthiness with potential adverse spillover effects to the financial sector, divergence in the lending conditions to firms and households for investments and consumption in European countries emerged as well (Neri and Ropele 2015; Del Giovane et al. 2013). In addition to the monetary policy rates impacting the lending rates, these fluctuations in lending rates were to a large extent ascribed to changes in government creditworthiness (Eller and Reininger 2016). Given these fluctuations in the lending rates and the importance of external financing for the non-financial sector, the public policy debate renewed its attention to the determinants of lending rates and the channels of stress transmission from the government to the private sector (Altavilla et al. 2022; Eller and Reininger 2016; Neri 2013).

In light of these developments, the aim of this paper is to empirically investigate the impact of government cost of borrowing on the private sector borrowing rates and its impact on the general economic activity of the European transition economies. By focusing on European transition economies – as a set of countries that are different from emerging economies – this paper brings evidence from a largely neglected set of countries in the literature.

The remainder of the paper is organized as follows. In the following section (2), we review the literature by focusing on the risk transmission channels through which sovereign creditworthiness is expected to affect bank funding conditions and possible reflection in private lending rates. In Section 3 we present the methodology and data. Estimated results are presented in Section 4 and Section 5 presents conclusions.

2. Literature Review

Several channels have been proposed by the literature through which governments – via policies or via unintended spillovers from their actions – affect the interest rates on lending to the private sector. These literature suggestions can be classified into two main pillars. First is the traditional thesis that argues in the context of the monetary transmission mechanism, and highlights the effects of changes in the key policy rate on the money market and their effect on lending rates to the private sector. In the context of the monetary transmission mechanism, the credit channel thesis is proposed – which is decomposed into the balance sheet channel and the bank lending channel – that considers the implications of monetary policy shifts on the balance sheets of firms and the balance sheets of banks as providers of financing. And, secondly, a more recent and narrow view focuses on the influence of sovereign creditworthiness on bank funding conditions and lending rates via the possible deterioration of, among others, asset holdings, collateral values, and ratings by rating agencies. Our interest and focus in what follows and the upcoming empirical specifications is positioned in the second strand of the literature that considers the spillover risks from government risk, particularly from the government cost of borrowing to private sector lending rates.

The report from the Bank for International Settlements (CGFS 2011) gives a review, albeit relatively brief, on the potential channels of transmission of government stress to the private borrowing conditions. According to this report, there are at least four possible specific channels of transmission of stress from the sovereign to the financial sector that has the potential to result in higher interest rates and/or lower quantitates of loans supplied to the private sector. The first potential channel is via the asset side of banks. Due to holdings of government debt on the asset side of the banks, deteriorated sovereign creditworthiness, devalues sovereign assets, weakens the balance sheets of banks, and, therefore, has a negative impact on the cost of funding and the ability of banks to secure liquidity. Secondly, as government debt is used by banks as collateral in their interbank lending, a reduction in the value of government securities due to an increase in sovereign risk lowers the banks' funding capacity. The third channel is via the credit

ratings undertaken by credit rating agencies (e.g. S&P, Moody's, and Fitch). In the event of a downgraded rating for the sovereign resulting from an increase in credit risk, the rating of banks in the downgraded country is expected to face a similarly downgraded scoring as well. And, finally, with the increase in sovereign risk, the ability to provide an implicit and explicit guarantee by the government for banks is reduced, which in turn increases banks' funding costs.

In addition to the above four specific channels through which government risk has the potential to influence the banking sector and, therefore, the cost and quantity of private borrowing, there is also a possibility of influence via the general economic activity channel. An increase in sovereign risk could result also in a general economic recession, which in turn may result in an increase in private sector borrowers' riskiness and also may lead to the deterioration of banks' funding costs. Irrespective of the banks' exposure to the government debt, this may result in credit tightening to the private sector either through an increase in interest rates and/or lowering of the number of loans as a result of increased business environment risks for banks and also the increasing risks of business operating in the downgraded economy (BCBS 2017).

Considering the influence of the sovereign debt issuance from peripheral EU countries on the stock market performance of 65 European banks, Angeloni and Wolff (2012) find some evidence of a negative influence from deteriorated sovereign creditworthiness on the banks' market valuation (asset holding channel). Nevertheless, the authors point out also that the financial performance of banks cannot be ascribed to the bank's portfolio composition only, hence, sovereign exposure, but other factors determine the overall market value of the banks such as the location of the banks. In a somewhat similar line of investigation, De Bruyckere et al. (2012) use a longer time dimension that covers also the period of the financial crisis (2006-2011) for more than 50 banks in 16 European countries. The focus of their study is on the risk spill-over between sovereign and banks. Moreover, they also shed light on the determinants of risk spill-over between the sovereign and the banking sectors; more specifically, they explore the differences in the risk spill-over based on the characteristics of the sovereigns and the banks in their sample. In this consideration, their findings suggest that contagion (or excess correlation) between sovereigns and banks has increased in recent years and that this increased correlation is more visible during the global financial crisis and the European sovereign debt crisis. Their results support the asset holding channel by suggesting that the contagion and therefore the risk transmission is greater in countries that have a higher share of domestic debt held in banks' portfolios. In addition, their results also indicate that bank size matters, in that the larger the banks are in a specific country, the higher the contagion between the sovereign and banks. Given the positive results with respect to the bank size variable, the authors further suggest that this positive result represents evidence for the existence of the government guarantee risk transmission channel, by noting that the larger the banks in a particular country the higher the pressures are for a bail-out from the public sector in times of financial distress. As in the case of Angeloni and Wolff (2012), also De Bruyckere et al. (2012) find evidence of home-biased holdings of sovereign security by banks.

Altavilla et al. (2020) utilize OLS estimation to investigate the determinants of banks' exposure to government debt and the effects on the bank lending activities of the banks located in the euro area. Their results confirm the findings of several previous studies with similar interest by showing that domestic banks, publicly-owned banks, and recently bailed-out banks have a higher likelihood of holding government bonds as compared to other banks. Moreover, in addressing the effects of sovereign debt exposure on bank lending activities, the study finds that an increase in government bond yields (10-year and 5-year maturity) would lead to a decline in the quantity of lending to the private sector by banks that are more exposed to sovereign debt. Conversely, these reactions to the sovereign bond yield movements are not present when foreign-owned banks are considered. In addition to the quantity of loans, also interest rates on loans charged to non-financial corporations tend to increase in the event of deterioration in sovereign creditworthiness (as measured by government bond yields). The changes in interest rates, similar to the changes in the quantity of loans, are more visible for those banks that have higher exposure to public debt. Given these results, the authors indicate the existence of the asset holding channel and the collateral channel as risk transmission mechanisms.

In a recent study, Bouis (2019) suggest different reasoning for the negative relationship between banks' holdings of domestic government debt and credit growth to the private sector. Differently from Altavilla et al. (2020), Bouis (2019) uses macroeconomic-level data as compared to the bank-level data used in most studies with a similar aim. In unbalanced panel data from around 80 countries in emerging markets and developing economies covering the period 2001 to 2016, the evidence of the fall in loans extended to the private sector, especially in stressed times, is ascribed to the banks' portfolio rebalancing strategy and

"run to safety" operations rather than as an outcome of adverse effects on the increase in banks' cost of financing.

Differentially from Altavilla et al. (2020), Williams et al. (2015) argue for a relatively modest role of the collateral and government guarantees channels in risk transmission from the sovereign to the banking sector. In a sample of 19 emerging market economies with 277 banks and using fixed effects estimation, the authors argue for the strong impact of the credit rating channel as the risk transmission mechanism. According to their findings, both positive and negative rating changes by credit rating agencies for a particular sovereign have an impact on the banks' market valuations (share prices of banks residing in the rated country). Thus, downgraded sovereign creditworthiness influences negatively the banks' market valuations.

The effects of government risk and sovereign defaults on banks' balance sheets have been further explored in a study by Gennaioli et al. (2014). Employing OLS estimation, their study takes into consideration a large number of countries in emerging and developing countries across a relatively long time dimension (1980-2005). According to their results, sovereign default is shown to be followed by a banking crisis in the majority of countries in their sample, hence, reinforcing the argument for a sovereign and banking sector nexus. Moreover, in the event of sovereign default, credit activities are more disrupted for banks that hold more public debt as compared with other banks and these credit disruptions are more pronounced in countries with more developed financial institutions. The reasons for the latter point are due to more engagement in financial intermediation, with the private sector as well as the public sector, of the banking sector in more developed financial markets. These conclusions indicate that the asset holding channel and possibly the collateral channel are at work in sovereign risk transmission to the banking sector and, ultimately, to real economic activity.

In addition to the above empirical studies that provide evidence for the various links between the sovereign and the banking sector (via influences on the bank's cost of borrowing), another avenue of research focuses on the effects of sovereign creditworthiness – as expressed by the sovereign bond yields – on banks' lending activities. This strand of research, which includes the sovereign bond yields in the empirical specifications, has gained interest only more recently and has yet to gain appropriate empirical attention (Eller and Reininger 2016). From the current empirical work, there are a few papers that focus on Italian banks, while there are still only very few papers with a cross-country dimension. From the limited studies with a cross-country dimension, the focus is on the EU advanced economies, while there are no systematic studies that include less advanced transition economies.

In the context of Italian banks, by employing a VAR estimation method, Zoli (2013) investigates the determinants of Italian government bond spreads and the pass-through of sovereign spreads to the Italian banks' bond yields, interest rates on lending to the private sector, and lending growth rates. The results indicate that an increase in the sovereign bond spreads influences positively the CDS spreads (a proxy for banks' risks) as well as the bond yields of the five largest banks in Italy. This influence is found to be larger for banks with weaker fundamentals, such as lower capital ratios and higher non-performing loans. Furthermore, as for the impact of sovereign bond spreads on firm lending rates, their results suggest a fast pass-through of government higher borrowing rates to private borrowing conditions.[1] More specifically, during the first 3-months of the increased sovereign spreads, around 30-40 percent of the increase is passed to the firms' lending rates and around 50-60 percent within a 6-month period. In addition to the impact on lending rates, a deteriorated Italian sovereign position is shown to impact also the quantity of lending. However, the decrease in credit growth has been ascribed to the slowdown of credit demand as well as the worsening of loan supply conditions.

Similar findings to the ones presented by Zoli (2013) are presented also by Albertazzi et al. (2012) that investigate the effects of Italian sovereign bond spreads on the cost of borrowing for non-financial corporations and households in Italy for the period 1991 – 2011. In investigating the effects of sovereign bond spreads on the interest rate on loans and also the cost of banks' financing, the authors utilize an autoregressive distributed lags (ARDL) model. Their results suggest that an increase in sovereign bond spreads increases the cost of borrowing for both non-financial corporations and households. In addition to the price of borrowing increase, this paper presents evidence of a decrease in the volume of lending as a result of deteriorated conditions in the sovereign cost of borrowing. However, the pass-through of the price increase into the cost of private borrowing has been shown to depend both on the existing rate and on its volatility: Albertazzi et al. (2013) provide evidence for non-linear effects of the sovereign bond spreads in Italy – i.e. when sovereign spreads are higher, there is a higher rate of pass-through to private borrowing conditions, for both non-financial corporations as well as households; and sovereign bond spreads in Italy are higher when the sovereign experiences higher volatility in its

cost of borrowing.

Neri and Ropele (2015) investigate the effects of the sovereign debt crisis – measured by sovereign bond spreads – on the main macroeconomic indicators for a panel of 11 EU countries. Overall their results suggest that an increase in the sovereign bond spreads of Greece influences negatively the sovereign bond spreads of EU peripheral countries significantly, while for the EU core countries government bond spreads are not affected. In addition, a shock to sovereign bond spreads is shown to influence negatively the cost (by between 50 and 40 b.p.) and quantity (by between 2 to 3 percent) of borrowing by non-financial corporations in EU peripheral countries. In contrast, for the EU core countries, the cost of borrowing increase following a sovereign spread shock is significantly lower. The highest increase in the cost of borrowing for the EU core countries is shown to be in France (with an increase of 10 b.p.) and with lesser magnitudes for the other EU core countries. In addition, similar behavior is also observed with regard to loans to households. Moreover, their results also show that sovereign spread shocks have a negative influence on overall economic activity in the EU peripheral as well as in the EU core countries. The results presented show that an increase in government bond spreads has a negative influence on the annual growth rates of industrial production and also increases the rate of inflation.

Again, in the context of Italian financial sector developments in conjunction with sovereign creditworthiness, Del Giovane et al. (2013) analyze the role of demand and supply factors in explaining the overall credit development between two crisis periods, that is, the global financial crisis and the sovereign debt crisis. Similar to the findings of Neri and Ropele (2015), Zoli (2013) and Albertazzi et al. (2013), also Del Giovane et al. (2013) find that increase in government bond spreads increases the cost of borrowing for firms and households and that the magnitude of the increase is found to be similar to the previous empirical findings. However, unlike the previous studies, Del Giovane et al. (2013) do not find evidence for a fall in the quantity of credit to the private sector after an increase in the sovereign borrowing cost.

A more comprehensive analysis – both from the perspective of the number of countries under investigation and of the empirical methodologies employed – on the influence of sovereign bond yields on bank lending rates has been done by Eller and Reininger (2016). In addition to the consideration of core EU countries, this paper, by including also the countries from Central and Southern Europe, stands out as the only study – to the best of our knowledge – with such a broader country consideration. Given this large set of countries, the first empirical approach in this analyze consists of a fixed effects panel model with variables for the long-term loan rates, deposit rates, money market rates, and government bond yields. Moreover, besides the panel fixed-effects model, individual country models are estimated by means of Vector Error Correction Models (VECM) and VAR models. From the panel model estimation, the results suggest that long-term borrowing rates for the private sector are largely influenced by movements in government creditworthiness – as measured by government bond yields. Also, given that the period in this paper covers the pre-, during- and post-crisis periods, it is further suggested that the changes in private sector borrowing rates are not only crisis-related movements, but these changes are visible throughout the entire period. As for the individual country estimations, the positive results are confirmed for the EU core countries, although this paper finds a rather limited role for sovereign bond yields in the cost of private borrowing for the countries in Central and South Europe (with the exception of Hungary). The lack of positive results for the influence of sovereign creditworthiness on the private cost of borrowing is attributed to the ownership structure of the banking sector in these economies – as there is large foreign ownership – and also to the relatively short time-series dimension of the data.

The impact of sovereign creditworthiness on the cost of private sector borrowing rates has been explored by Hristov et al. (2014) in the context of studying the effect of the ECB's Outright Monetary Transaction (OMT) program on the monetary policy transmission process. By using a VAR methodology, this paper is able to distinguish between different time-periods for the effects that changes in government bond rates have on borrowing rates for the private sector. Overall, their results suggest that the link between the government cost of borrowing and the private borrowing cost has been weakening over time. According to their findings, the link between the two was stronger before the European sovereign debt crisis but much weaker thereafter. In this consideration, a drop in government bond rates during the period before the sovereign debt crisis was found to be transmitted to banking lending rates by nearly 40 percent. However, after this period, the pass-through of sovereign bond rates to bank lending rates has been weak, if not non-existent.

From the above review of the literature, a few general highlights have emerged. First, the literature has established a strong nexus between the sovereign and banking sector and compelling evidence has been found identifying the transmission of government risk to the banking sector through various

channels of risk transmission. Second, the literature with a similar focus as ours that explores the effects of sovereign creditworthiness – as expressed by the sovereign bond yields – on banks' lending activity finds evidence of risk pass-through from sovereign on interest rates on lending to the private sector. However, this evidence is mainly presented for a few selected advanced economies while a large gap persists in the literature in terms of studies with a focus on other European economies. Hence, our aim is to bridge this gap in the literature by examining the impact of sovereign creditworthiness on the banks' lending activity and extend the analysis by considering the impact on the growth rate of investment and consumption, and, ultimately, on general economic activity for the European transition economies.

3. Methodology, Variables and Data Description

The main focus of this paper is to explore the transmission of price shocks – if any – from the government cost of borrowing to the private borrowing cost using quarterly data. Considering the transition context of our countries under consideration, the nature of the data, and the literature, for our empirical estimation we will employ a VAR methodology based on panel data.

The panel VAR specification that we will be using in our empirical specification takes a form similar to the simple VAR framework; however, since the data set that we aim to explore consist of a panel of countries, it includes also the cross-section specification as below (Ciccarelli and Canova 2013):

$$Y_{it} = A_{Oi}(t) + A_i(l)Y_{i,t-1} + F_i(l)W_{t-1} + u_{i,t} \quad (1)$$

where i represent the cross-section units and t indexes years. Y_{it} is the vector of our endogenous variables, while $W_{t\text{-}1}$ represents the vector of exogenous variables. All deterministic components of the data – which may contain the constant, seasonal dummies and deterministic polynomial in time – are compacted in $A_{Oi}(t)$. A_{Oi} and $F_i(l)$ are polynomials in the lag operators. $u_{i,t}$ are the identically and independently distributed errors $u_{i,t} \sim iid(0,\Sigma_u)$. Lags of all variable units enter the model for each i, hence allowing for dynamic interdependencies.

Depending on the nature of the data sets and also the questions to be addressed, practitioners have developed different methods to impose restrictions on the parameters (to achieve identification). Following the vast majority of the literature, we implement the recursive identification method based on Choleski decomposition as originally applied by Sims (1980). According to Sims (1980), in order to isolate the shock to one of the VAR variables, residuals need to be rendered orthogonal (uncorrelated). To achieve this, Sims (1980) proposes that the VAR structure should have a recursive causal order, meaning that the variables ordered first in the VAR system are allowed to have an effect on the subsequent variables and their lags but later variables are not allowed to contemporaneously affect the previous variables.

In this regard, the variable ordered first in our PVAR system would be *government bond yields* followed by the interest rates of loans to non-financial corporations. Under the recursive identification approach, the ordering of *the interest rates of loans to non-financial corporations* as a second variable implies that interest rates on loans to non-financial corporations are allowed to be affected only by government bond yields, whereas loans to non-financial corporations can have a contemporaneous effect on other variables ordered subsequently in the sequence. A similar approach to the ordering of these two variables has been implemented by Eller and Reininger (2016). Moreover, motivated by a simple IS – LM model, in which investments are a function of borrowing conditions, we take into account the behavior of *investments growth rate* – as the third variable – in the process of price transmission shock from bond yields to private borrowing conditions. This ordering implies that investment growth rates in the period of the shock are allowed to be affected by the movement of variables ordered before, namely the loans to non-financial corporations and government yields; however, the growth rate of investments are not allowed to be affected by variables ordered after it in the period of shock. In other words, we assume that the interest rates of loans to non-financial corporations have an effect on the contemporaneous investments growth rate, while the investment growth rate is allowed to have an effect – if any – on the interest rate of loans to non-financial corporations only with a lag. In this setting, it is expected that an increase in interest rates will discourage investments, which, in turn, will contribute negatively to output growth rates (ECB 2005; Sims 1992). In accounting for the latter, the fourth variable that enters the baseline PVAR system is the *GDP growth rate*. The ordering of GDP growth rates as the last variable in the PVAR system is motivated by the study from Sims (1992) that investigates the effects of monetary policy on some macroeconomic variables.[2]

The quarterly data used for our empirical estimation are taken from the ECB and Eurostat databases. The database is characterized by an unbalanced panel

for our eight European transition economies and includes Bulgaria, Croatia, the Czech Republic, Romania, Poland, Hungary, Slovenia, and Slovakia. The dataset starts in the first quarter of 2003 for Hungary (the earliest available data); for the Czech Republic in the first quarter of 2004; for Poland, Slovakia and Slovenia in the first quarter of 2005; and for Romania and Bulgaria in the first quarter of 2007. Similarly, for all the countries, the sample ends in the fourth quarter of 2016.

The data on our endogenous variables in the PVAR system includes Government Bond Yields (G), which are defined as nominal long-term interest rates, used as a convergence criterion for the European Monetary Union, based on the Maastricht Treaty, and are expressed in percentages. The second variable of interest is the interest rates on Loans to Non-Financial Corporations (L), expressed in percentages and defined in nominal terms. As earlier noted, in different model specifications different loan maturities will be investigated; we will take into account the interest rates on loans to non-financial corporations starting from loans with a maturity of up to 1 year (L1) and above 5 years of maturity (L5), which are all expressed in percentages. Additionally, besides loans to non-financial corporations, we will also be interested in exploring the reactions of interest rates on loans to Households. Similarly to interest rates on loans to NFC, in different model specifications, we will be using different maturities also for loans to households: starting from loans with a maturity of less than 1 year (HH1), and then above 5 years of maturity (HH5), which are all expressed in percentages. The third variable that enters our PVAR system is the real gross capital formation (I) expressed in percentage growth rates from quarter to quarter. Lastly, the fourth variable is the real GDP growth rates (Y) expressed as percentage changes compared to the same period of the previous year. Table 1 in the Appendix presents the variables used in our empirical models, their description, abbreviations, and the source of the data.

In the list of our considered variables as outlined in the table above, we have variables defined in nominal terms and also variables that are expressed in real terms. More specifically, the interest rate variables – interest rates on loans to non-financial corporations, interest rates on loans to households at different maturities and government bond yields – are defined in nominal terms, while macroeconomic variables (GDP growth, investment growth and household consumption growth) are all expressed in real terms. Using real macroeconomic variables with nominal monetary/financial variables is a standard practice in monetary literature and not only in the models that apply panel VAR estimation methodology. Among others, the practice of mixing nominal and real variables can be found in the study of Sims (1982), Bernanke and Mihov (1998), Brischetto and Voss (1999), Cheng (2006), Amarasekara (2009) and Vinayagathasan (2013). Therefore, in line with the previous practices, we too use real macroeconomic variables with other nominally defined financial variables in our PVAR models.

The structural form of our baseline PVAR system in a matrix form can be presented as follows:

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ -\alpha_{GL} & 1 & 0 & 0 \\ -\alpha_{GI} & -\alpha_{LI} & 1 & 0 \\ -\alpha_{GY} & -\alpha_{LY} & -\alpha_{I} & 1 \end{bmatrix} \begin{bmatrix} G_{i,t} \\ L_{i,t} \\ I_{i,t} \\ Y_{i,t} \end{bmatrix} = \mathrm{A} \begin{bmatrix} G_{i,t-1} \\ L_{i,t-1} \\ I_{i,t-1} \\ Y_{i,t-1} \end{bmatrix} + Bc_i + \begin{bmatrix} \varepsilon_{it}^{G} \\ \varepsilon_{it}^{L} \\ \varepsilon_{it}^{I} \\ \varepsilon_{it}^{Y} \end{bmatrix} \quad (2)$$

In the matrices in Eq.2, the endogenous variables are represented by G, L, I and Y, and *i* and *t* denotes countries and time, respectively. The zero elements in the first matrix represent the restrictions imposed by the recursive identification approach and α_{nm} represent the contemporaneous reaction of variable m to a shock on variable n. The country-specific fixed effects are an exogenous variable represented by c_i. A and B are corresponding vectors of coefficients and ε_{it} is the structural shock in each of the equations.

4. Estimated Results

When estimating a VAR system, including in the panel context, the estimated coefficients are rarely of interest in applied work. In the estimations of our model(s) that follow, and similar to other empirical studies in the literature that use VAR methodology, we instead make use of Impulse Response Functions (IRFs) to interpret our estimates.[3] The output of the IRFs are presented in graphical format (with 95% confidence interval bands generated by Monte Carlo simulation with 1000 replications), which describes the reaction of one variable to the innovation of another variable while holding the shocks to other variables at zero.[4] Following Comunale (2017), we consider IRFs from a one-unit positive shock. Using IRFs, we interpret the dynamic interrelationships between our variables in the system and investigate both the possibility and potential magnitude of price effects transmitted from the cost of public borrowing to the cost of private borrowing. The vertical axes of IRFs in Figure 1 display the percentage point responses of the variable to a one-unit shock in the variable to which the shock is imposed, while the horizontal axes display the periods, in our case quarters. The 1st column represents the shock imposed on Government bond yields (G), the 2nd column represents the shock imposed on Loans with maturity up to 1 year (L_NFC_1),

the 3rd column represents the shock imposed on Investments, and the 4th column the shock imposed on GDP growth rates (Y).

From the reported IRF results presented below, a number of interesting relationships can be observed amongst our variables in the PVAR system. The IRF results presented below suggest that, during the period 2003-2016 a shock to the government cost of borrowing is relatively persistent, as the shock fades away only after the 7th quarter from the shock (Row 1, 1st Column) as it becomes statistically insignificant. Moreover, and most importantly for our research question, a one percentage point positive shock imposed on the government cost of borrowing (G) has a positive and significant effect on the cost of borrowing for private non-financial corporations on loans with maturity below one year (L_NFC_1). This can be viewed in the 2nd Row, 1st Column. According to our results, the peak transmission of the shock materialized in the 3rd quarter, indicating that a unit shock (one percentage point) to Government Bond Yields (G) will induce an increase in the cost of borrowing for NFC by 0.59 percentage points. In subsequent quarters, the impact gradually decreases and becomes insignificant in the 7th quarter. The reported results suggest clear evidence that in the event of a positive shock to the price of Government borrowing, the price of borrowing for private businesses tends to increase immediately and that this higher price of borrowing persists up until the end of the second year after the shock, after which the impact fades away. Our findings are somewhat similar to the findings reported by Zoli (2013) and Albertazzi et al. (2013) for the case of Italy.

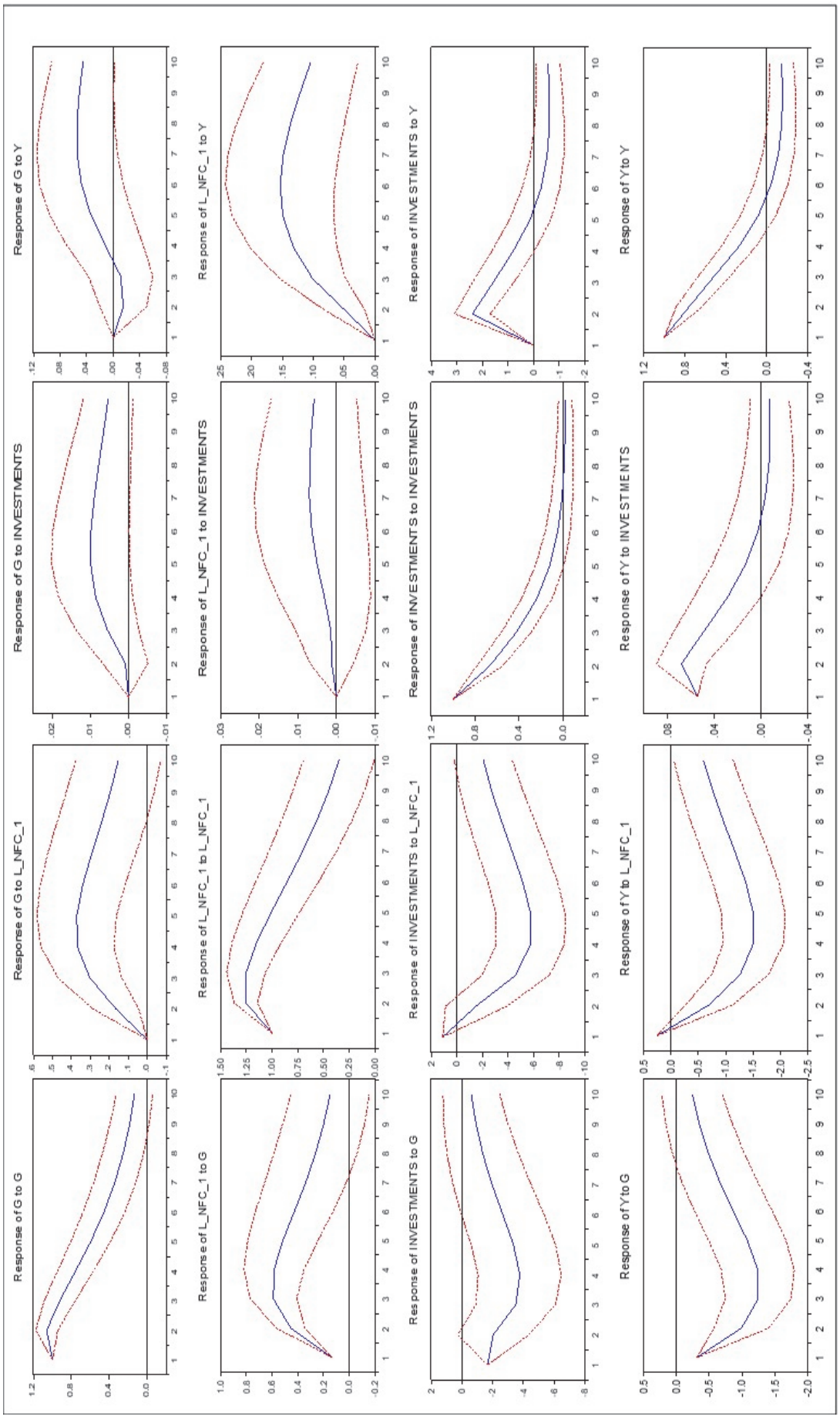
In addition, a shock to the government cost of borrowing has a negative and significant impact on the growth rate of gross capital formation growth (investments) from the 3rd quarter from the shock until the 5th quarter, after which the impact remains negative, although not statistically significant. Similarly to investments, also GDP growth rates decline in the event of a positive shock to the government cost of borrowing, this negative response being visible from the first quarter up until the end of the 7th quarter, after which the impact becomes statistically insignificant (Row 4, Column 1).

Moreover, in addition to the shock to the Government cost of borrowing and the chain effects (1st Column), the IRF results above give indications also for the effects of positive shocks to the other variables included in the PVAR system and their respective relationships. In this consideration, in the second Column, we report the relationship of variables in the event of the shock imposed on the cost of borrowing for NFCs. As can be observed from the relationship between the cost of NFC borrowing and investment growth rate (3rd Row, 2nd Column), with an increase in the cost of borrowing for NFC, the IRF suggests that in the period of the shock (1st quarter) investments growth rate remain positive and statistically significant. However, from the beginning of the 3rd quarter and onwards, the expected negative impact materializes – with the peak in the 5th quarter – and remains negative up until the end of the 9th quarter. These results indicate that similar to the case when there was an increase in the government cost of borrowing, also when the NFC borrowing cost increases, investment growth rates are expected to decline from the 3rd quarter and throughout the period. Moreover, the initial positive response might give an indication that the adjustment of investments to the higher cost of borrowing might take some time, and that investments in capital formation are not elastic and fast adjusting operations. Therefore, at least 2 quarters need to pass for the decrease in investment growth rate to take place after an increase in the borrowing rate for NFCs.

Moreover, the relationship between GDP growth rates and NFC borrowing rates can be observed in the 4th Row, 2nd Column. As can be observed, the GDP growth rate declines in the event of an increase in the cost of private borrowing in the second quarter, and this negative impact is persistent and continues until the end of the reported period. According to our results, the peak of this negative response is reached in the 4th and 5th quarter after the shock. The decrease in investment growth rates and GDP growth rates consequent upon an increase in the price of NFC borrowing might give some indication of the price effect in the overall formation of expectations in the private sector and their corresponding impact on overall business confidence. The increased price of borrowing can lead to uncertainties about profitability from investment projects, which would lead to a more conservative investment strategy implemented by investors with a correspondingly depressing effect on GDP growth rates.

Furthermore, in the 4th Row, 3rd Column is displayed the response of GDP growth rates (Y) to a shock in investment growth rates. In line with our expectations, in the period of the shock to the investment growth rate, the GDP growth rate responds positively by reaching its peak in the 2nd quarter. However, this positive impact fades away after 1 year from the shock and remains insignificant until the end of the 10th quarter. As one would expect, the IRF results suggest that a one-off increase in the investment growth rate – resulting from the positive shock to the investment growth rate – only positively affects GDP growth

Figure 1. IRFs, Loans to NFC with maturity below 1 year – European Transition Economies



rates for around 1 year. However, this one-off increase in investment growth rate would not have a long-run effect on GDP growth rates, as the impact becomes insignificant from the 5th quarter and onwards.

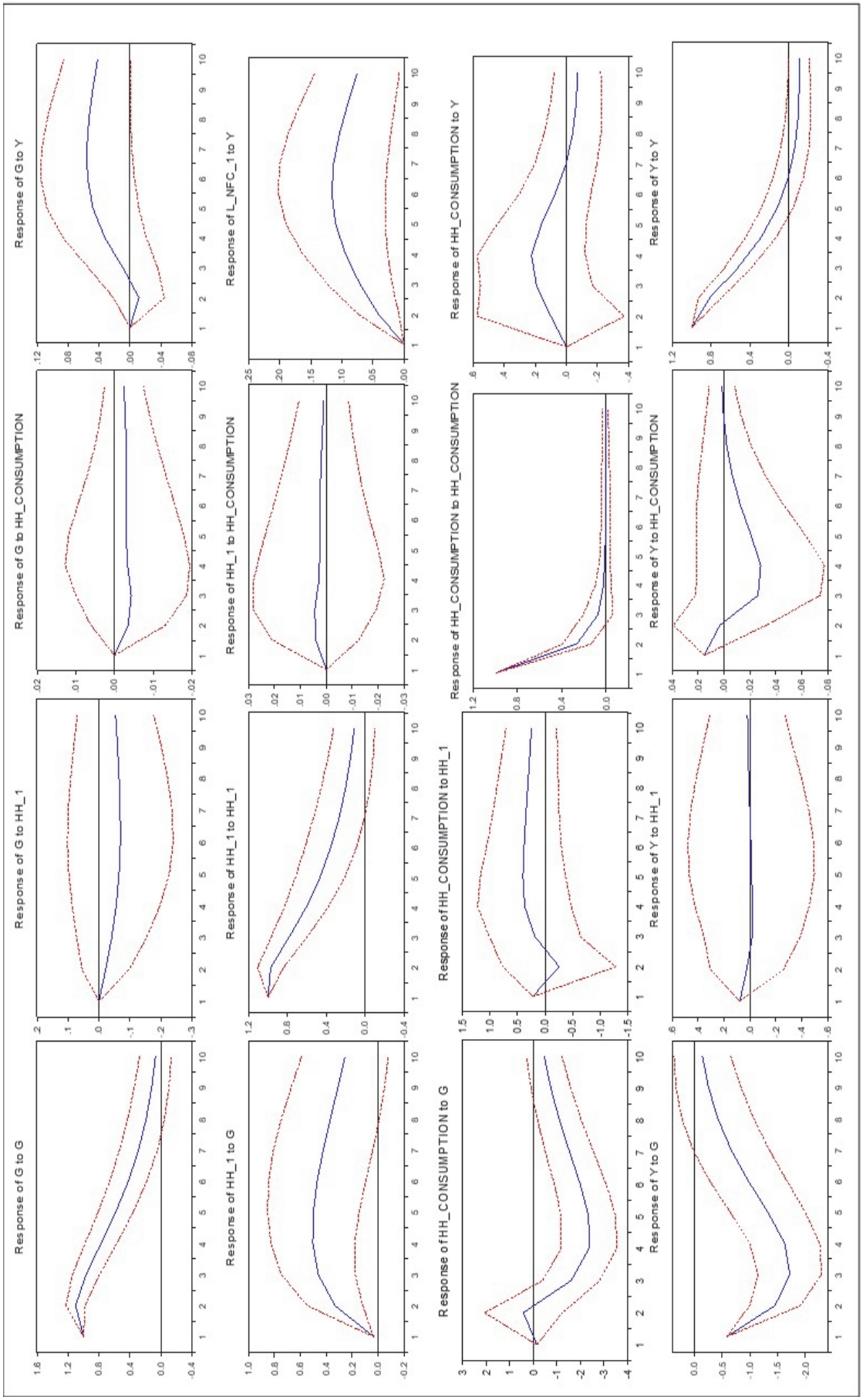
From the individual results presented above during our sample period 2003-2016, it is observed that a positive shock to the public borrowing cost (G) increases the cost of borrowing for the private sector for loans with maturity below 1 year (L_NFC_1). In investigating further other macroeconomic consequences from this relationship, the results suggest that an increase in the price of private borrowing for NFCs will hurt the growth of capital formation (investments), which, in turn, will have a negative impact on growth rates (Y). Hence, the chain reactions of our variables indicate that an increase in public borrowing cost will ultimately have a negative impact on GDP growth via gross capital formation. Not only do the results establish strongly this chain transmission impact, but also the IRFs confirm this interrelation in direct form – as can be viewed from the IRF in the 4th Row, 1st Column, which shows the reaction of GDP growth rates to a shock in the Government cost of borrowing. These results, besides giving valuable information with regard to the relationship between our variables of interest, also give us additional confidence with regard to the robustness of the findings, since the specific relationships between variables are confirmed when one views the results also from different angles. Finally, the consistency of our estimates is not only qualitative but also quantitative; for example, the impact of a one percentage point rise in the cost of government borrowing on investment growth rate (Row 3, Column 1) is – as expected – much larger than on GDP (Row 4, Column 1). Nevertheless, to add more to the confidence of the reported results, additional robustness has been performed, however, not reported here.[5]

Having considered the interrelationship of the cost of public borrowing with NFC borrowing costs, we consider also the cost of borrowing for Households. The importance of Household considerations stems not only from their deposit placements – as an important source of financing for bank lending to the economy – but also from their borrowing to finance consumption and mortgages that have the potential for extended influence on other macroeconomic indicators. Therefore, it is important to explore whether the cost of Household borrowing is influenced by the increased cost of public borrowing in a manner similar to NFC borrowing. In the following, we take into account interest rates on loans to Households at one year and above five years maturities together with their respective responses to shocks imposed on government borrowing costs.

The model specification for this analysis takes the form of the baseline specification; i.e., we allow for the lag of order 2 and include the country-fixed effects and year dummies as exogenous variables. In addition, in our PVAR system, we are interested to explore the possible transfer of prices from public to private borrowing as well as how this affects overall private consumption growth, and, ultimately, GDP growth rates. In this regard, we make use of the variable real household final consumption growth. In the PVAR to be estimated, the variables take the following order: Government Bond Yields (G); Interest Rates of Loans to Households (HH_1); real Household Consumption growth (HH_Consumption); and real GDP growth rates (Y). The sample period continues to be the same as in the baseline mode.

The estimated IRF results presented in Figure 2 below show in the vertical axes the percentage point responses of the variable to a one-unit shock to the variable to which the shock is imposed, while the horizontal axes display the periods, in our case quarters. The 1st column represents the shock imposed on Government bond yields (G); the 2nd column represents the shock imposed on Loans with maturity up to 1 year (HH_1); the 3rd column represents the shock imposed on the Consumption growth rate; and the 4th column the shock to GDP growth rates (Y). The results suggest that the cost of Household borrowing with a maturity of up to one-year during our sample period 2003-2016 increases with innovation in the public cost of borrowing. This increase in the price of household borrowing is persistent over seven quarters, reaching its peak in the 4th and 5th quarters, after which the effect slowly decreases (2nd Row, 1st Column). According to the IRFs, a one percentage point increase in the cost of public borrowing induces an increase in the cost of Household borrowing at a maximum of 0.50 percentage points. If one compares the magnitude of the impact of the increase in the cost of borrowing for Households and NFCs resulting from an increase in public borrowing costs, then it is observed that the impact of an increase in the private borrowing rate is slightly higher for NFCs as compared to Households for shorter maturity loans. Moreover, our newly included variable – household consumption growth – responds negatively to an increase in the government cost of borrowing (3rd Row, 1st Column), as per significant negative effects from the 4th quarter until the 8th quarter. These results might indicate that households anticipate that an increase in Government borrowing rates might signal a future tax increase and/or government spending cuts and, therefore, adjust downwards their consumption. In addition, and similarly to the case when loans to NFC

Figure 2. IRFs, Loans to Household with maturity up to 1 year – European Transition Economies



were part of the equation, also here a shock to the Government cost of borrowing has a negative effect on GDP growth rates for close to two years (4th Row, 1st Column).

In inspecting further the consumption growth rate behavior from the perspective of other relationships between the variables in the system, the IRF results suggest – perhaps surprisingly – that even with the price of Household borrowing increased, the final consumption of the household is not affected, although there is a hint of a negative effect (albeit statistically insignificant) in the 2nd quarter (3rd Row, 2nd Column). Moreover, a positive shock to Household consumption does not seems to impact GDP growth rates as per the insignificant effect throughout the period depicted (4th Row, 2nd Column).[6]

From the estimated results presented and discussed above, overall the results suggest that when government borrowing costs are subjected to a shock, this effect is (i) transmitted to household borrowing costs at both short and long maturities and (ii) that this impact lasts longer for the loans at longer maturity as compared to shorter-term loans. In addition, (iii) household consumption is negatively affected by an increase in the government cost of borrowing as well as GDP growth rates. However, an increase in the household borrowing rate does not seem to affect overall household consumption.

5. Conclusions

This paper provides empirical analyses of the effects of the government cost of borrowing on the cost of private borrowing and other macroeconomic variables, for both Non-Financial Corporations and Households in eight European transition economies (namely, Bulgaria, Croatia, The Czech Republic, Romania, Poland, Hungary, Slovenia, and Slovakia) during the period 2003-2016. Our results indicate that a one percentage point increase in the government cost of borrowing in European transition economies increases instantly the cost of borrowing for NFCs and that this increase in NFC borrowing costs is persistent for around two years after the shock. The maximum increase in the interest rate of loans to NFC with maturity below one year was found to be 0.59 percentage points. According to our results, price transmission mechanisms from government borrowing increase to the private sector are largely at play not only in borrowing rates but also in macroeconomic activity at large. With the increase in the government cost of borrowing, investment growth rates deteriorate from the second quarter after the increase in government borrowing rates. However, this negative response of investment growth rate is statistically significant only for around one year. GDP growth rates also are shown to be very responsive to the increase in the government cost of borrowing, as the GDP growth rates decreased by around one percentage point with the increase by one percentage point in the cost of government borrowing.

Even when we modify the baseline model to take into account the price of borrowing for households instead of NFCs, a similar transmission mechanism is visible. Similar to NFC borrowing costs, the price of borrowing for households in European transition economies has proven to be sensitive to changes in government borrowing costs, although the price increase is of a smaller magnitude compared to NFC borrowing rates. The price increase for household borrowing was found to be 0.50 percentage points for loans with maturity below one year. In addition, a price increase in government borrowing was shown to have a negative effect on Household consumption and GDP growth rates, although household consumption was found to be unaffected by an increase in Household borrowing rates.

These empirical findings suggests that policies directed towards reducing sovereign risk (e.g. institutional and macroeconomic stability), hence improving sovereign creditworthiness, are not only important from the perspective of decreasing the level of the sovereign cost of borrowing but also from the perspective of mitigating the transmission of sovereign risk to the private sector. Our comprehensive analysis revealed that increased levels of sovereign risk adversely affects the cost of private sector borrowing (both, for non-financial corporations and households) and also, in turn, the macroeconomic development of the country by negatively influencing investment, consumption and economic growth rates. Therefore, active policy engagement is required in order to guard a country from slipping into a vicious circle, in which deterioration of macroeconomic fundamentals increases sovereign risk, hence the sovereign cost of borrowing, which, in turn, adversely affects the cost of private borrowing and, ultimately, further deteriorates macroeconomic fundamentals.

Endnotes

1. The endogenous variables used in this VAR system are lending rates, the 10-year government bond spread, the average CDS spreads of the five largest Italian Banks, and changes in the 3-month Euribor.
2. The variables in the VAR system implemented in Sims (1992) are ordered as follows: Short-term Interest Rates, followed by Monetary Aggregate, the CPI, and the Industrial Production Index.
3. While detailed tables of estimated coefficients will be available upon request.
4. The vertical axes of IRFs display the percentage point responses of the variable to a one-unit shock in the variable to which the shock is imposed, while the horizontal axes display the periods.
5. In addition to short-term loans, we do estimate also loans at maturity above 10 years. Since the results are fairly similar to those with short-term maturity, we do not present the results but are available upon request.
6. In addition to short-maturity loans to households, we calculate also household loans with a maturity of more than five years, however, these are not presented here as the results are fairly similar but are available upon request. Similar to loans at a shorter maturity, also loans with a maturity above five years increase in the event of a shock to the Government cost of borrowing. As compared to loans with a maturity of up to one year, the response of loans at this higher maturity is more gradual, while the magnitude of the increase is slightly smaller as compared to the loans with shorter maturity. Moreover, different from loans with a maturity of up to one year, in the model with loans with a maturity above five years, the increase is persistent through the period. Moreover, similar to the model with loans with a maturity of up to one year, household consumption growth and GDP growth rates are negatively affected by an increase in the government borrowing rate; and household consumption growth is unaffected by a shock to the cost of household borrowing.

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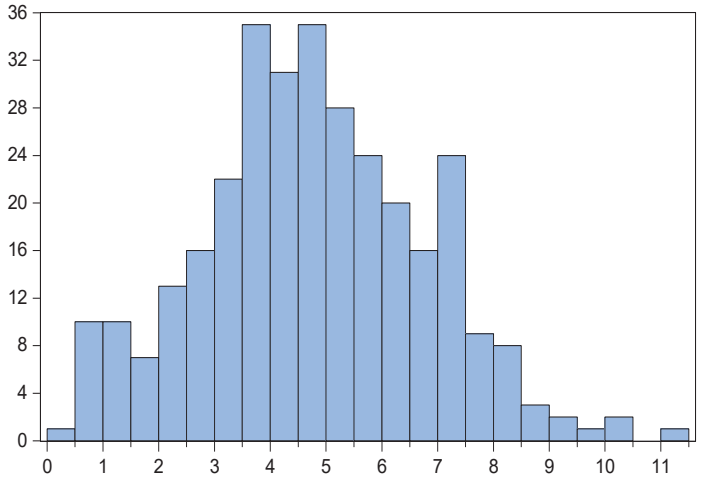
APPENDIX

1. Definition of variables and data sources

Variable	Description	**Abbreviations**	**Source**
Government Bond Yields	Quarterly average nominal long-term government bond yields with a maturity of close to ten years are used for convergence criteria by the EMU. They refer to central government bond yields on the secondary market expressed in percentages.	G	European Central Bank
Loans to Non-Financial Corporations of up to 1 year	Quarterly average nominal bank interest rates on loans to Non-Financial Corporations with an original maturity of up to one year (outstanding amounts) expressed in percentages.	L1	European Central Bank
Loans to Non-Financial Corporations of over 5 years	Quarterly average nominal bank interest rates on loans to Non-Financial Corporations with original maturity of over five years (outstanding amounts) expressed in percentages.	L5	European Central Bank
Loans to Households of up to 1 year	Quarterly average nominal bank interest rates on loans to Households for house purchase with original maturity of up to one year (outstanding amounts) expressed in percentages.	HH1	European Central Bank
Loans to Households of over 5 years	Quarterly average nominal bank interest rates on loans to Households for house purchase with original maturity of over five years (outstanding amounts) expressed in percentages.	HH5	European Central Bank
Real GDP growth	Chain linked volumes, percentage change compared to the same period in the previous year in real terms.	Y	Eurostat
Investments	Gross capital formation, percentage change compared to the same period in the previous year in real terms.	I	Eurostat
Household Consumption	Final consumption expenditure of households, percentage change compared to the same period of the previous year in real terms.	HH_Consumption	Eurostat

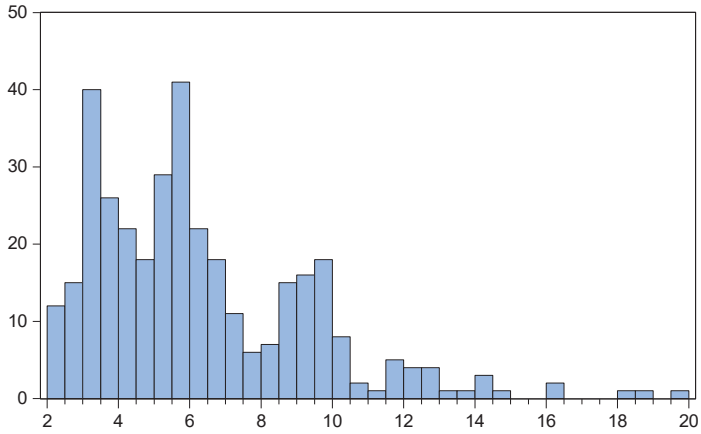
2. Descriptive Statistics

i) Government Bond Yields



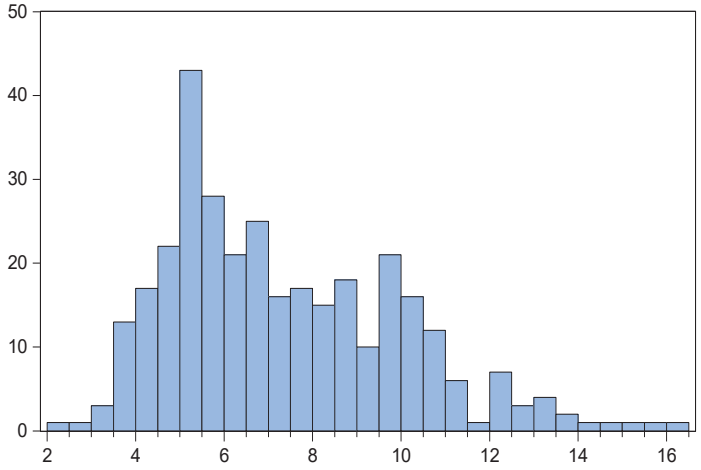
Series: G	
Sample 2003Q1 2016Q4	
Observations 318	
Mean	4.776069
Median	4.690000
Maximum	11.31000
Minimum	0.370000
Std. Dev.	2.017022
Skewness	0.149566
Kurtosis	2.889707
Jarque-Bera	1.346797
Probability	0.509973

ii) Loans to Non-Financial Corporations



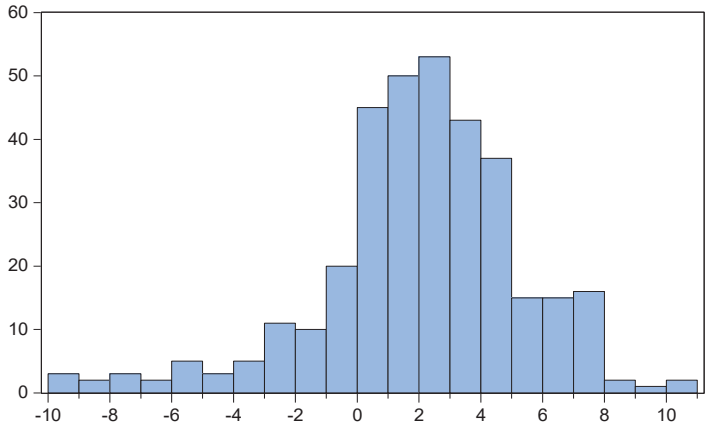
Series: L_NFC_1	
Sample 2003Q1 2016Q4	
Observations 351	
Mean	6.296290
Median	5.600000
Maximum	19.52333
Minimum	2.203333
Std. Dev.	3.051965
Skewness	1.270971
Kurtosis	5.001895
Jarque-Bera	153.1099
Probability	0.000000

iii) Loans to Households



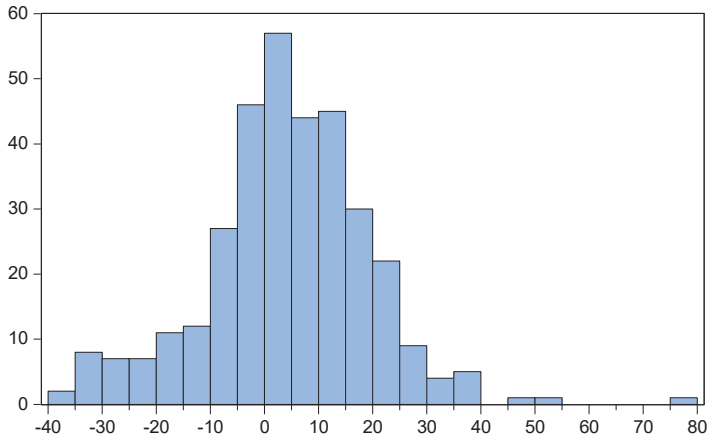
Series: HH_1	
Sample 2003Q1 2016Q4	
Observations 327	
Mean	7.342222
Median	6.756667
Maximum	16.18000
Minimum	2.496667
Std. Dev.	2.626665
Skewness	0.732128
Kurtosis	3.083937
Jarque-Bera	29.30858
Probability	0.000000

iv) GDP growth



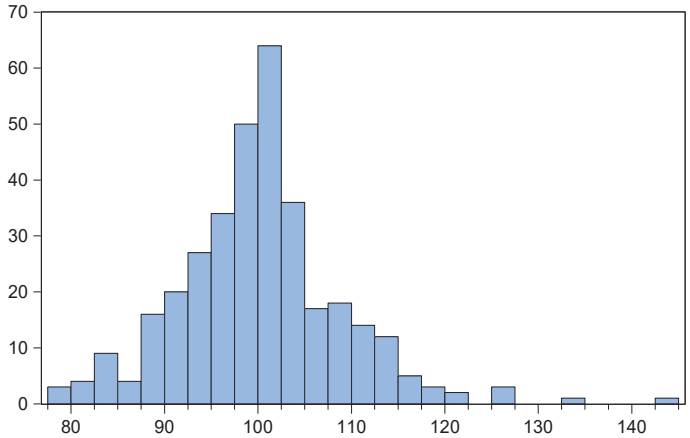
Series: Y	
Sample 2003Q1 2016Q4	
Observations 343	
Mean	2.016618
Median	2.200000
Maximum	10.70000
Minimum	-9.500000
Std. Dev.	3.282657
Skewness	-0.741050
Kurtosis	4.471330
Jarque-Bera	62.33212
Probability	0.000000

v) Investments



Series: INVESTMENTS	
Sample 2003Q1 2016Q4	
Observations 339	
Mean	4.321736
Median	4.386044
Maximum	78.63886
Minimum	-35.95563
Std. Dev.	15.41459
Skewness	0.011635
Kurtosis	4.695151
Jarque-Bera	40.59636
Probability	0.000000

vi) Household Consumption



Series: HH_CONSUMPTION	
Sample 2003Q1 2016Q4	
Observations 343	
Mean	100.1449
Median	100.0000
Maximum	142.8000
Minimum	78.80000
Std. Dev.	8.672709
Skewness	0.601822
Kurtosis	5.181564
Jarque-Bera	88.72239
Probability	0.000000

Appendix 3. IRFs, Loans to NFC with maturity above 5 years – European Transition Economies