EUROPEAN CENTRAL BANK
EUROSYSTEM

Working Paper Series

Romanos Priftis, Srecko Zimic

Sources of borrowing and fiscal multipliers

No 2209 / November 2018

Abstract

This paper finds that debt-financed fiscal multipliers vary depending on the location of the debt buyer. In a sample of 33 countries fiscal multipliers are larger when government purchases are financed by issuing debt to foreign investors (non-residents), compared to when they are financed by issuing debt to home investors (residents). In a theoretical model, the location of the government creditor produces these differential responses through the extent that private investment is crowded out. International capital mobility of the resident private sector decreases the difference between the two types of financing both in the model and in the data.

Keywords: Fiscal multipliers, structural vector autoregressions, sign restrictions, proxy-SVAR, investment crowding in, debt financing, small open-economy model

JEL: E62, F41, H3

Non-technical Summary

This paper investigates empirically and theoretically whether the transmission mechanism of a (debt-financed) fiscal shock depends on the location of the debt buyer.

Our empirical procedure consists of estimating a structural vector autoregression (SVAR) for a panel of 33 advanced and emerging economies, where data availability on public debt by creditor location is readily available at a quarterly frequency from 1995:Q1 to 2016:Q4. Identification is achieved by relying on standard timing restrictions and complementing them with a sign restriction on the movement of the ratio of domestic public debt to external public debt. We find that investment is crowded in for a foreign debt-financed spending shock and crowded out for a home debt-financed spending shock. This translates to an impact output multiplier that is 0.6 for a foreign shock and 0.25 for a home shock. Importantly, the impact responses on investment and output are significantly different across the two shocks in over 98% of the drawn impulse response functions.

We also test the importance of the private external borrowing constraint in affecting the response of investment and the size of fiscal multipliers. We do so by conditioning the panel on variables that proxy for private external financial market openness: i) real volatility, ii) the predominance of non-resident bank loans, and iii) the Chinn-Ito index of financial openness. The results verify that for subsamples where private access to external finance is low (high) the difference of investment responses and output multipliers is greater (smaller).

We finally construct a small-open economy model that explains the observed empirical regularity and clarifies the economic intuition of the mechanism. If the private sector is restricted in its external borrowing then domestic government borrowing takes resources from the private sector that can no longer be invested. Instead, if the government borrows abroad, the government acquires resources from abroad so that domestic investment need not fall; to the contrary, because labor supply increases investment will rise. The severity of the private sector's external borrowing friction is crucial in determining whether domestic government borrowing will displace investment.

On the policy front, our analysis can shed light on the effects of fiscal policies witnessed in recent years. For example, a change from financing government expenditures with external funds in favour of domestic funds could have contributed to the recession in the European periphery. Moreover, the fact that expansionary fiscal policy in Japan primarily relied on domestic financing may explain the only modest effects on aggregate demand.

1 Introduction

The question we attempt to answer in this paper is whether the transmission mechanism of a fiscal shock depends on the government's source of borrowing. Economic theory, but also our empirical investigation, suggests that a government spending shock can produce different effects on the real economy if it is financed with debt issued to home investors (residents) or debt issued to foreign investors (non-residents). These differences extend to the size of fiscal multipliers, which, in particular, are larger when government spending is financed with debt placed abroad.

The intuition for the story is the following: if the private sector is restricted in its external borrowing, then domestic government borrowing takes resources from the private sector that can no longer be invested. Instead, if the government borrows abroad, the government acquires resources from abroad so that domestic investment need not fall; on the contrary, because labor supply increases, investment will rise. Ultimately, this implies that the impact (and cumulative) fiscal multiplier is larger when spending is financed with debt held abroad.

The severity of the private sector's external borrowing friction is key in determining whether domestic government borrowing will displace investment. If private foreign credit markets functioned perfectly, then purchases of government debt could be fully financed by private external borrowing and would avoid the displacement of investment.

Armed with this intuition, we approach the question in a twofold way. First, we inspect if the mechanism is present in the data. We study the effects of a government spending shock and outline a strategy for identifying whether it is financed with debt held by residents, or by non-residents.[1] Our empirical procedure consists of estimating a structural vector autoregression (SVAR) for a panel of 33 advanced and emerging economies. Data availability on public debt and creditor location is readily available at a quarterly frequency from 1995:Q1 to 2016:Q4. To disentangle the location of debt financing, we rely on standard timing restriction identification and complement it with a sign restriction on the movement of the ratio of domestic public debt to external public debt. In particular, both foreign- and home-debt-financed fiscal shocks contemporaneously affect government spending, output, consumption and investment. Additionally, a foreign- (home-) debt-financed fiscal shock decreases (increases) the ratio of domestic public debt to external public debt. Since the restrictions are placed on the contemporaneous responses of debt, this approach identifies *marginal* increases to finance government spending.

[1] It is important to clarify here that we abstract from issues such as the location of debt issuance, the currency denomination of debt, the jurisdiction of issuance, the maturity of the assets, and other features such as which is the issuing government agency. What we are solely interested in exploring is whether debt-financed government policy produces differential results on macroeconomic aggregates depending on whether the creditor resides within or outside the economy.

The SVAR confirms the intuition outlined. We find that investment is crowded in following a foreign-debt-financed spending shock and crowded out following a home-debt-financed spending shock. This translates to an impact output multiplier that is 0.6 for a foreign shock and 0.25 for a home shock, in our baseline specification. In line with Blanchard and Perotti (2002), Fatas and Mihov (2001), and Pappa (2009), among others, we find that consumption is always crowded in. Importantly, the impact responses on investment and output are significantly different across the two shocks in more than 98% of the drawn impulse response functions.

We also test the importance of the private external borrowing constraint in affecting the response of investment and the size of fiscal multipliers. We do so by employing the approach in Ilzetzki, Mendoza and Vegh (2013) and conditioning the panel on variables that proxy for private external financial market openness: i) real volatility, ii) the predominance of non-resident bank loans, and iii) the Chinn-Ito index of financial openness. The results verify that for subsamples where private access to external finance is low (high), the difference of investment responses and output multipliers is greater (smaller).

To test for the stability of our results, we perform a number of robustness checks. Among these, the most notable are two alternative identification procedures. The first relies on identifying an additional shock to sovereign credit spreads. We include the sovereign bond yield as an additional variable in the panel SVAR and impose restrictions that a shock to the sovereign bond yield: i) does not contemporaneously affect other variables, ii) contemporaneously affects only government spending positively, or iii) contemporaneously affects government spending and the ratio of domestic public debt to external public (positively, or negatively). All these cases serve to disentangle between exogenous changes in (debt-financed) government spending and changes in government spending that may arise endogenously as a reaction to a decline in the cost of borrowing. Including such forward-looking variables also captures fiscal foresight on the part of the private sector.

Second, we focus on the US and exploit the available narrative evidence regarding announcements of exogenous government spending. To do so, we use the defense news series from Ramey and Zubairy (2018) and estimate a proxy-SVAR as in Mertens and Ravn (2013). We then concentrate our analysis on periods in which the correlation of government spending with the ratio of domestic public debt to external public debt is either positive or negative. This procedure allows to combine the identification advantages of the proxy-SVAR framework, with the appealing features of the sign restriction methodology that enables pinning down the location of financing of government spending. The results are robust to these alternative identification schemes.

To explore the mechanism more formally, we then construct a small open economy model with a government that finances its spending by borrowing domestically and abroad, and a domestic private

sector, which faces frictions in borrowing abroad. Since the response of investment depends on the composition of the resource constraint, the mechanism outlined is present in all classes of economic models. But the statement related to the different size of *impact* output multipliers is not an immediately ensuing result in either the standard neo-classical real business cycle (RBC) model or a prototypical New-Keynesian (NK) model. This derives simply from the fact that capital is pre-determined. As such, the impact response of output primarily depends on the impact response of labor. And agents in the economy will, in equilibrium, supply more labor when investment is crowded out because permanent income is lower and the negative wealth effect is larger. The foreign-debt-financed shock, however, becomes more expansionary in subsequent periods. *Cumulative* multipliers are thus in line with the data. The difference in impact output multipliers can be accounted for once we introduce a spread between external and domestic interest rates. The result then holds in the open-economy versions of both the RBC and NK models.

On the policy front, our analysis can shed light on the effects of fiscal policies witnessed in recent years. For example, a change from financing government expenditures with external funds in favour of domestic funds could have contributed to the recession in the European periphery. Moreover, the fact that expansionary fiscal policy in Japan primarily relied on domestic financing may explain the only modest effects on aggregate demand. Interestingly, our analysis also implies that the composition of public debt alone can play a role in determining the business cycle absent any additional debt issuance or changes in aggregate demand. Consider the example of a country that borrows \$1 from domestic creditors to finance a \$1 increase in exogenous spending. Assume also that it simultaneously reduces exogenous spending by \$1 to repay \$1 to external creditors. Given that the output multiplier is greater when spending is financed from abroad, portfolio rebalancing alone can trigger a downturn.

Related Literature

Our work ties in with several branches of the fiscal policy literature. On the empirical side, there are ample studies documenting the state-dependence of fiscal multipliers. Christiano, Eichenbaum and Rebelo (2011) are among the first to show that fiscal multipliers are larger when nominal interest rates are at the zero lower bound. Auerbach and Gorodnichenko (2013) show that multipliers depend on the state of the economy, being larger during recessions. However, Ramey and Zubairy (2018) challenge this result using historical military spending data. The work by Ilzetzki, Mendoza and Vegh (2013), in turn, finds that fiscal multipliers depend on several country and institutional characteristics, such as the level of economic development, the exchange rate regime, and trade openness. More recently, demographics have also been shown to be an important factor for the transmission mechanism of a

government spending shock in Basso and Rachedi (2018).

However, there is no previous work looking at the subset of fiscal multipliers that are debt-financed. In previous iterations of this paper (Priftis and Zimic (2015) and Priftis and Zimic (2017)), we use the predictions of an economic model regarding movements of the current account to identify an SVAR using a combination of sign and magnitude restrictions on total external debt and total public debt. The current version of the paper exploits information from a recent data set on domestic and external public debt and identifies debt-financed spending shocks in a more direct manner. The results we have been obtaining throughout the life cycle of the paper have always been consistent with the intuition developed.

Recently, Broner *et al.* (2018) show that multipliers are increasing in the share of debt that is in the hands of foreigners. They do so by identifying spending shocks as in Ramey and Zubairy (2018) and Guajardo *et al.* (2014). Like us, they rely on the crowding in or out of private investment, but there are differences in terms of approach and quantitative predictions. Our identification captures the contemporaneous change in debt and therefore directly extracts the marginal absorption of newly issued external or domestic debt. Differently, they proxy the marginal change in the composition of debt using the lagged average share. Their methodology is therefore similar to an interaction-VAR approach that we explore in Section 4.3.3. Second, we consider the effect of the private sector's borrowing constraint. As we show, this is crucial in generating a wedge between multipliers for foreign-debt-financed and home-debt-financed spending shocks. Third, beside the US, they focus on a panel of 17 OECD countries using debt data at annual frequency. Our panel uses quarterly data and has a larger country dimension. In terms of quantitative predictions, we find multipliers to be in the range of 0.3 to 1.2 for the US, the OECD, and emerging economies. Their analysis predicts impact multipliers, which range from being negative to over 7. Regardless of the differences it is encouraging that both approaches find strong evidence for differences in multipliers.

From a theoretical perspetive there are other studies that investigate the capacity of debt expansions to crowd in investment. Traum and Yang (2015) show that whether investment is crowded in or out in the short run depends on what policies generate the debt increase. For example, if debt rises because of a fall in capital tax rates or an increase in government investment, then private investment is crowded in because both policies raise the return to capital. In contrast, if debt rises because consumption tax rates fall, then private investment is crowded out, as the price of investment goods rises (relative to the price of consumption goods). Shen and Yang (2012) analyze the effects of investment crowding out in a setting of limited capital mobility specific to developing countries. In this environment, an increase in external debt reduces the crowding out of investment, but generates a real appreciation

of the exchange rate, which partially offsets the expansionary effects on output. However, Cacciatore and Traum (2018) show that the effects of fiscal policy can be larger in economies more open to trade, irrespective of the trade balance dynamics. Broner *et al.* (2014) show that in the context of creditor discrimination domestic purchases of sovereign debt lead to a crowding out of productive investment.

Finally, our argument that domestic and foreign flows can have different domestic effectiveness is connected to Farhi and Werning (2017). They show that transfer multipliers may be substantially larger than one when these are provided by foreigners.

The remainder of the paper is structured as follows: section 2 describes the empirical strategy used to estimate the SVAR. Section 3 presents results of the estimation for both the baseline specification and when conditioning on the degree of private external borrowing. Section 4 performs a number of robustness checks related to identification, sample selection and the SVAR specification. Section 5 builds a theoretical model and uses it to illustrate the mechanism obtained in the data. Finally, section 6 concludes.

2 Econometric Methodology

We study the effects of a government spending shock and outline a strategy for identifying whether it is financed with debt issued to residents or to non-residents. Our baseline empirical procedure consists of estimating an SVAR for a panel of advanced and emerging economies. We later conduct a number of robustness checks using alternative identification schemes, including estimating a proxy-SVAR for the US.

2.1 Data

For the baseline empirical specification we construct an unbalanced panel with quarterly data from 1995:Q1 to 2016:Q4 for 33 advanced and emerging economies for the following variables: government consumption, output, private consumption, private investment, domestic public debt, and external public debt.

National accounts data is hard to reliably obtain at a quarterly frequency for many emerging economies. As Ilzetzki, Mendoza and Vegh (2013) explain, many countries may report data at a quarterly frequency, but collect them at annual frequency. Following this premise, our panel includes countries that report and collect government consumption data at quarterly frequency (for EU countries based on the ESA2010 common statistical standard; for other advanced and emerging economies based on the International Monetary Fund's (IMF's) Special Data Dissemination Standard (SDDS)).

The debt data is obtained from the Quarterly Public Sector Debt (QPSD) database of the IMF-World Bank, whose coverage begins in 1995:Q1. To the best of our knowledge, this is the only source of debt data at *quarterly* frequency where creditor location is accounted for. We also believe we are the first to exploit the QPSD data set for an analysis of debt variables by creditor location in large samples. Alternatives would have been to rely on the ECB's SDW, which reports *annual* debt data by residents and non-residents for the EU28, starting in 1995. However, it would then be illegitimate to use annual government spending data with the Blanchard-Perotti framework, for which our identification builds on by combining sign restrictions on the responses of debt variables. Another option would be to identify government spending shocks using international variation in (annual) military spending. Miyamoto, Nguyen and Sheremirov (2016) compile such information for a large panel of countries from the Stockholm International Peace Research Institute (SIPRI). However, this would oblige us to turn to the ECB SDW for debt data, which would significantly diminish the panel in both dimensions, as well as its heterogeneity. An additional contribution of our paper is to study fiscal multipliers in low-income countries that have not received particular attention in the literature.

For more information on data sources, see section A in the Appendix.

2.2 Reduced form VAR

The objective is to estimate the following system of equations:

$$AY_{n,t} = \sum_{k=1}^{K} C_k Y_{n,t-k} + Bu_{n,t} \tag{2.1}$$

where $Y_{n,t}$ is a vector of endogenous variables (e.g., government consumption, GDP, and other endogenous variables) for a given quarter t and country n. C_k is a matrix of the own- and cross-effects of the k^{th} lag of the variables on their current observations. B is a diagonal matrix so that u_t is a vector of orthogonal i.i.d. shocks to government consumption such that $Eu_{n,t} = 0$ and $E\left[u_{n,t}u_{n,t}^{'}\right] = I_n$. A is a matrix that allows for contemporaneous effects between the endogenous variables in $Y_{n,t}$.

The baseline specification estimates the system in 2.1 in log differences using a panel OLS regression with country fixed effects. We employ four lags of the endogenous variables as proposed by the HQ criterion.[2] OLS provides an estimate for the matrices $A^{-1}C$, but additional identification assumptions are necessary to estimate the coefficients in A and B.

In the reference specification, $Y_{n,t}$ contains the variables: *government consumption, output, household consumption, private investment.* We follow Blanchard and Perotti (2002) and assume that

[2]We also perform robustness checks where we estimate the system in levels and remove fixed effects. These are shown in section 4. We use country block bootstrap to take into account parameter uncertainty. Results are robust to using standard residual bootstrap.

government consumption respond contemporaneously only to their own innovations. This translates to a Cholesky decomposition with government consumption ordered first. We provide this specification as a reference for when we introduce debt variables, and for comparison with the literature.

2.3 Identifying debt-financed fiscal shocks

The main question of interest is whether the location of debt financing of government spending can affect the endogenous variables in the system differently. We use the debt data to construct the *ratio* of domestic public debt to external public debt and introduce this into the SVAR. $Y_{n,t}$ is now modified to be: *government consumption, ratio, output, private consumption, private investment.*

Instead of a general government spending shock, we now identify separately two government spending shocks: a foreign-debt-financed spending shock (Foreign) and a home-debt-financed spending shock (Home). Using solely a Cholesky decomposition in this setup is no longer meaningful because both shocks, whatever the source of financing, impact government consumption and the ratio contemporaneously. Instead we combine timing with sign restrictions.

The availability of quarterly data allows us to employ standard timing restrictions, as in Blanchard and Perotti (2002) and Ilzetzki, Mendoza and Vegh (2013), to identify a (pure, location-free) government spending shock. The assumption is that the government's decision to change spending in response to a different macroeconomic environment takes more than a quarter. Timing restrictions, therefore, allow us to separate exogenous variation in government spending from systematic responses to macroeconomic conditions. To distinguish between a Foreign- and Home-government spending shock, we then employ sign restrictions on the response of the *ratio*. In particular, a Foreign shock decreases the ratio, while the Home shock increases it. Since the restrictions are placed on the contemporaneous increases of debt, this approach identifies *marginal* absorption in domestic or external debt to finance government spending, rather than just the outstanding composition of debt in the economy. The exact assumptions are summarized in Table 1.[3]

[3]We have opted for this approach because it is the closest to the standard method of identifying fiscal shocks, used for example in Ilzetzki, Mendoza and Vegh (2013). We only deviate with regards to assigning an additional sign restriction on the ratio. In the previous version of this paper (Priftis and Zimic (2015)), we use a slightly more involved identification. We use the predictions of an economic model regarding movements of the current account to identify an SVAR using a combination of sign and magnitude restrictions on total external debt and total public debt. In the robustness section (4) we also: i) identify a sovereign bond yield shock, ii) estimate a proxy-SVAR with defense news series for the US, and iii) use an interaction VAR to identify debt-financed government spending shocks. Throughout all approaches the qualitative results are unaffected.

Table 1: Identification Restrictions

	Foreign shock	Home shock	3	4	5
Government spending	+	+	0	0	0
Ratio	-	+	0	0	0
Output				0	0
Consumption					0
Investment					

Notes: Rows denote the variables in the SVAR. Columns denote the identified shocks. "Foreign shock" refers to a foreign-debt-financed government spending shock. "Home shock" refers to a home-debt-financed government spending shock. Ratio is defined as domestic public debt to external public debt. 0 denotes no contemporaneous effect (timing restriction). Sign restrictions are imposed for 1 quarter.

In the set of models that are consistent with the data and sign restrictions, we select the model that maximizes the difference in the impact response of the ratio for the two shocks. This allows us to exactly identify the model and capture shocks that are as close as possible to the theoretical counterpart of a purely foreign- or purely home-financed spending shock. Retaining all the models that are consistent with the sign restrictions does not qualitatively impact the results, except for standard error bands that become slightly wider as they also contain model uncertainty.[4]

2.4 Fiscal multipliers

Following the literature on fiscal multipliers (e.g., Ilzetzki, Mendoza and Vegh (2013)) we calculate the cumulative multiplier m_{t+s} as

$$m_{t+s} = \frac{\sum_{q=t}^{t+s} \Delta X_q}{\sum_{q=t}^{t+s} \Delta G_s} \left(\frac{\overline{X}}{\overline{G}}\right) \tag{2.2}$$

which measures the cumulative change of the endogenous variable X (where X can be output Y, consumption C, investment I) per unit of additional government consumption G, from the impulse at time t, to the horizon s. $\left(\frac{\overline{X}}{\overline{G}}\right)$ is the sample average of the endogenous variable over government consumption.

3 Results

3.1 Government spending shock in an SVAR without debt

Figure 1 plots the impulse response functions to a 1% innovation in government consumption in the reference SVAR without debt, where government consumption is ordered first. A government con-

[4] Including external debt and domestic debt as separate variables (rather than the ratio) and imposing additional zero restrictions does not qualitatively affect the results. We subscribe to using the ratio as it reduces the dimensionality (and computational time) of the panel SVAR.

sumption shock produces the well-known effects of an increase in output, a crowding in of private consumption and an insignificant response on private investment on impact. In the medium-run, the response of investment becomes positive. The results are in line with a number of studies in the empirical fiscal policy literature. For example, Blanchard and Perotti (2002), Fatas and Mihov (2001), and Pappa (2009) all document the crowding in of consumption. Fatas and Mihov (2001) find insignificant responses on private investment, whereas Pappa (2009) finds mixed effects depending on the sample employed. Investment is crowded out in the euro area, but in the US and Canada it is crowded in.

[Insert Figure 1 here]

Figure 2 plots cumulative multipliers based on these impulse response functions. The impact multiplier on output is 0.3 and 0.15 on consumption. The cumulative multiplier on output increases along the horizon and converges to a level of 1.2 after 3 years. In a bivariate VAR with government consumption and output, Ilzetzki, Mendoza and Vegh (2013) find an impact output multiplier of 0.37 in high-income countries, which in the long run reaches a level of 0.8.

[Insert Figure 2 here]

3.2 Foreign- and home-debt-financed government spending shocks

Figures 3 and 4 plot the cumulative impulse response functions (IRFs) following a 1% government spending shock in the SVAR with debt, identified using timing and sign restrictions. Figures 5 and 6 plot the associated cumulative fiscal multipliers.

[Insert Figures 3 to 6 here]

The main difference across the two ways of financing government spending relate to the response of investment. In line with the theory, a foreign debt-financed spending shock produces a crowding in of investment (investment multiplier is 0.35 on impact). If spending is financed domestically, private investment is crowded out (-0.18 on impact). The differences in investment have implications for the size of the output multiplier. When spending is financed abroad, the impact multiplier is 0.6 and converges to a level of 2 after 3 years. On the other hand, if it is financed domestically, the impact output multiplier is 0.25 and only reaches a level of 1.2 after 3 years. In both cases, consumption is crowded in, reflecting the results of the reference SVAR and the literature. It is also reconciled with the theoretical predictions of section 5, in that consumption declines less than investment due to consumption smoothing motives (and increases in an NK model). Finally, all impact responses are statistically significant.

To test whether the *difference* in multipliers is statistically significant, in Figure 7 we plot the empirical probability density function (PDF) of the difference in impact multipliers across the two shocks. The difference is defined as Foreign-Home and the empirical PDF is obtained by drawing from the simulated distribution of the models that satisfy the sign restrictions. With regards to output, foreign financing produces a median impact multiplier, which is greater by 0.39 than the impact output multiplier for home financing. This difference is positive in 98% of the cases. With regards to investment, foreign financing produces a median impact multiplier, which is greater by 0.54 than the impact investment multiplier for home financing. In this case, the difference is positive in 99% of cases.

[Insert Figure 7 here]

3.3 Does private external borrowing matter?

The key mechanism for obtaining different fiscal multipliers in the two financing cases depends on the degree of crowding out of private investment. In the theoretical model, we show that whether investment will be crowded out depends on the extent to which the private sector has access to external financial markets. We show this argument more formally in section 5.3, but the intuition is simple: if the private sector has access to external borrowing, then it can undo the effects that a government spending shock has on its private investment. Hence, we should observe a smaller difference in the impact responses of output for Home and Foreign shocks if external finance by the private sector is available.

In the spirit of Ilzetzki, Mendoza and Vegh (2013), we exploit the cross-section of the panel and condition it on country characteristics that proxy for the private sector's access to external financial markets. For each proxy, we split the panel into two groups: a subsample where private access to external finance is high, and another where private access to external finance is low. We consider the following three measures of financial market openness: i) the variance of GDP, ii) the share of loans from non-resident banks to GDP, and iii) the Chinn-Ito index of financial openness.

Real volatility is associated with rising risk premia for both government bonds and private sector lending rates (e.g., Pancrazi, Seoane and Vukotic (2015) show that public and private credit spreads are higher in "crisis times"). When volatility is high, access to external financing should therefore be more constrained. In contrast, countries with more non-resident bank loans will have better access to foreign financial markets. Recent studies that make use of this measure, especially for emerging economies are Bandyopadhyay, Lahiri and Younas (2012). However, given that this variable is reported as a share of GDP, very advanced economies (e.g., US) are classified into the "low access" subsample. Finally, the Chinn-Ito index measures the degree of a country's capital market openess, with higher values

reflecting greater openess (Chinn and Ito (2006)). Clearly, none of these statistics are perfect measures of the private sector's access to external markets, but given a lack of data for the element we are after, these proxies approximate well on average. Moreover, the analysis provides an informative slicing of the panel across different dimensions, which provides further robustness to the baseline results.

The results from splitting the panel along these dimensions are summarized in Table 2. The table reports the cumulative multipliers of output, consumption, and investment at different horizons, for a foreign-debt-financed and a home-debt financed spending shock. It also reports the median of the empirical PDF of the difference in multipliers (Foreign-Home), as well as the percentage of cases, where this difference is greater than zero. Grey cells correspond to the "low access" subsamples, whereas white cells correspond to the "high access" subsamples.

[Insert Table 2 here]

Overall, the results are consistent with the intuition developed. First, the results are in line with the predictions of the unconditional SVAR specification. A Foreign shock produces investment crowding in, and a Home shock produces investment crowding out for all measures. The impact output multiplier following a Foreign shock is also greater than the impact output multiplier following a Home shock. Moreover, across all measures, the difference in output and investment multipliers between a Foreign and a Home shock is smaller for countries with better private sector access to external markets. With regards to the output impact multiplier, the results are strongest using the Chinn-Ito index of financial openness. In particular, in the "low access" subsample the difference is 0.52 (with 98.7% of cases with a positive difference), while in the "high access" subsample the difference is only 0.03 (with 55.4% of cases with a positive difference). With regards to the impact response of investment, the effect is most pronounced using the GDP volatility measure. In the "low access" subsample the difference is 0.85 (with 99.8% of cases with a positive difference), while in the "high access" subsample the difference is 0.12 (with 78.4% of cases with a positive difference).

4 Robustness checks

We perform a battery of robustness checks related to different subsamples, different VAR specifications, and different identification assumptions.

4.1 OECD, emerging economies, and the US

First, we test the baseline specification using different country groupings (OECD, emerging economies, US). The subsample robustness checks are summarized in Table 3. For each robustness case, the table

reports the cumulative multipliers of output, consumption, and investment at different horizons, for a foreign debt-financed and a home-debt-financed spending shock. It also reports the median of the empirical PDF of the difference in multipliers (Foreign-Home), as well as the percentage of cases, where this difference is greater than zero.

[Insert Table 3 here]

The results carry over to the OECD subgroup with a median difference in the impact response of output standing at 0.36, and is positive in 95.2% of cases. Moreover, investment is crowded in following a Foreign shock and crowded out following a Home shock. The difference stands at 0.56 and is positive for 99.5% of cases.

Focusing on the emerging economies subsample, the results are weakened. The median impact output multiplier is greater for a Home shock (1.18) than for a Foreign shock (0.95) with a difference of -0.23. The difference is nevertheless positive in 40% of cases, implying that the data does not reveal a statistically significant difference in multipliers. Investment is crowded in on impact following both shocks, but the impact response is greater for a Foreign shock. The difference is 0.45 and is positive in 78% of cases. The emerging economies comprise approximately 20% of the global panel: this suggests that data quality for these countries may be lacking.[5]

When we restrict our analysis to the US the horizon of available data becomes longer.[6] In particular, we use quarterly data on domestic and external public debt that starts in 1952:Q2. Long series of US national accounts data are obtained from NIPA tables. For government spending data, NIPA reports total government expenditures consisting of both government consumption and government investment. The fact that government expenditures now include government investment does not weaken the appeal of the results. In contrast, the difference in output and private investment responses between Foreign and Home shocks can be understood as a lower bound. This is because government investment shocks are known to be more expansionary because of their productivity-enhancing properties and as such can be more likely to crowd in private investment.

As can be seen in Table 3, the results are in line with the predictions. The difference in impact output multipliers is 0.41, and the difference is positive in 100% of cases. On the side of investment, the Foreign shock leads to investment crowding in (0.13 on impact) while the Home shock leads to investment crowding out (-0.35 on impact). This difference is also positive on impact in 100% of cases. In the medium run (quarters 4 and 12), the response of investment following a Foreign shock becomes negative. This can be seen more evidently in Figures B.1 and B.2 in the Appendix , which

[5] When we remove the emerging economies from the panel and re-estimate the baseline SVAR, our results are qualitatively unaffected, but quantitatively strengthened.

[6] See Appendix for data sources.

plot cumulative IRFs for the two shocks. The fact that investment is crowded out in both cases in the US in the medium term is in line with Leeper, Traum and Walker (2017). They find that investment is decisively crowded out in a regime of active monetary policy coupled with passive fiscal policy.

4.2 Reduced-form robustness

Second, we perform robustness checks with regards to the reduced form model: we re-estimate the baseline specification without country fixed effects, and in levels. Table 3 also shows the VAR specification robustness checks. In both instances the results carry through. For the specification without country fixed effects, the difference in output multipliers is 0.31 and is positive for 93.3% of cases on impact. Investment is crowded in by a Foreign shock and crowded out by a Home shock. The median difference is 0.55 and is positive for 99.6% of cases on impact. When we estimate the SVAR in levels, the difference in impact output multipliers is again 0.31 and the difference is positive for 90.2% of the cases on impact. Here, again, investment is crowded in by a Foreign shock and crowded out by a Home shock. The median difference is now 0.46 and is positive for 99.5% of cases on impact.

4.3 Alternative identification schemes

4.3.1 Identifying a sovereign risk premium shock

The identification assumption we have been making so far is that government spending and the ratio of external-to-domestic debt do not react to other macroeconomic shocks due to policy lag. Although quarterly data makes this assumption plausible, it may be argued that there are additional shocks that could contemporaneously impact government spending and the composition of debt. Such a shock could take the form of a separate innovation that lowers credit risk premia (risk premium, credit supply, external finance premium), thereby lower borrowing costs and endogenously leading an otherwise constrained government to borrow more in order to finance government spending.[7]

We include the sovereign bond yield as an additional variable in the panel SVAR and experiment with three identifying restrictions.[8] In particular, a shock to the sovereign bond yield: A) does not contemporaneously affect other variables (i.e., is ordered last in the SVAR), B) is ordered third in the SVAR, but assumed to contemporaneously affect only government spending positively on impact, C1) is ordered third in the SVAR, but assumed to contemporaneously affect government spending positively, and the ratio of domestic public debt to external public *negatively*, and C2) is ordered third

[7] Reasons why in some countries credit spreads may be lower than in others include a higher level of (labor) productivity, higher institutional quality, higher capital account openess, lower debt-to-GDP ratios, etc. To check for potential omitted variables we regress the residuals of both identified government spending shocks on the above-mentioned variables and find they are uncorrelated at the 5% significance level. Results are available on request.

[8] See the Appendix for data sources on sovereign bond yields. We include the level of the sovereign bond yield in the system.

in the SVAR, but assumed to contemporaneously affect government spending positively, and the ratio of domestic public debt to external public *positively*. In all cases, we continue to identify foreign- and home-debt-financed spending shocks as per the (linearly independent) sign restrictions in Table 1.

Case A is in line with Uribe and Yue (2006) who specify a VAR where US and world interest rates are ordered after real variables. This presupposes that real variables do not react contemporaneously to innovations in external financial variables and that financial variables respond with a lag. Case B assumes that reductions in the cost of public borrowing will lead to increases in government spending, but is agnostic on how the debt is financed. Case C1 (C2) in turn assumes that reductions in the cost of borrowing will lead to increases in government spending, which are financed with external (domestic) debt. Moreover, including such forward-looking variables in the SVAR will also capture fiscal foresight on the part of the private sector and resolve the issue of government spending shocks being anticipated.

The results are summarized in Table B.1 in the Appendix, which reports the cumulative multipliers of output, consumption, and investment at different horizons, for a foreign- and a home-debt-financed spending shock. It also reports the median of the empirical PDF of the difference in multipliers (Foreign-Home).

It is clear that the results carry through when including the sovereign bond yield in the system. Apart from the specification where the sovereign bond yield is ordered last (A), in all others, the Foreign shock produces output multipliers that are greater than those produced by the Home shock, at all horizons. With regards to the difference in impact responses, this difference is greater than zero in 85%, 83%, and 82% of cases for B-type, C1-type, and C2-type restrictions respectively. The differences in the responses of output are driven by different responses of investment. In all cases again (except A), investment is crowded in for a Foreign shock, but crowded out for a Home shock. In the B-type and C1-type restrictions the different sign on investment persists in the medium-term; investment is always greater for a Foreign shock for all specifications. On impact, these differences are greater than zero in 97%, 96%, and 92% of cases for B-type, C1-type, and C2-type restrictions respectively.

Finally, the A-type restriction (where the sovereign bond yield is ordered last) leads to a Home shock producing greater effects on output and similar (zero) effects on investment on impact. However, with regards to output (investment), this difference it is only valid in 13% (51%) of the simulated draws, implying no statistical significance of the result.

The cumulative IRFs to foreign- and home-debt financed spending shocks, as well as sovereign bond yield shocks, for all specifications, are shown in Figures B.3 - B.13 in the Appendix. It is clear that the shock to the sovereign bond yield does not produce the same IRFs as those of a debt-financed spending shock, be it home- or foreign-financed. For B-type restrictions (Figure B.7) a risk premium

shock causes no movement in the ratio of domestic to external debt, and has no significant effects on investment. For C1-type restrictions (B.10), where the ratio decreases by assumption, the effect on output, consumption and investment are insignificant. Finally, the same is true for C2-type restrictions (B.13), where the ratio increases by assumption. In all cases, not only are the error bands wide, but the median responses too display little movement.

We can conclude therefore that the identified government spending shock (Foreign or Home) does not arise as an endogenous reaction to a decline in the costs of borrowing.

4.3.2 Estimating a Proxy-SVAR for the United States

To address possible additional endogeneity issues that may exist in the identification assumed so far, we exploit the informational content of narrative measures of exogenous changes in government spending for identification in an SVAR framework. This is done using the proxy-SVAR procedure of Stock and Watson (2012) and Mertens and Ravn (2013). The method employs exogenous variations in one variable, which is included in the VAR system, as a proxy for the structural shock of interest. The proxy is assumed to be correlated with the structural shock of interest, but orthogonal to other structural shocks. In practice, the proxy constitutes an instrument for the reduced form residuals of the VAR and is used for (partial) identification of the covariance matrix of the structural shocks. The clear advantage of this technique is that, as long as the proxy is a relevant and valid instrument, the identification relies on a much weaker set of assumptions than other identification schemes. For example, no assumptions are required on the contemporaneous relationship among the variables in the system.

We focus on the US only, and exploit the available narrative evidence regarding announcements of exogenous government spending.[9] We use the historical defense news series from Ramey and Zubairy (2018) as a proxy for a (pure, location-free) government spending shock. This defense news series focuses on movements in government spending that are connected to political and military events, and which are likely independent of the state of the economy. Given possible measurement problems that arise with historical records, it is natural to interpret this series as a proxy rather than a direct narrative observation of structural government spending shocks.[10]

To distinguish between foreign- and home-debt-financed spending shocks, we split the time series

[9] Our focus is on the US because of the availability of narrative evidence. The narrative database of Devries *et al.* (2011) and Guajardo *et al.* (2014) provides narrative evidence of budget consolidations for an international panel of countries. But this data is annual and the Blanchard-Perotti-type timing restrictions would be invalidated. It is also likely that positive and negative government spending shocks have asymmetric effects (because of stickiness of prices and proximity to full employment, for example), and that debt reductions do not induce the analagous investment crowding in and out effects.

[10] We use the same data of US national accounts and debt variables as described in section 4.1. The VAR includes 4 lags of the endogenous variables and has no constant.

of the panel into two groups and compare the IRFs of the identified government spending shock in these two time periods : i) one in which the correlation of government expenditures with the ratio of domestic public debt to external public debt is positive, and ii) one in which the correlation of government expenditures with the ratio of domestic public debt to external public debt is negative.[11] The mapping between this exercise and the baseline identification of section 2.3 is natural. Exploiting the time series of the data in this way can be interpreted as a loose form of sign restrictions ("poor man's sign restrictions" in the language of Jarocinski and Karadi (2018)). The responses in the periods where $corr(G, ratio) < 0$ can be understood as those to a foreign-debt-financed shock, while the responses in the periods where $corr(G, ratio) > 0$ to those of a home-debt-financed shock. This procedure allows to combine the identification advantages of the proxy-SVAR framework, with the appealing features of the sign restriction methodology that enables pinning down the location of financing of government spending.[12]

Figure 8 shows the IRFs of the proxy-identified SVAR for the full sample, while Figures 9 and 10 for the periods where $corr(G, ratio) < 0$ and $corr(G, ratio) > 0$, respectively.

[Insert Figures 8 to 10 here]

The results of the full sample (location-free government spending shock) closely mirror the findings of the reference SVAR without debt in Section 3.1. A 1% innovation in the proxy-identified government expenditure shock leads to a positive impact response on output of 0.3, on consumption of 0.25, and is statistically insignificant on investment in the short-run. Investment is crowded out significantly after one year. When implementing the "poor man's sign restrictions" investment is crowded in significantly on impact and the impact response of output is at 0.5 in periods where $corr(G, ratio) < 0$ (foreign financing). In contrast, in periods where $corr(G, ratio) > 0$ (home financing) investment is crowded out on impact and in the medium-term, and the short-run response of output is at 0.2. In the latter case consumption is significantly crowded in, while in the former the median response is negative, but not significant. As previously discussed, since government expenditures consist of both government consumption and government investment, we can interpret the difference in output and private investment responses between Foreign and Home shocks to be be a lower bound.

[11] We search and calculate the correlation for windows that vary in size. The size of the window for the results we present below is 12 quarters. The results remain robust to varying the window size in the range of 4 to 20 quarters. Overall, the periods in which $corr(G, ratio) < 0$ (home financing) is 114 quarters while the periods in which $corr(G, ratio) > 0$ (foreign financing) is 123 quarters; we do not include periods in which the correlation is zero.

[12] It may be argued that a more immediate separation of the two shocks can be obtained by including an indicator variable in the SVAR (i.e., low- and high- domestic to external debt thresholds) as in the state-dependent specifications of Ramey and Zubairy (2018). However, this implicitly identifies *outstanding* debt shares rather than *marginal* changes in debt to finance government spending. We check the validity of this approach in section 4.3.3 where we estimate an Interaction VAR.

4.3.3 Exploiting the cross-section of the panel

We return to the full set of countries and experiment with two alternative VAR specifications, which exploit cross-sectional information from the entire panel. These approaches capture the effects of changes in government spending for different average compositions of debt in the economy (outstanding debt), rather than the marginal absorption that we have been identifying so far. For both specifications we identify a single government spending shock using a Cholesky decomposition, as in the reference SVAR of section 3.1.

The "1 shock" robustness case splits the panel into two subsamples: one where the ratio of domestic-to-external debt is below the median (low ratio), and another where the ratio of domestic-to-external debt is above the median (high ratio). The "Interaction VAR" robustness case estimates the entire panel, but allows for an interaction term between government spending and the ratio of domestic-to-external public debt. This is in line with the methodology in Saborowski and Weber (2013).[13] The interaction term on the ratio of domestic-to-external public debt takes on the values of 1% (low domestic-to-external debt ratio) and 99% (high domestic-to-external debt ratio).

The results are summarized in Table B.2 in the Appendix, which reports the cumulative multipliers of output, consumption, and investment at different horizons, for the "low ratio" (foreign financing) and the "high ratio" (home financing) subsamples for both the "1 shock" and the "Interaction VAR". For the "Interaction VAR" it also reports the median of the empirical PDF of the difference in multipliers ("low ratio" - "high ratio"), as well as the percentage of cases, where this difference is greater than zero. The split based on the "1 shock" specification is not particularly insightful. In fact, for countries with low domestic debt-to-external debt (foreign) the multiplier is 0.09, while for countries with high domestic debt-to-external debt (home) the impact output multiplier is 0.38. The responses of investment are in line with our baseline specification, though. Investment increases in countries with a lower share of domestic-to-external debt (0.14) and decreases in countries with a higher share (-0.22). The increase in output for the high ratio group is, rather, driven by higher consumption (0.32).

When interacting government spending with the ratio on domestic-to-external debt ("Interaction VAR"), the results are more in line with our baseline specification. The difference in impact output multipliers between a "low ratio" (foreign) and "high ratio" (home) threshold is 0.48 (and positive for 90% of cases). On impact the asymmetric responses of investment are muted, but in the medium term investment increases in the "low ratio" case and decreases in the "high ratio" case.

[13] We thank Sebastian for sharing his codes.

5 Theoretical Model

We present a standard small open-economy model (Schmitt-Grohe and Uribe (2003)) that has sufficient ingredients to illustrate how the location of debt-financing of government spending affects the crowding in or crowding out of private investment. As hinted at earlier, this is a direct consequence of whether the private sector has access to external financial markets. We show that the result naturally obtains from the specification of the economy's resource constraint. Consequently, the predictions are not model-dependent and hold in both the neo-classical and the New-Keynesian versions of the small open economy model. To keep the framework intentionally simple, we present only the version with flexible prices.[14]

5.1 Outline

The framework can be understood a linear combination of two models. One where government spending is financed with domestic borrowing in a closed economy. And another where government spending is financed with debt-elastic foreign borrowing in an open economy. The degree of financial openness determines which setup is in effect.

The economy is populated by a representative household, which supplies labor and rents capital to perfectly competitive firms for the production of a final good, which is consumed domestically. The household can purchase government debt and borrow from international capital markets at a debt-elastic interest rate. Fiscal policy is determined by an (automaton) government, which finances public spending via lump-sum taxes, debt issued to resident households, and debt issued to non-residents.

5.1.1 Households

The representative household chooses consumption c_t, labor n_t, government debt b_t^h, and foreign debt $b_t^{f,k}$ to maximize its utility[15]

$$\mathbf{E_0} \sum_{t=0}^{\infty} \beta^t \left[\log\left(c_t\right) - \psi \log\left(n_t\right)\right] \tag{5.1}$$

subject to the budget constraint:

$$c_t + i_t + b_t^h - b_t^{f,k} = w_t n_t + r_t k_{t-1} + R_{t-1}^h b_{t-1}^h - R_{t-1}^{f,k} b_{t-1}^{f,k} - T_t \tag{5.2}$$

[14] The New-Keynesian model with sticky prices is available on request.

[15] We chose logarithmic utility as the simplest case of the class of separable utility functions in consumption and labor. Allowing for a more general specification with constant relative risk aversion for consumption, or a Frisch labor supply elasticity that is different to $\frac{n^*}{1-n*}$ does not affect the results. We explain the implications of introducing GHH preferences in section 5.4.

$E_0[.]$ denotes the expectation operator and $0 < \beta < 1$ is the subjective discount factor. $\psi > 0$ denotes the weight on labor dis-utility. i_t is investment in productive capital, $w_t n_t$ is labor income, $r_t k_{t-1}$ is the rent from capital, and $T_t > 0$ are lump-sum taxes (transfers when negative). b_t^h and $b_t^{f,k}$ denote the purchases of debt from the government and external financial markets, made at time t. If $b_t^h < 0$ and $b_t^{f,k} > 0$ the household is a borrower. $R_{t-1}^h b_{t-1}^h$ and $R_{t-1}^{f,k} b_{t-1}^{f,k}$ denote the gross returns from debt decisions made at time $t-1$.

The interest rate on government debt is determined endogenously through the Euler equation, whereas the interest rate on private foreign debt is assumed to follow a debt-elastic interest rate of the form:

$$R_t^{f,k} = r^* + \nu \left[\exp\left(b_t^{f,k} - \overline{b_t^{f,k}} \right) - 1 \right] \tag{5.3}$$

$R_t^{f,k}$ is a sum of the world interest rate r^* and a convex function of the deviation of debt from its steady state value $\overline{b_t^{f,k}}$. $\nu \in [0, \infty)$ parametrizes the sensitivity of the interest rate to debt deviations and is interpreted as the degree of external financial market openness for households. As $\nu \to 0$, households have perfect access and can borrow from abroad at the world interest rate. When $\nu \to \infty$, the cost of external capital increases in an exponential fashion.

5.1.2 Firms

Output is produced using a Cobb-Douglas technology over capital and labor:

$$Y_t = k_{t-1}^{\alpha} n_t^{1-\alpha} \tag{5.4}$$

where α determines the income share of capital in production. Capital evolves according to the law of motion

$$k_t = (1-\delta) k_{t-1} + i_t \tag{5.5}$$

where δ is the depreciation rate. Firms choose k_{t-1} and n_t to maximize profits taking prices $\{w_t, r_t\}$ as given.

5.1.3 Government

Exogenous public consumption g_t are financed with lump-sum taxes T_t, debt issued to domestic households b_t^h, and debt issued to non-residents $b_t^{f,g}$. For simplicity we assume that the interest rate for public external debt is equal to the public domestic interest rate $\left(R_t^{f,g} = R_t^h\right)$.[16] The government's

[16] This can be seen as the solution to the government's financing cost minimization problem $\left(\min R_{t-1}^h b_{t-1}^h + R_{t-1}^{f,g} b_{t-1}^{f,g} \quad \text{s.t.} \quad \text{eq. 5.6}\right)$, which yields the no-arbitrage (indeterminate) solution $R_t^h = R_t^{f,g}$ and

budget constraint is given by:

$$g_t - T_t = b_t^h - R_{t-1}^h b_{t-1}^h + b_t^{f,g} - R_{t-1}^{f,g} b_{t-1}^{f,g} \tag{5.6}$$

Public consumption follow an exogenous AR(1) process with constant κ^g and persistence ρ^g

$$g_t = \kappa^g + \rho_g g_{t-1} + \varepsilon_t^{g,h} + \varepsilon_t^{g,f} \tag{5.7}$$

The objective is to map the theoretical exercise to the shocks identified in the empirical investigation. In section 2 we disentangled the orthogonal cases of a home debt-financed and foreign debt-financed spending shock by extracting impulse response functions that satisfy restrictions on the ratio of domestic public debt to external public debt. Here, we omit specifying a tax rule and instead close the model by assuming that both domestic public debt and foreign public debt follow exogenous processes:

$$b_t^h = \rho_B b_{t-1}^h + \varepsilon_t^{g,h}; \qquad b_t^{f,g} = \rho_B b_{t-1}^{f,g} + \varepsilon_t^{g,f} \tag{5.8}$$

where $\varepsilon_t^{g,h}$ and $\varepsilon_t^{g,f}$ are innovations that drive the domestic debt and external debt processes, respectively, as well as government spending (eq. 5.7). When the government finances government spending using domestic debt, only the shock $\varepsilon_t^{g,h}$ is relevant. In contrast, when the government finances government spending using external debt, only the shock $\varepsilon_t^{g,f}$ is relevant. In the first instance, following a shock to $\varepsilon_t^{g,h}$, domestic debt b_t^h increases one-for-one with g_t, and external debt $b_t^{f,g}$ is exogenous and set to its steady-state value $\overline{b^{f,g}}$. In the second instance, following a shock to $\varepsilon_t^{g,f}$, external debt $b_t^{f,g}$ increases one-for-one with g_t, and domestic debt b_t^h is exogenous and set to its steady-state value $\overline{b^h}$. By assumption, the shocks are uncorrelated, but occur together at every point in time.[17] This makes the analysis here equivalent to the approach of section 2.[18]

a positive share of both domestic and foreign debt in equilibrium. We relax this assumption in section 5.4, where we assume that the public external interest rate is assigned a premium for sovereign risk, which may result in it being higher than the private external interest rate.

[17] We can similarly specify a tax rule (as in Leeper (1991); $T_t = \rho_T T_{t-1} + \xi\left(\frac{B_{t-1}}{\overline{B}}\right)$, where $B_t = b_t^h + b_t^{f,g}$ and $\overline{B}$ is the steady-state value of total debt) and then analyze debt-financing of spending in the following manner: when the government finances government spending using domestic debt, we let b_t^h be endogenous and set external public debt to its steady-state value, $b_t^{f,g} = \overline{b^{f,g}}$. Conversely, when the government finances government spending using external debt, we let $b_t^{f,g}$ be endogenous and set domestic public debt to its steady-state value, $b_t^h = \overline{b^h}$. The drawback of this approach is that we cannot have both shocks occur simultaneously, as is the case in section 2.

[18] In practice, if a government auctions off debt, it does not actively seek to influence the composition of the investor base in terms of its nationality, at least in developed countries. However, the intention here is to provide a mechanism for what we observe in the data, which is a limiting case of a purely home- and foreign- financed spending shock. Nevertheless, it is possible to endogenously determine the government's portfolio using insights from the sovereign default literature (e.g., D'Erasmo and Mendoza (2017)). We provide such a motivation for the model with interest rate spreads in section 5.4.

5.1.4 Identities

The resource constraint of the economy is given by aggregating the budget constraints of the household and government

$$c_t + i_t + g_t = Y_t + b_t^{f,g} - R_{t-1}^{f,g} b_{t-1}^{f,g} + b_t^{f,k} - R_{t-1}^{f,k} b_{t-1}^{f,k}. \tag{5.9}$$

The optimality conditions consisting of the competitive equilibrium of the economy can be found in section C of the Appendix.

5.2 Calibration

We calibrate the model by setting the discount factor to 0.99 in order to achieve an interest rate of 1% at the baseline. The world interest rate is given by $r^* = \frac{1}{\beta}$. Following conventional parameterization in the macroeconomic literature we set the share of capital in production α to 0.33, and given that our model is quarterly, the depreciation rate δ is set to 0.025. We calibrate the weight of labor supply in the utility function ψ to 1.75, as it can be analytically derived from the steady-state relationship between capital and labor, given α and δ. We calibrate the constant in the government spending rule κ^g to 0.02 to obtain a steady-state level of government spending to GDP of 20%. We calibrate the steady-state level of public debt to GDP to the typical value of 60%. Regarding the private financial openness parameter ν, as we explain below, we perform impulse response functions (IRFs) in the range [0, 50]. The level of private debt to GDP is in turn determined by ν, which falls as ν increases. When $\nu = 50$, private debt to GDP is set at 1%. We specify the persistence of government spending ($\rho_G = 0.9$) and debt rule ($\rho_B = 0.9$) processes such that all variables in the economy return to their steady states by period 20. Finally, the government spending shock is of size 1% of its steady-state value. Parameter values can be seen in Table 1.

[Insert Table 1 here]

5.3 Analysis

5.3.1 The response of investment and consumption

Figure 11 plots the responses of investment following a home-debt-financed and a foreign-debt-financed spending shock for different values of $0 \leq \nu < 50$. When ν is low, households can borrow externally at a favorable interest rate, while when ν is high external borrowing becomes prohibitively costly.[19] The key difference across a home-debt-financed and a foreign-debt-financed government spending shock is

[19] In theory, the latter is achieved when $\nu \to \infty$, but we experiment with several values for ν and conclude that a value of $\nu = 50$ is enough to restrict all private foreign borrowing.

the sensitivity of investment to ν. For a foreign-debt-financed shock, investment is always crowded in. For a home-debt-financed shock, investment is crowded in for low values of ν, but crowded out for high values of ν. This difference can be understood by contrasting the fundamental transmission channels of a government spending shock in closed and open economies.

[Insert Figure 11 here]

Consider first that v is large. Infinitesimal changes in $b_t^{f,h}$ will lead to infinite marginal increases in $R_t^{f,h}$, which disincentivize private external borrowing. In this case private external borrowing is perfectly restricted, so $b_t^{f,h}$ is constant. If government spending is financed domestically, the economy is essentially closed, so we can write the aggregate resource constraint as $c_t + i_t + g_t = Y_t$. On the other hand, if spending is financed externally, the resource constraint also includes external government debt: $c_t + i_t + g_t = Y_t + b_t^{f,g} - R_{t-1}^{f,g} b_{t-1}^{f,g}$. It is clear, that an increase in government spending will lead to a greater crowding out of consumption and/or investment when financed domestically, *ceteris paribus*. If financed externally, then there is an equivalent increase in $b_t^{f,g}$, allowing for investment to increase even in the case of an output multiplier less than one. The reason is that labor increases following a government spending shock (due to a negative wealth effect). The fact that consumption declines less than investment (see 12) for a home-debt-financed spending shock follows from consumption smoothing motives.

Consider next that ν is low. The aggregate resource constraint now takes the original form in equation 5.9. In this case the economy is open regardless of where spending is financed and investment is crowded in for both types of spending shocks. In the case of a foreign-debt-financed shock, the argument coincides with the above. In the case of a domestically financed shock, households now borrow privately from abroad to finance their purchases of domestic government debt.

5.3.2 Labor supply in equilibrium and the impact output multiplier

Despite predicting responses of investment along the lines mentioned earlier, the neo-classical small open economy model cannot account for the differences in *impact* output multipliers obtained in the empirical section. In fact, the home-debt-financed spending shock produces an impact multiplier that is greater than that produced by the foreign-debt-financed spending shock.[20] This obtains from the equilibrium response of labor. In subsequent periods, though, the foreign shock becomes more expansionary and yields *cumulative* multipliers in line with the data.

To see this, Figure 12 plots IRFs to a home debt-financed and a foreign debt-financed spending shock for the case where household external borrowing is restricted ($\nu = 50$). A spending shock will induce

[20] Again, these predictions carry through to a New-Keynesian small open economy framework. Results are available on request.

a negative wealth effect as households anticipate future increases in taxation to finance debt servicing interest rate payments. This will incentivize them to increase their labor supply. However, the degree of the wealth effect and the ensuing response of labor depends on how spending is financed. When spending is financed domestically, investment is crowded out and permanent income of households is lower than when spending is financed externally and investment is crowded in. In equilibrium, households will therefore supply more labor in response to a domestically financed spending shock. And since capital, as a state variable, is pre-determined, output responds only to changes in labor supply on impact. All this translates to an impact response of output that is 0.55 when spending is foreign-financed, but 0.59 when spending is home-financed.[21]

[Insert Figure 12 here]

From period 2 onward, the foreign-debt-financed spending shock becomes more expansionary. This is a direct consequence of the crowding in of investment. As investment increases, in period 2, the marginal product of labor rises. Households are incentivized to supply further labor when spending is financed abroad. In addition, since capital takes one period to build, it also contributes to the increase in output in period 2. This translates to a period 2 response of output of 0.6 when spending is foreign-financed, but 0.54 when spending is home-financed.

5.4 Interest rate spread between external and domestic interest rates

To qualitatively replicate the predictions from the data regarding impact output multipliers, we augment the model to allow for an interest rate spread between external and domestic interest rates. For consistency, we again show the implications in the flexible price model, but note that results would carry through in the NK framework. There, we would additionally obtain a crowding in of consumption, which is also a prediction obtained from the data. The latter, though, would not materially affect the difference in impact output responses between two shocks.[22]

The model is equivalent to the one outlined previously, with the exception of the no-arbitrage condition, which yielded $R_t^{f,g} = R_t^h$. Here, we assume that the external public interest rate deviates

[21] Of course, the values depend on parameterization, but the qualitative difference is independent of the calibration of the model and shock processes.

[22] One may be curious if other features that have been designed to generate a crowding in of consumption, may also reconcile the predictions regarding impact output responses between the model and the data. We have experimented with the following and find that they fail: i) GHH preferences circumvent the wealth effect. But in the flexible price model, GHH preferences imply that labor does not increase following a government spending shock. As a result, output too will not increase on impact. ii) By adding GHH preferences to the sticky price model (as in Monacelli and Perotti (2008)), we obtain an increase in labor supply because the real wage increases (since the markup declines, consumption increases, too). But the increase in labor is again greater following a home-financed shock, because in equilibrium households compensate for the crowding out of investment. iii) The same holds in both the RBC and NK models for preference specifications with varying degrees of the wealth effect (Jaimovich and Rebelo (2009)). iii) The equilibrium response of labor is again the same if, instead of GHH preferences, we augment the sticky price model with rule-of-thumb consumers (Gali, Lopez-Salido and Valles (2007)). iv) Finally, the same is true if we allow for government spending to enter the utility function (Bouakez and Rebei (2007)). All results are available on request.

from the domestic interest rate by a debt-elastic factor χ, such that: $R_t^{f,g} = R_t^h \left[1 + \chi \left(\frac{b_t^{f,g}}{\bar{b}^{f,g}}\right)\right]$. We interpret χ as a premium that external lenders demand in order to be compensated for sovereign default risk. If the probability of default is greater on external debt than domestic debt (for example, because it is in the interest of a benevolent government to maximize residents' utility), then the presence of external sovereign default risk will imply such a condition in equilibrium.[23] Moreover, there is ample evidence of a positive spread between external and domestic interest rates on government debt (see, for example, Guidotti and Kumar (1991); Giovannini and de Melo (1993); Gordon and Li (2003); Du and Schreger (2013)).

We place empirical discipline on the degree of financial openness by setting $\chi = 0.75$. This is line with evidence for emerging markets between 2005 to 2011 presented in Du and Schreger (2013), who find that foreign-currency credit spreads are greater than local-currency credit spreads by 0.67 to 0.87 basis points. Figure 13 plots IRFs for a home- and foreign-debt-financed spending shock in the model with an interest rate spread. A foreign-financed shock now produces a greater response to output on impact. The intuition is simple: interest rate payments of the government are now greater when spending is financed externally. This means that the wealth effect on labor is larger for a foreign-financed shock, despite the crowding in of investment. Since output on impact largely depends on the impact response of labor, output increases by more than a home-financed shock. The impact multipliers on output are 0.98 (Foreign) and 0.6 (Home).

[Insert Figure 13 here]

6 Conclusion

In this paper we have asked the following question: How do fiscal multipliers differ if a government spending shock is financed with home debt or foreign debt? To answer this question, we have estimated an SVAR identified using standard timing restrictions and complementing them with a single sign restriction on the movement of the ratio of domestic public debt to external public debt. We have found that fiscal multipliers are larger when government spending is financed by debt placed abroad. In this case investment is also crowded in, as opposed to the event where spending is financed using domestic debt. We also find that, in line with the theory, the difference in output multipliers is most emphasized when the private sector has limited access to external financing. The latter is proxied using measures on i) GDP volatility, ii) the share of non-resident bank loans to GDP, and iii) the Chinn-Ito index of financial openness.

[23] For selective default frameworks see, for example, Vasishtha (2010), Paczos and Shakhnov (2016) or D'Erasmo and Mendoza (2017).

The results are robust to alternative identification schemes. Namely, in an SVAR that includes shocks to the government's cost of borrowing (sovereign bond yields), in an Interaction VAR with different domestic-to-external debt thresholds, and for the US, when estimated using a proxy-SVAR with defense news series.

We validate our econometric methodology by building a model that can account for these asymmetries. The fundamental mechanism that brings about the differential effect of government spending financing is the extent to which private investment is crowded out or in. When the private sector obtains access to foreign borrowing, then investment is crowded in for both types of government spending shock, and output multipliers are quantitatively similar. When private access to foreign borrowing is restricted, then the difference between the two shocks is quantitatively different. A standard small open economy model (with flexible or sticky prices) cannot account for the differences in impact multipliers, but can predict the differences in cumulative multipliers. If supplemented with an interest rate spread between external and domestic interest rates then impact multipliers between the model and the data are also reconciled.

References

Auerbach, A. J. and Gorodnichenko, Y. (2013) Output Spillovers from Fiscal Policy, *American Economic Review*, **103**, 141–46. 1

Bandyopadhyay, S., Lahiri, S. and Younas, J. (2012) Do Countries with Greater Credit Constraints Receive More Foreign Aid?, *Federal Reserve Bank of St. Louis Review*, **94**, 481–493. 3.3

Basso, H. and Rachedi, O. (2018) The Young, the Old, and the Government: Demographics and Fiscal Multipliers, mimeo. 1

Beck, T., Demirguc-Kunt, A. and Levine, R. (2009) Financial Institutions and Markets Across Countries and Over Time - Data and Analysis, Policy Research Working Paper Series 4943, The World Bank. 2

Blanchard, O. and Perotti, R. (2002) An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output, *The Quarterly Journal of Economics*, **117**, 1329–1368. 1, 2.2, 2.3, 3.1

Bouakez, H. and Rebei, N. (2007) Why Does Private Consumption Rise After a Government Spending Shock?, *Canadian Journal of Economics*, **40**, 954–979. 22

Broner, F., Clancy, D., Erce, A. and Martin, A. (2018) Fiscal Multipliers and Foreign Holdings of Public Debt, Working Papers 30, European Stability Mechanism. 1

Broner, F., Erce, A., Martin, A. and Ventura, J. (2014) Sovereign Debt Markets in Turbulent Times: Creditor Discrimination and Crowding-out Effects, *Journal of Monetary Economics*, **61**, 114–142. 1

Cacciatore, M. and Traum, N. (2018) Trade Flows and Fiscal Multipliers, unpublished, mimeo. 1

Chinn, M. D. and Ito, H. (2006) What Matters for Financial Development? Capital Controls, Institutions, and Interactions, *Journal of Development Economics*, **81**, 163–192. 3.3, 2

Christiano, L., Eichenbaum, M. and Rebelo, S. (2011) When Is the Government Spending Multiplier Large?, *Journal of Political Economy*, **119**, 78–121. 1

D'Erasmo, P. and Mendoza, E. G. (2017) Optimal Domestic (and External) Sovereign Default, Working Papers 17-4, Federal Reserve Bank of Philadelphia. 18, 23

Devries, P., Leigh, J. G. D. and Pescatori, A. (2011) A New Action-Based Dataset of Fiscal Consolidation, IMF Working Papers 11/128, International Monetary Fund. 9

Du, W. and Schreger, J. (2013) Local Currency Sovereign Risk, International Finance Discussion Papers 1094, Board of Governors of the Federal Reserve System (U.S.). 5.4

Farhi, E. and Werning, I. (2017) Fiscal multipliers: Liquidity traps and currency unions, *Handbook of Macroeconomics*, **2**, 2417–2492. 1

Fatas, A. and Mihov, I. (2001) The Effects of Fiscal Policy on Consumption and Employment: Theory and Evidence, CEPR Discussion Papers 2760, C.E.P.R. Discussion Papers. 1, 3.1

Gali, J., Lopez-Salido, J. D. and Valles, J. (2007) Understanding the Effects of Government Spending on Consumption, *Journal of the European Economic Association*, **5**, 227–270. 22

Giovannini, A. and de Melo, M. (1993) Government Revenue from Financial Repression, *American Economic Review*, **83**, 953–63. 5.4

Gordon, R. H. and Li, W. (2003) Government as a Discriminating Monopolist in the Financial Market: The Case of China, *Journal of Public Economics*, **87**, 283–312. 5.4

Guajardo, J., Leigh, D. and Pescatori, A. (2014) Expansionary Austerity? International Evidence, *Journal of the European Economic Association*, **12**, 949–968. 1, 9

Guidotti, P. E. and Kumar, M. (1991) Domestic Public Debt of Externally Indebted Countries, IMF Occasional Papers 80, International Monetary Fund. 5.4

Ilzetzki, E., Mendoza, E. G. and Vegh, C. A. (2013) How Big (Small?) Are Fiscal Multipliers?, *Journal of Monetary Economics*, **60**, 239–254. 1, 2.1, 2.3, 3, 2.4, 3.1, 3.3

Jaimovich, N. and Rebelo, S. (2009) Can News about the Future Drive the Business Cycle?, *American Economic Review*, **99**, 1097–1118. 22

Jarocinski, M. and Karadi, P. (2018) Deconstructing Monetary Policy Surprises - The Role of Information Shocks, CEPR Discussion Papers 12765, C.E.P.R. Discussion Papers. 4.3.2

Leeper, E. M. (1991) Equilibria under Active and Passive Monetary and Fiscal Policies, *Journal of Monetary Economics*, **27**, 129–147. 17

Leeper, E. M., Traum, N. and Walker, T. B. (2017) Clearing up the Fiscal Multiplier Morass, *American Economic Review*, **107**, 2409–2454. 4.1

Mertens, K. and Ravn, M. O. (2013) The Dynamic Effects of Personal and Corporate Income Tax Changes in the United States, *American Economic Review*, **103**, 1212–47. 1, 4.3.2

Miyamoto, W., Nguyen, T. L. and Sheremirov, V. (2016) The Effects of Government Spending on Real Exchange Rates: Evidence from Military Spending Panel Data, Working Papers 16-14, Federal Reserve Bank of Boston. 2.1

Monacelli, T. and Perotti, R. (2008) Fiscal Policy, Wealth Effects, and Markups, NBER Working Papers 14584, National Bureau of Economic Research, Inc. 22

Paczos, W. and Shakhnov, K. (2016) Sovereign Debt Issuance and Selective Default, Economics Working Papers ECO2016/04, European University Institute. 23

Pancrazi, R., Seoane, H. D. and Vukotic, M. (2015) Sovereign Risk, Private Credit, and Stabilization Policies, The Warwick Economics Research Paper Series (TWERPS) 1069, University of Warwick, Department of Economics. 3.3

Pappa, E. (2009) The Effects of Fiscal Shocks On Employment and the Real Wage, *International Economic Review*, **50**, 217–244. 1, 3.1

Priftis, R. and Zimic, S. (2015) Sources of Borrowing and Fiscal Multipliers, in *Fiscal Policy in the Great Recession*, European University Insitute, Florence, Italy, EUI PhD Theses; Department of Economics, chap. 1, pp. 11–69. 1, 3

Priftis, R. and Zimic, S. (2017) Sources of Borrowing and Fiscal Multipliers, Economics Working Papers ECO2017/01, European University Institute. 1

Ramey, V. A. and Zubairy, S. (2018) Government Spending Multipliers in Good Times and in Bad: Evidence from US Historical Data, *Journal of Political Economy*, **126**, 850–901. 1, 4.3.2, 12, A

Saborowski, C. and Weber, S. (2013) Assessing the Determinants of Interest Rate Transmission Through Conditional Impulse Response Functions, IMF Working Papers 13/23, International Monetary Fund. 4.3.3

Schmitt-Grohe, S. and Uribe, M. (2003) Closing Small Open Economy Models, *Journal of International Economics*, **61**, 163–185. 5

Shen, W. and Yang, S.-C. (2012) The effects of government spending under limited capital mobility, IMF Working Papers 129, International Monetary Fund. 1

Stock, J. H. and Watson, M. W. (2012) Disentangling the Channels of the 2007-2009 Recession, NBER Working Papers 18094, National Bureau of Economic Research, Inc. 4.3.2

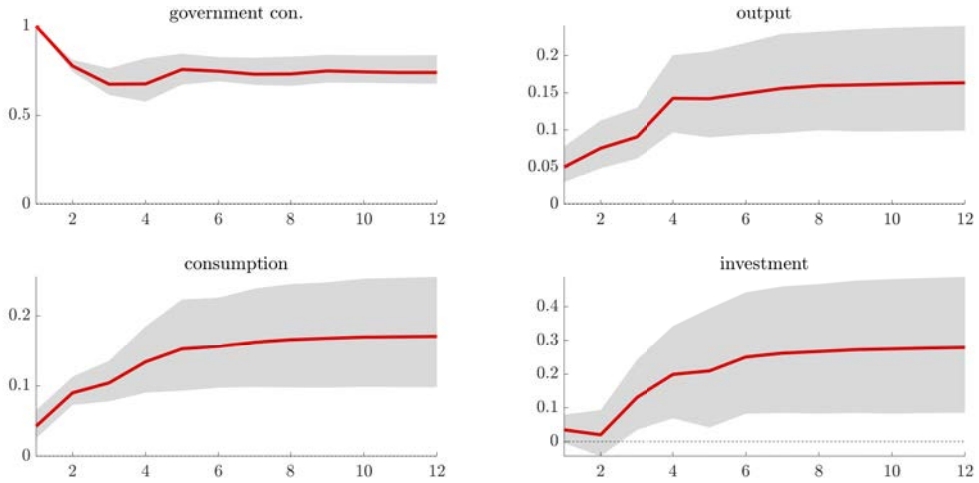
Traum, N. and Yang, S. (2015) When Does Government Debt Crowd out Investment?, *Journal of Applied Econometrics*, **30**, 24–45. 1

Uribe, M. and Yue, V. Z. (2006) Country spreads and emerging countries: Who drives whom?, *Journal of International Economics*, **69**, 6–36. 4.3.1

Vasishtha, G. (2010) Domestic versus External Borrowing and Fiscal Policy in Emerging Markets, *Review of International Economics*, **18**, 1058–1074. 23

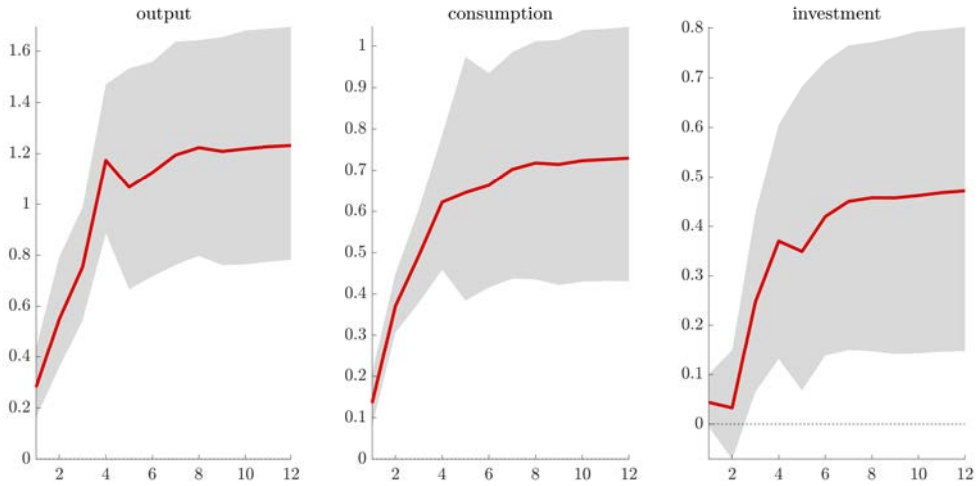
Figures

Figure 1: **Reference SVAR without debt – Cumulative IRFs to government spending shock**



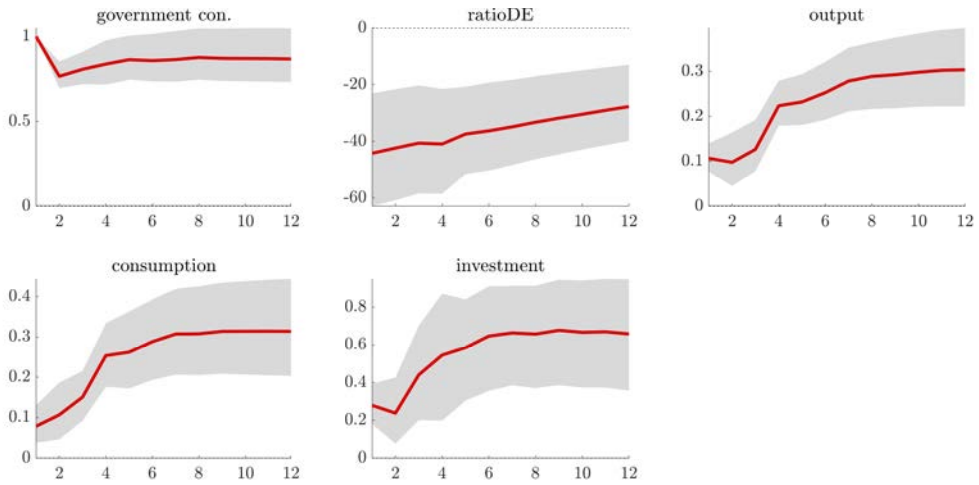
Notes: Cumulative IRFs of a shock to government consumption. Red lines correspond to median responses. Grey shaded areas correspond to parameter uncertainty of one-standard deviation.

Figure 2: **Reference SVAR without debt – Cumulative multipliers to government spending shock**



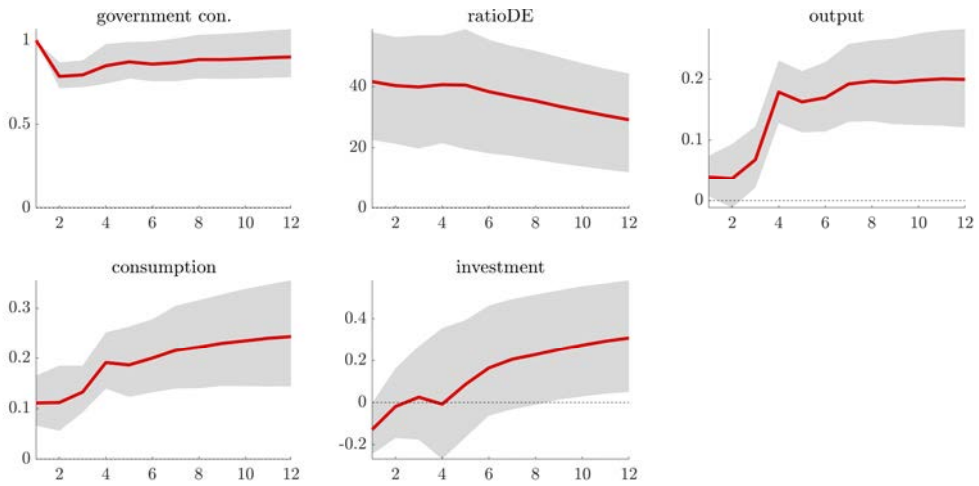
Notes: Cumulative multipliers following a shock to government consumption. Cumulative multipliers are calculated as in eq. 2.2. Red lines correspond to median responses. Grey shaded areas correspond to parameter uncertainty of one-standard deviation.

Figure 3: **Cumulative IRFs to foreign-debt-financed government spending shock**



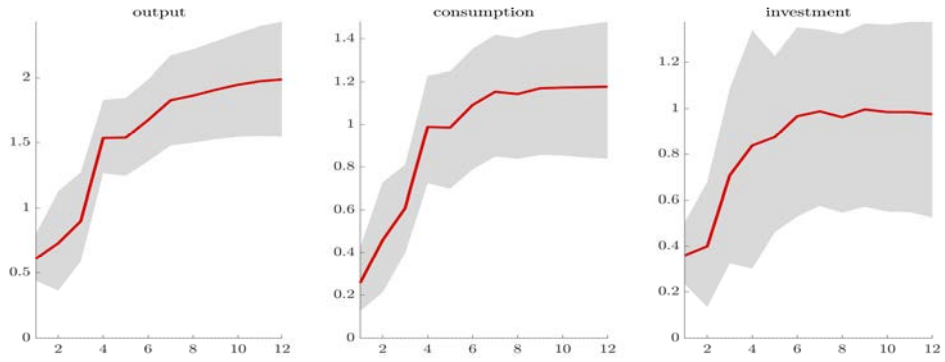
Notes: Cumulative IRFs of a shock to government consumption financed with foreign debt. Red lines correspond to median responses. Grey shaded areas correspond to parameter uncertainty of one-standard deviation.

Figure 4: **Baseline SVAR - Cumulative IRFs to home-debt-financed government spending shock**



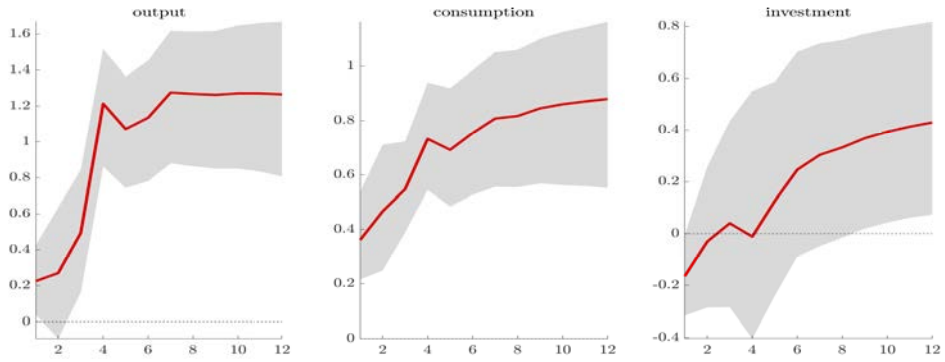
Notes: Cumulative IRFs of a shock to government consumption financed with home debt. Red lines correspond to median responses. Grey shaded areas correspond to parameter uncertainty of one-standard deviation.

Figure 5: **Baseline SVAR - Cumulative multipliers to foreign-debt-financed government spending shock**



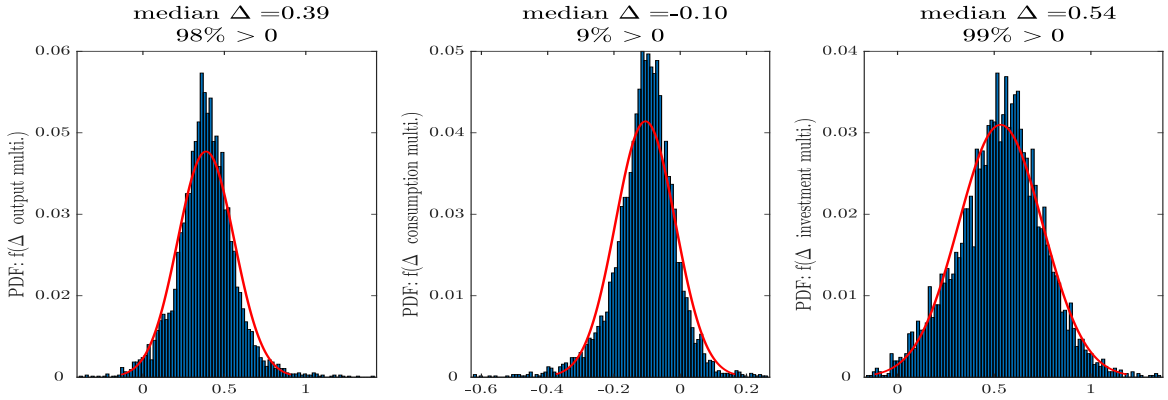
Notes: Cumulative multipliers following a shock to foreign-debt-financed government consumption. Cumulative multipliers are calculated as in eq. 2.2. Red lines correspond to median responses. Grey shaded areas correspond to parameter uncertainty of one-standard deviation.

Figure 6: **Baseline SVAR - Cumulative multipliers to home-debt-financed government spending shock**



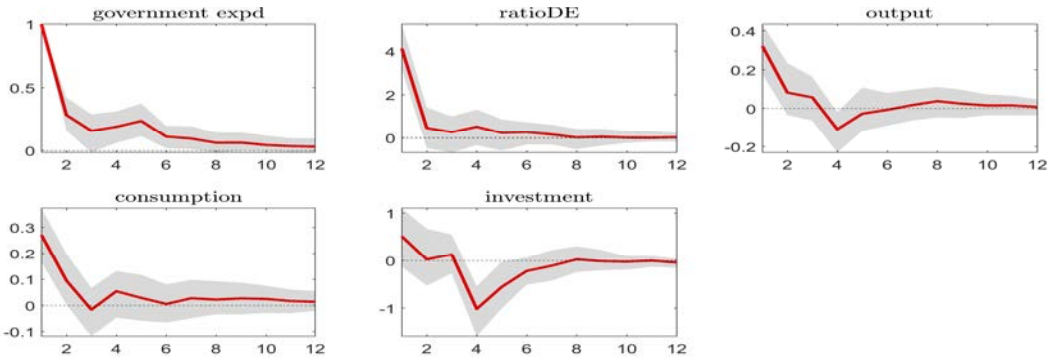
Notes: Cumulative multipliers following a shock to home-debt-financed government consumption. Cumulative multipliers are calculated as in eq. 2.2. Red lines correspond to median responses. Grey shaded areas correspond to parameter uncertainty of one-standard deviation.

Figure 7: **Baseline SVAR - Empirical PDF for difference of impact multipliers**



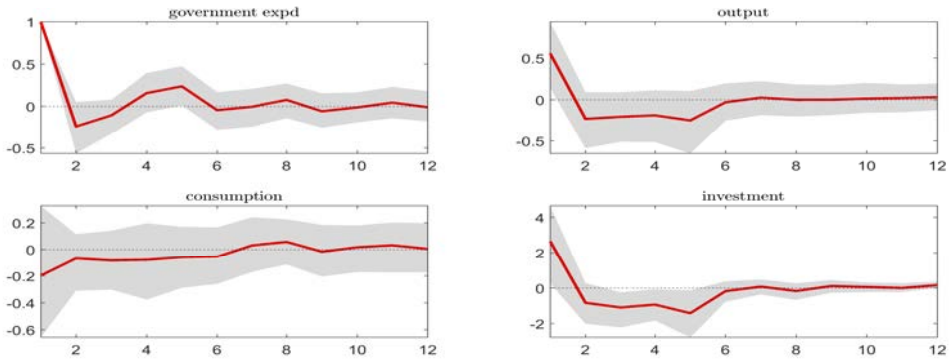
Notes: Empirical probability density function (PDF) of the difference in impact multipliers across the two shocks, where the difference is defined as Foreign-Home. The empirical PDF is obtained by drawing from the simulated distribution of the models that satisfy the sign restrictions. The median change in impact multipliers (Foreign-Home) is then calculated for each draw. The red curve shows a Normal distribution that approximates the empirical PDF.

Figure 8: **United States: Proxy-SVAR - IRFs to government spending shock**



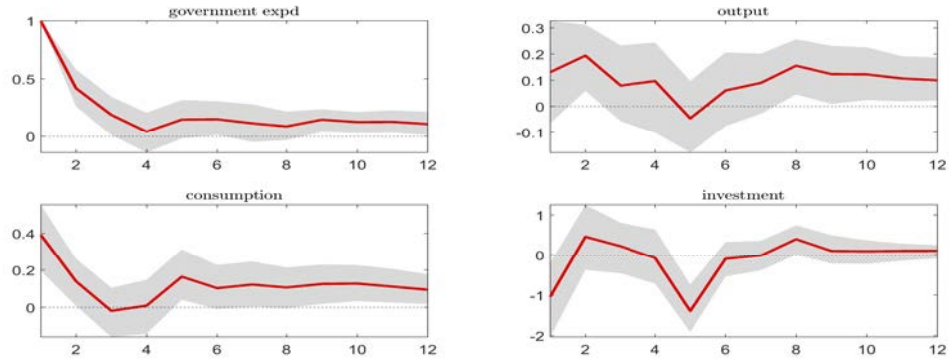
Notes: Sample is the US from 1952:Q1 to 2015:Q2. IRFs of a shock to government expenditures with defense news as a proxy. Red lines correspond to median responses. Grey shaded areas correspond to parameter uncertainty of one-standard deviation.

Figure 9: **United States: Proxy-SVAR when** $corr\,(G, ratio) < 0$ **(Foreign) - IRFs to government spending shock**



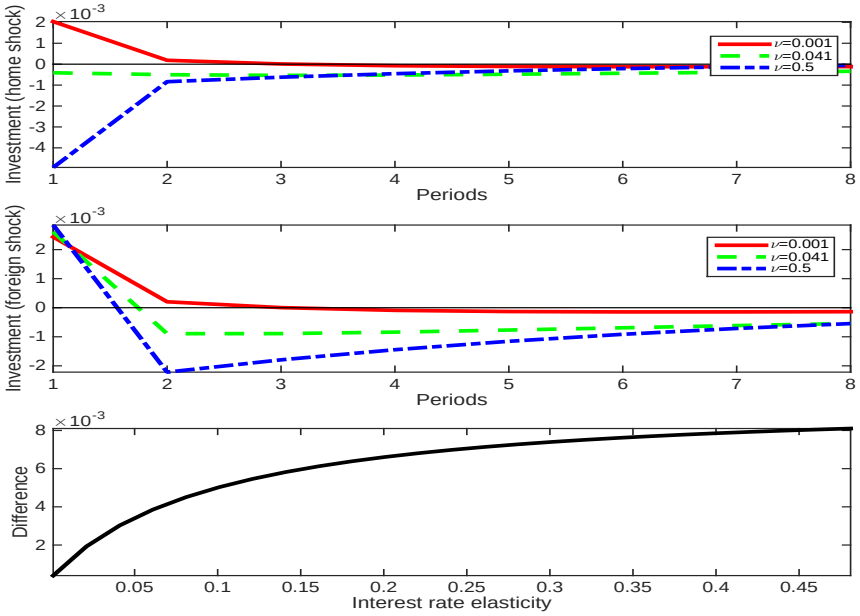
Notes: Sample is the US from 1952:Q1 to 2015:Q2 when $corr\,(G, ratio) < 0$. IRFs of a shock to government expenditures with defense news as a proxy. Red lines correspond to median responses. Grey shaded areas correspond to parameter uncertainty of one-standard deviation.

Figure 10: **United States: Proxy-SVAR when** $corr\,(G, ratio) > 0$ **(Home) - IRFs to government spending shock**



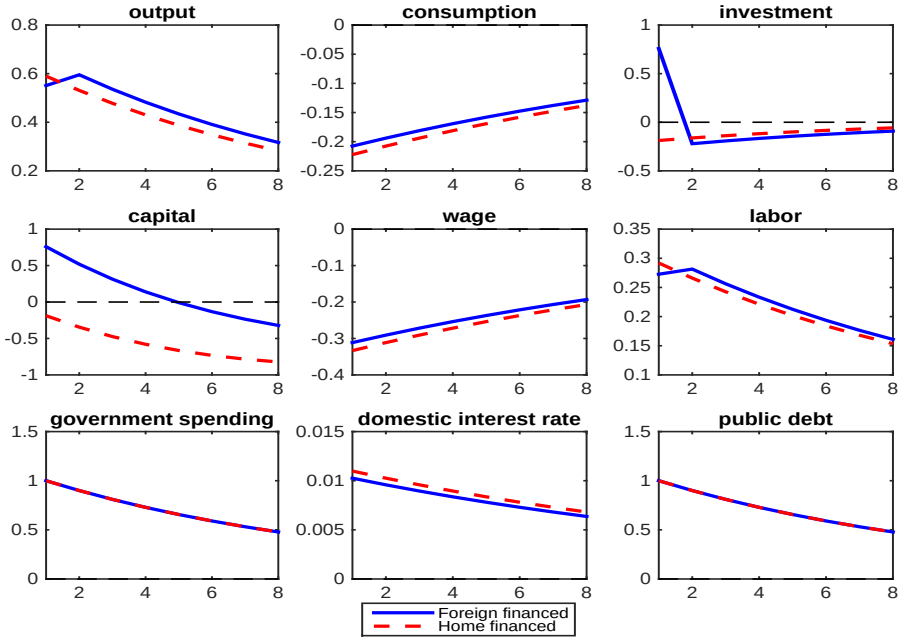
Notes: Sample is the US from 1952:Q1 to 2015:Q2 when $corr\,(G, ratio) > 0$. IRFs of a shock to government expenditures with defense news as a proxy. Red lines correspond to median responses. Grey shaded areas correspond to parameter uncertainty of one-standard deviation.

Figure 11: **Responses of investment for a home- and foreign-debt-financed government spending shock**



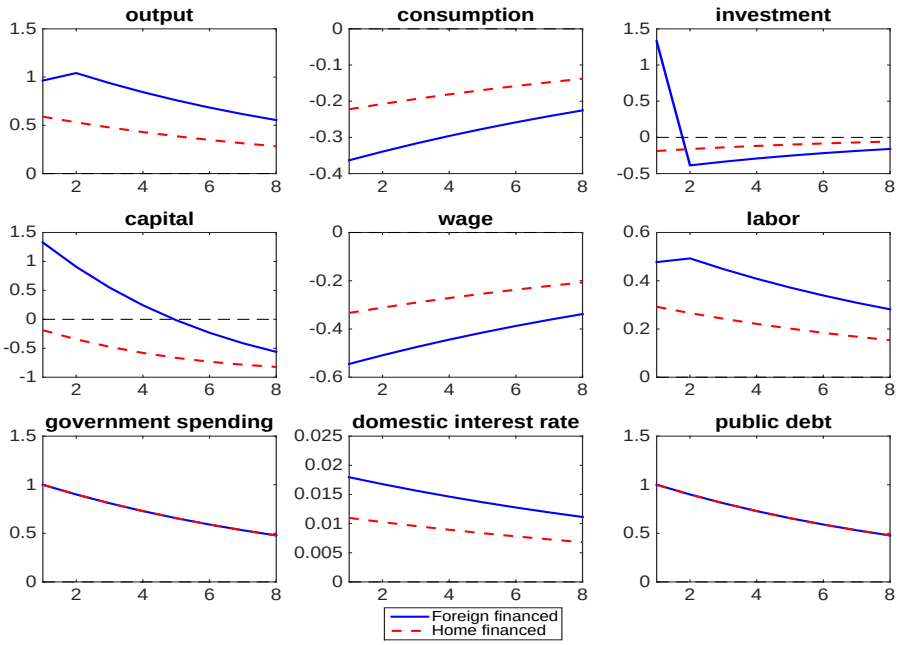
Notes: The top panel plots the responses of investment to a home-debt-financed spending shock. The middle panel plots the responses of investment to a foreign-debt-financed spending shock. For both cases, the private interest rate debt-elasticity varies between $\nu = 0.001$ (solid red line), $\nu = 0.041$ (dashed green line), $\nu = 0.5$ (dotted-dashed blue line). The bottom panel plots the differences in investment (Foreign-Home) for a range of ν.

Figure 12: **IRFs for a home- and foreign-debt-financed government spending shock without private external borrowing**



Notes: Impulse response functions to a 1% government spending shock financed with domestic debt (dashed red line) and external debt (solid blue line). Households do not have access to external financial markets ($\nu = 50$). Public debt is external debt (domestic debt) for a Foreign (Home)-debt-financed shock.

Figure 13: **IRFs for a Home and Foreign government spending shock without private external borrowing - Positive interest rate spread**



Notes: Impulse response functions to a 1% government spending shock financed with domestic debt (dashed red line) and external debt (solid blue line). Households do not have access to external financial markets ($\nu = 50$). Public debt is external debt (domestic debt) for a Foreign (Home) financed shock. Model with interest rate spread between external and domestic interest rates.

Tables

Table 1: Parameter values

Parameter	Value	Label
β	0.99	Discount factor
r^*	$\frac{1}{\beta}$	World interest rate
α	0.33	Capital share
δ	0.025	Depreciation rate
ψ	1.75	Weight on labor supply disutility
ν	[0, 50]	Private financial openness
κ^g	0.02	Government spending constant
ρ_g	0.9	Government spending autocorrelation coefficient
ρ_B	0.9	Debt rule autocorrelation coefficient

Table 2: Sensitivity to private sector's access to external financial markets

variable	Output			Consumption			Investment		
horizon	*1*	*4*	*12*	*1*	*4*	*12*	*1*	*4*	*12*
GDP variance									
Foreign	0.9	1.83	2.31	0.36	1.46	1.74	0.59	1.83	1.78
Home	0.31	1.99	1.12	0.48	0.77	0.41	-0.24	-0.08	0.17
Δ	0.57 (97.34%>0)	-0.47 (34.54%>0)	1.02 (89.30%>0)	-0.07 (18.90%>0)	0.62 (96.88%>0)	1.29 (96.08%>0)	0.85 (99.82%>0)	1.98 (85.50%>0)	1.63 (96.10%>0)
Foreign	0.31	1.08	1.34	0.22	0.7	0.83	0.09	0.2	0.35
Home	0.18	0.53	0.9	0.15	0.57	0.89	-0.02	0.3	0.47
Δ	0.11 (71.22%>0)	0.52 (96.24%>0)	0.45 (79.62%>0)	0.06 (70.40%>0)	0.13 (68.94%>0)	-0.03 (47.08%>0)	0.12 (78.42%>0)	-0.11 (32.58%>0)	-0.10 (40.14%>0)
Loans from non-resident banks (% GDP)									
Foreign	0.76	1.89	1.79	0.23	1.15	1.36	0.3	0.93	1.03
Home	0.17	0.47	0.14	0.48	0.35	0.1	-0.17	0.26	0.04
Δ	0.59 (86.00%>0)	1.48 (89.72%>0)	1.67 (83.50%>0)	-0.23 (20.42%>0)	0.82 (83.08%>0)	1.32 (84.40%>0)	0.47 (96.86%>0)	0.65 (78.86%>0)	0.96 (80.56%>0)
Foreign	0.6	1.28	1.73	0.25	0.86	1.03	0.48	0.78	0.76
Home	0.38	1.25	1.38	0.26	0.57	0.86	-0.1	-0.19	0.38
Δ	0.24 (84.42%>0)	-0.01 (47.54%>0)	0.38 (82.58%>0)	-0.01 (42.66%>0)	0.33 (82.92%>0)	0.20 (69.54%>0)	0.61 (97.84%>0)	1.06 (66.74%>0)	0.40 (76.44%>0)
Chinn-Ito index									
Foreign	0.6	1.56	1.79	0.16	1.38	1.45	0.42	1.37	1.19
Home	0.08	1.52	1.21	0.2	0.79	0.75	-0.13	0.12	0.61
Δ	0.52 (98.70%>0)	-0.13 (40.30%>0)	0.60 (85.70%>0)	-0.05 (24.14%>0)	0.59 (96.54%>0)	0.73 (88.78%>0)	0.57 (88.68%>0)	1.38 (73.00%>0)	0.71 (74.86%>0)
Foreign	0.59	0.92	1.44	0.4	0.5	0.77	0.35	-0.08	0.27
Home	0.53	0.91	0.83	0.52	0.6	0.73	-0.15	0.19	0.02
Δ	0.03 (55.40%>0)	0.06 (54.74%>0)	0.67 (77.00%>0)	-0.13 (21.78%>0)	-0.15 (33.64%>0)	0.10 (56.10%>0)	0.47 (99.56%>0)	-0.24 (24.88%>0)	0.29 (70.20%>0)

Notes: The table reports cumulative multipliers for different subsamples that differ in the private sector's access to external financial markets. The latter are measured by: i) the variance of GDP, ii) loans to non-resident banks (% GDP), and iii) the Chinn-Ito index of financial openess. Grey shaded cells denote subsamples where access is low. White cells denote subsamples where access is high. Δ reports the difference in multipliers at different horizons, where the difference is defined as Foreign-Home. Inside the brackets is denoted the % of cases from draws of the simulated distribution of models, for which the difference is > 0. Data for non-resident bank loans are from Beck *et al.* (2009). Data for the Chinn-Ito index are from Chinn and Ito (2006).

Table 3: Robustness checks to sample and VAR specification

variable	Output			Consumption			Investment		
horizon	*1*	*4*	*12*	*1*	*4*	*12*	*1*	*4*	*12*
Baseline - OECD									
Foreign	0.38	1.13	1.82	0.11	0.94	1.27	0.36	0.68	0.93
Home	0.03	1.03	1.3	0.12	0.66	0.89	-0.18	-0.24	0.36
Δ	0.36 (95.22%>0)	0.04 (56.22%>0)	0.55 (92.32%>0)	-0.02 (36.80%>0)	0.31 (82.28%>0)	0.39 (85.98%>0)	0.56 (99.54%>0)	0.99 (76.06%>0)	0.59 (85.72%>0)
Baseline - Emerging economies									
Foreign	0.95	3.32	-0.17	0.2	1.13	-0.34	0.54	4.42	0.88
Home	1.18	1.88	2.69	1.13	0.29	1.02	0.1	0.38	1.19
Δ	-0.23 (39.54%>0)	1.53 (67.72%>0)	-2.92 (36.86%>0)	-0.93 (0.94%>0)	0.73 (60.32%>0)	-1.56 (39.76%>0)	0.45 (78.02%>0)	4.46 (82.66%>0)	-0.23 (48.54%>0)
Baseline - United States (1952:Q1 - 2015:Q2)									
Foreign	1.38	1.23	1.39	0.35	0.54	0.84	0.13	-0.47	-0.53
Home	1.05	0.79	0.7	0.47	0.47	0.55	-0.35	-0.69	-0.8
Δ	0.41 (100.00%>0)	0.65 (86.00%>0)	0.95 (84.00%>0)	-0.15 (0.00%>0)	0.10 (86.00%>0)	0.40 (84.00%>0)	0.61 (100.00%>0)	0.32 (86.00%>0)	0.37 (84.00%>0)
No fixed effects									
Foreign	0.55	1.42	1.88	0.26	0.96	1.19	0.37	0.81	0.28 (100.00%>0)
Home	0.25	1.25	1.27	0.34	0.71	0.81	-0.17	0	0.39
Δ	0.31 (93.32%>0)	0.12 (69.22%>0)	0.64 (91.36%>0)	-0.09 (8.84%>0)	0.27 (79.36%>0)	0.39 (83.42%>0)	0.55 (99.58%>0)	0.89 (70.88%>0)	0.63 (83.32%>0)
Levels									
Foreign	0.63	1.02	1.94	0.25	0.5	0.96	0.42	0.89	1.16
Home	0.34	0.78	1.6	0.33	0.48	0.79	-0.02	0.32	0.75
Δ	0.31 (90.20%>0)	0.24 (79.24%>0)	0.26 (64.32%>0)	-0.08 (14.74%>0)	0.03 (55.42%>0)	0.13 (60.38%>0)	0.46 (99.50%>0)	0.63 (73.82%>0)	0.42 (70.16%>0)

Notes: The table reports cumulative multipliers for different robustness checks related to sample selection and the specification of the VAR. Δ reports the difference in multipliers at different horizons, where the difference is defined as Foreign-Home. Inside the brackets is denoted the % of cases from draws of the simulated distribution of models, for which the difference is > 0. *Baseline*: variables in log-differences, estimation with fixed effects. *No fixed effects*: variables in log-differences, estimation without fixed effects. *Levels*: variables in levels, estimation with fixed effects.

A Data and variables

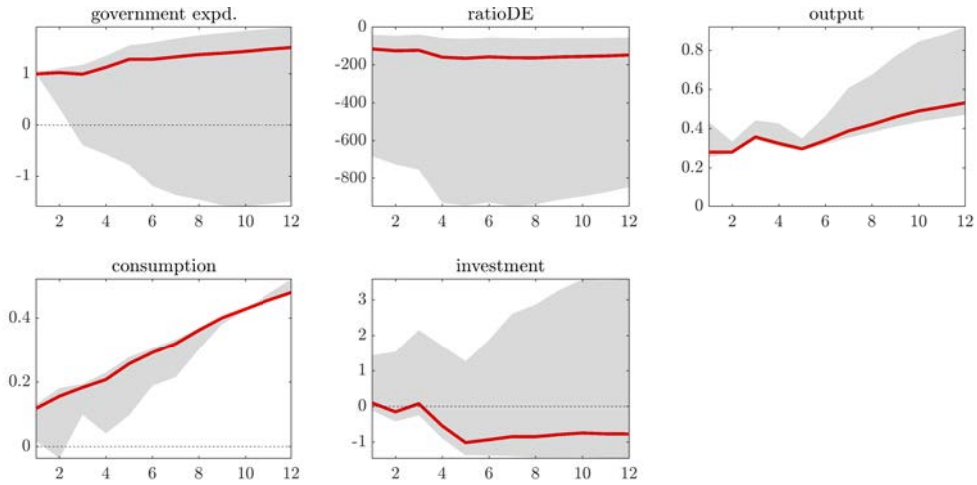
List of countries in panel: Argentina, Australia, Austria, Brazil, Bulgaria, Canada, Chile, Czech Republic, Finland, Hungary, Iceland, Indonesia, Ireland, Israel, Italy, Korea, Latvia, Lithuania, Luxembourg, Malta, Mexico, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States. Unless stated otherwise, nominal values are converted to real values using the price deflator☺ for GDP. Data are in constant 2000 US dollars.

Domestic public debt. Gross public sector debt, all maturities, all instruments, domestic creditors. Whenever gross public sector debt is not available we replace it with general government debt, and when the latter is not present we replace it with central government debt. *Source*: Quarterly Public Sector Debt statistics (IMF-World Bank). **External public debt**. Gross public sector debt, all maturities, all instruments, external creditors. Whenever gross public sector debt is not available we replace it with general government debt, and when the latter is not present we replace it with central government debt. *Source*: Quarterly Public Sector Debt statistics (IMF-World Bank). **Output**. Gross domestic product. *Source*: Eurostat for EU28, OECD for OECD economies. IMF-IFS for remaining countries. **Government consumption**. General government final consumption expenditure. *Source*: Eurostat for EU28, OECD for OECD economies. IMF-IFS for remaining countries. **Consumption**. Final household consumption expenditure. *Source*: Eurostat for EU28, OECD for OECD economies. IMF-IFS for remaining countries. **Investment**. Gross private fixed capital formation. *Source*: Eurostat for EU28, OECD for OECD economies. IMF-IFS for remaining countries. **Sovereign bond yield**. Government bond yield. Precise definition varies by country (e.g. 8-10 year government bond yield, 10-year government bond yield, weighted average, etc.) *Source*: IMF-IFS.

United States The sample runs from 1952:Q1 to 2015:Q2 **Domestic public debt**. 1952:Q1 to 1969:Q4: Nominal federal debt in the hands of the public, cash basis. 1970:Q1 to 2015:Q2. The sum of federal debt held by Federal Reserve banks and federal debt held by private investors, minus federal debt held by foreign and international investors. *Source*: Ramey and Zubairy (2018) and Federal Reserve Economic Data. **External public debt**. Treasury securities held by Rest of the World. *Source*: Federal Reserve Economic Data. **Output**. Gross domestic product. *Source*: NIPA, Table 1.1.3, line 1. **Government expenditures**. Government consumption expenditures and gross investment. *Source*: NIPA, Table 1.1.3, line 22. **Consumption**. Personal consumption expenditures. *Source*: NIPA, Table 1.1.3, line 2. **Investment**. Gross private domestic investment. *Source*: NIPA, Table 1.1.3, line 7.

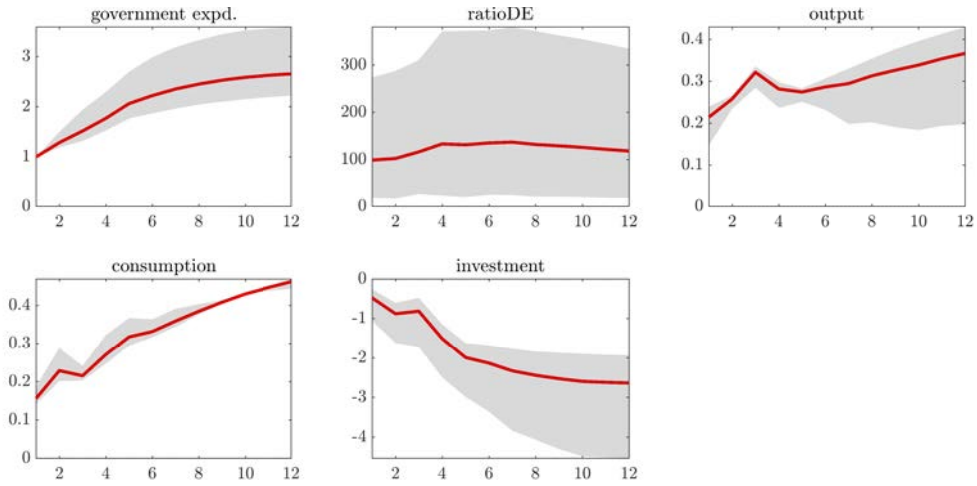
B Additional robustness checks

Figure B.1: **United States - Cumulative IRFs to foreign-debt-financed government spending shock**



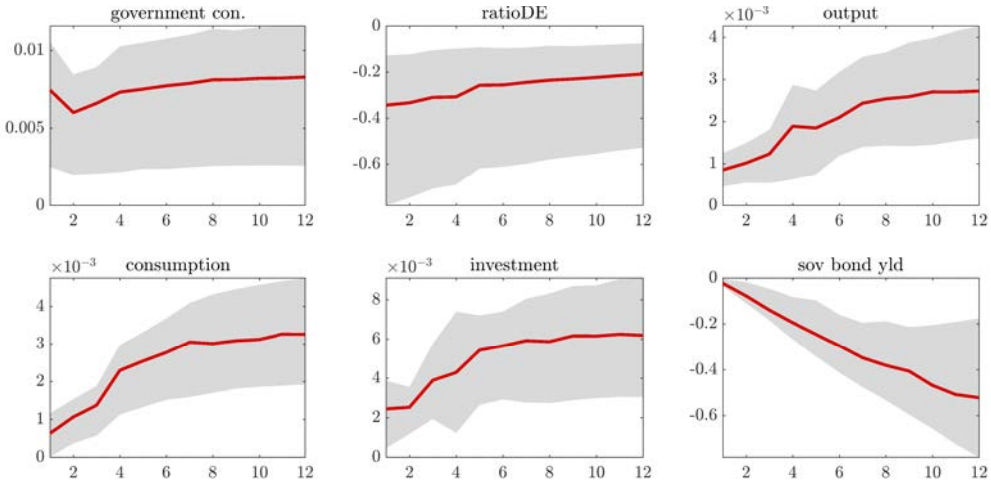
Notes: Sample is the US from 1952:Q1 to 2015:Q2. Cumulative IRFs of a shock to government expenditures financed with foreign debt. Red lines correspond to median responses. Grey shaded areas correspond to parameter uncertainty of one-standard deviation.

Figure B.2: **United States - Cumulative IRFs to home-debt-financed government spending shock**



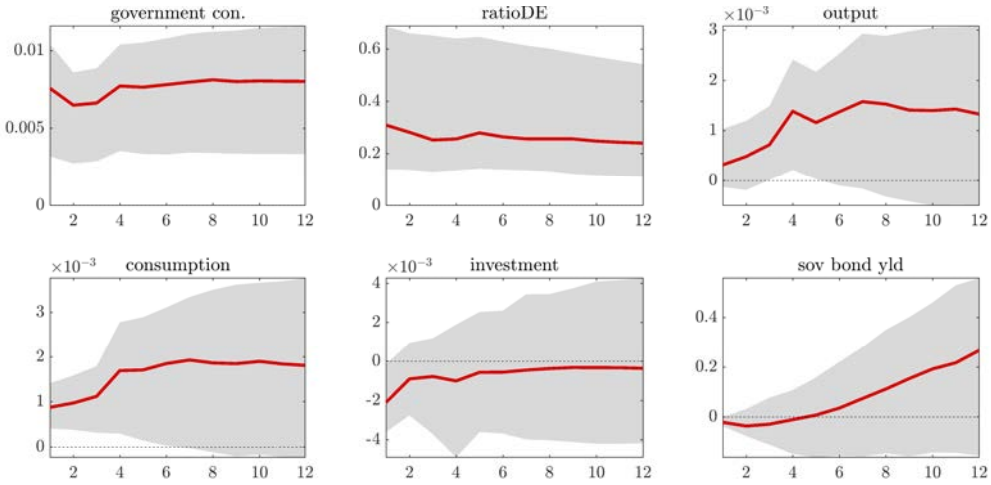
Notes: Sample is the US from 1952:Q1 to 2015:Q2. Cumulative IRFs of a shock to government expenditures financed with home debt. Red lines correspond to median responses. Grey shaded areas correspond to parameter uncertainty of one-standard deviation.

Figure B.3: **SVAR with sovereign bond yield ordered last (A) - IRFs to foreign-debt-financed government spending shock**



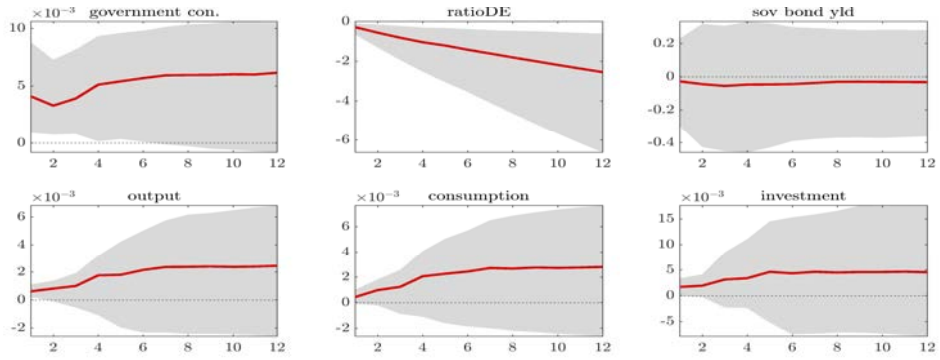
Notes: IRFs of a shock to government consumption financed with foreign debt. SVAR with sovereign bond yield ordered last. Sovereign bond yield identified as not affecting other variables contemporaneously. Red lines correspond to median responses. Grey shaded areas correspond to parameter uncertainty of one-standard deviation.

Figure B.4: **SVAR with sovereign bond yield ordered last (A) - IRFs to home-debt-financed government spending shock for VAR**



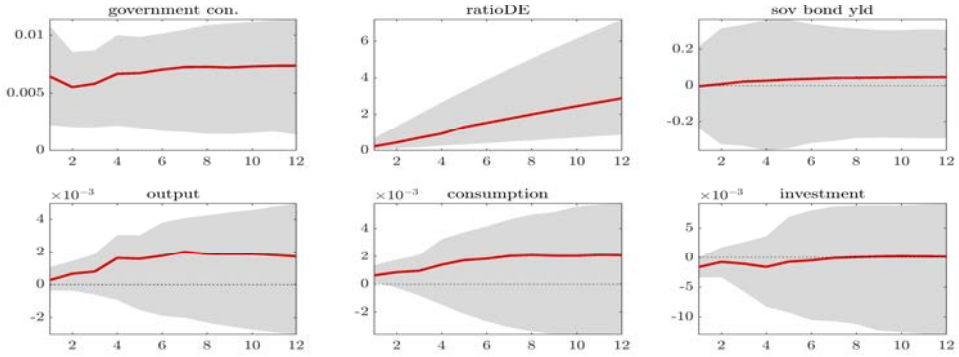
Notes: IRFs of a shock to government consumption financed with home debt. SVAR with sovereign bond yield ordered last. Sovereign bond yield identified as not affecting other variables contemporaneously. Red lines correspond to median responses. Grey shaded areas correspond to parameter uncertainty of one-standard deviation.

Figure B.5: **SVAR with sovereign bond yield ordered third (sign restrictions B) - IRFs to foreign-debt-financed government spending shock**



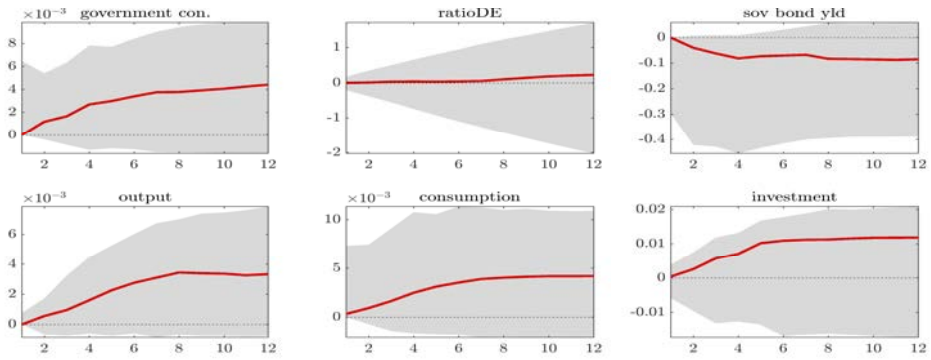
Notes: IRFs of a shock to government consumption financed with foreign debt. SVAR with sovereign bond yield ordered third. Shock to sovereign bond yield identified as only affecting government consumption positively on impact. Red lines correspond to median responses. Grey shaded areas correspond to parameter uncertainty of one-standard deviation.

Figure B.6: **SVAR with sovereign bond yield ordered third (sign restrictions B) - IRFs to home-debt-financed government spending shock**



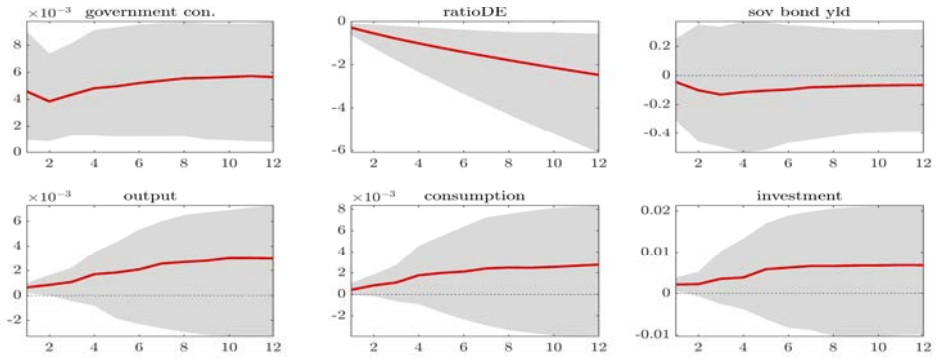
Notes: IRFs of a shock to government consumption financed with home debt. SVAR with sovereign bond yield ordered third. Shock to sovereign bond yield identified as only affecting government consumption positively on impact. Red lines correspond to median responses. Grey shaded areas correspond to parameter uncertainty of one-standard deviation.

Figure B.7: **SVAR with sovereign bond yield ordered third (sign restrictions B) - IRFs to sovereign bond yield shock**



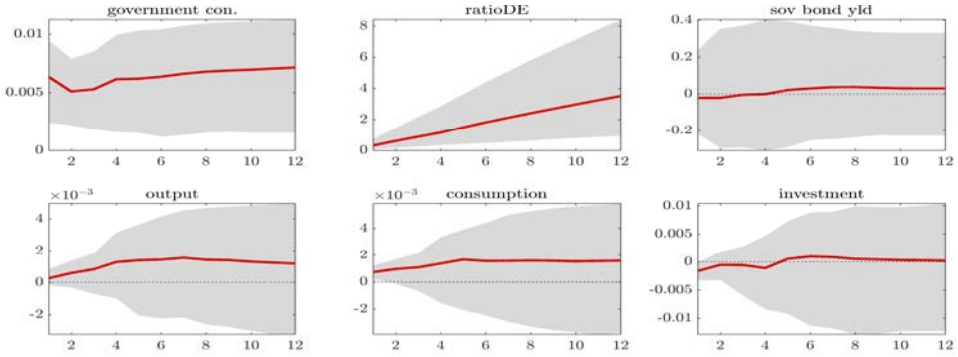
Notes: IRFs of a shock to sovereign bond yield. SVAR with sovereign bond yield ordered third. Shock to sovereign bond yield identified as only affecting government consumption positively on impact. Red lines correspond to median responses. Grey shaded areas correspond to parameter uncertainty of one-standard deviation.

Figure B.8: **SVAR with sovereign bond yield ordered third (sign restrictions C1) - IRFs to foreign-debt-financed government spending shock**



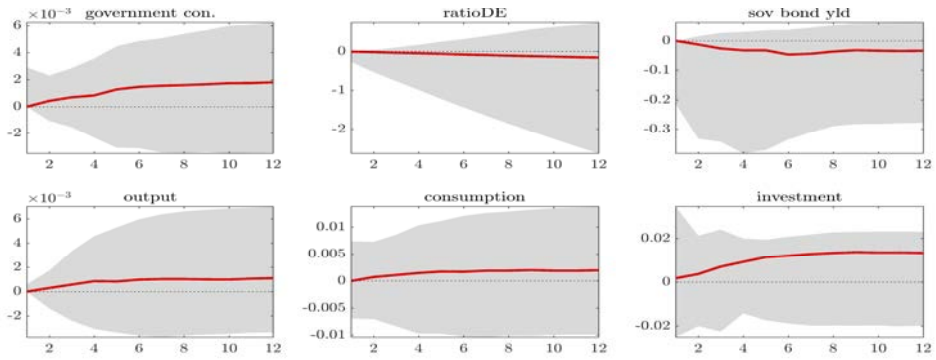
Notes: IRFs of a shock to government consumption financed with foreign debt. SVAR with sovereign bond yield ordered third. Shock to sovereign bond yield identified as only affecting government consumption positively and the ratio negatively on impact. Red lines correspond to median responses. Grey shaded areas correspond to parameter uncertainty of one-standard deviation.

Figure B.9: **SVAR with sovereign bond yield ordered third (sign restrictions C1) - IRFs to home-debt-financed government spending shock**



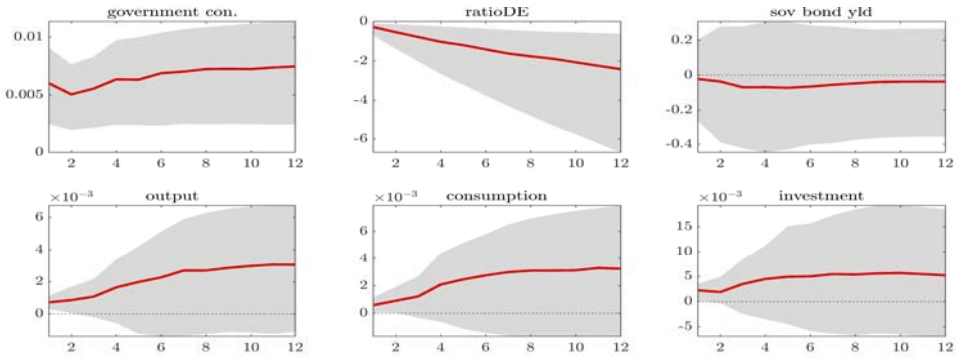
Notes: IRFs of a shock to government consumption financed with home debt. SVAR with sovereign bond yield ordered third. Shock to sovereign bond yield identified as only affecting government consumption positively and the ratio negatively on impact. Red lines correspond to median responses. Grey shaded areas correspond to parameter uncertainty of one-standard deviation.

Figure B.10: **SVAR with sovereign bond yield ordered third (sign restrictions C1) - IRFs to sovereign bond yield shock**



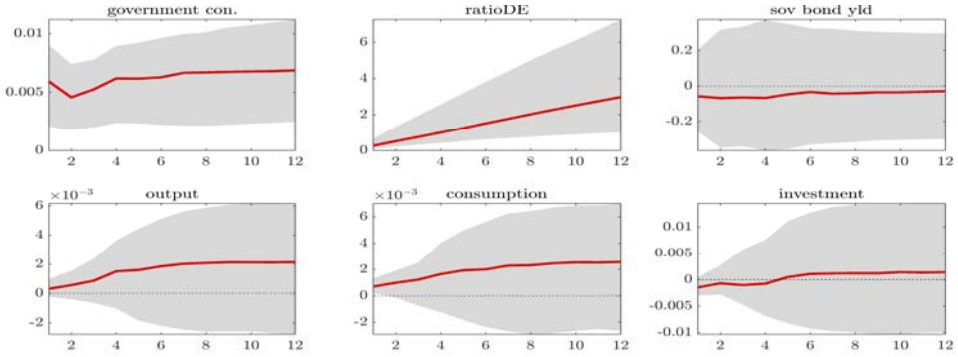
Notes: IRFs of a shock to sovereign bond yield. SVAR with sovereign bond yield ordered third. Shock to sovereign bond yield identified as only affecting government consumption positively and the ratio negatively on impact. Red lines correspond to median responses. Grey shaded areas correspond to parameter uncertainty of one-standard deviation.

Figure B.11: **SVAR with sovereign bond yield ordered third (sign restrictions C2) - IRFs to foreign-debt-financed government spending shock**



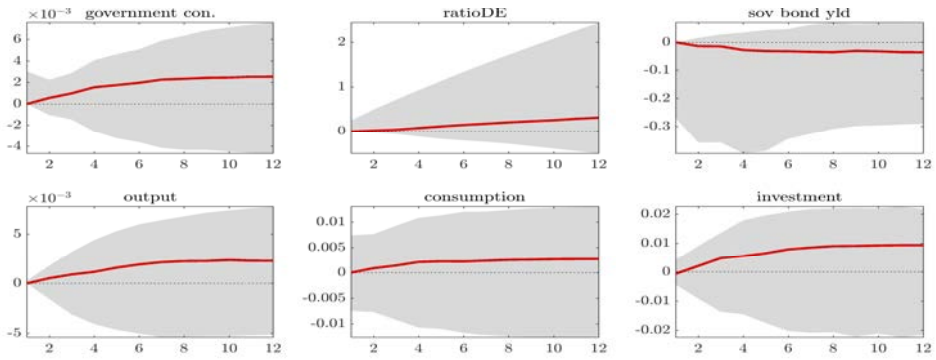
Notes: IRFs of a shock to government consumption financed with foreign debt. SVAR with sovereign bond yield ordered third. Shock to sovereign bond yield identified as only affecting government consumption and the ratio positively on impact. Red lines correspond to median responses. Grey shaded areas correspond to parameter uncertainty of one-standard deviation.

Figure B.12: **SVAR with sovereign bond yield ordered third (sign restrictions C2) - IRFs to home-debt-financed government spending shock**



Notes: IRFs of a shock to government consumption financed with home debt. SVAR with sovereign bond yield ordered third. Shock to sovereign bond yield identified as only affecting government consumption and the ratio positively on impact. Red lines correspond to median responses. Grey shaded areas correspond to parameter uncertainty of one-standard deviation.

Figure B.13: **SVAR with sovereign bond yield ordered third (sign restrictions C2) - IRFs to sovereign bond yield shock**



Notes: IRFs of a shock to sovereign bond yield. SVAR with sovereign bond yield ordered third. Shock to sovereign bond yield identified as only affecting government consumption and the ratio positively on impact. Red lines correspond to median responses. Grey shaded areas correspond to parameter uncertainty of one-standard deviation.

Table B.1: Robustness checks to identification (sovereign bond yield shock)

variable	Output			Consumption			Investment		
horizon	*1*	*4*	*12*	*1*	*4*	*12*	*1*	*4*	*12*
Sovereign bond yield ordered last (A)									
Foreign	0.28	0.91	1.28	0.44	0.69	1.02	0	-0.02	-0.06
Home	0.39	0.65	0.72	-0.36	-0.17	-0.02	0	0	0.03
Δ	-0.14 (13.00%>0)	0.41 (81.00%>0)	0.84 (91.00%>0)	0.95 (100.00%>0)	1.33 (88.00%>0)	1.30 (99.00%>0)	0.00 (51.00%>0)	-0.03 (3.00%>0)	-0.11 (1.00%>0)
Sovereign bond yield ordered third (B)									
Foreign	0.69	1.69	3.13	0.28	1.24	1.88	0.5	0.92	1.67
Home	0.24	1.28	1.22	0.36	0.66	0.81	-0.37	-0.2	0.24
Δ	0.70 (85.00%>0)	1.14 (58.00%>0)	3.65 (72.00%>0)	-0.03 (40.00%>0)	1.15 (70.00%>0)	2.48 (71.00%>0)	1.13 (97.00%>0)	1.97 (75.00%>0)	2.80 (72.00%>0)
Sovereign bond yield ordered third (C1)									
Foreign	0.74	1.56	2.69	0.24	1.07	1.87	0.65	1.21	1.82
Home	0.26	1.18	1.26	0.39	0.72	1.03	-0.37	-0.14	0.36
Δ	0.62 (83.00%>0)	0.64 (55.00%>0)	2.44 (65.00%>0)	-0.12 (29.00%>0)	0.72 (62.00%>0)	1.65 (64.00%>0)	1.23 (96.00%>0)	2.60 (70.00%>0)	2.34 (67.00%>0)
Sovereign bond yield ordered third (C2)									
Foreign	0.66	1.25	2.11	0.27	0.95	1.37	0.47	0.72	0.99
Home	0.25	1.43	1.88	0.39	0.86	1.35	-0.24	0.04	0.8
Δ	0.55 (82.00%>0)	0.26 (54.00%>0)	1.00 (55.00%>0)	-0.12 (35.00%>0)	0.48 (59.00%>0)	0.14 (51.00%>0)	0.84 (92.00%>0)	1.42 (68.00%>0)	0.80 (57.00%>0)

Notes: The table reports cumulative multipliers for different robustness checks related to identification (identifying a sovereign bond yield shock). Δ reports the difference in multipliers at different horizons, where the difference is defined as Foreign-Home. Inside the brackets is denoted the % of cases from draws of the simulated distribution of models, for which the difference is > 0. *Sovereign bond yield ordered last (A)*: VAR with sovereign bond yield ordered last. Sovereign bond yield identified as not affecting other variables contemporaneously. *Sovereign bond yield ordered third (B)*: VAR with sovereign bond yield ordered third. Sovereign bond yield identified as having positive impact response on government consumption. *Sovereign bond yield ordered third (C1)*: VAR with sovereign bond yield ordered third. Sovereign bond yield identified as having positive impact response on government consumption and negative impact response on ratio. *Sovereign bond yield ordered third (C2)*: VAR with sovereign bond yield ordered third. Sovereign bond yield identified as having positive impact response on government consumption and ratio.

Table B.2: Robustness checks to identification (exploiting VAR cross-section)

variable	**Output**			**Consumption**			**Investment**		
horizon	*1*	*4*	*12*	*1*	*4*	*12*	*1*	*4*	*12*
1 shock									
Low Ratio	0.09	0.54	0.69	0.1	0.47	0.63	0	0.14	0.24
High Ratio	0.38	1.42	1.38	0.32	0.81	0.83	-0.03	-0.22	-0.2
Interaction VAR									
Low Ratio	0.41	0.88	0.99	0.29	0.44	0.58	0.09	0.44	0.55
High Ratio	-0.07	0.53	0.08	-0.14	0.36	0.32	-0.03	-0.71	-0.45
Δ	0.48 (90.30%>0)	0.36 (61.64%>0)	0.87 (71.18%>0)	0.43 (98.92%>0)	0.08 (54.82%>0)	0.25 (63.42%>0)	0.12 (65.32%>0)	1.16 (92.70%>0)	0.99 (87.58%>0)

Notes: The table reports cumulative multipliers for different robustness checks related to identification using the cross-section of the VAR. Δ reports the difference in multipliers at different horizons, where the difference is defined as Foreign-Home. Inside the brackets is denoted the % of cases from draws of the simulated distribution of models, for which the difference is > 0. *1 shock*: variables in log-differences, estimation with fixed effects, Cholesky identification of spending shock, split subsamples by "low ratio" $<$ median of average ratio, and "high ratio" $>$ median of average ratio). *Interaction VAR*: variables in log-differences, estimation with fixed effects, Cholesky identification of spending shock, interaction term on ratio thresholds with "low ratio"=1% and "high ratio"=99%.

C Theoretical model

Optimality conditions

- Euler equation - capital: $c_t^{-\gamma} = \beta \mathbf{E_t}\left[c_{t+1}^{-\gamma}\left(r_{t+1} + 1 - \delta\right)\right]$
- Euler equation - domestic government debt: $c_t^{-\gamma} = \beta \mathbf{E_t}\left[c_{t+1}^{-\gamma} R_t^h\right]$
- Euler equation - external private debt: $c_t^{-\gamma} = \beta \mathbf{E_t}\left[c_{t+1}^{-\gamma} R_t^{f,k}\right]$
- Debt-elastic interest rate: $R_t^{f,k} = r^* + \nu\left[\exp\left(b_t^{f,k} - \overline{b_t^{f,k}}\right) - 1\right]$
- Intratemporal optimality: $w_t c_t^{-\gamma} = \psi n_t^{\phi}$
- Production function: $Y_t = k_{t-1}^{\alpha} n_t^{1-\alpha}$
- Capital law of motion: $k_t = (1-\delta)\, k_{t-1} + i_t$
- Wage: $w_t = (1-\alpha)\, k_{t-1}^{\alpha} n_t^{-\alpha}$
- Rental rate of capital: $r_t = \alpha k_{t-1}^{\alpha-1} n_t^{1-\alpha}$
- Government budget constraint: $g_t - T_t = b_t^h - R_{t-1}^h b_{t-1}^h + b_t^{f,g} - R_{t-1}^{f,g} b_{t-1}^{f,g}$
- No-arbitrage: $R_t^{f,g} = R_t^h$
- Government spending process: $g_t = \kappa^g + \rho_g g_{t-1} + \varepsilon_t^g$
- Debt processes: $b_t^h = \rho_B b_{t-1}^h + \varepsilon_t^{g,h}$; $b_t^{f,g} = \rho_B b_{t-1}^{f,g} + \varepsilon_t^{g,f}$
- Aggregate resource constraint: $c_t + i_t + g_t = Y_t + b_t^{f,g} - R_{t-1}^{f,g} b_{t-1}^{f,g} + b_t^{f,k} - R_{t-1}^{f,k} b_{t-1}^{f,k}$

Acknowledgements

We are grateful to Fabio Canova and Evi Pappa for valuable comments and suggestions. We would also like to thank Hafedh Bouakez, Charles Brendon, Julien Champagne, Tito Cordella, Giuseppe Fiori, Stefano Gnocchi, Daniela Hauser, Wataru Miyamoto, Rigas Oikonomou, Vincenzo Quadrini, Omar Rachedi, Ricardo Reis, Kirill Shakhnov, Nora Traum, as well as seminar and conference participants at the Bank of Canada, the Bank of Italy, the Bank of Spain, the European Central Bank, the European Commission, the European University Institute, the 2013 C.R.E.T.E. (Naxos), the 2014 T2M Conference (HEC Lausanne), the 2014 Royal Economic Society Meetings (Manchester), the 2014 Barcelona GSE Summer Forum: session "International Capital Flows", the 2017 Society of Economic Dynamics Meetings (Edinburgh), the 2018 IAAE conference (Montreal), and the 2018 EEA-ESEM conference (Cologne). A previous iteration of this paper was published in 2015 as Chapter 1 of Priftis' PhD thesis at the European University Institute. The views expressed are those of the authors and do not necessarily reflect those of the Bank of Canada or the European Central Bank.

Romanos Priftis
Bank of Canada, Ottawa, Canada; email: rpriftis@bank-banque-canada.ca

Srecko Zimic
European Central Bank, Frankfurt am Main, Germany; email: srecko.zimic@ecb.europa.eu

Postal address 60640 Frankfurt am Main, Germany
Telephone +49 69 1344 0
Website www.ecb.europa.eu

PDF ISBN 978-92-899-3314-8 ISSN 1725-2806 doi: 10.2866/610515 QB-AR-18-089-EN-N