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The international transmission of US tax shocks:  
a proxy-SVAR approach

by Luca Metelli and Filippo Natoli

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# THE INTERNATIONAL TRANSMISSION OF US TAX SHOCKS: A PROXY-SVAR APPROACH

by Luca Metelli\*, Filippo Natoli\*

## Abstract

We investigate the international propagation of tax rate shocks originating in the United States using a global vector error-correction model (GVAR). We identify shocks to corporate and personal income tax rates by using narrative series as external instruments, following the proxy-SVAR methodology. The main results of the paper are the following: (1) the domestic effects of corporate tax shocks are stronger than those of personal income tax shock; (2) spillovers are in most cases positive and significant, albeit of small size; (3) the boost to exports in recipient economies, stimulated both by stronger US demand and by real exchange rate depreciation vis-à-vis the US dollar, is the main transmission channel; financial channels (through long-term interest rates) also play a role.

**JEL Classification:** C22, E62, F42.

**Keywords:** international fiscal spillovers, proxy SVAR, GVAR.

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# 1 Introduction<sup>1</sup>

Since the Great Recession, the discussion on the role of fiscal policy has gained traction, as discretionary fiscal measures have started afresh to serve as policy tools in advanced economies. During the global financial crisis, the US administration implemented a sizeable fiscal stimulus, which supported the recovery in the United States; in contrast, during the Euro area debt crisis many countries in Europe introduced tax increases and spending cuts as a way to restore confidence in the sustainability of public debt. The US Congress has recently adopted a major overhaul of the tax code, embracing tax cuts and increases in military spending.

The renewed interest in fiscal policy has spurred considerable academic research on its effects on economic activity. However, with much of the debate concentrated on the domestic effects, much less has been said on the international dimension of fiscal policy and its spillovers. We take up this issue by focusing on spillovers from tax policy that, differently than spillovers from government spending, have been mostly disregarded in the fiscal policy literature. We evaluate the domestic and spillover effects of an expansionary tax rate shock in the United States, focusing on the international channels of transmission. Our analysis provides answers to some relevant policy questions, such as: does a fiscal expansion in the US increase output abroad? Is there heterogeneity in the transmission across recipient countries? Are spillovers driven by real or financial channels? Also, we provide evidence on how the impact of fiscal policy depends on the specific instrument adopted, comparing specific components of tax policies. Are corporate and personal income tax shocks both effective? Are their effects equally persistent? Do they propagate through the same channels?

We answer these questions within a global vector error-correction model (GVAR), the framework developed by [Pesaran et al. \(2004\)](#), in which each country model features domestic and foreign variables. Target variables are real GDP, inflation, real equity prices, interest rates, real exchange rates and exports. In the US model, we also include fiscal variables, and identify tax rate shocks following the proxy-SVAR methodology. For this purpose, we use the narrative series of [Mertens and Ravn \(2013\)](#) as instruments for personal and corporate income tax rate shocks. The main results of the paper are the follow-

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ing. First, the domestic effects of tax rate shocks are strong, with multipliers consistently above unity one year after the shock. This result is in line with [Ramey \(2017\)](#), showing that tax shocks have an impact on output that is even stronger than that of a spending shock.<sup>2</sup> Second, spillovers are positive and, in most cases, statistically significant, albeit of a small size. Third, in terms of geographical distribution, US tax shocks have a stronger impact on advanced than emerging countries; moreover, economies that are geographically close to the US are not impacted in the same way, with Mexico benefiting less than Canada from the US fiscal expansion.

This paper also sheds light on the international transmission mechanism of US fiscal policy. The main channel through which fiscal shocks propagate is international trade. Independently of the type of shock, following a fiscal expansion the United States increases its imports from the rest of the world, stimulating output in foreign countries. This occurs via both a price and a quantity effect. Indeed, for some countries real exchange rates depreciate vis-à-vis the US dollar, improving their price competitiveness (expenditure switching or price effect); for other countries, higher US output stimulates demand for imports without significant exchange rate variations (expenditure boosting or quantity effect). Financial channels (through interest rates and equity prices) also play a role in the international transmission, although a smaller one than the trade channel. Foreign long-term interest rates generally increase following the US fiscal shocks, acting as a drag on economic growth; only in a few cases they fall on impact reinforcing expansionary effects, as suggested by the literature focusing on fiscal policy reversals as the key driver of domestic and international responses (see *Literature Review*). Concerning equity markets, a US fiscal expansion may lead to an increase in foreign equity prices, generating positive wealth effects which, in principle, could support consumption and investment; however, in our framework the response of equity prices to fiscal shocks is generally not significant, suggesting that wealth effects are of minor importance in channeling fiscal shocks across the board.

This paper contributes to the recently growing literature on fiscal spillovers in several ways. First, it is one of the first studying empirically the international transmission of fiscal shocks originating in the US, in particular for what concerns tax shocks. As we model the world economy in a single framework, we are able to take into account the indirect effect of shocks arising from the economic linkages among recipient countries (third-party effects), and obtain more accurate spillover estimates than those delivered by widely-used bilateral models (such as two-country VARs or local projections à la [Jorda](#),

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<sup>2</sup>This result is not uncontroversial. For a different point of view, see [Caldara and Kamps \(2017\)](#).



2005), as highlighted by [Georgiadis \(2017\)](#). Second, the paper highlights the differences in the international propagation among the implemented tax policy tools, i.e. personal and corporate income tax policies. Third, it is the first paper quantifying spillovers in terms of fiscal multipliers for each type of tax shocks and at different points in time. Fourth, fiscal policy shocks in the US are identified using narrative series, which allow for the identification of tax rate shocks, as opposed to the more endogenous measure of tax revenues usually adopted in the literature on fiscal spillovers. As far as we know, this is also the first time a proxy-SVAR identification strategy is employed in a GVAR framework.

## Literature review

The paper draws on different strands of literature. First, it relates to the literature analyzing international fiscal spillovers, in particular to the very scant literature analyzing tax spillovers. The closest paper to ours are [Blagrave et al. \(2018\)](#) and [Christofzik and Elstner \(2018\)](#). [Blagrave et al. \(2018\)](#) investigates spillovers stemming from a global fiscal shock (both spending shock and tax revenue shock), aggregated across five advanced economies; by running the local projection estimates of [Jorda \(2005\)](#) on the GDP of each recipient economy separately, the paper finds that spillovers depend on the monetary policy response (in particular at the zero lower bound) and on the degree of economic slack in source and recipient countries. Although it addresses the relevant issue of the state-dependency of fiscal policy effectiveness, [Blagrave et al. \(2018\)](#) focus on the more endogenous variable tax revenues instead of tax rate shocks. Moreover, they do not concentrate on the transmission mechanism of fiscal shocks, which is instead our focus. [Christofzik and Elstner \(2018\)](#) analyze the spillover effect of tax rate shocks, identified as in our case through the methodology of [Mertens and Ravn \(2013\)](#). They find positive but small spillovers on German output, also considering the reaction of the German fiscal variables. This study, contemporaneous to our, is also the closest. However, it focuses only on the German economy, neglecting the whole international dimension. Aside from these two papers, most of the literature on fiscal spillovers concentrates on government spending. [Auerbach and Gorodnichenko \(2013\)](#) estimate government spending spillovers in a panel of OECD countries; they find, in line with [Blagrave et al. \(2018\)](#), positive effects on foreign output. [Bussiere et al. \(2017\)](#) use a three-country specification of the Global Integrated Monetary and Fiscal (GIMF) model of the IMF to simulate different types of budget-neutral spending policies in the US; they find positive domestic and spillover effects, that can be amplified in case of a coordinated action across countries, and a trade-off

between growth and distributional consequences. [Faccini et al. \(2016\)](#) estimate spillovers from a US government spending shock in a factor model, finding positive and sizable effects on foreign output operating mainly through a financial channel, i.e. a reduction of real interest rates abroad. This paper follows some theoretical and empirical papers claiming that expectations of future spending reversals, triggered by fiscal rules on debt, are such that the effect of expansionary shocks on domestic interest rates, positive in standard models, is instead negative and acts as the main driver of fiscal expansion in the medium run.<sup>3</sup> According to this literature, spillovers are mainly determined by the evolution of the foreign interest rates determined by international financial linkages ([Corsetti et al., 2010](#); [Corsetti et al., 2012a](#); [Corsetti and Muller, 2013](#); [Ong, 2018](#)). While we find some negative effects on long rates in the case of corporate tax shocks, in our paper the international transmission goes mainly through the trade channel. In this respect, our results are more in line with those of papers that investigate fiscal spillovers indirectly, i.e. by studying the reaction of those domestic variables that can influence foreign output dynamics, such as the exchange rate (e.g., [Auerbach and Gorodnichenko, 2016](#), [Forni and Gambetti, 2016](#)), the trade balance (e.g., [Kim and Roubini, 2008](#)), or the terms of trade ([Monacelli and Perotti, 2010](#); [Enders et al., 2011](#)). In general, the literature on fiscal spillovers is not particularly large; it focuses only on specific country groups and mainly on spending shocks, neglecting the tax side.<sup>4</sup>

Second, our paper is related to the strand of literature analyzing the domestic effects of fiscal policy, specifically for the United States (e.g., [Blanchard and Perotti, 2002](#); [Ramey, 2011](#); [Romer and Romer, 2010](#); [Mountford and Uhlig, 2009](#); [Mertens and Ravn, 2013](#); [Ilzet-zki et al., 2013](#)). We are closer to those empirical studies using proxy-SVAR methods and the narrative approach as identification scheme, in particular [Mertens and Ravn \(2013\)](#). The latter is one of the papers that develops the proxy-SVAR methodology, together with [Stock and Watson \(2008\)](#);<sup>5</sup> also, [Mertens and Ravn \(2013\)](#) construct the exogenous narrative tax rate series that we use in the estimation, both for the corporate tax and the personal income tax. They moreover quantify the effects of tax rate shocks, finding large multipliers in the case of personal income tax rate shocks but smaller effects for the corporate tax shock, although they do not provide explicitly an estimate of the corporate tax

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<sup>3</sup> As also noted in [Blagrove et al. \(2018\)](#), in a standard Mundell-Fleming-Dornbusch framework a fiscal expansion puts upward pressure on interest rates, appreciates the nominal exchange rate, and increases domestic prices.

<sup>4</sup> A set of papers investigate fiscal spillovers within the Euro area, see for instance, [Beetsma et al. \(2008\)](#), [Beetsma and Giuliodori \(2011\)](#) and, more recently, [IMF \(2017\)](#).

<sup>5</sup> Indeed, the methodology of [Mertens and Ravn \(2013\)](#) builds on the precedent work by [Stock and Watson \(2008\)](#) presented in a 2008 NBER summer school, and later applied in [Stock and Watson \(2012\)](#).

multiplier. In our paper we follow the [Mertens and Ravn \(2013\)](#) methodology and we embody it in the GVAR. As in [Mertens and Ravn \(2013\)](#), we also find significant effects on US output of both tax measures; however, our estimates highlight opposite results in terms of relevance of the adopted policy instrument, with the corporate income tax policy being more output enhancing than the personal income tax. This seems to be related to the different sample period of estimate (our sample is thirty years shorter), and to the fact that shocks are unevenly distributed across time: on one side, we miss the big personal income tax shocks of the 1960s and, on the other side, we restrict the analysis to the big corporate income tax shocks of the 1980s and 2000s.

Finally, our paper draws on the GVAR methodology, introduced in the two seminal papers by [Pesaran et al. \(2004\)](#) and [Di Mauro et al. \(2007\)](#). The GVAR framework has been widely used to assess the international transmission of shocks; however, also in the GVAR literature, the topic of fiscal spillovers has been under-investigated. [Caporale and Girardi \(2013\)](#) and [Hebous and Zimmermann \(2013\)](#) study the propagation of non-identified fiscal disturbances originated in the Euro area, while [Favero et al. \(2011\)](#) investigate the effects of contemporaneous fiscal policy shocks at the global level.<sup>6</sup> None of these studies aims at quantifying the output effect of an identified fiscal shock stemming from the US on the rest of the world. In our paper we aim at filling this gap. The rest of the paper is organized as follows. Section 2 describes the GVAR methodology, the proxy-SVAR methodology and the identification strategy, while Section 3 discusses the data and the specification adopted in the paper, focusing also on the cross-border transmission mechanism of fiscal shocks. Section 4 reports the results obtained. Finally, Section 5 concludes.

## 2 Model and identification strategy

### 2.1 The GVAR model

The GVAR model is a multi-country framework which explicitly allows for interdependencies among countries and markets. The model is particularly useful to investigate the transmission channels of shocks across countries and to quantify the magnitude of such spillovers. The GVAR modeling strategy consists of two steps. In the first step, each country  $i$  is modeled separately in a single-country VAR model augmented with exogenous variables (VARX). In each VARX, the endogenous variables are domestic only ( $X_{i,t}$ ), while country-specific foreign variables  $X_{i,t}^*$ , constructed as averages of all other

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<sup>6</sup>Other studies which employ the GVAR methodology to investigate fiscal shocks among Euro area countries are [Ricci-Risquete and Ramajo-Hernandez \(2015\)](#) and [Dragomirescu-Gaina and Philippas \(2015\)](#).

countries' variables, serve as a proxy for common unobserved factors. In this way each country is affected by its domestic developments and by the rest of the world. Each country model is estimated separately, conditional on the foreign variables, in error correction form. In the second step, the country-specific VARX's are stacked together and linked using a matrix of cross country linkages  $W$ , building in this way the global model.

## First step

Consider  $N+1$  countries, indexed by  $i = 0, 1, 2, \dots, N$ . Each country is modeled through a VARX( $K_i, P_i$ ) of the following form:

$$X_{i,t} = a_{i,0} + a_{i,1}t + \sum_{k=1}^{K_i} \phi_{i,k} X_{i,t-k} + \sum_{p=0}^{P_i} \Lambda_{i,p} X_{i,t-p}^* + u_{i,t} \quad (2.1)$$

where  $X_{i,t}$  is the vector of country  $i$ 's domestic variables and  $\sum_{k=1}^{K_i} \phi_{i,k}$  are the corresponding lagged coefficients;  $X_{i,t-p}^*$  is the vector of country  $i$ 's foreign variables and  $\sum_{p=0}^{P_i} \Lambda_{i,p}$  the associated coefficients;  $a_{i,0}$  and  $a_{i,1}$  are, respectively, the vector of intercepts and the vector of the coefficients of the deterministic time trend.  $u_{i,t}$  is the vector of country-specific residuals, which is assumed to be distributed as a white noise process, i.e.  $u_{i,t} \sim i.i.d.(0, \Sigma_i^u)$ . The vector  $X_{i,t}^*$  plays a crucial role in the GVAR framework and it is defined in the following way:

$$X_{i,t}^* = \sum_{j=0}^N w_{i,j} X_{j,t} \quad (2.2)$$

where  $w_{i,j}$  represents the trade share of country  $j$  for country  $i$ , i.e. the country-specific weight of country  $j$  in the total trade of country  $i$ . Moreover,  $w_{i,i} = 0$  and  $\sum_{j=0}^N w_{i,j} = 1$ . Equation 2.1 can be consistently estimated assuming that  $X_{i,t}^*$  is weakly exogenous with respect to the other variables in the system. In words, this means that each country is considered as a small open economy with respect to the rest of the world and therefore that Equation 2.1 can be estimated on a country-by-country basis.

Di Mauro et al. (2007) show that Equation 2.1 can be re-written in Error Correction (EC) form, thus allowing for cointegration both within  $X_{i,t}$  and between  $X_{i,t}$  and  $X_{i,t}^*$ ; the model in EC form can be estimated with the Johansen procedure, modified to take into account the exogenous variables (Harbo (1998), Pesaran et al. (2000)).

## Second step

After the estimation of each country-specific VARX, these are combined and stacked in order to form the global model. For the ease of exposition, we assume that a VARX(1,1) is estimated for each country:

$$X_{i,t} = a_{i,0} + a_{i,1}t + \phi_{i,1}X_{i,t-1} + \Lambda_{i,0}X_{i,t}^* + \Lambda_{i,1}X_{i,t-1}^* + u_{i,t}, \quad (2.3)$$

Defining

$$z_{i,t} = \begin{pmatrix} X_{i,t} \\ X_{i,t}^* \end{pmatrix}, \quad (2.4)$$

Equation 2.3 can be written as:

$$A_{i,0}z_{i,t} = a_i + a_{i,1}t + A_{i,1}z_{i,t-1} + u_{i,t} \quad (2.5)$$

where

$$A_{i,0} = (I, -\Lambda_{i,0}), A_{i,1} = (\phi_{i,1}, \Lambda_{i,1}) \quad (2.6)$$

The trade weights  $w_{i,j}$  are then used to define the link matrix  $W_i$  and obtain the identity:

$$z_{i,t} = W_i X_t \quad (2.7)$$

with  $X_t = [X'_{0,t}, X'_{1,t}, \dots, X'_{N,t}]'$ , i.e. the vector collecting all the country specific endogenous variables of the model. Substituting 2.7 in Equation 2.5, we obtain:

$$A_{i,0}W_i X_t = a_{i,0} + a_{i,1}t + A_{i,1}W_i X_{t-1} + u_{i,t} \quad (2.8)$$

Now the country-specific models given by Equation 2.8 are stacked to generate the global model for  $X_t$ :

$$G_0 X_t = a_0 + a_1 t + G_1 X_{t-1} + u_t \quad (2.9)$$

where

$$G_0 = \begin{pmatrix} A_{00}W_0 \\ A_{10}W_1 \\ \vdots \\ A_{N0}W_N \end{pmatrix}, G_1 = \begin{pmatrix} A_{01}W_0 \\ A_{11}W_1 \\ \vdots \\ A_{N1}W_N \end{pmatrix},$$

$$a_0 = \begin{pmatrix} a_{00} \\ a_{10} \\ \vdots \\ a_{N0} \end{pmatrix}, a_1 = \begin{pmatrix} a_{01} \\ a_{11} \\ \vdots \\ a_{N1} \end{pmatrix}, u_t = \begin{pmatrix} u_{0t} \\ a_{1t} \\ \vdots \\ a_{Nt} \end{pmatrix}$$

With  $G_0$  non-singular matrix, depending on the trade weights and the estimated parameters, we obtain:

$$X_t = b_0 + b_1 t + F_1 X_{t-1} + v_t \quad (2.10)$$

where

$$F_1 = G_0^{-1} G_1, \quad b_0 = G_0^{-1} a_0, \quad b_1 = G_0^{-1} a_1, \quad v_t = G_0^{-1} u_t \quad (2.11)$$

Equation 2.10 represents the GVAR model and can be solved recursively. The variance-covariance matrix of the global model is computed directly from the country-specific reduced form residuals  $v_{i,t}$  and is represented by the following:

$$\Sigma_v = \begin{bmatrix} \Sigma_{v_0} & \Sigma_{v_0,v_1} & \dots & \Sigma_{v_0,v_N} \\ \Sigma_{v_1,v_0} & \Sigma_{v_1} & \dots & \Sigma_{v_1,v_N} \\ \dots & \dots & \dots & \dots \\ \Sigma_{v_N,v_0} & \Sigma_{v_N,v_1} & \dots & \Sigma_{v_N} \end{bmatrix} \quad (2.12)$$

where  $\Sigma_{v_i,v_j}$  is the sample covariance matrix between country  $i$  and country  $j$  and  $\Sigma_{v_i}$  is the covariance matrix of country  $i$ .

## 2.2 Identification approach

In order to identify shocks in the GVAR, one needs to specify a matrix  $P_0$  that pre-multiplies Equation 2.10 yielding

$$P_0 X_t = P_0 b_0 + P_0 b_1 t + P_0 F_1 X_{t-1} + \epsilon_t \quad (2.13)$$

where  $P_0$  is

$$P_0 = \begin{bmatrix} P_{0,0} & P_{0,1} & \dots & P_{0,N} \\ P_{1,0} & P_{1,1} & \dots & P_{1,N} \\ \dots & \dots & \dots & \dots \\ P_{N,0} & P_{N,1} & \dots & P_{N,N} \end{bmatrix} \quad (2.14)$$

and

$$\epsilon_t = P_0 v_t \quad (2.15)$$

is the vector of identified structural shocks, with covariance matrix  $\Sigma_\epsilon$ :

$$\Sigma_\epsilon = \begin{bmatrix} \Sigma_{\epsilon_0} & \Sigma_{\epsilon_0, v_1} & \cdots & \Sigma_{\epsilon_0, v_N} \\ \Sigma_{v_1, \epsilon_0} & \Sigma_{v_1} & \cdots & \Sigma_{v_1, v_N} \\ \cdots & \cdots & \cdots & \cdots \\ \Sigma_{v_N, \epsilon_0} & \Sigma_{v_N, v_1} & \cdots & \Sigma_{v_N} \end{bmatrix} \quad (2.16)$$

We are interested in identifying shocks originating from the US only, chosen on  $i = 0$ ; therefore we need to make specific assumptions on  $P_{0,0}$  (to identify the US model) and then on the other matrices within  $P_0$ . We take up these issues in the following two paragraphs.

**Identifying US fiscal shocks using external instruments.** In order to identify fiscal shocks in the US model, we rely on the proxy SVAR methodology. Restrictions on the  $P_{0,0}$  matrix are obtained by using proxies for the latent shocks. In each of the two GVAR models we estimate, following [Mertens and Ravn \(2013\)](#), we assume that a narrative measure, denoted by  $m_t$ , is a proxy for the unobserved structural fiscal shock of interest  $\epsilon_{f,t}$ , with  $E(m_t) = 0$ ; in addition, denoting the other non-fiscal US shocks as  $\epsilon_{nf,t}$ , the methodology assumes that the defined proxy satisfies the following conditions

$$E[m_t, \epsilon_{f,t}] = \gamma \neq 0 \quad (2.17)$$

$$E[m_t, \epsilon_{nf,t}] = 0 \quad (2.18)$$

In other words,  $m_t$  is correlated with the unobserved fiscal policy shock of interest and orthogonal with the remaining shocks. Assuming that the fiscal variable is ordered  $l^{th}$  in the US model, the proxy SVAR method provides the restrictions to be placed on the  $l^{th}$  column of the matrix  $P_{0,0}$ . To obtain those restrictions, one must follow a two-step procedure:

- Run two-stage least squares (2SLS) estimates of all non-fiscal residuals in the US model,  $v_{nf,t}$ , on the fiscal residual  $v_{f,t}$ , using each time  $m_t$  as an instrument for  $v_{f,t}$ ; the estimated coefficients represent each variables' restrictions up to a scale factor;
- Impose covariance restrictions to identify each element in the  $l^{th}$  column of  $P_{0,0}$ .

Details on the proxy SVAR procedure are reported in [Mertens and Ravn \(2013\)](#). Narrative measures of fiscal policy changes are constructed from historical sources and, as suggested by [Mertens and Ravn \(2013\)](#), they can be viewed as imperfectly correlated

with linear combinations of the latent structural policy shocks.<sup>7</sup> In order to validate the use of narrative series as instruments for the latent shocks, one should test the relevance of the proxy by constructing the reliability test statistic of [Mertens and Ravn \(2013\)](#) that is based on the hypothesis of linear random measurement errors. The reliability test statistic represents the fraction of the variance of the measured variable that is explained by the latent variable; it lies between 0 and 1, with large values indicating a high correlation between the proxy and the true underlying tax shock.

**Imposing cross-country restrictions.** After having imposed restrictions on  $P_{0,0}$ , we have to impose restrictions on the other elements of  $P_0$ . Provided that we are not interested in identifying shocks in other countries, we assume that all the other matrices on the diagonal of  $P_0$  are identity matrices. Concerning off-diagonal matrices, we impose all cross-country correlations between model residuals to be zero. Indeed, correlations between the residuals of the GVAR may occur both within countries (i.e. among variables of a country-specific model) but also across countries (i.e. among variables in different countries). While the first type of correlations is taken care of through the identification procedure described in the previous paragraph, residuals can still be contemporaneously correlated across countries, creating concerns about reverse spillover effects. Although, having conditioned domestic models on foreign variables, cross-country correlations are generally very small, the case of significant correlations with specific foreign variables can not be ruled out, giving rise to possible identification issues. Given the central role of the US economy, it is reasonable to assume that it does not react within the quarter to foreign developments. This restriction is crucial to complete identification in GVAR models, although it is not always stressed in the GVAR literature.

By imposing such correlations to be zero, we obtain a block-diagonal  $P_0$  matrix. Therefore, the resulting  $P_0$  matrix is

$$P_0 = \begin{bmatrix} P_{0,0} & 0 & 0 & \dots & 0 \\ 0 & I & 0 & \dots & 0 \\ \dots & \dots & \dots & \dots & \dots \\ 0 & 0 & 0 & \dots & I \end{bmatrix} \quad (2.19)$$

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<sup>7</sup>Indeed, measurement errors may arise both from the fact that historical records sometimes contradict each other, and because narrative series typically disregard minor policy changes that are censored to zero.



### 2.3 Impulse response functions

For the dynamic analysis of shocks, the GVAR literature largely relies on Generalized Impulse Response Functions (GIRFs) (Koop et al. (1996) and Pesaran and Shin (1997)), that in our case take the form of Structural GIRFs (SGIRFs) as our model is identified. The response of variable  $j$  at time  $t + n$  to a one standard error shock at time  $t$  given to variable  $l$  is given by the  $j^{th}$  element of:

$$SGIRF(x_t; \epsilon_{lt}, n) = \frac{\epsilon'_j A_n (P_0 G_0)^{-1} \Sigma_\epsilon e_l}{\sqrt{e'_l \Sigma_\epsilon e_l}} \quad (2.20)$$

where  $e_l = (0; 0; \dots; 0; 1; 0; \dots; 0)$  is a selection vector with unity as the  $l^{th}$  element;  $G_0$  is defined as in Equation 2.9;  $A_n$  is

$$A_n = \sum_{i=1}^p F_i A_{n-i}, \quad A_0 = I, \quad n = 1 \dots p \quad (2.21)$$

## 3 Data and transmission channels

We specify two GVAR models using quarterly data. Each model encompasses 25 economy-specific VARX models, where the included economies account for about 90 percent of world GDP.<sup>8</sup> Subject to data availability, we consider the same set of variables for each economy except for the US. For non-US economies, domestic variables are real GDP  $y_{i,t}$ , consumer price inflation  $\pi_{i,t}$ , real exchange rate  $r_{i,t}$  (defined as the nominal exchange rate  $e_{i,t}$  minus domestic CPI, following Di Mauro et al., 2007), the 3-month interest rate  $i_{i,t}^s$ , the 10-year government bond yield  $i_{i,t}^l$ , the real equity price index  $q_{i,t}$  (the equity index deflated by domestic CPI) and real exports of goods and services  $exp_{i,t}$ .<sup>9,10</sup> Foreign variables, constructed as trade-weighted averages of variables in all other economies, are the following: foreign real GDP  $y_{i,t}^*$ , foreign consumer price inflation  $\pi_{i,t}^*$ , foreign real equity price  $q_{i,t}^*$  and the foreign 3-month short-rate  $i_{i,t}^{s*}$ . The real exchange rate is not included in the set of foreign variables of non-US models to avoid multicollinearity.

<sup>8</sup>The countries included are Argentina, Australia, Brazil, Canada, China, Chile, Euro Area, India, Indonesia, Japan, Korea, Mexico, Norway, New Zealand, Peru, Philippines, South Africa, Saudi Arabia, Singapore, Sweden, Switzerland, Thailand, Turkey, United Kingdom and USA. The Euro area is constructed as the aggregation of eight countries: Austria, Belgium, Finland, France, Germany, Italy, Netherlands, Spain.

<sup>9</sup>All variables except the 3-month and 10-year rates are set equal to 100 in 2000Q1 and expressed in natural logarithms.

<sup>10</sup>The nominal exchange rate  $e_{i,t}$  is defined as the exchange rate vis-à-vis the US dollar. For this reason, the real exchange rate is not included in the US model, as  $e_{US,t} = 1$  for all  $t$ .

Table 1: Summary of the variables included in the GVAR.

	Non-US model		US model	
	Domestic	Foreign	Domestic	Foreign
All GVARs:	$y_i$	$y_i^*$	$y_{US}$	$y_{US}^*$
	$\pi_i$	$\pi_i^*$	$\pi_{US}$	$\pi_{US}^*$
	$r_i$	-	-	$r_{US}^*$
	$i_i^s$	$i_i^{s*}$	$i_{US}^s$	$i_{US}^{s*}$
	$i_i^l$	-	$i_{US}^l$	$i_{US}^{l*}$
	$q_i$	$q_i^*$	$q_{US}$	$q_{US}^*$
	$exp_i$	-	-	-
GVAR 1:	-	-	$pitr_{US}$	-
	-	-	$pitb_{US}$	-
	-	-	$gcgi_{US}$	-
GVAR 2:	-	-	$citr_{US}$	-
	-	-	$citb_{US}$	-
	-	-	$gcgi_{US}$	-

Table 1 reports the variables included in the non-US models (for each country  $i$ ) and in the US model. Variables are: real GDP  $y_i$ , consumer price inflation  $\pi_i$ , real exchange rate  $r_i$  (defined as the nominal exchange rate  $e_i$  minus domestic CPI), the 3-month interest rate  $i_i^s$ , the 10-year government bond yield  $i_i^l$ , the real equity price index  $q_i$  (the equity index deflated by domestic CPI), real exports of goods and services  $exp_i$ .  $gcgi_{US}$  is government spending,  $taxrev_{US}$  are net tax revenues,  $pitr_{US}$  ( $citr_{US}$ ) is personal (corporate) income tax rate and  $pitb_{US}$  ( $citb_{US}$ ) is personal (corporate) income tax base.

The US model is slightly different for a number of reasons. First, as our aim is to study the effect of a fiscal policy expansion in the US on the rest of the world, we include, as domestic variables, US fiscal variables, both on the spending and on the tax side. Government spending and tax variables are constructed following previous works on US fiscal shocks (Blanchard and Perotti (2002) and Mertens and Ravn (2013), among others). On the spending side, we include real government expenditure to take into account the possible reaction of spending variables following the tax shock; on the tax side, we include the average personal income and corporate tax rates, together with their respective tax bases (net of transfers and interest payments).<sup>11</sup> Second, we do not include US exports among the domestic variables in the US, in order to reduce the number of parameters to be estimated and make the identification as neat as possible. Concerning the instruments for personal and corporate tax rate shocks, we rely on the legislated tax liability changes categorized by Mertens and Ravn (2013) from the total tax liabilities changes recorded by Romer and Romer (2010). Our tax models feature also personal and corporate income tax bases in order to be able to calculate fiscal multipliers, and general government spending to control for the endogenous response of fiscal policy. Regarding US foreign variables, we included, besides the same variables as in the non-US models, the real exchange rate, following Di Mauro et al. (2007). This implies that also the US is considered as a small open economy.<sup>12</sup> Table 1 summarizes the domestic and foreign variables included in the US and non-US models.

We estimate two GVARs, one to study the effects of personal income tax shocks and one for corporate income tax shocks:

- In GVAR #1, the US model is augmented with the personal income tax rate, the personal income tax base and government expenditure;
- In GVAR #2, the US model is augmented with the corporate income tax rate, the corporate income tax base and government expenditure;

The GVAR models are estimated over the period 1979 Q2 – 2006 Q4 because of data availability issues: observations before 1979 Q2 are not available for all countries, while the available tax instruments data end in 2006 Q4. Appendix A.1 and A.2 contain more details regarding the specification chosen and the data sources.

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<sup>11</sup>We do not include fiscal variables in non-US models because series of government spending and taxes are not available on a quarterly frequency for all countries; for countries in which series are available, we choose not to increase model size further.

<sup>12</sup>While the small open economy assumption may sound implausible in the case of the US, weak exogeneity requires that foreign variables are independent only with respect to the *long-run* parameters of the model, as Di Mauro et al. (2007) discuss and test formally. Results of such test, confirmed for our sample, are available upon request.

### 3.1 Transmission channels

Before describing the results of the paper, it is useful to summarize the main transmission channels through which fiscal policy shocks in the US may affect real variables in the rest of the world. The first channel operates through trade, in particular through the so-called *expenditure boosting* effect. Following a fiscal expansion that increases US output, US demand for imports increases as well, to an extent depending on the marginal propensity to import, both of the public and of the private sector. Output in foreign countries can thus rise through higher export demand. This direct channel can be reinforced via third-party effects, i.e. through the aforementioned mechanism working in all the foreign countries experiencing a boost in output. The second channel is represented by the real exchange rate. The US fiscal expansion is expected to increase domestic interest rates and to appreciate the US dollar, improving price competitiveness for all goods and services produced abroad and stimulating foreign exports and output (*expenditure switching* effect).

A fiscal shock can also impact foreign GDP through the financial channel. A loose fiscal policy stance in the US affects domestic interest rates, which in turn can impact foreign financial variables through financial linkages. The direction in which variables can be affected is not straightforward. On the one hand, in a standard portfolio balance model, the financial channel should cause both domestic and foreign interest rates to rise, putting a drag on the magnitude of spillovers on foreign output. On the other hand, an expansionary fiscal policy in the US might generate the opposite effect, putting downward pressure on domestic and foreign interest rates. [Faccini et al. \(2016\)](#) and [Corsetti and Muller \(2013\)](#) obtain falling interest rates by making the assumption of a subsequent reversal of the fiscal shock; alternative explanations suggest that lower taxes may either expand aggregate supply or increase firms' savings more than investments, in both cases putting downward pressures on prices and interest rates. Fiscal spillovers might also be transmitted by an equity price channel: expected profits of foreign exporting firms may rise and, depending on whether there is no offset from discount rates (which rise due to foreign central bank reactions), they put upward pressure on equity prices. This produces wealth effects for portfolio investors that could support consumption and investment.

Overall, the magnitude of fiscal spillovers is an empirical question. The relative importance of the aforementioned channels depends on the strength of trade and financial linkages among the source and recipient countries, and to a smaller extent, among recipient countries themselves. Finally, it might also depend on the composition of the fiscal shock, i.e. whether the fiscal expansion is implemented through spending increases or tax reductions, and also on the particular type of spending or tax instrument.

## 4 Results

In this section we describe our main results. In order to compare the effects of the two shocks, we comment on the results of the two GVAR models together, divided between domestic and spillovers effects; then, we construct domestic and international fiscal multipliers. The shocks of interest are: shock to average personal income tax rate (PITR henceforth) and shock to corporate income tax rate (CITR henceforth). Last, we discuss the main transmission channels.

Reliability tests ensure the relevance of the chosen tax instruments in our settings. In GVAR #1, the reliability test on the adopted instrument shows a statistic of 0.9, and in GVAR #2, of 0.8. These values are in the good-quality range for tax models reported in [Mertens and Ravn \(2013\)](#) and [Mertens and Ravn \(2014\)](#), validating the adopted identification procedures. Impulse response functions (IRFs), standardized to obtain comparable results, are shown in Figures 4.1 to 4.8. Regarding their interpretation, we highlight the following points. First of all, all impulse responses can be interpreted as percentage point reactions to a shock of -1 percentage point size in the tax rate. Second, the impulse response functions show a permanent behavior, both for the shocked and the response variables. Such behavior is driven by the fact that the model is estimated in error correction form and, therefore, takes into account the existing cointegrating relationships among variables, as outlined in Section 2. Finally, the IRFs display the median estimates along one standard deviation confidence bands, calculated through the bootstrap procedure.<sup>13 14</sup>

### 4.1 Domestic effects

Figure 4.1 displays the response of US real GDP to a -1 p.p. shock to US PITR and CITR. In both cases, the output response is positive and significant, showing a persistent behaviour, similar to that of the shocked variable, i.e. the tax rate. The timing of the response is slightly different across the two shocks, with GDP increasing on impact following the PITR shock, while reacting with a lag to the CITR shocks. Short and long-term interest

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<sup>13</sup>In order to bootstrap the GVAR model as in 2.10 we need to resample the estimated residuals, to obtain:

$$X_t^{\text{boot}} = \hat{b}_0 + \hat{b}_1 t + \hat{F}_1 X_{t-1} + v_t^{\text{boot}} \quad (4.1)$$

The resampling procedure is carried out by making random draws with replacement from the residual vector  $[\hat{v}_1, \hat{v}_1, \dots, \hat{v}_T]$ , and impulse responses are recomputed at each draw.

<sup>14</sup>We adopt one standard deviation confidence bands as uncertainty surrounding international spillover effects is considered higher than that around domestic effects. Other papers in the GVAR literature adopting one-standard deviation bands are, for example, [Caporale and Girardi \(2013\)](#) and [Inoue et al. \(2015\)](#).

rates react significantly, increasing in response to the personal income tax shock while they fall after the corporate tax shock.

In order to compare the quantitative effect of the two different shocks, we report the results in terms of their implied multipliers, i.e. the dollar increase in GDP following a one dollar decrease in tax revenues, see Table 4.1.<sup>15</sup> One year after the shock, both tax rate shocks yield multipliers greater than one, with the one related to the personal income tax equal to 1.1 and the multiplier related to the corporate income tax equal to 2.5; five years after the shock, tax multipliers reach high levels in case of a corporate income tax shock (4.8) while remain close to 1 in case of personal tax rate shock. The high value of the corporate tax multiplier partly relates to the negative response of the long-term interest rate, which reinforces the effect of fiscal policy on output. Such result is in line with tax multipliers reported in [Mountford and Uhlig \(2009\)](#). As discussed in the Literature review Section, the stronger output effect of the corporate tax rate shock with respect to the personal income tax rate shock can be ascribed to the higher relevance of surprises in the corporate tax rate in the post-80s sample.

	Impact	1-year	5-year
Personal income tax rate (PITR)	0.4	1.1	1.4
Corporate income tax rate (CITR)	n.s.	2.5	4.8

Table 4.1 reports fiscal multipliers for the United States in case of negative PITR and CITR shocks. GDP elasticities are scaled by average GDP ratios over the 1979-2006 sample. All reported multipliers are significant; n.s. stands for not significant.

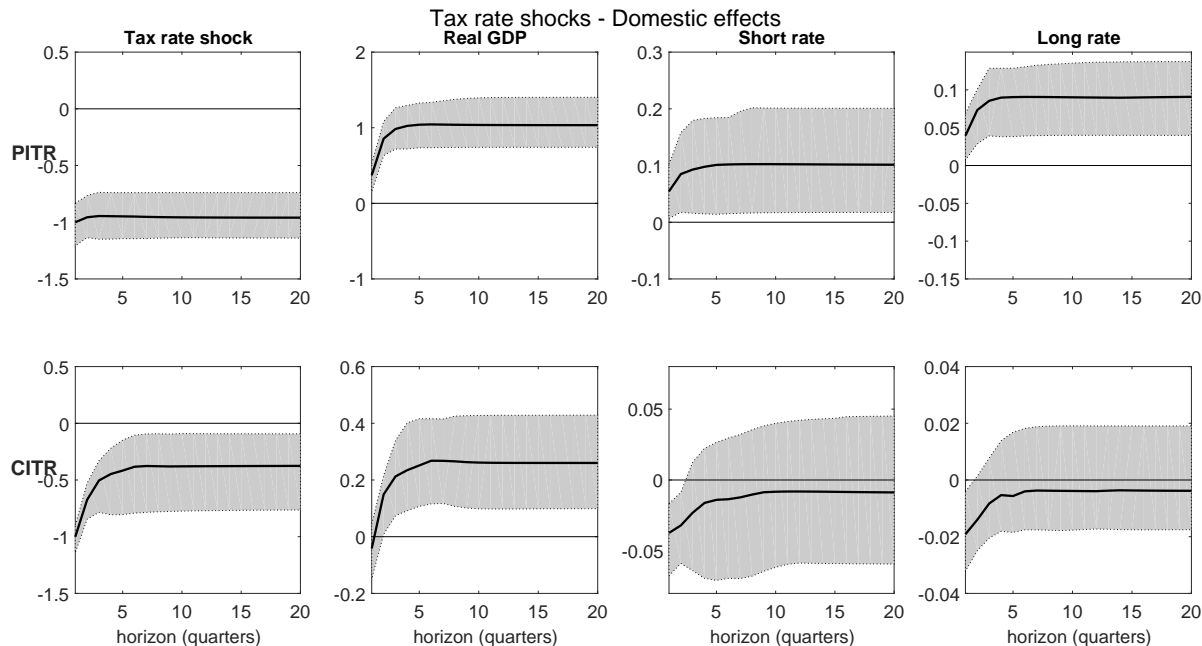
## 4.2 Spillover effects

Tax rate shocks have positive and statistically significant, albeit relatively small, international output spillovers. For the sake of brevity, we focus on the main economic partners of the United States, i.e. the Euro area, China, Japan, the United Kingdom and Canada, for which we detail the main transmission channels; for other emerging economies, we only discuss the overall effect of shocks on economic growth.

<sup>15</sup>The response of tax revenues  $t$  periods after the shock ( $t = 0, \dots, n$ ) is constructed by combining the dynamics of the shock with the response of the tax base, following [Mertens and Ravn \(2013\)](#)

$$\hat{tr}_t = \hat{T}_t^i / \bar{T}^i + \hat{b}_t^i$$

where  $T$  is the tax rate of type  $i = PITR, CITR$ ,  $\bar{T}^i$  is the mean average tax rate and  $b$  is the appropriate tax base; hats denote impulse responses and lower case letters denote logged variables.



**Figure 4.1: US tax rate shocks, domestic effects.** Impulse responses from a -1 percentage point shock to US Personal income tax rate (PITR) and to US Corporate income tax rate (CITR). Bootstrap median estimates with 68% confidence bands.

**Effects on GDP** International spillovers are reported in Figures 4.2 to 4.4. Output spillovers are significant in most of the main advanced economies. In particular, they are strongest in Canada and of comparable size in the Euro area, China, Japan and the United Kingdom. The shapes of foreign GDP responses follow those of US GDP: spillovers from PITR shocks are front-loaded while those from CITR shocks are more gradual. Concerning the differences between the effects among tax shocks, spillovers from personal tax shocks have tighter confidence bands. The effect of fiscal policy on emerging countries is on average less significant than that on advanced economies (Figure 4.4). Among EMEs, they are stronger in Mexico and South East Asia than in Latin America, and never significant in India.<sup>16</sup>

**International fiscal multipliers** Tables 2, 3 and 4 quantify the effect of fiscal shocks on GDP in recipient economies in terms of fiscal multipliers. International fiscal multipliers are here defined as the dollar increase in foreign GDP following a one dollar decrease in US tax revenues. The fiscal multiplier of country  $i$ ,  $M^i$ , observed  $t$  periods after the shock

<sup>16</sup>South East Asia is the GDP-weighted aggregation of Indonesia, Philippines and Thailand, while Latin America is the aggregation of Argentina, Brazil, Chile and Peru.

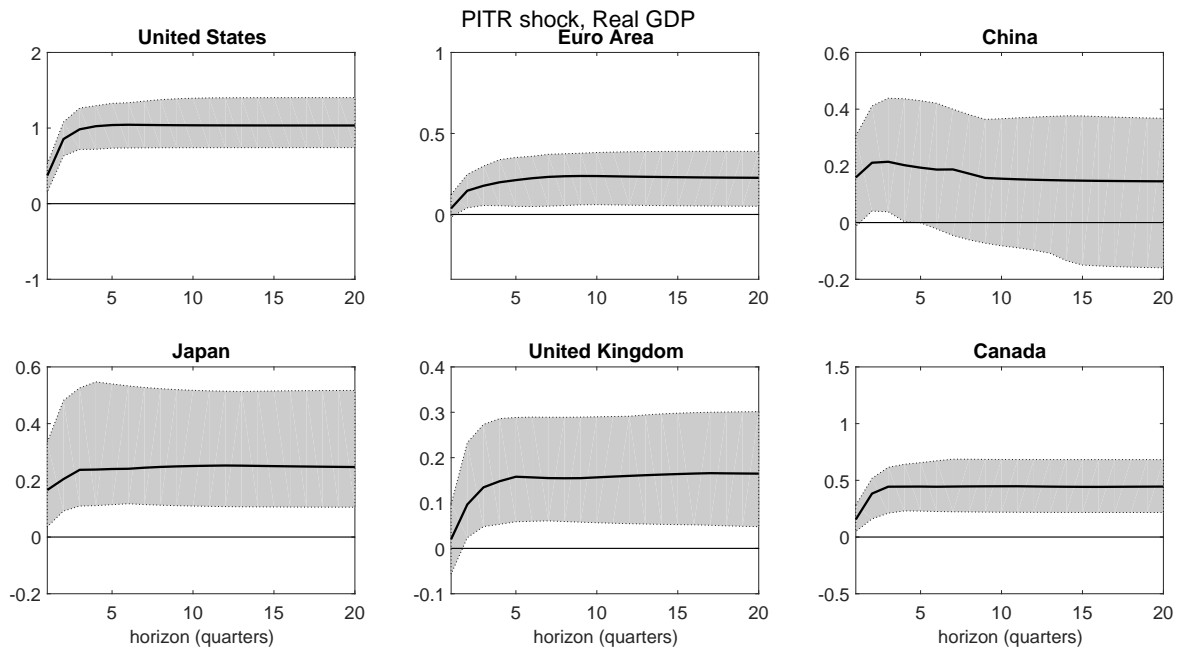


Figure 4.2: **Personal tax rate shock, spillover effects.** Impulse responses of real GDP rate from a -1 percentage point shock to US Personal income tax rate (PITR). Bootstrap median estimates with 68% confidence bands.

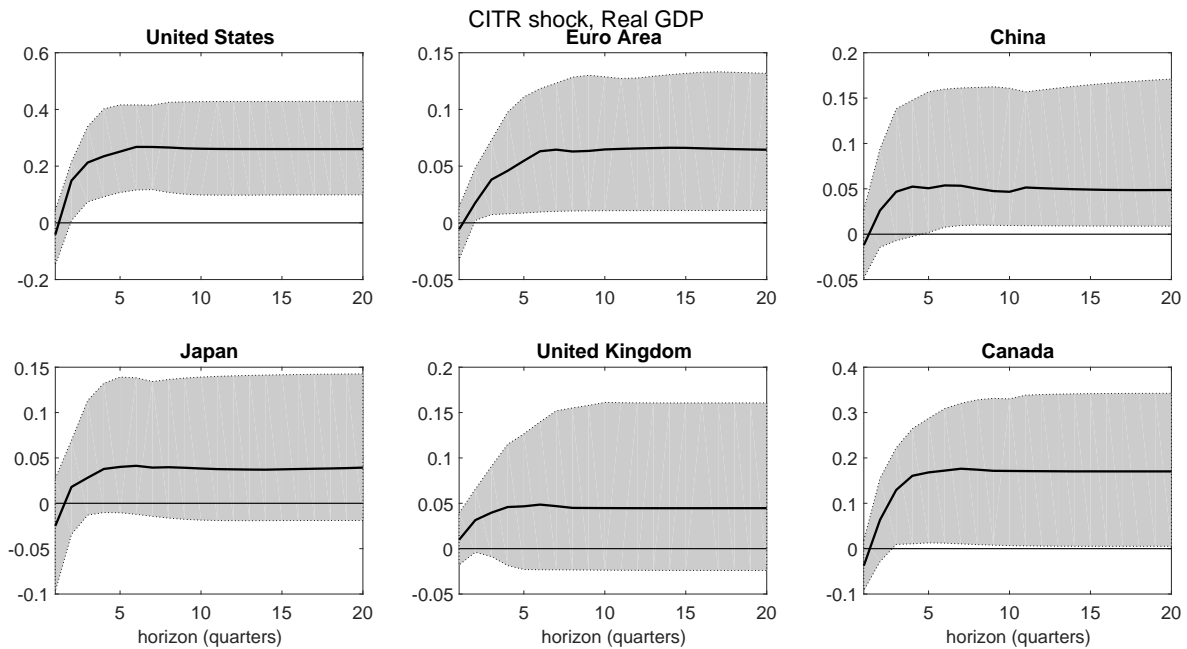


Figure 4.3: **Corporate tax rate shock, spillover effects.** Impulse responses of real GDP rate from a -1 percentage point shock to US Corporate income tax rate (CITR). Bootstrap median estimates with 68% confidence bands.



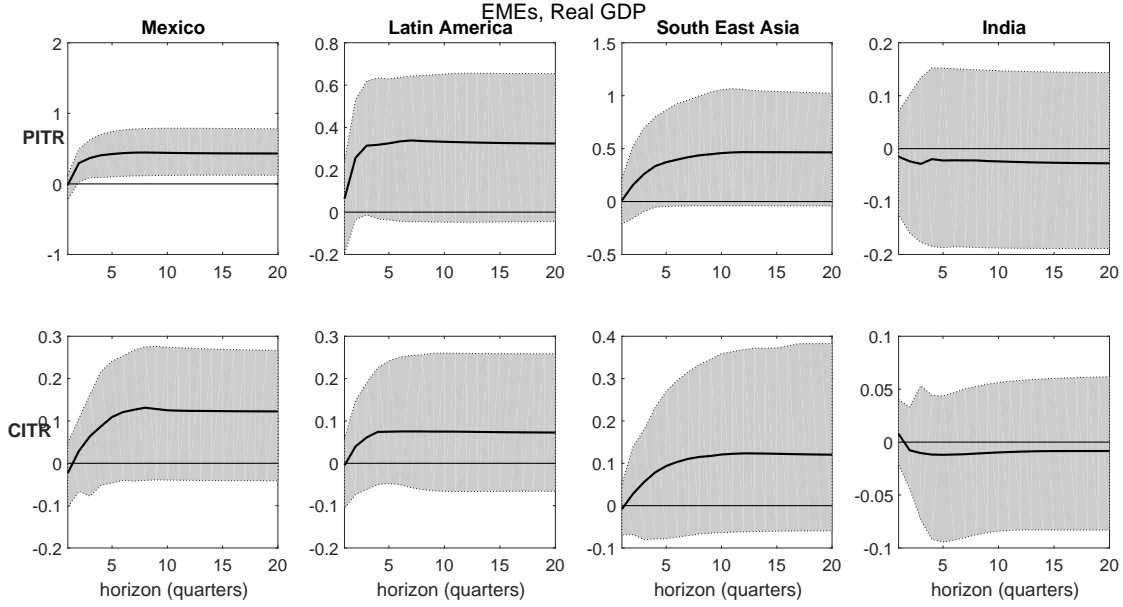


Figure 4.4: **Spillovers to EMEs.** Impulse responses of real GDP from a -1 p.p. shock to US Personal income tax rate (PITR) and US Corporate income tax rate (CITR). Latin America is the GDP-weighted aggregation of Argentina, Brazil, Chile and Peru. South East Asia is the GDP-weighted aggregation of Indonesia, Philippines and Thailand. Bootstrap median estimates with 68% confidence bands.

( $t = 0, \dots, N$ ) and referred to a US fiscal instrument  $FI^{us}$ , is given by the following:

$$M_{FI,t}^i = \frac{\Delta Y_t^i}{\Delta FI_t^{us}} \quad (4.2)$$

$\Delta FI^{us}$  is the response of the fiscal instrument and  $\Delta Y^i$  that of GDP in country  $i$ .<sup>17</sup> Empirically, international multipliers are computed as follows. Defining the elasticity of GDP to the fiscal instrument at period  $t$  as the ratio of the impulse response of GDP over that of the fiscal instrument, i.e.

$$\epsilon_{FI,t}^i = \frac{\Delta Y_t^i}{Y_t^i} \bigg/ \frac{\Delta FI_t^{us}}{FI_t^{us}}, \quad (4.3)$$

fiscal multipliers are obtained by weighting the elasticities by the ratio of the fiscal instrument to real GDP at some point in time

$$M_{FI,t}^i = \epsilon_{FI,t}^i \frac{FI^{us}}{Y^i} \quad (4.4)$$

<sup>17</sup>The fiscal instrument is the tax revenue, obtained by combining the tax rate shock and the response of tax base as detailed in footnote 15.

Following Ramey (2016), we report cumulated multipliers given by

$$M_{FI,t}^i = \frac{\sum_{s=0}^t \Delta Y_s^i}{\sum_{s=0}^t \Delta FI_s^{us}} \quad (4.5)$$

In order to compute international multipliers, we calculate the ratio FI/Y in Equation 4.4 as the average FI/Y ratios throughout the estimation period for each economy.<sup>18</sup>

The tables below summarize the estimates of the international fiscal multipliers for the two types of tax rate shocks: impact multipliers (Table 2), one-year and five-year multipliers (Tables 3 and 4). In general, international fiscal multipliers are small, ranging between 0 and 0.3. On the five year horizon, they are highest for the corporate tax shock. There is variation across countries: multipliers are basically null in China and strongest in Canada and Japan. The aforementioned results suggest that US fiscal policy does affect economic activity in foreign economies, but its impact is limited.

Table 2: International fiscal multipliers, impact.

	Euro area	China	Japan	UK	Canada
Personal income tax rate (PITR)	0	0	0	0	0
Corporate income tax rate (CITR)	0	0.1	0.1	0	0

Table 2 reports the fiscal multipliers for the subcategories of tax revenues, for the Euro area, China, Japan, UK and Canada. All reported multipliers are statistically significant; values equal to zero indicate multipliers between 0 and 0.1.

Table 3: International fiscal multipliers, one year after the shock.

	Euro area	China	Japan	UK	Canada
Personal income tax rate (PITR)	0	0	0	0	0.1
Corporate income tax rate (CITR)	0.1	0.1	0.1	0.1	0.2

Table 3 reports the fiscal multipliers for the subcategories of tax revenues, for the Euro area, China, Japan, UK and Canada. All reported multipliers are statistically significant; values equal to zero indicate multipliers between 0 and 0.1.

<sup>18</sup>This procedure can lead to a bias when significant trends in this ratio are present (Ramey, 2016). We also computed the ratio using end-of-sample values and multipliers do not change significantly.

Table 4: International fiscal multipliers, five years after the shock.

	Euro area	China	Japan	UK	Canada
Personal income tax rate (PITR)	0.1	0	0	0	0.1
Corporate income tax rate (CITR)	0.2	0.1	0.3	0.1	0.3

Table 4 reports the fiscal multipliers five years after the shock for the subcategories of tax revenues, for the Euro area, China, Japan, UK and Canada. All reported multipliers are statistically significant; values equal to zero indicate multipliers between 0 and 0.1.

**Transmission channels** Figures 4.5 to 4.8 document the international transmission channels of the US fiscal shocks. The trade channel appears to be the dominant propagation mechanism. This result is partly driven by the fact that, in the model, international financial markets are also linked by trade weights, so the pure financial spillovers from the US to the rest of the world may be underestimated. However, other estimates we made with our GVAR, assigning higher weights to US financial variables in foreign economies confirm the dominance of the trade channel.<sup>19</sup> Two different mechanisms lie behind the trade channel, i.e. the *expenditure switching* and the *expenditure boosting* effects, and affect the various economies in different ways. As Figure 4.5 shows, following a personal income tax cut in the United States, real exchange rates vis-à-vis the US dollar depreciate for the Euro Area, and the United Kingdom, making their exports cheaper: these countries benefit from an expenditure switching effect. This result is consistent with the main prediction of standard theoretical models, including both the Mundell-Fleming-Dornbush (MFD) model and open macro DSGEs. However, at least for what concerns spending shocks such theoretical result has been challenged by a number of empirical papers, like Kim and Roubini (2008), Ravn et al. (2012), Kim (2015), Corsetti et al. (2012b) and Ilzetzi et al. (2013).<sup>20</sup> This body of literature documents that an increase in government consumption leads to a depreciation of the real exchange rate and in some cases, also to a contemporaneous deterioration of the current account balance. While we do not consider spending shocks in our framework, we document that such puzzle regarding the

<sup>19</sup>In order to simulate a fully direct financial spillover, in a robustness analysis we assume that US short-term rates, long-term rates and equity prices enter the VARXs of foreign countries with unitary weights. We simulate a new GVAR with mixture of trade and unitary weights for PITR shocks, for which a stronger, positive reaction of foreign interest rates could, in principle, mute the positive trade effects on foreign output. Estimates, available upon request, show that spillovers are still positive, confirming the dominance of the trade channel on the financial channel.

<sup>20</sup>One notable exception in this literature is Forni and Gambetti (2016), which shows that government spending news shocks appreciate the real exchange rate, instead of depreciating. However, it is important to highlight that the authors focus on news shocks and not on the standard surprise shock.

response of the real exchange rate is less evident for tax rate shocks.

Figure 4.6 reports the response of real exports. Exports rise even in cases where the real exchange rate does not depreciate, as for Japan, Canada and China.<sup>21</sup> Indeed, notwithstanding the behavior of the real exchange rate, exports receive a boost from the stronger import demand in the US, suggesting the presence of a powerful expenditure boosting mechanism.

An important transmission mechanism is also represented by financial channels. Such channels point to the response of long-term interest rates and equity prices as vehicles for the transmission of fiscal shocks abroad, as explained in Section 3. Overall, the effect of financial channels on growth is ambiguous. As regards long-term rates, in most cases they increase following the US shocks while only in few cases they fall. Indeed, in the United States, long-term interest rates increase in the case of PITR shocks, putting a drag on economic activity both domestically and abroad. In the case of a CITR shock, they are generally much less significant and, in some cases, they fall on impact reinforcing the expansionary effects of trade. Possibly, the response of interest rates abroad depends on the balance between foreign monetary policy reactions and expectations of a policy reversal in the United States, acting as a drag on economic growth in the first case and stimulating investment and consumption in the second one.

Finally, Figure 4.8 reports impulse responses of stock prices, which are a possible source of wealth effects. In the case of PITR shocks, the response is significant, but has negative sign: domestic and foreign stock prices fall, meaning that the increase in interest rates (highly elastic to PITR shocks) prevails on the rise in firms' expected profits, producing a negative wealth effect. In case of CITR shocks, the effects are not significant, suggesting that stock prices do not play a key role in the transmission of US corporate tax shocks across the board.

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<sup>21</sup>The real exchange rate is not significant in China and, for the corporate tax shock, works in the opposite direction for Canada.

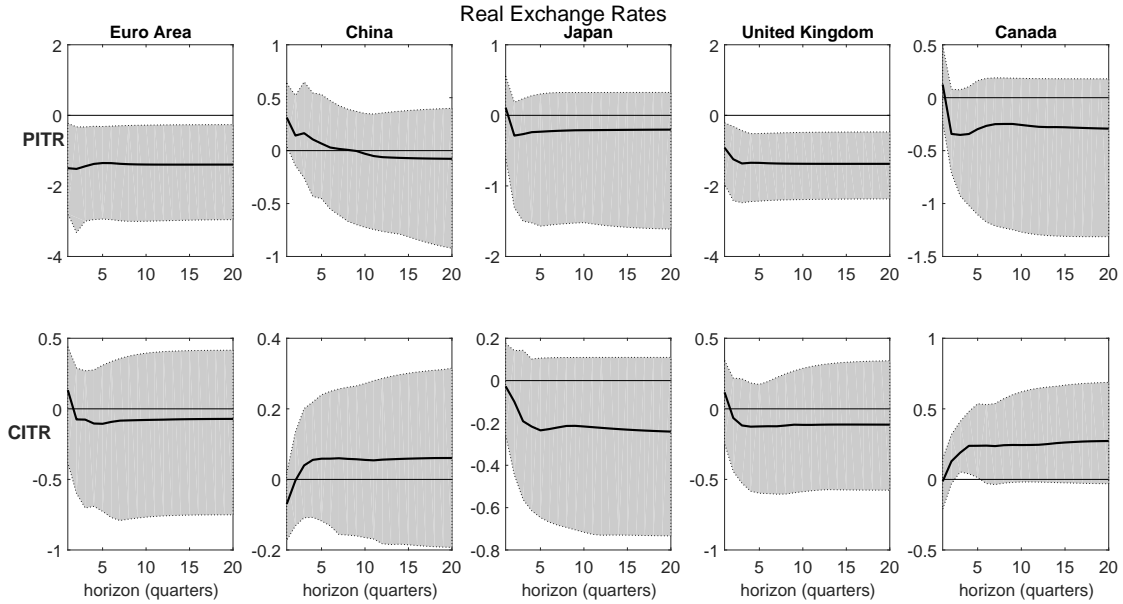


Figure 4.5: **Trade channel – exchange rates.** Impulse responses of real foreign exchange rate from a 1 percentage point (p.p.) shock to a -1 p.p. shock to US Personal income tax rate (PITR) and US Corporate income tax rate (CITR). Values above zero mean appreciation of foreign currencies towards the US dollar. Bootstrap median estimates with 68% confidence bands.

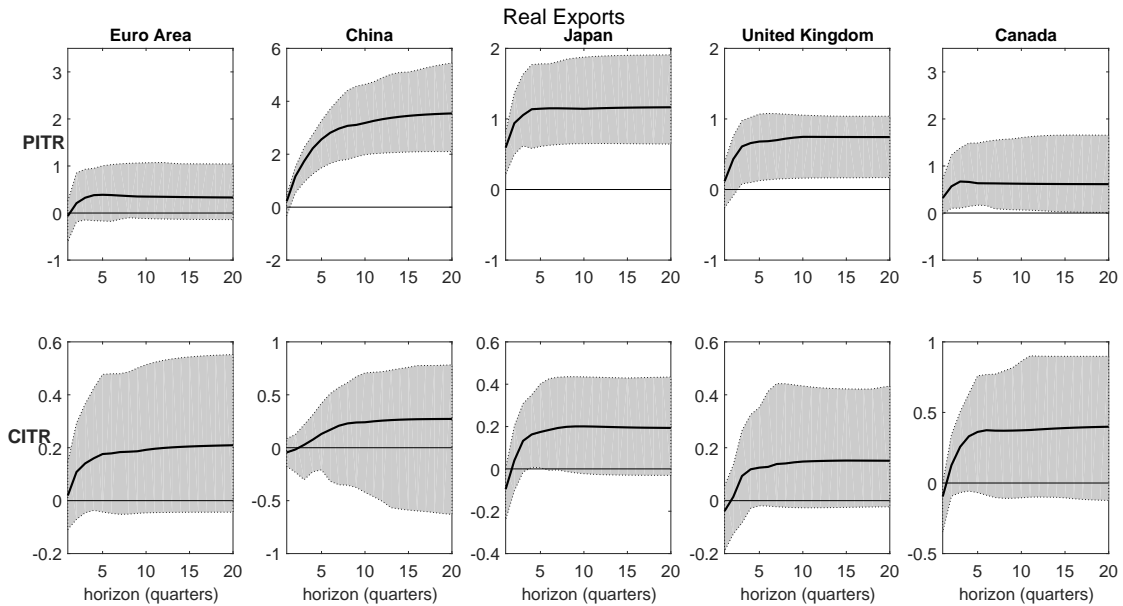


Figure 4.6: **Trade channel – real exports.** Impulse responses of real exports from a 1 percentage point (p.p.) shock to a 1 p.p. shock to US Personal income tax rate (PITR) and US Corporate income tax rate (CITR). Bootstrap median estimates with 68% confidence bands.

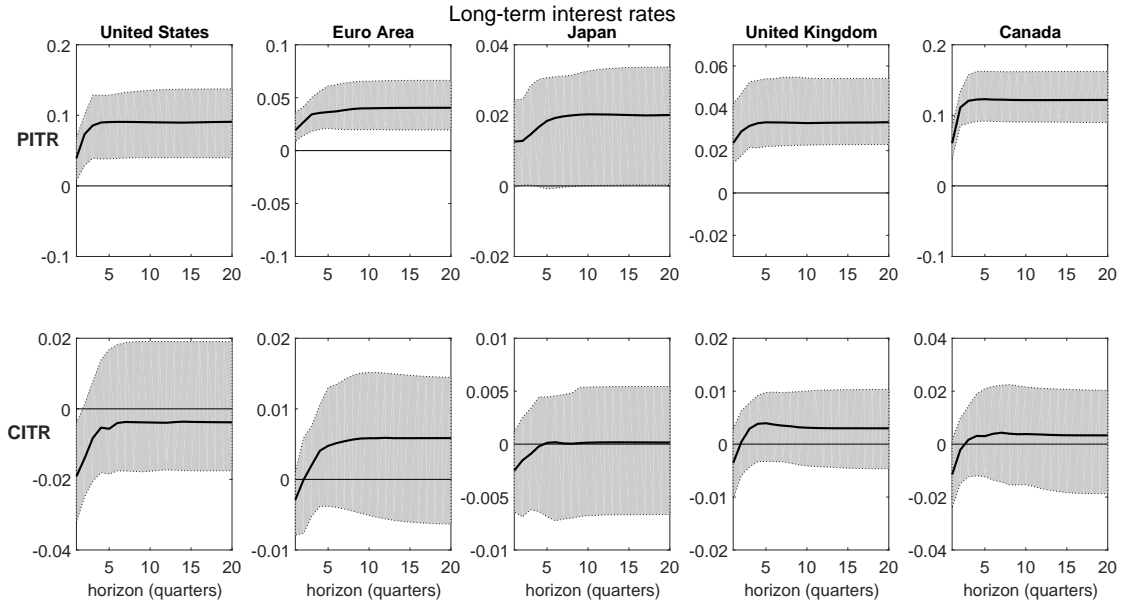


Figure 4.7: **Financial channel – long rates.** Impulse responses of nominal long-term interest rates from a 1 percentage point (p.p.) shock to a -1 p.p. shock to US Personal income tax rate (PITR) and US Corporate income tax rate (CITR). Bootstrap median estimates with 68% confidence bands.

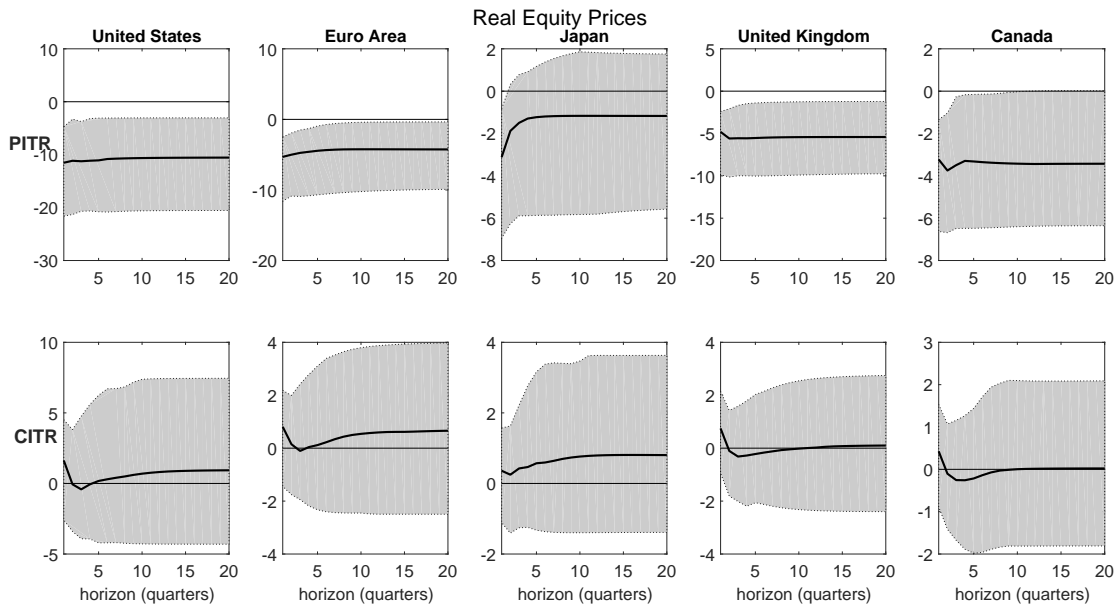


Figure 4.8: **Financial channel – equity prices.** Impulse responses of real equity prices from a 1 percentage point (p.p.) shock to a -1 p.p. shock to US Personal income tax rate (PITR) and US Corporate income tax rate (CITR). Bootstrap median estimates with 68% confidence bands.

## 5 Conclusions

In this paper we investigate the international dimension of fiscal policy, analyzing the spillover effects of tax rate shocks originating in the US. We study different subcategories of tax shocks, focusing on the international propagation mechanisms and quantifying the size of multipliers. The main finding is that fiscal spillovers are positive and statistically significant, albeit of a relatively small size.

This result suggests some relevant policy insights. First, the potential benefits of a fiscal expansion the US, from the point of view of recipient countries, are generated via the trade channel, which includes both an expenditure boosting and an expenditure switching effect. Second, the international spillovers of US fiscal policy seem to be more relevant for advanced countries than for emerging ones. This is in contrast with the effects of US monetary policy, which is considered a driver for international capital flows and a source of major concern for developing countries. Third, coordination among developed countries for a combined fiscal stimulus would dampen one important channel through which spillovers are transmitted, i.e. real exchange rate movements. As our results show, the international spillover effects are transmitted also through a real exchange rate depreciation in the recipient countries, a channel that would be muted if the fiscal stimulus were internationally coordinated. In this paper we do not address the question of non-linearity of fiscal policy spillovers, which still deserves further research.

## A Appendix: Estimation Specification and Data Source

### A.1 Estimation Specification

Here we summarize our model specification in terms of the number of cointegrating relationships and lags chosen. First of all, we conducted the Augmented Dickey-Fuller (ADF) test to check for the presence of unit root for the variables included in the GVAR. At the 5% significance level, we find that most of the domestic variables are integrated of order 1, i.e.  $I(1)$ , with the exception of some variables, mainly interest rate variables, being  $I(0)$  or near  $I(1)$ . The fact that almost all variables show a unit root behavior motivated our choice to proceed in the estimation of the  $N + 1$  single country models using the error correction form. In order to recover the cointegrating relationships among variables, we followed the standard Johansen cointegrating procedure; in some cases, we had to reduce the number of cointegrating relationships found by the Johansen test to guarantee the stability of the model, as in [Cesa-Bianchi \(2013\)](#). Concerning the choice of lags in each country model, we followed the Schwarz criterion for the domestic variables, while we impose one lag only for the foreign variables. In some cases, we had to reduce the number of lags for the domestic variables, also to preserve the stability of the model. Results of the tests are available upon request.

### A.2 Data source

The set of variables common to all GVAR models are taken from [Mohaddes and Raissi \(2018\)](#). The database contains data for real GDP  $y_i$ , consumer price inflation  $\pi_i$ , real exchange rate  $r_i$  (defined as the nominal exchange rate  $e_i$  minus domestic CPI), the 3-month interest rate  $i_i^s$ , the 10-year government bond yield  $i_i^l$ , the real equity price index  $q_i$  (the equity index deflated by domestic CPI). Exports  $exp_i$  are taken from the IMF IFS database. For what concerns the fiscal variables in the United States, we used the following sources. Nominal government spending ( $gcgi$ ) is taken from BEA NIPA table 3.1, and consists of both government consumption and investment. Nominal variables are then deflated using the CPI index. The personal income tax rate and tax base, as well as corporate income tax rate and tax base, are taken from the dataset provided by [Mertens and Ravn \(2013\)](#). The narrative series used to identify tax shocks are taken from [Mertens and Ravn \(2013\)](#).



## References

- Auerbach, A. J., Gorodnichenko, Y., May 2013. Output Spillovers from Fiscal Policy. *American Economic Review* 103 (3), 141–146.
- Auerbach, A. J., Gorodnichenko, Y., May 2016. Effects of Fiscal Shocks in a Globalized World. *IMF Economic Review* 64 (1), 177–215.
- Beetsma, R., Giuliodori, M., February 2011. The effects of government purchases shocks: review and estimates for the EU. *Economic Journal* 121 (550), F4–F32.
- Beetsma, R., Giuliodori, M., Klaassen, F., 04-05 2008. The effects of public spending shocks on trade balances and budget deficits in the European Union. *Journal of the European Economic Association* 6 (2-3), 414–423.
- Blagrove, P., Ho, G., Koloskova, K., Vesperoni, E., May 2018. Cross-Border Transmission of Fiscal Shocks: The Role of Monetary Conditions. *Imf working papers*, International Monetary Fund.
- Blanchard, O., 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 (4), 1329–1368.
- Bussiere, M., Ferrara, L., Juillard, M., Siena, D., 2017. Can fiscal budget-neutral reforms stimulate growth? model-based results. *Banque de France Working Paper* 625.
- Caldara, D., Kamps, C., 05 2017. The Analytics of SVARs: A Unified Framework to Measure Fiscal Multipliers. *The Review of Economic Studies* 84 (3), 1015–1040.
- Caporale, G. M., Girardi, A., 2013. How do us credit supply shocks propagate internationally? a gvarapproach. *Journal of International Money and Finance* 38, 84.e1–84.e16.
- Cesa-Bianchi, A., 2013. Housing cycles and macroeconomic fluctuations: A global perspective. *Journal of International Money and Finance* 37 (C), 215–238.  
URL <https://ideas.repec.org/a/eee/jimfin/v37y2013icp215-238.html>
- Christofzik, D. I., Elstner, S., 2018. International spillover effects of U.S. tax reforms: Evidence from Germany. *Tech. rep.*
- Corsetti, G., Meier, A., Muller, G. J., March 2010. Cross-Border Spillovers from Fiscal Stimulus. *International Journal of Central Banking* 6 (1), 5–37.  
URL <https://ideas.repec.org/a/ijc/ijcjou/y2010q1a1.html>

- Corsetti, G., Meier, A., Muller, G. J., November 2012a. Fiscal Stimulus with Spending Reversals. *The Review of Economics and Statistics* 94 (4), 878–895.
- Corsetti, G., Meier, A., Muller, G. J., October 2012b. What determines government spending multipliers? *Economic Policy* 27 (72), 521–565.
- Corsetti, G., Muller, G. J., March 2013. Multilateral Economic Cooperation and the International Transmission of Fiscal Policy. In: *Globalization in an Age of Crisis: Multilateral Economic Cooperation in the Twenty-First Century*. NBER Chapters. National Bureau of Economic Research, Inc, pp. 257–297.
- Di Mauro, F., Smith, L. V., Dees, S., Pesaran, M. H., 2007. Exploring the international linkages of the euro area: a global VAR analysis. *Journal of Applied Econometrics* 22 (1), 1–38.
- Dragomirescu-Gaina, C., Philippas, D., 2015. Strategic interactions of fiscal policies in europe: A global var perspective. *Journal of International Money and Finance* 59 (C), 49–76.
- Enders, Z., Muller, G. J., Scholl, A., January 2011. How do fiscal and technology shocks affect real exchange rates?: New evidence for the United States. *Journal of International Economics* 83 (1), 53–69.
- Faccini, R., Mumtaz, H., Surico, P., 2016. International fiscal spillovers. *Journal of International Economics* 99, 31 – 45.
- Favero, C., Giavazzi, F., Perego, J., November 2011. Country Heterogeneity and the International Evidence on the Effects of Fiscal Policy. *IMF Economic Review* 59 (4), 652–682.
- Forni, M., Gambetti, L., 2016. Government spending shocks in open economy VARs. *Journal of International Economics* 99 (C), 68–84.  
URL <https://ideas.repec.org/a/eee/inecon/v99y2016icp68-84.html>
- Georgiadis, G., 2017. To bi, or not to bi? differences between spillover estimates from bilateral and multilateral multi-country models. *Journal of International Economics* 107, 1 – 18.
- Harbo, Ingrid, e. a., October 1998. Asymptotic Inference on Cointegrating Rank in Partial Systems. *Journal of Business & Economic Statistics* 16 (4), 388–399.
- Hebous, S., Zimmermann, T., 2013. Estimating the effects of coordinated fiscal actions in the euro area. *European Economic Review* 58 (C), 110–121.

- Ilzetzki, E., Mendoza, E. G., Vegh, C. A., 2013. How big (small?) are fiscal multipliers? *Journal of Monetary Economics* 60 (2), 239–254.
- IMF, 2017. Fiscal spillovers in the euro area: Letting the data speak. IMF working paper 17.
- Inoue, T., Kaya, D., Ohshige, H., Oct. 2015. The impact of China's slowdown on the Asia Pacific region : an application of the GVAR model. Policy Research Working Paper Series 7442, The World Bank.  
URL <https://ideas.repec.org/p/wbk/wbrwps/7442.html>
- Jorda, March 2005. Estimation and Inference of Impulse Responses by Local Projections. *American Economic Review* 95 (1), 161–182.
- Kim, S., 2015. Country characteristics and the effects of government consumption shocks on the current account and real exchange rate. *Journal of International Economics* 97 (2), 436–447.
- Kim, S., Roubini, N., March 2008. Twin deficit or twin divergence? Fiscal policy, current account, and real exchange rate in the U.S. *Journal of International Economics* 74 (2), 362–383.
- Koop, G., Pesaran, M. H., Potter, S. M., September 1996. Impulse response analysis in nonlinear multivariate models. *Journal of Econometrics* 74 (1), 119–147.
- Mertens, K., Ravn, M. O., 2013. The dynamic effects of personal and corporate income tax changes in the united states. *American Economic Review* 103 (4), 1212–1247.
- Mertens, K., Ravn, M. O., 2014. A reconciliation of svar and narrative estimates of tax multipliers. *Journal of Monetary Economics* 68, 1–19.
- Mohaddes, K., Raissi, M., 2018. Compilation, Revision and Updating of the Global VAR (GVAR) Database 1979Q2-2016Q4. University of Cambridge: Faculty of Economics (mimeo).  
URL <https://ideas.repec.org/a/eee/inecon/v99y2016icp68-84.html>
- Monacelli, T., Perotti, R., 05 2010. Fiscal Policy, the Real Exchange Rate and Traded Goods. *Economic Journal* 120 (544), 437–461.
- Mountford, A., Uhlig, H., 2009. What are the effects of fiscal policy shocks? *Journal of Applied Econometrics* 24 (6), 960–992.

- Ong, K., 2018. Do fiscal spending news shocks generate financial spillovers? *Economics Letters* 164 (C), 46–49.  
URL <https://ideas.repec.org/a/eee/ecolet/v164y2018icp46-49.html>
- Pesaran, Schuermann, Weiner, April 2004. Modeling Regional Interdependencies Using a Global Error-Correcting Macroeconometric Model. *Journal of Business & Economic Statistics* 22, 129–162.
- Pesaran, M. H., Shin, Y., May 1997. Generalised Impulse Response Analysis in Linear Multivariate Models. Cambridge Working Papers in Economics 9710, Faculty of Economics, University of Cambridge.
- Pesaran, M. H., Shin, Y., Smith, R. J., August 2000. Structural analysis of vector error correction models with exogenous I(1) variables. *Journal of Econometrics* 97 (2), 293–343.
- Ramey, V. A., 2011. Identifying Government Spending Shocks: It's all in the Timing. *The Quarterly Journal of Economics* 126 (1), 1–50.
- Ramey, V. A., Feb. 2016. Macroeconomic Shocks and Their Propagation. NBER Working Papers 21978, National Bureau of Economic Research, Inc.
- Ramey, V. A., 2017. Rethinking macroeconomic policy. Peterson Institute for International Economics.
- Ravn, M. O., Schmitt-Grohe, S., Uribe, M., 2012. Consumption, government spending, and the real exchange rate. *Journal of Monetary Economics* 59 (3), 215–234.
- Ricci-Risquete, A., Ramajo-Hernandez, J., June 2015. Macroeconomic effects of fiscal policy in the European Union: a GVAR model. *Empirical Economics* 48 (4), 1587–1617.
- Romer, C. D., Romer, D. H., June 2010. The Macroeconomic Effects of Tax Changes: Estimates Based on a New Measure of Fiscal Shocks. *American Economic Review* 100 (3), 763–801.
- Stock, Watson, 2012. Disentangling the channels of the 2007-2009 recession. *Brookings Papers on Economic Activity* 43 (1), 81–156.
- Stock, J. H., Watson, M. W., 2008. Lecture 7: Recent Developments in Structural VAR Modeling. Presented at the National Bureau of Economic Research Summer Institute Minicourse: What's New in Econometrics: Time Series, Cambridge, MA.

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2018

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2019

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- CORSELLO F. and V. NISPI LANDI, *Labor market and financial shocks: a time-varying analysis*, Journal of Money, Credit and Banking, **WP 1179 (June 2018)**.
- COVA P., P. PAGANO and M. PISANI, *Domestic and international macroeconomic effects of the Eurosystem Expanded Asset Purchase Programme*, IMF Economic Review, **WP 1036 (October 2015)**.
- D'AMURI F., *Monitoring and disincentives in containing paid sick leave*, Labour Economics, **WP 787 (January 2011)**.
- D'IGNAZIO A. and C. MENON, *The causal effect of credit Guarantees for SMEs: evidence from Italy*, Scandinavian Journal of Economics, **WP 900 (February 2013)**.
- ERCOLANI V. and J. VALLE E AZEVEDO, *How can the government spending multiplier be small at the zero lower bound?*, Macroeconomic Dynamics, **WP 1174 (April 2018)**.
- FEDERICO S. and E. TOSTI, *Exporters and importers of services: firm-level evidence on Italy*, The World Economy, **WP 877 (September 2012)**.
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