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News and Surprises:

Revisiting Fiscal Shocks in the Open Economy*

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Abstract

Despite extensive research on fiscal policy, evidence on the international transmission of structural fiscal shocks remains limited and inconclusive. We address three gaps. First, we confront the perfect-foresight problem by incorporating a proxy for fiscal policy news into a multi-country VAR model – to our knowledge, the first such study to use this proxy to measure cross-border transmission of US fiscal shocks in a detailed setting. Second, we estimate a Bayesian multi-country VAR that, unlike two-country approaches, fully captures higher-order spillovers. Third, we revisit the interpretation of fiscal multipliers from New Keynesian closed-economy models. We find: (i) international spillovers operate mainly through trade (expenditure switching and boosting); (ii) transmission hinges on each recipient's growth model; (iii) higher-order spillovers substantially amplify direct spillovers; and (iv) the exchange rate puzzle reflects omitted variables and policy regime effects.

Keywords: Fiscal Foresight, Exchange Rate Puzzle, Openness, Bayesian Multi-Country VAR, Spillovers.

JEL Classification: F15, F32, F41, H68, H62

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1 Introduction

In recent decades, there has been a resurgence of research in fiscal policy (Ramey, 2019). This reflects many factors, including advances in theory and empirical methods to identify structural fiscal shocks, as well as access to richer data and modeling frameworks. Macroeconomic realities also played a role: fiscal policy became substantially more accommodative following the Great Recession and the COVID-19 pandemic, with US federal debt more than doubling as a percentage of output. This, coupled with the effective lower bound on policy rates (or "zero lower bound"), intensified that interest yet further.

Ongoing liberalization of trade and capital markets has enhanced the cross-border transmission of policy shocks. Given the US's pivotal global role (e.g., Dees and Saint-Guilhem, 2011; Gourinchas, 2023), its large fiscal responses likely have important repercussions abroad. Yet much of the spillover literature remains inconclusive.

Against that background, we reassess recent advances in modeling fiscal policy shocks in an explicitly open-economy setting. For example, how do we control for anticipation effects in fiscal policy changes (the "fiscal foresight problem") – and, accordingly, does distinguishing between 'News' and 'Surprise' shocks matter in an open-economy context? Likewise, do fiscal expansions lead to an appreciation or depreciation of the home currency (the 'exchange rate puzzle'[1]), and/or an improvement in the trade balance, and again does distinguishing between shock types play a role? On the methodological side, what is the appropriate size and scale of an open-economy model? Is it necessary to move beyond stylized two-country models to realistically capture spillovers (as argued by Georgiadis, 2017, among others). How important is the macroeconomic policy mix in the transmission and nature of fiscal shocks? Addressing those issues is our purpose.

Our Contribution. Although the literature on the transmission of fiscal shocks is large (e.g., Ravn, Schmitt-Grohé and Uribe, 2007; Nicar, 2015), as far as we are aware ours is the first study to integrate recent developments in the modeling of different structural fiscal shocks in a fully-fledged open economy setting – that is to say, one accounting for higher-order spillovers and country asymmetries. Of these structural fiscal shocks, News shocks are anticipated fiscal changes

[1] This refers to the empirical observation wherein an increase in government spending leads to a depreciation of the real exchange rate, contrary to the standard theoretical expectation that it should appreciate.

that affect expectations and behavior prior to the actual policy event, while Surprise shocks are unexpected changes that prompt immediate reactions. As might be expected, these can have very different impacts on home and partner economies and, in turn, shed light on a variety of open-economy issues typically discussed in the literature. Specifically, our proposed empirical framework offers three contributions to the estimation of international spillover effects of fiscal policy shocks.

First, we estimate the effects of **fiscal News shocks**. In doing so, we address the aforementioned fiscal foresight problem: fiscal policy actions (such as an announced future tax cut) are often anticipated, reflecting the lag between their announcement and implementation, potentially diluting the identification of their effects.[2] This problem arises when there is a misalignment between the information sets used by the econometrician, and that of economic agents. Failure to capture agents' forward-looking expectations and anticipations can lead to VAR models with non-fundamental moving average (MA) representations and potentially non-identifiable structural shocks.[3] In this context, a fiscal policy shock is thus not a conventional policy change, but rather news about future shifts in fiscal stance.[4] Many studies on fiscal shocks and spillovers attempt to mitigate the fiscal foresight problem by augmenting VAR models with measures of fiscal News.

Alternatively, a Surprise (unanticipated) shock affects spending on impact but is observed only when agents see realized spending (e.g., a sudden, unexpected increase in spending following a natural disaster). These reflect agents' real-time beliefs, and are typically implemented using either the forecast errors, or the forecast of government spending. However, Forni and Gambetti (2016) show that these Expectations Augmented VARs (EVARs) still fail to fully account for anticipated changes in government spending, News shocks.

To overcome these limitations, we follow their approach and construct a proxy for News based on the anticipated component of the fiscal policy shocks. This approach involves building a proxy for fiscal News using real federal government consumption and expenditure forecast

[2] Anticipation effects typically stem from government communications about future fiscal policies or from institutional processes, such as delays between proposals, legislation, and the implementation of new fiscal measures.

[3] Sims and Zha (2006) and Sims (2012), though, show that it is possible to recover a subset of shocks even if the MA representation of the variables included in the VAR is non-fundamental.

[4] Ramey (2011) and Leeper, Walker and Yang (2013) provide further discussion of the fiscal foresight problem.

revisions, exploiting data from the Survey of Professional Forecasters (SPF) provided by the Federal Reserve Bank of Philadelphia. This method allows us to better account for anticipated changes in government spending, addressing the shortcomings of previous approaches, and providing a more accurate estimation of international spillovers. To the best of our knowledge, this is the first study that has used a proxy for News shocks to estimate the international spillovers of US fiscal policy changes.

Our second contribution relates to the model used to capture international spillovers. Many studies in the literature use two-country econometric frameworks; in doing so, they overlook the presence of **higher-order spillovers**.[5] For example, Corsetti, Meier and Müller (2012), Ilori, Paez-Farrell and Thoenissen (2022) and Kim and Roubini (2008) use a two-country VAR to study the global impact of US fiscal shocks.[6] Although bilateral models are straightforward to interpret and computationally straightforward, by definition they fail to account for such indirect (i.e., higher-order) spillovers.

This turns out to be an important omission. Georgiadis (2017) demonstrated that because bilateral models do not account for these higher-order spillovers, they are subject to a bigger bias and a larger mean squared error than those produced from a multilateral setting. Moreover, Chudik and Pesaran (2011) consider the estimation of VAR models in which the number of economies and sample size approach infinity. They suggest distinguishing between 'neighbor' and 'non-neighbor' economies. When the set of neighbor economies exceeds one, then the multilateral framework is the proper framework to capture spillovers.[7] In line with that literature, our work examines the spillover of US fiscal shocks by implementing a structural Bayesian multi-country VAR.[8] This setting allows us to consider a realistic and fully-fledged multi-country dimension able to account for both direct and indirect (i.e., through a third country) spillovers, and the prevailing uncertainty

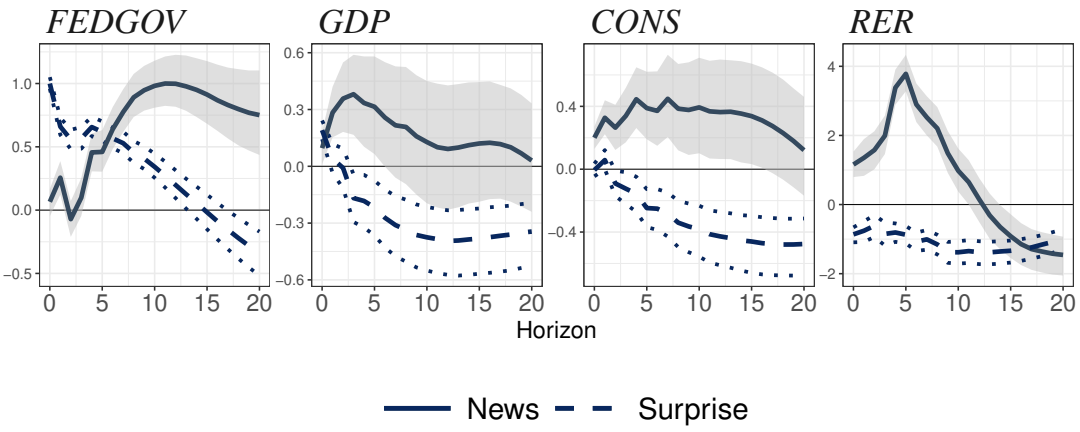
[5] Higher-order spillovers refer to the indirect effects that a country receives from a neighboring economy, which was affected by a common shock. For example, an expansionary fiscal shock can have a direct positive impact on the UK's net trade and an indirect impact by increasing the output of euro area countries, which in turn increase imports from the UK.

[6] For other papers that have used a two-country VAR to study the international spillover effect of US monetary policy (see e.g. Kim, 2001; Canova, 2005; Nobili and Neri, 2006).

[7] See for example, Chen et al. (2012). Georgiadis (2017) used such a framework to estimate the impact of the US monetary policy shock on a large number of spillover-receiving economies simultaneously. Alternatively, Canova and Ciccarelli (2013) suggested using Bayesian panel VAR to model spillovers across many countries. Other applications include examining monetary policy asymmetries (Georgiadis, 2015), labor-market reforms (Bettendorf and León-Ledesma, 2019), pollution abatement (Attílio, Faria and Rodrigues, 2023), growth and redistribution (Attílio, 2024).

[8] The framework used was proposed by Pesaran, Schuermann and Weiner (2004) and developed further by Dees et al. (2007).

Figure 1: Replication of Figures 3 and 6 in Forni and Gambetti (2016)



Notes: *This figure shows a replication and amalgam of results from Figures 3 and 6 in Forni and Gambetti (2016). These chart the responses of output (GDP), consumption (CONS), and the real exchange rate (RER) to an anticipated (News, solid line) and an unanticipated (Surprise, dashed line) shock to government expenditures (FEDGOV). A positive-valued response of the real exchange rate implies an appreciation. The sample is 1981q3 to 2013q3.*

bands around median responses. Using a detailed modeling framework of 19 countries, moreover, allows us to gauge the strengths and nature of fiscal shocks domestically and across borders and relate them to different country characteristics and empirical episodes.

Our **third** and final contribution deals with some interpretation of our results. For example, we examine the validity of the exchange rate puzzle, the relevance of the policy mix on the transmission of fiscal shocks, the nature of country heterogeneities, and the differential impact of different structural policy shocks and how they compare with the predictions of the existing literature.

Figure 1 illustrates the issue concerning the exchange rate puzzle by replicating Forni and Gambetti (2016), showing the striking difference in the responses of output, consumption, and the real exchange rate to the two types of structural fiscal shocks. The response of output and consumption to a News shock markedly contrasts with some recent literature. Ascari et al. (2023) argued that in a monetary regime, the response of output and consumption is negative.

Our Findings. Results yield four key findings. **First,** regarding domestic effects, we demonstrate that a fiscal News shock leads to a persistent increase in government expenditure, output

and consumption, while the exchange rate appreciates, and net trade deteriorates. This leads us to conclude that there is no exchange rate puzzle. Alternatively, when we consider an expansionary fiscal Surprise shock there is evidence of a depreciation of the real exchange rate and an improvement in net trade – but this is mainly driven by a fall in consumption that outweighs that in output. Our estimates (both from the News and Surprise shocks) are in contrast to Ascari et al. (2023) who show that the impact of anticipated fiscal policy shocks – News shocks – are contractionary in the monetary regime – active monetary and passive fiscal policy – and expansionary in the fiscal regime: – passive monetary and active fiscal policy. Alternatively, they show that unanticipated shocks are expansionary in both regimes. The contrasting results between our empirical estimates, and the theoretical suggestions of Ascari et al. (2023), stem from differences in modeling frameworks; the model in Ascari et al. (2023) is New Keynesian and closed economy, whereas ours is explicitly open-economy and global. Therefore, the closed-economy model of Ascari et al. (2023) could have overlooked the impact of the real exchange rate on the domestic business cycle. For example, a positive response of output and consumption following a positive News shock might be due to positive wealth effects generated by an appreciation of the real exchange rate and potential positive feedback effect produced by an increase in foreign output. Alternatively, negative wealth effects due to depreciation of the real exchange rate following a positive Surprise shock might explain the fall of output and consumption. Although our results do not provide a direct contribution to the theoretical literature, they suggest that an extension of Ascari et al. (2023) to an open economy framework will better accord with the data.

Second, regarding international spillovers, there are four key findings:

First, based on the responses of net trade and the real exchange rate to a positive US fiscal News shock, we identify two stylized groups of countries. Indeed, following Gopinath et al. (2017), Regan (2017), and others, for the euro area countries we can distinguish between southern and northern Europe. The latter tend to have relatively higher productivity, strong net trade positions, an implicit model of export-led growth and focus on export competitiveness, and lower financing costs. The first complete group, which includes Japan and the Northern euro area countries (NEA) of France and Germany, experienced an improvement in net trade driven mainly by a depreciation of the real exchange rate.

Alternatively, the second (former) group, which includes the UK and Southern euro area (SEA) countries, suffers a deterioration of net trade due to an appreciation. In the UK, although the real exchange rate appreciates, there is an improvement in net trade which is likely driven by a fall in domestic consumption and the long-term interest rate.

The second finding concerns the transmission channel of spillovers, which in almost all countries operates through trade: the real exchange rate is the conduit of spillovers. For example, although the long-term interest rate increases following a positive fiscal News shock, the real exchange rate in the NEA depreciates. A noticeable exception is the UK where, while there is an appreciation of the real exchange rate, the net trade improves due to expected depreciation reflected by the fall of long-term interest rate. Therefore, in the UK, not only does the trade channel matter but the financial channel also plays a significant role in the transmission of spillovers.

Third, we observe that the international transmission mechanism depends on the implicit model of economic growth pursued by individual countries/regions. For example, even though both the UK and the SEA countries experienced an appreciation of real exchange rates in response to a positive US fiscal News shock, there is evidence of net trade deterioration in SEA nations and improvement in the UK. The heterogeneous response of net trade among the countries that undergo an appreciation of real exchange rate is due, we would argue, to the demand-driven model of economic growth and capital misallocation policies adopted by SEA countries; an increase in consumption following the positive US fiscal shock. Alternatively, in the UK, consumption remains unresponsive to the US fiscal shock.

The fourth finding underlines the importance of our global framework used in the analysis of international spillovers. When analyzing the global impact of the US fiscal Surprise shock, higher-order spillovers amplify direct spillovers. For example, the fall of net trade in the UK and France following the US fiscal Surprise shock is not only driven by direct effects generated by the fall of US imports, but also by indirect effects induced by the negative response of output and imports in all other euro area countries, which are the main trade partners of both countries.[9] Therefore, the negative impact of the US import fall on UK exports has been intensified by the drop of output and imports of the euro-area countries generated by the negative demand shock emanating from the US.

[9] Note that more than 50 percent of the UK net trade is linked to the euro area countries over our sample.

Organization The next section summarizes the findings on the literature on the international transmission of US fiscal policy shocks. Section 3 describes the econometric methodology, namely a multi-country VAR employing Bayesian estimation. Section 4 shows how fiscal News shocks using forecast revisions from the Survey of Professional Forecasters are derived and validated against significant political and fiscal events. Section 5 describes the data and model assignments used for the exercises. In Section 6, we examine both the domestic effects of US fiscal shocks and their international spillovers on the G7, and other major economies. Regarding the responses, News shocks generally lead to real exchange rate appreciation and trade balance deterioration, while Surprise shocks have more varied effects. Section 7 concludes. Additional material is in the online appendices.

2 Fiscal Spillover Effects: Brief Literature Review

A key focus of the fiscal-policy spillover literature has been the 'exchange rate puzzle' and twin deficit hypothesis. This refers to the theoretical proposition that an increase in government spending leads to the depreciation of the real exchange rate, and an improvement in the trade balance. Forni and Gambetti (2016) show that the exchange rate puzzle was an artifact of the perfect foresight problem (anticipated fiscal shocks), for which the original literature failed to account.

Given this, the first criterion that we use to classify studies on international fiscal spillovers are the identification and separation of anticipated (News) and unanticipated (Surprise) shocks. Our second is based on the empirical framework used to estimate those spillovers. Most studies on international fiscal spillovers used a two-country framework overlooking higher-order spillovers (i.e., the indirect effects through the impact of a fiscal shock on other neighborhood economies), or else modeled such linkages in a highly reduced form, non-structural manner.

Surprise Shocks Literature Table 1 summarizes some of the relevant literature. Panel A relates to the effects of Surprise (unanticipated) US government spending changes. The seminal paper of Kim and Roubini (2008) drove a large body of research aiming to explain the apparent exchange rate puzzle and violation of the twin deficit hypothesis. For example, while both Müller (2008)

and Monacelli and Perotti (2010) show, using a Cholesky decomposition, that an unexpected increase in government spending leads to a real exchange rate depreciation; only the former study provides further evidence of a trade balance improvement. Enders, Müller and Scholl (2011) and Faccini, Mumtaz and Surico (2016) use sign restrictions to identify a fiscal policy shock, and provide evidence consistent with the exchange rate puzzle. The same conclusion is reached by Ilori, Paez-Farrell and Thoenissen (2022), though, they consider only a government consumption shock. Alternatively, Kim (2015) using a panel VAR of 18 countries and accounting for countries' characteristics -openness and exchange rate regime- shows that an unanticipated shock leads to a depreciation of the real exchange rate and improvement in net exports for countries with low capital mobility.[10] In the same vein, Miyamoto, Nguyen and Sheremirov (2019), based on a panel of 128 countries and identifying a government spending shock using international military spending, show that an increase in government spending will lead to an appreciation and deterioration of trade balance in developing countries. Lambertini and Proebsting (2023) also investigate the impact of austerity as a mechanism to alleviate the trade deficit of the euro area peripheral countries. Empirical evidence suggests that while a fall in government spending leads to an appreciation of the real exchange rate and an improvement of trade balance, the latter is driven by a fall in imports rather than an increase in exports.[11]

News Shocks Literature Panel B addresses studies that consider the impact of fiscal News (i.e., anticipated) shocks on trade and real exchange rate. Forni and Gambetti (2016), using a proxy for fiscal News shock based on the SPF, show that an appreciation of the real exchange rate and deterioration of net trade follow – implying the absence of a puzzle (see also Popescu and Shibata, 2017). Using a novel measure of daily government spending, Auerbach and Gorodnichenko (2016) show that following the announcements of future government spending, there is an immediate and sizable appreciation of the currency. Recently, Ferrara et al. (2021) also provides evidence of a dollar appreciation and a worsening trade balance using a proxy Structural VAR (SVAR) to

[10] The reverse was true for countries with high capital mobility. Kim also shows that the improvement of the current account was more pronounced for countries with a flexible exchange rate.

[11] Although Lambertini and Proebsting (2023) include forecast of government spending to address the issue of an anticipated fiscal shock, Forni and Gambetti (2016) demonstrated that the forecast of government spending still fails to capture fiscal news.

identify a government expenditure shock.[12]

Table 1: US Government Spending in an Open Economy: Literature

Literature	Identification Method	Expectations Proxy	RER	TB
PANEL A: **Unanticipated** US Government Spending Changes				
Kim and Roubini (2008)	Chol	No	−	+
Müller (2008)	Chol	No	−	+
Monacelli and Perotti (2010)	Chol	No	−	
Enders, Müller and Scholl (2011)	SR	No	−	−
Corsetti, Meier and Müller (2012)	Chol	FE (SPF)	−	
Faccini, Mumtaz and Surico (2016)	SR	No	−	
Ilori, Paez-Farrell and Thoenissen (2022)	Chol	OECD Forecasts	−	
PANEL B: **Anticipated** US Government Spending Changes				
Forni and Gambetti (2016)	Chol	CF or FR (SPF)	+	−
Auerbach and Gorodnichenko (2016)	LP	Procur. Announc.	+	−
Popescu and Shibata (2017)	Chol	CF (SPF)	+	−
Ferrara et al. (2021)	Ext. Inst.	Ramey Defense	+	−

Notes: *This table lists some past studies of the effects of government spending shocks in an open-economy setting. The abbreviations are* ***Chol:*** *Cholesky,* ***SR:*** *Sign Restrictions,* ***LP:*** *Local Projections;* ***Ext. Inst.:*** *External Instruments;* ***FE:*** *Forecast Error;* ***CF:*** *Sum of Cumulative forecasts;* ***FR:*** *Forecast Revisions;* ***SPF:*** *Survey of Professional Forecasters;* ***Procur. Announc:*** *Procurement Announcements; and* ***Ramey Defense*** *refers to the Ramey (2011) narrative measure of US military expenses announcements. The final two columns indicate the sign of the medium-run response of the real exchange rate and trade balance.*

Cross-Country Spillovers Although the aforementioned literature examines the impact of fiscal shocks in an open-economy setting, these works do not consider cross-country spillovers as such. Table 2 includes some key studies, which investigate the cross-country impact of US fiscal shocks. For example, Corsetti, Meier and Müller (2012) using a two-country New Keynesian model with spending reversals show that a positive government spending shock will lead to a fall in the long-term interest rate, depreciation of the real exchange rate, and an improvement of

[12] Ferrara et al. (2021) use the Ramey (2011) narrative measure as an external instrument for the identification of US public spending shocks.

the trade balance. Similarly, Nicar (2015) also uses a two-country SVAR to empirically test the cross-border effects of a US fiscal shock on the UK, Japan and Canada.[13] Results suggest that fiscal shocks have a positive and statistically significant impact on foreign output, at least in the short to medium run. However, the response of the trade balance and exchange rate differs across recipient countries. Faccini, Mumtaz and Surico (2016) estimate a regime-dependent factor model with sign restrictions to quantify fiscal spillovers. While there was no conclusive evidence of regime-dependent effects, spillovers on foreign output were positive. Finally, Ilori, Paez-Farrell and Thoenissen (2022) investigate the cross-border effects of US government consumption on the relative prices and output of the G7 countries using a two-country Bayesian SVAR based on a recursive identification scheme. Their empirical findings suggests that a fiscal expansion in the US generates positive output spillovers for the rest of the G7, mainly propagating through the trade channel.

Table 2: US Government Spending Spillovers

Literature	Recipient Countries	Model & Identification	Shock Definition Expectations proxy	Channel of Transmission
Corsetti and Müller (2013)	UK, EA	Bi-VAR Chol	Unexpected FE (SPF)	Financial
Nicar (2015)	CA, JP, UK	Bi-VAR SR	No	Trade
Faccini, Mumtaz and Surico (2016)	UK,DE, FR, CA, JP	Bi-VAR SR	No	Financial
Ilori, Paez-Farrell and Thoenissen (2022)	G7	Bi-VAR Chol	Unexpected OECD Forecasts	Trade

Notes: *This table lists some past studies of the spillover effects of government spending shocks in an open-economy setting. See also notes to Table 1. The two letter country symbols are standard, but for completeness are matched in Appendix A, with EA denoting the euro area.*

As described, these studies use a two-country empirical framework; in doing so, however, they overlook indirect spillovers that may exist through the impact of fiscal policy on the neighboring economies of the recipient country. There are in fact only a few studies that employ a multi-country

[13] Their identification of the fiscal shock was achieved based on the sign restriction method pioneered by Mountford and Uhlig (2009).

analysis to capture higher-order spillovers of structural fiscal shocks. For example, Hebous and Zimmermann (2013), Ricci-Risquete and Ramajo-Hernández (2015), and Belke and Osowski (2019) used a multi-country VAR model to explore the spillover effects of government spending among countries of the European Union. However, the fiscal policy shocks simulated by these studies were in reduced form, leaving direct policy implications unclear.[14]

The framework presented below overcomes that identification problem by distinguishing between News and Surprise fiscal shocks. We do so also by constructing a News series using the SPF. In doing so, we account for the omitted variable problem to which most studies in the literature are subject. To the best of our knowledge, no study explores the effects of US government spending shocks (News or Surprises) in a global multi-country setting. The only study close to the spirit of ours is Metelli and Natoli (2021) who use a multi-country VAR to investigate the international propagation of US tax reductions. However, instead of considering the role of News, they use a proxy SVAR to identify fiscal policy shocks.

3 Econometric framework

The curse of dimensionality is a critical issue when assessing spillovers in a multi-country framework. Notwithstanding the ease of interpretation and its limited computational burden, relying on a two-country model risks an error of some magnitude by disregarding higher-order effects (Georgiadis, 2017). However, on the other hand, if we try to empirically model a fully-fledged multi-country framework, we rapidly encounter said dimensionality issues.

Accordingly, we rely on the multi-country VAR methodology first introduced by Pesaran, Schuermann and Weiner (2004) and further extended by Dees et al. (2007). This enables us to investigate the temporal dynamics and geographical transmission of structural shocks. Moreover, we utilize Bayesian methods which can be more robust to (as here) relatively small samples since they combine data with prior information, potentially leading to more stable, reliable estimates. It also provides a natural framework for quantifying uncertainty through the posterior distribution relative to frequentist methods (e.g., McAdam and Warne, 2024). This allows for more informative

[14] Alternatively, Klein and Linnemann (2021) and Boehm (2020) use panel proxy VAR and panel local projections to estimate spillover effects. However, while a panel VAR imposes the restriction that the transmission mechanism is common between the G6 countries, local projections fails to capture higher spillovers.

inferences, such as credible sets, which can be more meaningful than traditional confidence intervals in small samples.

Alternative models to such a framework include Factor-Augmented VARs (FAVAR), Panel VARs (PVAR) and large Bayesian VARs. These have also been suggested to model cross-sectional dependence and linkages, but come with some important caveats. FAVAR models condense the information of a large number of variables into a small number of factors that are sometimes challenging to identify, whereas PVAR models and large BVARs, when dynamic interference is present, become operational through parameter shrinkage which might curtail important dynamics and miss some common factors expressed through foreign variables.[15]

The framework used here circumvents the dimensionality issue by breaking down large-dimension VARs into smaller conditional models connected by cross-sectional averages. Therefore, rather than limiting the dynamics of individual country sub-models, the methodology employed here imposes an intuitive structure on cross-sectional inter-linkages.

The mechanics of this modeling framework consist of two main steps. The first involves the estimation of a small-scale, country-specific VAR model augmented by country-specific exogenous variables. In the second step, individual country-specific $VARX^*$ models estimated in the first step are stacked into a global model that is then used to estimate the dynamic diffusion of a shock emanating from one chosen country to the other modeled countries.

3.1 The Multi-Country Open Economy Model

For each country $i = 0, .., N$, we consider a $VARX^*(p_i, q_i)$ model where p_i and q_i indicate the lag order of domestic and foreign variables:

$$\mathbf{X}_{it} = \boldsymbol{\alpha}_{\mathbf{0,i}} + \boldsymbol{\alpha}_{1,i}t + \sum_{j=1}^{p_i} \boldsymbol{\Phi}_{\mathbf{i,j}}\mathbf{X}_{i,t-j} + \sum_{j=0}^{q_i} \boldsymbol{\Lambda}_{\mathbf{i,j}}\mathbf{X}^*_{i,t-j} + \mathbf{u}_{\mathbf{i,t}} \tag{1}$$

where $\mathbf{X}_{it}$ is $k_i \times 1$ vector of domestic variables reflecting domestic macroeconomic conditions; $\mathbf{X}^*_{it} = \sum_{j\neq i} w_{i,j}\mathbf{X}_{j,t}$ with $\sum_{j\neq i} w_{ij} = 1$ is a $k^*_i \times 1$ vector of country-specific foreign variables; $\boldsymbol{\alpha}_{i,0}$ and $\boldsymbol{\alpha}_{1,i}$ are $k_i \times 1$ vectors of intercept and time-trend coefficients respectively; $\boldsymbol{\Phi}_{i,j}$ are $k_i \times k_i$ matrices corresponding to the lagged coefficient of domestic variables while $\boldsymbol{\Lambda}_{i,j}\, \forall j = 0, 1$ are $k_i \times k^*_i$

[15] See the arguments in Pesaran, Schuermann and Weiner (2004).

coefficient matrices of foreign variables; $\mathbf{u}_{i,t}$ is a $k_i \times 1$ vector of country-specific shocks which is assumed to follow a white noise process with variance-covariance matrix $\mathbf{\Sigma}_{ui}$: $\mathbf{u}_{i,t} \sim iid(\mathbf{0}, \mathbf{\Sigma}_{u,i})$.[16]

Next, once each country-specific $VARX^*$ model is estimated, the model can be written as

$$\mathbf{A_{i,0}Z_{it}} = \boldsymbol{\alpha}_{0,i} + \boldsymbol{\alpha}_{1,i}t + \mathbf{A_{i,1}Z_{i,t-1}} + \mathbf{u_{i,t}} \tag{2}$$

where $\mathbf{Z}_{i,t} = (\mathbf{X}'_{i,t}, \mathbf{X}^{*'}_{i,t})'$, is a $k_i + k_i^* \times 1$ vector, $\mathbf{A}_{i,0} = (\mathbf{I}_{k_i}, -\mathbf{\Lambda}_{i,0})$ and $\mathbf{A}_{i,1} = (\mathbf{\Phi}_i, \mathbf{\Lambda}_{i,1})$. We can then write $\mathbf{Z}_{it}$ and model (2) in terms of a $k = \sum_i k_i$-dimensional vector $\mathbf{X}_t = (\mathbf{X}'_{0,t}, \mathbf{X}'_{1,t}, \dots \mathbf{X}'_{N,t})'$ by using a $(k_i + k_i^*) \times k$ link matrix $\mathbf{W}_i$ (constructed based on the country-specific trade weights) such as $\mathbf{Z}_{i,t} = \mathbf{W}_i\mathbf{X}_t$ and

$$\mathbf{A}_{i,0}\mathbf{W}_i\mathbf{X}_t = \boldsymbol{\alpha}_{0,i} + \boldsymbol{\alpha}_{1,i}t + \mathbf{A}_{i,1}\mathbf{W}_i\mathbf{X}_{t-1} + \mathbf{u}_{i,t} \tag{3}$$

By stacking the $\mathbf{A}_{i,0}\mathbf{W}_i$ and $\mathbf{A}_{i,1}\mathbf{W}_i$ for all the countries in the model, we obtain:

$$\mathbf{G}\mathbf{X}_t = \boldsymbol{\alpha}_0 + \boldsymbol{\alpha}_1 t + \mathbf{H}\mathbf{X}_{t-1} + \mathbf{u}_t \tag{4}$$

where $\mathbf{G} = [(\mathbf{A}_{0,0}\mathbf{W}_0)', (\mathbf{A}_{1,0}\mathbf{W}_1)' \dots (\mathbf{A}_{N,0}\mathbf{W}_N)']$, $\mathbf{H} = [(\mathbf{A}_{0,1}\mathbf{W}_0)', (\mathbf{A}_{1,1}\mathbf{W}_1)' \dots (\mathbf{A}_{1,N}\mathbf{W}_N)']$, $\boldsymbol{\alpha}_0 = \left[(\boldsymbol{\alpha}'_{0,0}, (\boldsymbol{\alpha}'_{0,1})' \dots (\boldsymbol{\alpha}_{0,N})'\right]$, $\boldsymbol{\alpha}_1 = \left[(\boldsymbol{\alpha}'_{1,0}, (\boldsymbol{\alpha}'_{1,1})' \dots (\boldsymbol{\alpha}_{1,N})'\right]$ and $\mathbf{u}_t = \left[\mathbf{u}'_{0,t}, \mathbf{u}'_{1,t} \dots \mathbf{u}'_{N,t}\right]$. The global covariance matrix is block diagonal, with each individual block of the main diagonal, $\mathbf{\Sigma}_{u,i}$, calculated from the individual country-model residuals: $\mathbf{\Sigma_u} = diag(\Sigma_{u,0}, \Sigma_{u,1}, ..., \Sigma_{u,N})$.[17] Assuming that matrix $\mathbf{G}$ is non-singular, a pre-multiplication of (4) by $\mathbf{G}^{-1}$ yields:

$$\mathbf{X}_t = \boldsymbol{\beta}_0 + \boldsymbol{\beta}_1 t + \mathbf{F}\mathbf{X}_{t-1} + \boldsymbol{\epsilon}_t \tag{5}$$

where $\boldsymbol{\beta}_0 = \mathbf{G}^{-1}\boldsymbol{\alpha}_0$; $\boldsymbol{\beta}_1 = \mathbf{G}^{-1}\boldsymbol{\alpha}_1$; $\mathbf{F} = \mathbf{G}^{-1}\mathbf{H}$; and $\boldsymbol{\epsilon}_t = \mathbf{G}^{-1}\mathbf{u}_t$. The error term in (5) is correlated between and within countries, since matrix $\mathbf{G}$ encapsulates the contemporaneous correlation among countries.

[16] The term $w_{i,j}$ denotes country j's share in country i's total trade.

[17] We assume that $\mathbf{\Sigma_u}$ is block diagonal as the interactions between different countries should be captured by the foreign variables.

3.2 Identification of Structural Shocks

In order to identify shocks in this setting, one needs to specify a block matrix of structural coefficients $\mathbf{P}$ so as to express the reduced form residuals (from equation (4)), as a linear combination of structural shocks $\mathbf{v}_t \sim \mathcal{N}(\mathbf{0}, \mathbf{I}_{ki})$:

$$\mathbf{u}_t = \mathbf{P}\mathbf{v}_t \tag{6}$$

where

$$\mathbf{P} = \begin{bmatrix} \mathbf{P}_{0,0} & \mathbf{P}_{0,2} & \cdots & \mathbf{P}_{0,N} \\ \mathbf{P}_{1,0} & \mathbf{P}_{1,2} & \cdots & \mathbf{P}_{1,N} \\ \vdots & \vdots & \ddots & \vdots \\ \mathbf{P}_{N,0} & \mathbf{P}_{N,2} & \cdots & \mathbf{P}_{N,N} \end{bmatrix} \tag{7}$$

The diagonal elements of $\mathbf{P}$ contain the structural coefficients of the individual country models. The off-diagonal blocks represent the contemporaneous cross-country relationships.

The identification of the structural shock of the numeraire country ($i = 0$; here the US), requires us to recover the sub-matrix $\boldsymbol{P}_{0,0}$ which of course determines the contemporaneous interaction matrix of the US model. In practice, we are interested in identifying the first two columns of $\boldsymbol{P}_{0,0}$ that correspond to the contemporaneous impact of the Surprise and News shock, respectively.

We identify $\boldsymbol{P}_{0,0}$ by using a recursive identification scheme where the proxy for fiscal News is ordered second after government spending and before the rest of the variables. In this setting, the residual of the News equation will be the News shock, while the residual of the government spending equation will be purged from expectation effects and can therefore be interpreted as a Surprise shock. The block-element $\boldsymbol{P}_{0,0}$ will be the Cholesky factor of the covariance matrix of the US model $chol(\boldsymbol{\Sigma}_{u,0})$. For the rest of the diagonal blocks of $\mathbf{P}$, we assume identity matrices: $\mathbf{P} = diag(chol(\boldsymbol{\Sigma}_{u,0}), \mathbf{I}_{k_1}, \ldots \mathbf{I}_{k_N})$.[18]

We calculate the impulse response at horizon h as follows:

[18] We restrict the off-diagonal blocks to be null matrices. Cross-sectional correlation is expected to be very low as the domestic models are conditioned on foreign variables that account for common factors.

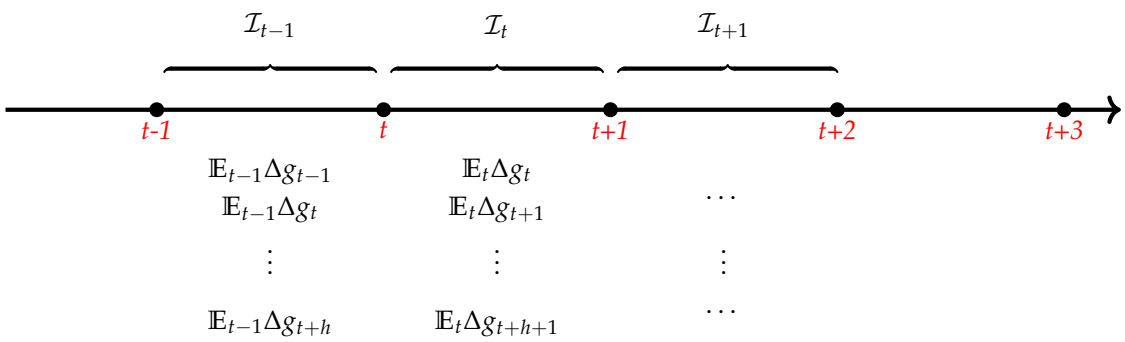
$$\mathbf{\Delta X_j}(h|y_t, \epsilon_{0,t}) = \mathbf{F^h G^{-1} P d_j} \tag{8}$$

where $\mathbf{\Delta X}_j(h|y_t, \epsilon_{0,t})$ is the $t+h$ response of the global vector, when a shock is imposed at time t, on the j^{th} element of $\mathbf{X}_t$. The $k \times 1$ selection vector d_j picks the j^{th} element of $\mathbf{X}$. In our case, where government spending is ordered first in the global vector so for the Surprise shock $d_{j=1}^{Surprise} = 1$ and $d_{j\neq1}^{Surprise} = 0$. The News shock proxy is ordered second so: $d_{j=2}^{News} = 1$ and $d_{j\neq2}^{News} = 0$.

4 Government spending shocks

Different measures of fiscal foresight indicators have been suggested in the literature. Ramey's (2011) narrative measure based on defense expenses is among the most well-known. However, Ramey also noted its low power in terms of predicting government spending for samples excluding WWII and the Korean War. Therefore, we follow Forni and Gambetti (2016), Caggiano et al. (2015) and Ricco (2015) and build a fiscal News measure based on the revisions of expectations using data from the SPF. To better illustrate the construction of this fiscal foresight proxy, Figure 2 describes the information flow involved.

Figure 2: The Information Flow in the SPF



Notes: *This graphic illustrates the information flow in the Survey of Professional Forecasters, and the associated expectations and information structure at each step.*

Every quarter a panel of professional forecasters provides their forecasts on a set of macroeconomic variables for the current and the next 4 quarters.[19] Official data are released with a lag,

[19] In practice, forecasts are reported for the levels of the variables for the current and the next 5 quarters. However, as the

so in each period, forecasters can observe only a recent vintage of the official data. Therefore, the information set $\mathcal{I}_{t-1}$ available to the forecasters at time $t-1$ incorporates past realizations of the relevant macroeconomic variables and signals concerning current and future fiscal policy changes. Forecasters, given the available information at time $t-1$ ($\mathcal{I}_{t-1}$) report their forecasts for current and future government spending. At time t, the information set of forecasters is updated by the realized values of macroeconomic variables of the past quarter and signals about future government spending received between time $t-1$ and t. The new information that forecasters acquire between periods (namely the difference between $\mathcal{I}_{t+s} - \mathcal{I}_{t+s-1}$, $s = 0, 1, 2, \dots$) is termed fiscal News. If the period of foresight h is known, then the problem of non-fundamentalness can be solved by augmenting the traditional VAR model with the conditional at time t h-step ahead forecast of the growth rate of government spending $\mathbb{E}_t \Delta g_{t+h}$, or the h-step ahead forecast revision: $\mathbb{E}_t \Delta g_{t+h} - \mathbb{E}_{t-1} \Delta g_{t+h}$. However, if the number of anticipation periods h is not known, then the consideration of the 'wrong' forecast horizon will not contain the News shock, and therefore the VAR model will still be subject to perfect foresight problem. Forni and Gambetti (2016) circumvent this issue by proposing to use the sum of the expectation revisions up to the maximum forecast horizon H:[20]

$$News_{1,h} = \sum_{h=1}^{H} \left(\mathbb{E}_t \Delta g_{t+h} - \mathbb{E}_{t-1} \Delta g_{t+h} \right) \tag{9}$$

The right-hand side of definition (9) is a sum of three forecasts at the maximum forecast horizon, $H = 3$. Note that we drop nowcast revisions: $h \neq 0$; nowcast revisions are not consistent with the News definition.[21]

Figure 3 shows the empirical News measure, derived using the SPF data similar to Forni and Gambetti (2016).[22] We further present some important political and fiscal events in vertical timelines, as well as overlaying Ramey's defense measure for comparison and motivation. Positive

base year has changed several times during the years, the transformation of the levels into quarter-to-quarter growth rates are often preferable. After the transformation in growth rates, forecasts are available only for the current and the next four quarters.

[20] Forni and Gambetti (2016) use two different measures of fiscal News: the cumulative sum of government spending growth forecasts and the sum of forecast revisions. They show that the two measures are equivalent. We use the former measure as a robustness exercise. Results from the alternative measure are almost identical to the baseline estimates and are available upon request.

[21] This is because nowcast revisions concern expectations about fiscal policy changes that occur at period t.

[22] Albeit using a longer and more recent sample in our case.

values indicate that professional forecasters revise their expectations about future spending upward. The variable displays positive spikes coinciding with major strategic events. For example, positive spikes are observed at the time of the Gulf War (90q3); the 911 attack; War in Afghanistan (01q4); and the Iraq War (03q1). There are also positive spikes at the time of the Strategic Defense Initiative ('Star Wars') program (83q2) or the fiscal stimulus programs/acts of Bush (Economic Growth and Tax Relief Reconciliation Act, 'EGTRRA' 01q2), Obama (09q1), and Trump (18q2).

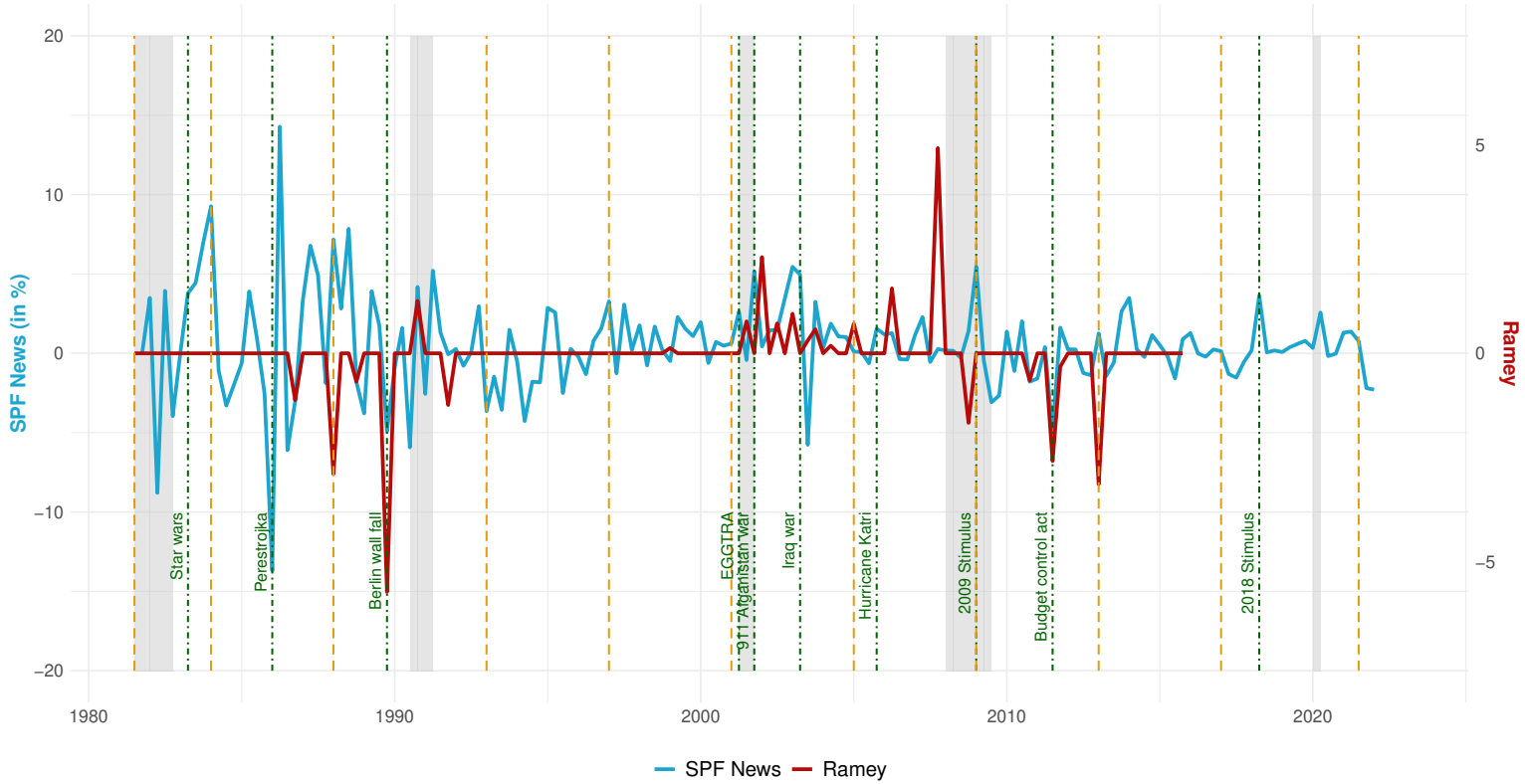
On the other hand, we see negative spikes that coincide with events indicating reductions in spending. For example, the Perestroika reforms (86q1) and the Berlin Wall fall (89q4) are associated with the end of the Cold War, and therefore cuts in military spending. The Budget Control Act (11q3) was a series of measures aimed at reducing the Federal debt.

Together, these 19 economies account for around 55% of world GDP. We treat the US (numeraire country) as the dominant global economy (sometimes in the game-theoretic macroeconomic cooperation literature, the Hegemon, Hughes-Hallett, 1989). Accordingly, we allow for spill-back effects to the US, which occur only through output. Therefore, the only foreign variable included in the US $VARX$ model is the weighted average of the 18 foreign outputs. For completeness, Table 3 shows the specifications of the US and non-US models. The former includes ten endogenous variables and one foreign variable. The non-US models include six endogenous variables and three foreign variables. In particular, the vector of the endogenous US variables are: real federal government spending and gross investment (g), the forecast revisions used as a proxy for fiscal News ($News$), real federal tax revenues (rev), real output (gdp), real private consumption ($cons$), real investment (inv), real long and short-term interest rates (respectively $ltir$ and $stir$), consumer price index (cpi), real effective exchange rate (rer), and real exports and imports (respectively, exp and imp). Where applicable, variables were transformed in per-capita terms.

5 Data

We consider a model with 19 countries, estimated over a sample of 1982q2–2019q4. This is in itself an interesting sample. For the US, for instance, there have been four NBER recessions, the Great Moderation, the Global Financial Crisis (GFC), and a variety of fiscal and monetary relief packages etc.

Figure 3: Fiscal News From Forecast Revisions and Ramey's (2011) Defense News Measure



Notes: *The figure plots a measure of fiscal News calculated as the forecast revisions of the median federal government spending and gross investment growth rate. The red line is Ramey's 2011 measure of Defense News. Gray bars indicate the NBER recession dates. Vertical dotted and dot-dashed lines, respectively, indicate dates of significant political and fiscal events: yellow for Presidential elections, and green for specific events which are labeled. The former are the elections of (in chronological order) Reagan, Reagan, Bush, Clinton, Clinton, G. W. Bush, G. W. Bush, Obama, Obama, Trump, Biden.*

Table 3: Model Specifications

Variable/Specification		US model		Non-US model	
		Domestic	Foreign	Domestic	Foreign
Government Spending	g	✓			
Fiscal News	$News$	✓			
Tax Revenues	rev	✓			
Real Output	gdp	✓	✓	✓	✓
Real Private Consumption	$cons$	✓		✓	✓
Real Private Investment	inv	✓			✓
Long-Term Interest Rate	$ltir$	✓		✓	✓
Short-Term Interest Rate	$stir$	✓		✓	✓
Consumer Price Index	cpi	✓		✓	✓
Real Effective Exchange Rate	rer	✓		✓	
Real Exports	exp	✓		✓	
Real Imports	imp	✓		✓	

Notes: *This table shows which variables enter the US and Non-US model and their categorization as domestic or foreign variables. Consistent with the exercise of examining the impact and spillover of US fiscal changes and its status as the leading financial economy, foreign outputs enter the US model, and foreign output, consumption and long-term interest rates enter the 'foreign block' of the non-US model (the foreign block comprises trade-weighted foreign output, foreign consumption, and foreign long-term yields).*

For many countries in Europe, there has been the monetary union, plus paths of economic performance across member states that have been quite distinct (reflecting different implicit growth models). For the UK, in addition to such common events, there has also been the much-discussed post-GFC productivity puzzle. Many of these events constitute a useful prism through which to understand and rationalize some dynamic responses and spillovers related to the fiscal shocks.

In the non-US country-specific models, we exclude government expenditures, tax revenues and fiscal News. We do so because (a) fiscal News and tax revenues data are in themselves not always available for each country, and (b) the inclusion of domestic government expenditure may complicate the identification of the direct impact of the US fiscal shock on domestic variables. For

all endogenous variables except exports, imports, and the real exchange rate, we construct the respective foreign variables as the weighted average of the corresponding domestic variables of all other countries included in our sample. For example, for country i, foreign output is given by

$$gdp^*_{it} = \sum_j w_{ij} gdp_{jt}$$

where the trade weight $w_{ij} \geq 0$ represents the trade share of country j to the total trade share of country i such that $\sum_j w_{ij} = 1$ and $w_{ii} \equiv 0$. For each country, the trade weights are constructed over 1990-2019. Data on trade flows were collected from the IMF's *Direction of Trade* database.

Table 4 shows some heat-mapped US trade weights with the 18 partner countries.[23] The highest weights are naturally among *NAFTA*, followed by Japan and South Korea, and then European economies (barring Ireland) which are characterized by smaller weights (in a $0.04 - 0.20$ range). To some extent, we shall see the importance of these weights in the impact and propagation of the US fiscal shocks across countries.

Table 4: Trade Weights: Non-US With The US (Heatmap)

Country	Weight	Country	Weight	Country	Weight
DE	0.13	DK	0.10	JP	0.40
GB	0.18	ES	0.07	KR	0.38
AU	0.12	FR	0.10	MX	0.85
BE	0.10	IE	0.29	NL	0.10
CA	0.82	IT	0.12	NO	0.06
CH	0.16	SE	0.08	PT	0.04

Notes: *Trade weights were calculated using data from the IMF Direction of Trade dataset. Annual data were averaged over the 1990-2019 period.*

[23] Appendix Table A.1 reports the *full* matrix of cross-country trade weights.

6 Fiscal Shocks: Measurement, Spillover and Size

In what follows, we report results from the time profile of News and Surprise shocks. We consider both the domestic and international spillovers of both shocks. By treating the US as the numeraire country, identification of government spending shock is achieved by a Cholesky decomposition of the US covariance matrix Σ_{u_0} as described in Section 3.2. The government spending shock is identified as the first Cholesky shock in a VAR constructed in the order of government spending followed by the News variable, tax revenues,[24] real output, real consumption, the long-term interest rate, the real effective exchange rate, real exports and real imports. In this setting, the residual of the News equation represents the *fiscal News shock*, while the residual of the government spending equation is the *fiscal Surprise shock*.

6.1 The Home Effect of US Government Spending Shocks

We now look purely at the *domestic* effect of US spending shocks, in the order of News then Surprise fiscal shocks. Thereafter in the two subsequent subsections, we assess their impact on the major economies (the G7 plus Spain), then the remaining modeled economies.

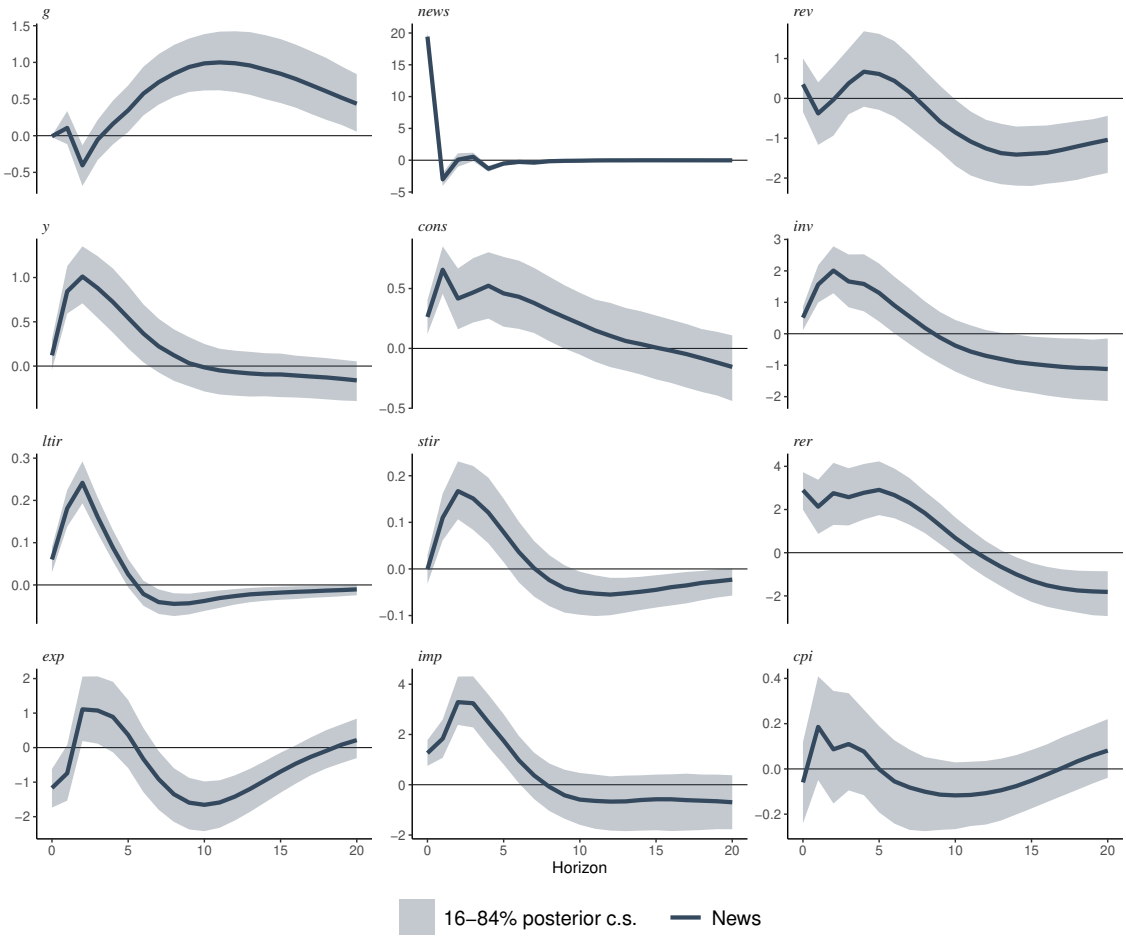
News Shock Figure 4 reports the responses of the US variables to a positive domestic fiscal News shock. The solid line shows the median responses while the shaded areas indicate 68% credible sets, which are approximately one standard deviation intervals for a normal distribution. Responses have been scaled, so that government spending peaks at 1% for both News and Surprise shocks.

Results demonstrate a strong positive response. Consistent with the concept of a News shock, government spending initially remains largely unresponsive (for three quarters). It then starts increasing persistently for 10 quarters, before declining gradually towards zero.[25] The persistent increase in government expenditures reflects market expectations about future expansionary fiscal policy, indicating that the News variable is a good predictor of future government spending

[24] Note, we follow the definition of Blanchard and Perotti (2002) and define tax receipts in real terms. Taxes are defined as federal tax receipts plus contributions for government social insurance, minus corporate income taxes from the Federal Reserve Banks divided by population, and then deflated by the GDP deflator. See also Ahmed and Park (1994).

[25] The same time profile of government spending has been observed in other studies under the same identification scheme (see e.g. Caggiano et al., 2015; Forni and Gambetti, 2016; Ricco, Callegari and Cimadomo, 2016).

Figure 4: Government Spending News Shock



Notes: *This figure shows the dynamic impact of a positive US fiscal News shock on key domestic variables. The two vertical axes have been adjusted, so the peak of government spending is 1%. The figure depicts median impulse responses and their 68% central posterior credible set (c.s). All y-axis values are in percentage change.*

movements. We also observe a rather long-lasting increase in output and consumption: zero is outside the credible set for six to seven quarters following the shock.[26]. Investment increases for more than a year, but then falls and becomes negative due to the fall in capital deepening following the financial crisis. Tenreyro (2018) shows that the slow recovery in productivity both in the US (and in the UK, see below) was due to a fall of capital investment and the flexible labor market.

[26] Note that the increase in consumption is lower but more persistent than the increase in output.

The short-lasting positive response of investment might also be due to the increase in the short-term interest rate, which, however, declines and becomes negative after two years.[27]. Although there is an increase in output and consumption, tax revenues fall, indicating a debt-financed fiscal expansion. Interest rates increase reflecting an anticipated increase in government spending growth, fall in tax revenues, and potential inflationary pressures. The rise in interest rates does not reflect a flight-to-safety behavior by investors, as the US bonds have remained among the safest assets throughout the period of our sample.

The rise in interest rates induces a pronounced and sustained appreciation of the real exchange rate. The real exchange rate increases for more than two years before the credible set includes zero.[28] The appreciation of the real exchange rate leads to an overall deterioration of the trade balance: exports fall on impact and remain negative for three quarters, while imports increase significantly and remains positive for approximately two years. The increase in imports is driven by the positive wealth effects generated by the real exchange rate appreciation – which aligns with the operation of an expenditure-switching channel.

The results of the News shocks support the twin-deficit hypothesis: an increase in government spending leads to an appreciation of the real exchange rate, and deterioration of net trade. Therefore, the exchange rate puzzle documented by Kim and Roubini (2008) appears, in part at least, to be an artifact of an omitted variable, namely, the News variable.

Surprise Shock Figure 5 plots the impulse responses to a positive Surprise shock. This shows that government spending increases on impact and declines gradually to become negative after three years. The shift in the sign of the government spending response at later horizons indicates evidence of a spending reversal, which is consistent with the short-lasting but positive response of output and consumption. Note that both output and consumption plunge below zero after a year following the shock. The fall of output, consumption (and investment which declines immediately) corroborate the expectation of a spending reversal, which in turn implies a fall of the long-term interest rate generated by a decline of expected inflation. The drop in the long-term

[27] The fall of short-term interest rate below zero might plausibly be driven by the large scale of quantitative easing policy pursued after the financial crisis

[28] Our results corroborate the view that forward-looking variables react on impact to a fiscal News shock (see e.g. Beetsma et al., 2021).

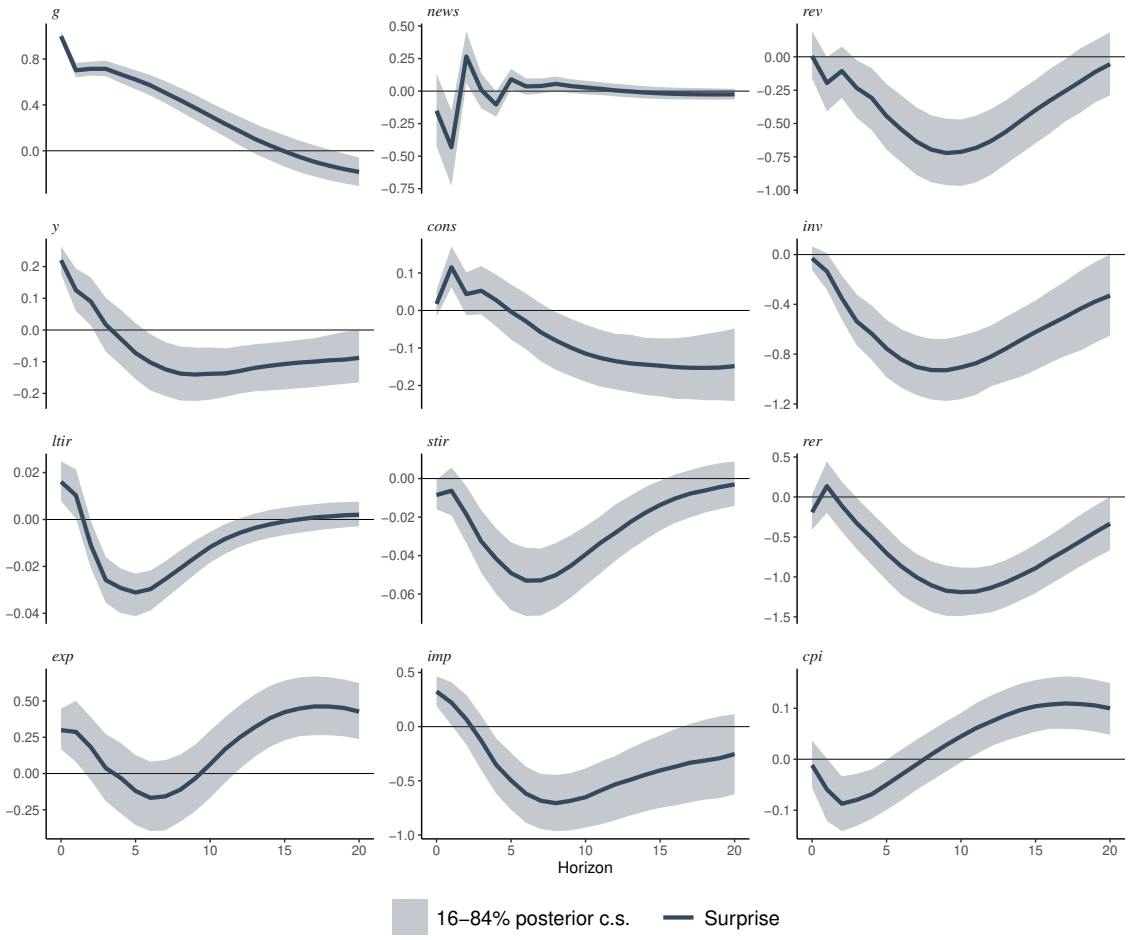
interest rate leads to a depreciation of the real exchange rate.

However, although we do observe a strong and persistent real exchange rate depreciation, exports remain muted for two years and increase afterwards (consistent with a J-curve dynamic).[29] Imports fall and remain negative for more than five years. The downturn of imports is due both to the negative wealth effects generated by the depreciation, and to Ricardian behavior reflected by the fall of private consumption. Note that the positive correlation between the response of exports and the response of the real exchange rate: after the seventh quarter, while the exchange rate starts increasing (appreciates), exports instead of falling start increasing faster. The counterintuitive positive correlation between exports and the real exchange rate implies that results are not driven by the fall of long-term interest rate but rather by the fall of output, consumption and investment.

The Policy Mix The responses to both News and Surprise shocks suggest that the implication of the closed economy model of Ascari et al. (2023) do not hold in an open economy framework. Recall that Ascari et al. (2023) show that the impact of anticipated fiscal shock is regime-dependent: contractionary in the monetary regime and expansionary in the fiscal policy regime. Alternatively, unanticipated fiscal shocks are expansionary in both regimes. In the case of anticipated (News) shock (recall Figure 4), results demonstrate that the argument that a fiscal expansion in the prevailing monetary regime – Active monetary policy, Passive fiscal policy – leads to a decline in output and consumption does not appear to hold in the open economy model. For example, the observed persistent increase in output and consumption following the News shock might be driven by the positive wealth effects generated by an appreciation of the real exchange rate, and possible positive feedback effects produced by the rise of foreign output: an increase in global income. Alternatively, Figure 5 shows that unanticipated shock has negative impact on domestic business cycle (output, consumption and investment) driven by negative wealth effects produced by the depreciation of the real exchange rate. Therefore, our empirical results contribute to the theoretical literature of fiscal multipliers by raising a theoretical and empirical question concerning the impact of fiscal News and Surprise shock on output and consumption accounting for the role of foreign variables. This suggests the theoretical literature still has some way to confront and account for this.

[29] Albeit, exports increase marginally on impact and then remain within the credible set for ten quarters.

FIGURE 5: GOVERNMENT SPENDING SURPRISE SHOCK



NOTES: *This figure shows the dynamic impact of a positive US fiscal Surprise shock on key domestic variables. The two vertical axes have been adjusted, so the peak of government spending is 1%. The figure depicts median impulse responses and their 68% central posterior credible set.*

6.2 The International effects of US Fiscal Shocks: The Major Economies

Now we explore the international transmission of US fiscal shocks. Before coming to the empirical results, note the two main channels through which a US fiscal policy shock may affect partner economies. The first channel operates through trade, which in turn affects foreign variables through either (i) the expenditure-boosting channel and/or (ii) an expenditure-switching channel. The former implies that following a US fiscal expansion, domestic income will increase through

higher export demand from the US (i.e., the US imports more). The latter channel (i.e., expenditure switching) implies that a US fiscal expansion will lead to the depreciation of the foreign real exchange rate, which in turn will boost exports. Note, Appendix B isolates the export, import, and net trade responses to the US shocks.

The second channel through which fiscal policy shocks diffuse across countries is the financial channel. A fiscal expansion in the US will increase domestic interest rates, which in turn can impact foreign financial variables through financial linkages. The direction of spillovers depends on whether the mechanism of spending reversal is Active or not.[30]

News Shock Figure 6 shows the impulse response functions for the major economies (non-US G7 countries plus Spain) to a positive US fiscal News shock: rows indicate the country; columns indicate the response of the variables. There is evidence of positive response of all variables with the exception of the real exchange rate. In Canada, UK and the Southern euro area (SEA) countries – Italy and Spain – the real exchange rate appreciates. The reverse is true for Japan and the Northern euro area (NEA) countries of France and Germany.[31]

The positive response of output is demand-driven reflecting the increase in consumption and investment following a positive external demand shock.[32] Depreciation of the *rer* in NEA and Japan leads to an improvement in net trade due to the strong positive response of exports that outpace imports. Specifically, we observe that for two years following the positive US fiscal shock, the increase in exports in Germany exceeded the positive response of imports by 0.25 percent per quarter before both the imports and exports responses become negative. In France, the positive response of exports exceeds the positive response of imports for a year following the shock before both become negative and the latter (imports) fall more than the former: improvement in net trade.[33] The positive response of net trade in Japan is even stronger and more persistent than that in France and Germany: net exports increased on average more than 1 percent per quarter for

[30] Corsetti, Meier and Müller (2012) show that an expansionary fiscal policy can lead to a fall in interest rate by assuming that agents expect a subsequent spending reversal. Alternatively, a standard portfolio balance model (e.g., Dornbusch, 1975; Obstfeld and Rogoff, 1996) predicts that an expansionary fiscal policy boosts both domestic (US) and foreign interest rates leading to lower foreign output.

[31] Note that in Germany and France the real exchange rate falls on impact and appreciates after two years.

[32] Note that data for investment (at least for the full sample) are available only for Canada and France.

[33] For ease of exposition, Figure B.1 and Figure B.2 present only the responses of net trade variables to News and Surprise shock, respectively. Extended results are available on request.

more than two years following the US fiscal shock.

Note that for the countries that experienced a depreciation of the *rer* and improvement in net trade, the long-term interest rate (*ltir*) increased after the US positive demand shock. The rise of the long-term interest rate (*ltir*) reflects the positive external demand shock induced by a positive US fiscal shock. Therefore, international spillovers are transmitted through the trade channel: that is to say, through, the expenditure boosting and expenditure switching channels.

When we focus on the countries that experienced an appreciation of the *rer*, we observed a deterioration of net trade driven by the stronger positive response of imports (relative to exports) from the US expansion.[34] A noticeable exception is the UK where not only did exports increase more than imports, but also imports fell after six quarters following the US fiscal shock.[35] Note that the responses of imports and exports are different from zero only for two years following the shock.

This improvement in UK net trade is mainly driven by two factors. First, output increases more than domestic absorption: while output increases for more than a year above 0.2 percent consumption falls and becomes negative across all the out-of-sample period.[36] Note that although we do not include private investment in the estimated model, there is a large literature concerning the UK productivity puzzle that argues that the fall of the UK productivity prior to and after the Great Recession was due to the drop of capital deepening and business investment.[37] The second factor that explains the positive response of the UK's net trade to an expansionary US fiscal News shock is related to the financial channel. In particular, we observed that long-term interest rates increased briefly – less than a year – and then fell below zero for most of the out-of-sample period. This downturn reflects the expectation of a future fall in inflation and depreciation of the *rer*, which in turn will lift exports and net trade. Our findings suggest that the trade and financial channels can both be employed to ameliorate trade imbalances in the UK.

Unlike the UK, the SEA countries experienced an appreciation of the *rer* and deterioration

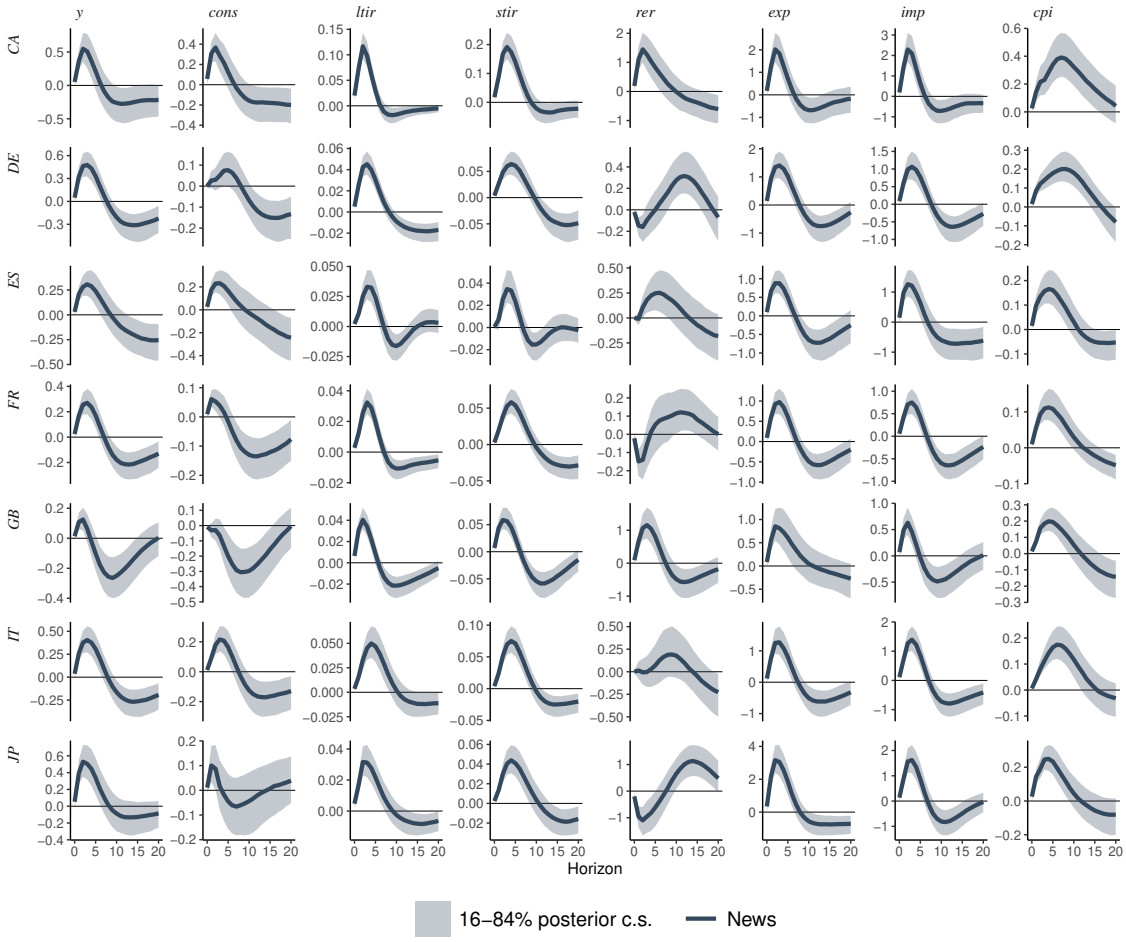
[34] This is only marginally true in Italy after a year following the shock.

[35] Figure B.1 shows that the positive response of net trade in the UK is even stronger and more persistent than the improvement of the net trade of the countries that experienced a depreciation of the *rer*.

[36] Real GDP growth becomes negative after a year following the shock but increases again and becomes positive after three years

[37] For example, Tenreyro (2018) shows that following the financial crisis credit constraints and a flexible labor market led UK firms to substitute capital for labor.

FIGURE 6: US GOVERNMENT SPENDING NEWS SHOCK EFFECT ON THE ADVANCED ECONOMIES



NOTES: *This figure shows the dynamic impact of a positive US fiscal News shock on key domestic variables across the Advanced economies (here the non-US G7 + Spain). The shock has been normalized, in order for the government spending to peak at 1%. The figure depicts median impulse responses and their 68% central posterior credible set.*

rather than improvement in net trade. The fall in net trade in Italy and Spain reflects a strong and persistent increase in consumption, which is consistent with the demand driven model of economic growth adopted by the SEA countries.[38] The positive and persistent increase in consumption is reinforced by the positive wealth effects generated by an appreciation of the *rer*, which in turn lifts imports. We also observe an increase in the *ltir*, which suggests an appreciation of the *rer* and a decline in net trade. Our findings are consistent with a sizable literature on capital misallocation and productivity slowdown observed in SEA and induced by the introduction of the single currency.[39] For instance, the downturn of net exports in Italy, Portugal (shown in Appendix C) and Spain was driven by both a demand-driven IGLM and a fall in productivity due to capital misallocation after the introduction of the euro and a subsequent credit abundance due to capital inflows. Giavazzi and Spaventa (2011) show that the negative relation between the real exchange rate and net trade in the SEA countries was driven by a fall in productivity. In the context of Spain, capital misallocation may reflect the historical legacy of investment in sectors of low productivity such as housing (and the impact of regulations, Laeven, McAdam and Popov, 2023). Alternatively, in Italy, Hassan and Ottaviano (2013) describes the observed fall of TFP in the context of capital misallocation as the "great unlearning". Finally, in Canada, there is evidence that both exports and imports increase by the same amount – 2 percentage per quarter – for one and a half year following the US expansionary fiscal shock. Therefore, unlike the UK and the SEA countries, both of which experience an appreciation of *rer*, net trade in Canada remained unchanged.

The key observation concerning the international transmission of the US fiscal News shock is thus that it operates through the expenditure boosting and switching channel: the trade channel. The exception to this is the spillover effect on the UK where both the trade and financial channels play a role in shaping the responses of the domestic business cycle.

Surprise Shock Figure 7 shows the international response to the US Surprise fiscal shock. Unlike responses to the News shock, we observed a fall in all variables. This is except for the real exchange

[38] Regan (2017) argues that the Southern euro area (SEA) economies such as Italy, Spain, Greece and Portugal, relied more on domestic consumption as a mechanism of economic growth. In doing so, the SEA countries arguably follow an *import-led growth model* (IGLM). Rivera-Batiz and Romer (1991) and Esfahani (1991) show that imports of intermediate goods and technologies can boost domestic economic growth.

[39] For example, Gopinath et al. (2017) demonstrated that capital inflows and subsequent real interest rate decline in SEA countries led to capital misallocation and the decline of total factor productivity (TFP). Gopinath et al. (2017) argue that low interest rates benefit disproportionately low-productivity firms with high net worth.

rate, where there are some country specificities.

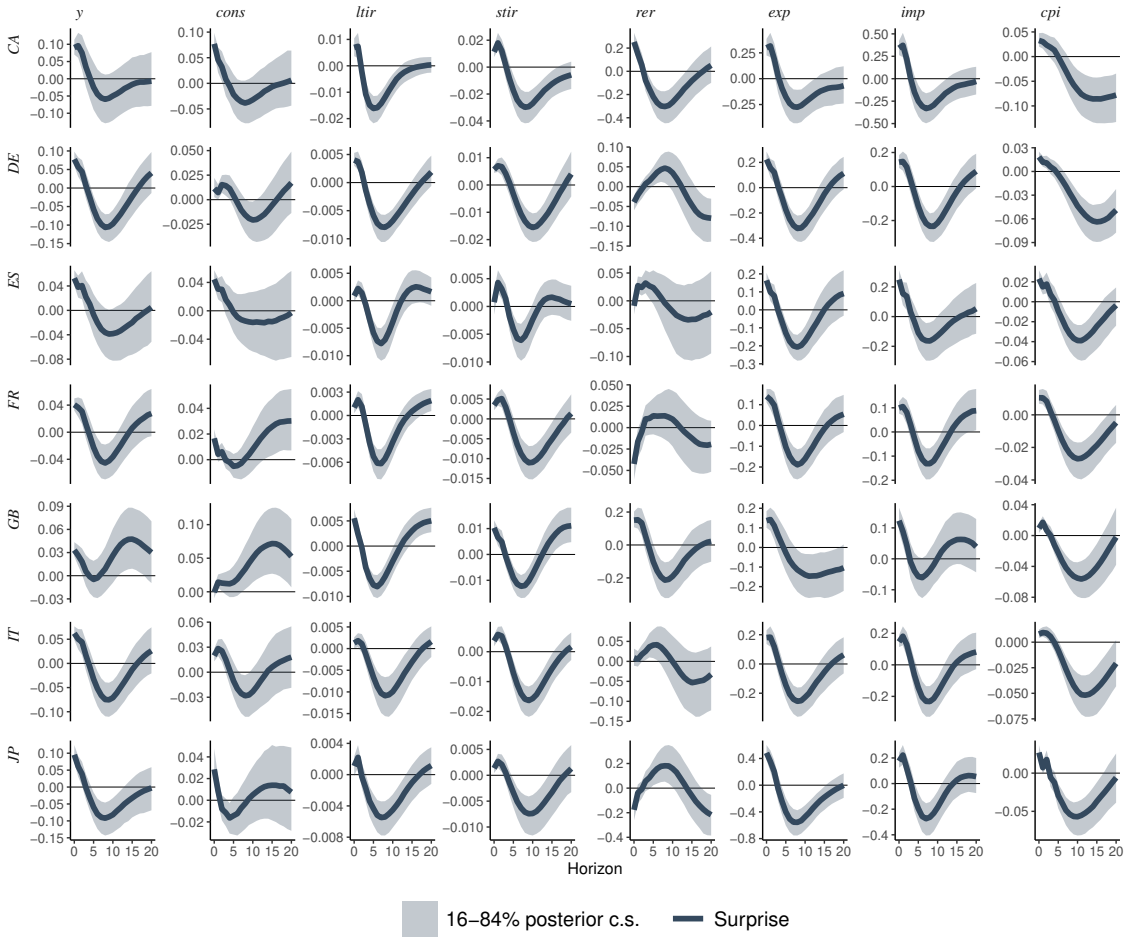
Based on the response of net trade, results again suggest that there are two groups of countries. In the first group – France, Japan and the UK – net trade declines for a considerable part of the horizon. For example, in France, both exports and imports fall sharply for a year and then imports start growing faster than exports. In the same vein, in the UK, we observe that while initially, the reduction of exports and imports was approximately equal after a year, the latter became stable and started increasing above zero but exports remained persistently low and negative for most of the out-of-sample period.[40] Deterioration of the net trade in both countries (France and the UK) is mainly driven by an external negative demand shock – the reduction of US imports following the fiscal Surprise. It is also worth stressing that the US fiscal Surprise shock leads to a fall in domestic output, consumption and imports, which in turn will generate a persistent fall in the UK's and France's net trade.[41] The negative response of these countries' net trade is driven not only by the direct spillovers generated by the fall of US imports but also by the higher-order (indirect) spillovers induced by the negative response of output and imports in all other euro area countries, which are the main trade partners of both of these countries. The fall of imports in the euro area countries would have exacerbated the fall of UK and French exports due to the negative US demand shock.

Unlike in France, the UK and Japan, the responses of net trade in Italy and Spain to the US fiscal Surprise shock are either positive or neutral: the response of exports and imports is equal in terms of size and sign. For example, in Spain, the fall in exports and imports is approximately the same for two years following the shock but then exports increase faster and above imports. The neutral response of net trade in SEA countries due to the fall of imports is not surprising because, as reported in the case of News shock, both countries (are widely interpreted to have) pursued a demand-driven model of economic growth. This is consistent with the fall of output and consumption following a negative external – fall in US imports – demand shock. More formally, in both countries (Spain and Italy), we observed a fall in output and consumption, which, in turn, affected imports negatively. Alternatively, even if there is a depreciation of the real exchange rate,

[40] Note, the fall in imports is outside the credible set only for a short period.

[41] Recall that a positive fiscal Surprise in the US led to the fall of both domestic output and imports (i.e., where domestic of course here means US).

FIGURE 7: US SURPRISE GOVERNMENT SPENDING SHOCK EFFECT ON THE ADVANCED ECONOMIES



NOTES: *This figure shows the dynamic impact of a positive US fiscal Surprise shock on key domestic variables across the Advanced Economies (here the non-US G7 economies plus Spain). The shock has been normalized in order for the government spending to peak at 1%. The figure depicts the median impulse responses and their 68% central posterior credible set.*

exports fall due to the decline of imports not only from the US but also from the other euro area countries (this also occurs for the UK).[42]

Hence, our results underline the importance of taking into account indirect spillovers. For example, while the trade weights between the US and individual SEA countries are low, the trade links between the US and NEA countries and the links of the latter with SEA are relatively high. Therefore, the fall in US imports has an indirect impact on the SEA exports through its negative impact on the output of NEA and the UK. These complex sequences of trades uncovered, further underscore the importance of a rich well-specified open economy framework.

6.3 The International effects of US Fiscal Shocks: Outside the Major Economies

This section briefly summarizes the results for the remaining countries. For brevity we place the relevant graphical material in appendices. Figure C.1 shows the country responses of GDP and Consumption, for the two shocks. Each point represents the peak or trough of the median IRF. Bars indicate the 68% posterior credible set. The numbers on each row indicate the horizon at which the IRF peaks or troughs.[43]

Output and consumption responses are consistent with the aforementioned G7 results. The first two panels show that for the majority of the countries output increases in response to a positive fiscal News shock while it declines in response to a positive Surprise shock. The absolute strength of those effects maps somewhat to the trade shares shown in earlier Table 4. The two right panels show the response of consumption which shows the same pattern as the responses of output. The positive responses of output and consumption to a fiscal News shock are due to an increase in the US output and imports: a positive external demand shock. On the other hand, the negative output and consumption response to the US Surprise shock is driven by the drop in output, consumption and imports in the US.

Figure C.2 illustrates the responses of the long and short-term interest rates. The responses of the former uniformly increase across all countries after the News shock, and decline after the Surprise shock (with the home economy most affected). A similar pattern is observed for the short-term rates, barring Australia and Mexico where the short-term rates fall after the News

[42] In both countries the fall (depreciation) of *rer* is not significant: zero is within the credible interval.

[43] The presentation of results aims to facilitate the comparison of responses across countries rather than across shocks.

shock and increase after the Surprise shock. In both shock cases, the interest rate reflect future expectations about inflation (as shown in Figure C.3). Moreover, interest rates responses indicate that the shock is propagated through a financial channel and counteracts the positive/negative effects of the trade channel.

Figure C.3 illustrates the responses of the CPI and the real effective exchange rate. The CPI responses uniformly increased across all countries after the News shock, and declined after the Surprise shock. The opposite effect is observed only in Mexico. Price responses are in line with the positive and the negative US effects after the News and the Surprise shock respectively. The last two panels show the responses of the real exchange rates, which to great extent mirror the responses of the interest rates: appreciate in response to a News shock; depreciate in response to a Surprise shock

Finally, Figure C.4 presents the responses of exports and imports. These display a similar pattern to the responses of output and consumption: namely, an increase following a News shock, and a downturn after a Surprise fiscal shock.[44] As before, though we see in these exercises a sizable degree of country-specific responses, reflecting the strength of the relevant trade linkages and the implicit growth model of the recipients' economies.

6.4 Robustness

In this section, we test the robustness of our results accounting for structural changes that occurred in US fiscal policy. More concretely, as pointed out by Ferrara et al. (2021), while prior to 1998 the US fiscal policy alternated between debt-financed (1982–1993) and tax-financed policies; after 1998, it shifted to debt-financed spending. Here, we gauge the IRFs for the post-1998 period because our sample starts in 1998. There are not enough observations to measure the impact of tax-financed policy.[45]

Figure D.1 shows the IRFs generated by a News shock. The results remained qualitatively similar to those observed using the full sample: the real exchange rate appreciated and net trade

[44] Interestingly the effects of the US shocks on Ireland's trade have a wide credible set, traversing zero. This accords with the well-known complexities of measuring US-Irish trade, particularly in the context of global supply chains, transfer pricing, multinational corporations, digital products, and statistical discrepancies (e.g., FitzGerald, 2013; Lane, 2017).

[45] Estimates for the period 1982-1997 show that while for the surprises shocks IRFs remain qualitatively similar to those observed in the full sample, the IRFs for the "News shock" were not significant. This might reflect that the "News shocks" for the period between 1982-1997 were rather muted: low variation.

deteriorated. However, most of the responses are weak.[46] Therefore, there is no exchange rate puzzle. Alternatively, the responses to a Surprise shock presented in Figure D.2, are significant and consistent with results generated from the full sample: output, consumption and investment fall while real exchange rate depreciates and net trade improves.

7 Concluding Remarks

Despite the surge of research on fiscal policy in recent years, and unprecedented fiscal accommodation witnessed across the world, studies on the international transmission of structural fiscal shocks in substantive open economy settings seem limited and inconclusive. Addressing those shortcomings has been our purpose. In doing so, we have contributed in three key respects.

First, we address the perfect foresight problem by constructing a proxy for fiscal News shocks using forecast revisions from the Survey of Professional Forecasters. This approach avoids model mis-specification and counterintuitive outcomes, such as the exchange rate puzzle. To our knowledge, ours is the first study employing fiscal News shocks to estimate US fiscal spillovers.

Second, we utilize a Bayesian structural multi-country VAR framework. This is in marked contrast with two-country stylized models typically used in previous studies, and which have attracted criticism as yielding inconsistent and biased econometric estimates, as well as neglecting higher-order interactions. This has allowed us a more nuanced and empirically sound means to analyze the sign and nature of fiscal shocks across borders.

Third, we examine the impact of anticipated (News) and unanticipated (Surprise) fiscal shocks. Our findings offer additional insight into existing research suggesting that the impact of fiscal shocks depends on the policy mix. Our results show a positive correlation between fiscal News shocks and the responses of output and consumption, suggesting that the closed economy model conclusions by Ascari et al. (2023) need not hold in an open economy.

What are the implications of our finding for fiscal policy research and policy making? We can identify four points of note:

1. **Domestic Effects:** Fiscal News shocks cause the real exchange rate to appreciate and net trade

[46] exception to this are the responses of government spending, inflation and export.

to fall, while Surprise shocks lead to real exchange rate depreciation; declines in output and consumption, and net trade improvement. This accounts for the evidence of the exchange rate puzzle noted by Kim and Roubini (2008).

2. **International Spillovers:** US fiscal News shocks impact other countries primarily through the trade channel, with the caveat that for the UK, both trade and financial channels matter; this observation is compatible with the UK's extensive financial services share.

3. **Growth Model Dependence:** The impact of US fiscal News shocks varies by region and implicit national economic model. This is an important and arguably overlooked aspect in the literature. Specifically, Southern European countries (and the UK) both experience a real exchange rate appreciation, but the former experience a net trade deterioration (reflecting increased consumption) while the latter (i.e., the UK) exhibits a net trade improvement with muted consumption and weak investment. This conclusion speaks to important state dependencies in fiscal spillovers and recognizing differences in international economic structures.

4. **Global Framework**: Higher-order spillovers amplify direct spillovers. SEA countries show persistent net trade improvement due to larger import declines (relative to exports) – while the UK, France, and Japan experience net trade downturns exacerbated by output and import declines in both the US and other countries in the sample.

Our findings underscore the importance of taking an avowedly global perspective when analyzing the international transmission of fiscal policy shocks and distinguishing between different types of policy shocks. Accordingly, our work should be useful to other researchers assessing the international dimension and nature of changes in fiscal policy and the appropriate supporting modeling framework. Similar considerations might well apply to analyzing the national and international dimension of monetary and macroprudential policies.[47]

[47] See also Breitenlechner, Georgiadis and Schumann (2022) and Rubio (2020), respectively, for interesting exercises in these areas.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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A Data

Table A.1 lists empirical trade weights for our set of countries. The trade weights are taken from the IMF's *Direction of Trade* (DOTS) database which may be found at www.imf.org/en/Publications/Books/Issues/2016/12/30/A-Guide-to-Direction-of-Trade-Statistics-154

The Survey of Professional Forecasters data may be found at www.philadelphiafed.org/surveys-and-data/real-time-data-research/survey-of-professional-forecasters

The country data on real output, real consumption and real government spending were all taken from the OECD data sources, whilst the financial data **(e**xchange rates, interest rates) were taken from the IMF's WEO database.

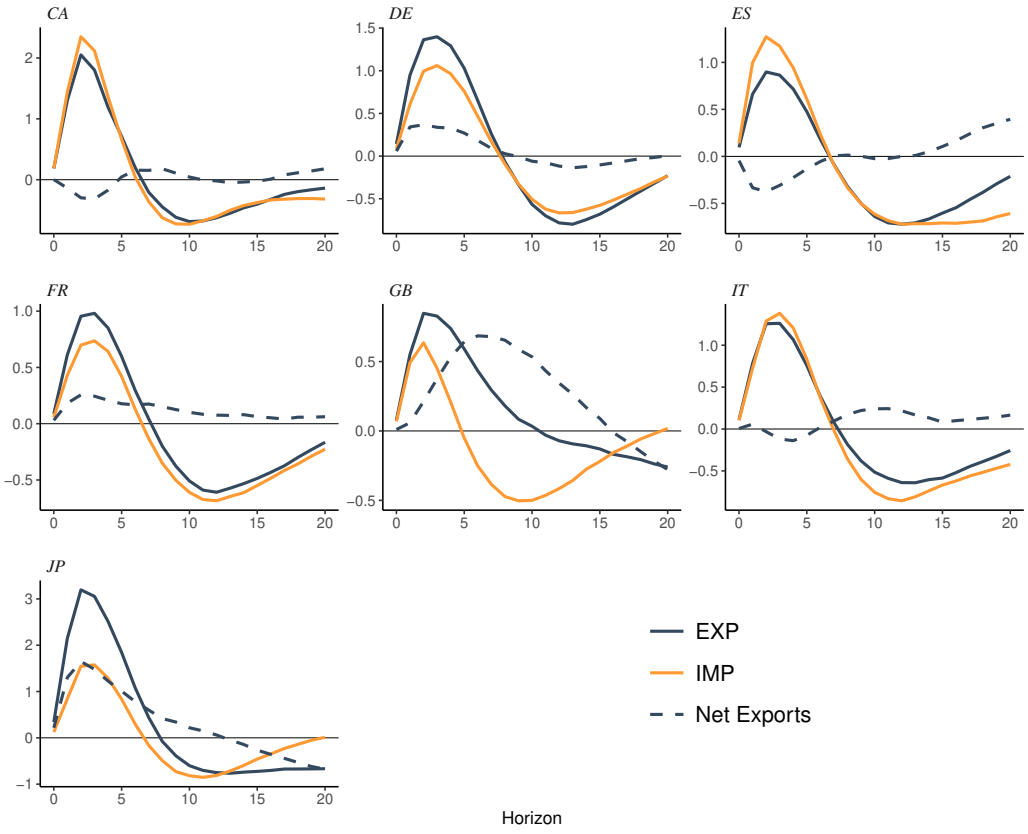
The country codes are: **US** = USA, **AU** = Australia, **BE** = Belgium, **CA** = Canada, **CH** = Switzerland, **DE** = Germany, **DK** = Denmark, **ES** = Spain, **FR** = France, **GB** = United Kingdom, **ID** = Indonesia, **IE** = Ireland, **IT** = Italy, **JP** = Japan, **KR** = South Korea, **MX** = Mexico, **NL** = Netherlands, **NO** = Norway, **PT** = Portugal, **SE** = Sweden.

Table A.1: Country weights matrix

	US	DE	GB	AU	BE	CA	CH	DK	ES	FR	IE	IT	SE	JP	KR	MX	NL	NO	PT
US		0.08	0.06	0.01	0.03	0.25	0.02	0.01	0.01	0.03	0.02	0.03	0.01	0.09	0.05	0.25	0.03	0.00	0.00
DE	0.13		0.09	0.01	0.09	0.01	0.07	0.02	0.06	0.13	0.02	0.09	0.03	0.03	0.02	0.01	0.17	0.02	0.01
GB	0.18	0.17		0.02	0.07	0.03	0.06	0.01	0.05	0.09	0.06	0.05	0.02	0.03	0.01	0.01	0.11	0.03	0.01
AU	0.20	0.07	0.09		0.02	0.02	0.02	0.01	0.01	0.02	0.01	0.03	0.01	0.31	0.14	0.01	0.03	0.00	0.00
BE	0.10	0.21	0.08	0.00		0.01	0.02	0.01	0.03	0.16	0.03	0.06	0.02	0.02	0.01	0.01	0.21	0.01	0.01
CA	0.82	0.02	0.03	0.00	0.01		0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.02	0.01	0.03	0.01	0.00	0.00
CH	0.16	0.29	0.11	0.01	0.03	0.01		0.01	0.03	0.10	0.02	0.12	0.01	0.03	0.01	0.01	0.04	0.00	0.00
DK	0.10	0.26	0.07	0.01	0.04	0.01	0.01		0.03	0.05	0.01	0.04	0.16	0.02	0.01	0.00	0.10	0.08	0.01
ES	0.07	0.19	0.08	0.00	0.05	0.01	0.03	0.01		0.21	0.01	0.12	0.01	0.01	0.01	0.02	0.07	0.01	0.09
FR	0.10	0.23	0.08	0.00	0.12	0.01	0.05	0.01	0.11		0.01	0.12	0.01	0.02	0.01	0.01	0.09	0.01	0.02
IE	0.29	0.11	0.22	0.00	0.09	0.01	0.03	0.01	0.02	0.05		0.03	0.01	0.03	0.01	0.01	0.07	0.00	0.00
IT	0.12	0.23	0.07	0.01	0.06	0.01	0.07	0.01	0.09	0.16	0.01		0.02	0.02	0.02	0.01	0.07	0.01	0.01
SE	0.08	0.21	0.07	0.01	0.07	0.01	0.02	0.11	0.03	0.06	0.01	0.05		0.02	0.01	0.00	0.12	0.12	0.01
JP	0.40	0.08	0.04	0.10	0.02	0.03	0.02	0.01	0.01	0.03	0.01	0.02	0.01		0.14	0.03	0.03	0.00	0.00
KR	0.38	0.08	0.03	0.07	0.01	0.03	0.01	0.00	0.02	0.03	0.00	0.03	0.01	0.22		0.05	0.03	0.01	0.00
MX	0.85	0.03	0.01	0.00	0.00	0.03	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.02	0.02		0.01	0.00	0.00
NL	0.10	0.31	0.10	0.01	0.15	0.01	0.02	0.02	0.04	0.09	0.02	0.05	0.03	0.02	0.01	0.01		0.02	0.01
NO	0.06	0.17	0.17	0.00	0.04	0.02	0.01	0.08	0.03	0.06	0.01	0.02	0.17	0.02	0.02	0.00	0.12		0.01
PT	0.04	0.17	0.05	0.00	0.04	0.01	0.02	0.01	0.35	0.14	0.01	0.07	0.01	0.01	0.01	0.00	0.07	0.01	

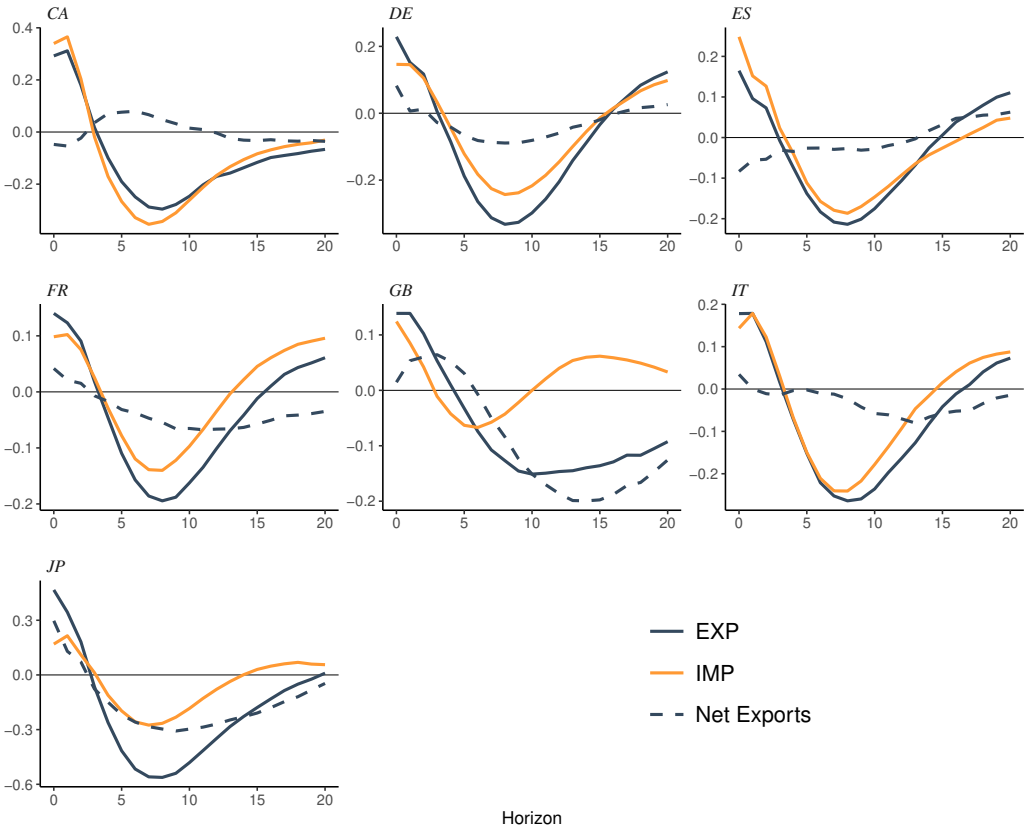
B Response of the Advanced Economies to a US News Fiscal shock

Figure B.1: Responses of the G7 net trade variables to the US Fiscal News shock



Notes: *This figure shows the dynamic impact of a positive US fiscal News shock on exports, imports and net trade of the G7.*

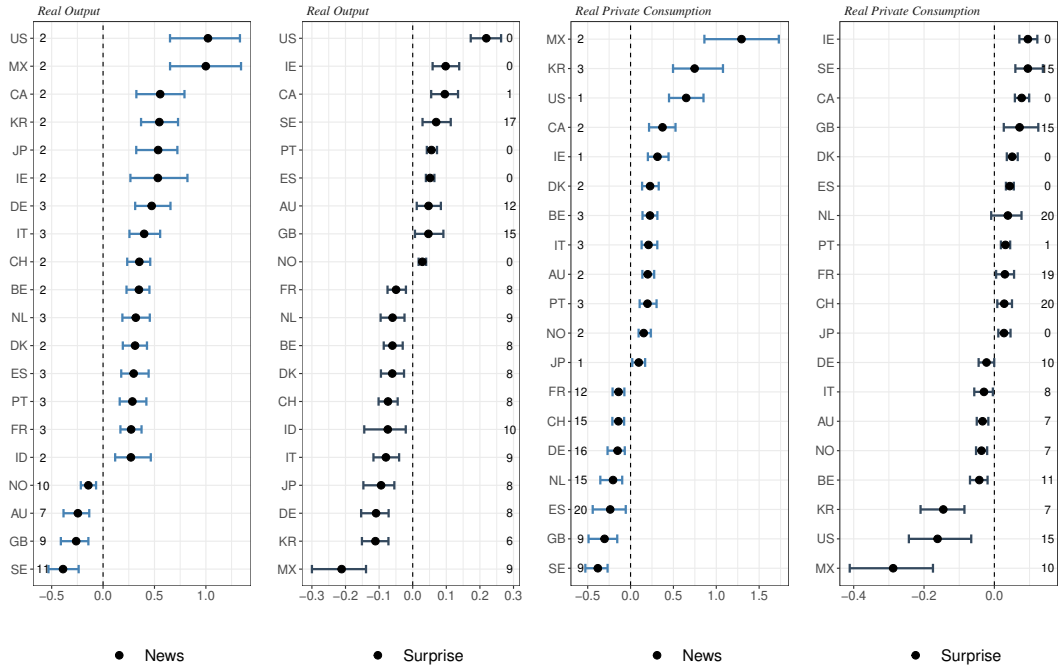
Figure B.2: Responses of the G7 net trade variables to a US Surprise Fiscal shock



Notes: *This figure shows the dynamic impact of a positive US fiscal Surprise shock on exports, imports and net trade of the G7.*

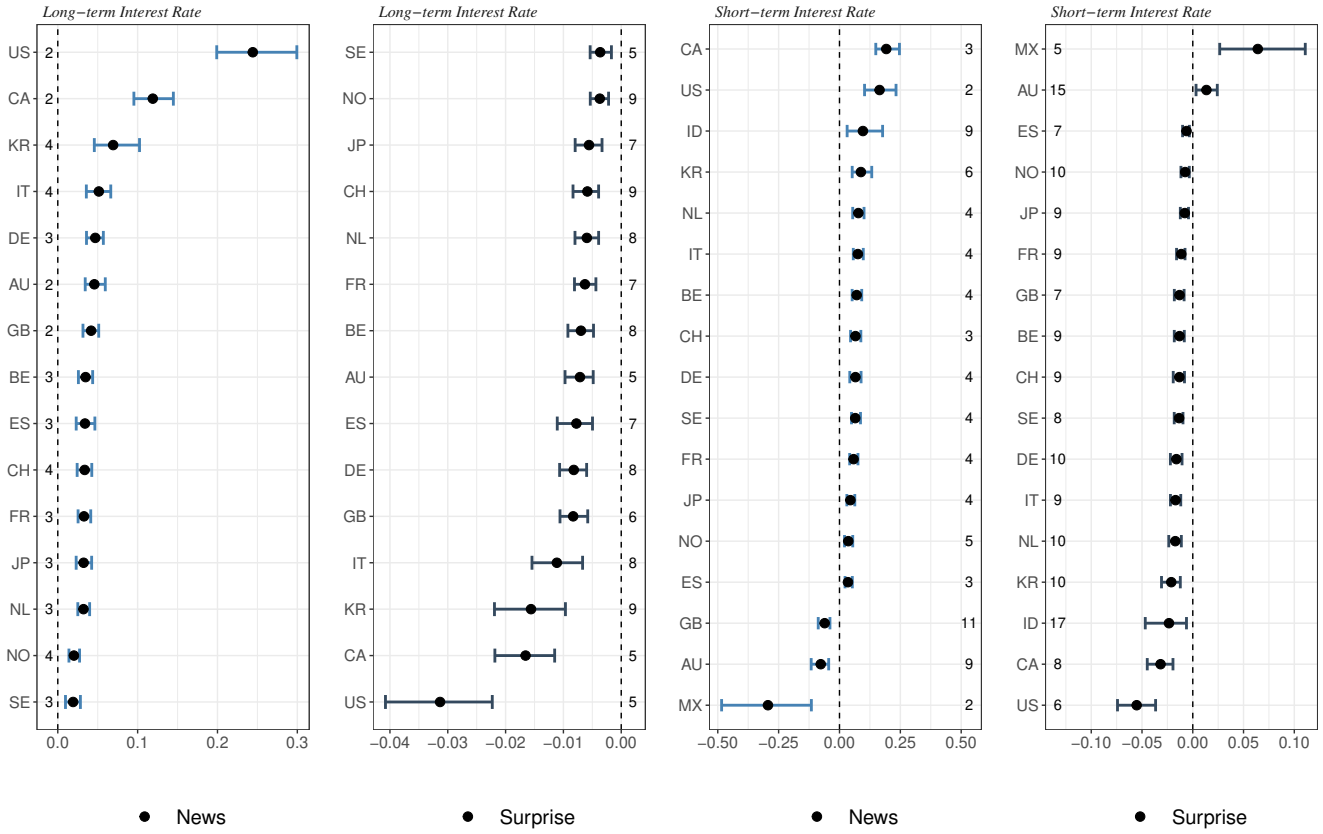
C Responses: Panel of Countries

Figure C.1: All Responses Of GDP/Consumption To A US News And Surprise Fiscal Shock



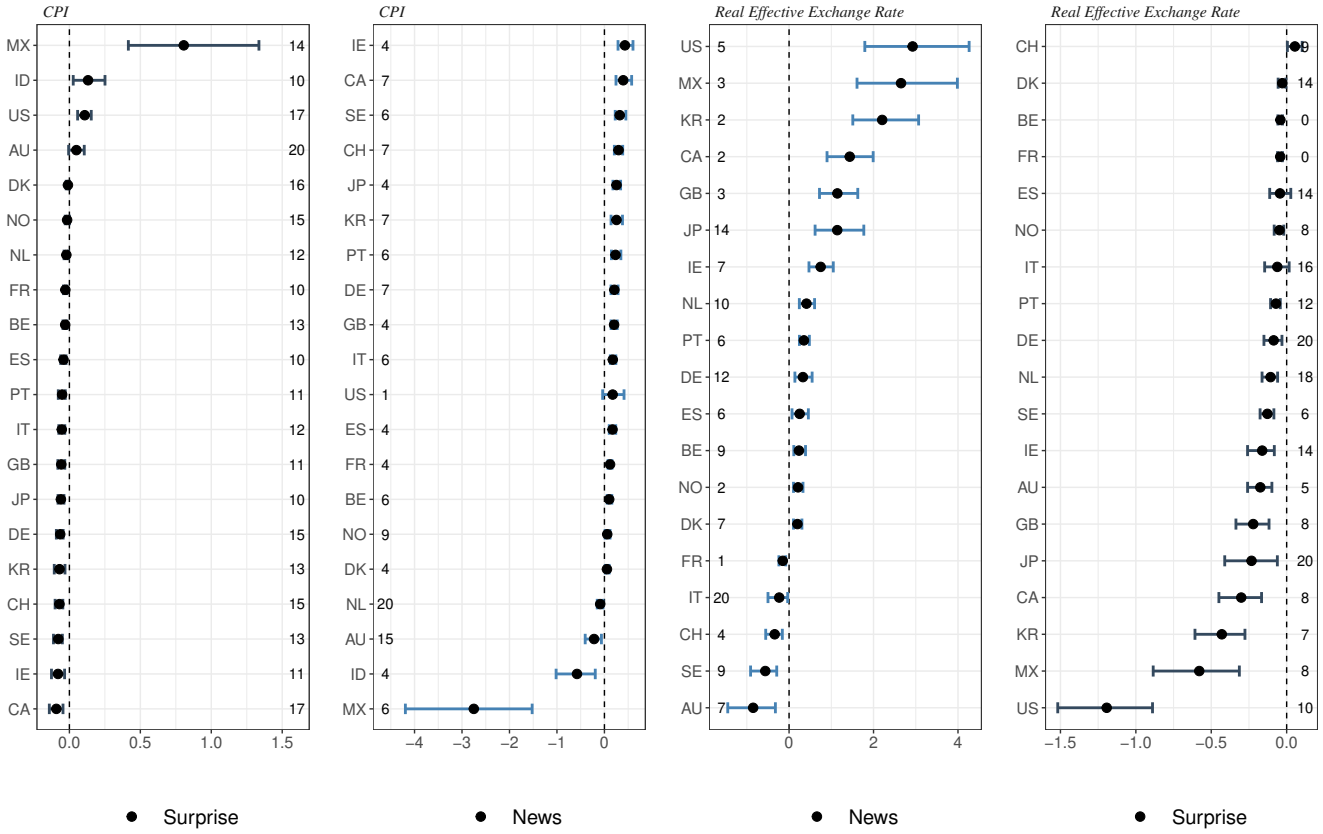
Notes: *Shocks are normalized so that the peak of the US government spending shock reaches 1%. Error bars represent the 68% central posterior credible set. The dashed vertical line indicates zero.*

FIGURE C.2: ALL RESPONSES OF LONG-TERM INTEREST RATES TO A US GOVERNMENT NEWS AND SURPRISE SPENDING SHOCK



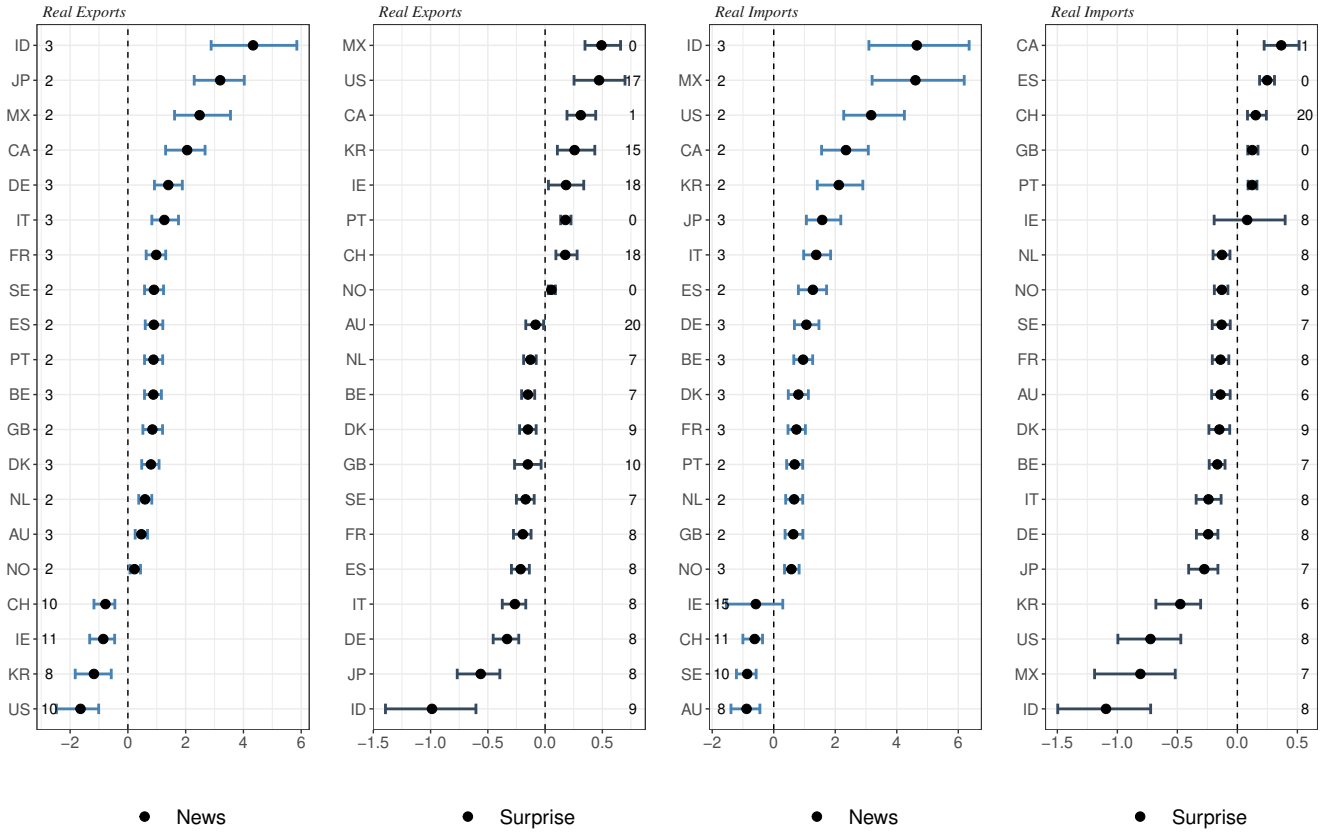
NOTES: *Shocks are normalized so that the peak of the US government spending shock reaches 1%. Error bars represent the 68% central posterior credible set. The dashed vertical line indicates zero.*

FIGURE C.3: ALL RESPONSES OF CPI/ REAL EFFECTIVE EXCHANGE RATE TO A US GOVERNMENT SPENDING NEWS AND SURPRISE SPENDING SHOCK



NOTES: *Shocks are normalized so that the peak of the US government spending shock reaches 1%. Error bars represent the 68% central posterior credible set. The dashed vertical line indicates zero.*

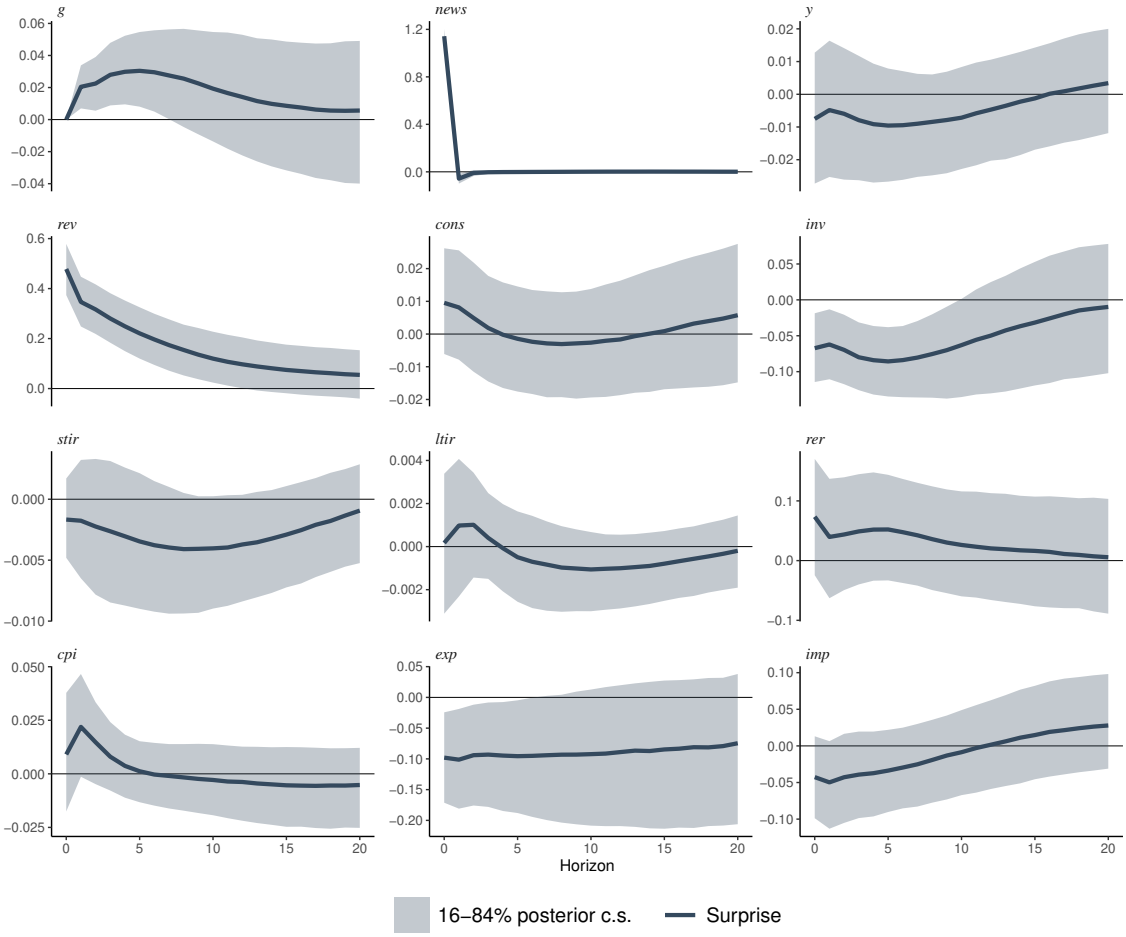
Figure C.4: All Responses of Exports/ Imports to a US Government Spending News and Surprise Spending shock



Notes: *Shocks are normalized so that the peak of the US government spending shock reaches 1%. Error bars represent the 68% central posterior credible set. The dashed vertical line indicates zero.*

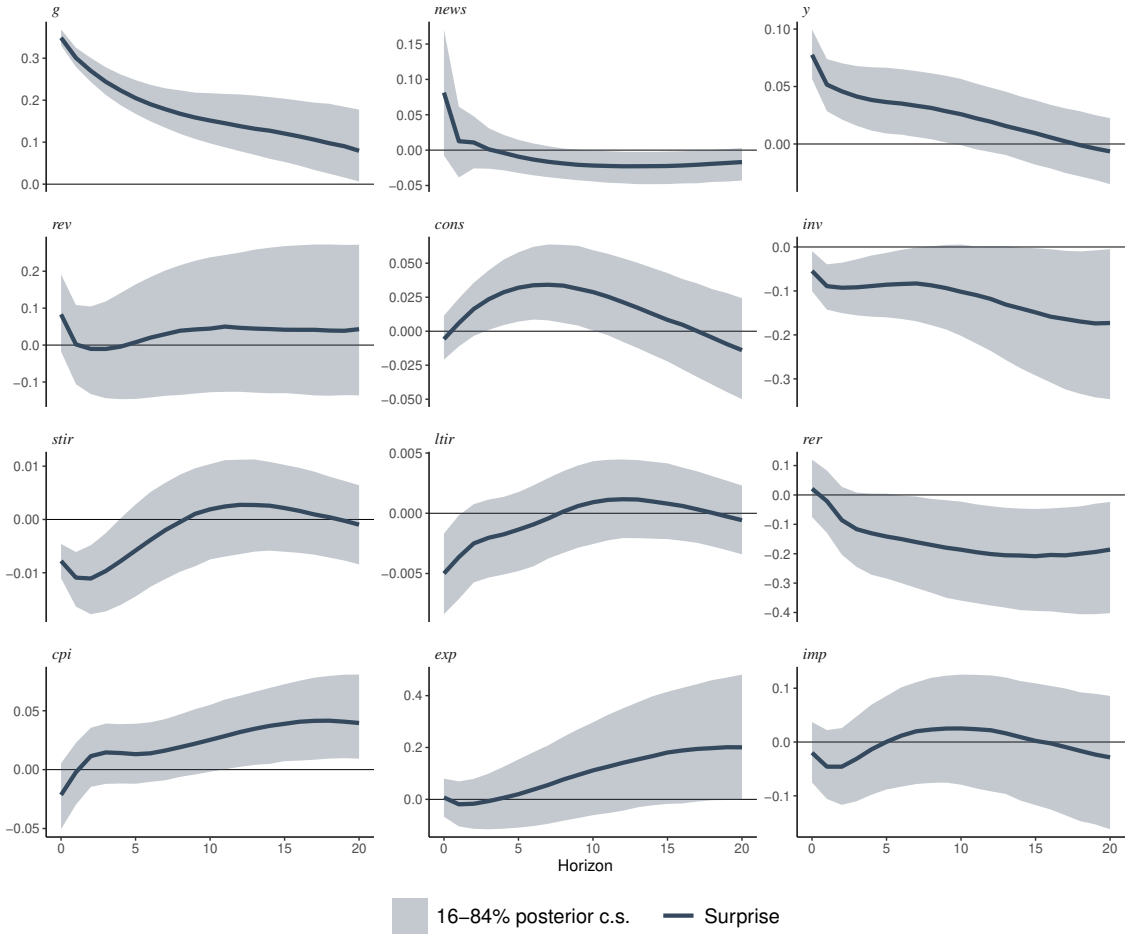
D Responses: Robustness Checks

Figure D.1: Government Spending News Shock - Post 1997 sample



Notes: *This figure shows the dynamic impact of a positive US fiscal News shock on key domestic variables. The two vertical axes have been adjusted, so the peak of government spending is 1%. The figure depicts median impulse responses and their 68% central posterior credible set.*

FIGURE D.2: GOVERNMENT SPENDING SURPRISE SHOCK - POST 1997 SAMPLE



NOTES: *This figure shows the dynamic impact of a positive US fiscal Surprise shock on key domestic variables. The two vertical axes have been adjusted, so the peak of the government spending is 1%. The figure depicts median impulse responses and their 68% central posterior credible set.*