

SPIILLOVER

NOTES

SPIILLOVERS FROM US GOVERNMENT SPENDING SHOCKS

Impact on External Positions

Adina Popescu and Ippei Shibata

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SPILLOVERS FROM US GOVERNMENT SPENDING SHOCKS: IMPACT ON EXTERNAL POSITIONS

This note analyzes the impact of preannounced government spending shocks in the United States on the real effective exchange rate and the trade balance. Using a vector autoregression framework that allows anticipated fiscal shocks to be identified using survey information, we find that preannounced spending shocks lead to a sizeable real effective dollar appreciation and a worsening of both the aggregate trade balance and bilateral trade balances in a panel of partner countries. The results are robust to controlling for country-specific variables like the macroeconomic and policy conditions in the recipient countries, are generalized across regions, and might have decreased during the zero-interest-lower-bound regime.

Introduction

Spillovers of fiscal policies have been extensively researched, in particular as pertains to their effects on aggregate economic activity.¹ Fiscal shocks transmit to other countries via movements in exchange rates and trade balances, which makes it important to clearly identify the spillovers on the external positions. However, the impact of fiscal policies on external positions is arguably not easy to assess, in part because of the presence of fast-moving variables like the exchange rate, which require careful identification. To some extent because of such issues, the existing literature does not provide conclusive answers regarding the effects of fiscal shocks on external positions.

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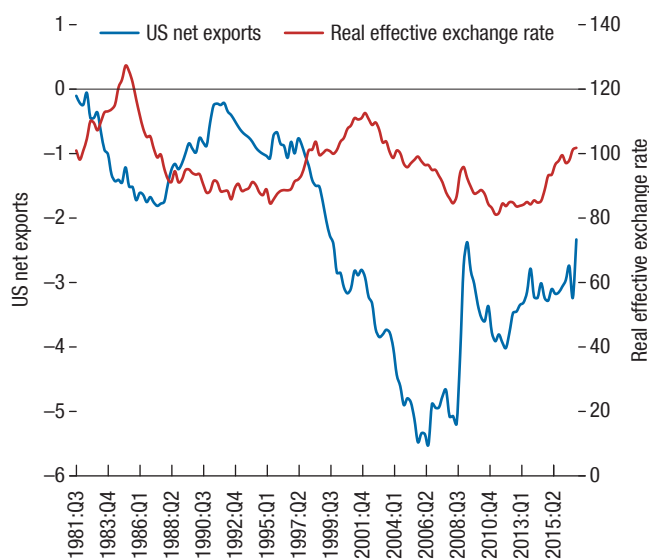
¹See Spillover Note 11, "Fiscal Spillovers: The Importance of Macroeconomic and Policy Conditions in Transmission" (Blagrave and others 2017).

This note looks at the impact of fiscal spending shocks from the United States on the US trade balance and real exchange rate. Our motivation for considering this type of fiscal shock is the following. As mentioned previously, the spillovers of US fiscal policy on exchange rates and the trade balance are still controversial. At the same time, the United States is a very significant contributor to developments in global imbalances. Additionally, data from professional forecasters' surveys, which are key for the identification procedure, are available only for the United States and cover only government spending (to the best of our knowledge, no comparable data exist for tax revenues or for other countries).

Historically, the US external imbalance has varied over time. US external deficits increased significantly during the period running up to the global financial crisis, mostly as a counterpart to emerging Asia's and advanced Europe's external surpluses, and have diminished considerably since then, partly because of the shale oil "revolution" (IMF 2016). Throughout the same period, the real effective exchange rate for the dollar has in general been negatively correlated with the trade balance, although this correlation may have attenuated over time (Figure 1).

In the case of the United States, the large external deficits have been accompanied by fiscal deficits (the so-called twin-deficits hypothesis, according to which changes in the fiscal balance are a main driver of the current account). Fiscal policies also affect relative prices and thus real exchange rates and through this channel also competitiveness and trade. As all these variables move together, the challenge for empirical analysis is to identify causality between fiscal policies and the external position and real exchange rate, while controlling for other factors, such as the state of the business cycle or the monetary policy stance.

The traditional approach has mainly identified shocks from actual fiscal spending in a structural vector autoregression framework. However, such methods face the challenge that fiscal shocks at the time of actual spending are to a large extent already anticipated (the "fiscal foresight" hypothesis; see Ramey 2011). This may result in a misidentification of shocks and thus biasing in the results. Some recent literature employs

Figure 1. US Trade Balance and Real Effective Exchange Rate

Source: Haver Analytics.

a narrative approach that uses announcement dates to capture exogenous changes in government spending, which seems to have significant influence on the results. The issue of the precise timing of fiscal shocks may be particularly important for the response of fast-moving variables such as exchange rates.

In order to address anticipation effects, this note uses a novel identification strategy to assess empirically the impact of preannounced US government spending shocks on exchange rates and trade balances. We employ a methodology put forward in Forni and Gambetti 2016 and use survey information to capture the changes in forecasts about future government spending to identify preannounced (referred to as “news”) fiscal spending shocks and study their effects. This approach can capture changes in agents’ expectations about future government spending to identify the fiscal shock at the time when expectations change.

The note employs two complementary methodologies. First, in a vector autoregression (VAR) setting using US data only, we estimate the impact of anticipated spending shocks on the US real exchange rate and trade balance. We then introduce these anticipated fiscal shocks in a panel VAR (PVAR) with trade-weighted linkages, which allows us to take into account the recipient country’s macro and policy variables (such as cyclical positions, monetary policy, and domestic fiscal policy).

The second analysis allows a better quantification of the effects from the perspective of the recipient countries, as the shocks are weighted according to the importance of US exports for these economies and are conditioned on domestic business cycle and macro policies.

The note adds to the literature along a number of dimensions. First, we extend the original contribution of Forni and Gambetti (2016) and show that preannounced fiscal policy shocks have the theoretically expected impact on the real exchange rate and the trade balance (eliminating concerns about the presence of a “depreciation” puzzle in the United States). We show that these findings hold also for bilateral exchange rates and trade balances, using a panel of advanced and emerging market economies. Our results are economically meaningful and very robust to method, specification, and regional grouping. A novel finding is that the response during the global financial crisis may have been weaker than before the crisis, in particular for real exchange rates, on account of the constrained monetary policy.

The main results can be summarized as follows:

- US fiscal spending has a significant impact on real exchange rates and trade balances. More precisely, preannounced increases in government expenditures appreciate the dollar and lead to a worsening in US net exports. Quantitatively, a stimulus spending announcement of 1 percent of GDP would appreciate the dollar by up to 7 percent over 1.5 years while worsening net exports by 0.65 percentage points over the course of 2–3 years.
- The impact of US stimulus is largely shared across all regions. For a panel of advanced and emerging market economies that constitute the main US trading partners, a US fiscal expansion results in an economically and statistically significant improvement in the trade balance and deterioration in the bilateral exchange rate for US partner countries.
- The impact of US fiscal shocks on exchange rates and trade balances may have diminished following the global financial crisis, as the constrained monetary policy at the zero lower bound may have dampened exchange rate appreciation (in response to expansionary fiscal shocks), potentially contributing to a weaker trade balance response.

The rest of the note is organized as follows. The next section presents a brief theoretical and empirical literature review. The third section explains the methodological approach behind our identification of the

fiscal shocks. It then presents the results from a VAR estimated on US data only and subsequently from a panel VAR on a sample of advanced and emerging market economies. The results are further checked for robustness along a number of dimensions.

Effects of U.S. Fiscal Shocks: What Do We Know?

Theoretical Channels of Transmission for Fiscal Spillovers on External Variables

The theoretical literature on fiscal spillovers has highlighted several channels of transmission. In the textbook Mundell-Fleming paradigm as well as in standard dynamic stochastic general equilibrium models, expansionary fiscal policy should lead to (both a nominal and a real) appreciation of the currency and a worsening of the trade balance. The effects are generally explained through several channels. The demand channel (also called the “trade” or “expenditure-shifting” channel) works through the fact that fiscal expansion boosts domestic demand and thus also the demand for foreign goods and should increase the (net) exports of trading partners.

The competitiveness/expenditure-switching channel works through the impact of currency appreciation on the trade balance. Namely, as fiscal expansion is accompanied by inflationary pressures in the source country, these pressures would lead to an increase in nominal and real interest rates. Higher capital inflows under a regime of flexible exchange rates would generate pressure on the nominal exchange rate (and with sticky prices, also on the real exchange rate) to appreciate. The loss in competitiveness would then lead to a deterioration in the source country’s trade balance.

Another channel emphasized in the literature has to do with the home bias of government spending. According to this channel, fiscal expansions increase the price of home-produced goods relative to imported goods, resulting in a real appreciation of the currency. Overall, higher government spending should lead to a real exchange rate appreciation and a fall in net exports, in line with the twin-deficits hypothesis.

Empirical Controversies on the Sign and Size of US External Spillovers

Empirical analyses have offered relatively inconclusive evidence on the sign and magnitudes of fiscal

spillovers over various time spans and countries. In particular, little consensus exists regarding the consequences of a US fiscal expansion for the exchange rate and the trade balance. For the United States, the empirical structural VAR (SVAR) evidence suggests that increases in government spending lead to a depreciation of the real domestic currency—the so-called depreciation puzzle (see Kim and Roubini 2008; Corsetti and Müller 2006; Monacelli and Perotti 2010; Ravn, Schmitt-Grohé, and Uribe 2012; and Enders, Müller, and Scholl 2011). Only more recently have papers using the narrative/historical approach to identify exogenous innovation to government spending or revenue been able to document appreciation in response to expansionary (defense) spending shocks (see, for example, Auerbach and Gorodnichenko 2016).

As regards the trade balance, findings are also mixed. Some papers, like Corsetti and Müller 2006 and Kim and Roubini 2008, find that the US trade balance improves, while Monacelli and Perotti 2010, Ravn, Schmitt-Grohé, and Uribe 2012 and Garcia-Solanes, Rodríguez-López, and Torres 2011 find that it worsens. Some papers have employed a PVAR to estimate the impact of fiscal stimulus and find a significant trade balance deterioration, but the sample is often limited to the euro area (Beetsma, Guiliadori, and Klaassen 2006, 2008; Ali Abbas and others 2011). Chapter 4 of the September 2011 *World Economic Outlook* (IMF 2011) documents that the current account responds substantially to fiscal policy in a panel of Organisation for Economic Co-operation and Development (OECD) member countries.

Effects of US Fiscal Spending Shocks: Results from a Novel Identification

Evidence from a Vector Autoregressive Model

In this section, we estimate a fiscal VAR on US data that incorporates information about the anticipated component of spending shocks to allow us to capture the idea of “fiscal foresight.” We rely on a novel identification approach put forward by Forni and Gambetti (2016), who employ Survey of Professional Forecasters (SPF) forecasts of government spending to extract preannounced/anticipated (also called “news” or “foresight”) fiscal spending shocks. These anticipated shocks represent announcements about future changes

in spending that have only delayed effects on spending itself, however, they affect on impact (that is, without delay) agents' expectations and thus behavior. Expenditure measures implemented through the budget and all other major fiscal spending increases or cuts—for example, substantial defense spending—would generate this type of shock. As in Forni and Gambetti's work, the fiscal news variable is defined as the cumulative SPF forecasts for government spending growth one year ahead (see Annex 1 for further details on the methodology).²

With the fiscal news variable thus defined, we conduct a VAR on quarterly US data from the first quarter of 1981 through the fourth quarter of 2016. The VAR includes, in this order: real federal government consumption expenditures and gross investment (FEDGOV), the fiscal “news” variable based on Survey of Professional Forecasters (SPF) forecasts, real GDP, private consumption, the federal surplus divided by GDP, net exports of goods and services divided by GDP, the 10-Year Treasury Constant Maturity Rate, and the effective real exchange rate.³ Figure 2 plots the effects of anticipated fiscal spending shocks, which are the identified structural shocks from the second equation in the VAR.

In response to a spending news shock, we find that actual government spending increases significantly and very persistently. The effect is negligible in the first four to five quarters, consistent with the idea of anticipation, after which actual spending does start to increase—that is, the announcements are confirmed. The hump-shaped rise in government spending peaks after about three years at about 2 percent and has a very slow decay rate. This pattern is consistent with episodes of large and persistent changes in fiscal expenditures, as in the case of wars or major civilian spending increase or cut episodes (an identification of key spending events as is generally done in the historical approach is presented later in the note).

²Forni and Gambetti (2016) also show that the inclusion of such a fiscal news variable provides sufficient information to extract the underlying shock to expectations.

³The VAR is identified recursively, and the ordering reflects several identification assumptions. Slow-moving macroeconomic variables are placed first in the VAR, while the fast-moving financial variables come last. Spending and the spending “news” variable are placed before the other macro variables, in particular before GDP, to reflect the assumption that fiscal policy can be assumed *not* to respond to unexpected changes in GDP within the quarter (owing to both information and implementation lags). Both sets of assumptions are widely employed in the literature.

In line with the very persistent increase in spending, the federal surplus also declines quite persistently by up to 1.5 percentage points of GDP at peak. This suggests that most of the spending increase is deficit financed. Our results thus lend support to the twin-deficits hypothesis. In anticipation of future spending growth, which would induce a very prolonged expansion, in addition to persistently higher deficits and debt, the nominal long-term interest rate increases immediately and very significantly, by about 1.4 percentage points, and these effects are highly significant for about 1.5 years.⁴

In line with this large and persistent fiscal stimulus, both output and private consumption react very significantly already on impact. The impact multiplier on output is 0.5, and the peak multiplier reaches 1.5 after one year, after which it gradually loses significance. Consumption is significantly and persistently crowded in, similar to government spending, in line with theories that emphasize a high degree of complementarity between the two.

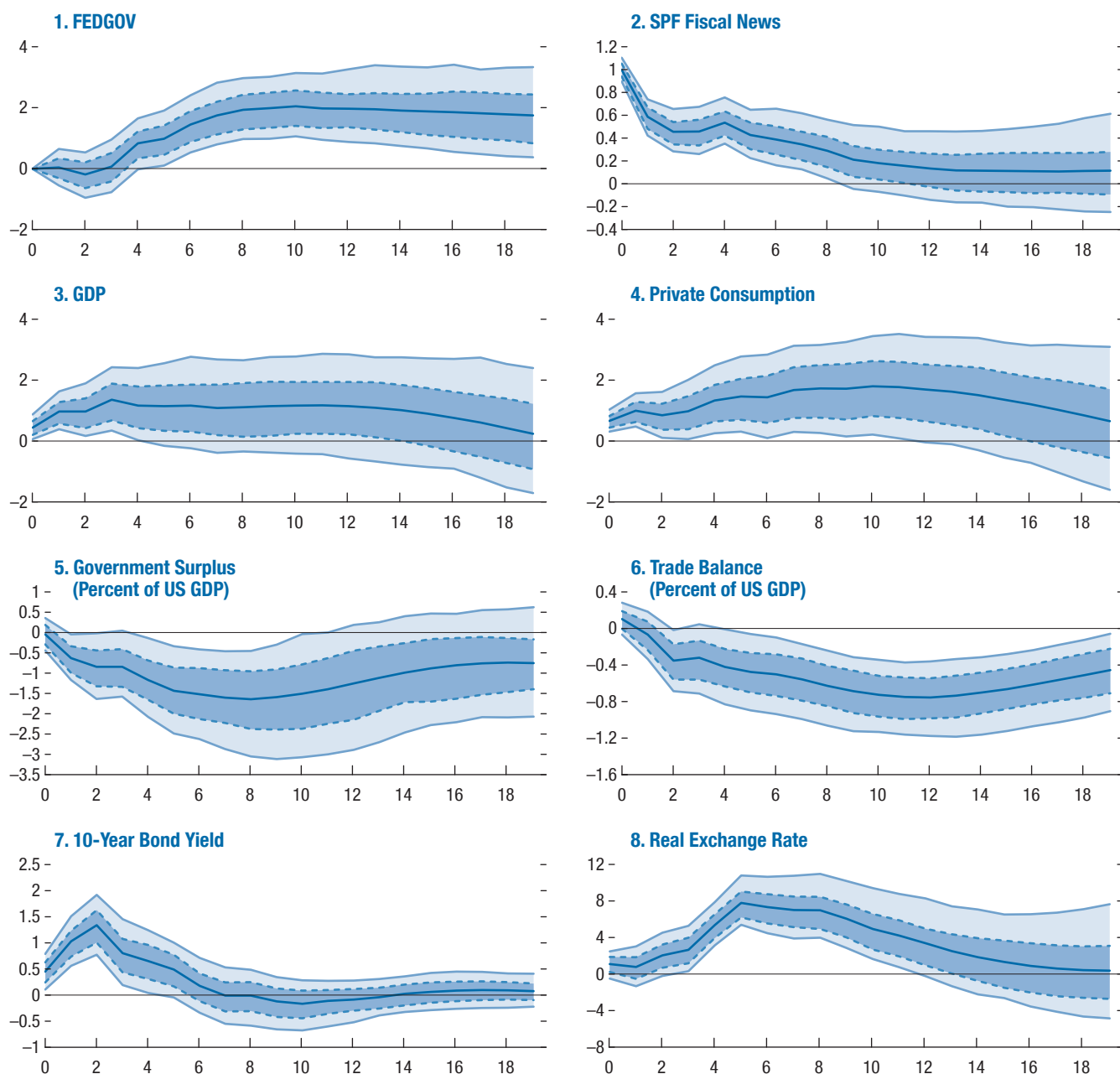
Turning to our key variables of interest, fiscal expansion leads to real appreciation of the dollar and a worsening of the US trade balance. The real dollar exchange rate peaks after about six quarters at about 7 percent.⁵ Consistently, the trade balance significantly worsens—by 0.65 percentage point of GDP after three years—and the effect is also very long lived. In terms of magnitude, these figures, which are economically significant, are comparable with estimates from other studies in the literature (although, as mentioned previously, our results do not suffer from the depreciation puzzle and have a consistent behavior between the trade balance and the real exchange rate).⁶

⁴This figure is quantitatively in line with earlier findings in the literature for the nominal long-term interest rate (see, for example, de Castro and Garotte 2015, which finds a 120 basis point increase in the 10-year nominal interest rate after two quarters in response to a 1 percent of GDP spending shock in the United States). On the other hand, other estimates such as those of Corsetti, Meier, and Müller (2009) find a 20 basis point change in the real long-term rate following a similar shock, suggesting that most of the effect on nominal yields may be due to higher inflation expectations.

⁵Including the nominal effective exchange rate rather than the real rate does not change the picture significantly, with the exception of the fact that the nominal rate seems to react slightly faster to the shock. The absence of a depreciation puzzle in our results compared to those in the earlier literature is mostly attributable to the identification strategy, which allows anticipation of fiscal policies to be captured (see also the detailed discussion in Forni and Gambetti 2016).

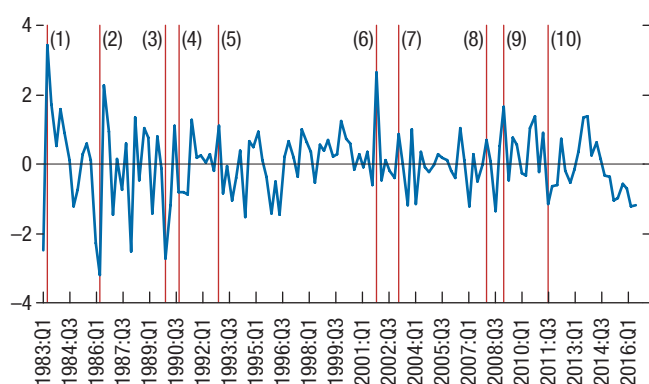
⁶On the trade balance, Monacelli and Perotti (2010) find that in response to a 1 percent of GDP fiscal expansion, the US trade balance falls significantly by about 0.45 percentage point

Figure 2. Impulse Responses to an Anticipated (News) Spending Fiscal Shock in the United States
(Percent, unless noted otherwise)



Source: IMF staff estimates.

Note: The figure shows orthogonalized responses to an anticipated ("news") US fiscal spending shock of 1 percent of GDP, with one- and two-standard-deviation confidence bands. Numbers on the horizontal axis represent quarters. FEDGOV = real federal government consumption expenditures and gross investment; SPF = Survey of Professional Forecasters.

Figure 3. News Shock

Source: Authors' calculations.

Note: The vertical lines are associated with the following episodes: (1) Strategic Defense Initiative; (2) Emergency Deficit Control Act; (3) fall of the Berlin Wall; (4) Gulf war; (5) Clinton's election; (6) War in Afghanistan; (7) Second Gulf War; (8) 2008 fiscal stimulus; (9) Obama (2009) fiscal stimulus; (10) 2011 Budget Control Act.

When plotting the identified news shocks, one can notice spikes that can be associated with episodes of large preannounced changes in government spending. Figure 3, which plots the standardized news shocks extracted from the VAR, reveals that some are related to increases in military spending (such as the Strategic Defense Initiative [first quarter of 1983], Gulf war [third quarter of 1990], war in Afghanistan [first quarter of 2001], and Iraq War [first quarter of 2003]) or decreases (the fall of the Berlin Wall [fourth quarter of 1989]). One can also identify large increases in nondefense government spending like the Obama fiscal stimulus package (first quarter of 2009). This episode identification, similar to the one performed in the narrative approach, helps confirm that the identified shocks are consistent with our intuition about their interpretation.

of GDP; however, in their VAR, the dollar depreciates, by about 5 percent at the end of the first year. Bluebird and Leigh (2011), who use the historical approach on a panel of OECD member countries, find that a 1 percent of GDP fiscal consolidation raises the current-account-balance-to-GDP ratio by about 0.6 percentage point. In terms of the real effective exchange rate response, the results in this note are most comparable with results from the narrative approach. For example, Auerbach and Gorodnichenko (2016) find a very significant dollar appreciation in response to defense-spending announcements of about 6 percent to a comparably sized shock.

The Effect of Anticipated US Spending Fiscal Shocks: Evidence from a Panel VAR

So far, the results from the US VAR have suggested significant spillover effects of US fiscal stimulus on other countries' trade balances and exchange rates. However, it is interesting to evaluate whether, from the perspective of recipient countries, the results are robust to conditions (macroeconomic or policy) in their domestic economies. Arguably, the level of economic slack, the fiscal and monetary policy space, the exchange rate regime, and the degree of capital openness, among other factors, could play a role in the size of the spillovers.⁷

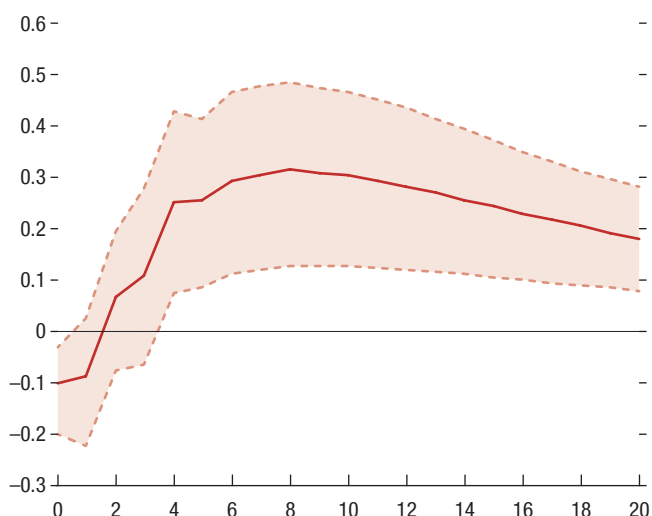
To account for the macroeconomic and policy settings in the recipient countries, in this section we extend the analysis within a PVAR framework. This allows us to study the effects of US fiscal shocks on bilateral external positions, while conditioning on a set of other country-specific determinants (for details on the methodology, see Annex 2). The baseline PVAR specification includes, in this order: the trade-weighted fiscal news shocks extracted from the US VAR in the previous section, real GDP, the fiscal balance as a percentage of GDP, net exports of goods and services as a percentage of GDP, long-term interest rates, and the real bilateral exchange rate. Because of limitations in the data for some of the recipient countries' macroeconomic variables, we are using an unbalanced panel comprising 30 US trading partners (23 advanced economies and 7 emerging market economies, representing about 80 percent of US imports) and spanning a period from the fourth quarter of 1982 to the third quarter of 2016.

Impulse responses from the PVAR⁸ show that the anticipated/news US fiscal shocks have significant impacts on both trade balance and exchange rates, even after recipients' macroeconomic conditions and policy variables are accounted for. Figures 4 and 5 plot the impulse responses of the trade balance (as a percentage of recipients' GDP) and real bilateral exchange rate to a 1 percent of US GDP "news"/anticipated fiscal spending shock. On average, the bilateral real exchange rate depreciates by about 5 percent after five quarters,

⁷It is also difficult to clearly distinguish the impact of US fiscal shocks from the impact of contemporaneous global events that may be very highly correlated.

⁸News shocks are identified recursively as the first shocks in the PVAR.

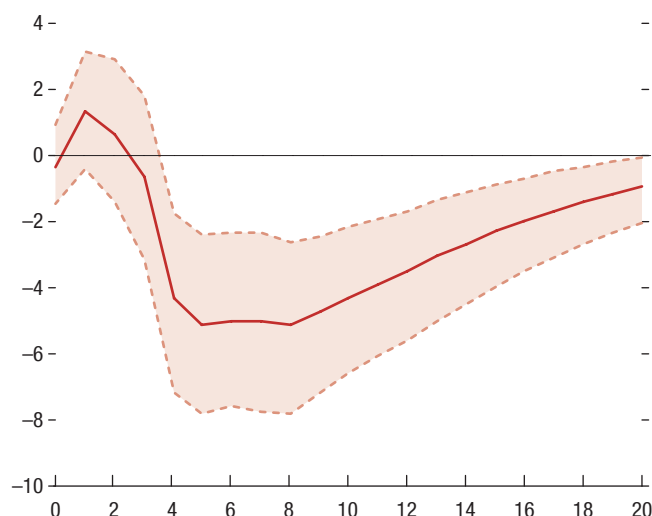
Figure 4. Trade Balance
(Percentage points)



Source: Authors' calculations.

Note: Impulse responses to a 1 percent of US GDP “news” fiscal spending shock in partner countries from a panel vector autoregression (PVAR) analysis. The trade balance is expressed as a percent of recipient's GDP. The dashed lines and shaded area represent the 90 percent confidence region. Numbers on the horizontal axis represent quarters.

Figure 5. Real Exchange Rate
(Percent)



Source: Authors' calculations.

Note: Impulse responses to a 1 percent of US GDP “news” fiscal spending shock in partner countries from a panel vector autoregression (PVAR) analysis. The real exchange rate is expressed from the recipient's perspective (a decrease represents a depreciation). The dashed lines and shaded area represent the 90 percent confidence region. Numbers on the horizontal axis represent quarters.

mirroring well the results on the aggregate level from the US VAR.

The trade balance improves significantly and persistently, peaking at about 0.3 percentage point of a recipient country's GDP after two years. The similarity to the results from the US VAR confirms that the finding that US fiscal expansion has a significant impact on trade and real exchange rate of partner countries is very robust, including to a different methodology and conditioning on recipient-country domestic variables.

In terms of magnitude, the impact of the US fiscal stimulus on recipients' trade balance is quite sizable. One way to evaluate the result is through a back-of-the-envelope calculation. Assume an average trade balance as a share of a recipient's GDP of 1.25 percent (the historical average for all countries in our sample). This would translate into an improvement of about 25 percent ($\approx 0.3/1.25$) in the recipient's total trade balance, which is quite large (however, one needs to bear in mind that our calibrated magnitude for the fiscal shock—1 percent of US GDP—is very large by historical standards).⁹

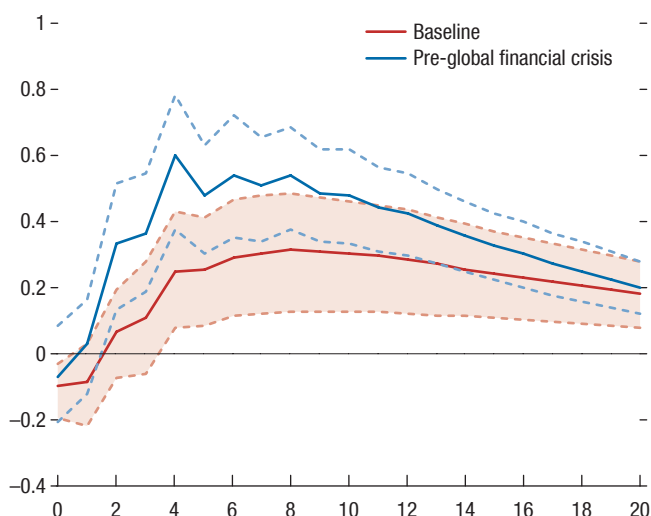
⁹Moreover, this magnitude is comparable to corresponding figures for the United States. Given the historical average US trade balance

Impact of the Global Financial Crisis

Estimation over subsamples reveals that the impact of the US fiscal expansion on the exchange rate and possibly the trade balance may have weakened after the global financial crisis. Figures 6 and 7 plot the response of the trade balance and real exchange rates prior to the global financial crisis (pre-2007) relative to the entire sample and find that the magnitudes were significantly higher before the crisis for the real exchange rate and possibly also for the trade balance. This result can be attributed to the fact that since the global financial crisis, the interest rate in the United States has remained at a zero lower bound and thus the response of the real exchange rate has been more subdued in response to expansionary fiscal shocks (that is, less appreciation), resulting in a weakening of the expenditure-switching channel. The impact on the trade balance has also potentially been more subdued during this period, however, the effect is less clear

over our sample as a percentage of US GDP was -2.45 , and the peak impact of US fiscal expansion on the trade balance as a percentage of US GDP is estimated at 0.65 , this yields a deterioration of roughly 25 percent in response to a 1 percent of GDP increase in the US government spending.

Figure 6. Trade Balance
(Percentage points)



Source: Authors' calculations.

Note: Dashed lines represent 90 percent confidence bands; the shaded area represents the baseline result. Numbers on the horizontal axis represent quarters.

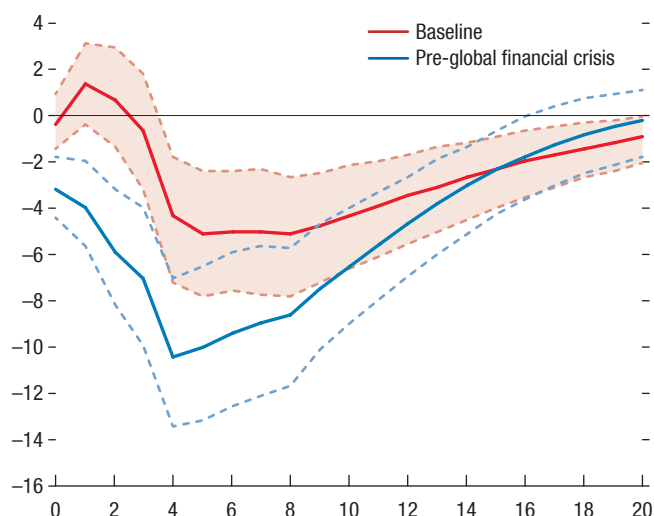
because of the presence of two countervailing effects. On the one hand, the weakening of the competitiveness channel may have dampened the trade balance response. On the other hand, prior literature would suggest that fiscal multipliers on output might have been larger during the global financial crisis,¹⁰ implying a stronger direct demand effect on trade.

Comparison across Regions

We are further interested in whether the spillovers of US spending shocks differ by region. For this purpose, we construct regional trade balances and real effective exchange rates, using the bilateral trade weights employed in the panel VAR. These regional aggregates are then inputted into the US VAR, allowing us to obtain region-specific estimates. The key finding is that expansionary fiscal policy does impact trade with all regions significantly and in a quantitatively similar manner. Notwithstanding country-specific heterogeneity, for key trading partner regions Europe, Asia, and Latin America, we find a decline in the trade balance

¹⁰See, for example, Blagrove and others 2017; Blanchard and Leigh 2014; Christiano, Eichenbaum, and Rebelo 2011; IMF 2010; Auerbach and Gorodnichenko 2011, 2012, 2013; and Corsetti, Meier, and Müller 2009.

Figure 7. Real Exchange Rate
(Percent)



Source: Authors' calculations.

Note: Dashed lines represent 90 percent confidence bands; the shaded area represents the baseline result. Numbers on the horizontal axis represent quarters.

of between 20 and 30 percent in response to our calibrated fiscal shock of 1 percent of US GDP.

Robustness

We conduct a battery of robustness checks for our main results. In terms of identification of the shocks in the US VAR, the results are robust to alternative orderings of the variables in the VAR as well as to using generalized impulse responses rather than orthogonalized Cholesky impulse-response functions. In the panel VAR, findings are very similar, including quantitatively, for groups of countries (advanced economies, Group of Twenty) and when significant trade partners (China) or outliers (Ireland) are excluded. Further robustness checks involve the inclusion of the short-term rate as an additional endogenous variable. Additionally, to test whether results are affected by the fact that the baseline specification treats country i 's export share with respect to the United States as fixed, we have conducted numerous robustness exercises with variations of these weighting coefficients, and the results are confirmed. Fiscal spillover effects remain significant and robust to using time-varying weights with rolling windows of between 1 and 10 years as well as to different definitions of the weights (that is, country i 's imports

from the United States as a share of country i 's total imports, US imports [exports] from [to] country i as a share of US total imports [exports], and similar measures for total trade volumes).

Conclusions

We find that preannounced government spending shocks in the United States lead to a sizable real effective appreciation in the dollar and a worsening of the aggregate trade balance. More precisely, preannounced increases in government expenditures appreciate the dollar and lead to a worsening in the US trade balance. Quantitatively, a spending announcement of a stimulus of 1 percent of GDP would appreciate the dollar by about 5–7 percent over 1.5 years while worsening net exports by about 0.6 percentage point over the course of 2–3 years.

For a panel of advanced and emerging market economies that constitute the main US trading partners, we find that a US fiscal expansion results in an economically and statistically significant improvement in the trade balance and deterioration in the bilateral exchange rate for US partner countries. These effects are consistent across regions. Moreover, we find that the spillovers of US fiscal shocks on exchange rates and trade balances may have diminished following the global financial crisis, as the constrained monetary policy at the zero lower bound may have dampened the exchange rate appreciation (in response to expansionary fiscal shocks), potentially contributing to a weaker trade balance response.

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Annex 1. Empirical Approach for the Identification of Anticipated US Fiscal Spending Shocks

The Forni and Gambetti (2016) approach is implemented in this note through the inclusion in an otherwise standard VAR of an additional variable, capturing fiscal "news," for example, the agents' information about future government spending. As in Forni and Gambetti's study, the fiscal "news" variable is defined as the cumulative expectation of future government spending growth rates from SPF forecasts for the subsequent four quarters,¹¹ for example:

$$\eta_t^1 = F_t(1, H) = \sum_{h=1}^H E_t^P g_{t+h}$$

in which $H = 4$ and $E_t^P g_{t+h}$ is the expectation at time t conditional on the information set of economic agents P_t of government spending h quarters ahead.¹² The rationale for using the cumulative forecast stems from the fact that it best predicts government spending itself, compared to forecasts made at shorter horizons. In other words, Forni and Gambetti (2016) show that the hypothesis of fiscal foresight does not hold very well in the very short term, while it holds better at the four-quarter horizon.

With the fiscal news variable defined in this way, we conduct a benchmark VAR with the following speci-

fication on quarterly US data (fourth quarter of 1981 through third quarter of 2016):

$$X_t = A(L)X_{t-1} + U_t$$

in which X_t includes, in this order: real federal government consumption expenditures and gross investment, the fiscal news variable based on SPF forecasts, real GDP, private consumption, the federal surplus divided by GDP, net exports of goods and services divided by GDP, the 10-year Treasury constant maturity rate, and the real effective exchange rate. All variables enter in (logged) levels, with the exception of the surplus, trade balance, and bond yield, which are expressed in percent. The SPF news variable is also expressed in percent of US GDP. The benchmark specification includes four lags, in line with standard criteria, and GDP and its components have been seasonally adjusted.

Using Cholesky ordering to identify the shocks implies that the first shock will capture the changes in government spending that have not been anticipated (that is, the "surprises"), while the second shock will reflect the anticipated changes—that is, they are orthogonal to professional forecasts and also not affected contemporaneously by other macroeconomic shocks, which we identify as unanticipated or "surprise" government spending shocks. On the other hand, the residuals from the second equation in the VAR capture innovations in SPF forecasts orthogonal to macroeconomic shocks only, thus capturing the anticipated or news government spending shocks. Macroeconomic variables follow next in the VAR and the financial variables last, on the basis of typical assumptions about the timing of responses.¹³ This approach intuitively allows one to disentangle between expected and unexpected changes in fiscal policy in a clear, straightforward way.

Annex 2. Empirical Approach for the Panel Vector Autoregression

The baseline PVAR specification is given by

$$X_{i,t} = a_i + A(L)X_{i,t-1} + U_{i,t}$$

in which a_i is country fixed effects; $U_{i,t}$ is the error term; and X_t includes, in this order: the trade-weighted fiscal news shocks extracted from the US VAR in the

¹¹As in Forni and Gambetti 2016, for robustness purposes, we also use an alternative definition that sets the news variable to equal the difference between the cumulated forecast of government spending made at time t for three quarters ahead and the cumulated forecast, for the same quarters, made at time $t-1$. This does not change our results. We refer the reader to Forni and Gambetti's paper for further details on the two specifications.

¹²The SPF reports, in every quarter t , the forecasts for government spending (real federal government consumption expenditure and gross investment) for periods t , $t+1$, \dots , $t+4$. The first figure is actually a nowcast and may differ substantially from the realized government spending at time t . At time t , forecasters only know the (first release of) government spending at time $t-1$. Government expenditures are expressed as annualized percentage changes of forecasters' mean response.

¹³As typical in this literature, we have performed various robustness checks with respect to the effects of changing the ordering, and we have also analyzed orthogonalized impulse-response functions.

previous section (US news shock), as explained later; real GDP; the fiscal balance as a percentage of GDP; net exports of goods and services as a share of GDP; the long-term interest rates; and the real bilateral exchange rate. All variables enter in (logged) levels, with the exception of the surplus, trade balance, and bond yield, which are expressed in percent. The benchmark specification includes four lags, in line with standard criteria. The PVAR methodology used in this analysis is the least-squares dummy variable (LSDV) estimator as in Bun and Kiviet 2006.

Because of limitations in data for some of the recipient countries' macroeconomic variables, we are using an unbalanced panel comprising the top 30 US trading partners (23 advanced economies and 7 emerging market economies representing about 80 percent of US imports) and spanning the period from the fourth quarter of 1982 to the third quarter of 2016 (see Annex 3 for additional information on the countries and data sources).

The SPF news shock is also expressed as a 1 percent of US GDP shock, as previously. However, to account for heterogeneity in a country's exposure to US fiscal policy, the fiscal news shock for the PVAR (US news shock) is constructed by weighting US news shocks extracted from the baseline US VAR with intercountry linkages as follows:

$$USNewsShock_{i,t} = w_{i,t}^{EXP} \times USNewsShock_t^{US-VAR},$$

in which $w_{i,t}^{EXP}$ is the ratio of country i 's exports to the United States to its total exports. The intercountry linkages capture country i 's exposure to the US fiscal shock from exports from country i to the United States as a share of country i 's total exports. This scheme captures the idea that the US fiscal stimulus would have a larger impact on a recipient's economy the stronger is the recipient's trade link with respect to the United States. Moreover, as previously explained, the theoretical models posit that the US fiscal stimulus would increase US imports from other countries through both the demand channel and the price competitiveness channel. Therefore, our preferred weighting scheme uses country i 's exports to the United States as

a share of its total exports, which corresponds to US imports from country i .

Annex 3. Data Description

The fiscal news variable based on SPF forecasts (SPFNEWS) is calculated using the annualized percent change in mean responses for the real federal government consumption expenditure and gross investment reported by the Federal Reserve Bank of Philadelphia. Real federal consumption expenditures and gross investment (FEDGOV) is the federal surplus divided by GDP; federal government budget surplus (SUR), real GDP (GDP), and the trade balance are all retrieved from Federal Reserve Economic Data (FRED) at the Federal Reserve Bank of St Louis.

For variables in the PVAR, the trade balance is calculated as $100 \times ((\text{country } i\text{'s real exports to the United States}) - (\text{country } i\text{'s real imports from the United States})) / (\text{country } i\text{'s real GDP})$, in which nominal exports/imports have been deflated by the partner country's export/import deflators. We use as exports and imports data an average of those reported by the United States and by its partners. The results are robust when we use the trade variables reported by the United States only. The real bilateral exchange rate is calculated as $(\text{nominal exchange rate}) \times (\text{GDP deflator in country } i) / (\text{US GDP deflator})$, normalized to be 100 in 2010, in which the nominal exchange rate in the PVAR is defined as (US dollar/national currency).

Annex Table 3.1. Data Definitions and Sources for the Panel Vector Autoregression

Variable	Description	Frequency	Source	Ticker
SUR	Fiscal balance, percent of GDP	Quarterly	GDS	GB_GDP
STRATE	Short-term interest rate	Quarterly	GDS	FIDR
10YBOND	Long-term interest rate	Quarterly	GDS	FIGB
RGDP	Real gross domestic product	Quarterly	GDS	NGDP_R
TB	Trade balance	Quarterly	DOTS	
RER	Real bilateral exchange rate	Quarterly	DOTS	

Note: DOTS = Direction of Trade Statistics; GDS = Global Data Source.

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