Abstract

The paper re-investigates the effects of government spending shocks on the real exchange rate, inflation and the trade balance. We find that an increase in government spending appreciates the real exchange rate, increases inflation and induces a trade balance deficit. The difference with previous puzzling results lies in the identification of fiscal shocks: embedding a narrative approach in a proxy-SVAR over a sufficiently large sample is what makes the difference. Empirical results are then shown to be consistent with an estimated standard small open economy model, for a broad range of variables.

JEL classification: E62, F41, C36

Keywords: fiscal shocks, proxy SVAR, real exchange rate, inflation
1 Introduction

During the Great Recession, the discussion on the role of fiscal policy has gained traction, as discretionary fiscal measures have started afresh to serve as policy tools in advanced economies. The renewed interest in fiscal policy has spurred considerable academic research on its effects, especially on domestic variables such as output and inflation. Less attention as been devoted on the international aspect of these policies. This paper contributes to this debate, reexamining the role of fiscal policy shocks in an open economy environment.

In integrated economies, the real exchange rate and trade balances represent important channels for the transmission of fiscal policy, both at the domestic level and at the international level. For example, an appreciation (depreciation) of the real exchange rate following a fiscal stimulus might dampen (amplify) the effects of fiscal policy on output. Additionally, the reaction of the real exchange rate is likely to determine the size and sign of trade balance, affecting spillovers of the fiscal policy to other countries. Finally, the response of the real exchange rate, especially the U.S. one, is likely to determine global financial conditions, driving international capital flows.

Although the relevance of the question, it is still unclear how the real exchange rate responds to a fiscal shock. While according to standard theoretical frameworks, whether RBC or old and new-Keynesian theory, the real exchange rate should appreciate in response to a fiscal stimulus, the empirical literature finds the opposite. Starting with Kim and Roubini (2008), who found that fiscal expansions depreciates the real exchange rate and improves the trade balance, the literature has been confirming this result, establishing a well-know puzzle in the fiscal policy literature (e.g. Monacelli and Perotti (2010), Forni and Gambetti (2016), etc).

Moreover, recent papers have been challenging the common wisdom that an increase in government spending is inflationary, proposing a fiscal price puzzle (see for example dAlessandro et al. (2018) and Jorgensen and Ravn (2018)). As we mostly look at open economy advanced economies, the inflation dynamics and the real exchange rate are likely to be closely interconnected and we believe should be studied jointly.

This paper contributes to this two debates. We document that, using a narrative identification approach such as the one proposed by Ramey (2011) and Ramey (2016) and embedding it into a Proxy-SVAR framework, the real exchange rate appreciates, inflation raises and the trade balance worsens after a fiscal expansion. We also show that using such identification scheme delivers plausible reactions for the other variables relevant when analyzing fiscal shock, like private consumption or investment. The main contribu-
tion of the paper is therefore simply to show that the correct identification of fiscal shocks solves both real exchange rate and inflation puzzle and reconciles empirical and standard theoretical results.

We obtain our empirical results estimating the proxy-SVAR with quarterly data using Bayesian techniques. The estimation sample is 1947Q1-2006Q4. The reason of our time frame is the well established evidence that to use correctly the external instrument of Ramey (2016) is required a long data sample. This allows to increase the instrument relevance.\(^1\) The narrative identification has the advantage of dealing with the issue of fiscal foresight, i.e. the fact the consumers and investor foresee fiscal spending in advance before it is actually spent. Fiscal foresight might invalidate the identification procedure proposed by Blanchard and Perotti (2002) which doesn’t include the possibility that fiscal decisions are known before the implementation. Notice that the difference in the timing implied by the two identification methods is critical, especially for the response of those fast-moving variables like the nominal exchange rate and the interest rate. Contrary to the Blanchard and Perotti (2002) identification method, using a narrative approach in a SVAR model allows to be immune to the distinction between surprise and news shocks, proposed by Forni and Gambetti (2016). In fact, the narrative series is only used to properly instrument contemporaneous spending and then, using the Proxy-SVAR framework, we back-up truly surprise shocks.

The long time frame considered might raise a concern, as we start the analysis in a period where nominal exchange rates were under the Bretton Woods arrangement. While this is a relevant point, it is important to stress that our attention focuses on real exchange rates, which can therefore adjust to shocks through the response of inflation even during a period of fixed nominal exchange rates.

The main results of the paper is that the real exchange rate appreciates, inflation increases and the trade balance deteriorates following a positive government spending shock. This result is driven by the different identification scheme adopted with respect to the previous literature.

To conclude the paper, we set up a simple small open economy with two-goods and we show that the empirical response obtained in the empirical section of the paper are indeed consistent with standard theory. This is true for both international and domestic variables. However, what we call a standard small open economy model has been challenged by multiple studies that have been shown that the reaction of the real exchange rate can depend on the trade elasticity (Corsetti et al., 2008), on the persistency of shocks

\(^1\)We started the estimation in 1947Q1 as this is the first date for which many exchange rates are available at quarterly frequency.
(Corsetti et al., 2008) and on the wealth elasticity of the labor supply (Monacelli and Perotti, 2010). We therefore construct a model potentially accounting for all these channels and we estimate it through and impulse-response matching procedure.

**Literature review**

The paper draws on different strands of literature. First, it relates to the literature analyzing the empirical effects of fiscal policy, in particular on the real exchange rate. The seminal paper on this topic is Kim and Roubini (2008), where the authors document the US real exchange rate depreciation following a positive US fiscal shock, at odds with what the theory predicts. Moreover, they also document a counterintuitive reaction of the trade balance, which improves instead of deteriorating. Such puzzling results ignited a stream of the literature studying this topic, which found similar empirical regularities. Monacelli and Perotti (2010) finds that, in the US and other advanced economies, a rise in government spending induces a depreciation of the CPI real exchange rate and a trade balance deficit. They also find that private consumption rises in response to a government spending shock, in line with Blanchard and Perotti (2002). Ravn et al. (2012) use panel structural VAR analysis to document that an increase in government purchases raises output and private consumption, deteriorates the trade balance, and depreciates the real exchange rate, both in the US and in other four industrialized countries. Ilzetzki et al. (2013) concentrate on the output effect of fiscal policy, but it highlights the same puzzling response of the real exchange rate, using a panel of 44 countries. More recently, Kim (2015) investigated again the question, examining 19 OECD countries. The empirical results of Kim (2015) show that current account worsening and real exchange rate appreciation are found in the majority of the countries. The author also show how the various country characteristics (e.g. trade openness, capital mobility, etc) influence the results. One common feature through all of the aforementioned papers is the identification method adopted in order to recover the structural fiscal shock. Indeed, such empirical investigations are based either on the Choleski triangularization of the variance-covariance matrix or on the identification method of Blanchard and Perotti (2002). In our paper we show that, once adopting the narrative method and embedding it into a Proxy-SVAR, we obtain opposite results for what concerns the behaviour of the real exchange rate and the trade balance. The two papers closest to our are Auerbach and Gorodnichenko (2016) and Forni and Gambetti (2016). Auerbach and Gorodnichenko (2016) uses daily data on U.S. defense spending and documents that the dollar immediately and strongly appreciates after announcements of future government spending. At the opposite, when the actual
payments is made, this has no significant effect on the exchange rate. While this result is clearly related to what we find in our paper, Auerbach and Gorodnichenko (2016) focuses on the nominal exchange rate and employs a very different methodology. Forni and Gambetti (2016) use the Survey of Professional Forecasters to generate both government spending news shocks and surprise shocks. They estimate the effects of both type of shocks using a quarterly VAR from the 80's, finding that government spending news shocks generate an appreciation of the real exchange rate, while surprise shock generate a depreciation real exchange rate. Our paper differs from Forni and Gambetti (2016) in the following respects. First of all, they are able to obtain an appreciation of the real exchange rate only following a news shock. While this is certainly a important step in the understanding of the effects of fiscal policy on international variables, the puzzle established in the literature concerns the behaviour following a standard surprise shock. Second, while Forni and Gambetti (2016) obtain the right sign on the response of the real exchange rate, the behaviour of the other variables included in their VAR is inconsistent with theoretical predicitions, generating a new puzzle. Indeed, a spending news shocks generates consumption and interest rate moving in the same direction (instead of opposite direction as the theory would suggest) and an increase of output on impact, again contrary to the prediction of standard DSGE models.

Second, our paper is related more in general to the literature of fiscal policy, also at the domestic level. First of all, the paper draws on the proxy-SVAR methodology, developed independently by Mertens and Ravn (2013) and Stock and Watson (2008). In particular, we use the approach of Mertens and Ravn (2013) and we apply it to the identification of government spending shock, using as external instruments the narrative series provided by Ramey (2011) and Ramey (2016). Second, the paper is related to those papers focusing on the effects of fiscal policy on inflation. In particular, Jorgensen and Ravn (2018) document empirically that, in response to an increase in government spending inflation falls, at odds with standard theory. They obtain such results using data from the 80’s and adopting different identification schemes. They explain the negative behaviour of inflation through a contemporaneous increase in TFP generated by the fiscal shock, documented in the paper, which generates a large enough supply side effect. In contrast, we show that when identifying fiscal shocks through the narrative method, the result on inflation disappears, even though we also find a positive effect on TFP. Similar results as in Jorgensen and Ravn (2018) are found by D’Alessandro et al. (2019), which develops a quarterly Bayesian VAR including fiscal and TFP variables for the period 1954Q3-2007Q4, finding that inflation turns negative after a positive fiscal shock. For the baseline results, they identify the shock through the Blanchard and Perotti (2002) approach, but they also
controls for fiscal foresight adding forecast series for government spending growth using the Survey of Professional Forecasters and the Greenbook forecasts. In our paper we find that addressing fiscal foresight issues using the Ramey (2016) narrative series produces different results for what concerns the behaviour of inflation.

The results of our paper are also relevant for the literature studying fiscal spillovers, like Faccini et al. (2016), Corsetti et al. (2009), Corsetti et al. (2011), Corsetti and Muller (2013) and Auerbach and Gorodnichenko (2013). It is indeed crucial to understand what is the response of the real exchange rate following a fiscal shock, as the trade channel, in particular through its price effect, is one of the main transmission channel at the international level.

Finally, our paper is related to the strand of literature analyzing the effects of fiscal policy from a DSGE perspective.

The rest of the paper is organized as follows. Section 2 describes briefly the proxy-SVAR methodology, the identification strategy and the data and specification adopted in the paper. Section 3 reports the results obtained. Section 4 presents the theoretical model and the results in terms of impulse response matching. Finally, Section 5 concludes.

2 Model and identification strategy

2.1 The proxy-SVAR framework

Consider the following VAR, in reduced form:

\[ X_t = c_0 + c_1 t + \sum_{k=1}^{P} A_k X_{t-k} + u_t \quad u_t \sim N(0, \Sigma) \]  

where \( X_t \) is a vector of endogenous variables, \( u_t \) is the vector of reduced-form residuals, \( A_k \) are the matrices containing the reduced-form parameters, \( \Sigma^u \) is the sample covariance matrix.

In order to identify shocks in the VAR, one needs to specify a matrix \( P_0 \) that pre-multiplies Equation 1 yielding

\[ P_0 X_t = P_0 c_0 + P_0 c_1 t + P_0 \sum_{k=1}^{P} A_k X_{t-k} + \epsilon_t \]  

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where $P_0$ is the identifying matrix and

$$\epsilon_t = P_0 u_t$$

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

In order to identify fiscal shocks we rely on the proxy-SVAR methodology, developed independently by Mertens and Ravn (2013) and Stock and Watson (2008). Restrictions on the $P_0$ matrix are obtained by using proxies for the latent shocks. Following Mertens and Ravn (2013), we assume that a narrative measure, denoted by $m_t$, is a proxy for the unobserved structural fiscal shock of interest $\epsilon_{f,t}$, with $E(m_t) = 0$; in addition, denoting the other non-fiscal US shocks as $\epsilon_{nf,t}$, the methodology assumes that the defined proxy satisfies the following conditions

$$E[m_t, \epsilon_{f,t}] = \gamma$$

$$E[m_t, \epsilon_{nf,t}] = 0$$

In other words, $m_t$ is correlated with the unobserved fiscal policy shock of interest and orthogonal with the remaining shocks. The proxy SVAR method provides the restrictions to be placed on the columns of the matrix $P_0$ related to the fiscal variables. To obtain those restrictions, one must follow a two-step procedure:

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

Details on the proxy SVAR procedure are reported in Mertens and Ravn (2013). Narrative measures of fiscal policy changes are constructed from historical sources and, as suggested by Mertens and Ravn (2013), they can be viewed as imperfectly correlated with linear combinations of the latent structural policy shocks. We use the methodology suggested by Mertens and Ravn (2013) for identify tax shock for identifying government spending shock. In particular, we use the narrative series provided by Ramey (2016) to instrument contemporaneous government spending. This allows us to identify government spending surprise shocks. In order to validate the use of narrative series as instruments for the latent shocks, one should test the relevance of the proxy by constructing the reliability test statistic of Mertens and Ravn (2013) that is based on the hypothesis of linear

\footnote{Indeed, measurement errors may arise both from the fact that historical records sometimes contradict each other, and because narrative series typically disregard minor policy changes that are censored to zero.}
random measurement errors. The reliability test statistic represents the fraction of the variance of the measured variable that is explained by the latent variable; it lies between 0 and 1, with large values indicating a high correlation between the proxy and the true underlying tax shock. The results of this test are reported in section 3.1.

2.2 Data and specification

As our baseline, we specify a VAR with the following US variables: real government spending (in log) $G_t$, real GDP (in log) $y_t$, tax revenues (in log) $tax_t$, real private consumption (in log) $c_t$, inflation rate $\pi_t$, trade balance (in percent of GDP) $TB_t$, the 3 months TBill rate $i_t$ and the real effective exchange rate (in log) $reer_t$. We estimate the model on quarterly data and, as standard in the literature, we include four lags of the endogenous variables, a constant and a time trend. The baseline estimation sample ranges from 1947Q1 to 2006Q4.\footnote{We excluded the great recession from our sample. However, in the robustness section we show the results when starting when ending the sample in 2015Q4} As the real effective exchange rate produced by official statistics is available at the earliest from 1964Q1, we generated the effective exchange rate with own calculations. In particular, the US effective exchange rate is constructed weighting the US real exchange rate vis-à-vis the following countries: Australia, Canada, Germany, Japan, Italy, Switzerland, UK.\footnote{These are the only countries for which we were able to obtain the exchange rate and the CPI index starting from 1947 (or 1949). As for the weighting scheme, we employed both a simple average and the weights produced by the BIS to generate the effective exchange rate (narrow definition) in the period 1964-1966.}

The model is estimated using Bayesian techniques. In particular, we use dummy observations as in Del Negro and Schorfheide (2011) and Caldara and Kamps (2017) in order to impose a Minnesota prior on the reduced-form VAR parameters and we select the hyperparameters governing the prior distributions in a way to obtain a relatively weak prior.

3 Results

This section presents the main empirical results of the paper. First, we provide evidence on the relevance of the instruments used to identify the government spending shock. We also provide the results in terms of the non-fundamentalness test introduced by Forni and Gambetti (2016). Second, we report the impulse response functions. In particular, we compare the baseline response of the real exchange rate obtained identifying the fiscal shock through the proxy-SVAR methodology with the response stemming from the more
standard identification method as in Blanchard and Perotti (2002). Finally, in the last part of the section, we provide additional empirical evidence as robustness checks of the baseline result.

3.1 Relevance of the instruments and non-fundamentalness test

Non-fundamentalness test

In order to make sure that our identified shocks are indeed surprise shocks, we implement the non-fundamentalness test proposed by Forni and Gambetti (2014). This test consist in extracting the information from a large dataset, using the first principal components, and test if that information has predictive power on our shock, which should be unanticipated.

3.2 Impulse response functions

In this section we describe the results of our estimations.\(^5\) Figure ?? reports the response of the variables considered in the paper following a 1 standard deviation positive shock to US government spending, obtained applying the identification method of Blanchard and Perotti (2002). The figure summarizes the puzzle identified by the literature, in particular regarding the evolution of the real exchange rate and the trade balance. The former falls on impact, depreciating, while the latter improves, showing an inconsistent response with respect to the standard theory. Interestingly, inflation is found to fall on impact, in line with the most recent papers of Jorgensen and Ravn (2018) and D’Alessandro et al. (2019).

Figure 5 displays the response of the same variables as in Figure ?? when the fiscal shock is instead identified using the proxy-SVAR methodology. The last panel of Figure 5 shows the main empirical finding of the paper, i.e. that once the shock is identified using the narrative approach the real exchange rate appreciates, in line with what standard theory predicts. This behaviour is driven both by the evolution of inflation, especially in the first part of the sample where nominal exchange rates were under the Bretton Woods arrangement, and by the evolution of the nominal effective exchange rate. This difference in the response of the real exchange rate with respect to previous findings is driven by the identification scheme. Indeed, the narrative identification aims at dealing with one of the issues of the identification of Blanchard and Perotti (2002), which is the issue of fiscal

\(^5\)The IRF bands reported are calculated using the 68% credible set.
foresight, i.e. the fact the consumers and investor foresee fiscal spending in advance before it is actually spent. Such timing difference between the two identification methods is crucial, especially for the response of those fast-moving variables like the nominal exchange rate and the interest rate. For what concerns the trade balance, the graph shows how it falls on impact, supporting the twin deficit hypothesis and contrasting with the twin divergence hypothesis put forward by Kim and Roubini (2008). Such behaviour of the trade balance is consistent with an appreciating real effective exchange rate. In the next section we provide additional evidence regarding the evolution of the real exchange rate and the trade balance, showing that the approach outlined in Section 2 delivers similar results also in other samples and using slightly different definitions to measure the real effect exchange rate.

Regarding the evolution of the other variables included in the VAR, an important one is inflation, which increases on impact to then returning to the baseline level after a few quarters, showing another time an opposite behaviour with respect to Figure ??.

The evolution of inflation is relevant for two reasons. First of all, it represent one of the components of the real exchange rate. Therefore, an increasing inflation contributes to the appreciation of the real exchange rate. Second, it highlights another difference between the identification methods relying on Choleski-Blanchard Perotti schemes and the narrative approach. Jorgensen and Ravn (2018), surveying the literature and with own estimations, show how inflation responds negatively to positive fiscal shock. To explain such evidence, they suggest that the fiscal shock on the demand side is accompanied by a strong supply-side indirect effect, i.e. an increase in TFP, which produces an overall negative response on inflation. In our estimates we do not obtain such result and we document that, once properly identified, inflation behaves as theory predicts. The remaining variables included in the VAR show a standard behaviour. Economic activity, while not significant through all the IRF periods, increase. The interest rate also increases, while consumption falls. The behaviour of consumption is in line with Ramey (2011), which already highlighted the opposite behaviour of private consumption following a spending shock according to the identification method employed.

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6 However, inflation is not the sole driver for the behaviour of the real exchange rate. We included in the VAR the nominal effective exchange rate, documenting that also the nominal effective exchange rate appreciates, in line with Mussa (1986).

7 We also added TFP to the variables considered in the VAR, documenting a positive reaction of TFP following the fiscal shock, but still obtaining a positive effect on inflation.

8 In the second part of the paper, we develop an open economy fiscal policy model, and we show that in such environment we obtain that theoretically the response of consumption is in line with our empirical estimates.
Blanchard-Perotti identification scheme (1949Q1-2006Q4)

Figure 1: The figure reports the response of government spending, tax revenues, GDP, private consumption, inflation, trade balance, short-term interest rate and real effective exchange rate, calculated adopting the Blanchard-Perotti identification scheme. Shaded bands denote the 68% pointwise credible sets.
Figure 2: The figure reports the response of government spending, tax revenues, GDP, private consumption, inflation, trade balance, short-term interest rate and real effective exchange rate, calculated adopting the Proxy-SVAR methodology. Shaded bands denote the 68% pointwise credible sets.

### 3.3 Robustness

This section reports additional evidence to support our baseline result, i.e. that the real exchange rate appreciates after a positive spending shock. Figure 3 reports a smaller-scale Proxy-SVAR, estimated using the sample 1919Q1-2006Q4. As not all the baseline variables are available, we had to restrict our attention on GDP, inflation, tax revenues, the interest rate and the real exchange rate between the US and the UK. Such real exchange rate has been constructed using the nominal exchange rate US vs UK\(^9\), and the relative US and UK CPI indices.\(^{10}\) Such bilateral rate is the only real rate available for such a long-term historical span at quarterly frequency. Figure 3 confirms the main findings of the paper: the real exchange rate appreciates using the narrative approach while

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9 Available in the MacroHistory Database of the Fed

10 Regarding the other variable of interest, i.e. the trade balance, such data are not available earlier than 1947.
in depreciates using the Blanchard-Perotti identification method. Also inflation and the interest rate show an opposite behaviour in the two types of identification schemes. Figure 4 presents a similar VAR as the baseline one but estimated using the period 1964Q1-2006Q4, as from 1964Q1 the official real effective exchange rate calculated by the BIS is available. Although it is well known that the relevance of the instruments of Ramey (2016) worsens when excluding WWII and the Korea War, we nonetheless provide the results of this exercise to document that the behaviour of the real exchange rate and the trade balance following the positive fiscal shock are unchanged, as they both follow, once again, the standard theoretical prediciton. Finally, we also repeated the same exercise for the period 1980Q1-2006Q4, which suffer from the problem, obtaining similar results.\footnote{Results are available upon request.}

Proxy-Bayesian SVAR (1919Q1-2006Q4)

Figure 3: The figure reports the response of government spending, tax revenues, GDP, inflation, short-term interest rate and US-UK real exchange rate, calculated adopting the Proxy-SVAR methodology. The estimation sample is 1919Q1-2006Q4. Shaded bands denote the 68\% pointwise credible sets.
4 Model predictions

We build a simple two-goods RBC small open economy model first to check if results are indeed in line with our empirical one and second, to estimate some crucial open-macro parameters for which there is still no consensus. There are three agents in the economy: households, firms and the government. Households consume a composite of domestic and foreign goods, supply labor and save/borrow using a single internationally traded asset. They own the physical capital, rent it to firms and take investment decisions. Firms produce a domestic good using capital and labor and they sell it domestically and abroad. The government purchases domestic goods raising funds through taxes, running a balanced fiscal budget.

To account for different empirical features, the simplest SOE-RBC model by Mendoza (1991) is enriched with a domestic and foreign goods, preferences with an estimable
wealth effect on the labor supply and different convex adjustment costs. Government is introduced following Monacelli and Perotti (2010).

In this section we sketch the structure of the model. Aggregate foreign variables are denoted by an asterisk (*) and $i$ are the single countries.

Figure 4.1 shows that a small open economy rbc model a la Mendoza (1991) does match our empirical findings. An increase in government spending is inflationary, appreciates the real exchange rate and, while increasing aggregate output, generates a current fall in aggregate consumption.

Model response to a 1% increase in government spending

![Graphs showing the response of various economic indicators](image)

Figure 5: The figure reports the response of government spending, GDP, consumption, inflation, trade balance and real effective exchange rate.

### 5 Conclusions

Starting from an extensive closed and open economy literature showing puzzling effects of government spending shock on inflation and real exchange rate, we show that properly identified unanticipated changes in government choices have standard RBC results. In practice, the paper re-investigates the effects of government spending shocks on the real exchange rate, inflation and the trade balance embedding a narrative approach in a proxy SVAR over a sufficiently large sample. Doing this, we find that an increase in government spending appreciates the real exchange rate, increases inflation and induces
a trade balance deficit. These results are consistent with a simple two-goods small open economy RBC model. We estimate this model to show that the model does a fair job in matching the empirical evidence and successfully matches the dynamics of all critical macroeconomic variables.

References


