Fiscal Policy, Portfolio Frictions, and International Transmission*

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Abstract

I offer a unified explanation for two puzzles in international economics: (i) the tendency for fiscal expansions to depreciate the exchange rate and increase net trade, and (ii) the exchange rate disconnect — the near-random-walk behavior of exchange rates uncorrelated with macroeconomic fundamentals. I present new evidence showing that debt-financed US fiscal expansions lead to deviations from uncovered interest parity, favoring dollar-denominated assets, and increases in US gross foreign assets, contrary to predictions of standard models. I propose a model where portfolio rebalancing frictions drive the international transmission of debt-financed fiscal expansions and generate exchange rate dynamics consistent with the disconnect.

JEL Classifications: E62, F00, F30, F44, F31

Keywords: International Business Cycles, Fiscal Policy, Exchange Rates, Trade Balance

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1 Introduction

Explaining cross-country differences in business cycles is fundamental to macroeconomics and international economics, from both positive and normative perspectives. In this context, two variables are crucial for the international transmission: the real exchange rate (RER), which reflects the prices that clear the international goods and asset markets, and the net trade flows, the quantities traded in those markets. Although these are key variables for international transmission and draw significant attention from policymakers, consumers, and firms, their joint dynamics are difficult to explain within standard models.

One of the most perplexing puzzles in puzzles in international macro is the RER disconnect, the near-random-walk behavior of the RER and its lack of correlation with macroeconomic fundamentals.[1] While there have been recent advances toward developing general equilibrium models that account for the RER dynamics, the theories rely on shocks, or wedges, for which there is limited direct empirical evidence.[2] On the other hand, existing models have failed to account for the RER and net trade dynamics in response to well identified shocks. In advanced economies, positive government spending shocks lead to a depreciation of the RER and, in some cases, increases in net trade, contrary to the predictions of existing models.[3]

In this paper, I study the international transmission of US fiscal policy and its impact on the RER and net trade flows. I start by documenting new evidence showing that there is a strong relation between government debt, the RER and net trade. Then, I focus on the effect of well-identified US government spending shocks to present new evidence on the key channels driving the international transmission of fiscal policy. Finally, I build a two-country general equilibrium

[1] The RER disconnect include a set of empirical moments which standard models have trouble in explaining: (*i*) high volatility and persistence of RERs (Meese and Rogoff, 1983), low relative consumption growth in periods of low relative prices (or a depreciation of the RER) (Backus and Smith, 1993; Kollmann, 1995), and (*iii*) violations of the uncovered interest parity, where high domestic, relative to foreign, interest rates predict appreciations of the RER and have low predictive power (Fama, 1984).

[2] See Itskhoki and Mukhin (2021); Alessandria and Choi (2021); Mac Mullen and Woo (2024); Kekre and Lenel (2024); Bodestein, Cuba-Borda, Gornemann and Presno (2024). These include financial shocks, trade shocks, and demand shocks. These shocks are usually residuals of the uncovered interest parity condition, the export-import demand ratio, or the Euler equation.

[3] See Kim and Roubini (2008); Monacelli and Perotti (2010a); Ravn, Schmitt-Grohé and Uribe (2012); Corsetti, Meier and Müller (2012); Kim (2015); Forni and Gambetti (2016); Miyamoto, Nguyen and Sheremirov (2019).

model that rationalizes the joint dynamics of US fiscal policy, the RER and net trade, both unconditionally and conditional on US government spending shocks. Importantly, using the estimated model, which features a rich set of frictions and shocks, I show that US fiscal policy is a key driver of the RER, offering a resolution to the RER disconnect puzzle through well-identified shocks.

The starting point of the analysis is the observation of a strong relation between fiscal policy, the RER and net trade flows in the US. Figure 1 presents the cyclical component of the US RER (blue line with *o*), US net trade flows (red dotted line), and government debt in the US relative to the rest of the world (solid black line).[4] The relationship between these variables is very strong. The correlation of relative government debt with the RER and net trade is 0.74 and 0.76, respectively. When government debt in the US is high relative to the rest of the world (ROW), the US RER is depreciated relative to its long-run level, and the net trade flows are high. The strong relation of US fiscal policy with the RER and net trade flows suggests that developing a theory that explains their joint dynamics is important for understanding the drivers of the RER and net trade flows over the business cycle.[5]

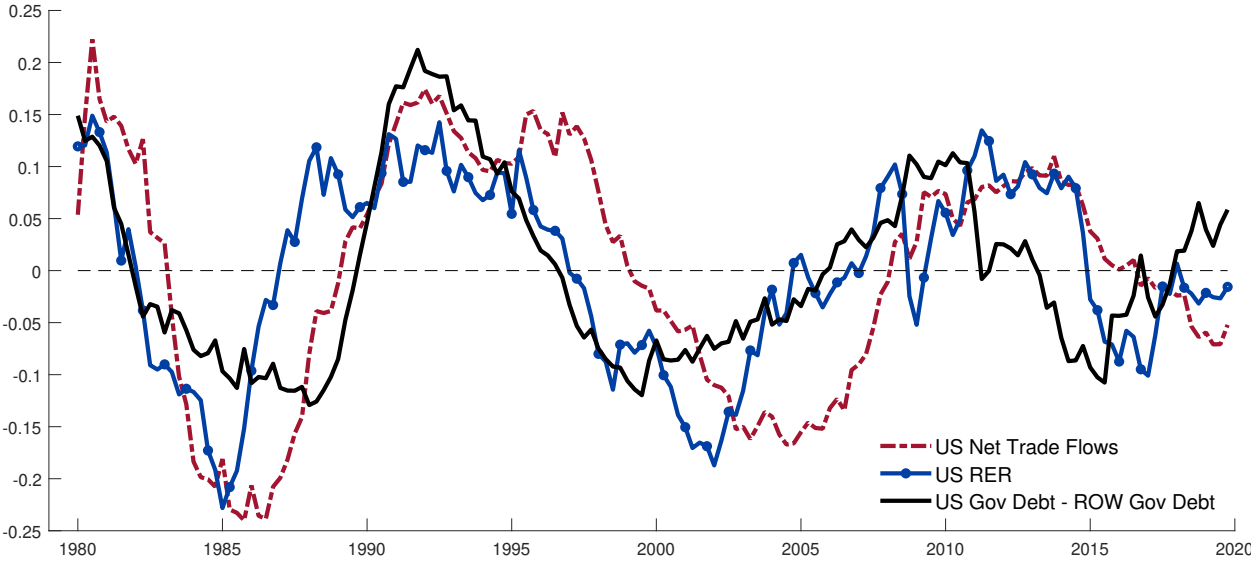
To provide direct empirical evidence on the international transmission channels of US fiscal policy, I take advantage of existing identification strategies that isolate the causal effect of government spending shocks. Following Ramey (2011, 2016), I identify these shocks instrumenting realized government spending with forecasts and estimate a Structural VAR (SVAR) model.[6] I find that positive US government spending shocks are primarily financed with debt, and trigger a depreciation cycle of the RER together with an increase in net trade that occurs gradually over time. These shocks induce dynamics to government debt, the RER and net trade flows that align with their unconditional comovement documented in Figure 1. Using the variance decomposition

[4]The cyclical component of these variables are obtained from a cubic de-trend to capture the medium and low frequency dynamics. The results are robust to de-trending the data using a quadratic de-trend, or a Band Pass filter capturing cyclicality up to twenty years, the frequency where most of the variance of the RER and net trade arises (Rabanal and Rubio-Ramirez, 2015; Gornemann, Guerrón-Quintana and Saffie, 2020; Mac Mullen and Woo, 2024). See Appendix A.1, for a discussion of the filtering of the data. I measure government debt in the rest of the world as a PPP-trade weighted average of real government debt. The results are robust to using nominal government debt or in real terms deflated by the CPI or the price of the government bonds. See Figure A2 for a comparison.

[5]Figure A6, shows the dynamic correlation of relative government debt with the RER in Panel (a), and with net trade in Panel (b). The dynamic correlations are hump-shaped, being the strongest around zero leads for the RER, and around five quarters lead for net trade.

[6]The SVAR results are robust to several controls and alternative identification strategies, such as, external instruments or proxy SVARs (Mertens and Ravn, 2013; Ferrara, Metelli, Natoli and Siena, 2021). I also find similar results using tax shocks.

Figure 1: Government Debt in US relative to ROW, the US RER, and US Net Trade Flows



Notes: An increase in the US RER means a depreciation of the dollar. Net trade flows are measured as the log of the real export to import ratio. ROW stands for Rest of the World.

of the SVAR, I find that US government spending shocks explain between 25 to 35 percent of the variance of US government debt, the RER and net trade flows, hence being a key driver of these variables.

Importantly, I document that in response to a positive US government spending shock, US government debt pays positive expected excess returns relative to ROW government debt. In other words, the shock triggers deviations from the uncovered interest parity (UIP). Furthermore, while US agents save more in US government bonds after a positive spending shock, they also increase their holdings of foreign assets, as measured by the US gross foreign asset position. The responses of the excess returns and US gross foreign assets contradict the predictions of frictionless models. I argue that these responses are informative about the international transmission channel of fiscal policy. In particular, they suggest the presence of financial market imperfections, consistent with a broad set of findings in the literature.[7]

To rationalize the empirical evidence, I build a two-country general equilibrium model based on Backus, Kehoe and Kydland (1994), and Heathcote and Perri (2014). I incorporate two key elements; a fiscal rule and portfolio frictions. The fiscal rule, governing the response of government

[7]Engel and West (2005); Gabaix and Maggiori (2015); Bacchetta, Davenport and van Wincoop (2022).

debt to changes in government spending, is a simplified version of that in Leeper, Plante and Traum (2010). Portfolio frictions are modeled as a cost to deviate from the long-run portfolio share of foreign assets, similar to that in Guo, Ottonello and Perez (2023), Camara, Christiano and Dalgic (2024), and Fukui, Nakamura and Steinsson (2023). The model also includes productivity, trade, and financial shocks, as well as, dynamic trade frictions.

I estimate the model via Simulated Method of Moments, targeting a combination of the empirical impulse response functions (IRFs) to US government spending shocks estimated from the SVAR, and a broad set of unconditional moments, which includes key RER and net trade moments. Importantly, the fiscal rule and the portfolio frictions are separately identified. The portfolio re-balancing cost is disciplined externally to match the partial equilibrium aggregate demand elasticity estimated by Koijen and Yogo (2024) in the cross-section of global investors, while the fiscal rule is pinned down by targeting the response of US government debt to the US government spending shock from the SVAR. The model successfully captures both the responses of key variables to US government spending shocks and a broad set of unconditional moments.

The interaction between the fiscal rule and portfolio frictions determines the international transmission of government spending shocks. In the model, the domestic household can save in both domestic government bonds and foreign bonds issued in foreign currency.[8] Positive government spending shocks financed with debt directly decrease the share of the domestic household's financial savings in foreign bonds. In models without portfolio frictions, given the increase in the domestic interest rate, the RER appreciates so that there is an expected depreciation that equates the expected returns of domestic and foreign bonds. However, in the presence of portfolio re-balancing frictions, investors require a premium to increase their share of savings in US government bonds. They are compensated by earning positive excess returns from holding US government bonds. This happens in equilibrium through a depreciation of the RER, that triggers and expected appreciation which raises the return of US relative to foreign government bonds. Furthermore, the gross foreign assets increase to smooth out the cost of deviating from the long-run portfolio share of foreign assets. Finally, the depreciation of the RER triggers an expenditure

[8]To simplify the model and the intuition of the mechanism I do not allow for cross-country trade in government bonds. However, allowing for this does not change the results, which is shown in the sensitivity analysis of the model in Section 6.

switching effect that increases net trade. This mechanism allows the model to capture the responses of the US government debt, the RER, net trade, the excess returns on bonds, and the gross foreign assets, to US government spending shocks.

Finally, the model successfully captures the unconditional moments of international business cycles. Importantly, US government spending shocks contribute considerably to this outcome, and to explain the RER disconnect. They trigger a highly volatile and persistent RER (Meese and Rogoff (1983) puzzle), low predictive power of interest rates on the RER with violations of the UIP condition (Fama (1984) or Forward Premium puzzle), and periods of high consumption growth associated with appreciations of the RER (Backus and Smith (1993) and Kollmann (1995) puzzle). Hence, US government spending shocks offer a resolution to the RER disconnect puzzle through well-identified shocks. By doing this, the theory, which relates shocks to demand for goods, the government spending shock, with changes in asset's demand in the context of imperfect financial markets, endogenizes some of the channels treated as exogenous in the literature on exchange rate dynamics (Itskhoki and Mukhin, 2021, 2025; Kekre and Lenel, 2024).

The rest of the paper is organized as follows. Section 2 reviews the literature. In Section 3, I present the SVAR analysis, the identification of shocks to US government spending, the impulse response functions and evidence on transmission mechanisms. Section 4 presents the quantitative model, and its estimation. Section 5 presents the main results of the model. Section 6 discusses the sensitivity of the model and present further evidence in favor of the theory using cross-country panel data. Finally, Section 7 presents the concluding remarks and discusses further avenues of research.

2 Literature Review

First, I contribute to the literature studying the international transmission of fiscal shocks in advanced economies. Table G.1 summarizes the findings in the literature studying the effects of government spending shocks on the RER and net trade. Most of the work has found that the RER depreciates in response to government spending shocks in advanced economies (Corsetti and Müller, 2006; Kim and Roubini, 2008; Monacelli and Perotti, 2010a; Ravn et al., 2012; Corsetti

et al., 2012; Kim, 2015; Forni and Gambetti, 2016; Miyamoto et al., 2019; Boehm, 2020).[9] On the other hand, there is more heterogeneity regarding the empirical response of net trade flows. On the theoretical side, there is less work done in rationalizing the depreciation of the RER in response to positive government spending shocks. In particular, Corsetti et al. (2012) propose a mechanism through spending reversals, Ravn et al. (2012) mechanism is driven by deep habits at the intermediate goods level that leads to time variation in markups, and Jiang (2021) shows that the combination of a fiscal theory of the price level with (strong) price rigidity lead to a depreciation of the RER.

All the proposed mechanisms generate a depreciation of the RER through a fall in the interest rate differential, since there are no excess returns across assets, or deviations from UIP, in these models.[10] However, I show that the empirical response of the interest rate differential is orders of magnitude smaller than that of the RER. This implies that any model where the RER is driven solely by the interest rate mechanism cannot explain the quantitative response of the RER. The main contribution to this strand of the literature is to provide new empirical evidence showing that US government spending shocks trigger sizable excess returns of US government bonds, relative to foreign bonds, and build a model that explains the quantitative response of the RER through a mechanism arising from endogenous excess returns, or deviations from UIP.[11]

I also contribute to the large literature studying international business cycles and exchange rate dynamics.[12] The literature has highlighted the importance of various shocks in driving the

[9]The papers that found appreciations of the RER are Auerbach and Gorodnichenko (2016), Ferrara et al. (2021), and Alpanda, Aysun and Kabaca (2024). Ferrara et al. (2021) finds the appreciation of the RER (and fall in net trade) in the short and medium run using external instruments or Proxy SVARs. I show that by including a trend in the SVAR, as it is the standard practice, then the RER depreciates and net trade increases across these horizons using Proxy SVARs. Auerbach and Gorodnichenko (2016) finds an appreciation of the RER at daily frequency (but a depreciation at the monthly frequency), and Alpanda et al. (2024) an appreciation in the same quarter of the shock. My empirical results show that the depreciation of the RER in the quarter of the shock is not significant, and that there is a small appreciation in the subsequent two quarters, which is not inconsistent with the findings in Auerbach and Gorodnichenko (2016) and Alpanda et al. (2024). However, after a couple of quarters there is a sizable depreciation cycle of the RER for around six years, which is the main focus of the analysis in this work.

[10]These mechanism operates in the context of complete markets.

[11]Another difference with the literature is that I include ROW variables in my SVAR, having the advantage to account for the state of the ROW economy, and provide a closer mapping to two-country general equilibrium models.

[12]Meese and Rogoff (1983); Backus et al. (1994); Obstfeld and Rogoff (2000); Devereux and Engel (2002); Heathcote and Perri (2002, 2014); Engel and West (2005); Alessandria and Choi (2007, 2021); Corsetti, Dedola and Leduc (2008); Colacito and Croce (2011); Rabanal and Rubio-Ramirez (2015); Gabaix and Maggiori (2015); Farhi and Gabaix (2016); Valchev (2020); Gornemann et al. (2020); Itskhoki and Mukhin (2021, 2025); Jiang, Krishnamurthy and Lustig (2021); Akinci, Kalemli-Ozcan and Queralto (2023); Mac Mullen and Woo (2024); Chahrour, Cormun, De Leo, Guerrón

dynamics of the RER and net trade, including both financial and real shocks. First, I contribute by providing direct empirical evidence from the SVAR that shows that US government spending shocks are an important driver of the RER and net trade, as these shocks explain between 30 and 35 percent of their variances. Second, I develop a quantitative model, which features a rich set of frictions and shocks, that accounts for the main international business cycle moments, including the RER disconnect puzzles, where fiscal policy is a key driver of these dynamics. Furthermore, the government spending mechanism endogenizes some of the transmission channels treated as exogenous in the recent literature on exchange rate dynamics, such as UIP and demand shocks. Hence, I contribute by providing a resolution to the RER disconnect puzzle through well-identified shocks.

3 The International Transmission of Government Spending Shocks

In this section, I focus on the effect of US government spending shocks to identify the key channels driving the international transmission of fiscal policy. I describe the data, present the empirical strategy to identify US government spending shocks, and the main results. Finally, I show the robustness of the results to a variety of controls and alternative identification strategies.

3.1 Data

The details on the data sources and construction of variables are in Appendix A. I focus on the period of flexible exchange rate regime after the fall of the Bretton Woods system and before the COVID pandemic. My baseline specification is between 1980Q1 and 2019Q4, but the results are robust to starting in 1973Q1. I use data on per-capita gross domestic product, consumption, investment, government spending, federal spending in the US, exports, imports, nominal and real interest rates, the US trade weighted RER, and US gross foreign assets and liabilities.[13] The main data sources are NIPA, OECD, IMF, Bank of International Settlements and Gourinchas and Rey

Quintana, and Valchev (2024); Bodestein et al. (2024); Camara et al. (2024).

[13] I measure net trade flows by the log of the export-import ratio because it is stationary, controls for trade integration, and is tighly tied to the structure in the model. See Alessandria and Choi (2021) for more details.

(2007). The ROW is constructed as a trade weighted average of eighteen countries.[14] Finally, I focus on federal spending in the US, and refer to it either as federal spending or government spending.

3.2 Identification of Government Spending Shocks

To identify innovations to US government spending I follow the strategy in Ramey (2011, 2016). The identification is based on Blanchard and Perotti (2002), which argues that, due to institutional features, the endogenous component of government spending takes at least one quarter to react to the state of the economy.[15] Under this assumption, ordering government spending first in the VAR and applying a Cholesky decomposition would identify the exogenous variation in government spending. However, Ramey (2011, 2016) argues that the private sector might react in anticipation to the change in the exogenous component of government spending, for which it is necessary to control for the anticipation effects. To do so, I follow Ramey (2011, 2016) and construct one-quarter ahead forecast errors of federal spending in the US, using data from the survey of professional forecasters available from the Federal Reserve Bank of Philadelphia.[16] Hence, applying the Cholesky decomposition to a VAR where the forecast error on federal spending is ordered first and the realized spending second, would identify the exogenous component of government spending while controlling for anticipation effects of the private sector. I estimate the following VAR model of the data,

$$Y_t = \Phi(L_h)Y_{t-1} + B\varepsilon_t$$

where the vector Y_t contains data on the US and the ROW aggregate and L_h is the lag operator. Specifically, the vector Y_t contains

$$Y_t' \equiv \left[FEG_t^{fed,us},\ g_t^{fed,us},\ g_t^{row},\ y_t - y_t^{row},\ r_t - r_t^{row},\ NT_t,\ RER_t\right] \tag{1}$$

[14] The ROW countries are Australia, Austria, Belgium, Canada, Denmark, Finland, Germany, Ireland, Italy, Japan, South Korea, Netherlands, Norway, Portugal, Spain, Sweden, Great Britain and Mexico.

[15] For this reason it is preferred to focus on federal spending rather than state and local spending, since the latter is more discretionary, and to exclude transfers.

[16] I use the same measure as Ramey (2011), who shows that the professional forecasts Granger-cause the standard VAR shocks and are powerful instruments for federal spending for the period after 1970. The results are robust to using one-year ahead forecast errors instead of one quarter ahead.

where $FEG_t^{fed,us}$ are the one quarter-ahead forecast error on US real federal spending, $g_t^{fed,usa}$ is US real federal government spending, g_t^{row} is real general government spending in the ROW, $y_t - y_t^{row}$ is relative real GDP between the US and ROW, $r_t - r_t^{row}$ the (long) real interest rate differential, NT_t is the US real export-import ratio, and RER_t the US trade-weighted RER. To study the response of relative consumption, relative investment, US federal debt (held by US agents excluding US government institutions), and US gross foreign assets and liabilities, I rotate these variables as an additional variable in Equation 1 to avoid including too many variables in the SVAR.[17] I include the ROW variables in my SVAR because it accounts for the state of the economy in the ROW and provides a better mapping with two-country general equilibrium models. Finally, following the literature, the VAR is in log-levels, include a quadratic trend and I control for four lags to deal with omitted variables (Galí, López-Salido and Vallés, 2007; Blanchard and Perotti, 2002; Ramey, 2011, 2016; Forni and Gambetti, 2016). To identify the unanticipated component of the innovations to US federal spending, I follow Ramey (2011, 2016) and apply a Cholesky decomposition as explained before.

3.3 Impulse Response Functions to Government Spending Shocks

Figure 2 presents the IRFs of selected variables to a positive shock to the one quarter-ahead forecast error on US federal spending.[18] Panel (a) shows the response of US federal spending, which increases on impact and falls over time, falling under trend after around five years, similar to the findings in Corsetti et al. (2012). Panel (b) shows the response of the US federal government debt held by US agents (excluding government institutions), which increases significantly. Appendix C presents the response of other fiscal instruments which makes clear that government debt is the main instrument used to finance spending shocks over the business cycle.

Panel (c) shows that the interest rate differential increases on impact, although the magnitude is not statistically significant, and then falls under trend until around five years after the shock, consistent with the findings in Corsetti et al. (2012). Importantly, Panel (d) shows the

[17] When I include the US federal debt I exclude the interest rate differential since the debt is measured in real value so it includes its price. Finally, the US gross foreign assets and liabilities are included together as two additional variables in Equation 1.

[18] The IRFs are normalized so that the impact effect on US federal spending equals one percent.

response of the excess return of US government bonds relative to ROW government bonds, in other words the deviations from UIP.[19] There is an initial fall in the excess return but it is not statistically significant. However, over time the excess return becomes positive and stays so until ten years after the shock. The existence of excess returns, or UIP deviations, suggests the presence of imperfections in international financial markets, consistent with previous findings in the literature (Engel and West, 2005; Gabaix and Maggiori, 2015; Bacchetta et al., 2022). Finally, Panel (g) shows that US agents increase their savings in foreign assets. This contradicts the predictions of frictionless models, which is therefore further evidence of financial market imperfections.[20] The responses of the excess returns of US government bonds and the US gross foreign assets are key to identify the frictions driving the international transmission of US fiscal policy, as will be shown in Section 4 and 5.

Panel (e) shows that the shock triggers a depreciation cycle of the US RER, relative to its long-run level. The response of the RER is hump-shaped, peaking between two and three years after the shock. On the other hand, Panel (f) shows that the US net trade flows increase slowly over time, reaching a peak around four years after the shock. Hence, US government spending shocks trigger a lead-lag relationship between the RER and net trade consistent with their unconditional comovement documented in the J-Curve literature (Baldwin and Krugman, 1989; Rose and Yellen, 1989; Backus et al., 1994; Fitzgerald, Yedid-Levi and Haller, 2019; Alessandria and Choi, 2021).

The responses of the remaining variables in the SVAR are displayed in Figure B.1 in Appendix B. I find that US government spending shocks have modest effects on ROW government spending. Secondly, the shock increases relative GDP on impact, but the effect is not persistent. Relative consumption slightly falls on impact and remains low over time. The biggest effect is on relative investment. There is a strong crowding-out of US investment relative to the ROW, which drives the cycle of positive net trade flows shown in Panel (f) of Figure 2. Finally, in Figure G.1, I present

[19] The figure shows the one-year cumulative excess returns, since this variable presents significant noise in early periods. Figure B.2 shows the IRF of the excess returns for each horizon along with the one-year cumulative.

[20] In frictionless models, increases in the supply of government bonds rises the interest rate so that agents are willing to hold these bonds. Consequently, the agents would decrease the holdings of other assets, such as foreign assets, until the returns across all assets are equalized. Hence, the frictionless model predicts a fall in gross foreign assets in response to an increase in the supply of government bonds. This is true under a first order log-linearized model, or certainty equivalent model. Under higher order approximations, changes in risk might generate an incentive to increase the foreign assets in response to the increase in the supply of home government bonds. However, the previous effect would still be present and most likely dominate due to its first order effects.

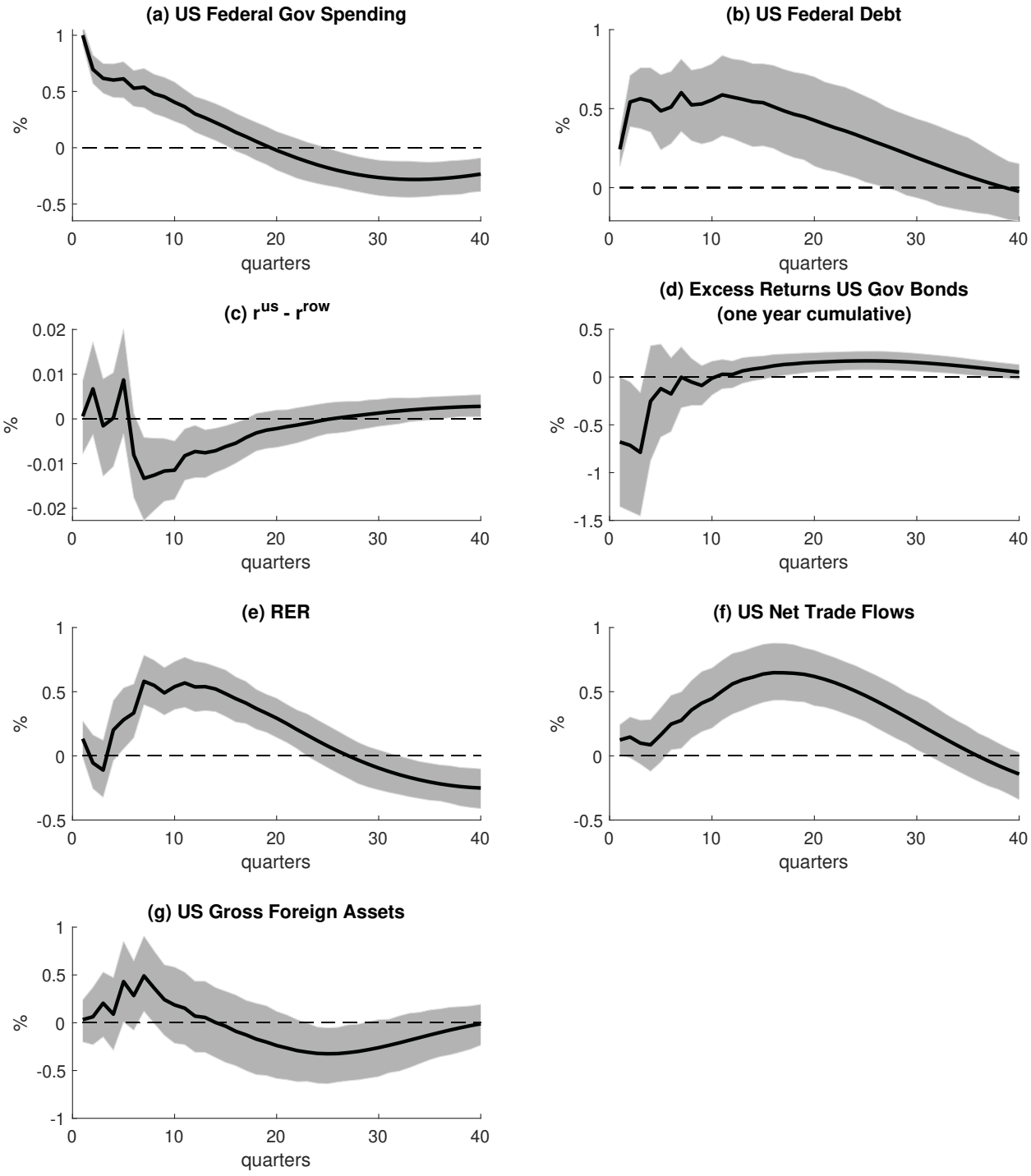


Figure 2: Impulse Response Functions to a Positive US Government Spending Shock

Notes: Standard error bands are 68% confidence intervals. The one year cumulative excess return on the US government bond in Panel (d) is defined as Excess $\text{Return}_{t,t+4} \equiv \sum_{h=0}^{4} r_{t+h}^{us} - r_{t+h}^{row} - \mathbb{E}_t\left[\Delta e_{t+1+h}\right]$.

the IRFs of macro aggregates in dollars, where it can be observed that an impact effect of one dollar increase in US government spending, triggers a crowding-out of relative investment or around 1.25 dollars between four and twenty quarters after the shock.

To summarize, US government spending shocks are mainly financed with debt, trigger a depreciation cycle of the RER and an increase in net trade that occurs gradually over time. At the same time, there are positive excess returns on US government debt relative to foreign debt, and the US gross foreign assets increase. The comovement between US government debt, the RER and net trade triggered by the US government spending shock is consistent with the unconditional dynamics of these variables presented in Figure 1. This raises the question: to what extent are these unconditional dynamics driven by this shock? The next section quantifies the importance of the US government spending shock in driving the unconditional dynamics of key variables of interest.

3.4 Quantifying the Importance US Government Spending Shocks

To quantify the importance of the US government spending shock in driving the dynamics of key variables, I compute their contribution to the forecast error variance decomposition of the variables, displayed in Table 1. The first column presents the variables of interest. The sum of the contribution of the unanticipated and anticipated shock to US government spending is displayed in the second column. The third column shows the contribution of the identified unanticipated shock to US government spending, while the fourth column displays the contribution of anticipated shocks to government spending. Finally, column 5 presents the contribution of the remaining (reduced form) innovations in the SVAR.

The sum of the contribution of unanticipated and anticipated shocks to US government spending accounts for 45% of the variance of US federal spending and 27% of US federal debt. Furthermore, it explains between 30% to 35% of the variance of the RER and net trade. Between 60% and 75% of the contribution of US government spending shocks to these variables is driven by the unanticipated component (column 3). Hence, shocks to US government spending are important drivers of US federal spending and debt, the RER and net trade flows. US government

	Total US Gov	Forecast Error US Gov	Anticipated US Gov	Other Shocks
US Federal Gov Spending	45	26	19	55
US Federal Debt	27	20	7	73
Interest Rate Differential	11	5	6	89
Excess Returns US Gov Bonds	17	7	10	83
RER	32	19	13	68
Net Trade	35	24	11	65
US Gross Foreign Assets	10	6	4	90

Table 1: SVAR Error Forecast Variance Decomposition

spending shocks also explain a significant share of the variance of excess returns on US government bonds, and less so of the interest rate differential and the US gross foreign assets.

3.5 Robustness and Further Extensions

I perform robustness analysis to a battery of controls, identification strategies, and also study the effect of tax shocks. All details are presented in Appendix D. Overall, the main results are robust to these alternative specifications: in response to a positive US government spending shock US government debt raises, the RER depreciates, and the net trade flows increase. The response of the excess returns of US government debt and the US gross foreign assets are also similar to the baseline specification. The contribution of this shock to the error forecasts variance of variables of interest is also similar across specifications. Finally, in Appendix C I also investigate the response of a wider set of variables related to risk in the financial and real economy, the banking sector, and capital goods markets.

The results are robust to including the following controls: (*i*) using the Price-Dividend ratio in the US to control for the possibility of US government spending reacting endogenously to expected changes in the economy, (*ii*) the inclusion of forecast errors of other macro aggregates to control for the potential correlation with forecasts of government spending, (*iii*) using the

sample up to the great recession (1980Q1 to 2007Q4), (*iv*) long nominal interest rates, (*v*) short nominal interest rates, (*vi*) short real interest rates, (*vii*) controlling for the US fiscal balance, (*viii*) ordering ROW government spending first to control for the possibility that innovations in the ROW drive the dynamics of government spending in the US, (*ix*) using a linear trend in the SVAR, and (*x*) controlling for anticipation effects of wars using the (global and US) geopolitical risk index from Caldara and Iacoviello (2022).

Furthermore, the results are robust to the following alternative identification strategies: (*i*) Blanchard and Perotti (2002), and (*ii*) external instruments or Proxy SVARs (Mertens and Ravn, 2013; Ferrara et al., 2021).[21] Hence, the results are robust to the main identification strategies developed in the literature. Lastly, I find similar results using US tax shocks. Figures C.27 and C.28, show the responses to unanticipated tax cuts using the measure from Mertens and Ravn (2012) and to VAR shocks to federal tax rates, respectively.[22] In all these cases, tax cuts lead to increases in government debt, depreciation of the RER and increase in net trade, consistent with the results obtained using US government spending shocks.

To summarize, I document that US government spending shocks have been financed mostly with debt. Furthermore, the positive excess returns of US government bonds, or UIP deviations, and the increase in US gross foreign assets triggered by this shock suggest the presence of financial market imperfections.

4 Quantitative Model

In this section, I present the quantitative model to study the international transmission of US fiscal policy. The model is based on Backus et al. (1994) and Heathcote and Perri (2014), but departs in several dimensions. I also present the estimation of the model.

[21] Figure C.3 shows that the results obtained in the Proxy SVAR, which includes trends as it is the standard practice in the literature, are very similar to the baseline specification. Figure C.4 shows that the results differ when one estimates the Proxy SVAR with no trends in the VAR, which explain the difference with the results in Ferrara et al. (2021).

[22] The VAR shocks to federal tax are from a VAR under a Cholesky decomposition where the federal tax rate is ordered after the forecast error on federal spending, although results are almost unchanged if the federal tax rate is ordered first.

4.1 Two-Country Model: Fiscal Rules and Portfolio Frictions

I extend the standard two-country international business cycle model in numerous dimensions. First, I incorporate a fiscal rule that allows government spending, lump-sum taxes and government debt to respond endogenously to the state of the economy, together with shocks to government spending, similar to Leeper et al. (2010).[23] Second, households can save in two assets, a domestic government bond and a foreign bond issued by the foreign household in foreign currency.[24] I incorporate portfolio frictions by assuming that the household pays a cost to deviate from the long-run portfolio share of savings in foreign assets. This is similar to the specifications in Guo et al. (2023), Camara et al. (2024) and Fukui et al. (2023). This friction is at the core of the international transmission mechanism by generating endogenous excess returns of US government bonds, or deviations from UIP. It captures in reduced form, and a tractable way, different frictions faced by investors that I discuss later on.

I also incorporate dynamic trade frictions modeled as an adjustment costs in the use of imported to domestic inputs in the CES aggregators, following Erceg, Guerrieri and Gust (2006). In each country, there are three different retailers, for materials, consumption and investment goods. They aggregate bundles of domestic and imported intermediate goods using a CES technology. The aggregators are heterogeneous in their home bias, to capture the average trade structure of the US economy. Finally, the model includes shocks to aggregate TFP, the marginal cost of exporting (or iceberg trade cost shocks), and to the long-run portfolio shares of foreign assets, capturing changes in financial liberalization that give rise to exogenous deviations from UIP. The two countries are symmetric reflecting the US and the ROW economies. I present the model from the point of view of US agents.

[23] To be precise, these are shocks to purchases of goods by the government, in line with the identified shocks in Section 3.

[24] The domestic household can borrow from the foreign household by issuing a bond in domestic currency.

4.1.1 Households

The representative household has balanced growth preferences. She maximizes the discounted expected utility over consumption, C_t and labor, L_t,

$$U_0 = E_0 \sum_{t=0}^{\infty} \beta^t \frac{\left[C_t^{\eta}(1-L_t)^{1-\eta}\right]^{1-\sigma} - 1}{1-\sigma}$$

where $\eta > 0$ and σ governs the risk-aversion and intertemporal elasticity of substitution. The flow budget constraint is given by

$$\begin{aligned} &P_t^c C_t + P_t^I I_t + B_{t+1}^{g,us} P_t^{g,us} + \mathcal{E}_t B_{t+1}^{row,us} P_t^{row,us} + \mathcal{F}\left(B_{t+1}^{row,us}, \bar{S}_{t+1}^{us}; \psi_t^{us}\right) \\ &\leq W_t L_t + R_t^k K_t + \Pi_t^{us} - T_t^{us} + B_t^{g,us} + \mathcal{E}_t B_t^{row,us} + B_{t+1}^{us,row} P_t^{us,row} - B_t^{us,row} \end{aligned}$$

where P_t^c is the price index of the final consumption good in the US, C_t the purchases of the US final consumption good, P_t^I is the price index of the final investment good in the US, I_t are the purchases of US final investment goods, K_t is aggregate capital in the US, $B_{t+1}^{g,us}$ are savings in US government bonds, P_t^g the price of this bonds, Π_t^{us} the aggregate profits of intermediate firms, and T_t are lump-sum taxes from the government.

The international asset block is given by two gross bonds. $B_{t+1}^{row,us}$ is the quantity of bonds purchased by the US household issued by the ROW household in ROW currency at period t, and $P_t^{row,us}$ its price (i.e. $B_{t+1}^{row,us} > 0$ are the savings of US household in ROW bonds, or the US gross foreign assets). $B_{t+1}^{us,row}$ is the quantity of bonds purchased by the ROW household issued by the US household in dollars at period t and $P_t^{us,row}$ its price (i.e. $B_{t+1}^{us,row} > 0$ is the amount borrowed by the US household from the ROW household, or the US gross foreign liabilities). Finally, $\mathcal{E}_t$ is the nominal exchange rate (NER), where an increase in $\mathcal{E}_t$ is a depreciation of the dollar,

The function $\mathcal{F}\left(B_{t+1}^{row,us}, \bar{S}_{t+1}^{us}; \psi_t^{us}\right)$ captures portfolio frictions. In particular, it takes the following functional form,

$$\mathcal{F}\left(B_{t+1}^{row,us}, \bar{S}_{t+1}^{us}; \psi_t^{us}\right) = \frac{\Gamma}{2}\left(\frac{\mathcal{E}_t B_{t+1}^{row,us} P_t^{row,us}}{\bar{S}_{t+1}^{us}} - \frac{\mathcal{E}_{ss} B_{ss}^{row,us} P_{ss}^{row,us}}{\bar{S}_{ss}^{us}} \times e^{\psi_t^{us}}\right)^2 \times \bar{S}_{t+1}^{us} \tag{2}$$

where $\Gamma \geq 0$ governs the cost of adjusting the portfolio of assets, $\bar{S}^{us}_{t+1} = \bar{B}^{g,us}_{t+1} P^{g,us}_t + \mathcal{E}_t \bar{B}^{row,us}_{t+1} P^{row,us}_t$ are the aggregate financial savings of the US household, and ψ^{us}_t are shocks to the long-run portfolio of foreign assets capturing changes in financial liberalization. In equilibrium, the cost depends on the portfolio share of foreign assets, $\frac{\Gamma}{2}\left(s^{row,us}_{t+1} - s^{row,us}_{ss} \times e^{\psi^{us}_t}\right)^2$, where $s^{row,us}_{t+1} \equiv \frac{\mathcal{E}_t B^{row,us}_{t+1} P^{row,us}_t}{S_{t+1}}$ and $s^{row,us}_{ss} \equiv \frac{\mathcal{E}_{ss} B^{row,us}_{ss} P^{row,us}_{ss}}{S_{ss}}$. The adjustment cost in equation 2 follows the specification in Guo et al. (2023), Camara et al. (2024). The main difference is that the household does not internalize the effect on the aggregate financial savings, $\bar{S}^{us}_{t+1}$. The main implication of the portfolio friction is that it reduces the elasticity of demand for foreign assets. This friction also generates similar results as in the specification followed by Bacchetta et al. (2022), where the cost is paid relative to the previous period portfolio share rather than the long-run share.[25] In sum, the portfolio re-balancing friction makes agents more reluctant to deviate from their long-run portfolio share of foreign assets, relative to the frictionless case.

There are several reasons why agents face portfolio re-balancing frictions. First, there is a growing literature on institutional investors that finds that investors face strict mandates in the allocation of wealth across different assets (Basak and Pavlova, 2013; Greenwood, Hanson and Liao, 2018; Gabaix and Koijen, 2021; Bacchetta et al., 2022; Pavlova and Sikorskaya, 2022; Koijen and Yogo, 2024; Moretti, Pandolfi, Schmukler, Bauer and Williams, 2024). This type of frictions dampens the re-allocation of assets in response to shocks, resulting in lower asset demand elasticities. Second, increasing the holdings of domestic government bonds raises the exposure to domestic risk. Higher risk in the US can tilt portfolios towards foreign assets to diversify the risk, making portfolio shares less volatile. For example, it has been documeneted that inflation risk matters for the pricing of assets (Moerman and van Dijk, 2010). Moreover, in Appendix C I document that risk in the US increases after a positive government spending shock, since the VXO increases and the US Price-Dividend ratio falls. The friction can thus capture in reduced form variation in risk-premia. Finally, the literature on household portfolios has documented the presence of sticky portfolios and behavioral biases, which leads to hump-shaped dynamics of asset prices and portfolios in response to shocks,[26] similar to the implications of the portfolio

[25] Another difference is that Bacchetta et al. (2022) solve for the optimal portfolio, which requires second and third order approximations, where in this case long-run portfolios are pinned down by the presence of $s^{row,us}_{ss}$ in $\mathcal{F}\left(s^{row,us}_{t+1}, s^{row,us}_{ss}\right)$ and by the the fiscal rule described later.

[26] See Brunnermeier and Nagel (2008); Calvet, Campbell and Sodini (2009); Alvarez, Guiso and Lippi (2012); Chien,

friction in Equation 2.

To summarize, different microfoundations can generate portfolio dynamics similar to those induced by the portfolio friction in Equation 2. Furthermore, as will be shown in Section 5, portfolio frictions have the advantage of bringing the model closer to the data in other dimensions.

Portfolio frictions affect the demand for foreign assets. To see this consider the FOCs of the US household for US government bonds and foreign assets,

$$1 = \beta \mathbb{E}_t \left[\Omega_{t+1} (1 + r_t^{g,us}) \right], \tag{3}$$

and

$$1 + \Gamma \left(s_{t+1}^{row,us} - s_{ss}^{row,us} \times e^{\psi_t^{us}} \right) = \beta \mathbb{E}_t \left[\Omega_{t+1} \frac{\mathcal{E}_{t+1}}{\mathcal{E}_t} (1 + r_t^{row,us}) \right], \tag{4}$$

where equation 3 is the demand for US government bonds, and equation 4 is the demand for foreign assets, Ω_{t+1} is the stochastic discount factor, and $(1+r_t^{g,us}) \equiv 1/P_t^{g,us}$ and $(1+r_t^{row,us}) \equiv 1/P_t^{row,us}$. The portfolio friction reduces the elasticity of demand of the foreign bond, while keeping a perfectly elastic demand for US government bonds. This is consistent with empirical findings showing that the demand for US government bonds is more elastic than for other classes of assets, and close to perfectly elastic.

Using the demand for foreign assets it is useful to derive the partial equilibrium aggregate demand elasticity of internationally traded bonds, since this elasticity would be informative of the size of the portfolio re-balancing cost Γ. Proposition 1 presents this result.

Proposition 1 (Identification of portfolio re-balancing friction Γ)**.** *The partial equilibrium aggregate demand elasticity for the ROW bond ($\epsilon^d_{b^{row,us}}$) is given by,*

$$\frac{\partial(\beta \hat{B}_{t+1}^{row,us})}{\partial \hat{R}^{row,us}} = \frac{\beta(1 + \Gamma \bar{s}^{row,us})}{\Gamma \bar{s}^{row,us}} = \epsilon^d_{b^{row,us}}$$

where $\bar{s}^{row,us}$ is the steady state share of savings in ROW bonds. Hence, the value of the portfolio

Cole and Lustig (2012)

re-balancing cost Γ *consistent with micro estimates of* $\epsilon^d_{b^{row,us}}$ *is,*

$$\Gamma = \frac{\beta}{\bar{s}^{row,us}(\epsilon^d_{b^{row,us}} - \beta)}$$

The formal proof is in Appendix E. Proposition 1 shows that there is a clear mapping between the portfolio re-balancing cost (Γ), the discount factor (β), the steady state share of savings in ROW bonds ($\bar{s}^{row,us}$), and the partial equilibrium aggregate demand elasticity of internationally traded bonds ($\epsilon^d_{b^{row,us}}$). Hence, the portfolio re-balancing cost can be externally disciplined by using empirical estimates of the partial equilibrium aggregate demand elasticity of internationally traded bonds. Koijen and Yogo (2024) estimate this elasticity by exploiting the cross-section of global investors. They find a value of the partial equilibrium aggregate demand elasticity of 2.1.[27] This value of the elasticity of demand, together with a discount factor of 0.99, and an average share of savings in ROW bonds of 0.61 in the US, gives a value of the portfolio re-balancing cost, Γ, of 1.462. This is the value that will be used in the benchmark model, where the estimation of the model is discussed in Section 4.2.

The key channel through which portfolio frictions affect the international transmission, is by inducing excess returns of bonds, or UIP deviations.[28] To see this, consider the first-order log-linearized UIP condition,

$$r^{g,us}_t - r^{g,row}_t - \mathbb{E}_t\left[\Delta e_{t+1}\right] = \Gamma \bar{s}^{g,us}\left(s^{g,us}_{t+1} - \bar{s}^{g,us}\right) + \Gamma(1 - \bar{s}^{g,us})\psi^{us}_t \tag{5}$$

where $\bar{S}^{us}$ is the value of total financial savings in the US in steady state, $\bar{s}^{g,us}$ the steady state portfolio share of US government bonds, and s^g_{t+1} the portfolio share of US government bonds between t and $t+1$.[29] There are two sources driving the excess returns. The first term in the right hand side captures the endogenous excess returns arising from the portfolio frictions, and the second term the exogenous deviations arising from shocks to long-run portfolios, capturing

[27] This value corresponds to the long-term debt, which I map to the model since most of the increase in US government debt has been long-term.

[28] The presence of this friction result in the failure of Ricardian equivalence (Barro, 1974). The model also features another source of deviation from Ricardian equivalence arising from the endogenous response of government spending to changes in the value of debt as shown later.

[29] The portfolio share of government bonds is defined as $s^{g,us}_{t+1} \equiv \frac{B^{g,us}_{t+1} P^{g,us}_t}{S_{t+1}}$, or $s^{g,us}_{t+1} = 1 - s^{row,us}_{t+1}$.

the UIP shock in Itskhoki and Mukhin (2021).

By rolling forward equation 5, we can derive an expression for the transitory component of the exchange rate, given by

$$e_t = -\mathbb{E}_t \sum_{j=0}^{\infty} \left(r^{g,us}_{t+j} - r^{g,row}_{t+j} \right) + \Gamma \bar{s}^{g,us} \mathbb{E}_t \sum_{j=0}^{\infty} \left(s^{g}_{t+1+j} - \bar{s}^{g} \right) + \Gamma (1 - \bar{s}^{g,us}) \mathbb{E}_t \sum_{j=0}^{\infty} \psi^{us}_{t+j} \tag{6}$$

so that the exchange rate depreciates in response to: (*i*) a fall in the sum of expected future (transitory) interest rate differentials, (*ii*) an increase in the sum of expected future (transitory) portfolio share differentials of government bonds, (*iii*) an increase in the sum of the exogenous UIP wedge. The second term on the right hand side explicitly indicates how the presence of portfolio frictions affect the propagation of shocks in the economy by linking the response of the portfolio shares to the exchange rate determination. This equation shows that the exchange rate would depreciate in response to a government spending shock through the portfolio channel if the share of savings in US government bonds increases sufficiently. This implies that the fiscal rule, determining the response of government debt, has implications for the exchange rate determination by inducing deviations of UIP when $\Gamma > 0$.

Next, the US household purchases capital goods from US retailers, I_t, to accumulate capital, which follows the law of motion

$$K_{t+1} = (1 - \delta) K_t + I_t \times \left[1 - \frac{\kappa}{2} \left(\frac{I_t}{I_{t-1}} - 1 \right)^2 \right],$$

where the parameter κ governs the adjustment cost of investment following Christiano, Eichenbaum and Evans (2005).

The problem of the US Household is to maximize the expected life-time utility subject to the budget constraint, the capital accumulation equations, the CES aggregator of capital and the adjustment cost in the CES. The RER, $\mathcal{Q}_t$, is defined in units of the US final consumption good,

$$\mathcal{Q}_t = \mathcal{E}_t \frac{P^{c^*}_t}{P^{c}_t}$$

4.1.2 Retailers

In each country there are three representative retailers, one for consumption goods, one for investment goods and one for materials. Denote the retailer by $X \in \{C, I, M\}$. These retailers aggregate bundles of domestic and imported varieties from,

$$Y^x_{us,us,t} = \left(\int_0^1 y^x_{us,us,t}(j)^{\frac{\theta-1}{\theta}} dj \right)^{\frac{\theta}{\theta-1}} \quad \text{, and} \quad Y^x_{row,us,t} = \left(\int_0^1 y^x_{row,us,t}(j)^{\frac{\hat{\theta}_t-1}{\hat{\theta}_t}} dj \right)^{\frac{\hat{\theta}_t}{\hat{\theta}_t-1}}$$

where $\hat{\theta}_t = \theta \mathcal{Q}_t^{\zeta}$ is a reduced form pricing-to-market friction as in Alessandria and Choi (2021), Mac Mullen and Woo (2024) and Kekre and Lenel (2024). This friction allows the model to generate a volatility of the terms of trade that is lower than that of the RER and an incomplete pass-though of exchange rate to prices. The CES aggregators of the retailers are given by

$$Y^x_t = \left[(1-\gamma^x)^{\frac{1}{\rho^x}} \left(Y^x_{us,us,t} \right)^{\frac{\rho^x-1}{\rho^x}} + \gamma^{x\,\frac{1}{\rho^x}} \left(\varphi^x_t Y^x_{row,us,t} \right)^{\frac{\rho^x-1}{\rho^x}} \right]^{\frac{\rho^x}{\rho^x-1}}$$

and

$$\varphi^x_t = 1 - \frac{\iota^x}{2} \left(\frac{Y^x_{row,us,t}/Y^x_{us,us,t}}{Y^x_{row,us,t-1}/Y^x_{us,us,t-1}} - 1 \right)^2$$

where $(1-\gamma^x)$ is the home bias of good X, ρ^x is the long-run Armington elasticity and φ^x is an adjustment cost in the use of imported to domestic intermediates as in Erceg et al. (2006). This adjustment cost makes trade flows more inelastic in the short-run generating a gradual response of trade flows to shocks. This feature allows the model to capture the dynamic (unconditional) comovement between the RER and net trade and contributes to account for the size of the response of the RER to government spending shocks. The problem of the retailer X is given by

$$\max_{\{Y^x_{t+k}, Y^x_{us,us,t+k}, Y^x_{row,ust+k}\}} E_t \sum_{k=0}^{\infty} \beta^k \Omega_{t+k} \left(P^x_{t+k} Y^x_{t+k} - P^x_{us,us,t+k} Y^x_{us,us,t+k} - P^x_{row,us,t+k} Y^x_{row,us,t+k} \right)$$

subject to the CES aggregator and adjustment cost φ^x, where Ω_{t+k} is the US Household stochastic discount factor and $P^x_{us,us,t}$ and $P^x_{row,us,t}$ are ideal price indexes of bundles of varieties. The FOCs

yield the demand functions

$$P_t^x \frac{\partial Y_t^x}{\partial Y_{us,us,t}^x} + \beta E_t \left(\Omega_{t+1} P_{t+1}^x \frac{\partial Y_{t+1}^x}{\partial Y_{us,us,t}^x} \right) = P_{us,us,t}^x \quad \text{and} \quad P_t^x \frac{\partial Y_t^x}{\partial Y_{row,us,t}^x} + \beta E_t \left(\Omega_{t+1} P_{t+1}^x \frac{\partial Y_{t+1}^x}{\partial Y_{row,us,t}^x} \right) = P_{row,us,t}^x$$

The ideal price index of final good X in the US is $P_t^x = \left[(1-\gamma^x) \left(P_{us,us,t}^x \right)^{1-\rho^x} + \gamma^x \left(P_{row,us,t}^x \right)^{1-\rho^x} \right]^{\frac{1}{(1-\rho^x)}}$.

The consumption good retailer sells to the US household and the US government, so that its revenue is given by $P_t^c \left(C_t + G_t^c \right)$, were C_t is the US household purchases of US consumption goods and G_t^c the US government purchases of the US consumption good. The investment good retailer sells to the US household and the US government, so that its revenue is given by $P_t^I \left(I_t + G_t^I \right)$. Here I_t are the US household purchases of US investment goods, and G_t^I the US government purchases of US final investment good. Finally, the materials retailer only sells domestically, so that its revenue is given by $P_t^M (M_t)$, where M_t are the purchases of materials of intermediate firms.

4.1.3 Intermediate Firms

Home output is produced under monopolistic competition. Since in equilibrium all varieties are the same I omit the subscript j indexing each firm and present the problem for a single firm. The intermediate firm faces a Cobb-Douglas production function,

$$Y_t^{us} = e^{z_t^{us}} \left(K_t^{\alpha} L_t^{1-\alpha} \right)^{\eta} M_t^{1-\eta}$$

where α is the capital share of income, η the share of materials in total expenditure and z_t^{us} is the aggregate productivity in the US.

The firm maximizes profits in the US and ROW markets by setting $P_{us,us,t}^x$ and $P_{us,row,t}^x$ subject to demands and resource constraint $Y_t^{us} = \sum_{x \in \{C,I,M\}} \left(Y_{us,us,t}^x + Y_{us,row,t}^x e^{\xi_t^{us}} \right)$, where ξ_t^{us} is an stochastic iceberg trade cost. Profits are given by

$$\Pi_t^{us} = \sum_{x \in \{C,I,M\}} \left(P_{us,us,t}^x - MC_t \right) Y_{us,us,t}^x + \sum_{x \in \{C,I,M\}} \left(P_{us,row,t}^x - MC_t \right) Y_{us,row,t}^x$$

The solution to this problem is characterized by the optimal price setting, which is a markup over

the marginal cost,

$$P^x_{us,us,t} = \frac{\theta}{\theta - 1} MC_t \quad \text{and} \quad \mathcal{E}_t P^x_{us,rowt} = e^{\xi^{us}_t} \frac{\hat{\theta}}{\hat{\theta} - 1} MC_t$$

and by demands for factors of production,

$$W_t L_t = (1-\eta)(1-\alpha) MC_t Y^{us}_t; \quad R^k_t K_t = (1-\eta)\alpha MC_t Y^{us}_t; \quad P^M_t M_t = \eta MC_t Y^{us}_t$$

where MC_t is the marginal cost of production, given by

$$MC_t = \frac{\left[e^{-z^{us}_t} \left(R^k_t\right)^{\alpha} (W_t)^{1-\alpha})^{(1-\eta)}\right] \left(P^M_t\right)^{\eta}}{\eta^{\eta} \left[(1-\eta)\alpha^{\alpha}(1-\alpha)^{1-\alpha}\right]^{1-\eta}}$$

4.1.4 Fiscal Rule

I focus on the federal government in the US to be consistent with the empirical evidence documented in Section 3. The US government purchases consumption and investment goods from local retailers, G^c_t and G^I_t respectively. To finance its expenditures, the US fiscal authority uses a combination of lump-sum taxes, T_t, and debt, $\hat{B}^{g,us}_{t+1}$. The budget constraint of the US government is given by,

$$T_t + P^{g,us}_t \hat{B}^{g,us}_{t+1} = P^c_t G^c_t + P^I_t G^I_t + \hat{B}^{g,us}_t$$

Lump-sum taxes and government spending follows a rule similar to the one adopted by Leeper et al. (2010).[30] Lump-sum taxes are used in the steady state to finance government purchases of consumption and investment goods, denoted by μ^g_{ss}, and the interest payments on debt, denoted by μ^b_{ss}. Outside the steady state, lump-sum taxes are allowed to respond endogenously to deviations in interest payments on debt according to the rule,

$$T_t = \mu^g_{ss} + \mu^b_{ss} + \varphi^{T,b}\left(P^{g,us}_t \hat{B}^{g,us}_{t+1} - \mu^b_{ss}\right) + \varphi^{T,g}\left(P^c_t G^c_t + P^I_t G^I_t - \mu^g_{ss}\right)$$

[30] I do not considering distortionary taxation, since I do not observe an increase in taxes in response to a US government spending shock in the SVAR analysis. Moreover, since distortionary taxation would have no direct effect on UIP deviations, its inclusion would have negligible effects on the international adjustment to shocks to government spending in the model.

where $\varphi^{T,b}$ and $\varphi^{T,g}$ govern the response of lump-sum taxes to deviations in the value of government debt from the steady state and deviations in purchases of goods from the steady state, respectively. Finally, the evolution of US government spending is given by,

$$\hat{g}_t^{us} = \varphi^{G,b}\left(P_{t-1}^{g,us}\hat{B}_t^{g,us} - \mu_{ss}^{b}\right) + \rho_g^{us}\hat{g}_{t-1}^{us} + \sigma_g^{us}\varepsilon_{g,t}^{us} \quad \text{with} \quad \varepsilon_{g,t}^{us} \sim N(0,1)$$

where $\varphi^{G,b}$ is the endogenous response of government spending to deviations from steady state debt payments, ρ_g^{us} governs the persistence of the process, σ_g^{us} the size of the shock, and $\varepsilon_{g,t}^{us}$ is *iid* across time.

Government spending in consumption and investment goods, evolve according to

$$G_t^c = \mu_{ss}^{G_c} \times e^{\hat{g}_t^{us}} \quad \text{and} \quad G_t^I = \mu_{ss}^{G_I} \times e^{\hat{g}_t^{us}}$$

where $\mu_{ss}^{G_c}$ and $\mu_{ss}^{G_I}$ capture the average share of government spending in consumption and investment goods, respectively. The log of real federal government spending is defined as,

$$g_t^{fed,us} \equiv \ln\left(G_t^c + G_t^I\right)$$

4.1.5 Other Shock Processes

The other stochastic processes for $i \in \{US, ROW\}$ are given by $\Phi \in \{z, \psi, \xi\}$: total factor productivity (z_t^i), the long-run portfolio shock (ψ_t^i), and the trade cost (ξ_t^i). I assume that the stochastic process have a common and a differential component,

$$\begin{bmatrix} \Phi_t^{us} \\ \Phi_t^{row} \end{bmatrix} = \begin{bmatrix} \Phi_t^c + \Phi_t^d/2 \\ \Phi_t^c - \Phi_t^d/2 \end{bmatrix}$$

where

$$\Phi_t^c = \mu_\Phi^c \times (1-\rho_\Phi^c) + \rho_\Phi^c \times \Phi_{t-1}^c + \varepsilon_{\Phi t}^c \qquad \varepsilon_{\Phi t}^c \sim N(0, \sigma_\Phi^c)$$

$$\Phi_t^d = \rho_\Phi^d \times \Phi_{t-1}^d + \varepsilon_{\Phi t}^d \qquad \varepsilon_{\Phi t}^d \sim N(0, \sigma_\Phi^d)$$

where Φ_t^c and Φ_t^d are the common and differential components. I assume that $\mu_\Phi^c = 0$ for all processes, except TFP. Finally, trade costs have only a differential component, i.e. $\xi_t^c = 0 \forall t$. All innovations are assumed to be uncorrelated with each other.

4.1.6 Market Clearing and Country Budget Constraint

The US consolidated budget constraint is obtained by combining the US Household budget constraint with the US government budget constraint and the profits of US intermediate firms. The consolidated US budget constraint is given by,

$$\mathcal{E}_t \left(\frac{B_{t+1}^{row,us}}{R_t^{row,us}} - B_t^{row,us} \right) - \left(\frac{B_{t+1}^{us,row}}{R_t^{row,us}} - B_t^{us,row} \right) = NX_t - \frac{\Gamma}{2} \left(s_{t+1}^g - s_{ss}^g \times e^{\psi_t^{us}} \right)^2$$

where NX_t are net exports and given by

$$NX_t \equiv \sum_{x \in \{C,I,M\}} \left(\mathcal{E}_t P_{us,us,t}^x Y_{us,us,t}^x - P_{row,us,t}^x Y_{row,us,t}^x \right)$$

Market clearing in bonds markets requires that at all t,

$$\hat{B}_{t+1}^{g,us} = B_{t+1}^{g,us} \quad ; \quad \hat{B}_{t+1}^{g,row} = B_{t+1}^{g,row} \quad ; \quad B_{t+1}^{us,row} = \hat{B}_{t+1}^{us,row} \quad ; \quad B_{t+1}^{row,us} = \hat{B}_{t+1}^{row,us}$$

where $\hat{B}_{t+1}^{g,row}$ and $B_{t+1}^{g,row}$ are the supply and demand of ROW government bonds by the ROW government and ROW household respectively, $\hat{B}_{t+1}^{us,row}$ the demand of US assets from ROW household, and $\hat{B}_{t+1}^{row,us}$ the supply of ROW assets from ROW households. Finally, the foreign country budget constraint is satisfied by Walras Law.

4.2 Estimation

I now describe the estimation procedure and the identification strategy. I define two sets of parameters. The first one is set externally. The second one is estimated via Simulated Method of Moments (SMM). Table 2 presents the parameters of the first group, and Tables 3 and 4 the

target moments and the estimated parameters with their standard errors in the SMM procedure, respectively.

The first group includes parameters that are quite standard and others that deserve more discussion. In particular, I choose the home bias in the four CES aggregators to match the average structure of trade in the US between 1980 and 2019. That is, a trade-to-GDP ratio of 21%, a share of material goods in trade of 29%, a share of consumption goods in trade of 39%, and a share of capital goods in trade of 32%.[31] Furthermore, I target a steady value of US gross foreign assets to GDP of 0.79 and a portfolio share of US government bonds of 0.39, to be consistent with the average values in the US between 1980 and 2019.[32]

I target a steady state ratio of US federal government spending to GDP of 8.5%, the average in the sample period, and a share of government spending in consumption goods of 75%. The volatility of the US government spending shock is chosen to match the impact effect of the US government spending impulse response from the SVAR. The adjustment cost of investment is set to 3.24, the value estimated in Christiano et al. (2005) for the flexible price model. The pricing-to-market friction is chosen to generate an exchange rate pass-through of 75%, in line with results in Alessandria and Choi (2021) and estimates in Gopinath and Itskhoki (2010). I target an intertemporal elasticity of substitution of 1.5, which gives a value of σ of 2/3, which is within the range used in the literature. Finally, following Proposition 1, the portfolio friction is set to match the partial equilibrium aggregate demand elasticity for internationally traded bonds of 2.1 estimated by Koijen and Yogo (2024), which gives a value of Γ of 1.462.

The moments used in the SMM estimation are displayed in Table 3, and the estimated parameters with their standard errors in Table 4. The parameters include those related to shock

[31] I use the classification in NIPA to define trade in capital goods. I use the category 'Capital goods, except automotive', and split the category 'Automotive vehicles, engines, and parts' into capital goods and consumption goods. Since I do not observe directly within the last category how much is trade in capital goods, I estimate it using the shares from Erceg, Guerrieri and Gust (2008), who has data on this decomposition for the year 2004. Their average share of capital goods trade within this category is 0.135. This gives a share of trade in capital goods in my data of 32%, close to the value in Erceg et al. (2008) data of 36%, and 46% in Engel and Wang (2011) who only focuses on durable goods.

[32] I map the holdings of US government bonds by US households in the model to the holdings of US government bonds by US agents net of the holdings of US government institutions in the data. I use the gross foreign assets in the data as my measure in the model. The results are similar if I consider the US gross foreign assets net of the claims on foreign government bonds for the period for which I have quarterly data on the components of US gross foreign assets (1980Q1-2004Q4) (Gourinchas and Rey, 2007).

Parameter		Value	Target Moment
Mean common TFP	μ_z^c	3.5	Normalize GDP to 1
Discount factor	β	0.99	Annual interest rate of 4%
Intertemporal Elasticity of substitution	$1/\sigma$	1.5	Intertemporal Elasticity of substitution of 1.5
Weight on labor	ϱ	0.29	Hours worked of 1/3
Materials Share	η	0.50	Intermediate input share of 0.5 of expenditure
Capital share	α	0.36	Capital share in value added
Depreciation rate of capital	δ	0.025	standard
Elasticity of substitution across varieties	θ	4	Producer markup of 33%
Steady State Portfolio Gov Bonds	s_{ss}^g	0.39	Average portfolio share of US agents on US gov bonds
Steady State Gross Financial Flows	B^{ss}	0.798	Average ratio US foreign assets to GDP of 0.79
Portfolio adjustment cost	Γ	1.462	PE aggregate asset demand elasticity of 2.1 (Koijen and Yogo, 2024)
Investment adjustment cost	κ	3.24	Christiano et al. (2005)
Armington elasticity intermediate goods	$\rho^c = \rho^I = \rho^m$	1.5	standard
Pricing-to-market friction	ζ	0.75	Pass-through of exchange rate to prices of 75%
Home bias in aggregators	γ^I	0.056	i. Trade-to-GDP ratio of 21%
	γ^m	0.030	ii. Share of Materials in US Trade 29%
	γ^c	0.058	iii. Share of Consumption in US Trade 39%
	γ^k	0.065	iv. Share of Capital in US Trade 32%
Steady State gov expenditure	$\mu_{ss}^{G_k}$	0.0212	i. US federal government spending over GDP of 0.085%
	$\mu_{ss}^{G_c}$	0.0638	ii. Share of US government consumption goods of 75%
Std US gov spending shock	σ_g^{us}	0.011	impact effect US gov spending IRF

Table 2: Externally Calibrated Parameters

processes, adjustment costs, and the endogenous response of the fiscal rule to the state of the economy. To simplify the estimation, the adjustment costs in the CES aggregators are set to be the same ($\iota^c = \iota^I = \iota^m$). The moments include a subset of the empirical IRFs estimated in Section 3, and unconditional moments chosen to capture a broad set of international business cycle moments, including those of the net trade and the RER. Hence, my identification strategy targets a combination of conditional and unconditional moments.[33] To estimate the unconditional moments, I filter the data using a cubic de-trend, but results are robust to using a quadratic de-trend or the Band Pass filter to capture cyclicality up to twenty years.[34] I choose this filter to capture

[33]Targeting a combination of conditional and unconditional moments is a strategy also followed by Winberry (2021) and Fukui et al. (2023).

[34]There are three moments that I estimate without de-trending, in the data and model simulated data. The short and long-run trade elasticity to prices from an error correction model, and the coefficient on the interest rate differential in the Fama (1984) regression.

medium to low frequency dynamics, where most of the variance of the RER and net trade arise.[35]

In total there are 15 parameters and 178 moments (Table 4 displays the parameters, and Table 3 the target moments).[36] Out of 178 moments, 160 correspond to IRF moments, and the remaining 18 are unconditional moments. Since there are more moments than parameters, I weight the moments according to the inverse of their variance. Similar to Christiano et al. (2005), let τ denote the vector of parameters, $\mathbf{\Psi}(\tau)$ the mapping from τ to model moments, and $\hat{\mathbf{\Psi}}$ the corresponding empirical estimates. Then the estimator τ is the solution to

$$J = \min_{\tau} [\hat{\mathbf{\Psi}} - \mathbf{\Psi}(\tau)]' \mathbf{V}^{-1} [\hat{\mathbf{\Psi}} - \mathbf{\Psi}(\tau)]$$

where $\mathbf{V}$ is diagonal matrix with sample variances of $\hat{\mathbf{\Psi}}$'s along the diagonal.[37]

I. SVAR IRFs	$\{g_h^{us}, rer_h,\ nt_h,\ P_h^{g,us}\ B_h^{g,us}\}$, for $h = 1, ..., 40$
II. Standard business cycle moments	$\frac{\sigma(g^{us})}{\sigma(gdp^{us})}$; $\frac{\sigma(g^{row})}{\sigma(gdp^{us})}$; $\rho(g^{row})$; $\frac{\sigma(inv^{us})}{\sigma(gdp^{us})}$; $\rho(gdp^{us}, gdp^{row})$
III. International quantities and prices	$\frac{\sigma(rer)}{\sigma(gdp^{us})}$; $\frac{\sigma(nt)}{\sigma(rer)}$; $\rho(rer)$; Short-Run Trade Elasticity (ECM); Long-Run Trade Elasticity (ECM)
IV. Financial variables	$\frac{\sigma(gfa^{us})}{\sigma(gdp^{us})}$; $\frac{\sigma(B^{g,us})}{\sigma(gdp^{us})}$; $\frac{\sigma(s^{g,us})}{\sigma(gdp^{us})}$; $\frac{\sigma(i^{us}-i^{row})}{\sigma(gdp^{us})}$ $\rho(s^{g,us})$; $\rho(i^{us} - i^{row})$; β^{Fama} $\rho(B^{g,us} - B^{g,row}, rer)$

Table 3: SMM Target Moments

[35] See Appendix 3.1 for a discussion on the filtering method

[36] I set the volatility and persistence of the differential TFP process to zero, since the estimation pushed towards a very limited effect of this process. This is driven by the high comovement between GDP in the US and ROW at this frequency, as shown in Figure A11 Panel (a).

[37] The variances of the IRF moments are the confidence intervals at each horizon following Christiano et al. (2005), and for the unconditional moments these are the variances across rolling window estimations.

4.2.1 Discussion of Identification

The goal of the estimation is to capture the conditional and unconditional dynamics of US fiscal policy, net trade flows and the RER, while being consistent with a broad set of moments related to international financial and real variables. The moments and estimated parameters are displayed in Tables 3 and 4. For the conditional moments, displayed in Panel I of Table 3, I target horizons one to forty of the IRFs of US government spending and government debt which are informative about the fiscal rule. I also target the IRFs of the RER and net trade. Hence, the model is estimated to capture the increase in net trade and depreciation of the RER, conditional on matching the response of the US government spending and debt.

The unconditional moments are displayed in Panels II to IV in Table 3. Panel II includes standard international business cycle moments related to GDP, government spending and investment dynamics in the US and ROW. These moments are informative about the TFP processes, and the fiscal rule, since it includes the volatility of government spending. Panel III, includes a broad set of international quantities and prices. In particular it includes the volatility, of net trade, and the RER, and their joint comovement across different frequencies captured by the short and long-run trade elasticities estimated from an error correction model (ECM).[38] These moments are informative about the financial and trade shock processes and the trade adjustment cost in the CES aggregators.

Panel IV, shows the target unconditional moments related to financial variables. It includes the variance of the US gross foreign assets, the US government debt, the interest rate differential and the portfolio share of US government bonds of US agents. I also includes the autocorrelation of the interest rate differential and the portfolio share of US government bonds of US agents, and the coefficient on interest rates from the Fama (1984) regression. Furthermore, it includes the correlation between the relative government debt and the RER. These moments are informative about the financial shock processes and the fiscal rule.

Table 4 presents the estimated parameters with their standard errors. The estimation identifies a lower volatility and persistence of ROW government spending shocks than in the US,

[38] See the details on the ECM estimation in Section E.2.

Parameter		Value	Parameter		Value
1. Std common prod shock	σ_z^c	0.003 (0.0003)	9. Pers differential financial shock	ρ_ψ^d	0.909 (0.0256)
2. Pers common prod shock	ρ_z^c	0.909 (0.3715)	10. Std common portfolio shock	σ_ψ^c	0.004 (0.0012)
3. Pers US gov shock	ρ_g^{us}	0.956 (0.0156)	11. Pers common financial shock	ρ_ψ^c	0.882 (0.0338)
4. Std ROW gov shock	σ_g^{row}	0.003 (0.0001)	12. Adj cost CES	ι	390.36 (151.99)
5. Pers ROW gov shock	ρ_g^{row}	0.831 (0.0761)	13. Response gov spending to debt	$\varphi^{g,b}$	-0.061 (0.0093)
6. Std differential trade shock	σ_ξ^d	0.009 (0.0009)	14. Response taxes to debt	$\varphi^{T,b}$	0.047 (0.0138)
7. Pers of differential trade shock	ρ_ξ^d	0.967 (0.0167)	15. Response taxes to spending	$\varphi^{T,g}$	0.334 (0.1043)
8. Std differential financial shock	σ_ψ^d	0.006 (0.0009)			

Notes: standard errors are calculated using the asymptotic Delta function method as in Christiano et al. (2005).

Table 4: SMM Estimated Parameters

consistent with the unconditional dynamics of these variables.[39] The endogenous response of government spending to changes in government debt ($\varphi^{G,b}$) is negative, consistent with the findings in Corsetti et al. (2012). The estimated response of taxes to debt ($\varphi^{T,b}$) means that for every dollar the debt increases, the government raises 4 cents in tax revenue, and the estimated response of taxes to spending ($\varphi^{T,g}$) means that for every dollar increase in spending, the government raises 33 cents in tax revenue to finance it.

The volatility and persistence of the differential financial shock is higher than the common one. The trade shock is more volatile and persistent than the differential financial shock, consistent with the findings in Mac Mullen and Woo (2024). Finally, the adjustment cost in the CES

[39]The volatility of the US government spending process is 0.011, shown in Table 2.

aggregators has a value of 390.366, a bit higher than the estimated by Rabanal and Rubio-Ramirez (2015) of 325. However, they do not consider trade in investment goods which is more volatile and pushes the estimation towards a higher trade adjustment cost conditional on targeting the same volatility of net trade.

5 Quantitative Results

In this section, I present the results of the benchmark model. First, I focus on the international transmission of US government spending shocks. I show that the benchmark model captures the responses of key variables. To explain the mechanism, I perform two counterfactuals, a case where the government follows an alternative fiscal rule that keeps the value of government debt constant, and a model without portfolio frictions. I show how these two features contribute to the ability of the model to capture the international transmission of US government spending shocks. Second, I focus on the ability of the benchmark model to capture key unconditional moments related to international business cycles. I show that US government spending shocks provide a resolution to the RER disconnect puzzle. Finally, I show that US government spending shocks and portfolio frictions are key to account for the comovement between relative government debt and the RER presented in Figure 1.

5.1 The International Transmission of US Fiscal Policy

I describe the mechanism driving the international transmission of US government spending shocks in the model. The responses of key variables are presented in Figures 3 and 4, with the empirical IRFs displayed in solid black and the benchmark model IRFs in blue (with *o*). Panels (a) and (b) in Figure 3, show that the model captures the fiscal response to US government spending shocks. It captures the fact that the increase in spending is primarily financed with debt that present hump-shaped dynamics.

Panel (c) displays the IRF of the interest rate differential. The model generates a small positive increase on impact, but misses the subsequent fall. Equation 6 shows that a fall in the expected

sum of the interest rate differential would trigger a depreciation of the RER in the model. However, since the fall in the interest rate differential is small in the data, the depreciation of the RER that would be generated by this channel is limited. Indeed, Figure D.2 shows the response of the RER that would be triggered by the interest rate channel if the model would perfectly match the response of the latter variable from the SVAR in red dashed-dotted line.[40]. It is clear from the Figure that the implied RER depreciation by the interest rate differential channel in response to the US government spending shock is significantly smaller than in the data. Hence, any mechanism triggering a depreciation of the RER solely through a fall in the interest rate differential would not be able to capture the quantitative response of the RER. To capture this, the model requires a RER determination channel operating through endogenous excess returns, or deviations from UIP.

Panel (d) in Figure 3 shows the response of the excess return of US government bonds, or deviations from UIP. The excess return in the model falls on impact but becomes positive in the medium and long run, as in the data. As shown by Equation 5, the dynamics of the excess returns is driven by that of the portfolio share of US government bonds. Due to the presence of portfolio rebalancing frictions, investors need to be compensated to be willing to increase the share of their savings in US government bonds, and absorb the increased supply of this bond triggered by the shock. They are compensated precisely by earning positive excess returns. This channel, which is at the core of the international transmission in the model, is sizable and drives the dynamics of the RER, displayed in Panel (a) of Figure 4. Equation 6 further shows that the RER depreciates in response to an increase in the future expected portfolio share of US government bonds. A depreciated RER triggers an expected appreciation of the RER, relative to its long-run level. The expected appreciation of the RER drives the increase in the excess return of US government bonds. Since the fiscal rule triggers a hump-shaped response of US government bonds, it also does it for the response of the portfolio share of US government bonds and, hence, for the RER. Finally, the US gross foreign assets increase to smooth out the cost of deviating from the long-run portfolio share of US government bonds, as displayed in Panel (f) of Figure 4.

[40] I construct this counterfactual by taking the estimated response of the interest rate differential from the SVAR, $r^{g,us}_{t+j} - r^{g,row}_{t+j}$, to compute the counterfactual RER using the first term on the right hand side of Equation 6, hence $e^{\text{counterfactual}}_t = -\mathbb{E}_t \sum_{j=0}^{\infty} \left(r^{g,us}_{t+j} - r^{g,row}_{t+j}\right)$.

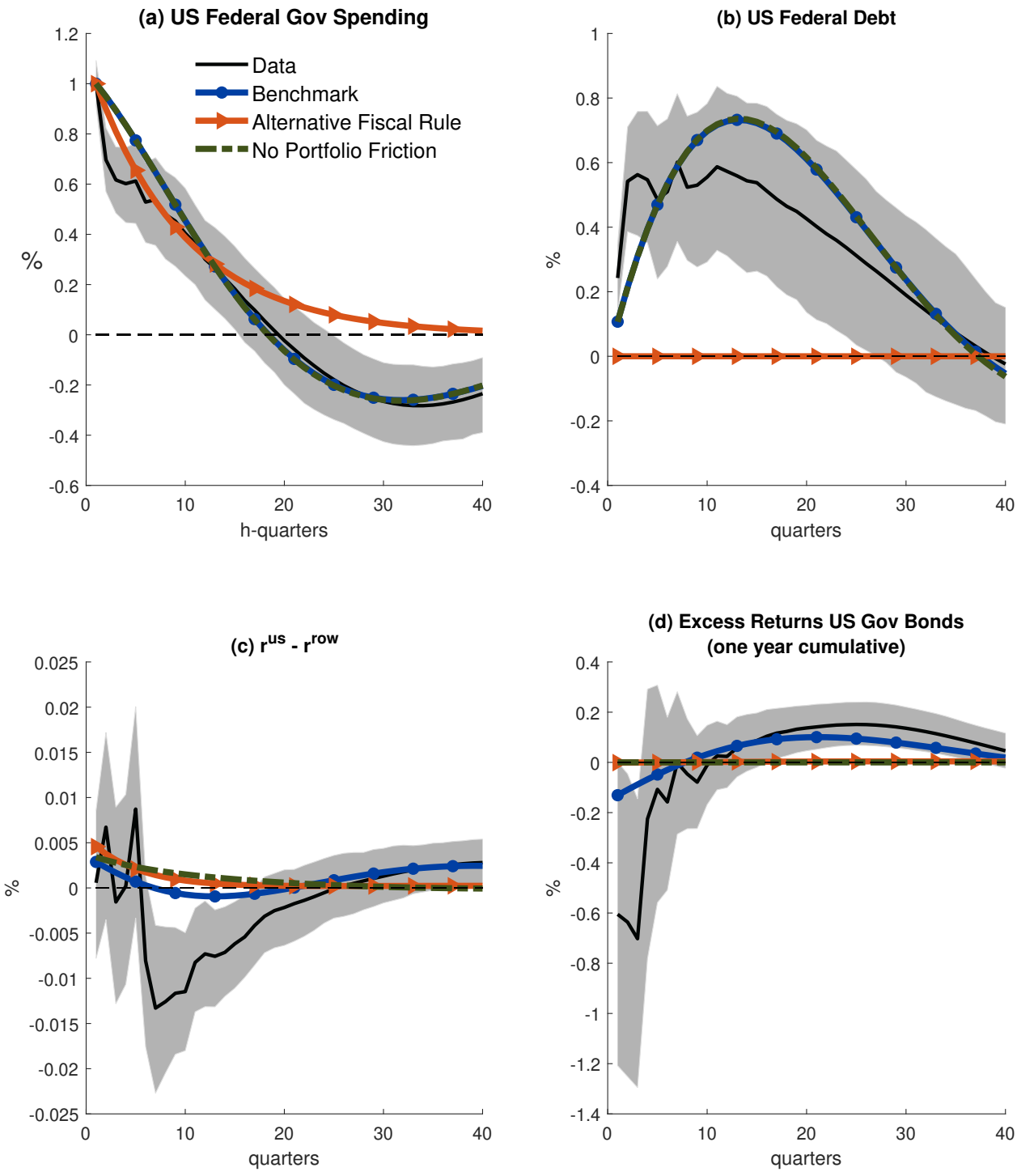


Figure 3: Impulse Response Functions: SVAR and Models

Notes: Standard error bands are 68% confidence intervals.

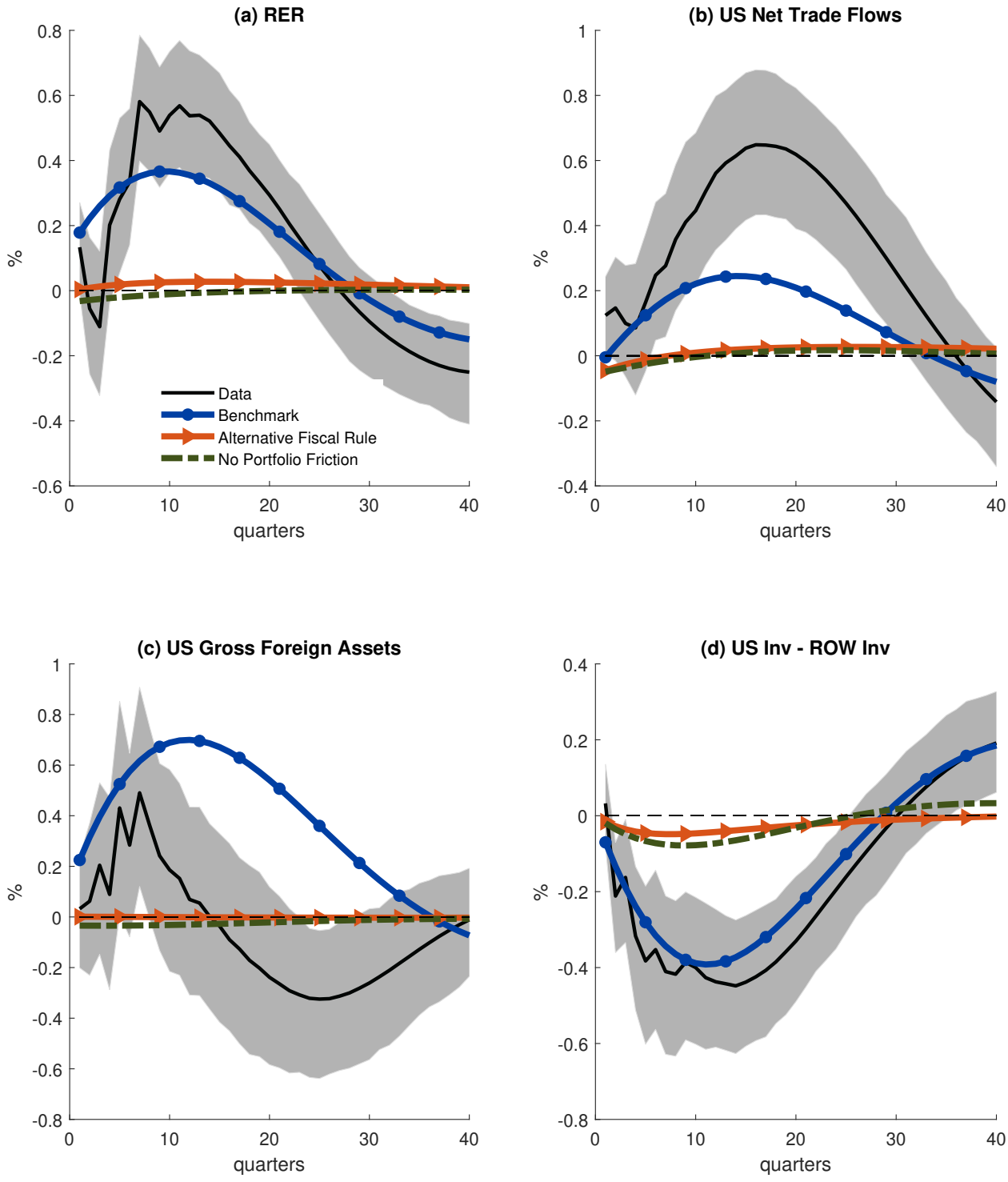


Figure 4: Impulse Response Functions: SVAR and Models

Notes: Standard error bands are 68% confidence intervals.

The depreciation of the RER triggers an expenditure switching effect that raises the net trade flows, displayed in Panel (b) of Figure 4. The response of the net trade flows is hump-shaped, as the RER, with a minimum response on impact. This dynamic is driven by two forces. First, the dynamics of the RER drive the expenditure switching effect, meaning that the strength of this channel is increasing in the size of the depreciation of the RER. While the RER depreciates on impact, the expenditure switching effect becomes stronger over time as the RER depreciates by more, relative to its long-run level. This effect itself generates hump-shaped dynamics of net trade flows. However, the presence of dynamic trade frictions, modeled as a cost of adjusting the bundle of domestic to imported intermediate goods in the CES aggregators, also drive the dynamics of the net trade flows. Dynamic trade frictions give rise to a trade elasticity that is smaller in the short than in the long run. Consequently, trade flows respond to shocks slowly over time. Due to this force, the peak of the net trade response occurs later than that of the RER.

The expenditure switching effect that increases the net trade flows operates mostly through a strong crowding-out of investment, as shown in Panel (d) of Figure 4. Figure D.1, shows the response of relative GDP and consumption in Panels (b) and (c), respectively. While relative GDP increases on impact, it falls shortly after the shock. On the other hand, relative consumption is crowded-out from impact and increases only slowly over time. The fall in relative GDP and consumption is significantly smaller than that of investment. This is driven by the durability of capital, which makes investment flows more volatile.

Overall, the benchmark model successfully captures the responses of key variables to US government spending shocks. However, the peak of the response of net trade flows is around half its value in the data. This arises from a response of relative GDP in the model that is smaller than in the data, as shown in Figure D.1. In the SVAR estimated in Section 3, TFP in the US increases in response to a US government spending shock, shown in Figure B.5 Panel (i). This channel, which would raise relative GDP, is absent in the benchmark model. If the model would capture the increase in TFP and a higher relative GDP, this would tend to reduce the interest rate, causing the RER to depreciate by more, which in turn would raise the net trade flows since the expenditure switching effect would be a stronger. Extending the model to include this channel would bring the model closer to the data.

Having shown that the benchmark model successfully captures the international transmission of US government spending shocks, I turn to study the importance of the fiscal rule and portfolio frictions in driving these results.

5.2 The Role of the Fiscal Rule and Portfolio Frictions in the International Transmission of US Fiscal Policy

To understand the role of the fiscal rule, consider an alternative case where the government stabilizes the value of its debt. This version of the model is one where the lump-sum tax rule equation is replaced by an equation where the value of government bonds is equal to its steady state value. The responses of key variables to US government spending shocks in this case are displayed in Figures 3 and 4 under the label 'Alternative Fiscal Rule' (orange line with >).[41]

Panel (a) in Figure 3 shows the response of US government spending to the shock. Since the value of government debt remains constant, this version of the model implies a different feedback between government spending and debt than in the benchmark model. For this reason, the dynamics of government spending differ across the two models. Panel (b) shows that the value of government debt remains unchanged after the shock.

The response of the interest rate differential is very similar to that in the benchmark model, as shown in Panel (c). On the other hand, Panel (d) shows that with the constant debt rule there are almost no excess returns of US government bonds. This arises from the fact that the portfolio share of US government bonds is not directly affected by the fiscal shock when the fiscal rule does not rely on the use of government debt to finance spending. Panel (c) in Figure 4 shows that there is a small fall in the US gross foreign assets which raise the portfolio share of US government bonds but only weakly. The weak increase in the portfolio share of US government bonds triggers a small depreciation of the RER (Panel (a) in Figure 4). Finally, net trade falls on impact because the small depreciation of the RER do not trigger a sufficiently strong expenditure switching effect that crowds-out private expenditure in the US more than the increase in government spending. This counterfactual shows the crucial role that the fiscal rule plays in shaping the international

[41] The response of government spending is different in this case, but re-calibrating to match it does not make a difference in the remaining results.

transmission of US government spending shocks.

Consider now the same fiscal rule as in the benchmark model, but no portfolio frictions.[42] The responses of key variables to US government spending shocks of this case are displayed in Figures 3 and 4 under the label 'No Portfolio Friction' (green dashed-dotted line).

Although the response of the US government debt is the same than in the benchmark model (Panel (b) in Figure 3), in the case without portfolio frictions there are (almost) no excess returns, or UIP deviations, as shown in Panel (d) in Figure 3.[43] Consequently, the dynamics of the RER and net trade are driven by the standard mechanism triggered by a positive government spending shock. In this case, a positive government spending shock causes a negative wealth effect that reduces consumption. The interest rate in the US must increase to be consistent with an increasing path in consumption, which needs to return to its steady state level in the long-run. A higher interest rate in the US appreciates the RER. Finally, net trade falls in response to the increase in US government spending and the appreciation of the RER. Hence, the presence of portfolio frictions is crucial for capturing the international transmission of US government spending shocks, by triggering endogenous excess returns on US government bonds, or deviations from UIP..

5.3 Implications for International Business Cycles

The benchmark model captures the dynamics of international business cycles, both in terms of targeted and untargetted unconditional moments. These are displayed in Table 5, where Panel A, presents the target moments, and Panel B the untargetted moments. The benchmark model accounts for the RER disconnect puzzles. It captures the RER moments related to the Meese and Rogoff (1983) puzzle, that is a RER that is more volatile that macro aggregates and highly persistent. Furthermore, it captures the Fama (1984), or Forward Premium puzzle. In the model, high interest rets predict a depreciation of the RER and have low predictive power, which is a violation of the UIP condition. Finally, the model captures the negative Backus-Smith-Kollmann correlation (Backus and Smith, 1993; Kollmann, 1995). Furthermore, the benchmark model accounts for

[42] In this case I set $\Gamma = 0$, and I add a small adjustment cost (0.001) on the level of the foreign assets in the US and the ROW with the only purpose of closing the model, following Schmitt-Grohé and Uribe (2003).

[43] Due to the adjustment cost on the level of foreign assets introduced to close the model there are small deviations from UIP, but they are quantitatively insignificant due to the small adjustment cost.

the joint RER and the net trade dynamics. It captures their relative volatility, and a trade elasticity that is lower in the short than in the long-run.

Importantly, the benchmark model is able to capture the RER disconnect puzzles and the net trade dynamics, while being successful in generating other key financial and real moments. It captures the unconditional dynamics of GDP, investment, interest rates, government debt, gross foreign assets and liabilities, and the portfolio share of US government bonds. The model replicates the negative correlation between the interest rate differential and the RER, a moment that models mainly driven by financial shocks have trouble in explaining (Kekre and Lenel, 2024). It also generates a positive correlation between gross foreign assets and liabilities, which is hard to account for in existing models (Broner, Didier, Erce and Schmukler, 2013; Davis and van Wincoop, 2024; Oskolkov, 2024).

The benchmark model jointly accounts for the conditional moments related to the international transmission of US government spending shocks and the unconditional international business cycle moments. Importantly, it does so with the US government spending shock being a key driver of the RER. To see this, consider a counterfactual where the differential trade and financial shocks (ξ^d and ψ^d) are shut down, as well as ROW government spending shocks so that I focus on the role of US government spending shocks. The moments triggered by this version of the model are displayed in Table 5 under the column name 'No g^{row}, ξ^d & ψ^d'.[44] In this case, relative variables, such as the RER, are mainly driven by US government spending shocks, since the common financial and common productivity shocks have almost no effect on such variables.[45]

US government spending shocks significantly contribute to the Meese and Rogoff (1983) puzzle, the Fama (1984) or Forward Premium puzzle, and the Backus-Smith-Kollmann puzzle (Backus and Smith, 1993; Kollmann, 1995). They trigger a volatility of the RER that is 2.14 times larger than that of GDP, which is around 60% of the value in the benchmark model (i.e. with all the shocks). It also results in a nearly unit root in the RER, since its autocorrelation is 0.99, higher than 0.96 in the benchmark model. The coefficient of the Fama (1984) regression of the interest rate differen-

[44] This model is not re-estimated.

[45] The only source of asymmetry between the US and ROW is the difference in the persistence of the government spending processes (ρ_g^{us} and ρ_g^{row}). Hence, common shocks across countries would only generate differences in relative variables through the differential response of government spending.

Moment	Data	Benchmark	No g^{row}, ξ^d & ψ^d	Moment	Data	Benchmark	No g^{row}, ξ^d & ψ^d
Panel A: Target Moments							
1. $\sigma(gov^{us})/\sigma(gdp^{us})$	3.69	3.59	3.61	10. LR trade elast.	1.30	1.00	0.33
2. $\sigma(gov^{row})/\sigma(gdp^{row})$	0.62	0.58	0.18	11. $\sigma(gfa^{us})/\sigma(gdp^{us})$	4.40	5.06	4.58
3. $\rho(gov^{row})$	0.80	0.81	0.99	12. $\sigma(B^{g,us})/\sigma(gdp^{us})$	3.66	4.08	4.09
4. $\sigma(inv^{us})/\sigma(gdp^{us})$	3.49	2.88	2.57	13. $\sigma(s^{g,us})/\sigma(gdp^{us})$	1.12	0.76	0.64
5. $\rho(gdp^{us}, gdp^{row})$	0.86	0.90	0.94	14. $\sigma(r^{us} - r^{row})/\sigma(gdp^{us})$	0.06	0.04	0.02
6. $\sigma(rer)/\sigma(gdp^{us})$	3.82	3.56	2.14	15. $\rho(r^{us} - r^{row})$	0.89	0.94	0.96
7. $\sigma(nt)/\sigma(rer)$	1.27	1.33	0.75	16. $\rho(s^{g,us})$	0.91	0.90	0.90
8. $\rho(rer)$	0.95	0.96	0.99	17. β_{Fama}	-1.38	-1.44	-0.54
9. SR trade elast.	0.17	0.08	0.12	18. $\rho(B^{g,us} - B^{g,row}, rer)$	0.74	0.45	0.87
Panel B: Untargetted Moments							
1. BSK: $\rho(\Delta rer, \Delta(c^{us} - c^{row}))$	-0.17	-0.68	-0.75	8. $\rho(inv^{us}, inv^{row})$	0.31	0.22	0.53
2. R^2_{Fama}	0.01	0.00	0.00	9. $\rho(xm^{us})$	0.98	0.99	0.99
3. $\rho(tot, rer)$	0.86	0.99	0.99	10. $\rho(inv^{us} - inv^{row}, rer)$	-0.57	-0.76	-0.84
4. $\sigma(tot)/\sigma(rer)$	0.31	0.63	0.60	11. $\rho(B^{g,us})$	0.97	0.99	0.99
5. $\rho(r^{us} - r^{row}, rer)$	-0.56	-0.38	-0.48	12. $\rho(B^{g,us}, g^{us})$	0.50	0.40	0.40
6. Low freq RER spectrum	0.62	0.67	0.70	13. $\rho(B^{g,us}, gfa^{us})$	0.23	0.77	0.82
7. BC freq RER spectrum	0.31	0.26	0.25	14.$\rho(gfa^{us}, gfl^{us})$	0.83	0.61	0.93

Notes: gfa and gfl stand for gross foreign assets and liabilities. BC stands for 'Business Cycle'. The moments reported in the columns under 'No g^{row}, ξ^d & ψ^d' correspond to those obtained from simulating the model shutting down the differential trade and financial shock, i.e. $\sigma_g^{row} = \sigma_\xi^d = \sigma_\psi^d = 0$.

Table 5: Unconditional Moments

tial on the change in the RER is -1.44 close to the -1.38 in the data, meaning that high interest rates predict an appreciation of the RER and have low predictive power, as measured by an R^2 close to zero. Finally, the Backus-Smith-Kollmann correlation is negative, even more so than in the benchmark model. Hence, US fiscal policy provides a resolution to the RER disconnect puzzles through well-identified shocks.

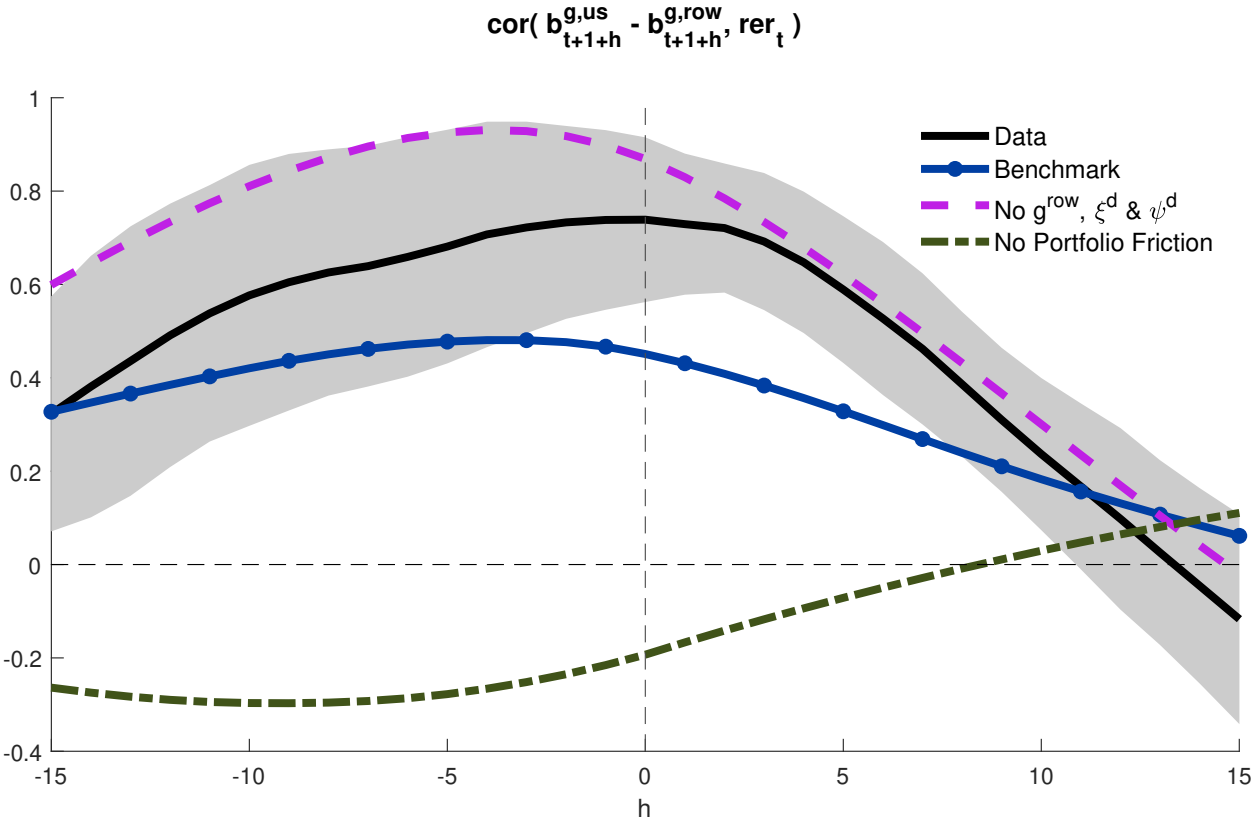


Figure 5: Dynamic Correlation between Relative Government Debt and the RER

Notes: Standard error bands are 68% confidence intervals.

Furthermore, the benchmark model captures the comovement between the relative government debt and the RER, presented in Figure 1. The contemporaneous correlation between these variables is a target moment in the benchmark model, as shown in Panel A of Table 5. The model generates a correlation of 0.45, with the value in the data being 0.74. Additionally, the benchmark model also captures the dynamic comovement between these variables. Figure 5, shows the correlation between lags and leads of relative government debt and the RER in the data in solid black and the benchmark model in blue (with o). The benchmark model generates a hump-shaped dynamic correlation close to the data. Furthermore, US government spending shocks are key for

the ability of the benchmark model to generate these results. The violet dashed line presents the dynamic correlations for the version of the model without the differential trade and financial shock and the ROW government spending shock presented in Table 5 under the column name 'No g^{row}, ξ^d & ψ^d'. In this case, the correlation is even stronger than in the data for all the lags and leads, demonstrating the importance of US government spending shocks in driving these dynamics.

It should be noted that the ability of the model to capture the positive correlation between relative government debt and the RER is not trivial. Figure 5 also presents the dynamic correlation for the version of the model without portfolio frictions (green dashed-dotted line) considered in Section 5.2. This version, which is closer to most of the models considered in the literature, generates exactly the opposite pattern. Absent portfolio frictions, high relative government debt is associated with an appreciated RER, contrary to the data. Consequently, the presence of portfolio frictions is key to account for the joints dynamics of relative government debt and the RER presented in Figure 1.

6 Sensitivity Analysis

In this section, I study the sensitivity of the benchmark model to alternative specifications, and test the implications of the theory in the cross-country panel data. The results of the alternative models, which are all re-calibrated, are displayed in the Appendix F.1. The estimated parameters are displayed in Table F.1, the IRFs to US government spending shocks are displayed in Figures F.1 to F.7, and the unconditional moments in Tables F.2 and F.3. The details on the panel data analysis are in Appendix F.2.

First, I study the implications of targeting conditional and unconditional moments for the identification in the benchmark model by considering cases where I only target the former or the latter set of moments. The version where I only target conditional moments, which is a standard practice in the literature on IRF matching, identifies parameters of the US government spending process, the fiscal rule, and the trade adjustment cost, that are close to the ones in the benchmark model (displayed in Table F.1 under the label 'Only IRF Targeting'). Consequently, the IRFs to US

government spending shocks are also very similar to the benchmark model (displayed in Figures F.1 and F.2). Hence, targeting the IRFs is important for the identification in the benchmark model. In the case where I only target unconditional moments, the model generates a depreciation of the RER and increase in net trade in response to the spending shock that is also close to the benchmark model, but it overstates the responses of government spending and debt, an advantage of targeting the IRFs (displayed in Tables and Figures under the label 'Only uncond moms targeting').[46] To summarize, both set of moments, conditional and unconditional, contribute to identifying the international transmission channel of US government spending shocks in the model.

I also consider the role of dynamic trade frictions and the implication of calibrating the model to a smaller intertemporal elasticity of substitution. Dynamic trade frictions play an important role for the ability of the model to capture the quantitative responses of the RER and net trade. To see this, consider a version where I set to zero the adjustment cost in the use of imported to domestic intermediate goods in the CES aggregators of final goods. Figure F.4, shows that the depreciation of the RER in response to a positive spending shock is significantly smaller than in the benchmark model (under the label 'No Dynamic Trade Frictions').[47] On the other hand, the response of net trade is front-loaded relative to the benchmark model and its significantly less persistent. Why is the RER depreciation smaller absent dynamic trade frictions? Figure F.3, shows that the response of the excess returns is not too different to the benchmark model. However, the same figure shows that the interest rate differential increases by more than in the benchmark model. This channel dampens the effect of spending shocks, as can be seen from Equation 6, which decomposes the dynamics of the RER into the contribution of the interest rate differential and the endogenous plus the exogenous UIP wedge. The model without dynamic trade frictions also performs significantly worse in terms of matching unconditional moments, specially those related to the net trade flows, as shown in Tables F.2 and F.3. Finally, the model that is calibrated to an intertemporal elasticity of substitution of 0.5 gives similar results to the benchmark model (displayed in Tables and Figures under the label 'IES= 0.5'). The main difference is that the inter-

[46] In this version, the estimation pushed the persistence of the US government spending shock to its upper bound (0.99), and the response taxes to debt to its lower bound (0.02). For those reasons, I set the former parameter to its upper bound, and the latter to its lower bound in the estimation.

[47] In this version, the estimation pushed towards a zero variance of the ROW government spending shock, and zero persistence of the common financial shock. For those reasons, I set those parameters to zero in the estimation.

est rate differential increases more on impact in response to the positive spending shock than in the benchmark model, with the later being closer to the empirical IRFs, as shown in Panel (c) of Figure F.3.

Next, I consider the implications of allowing the ROW household to save in US government bonds. The version of the model where the ROW household can save in US government bonds generates similar results than the benchmark model (displayed in Tables and Figures under the label 'Trade in US Gov Bonds').[48] It identifies similar parameters as the benchmark model. This arises from the fact that the mechanism is unchanged, since the same UIP condition in equation 5 is derived in this version of the model, and the benchmark model was calibrated to capture the response of the US government bonds held by US agents, which drives the response of the portfolio share of savings in US government bonds of the US household.

I study the sensitivity of the portfolio friction by calibrating it to target a higher partial equilibrium aggregate demand elasticity of internationally traded bonds. I target an elasticity of three, which is also within the range of estimates in the literature (Moretti et al., 2024) (displayed in Tables and Figures under the label '$\epsilon^{d}_{b^{row,us}} = 3$'). In this alternative case the value of Γ is 0.80, the same as that estimated one by Guo et al. (2023) for Canada. The results are similar to the benchmark model in this alternative case. Hence, the main results are robust to calibrating the model to a higher elasticity of demand of international traded bonds. Furthermore, the importance of portfolio frictions and their implications for the international transmission of fiscal policy would strengthen if the model would be calibrated to a lower asset demand elasticity, which would be the case under the estimated value by Camara et al. (2024) for advanced economies (a value of Γ equal to 3.20).

Finally, the role of the fiscal rule in shaping the international transmission of government spending shocks can be further tested empirically. The model predicts that the more a country

[48] In this version I add a small adjustment cost to the deviations from steady state holdings of US government bonds for the ROW household. It set a value of 0.0002 with the main role being to pin down the steady state level of the ROW household in US government bonds, which targets the average of this variable in the data between 1980 and 2019 (16% of US GDP). I also add a similar adjustment cost for the US household so that its demand of US government bonds is not perfectly elastic, otherwise the US household would absorb all of the supply in US government bonds. I set this adjustment cost to 0.0001. By being slightly smaller than that of the ROW household it allows the model to capture the response of the US government debt in hands of US agents and in hand of ROW agents to the US government spending shock, which are displayed in Figure F.7.

relies on debt financing in response to a positive government spending shock, the stronger the depreciation of the RER and the increase in net trade. Using the panel data on military spending shocks from Miyamoto et al. (2019), I show that these predictions are supported by cross-country panel data. The details on the panel data analysis are in Appendix F.2. In particular, I estimate country-by-country responses of government debt, the RER and the current account, to military spending shocks and find results consistent with the implications of my theory. Hence, the mechanism proposed in this paper also contributes to rationalize some of the cross-country heterogeneity in the responses of the RER and net trade to government spending shocks.

7 Concluding Remarks

This paper provides a comprehensive analysis of the international transmission of US fiscal policy, and its impact on the RER and net trade flows. I uncover a new mechanism driving the dynamics of the RER and net trade flows in response to US government spending shocks. The mechanism operates through endogenous excess returns on US government debt relative to foreign debt. The model captures this mechanism due to a fiscal rule that relies heavily on the use of government debt to finance spending, and the presence of portfolio frictions. I embed the mechanism in a model that features a rich set of additional frictions and shocks that accounts for salient facts of international business cycles, and show that US government spending shocks are key to account for the RER dynamics. Hence, I offer a resolution to the RER disconnect puzzle through well-identified shocks.

The framework is also well suited for studying other important issues. In particular, it has implications for optimal taxation, since the presence of portfolio frictions induces an endogenous international risk-sharing inefficiency associated with the use of government debt, introducing a potential trade-off between debt and distortionary taxes. This is particularly important in present times given the sizable increase in government spending and debt after the COVID Pandemic which is also expected to increase in the future. Additionally, the framework can be applied to study government spending multipliers, the interaction of fiscal and monetary policy in the open economy, and the dynamics of gross financial flows.

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Appendix

A Data Description

The data description, sources and variable codes are listed below:

- Rest of the world (ROW) countries: Australia, Austria, Belgium, Canada, Denmark, Germany, Finland, France, Ireland, Italy, Japan, Mexico, Netherlands, Norway, South Korea, Portugal, Spain, Sweden, United Kingdom
- Trade weights are calculated using bilateral trade data between the US and the ROW countries for the period 1991-2019. I use the average value of the period.
- Population (PWT10, annual), and US population from FRED (B230RC0Q173SBEA, quarterly)
- GDP expenditure approach (B1_GE, OECD quarterly)
- Consumption: Private final consumption expenditure (P31S14_S15, OECD quarterly)
- Investment: Gross fixed capital formation (P51, OECD quarterly)
- Government spending in the US: I use federal spending from NIPA, following Ramey (2011).
- Government spending in the ROW: General government final consumption expenditure (P3S13, OECD quarterly)
- Exports: Exports of goods and services (P6, OECD quarterly)
- Imports: Imports of goods and services (P7, OECD quarterly)
- Narrow Trade Weighted Real Exchange Rate (RER) (BIS quarterly)
- Interest rates: 10 year government bonds in US and ROW countries (IMF, FRED), and short rates are Effective federal funds rate (IMF) fo the US and money market rates IMF) for the ROW. Real interest rates are calculated using inflation forecasts from OECD, whenever available, otherwise using realized inflation.

- NIPA variables for US:
  - US Macro aggregates ("Table 1.1.5. Gross Domestic Product")
  - Price indexes to transform to real ("Table 1.1.4. Price Indexes for Gross Domestic Product")
- US government debt:
  - i US Market Value of Marketable Treasury Debt (MVMTD027MNFRBDAL)
  - ii US total public debt held by foreigners (FRED, FDHBFIN)
  - iii US total public debt held by Federal Reserve System (FRED, FDHBFRBN)
  - US gov debt in hands of US agents (excluding US gov institutions) = $i - ii - iii$
  - In real terms: deflated by US CPI
- Tax rates:
  - total federal and corporate (TaxFoundation and Splinter (2020))
  - labor and capital income (US vs ROW) (globaltaxation.world)
- US net and gross financial flows (Rey and Gourinchas 07 + NIPA)
- Composition of international trade quantities and prices (NIPA)
- US Baking and financial markets data for Figure B.5 (FRED)

Macro aggregates are in log per-capita, expressed in US dollars, volume estimates, fixed PPPs.

A.1 Filtering

To capture cyclicality of variables of interest, I apply a cubic de-trend since I focus on medium and lower frequency cycles. As shown in Figures A3, A4, and A5, the cubic de-trend gives similar results to using a quadratic de-trend or the Band Pass filter capturing cyclicality up to twenty

years.[49] I focus on cycles of frequencies lower than the standard case (i.e. cycles up to eight years) for two reasons. First, the cyclical component of relative government debt is strongly driven by that in the US (Figure A8), which in turn is driven by the US military build-ups (Panel (a) in Figure A7) which lasted for more than a decade (Ramey, 2011). In particular, there are two big defense spending cycles, the first one started in the early 1980's with the Reagan-Bush military build-up and lasted until the late 1990's, and a latter cycle triggered by the second Iraq war between the early 2000's and 2015. Second, the bulk of the variance of net trade and the RER arises at lower frequency cycles (Rabanal and Rubio-Ramirez, 2015; Gornemann et al., 2020; Mac Mullen and Woo, 2024). The unconditional moments calculated for the estimation of the quantitative model in Section 4.2 are obtained using the cubic de-trend.

The time series of these variables also show that US government spending leads the cycle of the RER and net trade. This is shown in Panel (b) of Figures A9, and A10, which presents the dynamic correlation between the contemporaneous component of US government spending with lags and leads of the RER and net trade flows. The comovement of US federal spending with net trade present a stronger lead-lag relation than with the RER, which is not surprising since it is a well-known fact that the RER leads the cycle of net trade flows in the US.[50]

Finally, Figure A7 presents the time series of the cyclical component of US federal spending (blue line with *o*), and US government debt in (black solid line). The figure shows that US federal spending leads the variation in US government debt, and that they are highly correlated as shown in Panel (b). This is consistent with government debt in the US being the primary instrument used to finance spending over the cycle, with its stock evolving slowly over time in response to changes in spending.

[49] Figure A1, presents the raw data of the real government debt in the US and the ROW.

[50] See the J-curve literature (Baldwin and Krugman, 1989; Rose and Yellen, 1989; Backus et al., 1994; Fitzgerald et al., 2019; Alessandria and Choi, 2021).

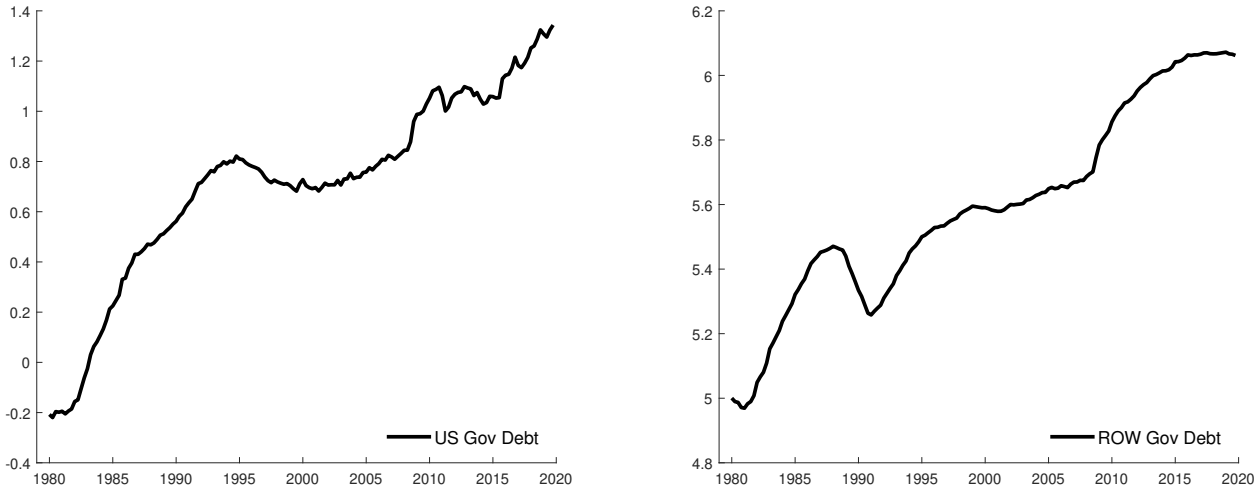


Figure A1: US and ROW Real per capita Government Debt: Raw Data

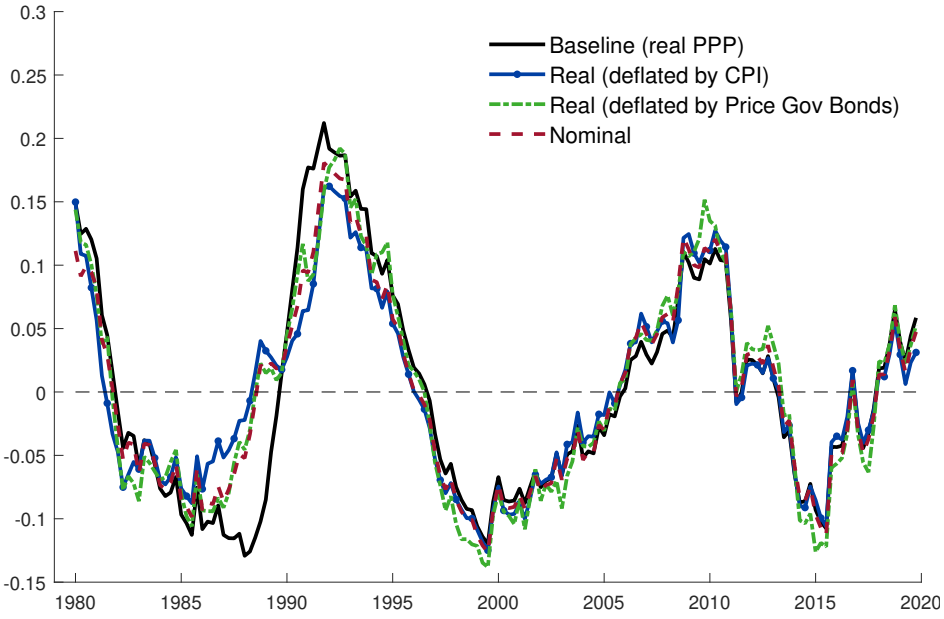


Figure A2: Relative Government Debt: Alternative Deflation Measures

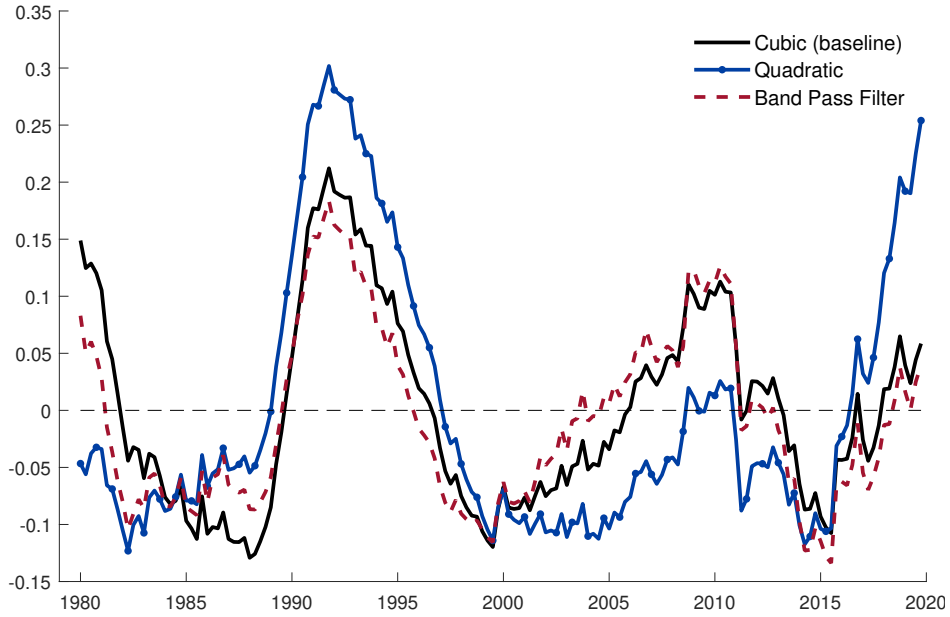


Figure A3: Relative Government Debt: Alternative De-trending Measures

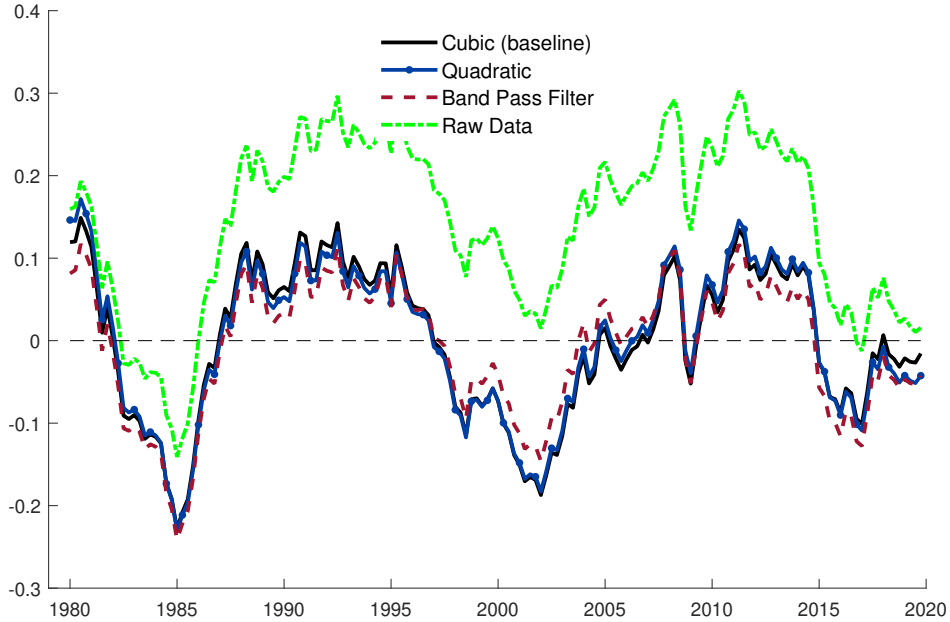


Figure A4: US RER: Alternative Measures

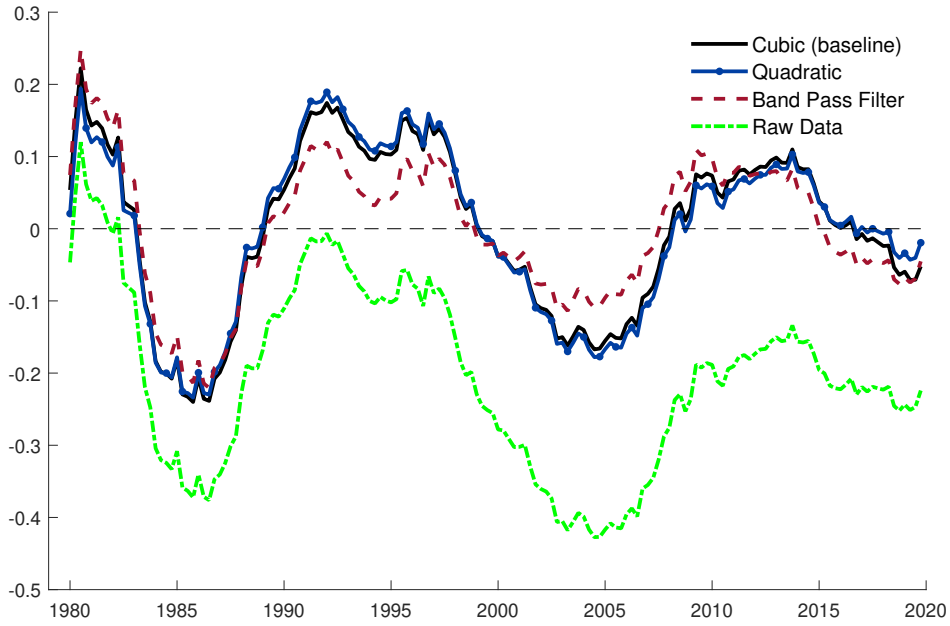


Figure A5: US Net Trade: Alternative Measures

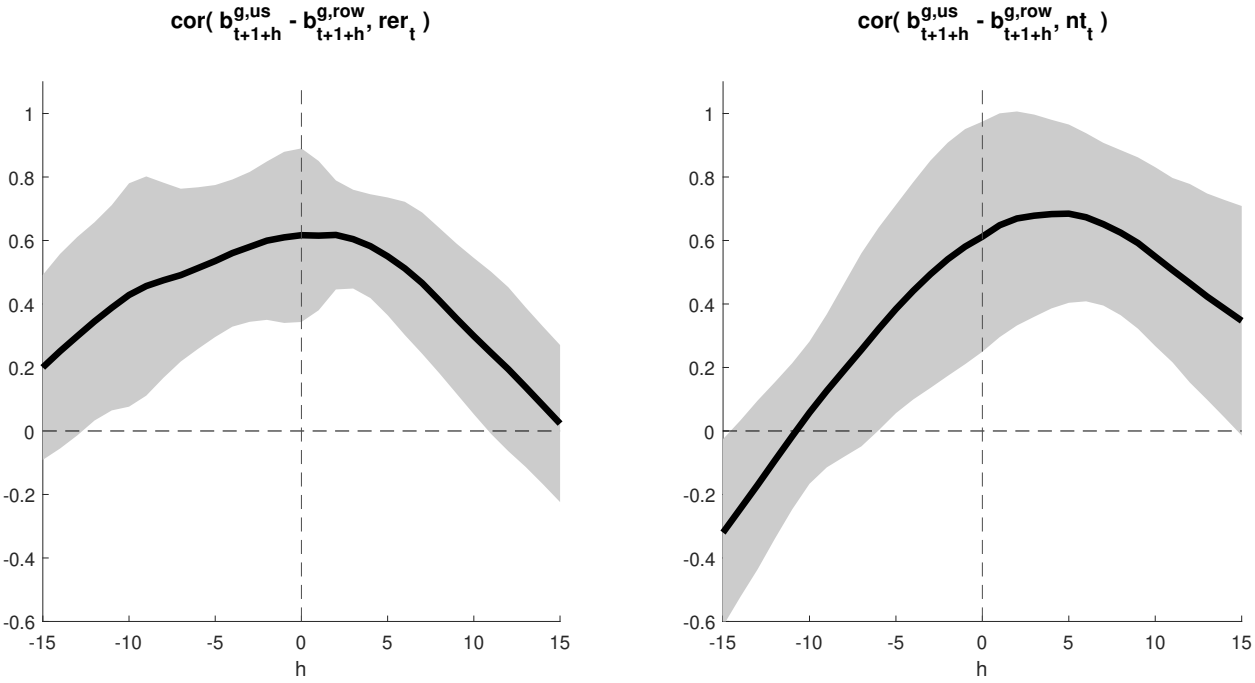


Figure A6: Dynamic Correlation of Relative Gov Debt with the RER and Net Trade

Notes: Standard error bands are 68% confidence intervals. They are calculated using 80 quarters rolling windows, where the data is de-trended in each sub-sample.

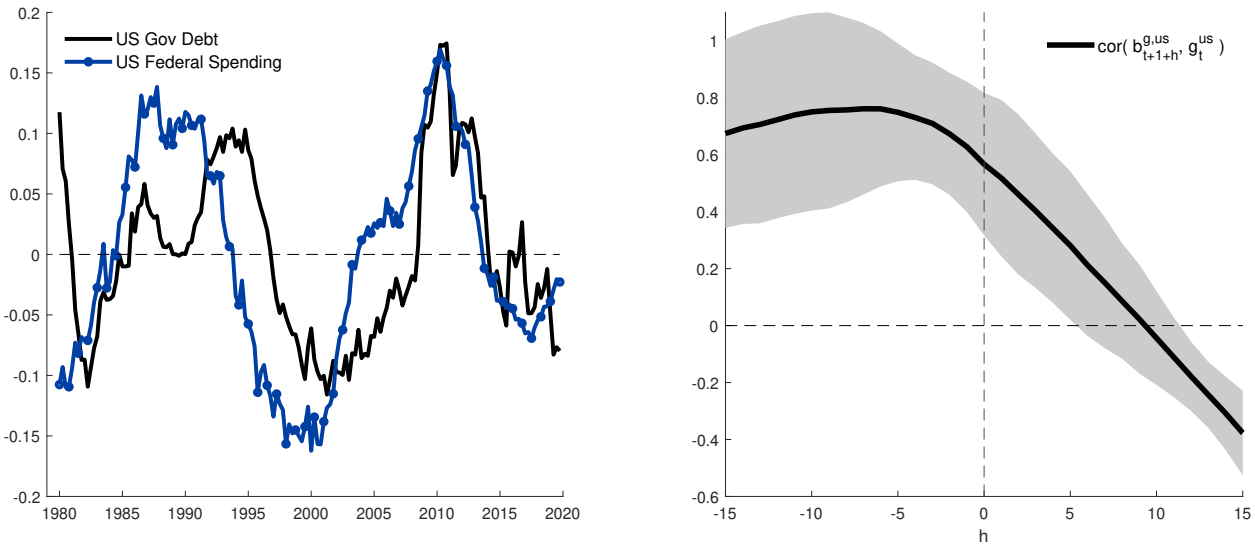


Figure A7: US Federal Spending and US Government Debt

Notes: Standard error bands are 68% confidence intervals. They are calculated using 80 quarters rolling windows, where the data is de-trended in each sub-sample.

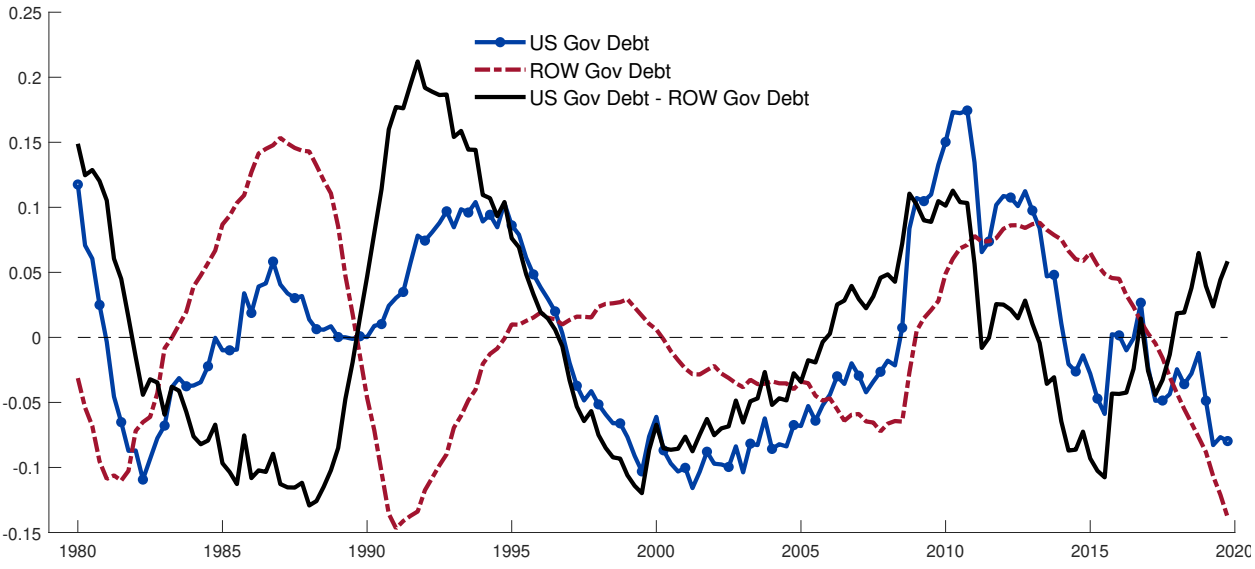


Figure A8: Relative Government Debt Components

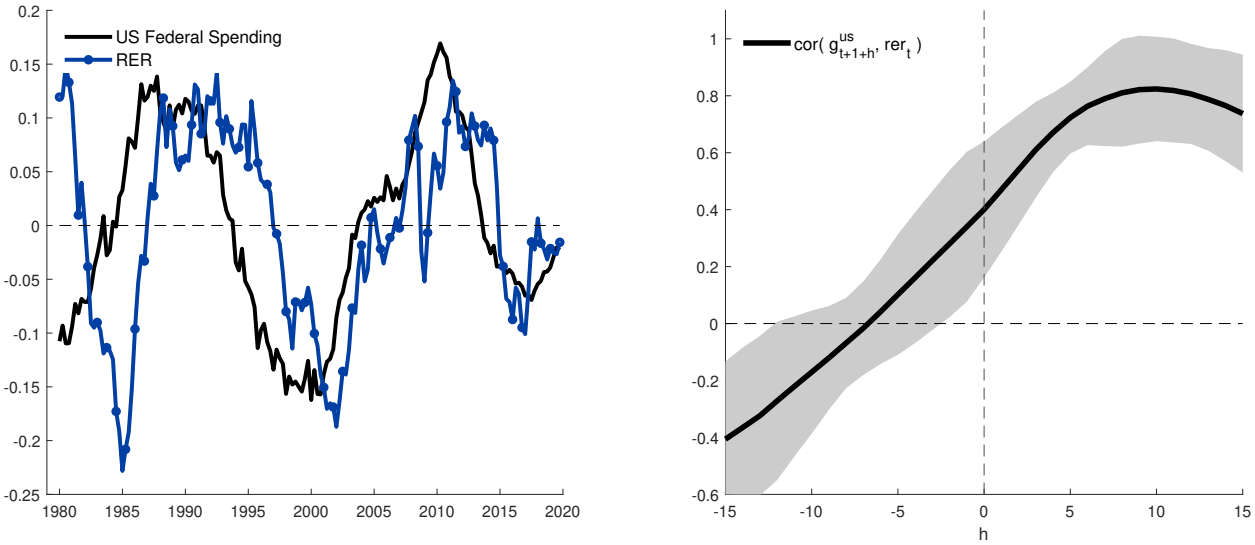


Figure A9: US Federal Spending and the RER

Notes: Standard error bands are 68% confidence intervals. They are calculated using 80 quarters rolling windows, where the data is de-trended in each sub-sample.

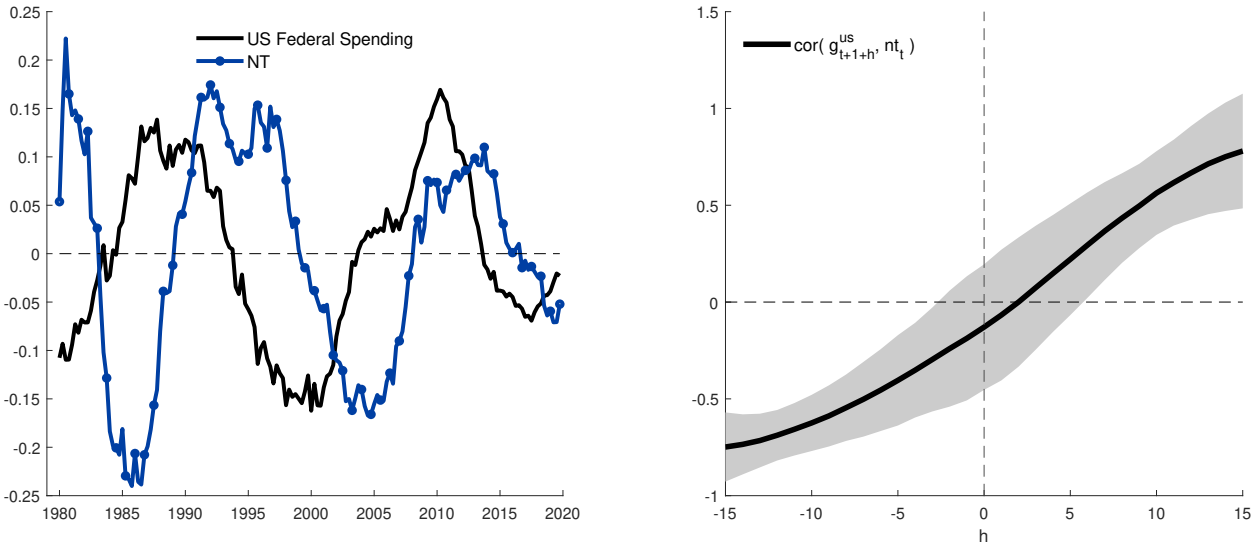


Figure A10: US Federal Spending and Net Trade

Notes: Standard error bands are 68% confidence intervals. They are calculated using 80 quarters rolling windows, where the data is de-trended in each sub-sample.

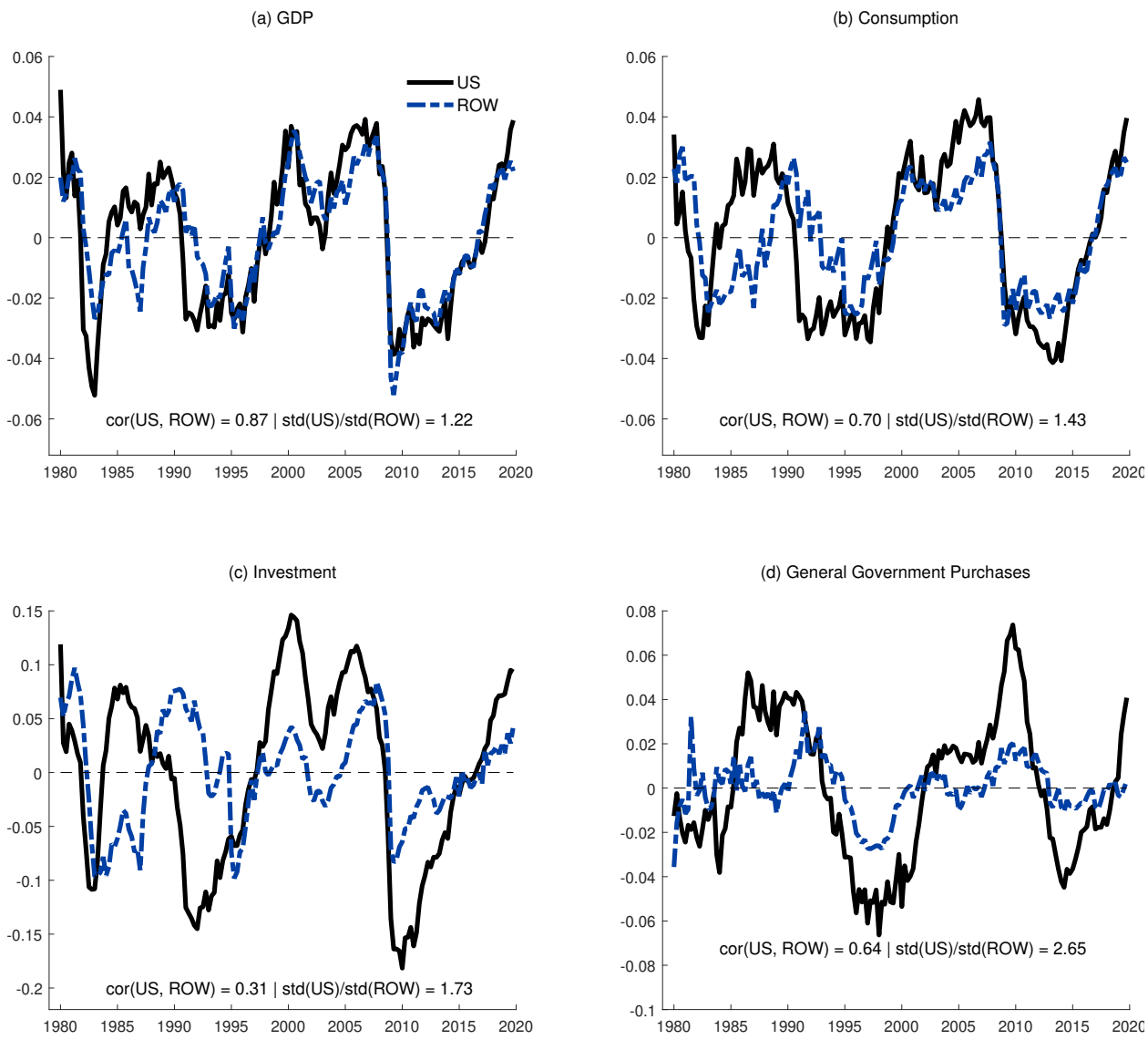


Figure A11: Macro Aggregates in US and ROW (Cubic De-trend)

B SVAR Appendix

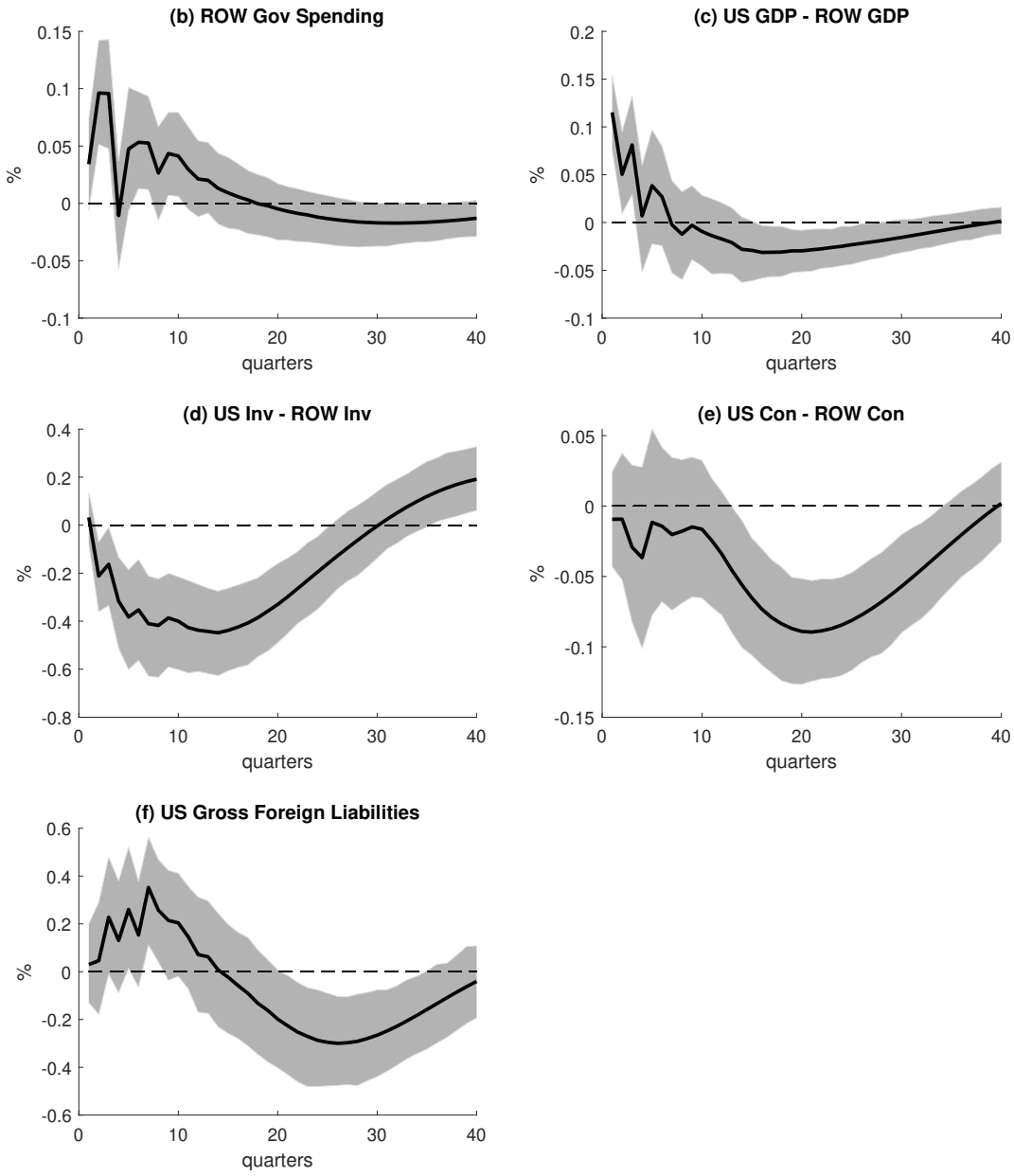


Figure B.1: IRF of the remaining variables in the SVAR

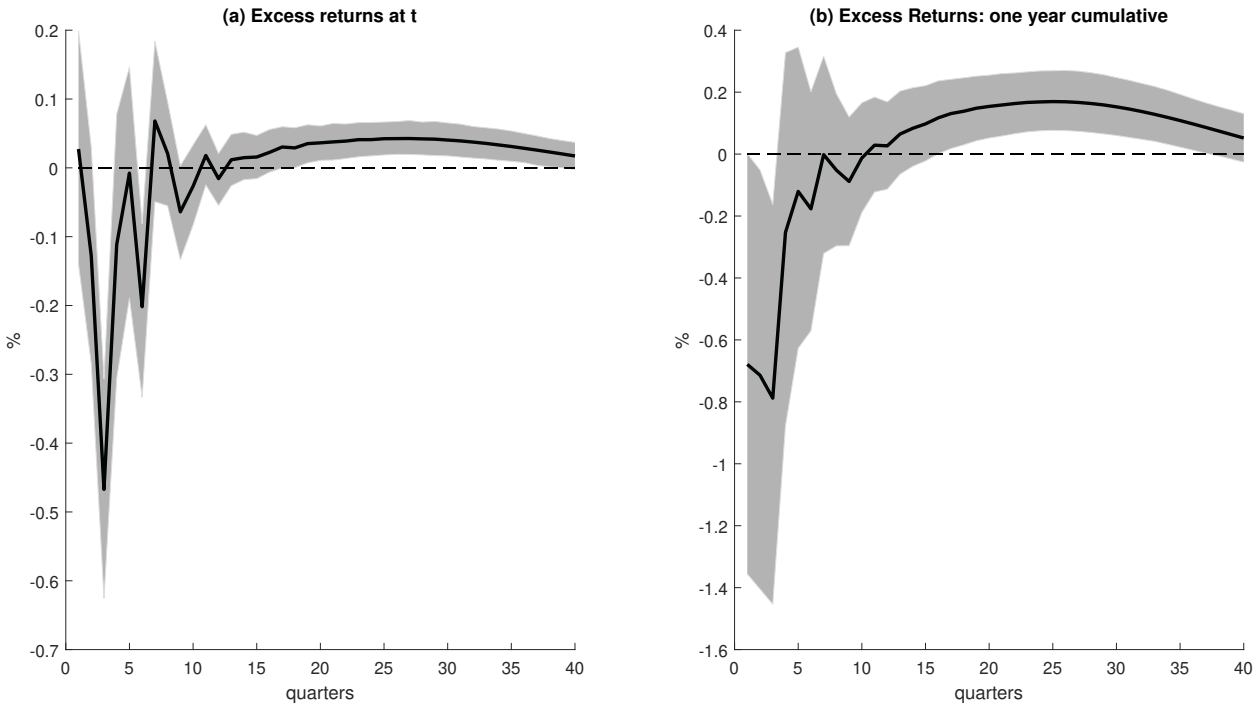


Figure B.2: IRFs of Excess Returns on US Gov Bonds in the SVAR

C Further Extensions in the SVAR: Taxes, Risk, Banks, TFP, and International Capital Goods Markets.

In this section, I consider the effect of US government spending shock on a broader set of variables. In all these cases I rotate each variables as an additional variable in the SVAR in Equation 1. The details on the sources and the construction of variables are in Section A.

Figure B.3 shows the response of fiscal variables to the US government spending shock. In particular, the effect on the federal and corporate tax rates in the US, and the relative labor and income tax rates between the US and the ROW. All the tax rates fall in the short and medium run. Hence, most of the increase in spending is financed with debt rather than taxes.

Figure B.4 shows the response of variables related to international capital goods markets to the US government spending shock. There is a stronger deterioration of the terms of trade of capital goods than for the average of goods. This is consistent with relative investment presenting the strongest crowding-out effect among all macro aggregates. Finally, in the short run there is a stronger increase in net trade of capital goods than for the aggregate of the goods.

Figure B.5 shows the response of other financial and real variables to the US government spending shock. In particular, variables related to the US banking sector, measures of risk in the US real and financial sector, and on US total factor productivity. US banks increase their holdings of US treasuries in response to the shock, while they decrease their commercial and industrial loans. There is a significant fall in the credit to the non-financial private sector as a share of GDP, which is accompanied by an increase in the yields of corporate bonds and an increase in the spread of high yield to AAA yields. Furthermore, the price-dividend ratio in the US falls and the VXO increases, meaning that financial risk in the US raises after the shock. Finally, US total factor productivity increases on impact, but falls under trend afterwards for around ten years.

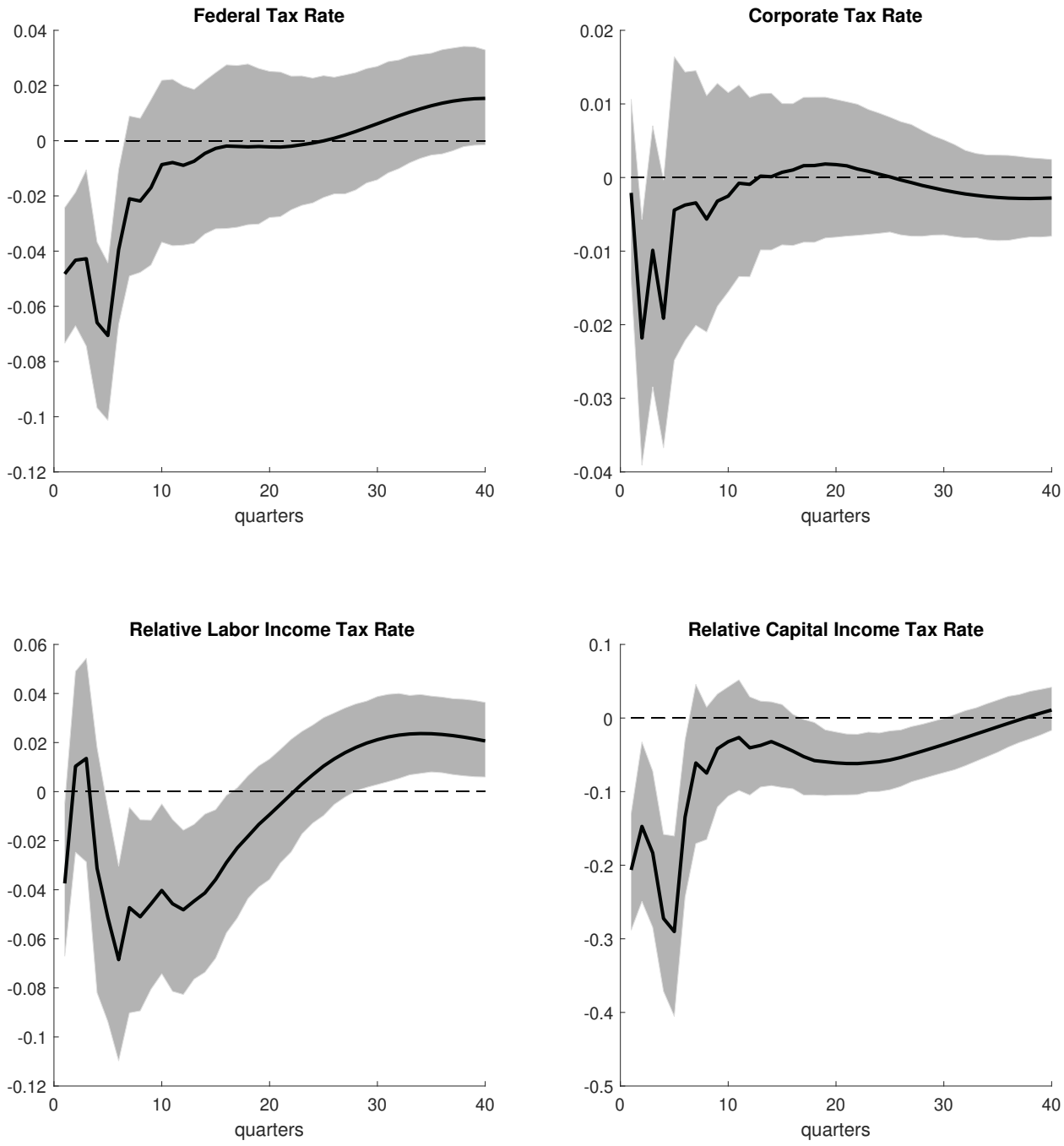


Figure B.3: IRFs other Fiscal Variables

Notes: Standard error bands are 68% confidence intervals.

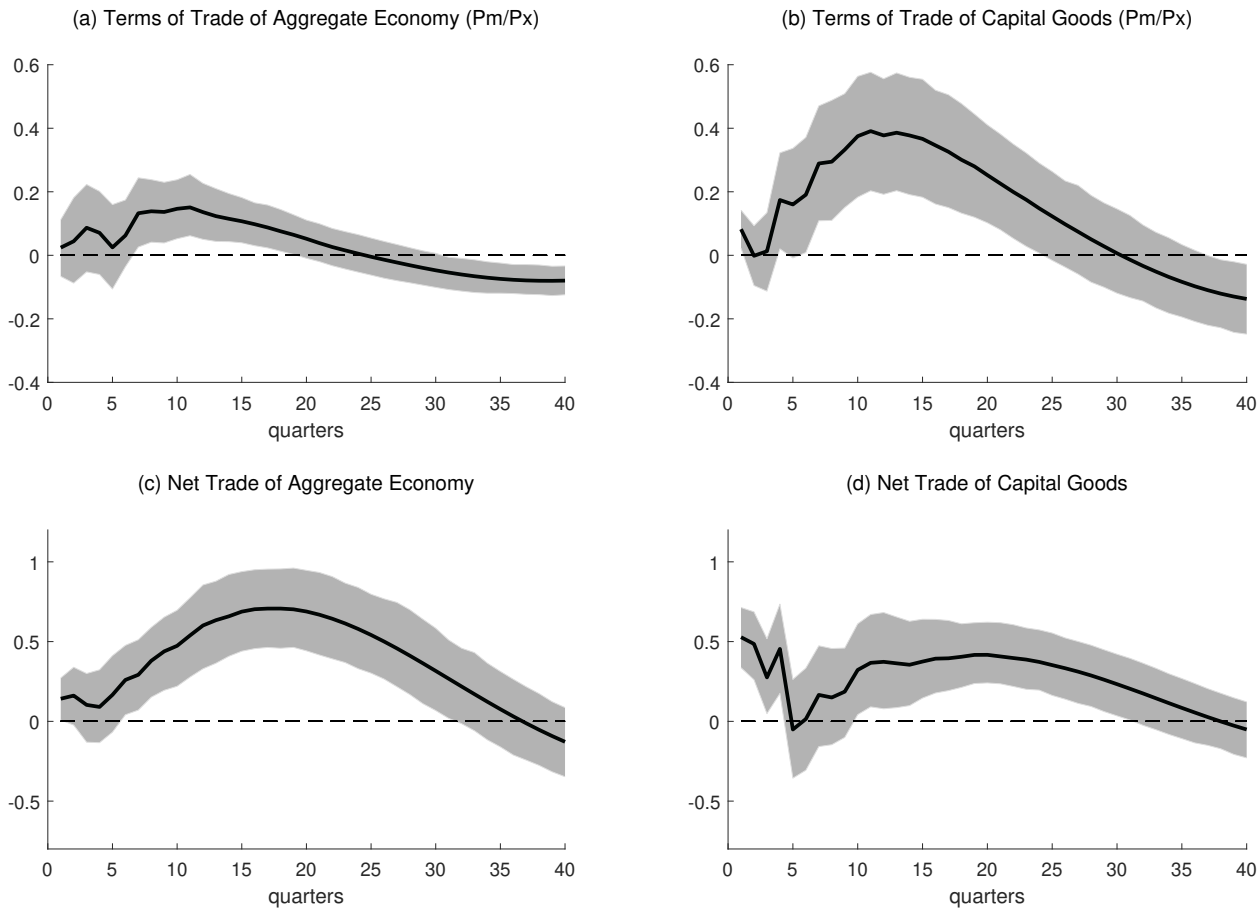


Figure B.4: International Goods Markets Mechanism

Notes: Standard error bands are 68% confidence intervals.

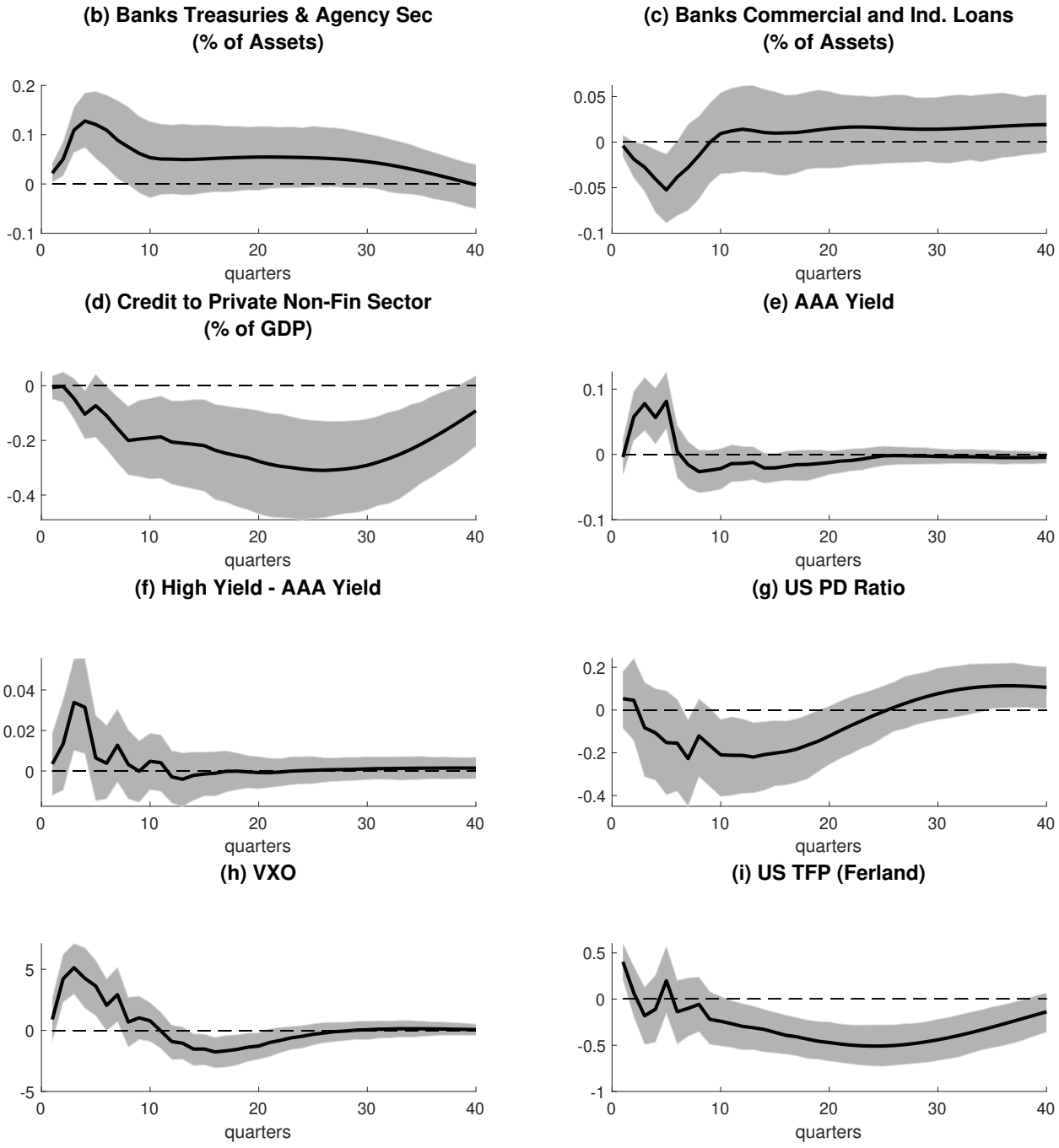


Figure B.5: IRFs of other US Financial Markets and Banking Variables

Notes: Standard error bands are 68% confidence intervals.

D SVAR Robustness

D.1 Alternative Identification Strategies

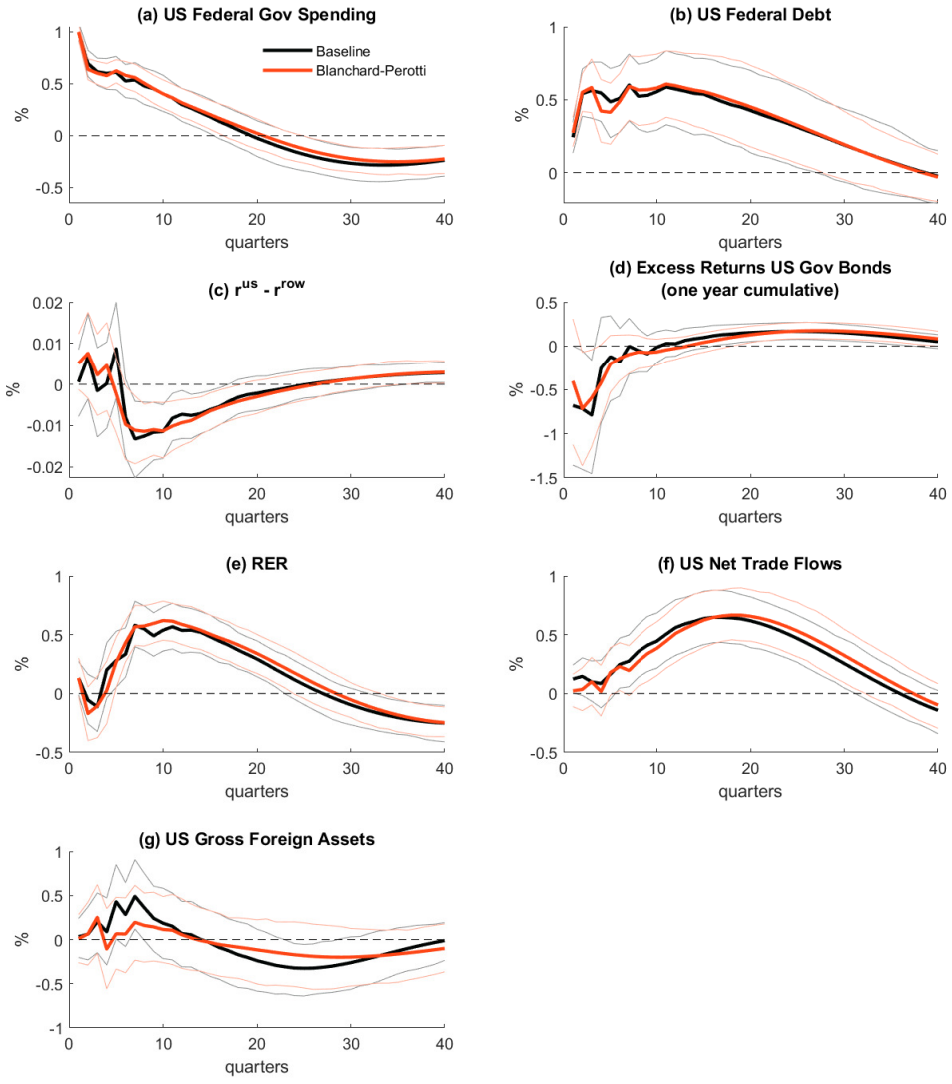


Figure C.1: Blanchard-Perotti

Notes: Standard error bands are 68% confidence intervals.

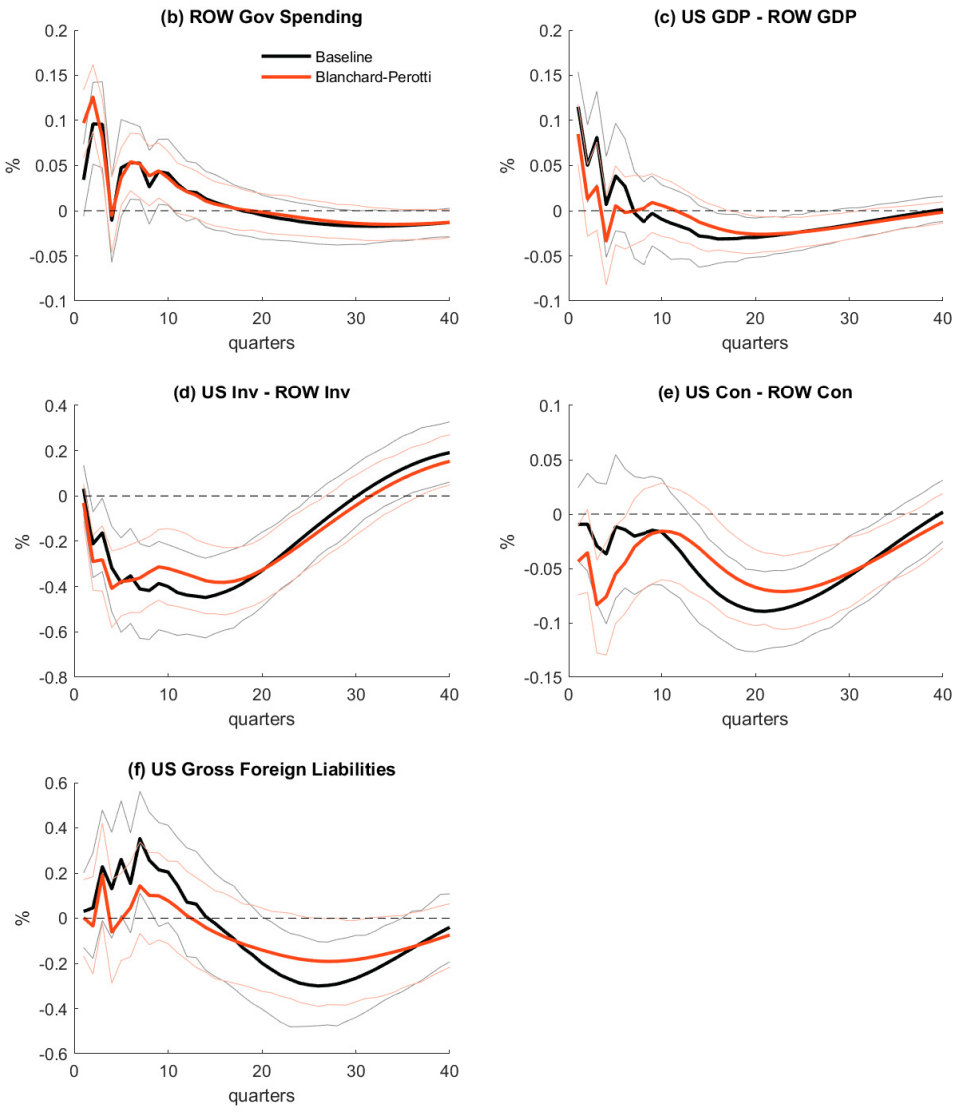


Figure C.2: Blanchard-Perotti

Notes: Standard error bands are 68% confidence intervals.

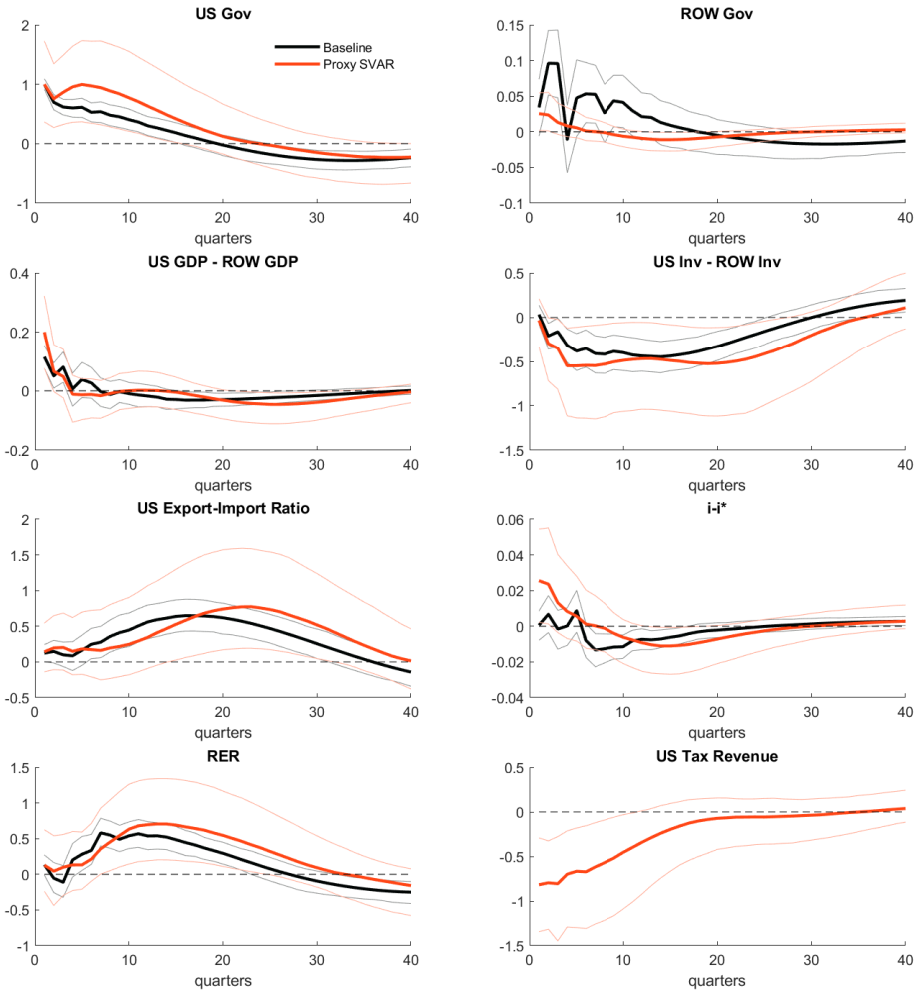


Figure C.3: External Instruments or Proxy SVAR

Notes: Standard error bands are 68% confidence intervals.

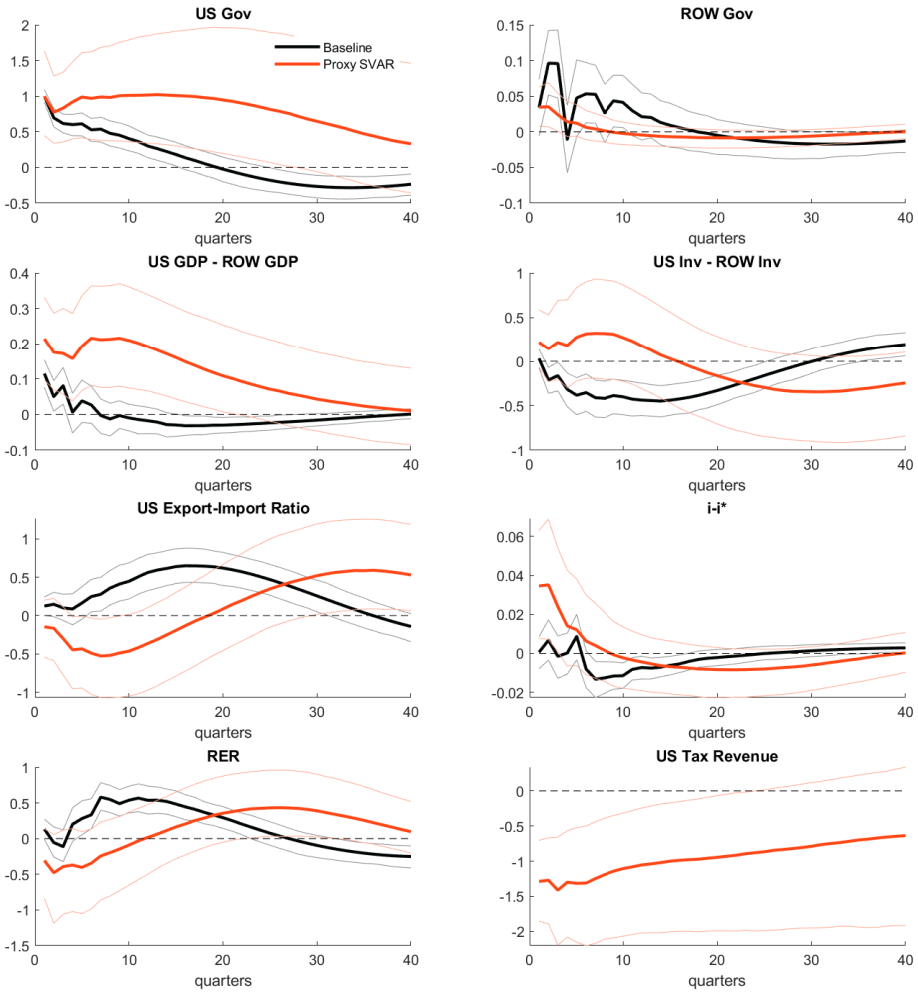


Figure C.4: External Instruments or Proxy SVAR: no trends in Proxy SVAR

Notes: Standard error bands are 68% confidence intervals.

D.2 Alternative Controls and Sensitivity

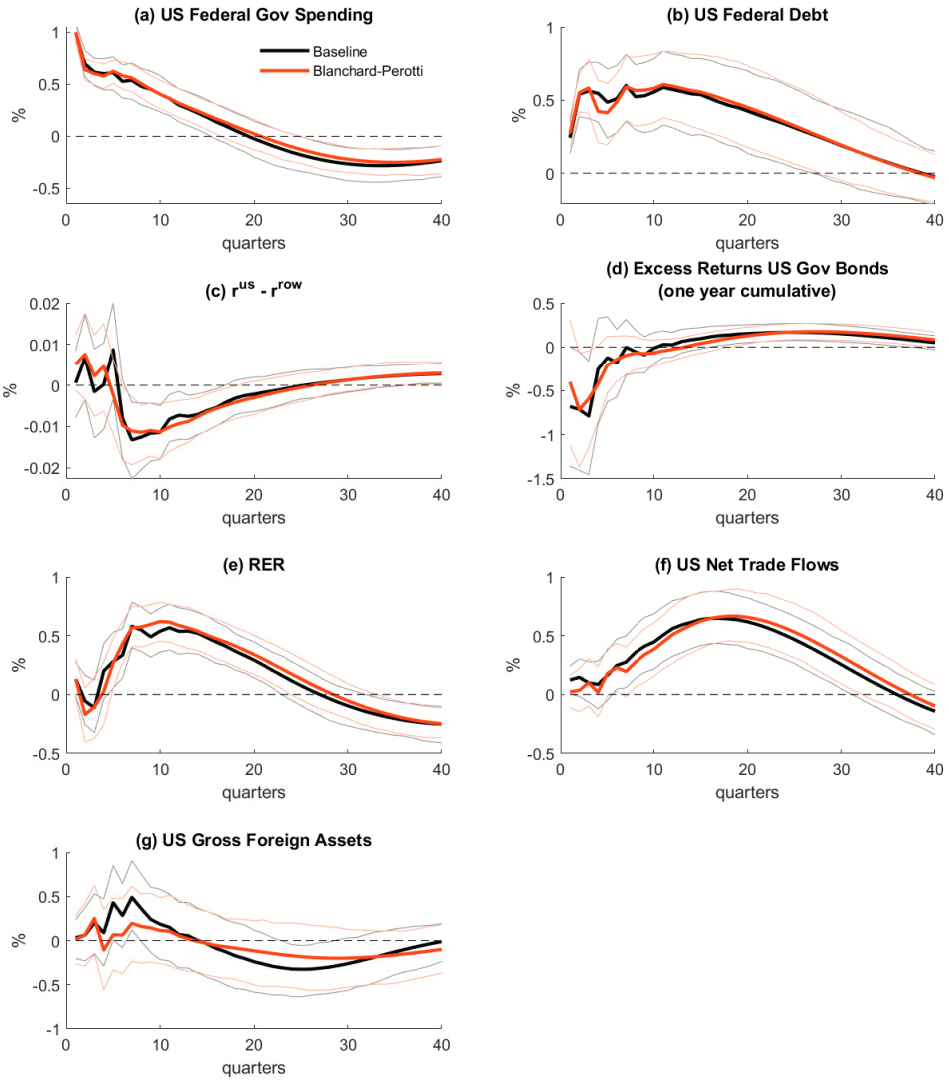


Figure C.5: Control for US Price-Dividend Ratio

Notes: Standard error bands are 68% confidence intervals.

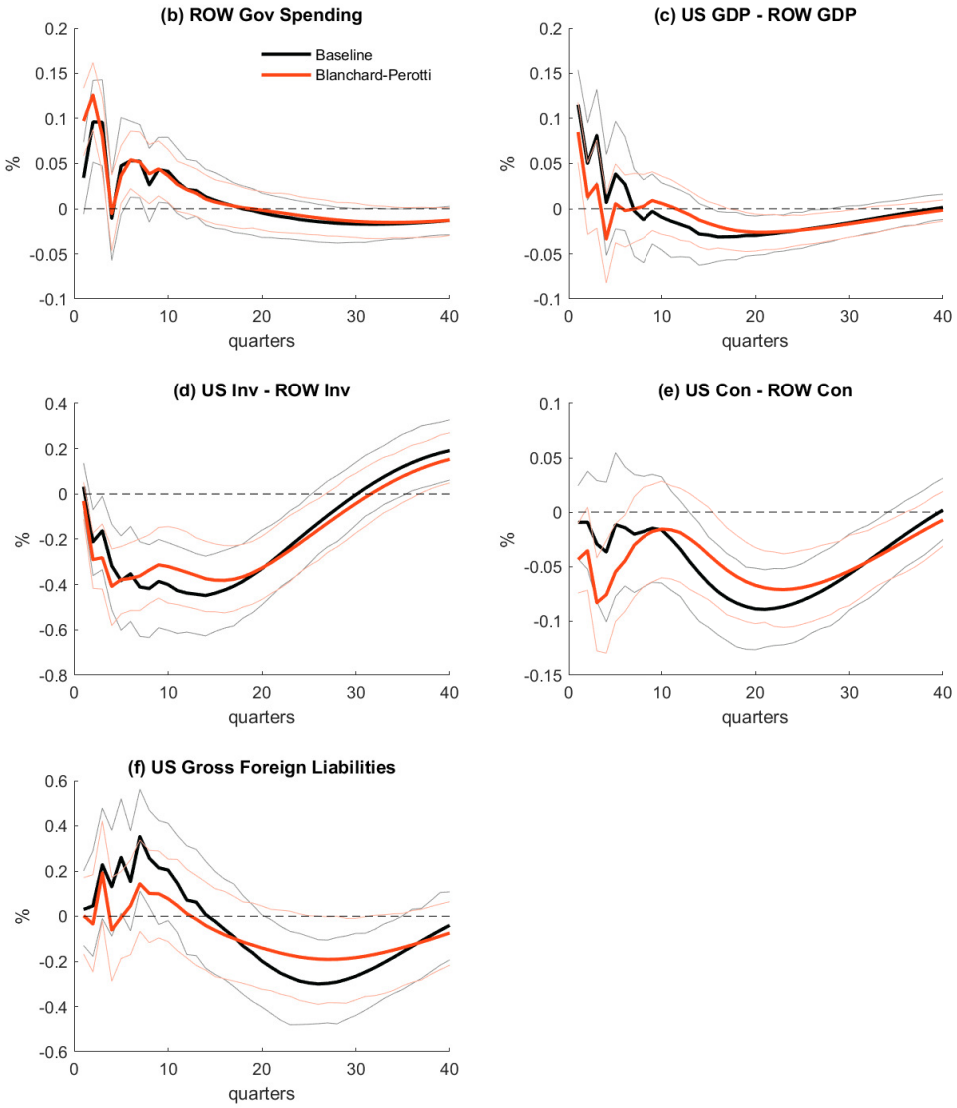


Figure C.6: Control for US Price-Dividend Ratio

Notes: Standard error bands are 68% confidence intervals.

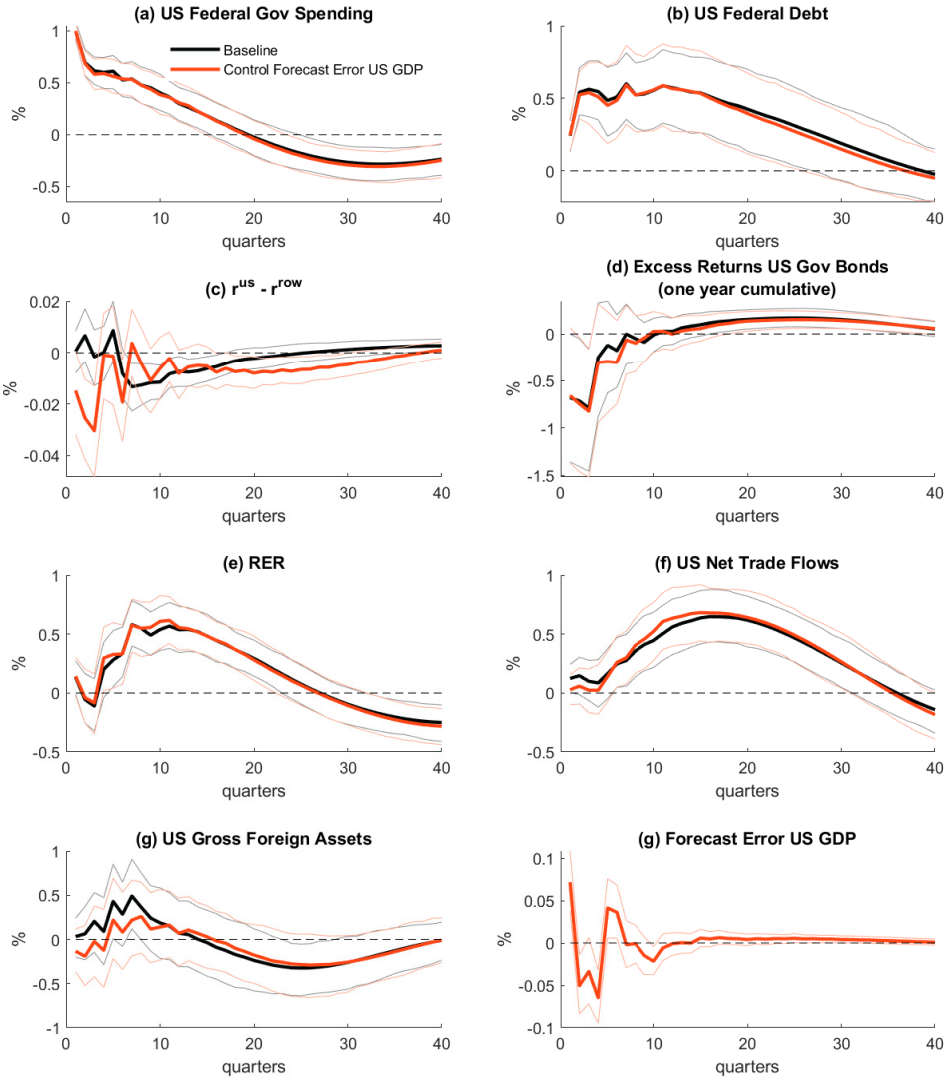


Figure C.7: Control for Forecast Errors of real GDP

Notes: Standard error bands are 68% confidence intervals.

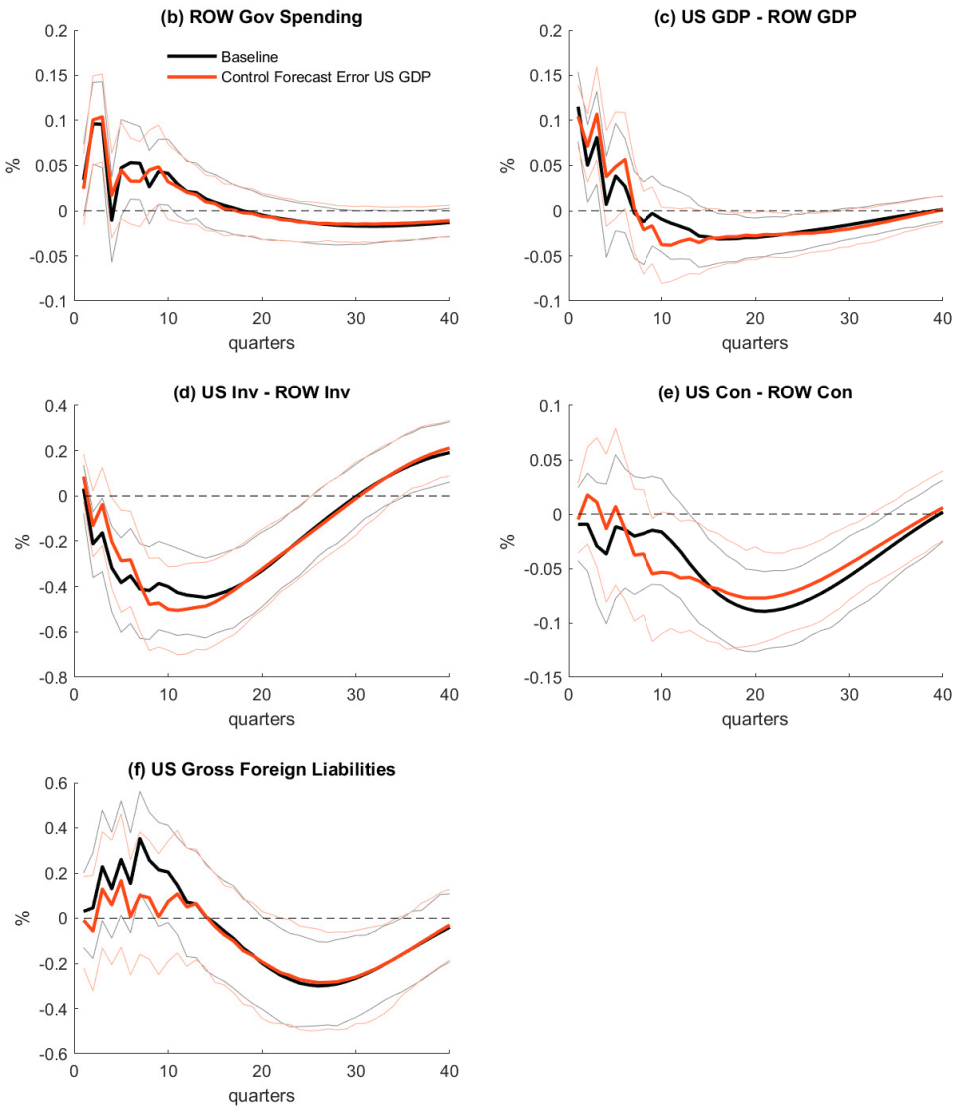


Figure C.8: Control for Forecast Errors of real GDP

Notes: Standard error bands are 68% confidence intervals.

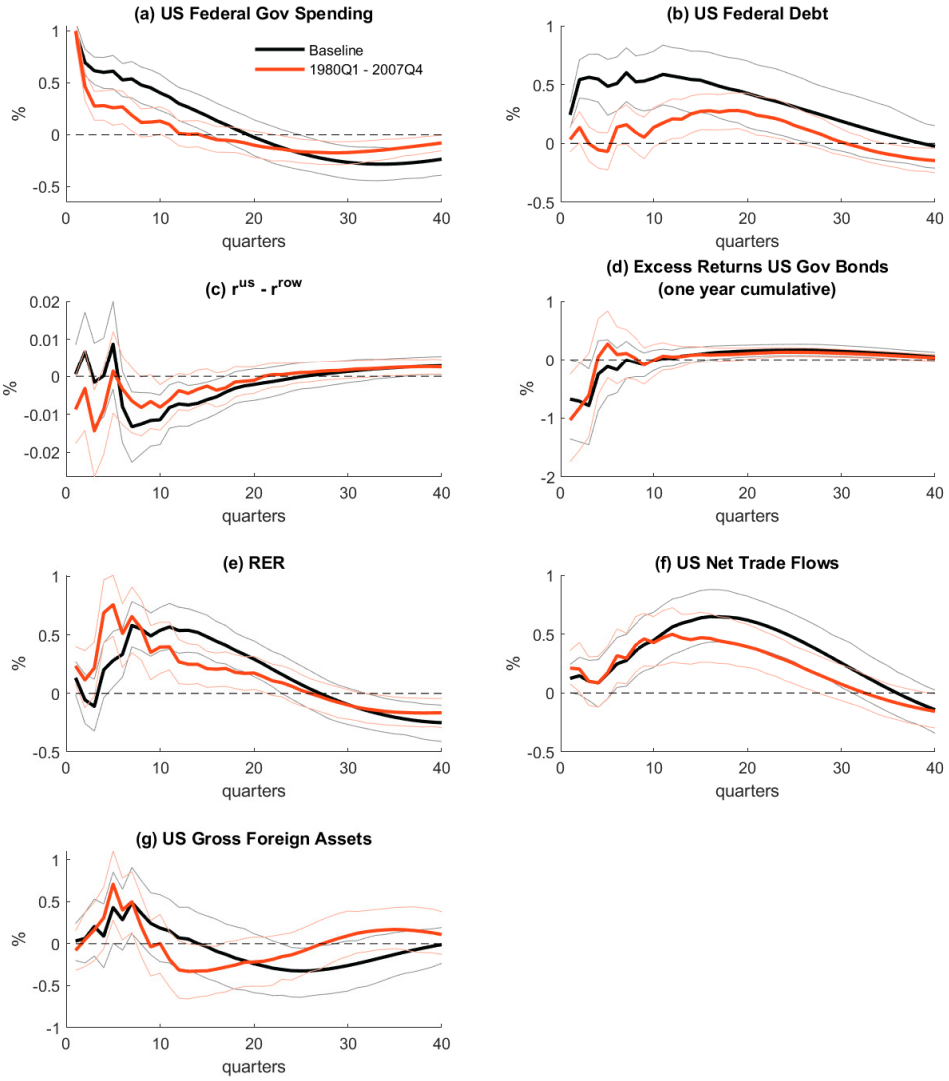


Figure C.9: Sample 1980Q1 - 2007Q4

Notes: Standard error bands are 68% confidence intervals.

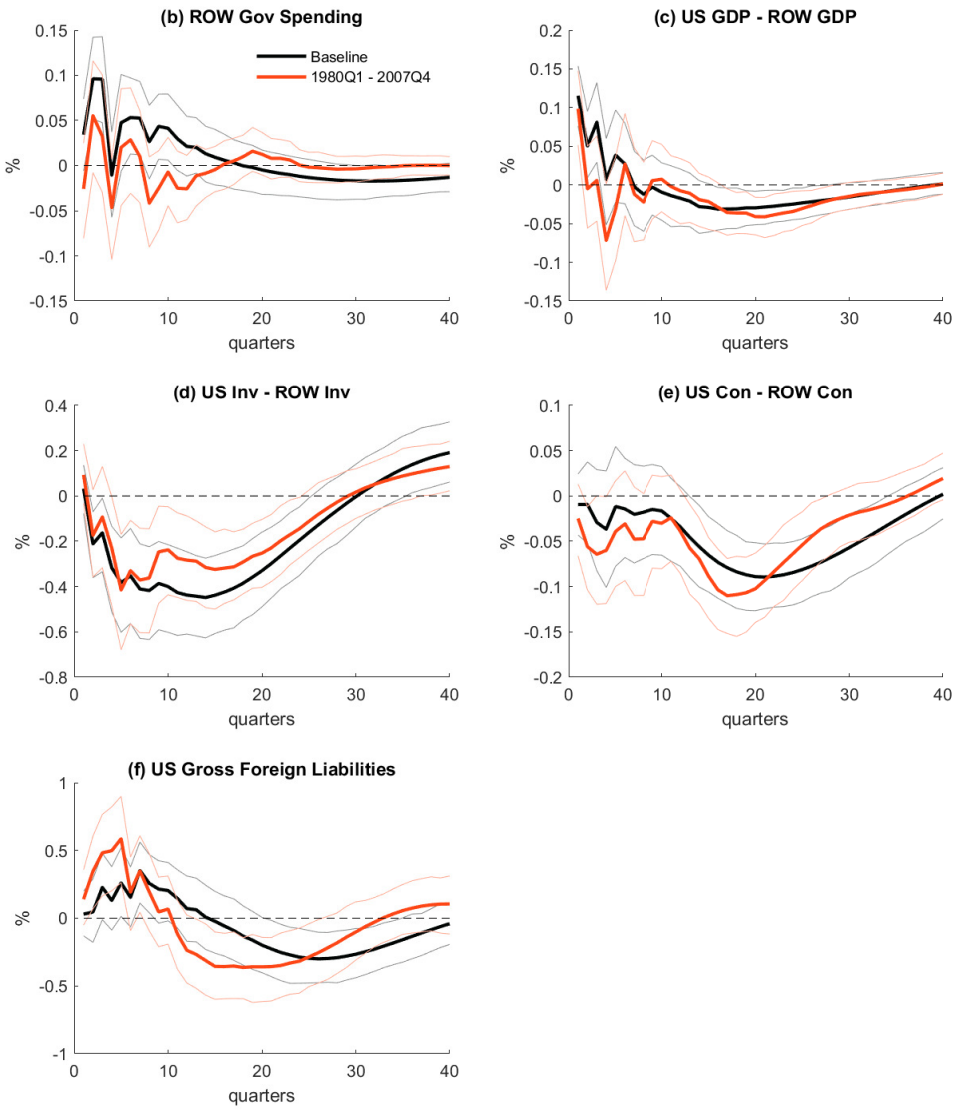


Figure C.10: Sample 1980Q1 - 2007Q4

Notes: Standard error bands are 68% confidence intervals.

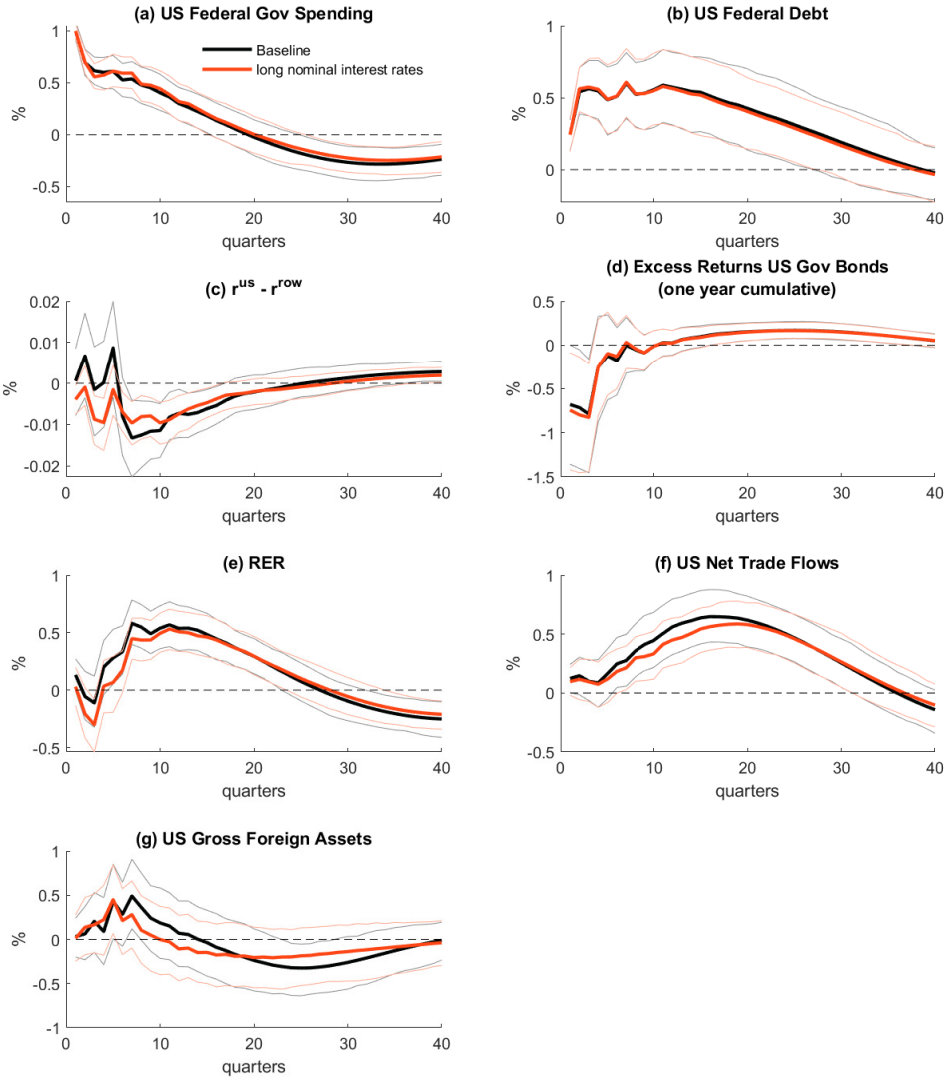


Figure C.11: Long Nominal Interest Rates

Notes: Standard error bands are 68% confidence intervals.

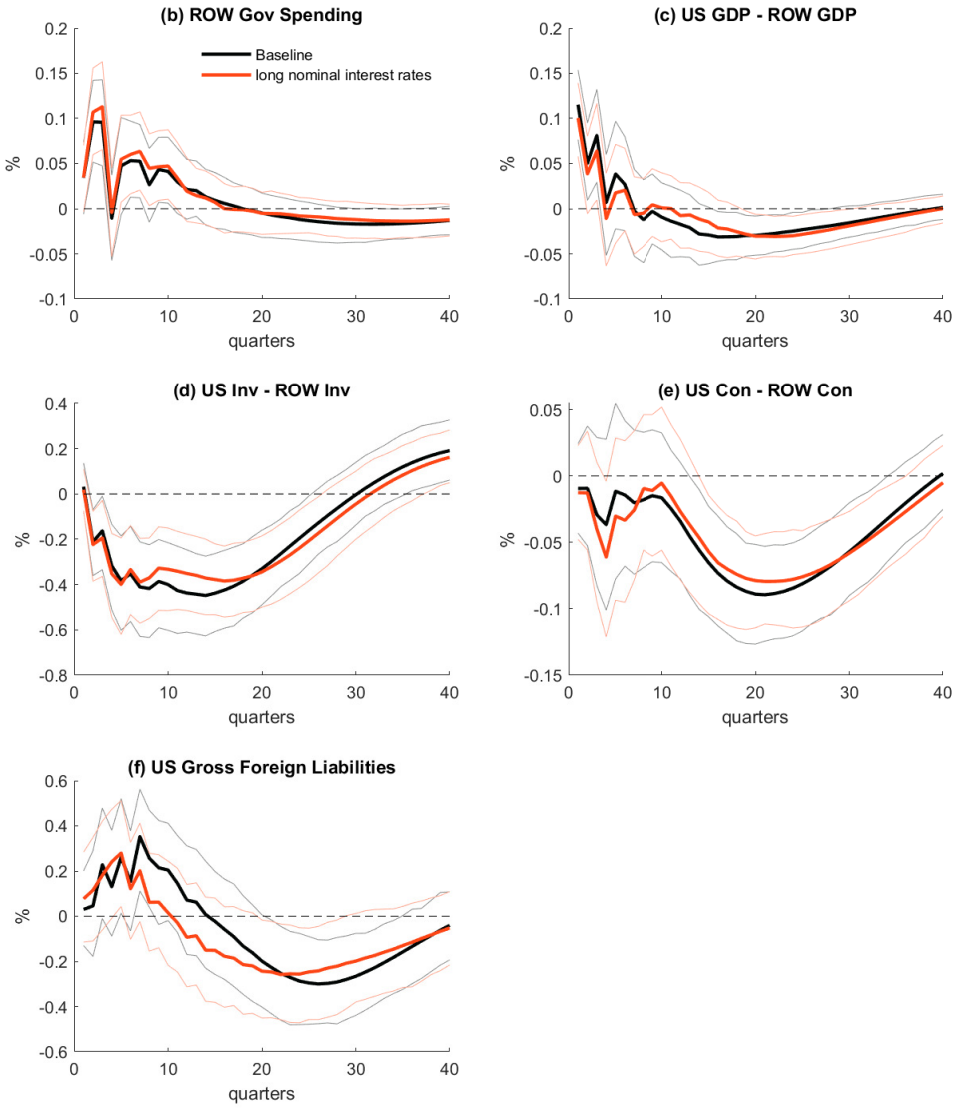


Figure C.12: Long Nominal Interest Rates

Notes: Standard error bands are 68% confidence intervals.

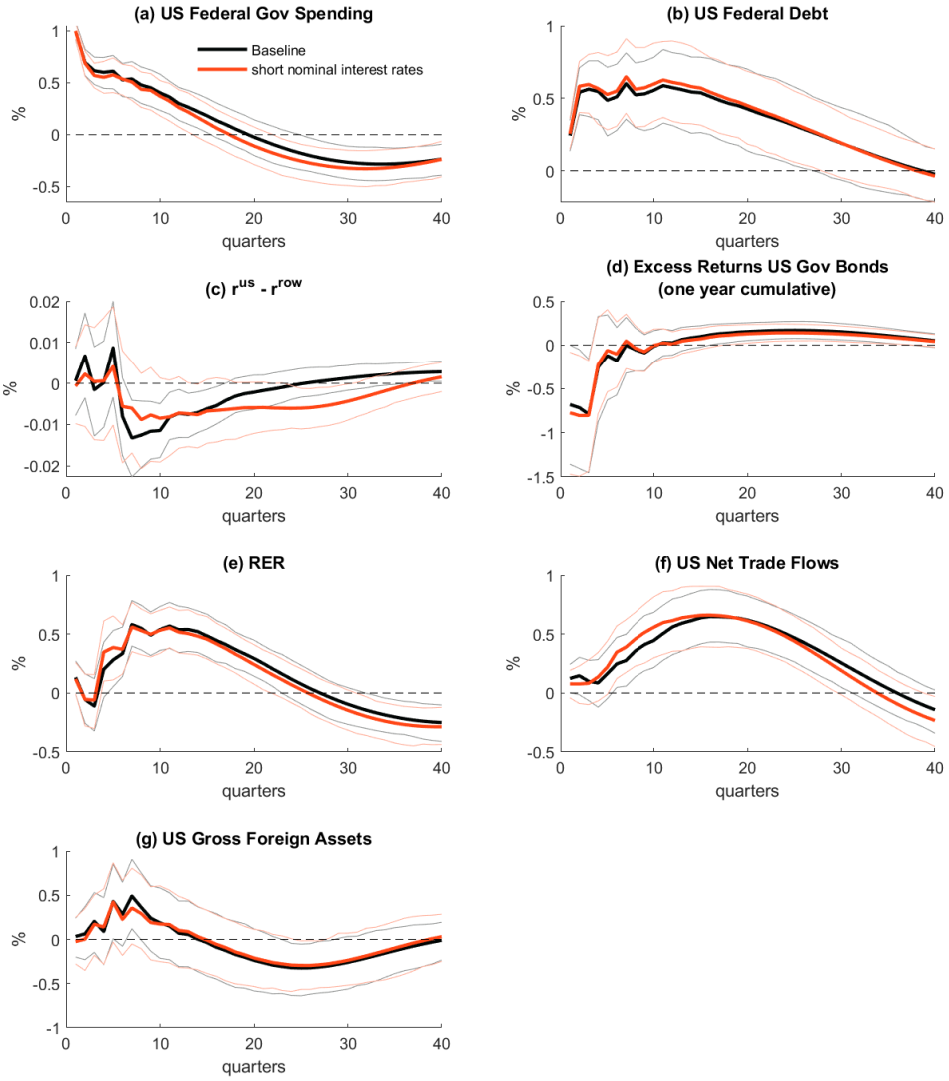


Figure C.13: Short Nominal Interest Rates

Notes: Standard error bands are 68% confidence intervals.

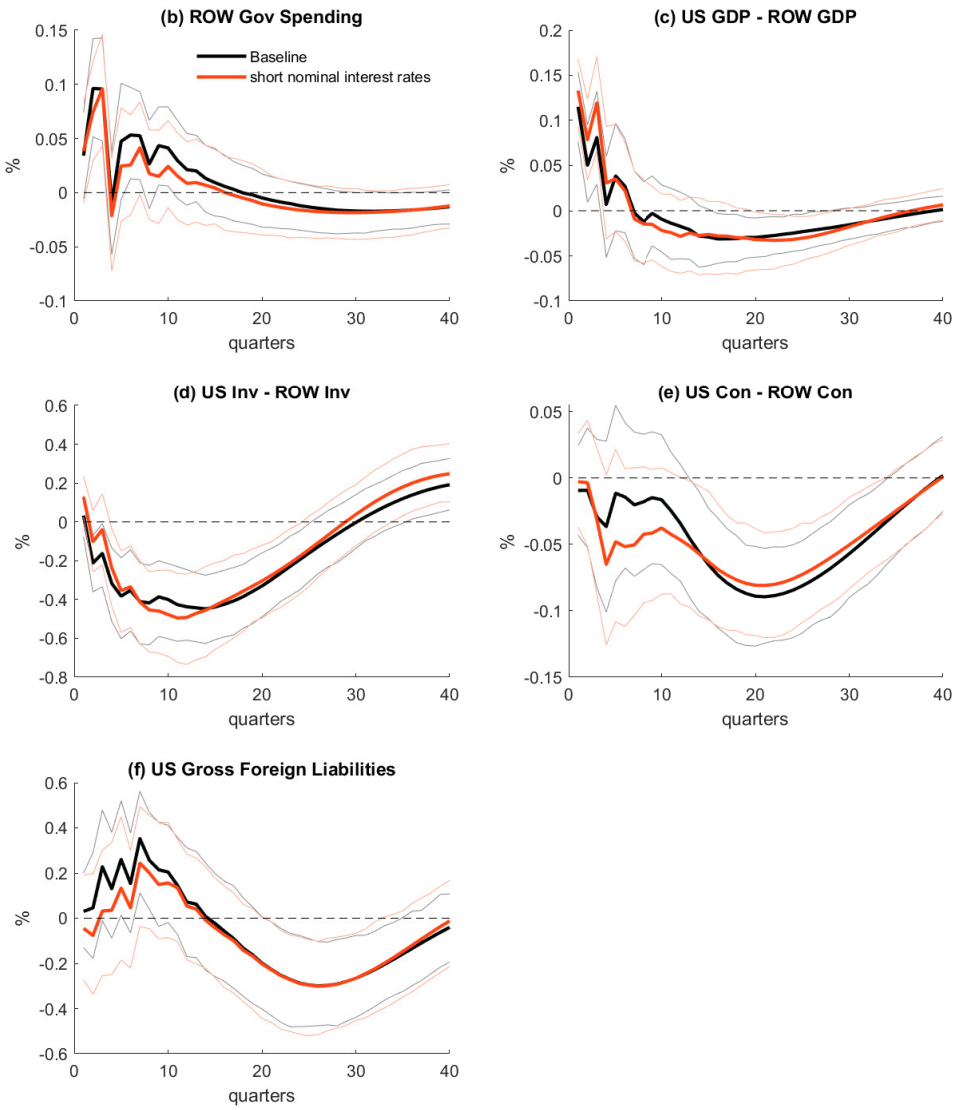


Figure C.14: Short Nominal Interest Rates

Notes: Standard error bands are 68% confidence intervals.

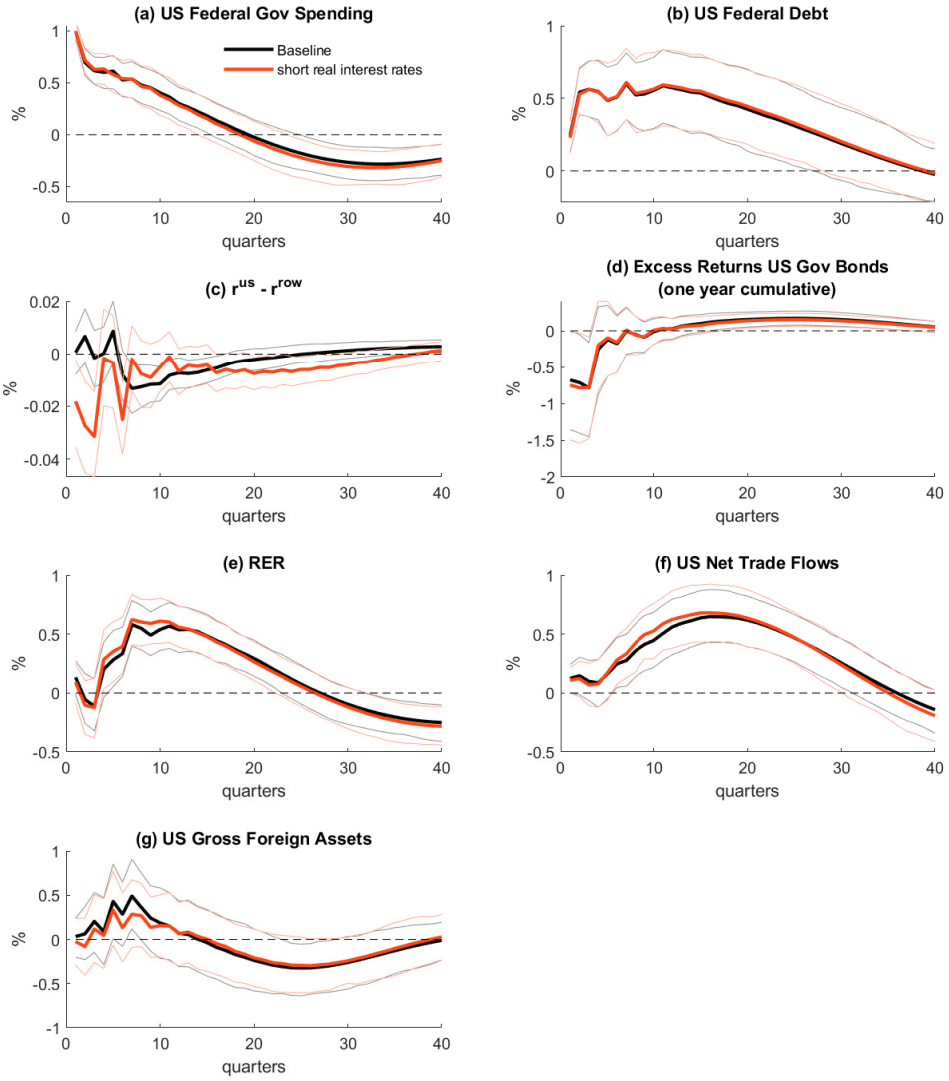


Figure C.15: Short Real Interest Rates

Notes: Standard error bands are 68% confidence intervals.

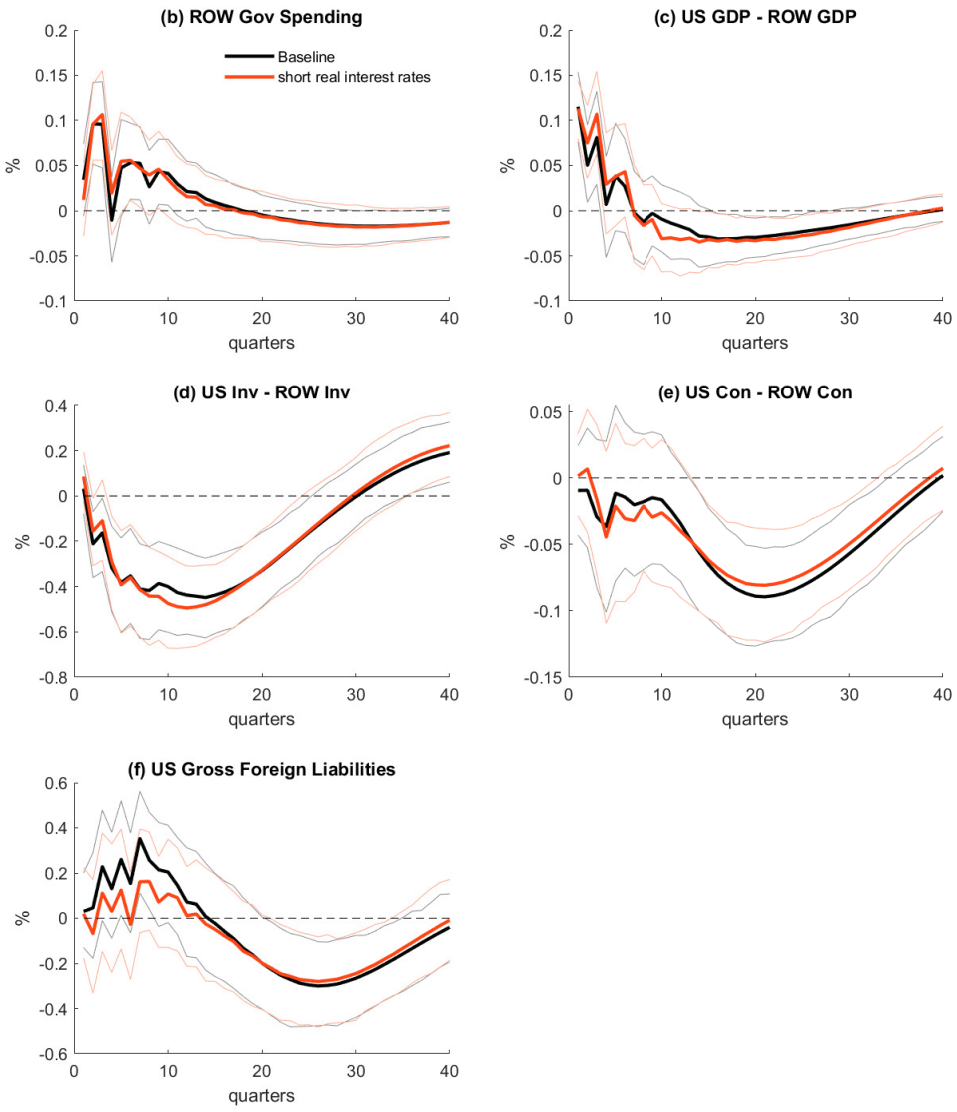


Figure C.16: Short Real Interest Rates

Notes: Standard error bands are 68% confidence intervals.

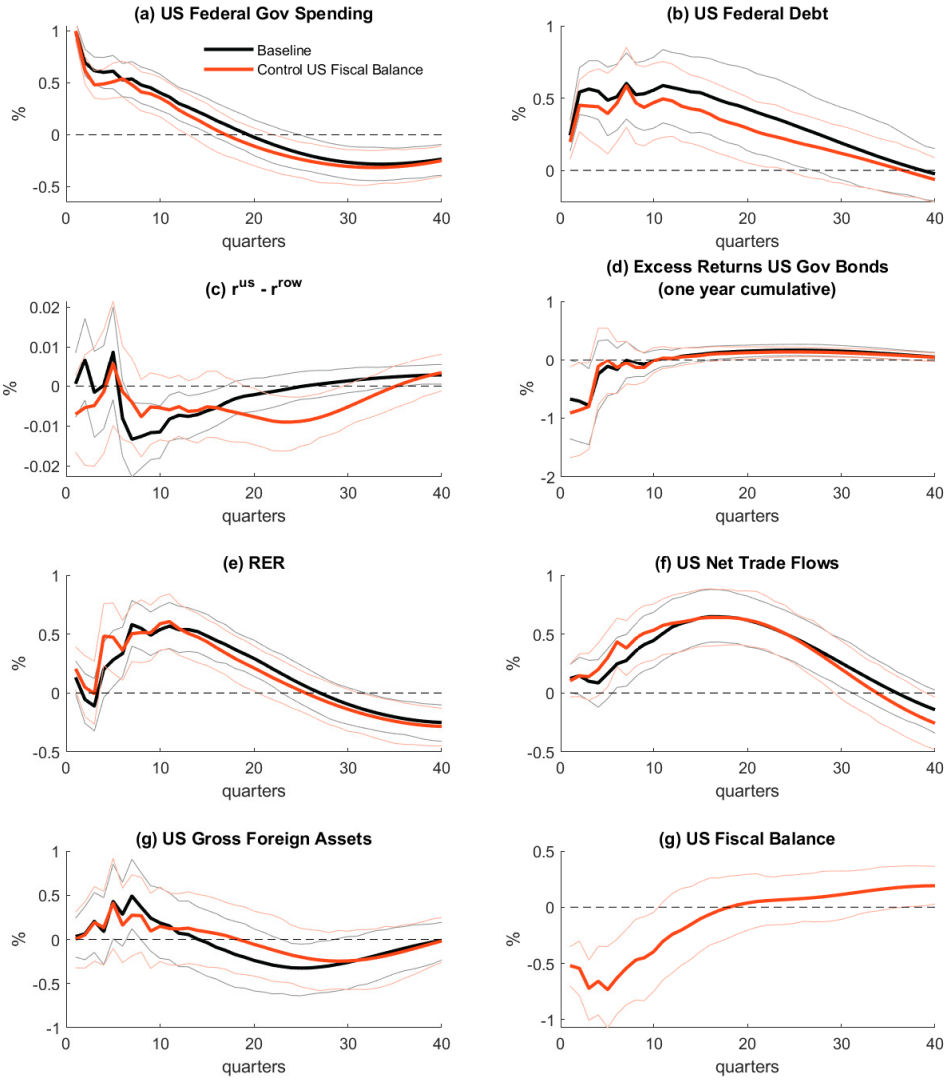


Figure C.17: Control for Fiscal Balance

Notes: Standard error bands are 68% confidence intervals.

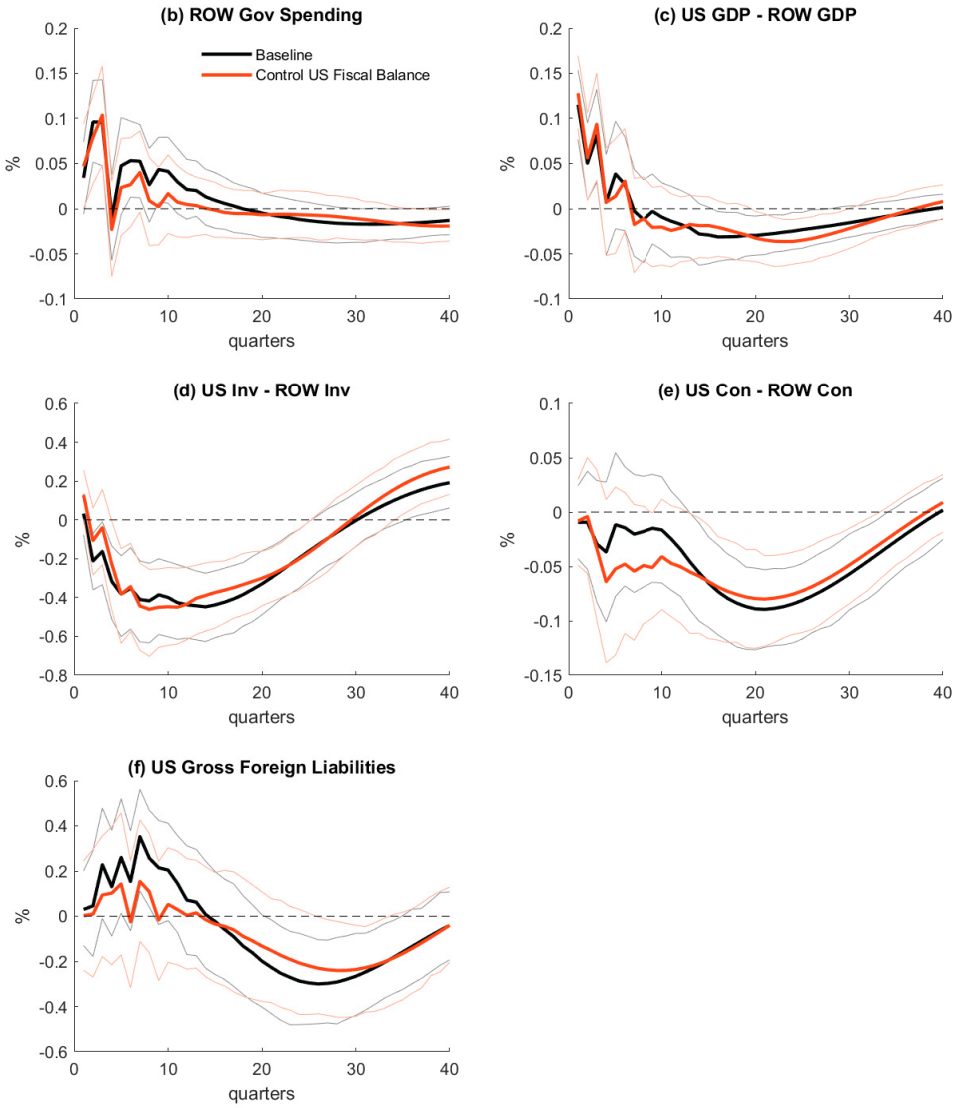


Figure C.18: Control for Fiscal Balance

Notes: Standard error bands are 68% confidence intervals.

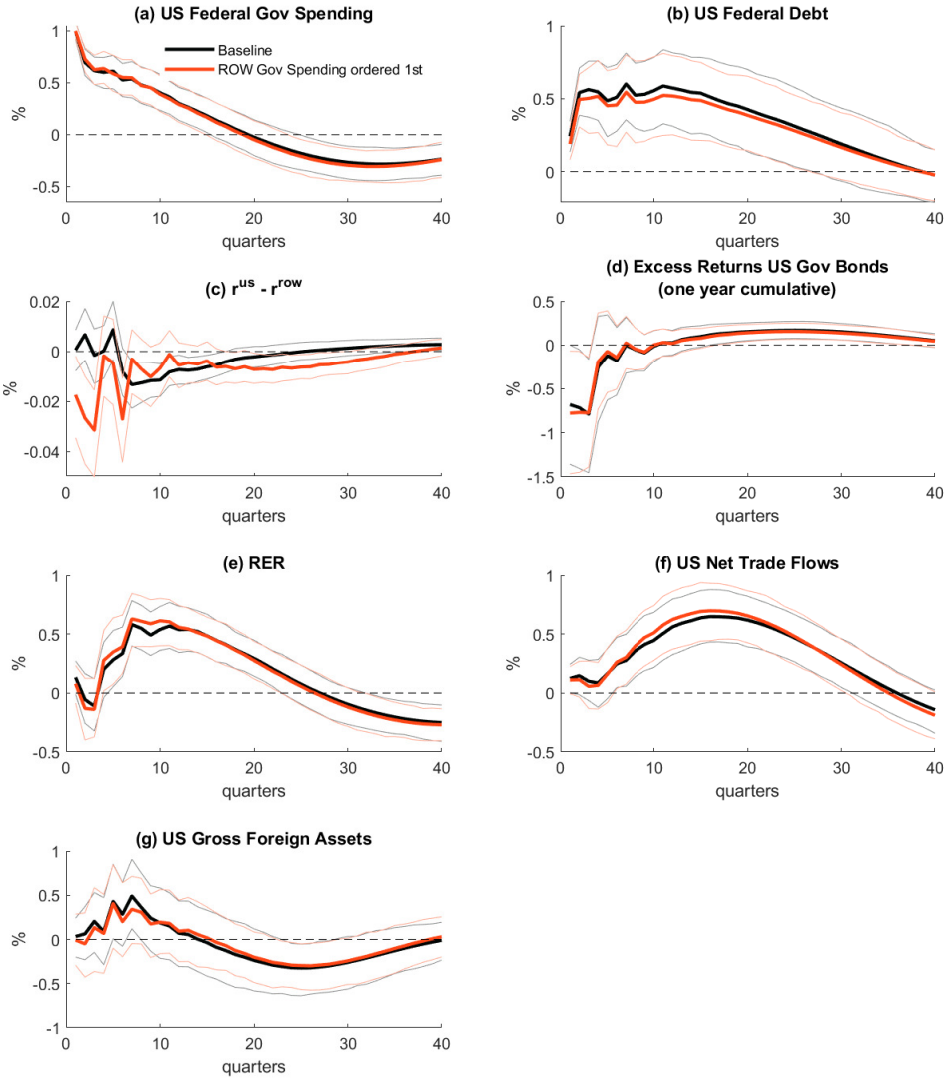


Figure C.19: ROW Gov Spending Ordered First and US Spending Forecast Error Ordered Last

Notes: Standard error bands are 68% confidence intervals.

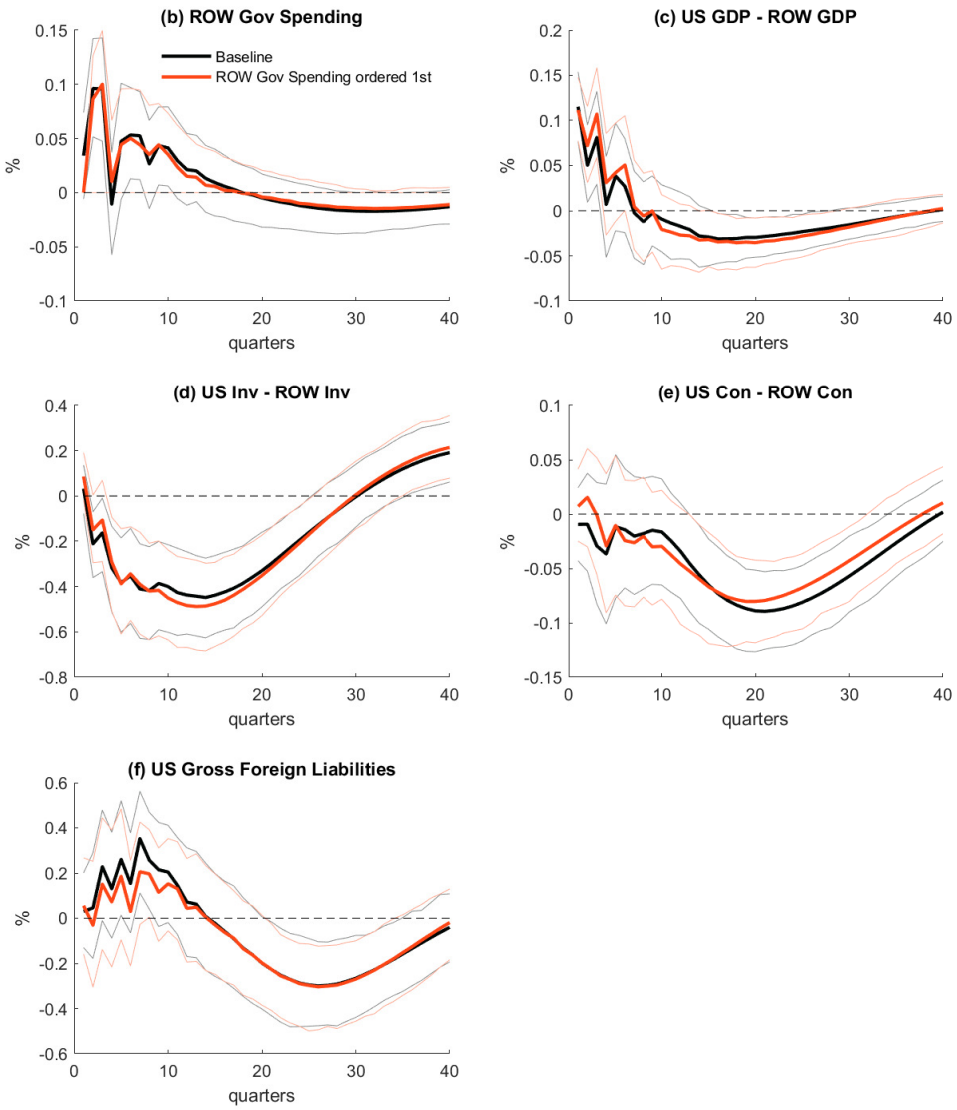


Figure C.20: ROW Gov Spending Ordered First and US Spending Forecast Error Ordered Last

Notes: Standard error bands are 68% confidence intervals.

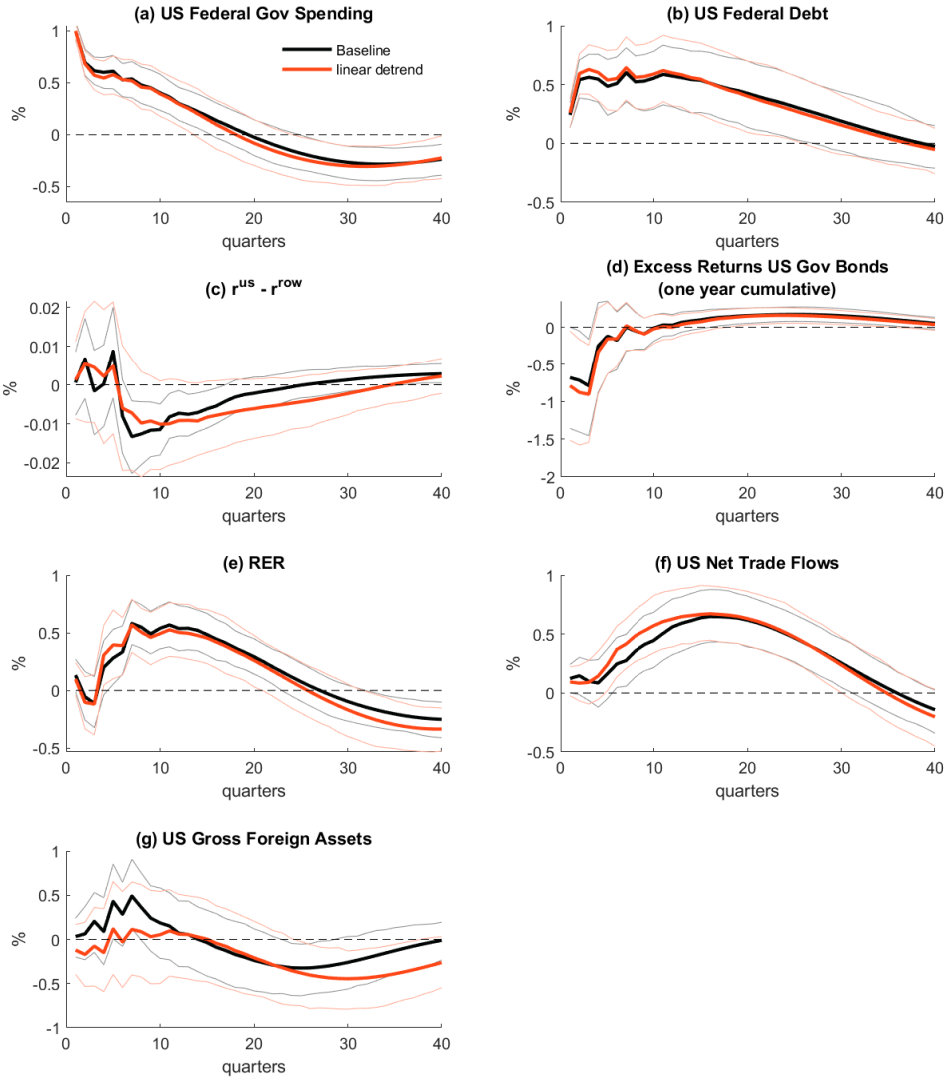


Figure C.21: Linear De-Trend

Notes: Standard error bands are 68% confidence intervals.

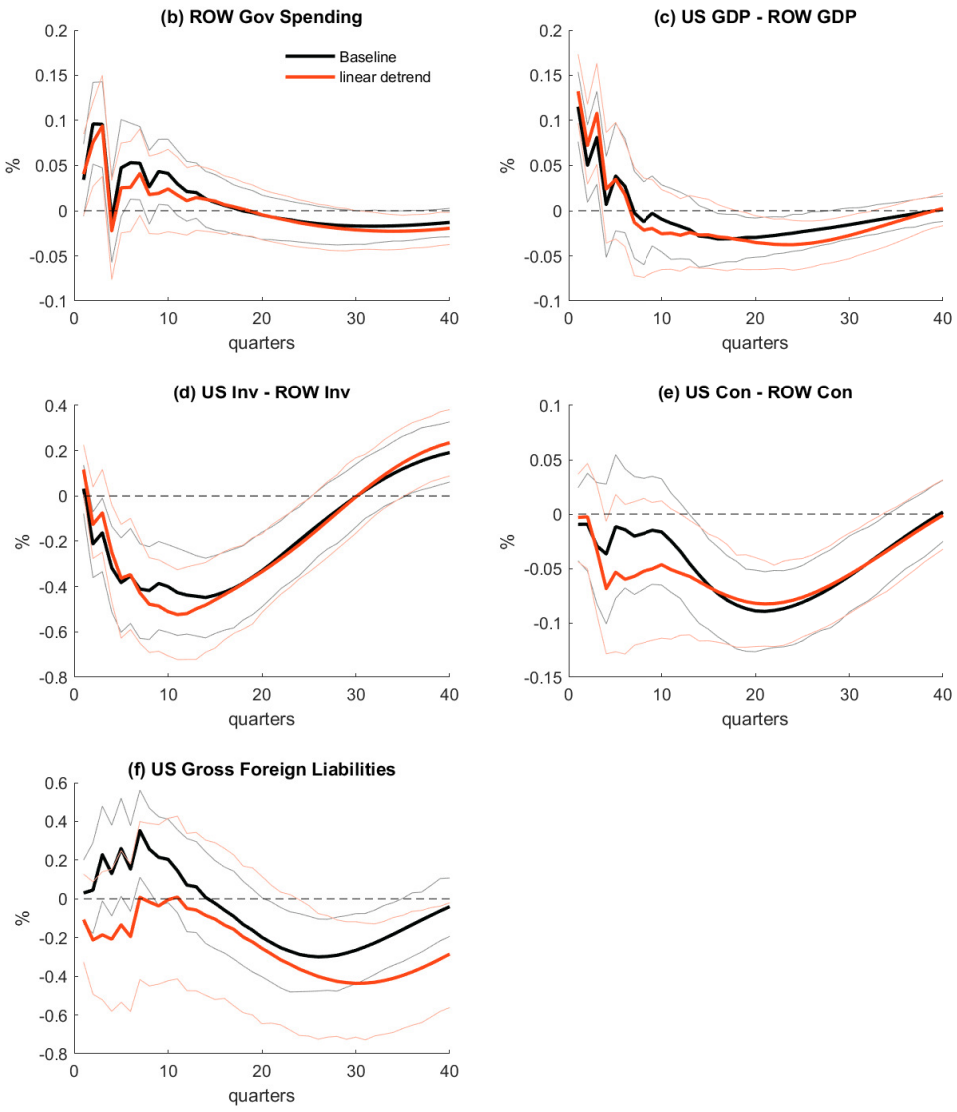


Figure C.22: Linear De-Trend

Notes: Standard error bands are 68% confidence intervals.

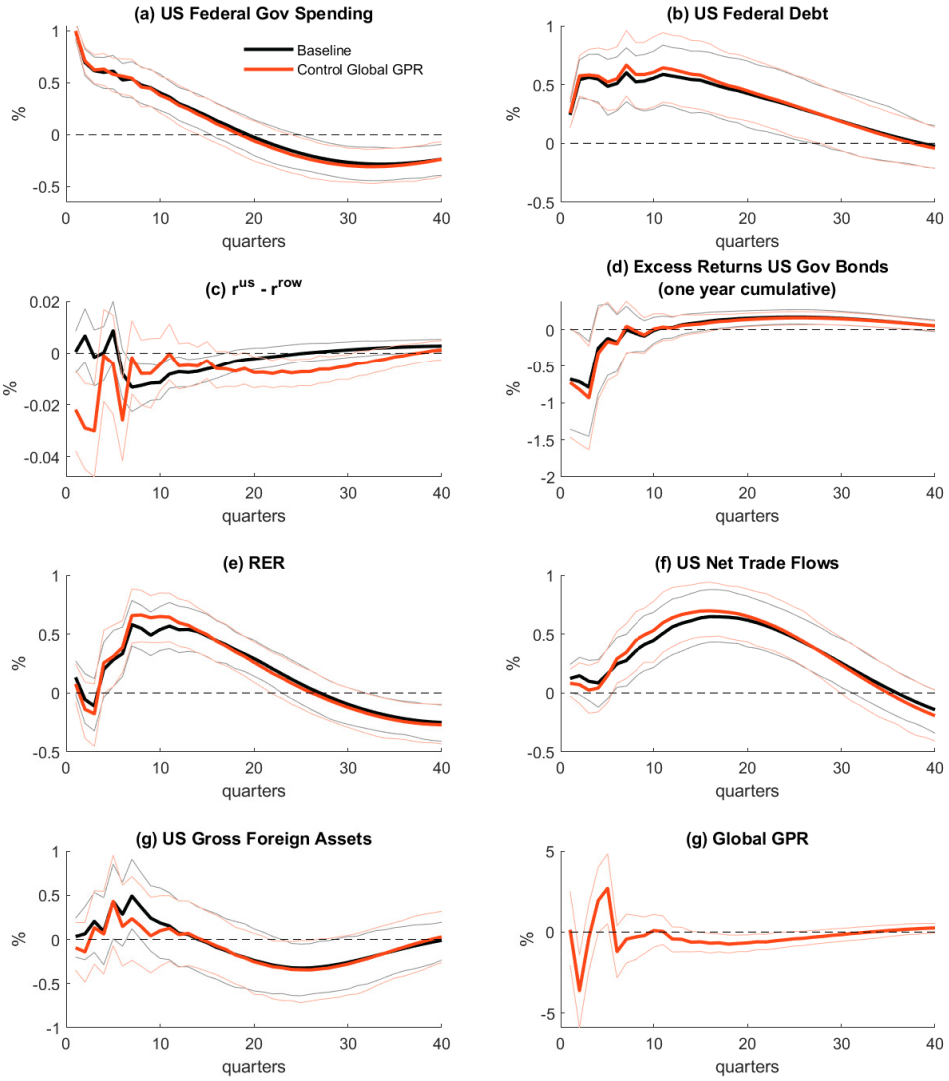


Figure C.23: Control for Geopolitical Risk Index (global) (Caldara and Iacoviello, 2022)

Notes: Standard error bands are 68% confidence intervals.

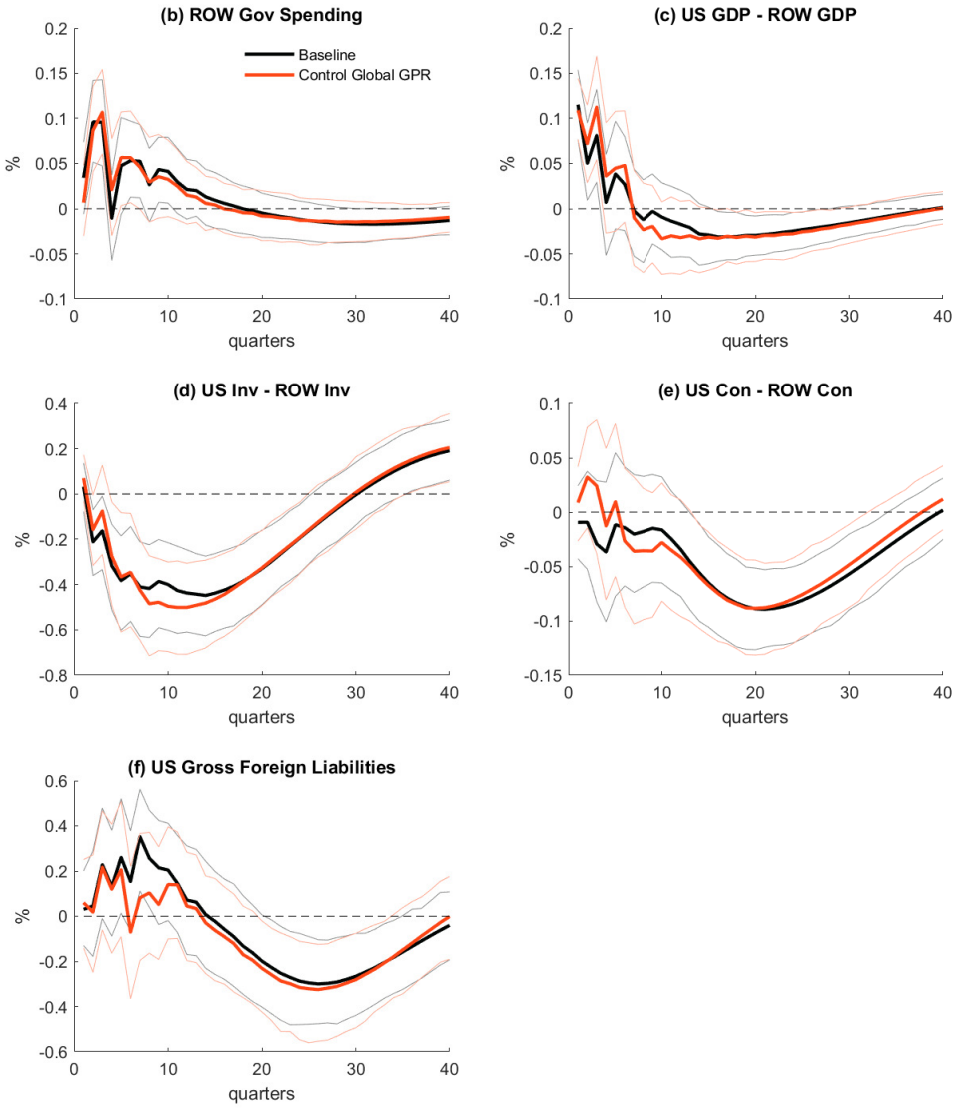


Figure C.24: Control for Geopolitical Risk Index (global) (Caldara and Iacoviello, 2022)

Notes: Standard error bands are 68% confidence intervals.

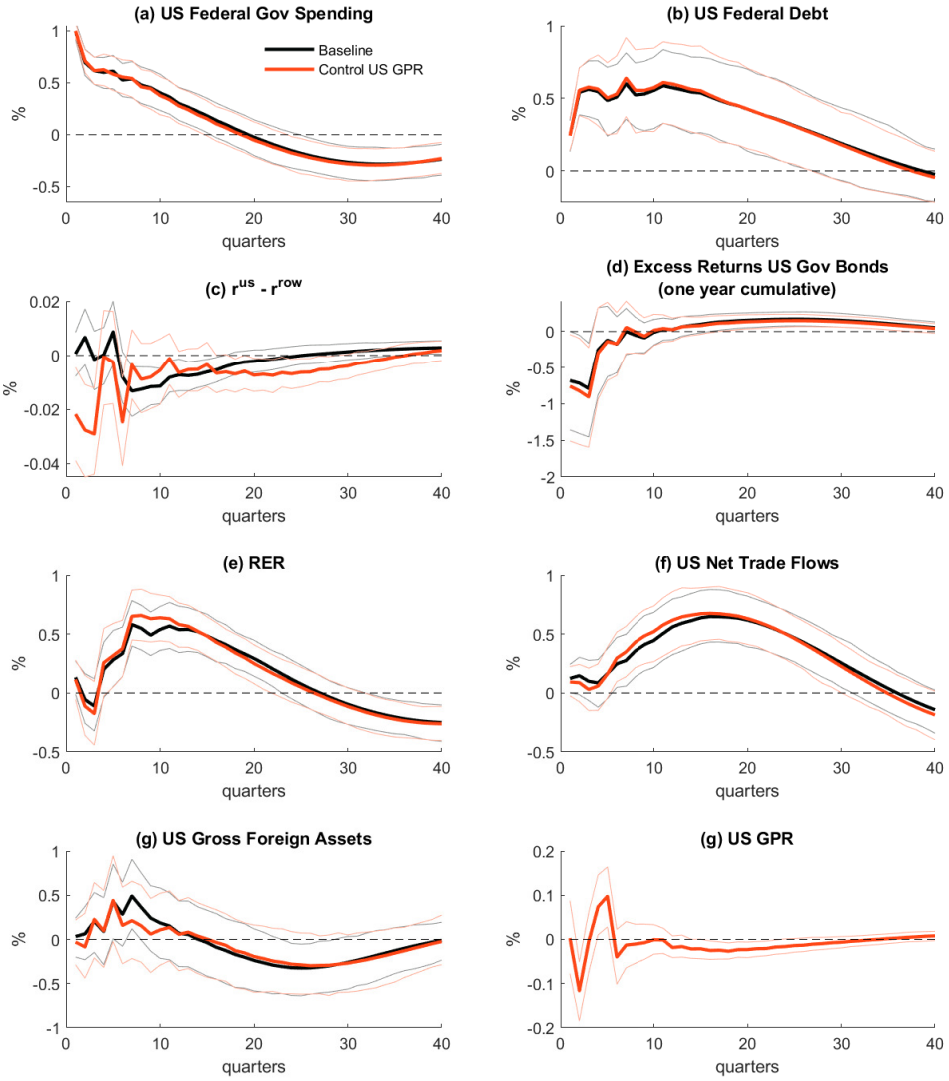


Figure C.25: Control for Geopolitical Risk Index (US) (Caldara and Iacoviello, 2022)

Notes: Standard error bands are 68% confidence intervals.

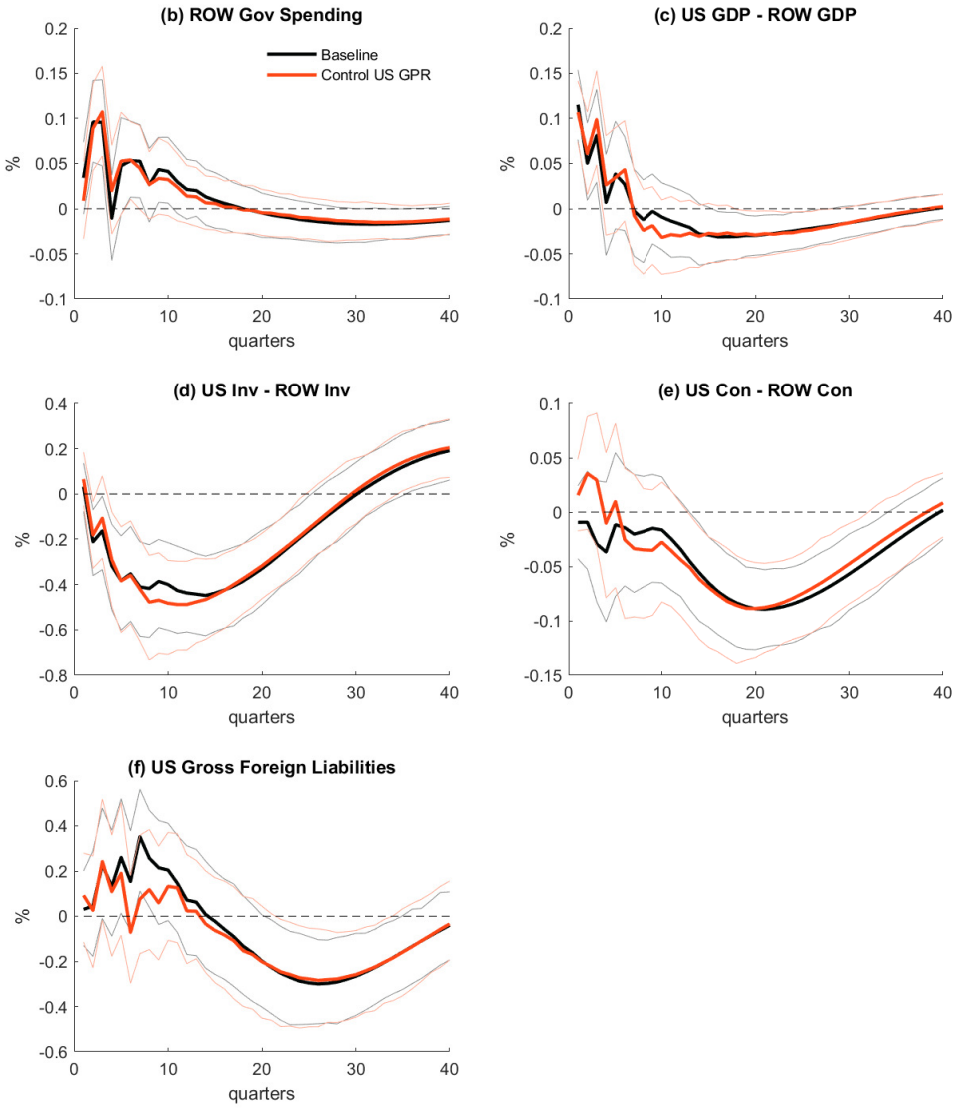


Figure C.26: Control for Geopolitical Risk Index (US) (Caldara and Iacoviello, 2022)

Notes: Standard error bands are 68% confidence intervals.

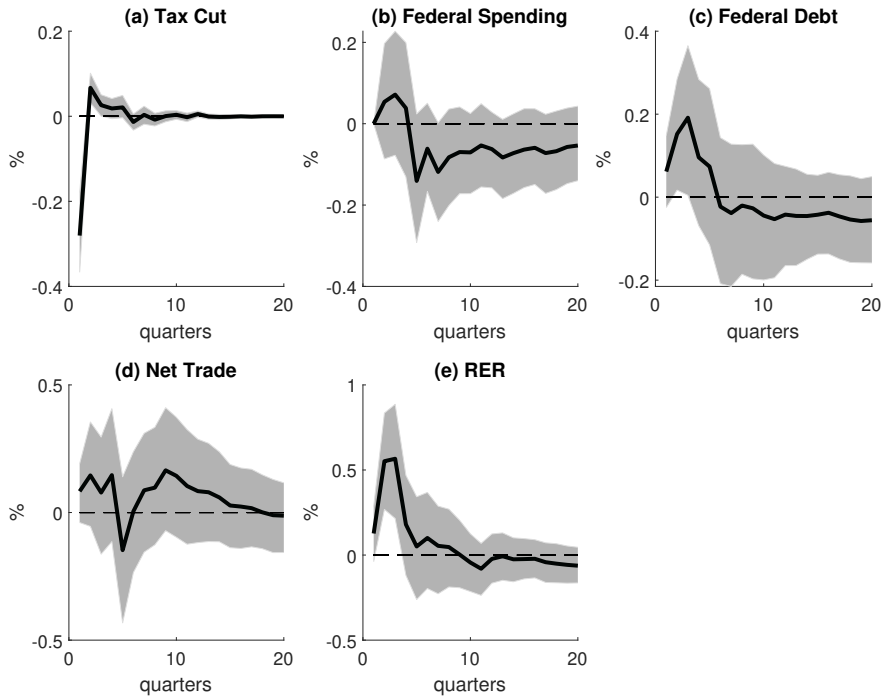


Figure C.27: Unanticipated Tax Cut (Mertens and Ravn, 2012)

Notes: Standard error bands are 68% confidence intervals.

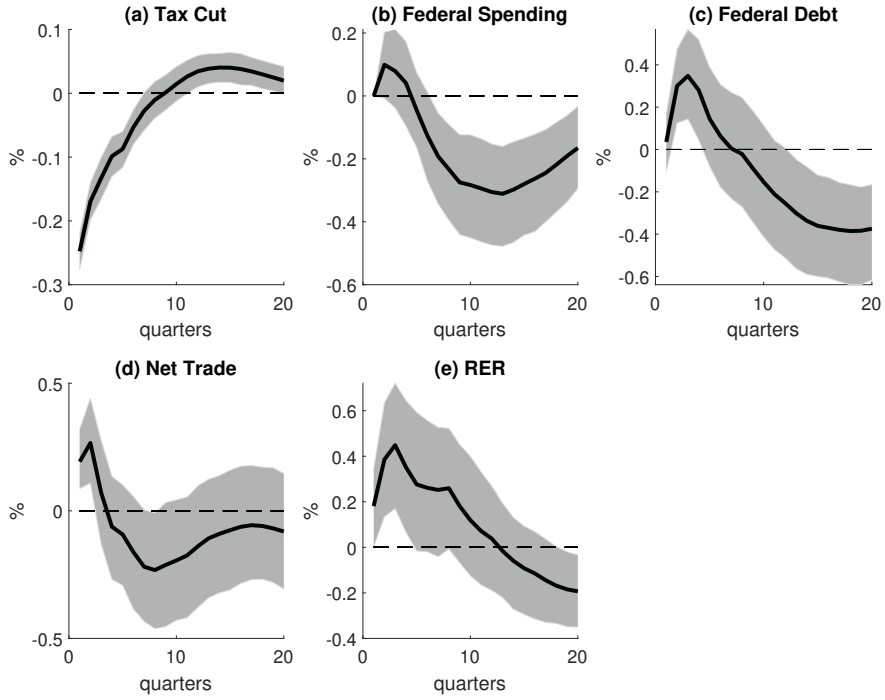


Figure C.28: VAR Federal Tax Cut Shock

Notes: Standard error bands are 68% confidence intervals.

	Baseline	BP	PD-ratio	1980:Q1 - 2007:Q4
Net Trade	35	26	35	29
RER	32	23	36	32
	Fiscal Balance	G^{row} order 1st	GPR	Linear De-trend
Net Trade	33	38	40	33
RER	30	33	37	23
	Long Nominal Rates	Short Real Rates	Short Nominal Rates	Forecasts US GDP
Net Trade	32	40	37	35
RER	28	36	33	33

Table C.1: Robustness Unconditional Variance Decomposition - Total US Gov (%)

	Baseline	BP	PD-ratio	1980:Q1 - 2007:Q4
Net Trade	24	-	19	20
RER	19	-	25	22
	Fiscal Balance	G^{row} order 1st	GPR	Linear De-trend
Net Trade	22	25	25	20
RER	17	21	21	12
	Long Nominal Rates	Short Real Rates	Short Nominal Rates	Forecasts US GDP
Net Trade	19	25	24	22
RER	16	21	18	19

Table C.2: Robustness Unconditional Variance Decomposition - Forecast Error US Gov (%)

E Model

E.1 Proof of Proposition I

The log-linearized Euler equation 4 (under $\psi_t^{us} = 0$) is,

$$\Gamma \bar{s}^{row,us}(1 + \hat{s}_{t+1}^{row,us}) = 1 + \hat{\Omega}_{t,t+1} + \mathbb{E}_t \hat{\mathcal{E}}_{t+1} - \hat{\mathcal{E}}_t + \hat{R}_t^{row,us}$$

where $\hat{x}_t$ denotes the log-deviation from the steady state of variable x. Log-linearizing the equation for $s_{t+1}^{row,us} \equiv \frac{P_t B_{t+1}^{row,us} \mathcal{E}_t}{S_{t+1}^{us}}$, gives

$$\bar{s}^{row,us}(1 + \hat{s}_{t+1}^{row,us}) = \bar{s}^{row,us}(1 + \hat{P}_t + \hat{B}_{t+1}^{row,us} + \hat{\mathcal{E}}_t - \hat{S}_{t+1}^{us})$$

Then it holds that,

$$\Gamma \bar{s}^{row,us}(1 + \hat{P}_t + \hat{B}_{t+1}^{row,us} + \hat{\mathcal{E}}_t - \hat{S}_{t+1}^{us}) = 1 + \hat{\Omega}_{t,t+1} + \mathbb{E}_t \hat{\mathcal{E}}_{t+1} - \hat{\mathcal{E}}_t + \hat{R}_t^{row,us}$$

Solve for $\hat{B}_{t+1}^{row,us}$ and multiply each side by β,

$$\beta \hat{B}_{t+1}^{row,us} = \frac{\beta(1 - \Gamma \bar{s}^{row,us})}{\Gamma \bar{s}^{row,us}} + \frac{\beta}{\Gamma \bar{s}^{row,us}}(\hat{\Omega}_{t,t+1} + \mathbb{E}_t \hat{\mathcal{E}}_{t+1} - \hat{\mathcal{E}}_t) - \beta(\hat{\mathcal{E}}_t - \hat{S}_{t+1}^{us}) + \frac{\beta(1 + \Gamma \bar{s}^{row,us})}{\Gamma \bar{s}^{row,us}} \hat{R}^{row,us}$$

The partial equilibrium aggregate demand elasticity for the ROW bond, $\epsilon_{b^{row,us}}^d$, is given by

$$\frac{\partial(\beta \hat{B}_{t+1}^{row,us})}{\partial \hat{R}^{row,us}} = \frac{\beta(1 + \Gamma \bar{s}^{row,us})}{\Gamma \bar{s}^{row,us}} = \epsilon_{b^{row,us}}^d$$

Hence, the value of Γ consistent with the partial equilibrium aggregate demand elasticity is,

$$\Gamma = \frac{\beta}{\bar{s}^{row,us}(\epsilon_{b^{row,us}}^d - \beta)}$$

■

E.2 Error Correction Model (ECM)

The Armington model, serves as the basic trade block for almost all multi-good international macro models. From the demand structure of the Armington model, net trade can be expressed as a function of the RER, the terms of trade and domestic absorption. I estimate an ECM of this relationship:

$$\begin{aligned}\Delta nt = \beta + &\gamma_{SR}\ \Delta(tot_t + q_t) + \Delta(d_t^* - d_t) \\ &- \alpha\left[nt_{t-1} - \gamma_{LR}\ (tot_{t-1} + q_{t-1}) - (d_{t-1}^* - d_{t-1})\right] + \varepsilon_t \end{aligned} \tag{7}$$

where $nt_t = \ln(X/M)$ is log of NT, $tot_t = \ln(p_t^M/p_t^X)$ is the log of the terms of trade, q_t is the log of the RER, and $d_t = \ln(C_t + I_t + G_t)$ and $d_t^* = \ln(C_t^* + I_t^* + G_t^*)$ are the log of domestic absorption in the domestic and foreign country. Here, γ_{SR} is the short-run elasticity, γ_{LR} is the long-run elasticity, and α captures the speed of adjustment. The term in square brackets captures the cointegration relationship implied by the Armington model,

$$nt_t = \gamma\ (tot_t + q_t) + (d_t^* - d_t).$$

This type of regression has been widely used in studies of trade dynamics (Hooper, Johnson and Marquez, 2000; Marquez, 2002; Alessandria and Choi, 2021; Mac Mullen and Woo, 2024; Alessandria, Bai and Woo, 2024).

E.3 Other Moments

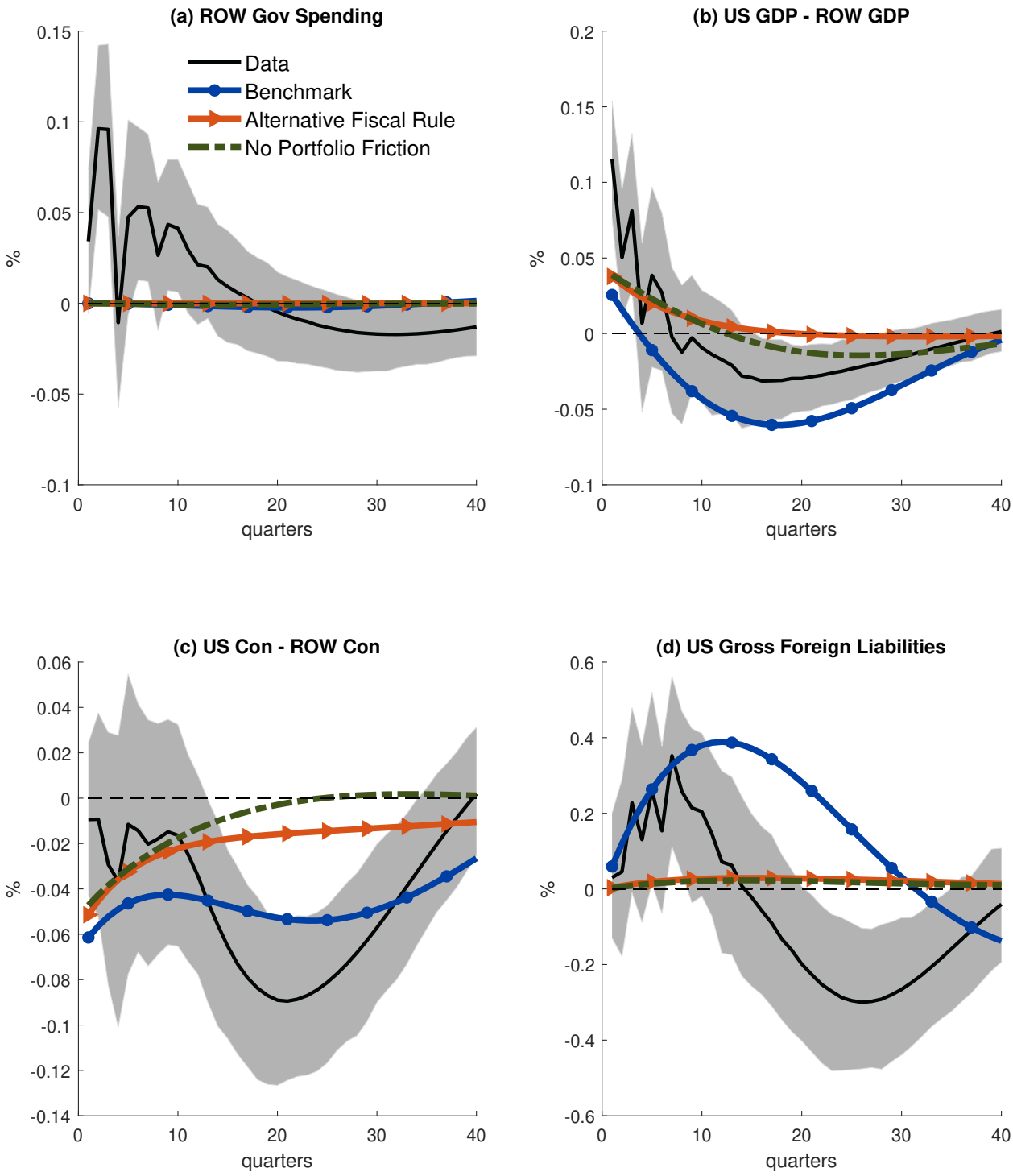


Figure D.1: Impulse Response Functions in Data and Models

Notes: Standard error bands are 68% confidence intervals.

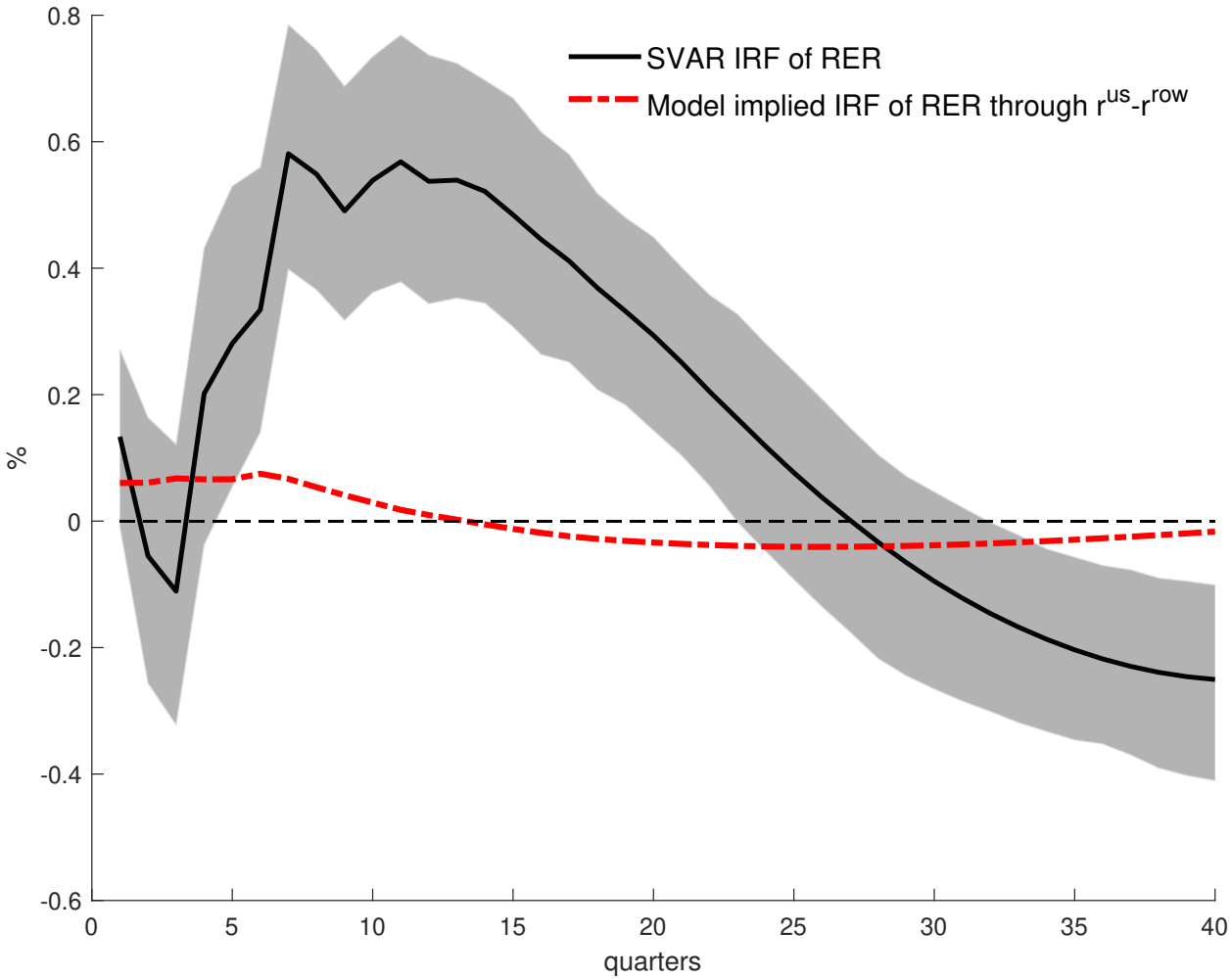


Figure D.2: Impulse Response Functions of the RER: estimated vs counterfactual through the interest rate differential

Notes: Standard error bands are 68% confidence intervals.

F Sensitivity

F.1 Alternative Models

Parameter		Benchmark	Only IRF Targeting	Only uncond moms targeting	No Dynamic Trade Frictions	IES = 0.5	Trade in US Gov Bonds	$\epsilon^d_{b^{row,us}} = 3$
1. Std common prod shock	σ_z^c	0.003	0†	0.0051	0.002	0.003	0.003	0.003
		(0.0003)		(0.0005)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
2. Pers common prod shock	ρ_z^c	0.909	0†	0.917	0.920	0.909	0.916	0.909
		(0.3715)		(0.1583)	(0.0977)	(0.1745)	(0.2745)	(0.3853)
3. Pers US gov shock	ρ_g^{us}	0.956	0.945	0.990†	0.950	0.961	0.956	0.952
		(0.0156)	(0.0174)		(0.0148)	(0.0138)	(0.0163)	(0.0156)
4. Std ROW gov shock	σ_g^{row}	0.003	0†	0.005	0†	0.003	0.003	0.003
		(0.0001)		(0.0018)		(0.0008)	(0.0.0008)	(0.0009)
5. Pers ROW gov shock	ρ_g^{row}	0.831	0.84†	0.790	0.983	0.824	0.842	0.827
		(0.0761)		(0.0958)	(0.0371)	(0.1043)	(0.0565)	(0.0836)
6. Std differential trade shock	σ_ξ^d	0.009	0†	0.021	0.007	0.009	0.008	0.009
		(0.0009)		(0.004)	(0.0021)	(0.0007)	(0.0007)	(0.0009)
7. Pers of differential trade shock	ρ_ξ^d	0.967	0†	0.950	0.983	0.963	0.977	0.967
		(0.0167)		(0.0279)	(0.0432)	(0.0133)	(0.0137)	(0.0153)
8. Std differential financial shock	σ_ψ^d	0.006	0†	0.010	0.006	0.008	0.006	0.008
		(0.0009)		(0.0026)	(0.0009)	(0.0008)	(0.0009)	(0.0012)
9. Pers differential financial shock	ρ_ψ^d	0.909	0†	0.909	0.971	0.781	0.903	0.892
		(0.0256)		(0.0508)	(0.0080)	(0.0696)	(0.0291)	(0.0346)
10. Std common portfolio shock	σ_ψ^c	0.004	0†	0.009	0.0025	0.004	0.004	0.004
		(0.0012)		(0.0023)	(0.0006)	(0.0009)	(0.0014)	(0.0012)
11. Pers common financial shock	ρ_ψ^c	0.882	0†	0.887	0†	0.898	0.880	0.889
		(0.0338)		(0.0277)		(0.0262)	(0.0296)	(0.0308)
12. Adj cost CES	ι	390.4	406.21	391.28	0†	357.24	447.25	440.07
		(151.99)	(255.79)	(223.84)		(125.91)	(0.159.80)	(167.74)
13. Response gov spending to debt	$\varphi^{g,b}$	-0.061	-0.053	-0.069	-0.073	-0.062	-0.057	-0.059
		(0.0093)	(0.0089)	(0.0210)	(0.0120)	(0.0095)	(0.0096)	(0.0091)
14. Response taxes to debt	$\varphi^{T,b}$	0.047	0.042	0.020†	0.034	0.052	0.053	0.043
		(0.0138)	(0.0144)		(0.0118)	(0.0135)	(0.0148)	(0.0132)
15. Response taxes to spending	$\varphi^{T,g}$	0.334	0.275	0.522	0.56	0.341	0.283	0.355
		(0.1043)	(0.1339)	(0.0631)	(0.0738)	(0.1028)	(0.1194)	(0.1035)

Notes: standard errors (se) are calculated using the asymptotic Delta function method as in Christiano et al. (2005). The subscript † indicates the parameter is set externally.

Table F.1: SMM Estimated Parameters

Moment	Data	Benchmark	Only uncond moms targeting	No Dynamic Trade Frictions	IES = 0.5	Trade in US Gov Bonds	PE demand elast of bonds = 3
$\sigma(gov^{us})/\sigma(gdp^{us})$	3.69	3.59	3.80	3.89	3.68	3.59	3.62
$\sigma(gov^{row})/\sigma(gdp^{row})$	0.62	0.58	0.58	0.80	0.58	0.56	0.57
$\rho(gov^{row})$	0.80	0.81	0.80	0.99	0.82	0.82	0.81
$\sigma(inv^{usa})/\sigma(gdp^{usa})$	3.49	2.88	3.12	2.57	2.77	2.81	2.84
$\rho(gdp^{us}, gdp^{row})$	0.86	0.90	0.86	0.86	0.93	0.91	0.91
$\sigma(rer)/\sigma(gdp^{us})$	3.82	3.56	3.57	2.17	3.33	3.54	3.55
$\sigma(nt)/\sigma(rer)$	1.27	1.33	1.32	2.60	1.34	1.30	1.31
$\rho(rer)$	0.95	0.96	0.98	0.94	0.96	0.97	0.96
SR trade elast.	0.17	0.08	0.10	1.30	0.08	0.07	0.07
LR trade elast.	1.30	1.00	0.80	1.07	0.93	1.02	0.98
$\sigma(gfa^{us})/\sigma(gdp^{us})$	4.40	5.06	4.95	5.66	5.05	5.09	4.98
$\sigma(B^{g,us})/\sigma(gdp^{us})$	3.66	4.08	3.88	3.42	4.17	4.10	4.13
$\sigma(s^{g,us})/\sigma(gdp^{us})$	1.12	0.76	0.80	0.95	0.77	0.77	0.79
$\sigma(r^{us} - r^{row})/\sigma(gdp^{us})$	0.06	0.02	0.05	0.07	0.07	0.04	0.04
$\rho(r^{us} - r^{row})$	0.89	0.96	0.90	0.82	0.87	0.94	0.93
$\rho(s^{g,us})$	0.91	0.90	0.90	0.94	0.89	0.89	0.90
β_{Fama}	-1.38	-1.44	-1.37	-2.39	-1.36	-1.44	-1.42
$\rho(B^{g,us} - B^{g,row}, rer)$	0.74	0.45	0.47	0.20	0.47	0.38	0.41

Notes: The subscript $^{+}$ means the moment is not targeted.

Table F.2: Target Unconditional Moments

Moment	Data	Benchmark	Only uncond moms targeting	No Dynamic Trade Frictions	IES = 0.5	Trade in US Gov Bonds	PE demand elast of bonds = 3
BSK: $\rho\left(\Delta rer, \Delta(c^{us} - c^{row})\right)$	-0.17	-0.68	-0.52	-0.82	-0.76	-0.67	-0.70
R^2_{Fama}	0.01	0.00	0.01	0.06	0.01	0.00	0.00
$\rho(tot, rer)$	0.86	0.99	0.99	0.99	0.99	0.99	0.99
$\sigma(tot)/\sigma(rer)$	0.31	0.63	0.77	0.55	0.64	0.63	0.64
$\rho(r^{us} - r^{row}, rer)$	-0.56	-0.38	-0.59	0.58	-0.36	-0.41	-0.34
Low freq RER spectrum	0.62	0.67	0.70	0.61	0.67	0.67	0.66
BC freq RER spectrum	0.31	0.26	0.24	0.30	0.25	0.26	0.26
$\rho(inv^{us}, inv^{row})$	0.31	0.22	0.06	0.40	0.39	0.27	0.26
$\rho(xm^{us})$	0.98	0.99	0.99	0.92	0.99	0.99	0.99
$\rho(inv^{us} - inv^{row}, rer)$	-0.57	-0.76	-0.83	-0.61	-0.67	-0.76	-0.76
$\rho(B^{g,us})$	0.97	0.99	0.99	0.99	0.99	0.99	0.99
$\rho(B^{g,us}, g^{us})$	0.50	0.40	0.16	0.26	0.43	0.44	0.37
$\rho(B^{g,us}, gfa^{us})$	0.23	0.77	0.74	0.72	0.77	0.77	0.75
$\rho(gfa^{us}, gfl^{us})$	0.83	0.61	0.67	-0.60	0.71	0.56	0.62

Notes: gfa and gfl stand for gross foreign assets and liabilities. BC stands for 'Business Cycle'.

Table F.3: Untargetted Unconditional Moments

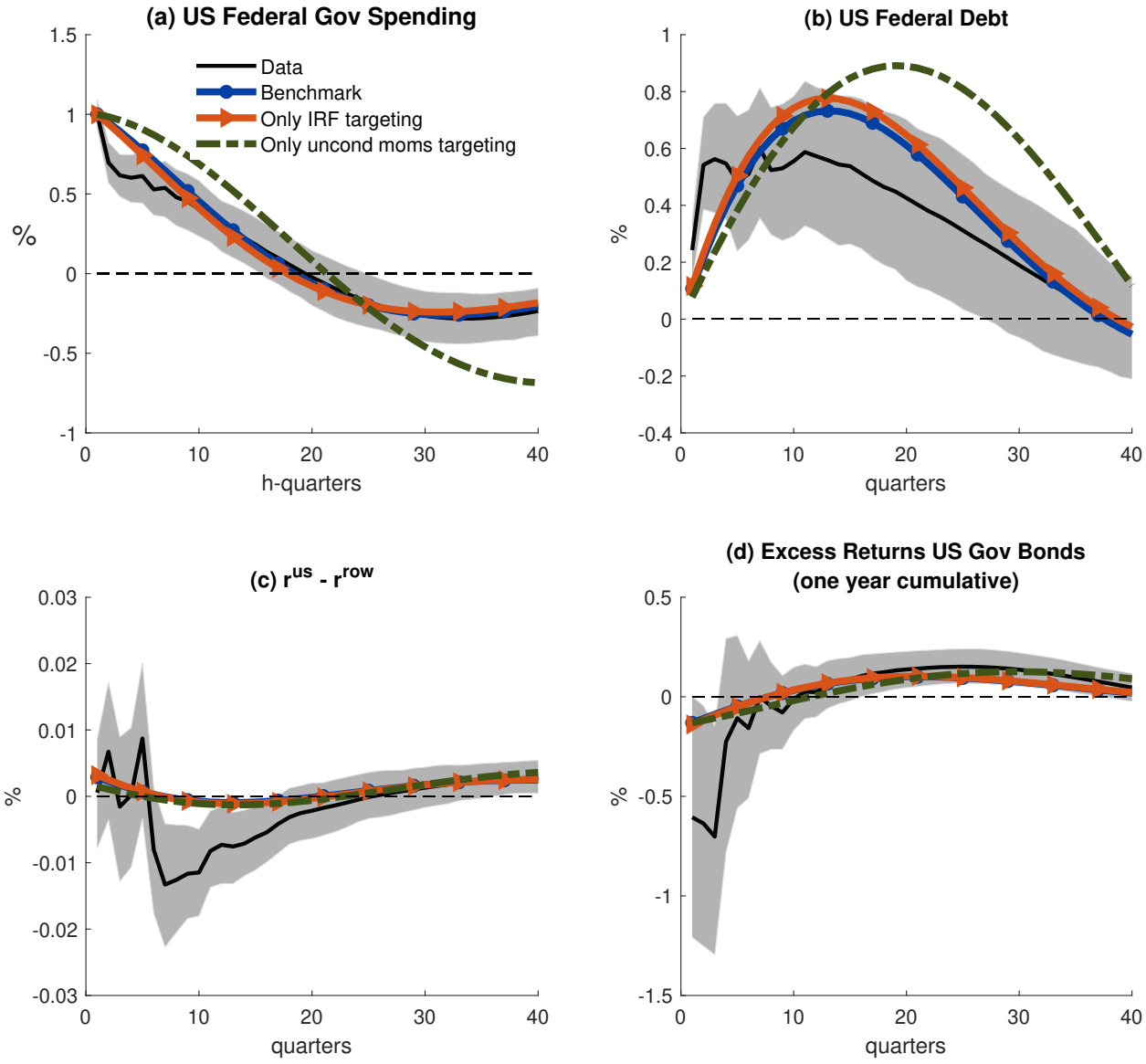


Figure F.1: Impulse Response Functions: SVAR and Models

Notes: Standard error bands are 68% confidence intervals.

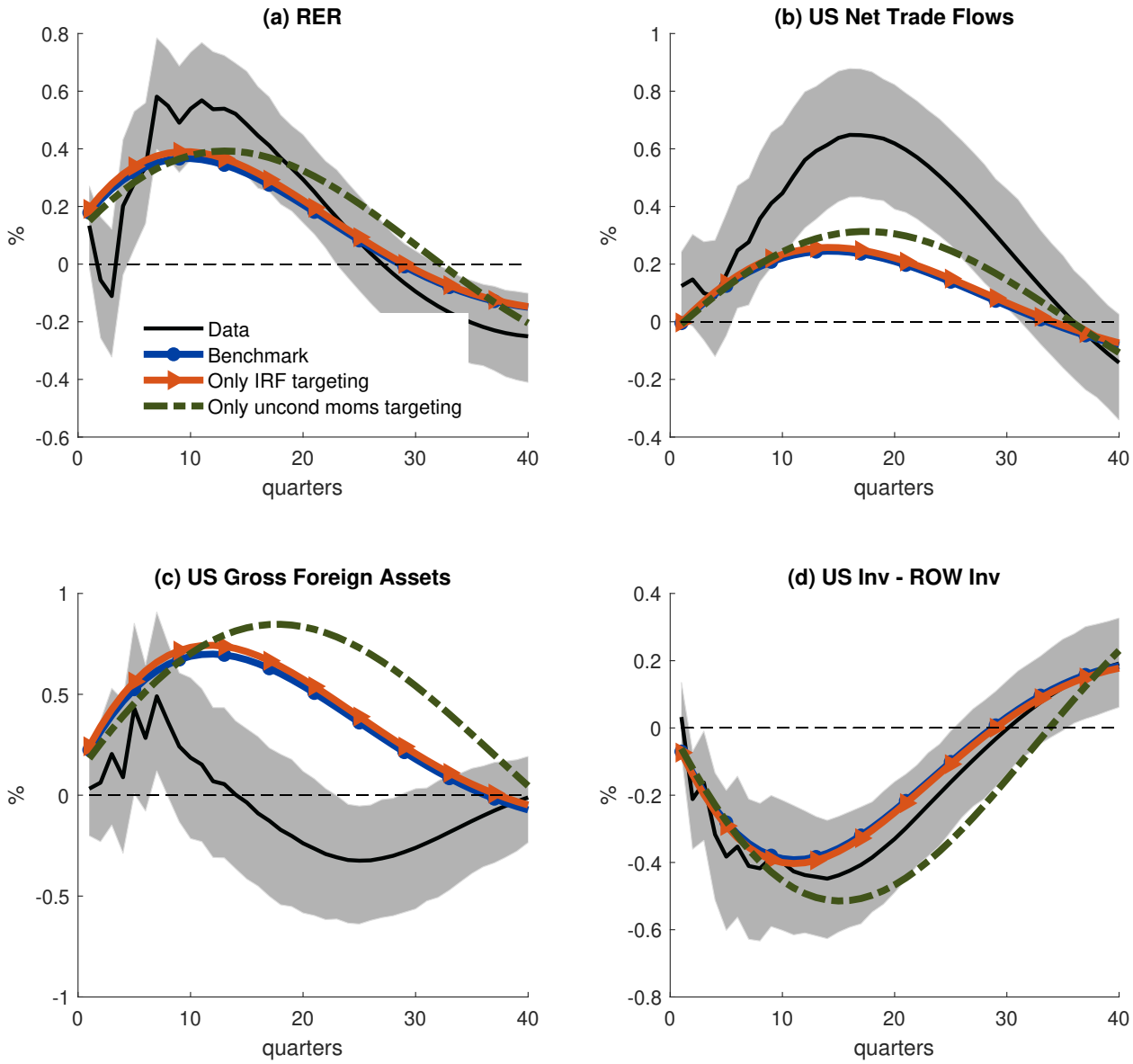


Figure F.2: Impulse Response Functions in Data and Models

Notes: Standard error bands are 68% confidence intervals.

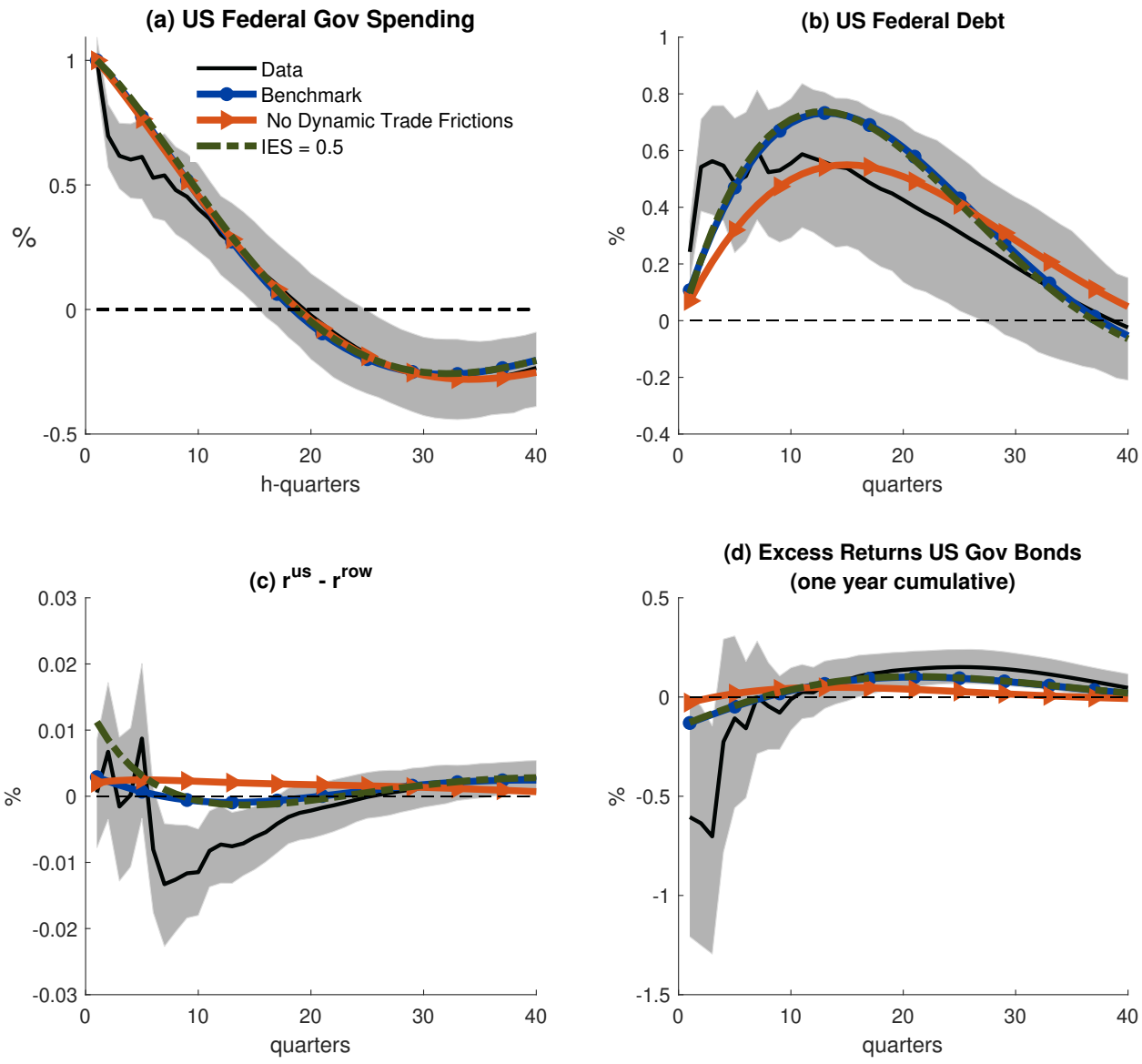


Figure F.3: Impulse Response Functions: SVAR and Models

Notes: Standard error bands are 68% confidence intervals.

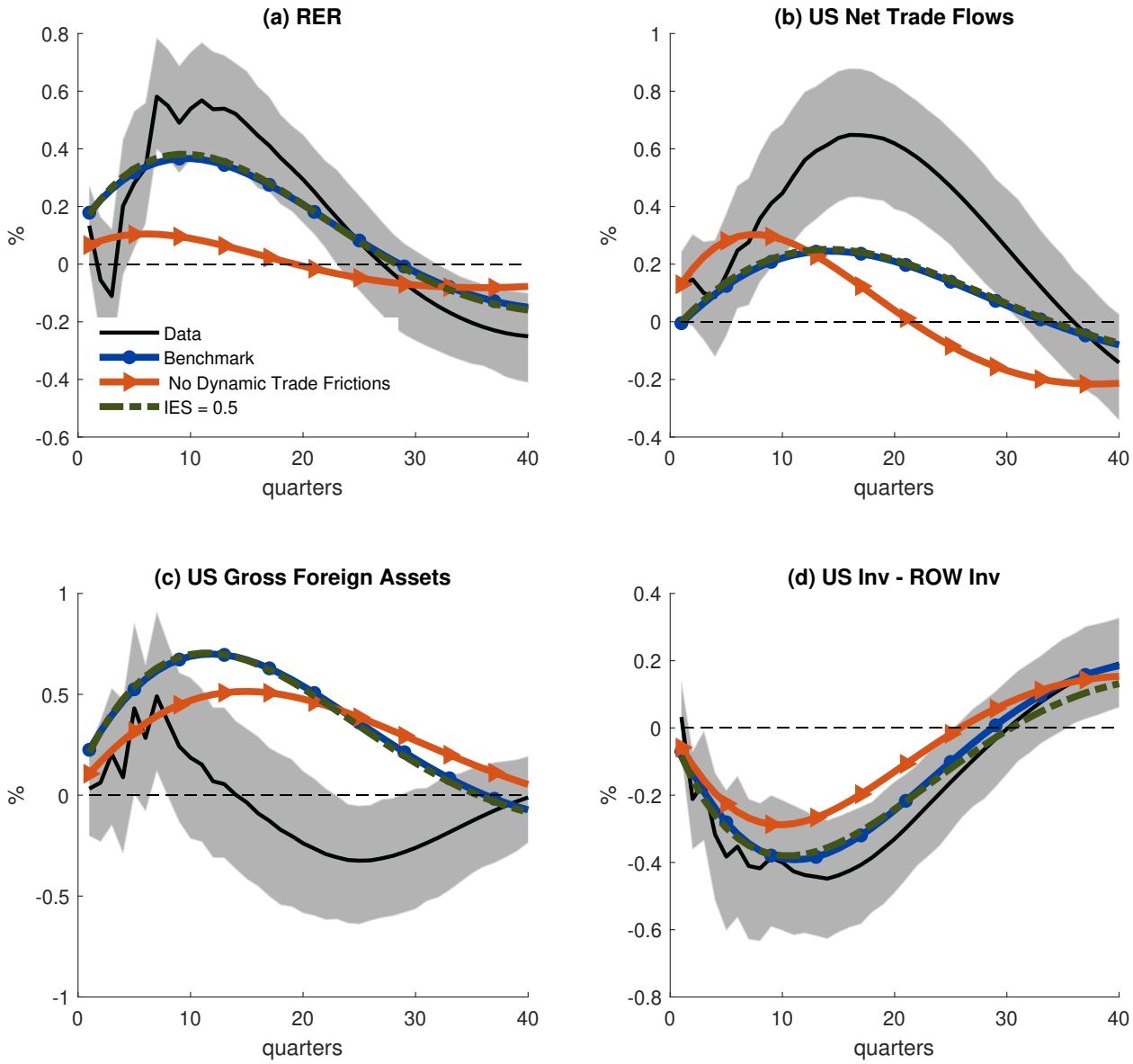


Figure F.4: Impulse Response Functions in Data and Models

Notes: Standard error bands are 68% confidence intervals.

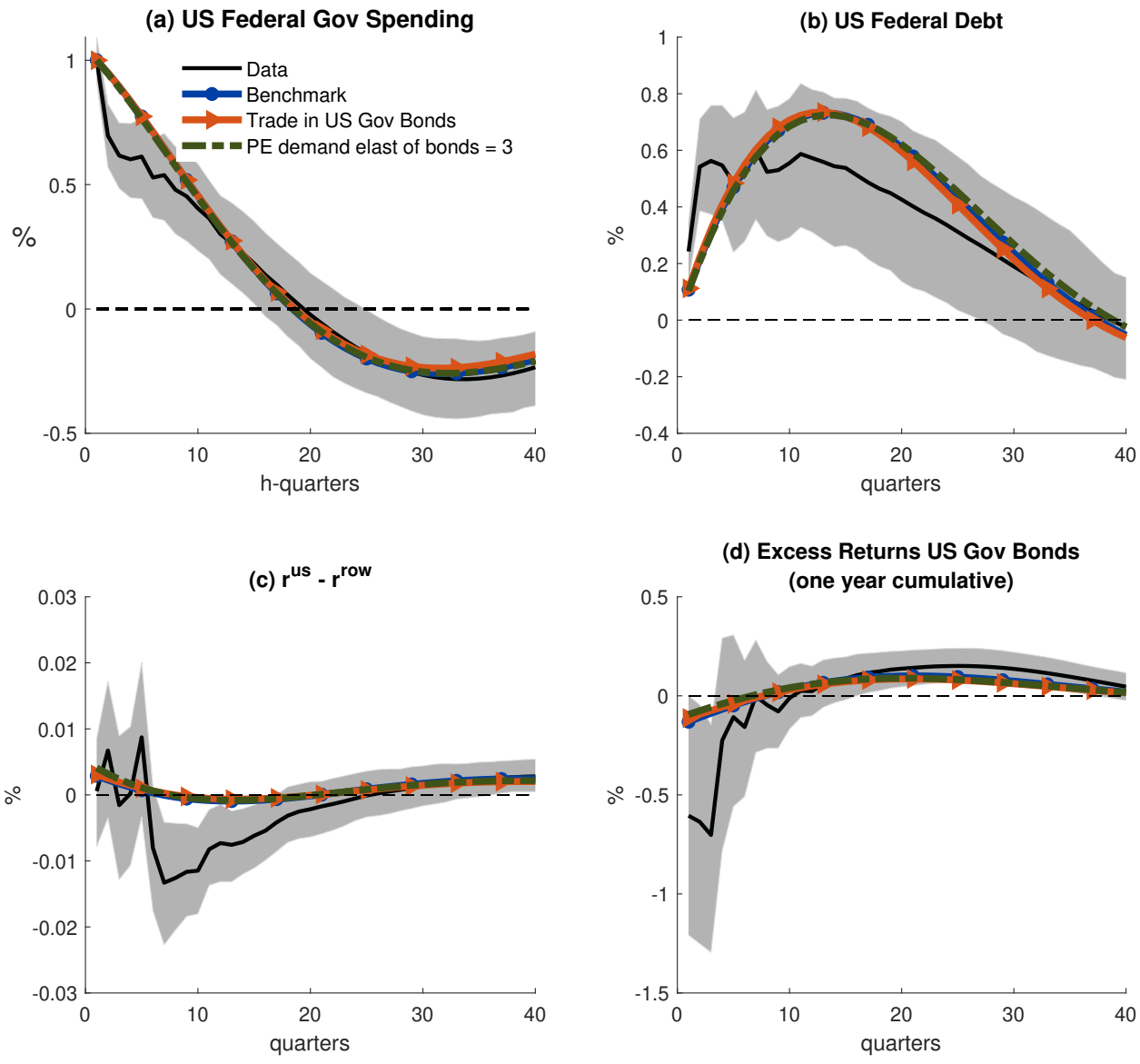


Figure F.5: Impulse Response Functions: SVAR and Models

Notes: Standard error bands are 68% confidence intervals.

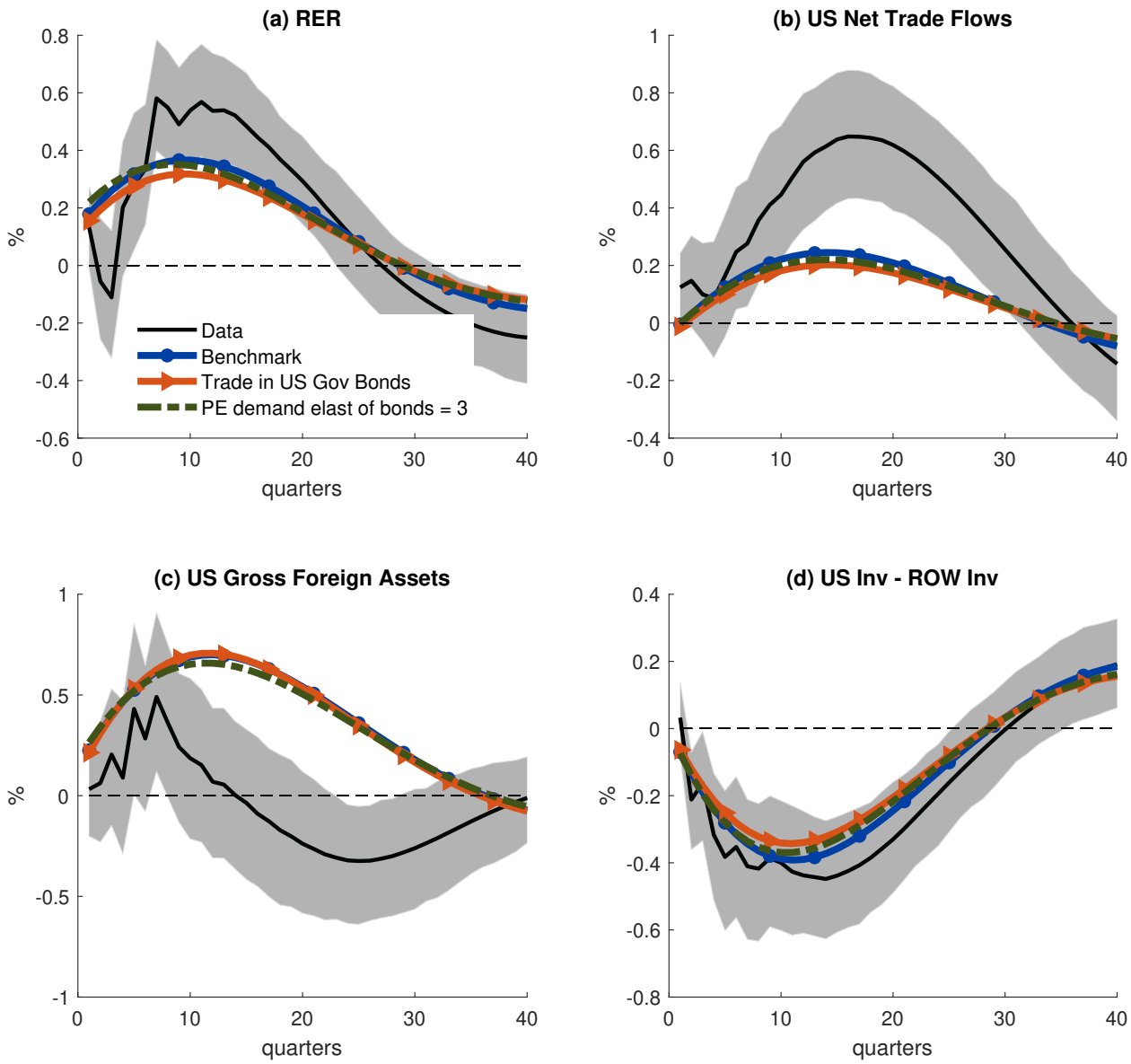


Figure F.6: Impulse Response Functions in Data and Models

Notes: Standard error bands are 68% confidence intervals.

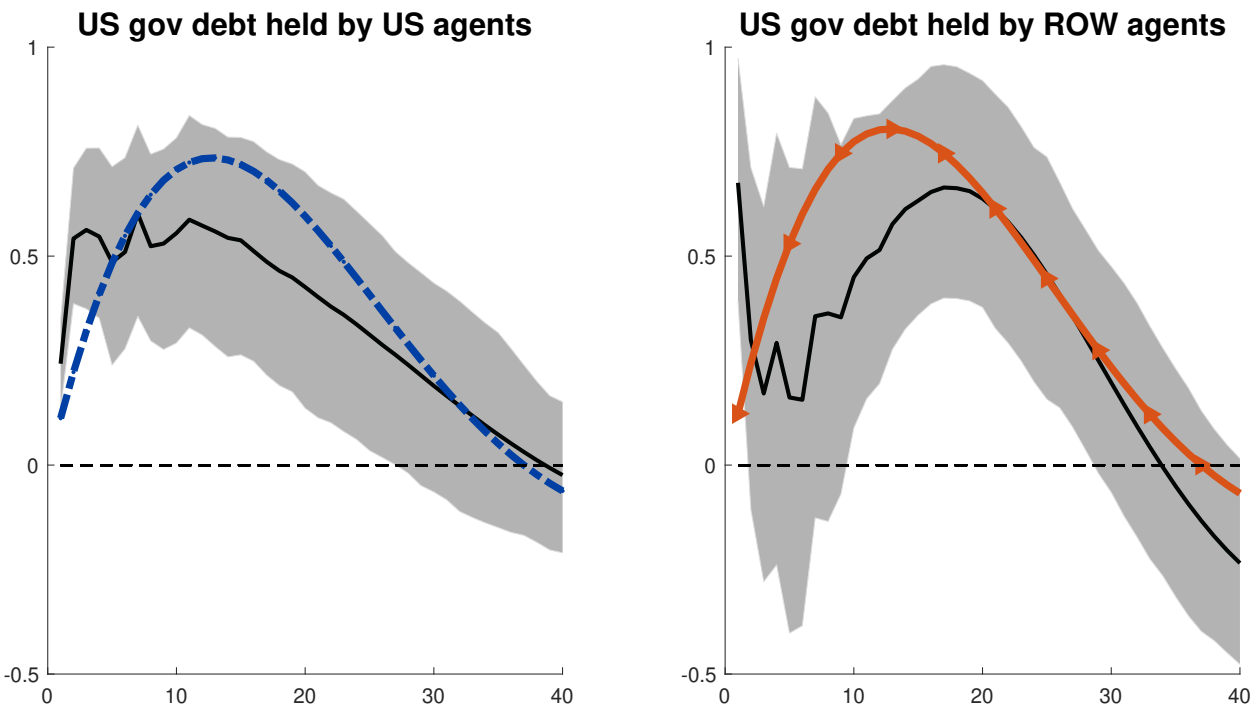


Figure F.7: Impulse Response Functions: SVAR and Models

Notes: Standard error bands are 68% confidence intervals.

F.2 Panel Data Analysis

The role of the fiscal rule in shaping the international transmission of government spending shocks can be further tested empirically. Using the panel data on military spending shocks from Miyamoto et al. (2019), I show that the predictions of the theory in terms of the fiscal rule are supported by cross-country panel data evidence. That is, countries that experience stronger depreciations of the RER and improvements in net trade are those that rely more heavily on the use of government debt to finance the increase in spending. This is important because the literature has documented cross-country heterogeneity in the responses of the RER and net trade, but there is no existing theory explaining why countries might differ in these dimensions.[51] The mechanisms proposed in this paper can explain some of the heterogeneity in the responses.

To show this, I run country-by-country local projections. The sample includes 125 countries, where 29 are advanced economies, 60 are developing economies, and 36 poor economies. Let i denote a country, and $h = 0, 1, 2$, the horizon in years. I project the variable of interest $y_{i,t+h}$ on military spending $m_{i,t}$, where $y_{i,t+h}$ can be debt over GDP, RER or current account over GDP. I estimate the following equation for each country-horizon in the sample,

$$\frac{y_{i,t+h} - y_{i,t-1}}{y_{i,t-1}} = \beta_i^y + \beta_{i,h}^y \frac{m_{i,t} - m_{i,t-1}}{m_{i,t-1}} + \text{controls} + \epsilon_{i,t+h}^y$$

for $y \in \{\text{debt, RER, CA}\}$ where I control for one lag of military spending growth, GDP growth and the left hand side variable. Figure F.8 Panel (a) shows the scatter plot between $\beta_{i,h}^{\text{debt}}$ and $\beta_{i,h}^{\text{rer}}$, and Panel (b) the scatter plot between $\beta_{i,h}^{\text{debt}}$ and $\beta_{i,h}^{\text{ca}}$. Furthermore, Figures F.9, F.10 and F.11 shows the same results but separately for advanced, developing and poor economies, respectively.

There is a positive relationship between the use of government debt to finance the increase in government spending and the depreciation of the RER as well as with the current account response in the full sample, and in each sub-sample. This is consistent with the implications of the theory developed in this paper. Moreover, in the full sample 50% of the observations have positive increases in government debt, 43% show a depreciation of the RER, and 35% increases in

[51] See Corsetti and Müller (2006); Kim and Roubini (2008); Monacelli and Perotti (2010a); Ravn et al. (2012); Corsetti et al. (2012); Kim (2015); Forni and Gambetti (2016); Miyamoto et al. (2019); Ferrara et al. (2021).

the current account. Within advanced economies 59% of the observations have positive increases in government debt, 56% show a depreciation of the RER, and 45% increases in the current account. These numbers are smaller for developing economies (53% for debt, 42% for RER, and 36% for current account), and more so for poor countries (39% for debt, 33% for RER, and 26% for current account). Hence, even across groups one observes that a more cases with government debt used to finance spending correlates with more cases with deprecations of the RER and increases in the current account.

The theory presented in this paper suggests two reasons why these numbers might differ across country groups: (*i*) advanced economies might rely more heavily on debt than taxes relative to advanced and poor economies, and (*ii*) advanced economies might rely more on domestic currency debt than advanced and poor economies. The first one is more obvious than the second one. In the model, if the debt is issued in foreign currency there would be no effect on the UIP deviations since the terms where the exchange rate appear in the Euler equations would cancel each other when collapsing the Euler equations for the government and foreign bonds. In this case all the adjustment to compensate for re-balancing costs would operate through the interest rate in the (foreign currency) government bonds.

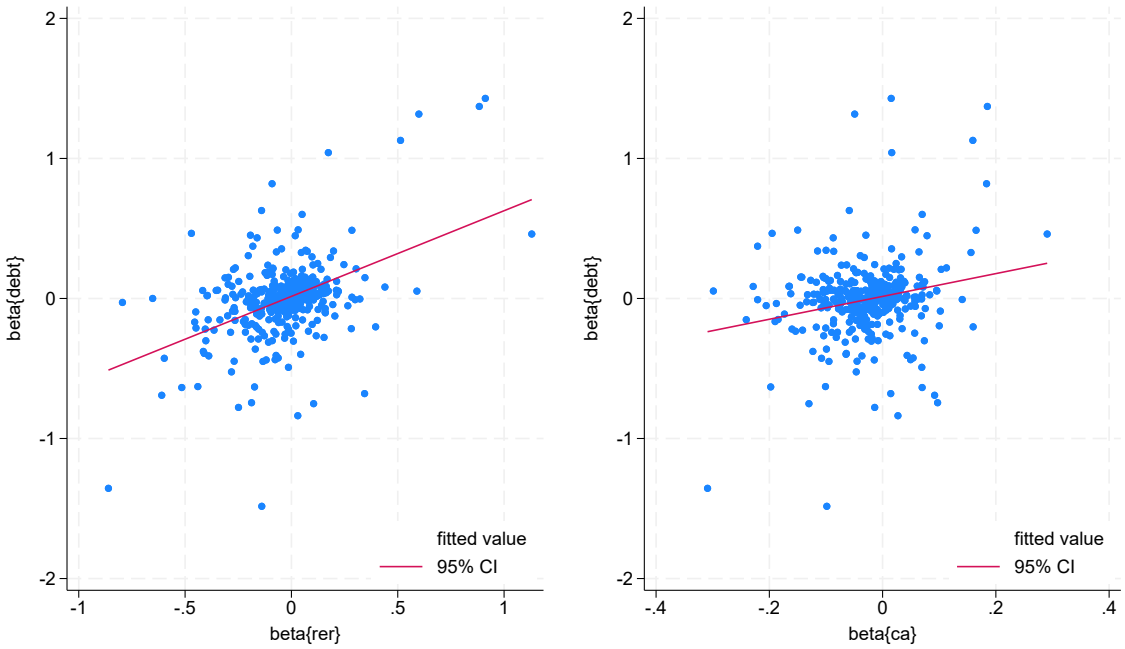


Figure F.8: Cross-country Responses of Government Debt, the RER and Current Account (all countries)

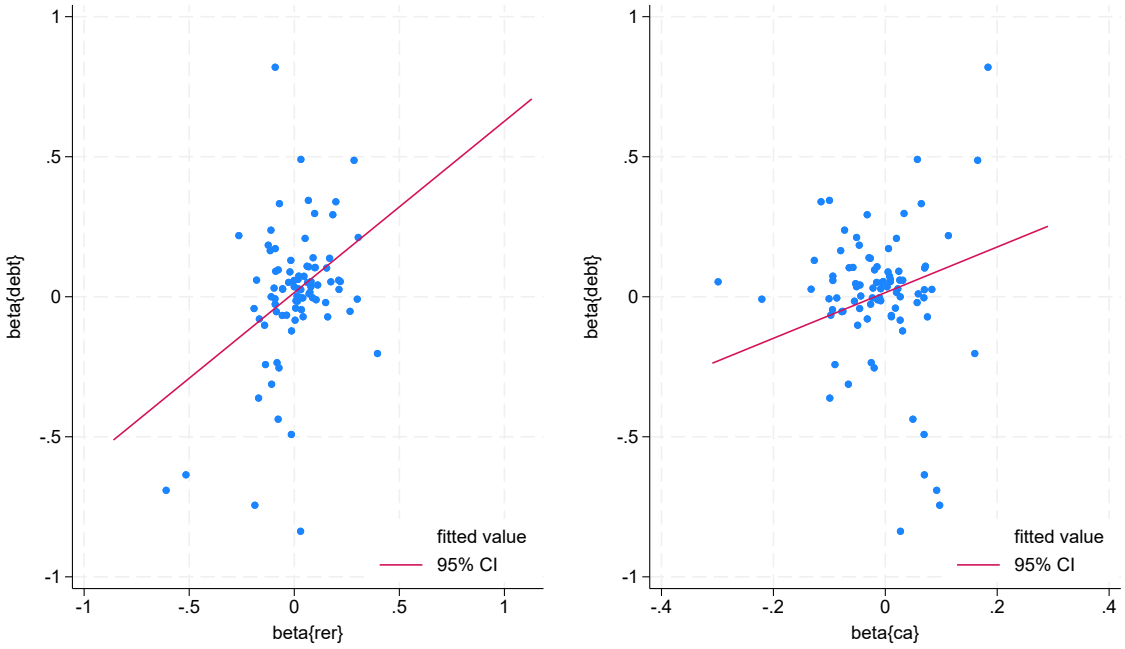


Figure F.9: Cross-country Responses of Government Debt, the RER and Current Account (advanced economies)

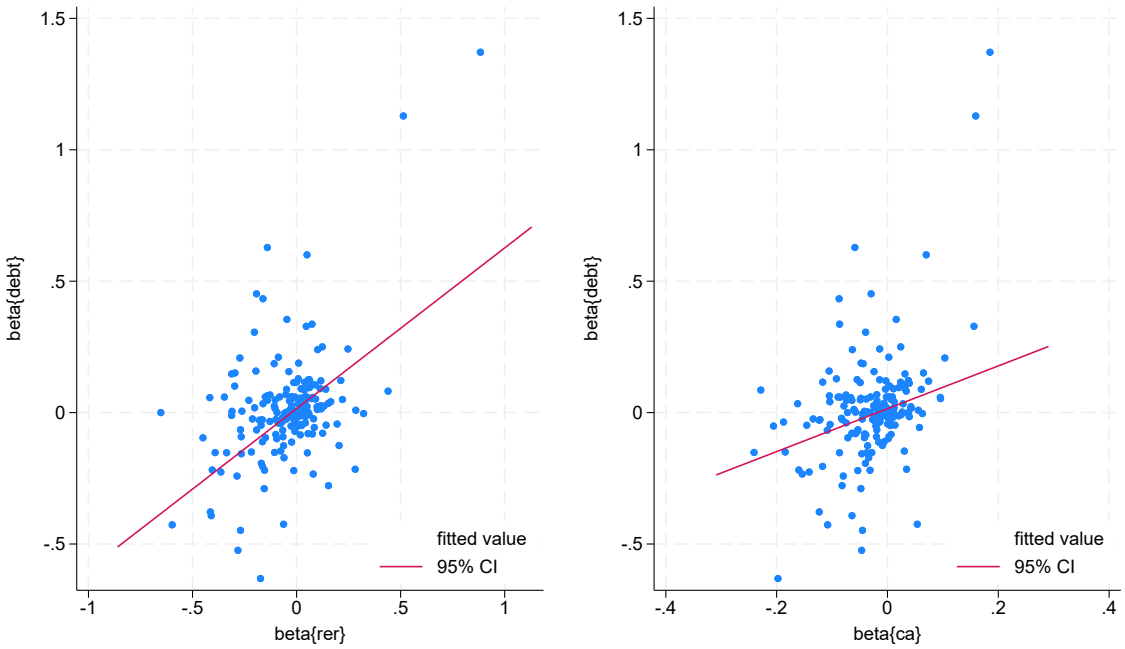


Figure F.10: Cross-country Responses of Government Debt, the RER and Current Account (developing economies)

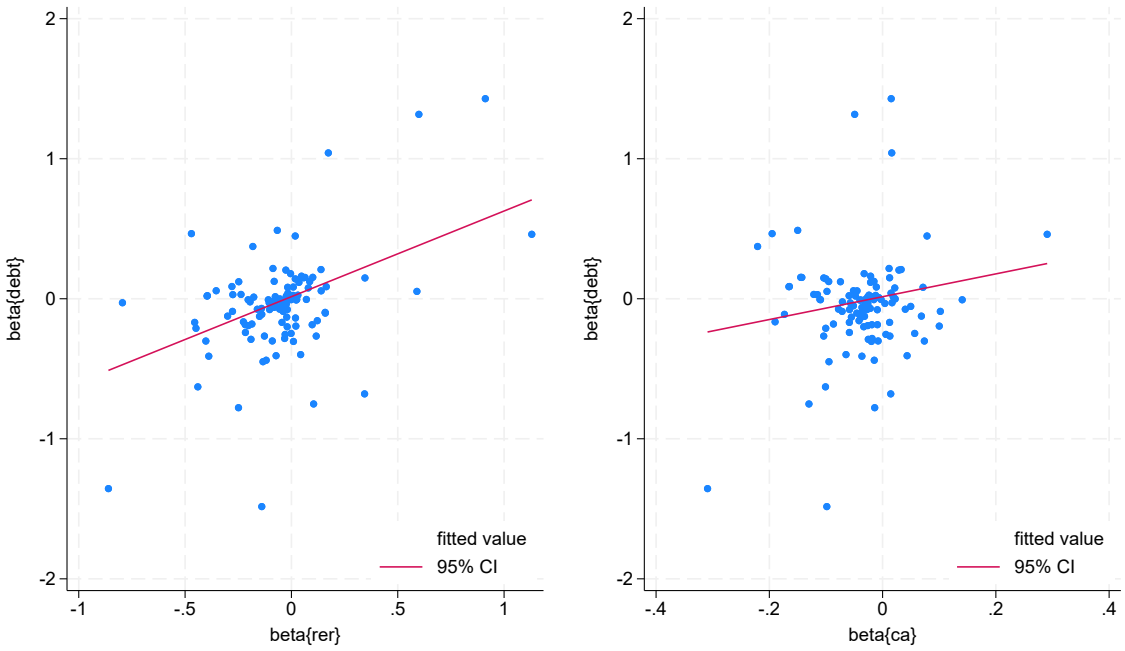


Figure F.11: Cross-country Responses of Government Debt, the RER and Current Account (poor economies)

G Additional Tables and Figures

Paper	RER	Net Trade or Current Account	Sample	Model (Mechanism)
Corsetti and Müller (2006)	–	< 0 or ≈ 0	US, Aus, Can, UK (1980 - 2006)	Yes (trade openness, but $NT < 0$)
Kim and Roubini (2008)	> 0	> 0	US (1973 - 2004)	No
Monacelli and Perotti (2010b)	> 0	< 0	US, Aus, Can, UK (1973 - 2005)	Yes (GHH pref but unrealistic calib)
Ravn et al. (2012)	> 0	< 0 for Panel (> 0 for US and Can)	US, Aus, Can, UK (1975 - 2005)	Yes (deep habits at good level)
Corsetti et al. (2012)	> 0	> 0	US (1983 - 2007)	Yes (spending reversals)
Kim (2015)	> 0	Panel: > 0; country groups: $\lessgtr 0$	18 Advanced Econs (1981 - 2010)	No
Auerbach and Gorodnichenko (2016)	< 0	–	US (1994 - 2014)	No
Forni and Gambetti (2016)	Surprise: > 0 & News: < 0	Surprise: > 0 & News: < 0	US (1980 - 2015)	No
Miyamoto et al. (2019)	> 0 in Advanced Econs	< 0 in Advanced Econs	29 Advanced Econs (1993 - 2013)	No (discussion of std model)
Boehm (2020)	> 0 or ≈ 0	< 0	17 Advanced Econs (2003- 2016)	Yes (closed economy)
Ferrara et al. (2021)	< 0	< 0	US (1964- 2015)	No
Alpanda et al. (2024)	< 0	< 0	US and Panel (2000Q1- 2020Q4)	Yes (portfolio rebalancing)

Table G.1: Summary of Findings in the Literature

Notes: for the RER the sign > 0 means depreciation.

G.1 Baseline IRFs in Dollars

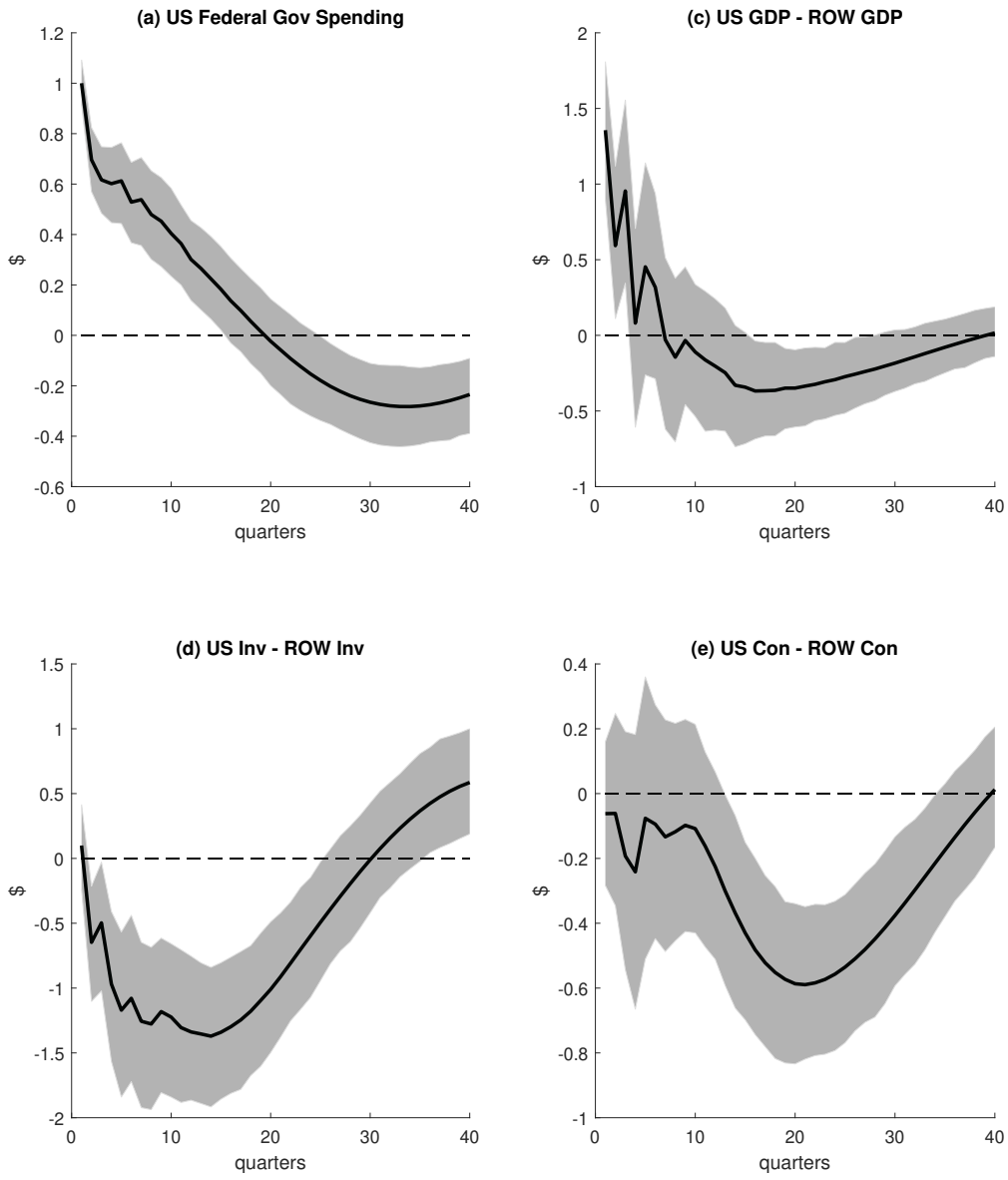


Figure G.1: Baseline IRFs of Macro Aggregates in Dollars

Notes: Standard error bands are 68% confidence intervals.