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

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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 variables are key for the 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 international macro is the RER disconnect, the near-random-walk behavior of the RER and its weak 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 typically 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. I start by documenting new evidence showing that there is a strong relationship among government debt, the RER, and net trade in the US. Then, I focus on the effect of well-identified US government spending shocks and uncover new evidence on the key channels driving the international transmission of fiscal policy. I propose a model where portfolio rebalancing frictions drive the international transmission of debt-financed fiscal expansions that explains the empirical evidence, both unconditionally and conditional on US government spending shocks. Importantly, using the estimated model, which features a rich set of frictions and

[1] The RER disconnect include a set of moments which standard models have trouble in explaining: (*i*) high volatility and persistence of RERs (Meese and Rogoff, 1983), violations of the risk-sharing condition (Backus and Smith, 1993; Kollmann, 1995), and (*iii*) violations of uncovered interest parity (Fama, 1984).

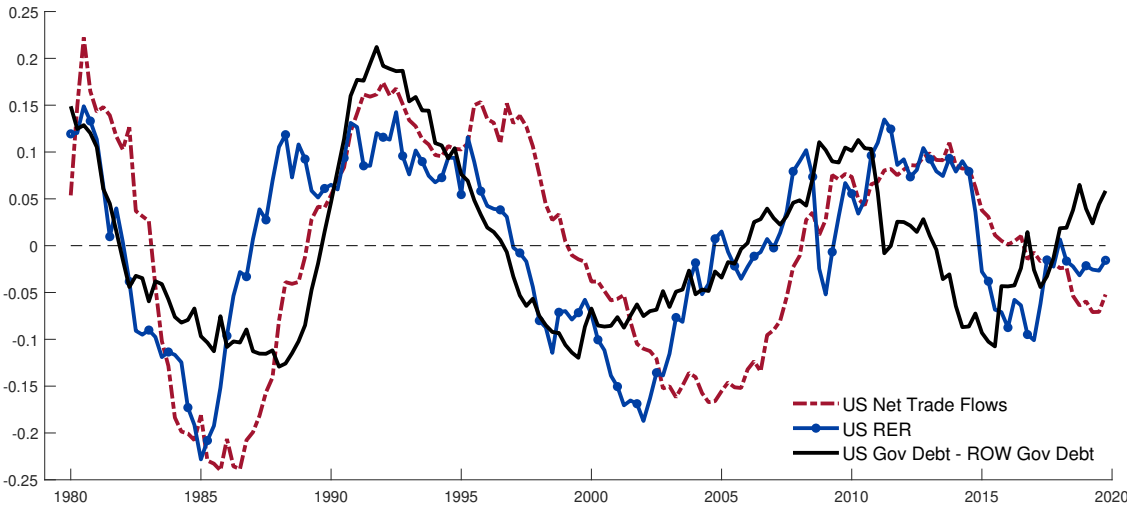
[2] See Itskhoki and Mukhin (2021); Alessandria and Choi (2021); Mac Mullen and Woo (2024); Kekre and Lenel (2024); Bodestein, Cuba-Borda, Gornemann and Presno (2024). These shocks are residuals of the uncovered interest parity condition (financial shocks), the export-import ratio (trade shocks), and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

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

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-*o* line), US net trade flows (red-dotted line), and government debt in the US relative to the rest of the world (solid-black line).[4,5] The relationship among 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 that of 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.

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.

[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

[5]Government debt in the rest of the world is measured 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.

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 by instrumenting realized government spending with forecasts and estimate a structural VAR (SVAR) model. I find that positive US government spending shocks are primarily financed through debt and trigger a depreciation cycle of the RER, along with a gradual increase in net trade over time. These shocks induce dynamics in government debt, the RER, and net trade that align with their unconditional comovement documented in Figure 1. Using the variance decomposition of the SVAR, I find that US government spending shocks explain between 25 and 35 percent of the variance of the US government debt, the RER, and net trade, and are therefore a key driver of these variables.

Importantly, I show that US government spending shocks trigger deviations from uncovered interest parity (UIP), or excess returns between US and ROW government bonds. These dynamics are non-monotonic, with US government bonds earning an excess return over ROW bonds in the medium and long run.[6] Furthermore, while US agents increase their savings 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 excess returns and US gross foreign assets contradict the predictions of frictionless models. I argue that these responses are informative about the international transmission 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 begin with a simplified version of the model to illustrate the mechanism. The two key features are a fiscal rule that relies heavily on government debt to finance spending—closely related to that in Leeper, Plante and Traum (2010)—and portfolio rebalancing frictions, modeled as a convex cost of deviating from the long-run portfolio share of foreign assets, similar to the specifications in Guo, Ottonello and Perez (2023) and Camara, Christiano and Dalgic (2024). This reduced-form portfolio friction offers a tractable way to capture a variety of underlying factors that limit the extent to which

[6] Engel (2016) and Valchev (2020) also document non-monotonic dynamics of excess currency returns.
[7] Engel and West (2005); Gabaix and Maggiori (2015); Bacchetta, Davenport and van Wincoop (2022).

agents rebalance their portfolio shares, such as risk, liquidity, or behavioral biases.[8]

The interaction between the fiscal rule and portfolio frictions determines the international transmission of US government spending shocks. In the model, the US household can save in both US government bonds and ROW bonds issued in ROW currency.[9] Positive US government spending shocks financed with debt directly decrease the share of the US household's financial savings in ROW bonds. In models without portfolio frictions, given the increase in the US interest rate, the US RER appreciates so that there is an expected depreciation that equates the expected returns of US and ROW bonds. However, in the presence of portfolio rebalancing frictions, investors require a premium to increase their share of savings in US government bonds, as the marginal cost of adding an extra unit of US government bonds rises. This happens in equilibrium through a depreciation of the US RER, that triggers and expected appreciation which raises the return of US relative to ROW bonds. Furthermore, the US gross foreign assets increase to smooth out the cost of deviating from the long-run portfolio share of ROW assets. Finally, the depreciation of the US RER triggers an expenditure switching effect that increases US net trade flows.

I then extend the simple model to include productivity, trade, and financial shocks, as well as capital accumulation, trade frictions, pricing-to-market frictions, roundabout production, and monopolistic competition. I estimate the model using the Simulated Method of Moments, targeting a combination of empirical impulse response functions (IRFs) to US government spending shocks—estimated from the SVAR—and a broad set of unconditional moments, including key RER and net trade moments. Importantly, the fiscal rule and portfolio frictions are separately identified. The portfolio rebalancing friction 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 government spending shocks in the SVAR.

The model successfully captures the empirical responses of US government debt, the RER, net trade, excess bond returns, and US gross foreign assets to US government spending shocks.

[8] See Section 4.2.2 for a discussion.

[9] To simplify the model and the intuition of the mechanism I do not allow for cross-country trade in US government bonds. However, allowing for this does not change the results, which is shown in the sensitivity analysis of the model in Section 7.

It also matches key unconditional moments related to international business cycles. Importantly, US government spending shocks contribute significantly to these outcomes and to explain the RER disconnect. In particular, they generate a highly volatile and persistent RER (the Meese and Rogoff (1983) puzzle), low predictive power of interest rates for the RER with violations of the UIP condition (the Fama (1984) or forward premium puzzle), and periods of high consumption growth associated with RER appreciations (the Backus and Smith (1993) and Kollmann (1995) puzzle). Thus, US government spending shocks offer a resolution to the RER disconnect puzzle. In doing so, the theory endogenizes several channels typically treated as exogenous in the literature on exchange rate dynamics arising from deviations from UIP and convenience yields (Itskhoki and Mukhin, 2021, 2025; Kekre and Lenel, 2024; Jiang, Krishnamurthy, Lustig and Sun, 2024).

The rest of the paper is organized as follows. Section 2 reviews the literature. In Section 3, I present the SVAR analysis. Section 4 introduces a simple model to lay out the intuition behind the mechanism driving the international transmission of US government spending shocks. Section 5 presents the full quantitative model, and Section 6 presents the main results. Section 7 discusses the model's sensitivity. Section 8 provides cross-country panel data evidence in support of the theory's implications. Finally, Section 9 presents concluding remarks and discusses further avenues for research.

2 Literature Review

First, I contribute to the literature studying the international transmission of fiscal shocks in advanced economies. Table H.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, 2010; Ravn et al., 2012; Corsetti et al., 2012; Kim, 2015; Forni and Gambetti, 2016; Miyamoto et al., 2019; Boehm, 2020).[10] On the

[10]The papers that found appreciations of the RER are Auerbach and Gorodnichenko (2016), Ferrara, Metelli, Natoli and Siena (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

other hand, there is more heterogeneity regarding the empirical response of net trade flows. An advantage relative to the literature is that I include ROW variables in my SVAR, which controls for the state of the ROW economy, including fiscal policy in the ROW, while providing a closer mapping to two-country general equilibrium models.

On the theoretical side, less work has been done to rationalize the depreciation of the RER in response to positive government spending shocks. In particular, Corsetti et al. (2012) propose a mechanism based on spending reversals, Ravn et al. (2012) present a mechanism 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 leads to a depreciation of the RER in response to government spending shocks.

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

I also contribute to the large literature studying international business cycles and exchange rate dynamics.[11] This literature has highlighted the importance of various shocks—both financial and real—in driving the dynamics of the RER and net trade. First, I contribute by providing direct empirical evidence from the SVAR showing that US government spending shocks are a significant driver of the RER and net trade, explaining between 30 and 35 percent of their variances.

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.

[11] 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 (2021); Corsetti, Dedola and Leduc (2008); Colacito and Croce (2011); Rabanal and Rubio-Ramirez (2015); Gabaix and Maggiori (2015); Engel (2016); 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 Quintana, and Valchev (2024); Bodestein et al. (2024); Camara et al. (2024); Jiang et al. (2024); Devereux, Engel and Wu (2025).

Second, I develop a quantitative model in which fiscal policy plays a key role in driving the RER. The government spending mechanism endogenizes some of the transmission channels treated as exogenous in recent literature on exchange rate dynamics, such as UIP and convenience yields. Thus, I contribute by offering a resolution to the RER disconnect puzzle through well-identified shocks.

3 The International Transmission of US 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.[12] The main data sources are NIPA, OECD, IMF, Bank of International Settlements and Gourinchas and Rey (2007). The ROW is constructed as a trade weighted average of eighteen countries.[13] Finally, I focus on government spending at the federal level in the US, and refer to it as either government spending or federal spending.

[12] 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.

[13] 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.

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.[14] 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. To control for anticipation effects, 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.[15] 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

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

where $FEG_t^{fed,us}$ are the one quarter-ahead forecast error on US federal spending, $g_t^{fed,usa}$ is realized US federal spending, g_t^{row} is (general) government spending in the ROW, $gdp_t - gdp_t^{row}$ is relative GDP between the US and ROW, $inv_t - inv_t^{row}$ is relative investment, $r_t - r_t^{row}$ the (long) interest rate differential, NT_t is the US export-import ratio, and RER_t the US trade-weighted RER.[16] To study the

[14] 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.

[15] 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.

[16] All variables are in real terms.

response of relative consumption, UIP, US (federal) government debt (held by US agents excluding US government institutions), the US gross foreign assets and liabilities, and the portfolio share of US savings in Us government bonds, I rotate these variables as an additional variable in Equation 1 to avoid including too many variables in the SVAR. See Appendix B for details.

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. This is an advantage relative to the usual practice in the literature of including only US variables. Since the SVAR includes government spending in the ROW, it also controls for fiscal policy in the ROW.[17]

Finally, following the literature, the VAR is in log-levels, include a quadratic trend and controls 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 US Government Spending Shocks

Figure 2 presents the IRFs of selected variables to a positive shock to the one quarter-ahead forecast error on US government spending.[18] Panel (a) shows the response of US government spending, which increases on impact and then presents a reversal after around five years, similar to the findings in Corsetti et al. (2012). Panel (b) shows the response of the US government debt held by US agents (excluding government institutions), which increases significantly. Appendix C presents the response of other fiscal instruments which shows that government debt was the main instrument used to finance spending shocks in the US for the period in consideration.

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 (f) shows the 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 statisti-

[17] I also similar results including the government debt in the ROW.

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

[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.

cally 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 4.1 and 6. Finally, Panel (e) shows the response of the portfolio share of US government bonds, which shows hump-shaped dynamics.[21] The hump-shaped dynamics arise from that of the US government debt and the US gross foreign assets.

Panel (g) 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 (h) 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.[22]

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 B.3, I present

[20] In frictionless models, increases in the supply of government bonds raises 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.

[21] The portfolio share of US government bonds is defined as the value of the US government bonds held by US agents (excluding US government institutions) relative to the sum of this variable and the US gross foreign assets.

[22] Baldwin and Krugman (1989); Rose and Yellen (1989); Backus et al. (1994); Fitzgerald, Yedid-Levi and Haller (2019); Alessandria and Choi (2021).

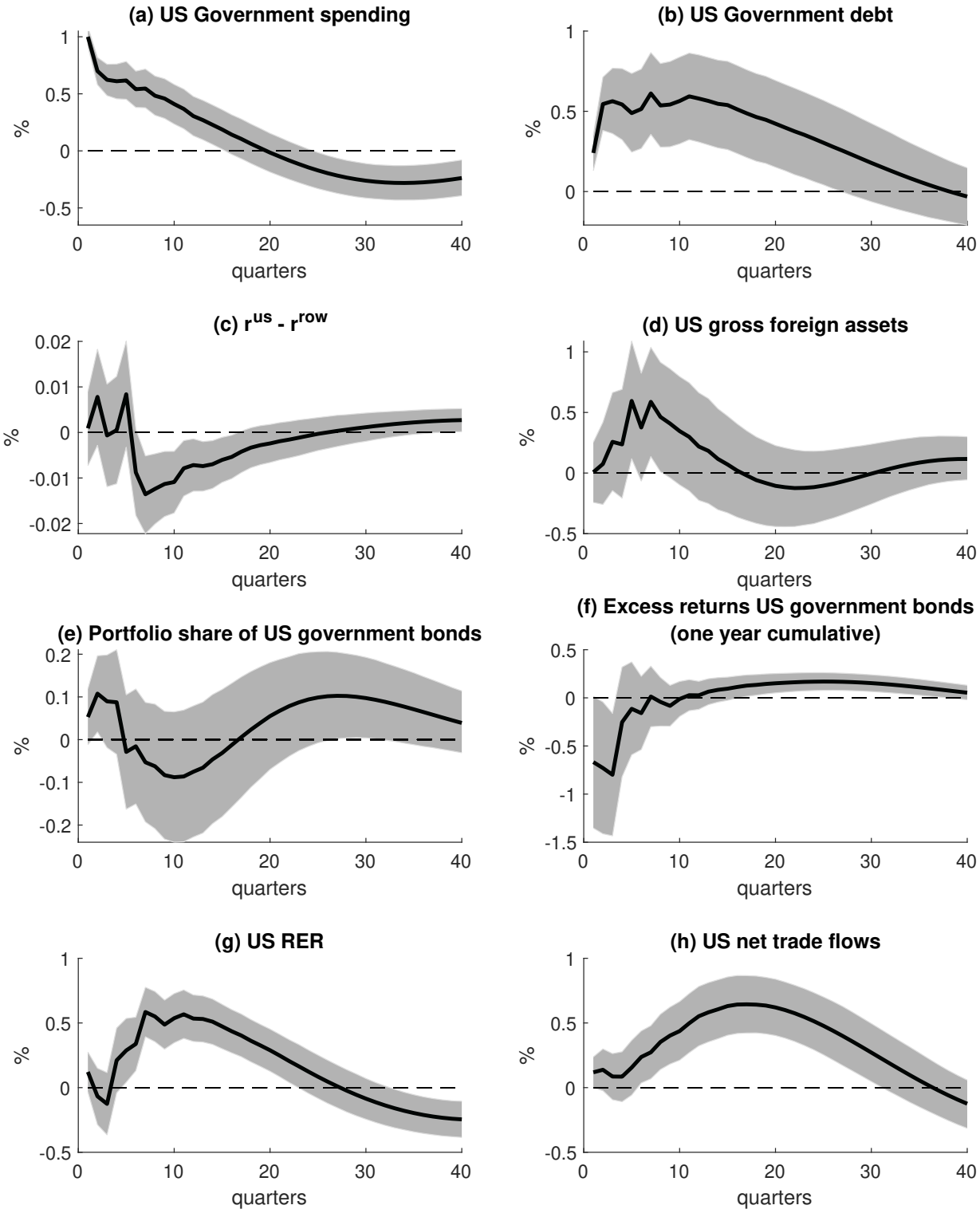


Figure 2: Impulse Response Functions to a Positive US Government Spending Shock

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 Return$_{t,t+4} \equiv \sum_{h=0}^{4} r^{us}_{t+h} - r^{row}_{t+h} - \mathrm{E}_t\left[\Delta e_{t+1+h}\right]$.

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 government spending and 27% of US government 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 government spending and debt, the RER and net trade flows. US government 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

	Total US Gov	Forecast Error US Gov	Anticipated US Gov	Other Shocks
US Government Gov Spending	45	26	19	55
US Government Debt	27	20	7	73
Interest Rate Differential	11	5	6	89
US Gross Foreign Assets	10	6	4	90
Portfolio share US gov bonds	3	1	2	97
Excess Returns US Gov Bonds	17	7	10	83
RER	32	19	13	68
Net Trade	35	24	11	65

Table 1: SVAR Error Forecast Variance Decomposition

assets. Finally, these shocks only explain 3 percent of the variance of the portfolio share of US government bonds.[23]

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, the US gross foreign assets, and the portfolio share of US government bonds are also similar to the baseline specification. The contribution of the US government spending shock to the error forecasts variance of variables of interest is also similar to the baseline specification. 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.

[23]The reader might find a tension between the idea that US government shocks drive the dynamics of the RER through changes in the portfolio share of US government bonds and the fact that empirically these shocks explain a high portion of the variance of the RER (32%) at the same time that they explain a small share of the variance of the portfolio share of US government bonds (3%). The model in Section 5 will be consistent with these facts, see Section 6.2 for an explanation.

In particular, 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 remaining main identification strategies developed in the literature: (*i*) Blanchard and Perotti (2002), and (*ii*) external instruments or Proxy SVARs (Mertens and Ravn, 2013; Ferrara et al., 2021).[24] Lastly, I find similar results using US tax shocks. Figures D.27 and D.28, show the responses to unanticipated tax cuts using the measure from Mertens and Ravn (2012) and to VAR shocks to federal taxes, respectively.[25] In all these cases, tax cuts lead to increases in government debt, a depreciation of the RER and increases in net trade.

4 Simple Model

This section presents a simple two-country model to layout the intuition of the mechanism. The two key features in the model are a fiscal rule that relies heavily on the use of government debt to finance spending in the US and a portfolio rebalancing friction. The fiscal rule follows that in Leeper et al. (2010), while the portfolio friction is similar to the specifications adopted by Guo et al. (2023) and Camara et al. (2024). In this section, I also provide a discussion of the portfolio friction, focusing on the identification and relation to other mechanisms in the literature.

The model features two countries: the US and the ROW. Households in each country can save in two assets: a domestic government bond, and a foreign bond issued by the foreign house-

[24] Figure D.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 D.4 shows that the results differ when one estimates the Proxy SVAR with no trends, which explain the difference with the results in Ferrara et al. (2021).

[25] The VAR shocks to federal taxes are obtained from a Cholesky decomposition where the federal tax rate is ordered after the forecast error on federal spending. The results are similar with the federal tax rate ordered first.

hold denominated in foreign currency. Households are subject to a portfolio friction which makes it costly for them to deviate from their long-run share of savings in the foreign bond. They can also borrow from the foreign household by issuing a bond in domestic currency. The US government is subject to spending shocks, which follow and AR(1) process, and finance spending through lump-sum taxes and debt. To isolate the role of US fiscal policy, I assume that the ROW government is not subject to spending shocks and follows a rule that stabilizes the value of its debt. The final good, which is a CES aggregate of domestic and imported intermediate goods, is consumed by the household and the government. I present the model from the point of view of US agents.

Household

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

$$U = E_0 \sum_{t=0}^{\infty} \beta^t \frac{\left[C_t^{\varrho}\left(1-L_t\right)^{1-\varrho}\right]^{1-\sigma}-1}{1-\sigma} \tag{2}$$

where $\beta \in [0,1)$ is the discount factor, σ is the risk-aversion, and $\varrho > 0$. The household faces the following flow budget constraint,

$$P_t^{us}C_t + P_t^{g,us}B_{t+1}^{g,us} + \mathcal{E}_t P_t^{row,us}B_{t+1}^{row,us} + \mathcal{F}\left(B_{t+1}^{row,us}, \bar{S}_{t+1}^{us}\right) \leq W_t L_t + B_t^{g,us} + \mathcal{E}_t B_t^{row,us} + B_{t+1}^{us,row}P_t^{us,row} - B_t^{us,row} - T_t$$

where P_t^{us} is the price of the final consumption good, $B_{t+1}^{g,us}$ are savings in US government bonds and P_t^g the price of these bonds, $B_{t+1}^{row,us}$ are the savings in the ROW bond, issued by the ROW household, $P_t^{row,us}$ is the price of these bonds which is denominated in ROW currency, and $\mathcal{E}_t$ is the nominal exchange rate (NER), where an increase in $\mathcal{E}_t$ is a depreciation of the dollar. The US household receive income from labor, $W_t L_t$, their holdings of US government bonds, $B_t^{g,us}$, and ROW bonds, $B_t^{row,us}$, and they can also borrow from the ROW household by issuing a domestic bond, $B_t^{us,row}$, denominated in dollars. The household is also subject to lump-sum taxes, T_t.

The function $\mathcal{F}\left(B_{t+1}^{row,us}, \bar{S}_{t+1}^{us}\right)$ introduces the portfolio friction, which depends on the choice of ROW bonds, $B_{t+1}^{row,us}$, and the total financial savings in the US, $\bar{S}_{t+1}^{us} = P_t^{g,us}\bar{B}_{t+1}^{g,us} + \mathcal{E}_t P_t^{row,us}\bar{B}_{t+1}^{row,us}$.

The household do not internalize the effects on the aggregate financial savings. The portfolio friction is similar to the specifications in Guo et al. (2023) and Camara et al. (2024),

$$\mathcal{F}\left(B_{t+1}^{row,us}, \bar{S}_{t+1}^{us}\right) = \frac{\Gamma}{2}\left(\frac{\mathcal{E}_t P_t^{row,us} B_{t+1}^{row,us}}{\bar{S}_{t+1}^{us}} - \frac{\mathcal{E}_{ss} P_{ss}^{row,us} B_{ss}^{row,us}}{\bar{S}_{ss}^{us}}\right)^2 \times \bar{S}_{t+1}^{us} \tag{3}$$

where x_{ss} denotes the steady state value of variable x. In equilibrium, the household pays a quadratic cost from deviating from the long-run share of savings in ROW bonds.

Retailer

The final good, produced by a competitive representative retailer, is a CES aggregate of domestic and imported intermediate goods,

$$C_t + G_t = \left[(1-\gamma)^{\frac{1}{\rho}}\left(Y_t^{us,us}\right)^{\frac{\rho-1}{\rho}} + \gamma^{\frac{1}{\rho}}\left(Y_t^{row,us}\right)^{\frac{\rho-1}{\rho}}\right]^{\frac{\rho}{\rho-1}}$$

where $1-\gamma$ is the home bias in expenditure, and ρ the elasticity of substitution between domestic and imported intermediate goods. G_t denotes purchases of consumption goods by the government, $Y_t^{us,us}$ is the quantity of intermediate goods bought from US producers, and $Y_t^{row,us}$ the quantity of intermediate goods imported from the ROW. The budget constraint of the retailer is,

$$P_t^{us}\left(C_t + G_t\right) = P_t^{us,us} Y_t^{us,us} + P_t^{row,us} Y_t^{row,us}$$

where $P_t^{us,us}$ is the price of the US intermediate good, and $P_t^{row,us}$ the price of the imported intermediate good. The price index of the final good is $P_t^{us} = \left[(1-\gamma)\left(P_t^{us,us}\right)^{1-\rho} + \gamma\left(P_t^{row,us}\right)^{1-\rho}\right]^{\frac{1}{1-\rho}}$.

Intermediate Firms

Intermediate firms are competitive, produce using labor and sell their output domestically and internationally. The production function is linear in labor, $Y_t^{us} = AL_t$, where A is a constant level of productivity. The resource constrain is $Y_t^{us} = Y_t^{us,us} + Y_t^{us,row}$, where $Y_t^{us,us}$ is the quantity sold domestically and $Y_t^{us,row}$ the quantity exported to the ROW. Profits of firms are given by,

$$\Pi_t = P_t^{us,us} Y_t^{us,us} + \mathcal{E}_t P_t^{us,row} Y_t^{us,row} - W_t L_t$$

where $P_t^{us,us}$ is the price of the goods sold domestically and $P_t^{us,row}$ the price of the exported goods, denominated in foreign currency.

Government

The US government budget constraint is

$$T_t + P_t^{g,us}\hat{B}_{t+1}^{g,us} = P_t^{us}G_t + \hat{B}_t^{g,us}$$

where T_t are lump-sum taxes and $\hat{B}_{t+1}^{g,us}$ is government debt. Lump-sum transfers follow a rule similar to that in Leeper et al. (2010),

$$T_t = \mu_{ss}^g + \mu_{ss}^b + \varphi^{T,b}\left(P_t^{g,us}\hat{B}_{t+1}^{g,us} - \mu_{ss}^b\right) + \varphi^{T,g}\left(P_t^{us}G_t - \mu_{ss}^g\right), \tag{4}$$

where μ_{ss}^g and μ_{ss}^b are the steady state government purchases and interest payments on debt, and $\varphi^{T,b}$ and $\varphi^{T,g}$ are the endogenous response of taxes to deviations in the long-run value of the government debt and spending in goods, respectively. Finally, government spending follows and AR(1) process in logs,

$$g_t^{us} = \rho_g^{us} g_{t-1}^{us} + \sigma_g^{us}\varepsilon_{g,t}^{us} \quad \text{with} \quad \varepsilon_{g,t}^{us} \sim N(0,1)$$

where $g_t = \ln(G_t)$.

To isolate the role of the US government, I assume that the ROW government is not subject to spending shocks and follows a rule that stabilizes the value of its debt. The budget constraint for the ROW government and its rule for its debt are,

$$T_t^{row} + P_t^{g,row}\hat{B}_{t+1}^{g,row} = P_t^{row}G_{ss}^{row} + \hat{B}_t^{g,row}$$

and

$$P_t^{g,row}\hat{B}_{t+1}^{g,row} = P_{ss}^{g,row}\hat{B}_{ss}^{g,row}$$

Hence, any changes in the the value of the expenses, either from fluctuations in the price of the final goods or the price of debt, are fully absorbed by taxes.

Market Clearing

Market clearing for goods imply that total production of intermediate goods in each country equals the total demand from domestic and foreign retailers, and the market clearing for government bonds in each country imply that,

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

The consolidated budget constraint for the US is obtained by combining the US household budget constraint, the budget constraint of the US retailer, and the US government budget constraint,

$$\mathcal{E}_t \left(\frac{B^{row,us}_{t+1}}{R^{row,us}_t} - B^{row,us}_t \right) - \left(\frac{B^{us,row}_{t+1}}{R^{row,us}_t} - B^{us,row}_t \right) = \left(P^{us,us}_t Y^{us,us}_t - \mathcal{E}_t Y^{row,us}_t Y^{row,us}_t \right) + \frac{\Gamma}{2} \left(s^{row,us}_{t+1} - s^{row,us}_{ss} \right)^2$$

where $s^{row,us}_{t+1} \equiv \frac{\mathcal{E}_t B^{row,us}_{t+1} P^{row,us}_{t+1}}{\bar{S}_{t+1}}$ is the share of savings in ROW bonds. The left hand side is the change in the US net foreign assets, the difference between the change in US gross foreign assets and liabilities, and the right hand side the trade balance plus the portfolio cost. The foreign country budget constraint is satisfied by Walras Law.

Finally, the RER is defined as $Q_t \equiv \frac{\mathcal{E}_t P^{row}_t}{P^{us}_t}$. I normalize the price level of the final goods to be equal to one in both countries, hence the RER equates the NER. This corresponds to the limiting case where the monetary authority perfectly stabilizes prices. This is a good approximation of the data given the high correlation between the RER and NER in advanced economies in the period of consideration (1980 - 2019), due to the low inflation levels.

4.1 Mechanism

To provide intuition for the mechanism I derive the equations summarizing the equilibrium in international financial markets, and present the impulse responses of key variables to US government spending shocks.

The presence of the portfolio friction $\mathcal{F}\left(B^{row,us}_{t+1}, \bar{S}^{us}_{t+1}\right)$, implies the following asset demand equations from the FOCs of the household problem,

$$1 = \beta \mathbb{E}_t \left[\frac{u_c\left(C_{t+1}\right)}{u_c\left(C_t\right)} (1 + r_t^{g,us}) \right], \tag{5}$$

and

$$1 + \Gamma \left(s_{t+1}^{row,us} - s_{ss}^{row,us} \times e^{\psi_t^{us}} \right) = \beta \mathbb{E}_t \left[\frac{u_c\left(C_{t+1}\right)}{u_c\left(C_t\right)} \frac{\mathcal{E}_{t+1}}{\mathcal{E}_t} (1 + r_t^{row,us}) \right], \tag{6}$$

where $u_c\left(C_t\right)$ denotes the derivative of the utility function with respect to C_t, and the return on assets are given by $(1 + r_t^{g,us}) \equiv 1/P_t^{g,us}$ and $(1 + r_t^{row,us}) \equiv 1/P_t^{row,us}$, for the government bond and the ROW bond respectively. 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.

The key channel through which portfolio frictions affect the international transmission, is by inducing excess returns, or UIP deviations. To see this, consider the first-order log-linearized UIP condition obtained from the asset demands 5 and 6,

$$r_t^{g,us} - r_t^{g,row} - \mathbb{E}_t \left[\Delta e_{t+1} \right] = \Gamma \bar{s}^{g,us} \left(s_{t+1}^{g,us} - \bar{s}^{g,us} \right) \tag{7}$$

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_{t+1}^{g} the portfolio share of US government bonds between t and $t+1$. The right hand side captures the endogenous excess returns arising from the presence of portfolio frictions. This equation shows that, all else equal, a higher share of savings in US government bonds relative to the long-run raises the expected returns on this bond relative to the ROW bond. Since increasing the share of savings in US government bonds relative to ROW bonds is costly, the household requires a compensation to be willing to hold more government bonds, which materializes in the form of excess returns.

By rolling forward equation 7, we can derive an expression for the transitory component of the RER, given by

$$e_t = -\mathbb{E}_t \sum_{j=0}^{\infty} \left(r_{t+j}^{g,us} - r_{t+j}^{g,row} \right) + \Gamma \bar{s}^{g,us} \mathbb{E}_t \sum_{j=0}^{\infty} \left(s_{t+1+j}^{g} - \bar{s}^{g} \right) + \lim_{j \to \infty} \mathbb{E}_t e_{t+j} \tag{8}$$

so that the RER depreciates in response to: (*i*) a fall in the sum of expected future (transitory) interest rate differentials, and (*ii*) an increase in the sum of expected future (transitory) portfolio share differentials of government bonds.[26] 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 of US government bonds to the RER determination. The second term on the right hand side shows that, all else equal, future expected increases in the share of savings in US government bonds tend to depreciate the RER. The intuition is similar to the one applying to equation 7. If the household is expected to increase her share of savings in US government bonds it is expected to incur in the portfolio cost for which she will require a compensation. A depreciation of the RER, relative to its long-run level, imply that over time the RER has to appreciate to eventually converge back to its steady state level. Consequently, the return of the US government bond raises relative to the ROW bond through this channel, since the former is denominated in dollars.

To illustrate the role of fiscal policy in driving the dynamics of the RER and NT, consider the calibration of the model displayed in Table 2. All the parameter values are fairly standard. The model is calibrated to match the average holdings of US government bonds by US agents and the US gross foreign assets during the period 1980 - 2019. The standard deviation of the US government spending shock is normalize to be 1%, and its persistence to be 0.95. The coefficients in the fiscal rules regarding the response of taxes to spending and debt are chosen to generate a hump-shaped response of government debt to spending shocks. In Section 6, I provide an estimation of these parameters in the full model.

Figure 3 displays some key impulse responses to a 1% positive government spending shock. Panel (a) shows the response of spending, which slowly converges back to its long-run level given its AR(1) structure, while Panel (b) presents the response of government debt, which has a hump-shaped dynamic.

The remaining panels show the response of key variables of interest in the case without portfolio frictions ($\Gamma = 0$) in the green dashed dotted line.[27] Hence , this is the case of no portfo-

[26] Since the steady state value of the log of the RER is zero, then $\lim_{j\to\infty} \mathbb{E}_t e_{t+j} \to 0$.

[27] To make the model stationary in this case, I assume there is a small quadratic cost of deviating from the long-run level of the ROW bond, $\frac{\chi}{2}\left(B^{row,us}_{t+1}\mathcal{E}_t P^{row,us}_t - B^{row,us}_{ss}P^{row,us}_{ss}\right)^2$ where $\chi = 0.001$.

Parameter		Value	Target Moment
Discount factor	β	0.99	Annual interest rate of 4%
Risk Aversion	σ	1	normalization
Weight on Labor	ϱ	0.31	hours worked of 1/3
Home bias in expenditure	γ	0.10	Trade-to-GDP ratio of 20%
Armington Elasticity	ρ	1.5	standard
Productivity level	A	3	normalize output to 1
Steady State Portfolio government Bonds	s^g_{ss}	0.39	Average portfolio share of US government bonds
Steady State Gross Financial Flows	B^{ss}	0.798	Average ratio US foreign assets to GDP of 0.79
Steady State government expenditure	μ^g_{ss}	0.085	US federal government spending over GDP of 0.085%
Std of US government spending shock	σ^{us}_g	0.01	normalization
Persistence of US government spending shock	ρ^{us}_g	0.95	normalization
Response of taxes to government spending	$\varphi^{T,g}$	0.01	normalization
Response of taxes to government debt	$\varphi^{T,b}$	0.08	normalization

Table 2: Calibrated Parameters for Simple Model

lio frictions, which is present in many models in the literature,[28] with the standard international transmission of government spending shocks. A positive US government spending shock raises the interest rate in the US relative to the ROW, shown in Panel (c). A higher US interest rate induces US households to re-balance their portfolios towards US government bonds and in detriment of the ROW bond, so that the US gross foreign assets fall (Panel d) and the share of savings in US government bonds raises (Panel e). Furthermore, in this case there are no excess returns of US government bonds, as shown in Panel (f), and the level of the RER is solely determined by the interest rate differential, as shown by Equation 8 under $\Gamma = 0$. Consequently, the US RER appreciates on impact (panel g), given the increase in the interest rate differential. Since the UIP holds in this case, high interest rates in the US predict a depreciation of the dollar so that the initial appreciation of the RER is followed by a path of a depreciation of the RER. Finally, both the raise in the domestic demand, following the increase in government spending, and the expenditure switching effect, triggered by the appreciation of the RER, reduces the net trade flows (Panel h).

Consider now the case with portfolio frictions, displayed in red-dashed lines for $\Gamma = 0.1$ and in blue-solid line for $\Gamma = 0.3$ in Panels (c) to (h). The presence of portfolio frictions limits the

[28] Backus et al. (1994); Devereux and Engel (2002); Heathcote and Perri (2014); Itskhoki and Mukhin (2021, 2025).

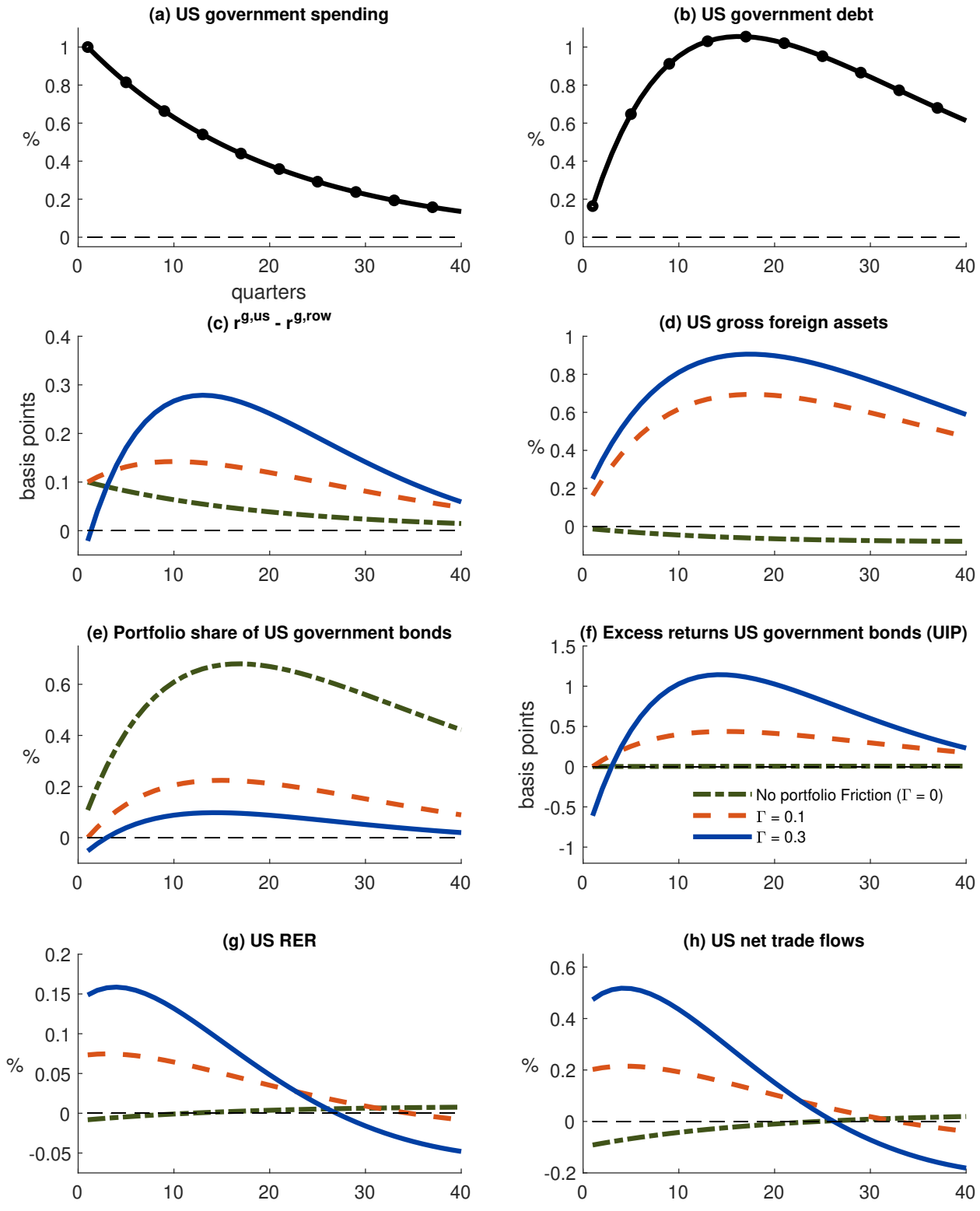


Figure 3: Impulse Response Functions: The Role of Portfolio Frictions

extend to which households rebalance their portfolios shares. The higher the portfolio friction Γ the stronger the increase in the US gross foreign assets (Panel d), in order to smooth-out the cost of deviating from the long-run share of ROW bonds (Panel e). Furthermore, Panel (f) shows that the shock triggers excess returns of US government bonds relative to ROW bonds in the presence of portfolio re-balancing frictions, as shown in Equation 7 under $\Gamma > 0$.

Following Equation 7, the excess return depends positively on the share of savings in US government bonds. In the case of $\Gamma = 0.1$, since the portfolio share remains almost unchanged on impact (Panel e), there almost no excess returns on impact (Panel f). In the case of $\Gamma = 0.3$, the portfolio share falls on impact (Panel e), which triggers negative excess return of US government bonds on that period (Panel f). However, as time passes, the portfolio share of government bonds increase for both values of Γ. As shown in Equation 8, the level of the RER is driven by the sum of expected future portfolio share differentials of government bonds. Since this sum is positive, the RER depreciates on impact in response to a positive US government spending shock (Panel g). Furthermore, the presence of portfolio frictions induce hump-shaped RER dynamics. In the case of $\Gamma = 0.3$ the hump-shaped dynamics of the RER are more pronounced since there is fall in the portfolio share of government bonds for the first two periods, which according to Equation 7 triggers an expected appreciation of the dollar. Hence, the hump-shaped RER dynamics are driven by the hump-shaped dynamics of the portfolio share of US government bonds which are in turn driven by the response of the US government debt to the shock.

Finally, the depreciation of the RER triggers an expenditure switching effect that raises the net trade flows (Panel h). Consequently, the net trade dynamics are also hump-shaped, since the strongest expenditure switching effect is at the peak of the RER depreciation.

To see the role that the fiscal rule has on the international transmission of US government spending shocks, consider the same model under $\Gamma = 0.3$, but where the US government stabilizes the value of its debt. This implies replacing the fiscal rule in Equation 4 by,

$$P_t^{g,us} \hat{B}_{t+1}^{g,us} = P_{ss}^{g,us} \hat{B}_{ss}^{g,us} \tag{9}$$

so that any changes in the expenses due to fluctuations in the price of goods or the price of debt are accommodated solely by taxes.

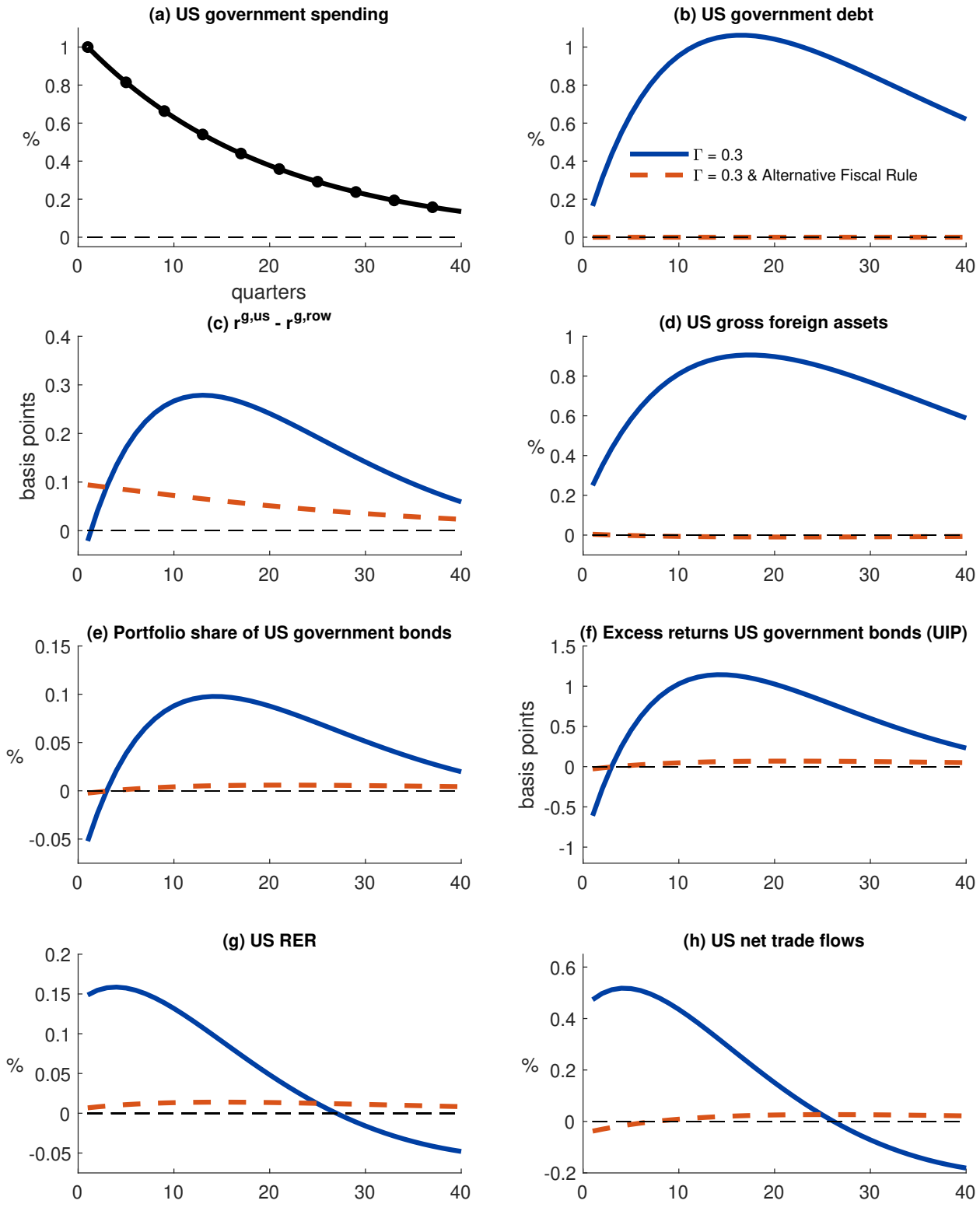


Figure 4: Impulse Response Functions: The Role of the Fiscal Rule

Figure 4 compares the impulse responses to US government spending shocks in the model under the alternative fiscal rule that stabilizes the value of the US government debt (red-dotted line) with the case displayed in Figure 3 under $\Gamma = 0.3$ (blue-solid line). Panel (a) shows the response of US government spending, which is identical for both models, while Panel (b) shows the response of US government debt in each case. In the model with a constant government debt, the effect on the portfolio share of US government bonds is only driven by the changes in the US gross foreign assets, which are almost unchanged on impact and fall modestly afterwards. Consequently, the effect on the portfolio share of US government bonds, which is positive, is quite small. From Equation 8, it follows that the effect on the level of the RER through the portfolio channel would be significantly smaller than in the benchmark case where the US government relies heavily on the use of debt to finance the spending shock. A dampened effect on the RER translates into a weak expenditure switching effect, so that the net trade flows fall in response to the shock. Therefore, a fiscal rule that relies heavily on the use of government debt to finance spending is crucial for the mechanism.[29]

The interaction of portfolio frictions with a fiscal rule that relies heavily on the use of government debt can also provide a potential resolution to the RER disconnect puzzle. In particular the Meese and Rogoff (1983) puzzle, that is highly volatile and persistent RERs, the Backus and Smith (1993) and Kollmann (1995) puzzle, or the violation of the risk-sharing condition, and the Fama (1984) or Forward Premium puzzle, i.e. high interest rates predict appreciations of the RER with low predictive power. Table 3 present the moments related to the RER disconnect obtained from simulating the model under $\Gamma = 0.3$. Although this is a simple model and the result of a particular calibration, the table indicates that it is possible for US government spending shocks to explain the disconnect, more so given that the variance decomposition from the SVAR in Section 1 shows that these shocks explain around 30% of the variance of the RER in the data.

To summarize, the interaction of portfolio frictions with a fiscal rule that relies heavily on the use of government debt drive the dynamics of the RER and the net trade flows in response to US government spending shocks. In Section 5, I extend this simple model in various dimension

[29] In Section 8, I show that these results are consistent with cross-country panel data. I find that countries that rely more on government debt to finance spending shocks experience stronger depreciations of their RERs and increases in the net trade flows. This is true for the whole sample of 125 countries, and within advanced, emerging and poor economies, albeit stronger for the first group consistent with the fact that advanced economies issue mostly domestic currency debt.

Moments	Data	Simple Model ($\Gamma = 0.3$)
$\sigma(rer)/\sigma(gdp)$	3.82	2.09
$autocorr(rer)$	0.97	0.97
$corr\left(\Delta\left(c^{us} - c^{row}\right), \Delta rer\right)$	-0.17	-1.00
β_{Fama}	-1.38	-2.78
R^2_{Fama}	0.01	0.06

Table 3: RER Disconnect Moments

and show that the mechanism highlighted in this section explains the evidence on the international transmission of US government spending shocks documented in Section 3, and that US government spending shocks contribute to account for the RER disconnect.

4.2 Discussion of the Portfolio Friction

Before moving to the full quantitative model, it is worth discussing the identification of the portfolio friction Γ and its relation with various underlying mechanisms previously highlighted in the literature.

4.2.1 Identification of the portfolio friction

By using the demand for foreign assets in equation 6 one can derive the partial-equilibrium aggregate demand elasticity of internationally traded bonds. This is useful since the elasticity is informative about 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,*

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

where $\bar{s}^{row,us}$ is the steady state share of savings in ROW bonds. Hence, the value of the portfolio 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. 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 for the period in consideration, gives a value of the portfolio re-balancing cost, Γ, of 1.462. This is the value that will be used in the full quantitative model in Sections 5 and 5.2.

4.2.2 What does the portfolio friction capture?

The key benefit of adopting the reduced form portfolio friction is its tractability. Nevertheless, due to its central role in the fiscal mechanism it is worth discussing what this reduced form friction captures. There are two main implications of the friction: (i) it reduces the demand elasticity of foreign assets as shown in Equation 6, and (ii) it reduces the extent to which agents rebalance their portfolio shares.

There is a recent literature in finance, both in closed and open economy, that has documented and highlighted the importance of inelastic demands for various assets, including government and corporate bonds both in advanced and emerging market economies.[30] Hence, a model that deviates from perfectly elastic demand for assets is widely supported by the findings in the recent literature.

On the other hand, there are several reasons that would limit the ability of agents to deviate from their portfolio shares. 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

[30] Koijen and Yogo (2019); Jiang, Lustig, Van Nieuwerburgh and Xiaolan (2020); Gabaix and Koijen (2021); Vayanos and Vila (2021); Calomiris, Larrain, Schmukler and Williams (2022); Bretscher, Schmid, Sen and Sharma (2022); Greenwood, Hanson, Stein and Sunderam (2023b); Kaldorf and Röttger (2023); Greenwood, Hanson and Vayanos (2023a); Koijen and Yogo (2024); Gourinchas, Ray and Vayanos (2024); Choi, Kirpalani and Perez (2024); Dathan and Davydenko (2024); Moretti, Pandolfi, Schmukler, Bauer and Williams (2024).

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 et al., 2024). Consequently, portfolio shares of different assets tend to vary less in the presence of strict mandates.

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.[31] In Appendix C, I document that risk in the US increases after a positive government spending shock. I find that the VXO raises, the US Price-Dividend ratio falls, and there is an increase in the yields of corporate bonds and spreads of high yield to AAA yields in the US. Furthermore, although TFP raises on impact, it falls under trend afterwards for around ten years, which is also consistent with mechanisms highlighted in the literature on long-run risk (Colacito and Croce, 2011). Hence, higher government debt might rise concerns about the sustainability of the debt, and who would bear the cost of paying for it. Consequently, this might also rise concerns about the functioning of financial system, given that government bonds in the US and other advanced economies represent a large share of the total assets in the financial system and are used as collateral by many institutions. The portfolio friction can thus capture in reduced form time variation in risk-premia.

The literature on exchange rate dynamics has also highlighted the importance of the liquidity of government bonds, specially for US treasuries (Engel and Wu, 2022). For example, Devereux et al. (2025) show how the tightening collateral constraints of international investors affect exchange rates. In their model, an unexpected increase in the supply of US government bonds would reduce the marginal benefit of liquidity of an extra unit of government debt. This reduces the convenience for US government bonds, depreciating the RER relative to its long-run level, consistent with the mechanism proposed in this paper. Bianchi, Bigio and Engel (2024) also highlight the importance of demand for assets from financial intermediaries, with focus on the liquidity return of dollar assets. Hence, the friction can captures variation in the marginal benefit of liquidity in response to changes in the supply of US government bonds.

Several papers have also highlighted the importance of convenience yields for the demand for assets (Krishnamurthy and Lustig, n.d.; Jiang et al., 2021; Jiang, Krishnamurthy and Lustig,

[31] For example, it has been documented that inflation risk matters for the pricing of assets (Moerman and van Dijk, 2010).

2023; Jiang et al., 2024; Kekre and Lenel, 2024). While in those papers model convenience yields as an exogenous stochastic process, the portfolio friction adopted in this paper generates endogenous time variation in convenience yields. This channel is also similar to that in Valchev (2020), where convenience yields arise endogenously in response to changes in the relative supply of government bonds, since an increase in the supply of US government debt relative to ROW government bonds tend to depreciate the US RER.

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.[32] This is similar to the implications of the portfolio friction in Equation 3, as shown by the hump-shaped impulse responses of the excess returns and the RER in Figure 3.

To summarize, the reduced form portfolio friction allows the model to capture time-variation in convenience yields that arise endogenously to the state of the economy in a tractable way. The friction is related to several mechanisms that have been highlighted in the literature such as institutional frictions, risk, liquidity, and behavioral biases. Furthermore, as will be shown in Section 6, portfolio frictions have the advantage of bringing the model closer to the data in other dimensions, such as capturing the joint dynamics of relative government debt and the RER displayed in Figure 1.

5 Quantitative Model

In this section, I present the full quantitative model to study the international transmission of US fiscal policy. I also present the estimation of the model.

5.1 The Model

I extend the simple model developed in Section 4, with the following features. Households own physical capital and are subject to investment adjustment costs as in Christiano, Eichenbaum and Evans (2005). They are also subject to shocks to the long-run portfolio shares of foreign assets, capturing changes in financial liberalization that give rise to exogenous deviations from UIP, as

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

in Itskhoki and Mukhin (2021). There are three representative retailers: for consumption goods, investment goods, and materials. These retailers are heterogeneous in their home bias, capturing the average structure of trade in the US. They are also subject to trade frictions in the form of adjustment cost in the use of imported to domestic inputs in the CES aggregators which give raise to a dynamic trade elasticity, following Erceg, Guerrieri and Gust (2006). There are pricing-to-market frictions resulting in endogenous deviations from the law of one price and incomplete exchange rate pass-through to import prices, as in Alessandria and Choi (2021), Mac Mullen and Woo (2024) and Kekre and Lenel (2024). Intermediate goods are produced under monopolistic competition. Firms are subject to aggregate TFP shocks and trade cost shocks. The governments in the US and ROW are symmetric. They follow 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.

5.1.1 Households

Preferences are the same as in equation 2. The budget constraint is now given by,

$$P_t^c C_t + P_t^I I_t + B_{t+1}^{g,us} P_t^{g,us} + \mathcal{E}_t B_{t+1}^{row,us} P_t^{row,us} + \mathcal{F}\left(B_{t+1}^{row,us}, \bar{S}_{t+1}^{us}; \psi_t^{us}\right)$$

$$\leq W_t L_t + R_t^k K_t + \Pi_t^{us} - T_t^{us} + B_t^{g,us} + \mathcal{E}_t B_t^{row,us} + B_{t+1}^{us,row} P_t^{us,row} - B_t^{us,row}$$

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 portfolio frictions now includes a shock to the long-run portfolio share of ROW bonds, ψ_t^{us},

$$\mathcal{F}\left(B_{t+1}^{row,us}, \bar{S}_{t+1}^{us}; \psi_t^{us}\right) = \frac{\Gamma}{2}\left(\frac{\mathcal{E}_t B_{t+1}^{row,us} P_t^{row,us}}{\bar{S}_{t+1}^{us}} - \frac{\mathcal{E}_{ss} B_{ss}^{row,us} P_{ss}^{row,us}}{\bar{S}_{ss}^{us}} \times e^{\psi_t^{us}}\right)^2 \times \bar{S}_{t+1}^{us} \tag{10}$$

The modified equations for the UIP and the level of the RER are given by,

$$r_t^{g,us} - r_t^{g,row} - \mathbb{E}_t\left[\Delta e_{t+1}\right] = \Gamma \bar{s}^{g,us}\left(s_{t+1}^{g,us} - \bar{s}^{g,us}\right) + \Gamma(1-\bar{s}^{g,us})\psi_t^{us} \tag{11}$$

$$e_t = -\mathbb{E}_t \sum_{j=0}^{\infty}\left(r_{t+j}^{g,us} - r_{t+j}^{g,row}\right) + \Gamma \bar{s}^{g,us}\mathbb{E}_t \sum_{j=0}^{\infty}\left(s_{t+1+j}^{g} - \bar{s}^{g}\right) + \Gamma(1-\bar{s}^{g,us})\mathbb{E}_t \sum_{j=0}^{\infty}\psi_{t+j}^{us} + \lim_{j\to\infty}\mathbb{E}_t e_{t+j} \tag{12}$$

where the second term on the right hand side of equation 11 and the third term on the right hand side of in equation 12 captures the effect of the exogenous financial shock, ψ_t^{us}, similar to the UIP shock in Itskhoki and Mukhin (2021).

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 κ governs the adjustment cost of investment as in Christiano et al. (2005).

5.1.2 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,

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

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), that depends on the RER, defined in units of the US final consumption good, i.e. $\mathcal{Q}_t \equiv \mathcal{E}_t \frac{P_t^{c^*}}{P_t^c}$. This friction allows the model to generate a volatility of the terms of trade that is lower than that of the RER, an incomplete pass-though of exchange rate to prices, and endogenous deviations from the law of one price. The CES aggregators of the retailers are given by

$$Y_t^x = \left[(1-\gamma^x)^{\frac{1}{\rho^x}}\left(Y_{us,us,t}^x\right)^{\frac{\rho^x-1}{\rho^x}} + \gamma^{x\,\frac{1}{\rho^x}}\left(\varphi_t^x Y_{row,us,t}^x\right)^{\frac{\rho^x-1}{\rho^x}}\right]^{\frac{\rho^x}{\rho^x-1}}$$

and

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

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), capturing frictions in importing goods. The adjustment cost makes trade flows more inelastic in the short-run than in the long run, leading to a dynamic trade elasticity. The problem of the retailer X,

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

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 price indexes of bundles of varieties. The FOCs yield the demand functions,

$$P^x_t \frac{\partial Y^x_t}{\partial Y^x_{us,us,t}} + \beta E_t\left(\Omega_{t+1}P^x_{t+1}\frac{\partial Y^x_{t+1}}{\partial Y^x_{us,us,t}}\right) = P^x_{us,us,t} \quad \text{and} \quad P^x_t \frac{\partial Y^x_t}{\partial Y^x_{row,us,t}} + \beta E_t\left(\Omega_{t+1}P^x_{t+1}\frac{\partial Y^x_{t+1}}{\partial Y^x_{row,us,t}}\right) = P^x_{row,us,t}$$

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

5.1.3 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,

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

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,

$$P_{us,us,t}^x = \frac{\theta}{\theta - 1} MC_t \quad \text{and} \quad \mathcal{E}_t P_{us,rowt}^x = e^{\xi_t^{us}} \frac{\hat{\theta}}{\hat{\theta} - 1} MC_t$$

and by demands for factors of production,

$$W_t L_t = (1-\eta)(1-\alpha) MC_t Y_t^{us}; \quad R_t^k K_t = (1-\eta)\alpha MC_t Y_t^{us}; \quad P_t^M M_t = \eta MC_t Y_t^{us}$$

where MC_t is the marginal cost of production, given by

$$MC_t = \frac{\left[e^{-z_t^{us}} \left(R_t^k\right)^{\alpha} (W_t)^{1-\alpha})^{(1-\eta)}\right] \left(P_t^M\right)^{\eta}}{\eta^{\eta} \left[(1-\eta)\alpha^{\alpha}(1-\alpha)^{1-\alpha}\right]^{1-\eta}}$$

5.1.4 Fiscal Rule

The US government purchases consumption and investment goods from local retailers, G_t^c and G_t^I respectively. The budget constraint of the US government is given by,

$$T_t + P_t^{g,us} \hat{B}_{t+1}^{g,us} = P_t^c G_t^c + P_t^I G_t^I + \hat{B}_t^{g,us}$$

Lump-sum taxes follow the same rule as in Equation 4.[33] 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. The inclusion of a feedback between spending and debt allows the model to capture the spending reversal after the government spending shock, as in Corsetti et al. (2012). 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 government government spending is defined as,

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

5.1.5 Other Shock Processes

The other stochastic processes for country $i \in \{US, ROW\}$ 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, Φ_t^c and Φ_t^d,

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

[33] 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 response of the RER to government spending shocks in the model.

where

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

I assume that $\mu_\Phi^c = 0$ for all processes, except TFP. Finally, trade costs have only a differential component, i.e. $\varepsilon_{\xi t}^c = 0 \ \forall t$. All innovations are assumed to be uncorrelated with each other.

5.1.6 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.

5.2 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 4 presents the parameters of the first group, and Tables 5 and 6 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%.[34] 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.[35]

I target a steady state ratio of US federal spending to GDP of 8.5%, the average in the sample period, and a share of federal 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 5, and the estimated parameters with their standard errors in Table 6. The parameters include those related to shock

[34] 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.

[35] 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	0.34	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 4: 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.[36] 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.[37] I choose this filter to capture

[36]Targeting a combination of conditional and unconditional moments is a strategy also followed by Winberry (2021) and Fukui, Nakamura and Steinsson (2023).

[37]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.[38]

In total there are 17 parameters and 178 moments. 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.[39]

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	$\rho(\Delta(c^{us} - c^{row}), \Delta rer)$; $\frac{\sigma(rer)}{\sigma(gdp^{us})}$; $\frac{\sigma(nt)}{\sigma(rer)}$; $\rho(rer)$; 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}

Table 5: SMM Target Moments

5.2.1 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. For the conditional moments, displayed in Panel I of

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

[39] 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.

Table 5, 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 5. 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, the Backus-Smith-Kollmann correlation is informative about the variance of the differential financial shock that induces deviations from UIP (Itskhoki and Mukhin, 2021). Furthermore, the volatility of the RER relative to net trade is informative about the volatility of the trade shock, while the short and long run trade elasticity estimated from an error correction model (ECM) is informative about the persistence of the trade shock and the trade adjustment cost in the CES aggregators (Mac Mullen and Woo, 2024).[40] The autocorrelation of the RER is also informative about the persistence of these shocks.

Panel IV, shows the target unconditional moments related to financial variables. The variance of the US gross foreign assets and the variance and persistence of portfolio share are informative about the common financial shock process. I also include the variance and autocorrelation of the interest rate differential and the coefficient on interest rates from the Fama (1984) regression, which are useful to identify the differential financial shock process. Finally, the volatility of the US government debt is informative about the fiscal rule.

Table 6 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, consistent with the unconditional dynamics of these variables.[41] 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 around 4 cents in tax revenue, and the estimated

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

[41] The volatility of the US government spending process is 0.011, shown in Table 4.

Parameter		Value	Parameter		Value
1. Std common prod shock	σ_z^c	0.003 (0.0005)	10. Std differential financial shock	σ_ψ^d	0.008 (0.0011)
2. Pers common prod shock	ρ_z^c	0.894 (0.9012)	11. Pers differential financial shock	ρ_ψ^d	0.843 (0.0327)
3. Std differential prod shock	σ_z^d	0.002 (0.0002)	12. Std common portfolio shock	σ_ψ^c	0.003 (0.0009)
4. Pers differential prod shock	ρ_z^d	0.926 (0.0223)	13. Pers common financial shock	ρ_ψ^c	0.939 (0.0380)
5. Pers US gov shock	ρ_g^{us}	0.963 (0.0149)	14. Adj cost CES	ι	459.66 (137.08)
6. Std ROW gov shock	σ_g^{row}	0.003 (0.0010)	15. Response gov spending to debt	$\varphi^{g,b}$	-0.067 (0.0095)
7. Pers ROW gov shock	ρ_g^{row}	0.813 (0.1882)	16. Response taxes to debt	$\varphi^{T,b}$	0.046 (0.0135)
8. Std differential trade shock	σ_ξ^d	0.008 (0.0011)	17. Response taxes to spending	$\varphi^{T,g}$	0.379 (0.1029)
9. Pers of differential trade shock	ρ_ξ^d	0.983 (0.0008)			

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

Table 6: SMM Estimated Parameters

response of taxes to spending ($\varphi^{T,g}$) means that for every dollar increase in spending, the government raises around 38 cents in tax revenue to finance it.

The trade shock is found to be more persistent than the differential financial shock, consistent with the findings in Mac Mullen and Woo (2024). Finally, the adjustment cost in the CES aggregators has a value of 459.66, 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.

6 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 estimated in the SVAR in Section 3. 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 the fiscal mechanism is key to account for the comovement between relative government debt and the RER presented in Figure 1.

6.1 The International Transmission of US Fiscal Policy

Figure 5 present the responses of key variables to US government spending shocks estimated in the SVAR (black-solid line) and in the benchmark model (blue-*o* line). Qualitatively, the responses to US government spending shocks in the benchmark model are very similar to those in the simple model presented in Figure 3. The main difference is that the benchmark model successfully captures the *quantitative response* of key variables estimated in the SVAR.

The benchmark model captures the response of US government spending, including its reversal after five years which arises from the endogenous response of spending to the government debt ($\varphi^{g,b}$), as shown in Panel (a). It also replicates the hump-shaped response of government debt (Panel b).

Conditional on capturing the US fiscal response, the benchmark model is able to generate a response of the US gross foreign assets (Panel d), the portfolio share of US government bonds (Panel e), the excess returns (Panel f), and the RER (Panel g) that aligns with the data considering the standard error bands. The response of the US gross foreign assets closely tracks the data counterpart for the first three years after the shock, since it is within the 68% confidence intervals, but then it becomes more persistent. The portfolio share of US government bonds shows a weaker response than the data, but it is inside the confidence intervals for all periods except on impact, where it slightly falls rather than increase. This discrepancy arises from an impact effect of the government debt that is smaller than in the data and a response of the US gross foreign assets that overpredicts the data.

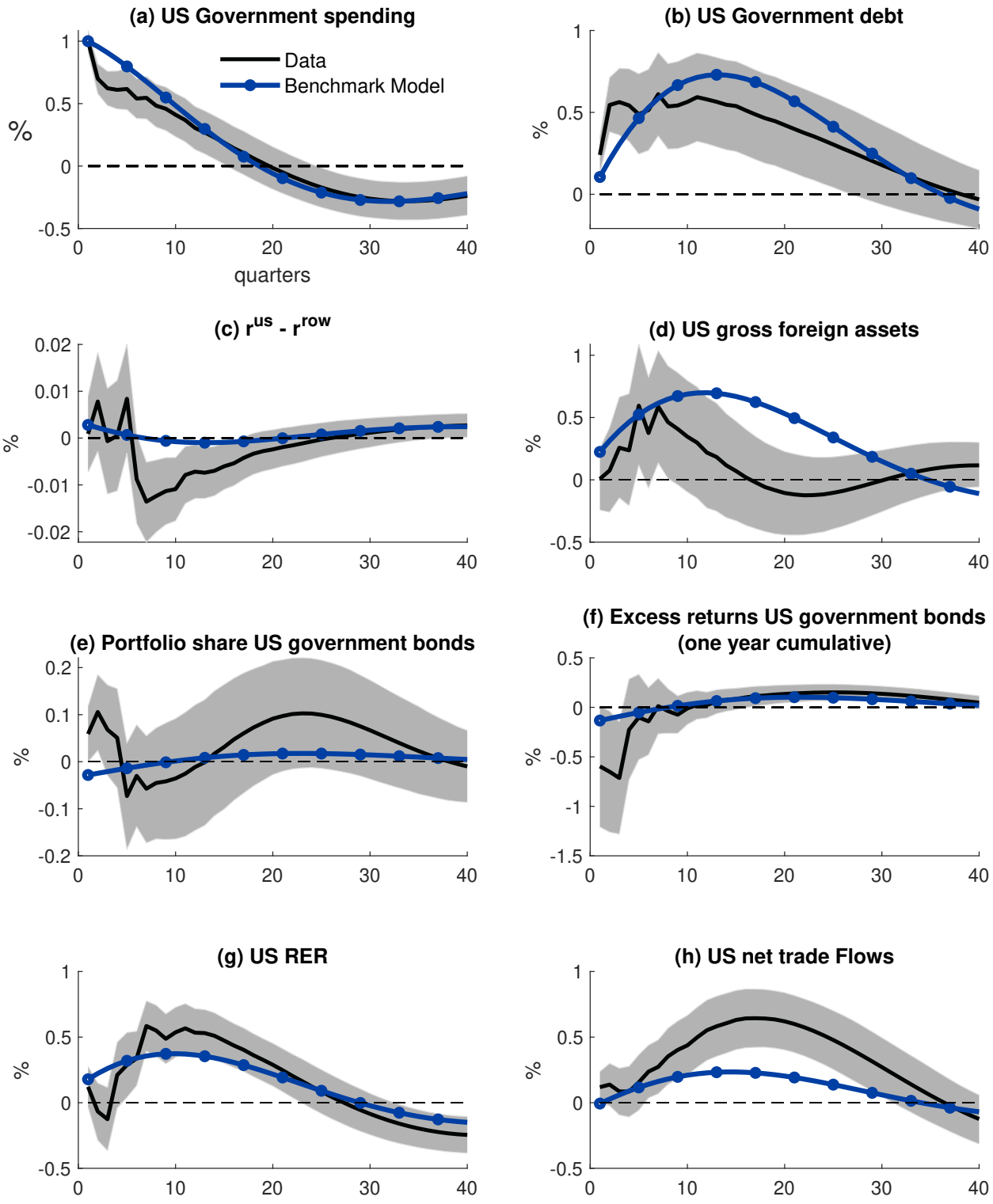


Figure 5: Impulse Response Functions: SVAR and Model

Notes: Standard error bands are 68% confidence intervals.

The path of the excess returns generated by the benchmark model is very close to the data, specially after one year. The model captures its hump-shaped dynamics, which is inherited from that of the portfolio share of US government bonds, following equation 11.

Consequently, the benchmark model is able to replicate the quantitative response of the RER, which has not been done before. Previous explanations for the depreciation of the RER in response to government spending shocks relied on mechanisms where the RER was solely determined by the path of the interest rate differential (Corsetti et al., 2012; Ravn et al., 2012; Jiang, 2021). Figure E.2 shows the response of the RER that would be triggered by the interest rate channel only (i.e. no excess returns) if the model would perfectly match the response of the interest rate differential from the SVAR in red dashed-dotted line.[42]. It is clear from the Figure that the implied RER depreciation that would be triggered 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.

The depreciation of the RER triggers an expenditure switching effect that raises the net trade flows (Panel h). 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 is also present in the simple model of Section 4.1. However, the presence of trade frictions, modeled as a cost of adjusting the bundle of domestic to imported intermediate goods in the CES aggregators, also drives the dynamics of the net trade flows. 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. This allows the model to capture a peak response of the net

[42] I construct this counterfactual by taking the estimated response of the interest rate differential from the SVAR to compute the counterfactual RER using the first term on the right hand side of Equation 8. Hence, $e_t^{\text{counterfactual}} = -\mathbb{E}_t \sum_{j=0}^{\infty} \left(r_{t+j}^{g,us} - r_{t+j}^{g,row}\right)$, where $\mathbb{E}_t \sum_{j=0}^{\infty} \left(r_{t+j}^{g,us} - r_{t+j}^{g,row}\right)$ is constructed from the SVAR IRF of the interest rate differential.

trade response that occurs later than that of the RER.

Figure E.1 displays the responses of other macro variables including relative investment, consumption and GDP. The expenditure switching effect that increases the net trade flows operates mostly through a strong crowding-out of investment, consistent with the data (Panel b). This arises due to the durability of capital goods which makes investment flows more volatile than consumption, and due to the large share of imports of investment goods (32%). On the other hand, while relative GDP increases on impact (Panel a), it falls shortly after the shock, and relative consumption is crowded-out on impact and increases only slowly over time (Panel c), consistent with the data.

Furthermore, Figure E.3 shows that portfolio frictions and the fiscal rule play a crucial role in the international transmission of US government spending shocks, as shown with the simple model of Section 4. In particular, absent portfolio frictions (green dash-dotted line) the model does not generate excess returns of US government bonds, and hence cannot generate the depreciation of the RER (Panel g) and the increase in net trade (Panel h). This version of the model overpredicts the effect on the portfolio share of US government bonds. This arises from a counterfactual fall in the US gross foreign assets in response to the shock, since the response of the government debt is virtually the same as in the benchmark model.

On the other hand, the case where the fiscal rule stabilizes the value of government debt in the US, so that taxes are the instrument used to finance the spending shock, cannot replicate the data as well (orange-> line). Without a response of the US government debt, there is no direct effect on the portfolio share of US government bonds. As shown by equation 11, this implies that the excess returns would be almost unchanged and hence the RER would not be affected by this channel. Consequently, the standard interest rate channel operates and the RER appreciates due to the increase in the interest rate differential. Hence, the benchmark model confirms that both portfolio frictions and a fiscal rule that relies heavily on the sue of government debt to finance spending are key for capturing the international transmission of US government spending shocks.

Finally, the presence of trade frictions also plays an important role in the quantitative success of the benchmark model to capture the international transmission of US government spending shocks. Figure E.4 shows the responses of key variables in the case with no trade frictions, i.e. under $\iota = 0$, and in the benchmark model. In the absence of frictions in moving goods across

countries, there is a stronger response of US consumption growth after its initial fall relative to the benchmark model (Panel a). A stronger US consumption growth translates into higher interest rates in the US (Panel c). As shown by equation 12, a higher expected sum of future interest rate differentials tends to appreciate the RER. Hence, trade frictions dampen the interest rate channel that tends to appreciate the RER, by weakening the response of US consumption growth. Finally, since absence trade frictions the depreciation of the RER is smaller, the expenditure switching effect is also dampened. Hence, the increase in net trade weakens significantly in the absence of trade frictions (Panel h). Additionally, the response of net trade is more front-loaded than in the benchmark model, due to the absence of a dynamic trade elasticity.

6.2 Implications for International Business Cycles and the RER Disconnect

The benchmark model captures the dynamics of international business cycles, both in terms of targeted and untargetted unconditional moments. These are displayed in Table 7, 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 rates 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 the joint RER and the net trade dynamics. It captures their relative volatility, and the short and long run trade elasticity.

The benchmark model captures other key financial and real moments, such as the unconditional dynamics of GDP, investment, interest rates, government debt, gross foreign assets and liabilities, and the portfolio share of US government bonds. 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).

Furthermore, the model replicates the negative correlation between the interest rate differential and the RER. This moment has been highlighted by Kekre and Lenel (2024) as a shortcoming of models where the RER is mainly driven by UIP shocks. However, it is worth noticing that the

presence of trade frictions alone can generate a negative correlation in these types of models, without any need to include demand shocks, as shown by Mac Mullen and Woo (2024).[43] The presence of trade frictions dampens the effect of UIP shocks on consumption growth, making it negative so that the domestic interest rate actually falls, similar to the role of trade frictions in the international transmission of US government spending shocks described in Section 6.1.

Moment	Data	Benchmark	Contribution G^{us} shocks	Moment	Data	Benchmark	Contribution G^{us} shocks
Panel A: Target Moments							
1. $\sigma(gov^{us})/\sigma(gdp^{us})$	3.69	3.46	3.62	10. SR trade elast.	0.17	0.06	0.11
2. $\sigma(gov^{row})/\sigma(gdp^{row})$	0.62	0.62	0.23	10. LR trade elast.	1.37	1.36	0.30
3. $\rho(gov^{row})$	0.80	0.81	0.99	11. $\sigma(gfa^{us})/\sigma(gdp^{us})$	4.40	4.97	4.71
4. $\sigma(inv^{us})/\sigma(gdp^{us})$	3.49	2.97	2.57	12. $\sigma(B^{g,us})/\sigma(gdp^{us})$	3.66	3.77	3.94
5. $\rho(gdp^{us}, gdp^{row})$	0.86	0.75	0.94	13. $\sigma(s^{g,us})/\sigma(gdp^{us})$	1.12	0.75	0.62
6. BSK: $\rho(\Delta(c^{us} - c^{row}), \Delta rer)$	-0.17	-0.32	-0.74	14. $\sigma(r^{us} - r^{row})/\sigma(gdp^{us})$	0.06	0.06	0.02
7. $\sigma(rer)/\sigma(gdp^{us})$	3.82	4.18	2.01	16. $\rho(r^{us} - r^{row})$	0.89	0.86	0.96
8. $\sigma(nt)/\sigma(rer)$	1.27	1.50	0.70	17. $\rho(s^{g,us})$	0.91	0.91	0.93
9. $\rho(rer)$	0.95	0.97	0.99	18. β_{Fama}	-1.38	-1.31	-0.10
Panel B: Untargetted Moments							
1. $\rho(B^{g,us} - B^{g,row}, rer)$	0.74	0.40	0.89	8. $\rho(inv^{us}, inv^{row})$	0.31	0.02	0.56
2. R^2_{Fama}	0.01	0.001	0.001	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	-0.85	-0.99
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	-0.31	-0.44	12. $\rho(B^{g,us}, g^{us})$	0.50	0.38	0.38
6. Low freq RER spectrum	0.62	0.68	0.70	13. $\rho(B^{g,us}, gfa^{us})$	0.23	0.77	0.84
7. BC freq RER spectrum	0.31	0.25	0.25	14.$\rho(gfa^{us}, gfl^{us})$	0.83	0.68	0.95

Notes: gfa and gfl stand for gross foreign assets and liabilities. BC stands for 'Business Cycle'. The moments reported in the columns 'Contribution G^{us} shocks' correspond to those obtained from simulating the model shutting down the ROW government spending shock, and the differential productivity, trade and financial shock, i.e. $\sigma_g^{row} = \sigma_z^d = \sigma_\xi^d = \sigma_\psi^d = 0$.

Table 7: Unconditional Moments

The benchmark model jointly accounts for the conditional moments related to the inter-

[43] See Mac Mullen and Woo (2024) Table 2 Column 4.

national 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 productivity, trade and financial shocks (ϵ_z^d, ϵ_ξ^d and ϵ_ψ^d) are shut down, as well as ROW government spending shocks (ϵ_g^{row}). In this case, relative variables, including 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.[44] The moments triggered by this version of the model are displayed in Table 7 under the column name 'Contribution G^{us} shocks'.[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 2.01 times larger than that of GDP. It also results in a nearly unit root in the RER, since its autocorrelation is 0.99, higher than 0.97 in the benchmark model. The Backus-Smith-Kollmann correlation is negative, even more so than in the benchmark model. Finally, the coefficient of the Fama (1984) regression of the interest rate differential on the change in the RER is negative 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.

The importance of US government spending shocks for the RER dynamics can also be seen from the variance decomposition. Table E.1 presents the variance decomposition of the SVAR model and the benchmark model. The share of the variance of the RER explained by the US government spending shock in the data and model are similar, 32 and 21 percent respectively. The share of the variance of the excess returns or UIP deviations are also similar, being 17 percent in the SVAR and 20 percent in the benchmark model. This is further evidence in favor of the model mechanism. Importantly, the model delivers these results while being consistent with the portion of the variance of the portfolio share of US government bonds explained by this shock. In the SVAR this number is 3 percent and in the model it is 2 percent.

But, how is it possible that the share of the variance of the portfolio share of US government

[44] 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.

[45] This model is not re-estimated.

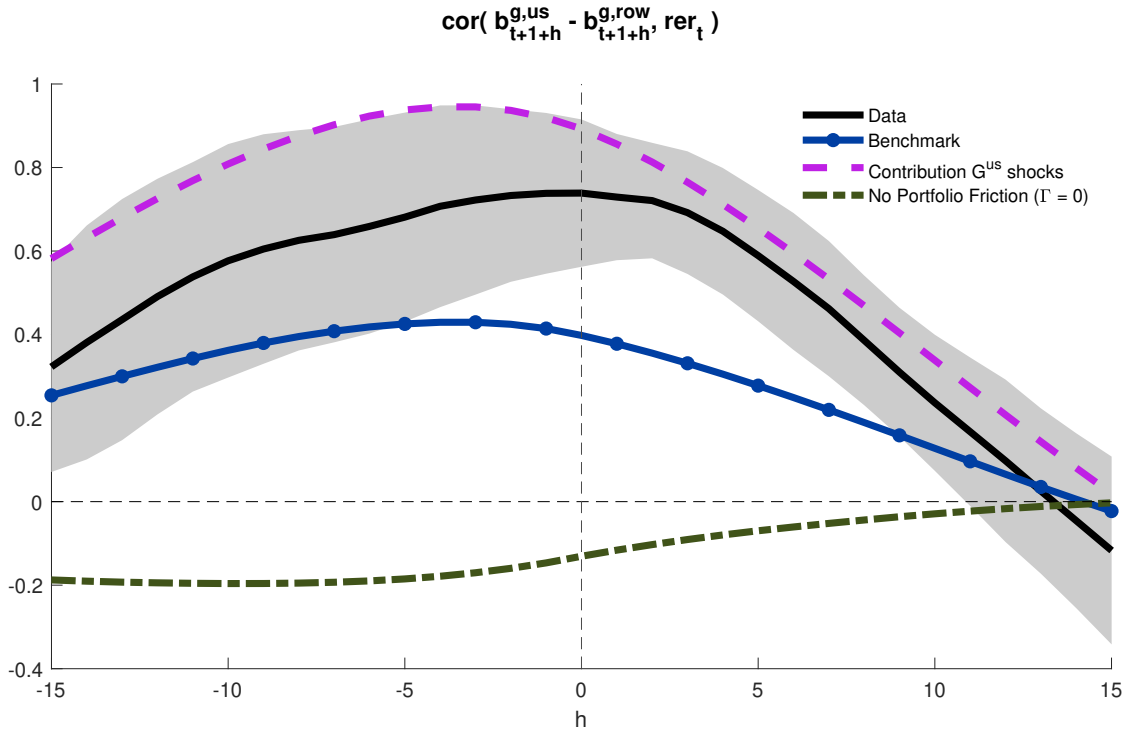


Figure 6: Dynamic Correlation between Relative Government Debt and the RER

Notes: Standard error bands are 68% confidence intervals.

bonds explained by the US government spending shock is so low relative to the share explained for the excess returns and the RER when the latter variables are driven by the former? The reason is that most of the variance of the portfolio share of US government bonds is explained by the common financial shock, which has no effect on the RER and excess returns. A positive common financial shock raises the long-run level of the portfolio share of foreign bonds in the adjustment cost in Equation 10 for both the US and ROW households. This captures for example common changes in long trends in financial liberalization. Since the effect is symmetric for both households, they both increase their share of savings in foreign bonds in the amount exactly needed to avoid paying the cost of deviating from the long-run share of foreign assets. Hence, although the portfolio share of foreign assets changes in response to this shock, there are no deviations relative to its long-run level inclusive of the shock and therefore no effect on excess returns and the RER.[46] The benchmark model is then consistent with the share of the variance of

[46]Following Equations 11 and 12, what happens is that the term of the financial shock exactly cancels out with the term of the deviations of the portfolio share of government bonds.

key variables explained by the US government spending shock in the SVAR.

Finally, the benchmark model goes a long way in capturing the comovement between the relative government debt and the RER, presented in Figure 1. The model generates a correlation of 0.40, with the value in the data being 0.74. Additionally, the benchmark model also captures the dynamic comovement between these variables. Figure 6, 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 7 under the column name 'Contribution G^{us} shocks'. 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 is worth mentioning that the ability of the benchmark model to capture the positive correlation between relative government debt and the RER is not trivial. Figure 6 also presents the dynamic correlation obtained from simulating the model without portfolio frictions, i.e. under $\Gamma = 0$ (green dashed-dotted line). This version, which is closer to 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 portfolio friction is key to account for the joint dynamics of relative government debt and the RER presented in Figure 1.

To summarize, the fiscal mechanism proposed in this paper is able to explain quantitatively the empirical evidence on the international transmission of US government spending shocks. The mechanism operates through endogenous deviations from UIP, arising from the interaction of a fiscal rule that relies heavily on the use of government debt to finance spending and portfolio rebalancing frictions. Furthermore, the mechanism provides a resolution to the RER disconnect puzzle based on well-identified shocks, and rationalizes the observed comovement between relative government debt and the RER displayed in Figure 1.

7 Sensitivity Analysis

I investigate the sensitivity and robustness of the results of the benchmark model to alternative specifications. I explore the implications of targeting conditional moments from the SVAR and the unconditional moments for the identification, the sensitivity to the calibrated partial equilibrium aggregate demand elasticity of internationally traded bonds and to allowing for a special role of US government debt in international financial markets. The details are in Appendix F.[47]

I find that targeting the IRFs from the SVAR is crucial for identifying the fiscal rule, otherwise the model overpredicts the response of of both government spending and debt. Nevertheless, whenever I target either the conditional moments or the unconditional moments, the results are similar to the benchmark model in terms of the implications for the portfolio share of US government bonds, the excess returns, the US gross foreign assets, the RER and net trade in response to US government spending shocks.

A key parameter in the model is the portfolio cost Γ which governs the partial equilibrium aggregate demand elasticity of internationally traded bonds. I study the sensitivity to this by considering a version where the portfolio friction is set to a higher elasticity of 3, which is within the range of estimates in the literature (Moretti et al., 2024). In this alternative case the value of Γ is 0.80, the same as that estimated one by Guo et al. (2023) for Canada. In this case the response of the portfolio share of US government bonds is closer to the data, as it responds more than in the benchmark model, and the main results from the benchmark model still hold. Moreover, the importance of portfolio frictions for the international transmission of fiscal policy would strengthen if the asset demand elasticity would be lower, which would be the case under the estimated value by Camara et al. (2024) for advanced economies (Γ equal to 3.20).

Finally, I consider the implications of allowing for a special role of the US government bonds, by letting them be the only government bond traded internationally. Hence, US government bonds are the only asset in the model through which both US and ROW households can save.[48] This version of the model captures how much of the increase in the supply of total US government

[47] All models are re-calibrated. The estimated parameters are displayed in Table F.1, the IRFs to US government spending shocks are displayed in Figures F.1, F.2 and F.3, and the unconditional moments in Tables F.2 and F.3.

[48] Recall that in the model bonds issued by households are considered assets for the issuing household but liabilities for the purchasing household. In this version of the model US government bonds are assets for both households.

debt after the spending shock is absorbed by the US and ROW agents (Figure F.3).[49] This model identifies similar parameters as the benchmark model, thus generating similar results. This arises from the fact that the mechanism is unchanged, since the same UIP condition in equation 7 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. Finally, allowing for cross-country trade in government bonds brings the model closer in capturing the volatility of the portfolio share of US government bonds.

8 Testing the Implications of the Theory using Cross-Country Data

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 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 G. In particular, I estimate country-by-country responses of government debt, the RER and the current account, to military spending shocks. The sample includes 125 countries, where 29 are advanced economies, 60 are developing economies, and 36 poor economies.

I find a positive relationship between the use of government debt to finance the government spending shock, a depreciation of the RER, and an increase in the current account. This is the case for the full sample and within each country group (Figures G.1, G.2, G.3 and G.4). Hence, the mechanism proposed in this paper also helps to explain some of the cross-country heterogeneity in the responses of the RER and the current account/net trade to government spending shocks.

Finally, the findings are stronger for advanced economies than for developing and poor economies. This could be related to differences in the currency composition of government debt

[49] I assume in this model that the ROW household faces an adjustment cost for changing the value of her holdings of US government bonds relative to the steady state, $\frac{\chi}{2}\left(B^{g,us,row}_{t+1}P^{g,us}_{t}/\mathcal{E}_t - B^{g,us,row}_{ss}P^{g,us}_{ss}/\mathcal{E}_{ss}\right)^2$, and for the bonds issued by the US household relative to the steady state, $\frac{\chi}{2}\left(B^{us,row}_{t+1}P^{us,row}_{t}/\mathcal{E}_t - B^{us,row}_{ss}P^{us,row}_{ss}/\mathcal{E}_{ss}\right)^2$. The adjustment cost χ is set to 0.00001, and is used to pin down the steady state values of $B^{g,us,row}_{ss}$ and $B^{us,row}_{ss}$. The value of $B^{g,us,row}_{ss}$ is chosen to match the average of this variable in the data between 1980 and 2019 (16% of US GDP).

across country groups. In the model, if the government debt would issue debt in foreign currency then the excess returns of domestic government bonds would not depend on the exchange rate, but only on the interest rate differential. In this case all the adjustment to compensate for the re-balancing friction would operate through the interest rate of government bonds, with no effect on the RER. Since governments in developing and poor economies rely more on foreign currency than in advanced economies, one would expect to find a relation between government debt, the RER and net trade that aligns more closely with the predictions of the theory in advanced economies, as it is the case.

9 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 in response to US government spending shocks. This mechanism operates through endogenous excess returns on US government debt relative to foreign debt. The model captures this mechanism via a fiscal rule that relies heavily on government debt to finance spending and the presence of portfolio frictions. I embed the mechanism in a model featuring a rich set of additional frictions and shocks that account for salient facts of international business cycles, showing that US government spending shocks are crucial for explaining 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 portfolio frictions induce 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 especially relevant given the sizable increase in government spending and debt worldwide following the COVID-19 pandemic, which is expected to remain elevated in the future. Additionally, the framework can be applied to study government spending multipliers and the interaction of fiscal and monetary policy in the open economy. It can also readily accommodate salient features of developing economies to further investigate cross-country heterogeneity in the responses of the RER and net trade to fiscal shocks, such as the foreign currency denomination of domestic government bonds.

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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 C.3 (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.[50] I focus on cycles of frequencies lower than the standard case (i.e. cycles up to eight years)

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

for two reasons. First, the cyclical component of relative government debt is strongly driven by that in the US (Figure A7), which in turn is driven by the US military build-ups (Panel (a) in Figure A6) 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 5.2 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 A8, and A9, 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 government 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.[51]

Finally, Figure A6 presents the time series of the cyclical component of US government spending (blue line with *o*), and US government debt in (black solid line). The figure shows that US government 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.

[51] 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).

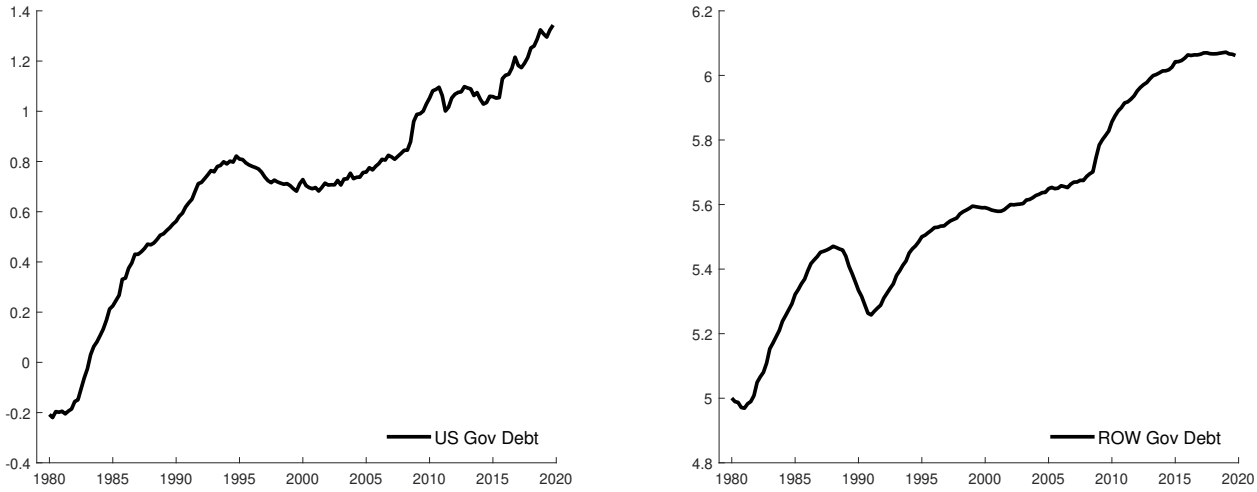


Figure A1: US and ROW Real per capita Government Debt: Raw Data

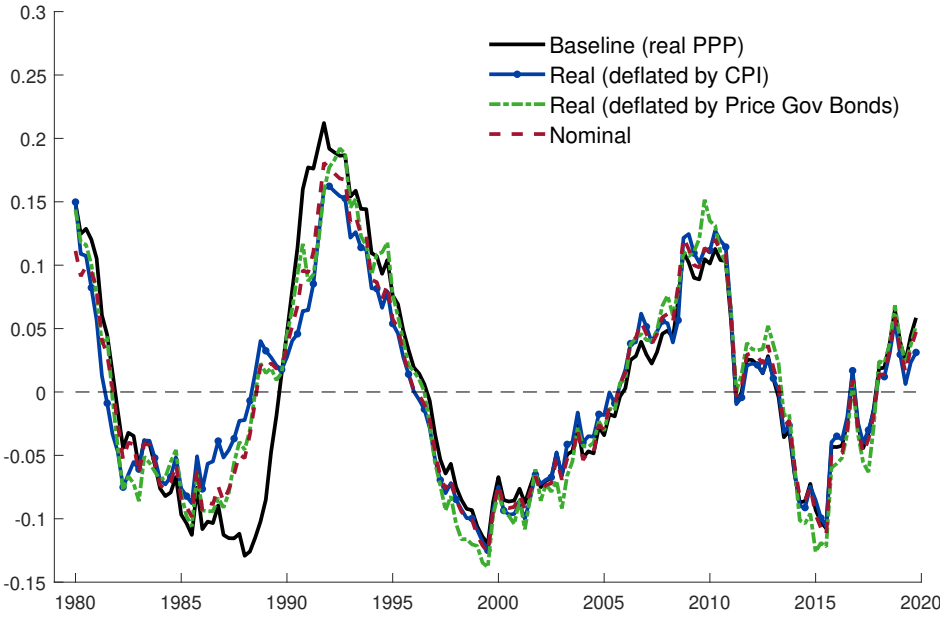


Figure A2: Relative Government Debt: Alternative Deflation Measures

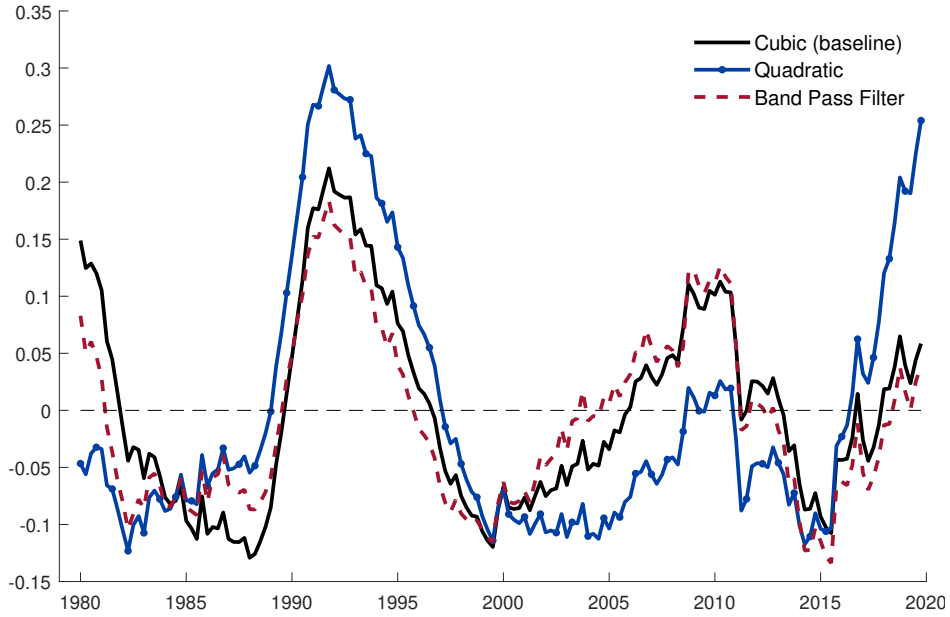


Figure A3: Relative Government Debt: Alternative De-trending Measures

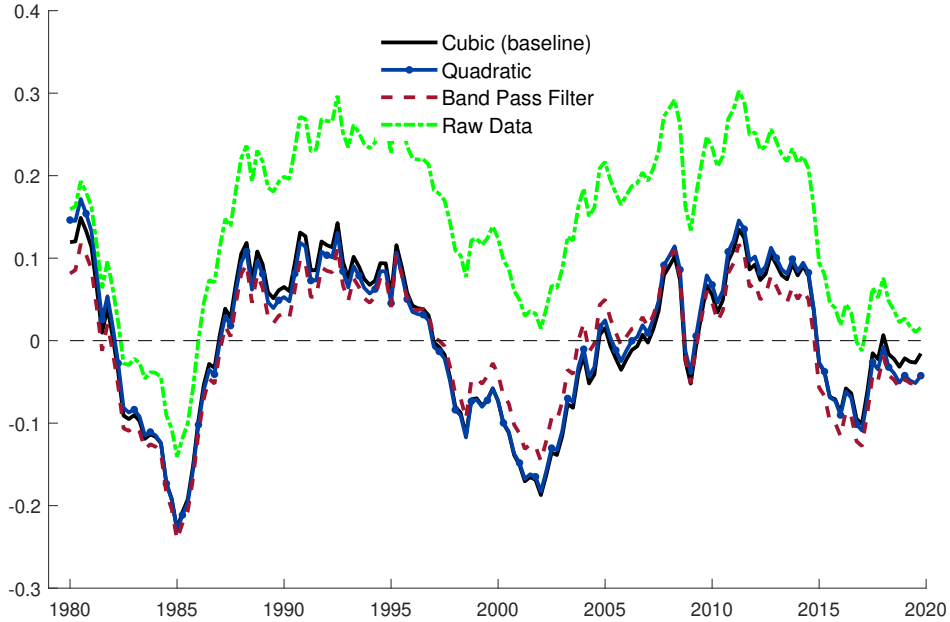


Figure A4: US RER: Alternative Measures

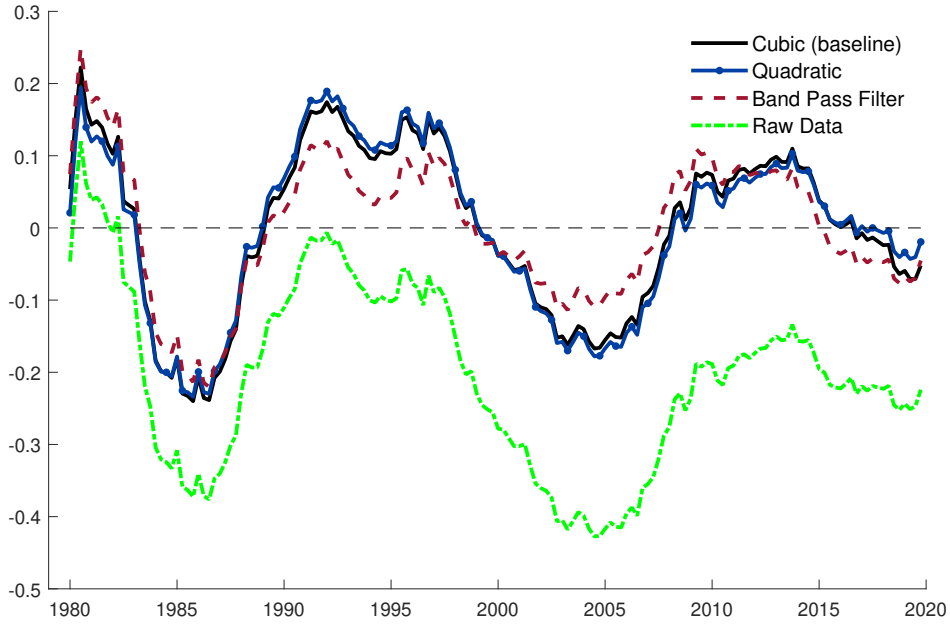


Figure A5: US Net Trade: Alternative Measures

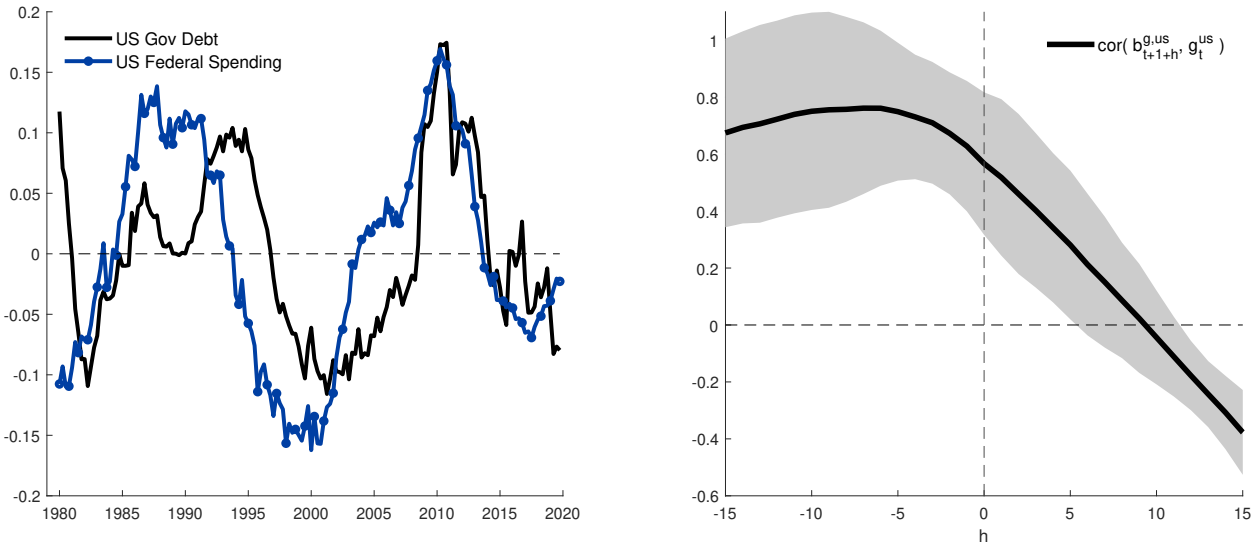


Figure A6: US Federal Spending and US Government Debt

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.

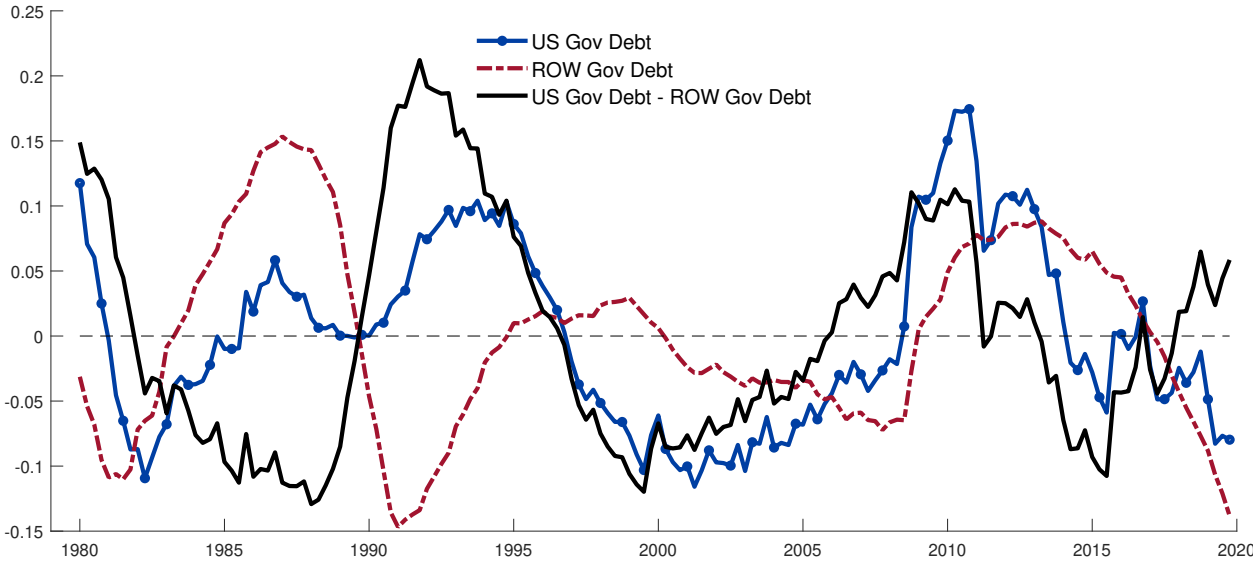


Figure A7: Relative Government Debt Components

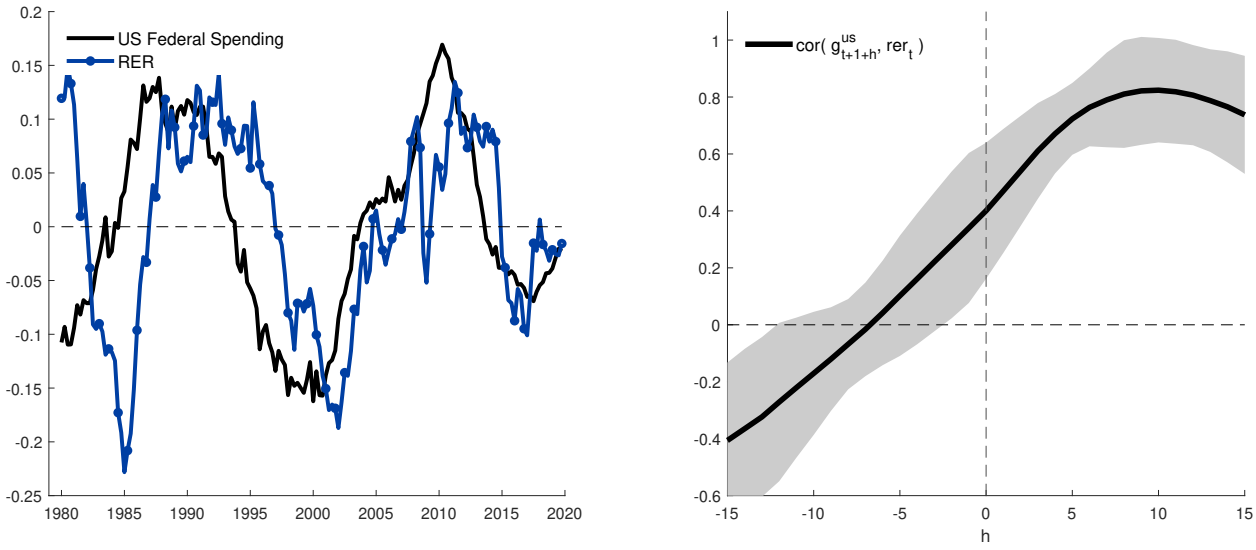


Figure A8: US Government Spending and the RER

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.

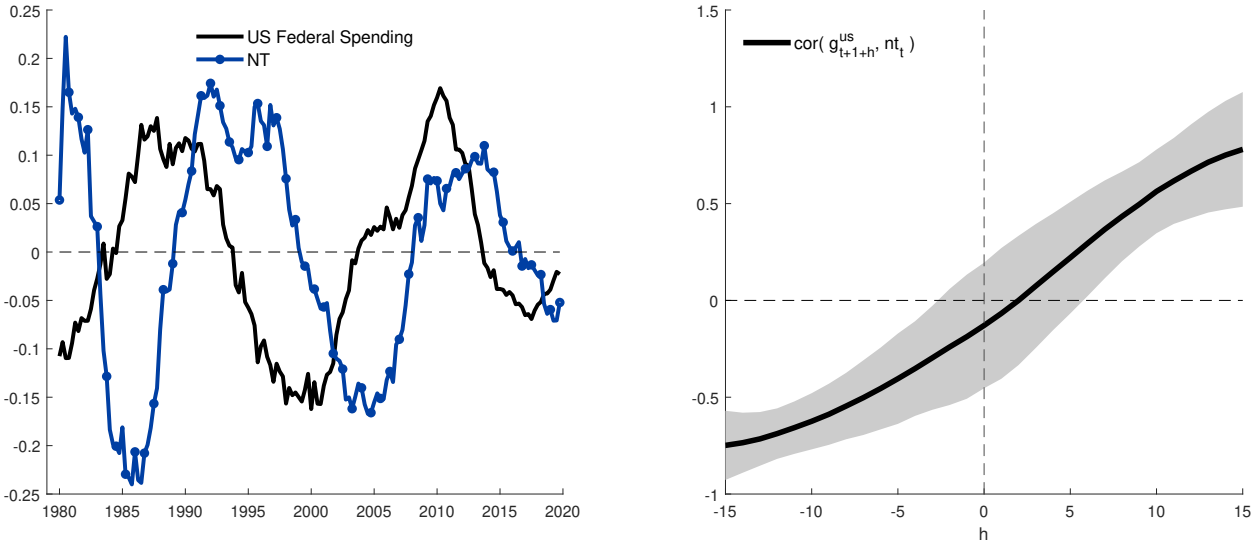


Figure A9: US Government Spending and Net Trade

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.

B SVAR Appendix

To study the effects of US government spending shocks on relative consumption, UIP, US (federal) government debt (held by US agents excluding US government institutions), the US gross foreign assets and liabilities, and the portfolio share of US savings in US government bonds, I rotate these variables in the SVAR. The vectors of data in these specifications of the SVAR are given by,

Relative consumption:

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

where $con_t - con_t^{row}$ is relative log consumption (per capita).

UIP:

$$Y_t' \equiv \left[FEG_t^{fed,us},\ g_t^{fed,us},\ g_t^{row},\ gdp_t - gdp_t^{row}, NT_t, UIP_t\right]$$

where $UIP_t = r_t^{us} - r_t^{row} - (RER_{t+1} - RER_t)$.

US Government debt:

$$Y_t' \equiv \left[FEG_t^{fed,us},\ g_t^{fed,us},\ g_t^{row},\ gdp_t - gdp_t^{row},\ RER_t, NT_t, d_t^{us\,gov}\right]$$

where $d_t^{us\,gov}$ is the logarithm of the real value of per capita US (federal) government debt in hands of US agents (excluding US government institutions). I exclude the interest rate differential since the US government debt is measured in terms of its market value.

US Gross foreign assets and liabilities:

$$Y_t' \equiv \left[FEG_t^{fed,us},\ g_t^{fed,us},\ g_t^{row},\ gdp_t - gdp_t^{row}\ RER_t, gfl_t, gfl_t\right]$$

where gfl_t and gfa_t are the logarithm of the US gross foreign liabilities and assets, respectively. These are measured in per capital real terms. I exclude the interest rate differential since the US gross foreign liabilities and assets are measured in terms of its market value, and net trade since it is highly correlated with the difference between the gross foreign assets and liabilities.

Portfolio share of US government bonds:

$$Y_t' \equiv \left[FEG_t^{fed,us},\ g_t^{fed,us},\ g_t^{row},\ gdp_t - gdp_t^{row},\ RER_t, gfl_t, s_t^{g,us}\right]$$

where $s_t^{g,us} = \frac{\hat{D}_t^{us\ gov}}{\hat{D}_t^{us\ gov} + G\hat{F}A_t}$ is the share of savings in US government bonds, $\hat{D}_t^{us\ gov}$ is the nominal value of the US (federal) government debt in hands of US agents (excluding US government institutions) and $G\hat{F}A_t$ the nominal value in dollars of the US gross foreign assets.

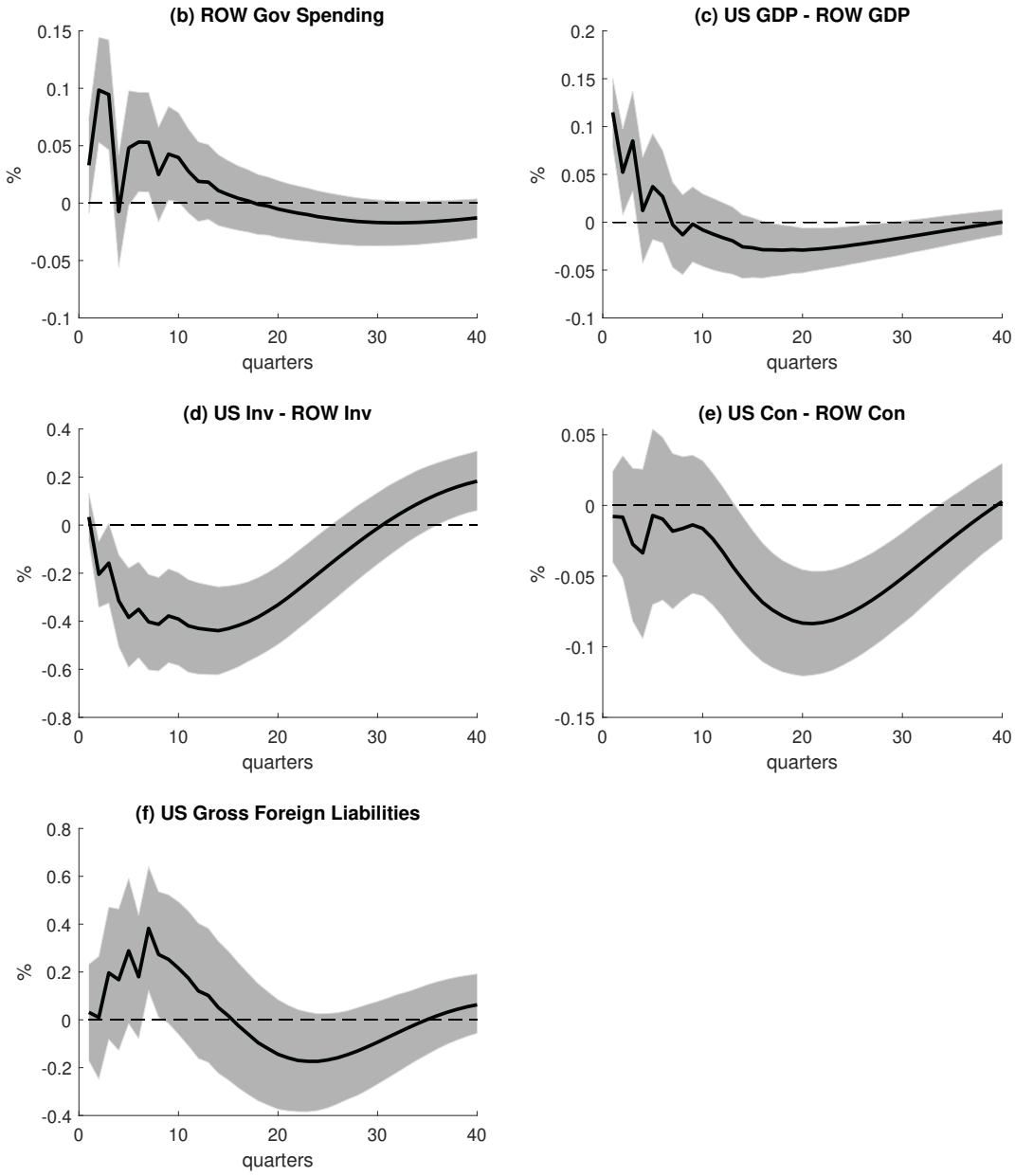


Figure B.1: IRF of the remaining variables in the SVAR

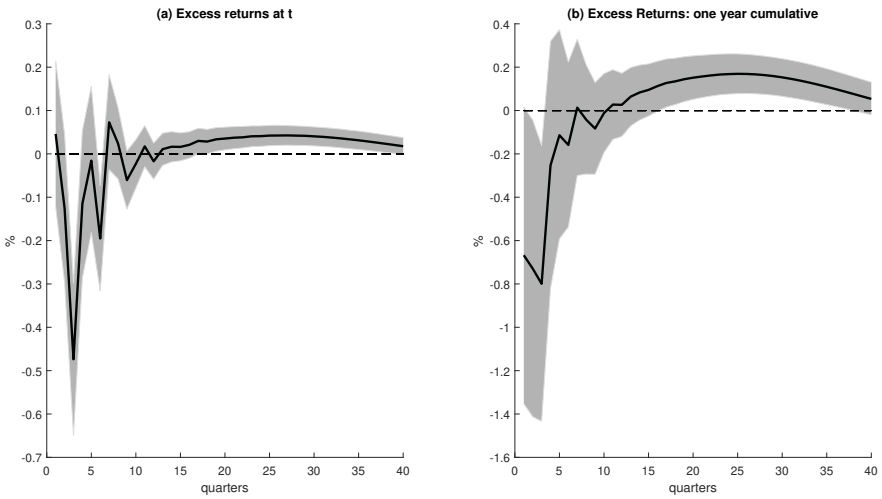


Figure B.2: IRFs of Excess Returns on US Gov Bonds in the SVAR

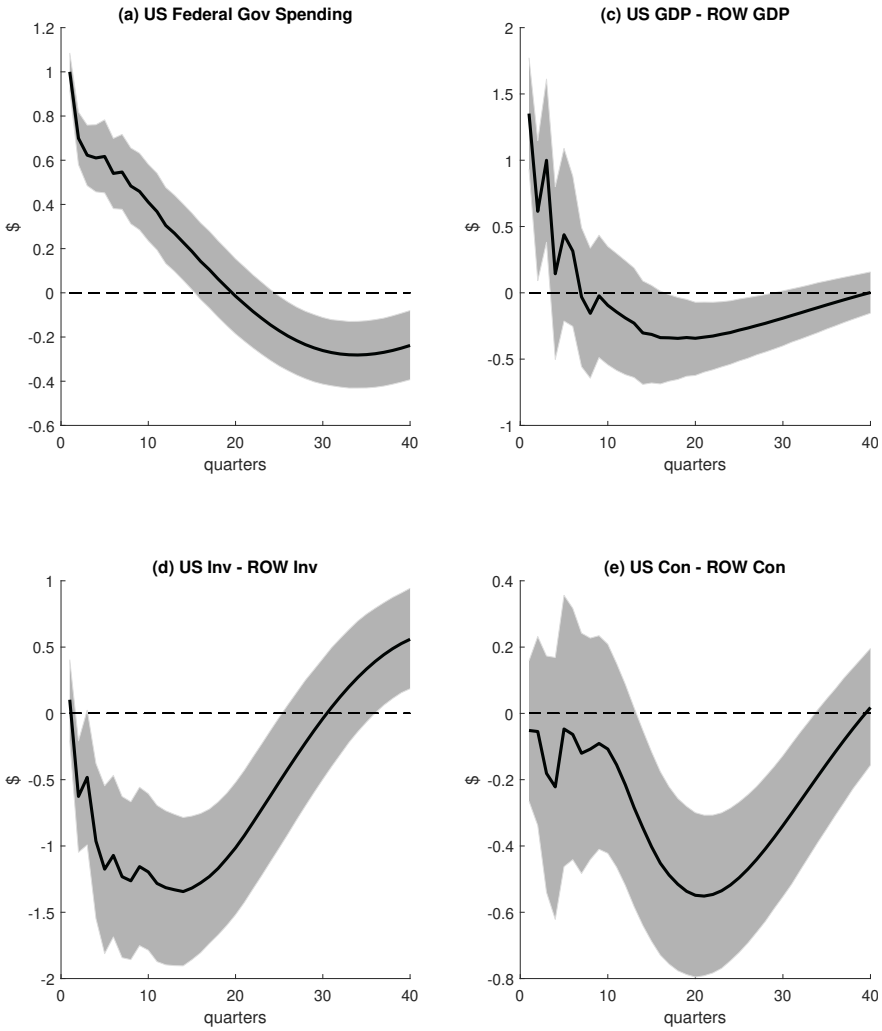


Figure B.3: Baseline IRFs of Macro Aggregates in Dollars

Notes: Standard error bands are 68% confidence intervals.

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 C.1 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 C.2 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 C.3 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.

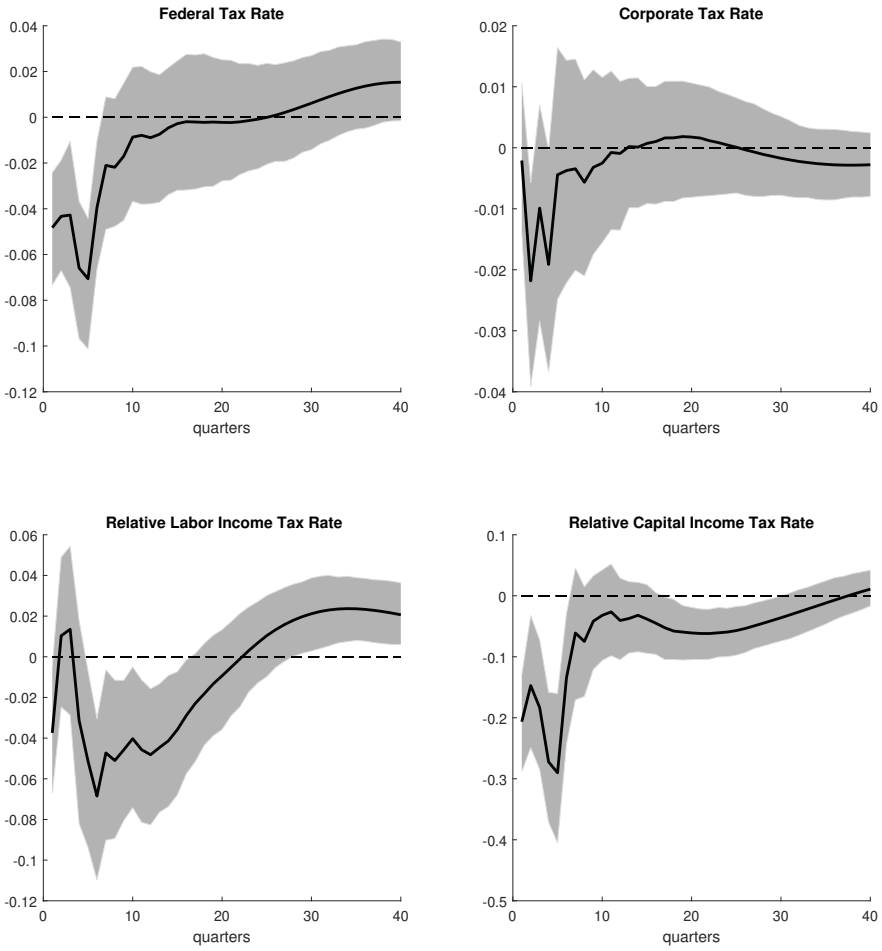


Figure C.1: IRFs other Fiscal Variables

Notes: Standard error bands are 68% confidence intervals.

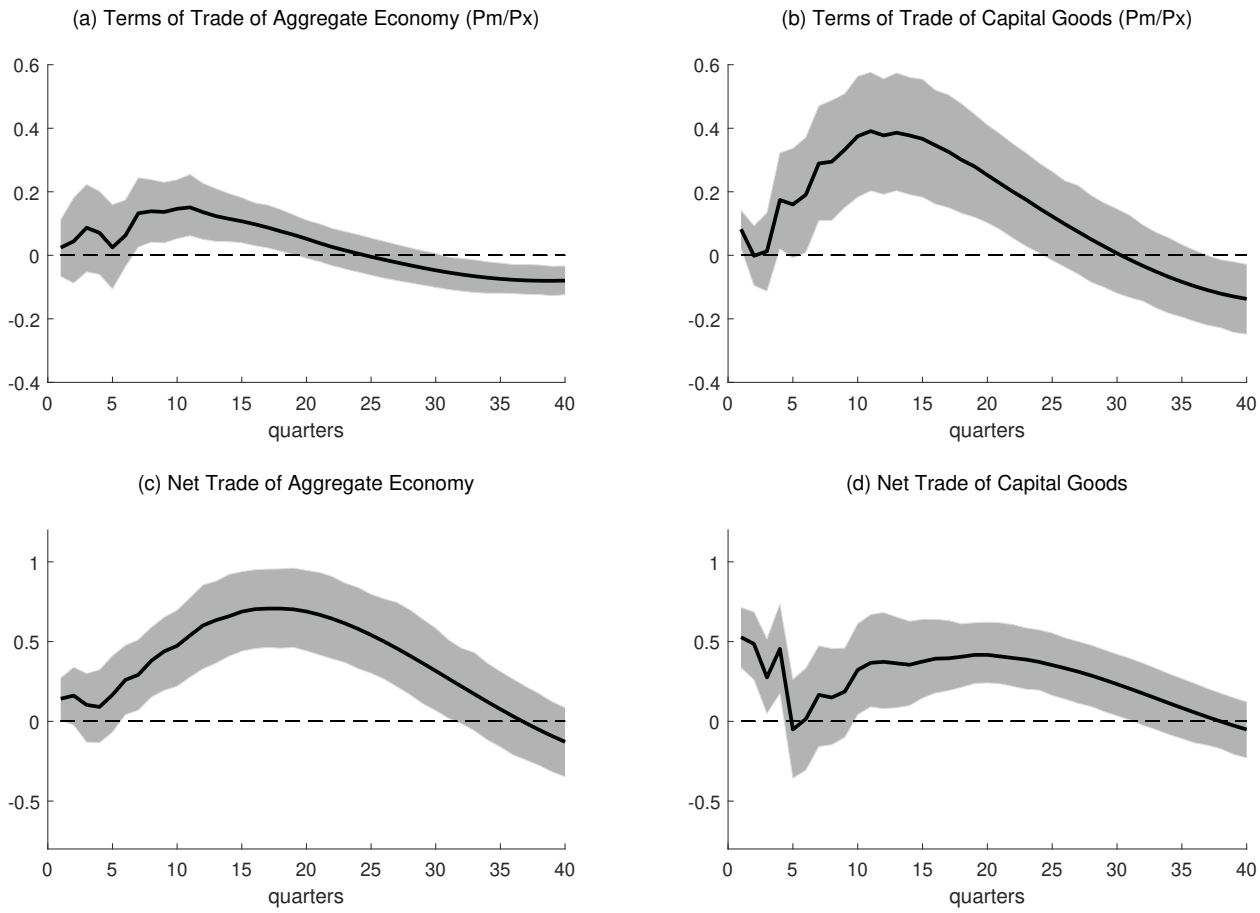


Figure C.2: International Goods Markets Mechanism

Notes: Standard error bands are 68% confidence intervals.

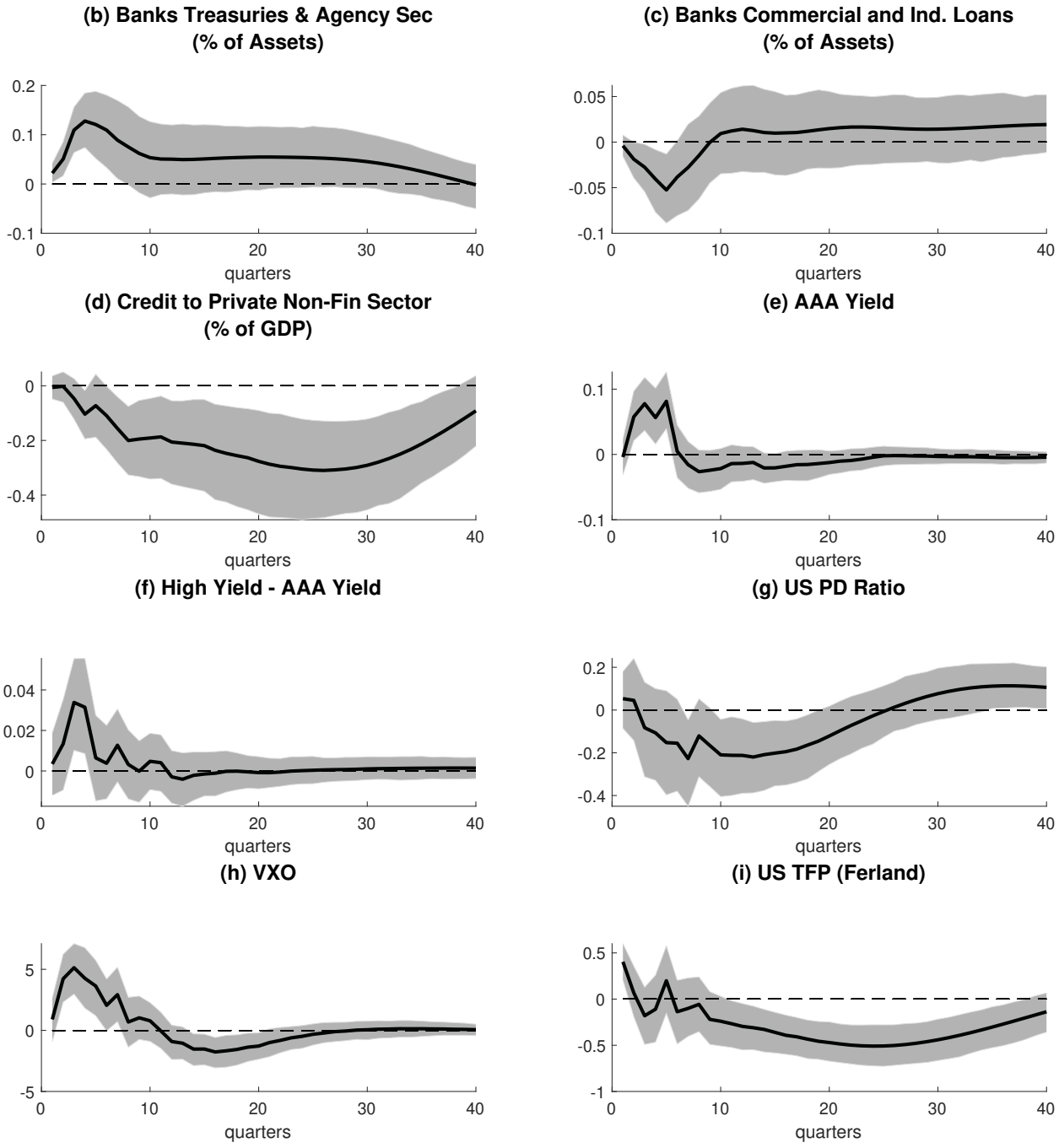


Figure C.3: IRFs of other US Financial Markets and Banking Variables

Notes: Standard error bands are 68% confidence intervals.

D SVAR Robustness

D.1 Alternative Identification Strategies

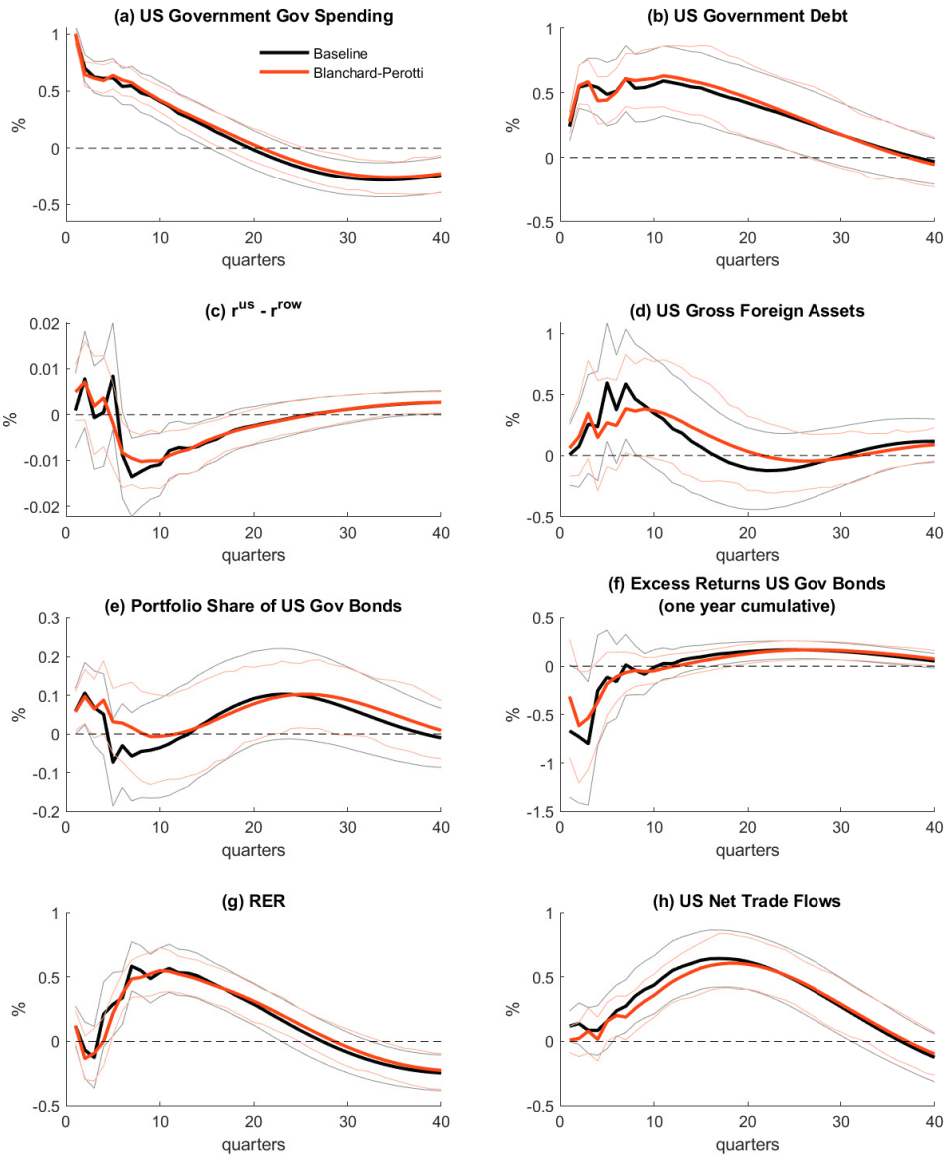


Figure D.1: Blanchard-Perotti

Notes: Standard error bands are 68% confidence intervals.

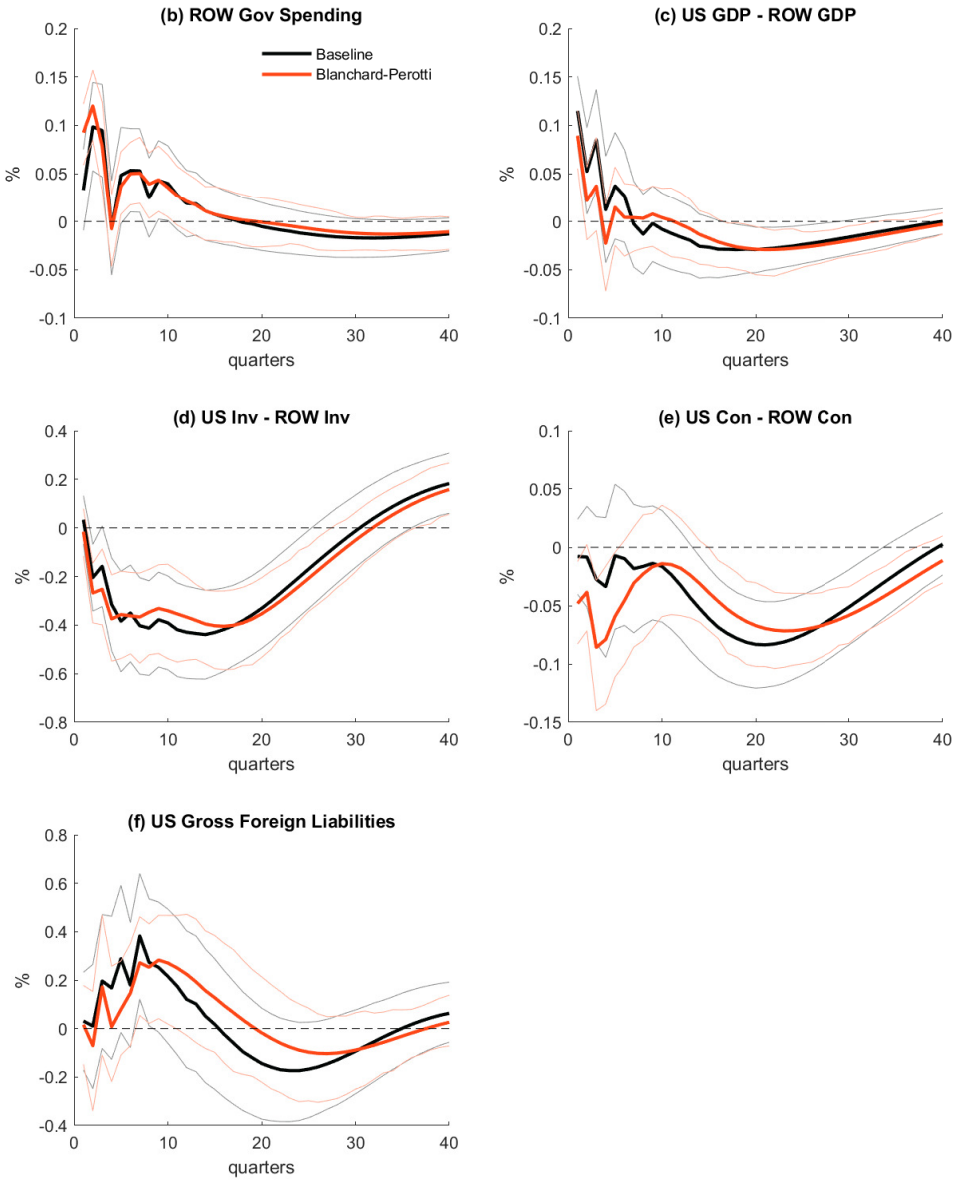


Figure D.2: Blanchard-Perotti

Notes: Standard error bands are 68% confidence intervals.

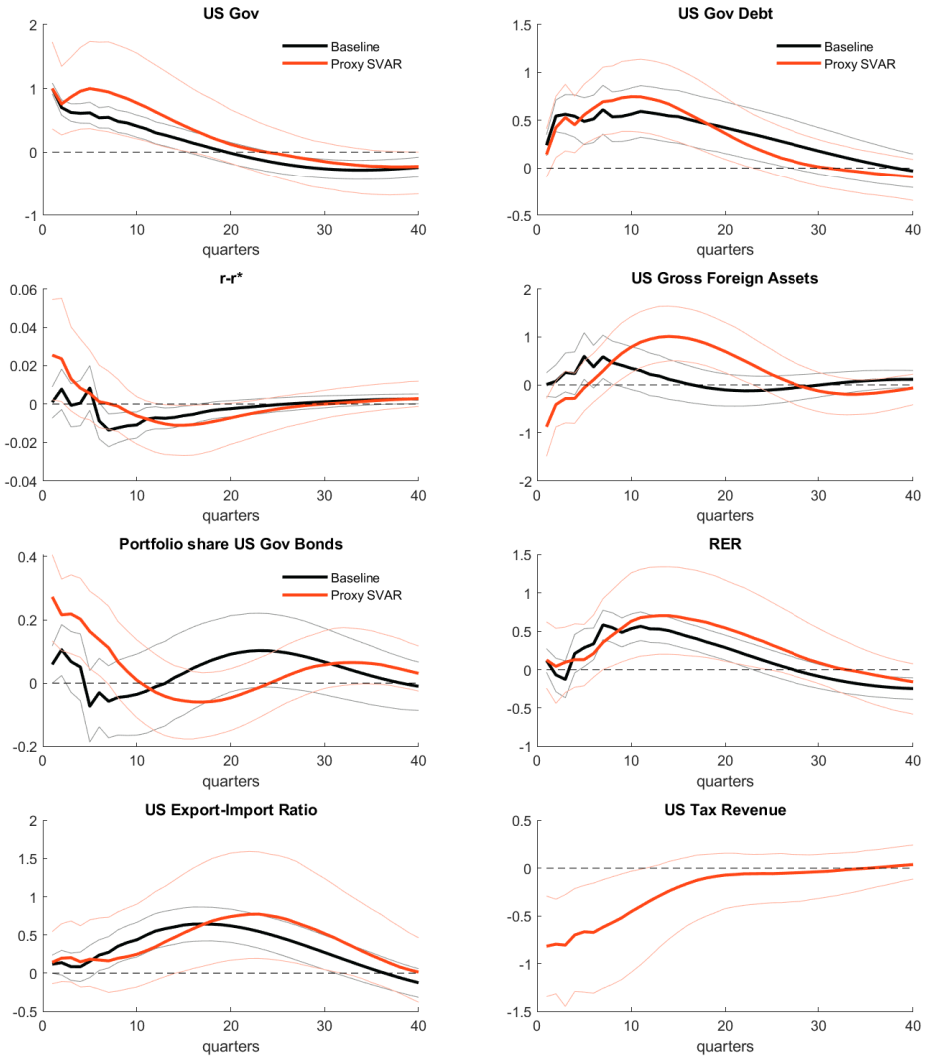


Figure D.3: External Instruments or Proxy SVAR

Notes: Standard error bands are 68% confidence intervals.

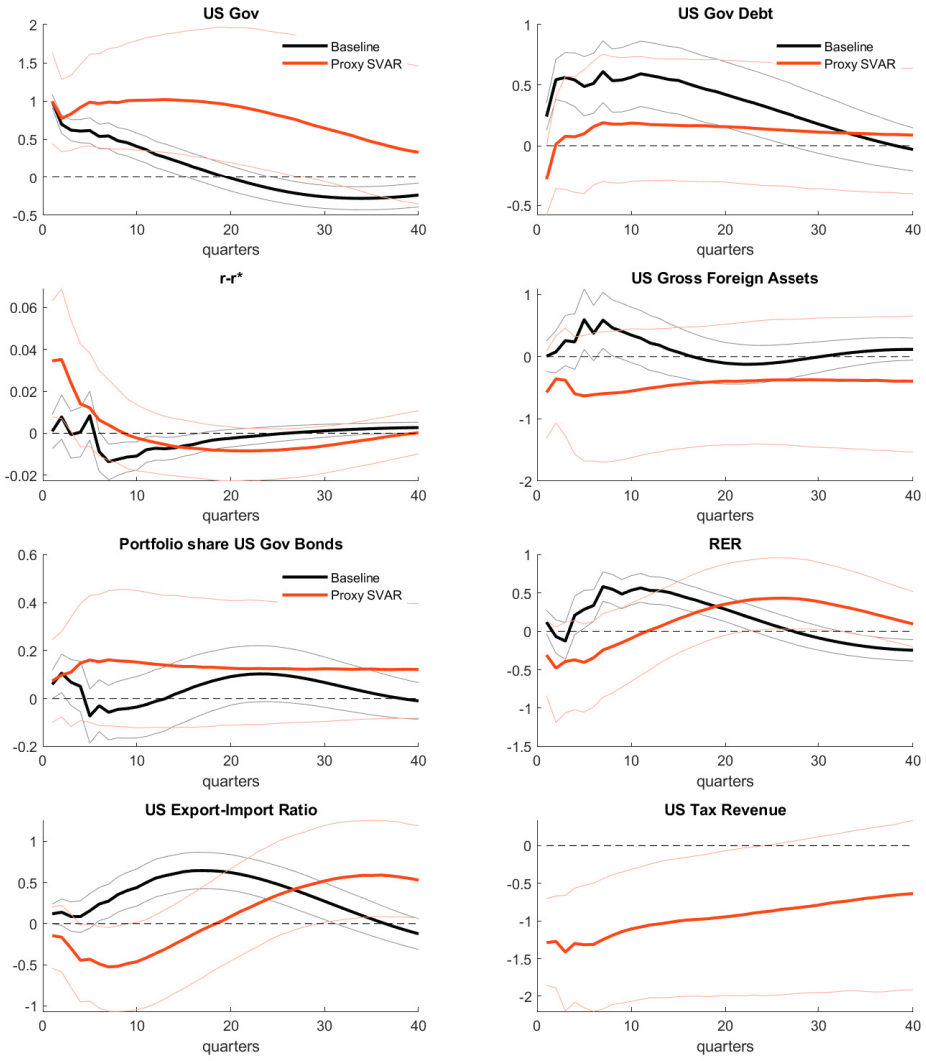


Figure D.4: External Instruments or Proxy SVAR: no trends in Proxy SVAR

Notes: Standard error bands are 68% confidence intervals.

D.2 Alternative Controls and Sensitivity

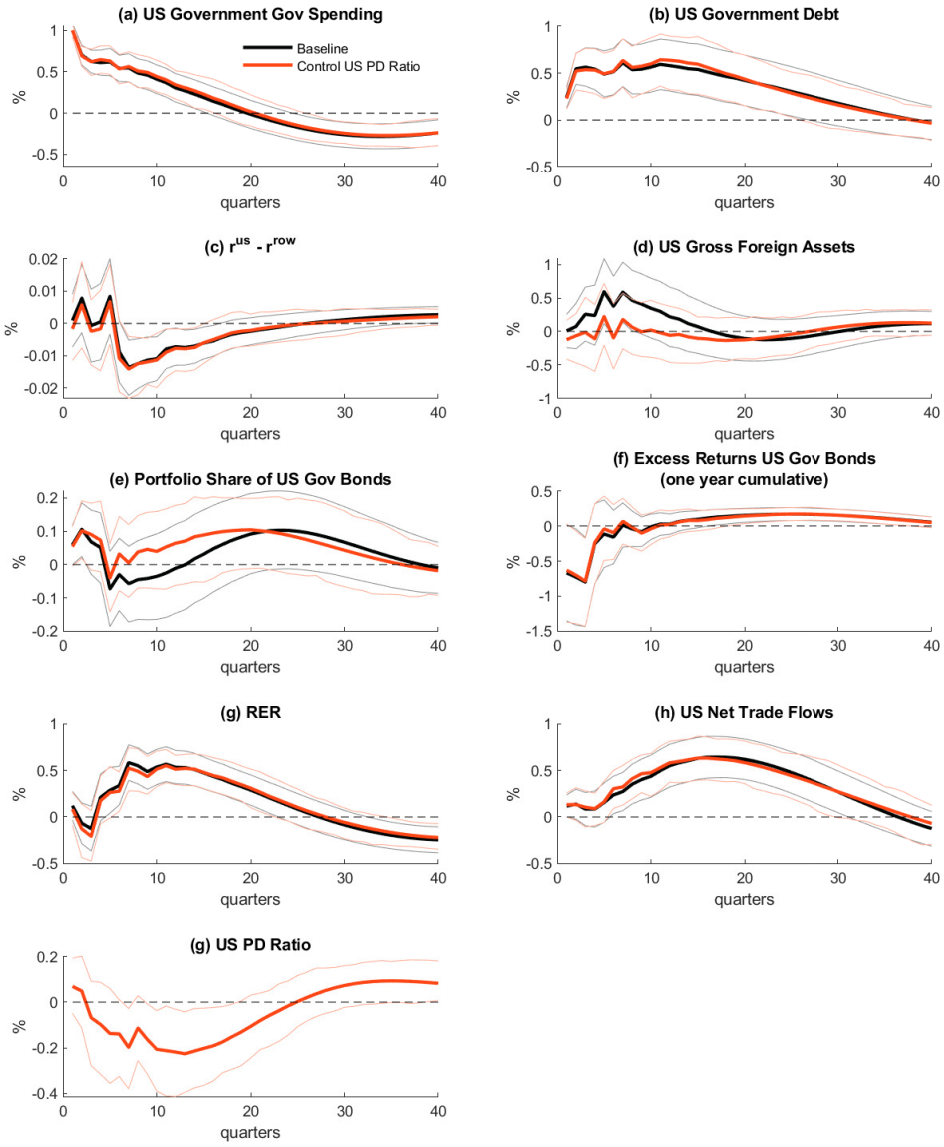


Figure D.5: Control for US Price-Dividend Ratio

Notes: Standard error bands are 68% confidence intervals.

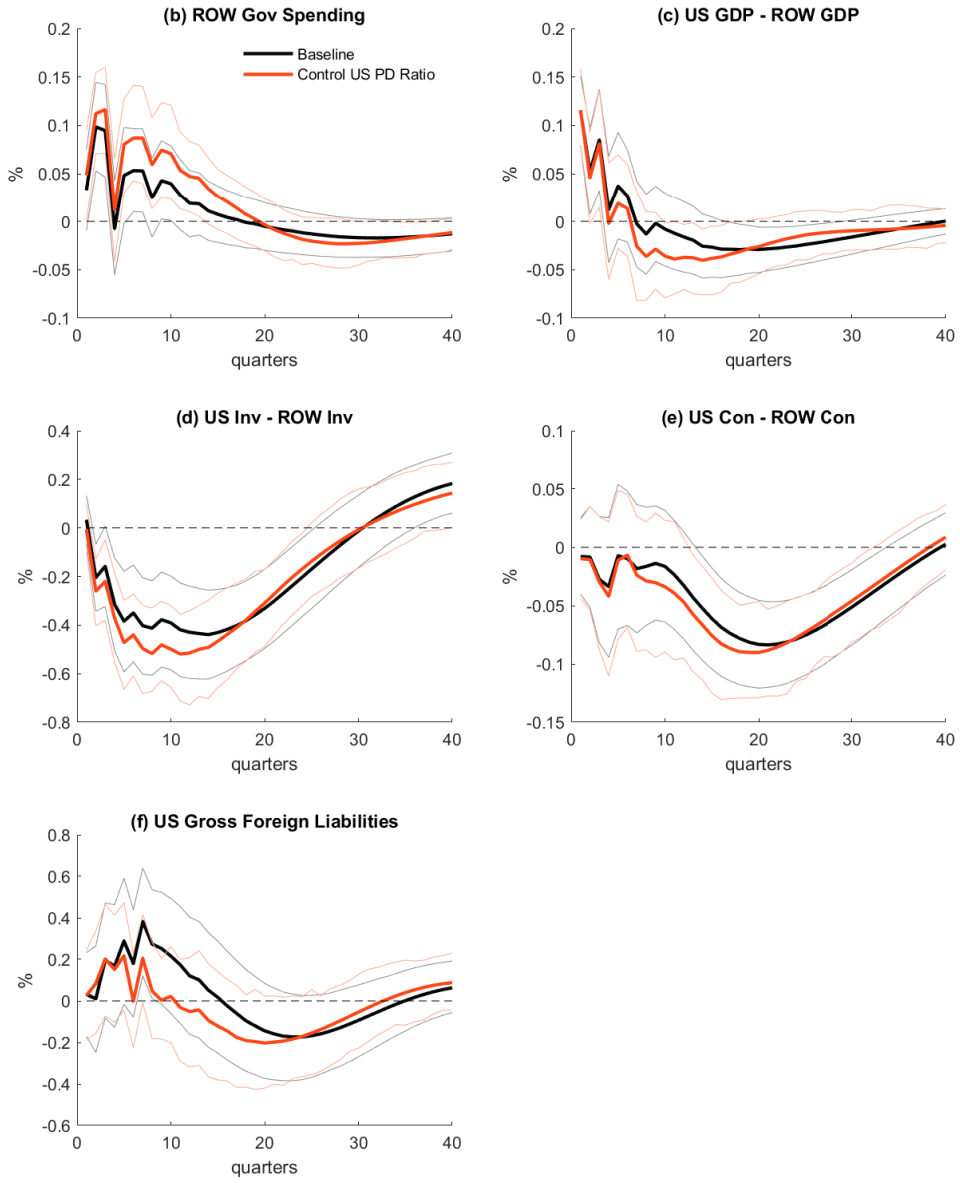


Figure D.6: Control for US Price-Dividend Ratio

Notes: Standard error bands are 68% confidence intervals.

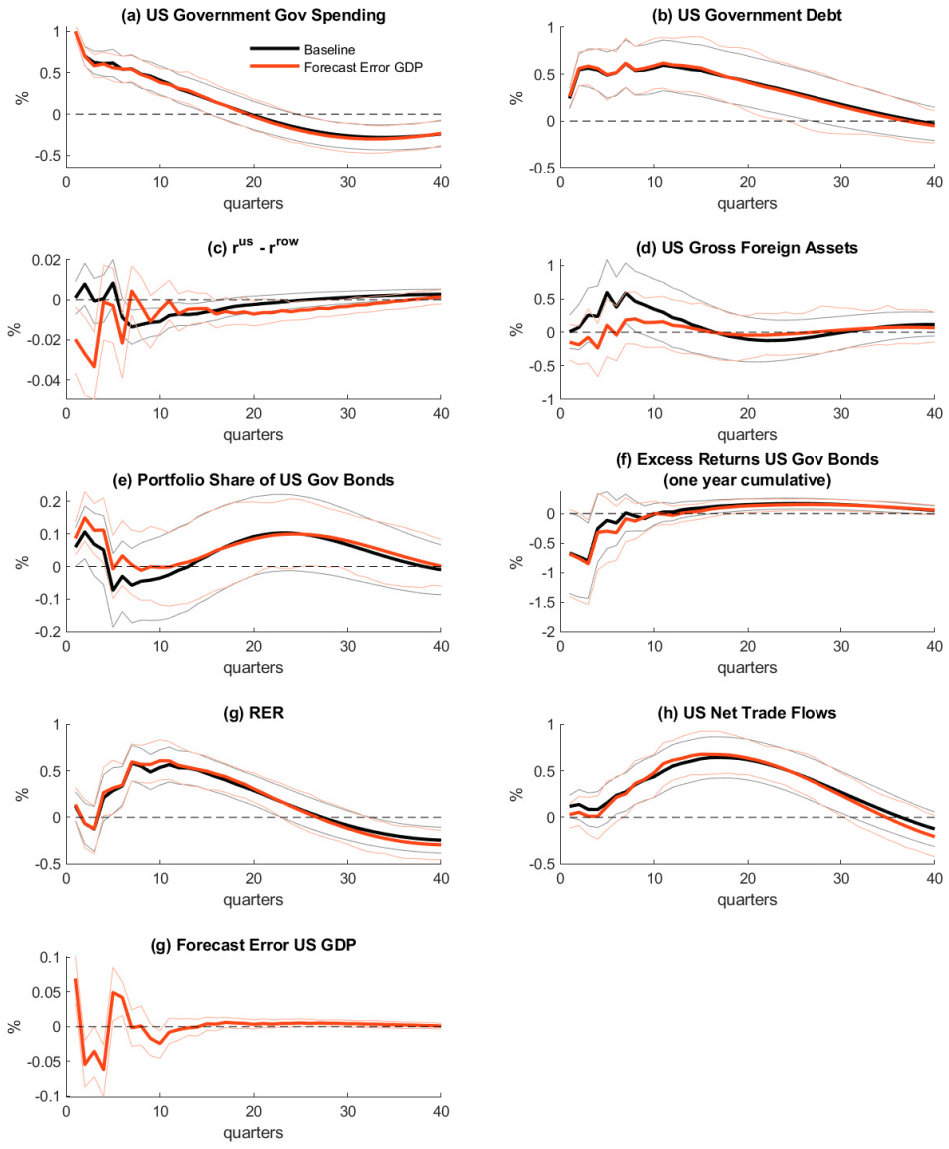


Figure D.7: Control for Forecast Errors of real GDP

Notes: Standard error bands are 68% confidence intervals.

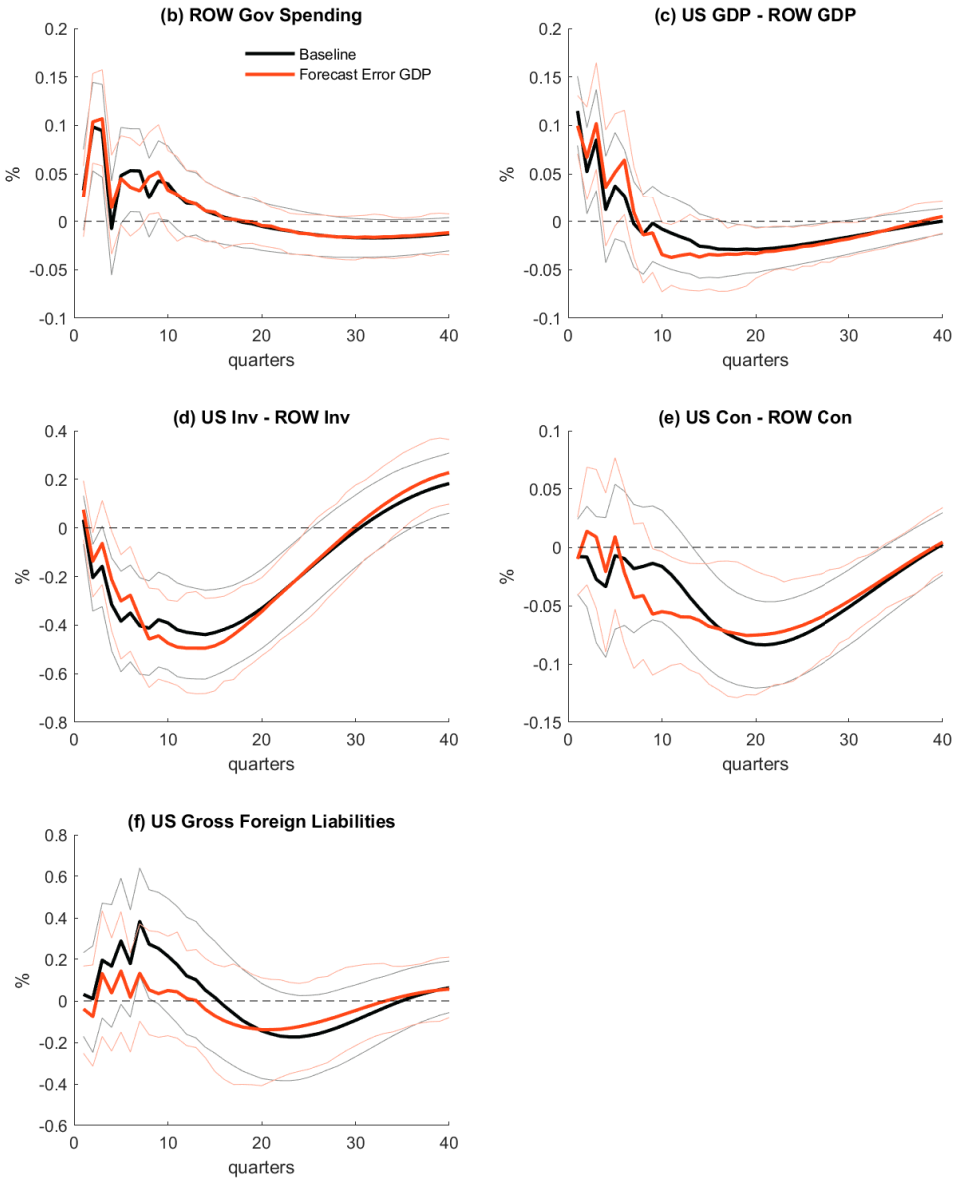


Figure D.8: Control for Forecast Errors of real GDP

Notes: Standard error bands are 68% confidence intervals.

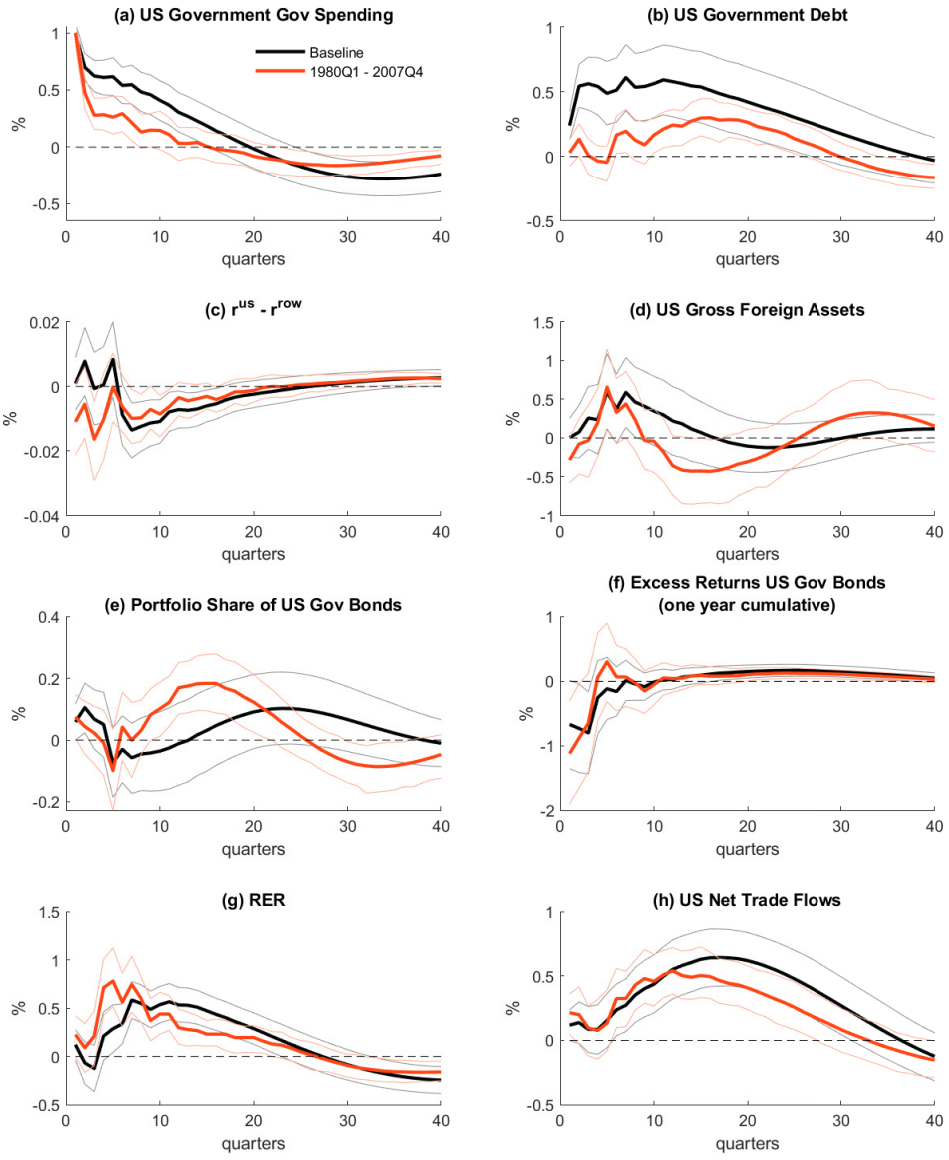


Figure D.9: Sample 1980Q1 - 2007Q4

Notes: Standard error bands are 68% confidence intervals.

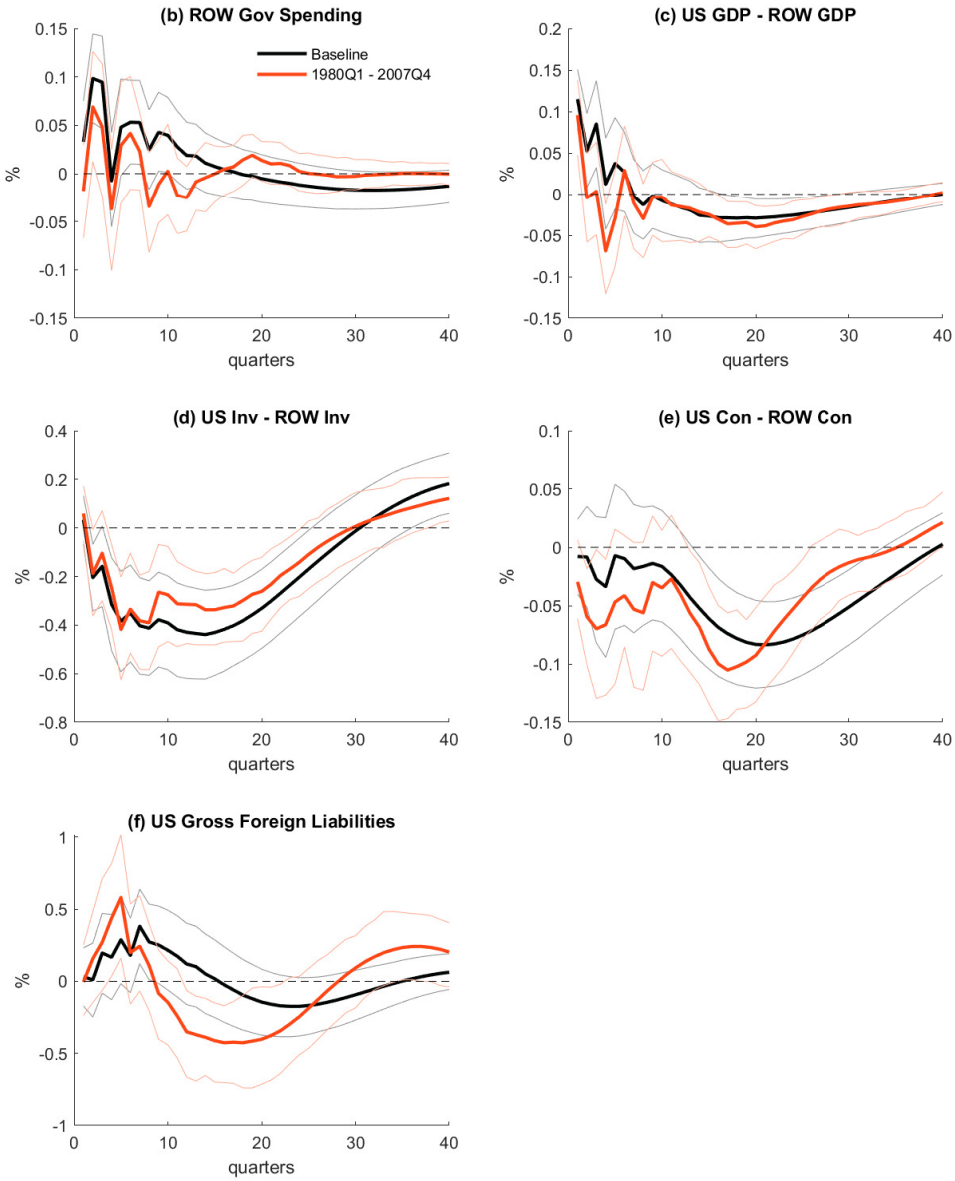


Figure D.10: Sample 1980Q1 - 2007Q4

Notes: Standard error bands are 68% confidence intervals.

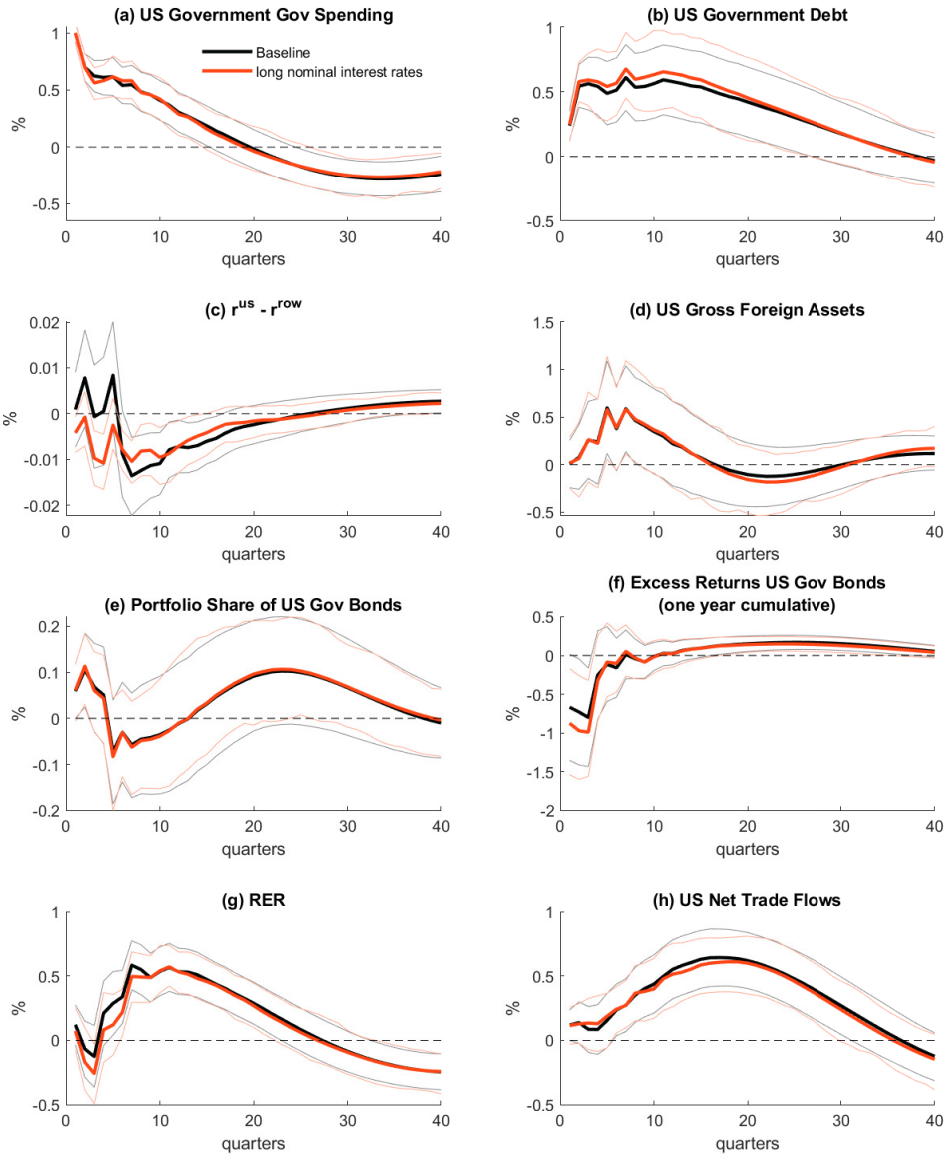


Figure D.11: Long Nominal Interest Rates

Notes: Standard error bands are 68% confidence intervals.

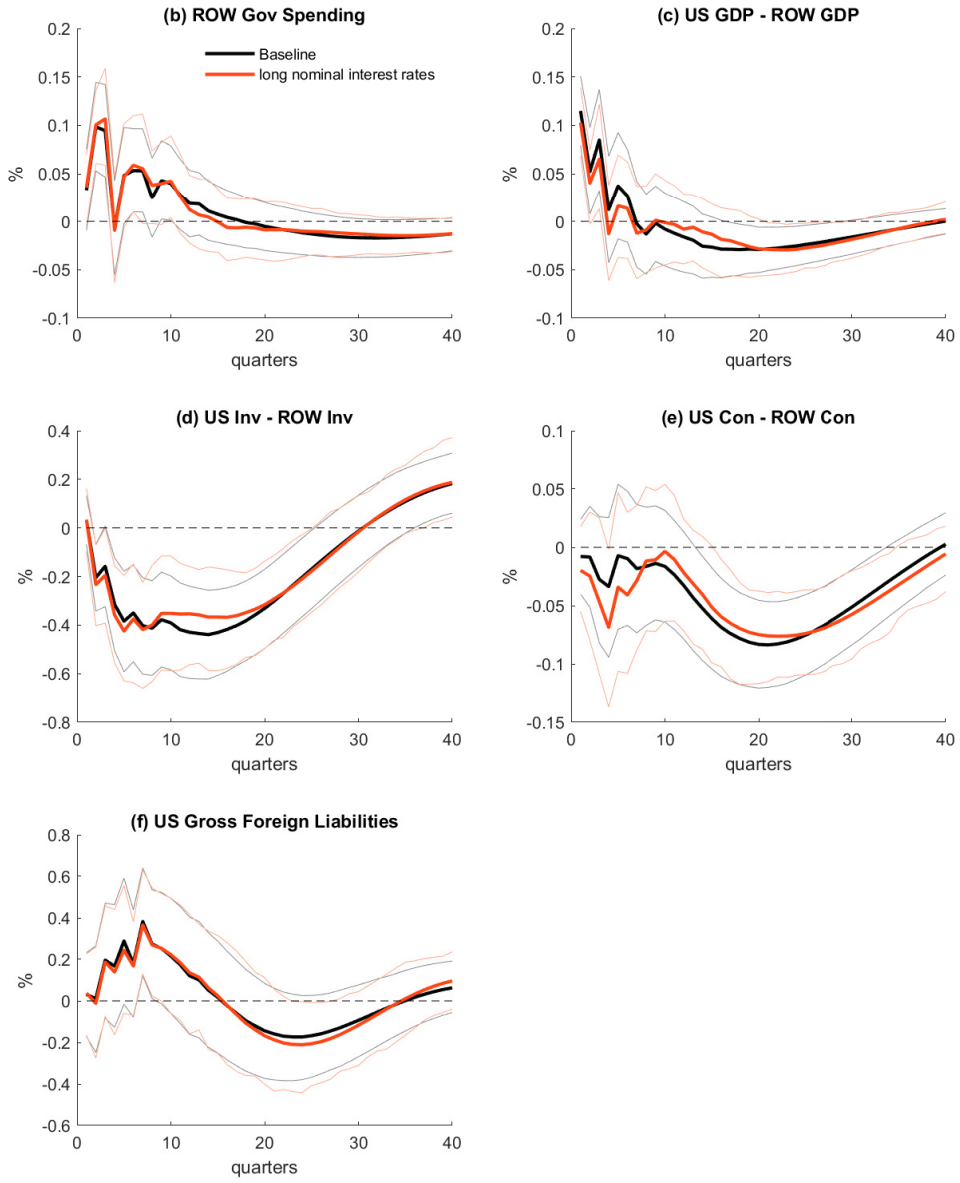


Figure D.12: Long Nominal Interest Rates

Notes: Standard error bands are 68% confidence intervals.

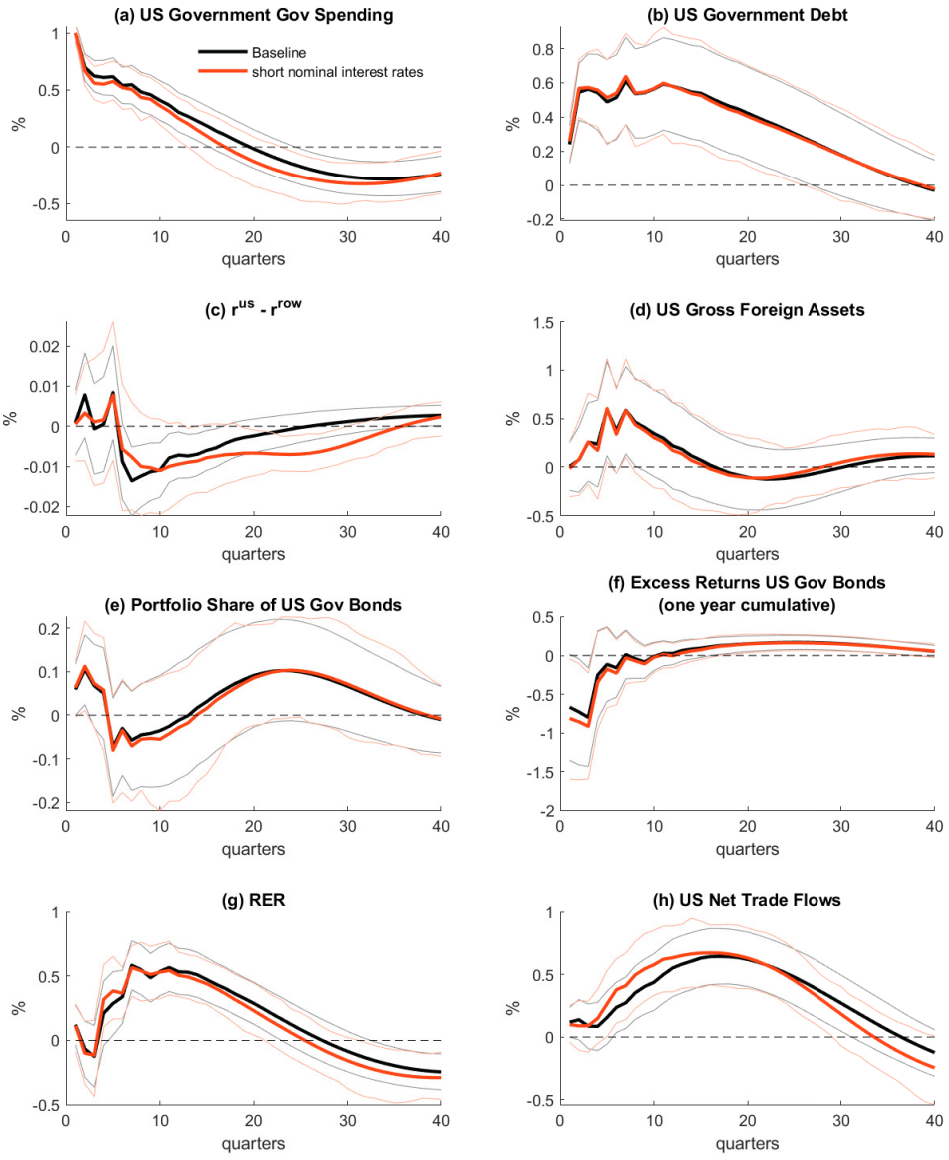


Figure D.13: Short Nominal Interest Rates

Notes: Standard error bands are 68% confidence intervals.

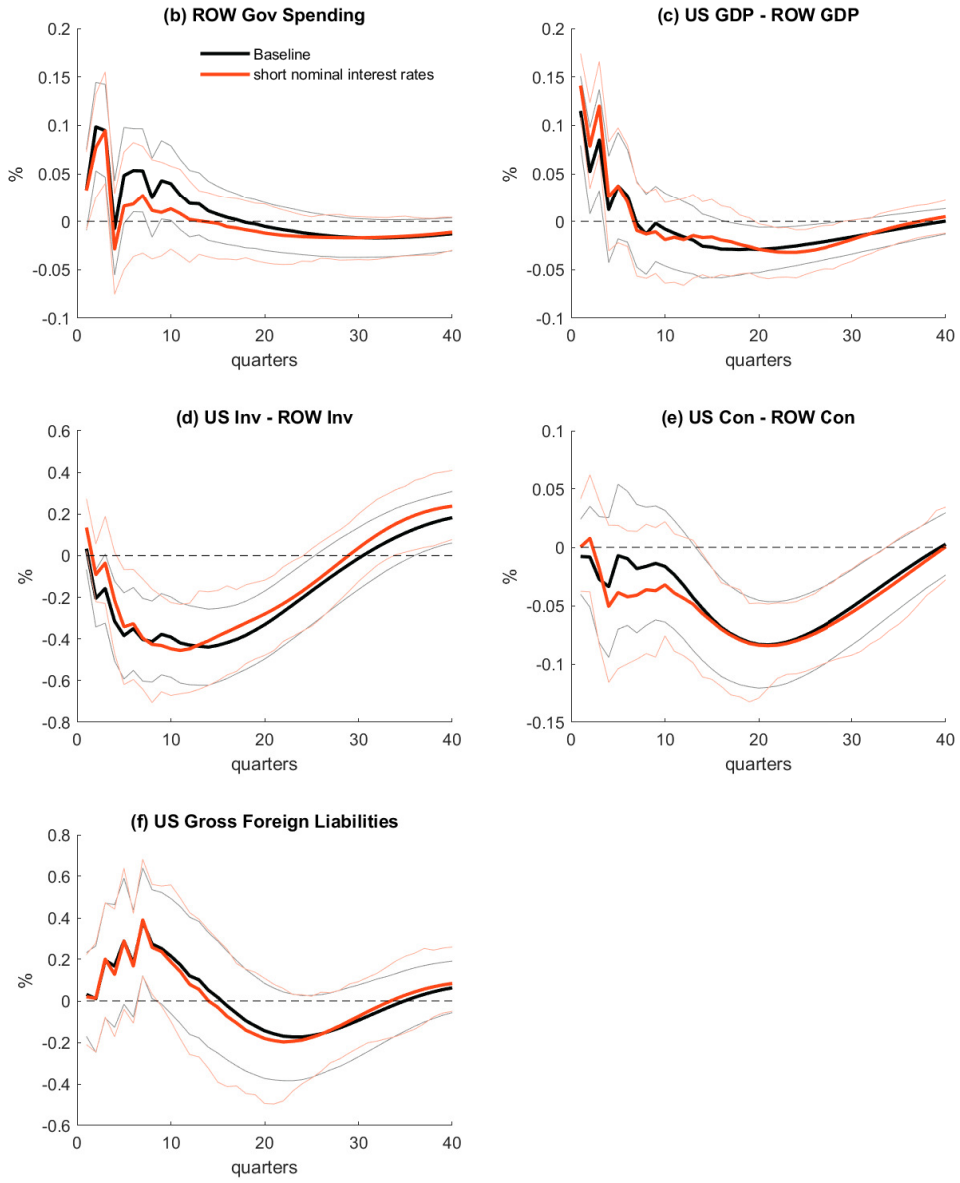


Figure D.14: Short Nominal Interest Rates

Notes: Standard error bands are 68% confidence intervals.

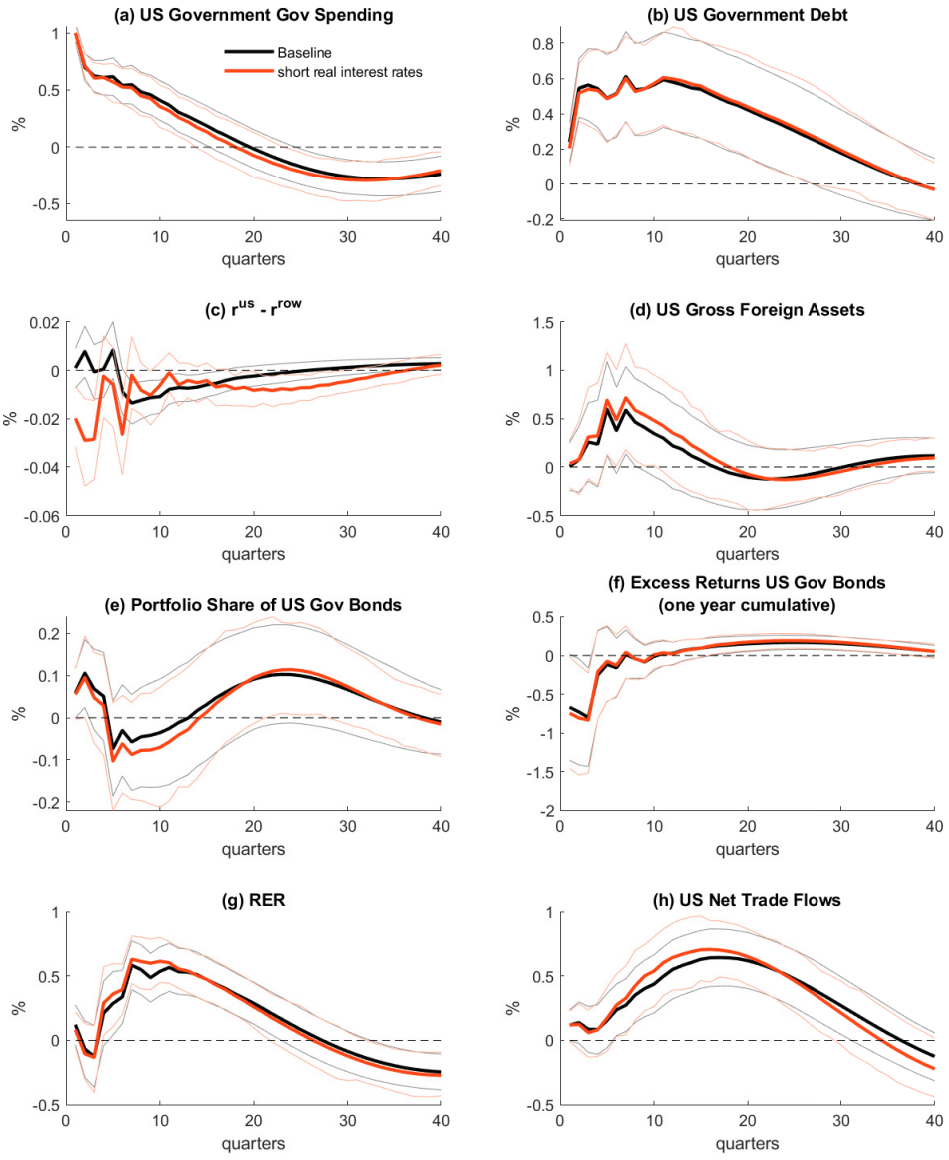


Figure D.15: Short Real Interest Rates

Notes: Standard error bands are 68% confidence intervals.

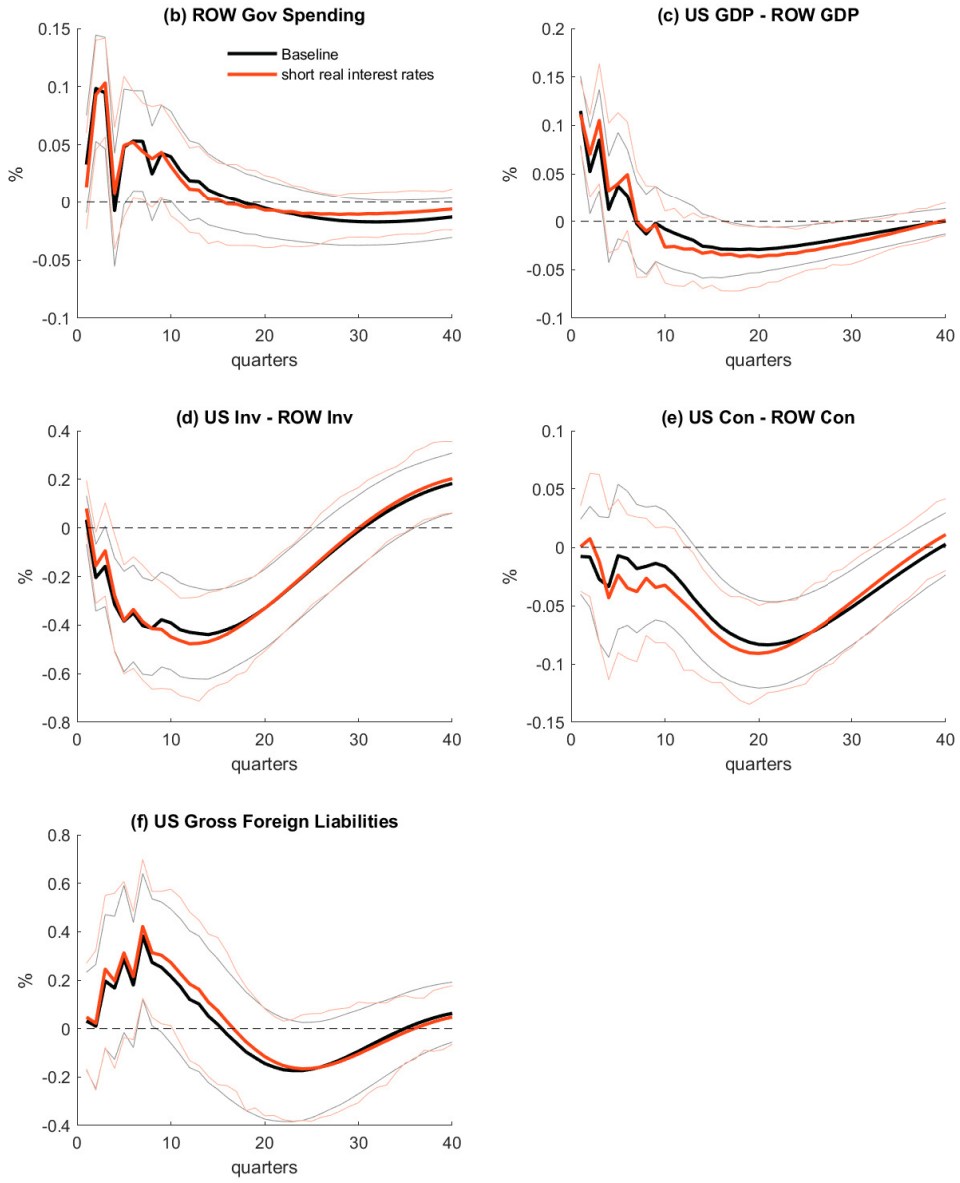


Figure D.16: Short Real Interest Rates

Notes: Standard error bands are 68% confidence intervals.

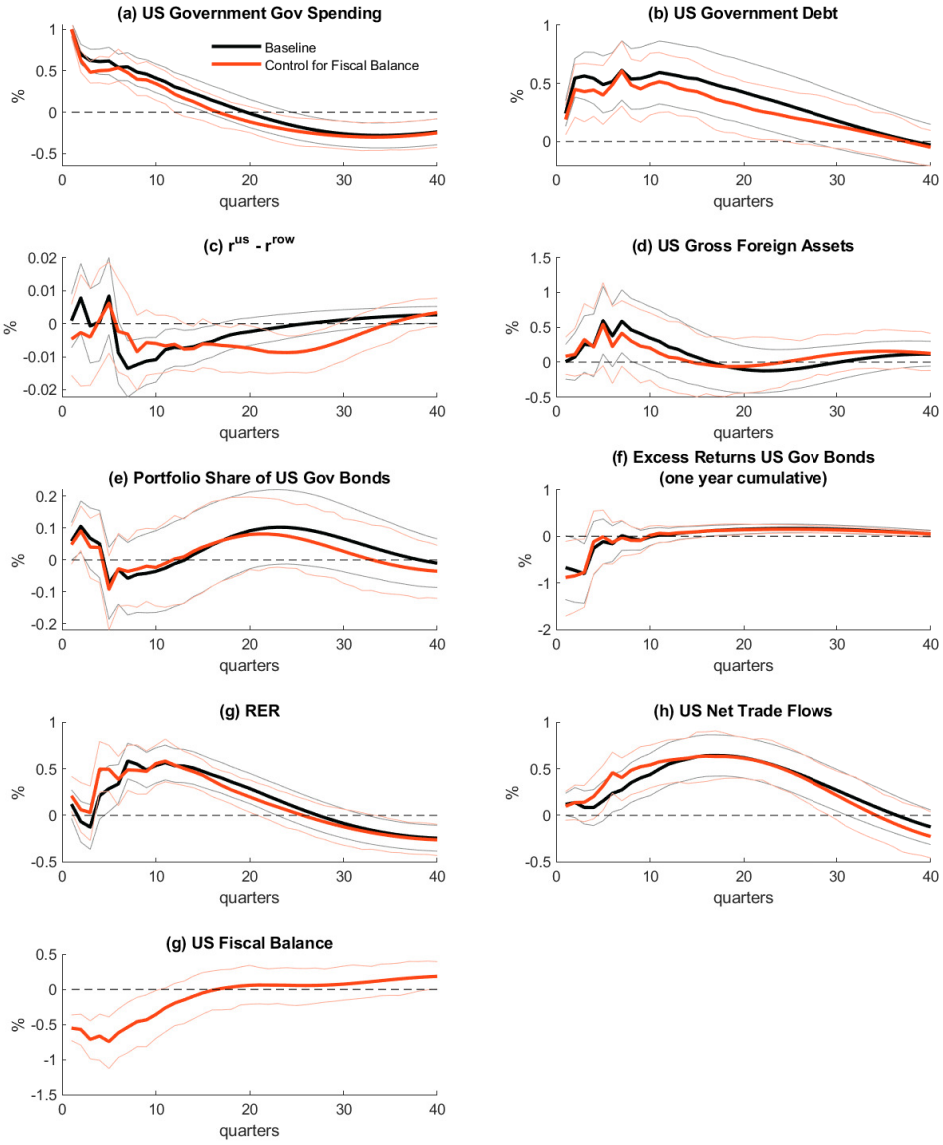


Figure D.17: Control for Fiscal Balance

Notes: Standard error bands are 68% confidence intervals.

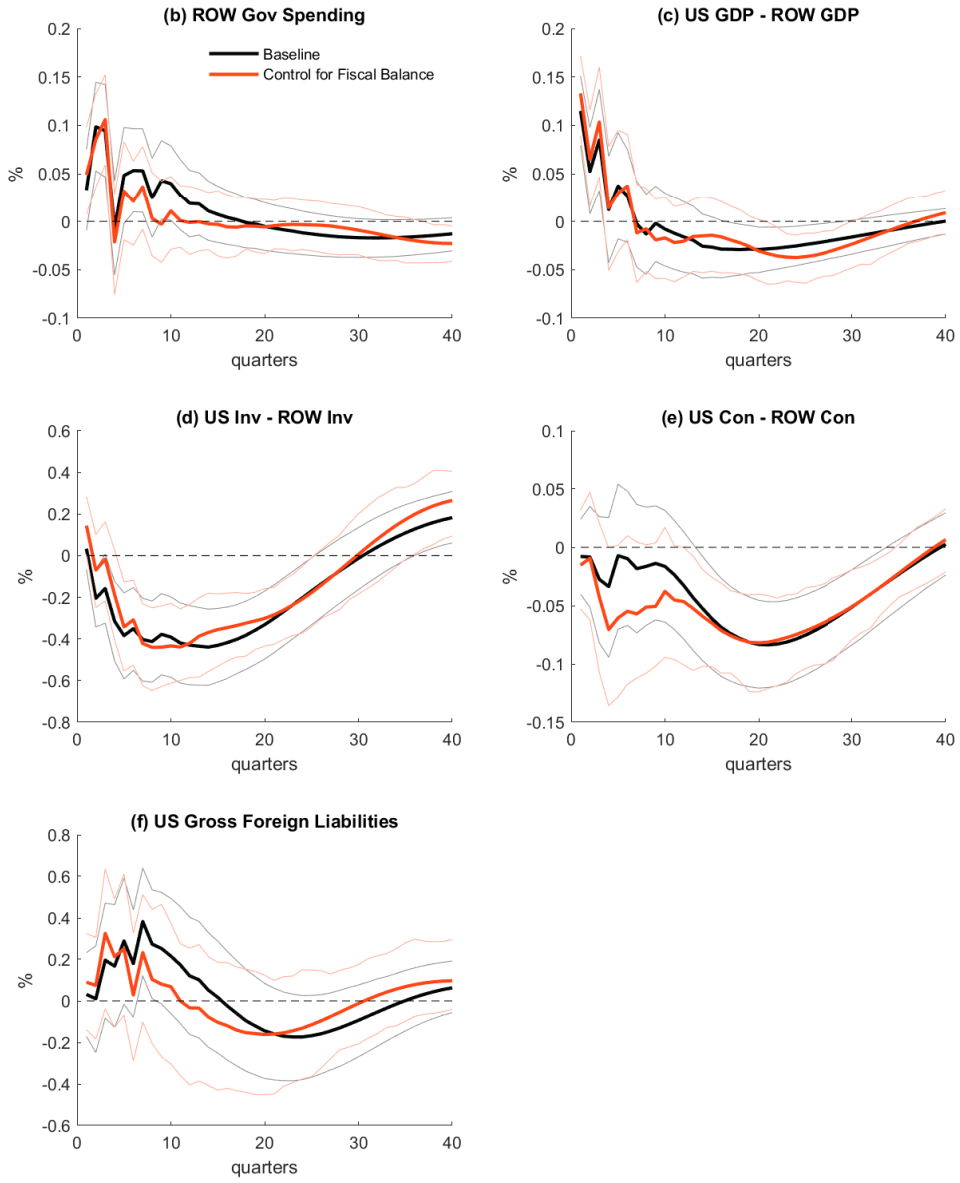


Figure D.18: Control for Fiscal Balance

Notes: Standard error bands are 68% confidence intervals.

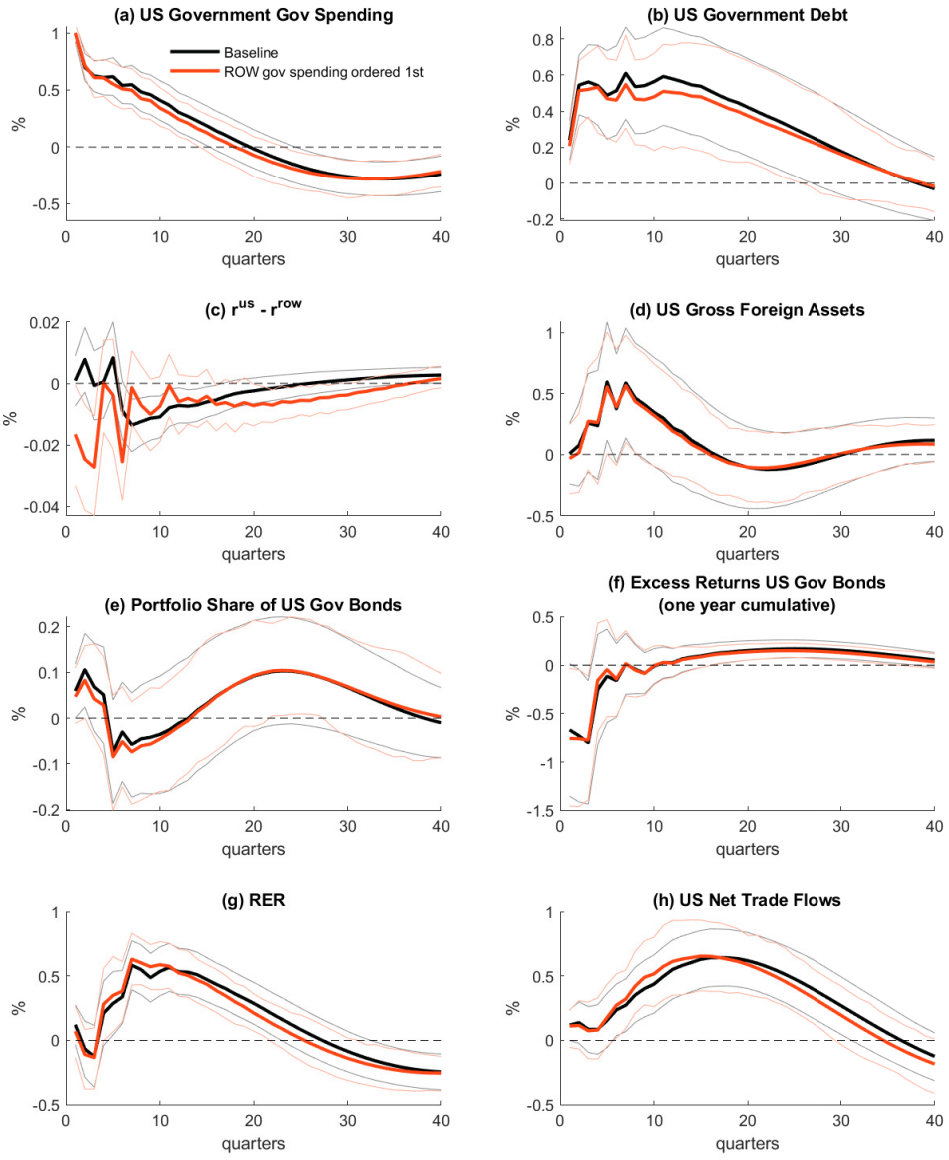


Figure D.19: ROW Gov Spending Ordered First and US Spending Forecast Error Ordered Last

Notes: Standard error bands are 68% confidence intervals.

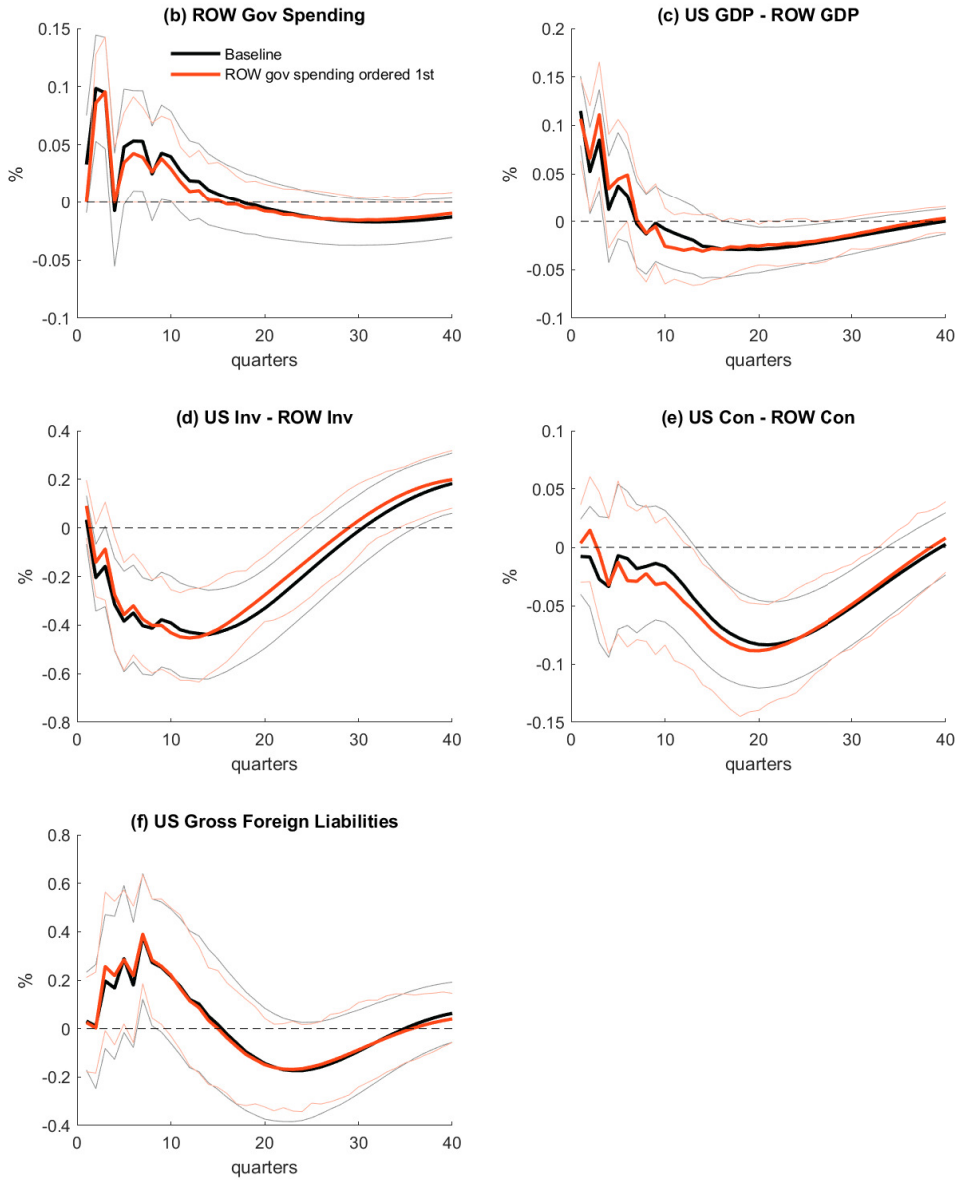


Figure D.20: ROW Gov Spending Ordered First and US Spending Forecast Error Ordered Last

Notes: Standard error bands are 68% confidence intervals.

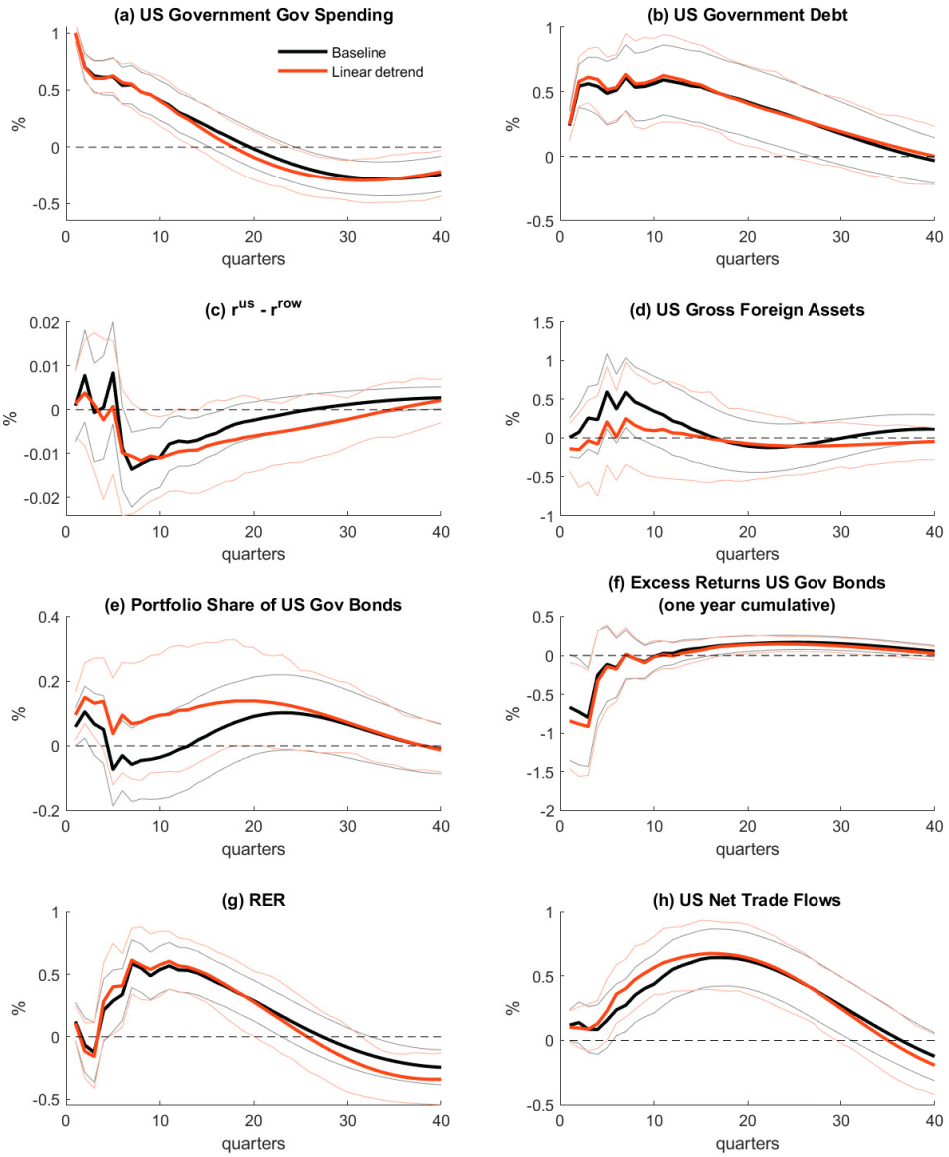


Figure D.21: Linear De-Trend

Notes: Standard error bands are 68% confidence intervals.

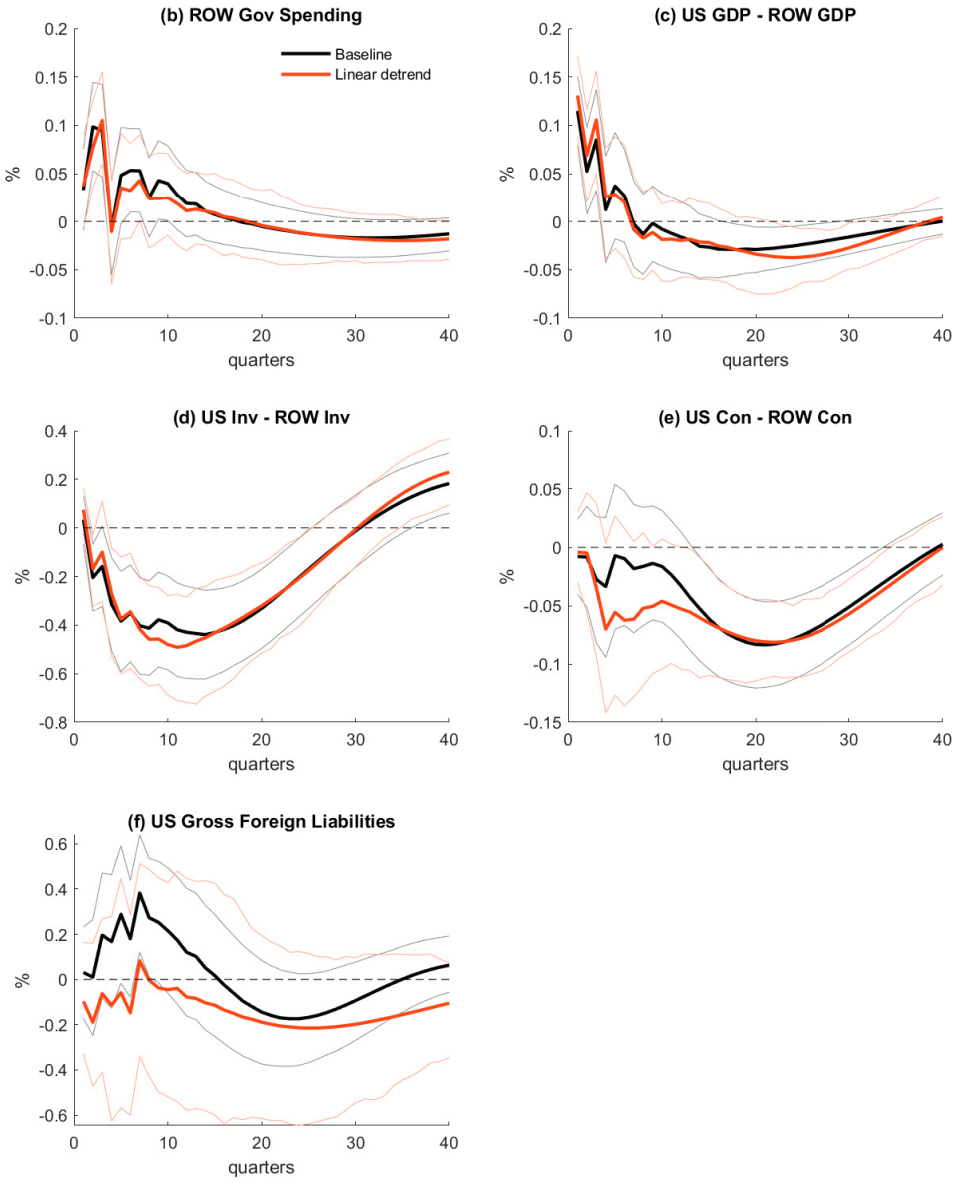


Figure D.22: Linear De-Trend

Notes: Standard error bands are 68% confidence intervals.

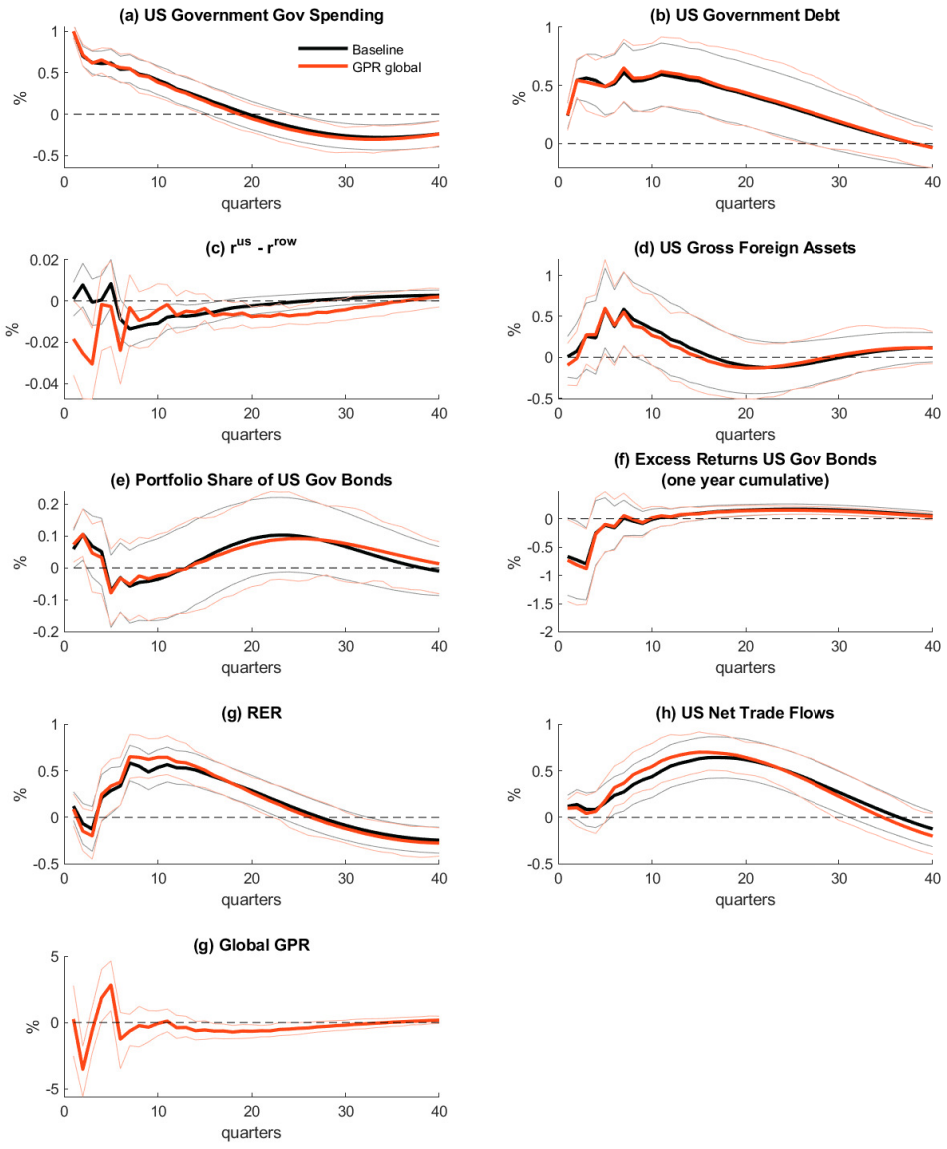


Figure D.23: Control for Geopolitical Risk Index (global) (Caldara and Iacoviello, 2022)

Notes: Standard error bands are 68% confidence intervals.

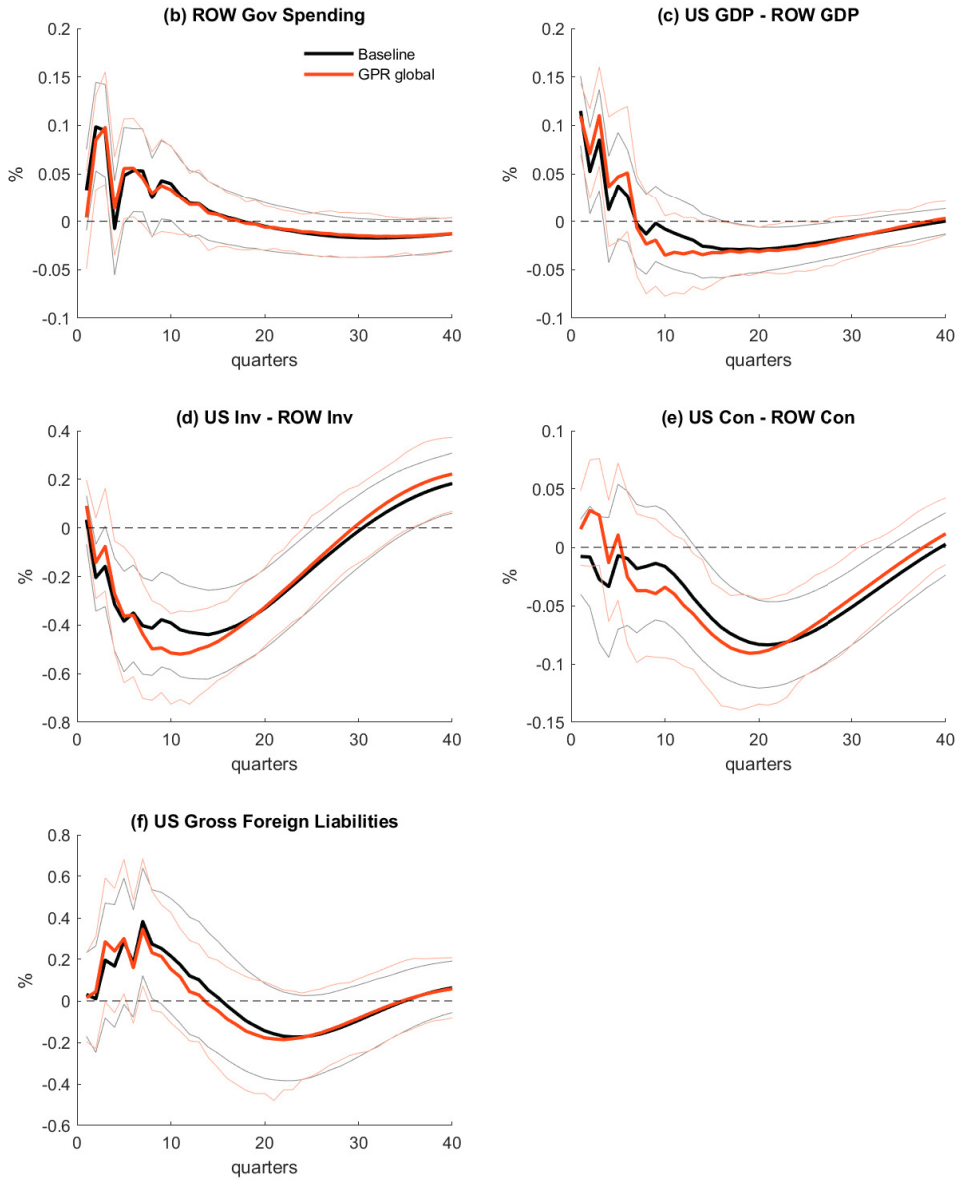


Figure D.24: Control for Geopolitical Risk Index (global) (Caldara and Iacoviello, 2022)

Notes: Standard error bands are 68% confidence intervals.

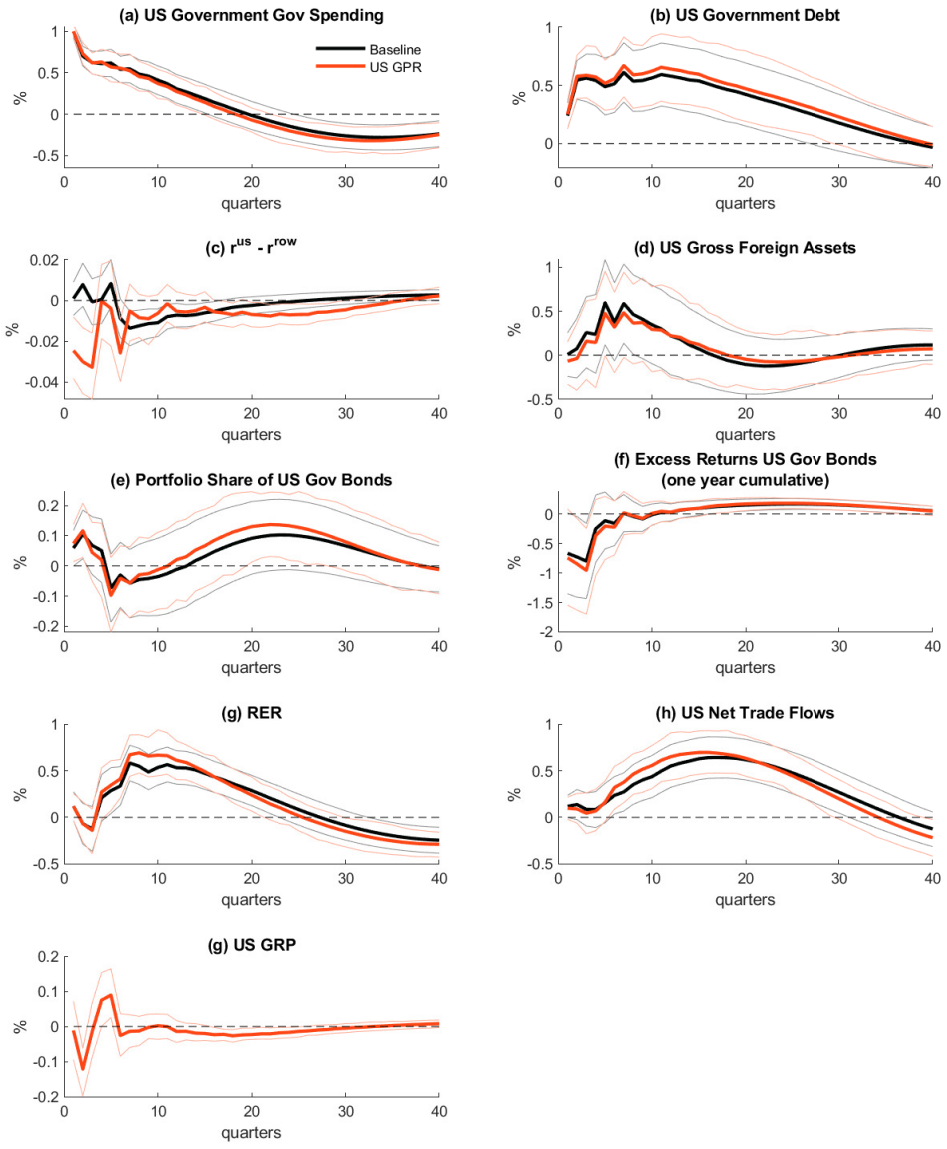


Figure D.25: Control for Geopolitical Risk Index (US) (Caldara and Iacoviello, 2022)

Notes: Standard error bands are 68% confidence intervals.

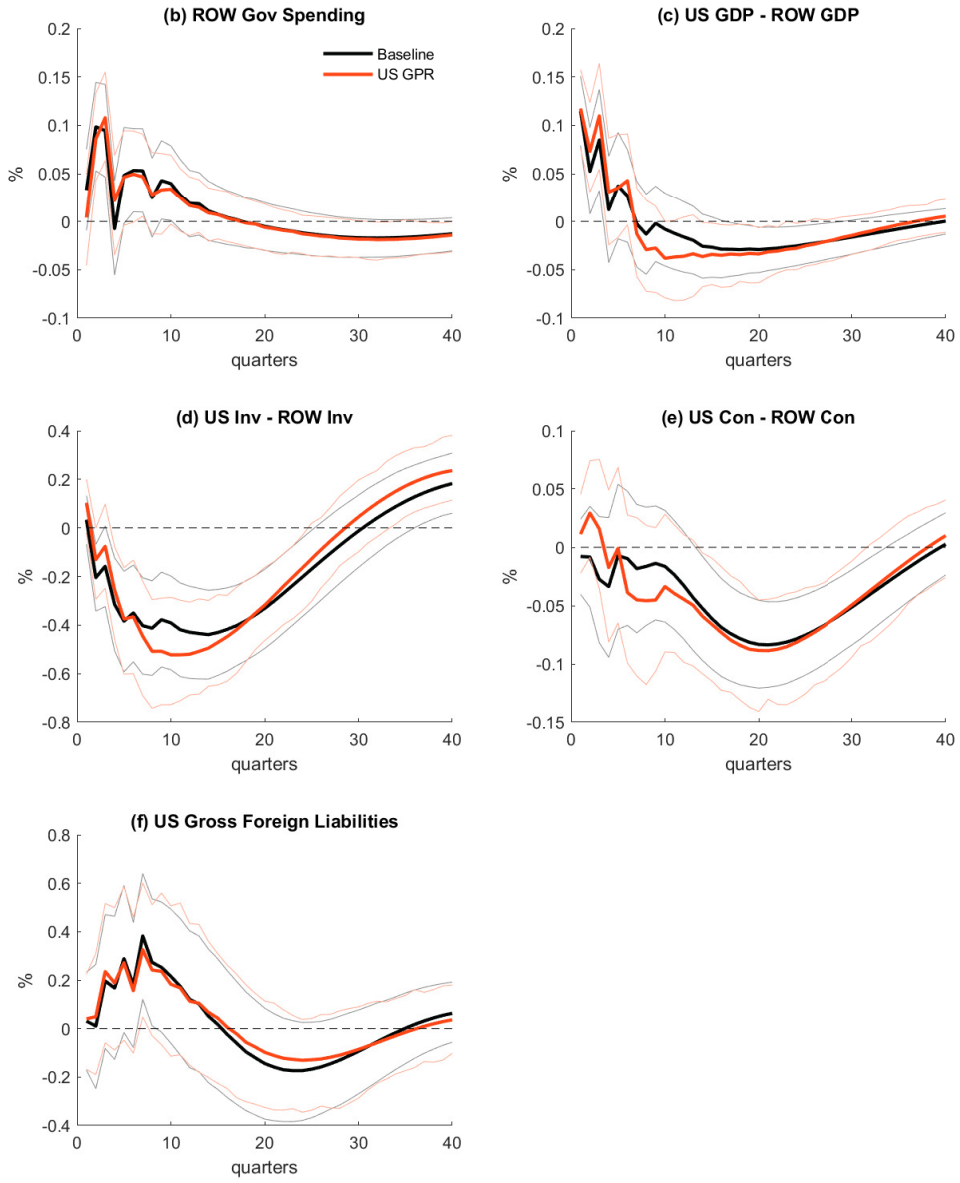


Figure D.26: Control for Geopolitical Risk Index (US) (Caldara and Iacoviello, 2022)

Notes: Standard error bands are 68% confidence intervals.

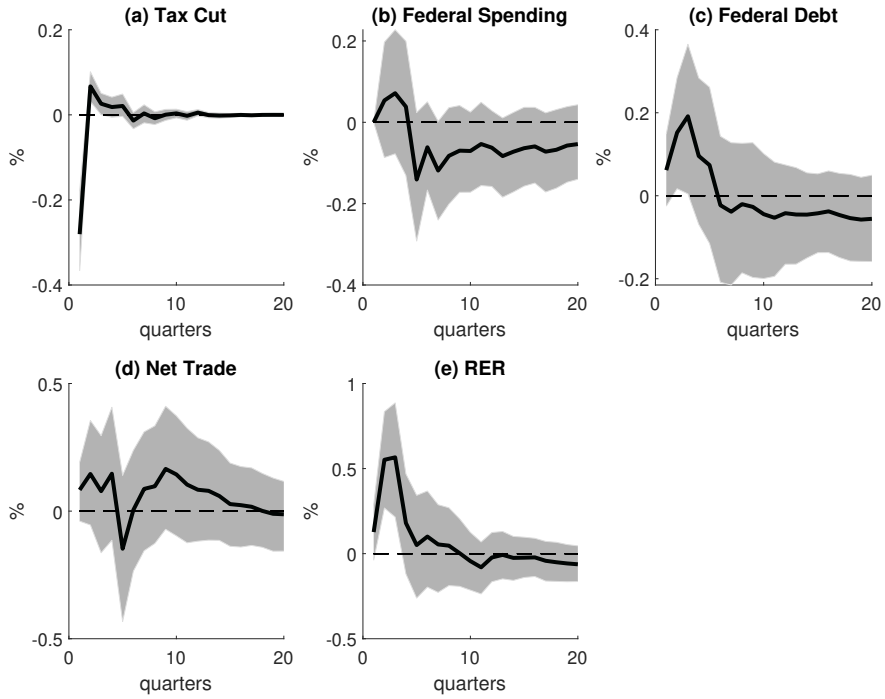


Figure D.27: Unanticipated Tax Cut (Mertens and Ravn, 2012)

Notes: Standard error bands are 68% confidence intervals.

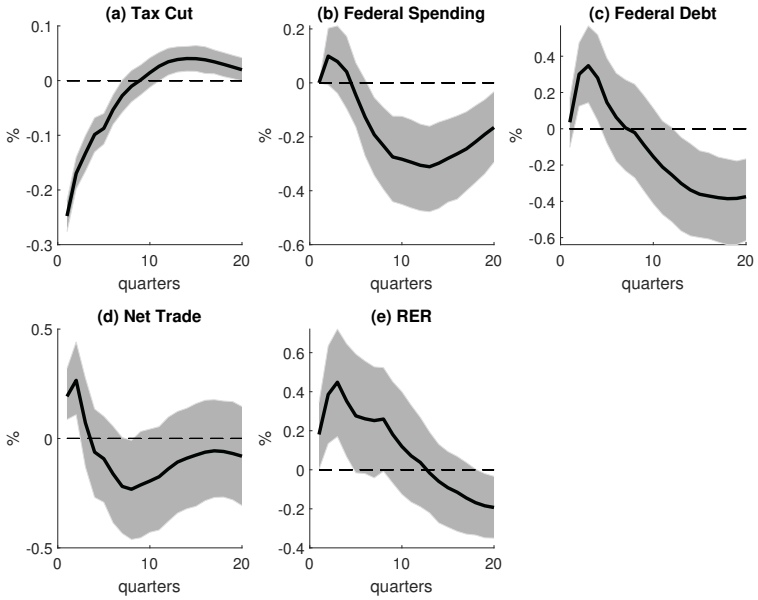


Figure D.28: VAR Federal Tax Cut Shock

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

E Model

E.1 Proof of Proposition I

The log-linearized Euler equation 6 (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:

$$\begin{aligned}\Delta nt = \beta + &\gamma_{SR}\,\Delta(tot_t + q_t) + \Delta(d_t^* - d_t) \\ &- \alpha\left[nt_{t-1} - \gamma_{LR}\,(tot_{t-1} + q_{t-1}) - (d_{t-1}^* - d_{t-1})\right] + \varepsilon_t \end{aligned} \tag{13}$$

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

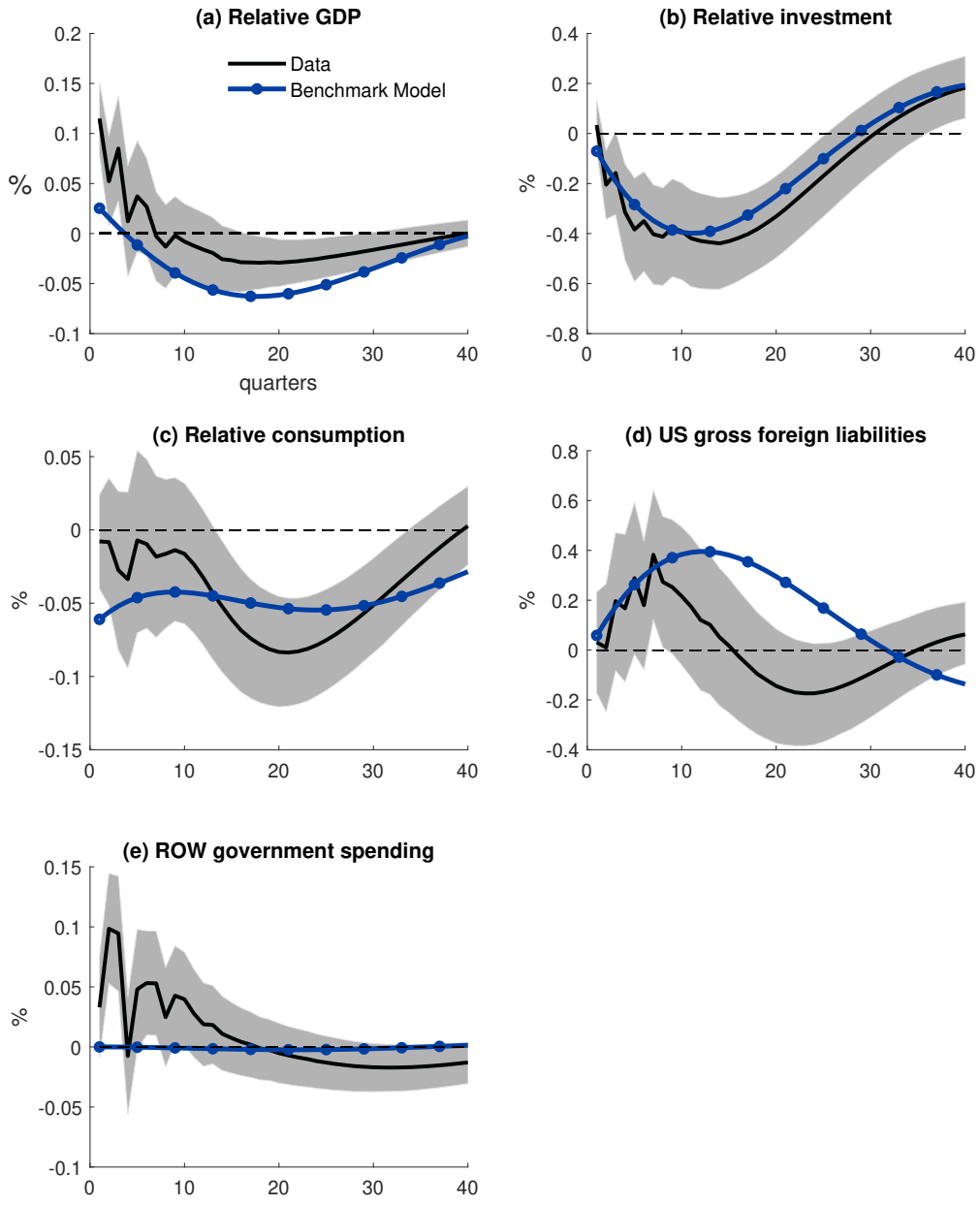


Figure E.1: Impulse Response Functions in Data and Models

Notes: Standard error bands are 68% confidence intervals.

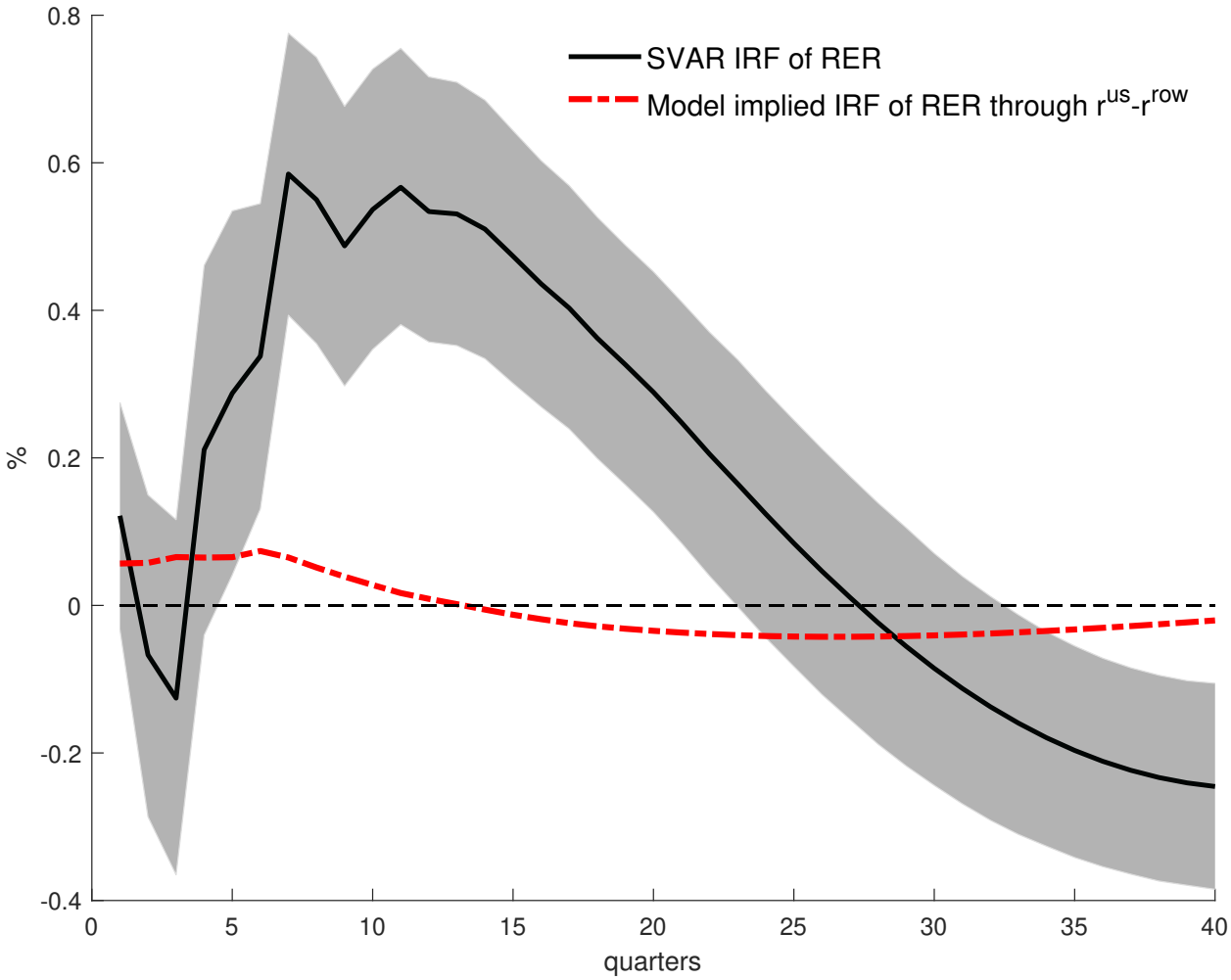


Figure E.2: Impulse Response Functions of the RER: estimated vs counterfactual through the interest rate differential

Notes: Standard error bands are 68% confidence intervals.

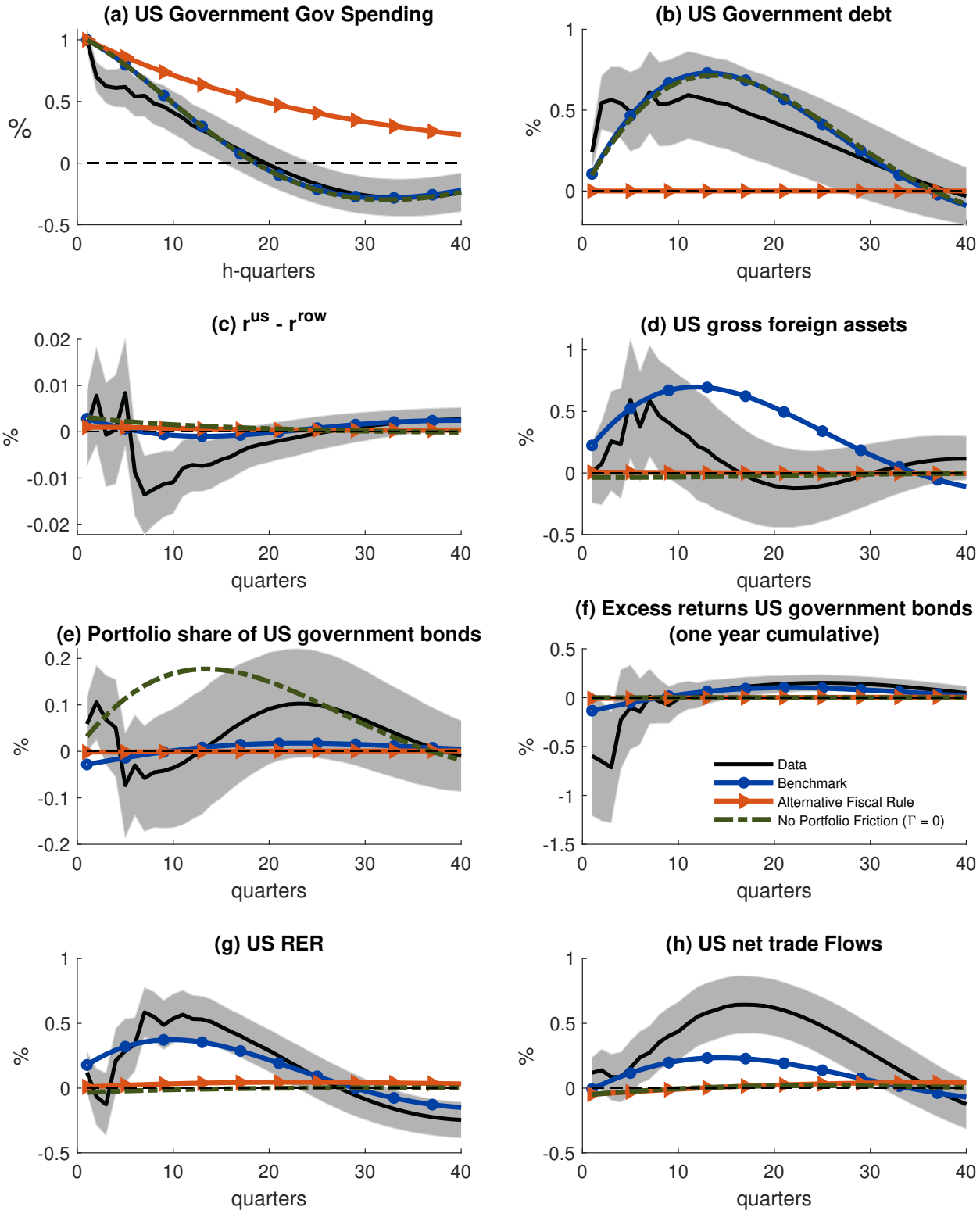


Figure E.3: Impulse Response Functions in Data and Models

Notes: Standard error bands are 68% confidence intervals.

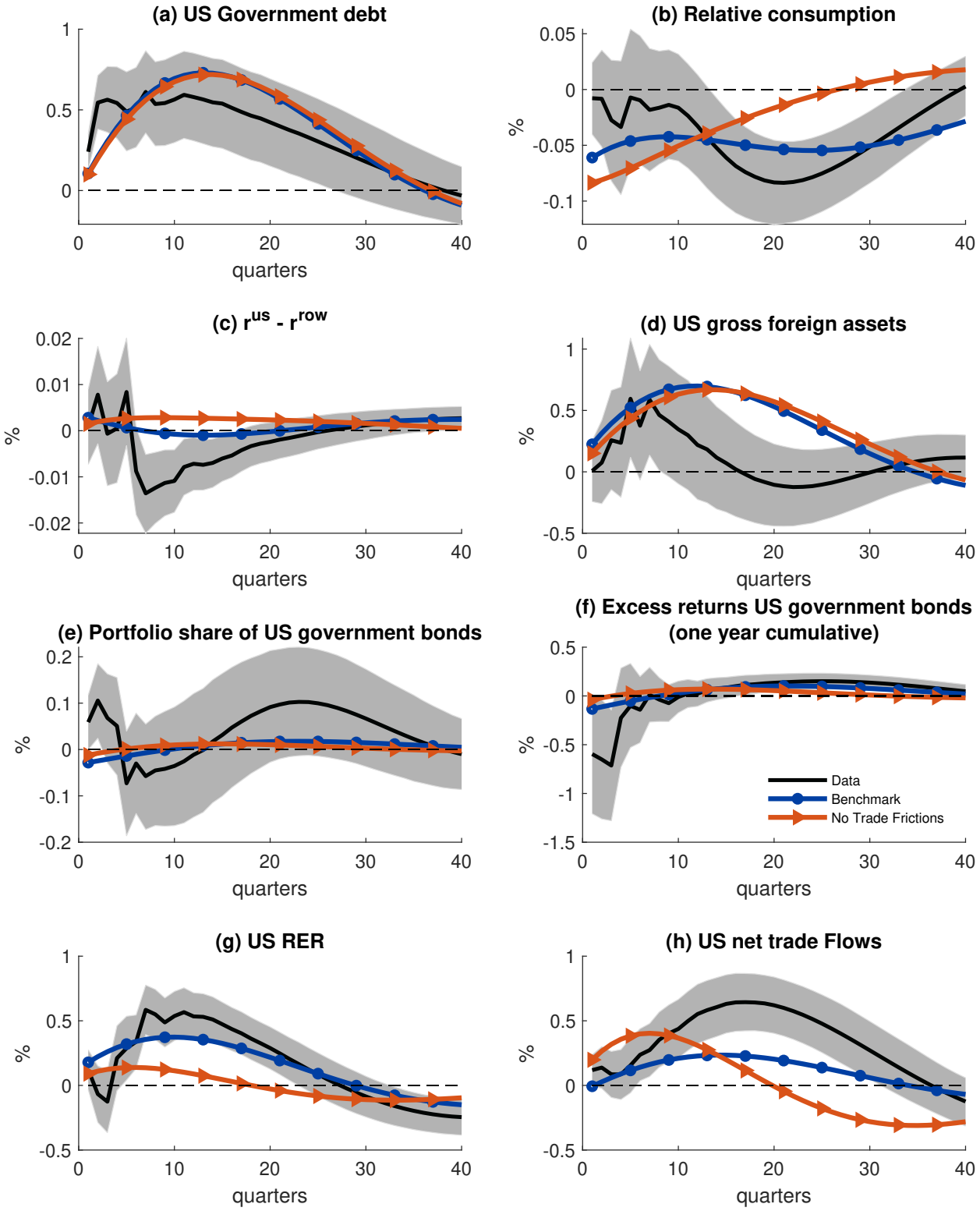


Figure E.4: Impulse Response Functions in Data and Models

Notes: Standard error bands are 68% confidence intervals.

E.4 Variance Decomposition: Benchmark Model vs SVAR

	SVAR		Benchmark Model				
	Total US Gov	Forecast Error US Gov	US Gov	Productivity	Trade	Differential Financial	Common Financial
US gov spending	45	26	98	2	0	0	0
US gov debt	27	20	98	2	0	0	0
Interest rate differential	11	5	6	42	37	15	0
US gross foreign assets	10	6	55	1	1	14	29
Portfolio share US gov bonds	3	1	2	0	2	30	66
Excess returns US gov bonds	17	7	20	2	20	57	0
RER	32	19	21	3	51	25	0
Net Trade	35	24	4	1	93	2	0

Table E.1: Unconditional Variance Decomposition (in %): SVAR vs Benchmark Model.

Notes: The column 'Productivity' is the sum of the differential and common components. The remaining portion of the variance decomposition in the model is explained by the ROW government spending shock.

F Sensitivity

Parameter		Benchmark	Only IRF Targeting	Only uncond moms targeting	Trade in US Gov Bonds	$\epsilon^d_{b^{row,us}} = 3$
1. Std common prod shock	σ_z^c	0.003 (0.0005)	0†	0.0057 (0.0013)	0.002 (0.0004)	0.003 (0.0004)
2. Pers common prod shock	ρ_z^c	0.894 (0.9012)	0†	0.881 (0.4007)	0.895 (0.6193)	0.895 (0.5356)
3. Std differential prod shock	σ_z^d	0.002 (0.0002)	0†	0.0015 (0.0002)	0.001 (0.0002)	0.001 (0.0002)
4. Pers differential prod shock	ρ_z^d	0.926 (0.0223)	0†	0.914 (0.0537)	0.930 (0.0233)	0.931 (0.0259)
5. Pers US gov shock	ρ_g^{us}	0.963 (0.0149)	0.947 (0.0176)	0.99†	0.963 (0.0144)	0.962 (0.0145)
6. Std ROW gov shock	σ_g^{row}	0.003 (0.0010)	0†	0.005 (0.0016)	0.003 (0.0010)	0.003 (0.0010)
7. Pers ROW gov shock	ρ_g^{row}	0.813 (0.1882)	0†	0.739 (0.4339)	0.827 (0.1204)	0.810 (0.1366)
8. Std differential trade shock	σ_ξ^d	0.003 (0.0011)	0†	0.011 (0.0023)	0.007 (0.0010)	0.007 (0.0010)
9. Pers of differential trade shock	ρ_ξ^d	0.983 (0.0008)	0†	0.988 (0.0011)	0.984 (0.0007)	0.986 (0.0005)
10. Std differential financial shock	σ_ψ^d	0.008 (0.0011)	0†	0.002 (0.0006)	0.006 (0.0008)	0.008 (0.0001)
11. Pers differential financial shock	ρ_ψ^d	0.843 (0.0327)	0†	0.99†	0.500†	0.500†
12. Std common portfolio shock	σ_ψ^c	0.003 (0.0009)	0†	0.009 (0.0023)	0.005 (0.0009)	0.004 (0.0010)
13. Pers common financial shock	ρ_ψ^c	0.939 (0.0380)	0†	0.877 (0.0448)	0.941 (0.0177)	0.914 (0.0205)
14. Adj cost CES	ι	459.66 (137.08)	429.72 (277.92)	853.92 (527.66)	600.96 (185.27)	710.10 (173.31)
15. Response gov spending to debt	$\varphi^{g,b}$	-0.067 (0.0095)	-0.054 (0.0087)	-0.082 (0.0361)	-0.068 (0.0090)	-0.068 (0.0093)
16. Response taxes to debt	$\varphi^{T,b}$	0.046 (0.0135)	0.042 (0.0148)	0.02†	0.046 (0.0131)	0.043 (0.0130)
17. Response taxes to spending	$\varphi^{T,g}$	0.379 (0.1029)	0.261 (0.1412)	0.541 (0.2901)	0.173 (0.1289)	0.399 (0.0989)

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	Trade in US Gov Bonds	$\epsilon^d_{b^{row,us}} = 3$
$\sigma(gov^{us})/\sigma(gdp^{us})$	3.69	3.46	3.81	3.55	3.50
$\sigma(gov^{row})/\sigma(gdp^{row})$	0.62	0.62	0.62	0.62	0.62
$\rho(gov^{row})$	0.80	0.81	0.80	0.81	0.81
$\sigma(inv^{usa})/\sigma(gdp^{usa})$	3.49	2.97	3.05	2.93	2.93
$\rho(gdp^{us}, gdp^{row})$	0.86	0.75	0.82	0.77	0.79
BSK: $\rho\left(\Delta rer, \Delta(c^{us} - c^{row})\right)$	-0.17	-0.32	-0.185	-0.28	-0.23
$\sigma(rer)/\sigma(gdp^{us})$	3.82	4.18	4.09	4.04	4.46
$\sigma(nt)/\sigma(rer)$	1.27	1.50	1.41	1.57	1.55
$\rho(rer)$	0.95	0.97	0.99	0.98	0.99
SR trade elast.	0.17	0.06	0.17	0.08	0.11
LR trade elast.	1.37	1.36	1.37	1.36	1.36
$\sigma(gfa^{us})/\sigma(gdp^{us})$	4.40	4.97	4.86	4.66	4.88
$\sigma(B^{g,us})/\sigma(gdp^{us})$	3.66	3.77	3.58	3.90	3.79
$\sigma(s^{g,us})/\sigma(gdp^{us})$	1.12	0.75	0.81	1.10	0.79
$\sigma(r^{us} - r^{row})/\sigma(gdp^{us})$	0.06	0.06	0.05	0.06	0.06
$\rho(r^{us} - r^{row})$	0.89	0.86	0.94	0.86	0.88
$\rho(s^{g,us})$	0.91	0.91	0.91	0.94	0.91
β_{Fama}	-1.38	-1.31	-1.35	-1.34	-1.35

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

Table F.2: Target Unconditional Moments

Moment	Data	Benchmark	Only uncond moms targeting	Trade in US Gov Bonds	$\epsilon^d_{b^{row,us}} = 3$
$\rho(B^{g,us} - B^{g,row}, rer)$	0.74	0.40	0.34	0.46	0.35
R^2_{Fama}	0.01	0.001	0.03	0.01	0.02
$\rho(tot, rer)$	0.86	0.99	0.99	0.99	0.99
$\sigma(tot)/\sigma(rer)$	0.31	0.63	0.63	0.64	0.64
$\rho(r^{us} - r^{row}, rer)$	-0.56	-0.31	-0.64	-0.45	-0.53
Low freq RER spectrum	0.62	0.68	0.76	0.72	0.75
BC freq RER spectrum	0.31	0.25	0.19	0.22	0.20
$\rho(inv^{us}, inv^{row})$	0.31	0.02	0.09	0.06	0.06
$\rho(xm^{us})$	0.98	0.99	0.99	0.99	0.99
$\rho(inv^{us} - inv^{row}, rer)$	-0.57	-0.85	-0.93	-0.88	-0.90
$\rho(B^{g,us})$	0.97	0.99	0.99	0.99	0.99
$\rho(B^{g,us}, g^{us})$	0.50	0.38	0.11	0.38	0.35
$\rho(B^{g,us}, gfa^{us})$	0.23	0.77	0.71	0.88	0.74
$\rho(gfa^{us}, gfl^{us})$	0.83	0.68	0.54	0.50	0.67

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

Table F.3: Untargetted Unconditional Moments

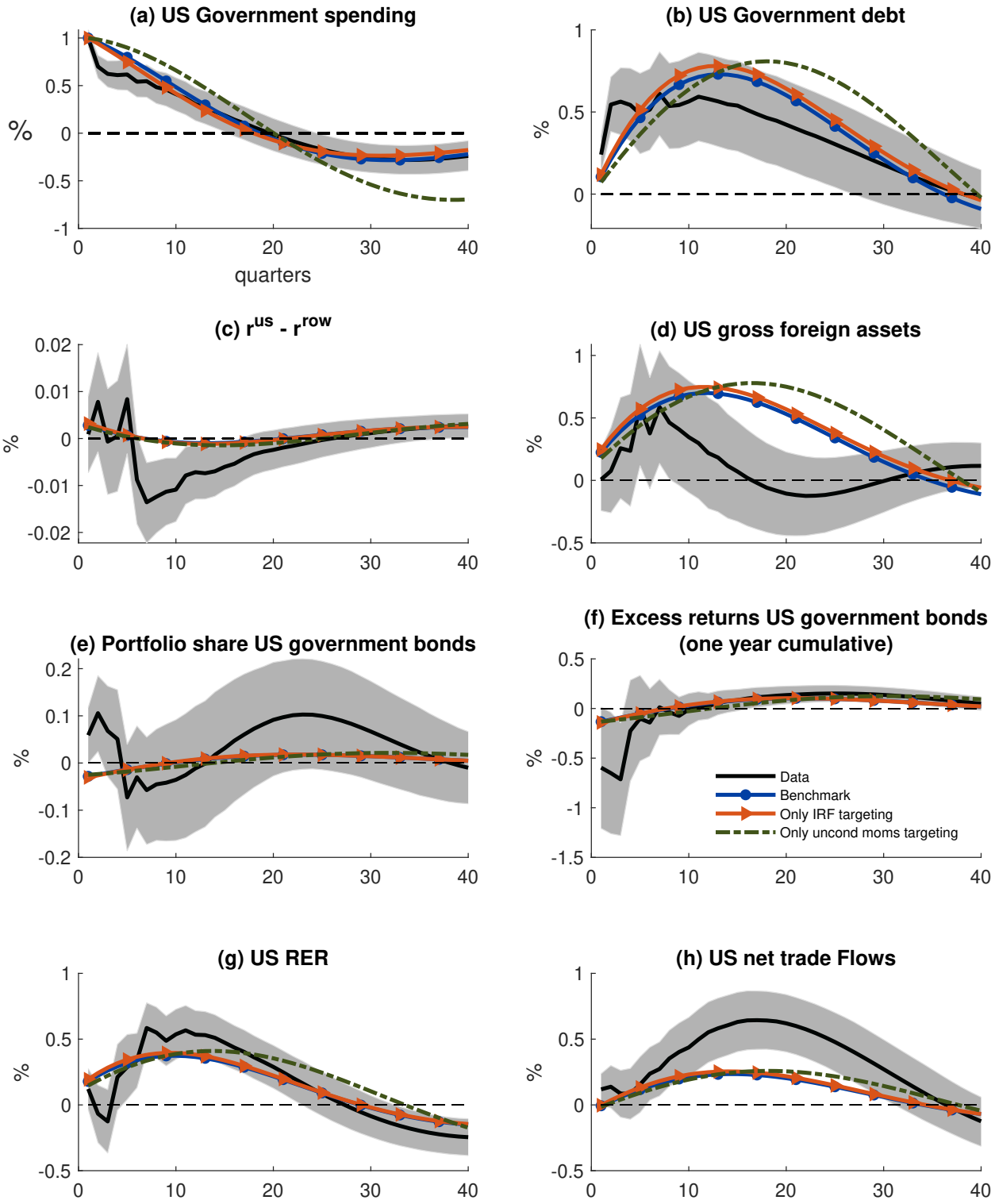


Figure F.1: Impulse Response Functions: SVAR and Models

Notes: Standard error bands are 68% confidence intervals.

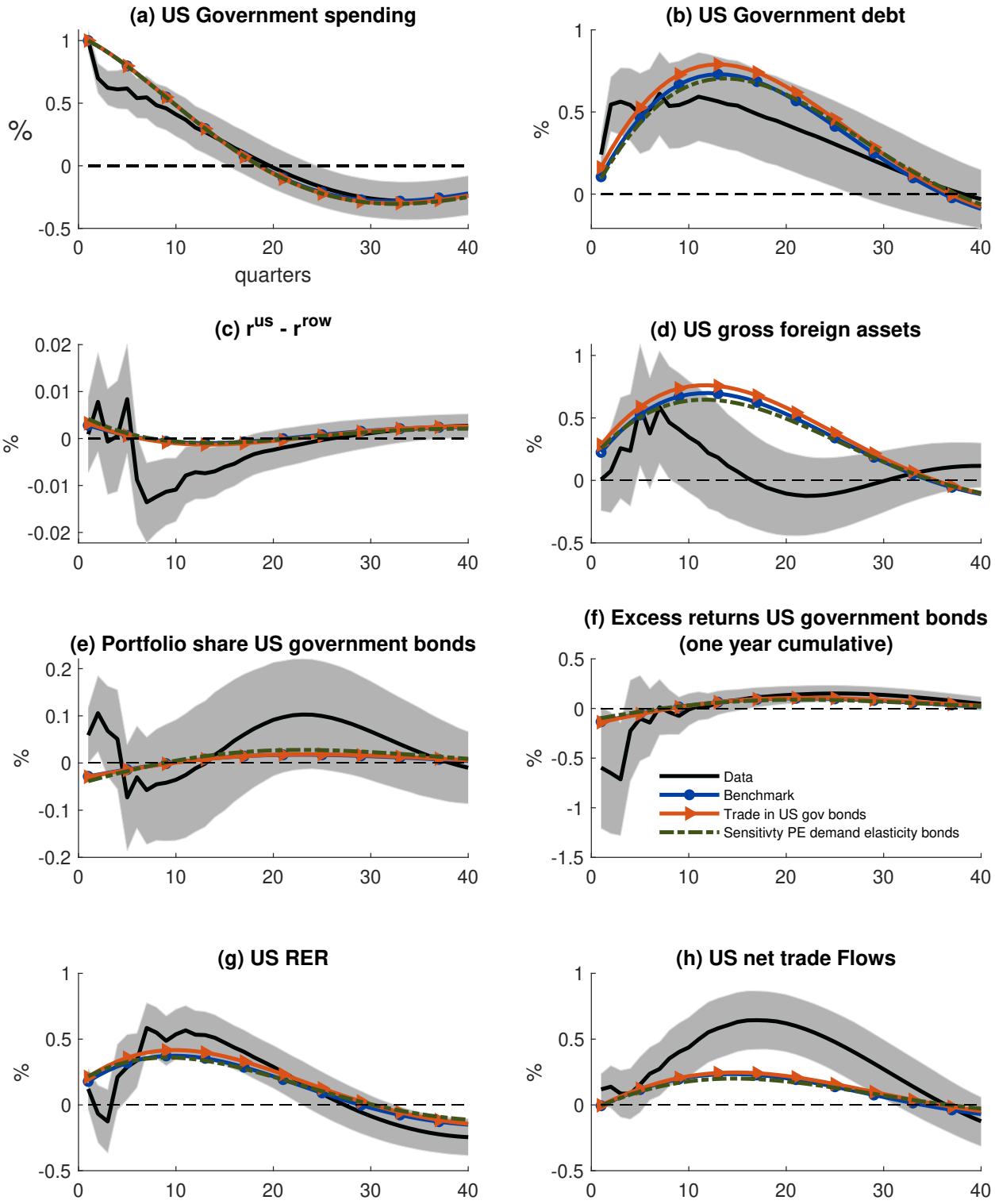


Figure F.2: Impulse Response Functions in Data and Models

Notes: Standard error bands are 68% confidence intervals.

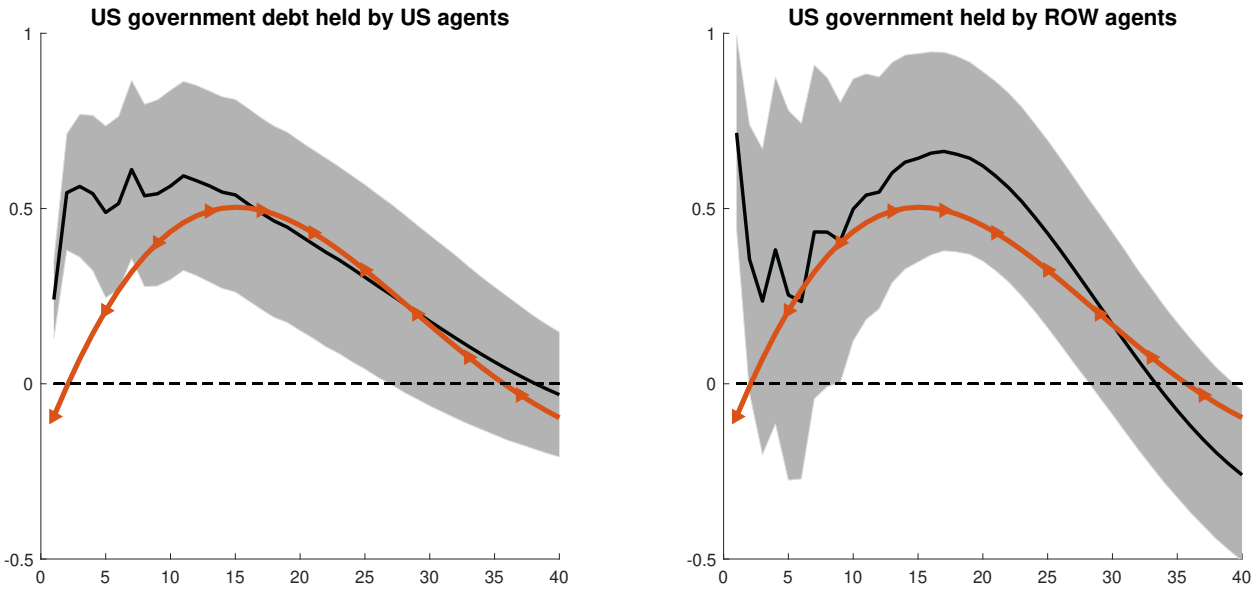


Figure F.3: Impulse Response Functions: SVAR and model where US government bonds are traded internationally

Notes: Standard error bands are 68% confidence intervals.

G 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.[52] 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 G.1 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 G.2, G.3 and G.4 shows the same results but separately for advanced, developing and poor economies, respectively.

The results show that 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 the current account. Within advanced economies 59% of the observations have

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

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.

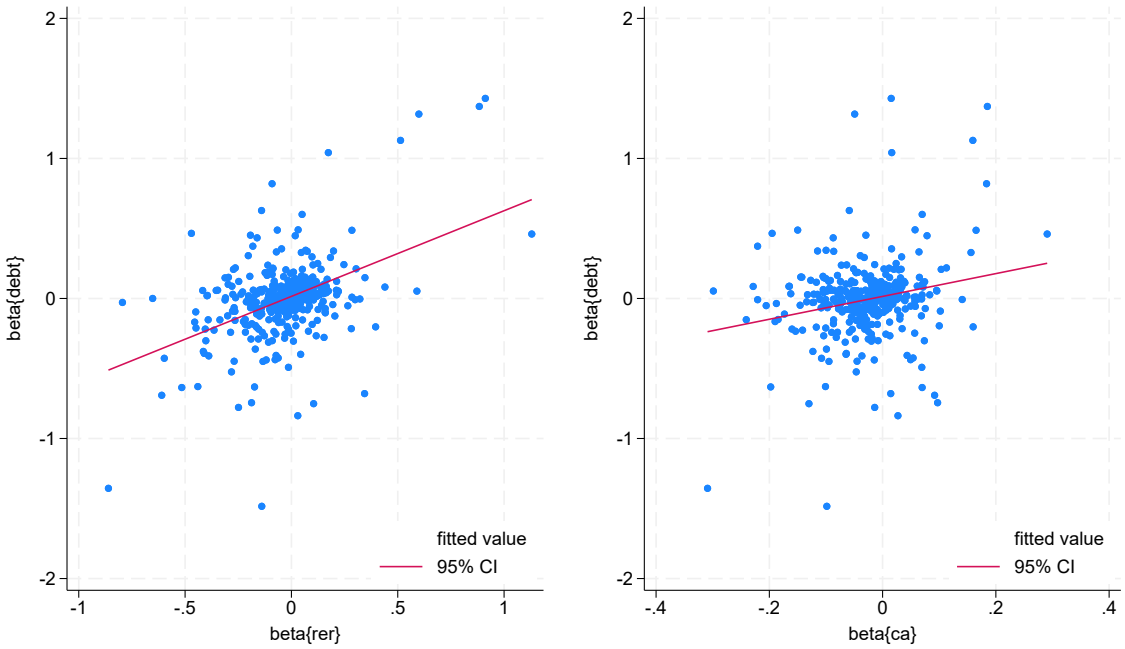


Figure G.1: Cross-country Responses of Government Debt, the RER and Current Account (all countries)

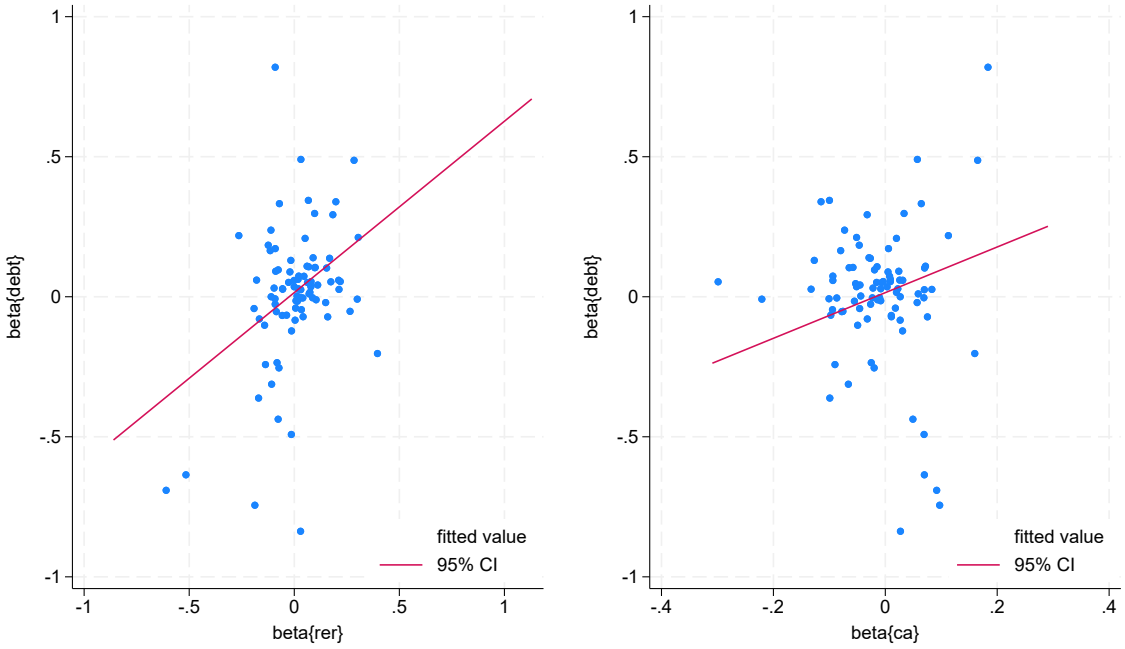


Figure G.2: Cross-country Responses of Government Debt, the RER and Current Account (advanced economies)

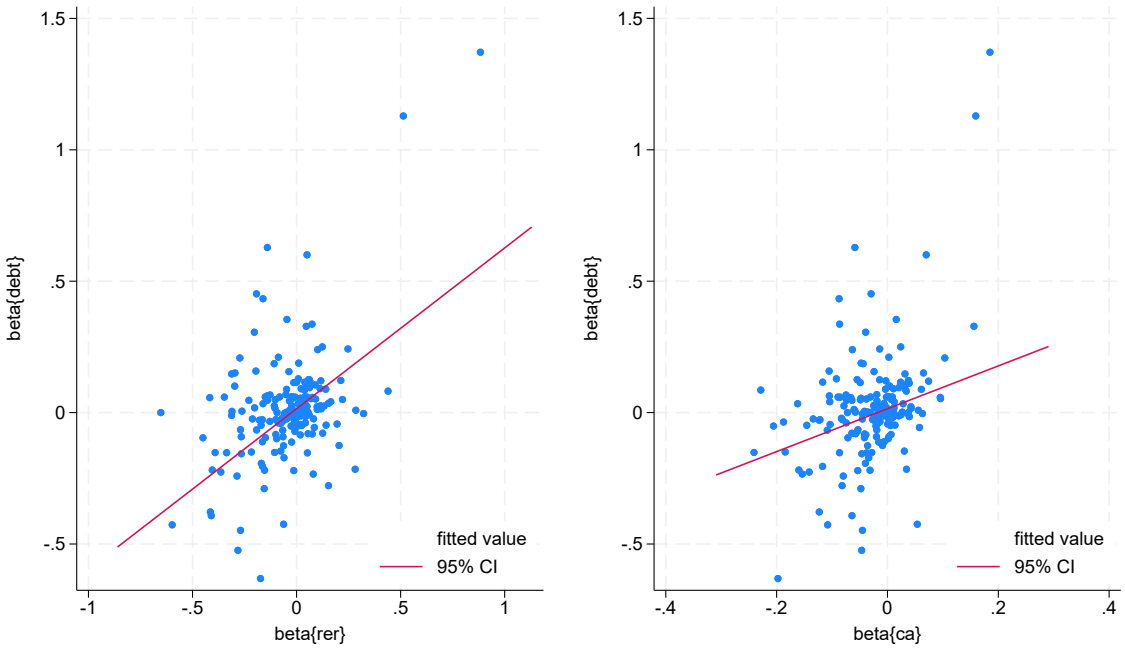


Figure G.3: Cross-country Responses of Government Debt, the RER and Current Account (developing economies)

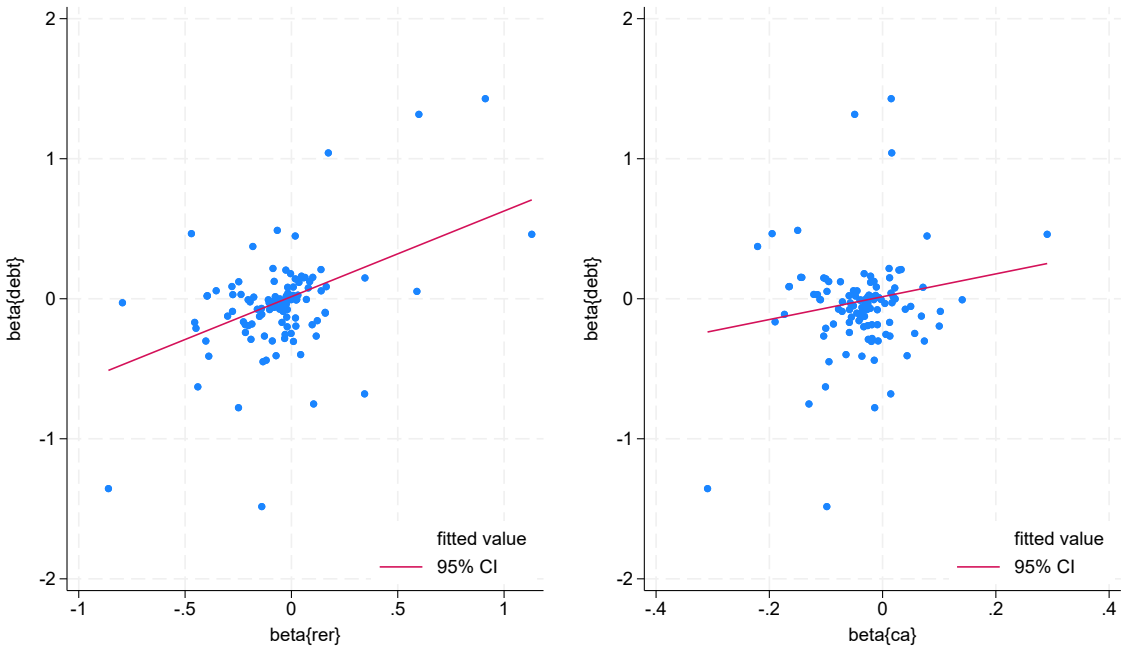


Figure G.4: Cross-country Responses of Government Debt, the RER and Current Account (poor economies)

H 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 (2010)	> 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 H.1: Summary of Findings in the Literature

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