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Fiscal Policy, Portfolio Frictions, and International Transmission*

Marcos Mac Mullen†

Federal Reserve Board

Abstract

I study the international transmission of fiscal policy and its impact on the real exchange rate (RER) and net exports. I document that periods of high government debt are strongly associated with a depreciated RER and subsequent increases in net exports. I present causal evidence that debt-financed fiscal expansions transmit primarily through deviations from uncovered interest parity, leading to a depreciated RER and increases in net exports over time. I propose a model in which portfolio rebalancing frictions drive the international transmission of fiscal policy that explains the empirical evidence, and show that this mechanism generates dynamics consistent with the RER disconnect.

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

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

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1 Introduction

Fiscal expansions in advanced economies often generate real exchange rate (RER) depreciations and, in some cases, improvements in net exports—outcomes that are difficult to reconcile with standard open-economy models.[1] The difficulty of explaining the dynamics of the RER and net exports through identifiable structural mechanisms—such as fiscal policy—has led much of the literature to rely on reduced-form shocks with limited direct empirical evidence to account for the behavior of these variables.[2]

In this paper, I study the international transmission of fiscal policy and its impact on the RER and net exports. I begin by documenting a strong empirical relationship between government debt, the RER, and net exports in the United States (US). I then analyze the effects of well-identified US government spending shocks to provide direct evidence on the channels driving the fiscal transmission, highlighting the central role of international financial adjustment. I develop a model in which portfolio rebalancing frictions govern the international transmission of debt-financed fiscal expansions that accounts for the empirical evidence. Using the estimated model, I show that US fiscal policy is an important driver of the unconditional RER dynamics, thereby linking RER fluctuations to structural forces.

The starting point of the analysis is the observation of a strong relation between fiscal policy, the RER and net exports in the US. Figure 1 presents the cyclical component of the US RER (blue-*o* line) and government debt in the US relative to the rest of the world (solid-black line).[3] The relationship among these variables is very strong. The correlation of relative government debt with the RER is 0.71.[4] Following the J-curve literature,[5] relative government debt is also

[1]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).

[2]See Itskhoki and Mukhin (2021); Alessandria and Choi (2021); Mac Mullen and Woo (2025); Kekre and Lenel (2024); Bodenstein, Cuba-Borda, Gornemann and Presno (2024). These shocks are residuals of the uncovered interest parity condition (financial shocks), the export-import ratio (trade shocks), or the Euler equation (demand shocks).

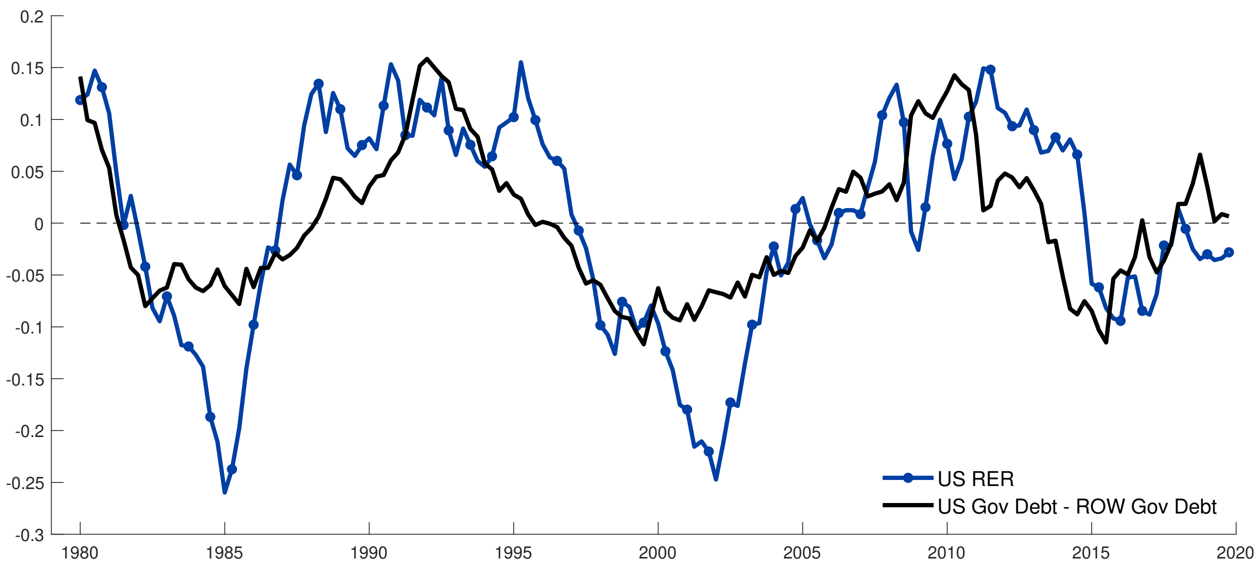
[3]The cyclical components are obtained from a cubic de-trend to capture the medium and low frequency dynamics. Government debt is measured in real terms, with the ROW debt expressed in real domestic currency. Results are robust to measuring the ROW debt in PPPs (Figure A2), and to extending the sample until 2024Q4 (Figure A7). 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. See Appendix A.1, for a discussion of the filtering of the data.

[4]In Appendix A, I show that the strong relationship between relative government debt and the RER holds for Canada, United Kingdom and Japan as well, both against their trade weighted rest of the world average (Figure A9) and for each bilateral pair inclusive of the US (Figure A10).

[5]Baldwin and Krugman (1989); Rose and Yellen (1989); Backus, Kehoe and Kydland (1994); Fitzgerald, Yedid-Levi

strongly correlated with leads of net exports, as shown in Figure A8 in the Appendix. 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 net exports are high. The strong relation among these variables suggests that developing a theory that explains their joint dynamics is important for understanding the overall drivers of the RER and net exports over the business cycle.

Figure 1: Government Debt in US relative to ROW and the US RER



Notes: An increase in the US RER means a depreciation of the dollar. ROW stands for Rest of the World.

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 effects of government spending shocks. Following Ramey (2011, 2016a), 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 exports over time. These shocks induce dynamics to government debt, the RER, and net exports 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 around 20 percent of the variance of US government debt, the RER, and net exports, and are therefore a significant driver of these variables.

and Haller (2019); Hooper, Johnson and Marquez (2000); Alessandria and Choi (2021)

I show that US government spending shocks transmit primarily through deviations from uncovered interest parity (UIP), or excess returns between US and ROW government bonds, rather than through interest rate differentials. The induced UIP 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 other findings in the literature.[7]

To rationalize the empirical evidence, I build a two-country general equilibrium model based on Backus et al. (1994) and Heathcote and Perri (2014). 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 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

[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).

[8] See Section 4.3.2 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 6.

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 exports.

I estimate the model, which also includes a rich set of shocks and frictions, using 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 exports 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 from the SVAR.

The model successfully captures the empirical responses of US government debt, the RER, net exports, excess bond returns, and US gross foreign assets to US government spending shocks. It also matches key unconditional moments of international business cycles, with US government spending shocks contributing to this outcome and to generating RER dynamics consistent with the 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). Taken together, these results link US government spending shocks—a structural force—to the RER dynamics, through endogenous UIP deviations rather than the exogenous wedges typically assumed in the literature (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 presents the quantitative model, Section 5 the main results, and Section 6 the sensitivity analysis. Finally, Section 7 presents the conclusion.

2 Literature Review

I contribute to the literature studying the international transmission of fiscal shocks in advanced economies, which predominantly found that government spending shocks depreciate the RER.[10] I contribute by showing that fiscal shocks are primarily transmitted through excess returns on US government bonds relative to foreign bonds, or UIP deviations, rather than through changes in interest rate differentials, the channel previously highlighted in the literature (Corsetti et al., 2012; Ravn et al., 2012; Jiang, 2021; Evans, Liu and Ou, 2025). I also find that fiscal expansions raise the gross foreign assets. To account for these facts, I develop a model in which portfolio rebalancing frictions generate endogenous excess returns and RER responses to debt-financed fiscal expansions that are quantitatively consistent with the empirical evidence.

I also contribute to the large literature studying international business cycles and exchange rate and net exports dynamics.[11] This literature has highlighted the importance of various reduced form shocks or wedges in driving the dynamics of these variables. First, I contribute by providing direct empirical evidence from the SVAR that US government spending shocks, i.e. structural shocks, are a significant driver of the RER and net exports, explaining around 20 percent of their variances. Second, I develop a quantitative model in which fiscal policy plays a key role in driving the unconditional RER dynamics. The government spending mechanism endogenizes some of the transmission channels treated as exogenous in the literature, such as UIP and convenience yields, offering a resolution to the RER disconnect puzzle through well-identified shocks.

[10]Table H.1 summarizes the findings in the literature. While 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) found depreciations of the RER, Auerbach and Gorodnichenko (2016), Ferrara, Metelli, Natoli and Siena (2021), Alpanda, Aysun and Kabaca (2024) and Born, D'Ascanio, Müller and Pfeifer (2024) found appreciations. However, the papers that find appreciations usually do so in the the short run, not necessarily in the medium run.

[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, Guerrón-Quintana and Saffie (2020); Itskhoki and Mukhin (2021, 2025); Jiang, Krishnamurthy and Lustig (2021); Akinci, Kalemli-Ozcan and Queralto (2023); Mac Mullen and Woo (2025); Chahrour, Cormun, De Leo, Guerrón Quintana, and Valchev (2024); Bodenstein et al. (2024); Camara et al. (2024); Jiang et al. (2024); Devereux, Engel and Wu (2025).

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 alternative identification strategies and a variety of controls.

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 and defense 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]

3.2 Identification of Government Spending Shocks

To identify innovations to US government spending I follow the strategy in Ramey (2011, 2016a). 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, 2016a) argues that the private sector might react in anticipation to these changes. To control for anticipation effects, I follow Ramey (2011, 2016a) and construct one-quarter ahead forecast errors of federal spending in the US, using data from the sur-

[12] I measure net exports 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.

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

vey 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 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

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

where FEG_t^{us} are the one quarter-ahead forecast error on US federal spending, g_t^{usa} is realized US government spending, g_t^{row} is 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) real interest rate differential, XM_t is the US export-import ratio, and RER_t the US trade-weighted RER.[16] To study the 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 estimate alternative SVAR specifications to avoid including too many variables in the SVAR. See Appendix B for details.

I include the ROW variables in my SVAR to account for the state of the economy in the ROW and provide 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, 2016a; Forni and Gambetti, 2016). To identify the unanticipated

[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 government 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.

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

component of the innovations to US government spending, I follow Ramey (2011, 2016a) 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 statistically significant. However, over time the excess return becomes positive and stays so until ten years after the shock. The existence of excess returns, or UIP deviations, suggests the presence of imperfections in international financial markets, consistent with previous findings in the literature (Engel and West, 2005; Gabaix and Maggiori, 2015; Bacchetta et al., 2022). Finally, Panel (g) shows that US agents increase their savings in foreign assets. This contradicts the predictions of frictionless models, which is therefore further evidence of financial market imperfections.[20] The responses of the excess returns of US government bonds and the US gross foreign assets are key to identify the frictions driving the international transmission of US fiscal policy, as will be

[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.

[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.

shown in Section 5. Finally, Panel (e) shows the response of the portfolio share of US government bonds, which presents a hump-shaped dynamic.[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 three and four years after the shock. On the other hand, Panel (h) shows that US net exports increase slowly over time, reaching a peak around five years after the shock. Hence, US government spending shocks trigger a lead-lag relationship between the RER and net exports 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. 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 exports shown in Panel (f) of Figure 2. Finally, in Figure B.3, I present the IRFs of macro aggregates in dollars, which shows that an impact effect of one dollar increase in US government spending, triggers a crowding-out of relative investment or around 3 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 exports that occurs gradually over time. They also trigger positive excess returns on US government debt relative to foreign debt in the medium and long run, and the US gross foreign assets increase. The comovement between US government debt, the RER and net exports 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.

[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 et al. (2019); Alessandria and Choi (2021).

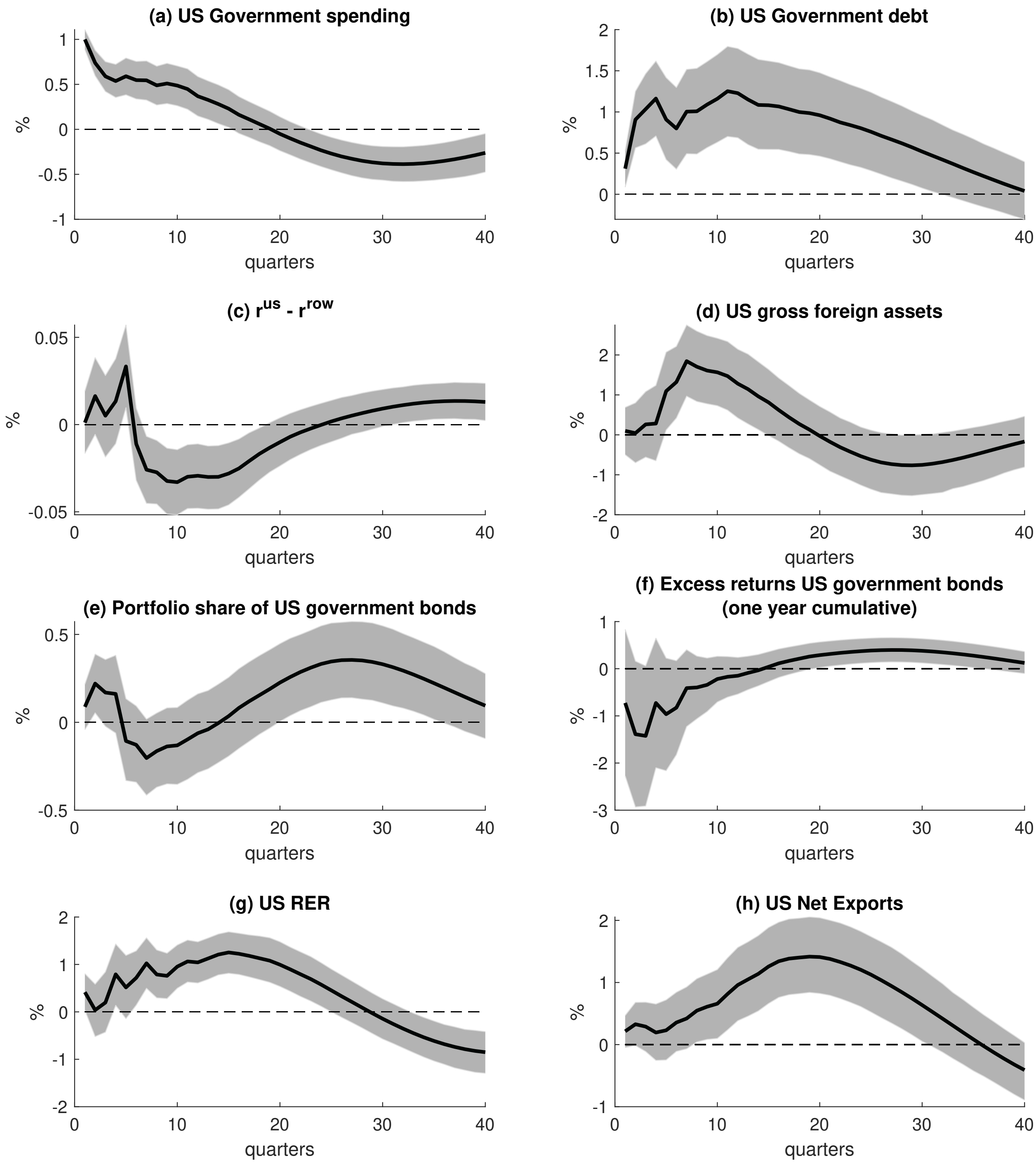


Figure 2: Impulse Response Functions to a Positive US Government Spending Shock

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

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 second column shows the contribution of the identified government spending shocks, and the third column the portion explained by the remaining (reduced form) innovations in the SVAR.

	US Gov spending	Other Shocks
US Government Gov Spending	24	76
US Government Debt	19	81
Interest Rate Differential	9	91
US Gross Foreign Assets	9	91
Portfolio share US gov bonds	6	94
Excess Returns US Gov Bonds	6	94
RER	20	80
Net Exports	20	80
US GDP	4	96

Table 1: SVAR Error Forecast Variance Decomposition

The US government spending shocks account for 24% of the variance of US government spending and 18% of US government debt. Furthermore, they explain 20% of the variance of the RER and net exports. US government spending shocks also explain a smaller portion of the variance of the excess returns on US government bonds, interest rate differential, the US gross foreign assets, and the portfolio share of US government bonds. Finally, consistent with previous findings in the literature, government spending shocks explain a very small share fo the variance of US GDP.

These numbers provide a lower bound for the total effect of fiscal policy and government spending. This is the case since anticipated exogenous changes in fiscal policy and endogenous changes in response to the state of the economy would also drive the RER and other variables of interest through similar channels as with unanticipated government spending shocks.

3.5 Robustness and Further Extensions

I perform a broad set of robustness exercises across alternative identification strategies, instruments, estimation frameworks, and controls. Full details are provided in Appendix D. Overall, the main findings are robust across specifications. In response to a positive US government spending shock, government debt rises, the RER depreciates, and net exports increase. The responses of excess returns on US government debt, US gross foreign assets, and the portfolio share of US government bonds are also similar to the baseline specification. Although the contribution of the spending shock to forecast error variance of different variables differs across specifications, the relative importance of the shock is consistently aligned across government spending, debt, the RER, and net exports. Finally, Appendix C examines the effect of US government spending shocks on a broader set of variables related to risk in financial and real markets, the banking sector, and international capital goods markets.

A potential concern with the baseline specification is the identification of government spending shocks using forecast errors within a recursive VAR. Although forecast errors isolate unanticipated changes in spending, they may still reflect endogenous policy responses to economic conditions. To address exogeneity concerns, I use defense spending as an implicit instrument within the SVAR, since its variation is commonly viewed as driven primarily by geopolitical rather than economic factors (Hall, 1980, 1986; Barro, 1981). The results are very similar as those obtained in the baseline specification.

A related concern is that the specification based on forecast errors can be affected by anticipation arising from delays between legislative authorization and the recording of purchases in the National Income and Product Accounts (Briganti, 2023; Briganti, Brunet and Sellemi, 2025).[23] To address anticipation concerns, I use shocks based on defense spending authorizations constructed by Briganti (2023) and Briganti et al. (2025), which capture policy decisions closer to their implementation. The responses of the RER, net exports, and financial variables are again very similar to those in the baseline specification. In this case, the response of government spending is hump-

[23] Briganti et al. (2025) is a revised joint version of Brunet (2023) and Briganti and Sellemi (2023).

shaped, consistent with the results in Ramey (2011, 2016a) and Briganti (2023). However, the share of the variance of the variables of interest explained by this shock is significantly smaller than in the baseline specification, including the effect on realized government spending. This most likely reflects a combination of smaller power of the instrument and the AR(2) nature of the response of government spending which incorporates a news component.

I also consider alternative estimation frameworks used in the literature, including proxy SVARs and local projection instrumental-variable (LP-IV) methods. For the proxy SVAR, I use the narrative military news instrument of Ramey (2011), following Ferrara et al. (2021). For LP-IV, I use forecast errors, defense spending shocks, and authorization-based shocks as internal instruments. The IRFs under these specifications are also broadly consistent with the baseline results.

Because the proposed mechanism operates mainly through government debt, rather than spending per se, I also estimate LP-IV specifications in which US government debt is instrumented directly by fiscal shocks. Among the candidate instruments considered—defense spending, forecast errors, and spending authorization—defense spending is the only instrument with enough power for government debt. The resulting IRFs are again similar to those obtained in the baseline SVAR.[24] Finally, I also use debt shocks from Phillot (2025) as instrument for changes in the supply of US government bonds and find results consistent with the baseline SVAR.

The results are also robust to Blanchard and Perotti (2002) identification and to focusing on VAR shocks to federal taxes in the US. A tax cut shock leads to an increase in government debt, a depreciation of the RER and an increase in net exports.[25]

In Appendix G, I study the cross-country effects of government spending shocks, using the panel data on military spending shocks from Miyamoto et al. (2019). I find results consistent with the baseline SVAR model and relate the cross-country heterogeneity to predictions of the model in Section 4.[26]

[24]While government spending has contributed to the rise in public debt over the past 45 years, transfers have accounted for an even larger share. This suggests that extending the analysis to transfer shocks would be a valuable exercise. However, identifying plausibly exogenous variation in transfers remains challenging. I therefore leave a systematic investigation of the effects of transfer shocks on government debt and the RER to future research.

[25]The VAR tax shocks are obtained from a recursive identification in which the federal tax rate is ordered first.

[26]Since the panel is available only at an annual frequency, it constrains the implementation of an out-of-sample forecasting exercise to assess the ability of government spending shocks to predict the RER and net exports across countries. A cross-country out-of-sample predictive analysis is beyond the scope of this paper, but would be useful

Finally, the results are robust to a wide range of additional controls to the baseline specification. These include: (i) the US price-dividend ratio, to account for expected economic conditions; (ii) forecast errors for other macroeconomic aggregates; (iii) restricting the sample to the pre–global financial crisis period (1980Q1–2007Q4);[27] (iv) long-term nominal interest rates; (v) short-term nominal rates; (vi) short-term real rates; (vii) the US fiscal balance; (viii) ordering rest-of-the-world government spending first; (ix) including a linear trend; and (x) controlling for geopolitical risk using the global and US indices of Caldara and Iacoviello (2022). None of these modifications materially affects the main results.

4 Quantitative Model

In this section, I present a quantitative model to aid interpretation of the empirical findings. The model is based on Backus et al. (1994) and Heathcote and Perri (2014), but departs in several dimensions. The two key extensions are a fiscal rule that relies heavily on the use of government debt to finance spending and portfolio frictions, two features that are strongly supported by the data.[28] I also present the estimation of the model.

4.1 Two-Country Model: Fiscal Rules and Portfolio Frictions

I extend the standard two-country international business cycle model in numerous dimensions. First, I incorporate a fiscal rule that allows government spending, lump-sum taxes and government debt to respond endogenously to the state of the economy, together with shocks to government spending, similar to Leeper et al. (2010). Second, households can save in two assets, a domestic government bond and a foreign bond issued by the foreign household in foreign currency.[29] I incorporate portfolio frictions by assuming that the household pays a cost to deviate from the long-run portfolio share of savings in foreign assets. This is similar to the specifications in Guo et al. (2023) and Camara et al. (2024). This friction is at the core of the international

for future work.

[27]In the shorter sample I also include federal spending in the SVAR since the big military cycles, which drove the cyclical component of federal and government spending, where more prominent in this period.

[28]See Auerbach (2003); Auerbach and Yagan (2024); Ramey (2024) for a discussion of the fiscal rule, and Bacchetta et al. (2022); Koijen and Yogo (2024) for further evidence on imperfections in international financial markets.

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

transmission mechanism by generating endogenous excess returns of US government bonds, or deviations from UIP.

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

4.1.1 Households

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

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

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

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

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

where P_t^c is the price index of the final consumption good in the US, 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 the holdings of US government bonds, P_t^g the price of these bonds, Π_t^{us} the aggregate profits of intermediate firms, and T_t are lump-sum taxes from the government.

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

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

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

where $\Gamma \geq 0$ governs the cost of adjusting the portfolio of assets, $\bar{S}_{t+1}^{us} = \bar{B}_{t+1}^{g,us} P_t^{g,us} + \mathcal{E}_t \bar{B}_{t+1}^{row,us} P_t^{row,us}$ are the aggregate financial savings of US households, and ψ_t^{us} are shocks to the long-run portfolio of foreign assets capturing changes in financial liberalization. In equilibrium, the cost depends on the portfolio share of foreign assets, $\frac{\Gamma}{2}\left(s_{t+1}^{row,us} - s_{ss}^{row,us} \times e^{\psi_t^{us}}\right)^2$, where $s_{t+1}^{row,us} \equiv \frac{\mathcal{E}_t B_{t+1}^{row,us} P_t^{row,us}}{S_{t+1}}$ and $s_{ss}^{row,us} \equiv \frac{\mathcal{E}_{ss} B_{ss}^{row,us} P_{ss}^{row,us}}{S_{ss}}$. The portfolio friction is similar to the specifications in Guo et al. (2023) and Camara et al. (2024). The main difference is that the household does not internalize the effect on the aggregate financial savings, $\bar{S}_{t+1}^{us}$. I discuss the relation of the portfolio frictions with different microfoundations in Section 4.3.2.

The US household also purchases capital goods from US retailers, I_t, to accumulate capital, which follow the law of motion,

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

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

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

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

4.1.2 Retailers

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

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

where $\hat{\theta}_t = \theta Q_t^{\zeta}$ is a reduced form pricing-to-market friction as in Alessandria and Choi (2021), Mac Mullen and Woo (2025) and Kekre and Lenel (2024). This friction allows the model to generate a volatility of the terms of trade that is lower than that of the RER and an incomplete pass-though of exchange rate to prices. The CES aggregators of the retailers are given by

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

and

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

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

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

4.1.3 Intermediate Firms

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

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

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

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

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

where MC_t is the marginal cost of production. The solution to this problem is characterized by the optimal price setting, which is a markup over the marginal cost,

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

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 given by,

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

4.1.4 Fiscal Rule

The US government purchases consumption and investment goods from local retailers, G_t^c and G_t^I respectively. To finance its expenditures, the US fiscal authority uses a combination of lump-sum taxes, T_t, and debt, $\hat{B}_{t+1}^{g,us}$. 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 and government spending follows a rule similar to the one adopted by Leeper et al. (2010).[30] Lump-sum taxes are used in the steady state to finance government purchases of consumption and investment goods, denoted by μ_{ss}^g, and the interest payments on debt, denoted by μ_{ss}^b. Outside the steady state, lump-sum taxes are allowed to respond endogenously to deviations in interest payments on debt and in spending according to the rule,

$$T_t = \mu_{ss}^g + \mu_{ss}^b + \varphi^{T,b}\left(P_t^{g,us}\hat{B}_{t+1}^{g,us} - \mu_{ss}^b\right) + \varphi^{T,g}\left(P_t^c G_t^c + P_t^I G_t^I - \mu_{ss}^g\right) \tag{3}$$

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

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

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

Government spending in consumption and investment goods, evolve according to

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

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

where $\mu_{ss}^{G_c}$ 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,

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

4.1.5 Other Shock Processes

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

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

where

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

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

4.1.6 Market Clearing and Country Budget Constraint

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

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

where NX_t are net exports and given by the sum of net exports in consumption goods, investment goods and materials,

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

Market clearing in bonds markets requires that for all t,

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

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

4.2 Mechanism

To provide intuition for the mechanism I derive the equations summarizing the equilibrium in international financial markets.

The presence of the portfolio friction in Equation 2, implies the following asset demand equations from the FOCs of the household problem,

$$1 = \beta \mathbb{E}_t \left[\Omega_{t+1}(1 + r^{g,us}_t)\right], \tag{4}$$

and

$$1 + \Gamma\left(s^{row,us}_{t+1} - s^{row,us}_{ss} \times e^{\psi^{us}_t}\right) = \beta \mathbb{E}_t \left[\Omega_{t+1} \frac{\mathcal{E}_{t+1}}{\mathcal{E}_t}(1 + r^{row,us}_t)\right], \tag{5}$$

where equation 4 is the demand for US government bonds, and equation 5 is the demand for foreign assets, Ω_{t+1} is the stochastic discount factor, and $(1 + r^{g,us}_t) \equiv 1/P^{g,us}_t$ and $(1 + r^{row,us}_t) \equiv 1/P^{row,us}_t$ the interest rate on US government bonds and the US gross foreign assets. 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 of bonds, or UIP deviations.[31] To see this, consider the first-order log-linearized UIP condition,

$$r_t^{g,us} - r_t^{g,row} - \mathbb{E}_t\left[\Delta e_{t+1}\right] = \Gamma \bar{s}^{g,us}\left(s_{t+1}^{g,us} - \bar{s}^{g,us}\right) + \Gamma(1-\bar{s}^{g,us})\psi_t^{us} \tag{6}$$

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 $t+1$.[32] There are two sources driving the excess returns. The first term in the right hand side captures the endogenous excess returns arising from the portfolio frictions, and the second term the exogenous deviations arising from shocks to long-run portfolios, capturing the UIP shock in Itskhoki and Mukhin (2021). This equation shows that, all else equal, a higher share of savings in US government bonds relative to the long-run, i.e. $\left(s_{t+1}^{g,us} - \bar{s}^{g,us}\right) > 0$, raises the expected returns on this bond relative to the ROW bond. This is the case because increasing the share of savings in US government bonds relative to ROW bonds is costly, and hence household requires a compensation to be willing to hold more government bonds in equilibrium, which materializes in the form of excess returns.

By rolling forward equation 6, we can derive an expression for the transitory component of the exchange rate, given by

$$e_t = -\mathbb{E}_t \sum_{j=0}^{\infty}\left(r_{t+j}^{g,us} - r_{t+j}^{g,row}\right) + \Gamma \bar{s}^{g,us}\mathbb{E}_t \sum_{j=0}^{\infty}\left(s_{t+1+j}^{g} - \bar{s}^{g}\right) + \Gamma(1-\bar{s}^{g,us})\mathbb{E}_t \sum_{j=0}^{\infty}\psi_{t+j}^{us} \tag{7}$$

so that the exchange rate depreciates in response to: (*i*) a fall in the sum of expected future (transitory) interest rate differentials, (*ii*) an increase in the sum of expected future (transitory) portfolio share differentials of government bonds, (*iii*) an increase in the sum of the exogenous UIP wedge. The second term on the right hand side explicitly indicates how the presence of portfolio frictions affect the propagation of shocks in the economy by linking the response of the portfolio shares to the exchange rate determination. This equation shows that the exchange rate would depreciate in response to a government spending shock through the portfolio channel if

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

[32] The portfolio share of government bonds is defined as $s_{t+1}^{g,us} \equiv \frac{B_{t+1}^{g,us}P_t^{g,us}}{S_{t+1}}$, or $s_{t+1}^{g,us} = 1 - s_{t+1}^{row,us}$.

the share of savings in US government bonds increases sufficiently. 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.

4.3 Discussion of the Portfolio Friction

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

4.3.1 Identification of the portfolio friction

By using the demand for foreign assets in equation 5 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 estimation of the quantitative model in Sections 4.4.

4.3.2 What does the portfolio friction reflect?

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 reflects. There are two main implications of the friction: (i) it reduces the demand elasticity of foreign assets as shown in Equation 5, 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.[33] 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 these investors face strict mandates in the allocation of wealth across different assets.[34] Consequently, portfolio shares 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,

[33] 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).

[34] (Basak and Pavlova, 2013; Greenwood, Hanson and Liao, 2018; Gabaix and Koijen, 2021; Bacchetta et al., 2022; Pavlova and Sikorskaya, 2022; Koijen and Yogo, 2024; Moretti et al., 2024).

making portfolio shares less volatile.[35] 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 reflect 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 capture 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.[36] While convenience yields are usually modeled 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.

Finally, the literature on household portfolios has documented the presence of sticky port-

[35] Dornbusch (1980) portfolio diversification model delivers an expression for the relative supply of government debt, UIP deviations and the RER similar to that in Equations 6 and 7.

[36] (Krishnamurthy and Lustig, n.d.; Jiang et al., 2021; Jiang, Krishnamurthy and Lustig, 2023; Jiang et al., 2024; Kekre and Lenel, 2024).

folios and behavioral biases, which leads to hump-shaped dynamics of asset prices and portfolios in response to shocks.[37] Such dynamics are similar to those induced by the portfolio friction in Equation 2.[38].

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 5, 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.

4.4 Estimation

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

The first group includes parameters that are quite standard and others that deserve more discussion. In particular, I choose the home bias in the four CES aggregators to match the average structure of trade in the US between 1980 and 2019. That is, a trade-to-GDP ratio of 21%, a share of material goods in trade of 29%, a share of consumption goods in trade of 39%, and a share of capital goods in trade of 32%.[39] 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 0.36, to be consistent with the average values in the US between 1980 and 2019.[40]

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

[38]See Figure 3.

[39]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.

[40]I map the holdings of US government bonds by US households in the model to the holdings of US government

I target a steady state ratio of US government spending to GDP of 18% and a share of government spending in consumption goods of 75%, the averages in the sample period. The volatility of the US government spending shock is chosen to match the impact effect of the US government spending impulse response from the SVAR. The adjustment cost of investment is set to 3.24, the value estimated in Christiano et al. (2005) for the flexible price model. The pricing-to-market friction is chosen to generate an exchange rate pass-through of 75%, in line with results in Alessandria and Choi (2021) and estimates in Gopinath and Itskhoki (2010). I target an intertemporal elasticity of substitution of 1.5, which gives a value of σ of 2/3, which is within the range used in the literature. Finally, following Proposition 1, the portfolio friction is set to match the partial equilibrium aggregate demand elasticity for internationally traded bonds of 2.1 estimated by Koijen and Yogo (2024), which gives a value of Γ of 1.462.

The moments used in the SMM estimation are displayed in Table 3, and the estimated parameters with their standard errors in Table 4. The parameters include those related to shock 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 net exports and the RER. Hence, my identification strategy targets a combination of conditional and unconditional moments.[41] 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.[42] I choose this filter to capture medium to low frequency dynamics, where most of the variance of the RER and net exports arises.[43]

In total there are 17 parameters and 180 moments, with 160 corresponding to IRFs moments,

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).

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

[42]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.

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

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	0.36	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^c	0.059	i. Share of Consumption in US Trade 39%
	γ^m	0.030	ii. Share of Materials in US Trade 29%
	γ^I	0.111	iii. Share of Capital in US Trade 32%
			iv. Trade-to-GDP ratio of 21%
Steady State gov expenditure	$\mu_{ss}^{G_k}$	0.045	i. Share of US government investment goods of 25%
	$\mu_{ss}^{G_c}$	0.135	ii. Share of US government consumption goods of 75%
			iii. US government government spending over GDP of 18%
Std US gov spending shock	σ_g^{us}	0.011	impact effect US gov spending IRF

Table 2: Externally Calibrated Parameters

and the remaining 20 to 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.[44]

[44] 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.

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	$\frac{\sigma(g^{us})}{\sigma(gdp^{us})}$; $\frac{\sigma(g^{row})}{\sigma(gdp^{us})}$; $\rho(g^{row})$; $\frac{\sigma(inv^{us})}{\sigma(gdp^{us})}$; $\rho(gdp^{us}, gdp^{row})$;$\rho(B^{g,us}, g^{us})$
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	$\frac{\sigma(gfa^{us})}{\sigma(gdp^{us})}$; $\sigma\left(\frac{B^{g,us}}{gdp^{us}}\right)$; $\frac{\sigma(s^{g,us})}{\sigma(gdp^{us})}$; $\frac{\sigma(i^{us}-i^{row})}{\sigma(gdp^{us})}$ $\rho(s^{g,us})$; $\rho(i^{us} - i^{row})$; β^{Fama}; $\rho(B^{g,us} - B^{g,row}, rer)$

Table 3: SMM Target Moments

4.4.1 Discussion of Identification

The goal of the estimation is to capture the conditional and unconditional dynamics of US fiscal policy, net exports 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 Table 3, I target horizons one to forty of the IRFs of US government spending and government debt which are informative about the fiscal rule. I also target the IRFs of the RER and net exports. Hence, the model is estimated to capture the increase in net exports and depreciation of the RER, conditional on matching the response of the US government spending and debt.

The unconditional moments are displayed in Panels II to IV in Table 3. Panel II includes standard international business cycle moments related to GDP, government spending and investment dynamics in the US and ROW. These moments are informative about the TFP processes, and the fiscal rule, since it includes the volatility of government spending, and the comovement between government spending and debt.

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 exports 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, 2025).[45] 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 the 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 informative about the differential financial shock process. I also include the correlation between relative government debt and the RER, computed from Figure 1, and the volatility of the US government debt relative to GDP which informative about the fiscal rule.

Table 4 presents the estimated parameters with their standard errors. The estimation identifies a lower volatility and persistence of ROW government spending shocks than in the US, consistent with the unconditional dynamics of these variables. 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 response of taxes to spending ($\varphi^{T,g}$) means that for every dollar increase in spending, the government raises around 48 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 (2025). Finally, the adjustment cost in the CES aggregators has a value of 611.28, 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 aggregate net exports.

5 Quantitative Results

In this section, I present the results of the benchmark model. First, I focus on the international transmission of US government spending shocks. I show that the benchmark model captures the

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

Parameter		Value	Parameter		Value
1. Std common prod shock	σ_z^c	0.007 (0.0008)	10. Std differential financial shock	σ_ψ^d	0.008 (0.0011)
2. Pers common prod shock	ρ_z^c	0.895 (0.1750)	11. Pers differential financial shock	ρ_ψ^d	0.767 (0.0700)
3. Std differential prod shock	σ_z^d	0.005 (0.0004)	12. Std common portfolio shock	σ_ψ^c	0.004 (0.0014)
4. Pers differential prod shock	ρ_z^d	0.900 (0.0297)	13. Pers common financial shock	ρ_ψ^c	0.984 (0.0533)
5. Pers US gov shock	ρ_g^{us}	0.966 (0.0121)	14. Adj cost CES	ι	611.28 (216.22)
6. Std ROW gov shock	σ_g^{row}	0.007 (0.0021)	15. Response gov spending to debt	$\varphi^{g,b}$	-0.032 (0.0038)
7. Pers ROW gov shock	ρ_g^{row}	0.862 (0.0363)	16. Response taxes to debt	$\varphi^{T,b}$	0.037 (0.0078)
8. Std differential trade shock	σ_ξ^d	0.013 (0.0018)	17. Response taxes to spending	$\varphi^{T,g}$	0.48 (0.0687)
9. Pers of differential trade shock	ρ_ξ^d	0.985 (0.0008)			

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

Table 4: SMM Estimated Parameters

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 the US government spending shock mechanism generates RER dynamics consistent with the 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.

5.1 Accounting for the International Transmission of US Fiscal Policy

Figure 3 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).

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 four 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 still within the confidence intervals for several periods. On impact the portfolio share slightly falls rather than increase, which 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. Over time the portfolio share falls under the value in the data, given that it overpredicts the US gross foreign assets response in the medium and long run.

The path of the excess returns generated by the benchmark model is close to the data. The model captures its hump-shaped dynamics, which is inherited from that of the portfolio share of US government bonds, following equation 6.

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; Evans et al., 2025). 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.[46]. It is clear that the implied RER depreciation that would be triggered by the interest rate differential channel is significantly smaller than in the data, showing that US government spending shocks are transmitted primarily through UIP deviations.

[46] 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 7. 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.

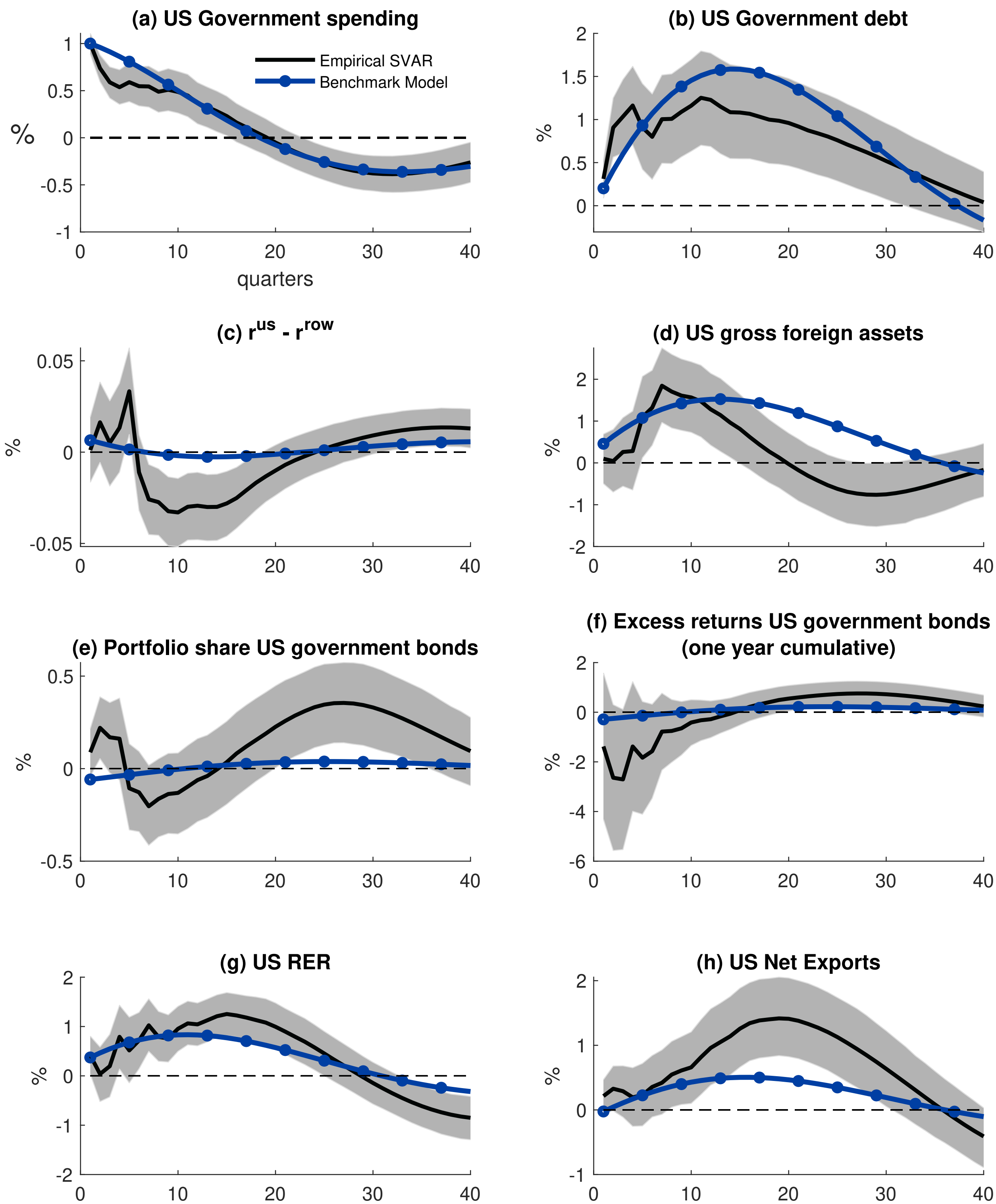


Figure 3: Impulse Response Functions: SVAR and Model

Notes: Standard error bands are 68% confidence intervals.

The depreciation of the RER triggers an expenditure switching effect that raises net exports (Panel h). The response of net exports is hump-shaped, as the RER, with almost no 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. Second, 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 net exports. Trade frictions give rise to a trade elasticity to prices 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 net exports 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 net exports 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 are key to account for the international transmission of US government spending shocks. It presents the IRFs under no portfolio frictions (green-dashed line), and under a fiscal rule that stabilizes the value of government debt in the US so that taxes are the instrument used to finance the spending shock (orange-> line).[47]

Absent portfolio frictions, the model generates 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. A higher US interest rate induces US households to re-balance

[47]In the model with no portfolio frictions I set $\Gamma = 0$, and to make the model stationary and pin down the gross foreign assets I assume there is a small quadratic cost of deviating from the long-run level of the ROW bond, $\frac{\chi}{2}\left(B_{t+1}^{row,us}\mathcal{E}_t P_t^{row,us} - B_{ss}^{row,us}P_{ss}^{row,us}\right)^2$ where $\chi = 0.001$. The model with the alternative fiscal rule replaces the fiscal rule in Equation 3 by $P_t^{g,us}\hat{B}_t^{g,us} = P_{ss}^{g,us}\hat{B}_{ss}^{g,us}$.

their portfolios towards US government bonds and in detriment of the ROW bond, so that the US gross foreign assets fall. This lead the model to overpredict the effect on the portfolio share of US government bonds. Furthermore, in this case there are no excess returns of US government bonds, and the level of the RER is solely determined by the interest rate differential, as shown by Equation 7 under $\Gamma = 0$ and $\psi_t^d = 0$. Consequently, the US RER appreciates on impact, given the increase in the interest rate differential. Finally, both the increase in the domestic demand from the government and the expenditure switching effect triggered by the appreciation of the RER reduces the net trade flows.

The case where the fiscal rule stabilizes the value of government debt in the US cannot replicate the data either. In this version of the model, 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. It follows from Equation 7 that the effect on the level of the RER through the portfolio channel will 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.[48]

The strong reliance of government debt of the US economy after 1980 is a well known feature of the data. Auerbach (2003) documents a modest feedback between Congress legislation to raise primary surplus in response to increases in projected future deficits between 1984 and 2003. Moreover, recent work by Auerbach and Yagan (2024) extends the analysis up to 2024 and find that between 2004 and 2024, the US Congress did not respond to deficits anymore.[49] As shown in the Appendix D, when the SVAR is estimated with data up to 2007, the response of debt is smaller than in the full sample, consistent with findings in Auerbach (2003) and Auerbach and Yagan (2024). The model captures the overall strong reliance on debt between 1980 and 2019 through parameters governing the response of taxes and spending to changes in debt that are close to zero. If the lack of fiscal response to changes in future deficits and government debt where to

[48]In Section G.1, 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.

[49]See also an insightful discussion by Ramey (2024) on the fiscal rule in Auerbach and Yagan (2024).

persistent over time, the model would capture this through an even weaker feedback between debt and taxes/spending. In this case we should expect fiscal shocks to gain more relevance as drivers of RERs and international business cycles.

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. A stronger US consumption growth translates into higher interest rates in the US. Following equation 7, 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, resulting in a weaker and more front-loaded increase in net exports.

To summarize, portfolio frictions and a fiscal rule that relies heavily on the the of government debt to finance spending are key for capturing the international transmission of US government spending shocks. This is consistent with findings in both the international literature that has documented several frictions in international financial markets (Bacchetta et al., 2022; Koijen and Yogo, 2024), and the macroeconomic literature on US fiscal rules (Auerbach, 2003; Auerbach and Yagan, 2024).

5.2 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 5, where Panel A presents the target moments and Panel B the untargetted moments. The benchmark model accounts for the RER disconnect puzzles. It captures the RER moments related to the Meese and Rogoff (1983) puzzle, that is a RER that is more volatile that macro aggregates and highly persistent. Furthermore, it captures the Fama (1984), or Forward Premium puzzle. In the model, high interest 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).

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 contemporaneous correlation of 0.47, with the value in the data being 0.71, and it also captures the dynamic comovement between leads and lags, presented in Figure E.5. This result is not trivial. Figure E.5 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.

Moment	Data	Benchmark	Contribution G^{us} shocks	Moment	Data	Benchmark	Contribution G^{us} shocks
Panel A: Target Moments							
1. $\sigma(gov^{us})/\sigma(gdp^{us})$	1.51	1.61	1.68	11. SR trade elast.	0.15	0.04	0.10
2. $\sigma(gov^{row})/\sigma(gdp^{row})$	0.59	0.64	0.16	12. LR trade elast.	1.11	1.10	0.25
3. $\rho(gov^{row})$	0.83	0.84	0.99	13. $\sigma(gfa^{us})/\sigma(gdp^{us})$	4.35	4.93	3.78
4. $\sigma(inv^{us})/\sigma(gdp^{us})$	3.42	2.93	2.66	14. $\sigma(B^{g,us}/gdp^{us})$	0.038	0.042	0.041
5. $\rho(gdp^{us}, gdp^{row})$	0.86	0.76	0.93	15. $\sigma(s^{g,us})/\sigma(gdp^{us})$	1.09	0.70	0.11
6. BSK: $\rho(\Delta(c^{us} - c^{row}), \Delta rer)$	-0.15	-0.30	-0.71	16. $\sigma(r^{us} - r^{row})/\sigma(gdp^{us})$	0.12	0.08	0.02
7. $\sigma(rer)/\sigma(gdp^{us})$	4.24	4.08	2.07	17. $\rho(r^{us} - r^{row})$	0.89	0.80	0.97
8. $\sigma(nt)/\sigma(rer)$	1.12	1.27	0.4	18. $\rho(s^{g,us})$	0.92	0.91	0.95
9. $\rho(rer)$	0.96	0.96	0.99	19. β_{Fama}	-1.49	-1.45	-0.20
10. $\rho(B^{g,us}, gov^{us})$	0.33	0.29	0.29	20. $\rho(B^{g,us} - B^{g,row}, rer)$	0.71	0.47	0.92
Panel B: Untargetted Moments							
1. R^2_{Fama}	0.03	0.01	0.00	7. $\rho(xm^{us})$	0.98	0.99	0.99
2. $\rho(tot, rer)$	0.88	0.99	1.00	8. $\rho(inv^{us} - inv^{row}, rer)$	-0.71	-0.83	-0.99
3. $\sigma(tot)/\sigma(rer)$	0.27	0.63	0.60	9. $\rho(B^{g,us})$	0.97	0.99	0.99
4. $\rho(r^{us} - r^{row}, rer)$	-0.59	-0.14	-0.50	10. $\rho(inv^{us}, inv^{row})$	0.31	0.16	0.58
5. Low freq RER spectrum	0.64	0.68	0.71	11. $\rho(B^{g,us}, gfa^{us})$	0.19	0.78	0.99
6. BC freq RER spectrum	0.30	0.24	0.24	12. $\rho(gfa^{us}, gfl^{us})$	0.83	0.72	0.97

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 5: Unconditional Moments

The benchmark model accounts for these unconditional international business cycle moments 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.[50] The moments triggered by this version of the model are displayed in Table 5 and Figure E.5 under the label 'Contribution G^{us} shocks'.[51]

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 2.07 times larger than that of GDP, and result in a nearly unit root in the RER, since its autocorrelation is 0.99. 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, presented in Table E.1. The share of the variance of the RER explained by the US government spending shock in the data and model are similar, 20 and 21 percent respectively.

In Appendix E.4, I consider a version of the model that also includes a stochastic wedge for taxes/transfers and use the Kalman Filter to infer the most likely sequence of shocks that match the time series of GDP, government spending and debt in the US and the ROW, the US RER, net exports and the portfolio share of US government bonds held by US agents.[52] Figure E.6 shows the path of the RER in the data together with its counterfactual path under only US fiscal policy shocks (government and tax/transfer shocks). The correlation between the two series is 0.51, showing that US fiscal shocks, including tax/transfer shocks, were key drivers of the US RER between 1980 and 2019.

To summarize, the fiscal mechanism explains quantitatively the empirical evidence on the international transmission of US government spending shocks. It operates through endogenous

[50] 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.

[51] This model is not re-estimated.

[52] The inclusion of the tax/transfer wedge is necessary for the model to simultaneously match government spending and debt in the US and the ROW. The parametrization of this model is the same as the Benchmark model in Table 4 and the two tax/transfer wedges are assumed to be *iid* with its variance chosen such that the variance of the realized tax/transfer innovations equals 1.

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. The mechanism links the RER disconnect moments to a well-identified shock, while accounting for the strong comovement between relative government debt and the RER documented in Figure 1.

6 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, allowing for a special role of US government debt in international financial markets, and modeling US government spending as an AR(2) process capturing its dynamics identified with the defense spending authorizations instrument. The details are in Appendix F.[53]

I find that targeting the IRFs from the SVAR is crucial for identifying the fiscal rule, otherwise the model overpredicts the response of government debt. Nevertheless, whenever I target either the conditional moments or the unconditional moments, the results are similar to the benchmark model for the implications of key variables 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, and the results of this version are similar to those of the benchmark model.

I allow for a special role of the US government bonds, by letting them be the only government bond traded internationally. This version captures how much of the increase in the total supply of US government debt after the spending shock is absorbed by the US and ROW agents (Figure F.4).[54] This model identifies similar parameters as the benchmark model, thus generating

[53] 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.3, F.2, F.3 and F.4, and the unconditional moments in Tables F.2 and F.3.

[54] In this model the ROW household faces an adjustment cost for changing the value of her holdings

similar results. This arises from the fact that the mechanism is unchanged, since the same UIP condition in equation 6 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. Furthermore, allowing for cross-country trade in government bonds brings the model closer in capturing the volatility of the portfolio share of US government bonds.

Finally, I consider the case where the US government spending follows an AR(2) process. In this case I target the IRFs from the SVAR that uses defense authorizations as an internal instrument. The responses of the US gross foreign assets in the data are stronger in the short run relative to the model, implying an even stronger fall in the portfolio share of US government bonds. Nevertheless, this model still captures well the response of the US RER and net exports.

7 Concluding Remarks

This paper studies the international transmission of fiscal policy and its effects on the RER and net exports. I show that fiscal shocks are primarily transmitted though UIP deviations, with US government spending shocks explaining around 20% of the variance of the US RER and net exports. To aid interpretation of the empirical findings, I develop a model that combines a debt-financed fiscal rule with portfolio frictions. The model matches the international transmission of US fiscal shocks and key features of international business cycles. In the estimated model, I find that US government spending shocks trigger RER dynamics consistent with the disconnect, offering a resolution to the disconnect puzzle through well-identified shocks.

The framework can also be applied to study other important issues. Portfolio frictions imply an endogenous international risk-sharing inefficiency associated with government debt, introducing a trade-off between debt and distortionary taxation. This mechanism is particularly relevant in light of the persistent rise in government spending and debt following the COVID-19 pandemic and recent geopolitical developments. More broadly, the framework can be used to study government spending multipliers and fiscal–monetary interactions in open economies.

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of US government bonds, $\frac{\chi}{2}\left(B_{t+1}^{g,us,row}P_t^{g,us}/\mathcal{E}_t - B_{ss}^{g,us,row}P_{ss}^{g,us}/\mathcal{E}_{ss}\right)^2$, and for the bonds issued by the US, $\frac{\chi}{2}\left(B_{t+1}^{us,row}P_t^{us,row}/\mathcal{E}_t - B_{ss}^{us,row}P_{ss}^{us,row}/\mathcal{E}_{ss}\right)^2$. The adjustment cost χ, set to 0.00001, pins down the steady state values of $B_{ss}^{g,us,row}$ and $B_{ss}^{us,row}$. The value of $B_{ss}^{g,us,row}$ is chosen to match its average value in 1980-2019 (16% of US GDP).

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Appendix

A Data Description and Robustness

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 government 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 (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 Federal Debt: Total Public Debt (GFDEBTN)
  ii Federal Debt Held by Foreign and International Investors (FDHBFIN)
  iii Federal Debt Held by Federal Reserve Banks (FDHBFRBN)
  - US gov debt in hands of US agents (excluding US gov institutions) = $i - ii - iii$
  - In real terms: deflated by US CPI
- ROW government debt (IMF)
  - Annual in real per capita terms.
  - Plots in Figures A9 and A10 are in annual frequency.
  - To construct the ROW trade weighted average government debt for the US to then compute the relative government debt plotted in Figure 1, the ROW government debt is transform from annual to quarterly frequency and then smoothed using a three-month moving average. The ROW government debt for the US comes from an unbalanced panel since not all countries have available data from 1980.
- 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.

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.[55] I focus on cycles of frequencies lower than the standard case (i.e. cycles up to eight years) for two reasons. First, the cyclical component of relative government debt is strongly driven by that in the US (Figure A6), which in turn is driven by the US military build-ups 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 exports and the RER arises at lower frequency cycles (Rabanal and Rubio-Ramirez, 2015; Gornemann et al., 2020; Mac Mullen and Woo, 2025). The unconditional moments calculated for the estimation of the quantitative model in Section 4.4 are obtained using the cubic de-trend.

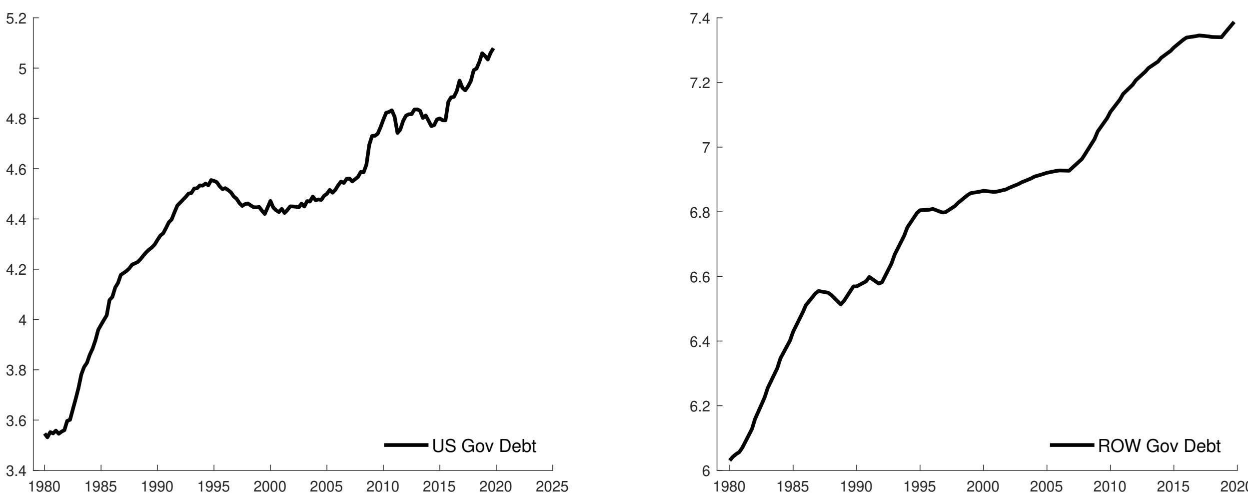


Figure A1: US and ROW Real per capita Government Debt: Raw Data

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

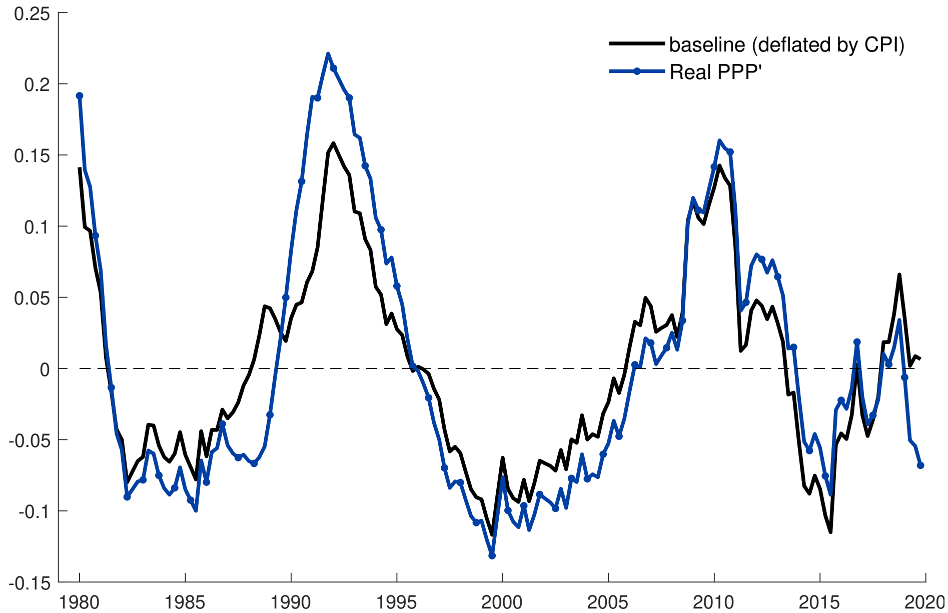


Figure A2: Relative Government Debt: Alternative Deflation Measures

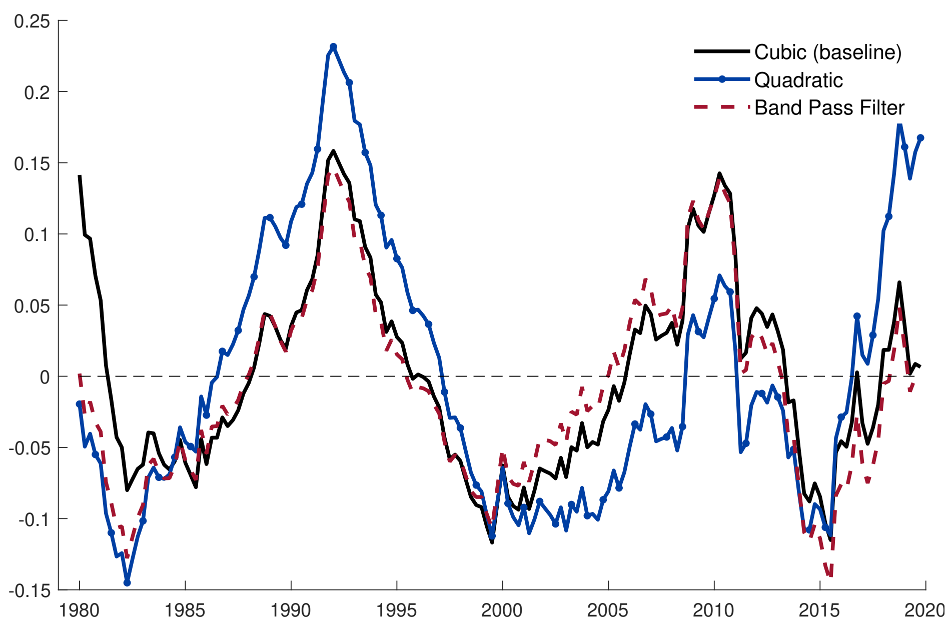


Figure A3: Relative Government Debt: Alternative De-trending Measures

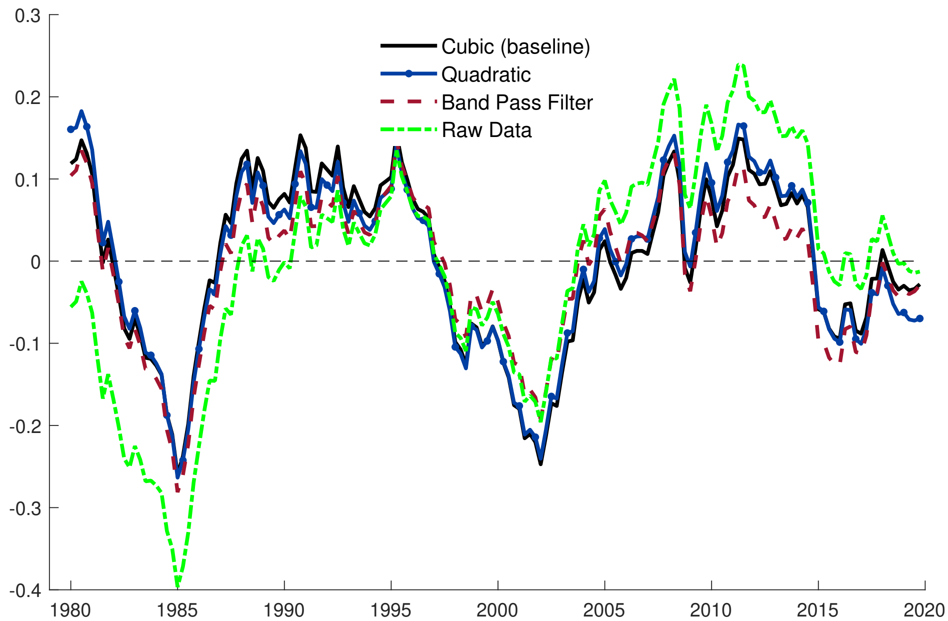


Figure A4: US RER: Alternative Measures

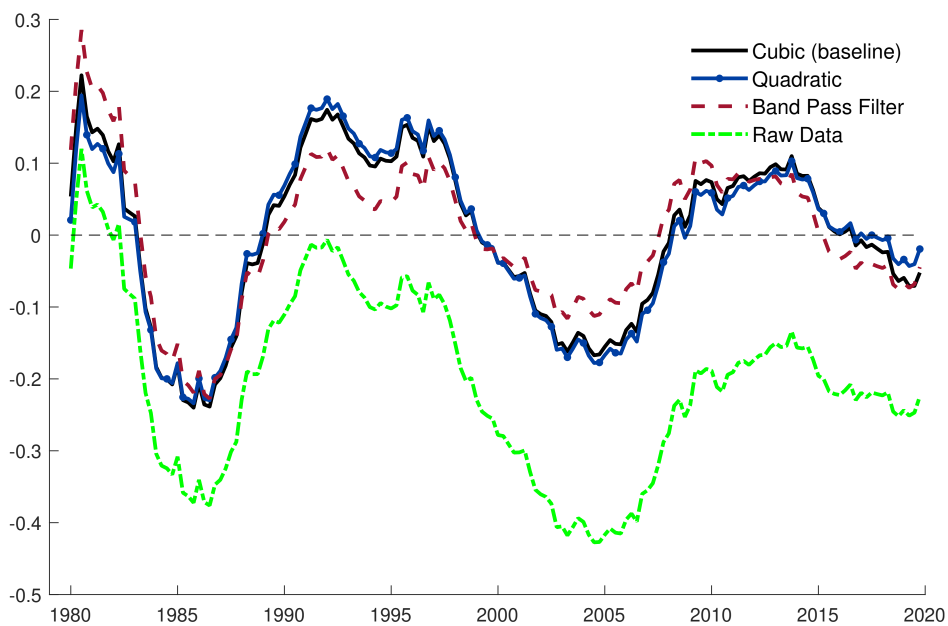


Figure A5: US Net Exports: Alternative Measures

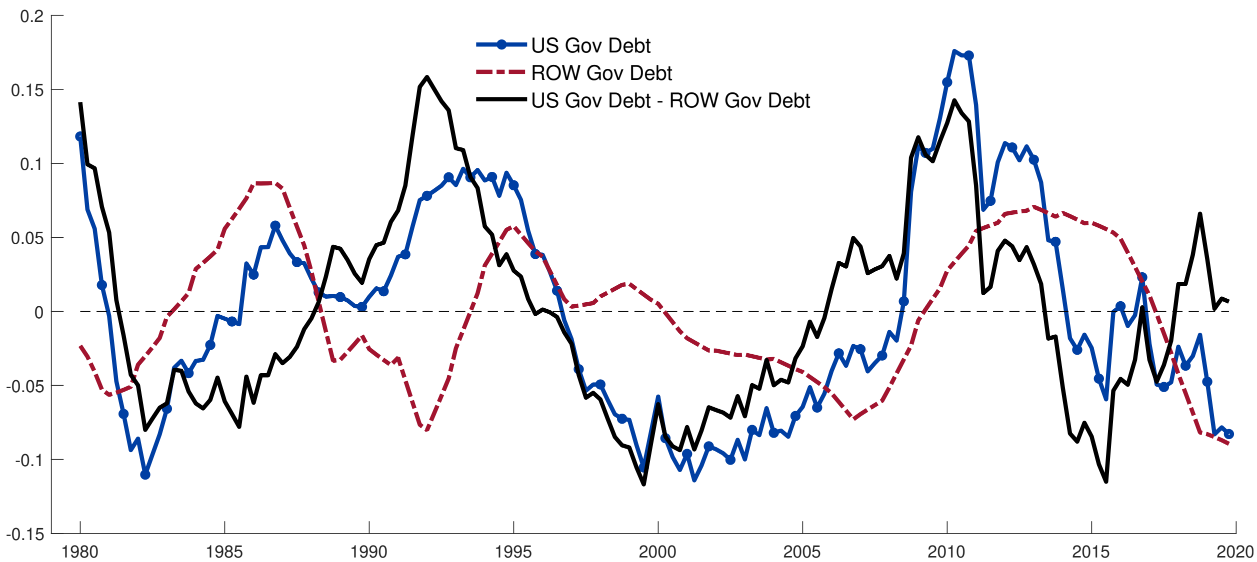


Figure A6: Relative Government Debt Components

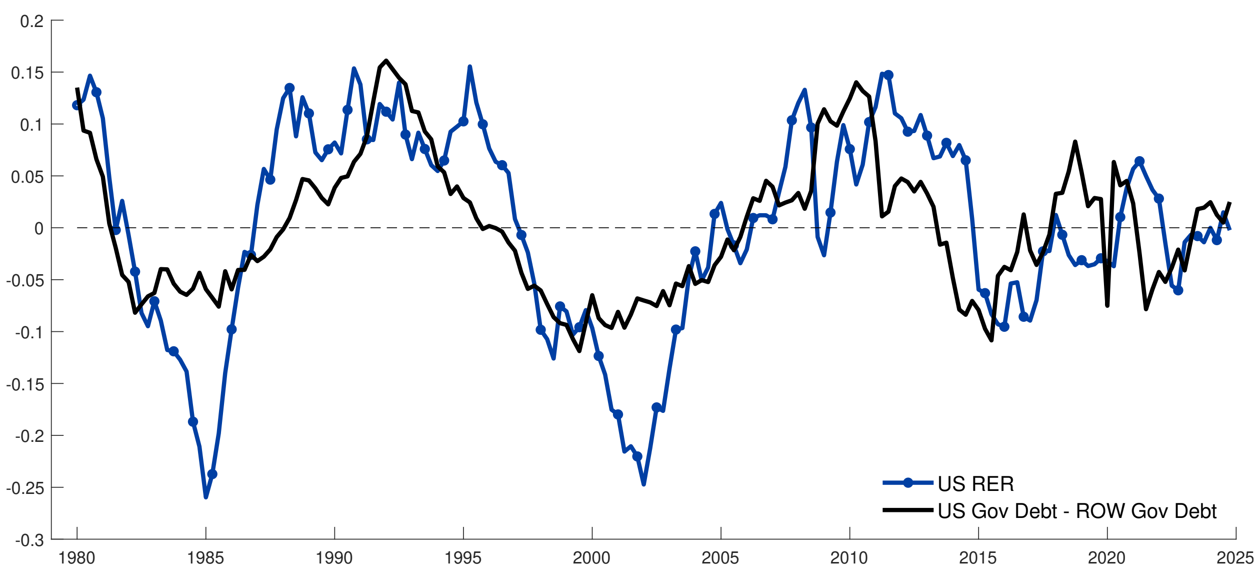
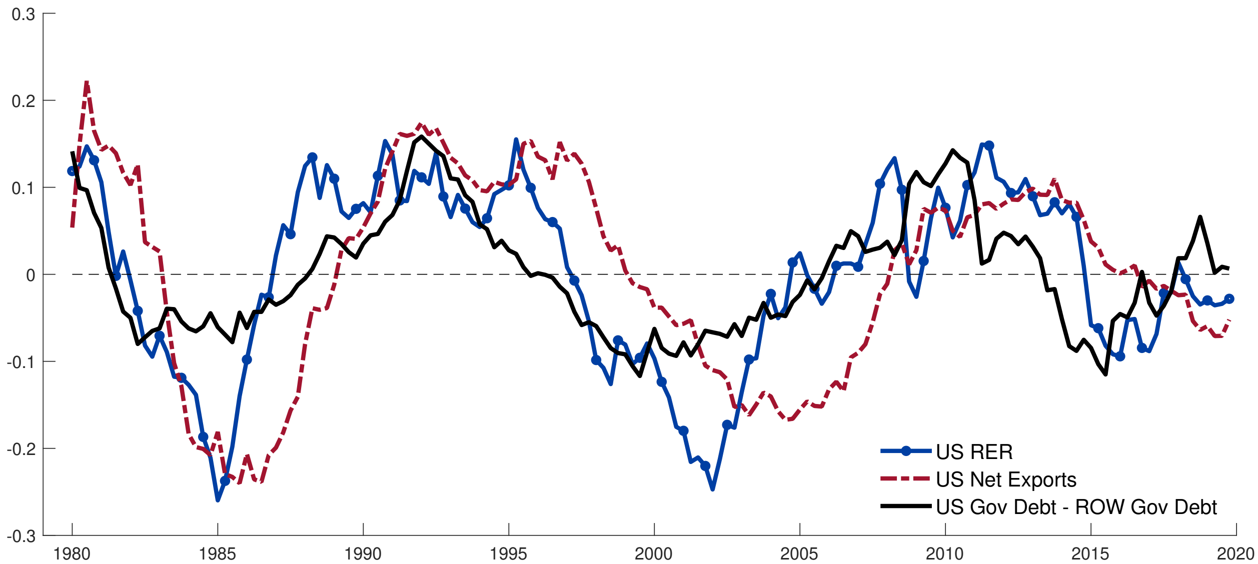


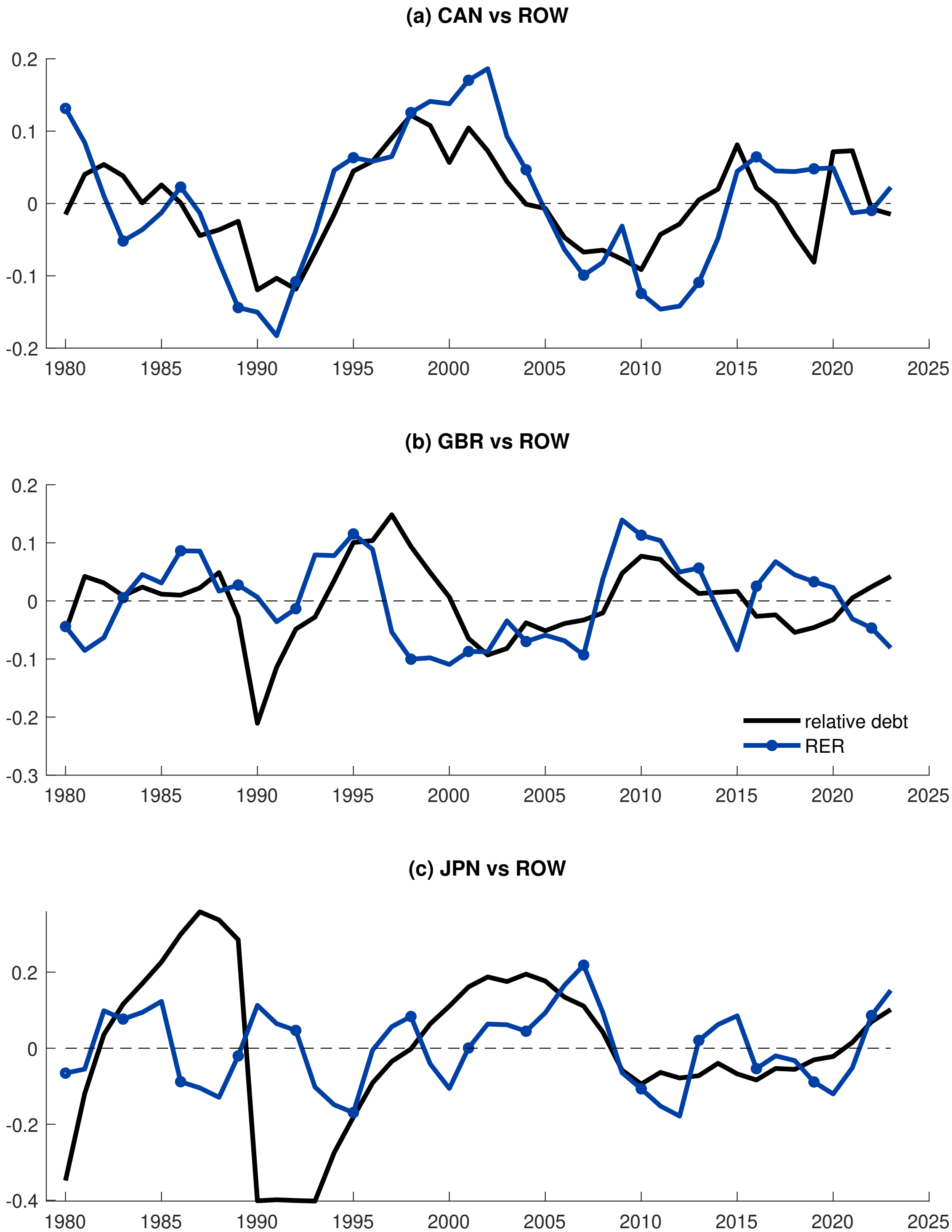
Figure A7: Government Debt in US relative to ROW and the US RER in extended sample

Figure A8: Government Debt in US relative to ROW, the US RER, and US Net Exports



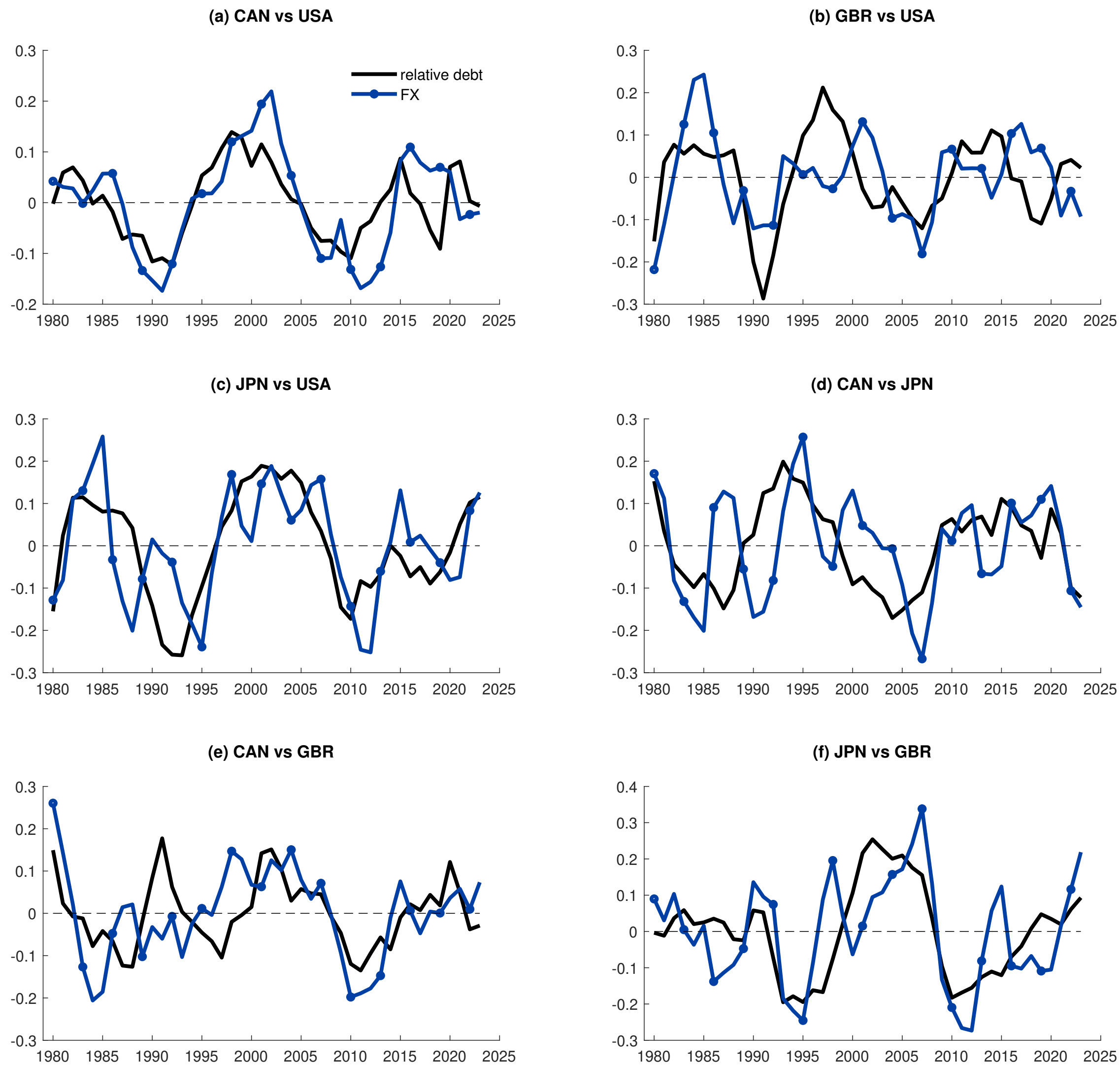
Notes: Net exports are measured as the log of the real export to import ratio.

Figure A9: Trade Weighted Relative Government Debt and the RER for Canada, United Kingdom and Japan



Notes: An increase in the RER means a depreciation of the domestic RER. ROW stands for Rest of the World. The correlation coefficients are 0.72 for Canada, 0.22 for United Kingdom, and 0.16 for Japan.

Figure A10: Bilateral Relative Government Debt and FX among Canada, United Kingdom, Japan and the US



Notes: An increase in the FX means a nominal depreciation of the currency of the first country vs the second one. The correlation coefficients are 0.71 for Canada vs USA, 0.38 for Canada vs Japan, 0.50 for Canada vs GBR, 0.35 for United Kingdom vs USA, 0.61 for Japan vs USA, and 0.62 for Japan vs United Kingdom.

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:

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

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

UIP:

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

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

US Government debt:

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

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).

US Gross foreign assets and liabilities:

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

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 net exports since it is highly correlated with the difference between the gross foreign assets and liabilities.

Portfolio share of US government bonds:

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

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.

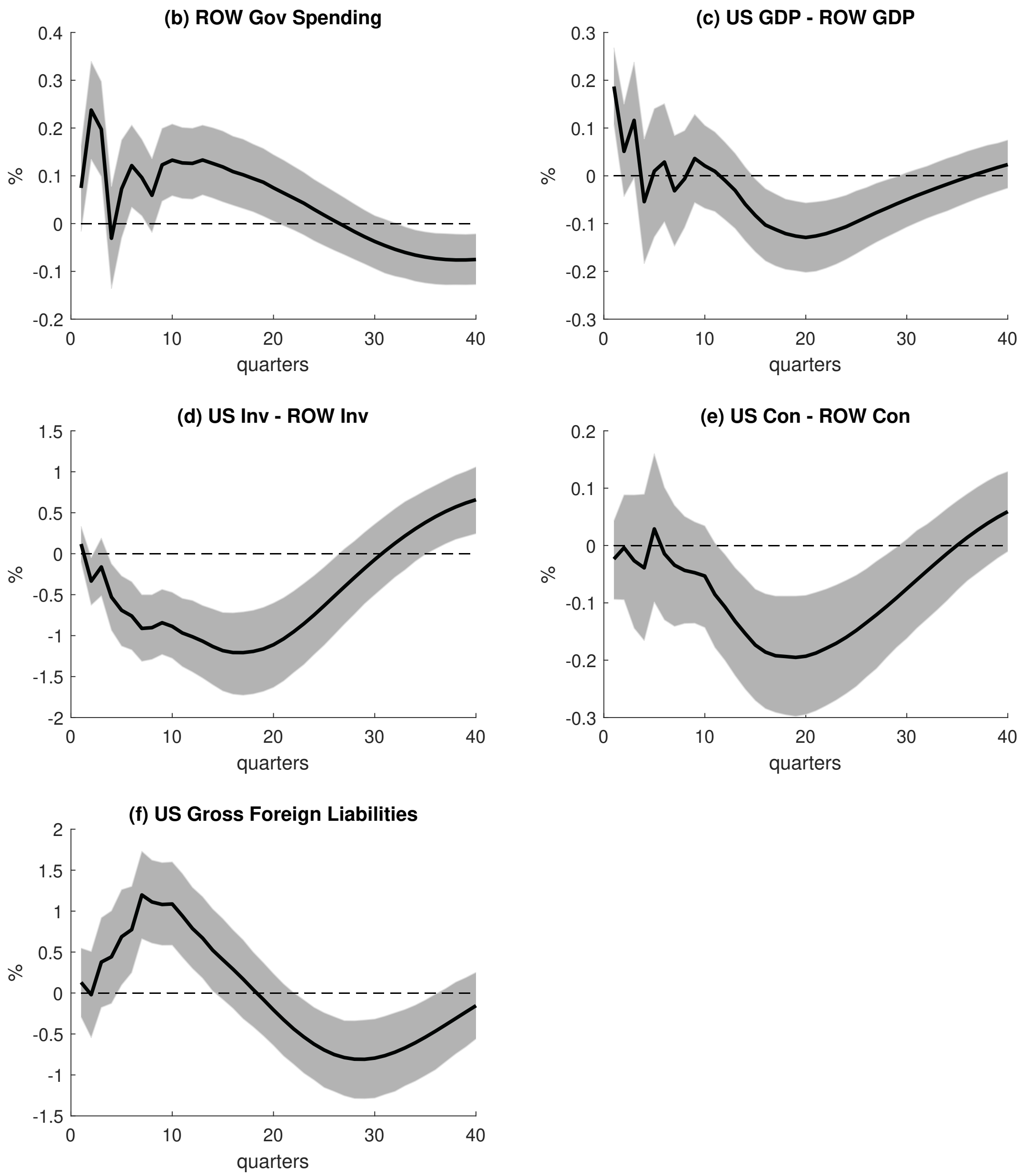


Figure B.1: IRF of the remaining variables in the SVAR

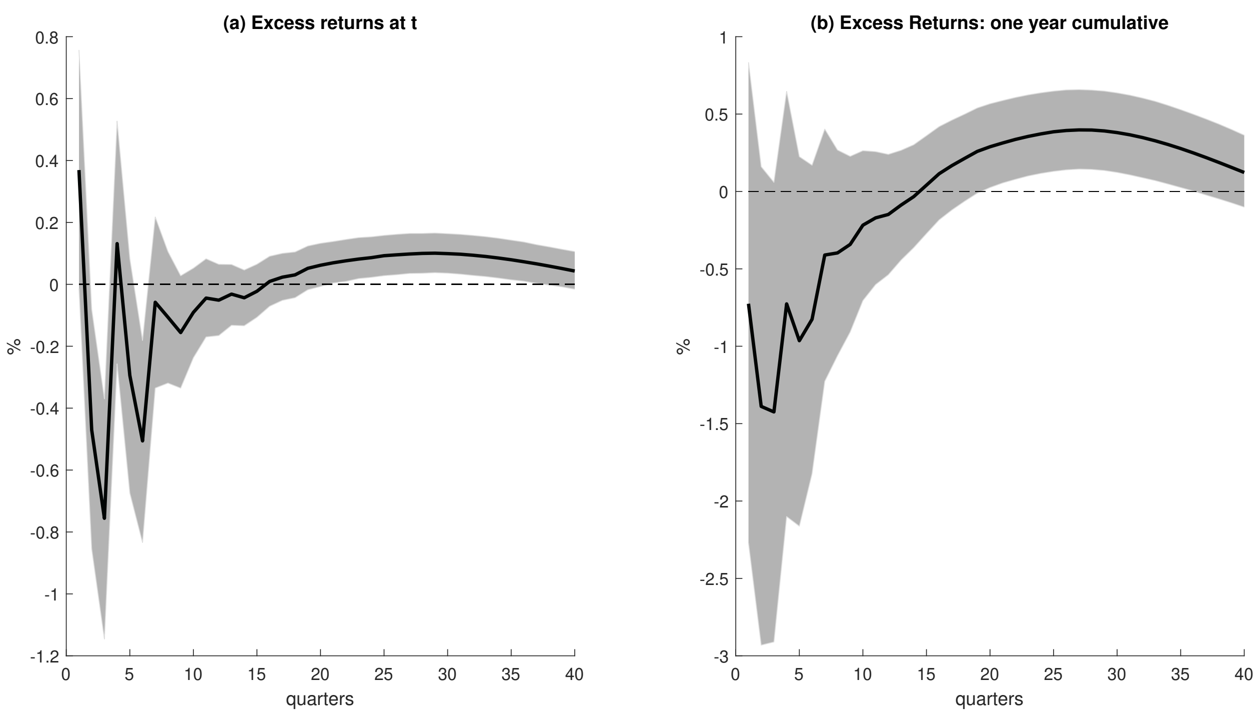


Figure B.2: IRFs of Excess Returns on US Gov Bonds in the SVAR

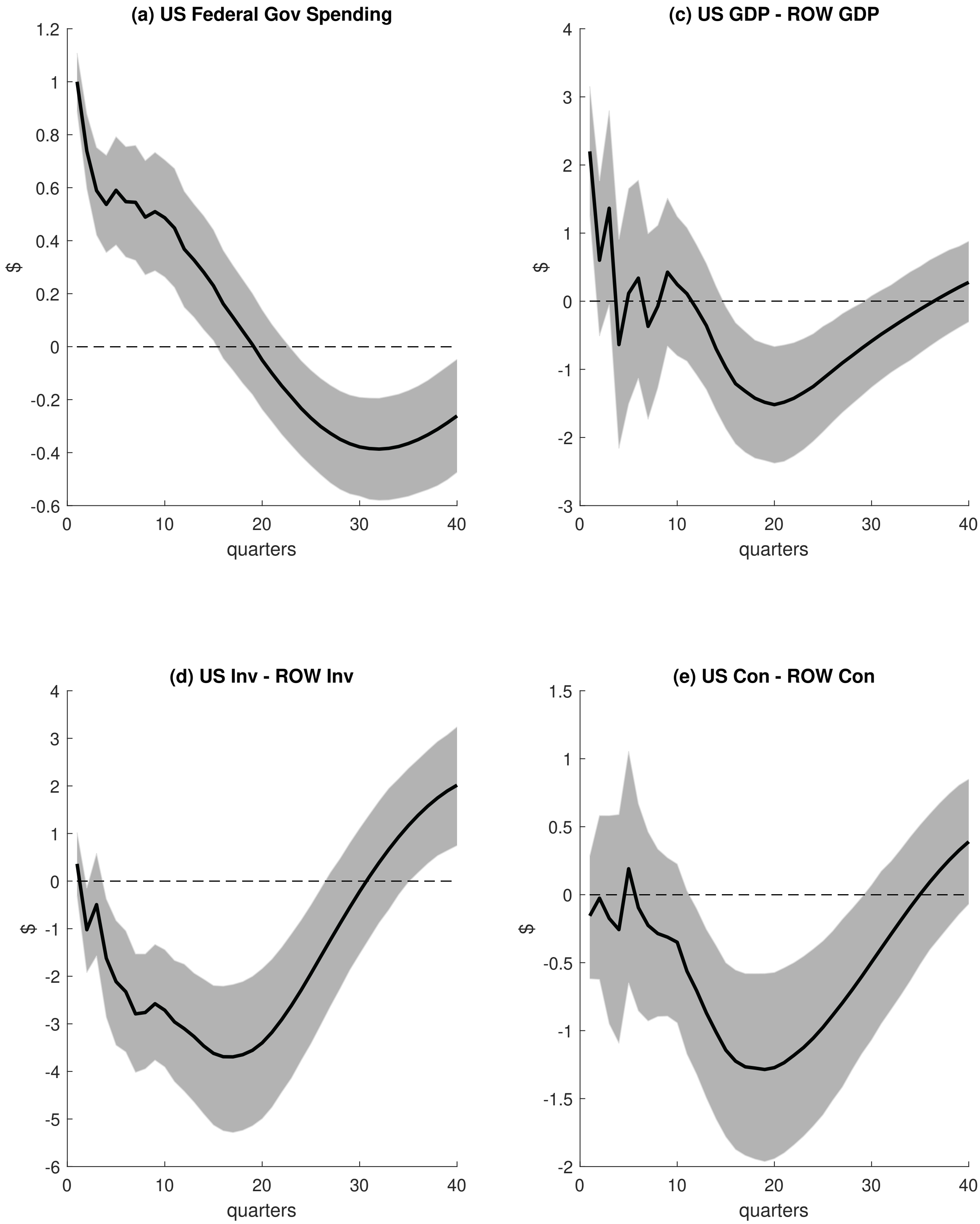


Figure B.3: Baseline IRFs of Macro Aggregates in Dollars

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 9. 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. 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 exports 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.

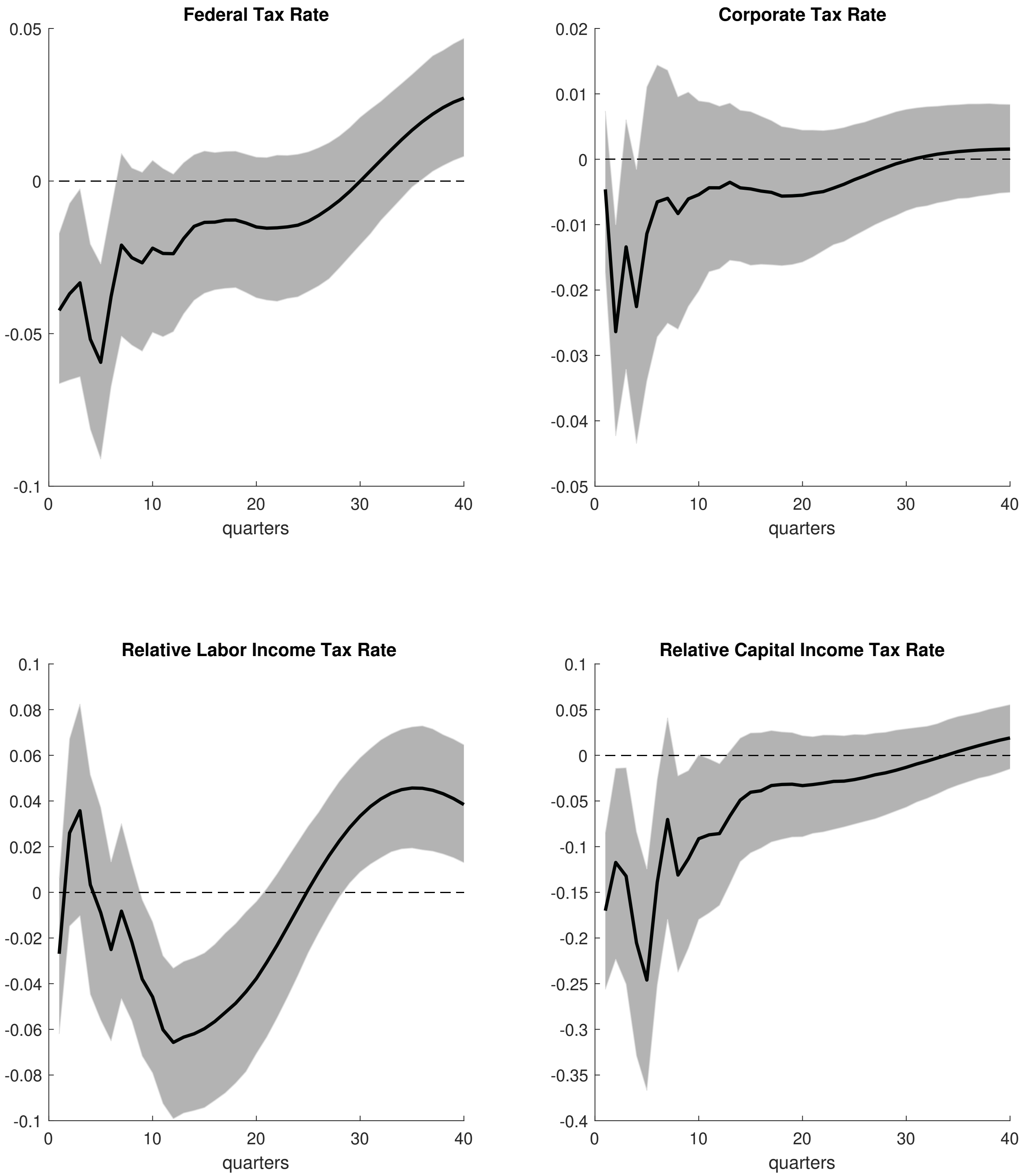


Figure C.1: IRFs other Fiscal Variables

Notes: Standard error bands are 68% confidence intervals.

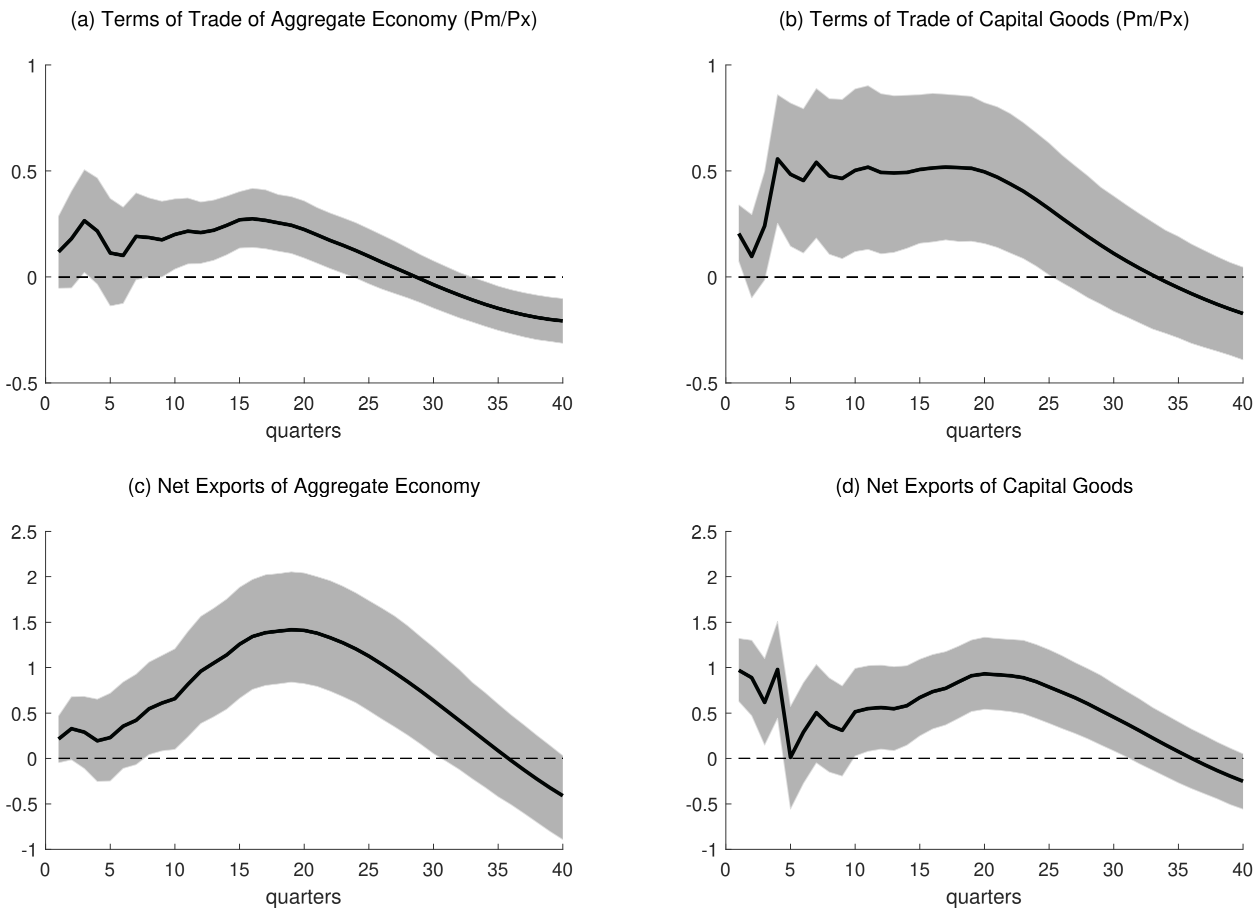


Figure C.2: International Goods Markets Mechanism

Notes: Standard error bands are 68% confidence intervals.

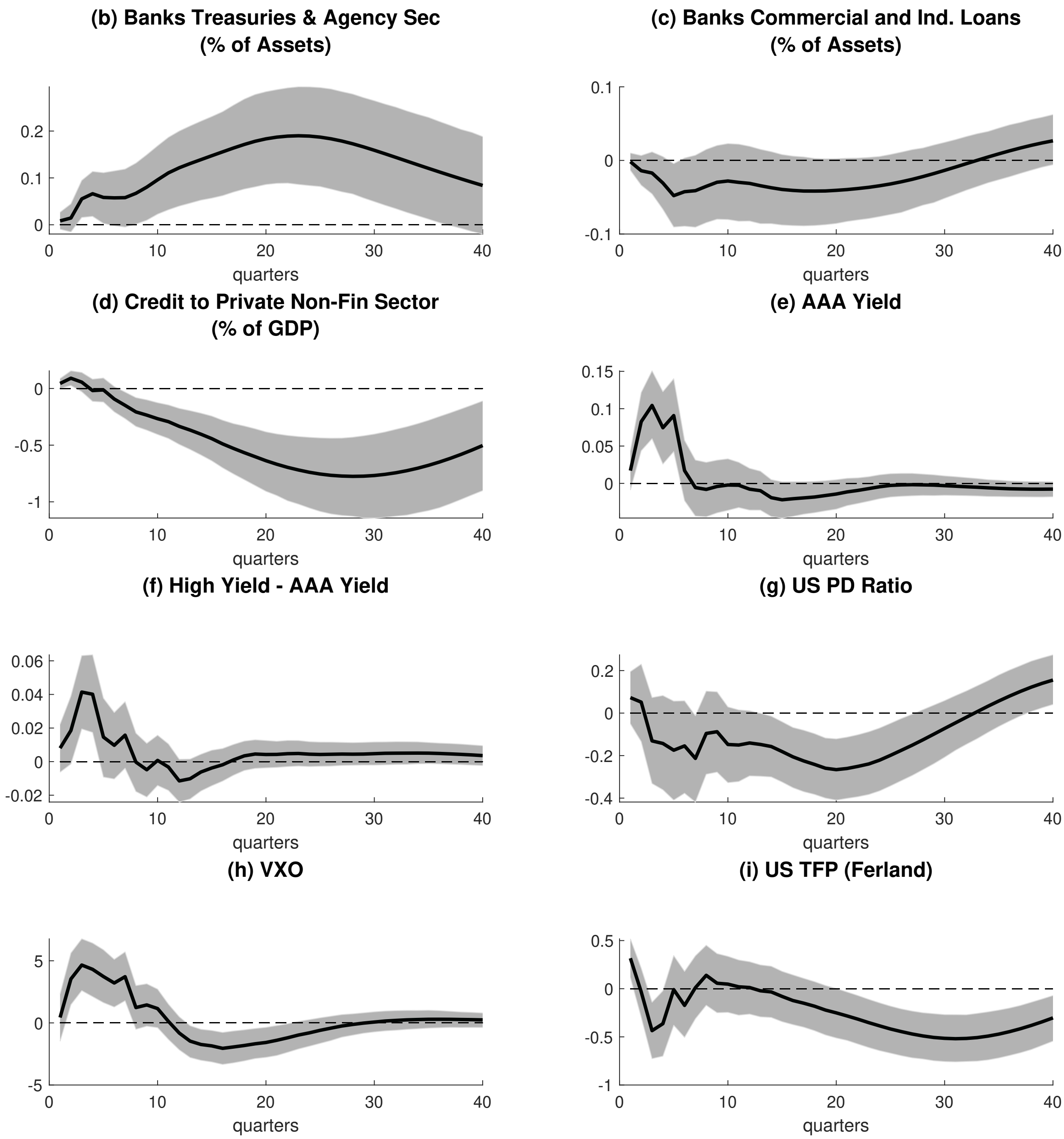


Figure C.3: IRFs of other US Financial Markets and Banking Variables

Notes: Standard error bands are 68% confidence intervals.

D SVAR Robustness

D.1 Alternative Identification Strategies

D.1.1 Defense Spending

To address the concern that forecast errors still reflect endogenous policy responses to economic conditions, I use defense spending as an implicit instrument within the SVAR. I estimate the SVAR model with the baseline vector of data Y_t,

$$Y_t' \equiv \left[g_t^{def,us},\ g_t^{us},\ g_t^{row},\ gdp_t - gdp_t^{row},\ inv_t - inv_t^{row},\ r_t - r_t^{row},\ XM_t,\ RER_t\right] \tag{8}$$

where $g_t^{def,us}$ is log of real per capita defense spending in the US. The remaining outcome variables of interest are estimated similarly to the specifications in Appendix B but using defense spending instead of the forecast errors as internal instrument.

D.1.2 Defense Spending Authorizations

To address the concern that forecast errors are subject to timing issues and anticipation as highlighted by Briganti (2023); Briganti et al. (2025). To address this concern, I use shocks based on defense spending authorizations constructed by Briganti (2023) and Briganti et al. (2025). I estimate the SVAR model with the baseline vector of data Y_t,

$$Y_t' \equiv \left[sa_t^{us},\ g_t^{us},\ g_t^{row},\ gdp_t - gdp_t^{row},\ inv_t - inv_t^{row},\ r_t - r_t^{row},\ XM_t,\ RER_t\right] \tag{9}$$

where sa_t^{us} is log of real per capita defense spending authorizations in the US. The remaining outcome variables of interest are estimated similarly to the specifications in Appendix B but using defense spending instead of the forecast errors as internal instrument.

D.1.3 Proxy SVAR

I use the methodology in Ferrara et al. (2021), which uses the military news narrative series constructed by Ramey (2011, 2016b) in a SVAR model employing the proxy SVAR methodology from

Mertens and Ravn (2013) and Stock and Watson (2008). I estimate a SVAR with the following variables: US government spending, US government debt, US tax revenue, the interest rate differential on long real government bonds, the US export-import ratio, the US RER, and the US gross foreign assets. US government spending is instrumented by a the news shock series in Ramey (2011, 2016b). Figure D.5 shows that the IRFs are similar to the baseline SVAR, although with significantly bigger confidence intervals which is not surprising given that the news shocks series have been shown to have limited power as instruments for the period in consideration (Ramey, 2011; Ferrara et al., 2021).

D.1.4 Local Projections: Internal Instruments

I study the robustness to estimating the IRFs using Local Projections with internal instruments (Jordà, 2005; Montiel Olea and Plagborg-Møller, 2021). Specifically, for each horizon $h = 0, 1, 2, \dots, H$, I estimate the following specification,

$$\Delta y_{t+h} = \beta^h \cdot \Delta \mathrm{z}_t + (\text{ Lagged Controls }) + \varepsilon_{t+h}$$

where $\Delta y_{t+h} = y_{t+h} - y_{t-1}$ is the change in the outcome variable at horizon h and $\Delta \mathrm{z}_t = z_t - z_{t-1}$ the change in the instrument between t and $t-1$. The instrument z is either the forecast error, defense spending, or spending authorizations. The model includes four lags of both the instrument and the control variables to account for serial correlation and the persistence of macroeconomic dynamics. The outcome variables of interest include the same set of controls as in the specifications in Appendix B.

D.1.5 Local Projections: External Instruments

Because the proposed mechanism operates mainly through government debt, rather than spending per se, I also estimate LP-IV specifications in which US government debt is instrumented directly by fiscal shocks. For each horizon $h = 0, 1, 2, \dots, H$, I estimate the following specification using two-stage least squares:

$$\Delta Y_{t+h} = \beta_h \Delta \mathrm{Debt}_t + \delta_0 \Delta DefSpend_t + \sum_{j=1}^{4} \Gamma_j \Delta X_{t-j} + \varepsilon_{t+h} \tag{10}$$

where ΔY_{t+h} is the change in the outcome variable of interest (such as the real exchange rate, government debt, or net exports) at horizon h, ΔDebt_t is the contemporaneous change in US government debt, and ΔX_{t-j} is a vector of lagged control variables. I instrument the potentially endogenous change in debt (ΔDebt_t) with the first lag of defense spending ($\Delta DefSpend_{t-1}$), while controlling for the contemporaneous change in defense spending ($\Delta DefSpend_t$) to isolate the effect operating through the debt channel. By controlling for contemporaneous defense spending, I isolate the variation in lagged defense spending that operates through debt accumulation rather than through direct demand effects. The first-stage Kleibergen-Paap Wald F-statistic is 10.2, meeting the conventional threshold and indicating adequate instrument strength.

I exclude US government spending from the control vector because it is highly correlated with defense spending—defense expenditures constitute a major component of total government spending—and including both variables results in multicollinearity that reduces the first-stage F-statistic below 10. I also do not control for relative investment since doing so reduces the F-statistic slightly below 10 (nevertheless, the IRFs are virtually the same when including relative investment).

Finally, I use an alternative instrument for changes in US government debt based on Phillot (2025) treasury supply shocks.[56] The first-stage Kleibergen-Paap Wald F-statistic is 7.6 at the quarterly frequency of the LP-IV estimation, falling slightly below the usual threshold. IRFs results under this instrument are similar to the baseline SVAR.

[56] In this specification, I control for up to 4 lags of the instrument to address potential serial correlation at quarterly frequency.

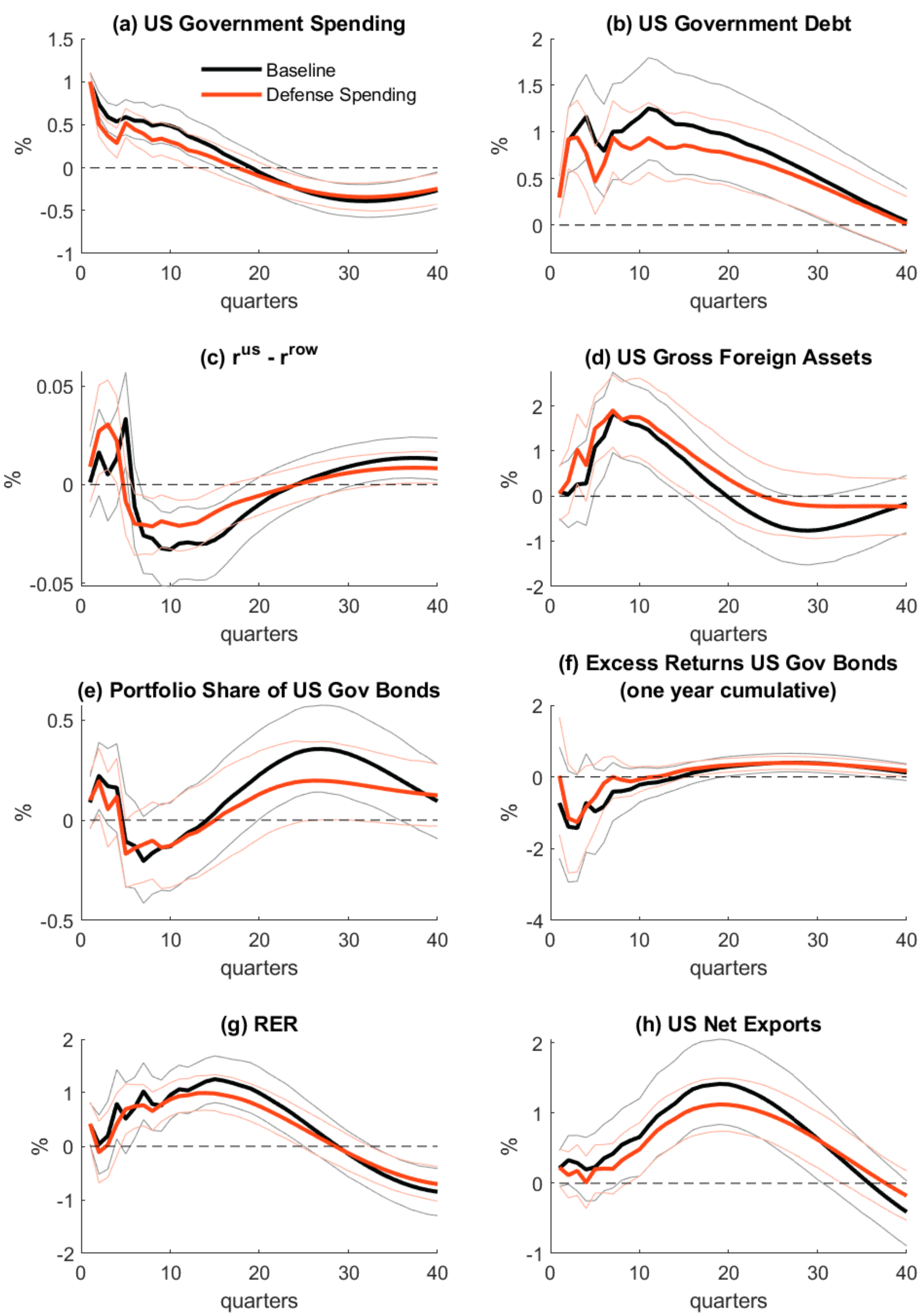


Figure D.1: Defense Spending

Notes: Standard error bands are 68% confidence intervals.

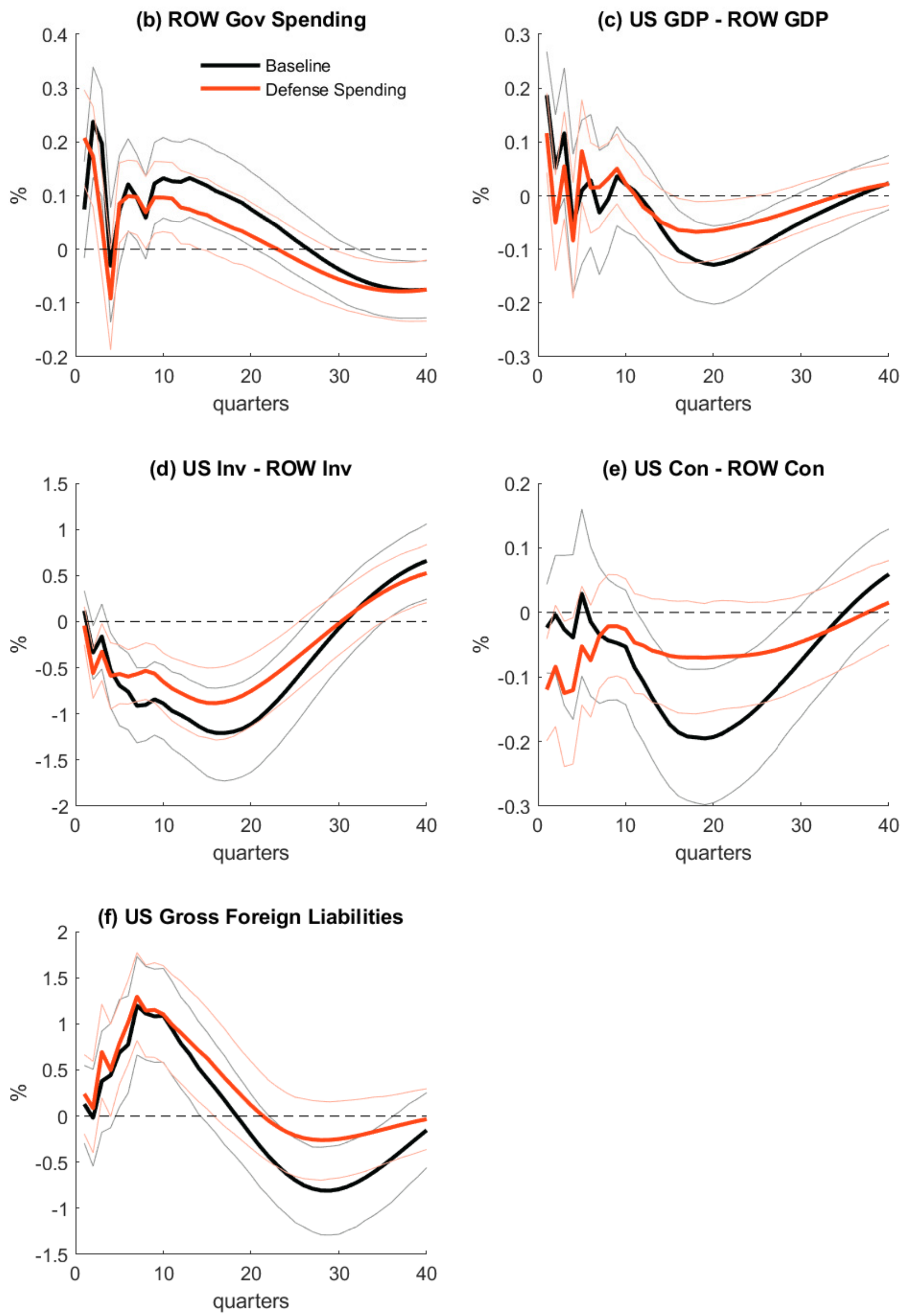


Figure D.2: Defense Spending

Notes: Standard error bands are 68% confidence intervals.

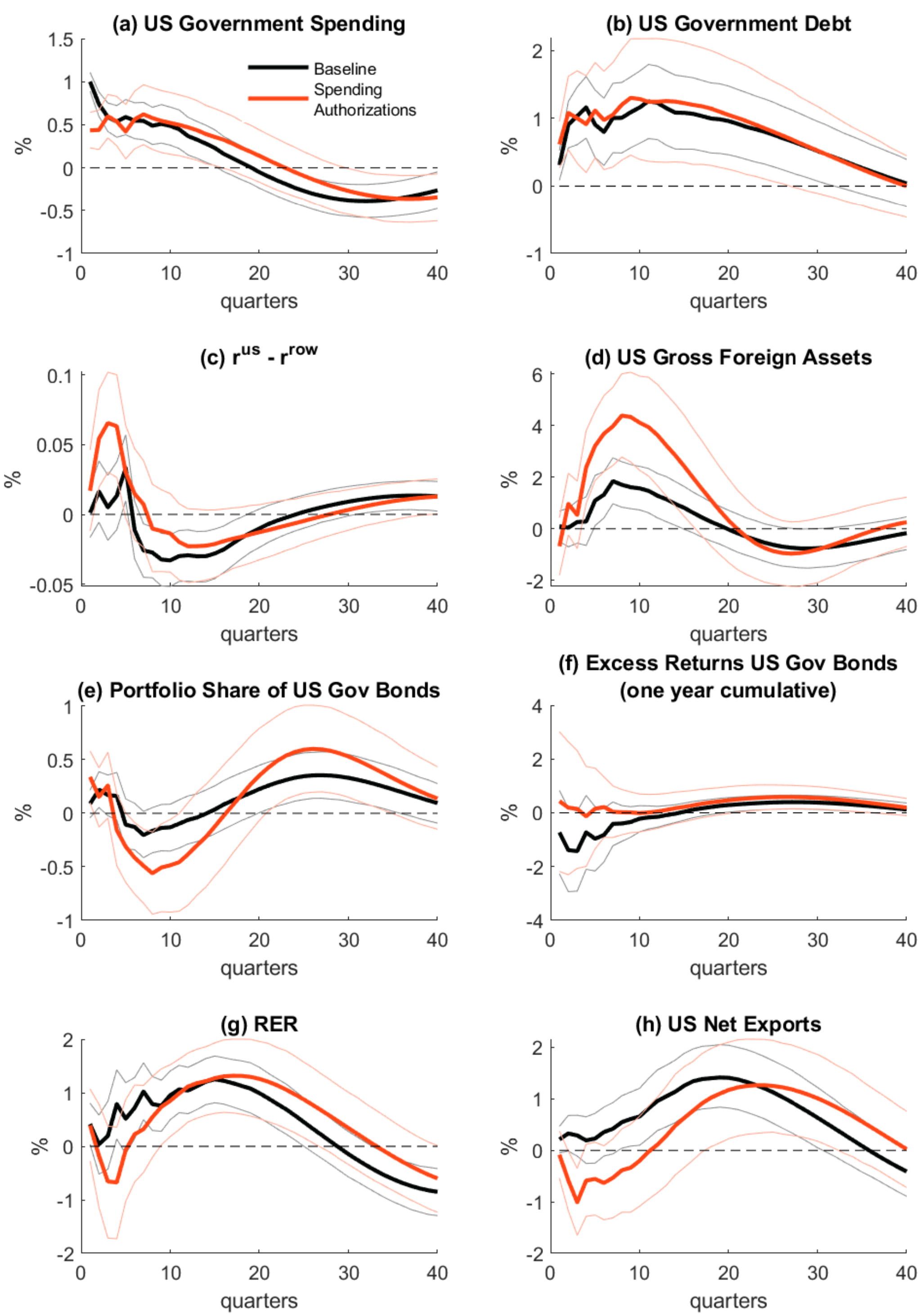


Figure D.3: Spending Authorizations

Notes: Standard error bands are 68% confidence intervals.

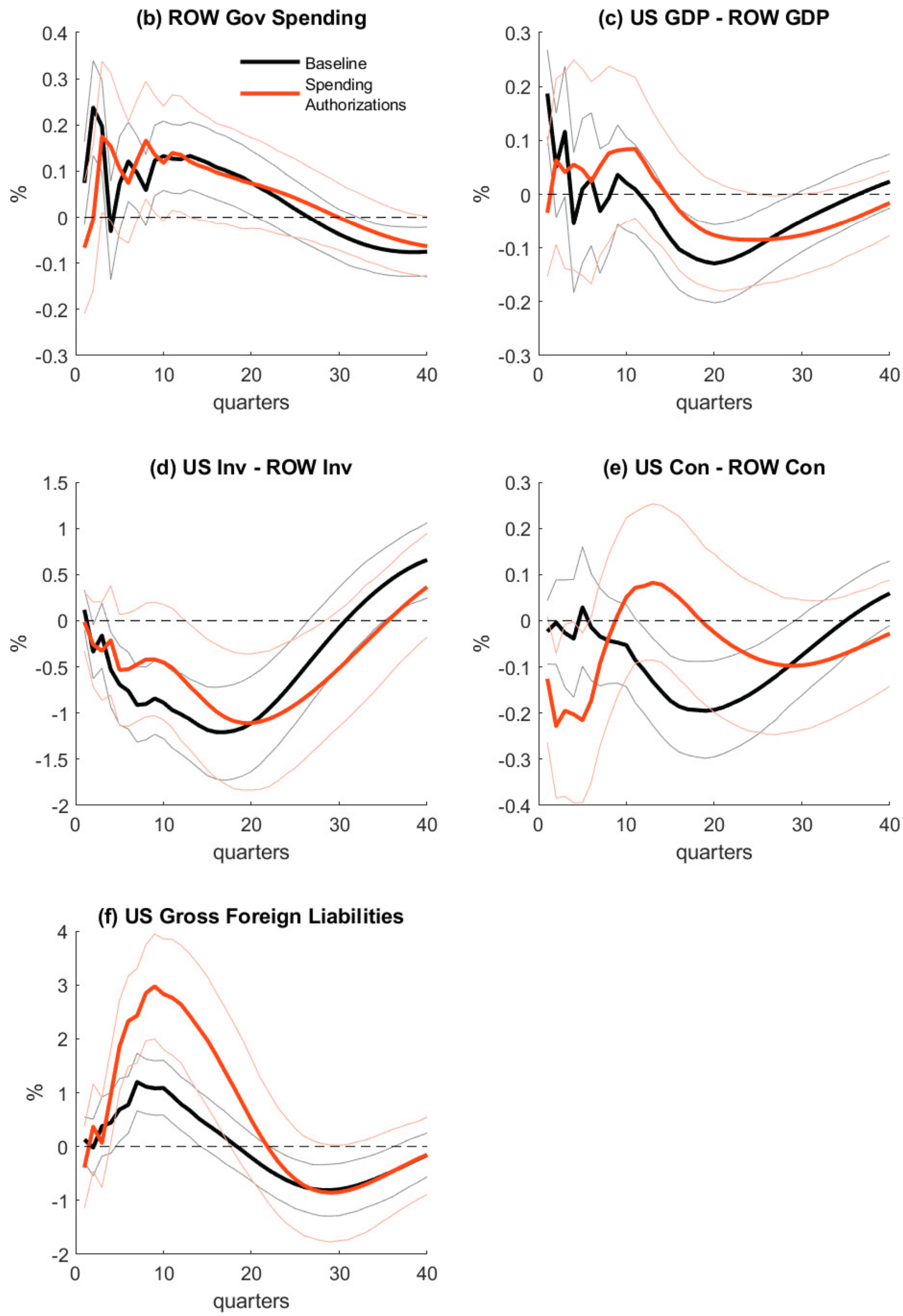


Figure D.4: Spending Authorizations

Notes: Standard error bands are 68% confidence intervals.

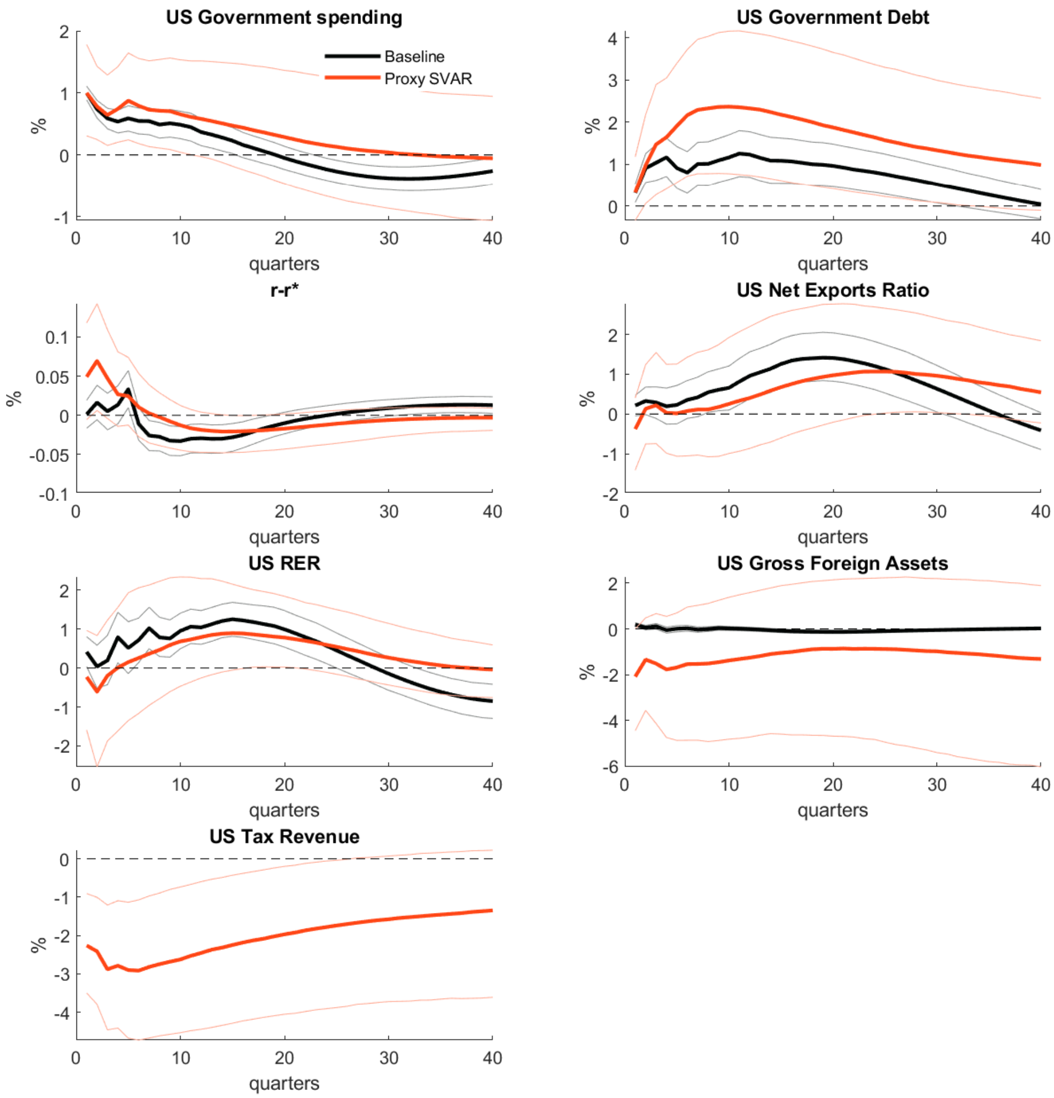


Figure D.5: Proxy SVAR

Notes: Standard error bands are 68% confidence intervals. Proxy SVAR is normalized to have same impact effect on US government debt as in Baseline.

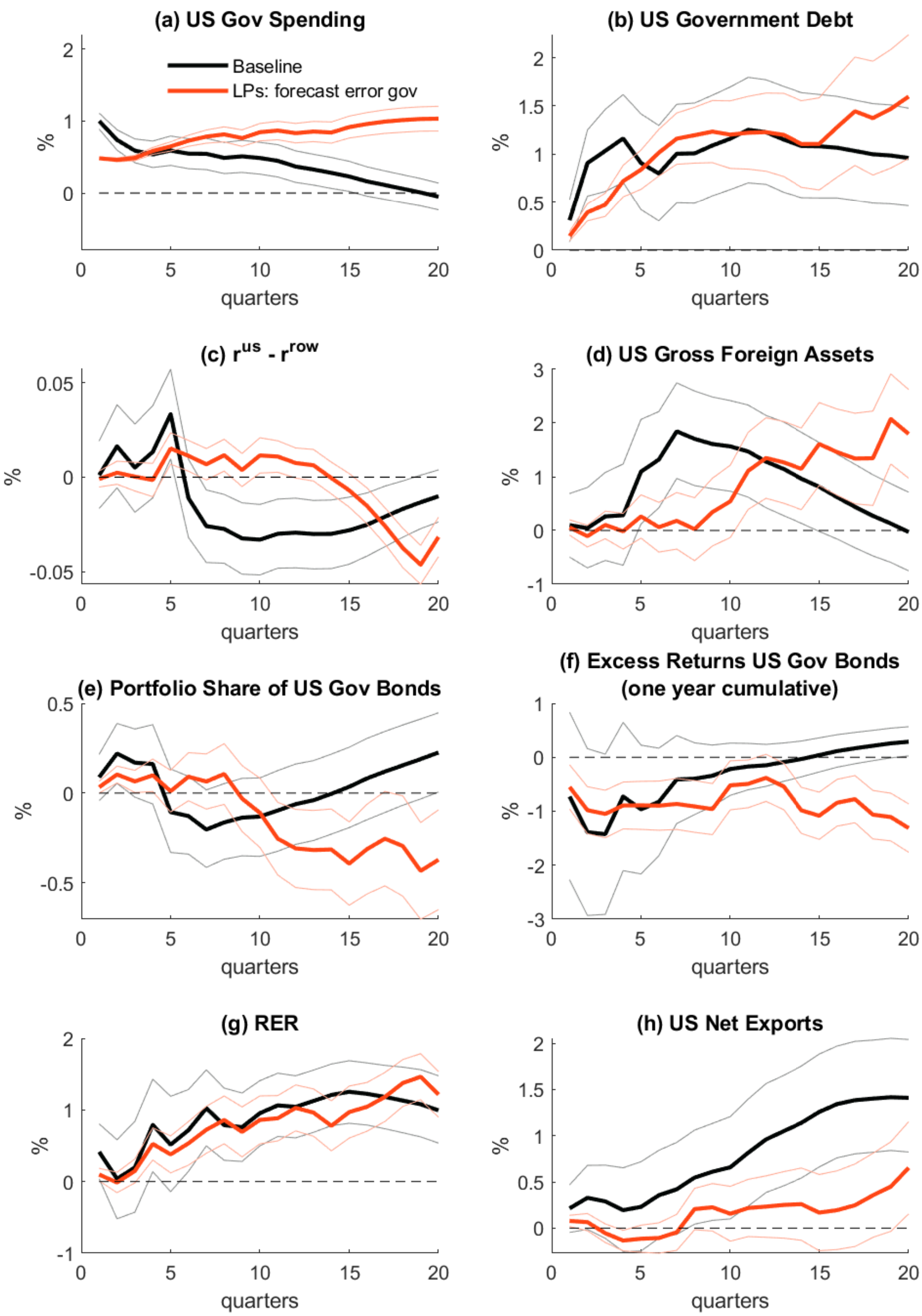


Figure D.6: LP internal instrument: forecast errors

Notes: Standard error bands are 68% confidence intervals.

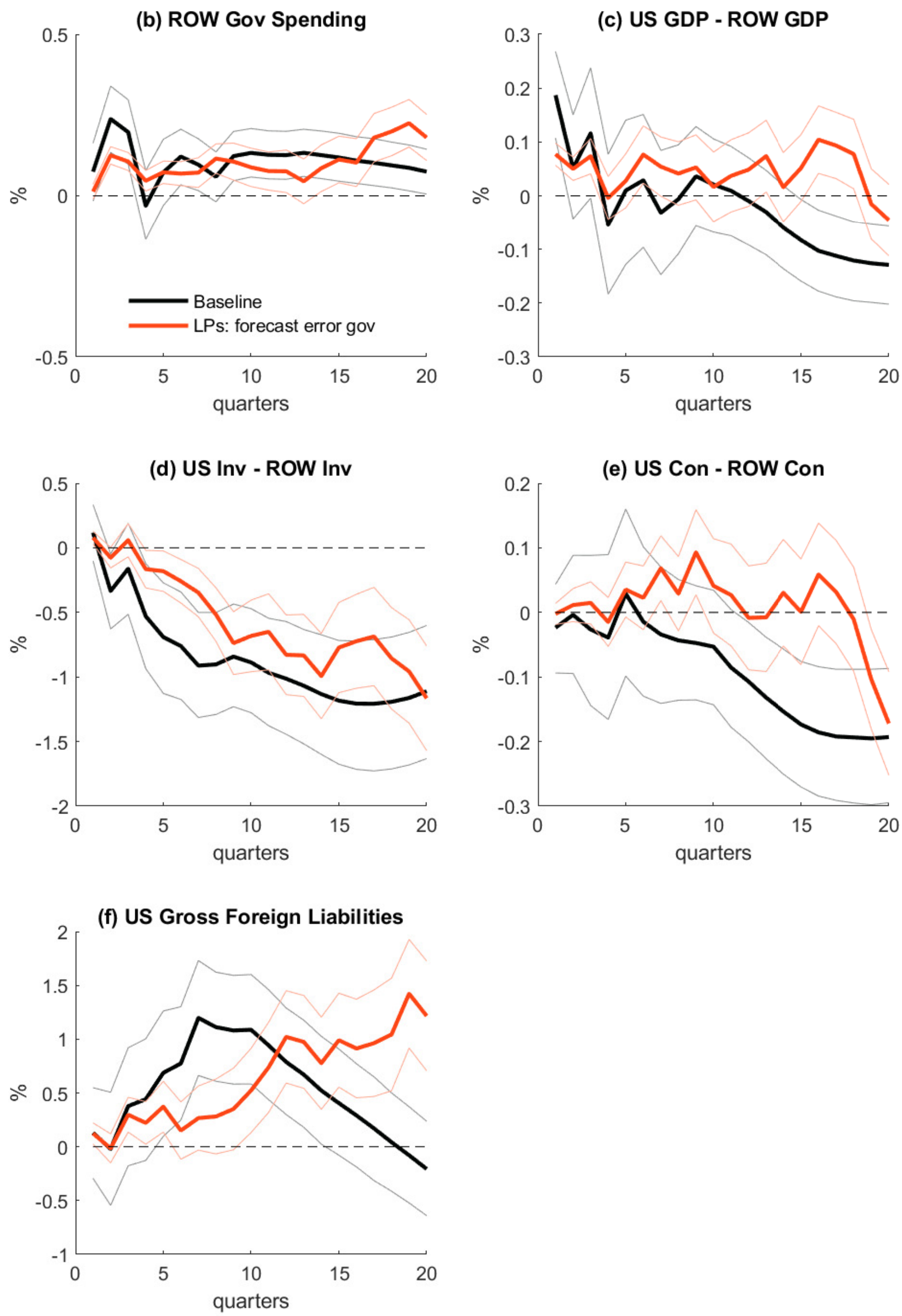


Figure D.7: LP internal instrument: forecast errors

Notes: Standard error bands are 68% confidence intervals.

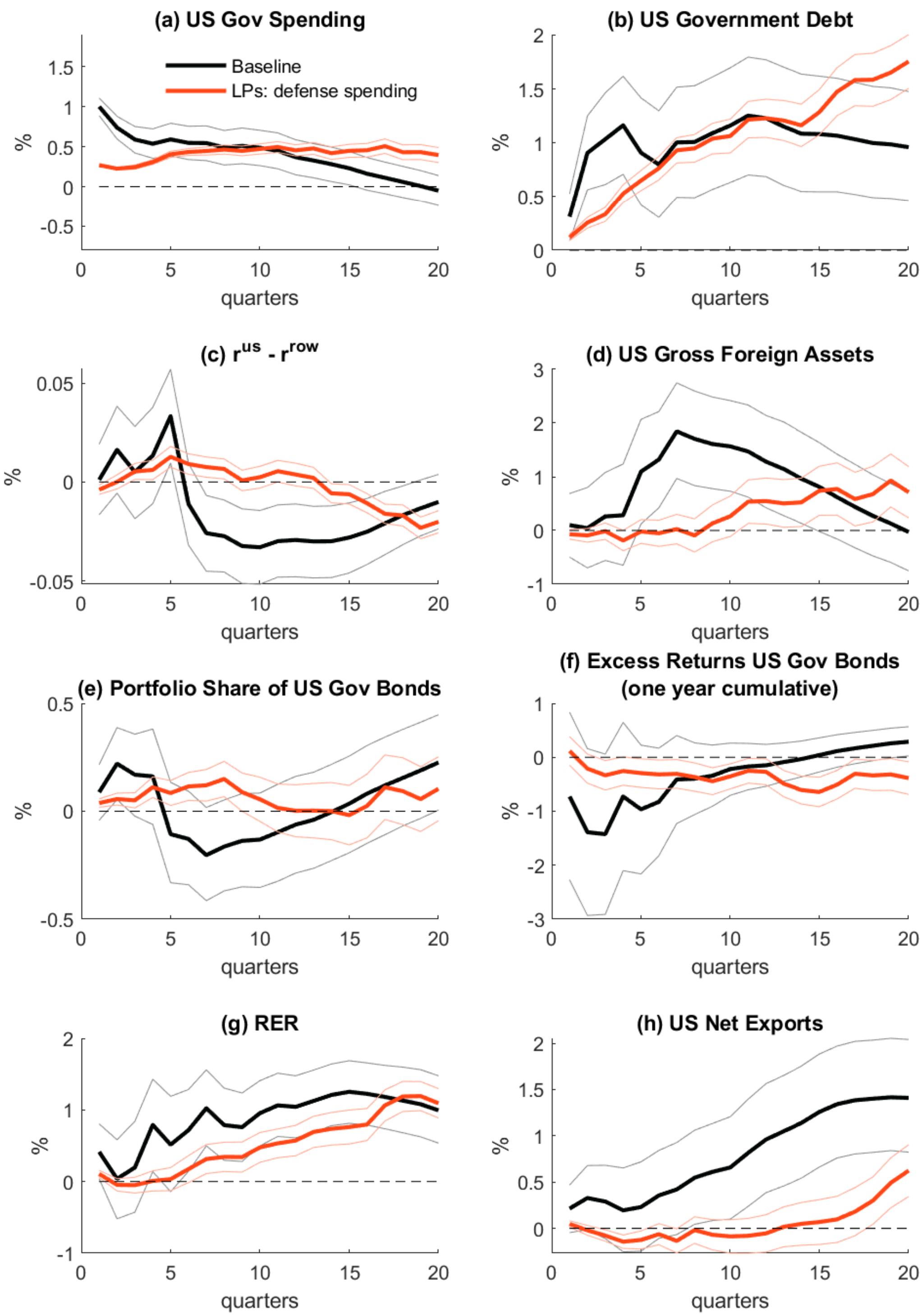


Figure D.8: LP internal instrument: defense spending

Notes: Standard error bands are 68% confidence intervals.

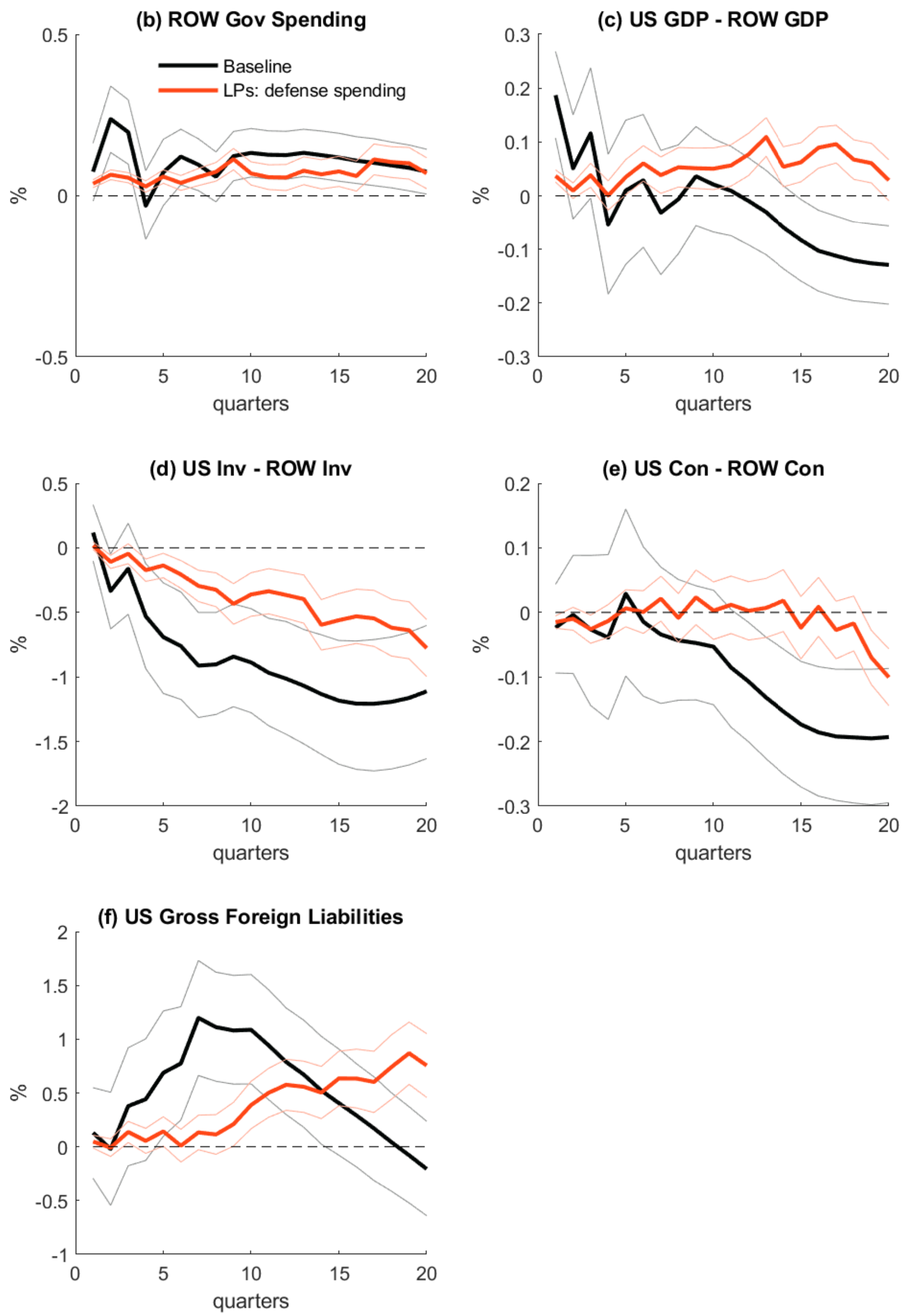


Figure D.9: LP internal instrument: defense spending

Notes: Standard error bands are 68% confidence intervals.

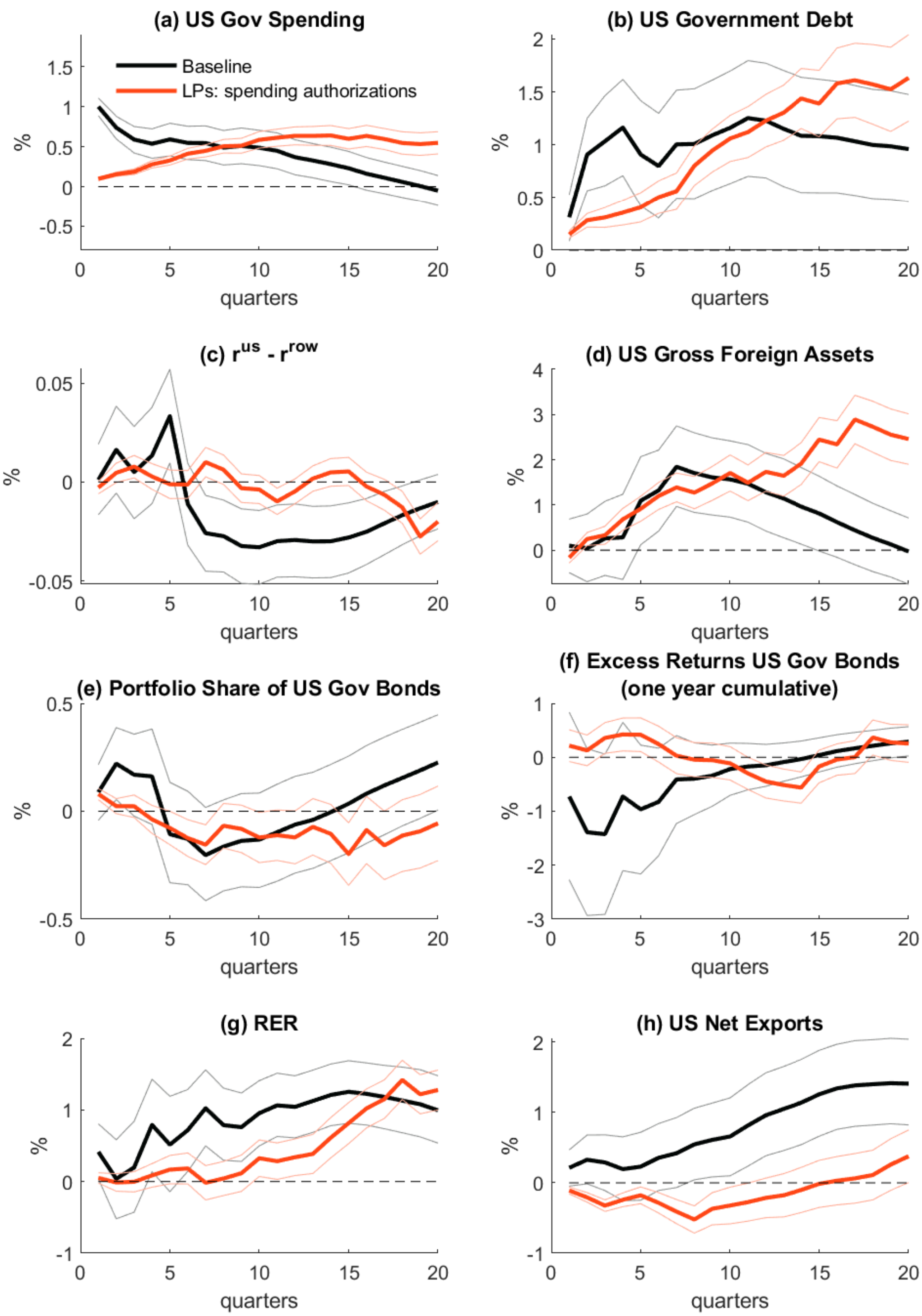


Figure D.10: LP internal instrument: defense spending authorizations

Notes: Standard error bands are 68% confidence intervals.

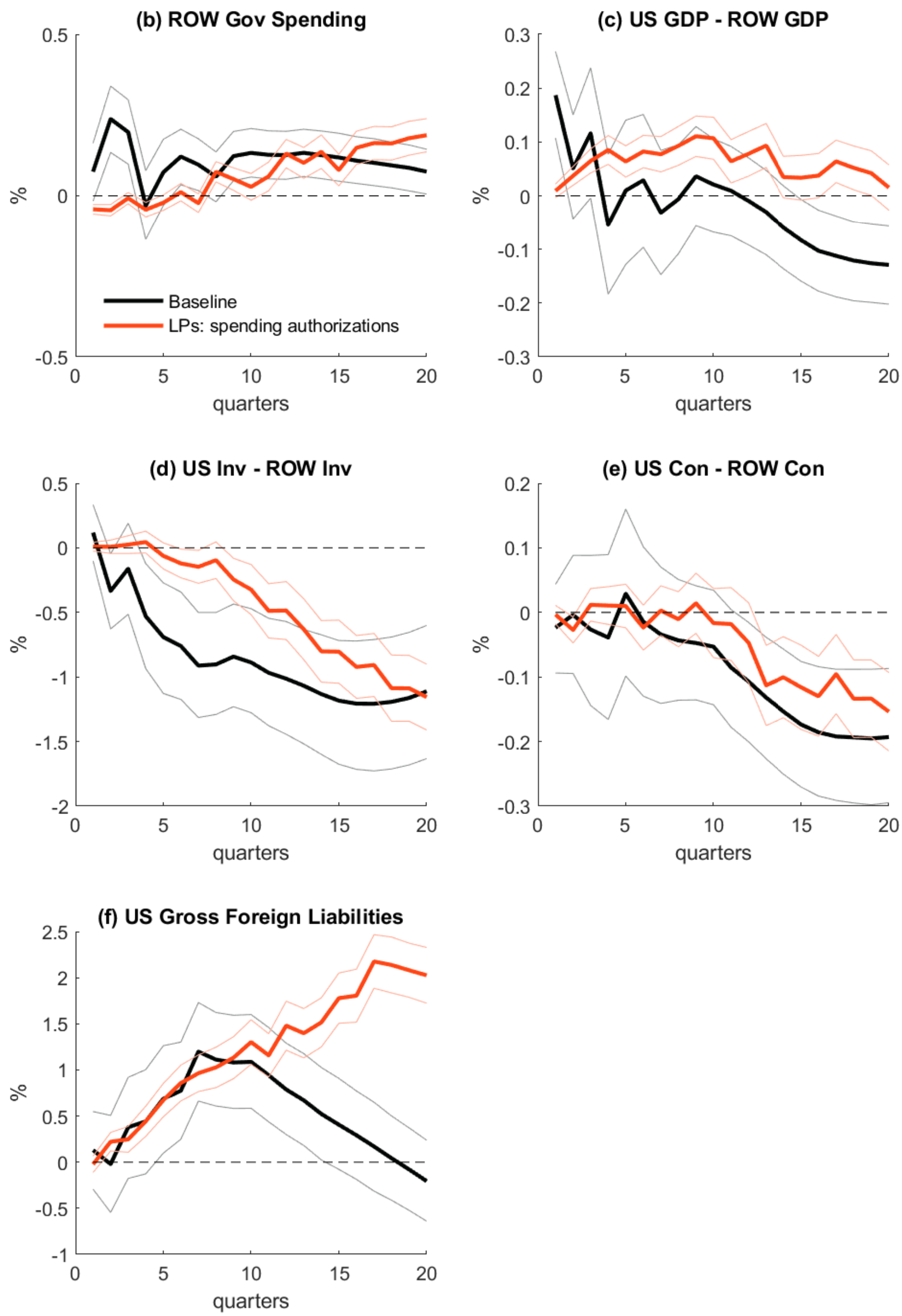


Figure D.11: LP internal instrument: defense spending authorizations

Notes: Standard error bands are 68% confidence intervals.

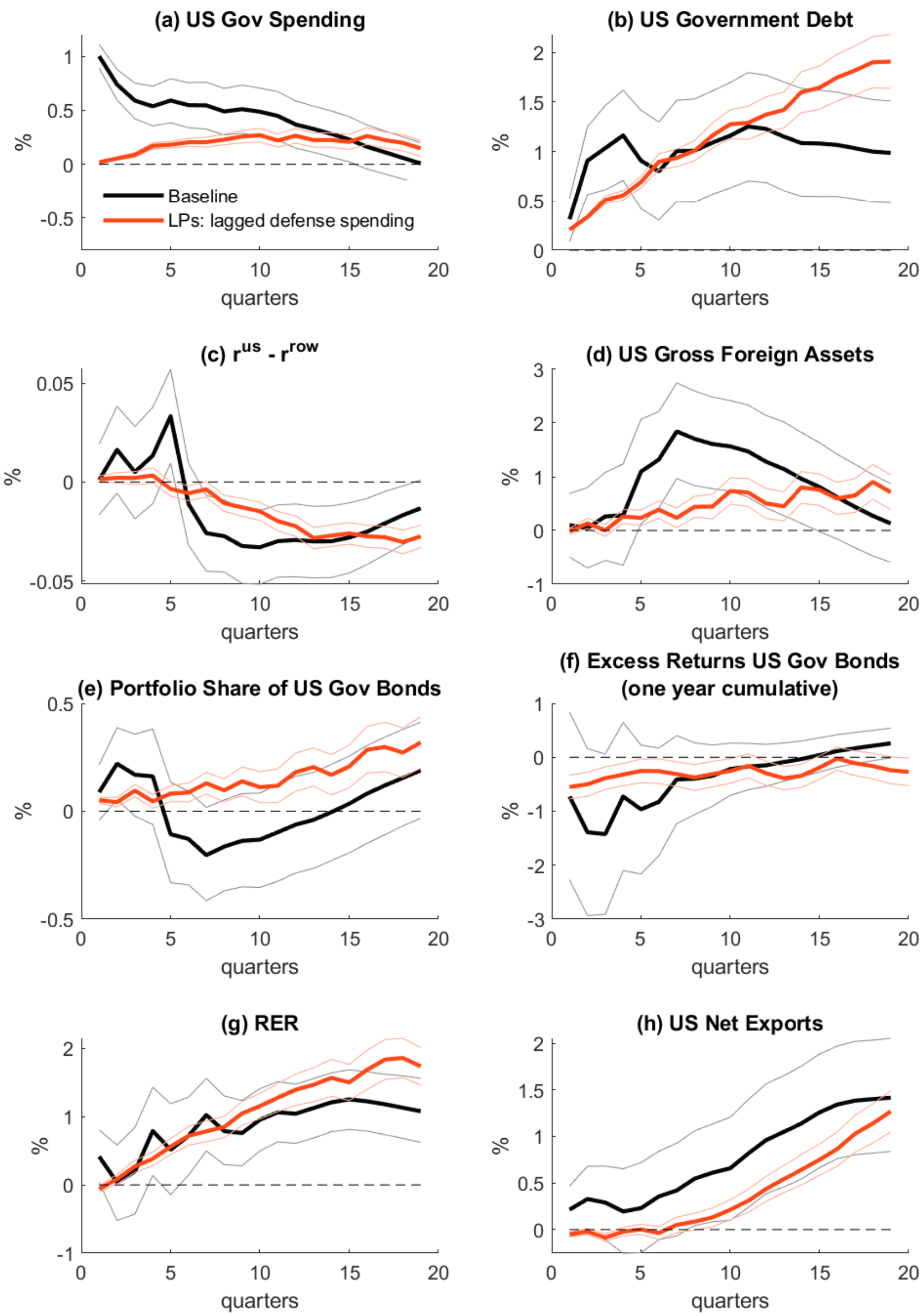


Figure D.12: LP lagged defense spending as external instrument for government debt

Notes: Standard error bands are 68% confidence intervals.

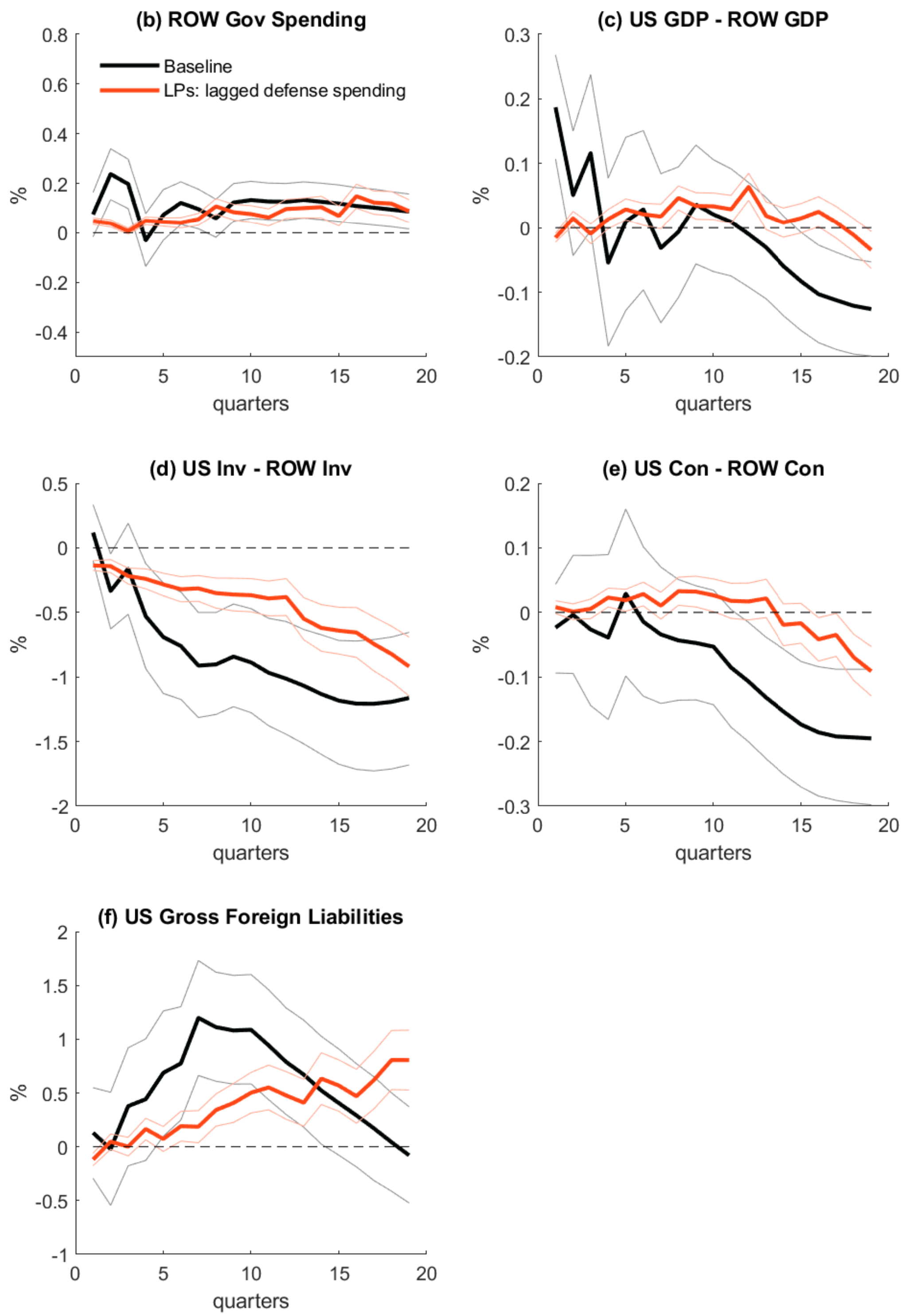


Figure D.13: LP lagged defense spending as external instrument for government debt

Notes: Standard error bands are 68% confidence intervals.

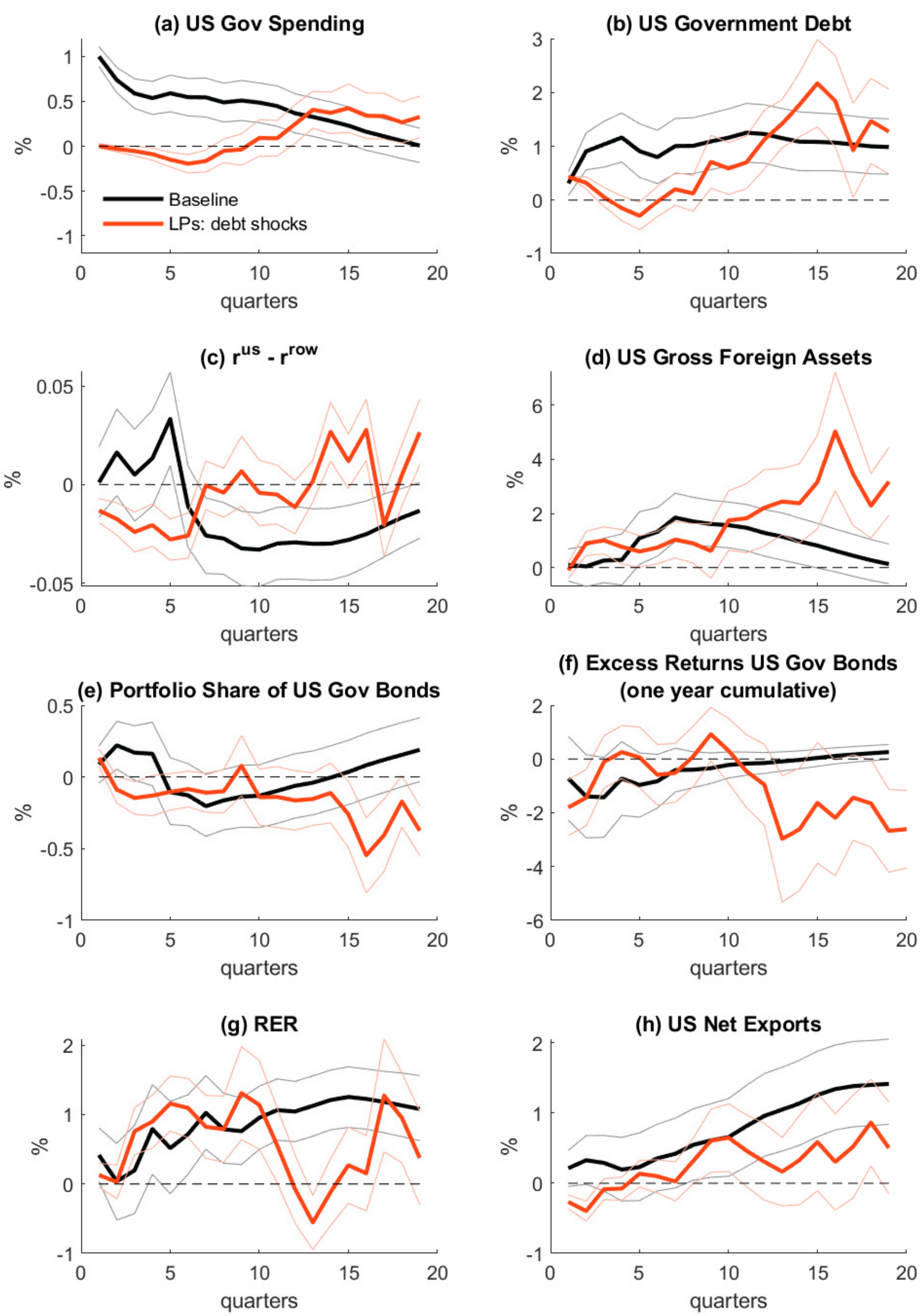


Figure D.14: LP using Phillot (2025) shocks as external instrument for government debt

Notes: Standard error bands are 68% confidence intervals.

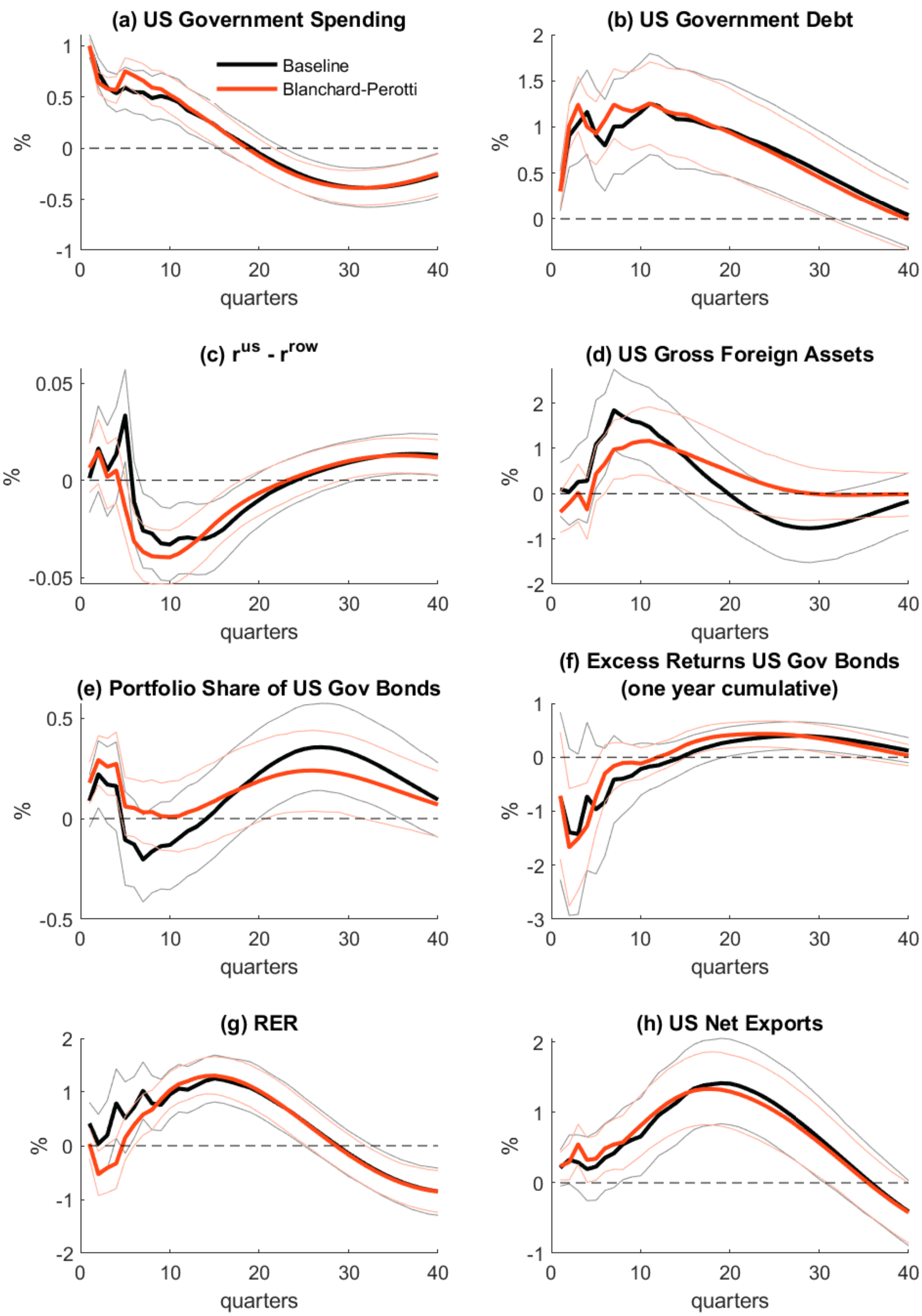


Figure D.15: Blanchard-Perotti

Notes: Standard error bands are 68% confidence intervals.

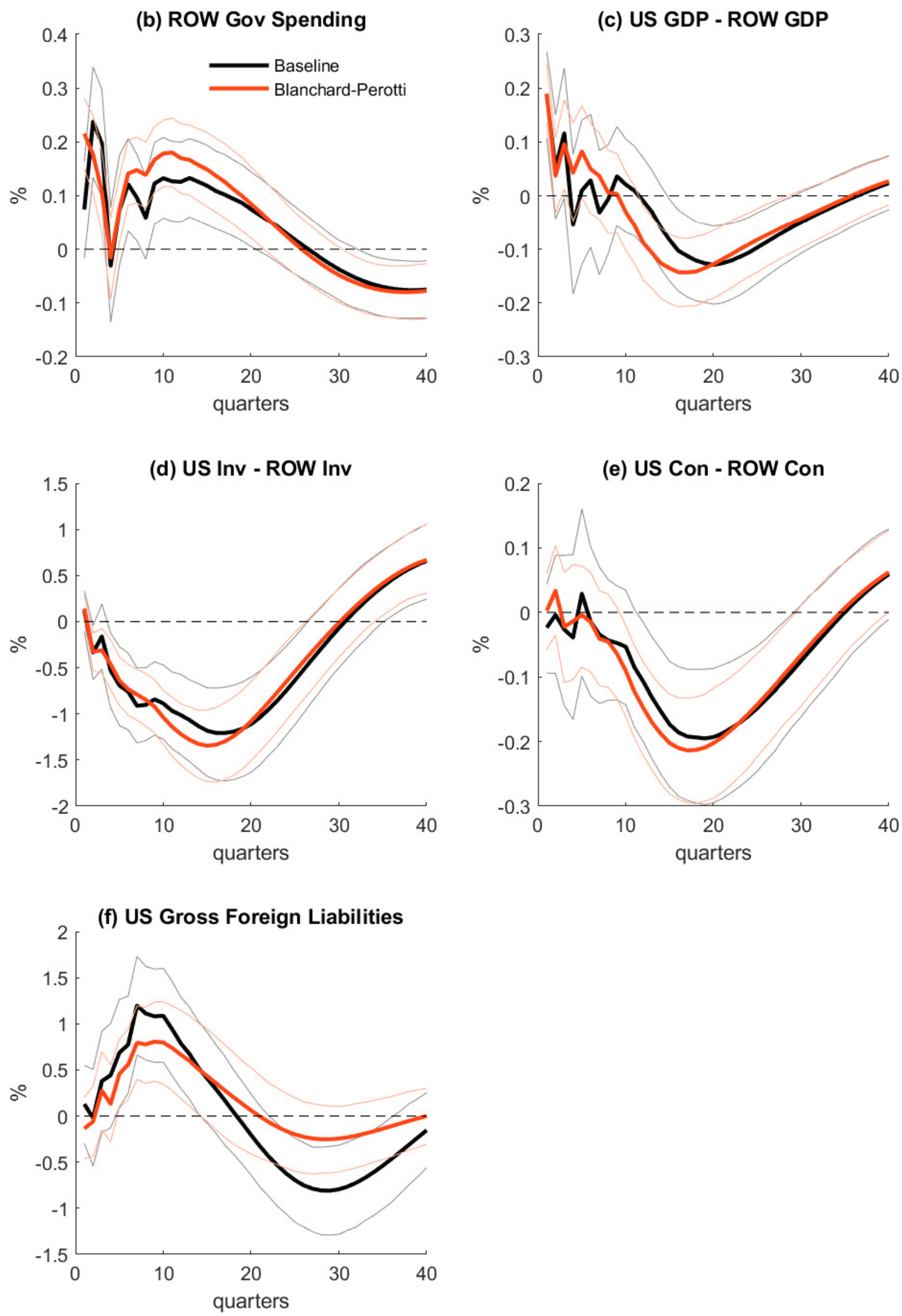


Figure D.16: Blanchard-Perotti

Notes: Standard error bands are 68% confidence intervals.

D.2 Alternative Controls and Sensitivity

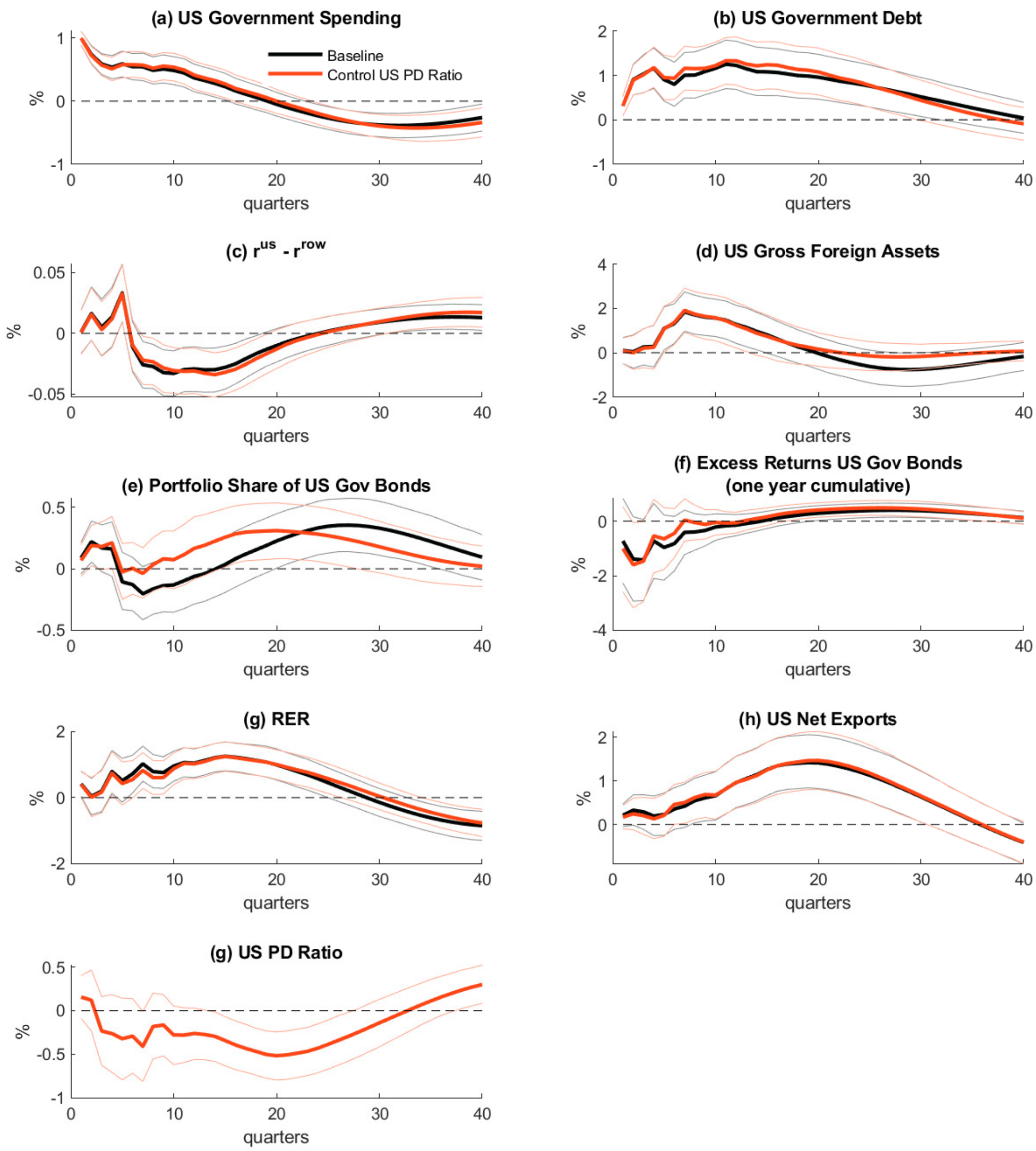


Figure D.17: Control for US Price-Dividend Ratio

Notes: Standard error bands are 68% confidence intervals.

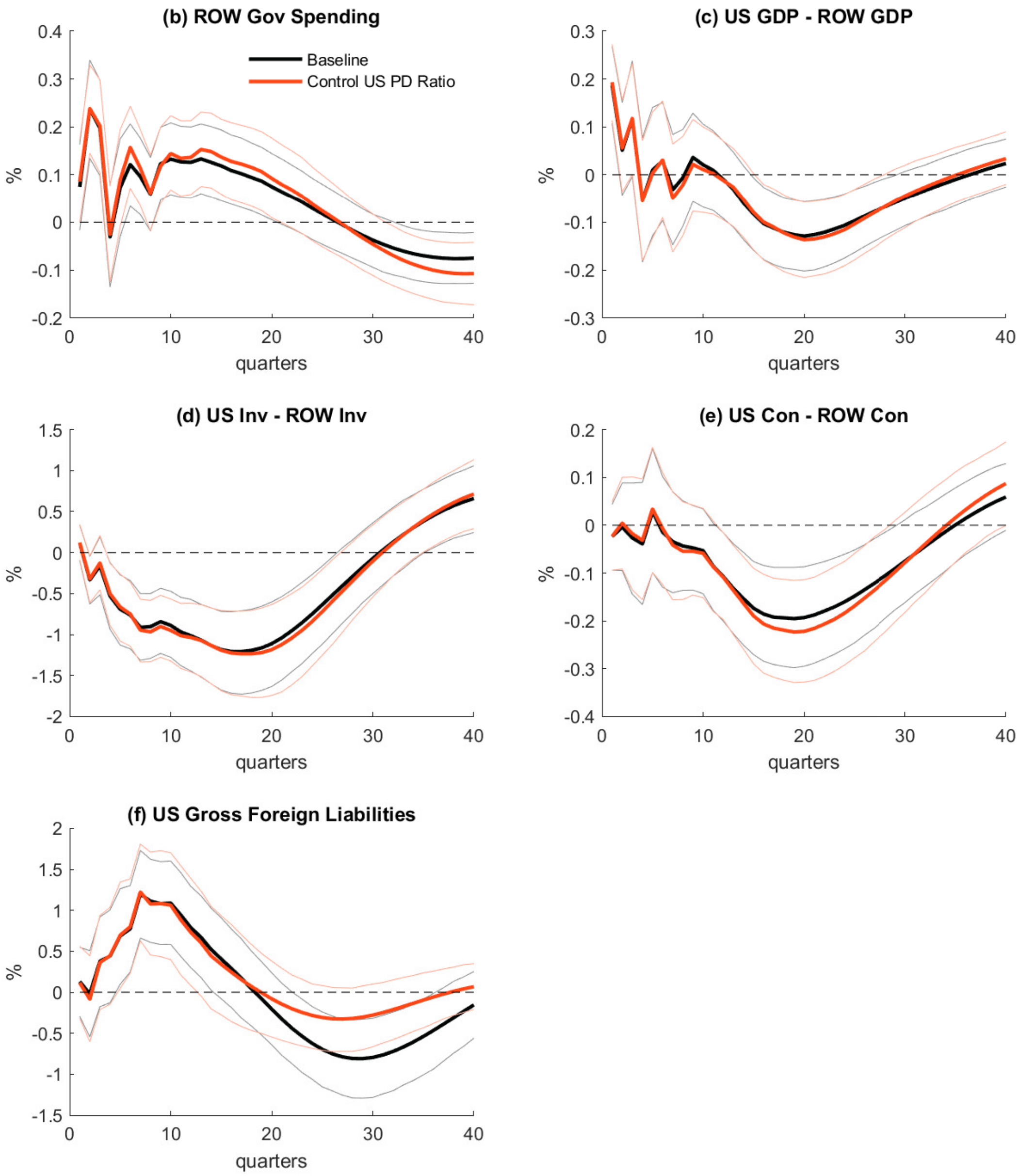


Figure D.18: Control for US Price-Dividend Ratio

Notes: Standard error bands are 68% confidence intervals.

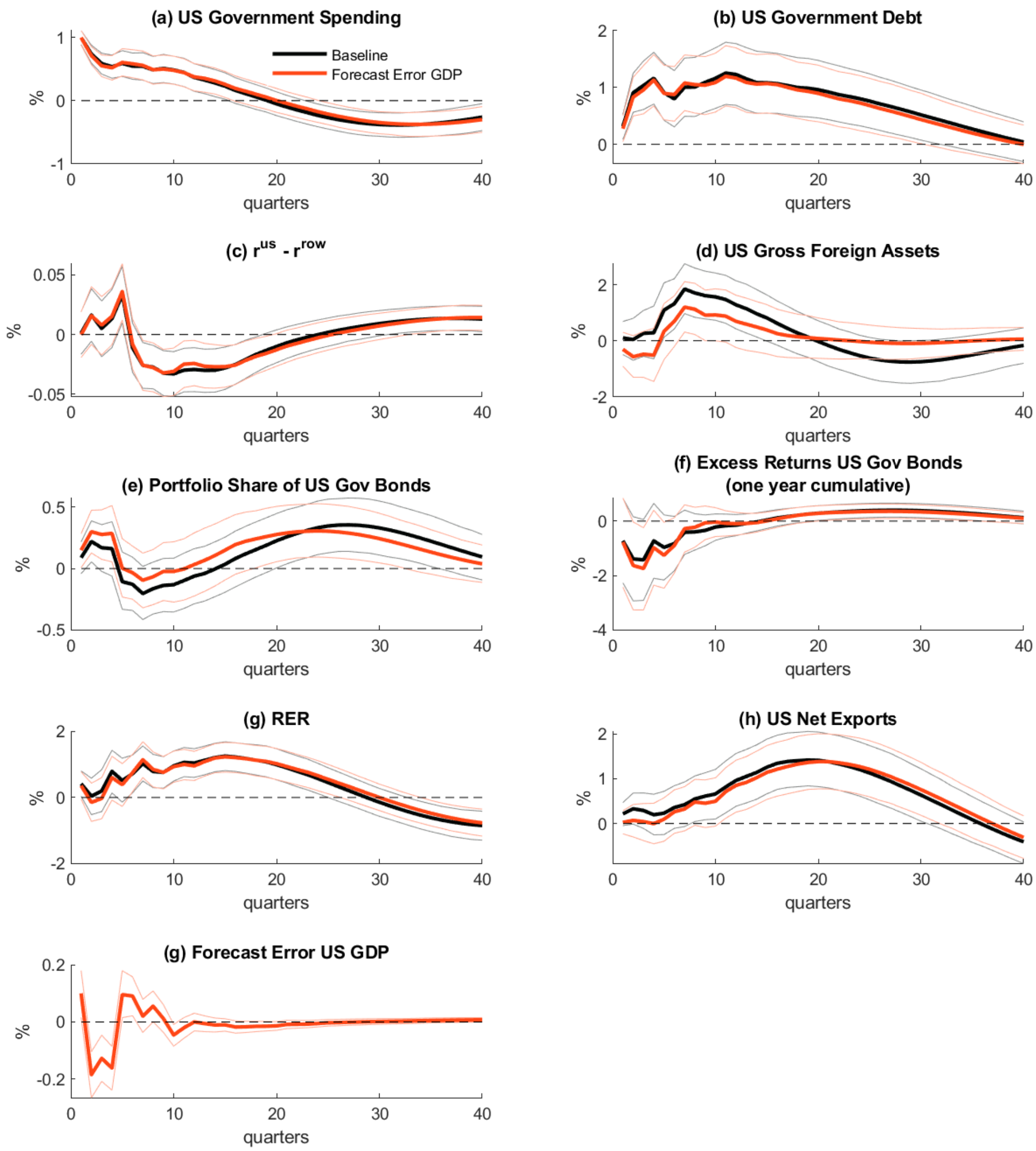


Figure D.19: Control for Forecast Errors of real GDP

Notes: Standard error bands are 68% confidence intervals.

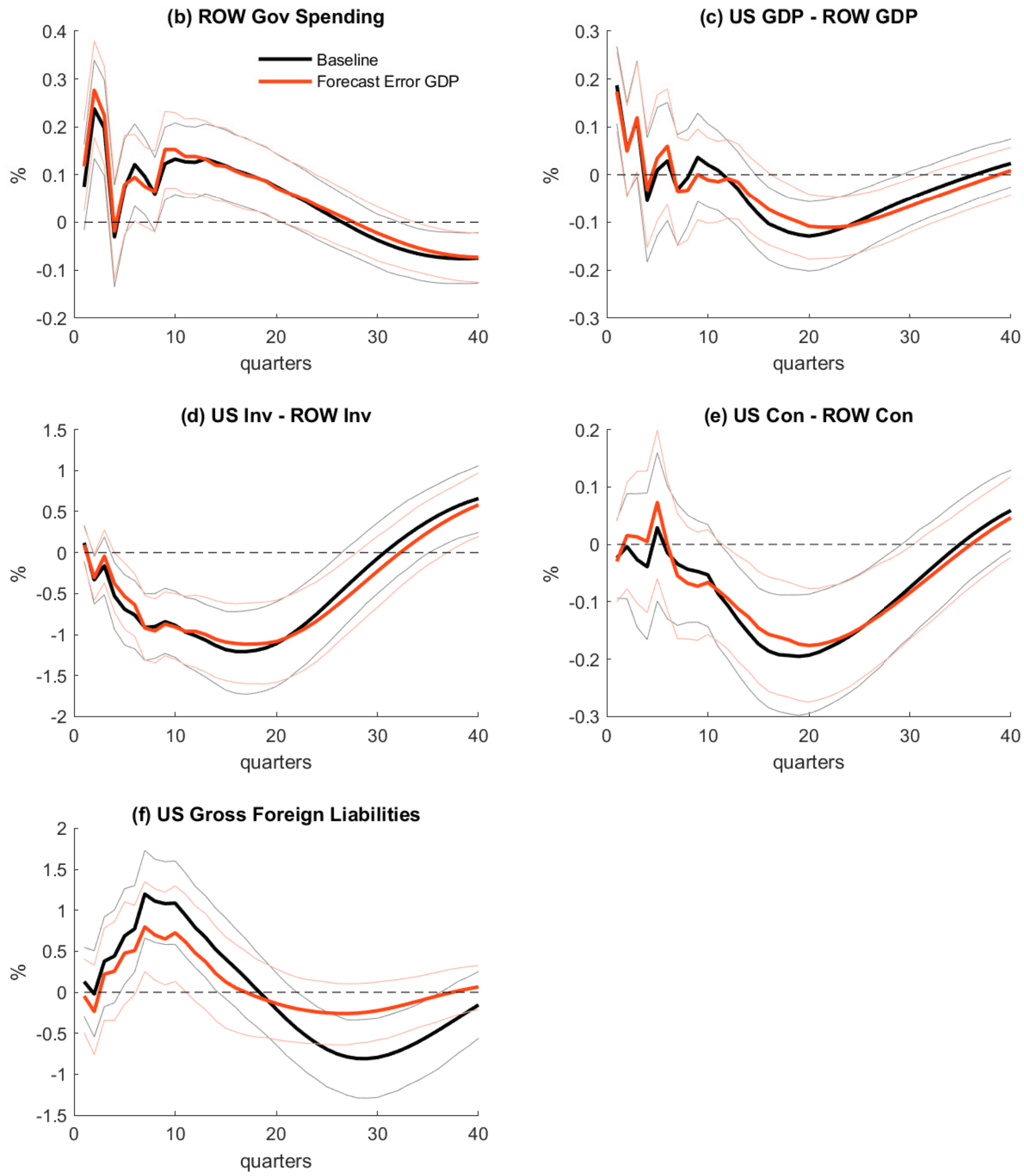


Figure D.20: Control for Forecast Errors of real GDP

Notes: Standard error bands are 68% confidence intervals.

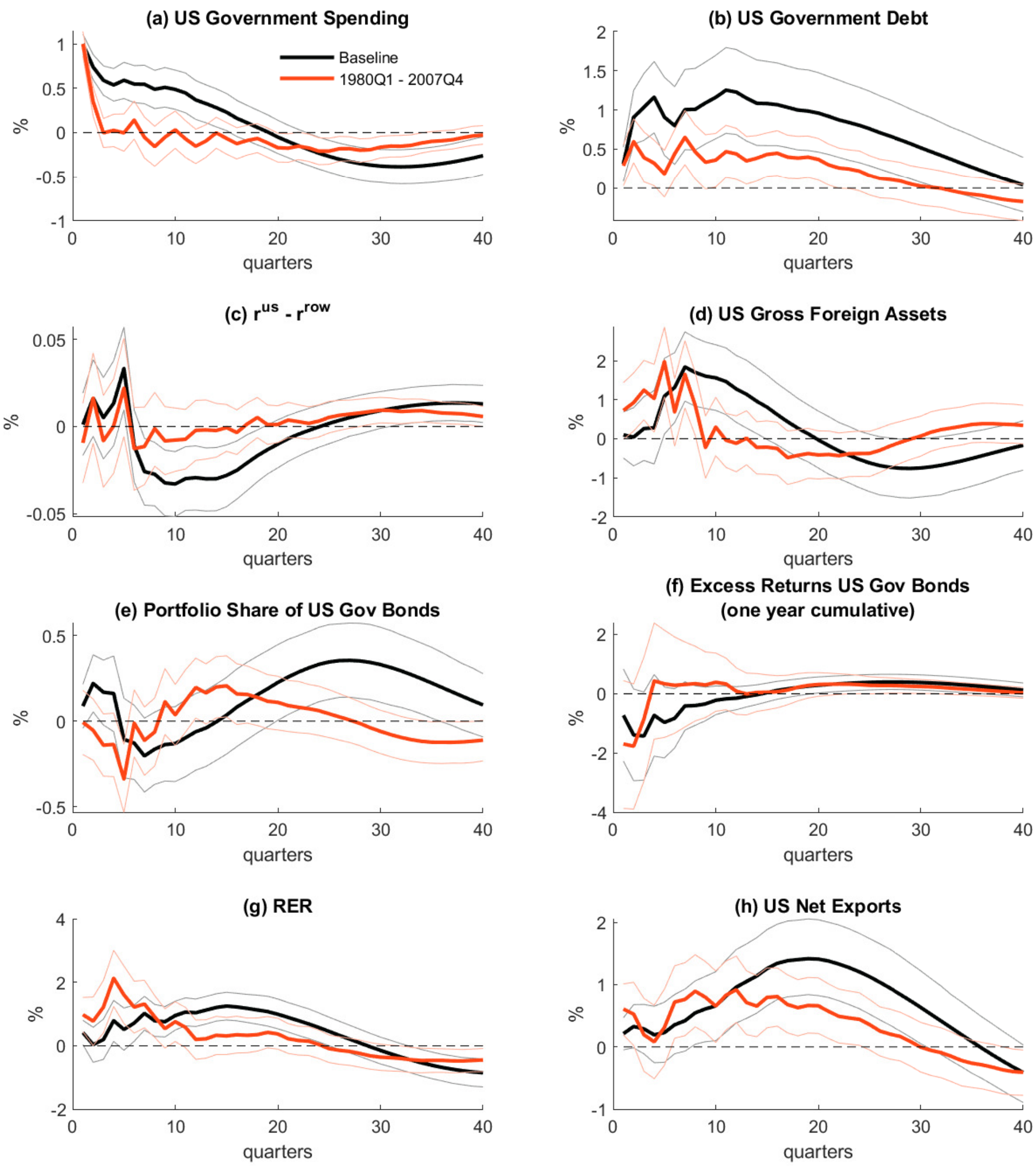


Figure D.21: Sample 1980Q1 - 2007Q4

Notes: Standard error bands are 68% confidence intervals.

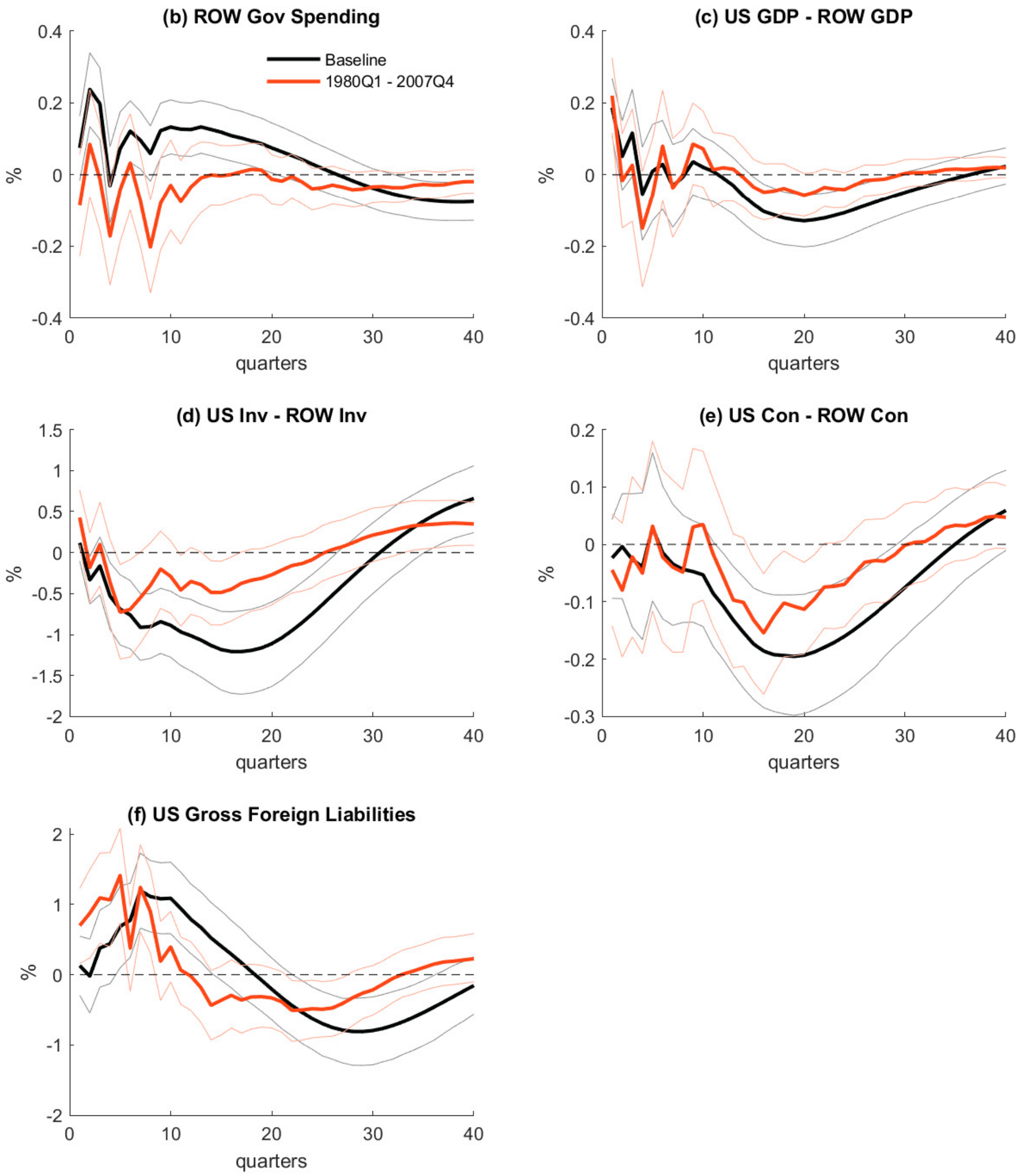


Figure D.22: Sample 1980Q1 - 2007Q4

Notes: Standard error bands are 68% confidence intervals.

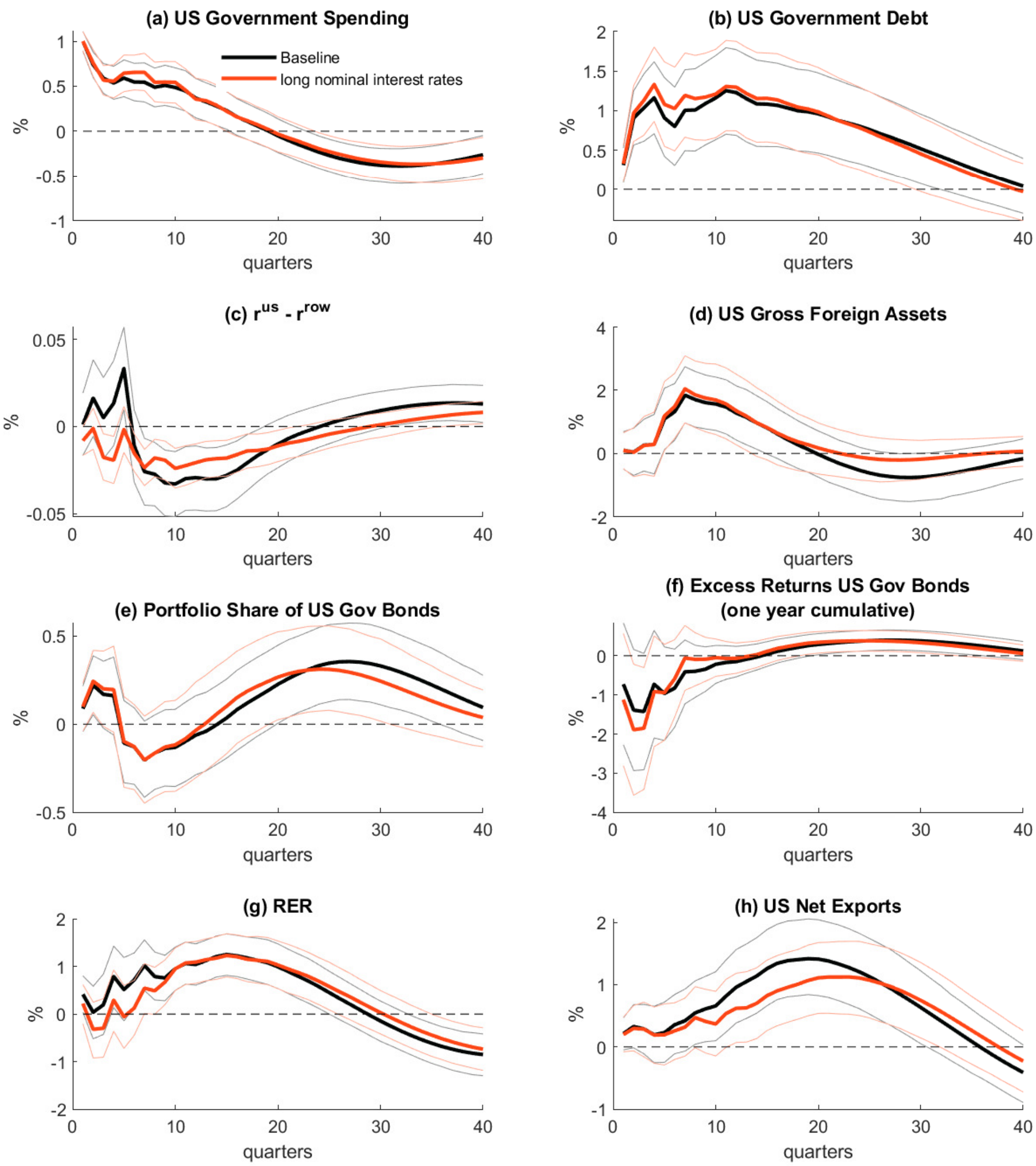


Figure D.23: Long Nominal Interest Rates

Notes: Standard error bands are 68% confidence intervals.

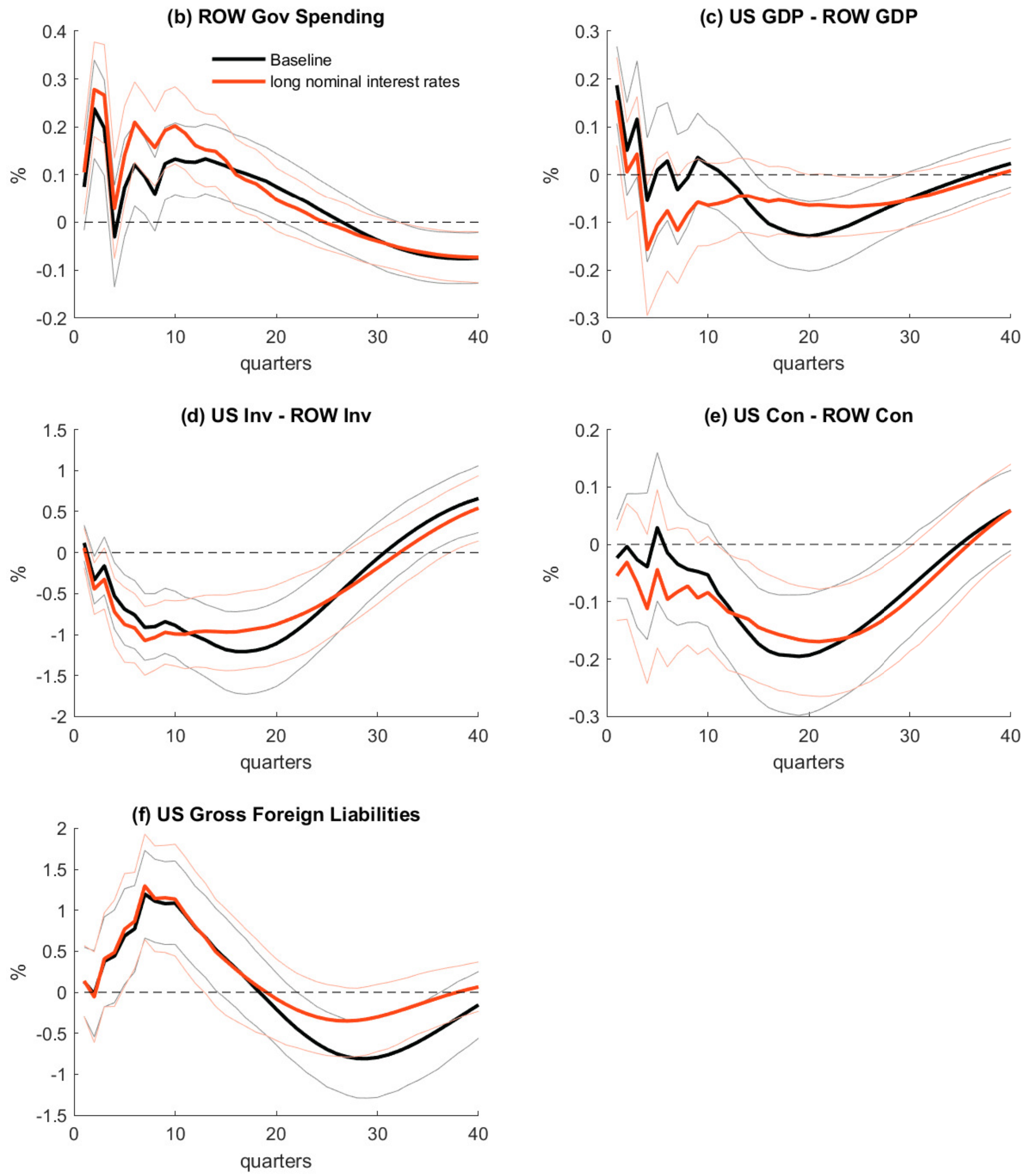


Figure D.24: Long Nominal Interest Rates

Notes: Standard error bands are 68% confidence intervals.

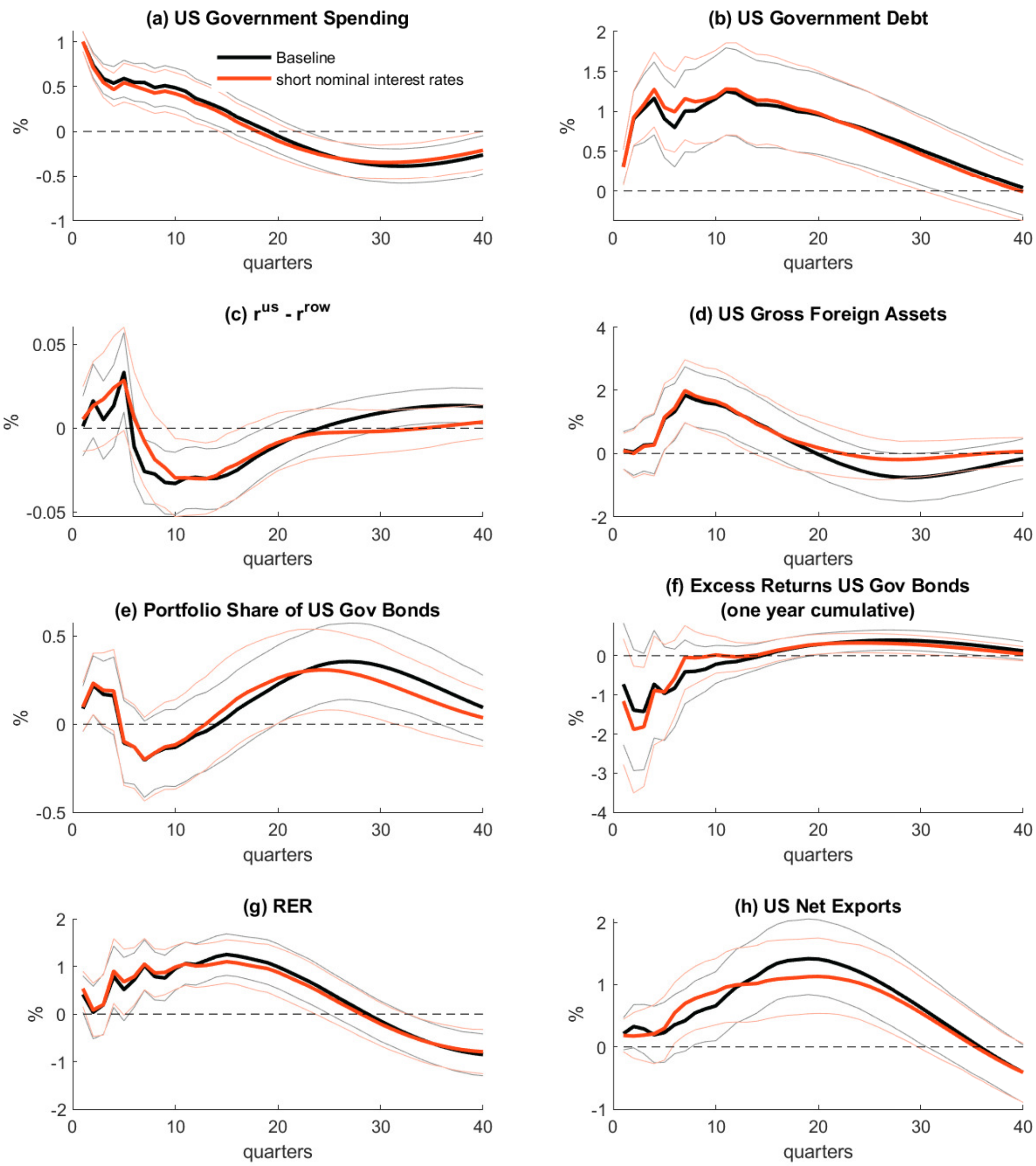


Figure D.25: Short Nominal Interest Rates

Notes: Standard error bands are 68% confidence intervals.

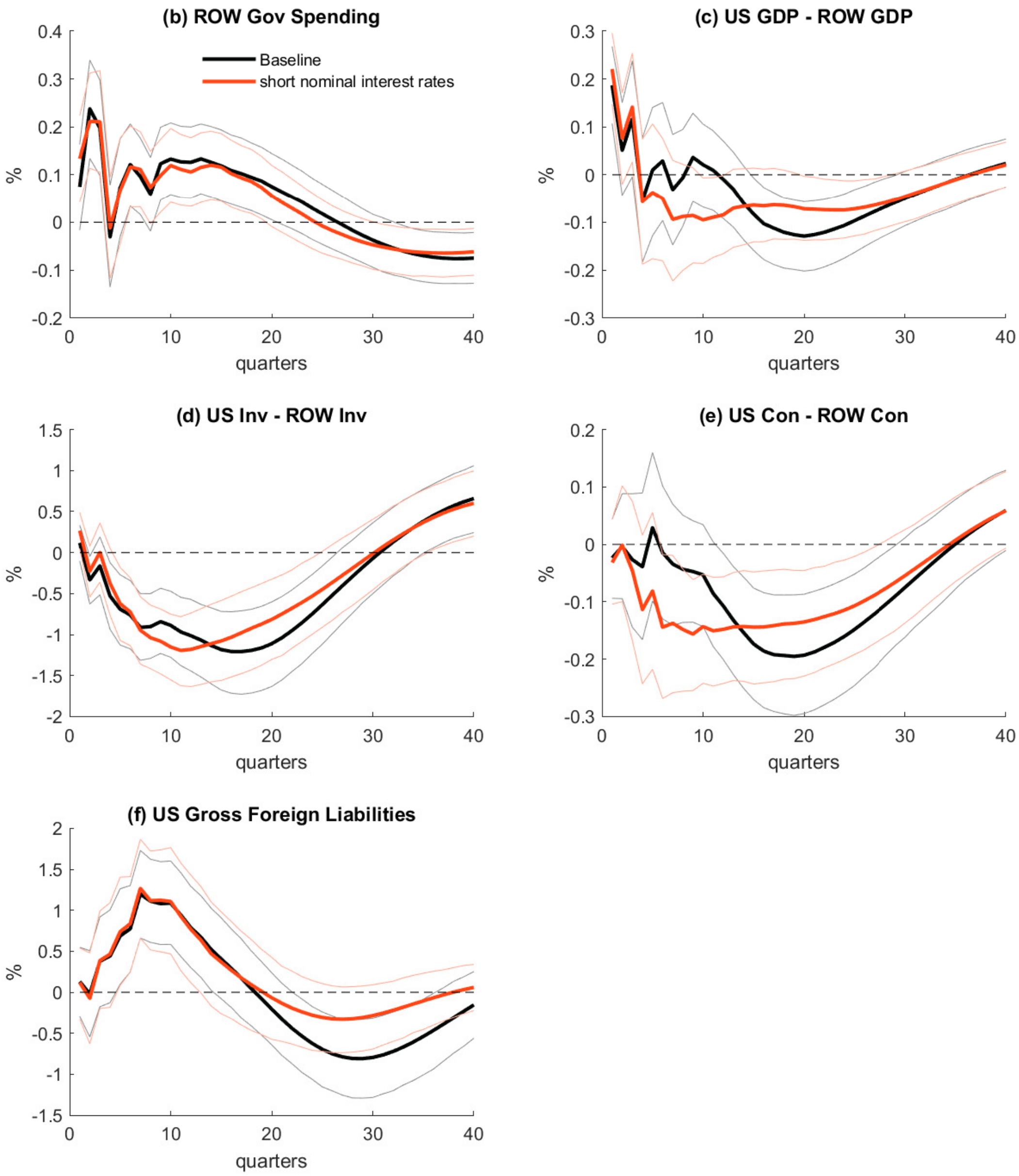


Figure D.26: Short Nominal Interest Rates

Notes: Standard error bands are 68% confidence intervals.

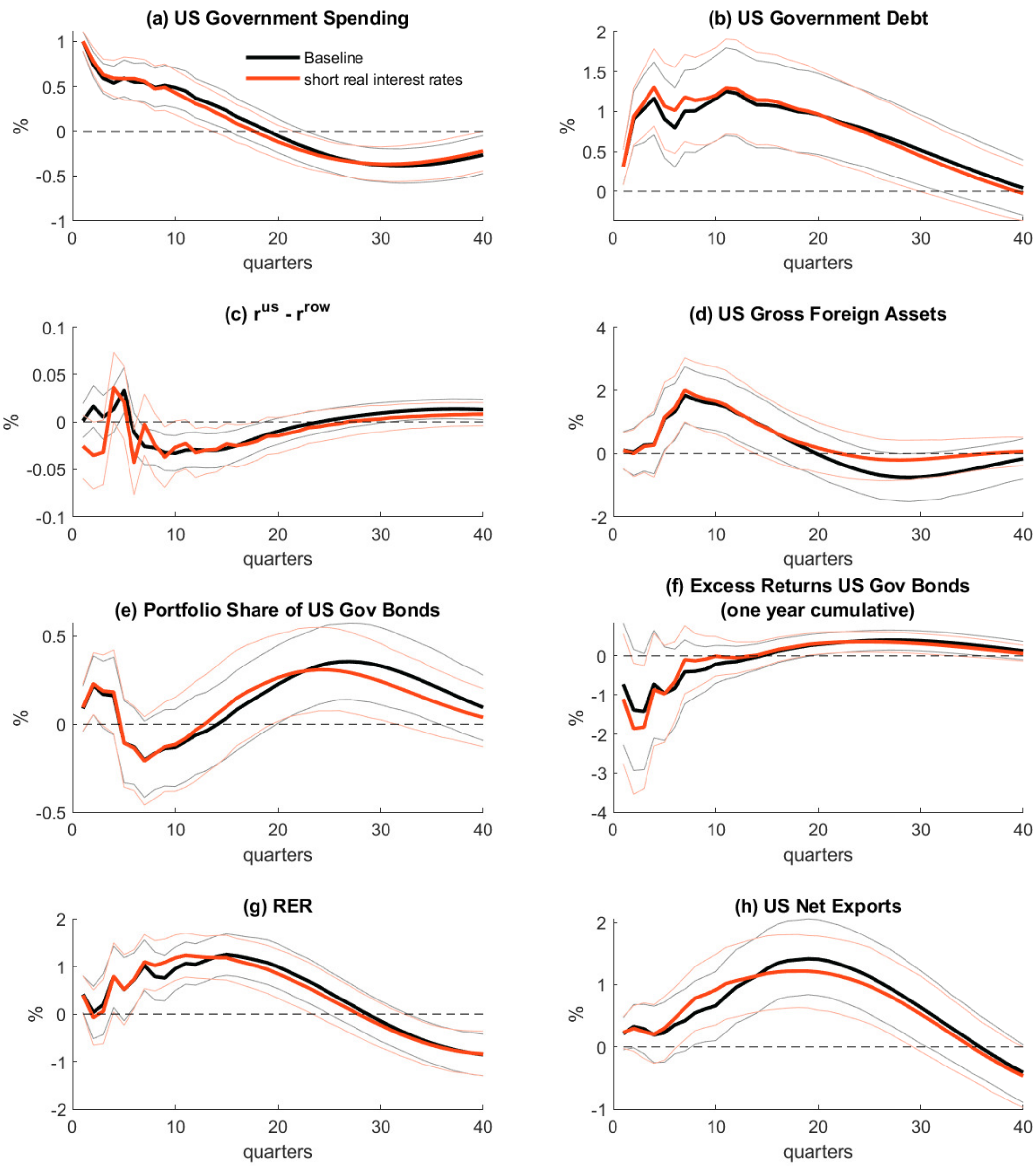


Figure D.27: Short Real Interest Rates

Notes: Standard error bands are 68% confidence intervals.

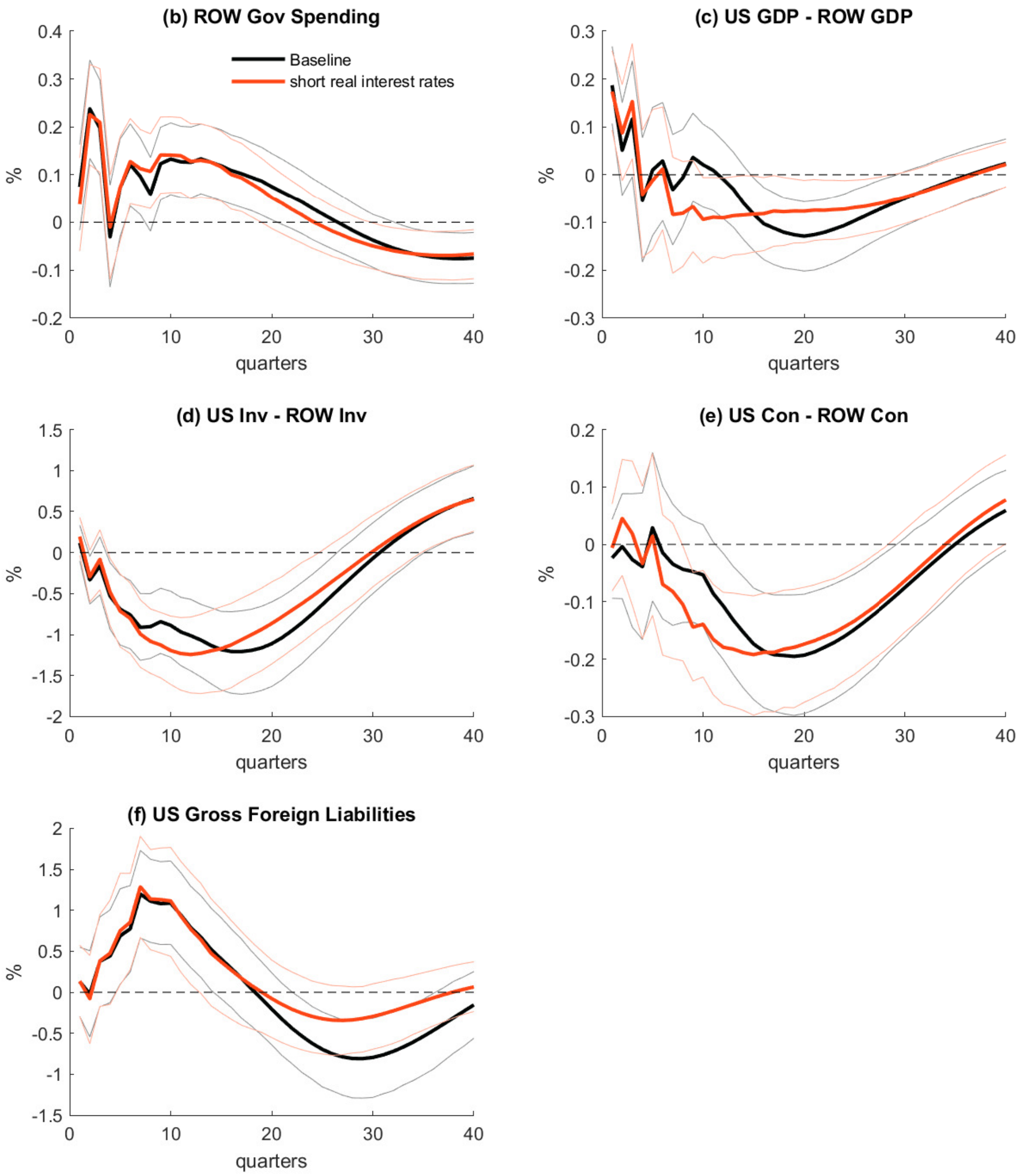


Figure D.28: Short Real Interest Rates

Notes: Standard error bands are 68% confidence intervals.

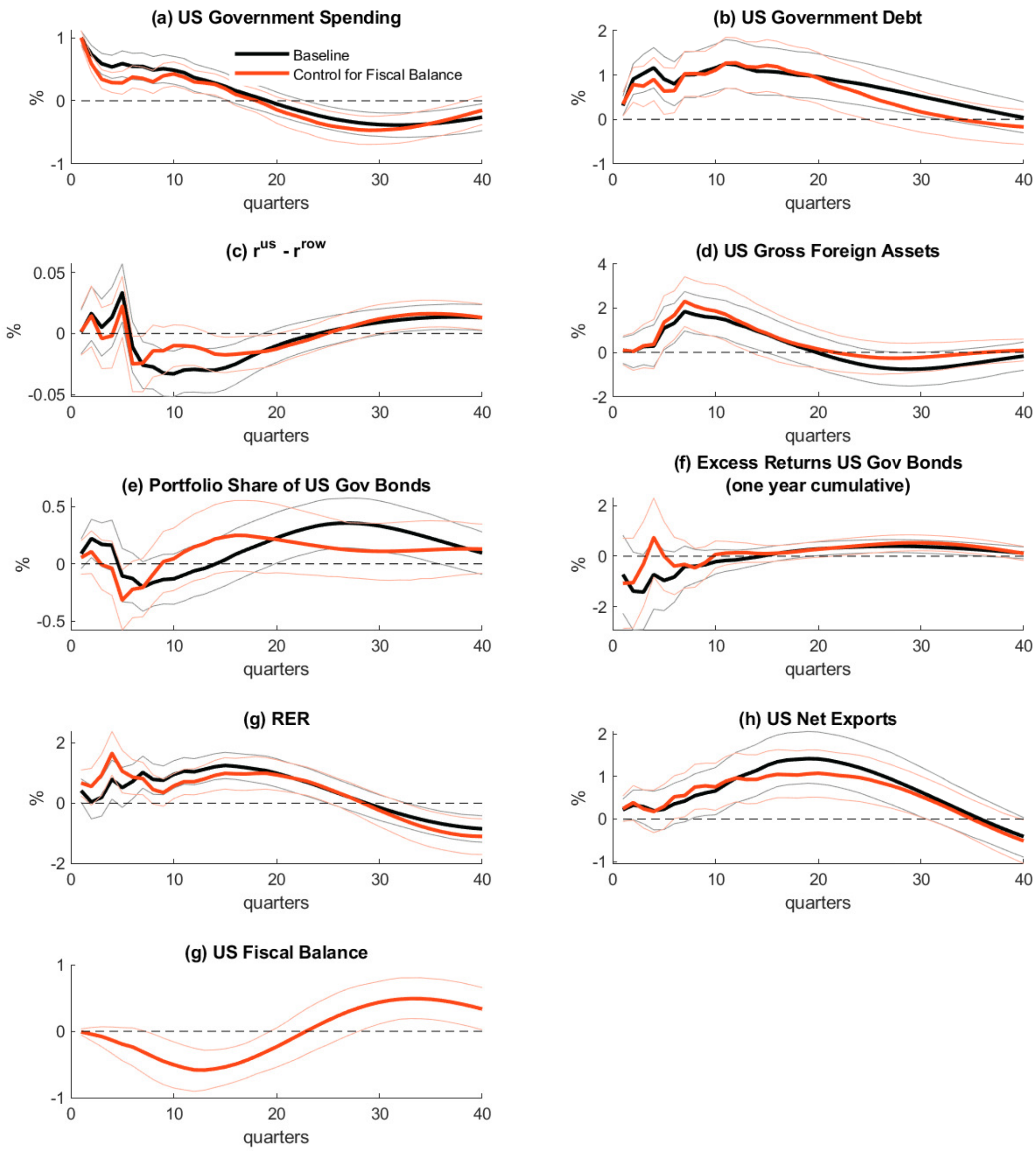


Figure D.29: Control for Fiscal Balance

Notes: Standard error bands are 68% confidence intervals.

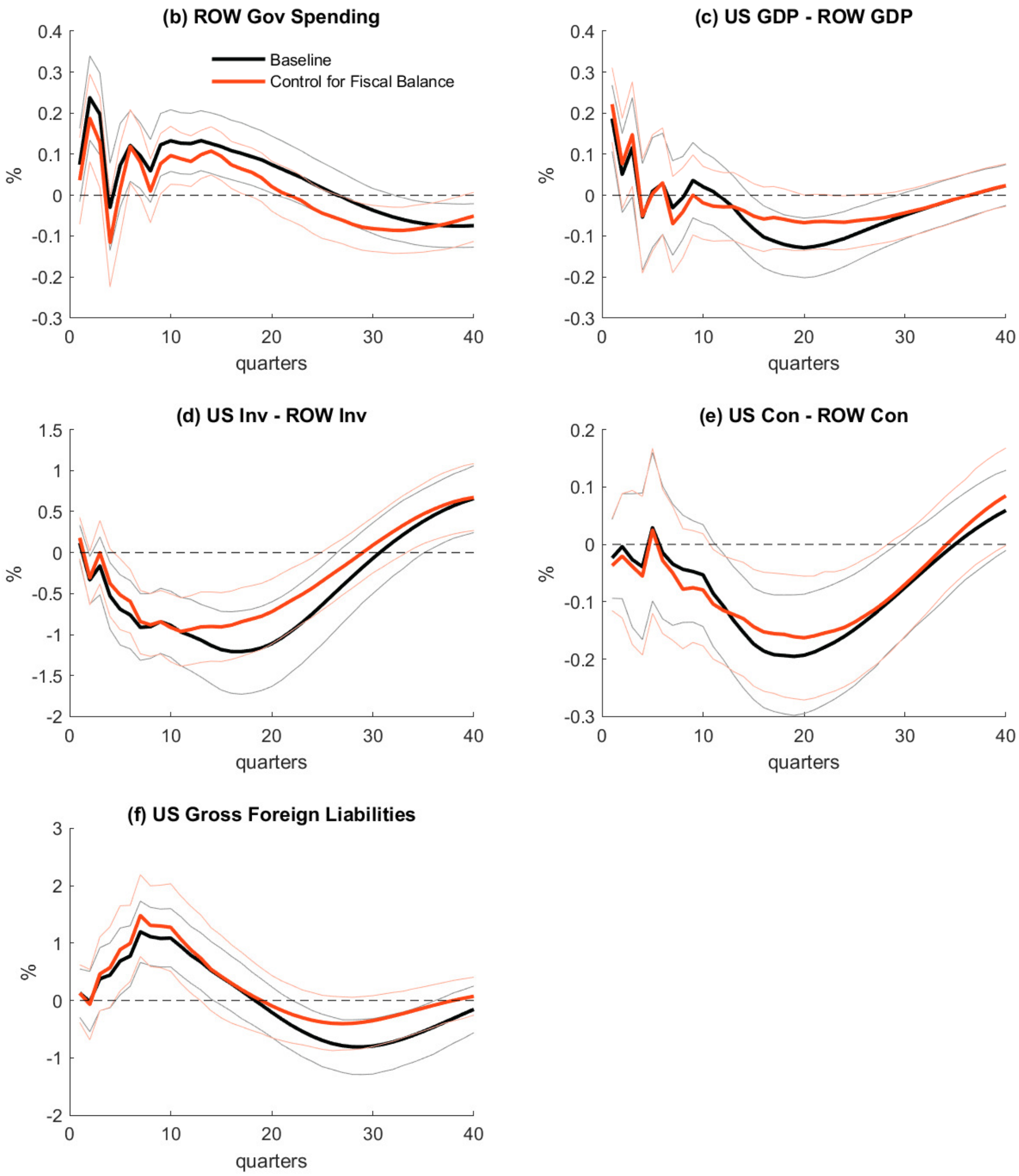


Figure D.30: Control for Fiscal Balance

Notes: Standard error bands are 68% confidence intervals.

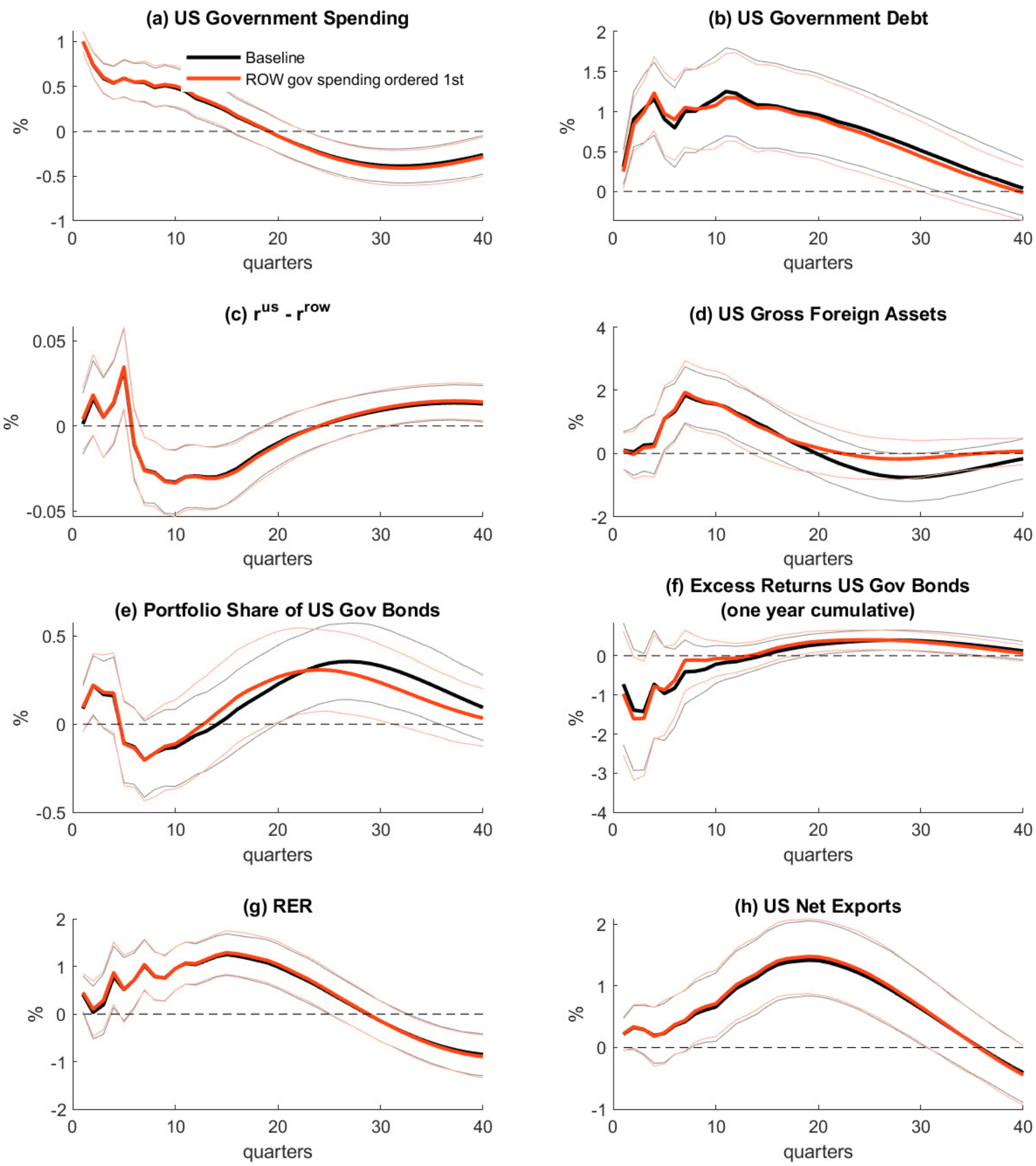


Figure D.31: ROW Gov Spending Ordered First and US Spending Forecast Error Ordered Last

Notes: Standard error bands are 68% confidence intervals.

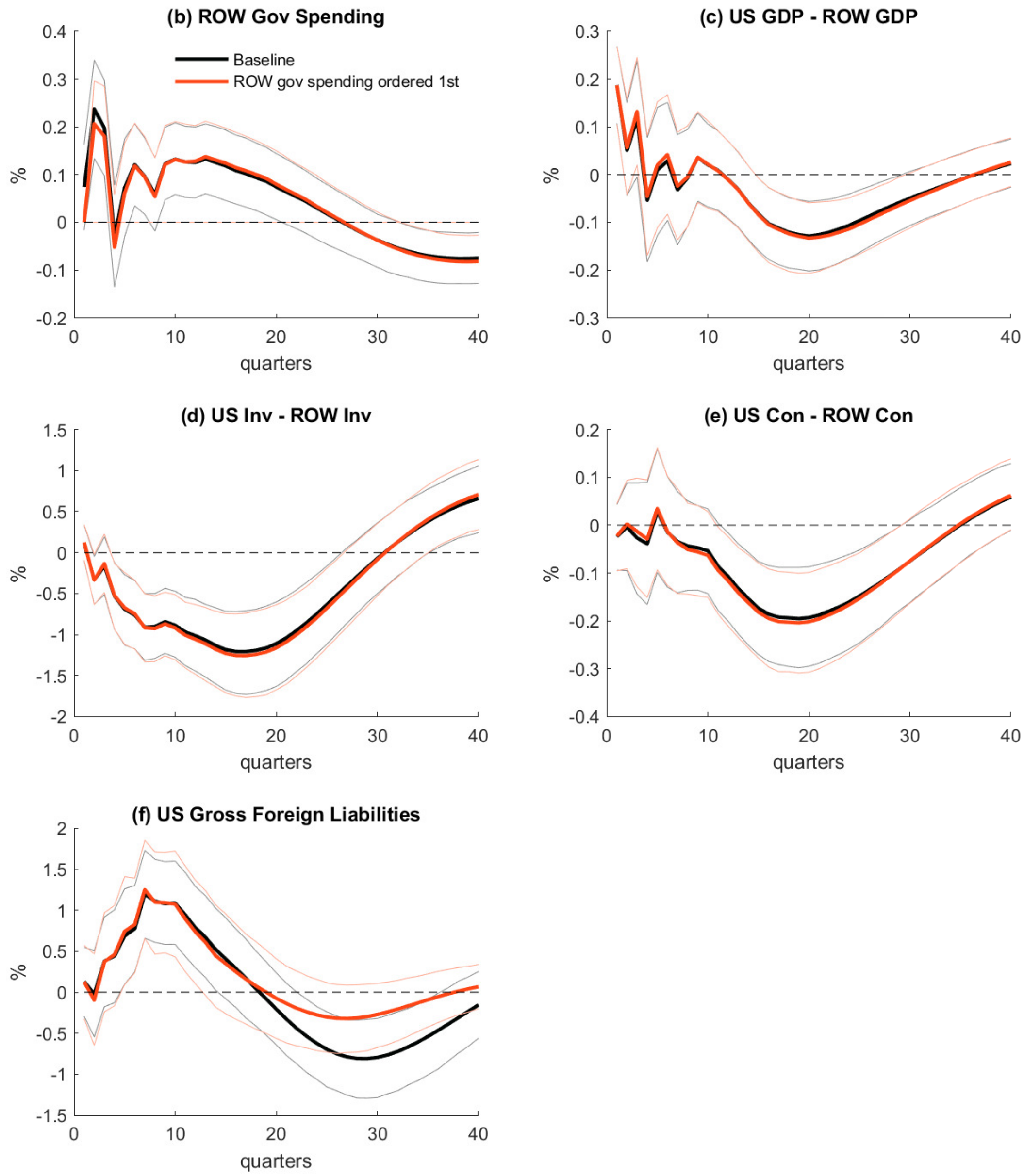


Figure D.32: ROW Gov Spending Ordered First and US Spending Forecast Error Ordered Last

Notes: Standard error bands are 68% confidence intervals.

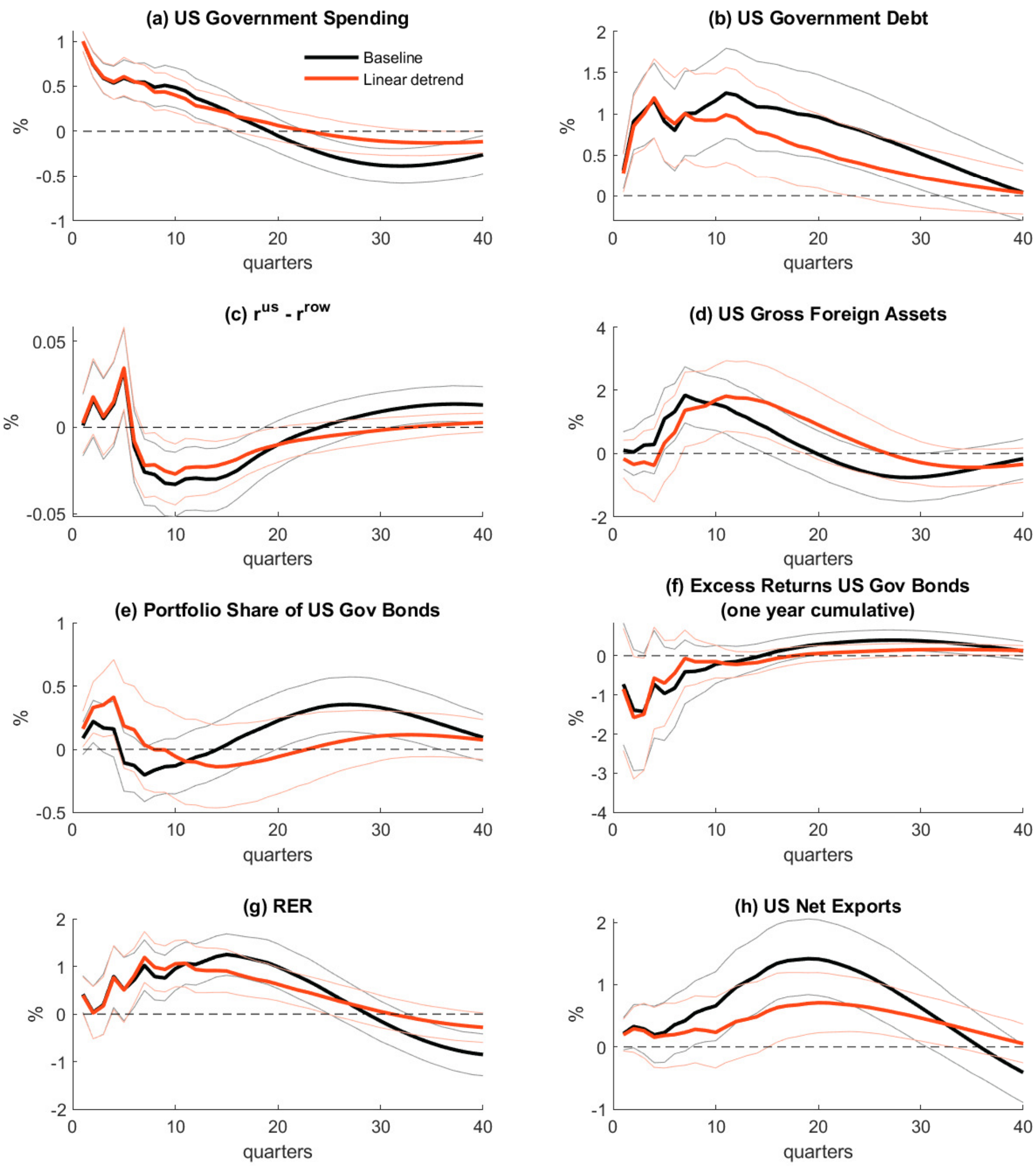


Figure D.33: Linear De-Trend

Notes: Standard error bands are 68% confidence intervals.

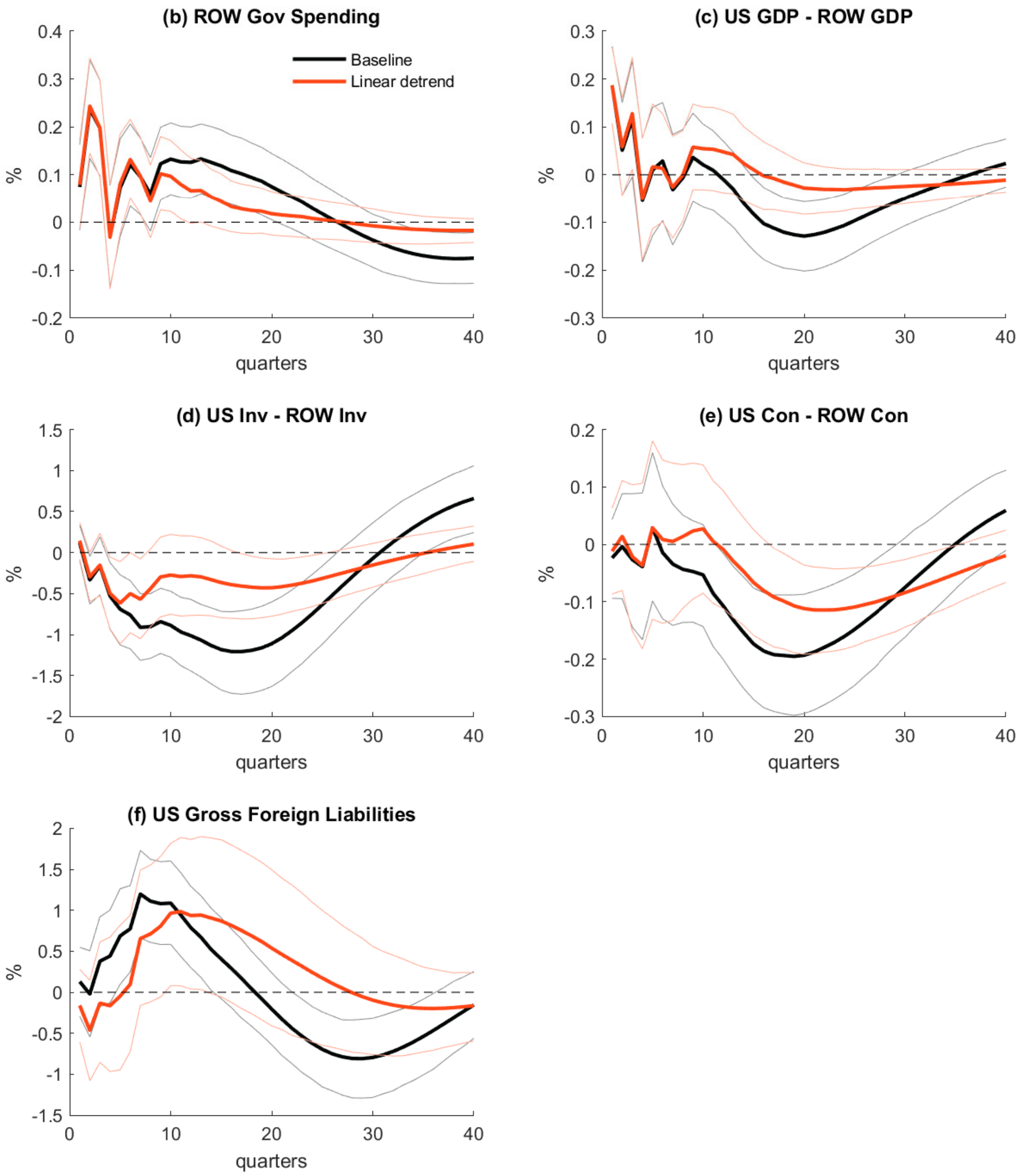


Figure D.34: Linear De-Trend

Notes: Standard error bands are 68% confidence intervals.

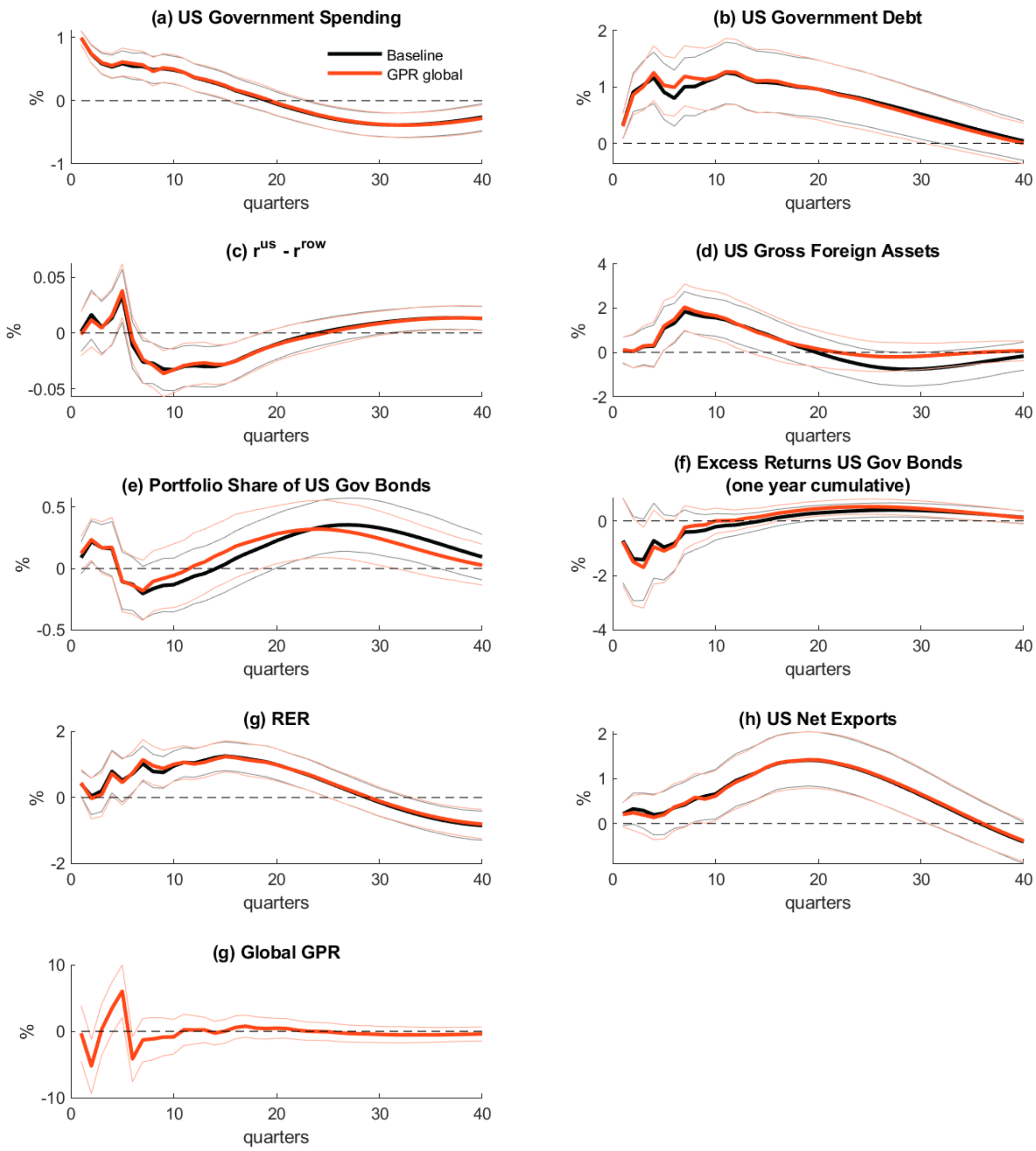


Figure D.35: Control for Geopolitical Risk Index (global) (Caldara and Iacoviello, 2022)

Notes: Standard error bands are 68% confidence intervals.

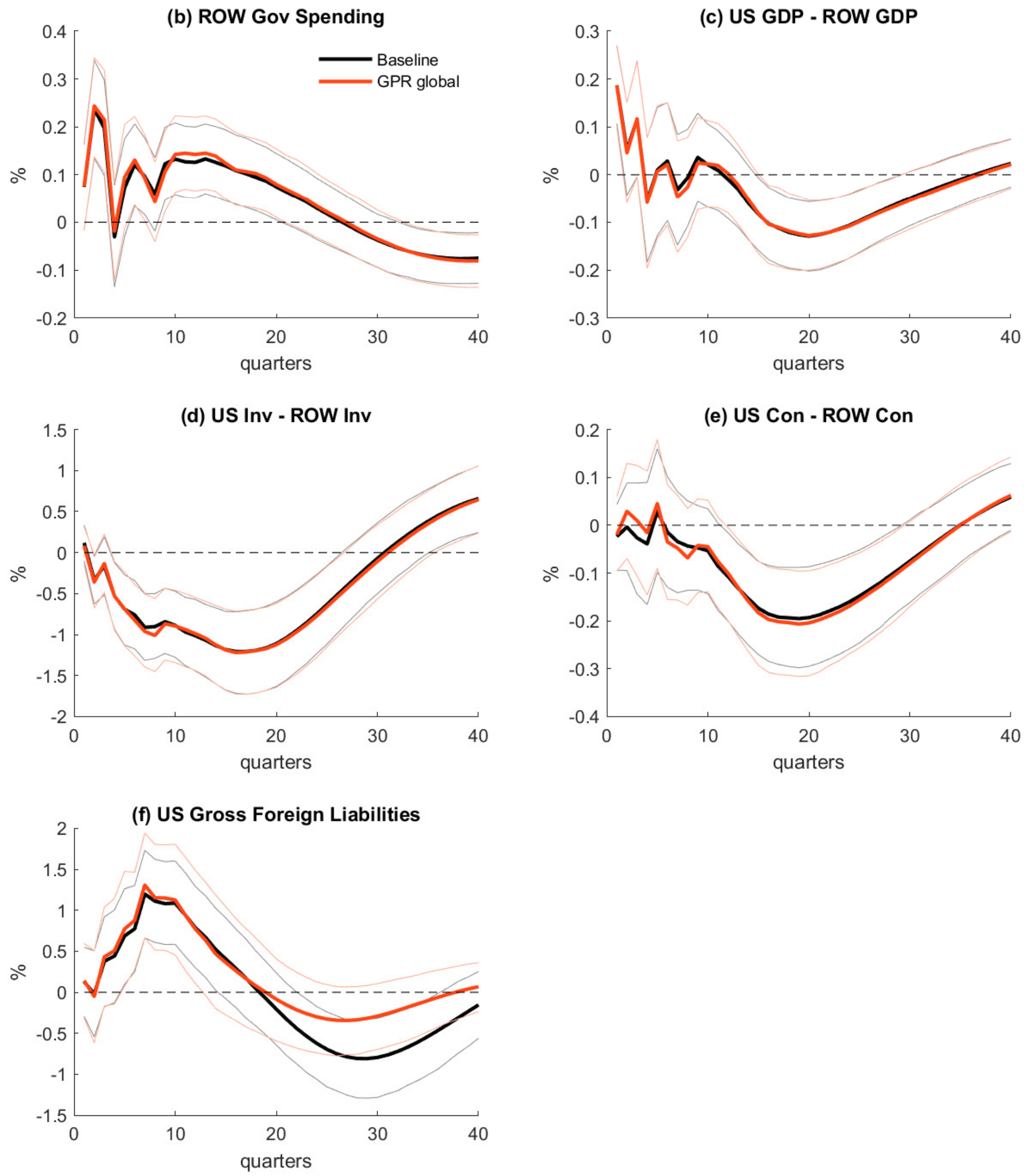


Figure D.36: Control for Geopolitical Risk Index (global) (Caldara and Iacoviello, 2022)

Notes: Standard error bands are 68% confidence intervals.

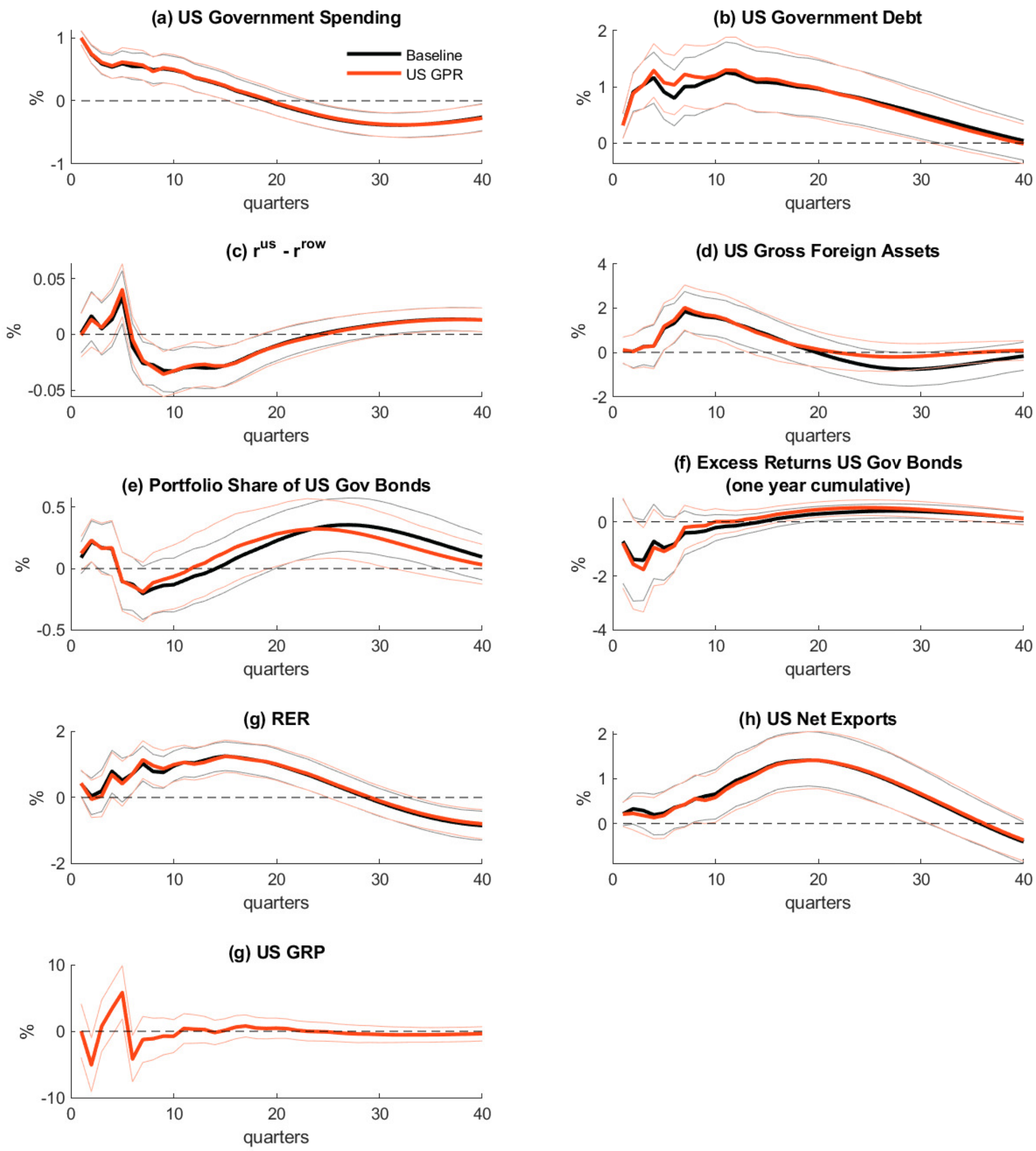


Figure D.37: Control for Geopolitical Risk Index (US) (Caldara and Iacoviello, 2022)

Notes: Standard error bands are 68% confidence intervals.

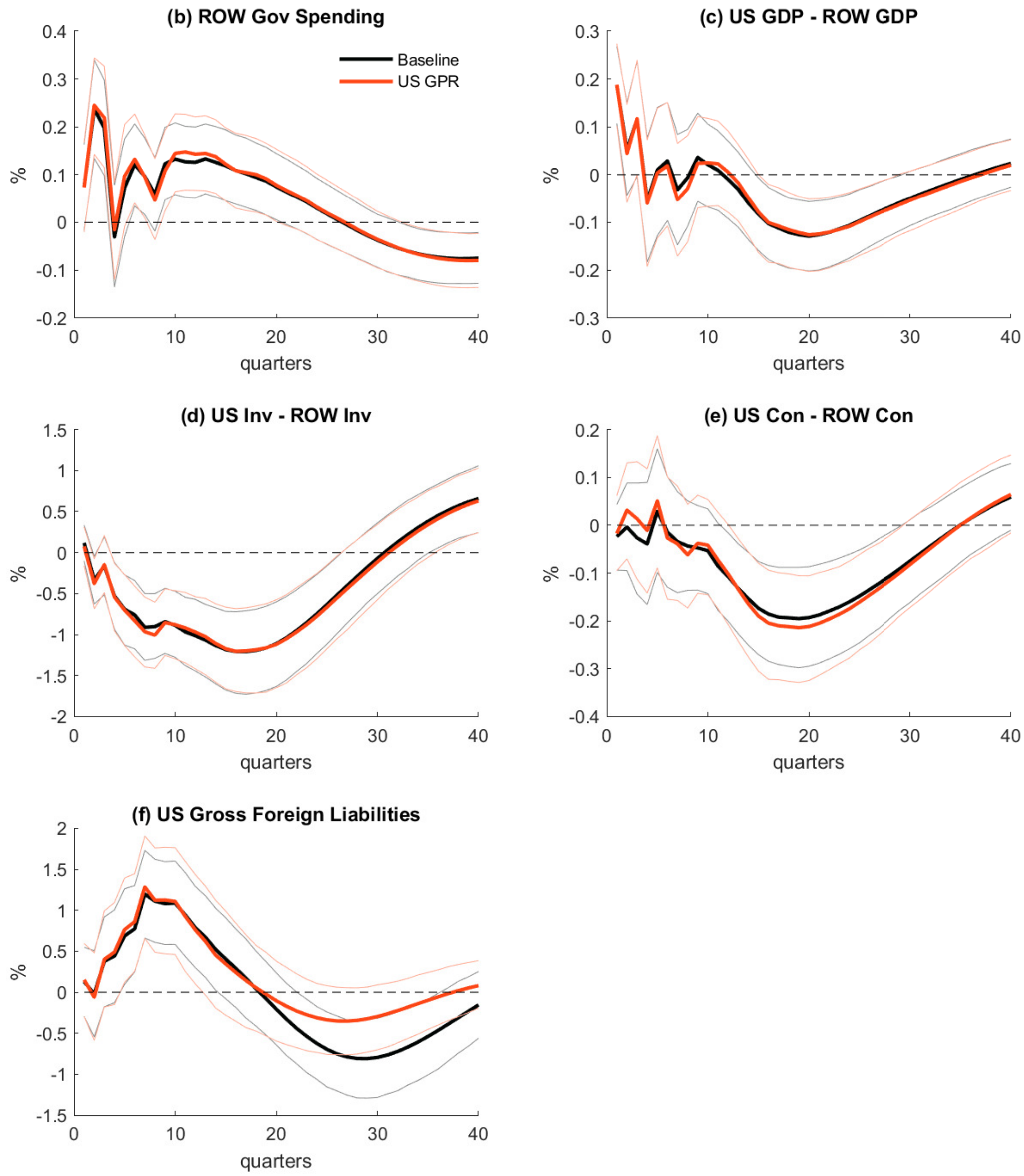


Figure D.38: Control for Geopolitical Risk Index (US) (Caldara and Iacoviello, 2022)

Notes: Standard error bands are 68% confidence intervals.

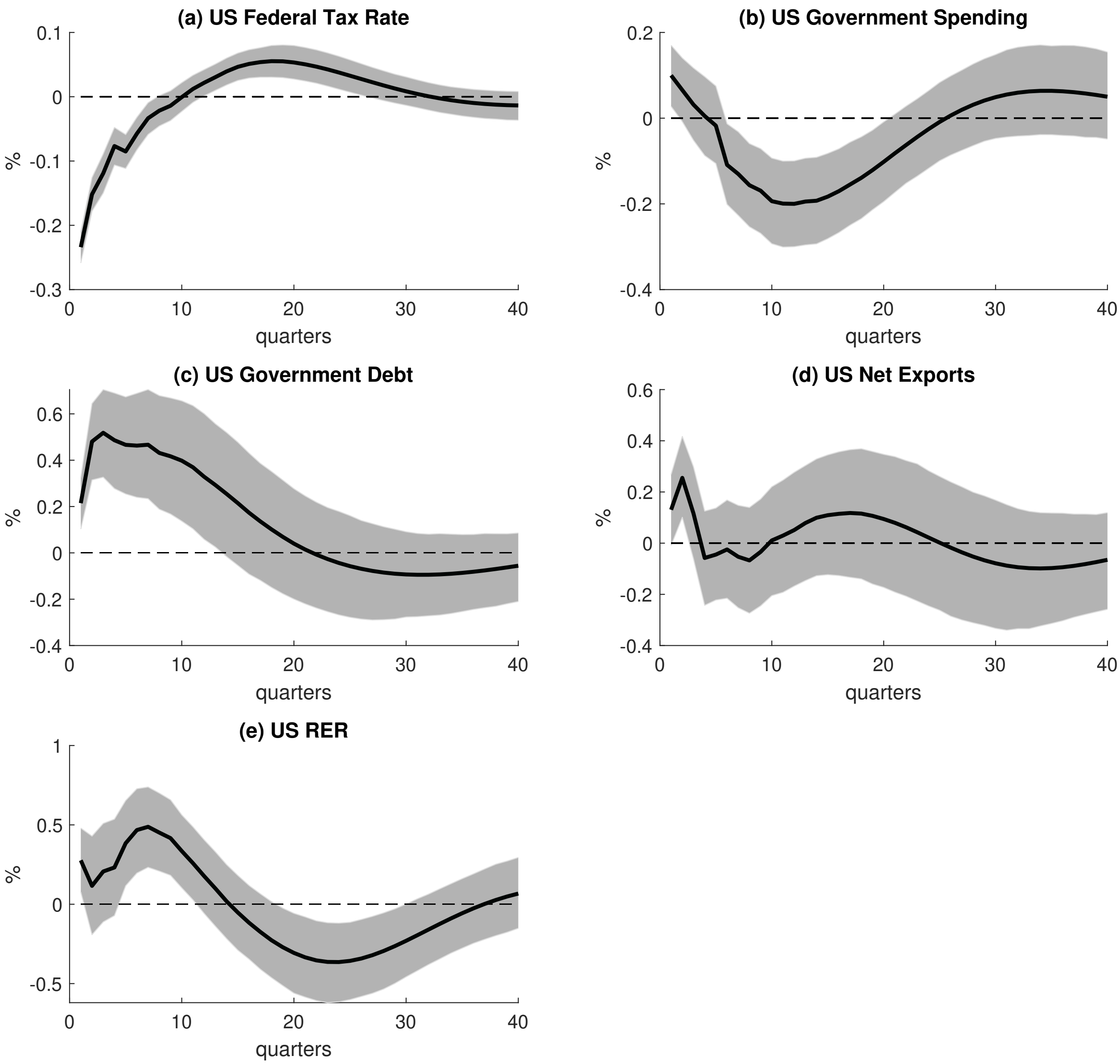


Figure D.39: VAR Federal Tax Cut Shock

Notes: Standard error bands are 68% confidence intervals.

	Baseline	Blanchard-Perotti	Defense Spending	Defense Spending Authorizations
US Gov spending	24	55	14	4
US Gov Debt	19	39	9	3
US RER	20	38	14	4
US Net Exports	20	41	15	3

	PD-ratio	1980:Q1 - 2007:Q4	Fiscal Balance	G^{row} order 1st
US Gov spending	28	16	14	24
US Gov Debt	22	8	13	16
US RER	22	20	13	20
US Net Exports	21	18	14	20

	GPR	Linear De-trend	Long Nominal Rates	Short Real Rates
US Gov spending	22	14	18	18
US Gov Debt	18	9	18	18
US RER	18	9	13	14
US Net Exports	18	6	11	14

	Short Nominal Rates	Forecasts US GDP
US Gov spending	16	20
US Gov Debt	18	15
US RER	12	16
US Net Exports	12	14

Table D.1: Robustness Unconditional Variance Decomposition - US Gov spending shocks (%)

E Model

E.1 Proof of Proposition I

The log-linearized Euler equation 5 (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 exports can be expressed as a function of the RER, the terms of trade and domestic absorption. I estimate an ECM of this relationship:

$$\begin{aligned}\Delta nt = \beta + \gamma_{SR}\, \Delta(tot_t + q_t) + \Delta(d_t^* - d_t) \\ - \alpha \left[nt_{t-1} - \gamma_{LR}\, (tot_{t-1} + q_{t-1}) - (d_{t-1}^* - d_{t-1}) \right] + \varepsilon_t \end{aligned} \tag{11}$$

where $nt_t = \ln(X/M)$ is log of XM, $tot_t = \ln(p_t^M / p_t^X)$ 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 et al., 2000; Marquez, 2002; Alessandria and Choi, 2021; Mac Mullen and Woo, 2025; Alessandria, Bai and Woo, 2024).

E.3 Other Moments

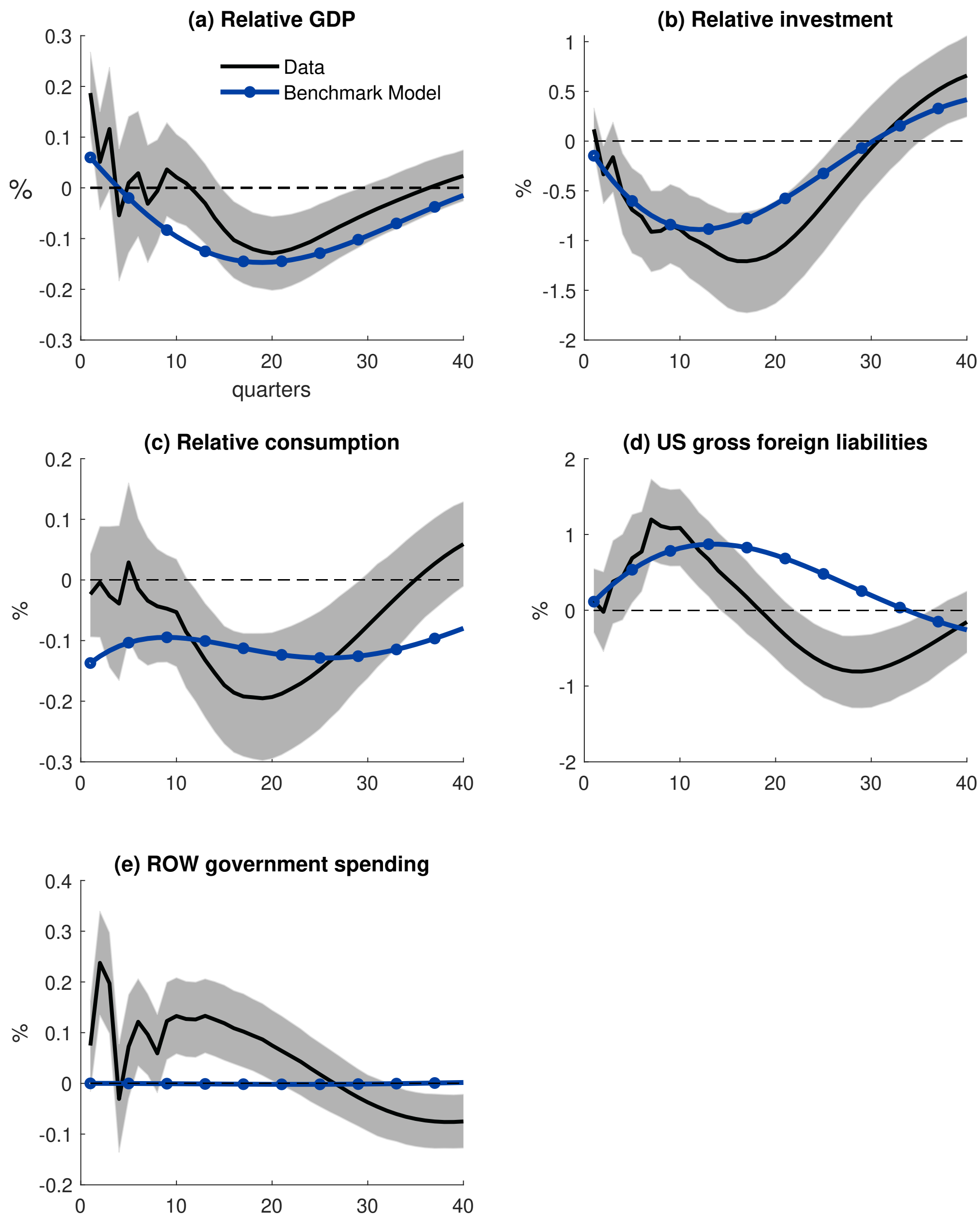


Figure E.1: Impulse Response Functions in Data and Models

Notes: Standard error bands are 68% confidence intervals.

E.4 A Model with Tax/Transfer Shocks

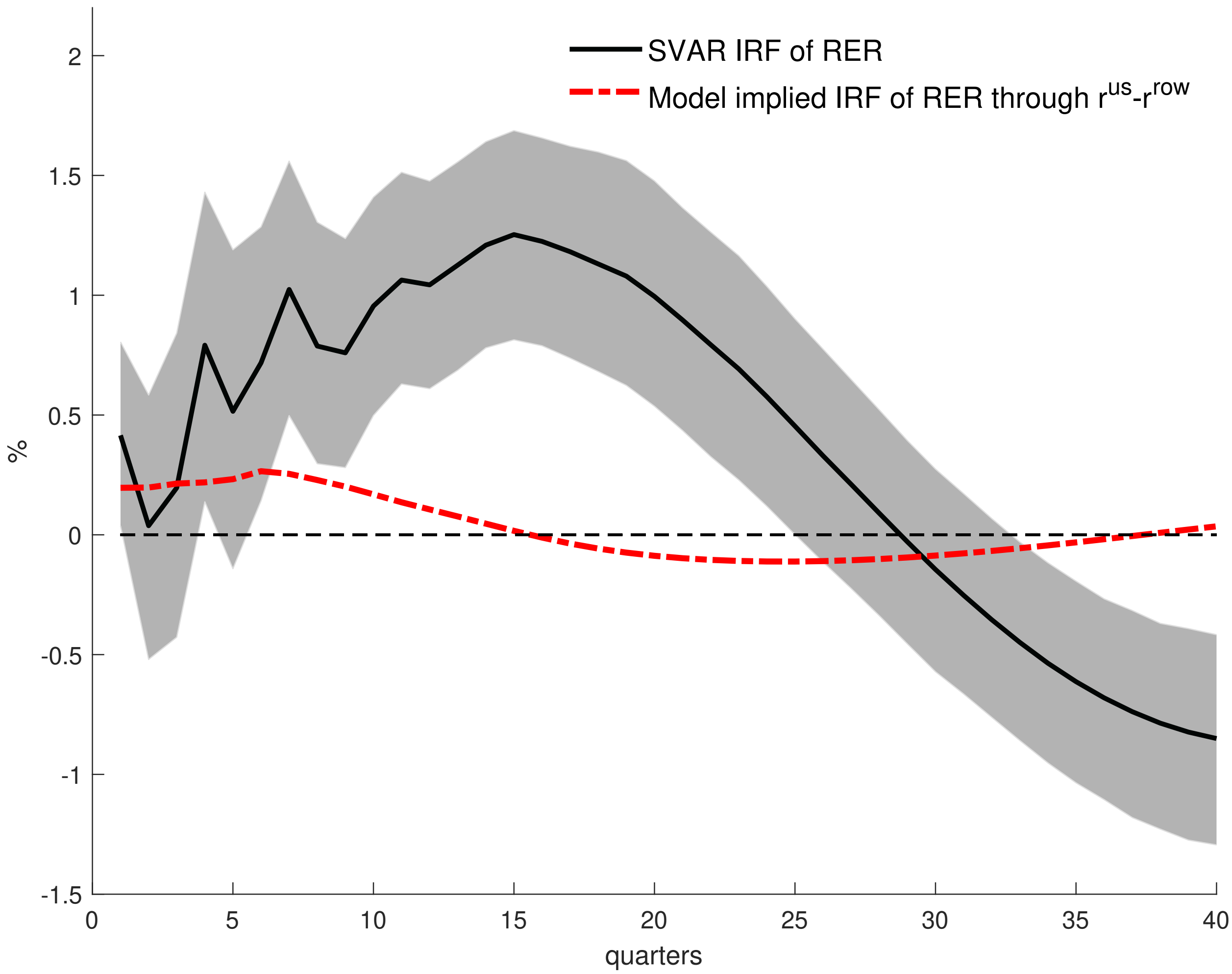


Figure E.2: Impulse Response Functions of the RER: estimated vs counterfactual through the interest rate differential

Notes: Standard error bands are 68% confidence intervals.

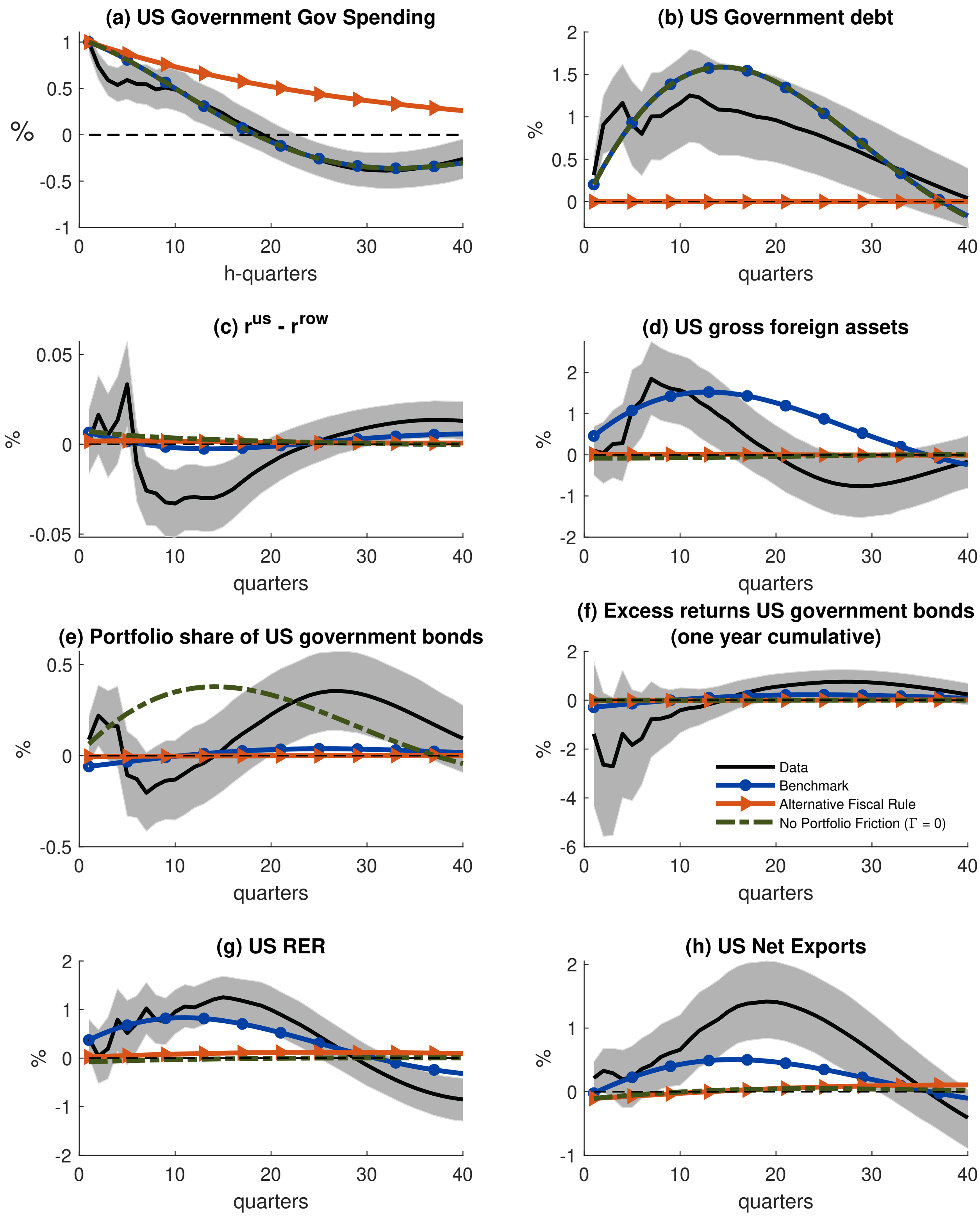


Figure E.3: Impulse Response Functions in Data and Models

Notes: Standard error bands are 68% confidence intervals.

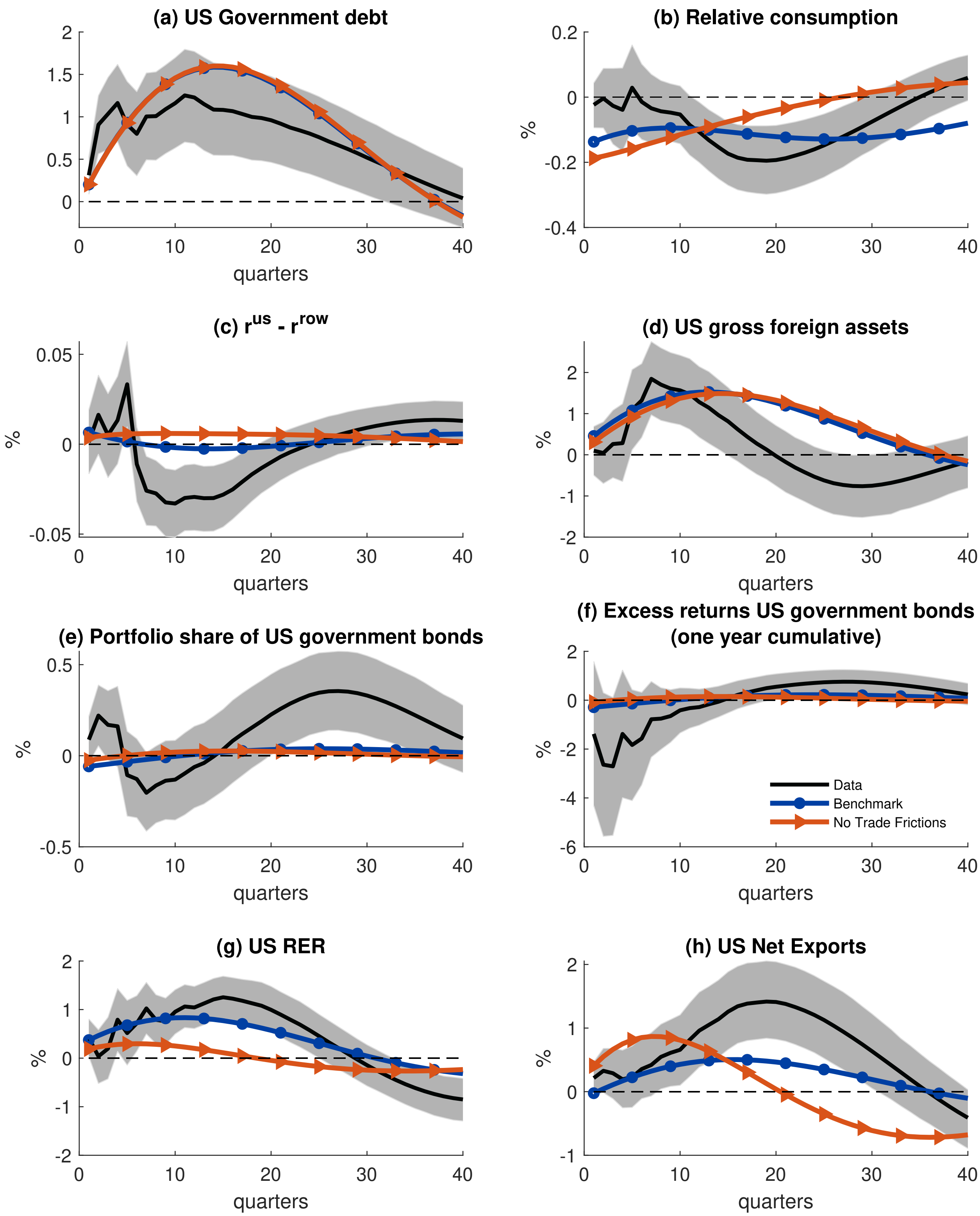


Figure E.4: Impulse Response Functions in Data and Models

Notes: Standard error bands are 68% confidence intervals.

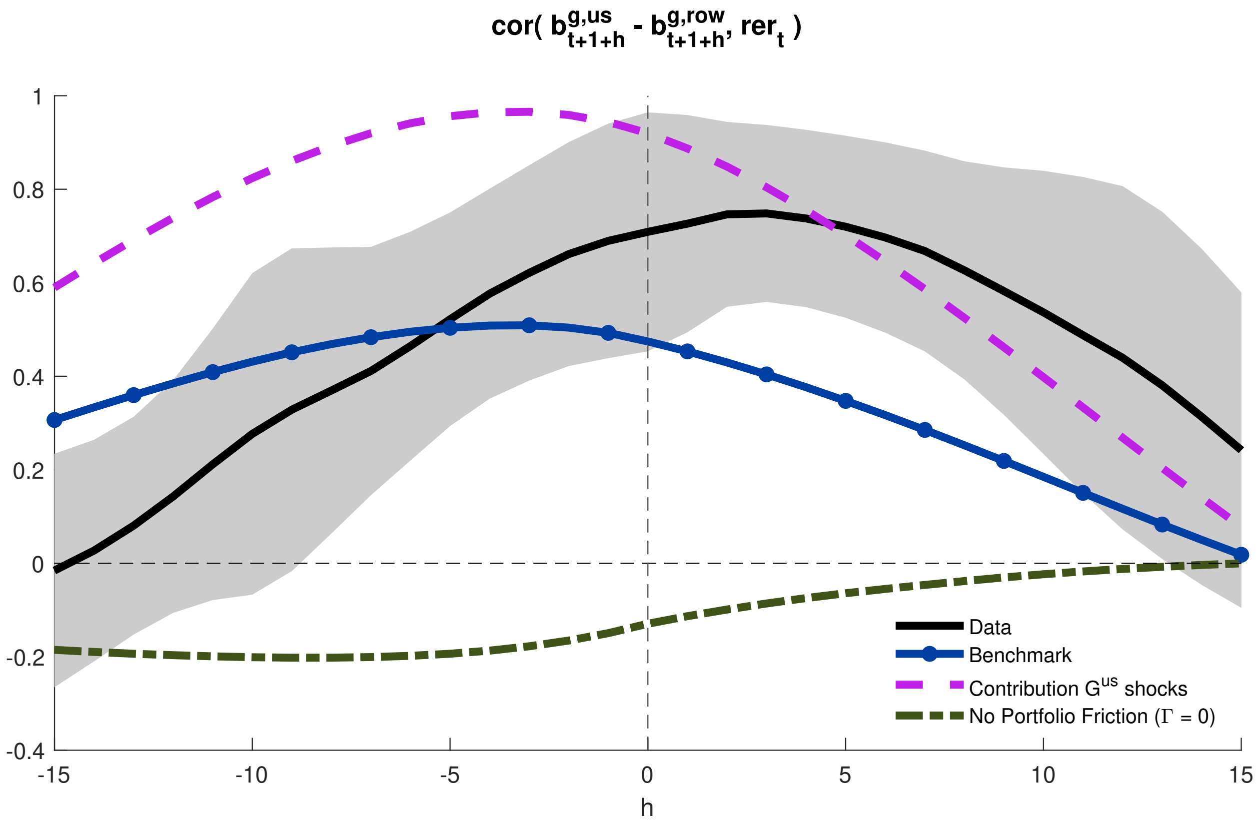


Figure E.5: Dynamic Correlation between Relative Government Debt and the RER

Notes: Standard error bands are 68% confidence intervals.

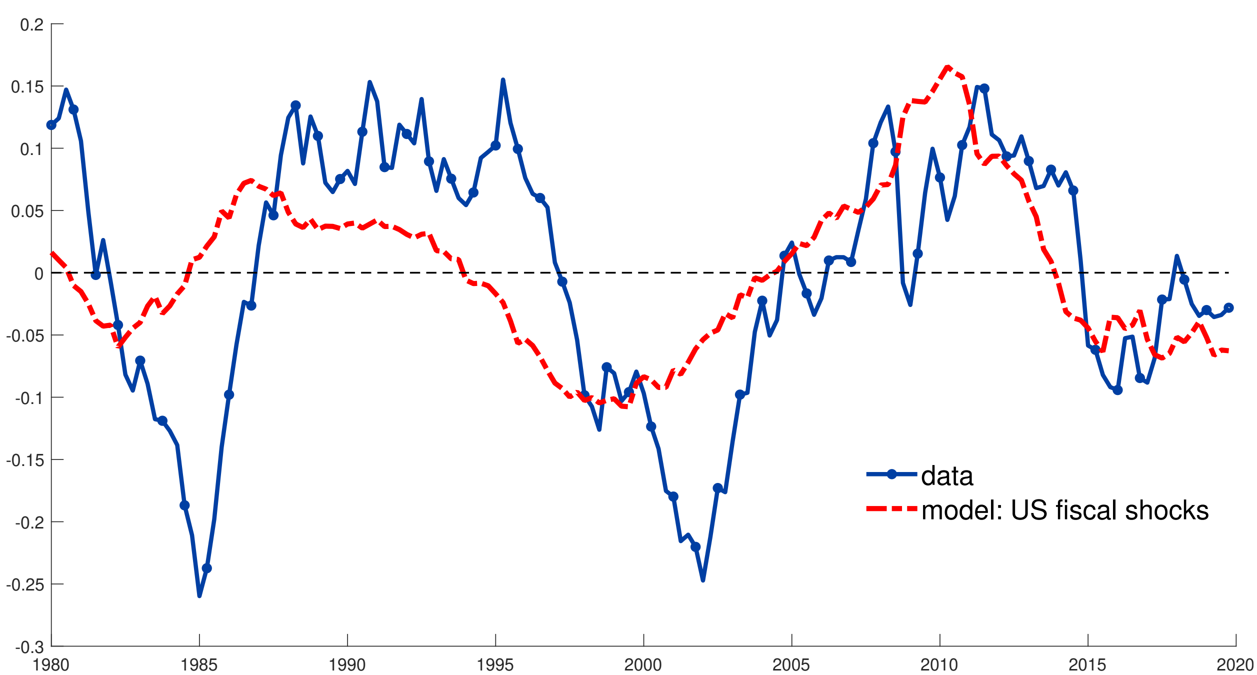


Figure E.6: RER in data vs model driven by US fiscal shocks

E.5 Variance Decomposition: Benchmark Model vs SVAR

	SVAR	Benchmark Model				
	Total US Gov	US Gov	Productivity	Trade	Differential Financial	Common Financial
US gov spending	24	97	3	0	0	0
US gov debt	19	97	3	0	0	0
Interest rate differential	9	4	59	17	19	0
US gross foreign assets	9	51	2	1	12	34
Portfolio share US gov bonds	6	2	0	1	24	72
Excess returns US gov bonds	6	14	2	10	73	0
RER	20	21	3	51	25	0
Net Exports	20	5	2	90	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	$\epsilon^d_{b^{row,us}} = 3$	US Gov AR(2)
1. Std common prod shock	σ^c_z	0.007 (0.0008)	$0^\dagger$	0.0095 (0.0037)	0.0061 (0.0008)	0.0067 (0.0008)	0.0148 (0.0037)
2. Pers common prod shock	ρ^c_z	0.895 (0.1750)	$0^\dagger$	0.896 (0.9520)	0.891 (0.2984)	0.895 (0.1789)	0.901 (0.3058)
3. Std differential prod shock	σ^d_z	0.005 (0.0004)	$0^\dagger$	0.0038 (0.0004)	0.0041 (0.0003)	0.0045 (0.0004)	0.0055 (0.0006)
4. Pers differential prod shock	ρ^d_z	0.900 (0.0297)	$0^\dagger$	0.924 (0.0474)	0.885 (0.0340)	0.894 (0.0316)	0.925 (0.0402)
5. Pers US gov shock	ρ^{us}_g	0.966 (0.0121)	0.959 (0.0175)	$0.99^\dagger$	0.963 (0.0121)	0.964 (0.0120)	1.342 (0.1160)
5a. AR(2) coeff pers US gov shock	$\rho^{us}_{g,2}$						-0.342 (0.1247)
6. Std ROW gov shock	σ^{row}_g	0.007 (0.0021)	$0^\dagger$	0.0095 (0.0028)	0.0065 (0.0018)	0.0069 (0.0021)	0.0150 (0.0039)
7. Pers ROW gov shock	ρ^{row}_g	0.862 (0.0363)	$0^\dagger$	0.863 (0.0417)	0.867 (0.0379)	0.862 (0.0361)	0.879 (0.0352)
8. Std differential trade shock	σ^d_ξ	0.013 (0.0018)	$0^\dagger$	0.0153 (0.0023)	0.0093 (0.0010)	0.0117 (0.0014)	0.0289 (0.0041)
9. Pers of differential trade shock	ρ^d_ξ	0.985 (0.0008)	$0^\dagger$	0.989 (0.0011)	0.988 (0.0011)	0.988 (0.0005)	0.985 (0.0011)
10. Std differential financial shock	σ^d_ψ	0.008 (0.0011)	$0^\dagger$	0.0114 (0.0032)	0.0232 (0.0026)	0.0353 (0.0050)	0.0164 (0.0073)
11. Pers differential financial shock	ρ^d_ψ	0.767 (0.0700)	$0^\dagger$	$0.500^\dagger$	0.619 (0.1507)	0.682 (0.1244)	$0.500^\dagger$ (0.7074)
12. Std common portfolio shock	σ^c_ψ	0.004 (0.0014)	$0^\dagger$	0.0113 (0.0032)	0.0107 (0.0017)	0.0056 (0.0014)	0.0180 (0.0050)
13. Pers common financial shock	ρ^c_ψ	0.984 (0.0533)	$0^\dagger$	0.933 (0.0153)	0.936 (0.0161)	0.965 (0.0358)	0.929 (0.0150)
14. Adj cost CES	ι	611.28 (216.22)	524.87 (423.36)	1003.21 (318.25)	561.55 (178.75)	821.08 (242.94)	850.00 (280.98)
15. Response gov spending to debt	$\varphi^{g,b}$	-0.032 (0.0038)	-0.032 (0.0041)	-0.033 (0.0167)	-0.035 (0.0038)	-0.032 (0.0037)	-0.019 (0.0031)
16. Response taxes to debt	$\varphi^{T,b}$	0.037 (0.0078)	0.033 (0.0135)	0.036 (0.0142)	0.036 (0.0089)	0.036 (0.0076)	0.049 (0.0100)
17. Response taxes to spending	$\varphi^{T,g}$	0.48 (0.0687)	0.487 (0.0997)	0.441 (0.8104)	0.337 (0.0850)	0.493 (0.0681)	0.408 (0.1031)

Notes: standard errors (se) are calculated using the asymptotic Delta function method as in Christiano et al. (2005). The subscript † indicates the parameter is either set externally or that it hit the lower or upper bound of the estimation.

Table F.1: SMM Estimated Parameters

Moment	Data	Benchmark	Only uncond moms targeting	Trade in US Gov Bonds	$\epsilon^{d}_{b^{row,us}} = 3$	US Gov AR(2)
$\sigma(gov^{us})/\sigma(gdp^{us})$	1.51	1.61	1.584	1.807	1.670	1.551
$\sigma(gov^{row})/\sigma(gdp^{row})$	0.59	0.64	0.636	0.687	0.648	0.655
$\rho(gov^{row})$	0.83	0.84	0.843	0.844	0.844	0.857
$\sigma(inv^{us})/\sigma(gdp^{us})$	3.42	2.93	2.978	2.980	2.888	3.036
$\rho(gdp^{us}, gdp^{row})$	0.86	0.76	0.810	0.751	0.773	0.832
BSK: $\rho(\Delta rer, \Delta(c^{us} - c^{row}))$	-0.15	-0.30	-0.205	-0.274	-0.249	-0.180
$\sigma(rer)/\sigma(gdp^{us})$	4.24	4.08	4.140	3.727	4.094	4.081
$\sigma(nt)/\sigma(rer)$	1.12	1.27	1.257	1.187	1.263	1.292
$\rho(rer)$	0.96	0.96	0.994	0.958	0.966	0.995
$\rho(B^{g,us}, gov^{us})$	0.33	0.29	0.286	0.269	0.273	0.437
SR trade elast.	0.15	0.04	0.101	0.045	0.043	0.146
LR trade elast.	1.11	1.10	1.104	1.105	1.102	1.101
$\sigma(gfa^{us})/\sigma(gdp^{us})$	4.35	4.93	4.968	4.637	4.879	5.029
$\sigma(B^{g,us}/gdp^{us})$	0.038	0.042	0.060	0.049	0.041	0.099
$\sigma(s^{g,us})/\sigma(gdp^{us})$	1.09	0.70	0.684	1.057	0.718	0.661
$\sigma(r^{us} - r^{row})/\sigma(gdp^{us})$	0.12	0.08	0.052	0.083	0.080	0.051
$\rho(r^{us} - r^{row})$	0.89	0.80	0.873	0.764	0.788	0.897
$\rho(s^{g,us})$	0.92	0.91	0.925	0.917	0.916	0.925
β_{Fama}	-1.49	-1.45	-1.471	-1.459	-1.463	-1.477
$\rho(B^{g,us} - B^{g,row}, rer)$	0.71	0.47	0.512	0.537	0.452	0.527

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	$\epsilon^d_{b^{row,us}} = 3$	US Gov AR(2)
R^2_{Fama}	0.03	0.01	0.027	0.013	0.012	0.036
$\rho(tot, rer)$	0.88	0.99	0.998	0.997	0.998	0.998
$\sigma(tot)/\sigma(rer)$	0.27	0.63	0.625	0.617	0.627	0.628
$\rho(r^{us} - r^{row}, rer)$	-0.59	-0.14	-0.510	-0.133	-0.182	-0.587
Low freq RER spectrum	0.64	0.68	0.755	0.676	0.707	0.756
BC freq RER spectrum	0.30	0.24	0.194	0.245	0.220	0.195
$\rho(inv^{us}, inv^{row})$	0.31	0.16	0.175	0.151	0.207	0.165
$\rho(xm^{us})$	0.98	0.99	0.999	0.998	0.998	0.999
$\rho(inv^{us} - inv^{row}, rer)$	-0.71	-0.83	-0.902	-0.847	-0.830	-0.922
$\rho(B^{g,us})$	0.97	0.99	0.996	0.965	0.996	0.996
$\rho(B^{g,us}, gfa^{us})$	0.19	0.78	0.801	0.589	0.769	0.820
$\rho(gfa^{us}, gfl^{us})$	0.83	0.72	0.723	0.579	0.712	0.724

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

Table F.3: Untargetted Unconditional Moments

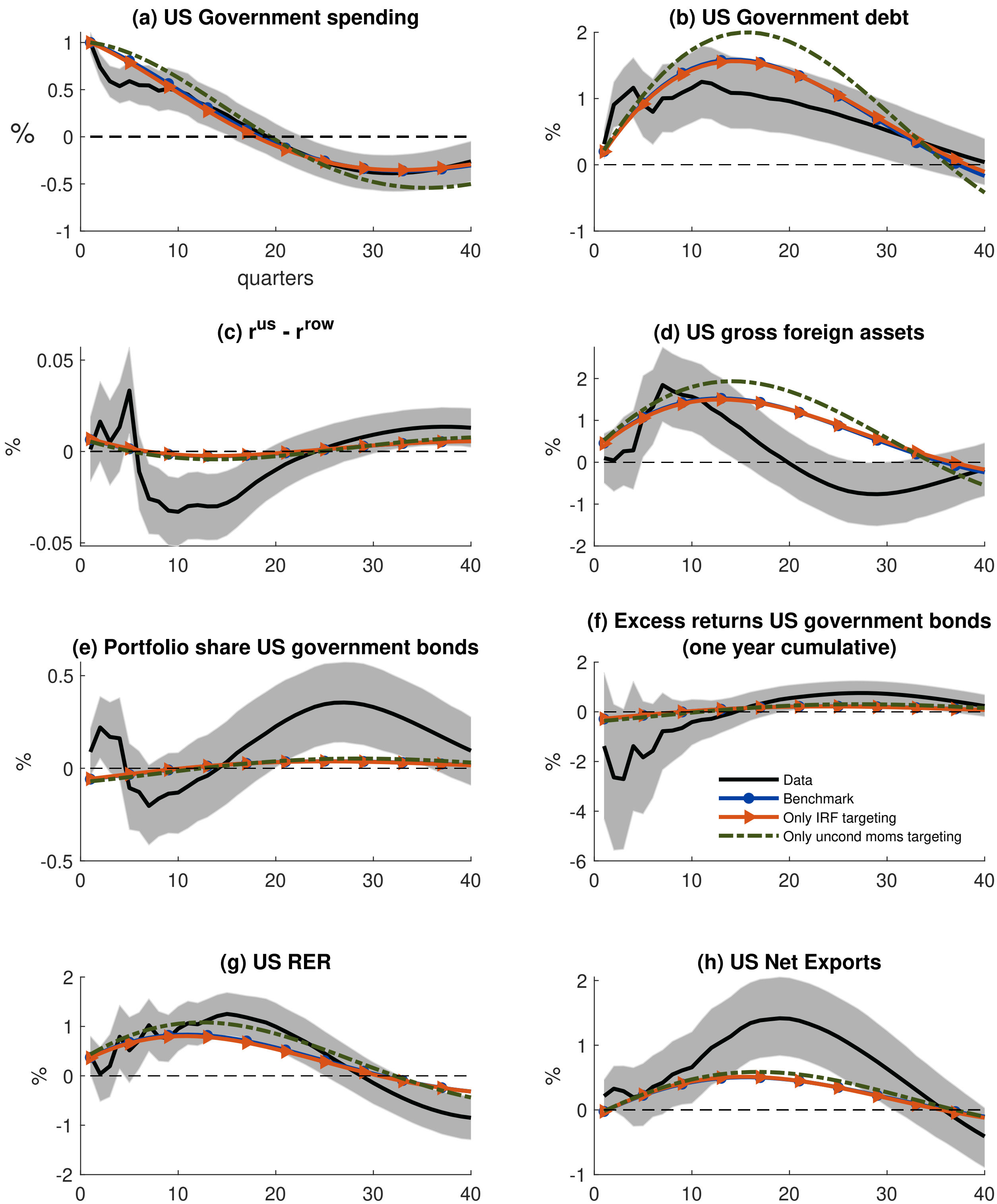


Figure F.1: Impulse Response Functions: SVAR and Models

Notes: Standard error bands are 68% confidence intervals.

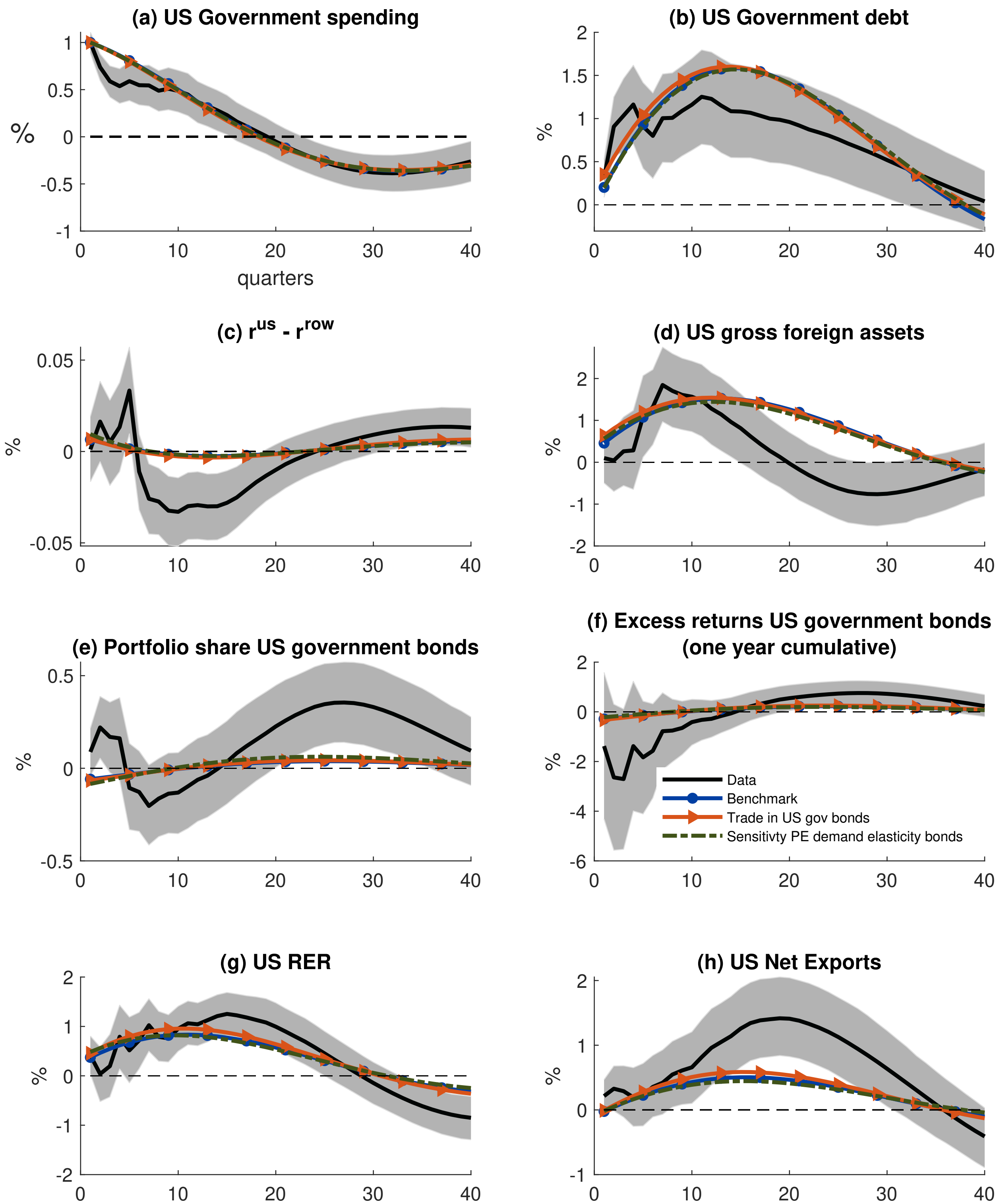


Figure F.2: Impulse Response Functions in Data and Models

Notes: Standard error bands are 68% confidence intervals.

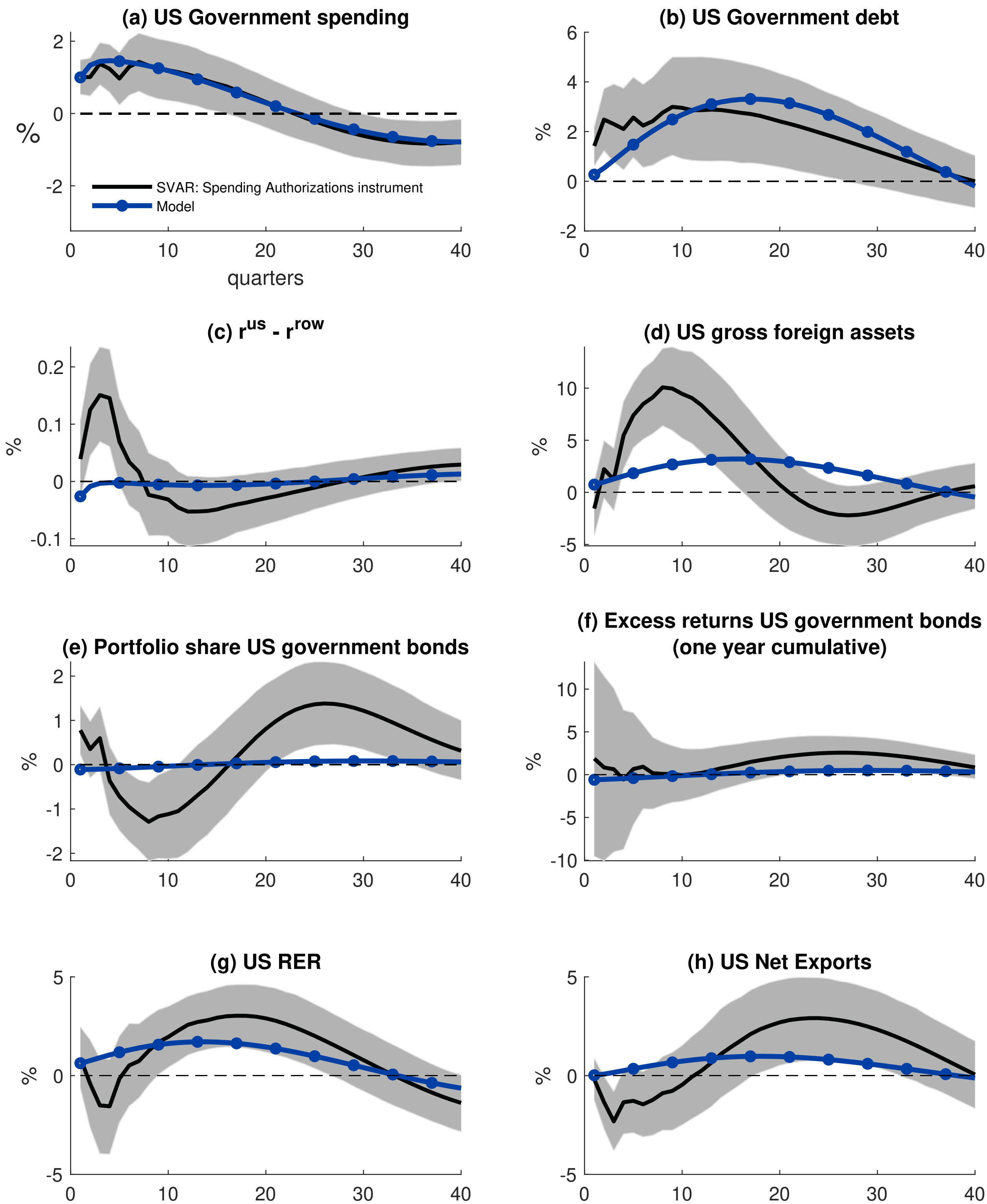


Figure F.3: Impulse Response Functions in Data and Model with AR(2) process for US Government Spending

Notes: Standard error bands are 68% confidence intervals.

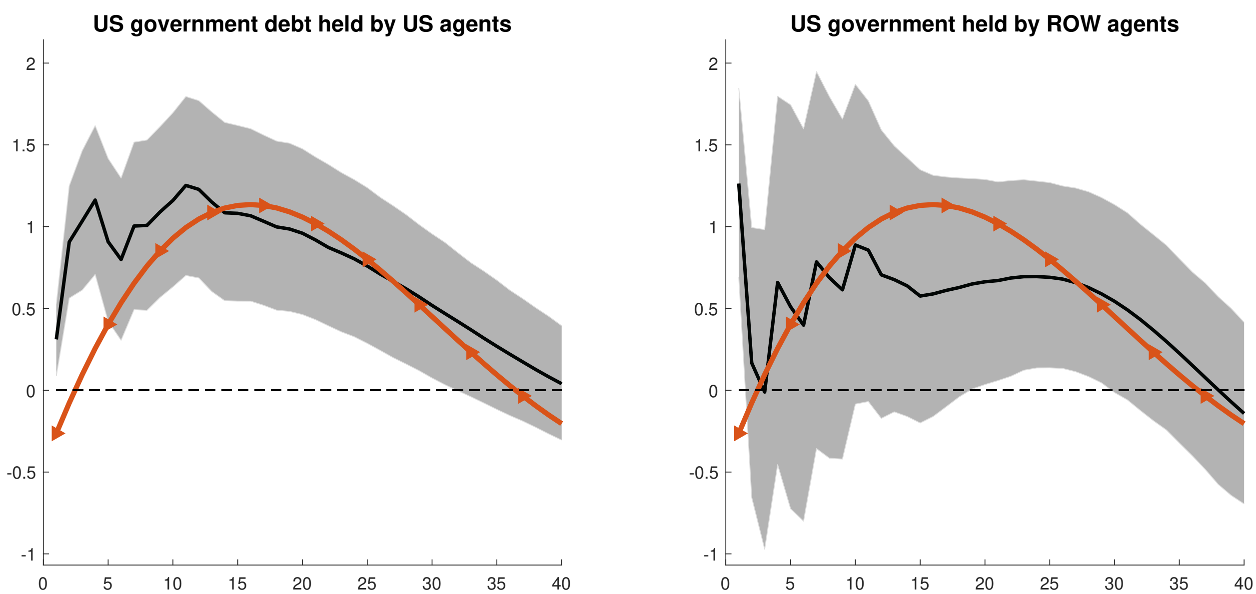


Figure F.4: Impulse Response Functions: SVAR and model where US government bonds are traded internationally

Notes: Standard error bands are 68% confidence intervals.

G Panel Data Analysis

G.1 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. 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 deprecations of the RER and improvements in net exports 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 exports between developed and emerging markets Miyamoto et al. (2019). The mechanism 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, between 1993 and 2013 at the annual frequency. 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 $y \in \{\text{debt}, \text{RER}, \text{CA}\}$ 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 (except for the current account in Advanced Economies which is not statistically different from zero). 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 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 a positive association of the use of government debt used to finance spending 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.

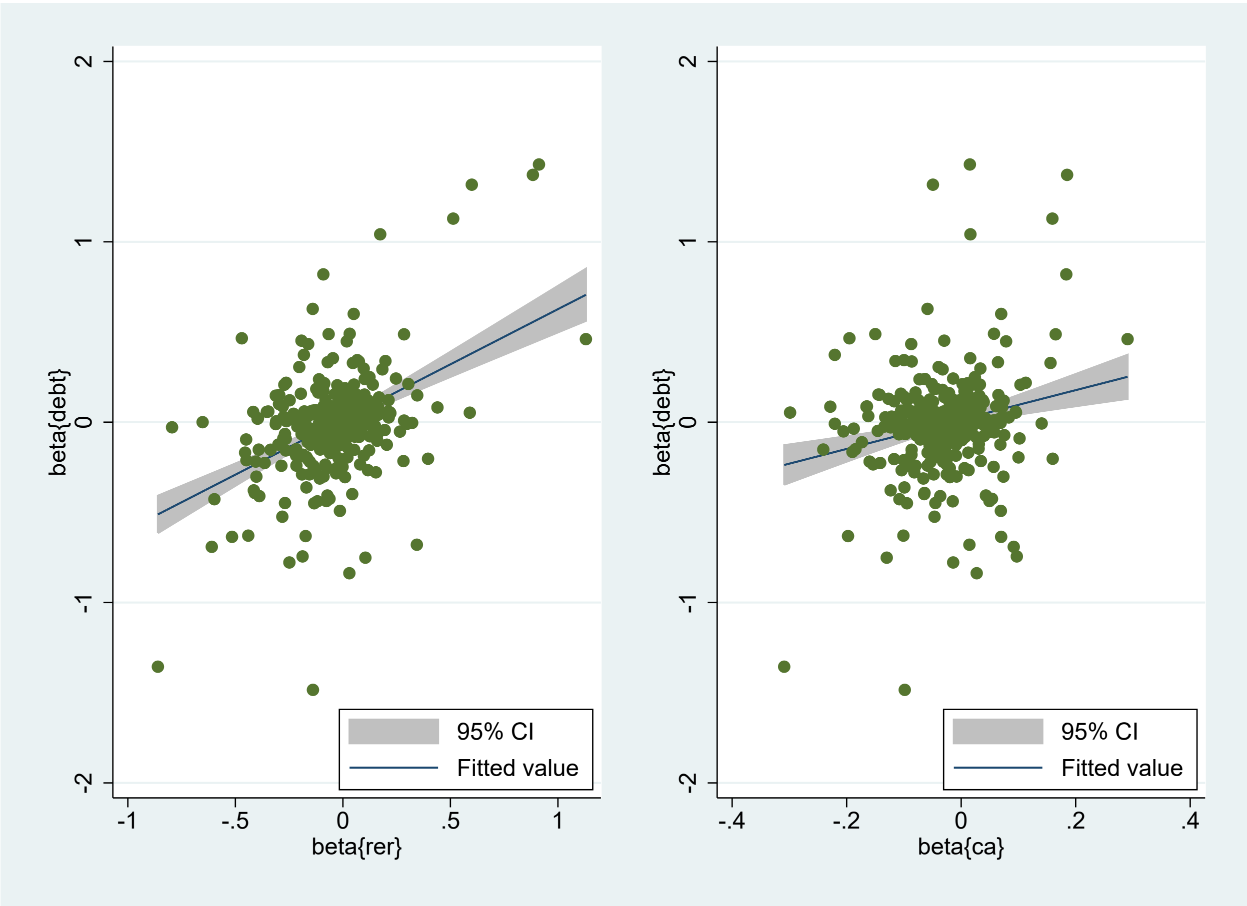


Figure G.1: Cross-country Responses of Government Debt, the RER and Current Account (all countries)

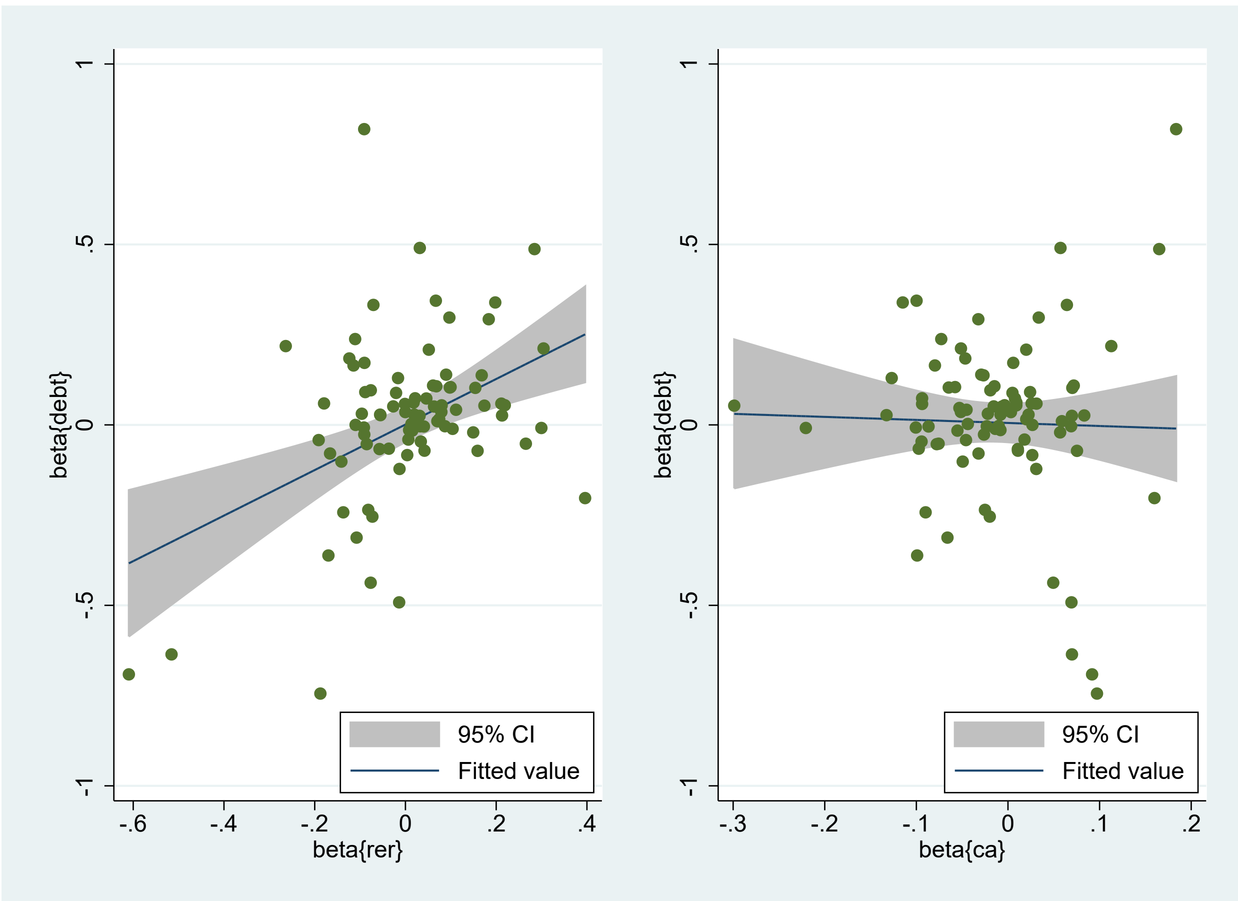


Figure G.2: Cross-country Responses of Government Debt, the RER and Current Account (advanced economies)

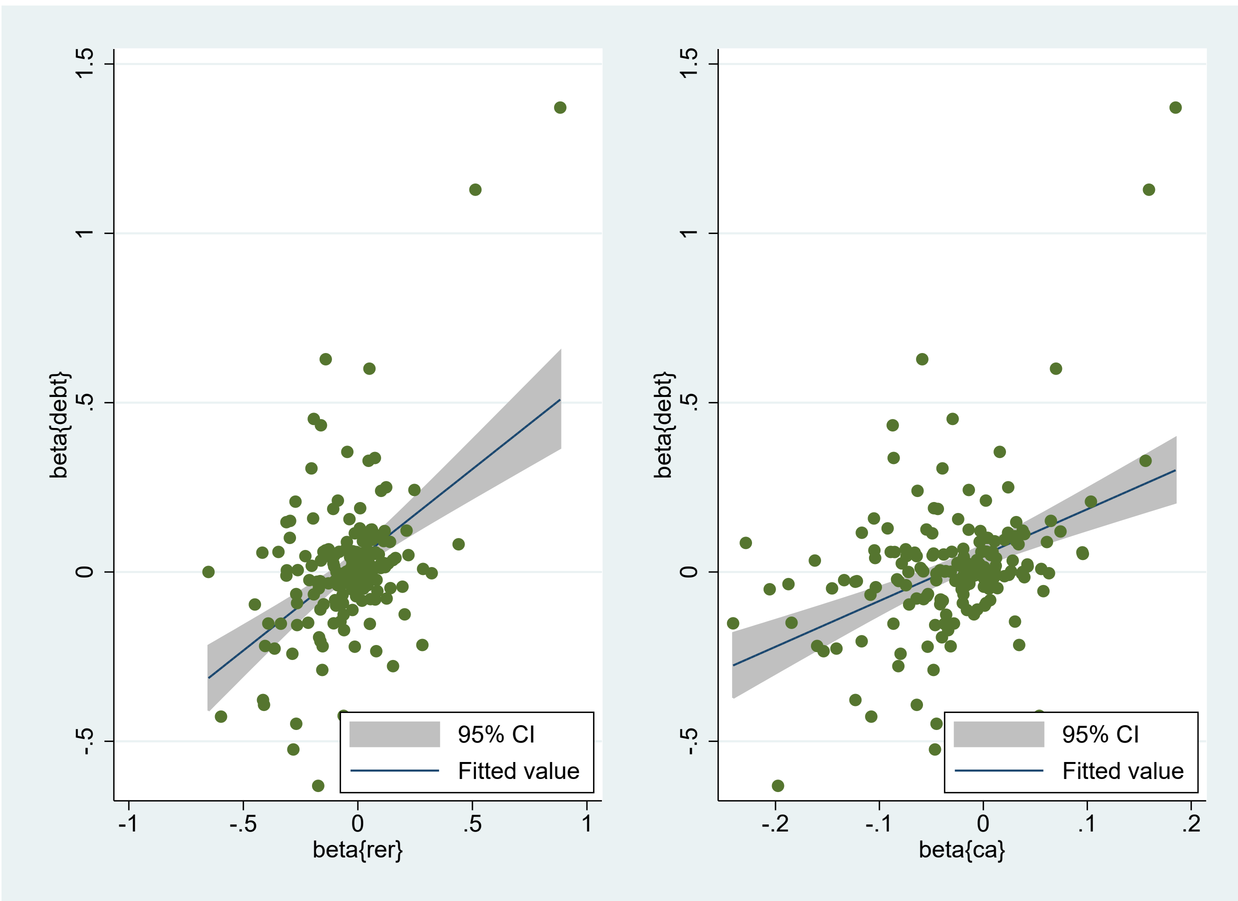


Figure G.3: Cross-country Responses of Government Debt, the RER and Current Account (developing economies)

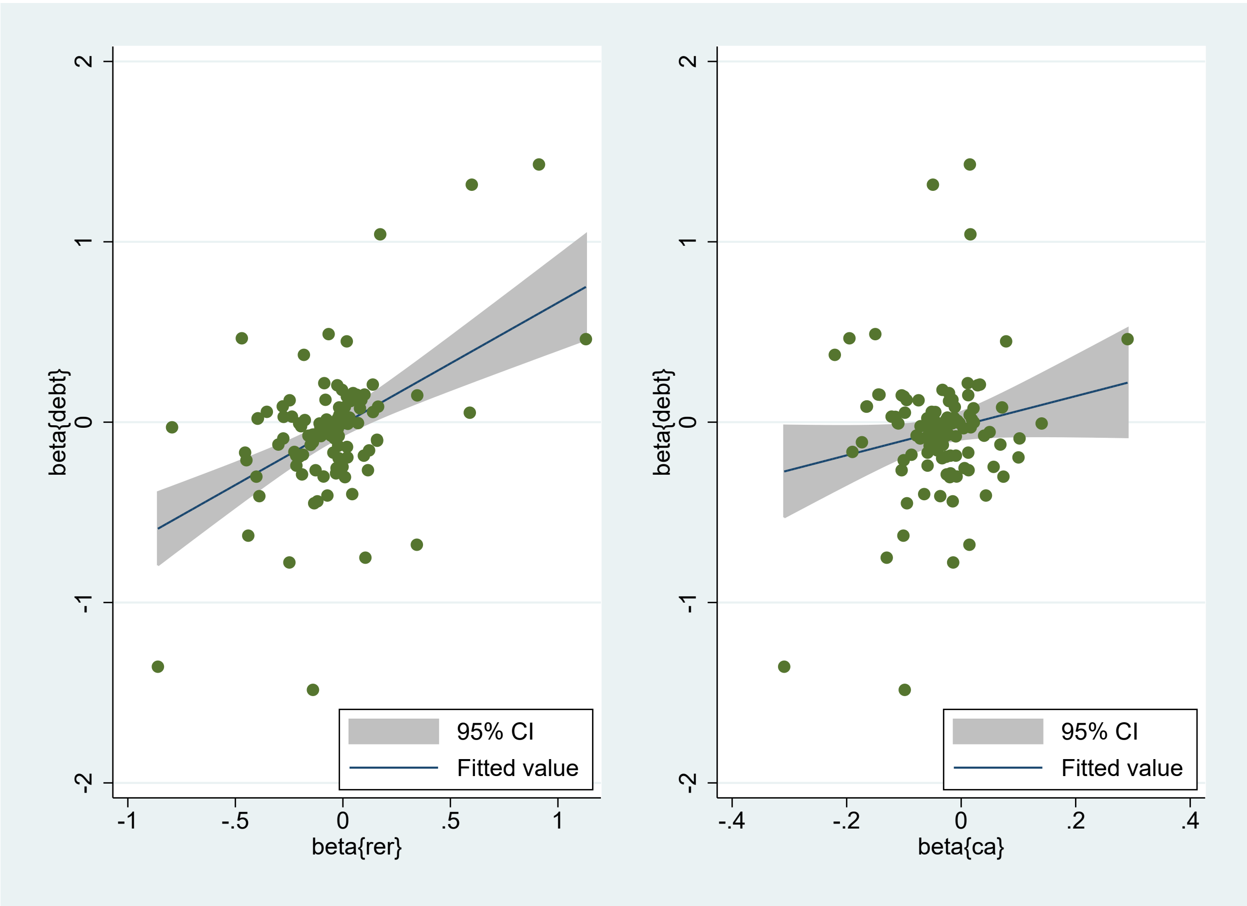


Figure G.4: Cross-country Responses of Government Debt, the RER and Current Account (poor economies)

H Additional Tables and Figures

Paper	RER	Net Exports or Current Account	Sample	Model (Mechanism)
Corsetti and Müller (2006)	–	< 0 or ≈ 0	US, Aus, Can, UK (1980 - 2006)	Yes (trade openness, but $XM < 0$)
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: $\lesseqgtr 0$	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)
Born et al. (2024)	< 0 short-run and > 0 medium-run	not reported	US (1983Q1- 2019Q4)	Yes (wage rigidity)
Evans et al. (2025)	> 0	< 0	Panel 41 countries (1990Q1- 2017Q4)	Yes (information of fiscal cyclicality)

Table H.1: Summary of Findings in the Literature

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