Credit Cycles, Fiscal Policy, and Global Imbalances*

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Abstract

We use a two-country model with financial frictions and fiscal policy to study the role that changes in credit and fiscal positions play in explaining current account fluctuations. We estimate the model using data for the U.S. and a "rest-of-the-world" aggregate. We find that about 32 percent of U.S. current account balance fluctuations are due to domestic credit shocks, while fiscal shocks explain about 21 percent. Simple macroprudential rules that react to domestic credit conditions and countercyclical fiscal policy can help reduce global imbalances, and lead to a smaller and less volatile U.S. current account deficit.

JEL Codes: C52, C54, F41

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1 Introduction

Global imbalances (i.e. the evolution of the world's current account surpluses and deficits) increased in the mid-nineties and accelerated in the run-up to the global financial crisis (Blanchard and Milesi-Ferretti, 2011). Given the link between large and sustained current account deficits and external crises, their evolution is monitored by the IMF and other policy institutions to understand risks to the global economy.[1] While the causes of the global financial crisis are numerous and complex, it is widely acknowledged that financial deregulation and increased leverage played an important role, which together with housing bubbles were a "critical codeterminant of global imbalances" (Obstfeld and Rogoff, 2009).[2] At the same time, changes in the U.S. fiscal position after 2000 coincided with a marked deterioration of the U.S. current account deficit (Obstfeld and Rogoff, 2007).

In this paper, we examine the role that changes in credit and fiscal positions play in explaining current account fluctuations using an estimated two-country macroeconomic model. The role of credit and fiscal positions have been emphasized in the vast empirical literature analyzing global imbalances, alongside other macroeconomic factors that may also affect the current account.[3] Our use of a structural model allows us to decompose the forces determining an economy's external balance, as well as the role of alternative policies in determining outcomes. For instance, a credit boom driven by a relaxation of lending standards will likely boost domestic consumption and investment, and lead to a current account deficit. But a credit increase driven by improved productivity may lead to a current account surplus if output expands by more than domestic demand. Similarly, the reaction of fiscal policy to other shocks in the economy, and whether it is procyclical or countercyclical, can affect the relationship between the fiscal balance and the current account. For instance, a fiscal expansion that is trying to offset a domestic demand shortfall does not have to increase the current account deficit. But, a fiscal expansion that is implemented when an economy is already experiencing robust private demand growth certainly will.

Over the last decade, a large literature has studied how boom-and-bust cycles in credit have important macroeconomic effects, see for instance Gourinchas et al. (2001), Mendoza

[1] On the link between current account deficits and worsening external debt indicators and external crises, see Catão and Milesi-Ferretti (2014) and Cubeddu et al. (2023) among others. The IMF's *External Sector Report* analyzes external developments and provides multilaterally consistent assessments of economies' external positions (see IMF, 2019, 2020).

[2] Gourinchas and Obstfeld (2012) study the critical role that private leverage play in determining the likelihood of financial crises and currency crises.

[3] These factors include demographics, differences in income per capita, institutional quality, provision of an adequate social safety net, and others; see for instance Cubeddu et al. (2019); Gruber and Kamin (2007); Chinn and Prasad (2003); Coutinho et al. (2018); Chinn et al. (2014) and Turrini and Zeugner (2019).

and Terrones (2012), and Dell'Ariccia et al. (2016).[4] These papers document the relationship between credit booms and busts and the current account, which is *negative*: countries experiencing a credit boom also witness a deterioration of their current account balances, while countries in a credit bust tend to have improving current accounts. These contributions study how credit comoves with several macroeconomic indicators and do not specifically focus on the drivers of the relationship between credit and the current account. A few other papers, such as Adam et al. (2011) and Ferrero (2015), provide a more structural explanation by emphasizing the role that housing booms have played in driving current account balances, through the relaxation of collateral constraints that may also trigger a credit boom. The relationship between fiscal policy and the current account has also been widely covered in the "twin deficits" literature (see the surveys by Cavallo, 2005 and Bartolini and Lahiri, 2006, and the references therein).

We first revisit the empirical relationship between credit, fiscal and the current account in a sample of 49 advanced and emerging economies that cover more than 90 percent of world GDP and trade. Regarding the relationship between credit and the current account, we confirm the results of the existing literature: when credit increases, the current account declines. We also confirm the results from the "twin deficits" literature: on average, the fiscal balance positively comoves with the current account. These results are obtained by estimating panel regressions under several specifications.

We next use this evidence to motivate the use of a two-country international real business cycle model (in the spirit of Heathcote and Perri, 2002) with financial frictions (as in Jones et al., 2022) to quantify the importance of credit shocks for driving domestic demand and hence, the current account.[5] The model also includes government spending, allowing us to study the role of fiscal policy in explaining current account fluctuations. The model is estimated using annual data for the U.S. and a "rest of the world" aggregate, using a Generalized Method of Moments approach (as in Andreasen et al., 2018). Importantly, we use this model because it gives rise to a flexible specification that allows for the strength of the credit channel to be determined in the estimation. Specifically, the model features households that face liquidity constraints; to alleviate these liquidity constraints, members of these households borrow up to their borrowing limit that is subject to exogenous shocks. Thus, how binding these liquidity constraints are determines the impact of changes in credit on consumption and activity. Our model, in contrast to other frameworks, does not impose ex ante an important role for credit, and we use the cross-country data to elicit the relationship between changes

[4]See also Mian and Sufi (2011, 2014); Mian et al. (2013); Jones et al. (2022).

[5]Cesa-Bianchi et al. (2018) use a two-country macroeconomic model with financial frictions to understand the transmission of international credit shocks. Giovannini et al. (2019) study the role that aggregate demand shocks – including those originating in emerging markets – play in driving global imbalances.

in credit and activity.

The estimated model is successful at matching the comovement between credit, fiscal policy and the current account. We show that this success relies importantly on the financial frictions that we embed into our otherwise standard framework. This is because the financial frictions that we introduce affect in an quantitatively relevant way the impact and propagation of the model's structural shocks. In particular, with weaker financial frictions, fluctuations in credit availability have little effect on aggregate variables and the model is unable to match the evidence on the comovement between credit and the current account. The effect of credit shocks in our model depends on the distribution of idiosyncratic preference shocks of the members of households–when that distribution is relatively dispersed, households cut consumption in response to a contraction in credit so as to maintain liquid asset balances for precautionary reasons and to smooth consumption across the members of its household. As a result, when financial frictions are present and important, following a contractionary shock to the availability of credit, the current account balance becomes more positive, generating the negative comovement between credit and the current account. Furthermore, we show that variants of the model which shut down financial frictions imply comovements between variables other than credit that are less aligned than with the data.

We use the estimated model to understand the drivers of the U.S. current account balance. We find that about 32 percent of the U.S. current account balance fluctuations are due to domestic credit shocks, and about 33 percent are explained by foreign credit shocks, while the importance of U.S. and foreign fiscal shocks is somewhat smaller, at about 21 and 6 percent, respectively.

In the final section of the paper, we evaluate a simple macroprudential policy rule in our estimated model and show that it could help to reduce global imbalances. This aspect of the paper is particularly novel.[6] We find that by taming the domestic financial cycle, a macroprudential rule that reacts to domestic credit conditions would have lead to a smaller and less volatile U.S. current account deficit. We also show that a countercyclical fiscal policy rule that aims to stabilize domestic consumption growth would also modestly reduce the level of the U.S. current account on average since 1991, although in some periods the deficit would have been larger. Moreover, the joint implementation of countercyclical macroprudential and fiscal rules would have further reduced the level and volatility of the U.S. current account deficit. Since the large U.S. current account deficit must be mirrored by cur-

[6]Several contributions in the literature have introduced macroprudential policies in macroeconomic models, with a focus on how: (i) macroprudential policies can help reduce banking sector vulnerabilities (see, for instance Rubio, 2020; Agenor et al., 2017; and Brzoza-Brzezina et al., 2015); or (ii) they can complement monetary policy in achieving price and financial stability (see, for instance Angelini et al., 2014 in a closed economy model and Quint and Rabanal, 2014 in a monetary union).

rent account surpluses elsewhere, we conclude that countercyclical credit and fiscal policies in the U.S. would have helped in reducing global imbalances over the last three decades.[7] We emphasize that these policy rules target domestic indicators and not the current account per se, and are calibrated to maximize domestic welfare. Nonetheless, we find these policies have implications for the level and volatility of the current account and for global imbalances.

The paper is organized as follows. Section 2 presents the empirical evidence and discusses the comovement between credit, the fiscal balance, and the current account. Section 3 presents the two-country model with financial frictions and fiscal policy. Section 4 details the estimation procedure and shows key implications of the estimated model. Section 5 presents counterfactual exercises and the effects of macroprudential and fiscal policy rules. Section 6 concludes.

2 Empirical Evidence

This section provides updated evidence on the negative relationship between credit and the current account for a group of advanced and emerging market economies. Credit expansions (contractions) are typically associated with increasing (decreasing) current account deficits, for a panel of 49 advanced and emerging economies, as well as for the United States. This relationship is robust to alternatives ways of specifying the relationship in a panel data setup. This section also presents updated evidence on the positive relationship between fiscal and current account balances, a relationship that has been studied previously and labelled as "twin deficits" in the literature (see Cavallo, 2005, Bartolini and Lahiri, 2006, and the references therein).

In Section A of the Online Appendix, we present additional empirical evidence on these relationships at the country-level and for different country groups.

2.1 Panel Regressions

To study the cross-country relationship between the current account, credit and fiscal policy, we estimate the following panel regression:

$$CA_{it} = \alpha_i + \beta X_{it} + \varepsilon_{it} \tag{1}$$

[7] This result would also hold if other economies also conducted countercyclical macruprudential and fiscal policies. However, we emphasize U.S. policies because the U.S. has a large impact in the global economy given its size.

Table 1: Relationship between Current Account, Credit, and Fiscal Policy

	(1)	(2)	(3)	(4)
Credit/GDP	-0.14**	-0.15*	-0.08**	-0.09**
Fiscal Balance/GDP	0.21**	0.21**	0.16**	0.17**
GDP Growth	-0.15**	-0.09	-0.22**	-0.15**
Relative	NO	YES	NO	YES
Transformation	FD	FD	GAP	GAP

Note: * denotes significance at the 10 percent level, ** denotes significance at the 5 percent level. T-statistics are based on robust standard errors. "Relative" denotes that we specify variables in terms of their differences from the world average.

where α_i is a country fixed effect, and X_{it} includes the credit-to-GDP ratio, the fiscal balance-to-GDP ratio, and also output. The relationship is estimated for 49 countries, using an unbalanced panel from 1980-2021. We include the credit-to-GDP ratio and real GDP in changes as well as in gaps, to study the role that alternative filtering techniques may play.[8]

Table 1 presents the estimates, under different specifications. In the baseline specification, in column 1, all the explanatory variables are country-specific, there are country fixed effects and both the credit-to-GDP ratio and (the log of) real GDP enter in first differences. Under this specification, an increase in the change in the credit-to-GDP ratio by 1 percentage point is associated with a current account-to-GDP ratio that is 0.14 percentage point lower. An increase in the fiscal balance-to-GDP ratio of 1 percentage point is associated with a current account-to-GDP ratio that is higher by 0.21, while an increase of real GDP growth of 1 percent of GDP is associated with a 0.15 percent lower current account-to-GDP ratio. All these results are significant at the 5 percent level. These results are consistent with the notion that a credit boom lowers the current account, that the "twin deficits" hypothesis holds, and that growth increases deteriorate the current account due to demand effects.

These quantitative and qualitative results hold under a battery of robustness checks. In the second column of Table 1, we include the three variables not as country-specific, but rather in differences from their world average. The idea, following the literature on current account regressions, is that macroeconomic variables such as the fiscal balance affect

[8]The country sample is the same as the IMF's External Balance Assessment model (see Cubeddu et al. (2019) for details). The 49 countries that are included in the IMF's External Balance Assessment model are: Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, China, Colombia, Costa Rica, Czech Republic, Denmark, Egypt, Finland, France, Germany, Greece, Guatemala, Hungary, India, Indonesia, Ireland, Israel, Italy, Japan, Korea, Malaysia, Mexico, Morocco, Netherlands, New Zealand, Norway, Pakistan, Peru, Philippines, Poland, Portugal, Russia, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Thailand, Tunisia, Turkey, United Kingdom, United States, and Uruguay. For private credit, we use data from the Bank of International Settlements (BIS) and is measured as total credit (bank and nonbank) provided to the non-financial private sector, excluding non-bank cross-border flows.

a country's current account to the extent that they are different than the trading partners (or the world's) average.[9] Interestingly, results are not affected when including variables as differences with respect to world averages, except for output growth which becomes non-significant.

In the first two columns of Table 1, credit-to-GDP is included in annual differences, and real GDP is included in growth rates (i.e. log-first differences). A natural question then becomes what would the implications of alternative filtering techniques. Columns (3)-(4) repeat the same exercise by estimating credit and output gaps as follows. Credit gaps are estimated using the Bank for International Settlements one-sided Hodrick-Prescott filter on the credit-to-GDP ratio (see Drehmann et al. (2011) for details). Output gaps are estimated using a standard two-sided Hodrick-Prescott filter, where the sample is extended using World Economic Outlook forecasts to avoid endpoint filtering issues. When using a gap methodology, the coefficient on credit gaps is somewhat lower (a one percent increase in the credit gap is associated with a current account-to-GDP ratio by 0.08-0.09 percentage points) but is always significant. Conversely, the coefficient on the output gap increases (in absolute value) to about -0.2. The coefficient on the fiscal balance declines below 0.2, but remains significant in all specifications. The results in this subsection are generally consistent with cross-country panel regressions that include more macroeconomic variables, including the IMF's External Balance Assessment model and other contributions, such as Cubeddu et al. (2019); Gruber and Kamin (2007); Chinn and Prasad (2003); Coutinho et al. (2018); Chinn et al. (2014) and Turrini and Zeugner (2019).

3 Model

The empirical analysis in the previous section and in the Online Appendix provides suggestive evidence using estimated coefficients from panel regressions. To understand which factors are at play for the dynamics of the current account, we use an open economy DSGE model. Given the significant and important comovement of credit, the fiscal balance and the current account, our model incorporates credit explicitly through financial frictions and fiscal policy to study the relationship between these two variables and the current account. The model also allows us to understand the main sources of fluctuations, since different shocks help explain different patterns of comovement between the key variables of interest in the data.

We use an international real business cycle model with trade in intermediate goods and

[9] The world averages for each of the three variables are computed as GDP-weighted averages, and take into account missing data for countries whose macroeconomic time series are available after 1980. For instance, for China data are only available after 1997. This means that China gets a zero weight when estimating world averages before 1997, and a weight consistent with is GDP every year after 1997.

credit frictions. There are two countries in our model, labeled Home and Foreign. The trade and production structure is standard, as in Heathcote and Perri (2002). The final good produced in each country is used for consumption and investment in country-specific capital. Firms in each country produce intermediate goods using capital and labor, and sell those intermediate goods to final goods producers in both countries who combine their domestically-produced goods and imports into the final good. Households derive utility from consumption of the final good, from housing, and from leisure. The model is annual, and thus we abstract from nominal frictions and monetary policy that are not central to our analysis.

Credit frictions in our model are introduced in the following way, as in Jones et al. (2022). The representative household in our economy is comprised of a continuum of members whose consumption is subject to individual-specific preference shocks. We explicitly distinguish between liquid and illiquid assets on households' balance sheets and assume that households allocate their wealth between these two assets prior to the realization of the individual-specific preference shocks. The consumption of each individual member of a household is limited by a liquidity constraint. Households also face a borrowing constraint tied to the value of housing that limits how much they can tap the equity in their homes. We introduce shocks to this borrowing constraint that loosens or tightens it. We call these shocks *credit shocks*.[10]

In equilibrium, households will borrow up to the borrowing limit to alleviate the liquidity constraints. The extent to which the liquidity constraints are binding on the members of the household depends on the volatility of the idiosyncratic preference shocks. If the distribution of those shocks is large, liquidity is valuable and households find it optimal to cut consumption in response to a tightening of credit rather than dip into their liquid assets. In contrast, if the distribution of these shocks is small, liquidity is less valued and households find it optimal to use their savings to smooth consumption intertemporally following a shock. We will use the cross-country comovement in private credit and consumption to pin down the extent to which these liquidity constraints bind and thus govern the importance of credit shocks.

We use this framework instead of a more familiar borrower-saver model as, for example, Iacoviello (2005) and Ferrero (2015). In a standard open-economy borrower-saver model, a

[10]As discussed in Jones et al. (2022) the form that these credit shocks take is not critical. They are introduced here as shocks to the demand for borrowing tied to the value of housing. An alternative approach would be to model credit intermediaries and allow for credit shocks to impact the cost at which intermediaries supply credit. The expansion and contraction of credit in the economy would then reflect changes in the supply of credit. We provide more discussion in the Appendix about how credit shocks in the form of exogenous changes in borrowing constraints can map to shocks that operate through changes in credit supply.

dollar change in credit can lead one-for-one to a dollar change in consumption, which can give rise to a tight connection between changes in credit and real variables. We do not want to impose ex-ante an important role for credit and our approach will allow us to elicit from the cross-country data the relationship between changes in credit and real variables. The model we use also ensures that households in a country are neither borrowers or savers ex-ante and allows us to consider a symmetric equilibrium with a potentially important role for credit constraints in a first-order perturbation of the model. Section 4.4 provides additional motivation for our modeling and use of financial frictions in the context of the estimated model.

We will next detail the key equations of the model and leave the full exposition of the model to the Appendix. We will describe the equations as they apply to the Home country. The Foreign country's equations mirror those of the Home country. The variables and parameters of the Foreign country are denoted with asterixes.

3.1 Production

We start by describing first the production side of the economy. We will then describe the problem of the households and fiscal policy. Competitive intermediate goods-producing firms in the Home country produce output $\tilde{y}_t$ with labor n_t and capital k_{t-1}:

$$\tilde{y}_t = \xi_{z,t} k_{t-1}^{\omega} n_t^{1-\omega}, \tag{2}$$

where ω is the Cobb-Douglas weight and $\xi_{z,t}$ is an autoregressive productivity process:

$$\log \xi_{z,t} = \rho_z \log \xi_{z,t-1} + \sigma_z \varepsilon_{z,t}, \tag{3}$$

where ρ_z governs the persistence of the productivity process, $\varepsilon_{z,t}$ is the home-specific productivity innovation scaled by σ_z. Firms in the Home country produce and sell their output for price P_t^H to final goods producers who construct the composite final good which sells at price P_t. The rental rate on capital in the Home country is, in terms of final goods:

$$r_t = \xi_{z,t} \frac{P_t^H}{P_t} \omega \left(\frac{n_t}{k_{t-1}} \right)^{1-\omega}, \tag{4}$$

while wages equal the marginal product of labor:

$$w_t = \xi_{z,t} \frac{P_t^H}{P_t} (1-\omega) \left(\frac{k_{t-1}}{n_t} \right)^{\omega}. \tag{5}$$

Define the composite final good produced in the Home country as:

$$y_t = \left[\kappa^{\frac{1}{\sigma}} \left(y_t^H\right)^{\frac{\sigma-1}{\sigma}} + (1-\kappa)^{\frac{1}{\sigma}} \left(y_t^F\right)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}, \tag{6}$$

where y_t is the final good, y_t^H is the inputs of intermediate goods produced at Home, y_t^F is the intermediate imports of the Foreign good by the Home country, κ governs the share of domestic inputs in the final good output, and σ is the elasticity of substitution between Home and Foreign inputs. Under this production structure, the price of the final good is:

$$P_t = \left[\kappa \left(P_t^H\right)^{1-\sigma} + (1-\kappa) \left(P_t^F\right)^{1-\sigma}\right]^{\frac{1}{1-\sigma}}. \tag{7}$$

The resource constraint for the final good in the Home country is

$$y_t = c_t + k_t - (1-\delta)k_{t-1} + \frac{\phi_k}{2} k_{t-1} \left(\frac{k_t}{k_{t-1}} - 1\right)^2 + g_t, \tag{8}$$

where c_t is household consumption, δ is the depreciation rate of capital, ϕ_k governs the degree of capital adjustment costs, and g_t denotes government spending, described in more detail below. The resource constraint for the intermediate good at Home is the sum of Home inputs into final goods production at Home, and the exports of Home goods to the Foreign intermediate producers:

$$\tilde{y}_t = y_t^H + y_t^{H*}. \tag{9}$$

3.2 Households

Households are comprised of a continuum of members, indexed by i. The problem of the Home consumer is to:

$$\max \sum_{t=0}^{\infty} \beta^t \left(\int v_{it} \log c_{it} \, \mathrm{d}i + \eta^h \log h_t - \frac{1}{1+\nu} n_t^{1+\nu} \right), \tag{10}$$

where c_{it} is the consumption of an individual member i of the household with $\int c_{it} \, \mathrm{d}i \equiv c_t$, h_t is housing, β is the discount factor, η^h is a preference parameter for housing, and ν is the Frisch elasticity of substitution. The term $v_{it} > 1$ is the idiosyncratic taste shock specific to individual i and which is drawn from a Pareto distribution

$$\Pr\left(v_{it} \leq v\right) = 1 - v^{-\alpha}. \tag{11}$$

The lower is α, the more dispersion there is in the idiosyncratic taste shocks, and thus the more uncertainty there is about consumption across members of a household. The parameter α is key for determining the strength of fluctuations in credit and how they relate to real variables like consumption and investment, as we discuss below in Section 3.4.

The budget constraint of the Home country household is:

$$P_t x_t + e_t\left(h_{t+1} - h_t\right) + P_t i_t = w_t n_t + r_t k_{t-1} + q_t b_{t+1} - b_t + a_t - P_t \text{tax}_t + b_t^g - \frac{1}{R_t} b_{t+1}^g, \quad (12)$$

where x_t is the amount of funds that the household transfers to each of its members for consumption prior to the realization of the idiosyncratic preference shocks, e_t is the price of housing, q_t is the price of new borrowing b_{t+1}, a_t is the amount that is saved, tax_t is lump-sum taxes levied by the home government, b_t^g is domestic government debt, R_t is the gross interest rate on government debt, and i_t is investment given by:

$$i_t = k_t - (1-\delta)k_{t-1} + \frac{\phi_k}{2} k_{t-1}\left(\frac{k_t}{k_{t-1}} - 1\right)^2. \quad (13)$$

Households at home can borrow domestically or from abroad, and q_t is the price of the bond in terms of domestic consumption goods. The household chooses this amount prior to the realization of the preference shocks v_{it}. The quantity of savings is the amount of unused funds in the goods market:

$$q_t a_{t+1} = P_t\left(x_t - \int c_{it}\, \mathrm{d}i\right). \quad (14)$$

The Home consumer faces the liquidity constraint on purchases of consumption:

$$P_t x_t \geq P_t c_{it}. \quad (15)$$

Consumers also face a borrowing constraint restricting the value of new borrowing to be below the value of housing

$$q_t b_{t+1} \leq m_t e_t h_{t+1}, \quad (16)$$

where m_t is an autoregressive process subject to i.i.d. shocks which move the amount that households can borrow against the value of their housing:

$$\log m_t = (1-\rho_m)\log \bar{m} + \rho_m \log m_{t-1} + \sigma_m \varepsilon_{m,t}, \quad (17)$$

where ρ_m governs the persistence of $\log m_t$, $\bar{m}$ is the steady-state loan to value ratio in the economy, and $\varepsilon_{m,t}$ are i.i.d. shocks scaled by σ_m. We refer to shocks to m_t as *credit shocks.*

Asset markets clear internationally, so that

$$a_t + a_t^* = b_t + b_t^*. \tag{18}$$

Finally, the current account balance includes the trade balance (net exports) and the net income balance (which is the implied net interest rate times the net foreign asset position):

$$\text{Current Account}_t = \left(P_t^H y_t^{H*} - P_t^F y_t^F\right) + \left(\frac{1}{q_{t-1}} - 1\right)(a_{t-1} - b_{t-1}). \tag{19}$$

3.3 Fiscal Policy

Next, we implement a simple fiscal policy regime to both countries. In terms of the home country's variables, we add exogenous government spending g_t, financed by a lump sum tax tax_t and government debt b_t^g that is purchased at price $1/R_t$. We assume that lump-sum taxes are determined by a debt-stabilizing rule:

$$\frac{\text{tax}_t}{y_t} = \frac{\text{tax}}{y} + \phi_b \left(\frac{b_{t+1}^g}{P_t y_t} - \frac{b^g}{Py}\right), \tag{20}$$

and that the government spending rule is:

$$g_t = \frac{g}{y} y_t + \xi_{g,t}, \tag{21}$$

where $\xi_{g,t}$ is an autoregressive process subject to i.i.d. shocks:

$$\log \xi_{g,t} = \rho_g \log \xi_{g,t-1} + \sigma_g \varepsilon_{g,t}, \tag{22}$$

where ρ_g governs the persistence of $\log \xi_{g,t}$, and $\varepsilon_{g,t}$ are i.i.d. shocks scaled by σ_g. The government budget constraint is therefore

$$\frac{1}{R_t} b_{t+1}^g - b_t^g = P_t g_t - P_t \text{tax}_t. \tag{23}$$

By assumption, we impose that governments can only borrow domestically.

3.4 Decision Rules

Each period, the consumers in the Home country choose a consumption profile that is a function of the idiosyncratic preference shock $c_t(v)$, how much funds to allocate to the goods market x_t, housing services h_{t+1}, private debt b_{t+1}, and government debt b_{t+1}^g. Consumers in the Foreign country make similar choices. As in the exposition of the model, we describe the decision rules of consumers in the Home country for brevity and leave the equations governing those of the Foreign country to the Appendix.

The first order condition of the choice of funds to allocate to the goods market x_t is

$$P_t\mu_t = \frac{\beta}{q_t} P_t \mathbb{E}_t \mu_{t+1} + P_t \int_0^1 \xi_t(v)\, \mathrm{d}F(v), \tag{24}$$

where μ_t is the shadow value of wealth, or the multiplier on the budget constraint, and $\xi_t(v)$ is the Lagrange multiplier on the liquidity constraint with a realized idiosyncratic preference shock of v. The expression says that a transfer x_t is valued at $P_t\mu_t$ today and any unused amount is valued at $\frac{\beta}{q_t} P_t \mathbb{E}_t \mu_{t+1}$ tomorrow. The transfer x_t also provides liquidity services for all members of the household that is summarized in the last term.

The optimal choice of debt in the Home country b_{t+1} is

$$q_t\mu_t = \beta \mathbb{E}_t \mu_{t+1} + q_t \lambda_t, \tag{25}$$

where λ_t is the Lagrange multiplier on the borrowing constraint. Debt is valued $q_t\mu_t$ and tomorrow is valued at μ_{t+1} units of the Home consumption good. Taking on debt also tightens the borrowing constraint $q_t\lambda_t$. The choice of government debt simply gives an Euler equation:

$$\frac{1}{R_t}\mu_t = \beta \mathbb{E}_t \mu_{t+1}. \tag{26}$$

Due to the presence of liquidity and borrowing constraints, there is a wedge between the interest rate paid on government debt, R_t, and the implicit yield paid on private borrowing, $1/q_t$. This wedge depends on the final terms in equations (24) and (25), and reflects how binding the liquidity and borrowing constraints are.

The choice of housing h_{t+1} in the Home country is

$$\lambda_t m_t e_t + \beta \eta^h \mathbb{E}_t \frac{1}{h_{t+1}} + \beta \mathbb{E}_t e_{t+1} \mu_{t+1} = \mu_t e_t. \tag{27}$$

An additional unit of housing relaxes the borrowing constraint ($\lambda_t m_t e_t$), provides utility services ($\beta \eta^h \mathbb{E}_t \frac{1}{h_{t+1}}$), and can be sold tomorrow ($\beta \mathbb{E}_t e_{t+1} \mu_{t+1}$), but entails a user cost ($\mu_t e_t$).

The consumption profile $c_t(v)$ is

$$c_t(v) = \min\left[\frac{v}{\frac{\beta}{q_t} P_t \mathbb{E}_t \mu_{t+1}}, x_t\right], \tag{28}$$

which says that consumption is either optimally set or limited by the transfer x_t. To understand how household consumption evolves in the model and the role of liquidity needs, first denote by $\underline{c}_t$ the consumption of the individual who has the lowest realization of the shock $v = 1$, so that

$$\underline{c}_t = \frac{1}{\frac{\beta}{q_t} P_t \mathbb{E}_t \mu_{t+1}}. \tag{29}$$

We show in the Appendix that we can write the average level of consumption relative to the minimum level as

$$\frac{c_t}{\underline{c}_t} = \frac{\alpha}{\alpha - 1} \left[1 - \frac{1}{\alpha} \left(\frac{\underline{c}_t}{x_t} \right)^{\alpha - 1} \right]. \tag{30}$$

In this expression, note that the final term is proportional to the fraction of consumers whose optimal consumption is constrained by x_t, which from our assumption that the taste shocks follow a Pareto distribution is $(x_t/\underline{c}_t)^{-\alpha}$. Thus, the wider is the dispersion of individual taste shocks (the lower is α), the larger the fraction of members who are constrained in their desired consumption by the availability of liquidity x_t, and the smaller is the gap between the average level of consumption and the minimum level of consumption.

The parameter α is key to governing the strength of the preference for liquidity services in our economy and the impact of shocks to credit availability m_t. When the dispersion of individual taste shocks is high (α is low), the household has a strong desire to hold liquid assets so as to smooth consumption across its members within a period. In response to a credit tightening, the household maintains its liquid asset position by cutting consumption. In contrast, when the dispersion of individual taste shocks is low (α is high), liquidity is less valuable, and the household taps its liquid asset holdings in response to a credit shock so as to smooth consumption across time. We explore the quantitative implications of α in the next section.

Finally, the optimal choice of capital k_t is

$$P_t \mu_t + \phi_k P_t \mu_t \left(\frac{k_t}{k_{t-1}} - 1 \right) = \beta \mathbb{E}_t \mu_{t+1} \left[P_{t+1} (1 - \delta) + r_{k,t+1} \right] + \beta \frac{\phi_k}{2} \mathbb{E}_t P_{t+1} \mu_{t+1} \left(\frac{k_t^2}{k_{t-1}^2} - 1 \right), \tag{31}$$

and the optimal choice of labor supply is:

$$n_t^{\nu} = \mu_t w_t. \tag{32}$$

The problem and decision rules in the foreign country are analogous, and detailed in the

Appendix.

4 Estimation

After having presented the two-country model with financial frictions and fiscal policy, this section describes how the model is estimated. The first subsection explains how the dataset is constructed. The second subsection explains how the model is estimated using the Generalized Method of Moments (GMM) procedure and describes the main model parameters, while the last subsection presents some key model implications.

4.1 Data

We estimate the two-country model by assuming that the United States is the home county, and an aggregate of all other 48 advanced and emerging economies as detailed in Section 2 are the rest of the world or foreign country.[11] The focus of the empirical analysis is to study how credit and fiscal policy comove with the current account in the United States. The set of observable variables is as follows: for the U.S., we include the current account-to-GDP ratio, the fiscal balance-to-GDP ratio, the annual change in the private credit-to-GDP ratio, and real GDP growth. For the rest of the world, we use the fiscal balance-to-GDP ratio, the annual change in the private credit-to-GDP ratio and real GDP growth.[12] Using real growth data allows to identify the effects of productivity shocks in the model.

The ROW aggregation is done as follows: the fiscal balance and credit-to-GDP ratios are computed using a weighted average of each variable for each country, using their nominal GDP in USD for each year as a weight. Real GDP growth is aggregated similarly, but using real GDP in USD for each year as a weight. As explained in Section 2, countries with missing data get a zero weight, and then a positive weight consistent with their GDP relative to the world in the first year for which there is an observable value. We do not include the ROW current account as an observable variable since, in the model, it should be the counterpart of the U.S. current account balance but in the data it is not. This is because our country sample, while covering about 90 percent of world GDP and trade, does not include all other countries that trade with the U.S., as well as well-known statistical discrepancies of current account data in the world aggregate. We demean all data before estimation.

[11] Our construction of a large ROW composite is similar to the work of Giovannini et al. (2019), who use 58 countries' data where available to construct a ROW data series from 1999.

[12] We use the annual change in the credit to GDP ratio as this allows us to compute its theoretical correlation with the current account in the model, which is then helpful when applying the GMM methodology that compares selected moments in the model and in the data. The relationship between different transformations of the credit to GDP ratio and the current account is robust (these results are available upon request).

4.2 GMM Estimation and Parameter Estimates

Following the methods in Andreasen, Fernandez-Villaverde and Rubio-Ramirez (2018), we estimate the model by taking a first-order approximation to the equilibrium conditions and applying a GMM methodology to match key moments in the data. The advantage of this methodology, compared to likelihood-based methods, is that it allows us to focus on the key features of data that are of particular interest. In our case, we are interested in matching the comovement between the current account, the fiscal balance, and credit.

Let $\mathbf{z}_t$ denote the vector of seven macroeconomic time series we described above at an annual frequency. We estimate the model by matching the standard deviation of the variables, the contemporaneous second moments and the persistence in the data.[13] Denote by $\mathbf{M}_t$ the vector of moments to match:

$$\mathbf{M}_t \equiv \begin{bmatrix} \text{diag}(\mathbf{z}_t\mathbf{z}_t') \\ \text{vech}(\mathbf{z}_t\mathbf{z}_t') \\ \text{diag}(\mathbf{z}_t\mathbf{z}_{t-1}') \end{bmatrix}, \tag{33}$$

where the vech($\bullet$) operator selects the lower triangular elements of a matrix and orders them in a vector, and the diag($\bullet$) operator selects the diagonal elements of a matrix. The size of the $\mathbf{M}_t$ vector is 35×1.

Letting Θ denote the vector of structural parameters that we wish to estimate, the GMM estimator is given by:

$$\hat{\Theta}_{GMM} = \arg\min \left(\frac{1}{T} \sum_{t=1}^{T} \mathbf{M}_t - \mathbb{E}[\mathbf{M}(\Theta)] \right)' \mathbf{W} \left(\frac{1}{T} \sum_{t=1}^{T} \mathbf{M}_t - \mathbb{E}[\mathbf{M}(\Theta)] \right), \tag{34}$$

where $\mathbb{E}([\mathbf{M}(\Theta)]$ denotes the model-implied moments that are counterparts to $\mathbf{M}_t$ when taking a first-order approximation to the model conditions and evaluated at Θ. $\mathbf{W}$ is a weighting matrix, which is positive definite. We use a conventional two-step approach. First, we use as a weighting matrix $\mathbf{W}$ the inverse of the long-run variance of the sample moments when centered at their sample mean, $\left(\frac{1}{T} \sum_{t=1}^{T} \mathbf{M}_t - \bar{\mathbf{M}} \right)'$, to obtain an initial estimate of the parameters denoted by $\hat{\Theta}_0$. Then, we use the inverse of the variance-covariance matrix of $\left(\frac{1}{T} \sum_{t=1}^{T} \mathbf{M}_t - \mathbb{E}[\mathbf{M}(\hat{\Theta}_0)] \right)$ as the weighting matrix, which is obtained with a Newey-West estimator with 3 lags (since we are using annual data) to obtain a final estimate of the parameters denoted by $\hat{\Theta}_1$.[14]

[13] Since we demean the data before estimation, we do not try to match the sample means of observable variables.

[14] We use seven macroeconomic variables for estimation, while the model has six shocks. This is not an

Table 2: Calibrated Parameters

Parameter	Description	Value
κ, κ^*	Share of domestic goods in domestic production	0.8
$\bar{h}$	Housing stock	1
$r = 1/q - 1$	Real interest rate	0.02
$\bar{m}$	Steady-state credit shock (Average LTV)	0.29
ν	Inverse Frisch elasticity labor supply	2
ω	Capital share of output	1/3
δ	Depreciation rate	0.1
g/Y, g^*/Y^*	Government spending to GDP ratio, U.S. and ROW	0.2
b^g/Y, b^{g*}/Y^*	Debt to GDP ratio, U.S. and ROW	0.6

Some parameters of the model are calibrated using external information while others are estimated. Table 2 presents the calibrated parameters of the model. The share of imports to GDP is set to 0.2 (corresponding to a κ of 0.8), which is close to the average value for the U.S. economy. The steady-state value of the credit shock denotes the average LTV in the U.S. using flow-of-funds data. The capital share of output and the depreciation rate of capital are set to standard values in the RBC literature (1/3 and 10 percent annual, respectively). We also assume standard values for the real interest rate of 2 percent, and use a Frisch elasticity of labor supply of 2. The aggregate housing to income ratio is set to 2.5, using the same value as Jones et al. (2022). The supply of the housing stock is normalized to one. Using these values together with the estimate for α pins down the discount factor β and the weight of housing in the utility function η^H. The steady-state government spending to GDP ratio is assumed to be 20 percent of GDP, while the target debt to GDP ratio in the fiscal rule is assumed to be 60 percent. Given these parameters, the ratio of government revenues to GDP is determined endogenously. The current account and the net international investment position of each country are assumed to be balanced in the steady state.

Table 3 presents the estimated parameters using GMM, together with their estimated standard deviation. We present the asymptotic standard errors which are computed using the asymptotic expression for the variance-covariance matrix of the parameters under GMM estimation and the optimal weighting matrix. The estimated value for the dispersion of taste shocks α is 2.52, smaller than the estimate in Jones et al. (2022), and a value that implies a discount factor of 0.95 and a spread between the interest rate and the rate of time preference of about 2.8 percent. At the country-level, we thus find a relatively strong preference for liquidity, which works to increase the endogenous correlation between credit and real variables,

issue when estimating the model using GMM. However, to conduct counterfactual policy analysis exercises in Section 5, we need to extract the structural shocks of the model using a Kalman smoother. To avoid singularity issues, a small observation error shock is included in the ROW output growth equation.

Table 3: Estimated Parameters

	Parameter	Point Estimate	Std Dev
α	Dispersion of Taste Shocks	2.52	0.05
σ	Elasticity of Substitution H/F Goods	1.99	0.44
ϕ_b	U.S. Tax Response to Debt	0.09	0.03
ϕ_b^*	ROW Tax Response to Debt	0.09	0.02
ϕ_k	Investment Adjustment Costs	5.84	1.71
ρ_z	U.S. TFP AR(1) Parameter	0.93	0.05
ρ_z^*	ROW TFP AR(1) Parameter	0.90	0.02
ρ_m	U.S. Credit Shock AR(1) Parameter	0.96	0.05
ρ_m^*	ROW Credit Shock AR(1) Parameter	0.91	0.04
ρ_g	U.S. Fiscal Shock AR(1) Parameter	0.63	0.04
ρ_g^*	ROW Fiscal Shock AR(1) Parameter	0.64	0.02
σ_z	U.S. TFP Innovation Std. Dev.	1.94	0.10
σ_z^*	ROW TFP Innovation Std. Dev.	1.88	0.16
σ_m	U.S. Credit Shock Innovation Std. Dev.	4.60	0.32
σ_m^*	ROW Credit Shock Innovation Std. Dev.	5.50	0.36
σ_g	U.S. Fiscal Shock Innovation Std. Dev.	3.70	0.27
σ_g^*	ROW Fiscal Shock Innovation Std. Dev.	1.92	0.12
$\sigma_{\Delta y}^*$	Measurement Error, ROW Output Growth	0.93	0.26

Note: Estimates for the standard deviation of the shocks are in percentage points.

as we will discuss below. The elasticity of substitution between home and foreign goods σ is estimated at 1.99, which is on the high side compared to standard calibrations of international business cycle models (such as Heathcote and Perri, 2016) but closer to estimates using disaggregated data (see Imbs and Mejean, 2015, for a discussion). The parameter estimates suggest a similar reaction of the U.S. tax revenues to deviations of government debt from steady-state values as its ROW counterpart. Finally, the parameter that governs investment adjustment costs is estimated at 5.84, suggesting a somewhat sluggish adjustment of the capital stock. The estimates of the shock processes are not that informative on their own, so in the next subsection we discuss the model fit from these parameter estimates.

4.3 Model Implications

4.3.1 Model Fit

Tables 4 and 5 shows how well the model fits the selected second moments in the data. The model does a good job in fitting most standard deviations in the data, in particular those that relate to the U.S. economy. The model also matches the volatility of the change in the credit to GDP ratio in the ROW, and overestimates somehwat the volatility of the fiscal balance and real GDP growth in the ROW. The model also matches well the persistence of all ROW variables, and real GDP growth and the fiscal balance in the US. But, it cannot match the persistence of the change in credit to GDP in the U.S., as well as the US current account. However, as we show in the Online Appendix, the estimated persistence in our credit shocks allows the model to match well the persistence (and volatility) of the level of credit to GDP.[15] The estimated model also matches the main comovement features of the U.S. current account. In particular, for the U.S., it matches the negative correlation between credit and the current account (-0.40 in the data and -0.26 in the model), and the positive correlation between the fiscal balance and the current account (0.23 in the data and 0.43 in the model), which are the key facts that we are interested in. The model also does a good job in matching the relationship between the ROW fiscal balance and the U.S. current account, with a correlation of -0.35 in the data and -0.27 in the model).

The model was also estimated using Bayesian methods. The results are available in the Online Appendix. Generally, the differences in terms of parameter estimates and model fit are relatively small between the two estimation methods. In particular, the estimate for α is 2.69 (the posterior mode), quite similar to the estimate obtained under GMM estimation. The Bayesian estimation method delivers a somewhat smaller correlation between credit and the current account in the US (-0.15 with the parameter estimates using Bayesian methods compared to -0.26 using the GMM parameter estimates). Also, the estimates with Bayesian methods deliver a slightly worse fit to the current account, credit and fiscal balance dynamics in the US, and does a poor job in fitting the ROW output growth. For these reasons, the parameter estimates using GMM are preferred.

4.3.2 Variance Decomposition

The estimated model also allows for a decomposition of the main sources of fluctuations. In Table 6 we present a variance decomposition exercise for the six observable U.S. variables as well as changes in the real exchange rate.[16] The model assigns multiple sources for current account fluctuations, but the main ones are credit shocks originating in the U.S. and in the ROW, each explaining about one third of the volatility of the current account. Domestic fiscal shocks explain 21.3 percent of the U.S. current account fluctuations, while foreign fiscal shocks account for 5.8 percent. Productivity shocks, both in the U.S. and the ROW contribute around 4 percent. Interestingly, most of the fluctuations of the other three U.S.

[15] The credit shocks in the model affect the persistence of the level of the credit to GDP ratio. One would need credit shocks with persistence in their growth rate to be able to match the persistence in the change of the credit to GDP ratio. However, this is not a trivial task since this would impose non-stationarity in the loan to value ratio, complicating the existence of a well-defined steady-state.

[16] The full variance decomposition of the observable variables is provided in the Online Appendix.

Table 4: Model Fit

Variable	Data Std. Dev.	Data Autocorr	Model Std. Dev.	Model Autocorr
Current Account/GDP, U.S.	1.45	0.87	0.90	0.63
Credit/GDP, Change, U.S.	3.80	0.38	3.71	-0.04
Fiscal Balance/GDP, U.S.	2.61	0.71	2.61	0.66
Real GDP Growth, U.S.	2.02	0.15	2.19	0.01
Credit/GDP, Change, ROW	4.16	0.01	4.27	-0.05
Fiscal Balance/GDP, ROW	0.94	0.53	1.39	0.67
Real GDP Growth, ROW	1.56	-0.09	2.32	0.00

Table 5: Model Fit, Correlations

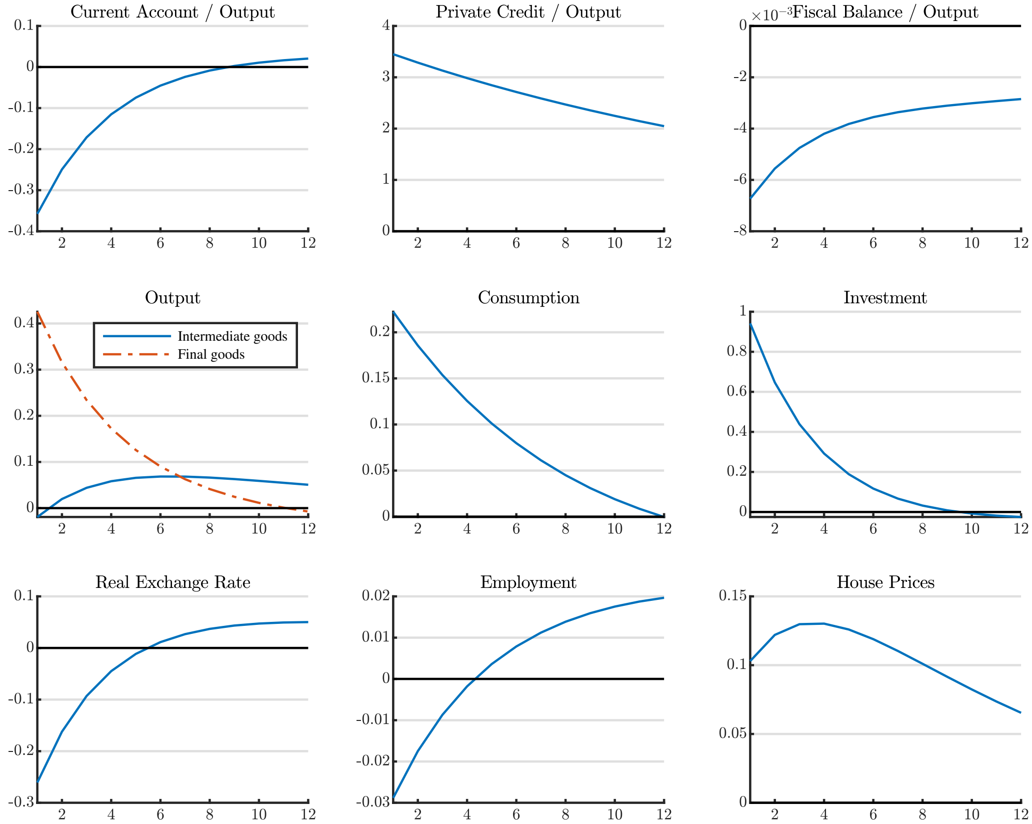
Correlation	Data	Model	Correlation	Data	Model
(CA, CRE)	-0.40	-0.26	(CRE*, GDP)	-0.40	0.00
(CA, CRE*)	0.00	0.37	(CRE*, GDP*)	-0.54	-0.17
(CA, GDP)	-0.08	-0.19	(CRE*, FB)	-0.23	0.02
(CA, GDP*)	-0.22	0.14	(CRE*, FB*)	-0.21	0.06
(CA, FB)	0.23	0.43	(GDP, GDP*)	0.72	0.01
(CA, FB*)	-0.35	-0.27	(GDP, FB)	0.17	-0.07
(CRE, CRE*)	0.37	-0.11	(GDP, FB*)	0.31	0.00
(CRE, GDP)	-0.09	-0.23	(GDP,* FB)	0.13	0.01
(CRE, GDP*)	-0.26	0.00	(GDP*, FB*)	-0.06	-0.06
(CRE, FB)	0.15	0.15	(FB, FB*)	0.35	0.00
(CRE, FB*)	-0.02	0.02			

Notes: CA is the U.S. current account balance to GDP ratio. CRE is the annual change in the U.S. credit to GDP ratio. FB is the U.S. fiscal balance to GDP ratio. GDP is the U.S. annual real GDP growth. Variables with an asterisk denote their rest of the world (ROW) counterparts.

Table 6: Variance Decomposition

Observable Variables	Productivity U.S.	Productivity ROW	Credit U.S.	Credit ROW	Gov Spending U.S.	Gov Spending ROW
Current Account to GDP	4.1	3.6	32.2	33.0	21.3	5.8
U.S. Credit to GDP	3.0	0.0	88.6	0.3	8.0	0.0
U.S. GDP Growth	96.3	0.0	0.1	0.1	3.5	0.0
U.S. Fiscal Balance to GDP	1.0	0.0	0.0	0.0	99.0	0.0
Δ Real Exchange Rate	29.6	29.2	14.6	17.1	7.5	2.0

Figure 1: Impulse Responses to a U.S. Credit Shock



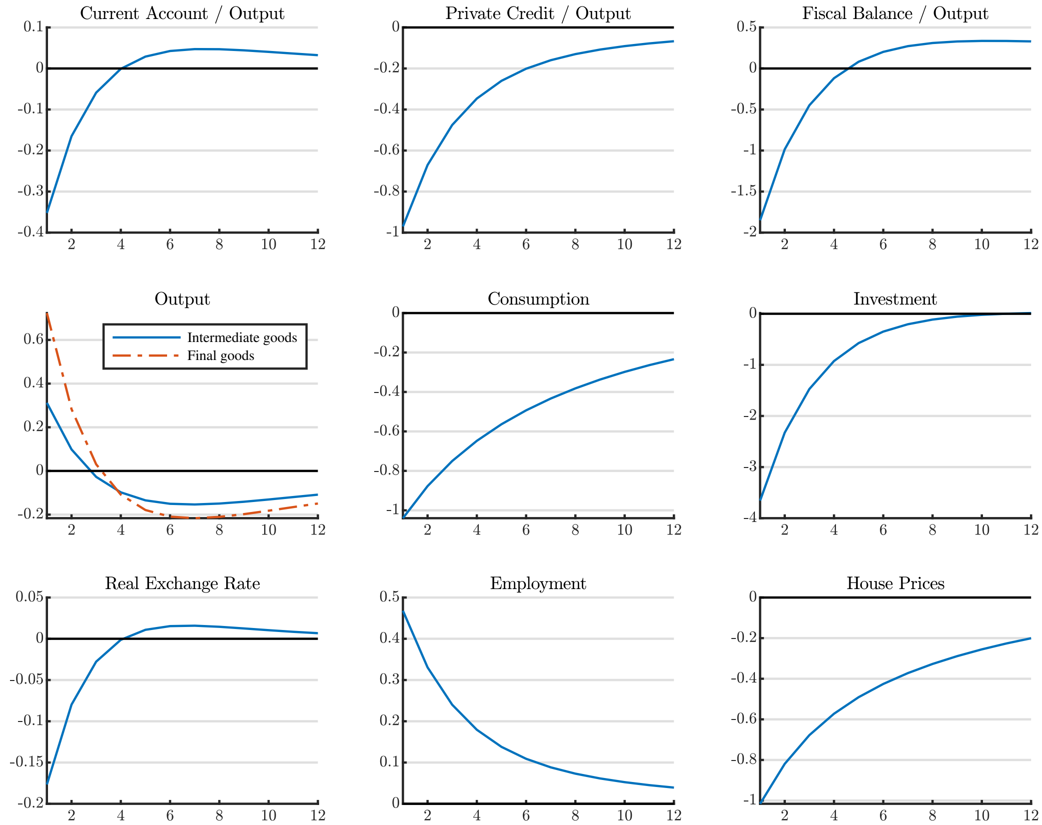
Notes: This figure shows the response of model variables to a one standard deviation U.S. credit shock. The real exchange rate is equal to P_t^*/P_t, so a rise in the real exchange rate represents a depreciation of the U.S. dollar vis-a-vis the ROW currency composite.

observable variables are primarily driven by just one shock. Specifically, fluctuations in the change in the credit to GDP ratio are largely driven by U.S. credit shocks, U.S. GDP growth is driven by productivity shocks, and the fiscal balance is driven by government spending shocks. U.S. fiscal shocks explain about 8 percent of the fluctuations in U.S. credit and 3.5 percent of real GDP growth. Finally, we also report in the last row of Table 6 the variance decomposition for changes in the real exchange rate. U.S. and ROW productivity shocks explain about 60 percent of the variance of changes in the real exchange rate, while credit shocks are responsible for about 30 percent, and fiscal shocks the remaining 10 percent.

4.3.3 Impulse Responses

After a U.S. credit shock that increases households' ability to borrow, the private credit to output ratio increases to about 3 percent of GDP, with a highly persistent impact (Figure 1). The increased ability to borrow increases domestic consumption and investment, while output (understood as intermediate goods production) displays a hump-shaped response

Figure 2: Impulse Responses to a U.S. Fiscal Shock

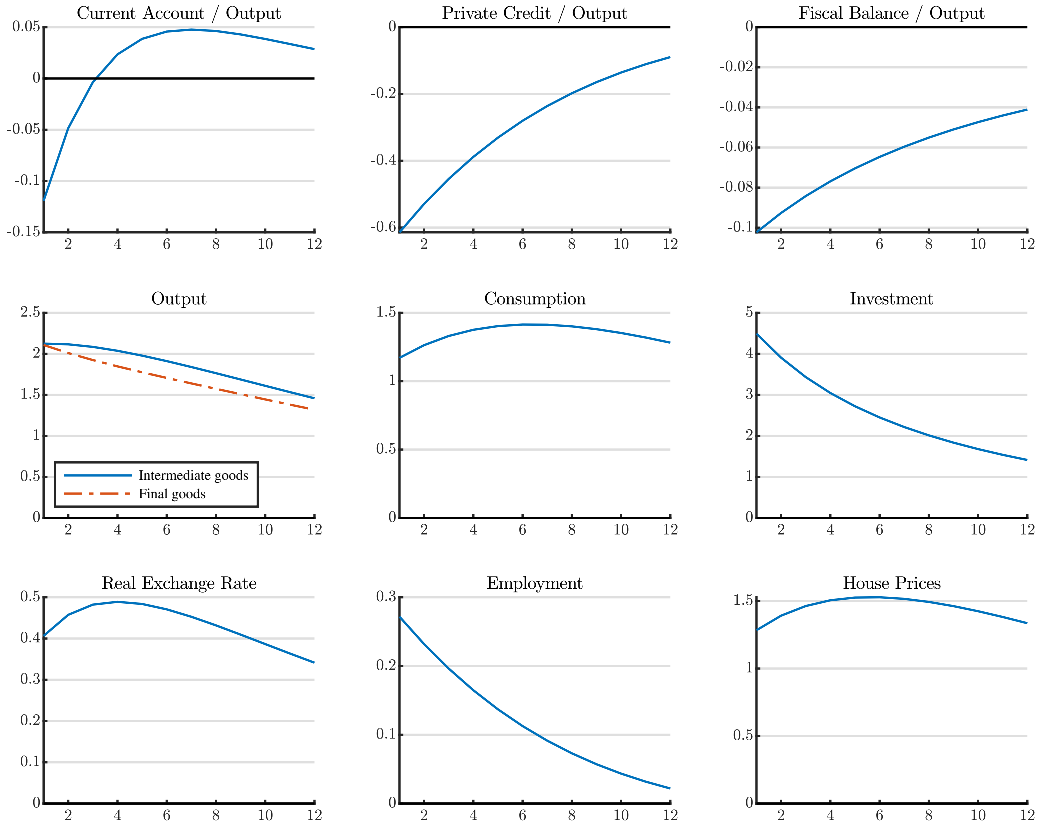


Notes: This figure shows the response of model variables to a one standard deviation U.S. fiscal shock. The real exchange rate is equal to P_t^*/P_t, so a rise in the real exchange rate represents a depreciation of the U.S. dollar vis-a-vis the ROW currency composite.

due to the initial decline of hours worked. As the level of employment increases and capital accumulates due to increased investment, output recovers. House prices increase under the credit shock, further relaxing borrowing constraints. Since the impact on domestic supply is smaller than on domestic demand, the current account moves into deficit, and converges back to zero monotonically. The fiscal balance moves to a slight deficit which is negligible in quantitative terms (-0.006 percent of GDP), due to the estimated fiscal rule.

After an increase in U.S. government spending, the model is able to replicate the "twin deficits" fact (Figure 2): both the fiscal and the current account balance turn into deficit as percent of GDP. The fiscal impulse is expansionary, leading to a short-lived increase in output, while the private credit to GDP ratio contracts, due to some crowding out from government borrowing that cannot be fully offset through international borrowing. The impact multiplier of the fiscal balance on the current account is about 0.15, which is close to the coefficient estimated in single-equation models (see Abbas et al., 2011, which includes a survey of the literature). The fiscal multiplier on output (intermediate goods production)

Figure 3: Impulse Responses to a U.S. Productivity Shock



Notes: This figure shows the response of model variables to a one standard deviation U.S. productivity shock. The real exchange rate is equal to P_t^*/P_t, so a rise in the real exchange rate represents a depreciation of the U.S. dollar vis-a-vis the ROW currency composite.

is about 0.15 on impact, while the multiplier on final goods production is about 0.3. These multipliers are smaller than the available estimates in the literature on the effects of government spending on GDP (see the survey in Ramey, 2011). While our model includes financial frictions, it does not include other features such as hand to mouth consumers, nominal rigidities, a weak response of monetary policy to inflation, and labor market frictions that are key to generating large fiscal multipliers in DSGE models (see Galí et al., 2007).

Finally, Figure 3 presents the responses to an increase in U.S. productivity. The response of the current account is quantitatively small as supply and demand effects generally offset each other: the current account moves to deficit on impact but then moves to surplus because increased production leads to higher exports than imports. However, the small quantitative response of the current account (it fluctuates between -0.1 and 0.04 percent of GDP while output increases by about 2 percent) confirms that productivity shocks cannot be a main driver of the current account in our estimated model. Private credit increases to take advantage of the investment opportunities that arise with high productivity and the relaxation of borrowing constraints due to higher house prices, however the private credit to GDP ratio declines because of the large expansion in output. Finally, the fiscal balance moves to deficit due to the estimated fiscal rule: the increase in output leads to a decline in the government debt-GDP ratio, which in turns triggers a lump-sum tax cut that temporarily lowers government revenue. This also helps to explain the comovement between the current account and the fiscal balance, at least on impact and up to three years after the shock.

4.4 Role of Financial Frictions

In this subsection, we explore in more depth the role of financial frictions in our model, motivating their inclusion into what is otherwise a standard two-country RBC framework. In particular, we first examine how the model's financial frictions affect the impact and propagation of the model's structural shocks. We then report key moments of variants of the model that shut down the financial frictions and show that the baseline version of the model with these frictions in place is better able to match the data.

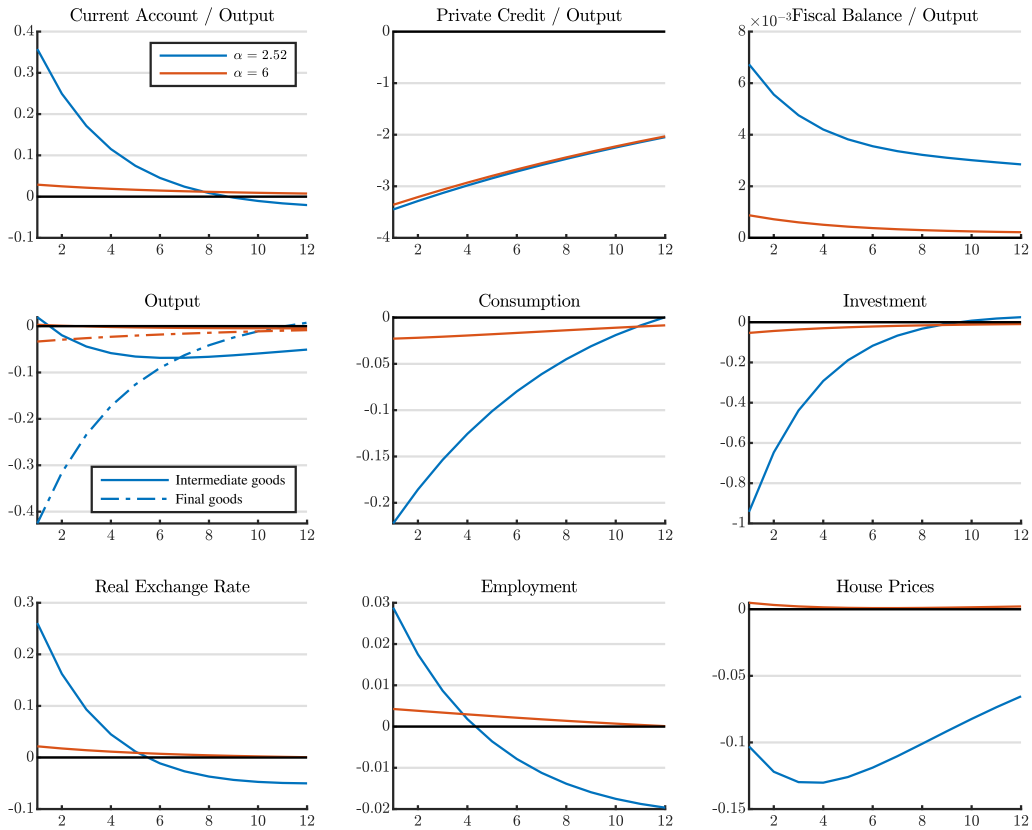
We first illustrate the impact of the tightness of financial frictions for the propagation of a contractionary shock to the availability of credit in Figure 4. At our baseline estimated value of $\alpha = 2.52$, the parameter which governs the distribution of idiosyncratic consumption preference shocks, households adjust consumption notably in response to tightening credit conditions so as to maintain liquid asset balances. This gives rise to a recession, a current account surplus, and a contraction in house prices. In contrast, when the distribution of idiosyncratic shocks is set to be narrow–we choose $\alpha = 6$ to illustrate, implying essentially no gap between the interest rate and the rate of time preference–financial frictions are relatively loose, and households in the economy do not cut consumption much following the negative credit availability shock as they have little preference to preserve liquid asset balances. As a result, the impact of credit shocks is muted, with output, employment and the current account largely irresponsive to the shock.

The presence of these financial frictions also affects the propagation of other shocks. For example, consider a fiscal shock that boosts output, lowers consumption, and leads to a current account deficit, shown in Figure 5. When financial frictions are relatively tight (at our estimated value of $\alpha = 2.52$) relative to when they are loose ($\alpha = 6$), households further cut consumption to maintain liquid asset balances. As a result, the current account–both on impact as well as throughout the impulse response horizon–is more positive relative to the case when financial frictions are less relevant.[17]

The introduction of financial frictions in our framework helps the model to match salient

[17] The case of how financial frictions affects the propagation of a productivity shock is illustrated in the Appendix.

Figure 4: Impulse Response to Negative U.S. Credit Shock Across α



Notes: This figure shows the response of model variables to a one standard deviation U.S. credit shock. The real exchange rate is equal to P_t^*/P_t, so a rise in the real exchange rate represents a depreciation of the U.S. dollar vis-a-vis the ROW currency composite.

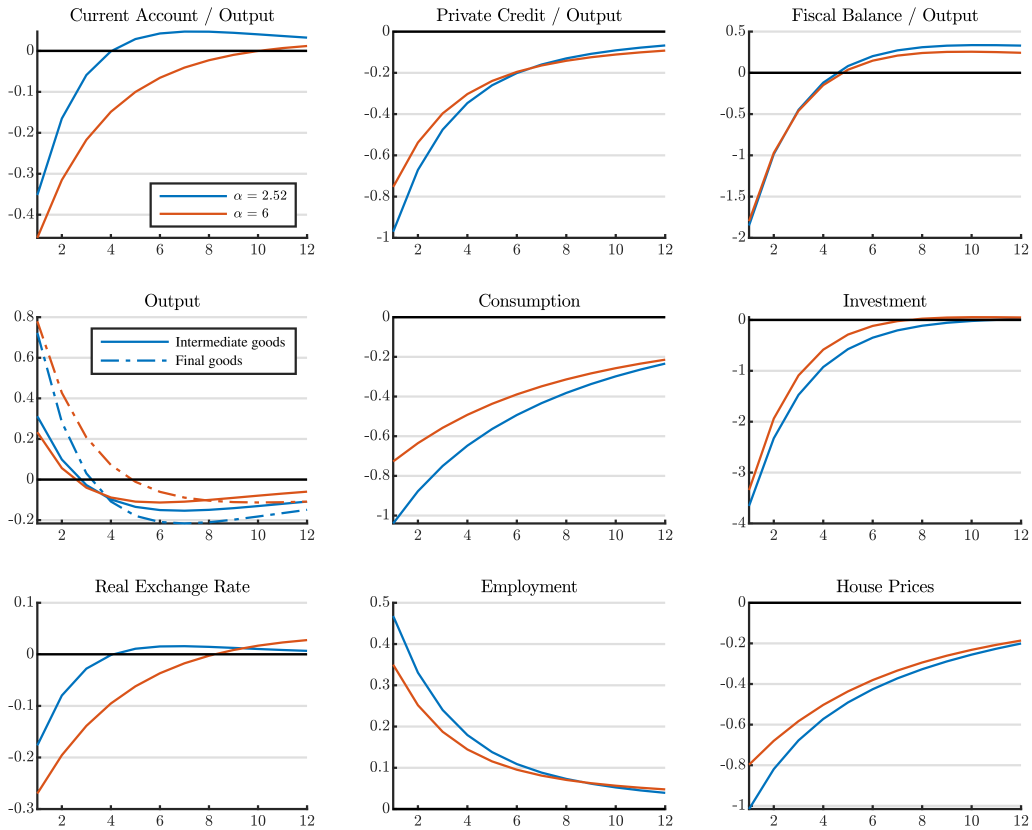
features of the data. For this purpose, we summarize the relationships between variables by regressing simulated series of the U.S. current account-to-GDP ratio, on covariates: the credit-to-GDP ratio, the fiscal balance-to-GDP ratio and GDP growth, and comparing them to analogous regressions using actual US data.[18] We report a separate set of regressions which also include the change in U.S. house prices. We then report, in Table 7, the regression coefficients obtained from the same regressions in the data versus versions of the model with an important role for credit (with α set to the baseline estimated value of 2.52) and a version with a limited role for financial frictions (setting $\alpha = 6$).[19]

We make several observations based on Table 7. First, the regression coefficients indicate that the presence of financial frictions helps the model better match the observed negative

[18] Section 2 presents analogous panel regressions on a multi-country dataset, and reports similar coefficient estimates. In the panel regressions, house prices are not significant to explain the current account across countries, and hence they are excluded from the analysis.

[19] In the Appendix, we report the coefficients of these regressions for versions of the model where we separately shut down productivity and fiscal shocks.

Figure 5: Impulse Response to Positive U.S. Fiscal Shock Across α



Notes: This figure shows the response of model variables to a one standard deviation U.S. fiscal shock. The real exchange rate is equal to P_t^*/P_t, so a rise in the real exchange rate represents a depreciation of the U.S. dollar vis-a-vis the ROW currency composite.

comovement between debt and the current account within countries. As indicated by the impulse responses, both the government spending and productivity shocks generate a positive correlation between credit-to-output and the current account-to-output ratio. With a weaker credit channel ($\alpha = 6$), the overall relationship between the current account and credit-to-GDP is weak. As reported in the first row of Table 7, the regression coefficient of the current account-to-GDP on credit-to-GDP is -0.10 when $\alpha = 2.52$, our estimated value, and much closer to the coefficient of -0.18 (without house prices) or -0.17 (with house prices) obtained using the data, versus a coefficient of 0.01 when $\alpha = 6$. These patterns also become clear when we consider theoretical correlations from the model variants at our estimated value of α versus when we set α to a high value. In the first row of Table 8, when $\alpha = 2.52$, our estimated value, the correlation between changes in credit and the current account to GDP ratio is -0.26, a little below the value in the U.S. data of -0.4. Instead, when financial frictions are weakened by setting a higher value of $\alpha = 6$, the correlation between changes in credit and the current account-to-GDP ratio can turn counterfactually

Table 7: Regression Coefficients, Current Account, Credit, and Fiscal Policy

	U.S. Data	Model $\alpha = 2.52$	Model $\alpha = 6$	U.S. Data	Model $\alpha = 2.52$	Model $\alpha = 6$
Credit/GDP	-0.18	-0.10	0.01	-0.17	-0.10	0.01
Fiscal Balance/GDP	0.18	0.17	0.19	0.18	0.16	0.23
GDP Growth	-0.13	-0.10	-0.12	-0.11	-0.10	-0.06
House Prices	-	-	-	0.02	0.01	-0.15

Note: The current account-to-GDP is used as the dependent variable. The variables in the regression are the annual change in the U.S. credit to GDP ratio, the U.S. fiscal balance to GDP ratio, the U.S. annual real GDP growth, and the annual change in U.S. house prices. We simulate 200 periods of shocks for the two model-based regressions and use the same shocks for when $\alpha = 2.52$ and for when $\alpha = 6$.

Table 8: Correlations Across α

Correlation	Data	Model $\alpha = 2.52$	Model $\alpha = 6$
(CA, CRE)	-0.40	-0.26	0.11
(CA, CRE*)	0.00	0.37	-0.05
(CA, GDP)	-0.08	-0.19	-0.30
(CA, GDP*)	-0.22	0.14	0.27
(CA, FB)	0.23	0.43	0.52
(CA, FB*)	-0.35	-0.27	-0.34
(CRE, H)	*0.31*	*0.12*	*-0.04*
(CRE, H*)*	*0.33*	*0.39*	*-0.01*

Notes: CA is the U.S. current account balance to GDP ratio. CRE is the annual change in the U.S. credit to GDP ratio. FB is the U.S. fiscal balance to GDP ratio. GDP is the U.S. annual real GDP growth. H is the annual change in U.S. house prices. Variables with an asterisk denote their rest of the world (ROW) counterparts. Correlations that are italicized are not targeted in estimation.

positive (0.11), reflecting instead the positive comovements between credit-to-GDP and the current account-to-GDP induced by fiscal and productivity shocks.

Second, the presence of financial frictions in our model helps to better align the current account with the fiscal balance-to-GDP ratio–the so-called "twin deficits" evidence that was presented in Section 2. In the regression using U.S. data of the current account-to-GDP ratio on its covariates, the coefficient on the fiscal balance-to-GDP ratio is 0.18. Using simulated data from our model with the estimated value of $\alpha = 2.52$, the coefficient estimate is 0.17 (without house prices) and 0.18 (with house prices), near that in the U.S. data. Instead, when $\alpha = 6$, so that the role of financial frictions is much reduced, the coefficient is higher, for example rising to around 0.23 when house prices are included as a covariate. These higher coefficients reflect how, absent the financial frictions, the effects of credit shocks are significantly muted, and so the model does not generate fluctuations in the current account and output through shocks to credit availability (as illustrated in Figure 4). The fifth row of Table 8 reinforces this point, showing that the correlation between the current account balance and the fiscal balance in the U.S. is higher when financial frictions are diminished.

The third observation we make is that with financial frictions we have a better alignment of the negative comovement between the current account and GDP growth in the model and the data. This is shown in the third row of Table 7, which reports the coefficient on GDP growth of the regression between the current account balance and its covariates. In the data, this coefficient is -0.11, and in our model it is -0.10, which in a model with a limited role for credit shocks due to loosened financial constraints, this coefficient is -0.06 in the regressions with house prices. This is because, as discussed above, in our model credit shocks reinforce a negative comovement between output and the current account balance. The third row of Table 8 also shows that the correlation of the current account-to-output ratio and GDP growth in the U.S. is more aligned with the data for our estimated degree of financial constraints (-0.08 in the data and -0.19 in our model) compared to when financial constraints are relatively loose (-0.30).

Finally, our financial frictions channel helps with matching the comovement between house prices and credit observed in the data (even though we do not target house prices in estimation). Credit shocks lead to a positive comovement between credit and house prices and offset the negative correlation generated by fiscal shocks. More formally, the last two rows of Table 8 show the bivariate correlation between credit and the change in house prices for the U.S. and the composite ROW. Allowing for our financial frictions improves the model correlation to near those observed instead of being counterfactually negative, as is the case if we shut down financial frictions by setting $\alpha = 6$.

We make two final observations motivating the introduction of credit frictions into an otherwise standard international real business cycle model. First, empirically, our approach allows for the estimation procedure to choose a value of α that covers the range of values which would imply either a strong role for financial frictions or essentially no role for financial frictions. The fact that the estimation minimizes its fit of the data at a value of $\alpha = 2.52$ is suggestive of an important role for our financial frictions channel by providing a better fit to the data, as discussed in the preceding paragraphs.

Second, in addition to providing a better fit to the data, we view our approach as appealing relative to existing models on theoretical grounds. Existing models based on the standard borrower-saver framework typically features a single financial asset, which a country with impatient households uses to borrow from a country with patient households. As described by Ferrero (2015), in these models, a symmetric equilibrium in which the net foreign asset position is zero implies that the borrowing constraint does not bind in steady-state. As a result, borrowing constraints become irrelevant up to a first-order approximation. By contrast, countries in the framework that we use are not borrowers or savers; instead, they do a combination of both borrowing or saving, and the tightness of binding borrowing constraints is flexibly determined by the single parameter, α, governing the distribution of idiosyncratic shocks. As a result, our approach allows us to consider a symmetric equilibrium with non-trivial debt-consumption dynamics in a first-order approximation, making feasible our estimation strategy and welfare analysis.

5 Credit Shocks, Fiscal Policy, and the Current Account

As the variance decomposition in Table 6 shows, credit shocks are an important driver of the current account while fiscal shocks explain a non-trivial amount of the variation in current account. In this section, we use our estimated model to explore counterfactual series constructed without U.S. credit and fiscal shocks to study how global imbalances would have evolved absent these forces. We focus on the period 1991-2021 as this is when the U.S. current account deficit and more generally global imbalances increased to unprecedented levels prior to the Global Financial Crisis, and then declined in its aftermath (Blanchard and Milesi-Ferretti, 2011, and IMF, 2020).

Motivated by these counterfactual series, we then explore alternative U.S. macroprudential and fiscal policy rules that alleviate the impact of domestic shocks and study implications for the extent of global imbalances. In this section, we use the law of motion of the model implied by the parameter estimates of Tables 2 and 3 and the seven macroeconomic time series to apply standard Kalman smoother equations to extract the model's structural shocks.[20]

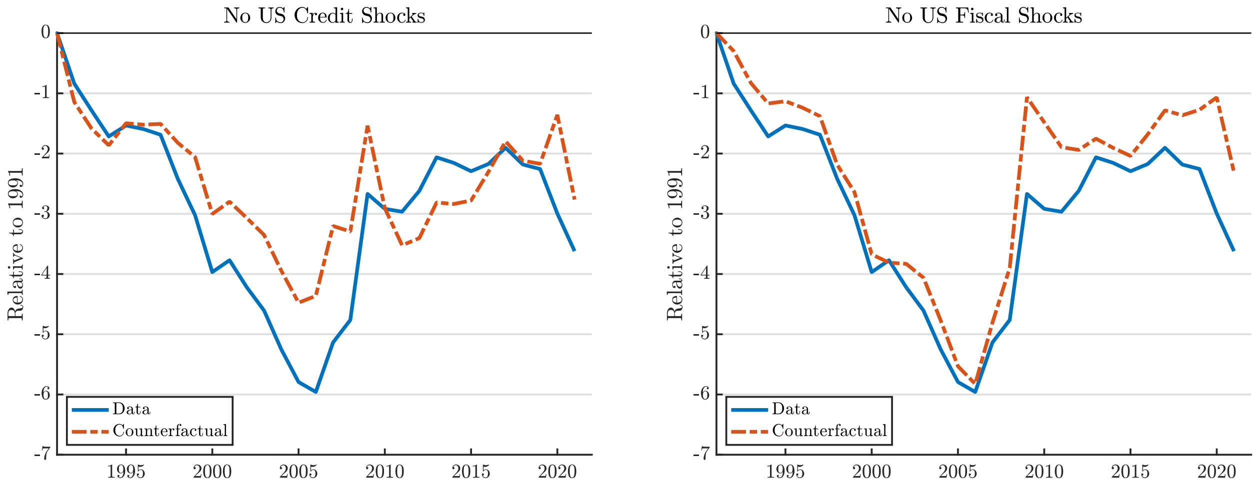
5.1 The Role of U.S. Credit and Fiscal Shocks

In this subsection, we present two counterfactuals for the U.S. current account balance, one where we remove the estimated U.S. credit shocks and another where we remove U.S. fiscal shocks. This exercise allows us to understand what has been the role of these two shocks in shaping the U.S. current account.

Figure 6 shows the U.S. current account to GDP ratio in the two experiments. In the first, plotted in the left panel, we remove U.S. credit shocks from 1991 onwards, that is, following

[20] See Harvey (1989). As explained above, we are using seven macroeconomic time series and the model has seven shocks, including the measurement error shock in the ROW output growth measurement equation.

Figure 6: U.S. Current Account to GDP, Counterfactuals



the 1990 recession when the U.S. current account was roughly in balance.[21] Absent U.S. credit shocks over this period, the U.S. current account to GDP ratio would have fallen to just over -4 percent at its lowest, compared to the almost -6 percent observed at the trough in 2006. Absent the tightening of credit from 2009 to 2013, the current account to GDP ratio would have expanded from about -1.5 percent to -3.5 percent, and below the value observed in 2013. The tightening of credit thus contributed to a significant reversal in the U.S. current account deficit after the Great Recession. Interestingly, towards the end of our sample, we find that credit shocks were again contributing to a larger U.S. current account deficit; absent credit shocks, the current account to GDP deficit would have been narrower by about 1 percentage point.

In the right panel of Figure 6, we plot the U.S. current account balance in a counterfactual where fiscal shocks are removed from 1991 onwards. Fiscal policy was mildly expansionary over 1991 to 2006, and absent fiscal shocks over this period, the U.S. current account to GDP ratio would have roughly tracked its actual evolution, being at most half a percentage point narrower. The more significant U.S. fiscal expansion during the 2008-09 recession contributed, by itself, to almost 2 percentage points of the U.S. current account to GDP deficit. Removing fiscal shocks over this period would have seen the current account narrow more in 2009 and remain in deficit between -1 and -2 percent of GDP until the end of our sample.

We finally note that these results are robust to a number of alternative model specifications, datasets, and estimation approaches, including using Bayesian methods, estimating the model with the real exchange rate as an observable variable, estimating the model with U.S. consumption growth and a U.S. discount factor shock, including nominal rigidities and

[21]The results are similar if we turn off credit (or fiscal) shocks for the entire sample.

estimating the model using also inflation and the federal funds rate as observables, as well as a model specification in which households may borrow government debt across countries.[22] These specifications and estimation results are provided in the Online Appendix.

5.2 Macroprudential Policies

We next consider the role of macroprudential policies, implemented as augmenting the borrowing constraint (16) as:

$$q_t b_t \leq \text{macropru}_t m_t e_t h_{t+1}. \tag{35}$$

We consider macroprudential instruments that are implemented as simple feedback rules, responding to credit conditions from equilibrium levels. To parameterize these rules, we use the utility function (up to second order) and search over a parameter grid to assign optimal coefficients.[23] We assume for simplicity that the U.S. regulator focuses on U.S. welfare taking the ROW as given.[24]

We explore a macroprudential rule that responds to the deviations in private credit to GDP from its steady-state value:[25]

$$\text{macropru}_t = 1 - \phi_m \left(\frac{q_t b_{t+1}}{\tilde{y}_t} / \frac{qb}{\tilde{y}} - 1 \right). \tag{36}$$

In our counterfactuals, we extract the model's shocks where macroprudential policy is turned off, impose the candidate macroprudential rule from 1991 onwards and simulate the economy under those shocks.

In the experiment with the macroprudential rule (36), the optimal value for the response is $\phi_m = 5.0$.[26] Imposing this value and resimulating the model, we generate a counterfactual series that is shown in Figure 7. In line with the results presented in Figure 6 in which we removed U.S. credit shocks, macroprudential policy in this case would work to ameliorate the impact of changes in credit. The private credit to GDP ratio would not have increased by the 37 percentage points observed between 1997 and 2008, and would instead have increased

[22] Our results accord with those of Ferrero (2015) who also find that monetary factors do not drive current accounts, but that credit and preference shocks do.

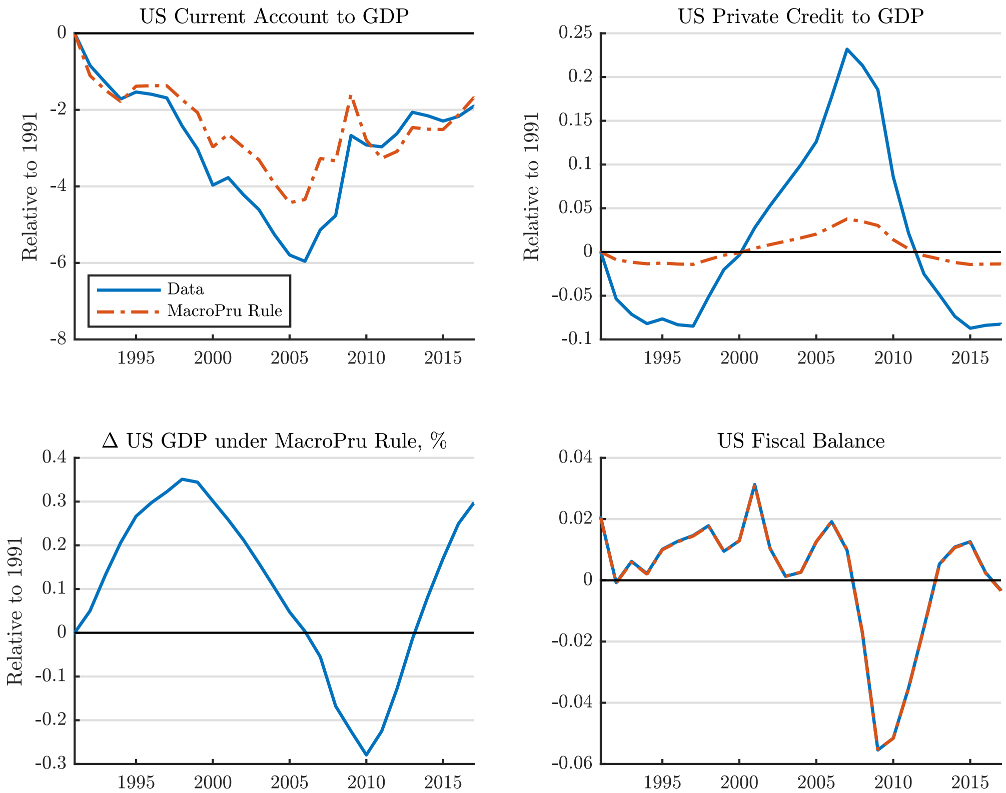
[23] The welfare function based on a second-order approximation to the household utility function is given in the Appendix.

[24] The qualitative results in this section would also apply if the ROW policymakers conducted similar countercyclical policies. However, we recognize that the ROW is an aggregate of several economies that would have to conduct that same policy in a coordinated way.

[25] We also explored a macroprudential rule that tightens credit as the value of the housing stock to GDP ratio rises relative to its steady-state value. Compared to the rule that responds to private credit to GDP, the macroprudential rule that responds to the value of the housing stock to GDP led to lower welfare gains. As a result, we do not discuss it here, but it is available upon request.

[26] We show how the welfare function varies over ϕ_m in the Appendix.

Figure 7: Macroprudential Rule Responding to Credit



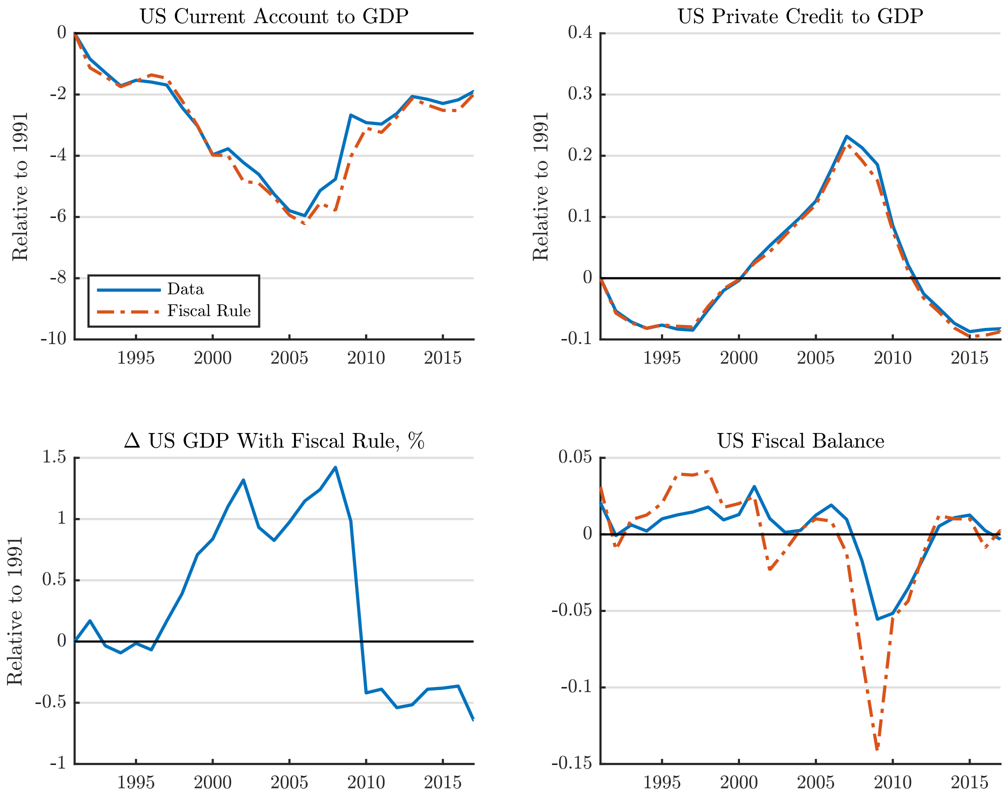
by only 6 percentage points by 2008. The current account to GDP balance would not have fallen by the same amount as observed under this macroprudential policy and would have been smaller by almost 2 percentage points by 2006. Real GDP would not have changed much compared to the actual data, reflecting the relatively small role that credit shocks have in explaining aggregate output in our estimated model. Moreover, there are no significant interactions between tighter macroprudential policies and the fiscal balance, since government spending is primarily driven by exogenous government spending shocks in the estimated model.

5.3 Fiscal Policy

We next study alternative settings of fiscal policy and how they can influence the dynamics of debt, GDP, and the current account. Recall that in our baseline specification, government spending adjusts in line with changes in output, subject to an autoregressive innovation. We study a countercyclical fiscal rule in which government spending responds also to contemporanous consumption growth:

$$g_t = \frac{g}{y} y_t - \phi_g \log \frac{c_t}{c_{t-1}} + \xi_{g,t}, \tag{37}$$

Figure 8: Fiscal Rule Responding to Consumption Growth

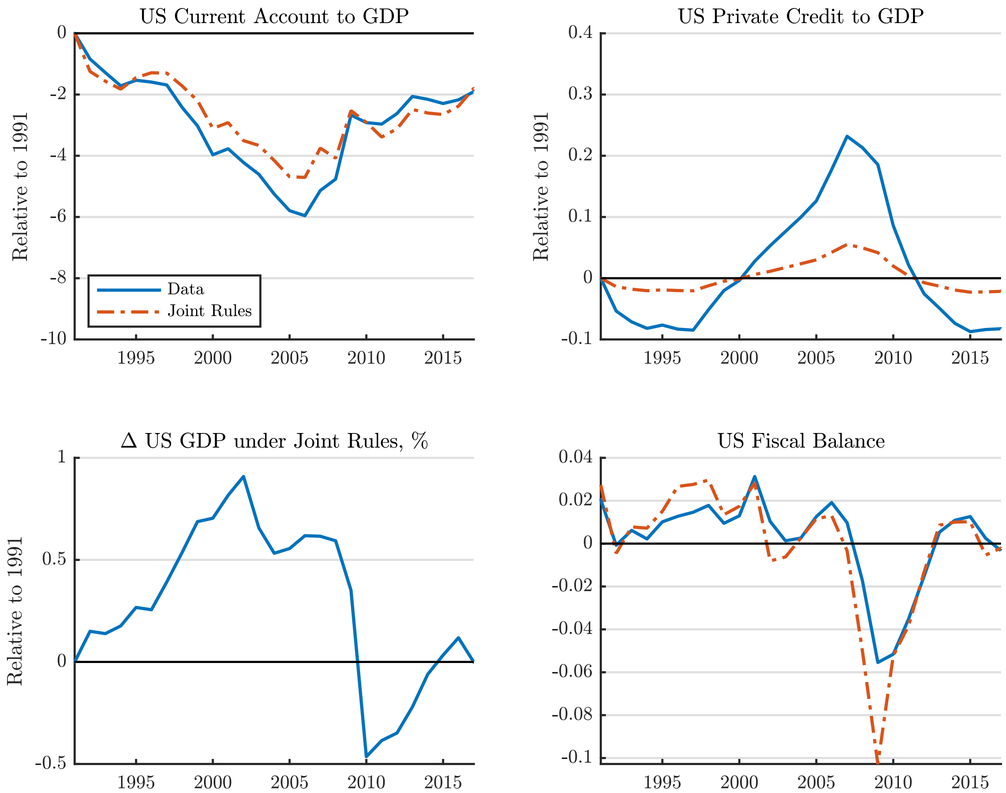


where ϕ_g parameterizes the extent to which government spending leans against consumption growth.[27] Optimal policy yields a value of $\phi_g = 2.1$, as we report in the Appendix. As in the counterfactual examining the macroprudential rule, we impose the candidate fiscal rule from 1991 onwards.

Figure 8 plots the paths of the variables under the fiscal rule (37) parameterized at its optimal value. Under this setting of fiscal policy, the current account deficit would contract in general up until 2007 while the path of private credit-GDP is similar to that observed. On average, a more countercyclical fiscal policy would have slightly lowered the U.S. current account deficit between 1995 and 2000, as it would have withdrawn domestic demand in periods where the economy was growing. In contrast, in the 2001 recession and the Great Recession, fiscal policy would call for a substantially more expansionary stance and where GDP in the U.S. would have benefitted from fiscal policy offsetting the large negative growth rate observed in 2009: in this period, the current account deficit would have been a larger by up to 1.5 percentage points, although the subsequent fiscal consolidation would have

[27] We also tried other specifications where the fiscal rule reacted to the level and growth rate of real GDP, final goods production and employment, either contemporaneous or lagged. The rule that aims at stabilizing consumption growth delivered improvements in welfare when active so we report the results in this section. Other results are available upon request.

Figure 9: Joint Macroprudential and Fiscal Rules



eventually narrowed the current account deficit towards the end of the sample.

The fourth panel of Figure 8 plots the fiscal balance in the data and in the counterfactual under the rule, which shows that during recessions the fiscal rule would have lead to larger fiscal deficits, including during the 2009 to 2010 period, where the U.S. fiscal deficit would have been almost three times as negative. In contrast, this rule would have called for faster fiscal consolidation in the boom years of 1991-2000.

5.4 Joint Macroprudential and Fiscal Policy

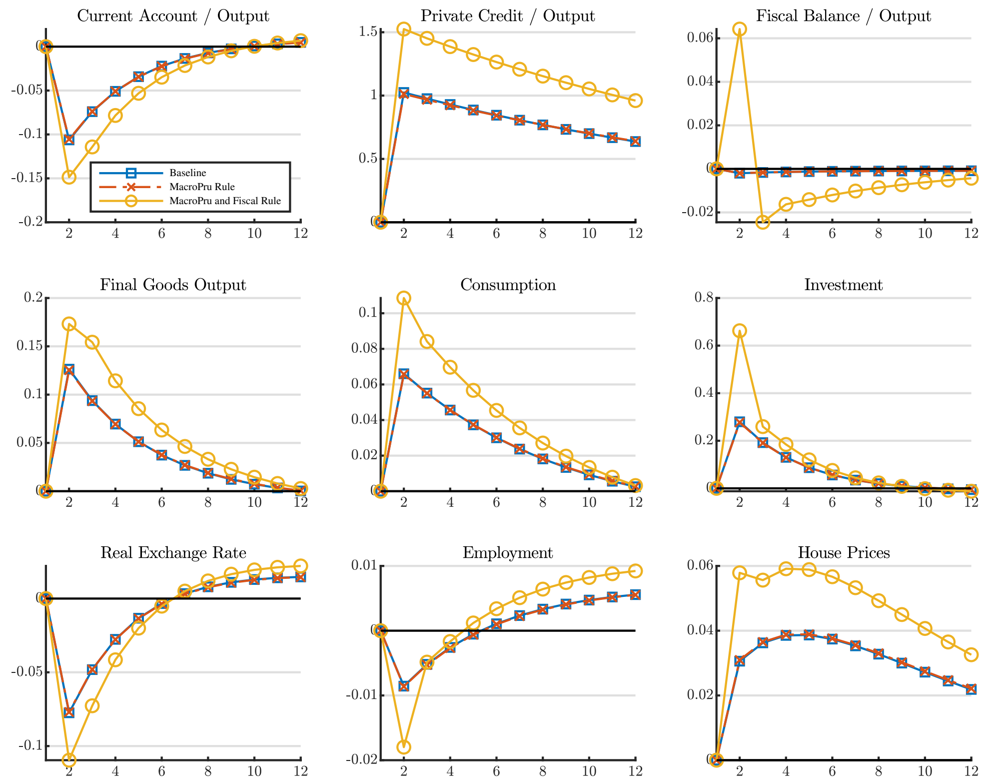
Given the sometimes contrasting behavior of the counterfactual current account series under macroprudential and fiscal policies, we finally consider the situation where policymakers jointly operate macroprudential and fiscal policies. In particular, we explore the case in which policymakers follow the macroprudential rule (36) that responds to deviations in private credit-to-GDP together with the fiscal rule (37) in which government spending responds to consumption growth. In assigning optimal coefficients, we maximize welfare with a grid search over the joint parameter space (ϕ_m, ϕ_g).

As we show in the Appendix, in maximizing welfare, we find that the optimal coefficients are $(\phi_m = 3.0, \phi_g = 1.25)$. In this case, when both policies are active, the optimal fiscal policy response is slightly smaller compared to when fiscal policy operates alone, indicating that, in maximizing welfare, more active macroprudential policies can call for less active fiscal policy. The counterfactual paths of the U.S. current account, U.S. private credit to GDP, the change in U.S. GDP, and the U.S. fiscal balance are shown in Figure 9. When both rules operate, the U.S. current account deficit would have peaked at 4.8 percent of GDP in the aftermath of the financial crisis, driven by a substantial fiscal stimulus. Towards the end of the sample, the U.S. current account would have narrowed towards the level observed, but would have been more in deficit, on average, over the post-2009 period.

To understand better how the macroprudential and fiscal rules operate in our model, we study the response of the economy to a credit shock that raises the credit to GDP ratio by 1 percent. As we showed above in Figure 1, consumption and output rise following the expansion of credit, and the current account moves into deficit. We next impose the macroprudential rule (36) that responds to deviations in private credit to GDP from its steady-state value, parameterized at its welfare-maximizing value. Under this rule, we find a larger credit shock that moves the credit to GDP ratio by 1 percent on impact – the same value as in the baseline impulse response – and plot the response of the economy in the red line in Figure 10. As shown, the path of the economy under the studied macroprudential rule is essentially indistinguishable from the baseline response for a given response of credit. This illustrates how, in our estimated model, the macroprudential rule we examine acts by directly dampening the effects of credit shocks.

The third line that we show on Figure 10 turns on both the macroprudential rule and the fiscal rules, parameterized at their jointly optimal values, and shows the response of the economy under the credit shock that which would have delivered a rise in credit to GDP of 1 percent under the macroprudential rule alone. Thus, comparing the red and yellow lines illustrates the effect of turning on the fiscal rule, with parameters set to their optimal values. With a sharp rise in consumption in response to the credit shock, fiscal policy is initially counter-cyclical, running a small surplus of about 0.06 percent. Despite fiscal policy acting against stronger demand, the less active macroprudential response under the jointly optimal parameterization leads to a wider current account deficit relative to the baseline, with the current account to GDP ratio falling by an additional 0.05 percentage points. The jointly optimal response thus accommodates more of the credit shock than under the macroprudential rule alone.

Figure 10: Impulse Response to Credit Shock Under Macroprudential and Fiscal Rules



Notes: This figure shows the response of model variables to a one standard deviation U.S. credit shock in the baseline model and the model with macroprudential and/or fiscal rules. The real exchange rate is equal to P_t^*/P_t, so a rise in the real exchange rate represents a depreciation of the U.S. dollar vis-a-vis the ROW currency composite.

6 Conclusion

This paper has shown that there is a strong link between credit cycles, fiscal policies and global imbalances. Using a sample of 49 advanced and emerging economies, we have shown that the credit cycle has an important impact on a country's currency account: when credit increases, the current account deteriorates; when credit declines, the current account improves. We have also confirmed the results for the "twin deficits" literature, showing that fiscal and current account balances comove positively in the data.

To dig deeper into these relationships for the case of the U.S., we have used an estimated two-country DSGE model with credit, financial frictions and fiscal policy and analyzed the role of credit, productivity and government spending shocks. The model is estimated using a Generalized Method of Moments methodology that aims at matching particular features of the data that we are interested in, such as the comovement between credit, fiscal policy, and the current account. Our findings suggest that credit market shocks are a main driver of the U.S. current account, with about roughly one-third of the volatility of the U.S current account driven by domestic credit market shocks and another one-third driven by foreign credit market shocks. U.S. fiscal shocks explain about 21 percent of the U.S. current account volatility. Absent these domestic shocks, the level and volatility of the U.S. current account deficit would have been smaller during the last three decades. In the last part of the paper, we studied U.S. macroprudential policy rules that aim to stabilize the domestic credit cycle, and U.S. fiscal policy rules that aim to stabilize the business cycle, would also help in lowering the level and volatility of the U.S. current account. This result is important because it shows how policies that have domestic objectives have implications for global imbalances.

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