Credit Cycles, Fiscal Policy, and Global Imbalances*

Callum Jones[†] Pau Rabanal[‡]

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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 34 percent of U.S. current account balance fluctuations are due to domestic credit shocks, while fiscal shocks explain about 18 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

Keywords: Current account balances, credit cycles, fiscal policy, macroprudential policies.

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†Division of Monetary Affairs, Federal Reserve Board. Constitution Ave NW & 20th St NW, Washington, DC 20551. Email: callum.j.jones@frb.gov

‡Research Department, International Monetary Fund. 700 19th St NW, Washington, DC 20431. Email: prabanal@imf.org

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

[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. (2021) 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).

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 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 38 advanced and emerging economies. 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, although there is important heterogeneity across countries when studying these relationships.

We next use this evidence to motivate the use of a two-country international

[4]See also Mian and Sufi (2011, 2014); Mian et al. (2013); Jones et al. (2020).

real business cycle model (in the spirit of Heathcote and Perri, 2002) with financial frictions (as in Jones et al., 2020) 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 that includes main advanced economies, using a Generalized Method of Moments approach (as in Andreasen et al., 2018). Importantly, the model has a flexible specification that allows for the strength of the credit channel to be determined in the estimation. The estimated model is successful at matching the comovement between credit, fiscal policy and the current account, and can be used to understand the drivers of the U.S. current account balance. We find that about 34 percent of the U.S. current account balance fluctuations are due to domestic credit shocks, and about 37 percent are explained by foreign credit shocks, while the importance of U.S. and foreign fiscal shocks is somewhat smaller, at about 18 and 9 percent, respectively. We find that, absent U.S. credit and fiscal shocks, the U.S. current account deficit would have been much smaller and less volatile, especially during the 1995-2006 period when the deficit grew from less than 2 percent of GDP to almost 6 percent of GDP.

In the final section of the paper, we evaluate a simple macroprudential policy rule 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 countercylical fiscal policy rule that aims to stabilize domestic consumption growth would also modestly reduce the level of the U.S. current

[5] Cesa-Bianchi et al. (2018) use a two-country macroeconomic model with financial frictions to understand the transmission of international credit shocks.

[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).

account on average since 1991. Moreover, the joint implementation of countercyclical macro-prudential 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 current 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.

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 extensive 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, and this relationship is robust to alternatives ways of filtering the credit data to extract its cyclical component. 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).

[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.

2.1 Credit and the Current Account

We estimate a measure of cyclical fluctuations of the credit to GDP ratio (i.e. the credit gap) by applying the methodology developed by the Bank for International Settlements (BIS). We use the filtered credit to GDP series to study the relationship between the cyclical component of credit and the current account at the annual frequency. The BIS methodology, explained in Drehmann et al. (2011), consists in applying a one-sided Hodrick-Prescott filter to the private sector credit to GDP ratio with a large penalty parameter.[8] Then, we study the comovement between the credit gap and the current account balance to GDP ratio.[9]

Table 1 presents the results for a sample of 38 systemic economies, including both advanced and emerging economies, for the 1986-2017 period. For a large majority of countries, the contemporaneous correlation between the credit gap and the current account is negative (in 31 out of 38 countries). On average, the contemporaneous correlation between the credit gap and the current account is -0.41, with small differences between the group of advanced economies (-0.38) and emerging and developing economies (-0.45). The corresponding median values show an even stronger negative correlation between the credit gap and the current account (-0.56 for advanced economies and -0.51 for emerging market and developing economies). While there is some cross-country heterogeneity, on average, the peak correlation occurs when $k = 0$, which means that the strongest comovement occurs contemporaneously.

Figure 1 presents the scatterplot for a group of selected advanced economies, where each dot denotes one annual observation. The correlation is large and

[8] Drehmann et al. (2011) suggest using a penalty value (a "lambda") of 400,000 using quarterly data. Since we use annual data, we use a penalty parameter of 25,000 in the one-sided Hodrick and Prescott filter.

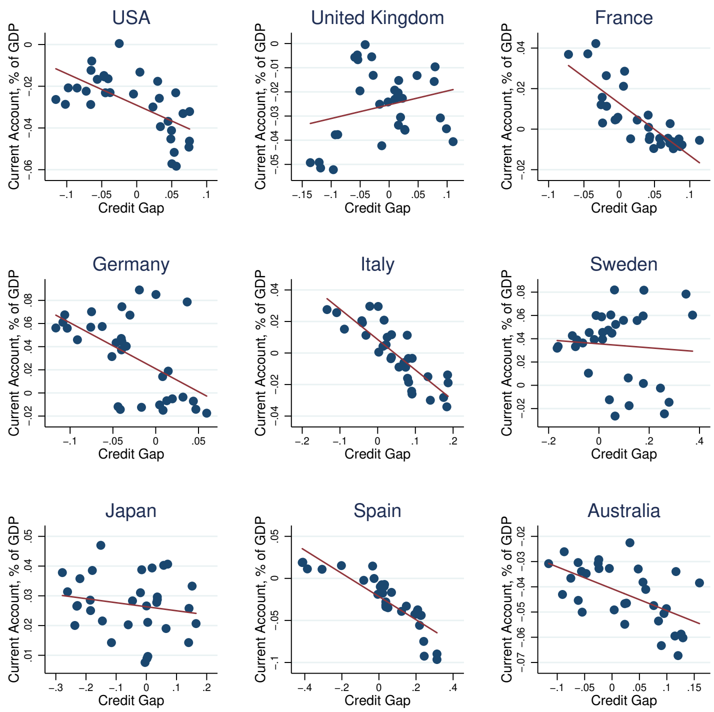
[9] The literature on the effects of credit booms and busts proceeds as follows. First, a credit boom phase and a credit bust phase is identified in the data. Then, the behavior of main macroeconomic variables is studied around those credit booms and busts (see Mendoza and Terrones, 2012, and Gourinchas et al., 2001, for details). We take a complementary approach by studying the relationship between the cyclical component of credit and the current account at all times, without having to date when credit booms and busts occur. Our results are qualitatively similar to this literature.

Table 1: Correlation, Credit Gap at $t+k$ and the Current Account at t

Country \ k	-3	-2	-1	0	1	2	3
Argentina	-0.50	-0.67	-0.64	-0.40	-0.32	-0.41	-0.28
Australia	-0.12	-0.29	-0.46	-0.57	-0.44	-0.31	-0.24
Austria	0.03	0.05	0.07	0.08	0.08	0.00	-0.08
Belgium	0.17	0.24	0.23	0.13	0.34	0.30	0.27
Brazil	0.24	0.26	0.15	-0.16	-0.47	-0.49	-0.30
Canada	-0.28	-0.36	-0.51	-0.67	-0.69	-0.61	-0.52
Chile	-0.42	-0.34	-0.35	-0.37	-0.29	-0.16	-0.13
China	0.00	-0.20	-0.45	-0.66	-0.68	-0.54	-0.28
Colombia	-0.47	-0.64	-0.79	-0.78	-0.63	-0.45	-0.35
Czech Republic	0.24	0.32	0.33	0.37	0.57	0.70	0.75
Denmark	-0.45	-0.53	-0.57	-0.58	-0.50	-0.36	-0.15
Finland	-0.01	-0.26	-0.48	-0.63	-0.71	-0.74	-0.71
France	-0.53	-0.66	-0.80	-0.81	-0.77	-0.70	-0.60
Germany	-0.54	-0.55	-0.56	-0.55	-0.59	-0.56	-0.49
Greece	-0.88	-0.91	-0.89	-0.81	-0.65	-0.43	-0.21
Hungary	-0.73	-0.63	-0.51	-0.35	-0.10	0.15	0.35
India	0.59	0.41	0.20	0.06	-0.06	-0.26	-0.42
Indonesia	-0.34	-0.56	-0.77	-0.82	-0.81	-0.69	-0.55
Ireland	0.24	-0.20	-0.45	-0.65	-0.73	-0.78	-0.79
Italy	-0.43	-0.67	-0.83	-0.85	-0.75	-0.55	-0.27
Japan	0.09	0.07	-0.02	-0.18	-0.34	-0.47	-0.51
Malaysia	-0.49	-0.67	-0.76	-0.73	-0.62	-0.56	-0.57
Korea	-0.08	-0.29	-0.37	-0.13	0.13	0.12	0.03
Mexico	-0.09	-0.31	-0.53	-0.72	-0.72	-0.65	-0.49
Netherlands	-0.04	-0.20	-0.23	-0.12	-0.08	-0.15	-0.27
Norway	0.47	0.33	0.11	-0.08	-0.02	0.09	0.12
Peru	-0.51	-0.58	-0.65	-0.60	-0.44	-0.26	-0.08
Poland	-0.32	-0.44	-0.50	-0.64	-0.59	-0.42	-0.19
Portugal	-0.52	-0.68	-0.74	-0.77	-0.74	-0.71	-0.69
Russia	0.52	0.33	0.15	0.05	0.06	-0.08	-0.32
South Africa	0.46	0.34	0.17	0.07	0.13	0.27	0.33
Spain	-0.44	-0.64	-0.79	-0.86	-0.86	-0.78	-0.65
Sweden	0.36	0.25	0.09	-0.07	-0.19	-0.29	-0.34
Switzerland	-0.02	-0.15	-0.25	-0.18	-0.12	-0.23	-0.29
Thailand	-0.59	-0.67	-0.61	-0.43	-0.23	-0.08	0.02
Turkey	-0.74	-0.76	-0.79	-0.81	-0.68	-0.59	-0.55
United Kingdom	0.32	0.25	0.24	0.25	0.26	0.26	0.25
United States	-0.42	-0.60	-0.69	-0.64	-0.54	-0.42	-0.30
Full sample, Mean	-0.16	-0.28	-0.38	-0.41	-0.36	-0.31	-0.25
Full sample, Median	-0.20	-0.32	-0.49	-0.56	-0.46	-0.41	-0.29
AEs, Mean	-0.13	-0.25	-0.34	-0.38	-0.33	-0.30	-0.26
AEs, Median	-0.06	-0.27	-0.46	-0.56	-0.47	-0.39	-0.28
EMDEs, Mean	-0.21	-0.32	-0.42	-0.45	-0.40	-0.33	-0.24
EMDEs, Median	-0.38	-0.50	-0.52	-0.51	-0.46	-0.41	-0.29

Sources: IMF World Economic Outlook database, Bank for International Settlements, World Development Indicators and authors' calculations.

Figure 1: Correlation between the Credit Gap and the Current Account



Sources: IMF World Economic Outlook database, Bank for International Settlements, World Development Indicators and authors' calculations.

negative for countries that experienced a credit boom and bust together with large changes in their current accounts, such as Spain (−0.86) and the United States (−0.64). In other countries with milder credit fluctuations, such as France, Germany, and Italy, the correlation is also large and negative, ranging from −0.55 to −0.85. In a few cases, the correlation is weaker, such as in Sweden (−0.07) and Japan (−0.18), or even mildly positive (United Kingdom, 0.25). Table 1 shows that this relationship also holds for important emerging economies such as China (−0.66), Colombia (−0.78), Malaysia (−0.73), Mexico (−0.72), Thailand (−0.43) and Turkey (−0.81).

The relationship between the cyclical component of credit to GDP and the current account is robust to how the credit to GDP series is filtered. As an alternative to the BIS-style credit gap, we also study the correlation between the cumulative annual change in the credit to GDP ratio, using a window of 1 to 3 years, and the current account. By using a wider window, we check whether persistent changes in the credit to GDP ratio that occur over a few years have a stronger effect on the current account than simply one-year fluctuations. We report these statistics in Tables A.1 to A.3 in the Appendix. For all cases, the correlation is negative, and it becomes more so when the window considered is three years. For the entire sample, the average correlation between the annual change in the credit to GDP ratio and the current account to GDP ratio is -0.34, while the correlation between the 3-year cumulative change in the credit to GDP ratio and the current account to GDP ratio is -0.39.

2.2 The Fiscal Balance and the Current Account

Next, we revisit the role of fiscal policy in affecting the current account. Table 2 presents, for the same country and time sample, the correlation between the fiscal balance and the current account at an annual frequency. For a majority of countries (31 out of 38 countries), this relationship is positive: fiscal deficits go hand-in-hand with current account deficits, a fact labelled "twin deficits" in the literature.[10] This relationship is stronger in advanced economies, where the average correlation is 0.29, than in emerging markets and developing economies, where the correlation is 0.08, although median correlations are more similar (0.29 vs 0.25).

Figure 2 presents the scatterplot for the same group of economies as in Figure 1. In most cases, the correlation is positive and ranges from 0.84 in Sweden, 0.61 in Germany, about 0.40 in France and Italy, 0.33 in Japan and 0.29 in the United States. On the other hand, Spain (0.01) and Australia (-0.33) are exceptions among the group of selected advanced economies. Finally, it is important to remark that this relationship is somewhat weaker in emerging and developing economies, although it is positive in Brazil (0.26), China (0.45), Colombia (0.28) and Peru (0.38).

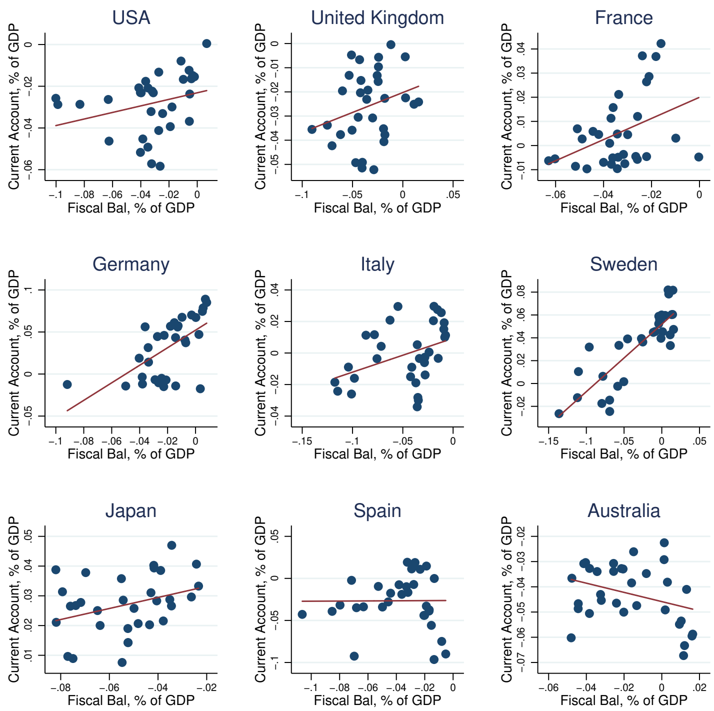
[10] For empirical evidence on the link between the fiscal balance and the current account see Abbas et al. (2011), Gruber and Kamin (2007), and Cubeddu et al. (2019).

Table 2: Correlation, Fiscal Balance at $t+k$ and the Current Account at t

Country \ k	-3	-2	-1	0	1	2	3
Argentina	0.37	0.65	0.65	0.52	0.14	0.06	0.05
Australia	0.21	-0.13	-0.28	-0.33	-0.47	-0.44	-0.38
Austria	0.04	-0.04	0.16	0.27	0.39	0.36	0.37
Belgium	0.34	0.28	0.19	0.07	-0.05	-0.18	-0.29
Brazil	0.48	0.52	0.44	0.26	0.17	0.02	-0.12
Canada	0.57	0.65	0.71	0.70	0.63	0.54	0.45
Chile	0.06	0.20	0.34	0.24	0.04	-0.06	-0.05
China	0.35	0.30	0.33	0.45	0.42	0.29	-0.02
Colombia	0.33	0.40	0.43	0.28	-0.03	-0.37	-0.49
Czech Republic	0.31	0.55	0.62	0.43	0.68	0.53	0.04
Denmark	0.26	0.15	0.12	0.16	0.13	0.13	0.26
Finland	0.70	0.67	0.61	0.54	0.44	0.33	0.17
France	0.35	0.49	0.44	0.40	0.37	0.29	0.17
Germany	0.49	0.53	0.58	0.61	0.54	0.45	0.37
Greece	0.16	0.34	0.46	0.47	0.37	0.23	0.01
Hungary	0.28	0.36	0.54	0.69	0.71	0.57	0.30
India	-0.16	-0.20	-0.23	-0.18	-0.19	-0.15	-0.11
Indonesia	0.17	0.27	0.22	0.19	0.09	0.11	0.15
Ireland	0.78	0.58	0.50	0.28	0.08	-0.05	-0.15
Italy	0.23	0.32	0.38	0.39	0.30	0.16	-0.04
Japan	-0.32	-0.14	0.20	0.33	0.26	0.06	-0.20
Korea	-0.06	0.20	0.04	0.01	-0.14	-0.16	-0.20
Malaysia	-0.61	-0.78	-0.82	-0.59	-0.50	-0.37	-0.27
Mexico	0.03	0.11	-0.15	-0.29	-0.36	0.10	0.32
Netherlands	0.35	0.35	0.29	0.15	0.01	-0.23	-0.12
Norway	0.31	0.27	0.32	0.35	0.37	0.37	0.46
Peru	0.42	0.57	0.42	0.38	0.27	0.17	0.29
Poland	-0.23	-0.19	-0.16	0.27	0.19	0.26	-0.11
Portugal	0.22	0.27	0.18	0.13	0.00	-0.27	-0.39
Russia	0.43	0.56	0.65	0.65	0.41	0.03	-0.10
South Africa	-0.03	-0.14	-0.30	-0.38	-0.37	-0.32	-0.30
Spain	0.48	0.41	0.28	0.01	-0.28	-0.46	-0.61
Sweden	0.90	0.93	0.90	0.84	0.76	0.67	0.59
Switzerland	0.61	0.50	0.28	0.08	-0.03	-0.06	-0.04
Thailand	-0.07	-0.22	-0.53	-0.70	-0.69	-0.61	-0.44
Turkey	-0.34	-0.34	-0.36	-0.31	-0.21	-0.29	-0.12
United Kingdom	0.51	0.47	0.34	0.27	0.24	0.23	0.33
United States	0.75	0.60	0.42	0.29	0.15	0.03	-0.09
Full sample, Mean	0.26	0.27	0.24	0.21	0.13	0.05	-0.01
Full sample, Median	0.31	0.33	0.32	0.27	0.15	0.06	-0.04
AEs, Mean	0.37	0.37	0.35	0.29	0.22	0.11	0.03
AEs, Median	0.35	0.38	0.33	0.29	0.25	0.15	-0.01
EMDEs, Mean	0.09	0.13	0.09	0.09	0.01	-0.03	-0.06
EMDEs, Median	0.12	0.23	0.27	0.25	0.06	0.02	-0.11

Sources: IMF World Economic Outlook database and authors' calculations.

Figure 2: Correlation between the Fiscal Balance and the Current Account



Sources: IMF World Economic Outlook database and authors' calculations.

3 Model

The empirical analysis in the previous section provides suggestive evidence using bilateral correlations. 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 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. (2020). 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*.[11]

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

[11] As discussed in Jones et al. (2020) 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. What is important is to match the evolution of the quantity of debt and have a mechanism which affects the portfolio choice households face when allocating resources between liquid and illiquid assets.

intertemporally following a shock. We will use the cross-country comovement in household debt 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 dollar change in credit can lead one-for-one to a dollar change in consumption, giving rise to a tight connection between changes in credit and real variables.[12] 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.

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}:

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

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

$$\log \xi_{z,t} = \rho_z \log \xi_{z,t-1} + \sigma_z \varepsilon_{z,t}, \tag{2}$$

[12] Ferrero (2015), for example, finds in an experiment loosening borrowing constraints, that there is an strong negative correlation (-0.98) between house prices and the current account.

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:

$$r_t = \xi_{z,t} \frac{P_t^H}{P_t} \omega \left(\frac{n_t}{k_{t-1}} \right)^{1-\omega}, \tag{3}$$

while wages equal the marginal product of labor:

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

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

$$y_t = \left[\kappa^{\frac{1}{\sigma}} \left(y_t^H \right)^{\frac{\sigma-1}{\sigma}} + (1-\kappa)^{\frac{1}{\sigma}} \left(y_t^F \right)^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}, \tag{5}$$

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:

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

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

$$y_t = c_t + k_t - (1-\delta) k_{t-1} + \frac{\phi_k}{2} k_{t-1} \left(\frac{k_t}{k_{t-1}} - 1 \right)^2 + g_t, \tag{7}$$

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:

$$\tilde{y}_t = y_t^H + y_t^{H*}. \tag{8}$$

3.2 Households

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

$$\max \sum_{t=0}^{\infty} \beta^t \left(\int v_{it} \log c_{it} \, \mathrm{d}i + \eta^h \log h_t - \frac{1}{1+\nu} n_t^{1+\nu} \right), \tag{9}$$

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

$$\Pr(v_{it} \leq v) = 1 - v^{-\alpha}. \tag{10}$$

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:

$$P_t x_t + e_t (h_{t+1} - h_t) + P_t i_t = w_t n_t + r_t k_{t-1} + q_t b_{t+1} - b_t + a_t - P_t \mathrm{tax}_t + b_t^g - \frac{1}{R_t} b_{t+1}^g, \tag{11}$$

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:

$$i_t = k_t - (1-\delta)k_{t-1} + \frac{\phi_k}{2} k_{t-1} \left(\frac{k_t}{k_{t-1}} - 1 \right)^2 . \tag{12}$$

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:

$$q_t a_{t+1} = P_t \left(x_t - \int c_{it}\, \mathrm{d}i \right) . \tag{13}$$

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

$$P_t x_t \geq P_t c_{it}. \tag{14}$$

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

$$q_t b_{t+1} \leq m_t e_t h_{t+1}, \tag{15}$$

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:

$$\log m_t = (1-\rho_m) \log \bar{m} + \rho_m \log m_{t-1} + \sigma_m \varepsilon_{m,t}, \tag{16}$$

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

$$a_t + a_t^* = b_t + b_t^*. \tag{17}$$

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):

$$\text{Current Account}_t = \left(P_t^H y_t^{H*} - P_t^F y_t^F\right) + \left(\frac{1}{q_{t-1}} - 1\right)(a_{t-1} - b_{t-1}). \quad (18)$$

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:

$$\frac{\text{tax}_t}{y_t} = \frac{\text{tax}}{y} + \phi_b \left(\frac{b_{t+1}^g}{P_t y_t} - \frac{b^g}{Py}\right), \quad (19)$$

and that the government spending rule is:

$$g_t = \frac{g}{y} y_t + \xi_{g,t}, \quad (20)$$

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

$$\log \xi_{g,t} = \rho_g \log \xi_{g,t-1} + \sigma_g \varepsilon_{g,t}, \quad (21)$$

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

$$\frac{1}{R_t} b_{t+1}^g - b_t^g = P_t g_t - P_t \text{tax}_t. \quad (22)$$

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^g_{t+1}. 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

$$P_t\mu_t = \frac{\beta}{q_t}P_t\mathbb{E}_t\mu_{t+1} + P_t\int_0^1 \xi_t(v)\,\mathrm{d}F(v), \tag{23}$$

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

$$q_t\mu_t = \beta\mathbb{E}_t\mu_{t+1} + q_t\lambda_t, \tag{24}$$

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:

$$\frac{1}{R_t}\mu_t = \beta\mathbb{E}_t\mu_{t+1}. \tag{25}$$

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 (23) and (24), and reflects how binding the liquidity and borrowing constraints are.

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

$$\lambda_t m_t e_t + \beta\eta^h\mathbb{E}_t\frac{1}{h_{t+1}} + \beta\mathbb{E}_t e_{t+1}\mu_{t+1} = \mu_t e_t. \tag{26}$$

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

$$c_t(v) = \min \left[\frac{v}{\frac{\beta}{q_t} P_t \mathbb{E}_t \mu_{t+1}}, x_t \right], \tag{27}$$

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

$$\underline{c}_t = \frac{1}{\frac{\beta}{q_t} P_t \mathbb{E}_t \mu_{t+1}}. \tag{28}$$

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

$$\frac{c_t}{\underline{c}_t} = \frac{\alpha}{\alpha - 1} \left[1 - \frac{1}{\alpha} \left(\frac{\underline{c}_t}{x_t} \right)^{\alpha - 1} \right]. \tag{29}$$

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

$$P_t\mu_t + \phi_k P_t\mu_t\left(\frac{k_t}{k_{t-1}} - 1\right) = \beta\mathbb{E}_t\mu_{t+1}\left[P_{t+1}(1-\delta) + r_{k,t+1}\right] + \beta\frac{\phi_k}{2}\mathbb{E}_t P_{t+1}\mu_{t+1}\left(\frac{k_t^2}{k_{t-1}^2} - 1\right), \quad (30)$$

and the optimal choice of labor supply is:

$$n_t^{\nu} = \mu_t w_t. \quad (31)$$

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 other advanced economies is the rest of the world or foreign country. The focus of the empirical analysis is to study how credit and fiscal policy comove with the current account in the United States.

The "rest of the world" (ROW) aggregate includes: Australia, Canada, France, Germany, Italy, Japan, Spain, Sweden, and the United Kingdom. The sample period is 1980-2017 at annual frequency. 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.[13] Using real growth data allows to identify the effects of productivity shocks in the model.

The ROW aggregation is done as follows: the fiscal 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. 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 measure of the ROW does not include all other countries that trade with the U.S.

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 co-movement 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 stan-

[13]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. As discussed in Section 2 and in the Appendix, the correlation between different transformations of the credit to GDP ratio and the current account is robust for the U.S.

dard deviation of the variables, the contemporaneous second moments and the persistence in the data. Denote by $\mathbf{M}_t$ the vector of moments to match:

$$\mathbf{M}_t \equiv \begin{bmatrix} \text{diag}(\mathbf{z}_t\mathbf{z}_t') \\ \text{vech}(\mathbf{z}_t\mathbf{z}_t') \\ \text{diag}(\mathbf{z}_t\mathbf{z}_{t-1}') \end{bmatrix}, \tag{32}$$

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:

$$\hat{\Theta}_{GMM} = \arg\min \left(\frac{1}{T}\sum_{t=1}^{T}\mathbf{M}_t - \mathbb{E}[\mathbf{M}(\Theta)]\right)' \mathbf{W} \left(\frac{1}{T}\sum_{t=1}^{T}\mathbf{M}_t - \mathbb{E}[\mathbf{M}(\Theta)]\right), \tag{33}$$

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]

Some parameters of the model are calibrated using external information while others are estimated. Table 3 presents the calibrated parameters of the model. The share of imports to GDP is set to 0.2 (corresponding to a κ of

[14]We use seven macroeconomic variables for estimation, while the model has six shocks. This is not an 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, an observation error shock is included in the ROW output growth equation.

Table 3: 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

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. (2020). 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 4 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 2.38, smaller than the estimate in Jones, Midrigan and Philippon (2020), and a value that implies a discount factor of 0.948 and a spread between the interest rate and the rate of time preference of about 3.5 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, as we will discuss below. The elasticity of substitution between home and foreign goods σ is estimated at 2.85, 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 stronger reaction of the U.S. tax revenues to deviations of government debt from steady-state values than its ROW counterpart. Finally, the parameter that governs investment adjustment costs is estimated at 5.48. 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 5 and 6 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 underestimates the volatility of the change in the credit to GDP ratio in the ROW, and overestimates the volatility of the fiscal balance in the ROW, but properly matches the volatility of the ROW real GDP growth. On the other hand, it does a poor job in matching the persistence of the credit to GDP change and real GDP growth in both the U.S. and the ROW, and falls short of matching the persistence of the U.S. current account and fiscal balance. The model is close to matching the persistence of the ROW fiscal balances.[15] The

[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.

Table 4: Estimated Parameters

	Parameter	Point Estimate	Std Dev
α	Dispersion of Taste Shocks	2.38	0.02
σ	Elasticity of Substitution H/F Goods	2.85	0.68
ϕ_b	U.S. Tax Response to Debt	0.16	0.07
ϕ_b^*	ROW Tax Response to Debt	0.09	0.04
ϕ_k	Investment Adjustment Costs	5.48	1.43
ρ_z	U.S. TFP AR(1) Parameter	0.70	0.16
ρ_z^*	ROW TFP AR(1) Parameter	0.76	0.13
ρ_m	U.S. Credit Shock AR(1) Parameter	0.999	0.03
ρ_m^*	ROW Credit Shock AR(1) Parameter	0.75	0.05
ρ_g	U.S. Fiscal Shock AR(1) Parameter	0.43	0.07
ρ_g^*	ROW Fiscal Shock AR(1) Parameter	0.74	0.09
σ_z	U.S. TFP Innovation Std. Dev.	1.06	0.09
σ_z^*	ROW TFP Innovation Std. Dev.	1.18	0.36
σ_m	U.S. Credit Shock Innovation Std. Dev.	4.04	0.42
σ_m^*	ROW Credit Shock Innovation Std. Dev.	8.33	0.42
σ_g	U.S. Fiscal Shock Innovation Std. Dev.	4.36	0.28
σ_g^*	ROW Fiscal Shock Innovation Std. Dev.	2.75	0.14
$\sigma_{\Delta y}^*$	Measurement Error, ROW Output Growth	0.58	0.95

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

estimated model also matches the main features of the U.S. current account. In particular, for the U.S., it matches the negative correlation between credit and the current account (-0.44 in the data and -0.30 in the model), and the positive correlation between the fiscal balance and the current account (0.46 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 -0.26 in the data and -0.29 in the model).

The estimated model also allows for a decomposition of the main sources of fluctuations. In Table 7 we present a variance decomposition exercise for the observable U.S. variables. 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

Table 5: Model Fit

	Data		Model	
Variable	Std. Dev.	Autocorr	Std. Dev.	Autocorr
Current Account/GDP, U.S.	1.51	0.86	1.15	0.52
Credit/GDP, Change, U.S.	3.04	0.62	3.47	-0.04
Fiscal Balance/GDP, U.S.	3.01	0.81	2.46	0.40
Real GDP Growth, U.S.	1.80	0.34	1.37	-0.12
Credit/GDP, Change, ROW	10.13	0.27	6.68	-0.13
Fiscal Balance/GDP, ROW	1.19	0.75	2.35	0.77
Real GDP Growth, ROW	1.51	0.36	1.56	-0.07

Table 6: Model Fit, Correlations

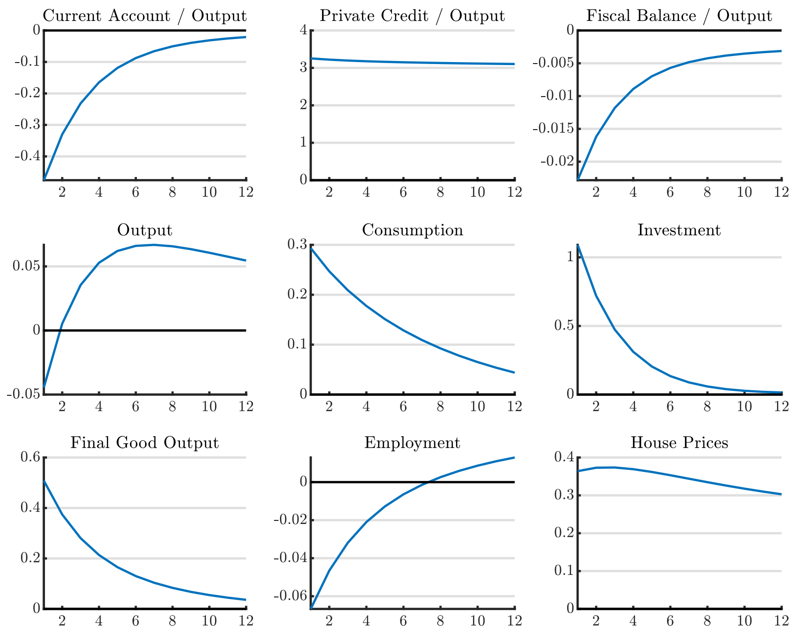
Correlation	Data	Model	Correlation	Data	Model
(CA, CRE)	-0.44	-0.30	(CRE*, GDP)	-0.15	0.03
(CA, CRE*)	-0.19	0.45	(CRE*, GDP*)	-0.02	-0.13
(CA, GDP)	-0.09	-0.12	(CRE*, FB)	-0.15	0.02
(CA, GDP*)	-0.04	0.09	(CRE*, FB*)	-0.17	0.06
(CA, FB)	0.46	0.43	(GDP, GDP*)	0.65	0.02
(CA, FB*)	-0.26	-0.29	(GDP, FB)	0.19	-0.15
(CRE, CRE*)	0.22	-0.11	(GDP, FB*)	0.28	0.01
(CRE, GDP)	0.19	-0.28	(GDP,* FB)	0.28	0.01
(CRE, GDP*)	0.20	0.02	(GDP*, FB*)	0.21	-0.07
(CRE, FB)	0.31	0.20	(FB, FB*)	0.33	-0.01
(CRE, FB*)	0.62	0.03			

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 7: Variance Decomposition

	Productivity		Credit		Gov Spending	
Observable Variables	U.S.	ROW	U.S.	ROW	U.S.	ROW
Current Account to GDP	0.4	0.6	33.7	37.5	18.4	9.3
U.S. Credit to GDP	2.9	0.0	87.8	0.3	8.9	0.2
U.S. GDP Growth	88.1	0.0	0.3	0.6	10.8	0.1
U.S. Fiscal Balance to GDP	0.4	0.0	0.0	0.0	99.5	0.0

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

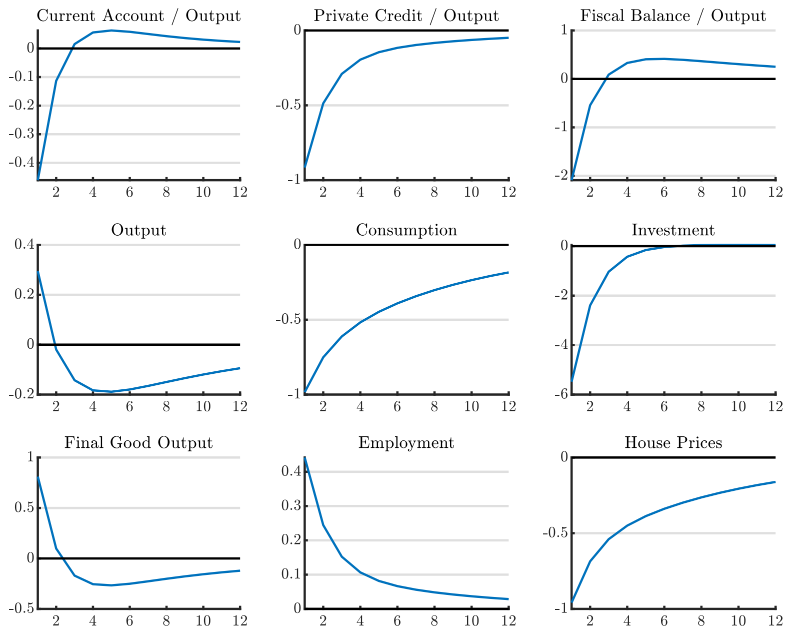


current account. Domestic fiscal shocks explain 18.4 percent of the U.S. current account fluctuations, while foreign fiscal shocks account for 9.3 percent. Productivity shocks, both in the U.S. and the ROW have a minor contribution. Interestingly, most of the fluctuations of the other three U.S. observable 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 one tenth of the fluctuations in U.S. credit and real growth.

4.3.2 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 3). The increased ability to borrow increases domestic consumption and investment, while output (understood as intermediate goods production) displays a hump-shaped response due to the initial decline of hours worked. As the level of employment increases and capital

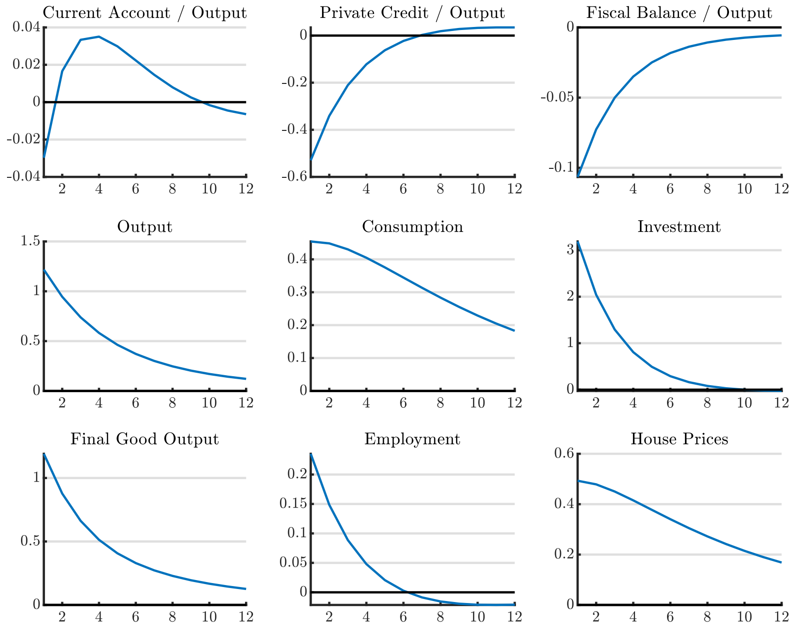
Figure 4: Impulse Responses to a U.S. Fiscal Shock



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 (-0.02 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 4): 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 0.2, 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) is about 0.15 on impact, while the multiplier on final goods production is about 0.3. These multipliers are smaller than the available

Figure 5: Impulse Responses to a U.S. Productivity Shock



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 5 presents the responses to an increase in U.S. productivity. The response of the current account is qunatitatively 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 -0.04 and 0.04 percent of GDP while output increases by more than 1 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, but the private credit to GDP ratio declines because of

Table 8: Moments Across α

Correlation	U.S. Data	$\alpha = 2.38$	$\alpha = 4$	$\alpha = 8$
Current Account, Δ Credit	-0.44	-0.30	-0.06	0.08

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 α in Estimated Model

In this subsection, we explore what features of the data help to identify α, the degree of idiosyncratic uncertainty, which is key in governing the impact of credit shocks on real variables. We report in Table 8 how changes in credit correlate with the current account for different values of α, holding fixed the other parameters at their estimated values. The first column reports these correlations in the data, while the third through fifth columns report their correlations at our estimated value of $\alpha = 2.38$ and for higher values of α.

As the table shows, with higher values of α, the correlation between the current account changes sign, from -0.30 at our estimated value to 0.08 at $\alpha = 8$. This is because, with lower α, the degree of idiosyncratic uncertainty increases, and the household values more liquid savings so as to smooth the marginal utilities of consumption across its members within each period. In response to a shock that reduces the availability of credit, the household finds it optimal to maintain its liquid asset holdings and instead cut consumption and imports. This generates the comovement between the current account and changes in credit observed. When the degree of idiosyncratic uncertainty is low (α is high), changes in credit have little effect, because the household prefers to use its liquid savings to smooth consumption intertemporally. In this case, the model cannot match the current account and credit comovement.

5 Credit Shocks, Fiscal Policy, and the Current Account

As the variance decomposition in Table 7 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 1991-2017 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 3 and 4 and the seven macroeconomic time series to apply standard Kalman smoother equations to extract the model's structural shocks.[16]

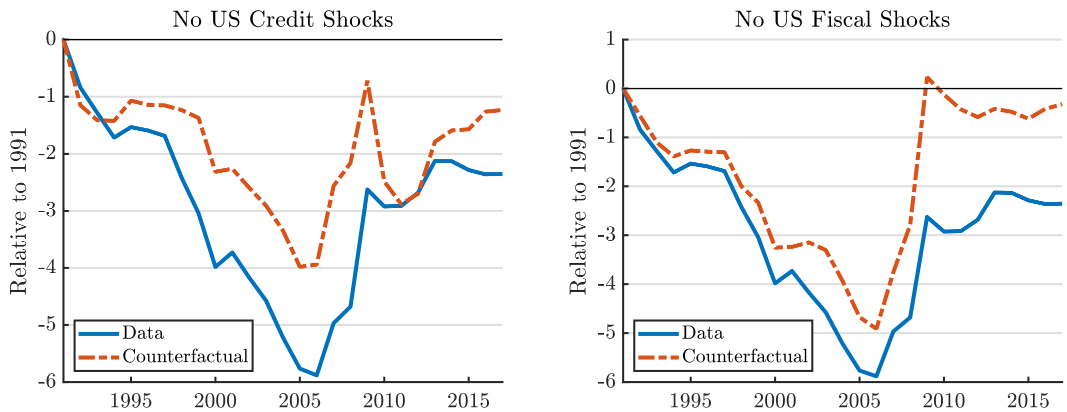
5.1 The Role of U.S. Credit and Fiscal Shocks

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

[16] See Harvey (1989). As explained in Section 4, since the model has six shocks and we are using seven macroeconomic time series, we included a measurement error shock in the ROW output growth measurement equation to avoid singularity issues. In extracting the model's shocks, to help replicate the level of debt to GDP in the data, we match the demeaned credit to GDP ratio in the data to the credit to GDP ratio relative to steady-state in the model. The structural shocks that we obtain are similar if we were to instead match the data used in estimation, i.e., the change in the debt to GDP ratio.

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



from 1991 onwards, that is, following the 1990 recession when the U.S. current account was roughly in balance.[17] Absent U.S. credit shocks over this period, the U.S. current account to GDP ratio would have fallen to −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 percent to −3 percent, similar to 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 in 2017, we find that credit shocks were again contributing to a larger U.S. current account deficit.

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 fallen to −4.9 percent, about 1 percentage point more positive than observed in 2006. The more significant U.S. fiscal expansion during the 2008-09 recession contributed, by itself, to about 3 percentage points of the U.S. current account to GDP deficit. Removing fiscal shocks over this period would have seen the current account turn positive in 2009 and remain close to a 1/2 percent of GDP deficit until the end of our sample.

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

5.2 Macroprudential Policies

We next consider the role of macroprudential policies, implemented as augmenting the borrowing constraint (15) as:

$$q_t b_t \leq \text{macropru}_t m_t e_t h_{t+1}. \tag{34}$$

The trivial case to insulate the economy from credit shocks would be for macroprudential policy to perfectly offset shocks to m_t. More realistically, 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.[18] We assume for simplicity that the U.S. regulator focuses on U.S. welfare taking the ROW as given.[19]

We explore a macroprudential rule that responds to the deviations in private credit to GDP from its steady-state value:[20]

$$\text{macropru}_t = 1 - \phi_m \left(\frac{q_t b_{t+1}}{\tilde{y}_t} / \frac{qb}{\tilde{y}} - 1 \right). \tag{35}$$

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 (35), the optimal value for the response is about $\phi_m = 5.1$.[21] The counterfactual series is shown in Figure 7. In line with the results presented in Figure 6 in which we removed U.S.

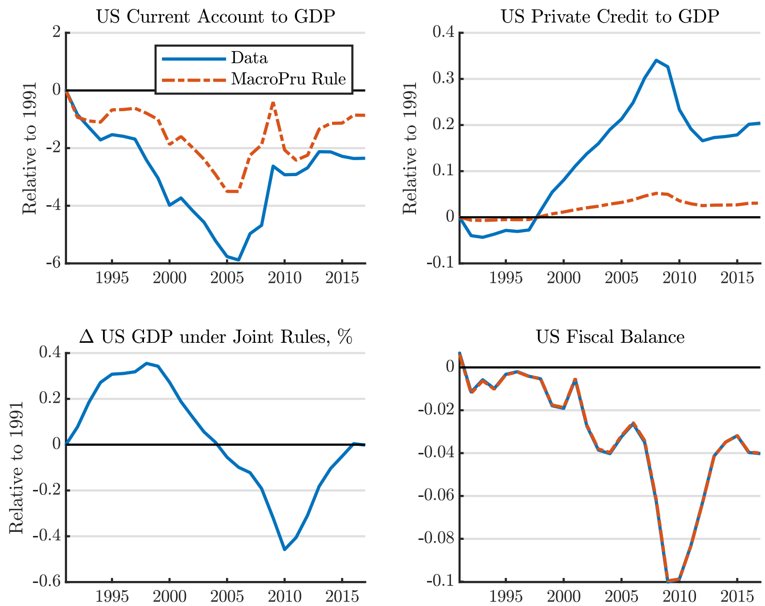
[18]The welfare function based on a second-order approximation to the household utility function is given in the Appendix.

[19]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.

[20]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.

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

Figure 7: Macroprudential Rule Responding to Household Debt

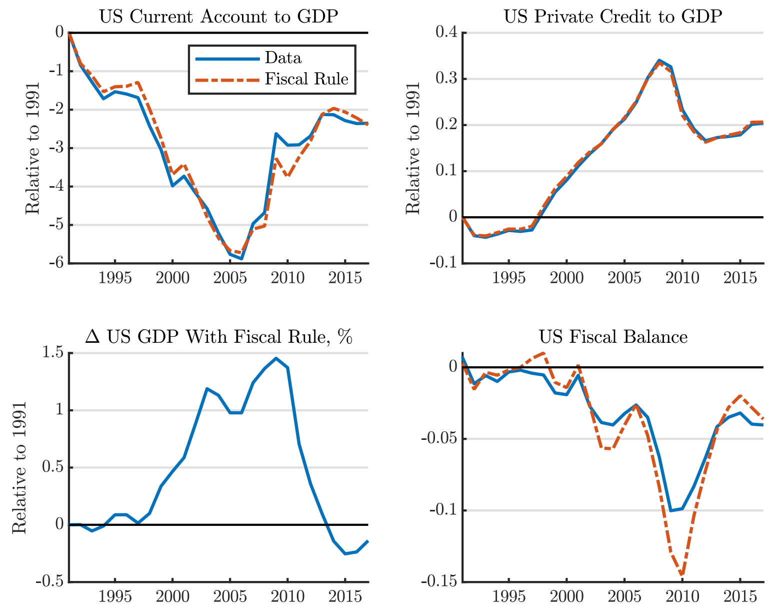


credit shocks, macroprudential policy in this case would work to ameliorate the impact of changes in credit. The private credit to GDP ratio would not have increased by the 37 percentage points observed between 1997 and 2008, and would instead have increased by only 6 percentage points by 2008. The current account to GDP balance would not have fallen by the same amount as observed under this macroprudential policy and would have been smaller by 2.4 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 this is assumed to be exogenous 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

Figure 8: Fiscal Rule Responding to Consumption Growth



output, subject to an autoregressive innovation. We study a countercyclical fiscal rule in which government spending responds also to lagged consumption growth:

$$g_t = \frac{g}{y} y_t - \phi_g \log \frac{c_{t-1}}{c_{t-2}} + \xi_{g,t}, \tag{36}$$

where ϕ_g parameterizes the extent to which government spending leans against consumption growth.[22] Optimal policy yields a value of $\phi_g = 1.3$, 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 (36) 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 slightly moderated compared to that observed. On average, a more countercyclical fiscal policy would have lowered the U.S. current account

[22]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 lagged consumption growth delivered improvements in welfare when active so we report the results in this section. Other results are available upon request.

deficit before the Great Recession, as it would have withdrawn domestic demand in periods where the economy was growing. The main exception to this is in the 2001 recession and the Great Recession, where fiscal policy calls for a 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 percentage points, although the subsequent fiscal consolidation would have eventually narrowed the current account deficit towards the end of the sample.

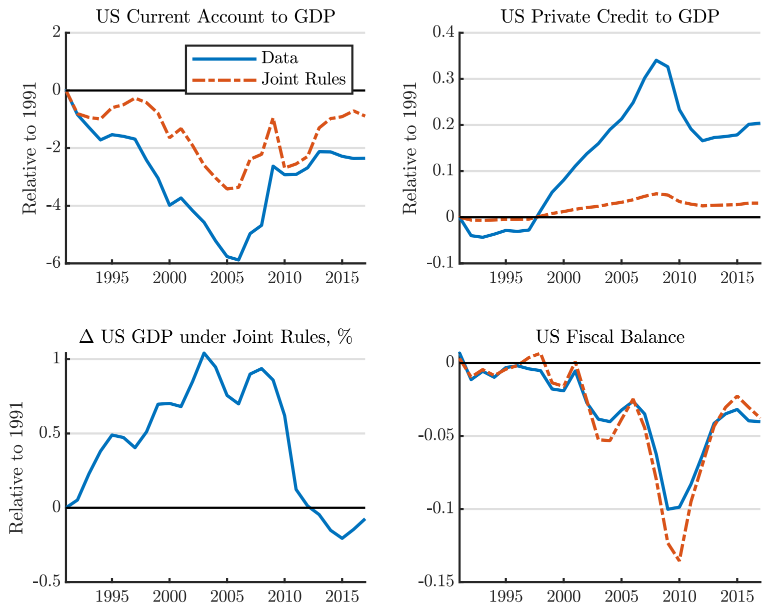
The fourth panel of Figure 8 plots the fiscal balance in the data and in the counterfactual under the rule, which shows that during recessions the fiscal rule would have lead to larger fiscal deficits, including during the 2009 to 2010 period, where the U.S. fiscal deficit would have been more negative by about 5 percentage points. This rule would have called for faster fiscal consolidation in the boom years of 1991-2000, and towards the end of the sample period.

5.4 Joint Macroprudential and Fiscal Policy

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 (35) that responds to deviations in household debt to GDP together with the fiscal rule (36) in which government spending responds to lagged consumption growth. In assigning optimal coefficients, we do 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 $(\phi_m = 5.1, \phi_g = 1.1)$. 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 stayed roughly in balance until the late-nineties, and it would have peaked at just over 3 percent

Figure 9: Joint Macroprudential and Fiscal Rules



of GDP in the mid-2000s. Towards the end of the sample, the U.S. current account would have converged to just under 1 percent of GDP. Therefore, the joint implementation of optimal macroprudential and fiscal rules would have significantly lowered the level and volatility of the U.S. current account deficit over the last three decades.

6 Conclusion

This paper has shown that there is a strong link between credit cycles, fiscal policies and global imbalances. Using a sample of 38 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 18 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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