Dollar Trinity and Global Co-movement*

Georgios Georgiadis, Gernot J. Müller,
and Ben Schumann

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Abstract

Economic activity, trade, and asset prices co-move strongly across countries, giving rise to a global financial cycle, a global trade cycle, and a global business cycle that are, in turn, mutually correlated. We document these two distinct forms of co-movement and their link to the U.S. dollar: it systematically appreciates during global contractions. We develop a structural two-country model of the world economy centered on the dollar trinity—the dollar is used to denominate safe assets, cross-border financial contracts, and trade invoicing. We show that dollar trinity is more than the sum of its parts and essential for global co-movement.

Keywords: Dollar dominance, dominant currency paradigm, Bayesian proxy structural VAR model, convenience yield.
JEL-Classification: F31, F42, F44

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"The owl of Minerva spreads its wings only with the falling of dusk."
(G.W.F. Hegel, 1821)

1 Introduction

Two distinct forms of co-movement characterize the world economy. First, business cycles, financial conditions, and trade flows move closely together across countries, giving rise to global cycles. Second, the global business cycle, the global financial cycle, and global trade are themselves highly synchronized—and closely intertwined with the dynamics of the U.S. dollar. In a perfectly symmetric world, exchange rates would not move when economic conditions across countries change in a synchronized manner. Alas, the world economy is not symmetric, and the dollar occupies a special role.

This raises the question of how exactly the dollar shapes the international co-movement across countries and across economic cycles. We address this question in the present paper—at a time when the dollar's special status in the world economy is increasingly contested. The irony, as suggested by Hegel's observation cited above, is that the prevailing status quo—the workings of the world economy since the end of Bretton Woods—may be best understood precisely when it is put in jeopardy.[1]

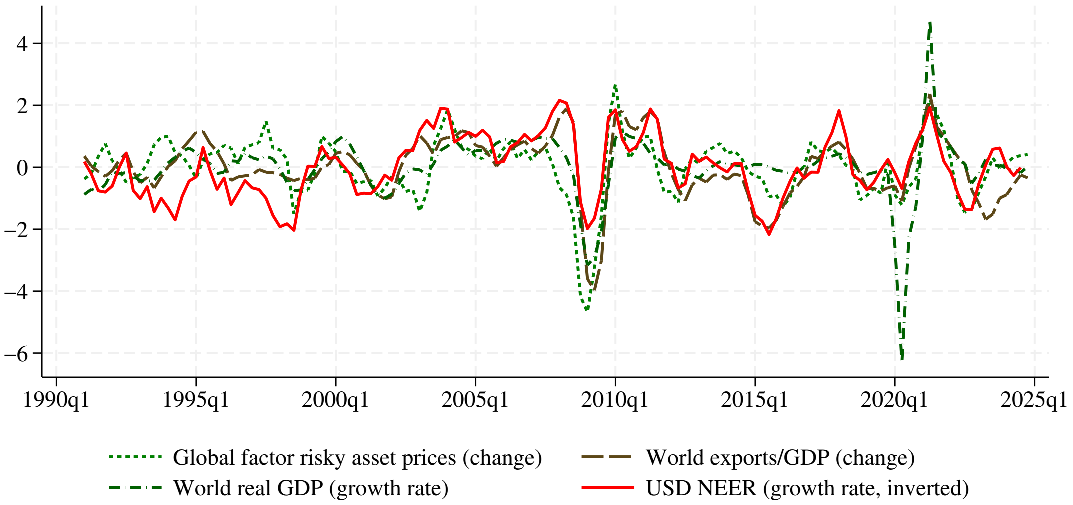
We proceed in three steps. First, we estimate a time-series model using data for the U.S. and the rest of the world. Adapting the business-cycle anatomy of Angeletos et al. (2020) to an open-economy setting, we identify a U.S. "main business cycle shock" and study its international repercussions. It generates a global downturn that is synchronized not only among countries, but also across asset prices, trade and economic activity. We further identify U.S. risk and monetary policy shocks and show that they generate similar adjustment patterns in the data, suggesting a common propagation mechanism.

Second, we present a structural, fundamentally asymmetric model of the world economy that features "dollar trinity": sticky dollar pricing, dollar-denominated credit, and U.S. Treasuries as the global safe asset. We show that the calibrated model replicates both the conditional and unconditional co-movement across both countries and across economic cycles.

Last, we zoom in on the dollar's role in shaping the global co-movement and find that the interaction among the three dimensions of dollar dominance is essential. Dollar trinity is more than the sum of its parts.

[1] For recent analyses of how dollar dominance might unravel, see Mukhin (2022); Chahrour & Valchev (2024); Bianchi & Sosa-Padilla (forthcoming).

Figure 1: Global Co-movement and the Dollar



Standardized year-on-year changes for the period from 1990 to 2024. The global factor in risky asset prices is taken from Miranda-Agrippino & Rey (2020) and Miranda-Agrippino et al. (2020). World exports and real GDP are from the Dallas Fed Global Economic Indicators (Martínez-García et al. 2015).

The first part of our analysis is based on a Bayesian proxy VAR model using a large set of monthly time series for the U.S. and the global economy. The dataset includes measures of economic and financial activity, interest rates, exchange rates, and the three global cycles. Our sample spans 35 years, from 1990 to 2024. Figure 1 illustrates the co-movement of the three global cycles with each other and with the dollar, based on standardized year-on-year changes. The global factor in risky asset prices, computed by Miranda-Agrippino & Rey (2020), serves as an indicator of the global financial cycle. Global exports relative to GDP capture the global trade cycle, while world GDP reflects the global business cycle. These series move closely with each other but inversely with the dollar—it appreciates during downturns that are highly synchronized across cycles.

Moving beyond the correlations shown in Figure 1, we estimate the effects of a contractionary U.S. main business cycle shock (Angeletos et al. 2020).[2] We establish that it appreciates the dollar, tightens global financial conditions, and slows down global economic activity and trade. Moreover, it accounts for a significant portion of the variance in the three global cycles and of their co-movement.

The main business cycle shock is a combination of the VAR's residuals and, as

[2]Chahrour et al. (2024) apply the approach to exchange rates establishing that the "main exchange rate shock" is indeed a dominant driver of exchange rate fluctuations.

such, a combination of a "linear combination" of structural shocks (Angeletos et al. 2020, p. 3504). To provide a more structural account and zoom in on the role of the dollar, we examine the relationship between the main business cycle shock and U.S. risk and monetary policy shocks, which are known to be key drivers of the dollar (Georgiadis et al. 2024). We identify these shocks in the VAR using high-frequency surprises around a diverse set of Federal Reserve policy announcements and U.S. risk events as instruments. We find that U.S. risk and monetary policy shocks have effects nearly identical to those of a U.S. business cycle shock: they appreciate the dollar and induce co-movement across countries and across cycles. Hence, all the identified forces that drive the dollar also generate the global co-movement shown in Figure 1, pointing to a "common propagation mechanism" (Angeletos et al. 2020, p.3030).

We propose the "trinity model" of the world economy to explain the observed co-movement and the central role of the dollar. The model features two countries, representing the U.S. and the rest of the world, and is fundamentally asymmetric owing to the dollar's dominance along three dimensions. First, cross-border credit is denominated in dollars (Bocola & Lorenzoni 2020; Eren & Malamud 2022). Financial intermediaries in the rest of the world fund themselves partly through cross-border dollar loans from the U.S, but do not lend to the U.S. in their own currency. Lending decisions of financial intermediaries in the U.S. depend on the riskiness of their borrowers in the rest of the world. Second, U.S. Treasuries are assumed to be safe assets (He et al. 2019; Coppola et al. 2023; Pflueger & Yared 2024). Holding U.S. Treasuries loosens the leverage constraint of rest-of-the-world financial intermediaries. Finally, the dollar is widely used as vehicle-currency in global trade (Rey 2001; Devereux & Shi 2013; Mukhin 2022). Incorporating dollar trinity into an otherwise standard international macro model captures key features of the global economy.

Dollar dominance in cross-border credit and safe assets drives a wedge in the uncovered interest parity (UIP) condition—a feature central to explaining major exchange rate puzzles (Itskhoki & Mukhin 2021, 2025). In the trinity model, UIP deviations arise endogenously from intermediaries' leverage constraints. Extending the setup of Gabaix & Maggiori (2015), financial intermediaries relax constraints by holding Treasuries: UIP deviations reflect an endogenous convenience yield, consistent with Engel & Wu (2023). Tightening global financial conditions raise this yield, reflecting the greater value of Treasuries in relaxing borrowing constraints.

We calibrate the model to match key moments of the data and find that it performs well along a number of dimensions. In particular, the model's predictions regarding the un-targeted propagation of U.S. risk and monetary policy shocks closely align with the VAR evidence. Moreover, the model also matches the un-targeted unconditional moments of U.S. and rest-of-the-world variables, including the global co-movement across countries and cycles.

The fundamental asymmetry implied by dollar trinity is crucial for the model's empirical success. To see why, consider a U.S. risk shock that tightens leverage constraints and raises the convenience yield. This, in turn, leads to an appreciation of the dollar, triggering a contraction in cross-border dollar credit and, consequently, in global economic activity. A global financial accelerator thus emerges, similar to the mechanism described in Akinci & Queralto (2024). Global trade declines because its prices are sticky in dollars and expenditure switches to domestically produced goods. In short: dominance in safe assets is crucial for the dollar to appreciate; dollar dominance in cross-border credit is key for the recessionary impact of dollar appreciation; and dominance in trade invoicing is why global trade contracts when the dollar appreciates.

But dollar trinity is more than the sum of its parts. The overall effect of the increase in investor risk aversion hinges on the dollar being *at the same time* the currency of safe assets and international credit. If dollar assets were not particularly safe, there would be no convenience yield and hence no dollar appreciation. Consequently, cross-border dollar debt would not amplify effects through a global financial accelerator, and there would also be no contraction in trade. The global financial, trade and business cycle are just different manifestations of a single global dollar cycle (Obstfeld & Zhou 2022).

The paper is structured as follows. In the remainder of the introduction, we place the paper in the context of the literature and clarify its contribution. Section 2 introduces our data, the empirical framework, and the new evidence on global co-movement. In Section 3 we outline the trinity model, discuss its calibration and assess its empirical performance. Section 5 runs a number of counterfactuals to understand the role of dollar trinity. A final section concludes.

Related literature. Our paper relates to several strands of the literature. First, it relates to work on the dollar as a global risk factor (Lustig et al. 2014; Verdelhan 2018), on global risk measures (Lilley et al. 2022; Hassan et al. 2024), and on the relationship between global risk, deviations from covered interest parity, the dollar and cross-border credit (Avdjiev et al. 2019; Erik et al. 2020; Hofmann et al. 2020; Bianchi et al. 2021; Dao & Gourinchas 2025). Our analysis offers a structural interpretation of the patters in the data—both through the lens of the VAR and the trinity model, respectively.

Second, in addition to the papers referenced above, there is model-based work on the special role of the dollar in the international monetary system (Gopinath et al. 2020; Akinci et al. 2024; Bacchetta et al. 2023; Cook & Patel 2023; Banerjee et al. 2016; Akinci et al. 2022; Hofmann et al. 2022; Kekre & Lenel 2024). While this line of work focuses on the implications of a single dimension of dollar dominance, we highlight the implications of dollar trinity. Trinity also resolves the 'reserve currency paradox' of Maggiori (2017), and rationalizes the 'exorbitant privilege' for the U.S. in normal times as well as an 'exorbitant duty' in crisis times (Gourinchas & Rey 2022). Other work explores how dollar dominance emerges in multiple dimensions due to complementarities in currency choice (Gopinath & Stein 2021; Chahrour & Valchev 2022; Bahaj & Reis forthcoming). We instead take dollar dominance as given and explore its implications for the global co-movement.

Third, a key feature of the trinity model is a balance-sheet constraint à la Gertler & Karadi (2011), recently employed in international business cycle models (Hofmann et al. 2022; Bodenstein et al. 2023; Caldara et al. 2024). What sets our work apart is an endogenous balance-sheet specific risk weight which gives rise to a global financial accelerator, in turn, for generating the global co-movement.

Fourth, the special status of U.S. government debt in banks' balance sheets is also central to closely related work by Devereux et al. (2023). In their model, just like in ours, Treasuries, because they have a special status as collateral, carry a convenience yield that emerges endogenously as a UIP wedge, rather than being imposed as in Jiang et al. (2024). Our analysis differs, however, in that banks not only face a dollar-asset portfolio choice but also a dollar-liability choice. This additional margin gives rise to the global financial accelerator.

2 Evidence

In this section, we present new evidence on the global transmission of business-cycle shocks originating in the U.S., based on monthly data covering the 35-year period from 1990 to 2024. We first identify main business cycle shock in the U.S. and subsequently adopt a more structural framework focusing on risk shocks and monetary-policy shocks. Across all types of shocks, we document an appreciation of the dollar, a pronounced and highly synchronized downturn in global business, trade, and financial conditions.

2.1 Empirical framework

Our estimation is based on a Bayesian structural VAR model along the lines of Rubio-Ramirez et al. (2010):

$$\boldsymbol{y}_t' \boldsymbol{A}_0 = \sum_{\ell=1}^{L} \boldsymbol{y}_{t-\ell}' \boldsymbol{A}_\ell + \boldsymbol{\mu_0} + \boldsymbol{\mu_1} D_t + \boldsymbol{\alpha_0} t + \boldsymbol{\alpha_1} t D_t + \boldsymbol{\epsilon}_t',$$

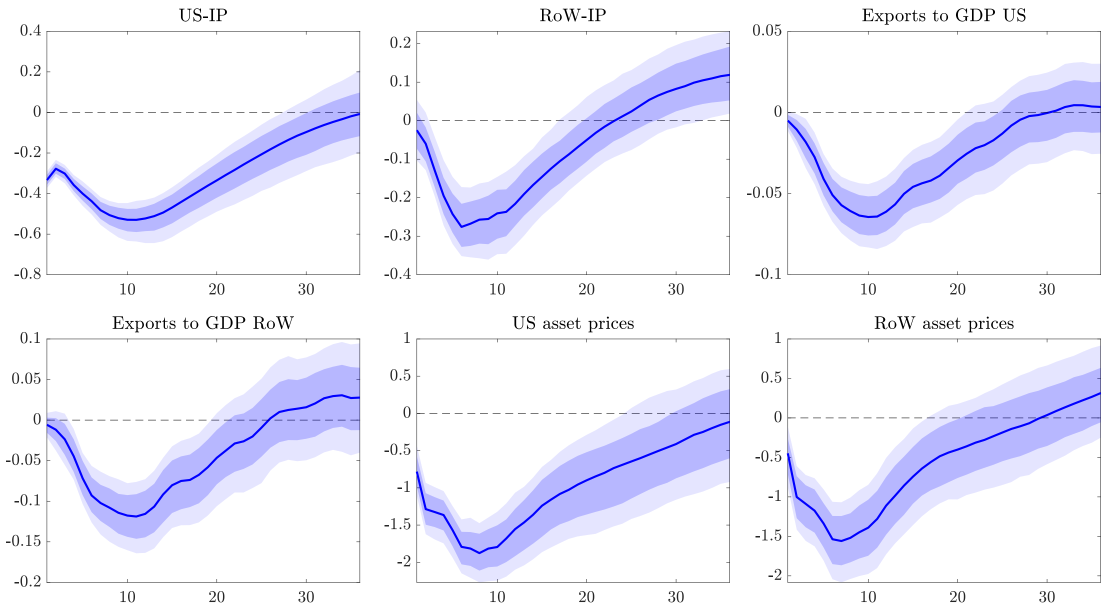
where $\boldsymbol{y}_t$ is an $n \times 1$ vector of endogenous variables, $\boldsymbol{\epsilon}_t$ an $n \times 1$ vector of (normally distributed) structural shocks and $\boldsymbol{A}_0$ captures the contemporaneous relationships between the variables. As in Born et al. (2025) D_t is a dummy variable equal to one starting in March 2020 to account for possible shifts in the level and trend observed after the onset of COVID-19 pandemic; μ_0, μ_1 and α_0, α_1 capture constants and time trends, respectively.

In terms of variables, our point of departure is the VAR specification ofGeorgiadis et al. (2024), where we include a U.S. block along the lines of Gertler & Karadi (2015) and a world/RoW block. In particular, the U.S. block includes as endogenous variables the logarithms of U.S. industrial production and consumer prices, the 1-year Treasury bill rate as monetary policy indicator, and the excess bond premium (EBP) of Gilchrist & Zakrajsek (2012) as a measure of risk aversion. The world/RoW block includes the RoW policy rate, the logarithm of the dollar nominal effective exchange rate (NEER), and RoW industrial production. We add to this the global factor in risky asset prices of Miranda-Agrippino & Rey (2020) and updated in Miranda-Agrippino et al. (2020) as an indicator of the global financial cycle, the world trade-to-GDP ratio as an indicator for the global trade cycle and world industrial production as an indicator of the global business cycle.[3]

We estimate the VAR model using the Bayesian approach of Arias et al. (2021), with Minnesota-type priors as in Miranda-Agrippino & Ricco (2021) and optimal hyperpriors controlling prior tightness and lag decay (Giannone et al. 2015). We furthermore incorporate the "pandemic priors" approach of Cascaldi-Garcia (2022) to account for the sequence of extreme observations during the COVID-19 pandemic. In our framework, this implies including dummies for March, April, and May 2020 alongside a non-informative prior for the corresponding coefficients.

[3]Because of extreme values associated with hyper-inflation episodes in some emerging market economies in the early to mid-1990s we use changes in advanced-economy policy rates to extend backward the corresponding RoW time series from 2001. We interpolate the series for the global trade-to-GDP ratio using the Chow & Lin (1971) approach. In particular, we use data for global trade from Martínez-García et al. (2015) and interpolate monthly world GDP from monthly world industrial production. Descriptions for all variables used are provided in Table C.1.

Figure 2: International co-movement following the MBCS



Note: The horizontal axis denotes time in months. The vertical axis deviation from pre-shock level in percent. The size of the shock is one standard deviation. Blue solid lines represent point-wise posterior means and shaded areas 68/90% equal-tailed, point-wise credible sets. The responses of the remaining variables in the VAR model are shown in Figure B.2.

2.2 The global transmission of U.S. business cycle shocks

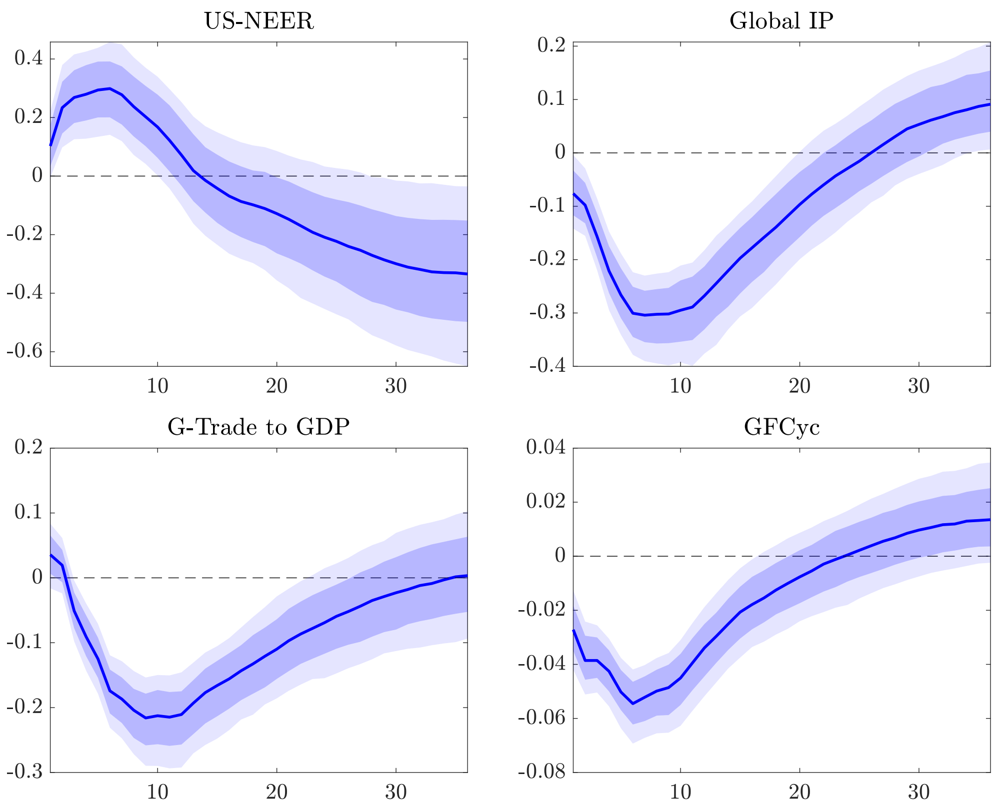
To understand global co-movement, we begin by examining the international transmission of business-cycle shocks originating in the U.S. We first do so without committing to specific structural drivers. Instead, we focus on the "U.S. main business-cycle shock" (MBCS), adapting the business-cycle anatomy framework of Angeletos et al. (2020). Because this type of shock can be viewed as a linear combination of structural shocks, the MBCS is a reduced-form object. We will show, however, that it triggers adjustments very similar to those induced by specific structural shocks, suggesting the existence of a "common propagation mechanism," as in Angeletos et al. (2020).

We pin down the MBCS as the combination of reduced-form residuals (and thereby a combination of structural shocks) that accounts for the largest share of the volatility of U.S. real activity over the business cycle along the lines of Angeletos et al. (2020, see Appendix A.1 for details).[4]

Figure 2 shows responses of U.S. and RoW real activity, asset prices and trade

[4]At quarterly frequency Stock & Watson (1999) define this frequency band as $[\frac{2\pi}{6}, \frac{2\pi}{32}]$, which we adapt to monthly frequency accordingly.

Figure 3: The adjustment pattern of global cycles following the U.S. MBCS



Note: The horizontal axis denotes time in months. The vertical axis deviation from pre-shock level in percent (U.S. NEER, Global IP), percentage points (Global Trade-to-GDP), and units of a standardized variable (GFCyc). The size of the shock is one standard deviation. Blue solid lines represent point-wise posterior means and shaded areas 68/90% equal-tailed, point-wise credible sets. The response of global IP is constructed by averaging the responses of U.S. and RoW IP with the U.S. given a weight of 17% in the global economy based on average PPP weights over the sample. The responses of the remaining variables in the VAR model are shown in Figure B.2.

to a one-standard-deviation MBCS. In each panel, horizontal axes measure time after the shock has hit in months, vertical axes the deviation from the pre-shock level. The solid line represents the point-wise posterior mean, while shaded areas indicate 68/90% credible sets. The MBCS induces a synchronized contraction in U.S. and RoW real activity, asset prices and trade.

Figure 3 shows how the dollar and the global cycles respond to the MBCS. The U.S. MBCS causes a persistent appreciation of the dollar, which exhibits some delayed overshooting (upper-left panel). At the same time, the MBCS causes a highly synchronized contraction of the three global cycles: global activity (upper-right panel) declines amid declining trade flows (lower-left panel) and asset prices (lower-right panel).

Table 1: Fraction of variance/co-variance explained by U.S. MBCS

	U.S. NEER	G business cycle	G trade cycle	G financial cycle
U.S. NEER	0.19 [0.13, 0.24]			
G business cycle	0.35 [0.26, 0.45]	0.25 [0.19, 0.33]		
G trade cycle	0.32 [0.21, 0.47]	0.23 [0.16, 0.31]	0.20 [0.14, 0.26]	
G financial cycle	0.35 [0.26, 0.46]	0.32 [0.24, 0.41]	0.29 [0.21, 0.38]	0.24 [0.18, 0.31]

Note: The table shows the point-wise median of the share of (unconditional) variance and covariance of the dollar and the global cycle that is accounted for by the MBCS. As suggested in (Kilian & Lütkepohl 2017) we approximate the unconditional variance using the Forecast Error Variance Decomposition at a very long horizon (50 years). In line with Figure 1, we report the statistics for year-on-year changes of the cycles by transforming the impulse responses accordingly. 68% highest posterior density interval in brackets.

All these dynamics play out simultaneously, which suggests that the MBCS contributes not only to the volatility of the three global cycles but also to their co-movement. Table 1 shows that the MBCS, which we estimate to explain 30% of the unconditional variance of US industrial production, also explains 19% of the unconditional variance of the dollar exchange rate.[5] At the same time, it also accounts for roughly 20-25% of the volatility of the three global cycles.[6,7] Moreover, the MBCS explains 24-35% of the contemporaneous co-movement of the three cycles.

[5]By construction, the MBCS explains a larger share of the forecast error variance ($\approx 60\%$) in the short-run (3 years) as discussed by (Angeletos et al. 2020).

[6]To quantify its contribution, we rely on the structural vector moving-average representation of the VAR model (see Equation (A.1)) and compute the forecast error variance covariance matrix $\mathbf{V}(h) = \sum_{t=0}^{h-1} \boldsymbol{\Omega}_t \boldsymbol{Q}\boldsymbol{Q}'\boldsymbol{\Omega}_t^{'}$, where $\boldsymbol{\Omega}_t$ is a matrix of reduced form impulse responses to all shocks at horizon t. $\boldsymbol{Q}$ is an orthonormal rotation matrix, whose first column is pinned down by the MBCS. To gauge the importance of the MBCS for the variation and the co-movement of the three global cycles we compute the $\mathbf{V}(h)$ for all horizons, and then recompute the same statistic while setting to zero the impulse responses corresponding to the MBCS, which yields $\widetilde{\boldsymbol{V}}(\boldsymbol{h})$. For each element, we then compute the difference between $\widetilde{\boldsymbol{V}}(\boldsymbol{h})$ and the corresponding entry in $\mathbf{V}(h)$. Lastly, we again divide the result by the corresponding value in $\mathbf{V}(h)$ to express it in terms of the forecast error variances and covariances of the data. We report the median of this statistic at horizon 400 (50 years), which is a good approximation of the unconditional variance (Kilian & Lütkepohl 2017).

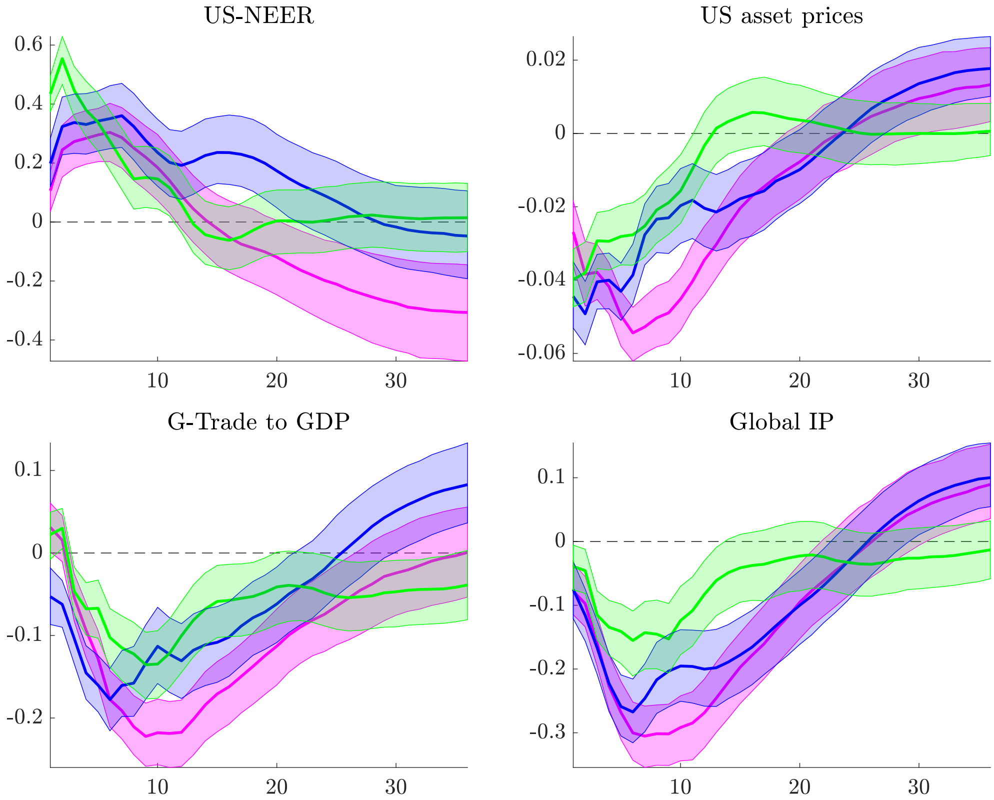
[7]The most prominent of our cycle indicators—the global factor in risky asset prices—accounts for 25% of the variation in risky asset prices around the world (see Miranda-Agrippino & Rey 2020).

2.3 A structural interpretation

The identification of the U.S. MBCS does not require us to commit to any specific structural account. However, to inform our model-based analysis in Section 3 below, we now zoom in on structural shocks that are known to be key drivers of the dollar, namely U.S. monetary policy and risk shocks (Georgiadis et al. 2024). In what follows, we identify these shocks in our sample based on external instruments. We discuss the instruments and identifying assumptions in detail in Appendix A.2. For the U.S. monetary policy shock, we use as an instrument changes in one-month Federal funds futures in narrow intra-daily windows around monetary policy events taken from Georgiadis & Jarocinski (forthcoming). Following recent work that highlights the informational content of surprises around diverse monetary policy events (Swanson 2023, 2024), we extend the analysis in Georgiadis et al. (2024) and as monetary policy events consider in addition to FOMC meetings also FOMC press conferences, minutes releases, Fed Chair speeches and testimonies. We purge the surprises around these events from central bank information effects following the poor-man's approach of (Jarociński & Karadi 2020), setting interest rate surprises to zero when the associated stock price surprises are positive. For the U.S. risk shock, we use as instrument changes in the price of gold in intra-daily windows around a series of narratively selected U.S. events (Bloom 2009; Piffer & Podstawski 2018; Bobasu et al. 2021).
We find that U.S. monetary policy and U.S. risk shocks transmit to the world economy in the same way. In particular, Figure 4 presents the responses of a one-standard-deviation shocks for the dollar and the three global cycles; results for the remaining variables are shown in Figure B.3. Figure 4 documents that the impulse responses to both shocks exhibit the same pattern for the dollar and the three global cycles. As for the U.S. MBCS, the dollar appreciation coincides with a tightening of global financial conditions, a slowdown in global trade, and global production. In line with Angeletos et al. (2020), we view the fact that "multiple shocks (...) produce similar impulse responses for the variables of interest" as pointing to a "common propagation mechanism" (Angeletos et al. 2020, p. 3030). In Section 5 we explore what role the dollar exchange rate plays in shaping this common propagation mechanism. Figure 5 documents that U.S. monetary policy and risk shocks also induce co-movement in U.S. and RoW real activity, trade and asset prices.[8]

[8] A natural question is how these two structural shocks are related to the MBCS. It turns out that in a simple regression, they explain about 48% of the variance of the MBCS. Individually, the U.S. risk shock accounts for 34% and the U.S. monetary policy shock for 14%. Thus, U.S. risk and U.S. monetary policy shocks –key drivers of the dollar— also account for an important part of the business cycle.

Figure 4: Adjustment pattern of global cycles following U.S. risk (blue), U.S. monetary policy (green), and U.S. MBCS (magenta)

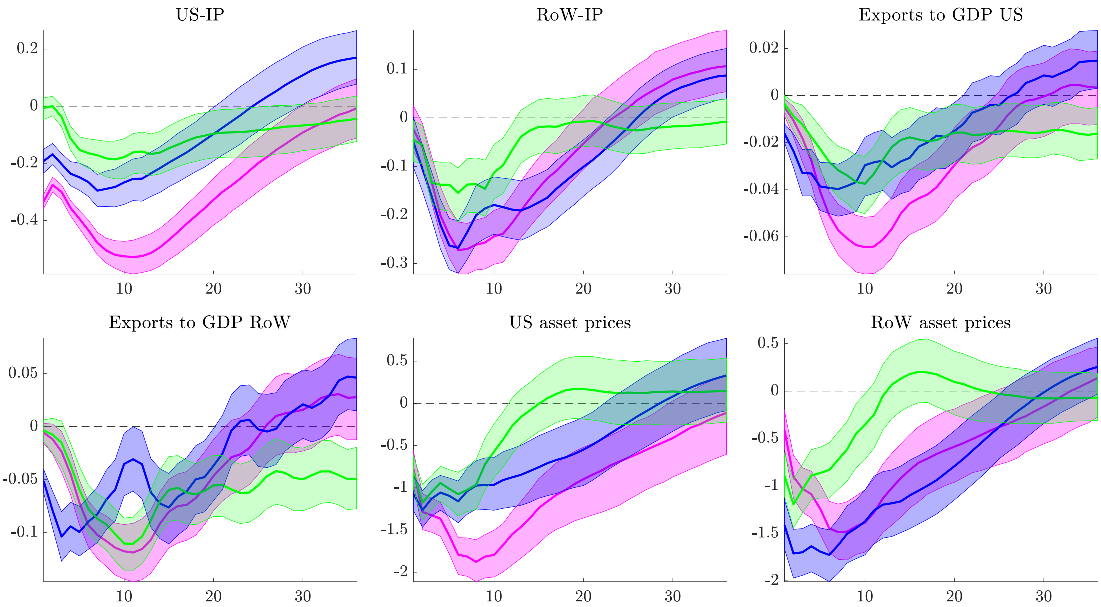


Note: Responses to a U.S. risk aversion (blue), U.S. monetary policy (green) shock, and the U.S. MBCS (magenta). The horizontal axis denotes time in months. The vertical axis deviation from pre-shock level in percent (U.S. NEER, Global IP), percentage points (Global Trade-to-GDP), and standard deviation units (GFCyc). The size of shock is one standard deviation. The response of global IP is constructed from the responses of U.S. IP and RoW IP using PPP weights. Responses of the remaining variables are shown in Figure 5 and Figure B.3.

Given these results for the role of U.S. risk and monetary policy shocks for driving dollar appreciation, the associated co-movements with and among the global cycles as well as the co-movement across the U.S. and the RoW, we focus on these shocks in the structural model we develop in Section 3.

To sum up our empirical analysis: We show that (i) a typical contraction of the U.S. business cycle as captured by the U.S. MBCS coincides with a simultaneous appreciation of the dollar, a slowdown of the three global cycles as well as a strong comovement of the underlying of U.S. and RoW variables, (ii) impulse responses to U.S. risk and monetary policy shocks display a similar pattern as the MBCS which can thus be thought of as evidence for "common propagation

Figure 5: International co-movement following the following U.S. risk (blue), U.S. monetary policy (green), and U.S. MBCS (magenta)



Note: Responses to a U.S. risk (blue), U.S. monetary policy (green) shock, and the U.S. MBCS (magenta). The horizontal axis denotes time in months. The vertical axis deviation from pre-shock level in percent or, for export to GDP ratios, percentage point changes in the corresponding values. The size of shock is one standard deviation.

mechanism" (Angeletos et al. 2020, p.3030).

Next, we set up a structural model to make the case that the common propagation mechanism that underlies the transmission of U.S. risk and monetary policy emerges because of the interaction of dollar dominance in global trade invoicing, cross-border credit, and safe asset supply: Dollar trinity.

3 The trinity model

We put forward a structural model of the world economy, featuring two country blocks: the U.S. (U) and the RoW (R). Key to the model is that the world economy is asymmetric along three dimensions: trade prices are sticky in dollar, cross-border credit is denominated in dollars and U Treasuries serve as a safe asset for R banks. Hence the dollar "trinity model".

Beyond dollar trinity, we assume symmetric real and nominal frictions such as sticky prices and wages, habit formation in consumption, investment-adjustment costs and variable capital utilization that are important to match key properties of aggregate time-series data (Smets & Wouters 2007). Monetary policy in U and R follows standard Taylor rules responding to final consumer-good inflation and output deviations. Fiscal policy issues one-quarter nominal bonds that return the corresponding central bank interest rates and balances the budgets by raising lump-sum taxes. We keep the model description short and focus the exposition on dollar dominance in global financial markets and trade. The full model description is provided in Appendix D.

3.1 Households

Economies are populated by households and firms, a fraction $s \in [0, 1]$ of which resides in R. Households are symmetric except for wages and labor supply, which we model as in Erceg et al. (2000).

In modeling banks we follow Gertler & Karadi (2011). A fraction $1 - f$ of the members of a household are workers, while f are bankers. Workers supply labor, make consumption decisions and save by making deposits to domestic banks, while bankers accumulate equity and intermediate funds to domestic firms. To ensure that bankers remain dependent on external funds, we assume that in every period a bank is closed with probability $1 - \theta_B$ and that the accumulated equity is transferred to the household. An equal number of workers randomly become bankers, keeping the ratio of workers to bankers fixed.

3.2 Firms

In each economy, there are four different types of firms. A continuum of perfectly competitive intermediate goods firms combine labor and capital using a standard CES production function and sell their output to domestic retailers. To acquire capital for use in the next period's production, the intermediate good firm raises funds by issuing claims that guarantee a return on capital; these claims are then purchased by financial intermediaries. (See appendix D.4 for details). Capital is provided by capital-producing firms that use domestic and imported goods in production and face quadratic adjustment costs (See appendix D.5 for details). Retail firms operate under monopolistic competition and use intermediate goods to produce a retail good subject to sticky prices in either domestic or foreign currency (See appendix D.7 for details). Lastly, goods bundling firms operate under perfect competition and combine retail goods into final goods using standard CES technology (See appendix D.6 for details).

3.3 Trade

The first of the three dollar trinity dimensions relates to bilateral trade between U and R as well as to trade within R. Specifically, we assume that prices of bilateral exports between U and R as well as a fraction of intra-R sales are at least in part sticky in dollars. To allow for a share of trade being priced in dollars and the remainder in R currency, we extend the multi-layered production structure of Georgiadis & Schumann (2021) in which differentiated goods are aggregated sequentially. The individual bundling steps and firms' pricing problems are standard.

For example, in order to have a share of R exports to U being priced in dollars, a U import-good bundler operating under perfect competition combines differentiated dollar-priced and R-currency-priced goods produced by R firms into an import good. Analogously, to reflect that a large share of trade between countries in the RoW is priced in dollars in the data, we assume that R consumption-good bundlers combine—in addition to an import good from U—dollar-priced and R-currency priced differentiated goods, respectively, produced by R firms into a domestic final good.

Details on the multi-layered production structure are provided in Appendix D (Figure D.3 provides a graphical overview).

3.4 Financial intermediation

Cross-border financial intermediation is asymmetric because credit is denominated in dollars and because U Treasuries serve as safe asset for R banks. This entails differences in incentives and constraints faced by banks in R and U, which we discuss next. The second and third dimensions of dollar dominance between R and U imply an endogenous wedge in the UIP condition that emerges as key driver of the dollar exchange rate. This UIP wedge has a natural interpretation of a convenience yield on holdings of U Treasuries for R banks.

3.4.1 Banks in the rest of the world

In a given period t, R bank j funds its claims on domestic capital, $K_{R,j,t}$, and its holdings of U Treasuries, $GB_{R,j,t}$ with domestic deposits, $D_{R,j,t}$, and cross-border dollar loans from U banks, $CBDL_{R,j,t}$. Denoting by $Q_{R,t}$ the price of domestic capital in terms of the final consumption good $P^C_{R,t}$, the balance sheet reads as follows:

$$Q_{R,t}K_{R,j,t} + RER_t GB_{R,j,t} = D_{R,j,t} + RER_t CBDL_{R,j,t} + N_{R,j,t}, \tag{1}$$

where $RER_t = \mathcal{E}_t P^C_{U,t}/P^C_{R,t}$ denotes the real exchange rate in terms of relative consumer-price levels and $\mathcal{E}_t$ is the nominal exchange rate, defined as the price of a dollar in units of R currency; an increase in $\mathcal{E}_t$ thus represents an appreciation of the dollar. $N_{R,j,t}$ is net worth. The balance sheet identity in Equation (1) reflects the assumption that cross-border credit is denominated in dollars—the second of the three dimensions of dollar trinity. In the baseline version of the model, we rule out cross-border credit in R currency.[9]

Claims on domestic capital and holdings of U Treasuries earn the rate $R^K_{R,t}$ and $D\mathcal{E}_t R^{GB}_{U,t-1}$, respectively, with $D\mathcal{E}_t \equiv \mathcal{E}_t/\mathcal{E}_{t-1}$. For simplicity, we assume that (net of exchange rate changes) the return on U Treasuries is the risk-free, central-bank rate $R^{GB}_{U,t} = R_{U,t}$, while deposits cost the pre-determined interest rate $R_{R,t-1}$, which we assume equals the R risk-free, central-bank rate. The interest rate R banks pay on cross-border dollar loans from U banks is $D\mathcal{E}_t R^{CBDL}_{U,t-1}$.

Banks apply the household's real stochastic discount factor $\Theta_{R,t,t+s}$ as they maximize the discounted value of current and expected future equity $N_{R,j,t}$:

$$V_{R,j,t} = \max \, \mathbb{E}_t \sum_{s=0}^{\infty} (1-\theta_B)\Theta_{R,t,t+s} N_{R,j,t+1+s}. \tag{2}$$

We assume banks face a balance-sheet constraint, reflecting, among other things, regulatory requirements.[10] For example, the Basel III framework puts a ceiling on a bank's leverage ratio, that is, the ratio of risk-weighted assets to equity (Basel Committee on Banking Supervision 2019). Hence, in what follows, we assume that the value of the banks must not fall below a fraction of their risk-weighted assets:

$$V_{R,j,t} \geq \delta_{R,j,t}(Q_{R,j,t}K_{R,j,t} + \Gamma^{GB}_R RER_t GB_{R,j,t}), \tag{3}$$

with

$$\delta_{R,j,t} = \bar{\delta}_R \left[1 - \epsilon_{R,\alpha}\alpha^{GB}_{R,j,t} + \frac{\kappa_{R,\alpha,\ell}}{2}\left(\alpha^{GB}_{R,j,t} - \ell^{CBDL}_{R,j,t}\right)^2\right], \;\; \bar{\delta}_R > 0. \tag{4}$$

In this expression, $\alpha^{GB}_{R,j,t} \equiv RER_t GB_{R,j,t}/(Q_{R,t}K_{R,j,t} + RER_t GB_{R,j,t})$ is the share of U Treasuries in total assets and $\ell^{CBDL}_{R,j,t} \equiv RER_t CBDL_{R,j,t}/(Q_{R,t}K_{R,j,t} + RER_t GB_{R,j,t})$ the share of total assets funded by cross-border dollar loans.

The assumptions in Equations (3) and (4) imply that U Treasuries are special due to unique safety and liquidity—the third dimension of dollar trinity. First, the asset-specific risk weight $\Gamma^{GB}_R < 1$ in Equation (3) means that less equity is required when holding Treasuries than when holding claims on domestic capital,

[9]In the data, about 70% of global cross-border debt is denominated in dollars (Bertaut et al. 2021).

[10]We assume that the balance-sheet constraint binds in the neighborhood of the steady state.

which reflects relative safety assessments in regulatory requirements.[11] Second, $\epsilon_{R,\alpha} > 0$ in Equation (4) incentivizes banks to hold U Treasuries independently from their relative safety, which reflects regulatory requirements to hold liquid assets to cover funding shortages in stress scenarios.[12] Third, $\kappa_{R,\alpha,\ell} > 0$ in Equation (4) further incentivizes banks to hold U Treasuries independently from their relative safety, which reflects regulatory requirements to hedge foreign-currency liabilities by holding foreign-currency assets.[13]

The assumptions in Equations (3) and (4) give rise to an endogenous convenience yield, which is the distinct feature of a safe asset (Gorton 2017).[14] We discuss this convenience yield in detail in Section 3.5 below.

3.4.2 U.S. banks

U banks differ from R banks in four ways. First, U banks are cross-border lenders rather than borrowers. Therefore, dollar loans appear on the asset side of the balance sheet of bank j:

$$Q_{U,t}K_{U,j,t} + CBDL_{U,j,t} = D_{U,j,t} + N_{U,j,t}, \tag{5}$$

where $K_{U,j,t}$, $CBDL_{U,j,t}$, $D_{U,j,t}$ and $N_{U,j,t}$ are claims on domestic capital, cross-border dollar loans, domestic deposits and net worth, respectively, deflated by the price of the U consumption good. Claims on domestic capital and cross-border dollar loans earn the rate $R^K_{U,t}$ and $R^{CBDL}_{U,t-1}$, respectively, and deposits cost the pre-determined interest rate $R_{U,t-1}$, which we assume equals the U risk-free, central-bank rate. Second, for simplicity and in order to focus on R, we assume U banks do not hold U Treasuries. Third, for U banks we assume the balance-sheet constraint

$$V_{U,j,t} \geq \delta_{U,j,t}(Q_{U,t}K_{U,j,t} + \Gamma^{CBDL}_{U,t}CBDL_{U,j,t}), \tag{6}$$

[11] Under Basel III AAA to AA- rated central government debt—such as U Treasuries—carry a risk weight of zero (Basel Committee on Banking Supervision 2019, CRE20).

[12] Under Basel III the "liquidity coverage ratio" ensures an adequate stock of high-quality liquid assets (HQLA) that can be converted into cash easily and immediately in private markets to meet liquidity needs in a 30 calendar day liquidity stress scenario (Basel Committee on Banking Supervision 2019, LCR30). To qualify as an HQLA, an asset's liquidity-generating capacity should remain intact even in periods of severe idiosyncratic and market stress and, ideally, it should be eligible as collateral for central bank liquidity facilities.

[13] Basel III risk weights are meant to account for the possibility of losses due to asset price—including exchange rate—movements. Of particular relevance for our purposes is that these are reduced if a bank's foreign-currency asset position hedges a corresponding liability position (Basel Committee on Banking Supervision 2019, MAR11.3).

[14] "The specialness of safe assets implies the existence of non-pecuniary returns (called the 'convenience yield'), in the form of liquidity or moneyness and safety, and so the pecuniary return is lower than it otherwise would be" (Gorton 2017, p.2).

with the asset-specific risk weight of cross-border dollar loans

$$\Gamma^{CBDL}_{U,t} = \bar{\Gamma}^{CBDL}_{U} + \Phi_{U,\phi}\phi_{R,j,t}, \tag{7}$$

where $\phi_{R,j,t} \equiv \frac{Q_{R,t}K_{R,j,t}+RER_t GB_{R,j,t}}{N_{R,j,t}}$ is the leverage ratio of R banks. Thus, again reflecting regulatory requirements, we assume cross-border dollar lending carries a higher risk weight the riskier the borrowers—that is the more leveraged R banks—are.[15] Note that this ties together the balance-sheet constraints of U and R banks. Finally, in contrast to R banks, a U bank does not have any foreign-currency exposure. Therefore, for a U bank we assume that the balance-sheet risk weight $\delta_{U,j,t}$ is given by

$$\delta_{U,j,t} = \bar{\delta}_U + \epsilon^{\delta}_t, \tag{8}$$

In the spirit of Gabaix & Maggiori (2015), we interpret ϵ^{δ}_t as a "risk aversion shock" (Gabaix & Maggiori 2015, p.1387), which we interchangeably refer to as "risk shock" for short. It reduces the willingness of depositors of U banks to provide funding for a given balance-sheet size and composition. We assume that ϵ^{δ}_t evolves according to an AR(1) process

$$\epsilon^{\delta}_t = \rho_\delta \epsilon^{\delta}_{t-1} + \eta^{\delta}_t. \tag{9}$$

In Appendix D.3 we characterize optimal R and U bank behavior. We show that there is an endogenous, optimal, maximum leverage ratio, which depends on the riskiness and profitability of the asset and liability composition of a bank's balance sheet.

3.5 UIP and convenience yield

Before we calibrate and solve the model, we highlight the key implication of the assumptions on dollar dominance in cross-border credit and safe assets: an endogenous UIP wedge, with a natural interpretation as a convenience yield of U Treasuries. Variation in the convenience yield is central for driving the dollar exchange rate in the trinity model.

The optimal portfolio choice of bank j in R satisfies

$$\mathbf{E}_t\left[\Omega_{R,j,t,t+1}\left(D\mathcal{E}_{t+1}R^{GB}_{U,t} - R_{R,t}\right)\right] + CY_{R,j,t} = RP^{GB}_{R,j,t}. \tag{10}$$

[15] Credit risk weights specified in Basel III need to take into account, among other things, counterparty risk and default probabilities (see (Basel Committee on Banking Supervision 2019), CRE20).

where $\Omega_{R,j,t,t+1}$ is the stochastic discount factor.

The first term on the left-hand side represents the expected excess return on U Treasuries, which would be zero if UIP was satisfied. The two remaining terms reflect UIP deviations, which imply the expected excess return on U Treasuries may be negative, in line with the empirical evidence (e.g., Kalemli-Özcan & Varela 2021).

The first UIP deviation in Equation (10) is given by

$$CY_{R,j,t} = -\frac{\partial \delta_{R,j,t} / \partial \alpha^{GB}_{R,j,t}}{\delta_{R,j,t}} \left[(1 - \alpha^{GB}_{R,j,t}) + \Gamma^{GB}_{R} \alpha^{GB}_{R,j,t} \right] \times \mathbf{E}_t \left[\Omega_{R,j,t,t+1} \left(R^K_{R,t+1} - R_{R,t} \right) \right], \tag{11}$$

which we refer to as the convenience yield on U Treasuries. In the steady state of the calibrated model the convenience yield is positive, in line with the evidence of Du et al. (2018), Jiang et al. (2021), and Engel & Wu (2023). Compared to other work on exchange rates and dollar dominance such as Jiang et al. (2024), Equation (11) offers a structural interpretation of the Treasury convenience yield: holding U Treasuries loosens the balance-sheet constraint of R banks ($\partial \delta_{R,j,t} / \partial \alpha^{GB}_{R,j,t} < 0$) in Equations (3) and (4) such that, all else equal and depending on the existing asset portfolio, $(1 - \alpha^{GB}_{R,j,t}) + \Gamma^{GB}_{R} \alpha^{GB}_{R,j,t}$, they can acquire additional claims on domestic capital and earn the credit spread $R^K_{R,t+1} - R_{R,t}$.

According to Equation (10), an increase in the convenience yield because of, say, an exogenous tightening of bank balance-sheet constraints, all else equal, requires the excess return on holdings of Treasuries to fall, which implies an expected depreciation—and hence an instantaneous appreciation—of the dollar.

The second UIP deviation in Equation (10) is given by

$$RP^{GB}_{R,j,t} = \Gamma^{GB}_{R} \mathbf{E}_t \left[\Omega_{R,j,t,t+1} \left(R^K_{R,t+1} - R_{R,t} \right) \right], \tag{12}$$

which is non-zero as long as U Treasuries carry a non-zero risk weight, $\Gamma^{GB}_{R} > 0$. The higher the risk weight of U Treasuries, the higher their equilibrium excess return has to be for R banks to hold them, all else equal.

3.6 Global financial accelerator

Another key implication of the assumptions on dollar dominance in cross-border credit and safe assets is a global financial accelerator.

Recall that the asset-specific risk weight $\Gamma^{CBDL}_{U,t}$ of a U bank's cross-border dollar lending in Equation (7) depends positively on the leverage ratio of its borrower, the R bank, defined as

$$\phi_{R,j,t} \equiv \frac{Q_{R,t}K_{R,j,t} + RER_t GB_{R,j,t}}{Q_{R,t}K_{R,j,t} + RER_t GB_{R,j,t} - D_{R,j,t} - RER_t CBDL_{R,j,t}}. \tag{13}$$

The numerator is the R-currency value of bank assets and the denominator the R-currency value of its equity.

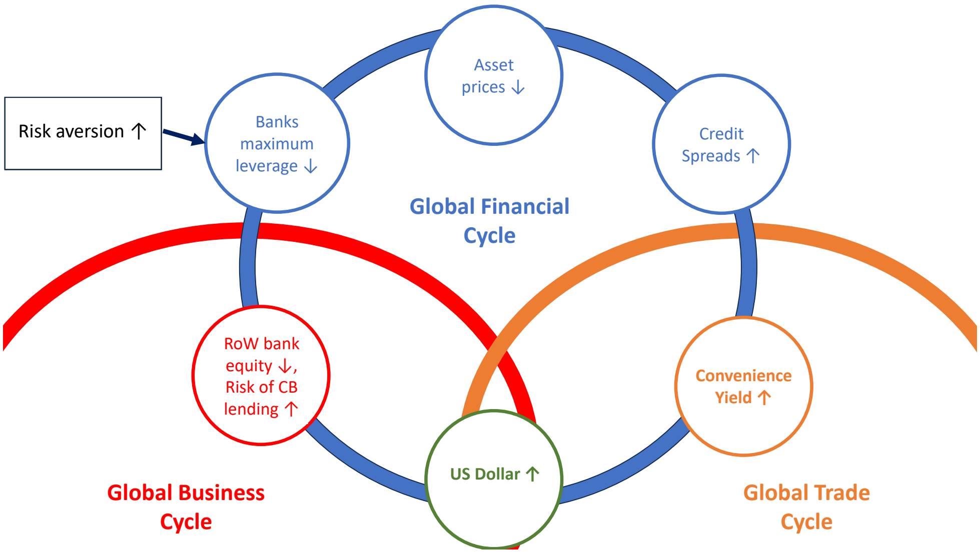
As part of the R bank's assets and liabilities are in dollars, its leverage ratio fluctuates with the exchange rate. In particular, the derivative of the leverage ratio with respect to the exchange rate is

$$\frac{\partial \phi_{R,j,t}}{\partial RER_{E,t}} = \frac{CBDL_{R,j,t} \times Q_{R,t}K_{R,j,t} - GB_{R,j,t} \times D_{R,j,t}}{\left(Q_{R,t}K_{R,j,t} + RER_t GB_{R,j,t} - D_{R,j,t} - RER_t CBDL_{R,j,t}\right)^2}. \tag{14}$$

The leverage ratio rises as the dollar appreciates if the R bank (i) has a dollar net short position $CBDL_{R,j,t} > GB_{R,j,t}$ or (ii) is fully hedged $CBDL_{R,j,t} = GB_{R,j,t}$. This is because in both cases we have that $Q_{R,t}K_{R,j,t} > D_{R,j,t}$ via the balance-sheet identity in Equation (1), given some positive net worth $N_{R,j,t} > 0$.[16] As a consequence, the U bank's asset-specific risk weight on cross-border dollar loans increases when the dollar appreciates, which forces it to deleverage and charge higher cross-border loan credit spreads. This further appreciates the dollar and triggers another round of amplification—and hence a global financial accelerator. The blue circle in Figure 6 illustrates graphically how dollar dominance in safe assets and cross-border credit interact to give rise to the global financial cycle. Suppose there is an exogenous reduction in the willingness of depositors to fund U banks (i.e., an increase in risk aversion of US creditors). As these global lenders cut back on their lending, credit spreads rise, and the dollar appreciates via the convenience yield due to its special status as a global safe asset (DCA). With dollar dominance in cross-border debt (DCD), this shock for U banks now additionally tightens the balance-sheet constraints of R banks (as it increases the value of dollar liabilities) and even further for U banks (which lend to now riskier R banks). Because R and U banks reduce cross-border lending and domestic investment, credit spreads rise simultaneously in U and R. This further appreciates the dollar exchange rate and thereby triggers another round of financial amplification. Hence, as the dollar appreciates, financial conditions tighten across U and R—a global financial cycle emerges.

[16] In the fully hedged case, hedging shields the denominator of the leverage ratio (i.e. the net worth) from exchange rate depreciation, but the numerator still moves if the bank holds some dollar assets.

Figure 6: The dollar exchange rate and global cycles



Note: This figure illustrates the interaction of the three global cycles embedded in the trinity model

3.7 Three intertwined global cycles

The trinity model also implies global business and trade cycles, which are intertwined with the global financial cycle. First, as financial conditions tighten when the global financial cycle slows down, dollar dominance in safe asset supply (DCA) implies that the convenience yield rises and the dollar appreciates. Second, dollar dominance in trade (DCP) then implies a global trade cycle that is correlated with the global financial cycle. In particular, as the dollar exchange rate appreciates together with the global financial cycle, U and intra-R exports contract, and so a global trade cycle emerges (orange circle in Figure 6). Lastly, dollar dominance in cross-border debt contracts (DCD) implies that the initial tightening of financial conditions is amplified globally, such that investment financing and hence output contract in U and R—a global business cycle emerges (red circle in Figure 6). Although we have described this mechanism using an initial shock originating from a disruption in financial markets, we will show that this propagation mechanism is common to all kinds of shocks once they move the dollar.

As such, the result of dollar trinity is three global cycles in financial conditions, output and trade that are tied together through the dollar exchange rate.

Table 2: Calibration targets for dollar dominance parameters

Moment	Target	Parameter	Value	Reference
U-R export DCP shares	93%, 97%	$\widehat{\gamma}_R^U, \widehat{\gamma}_U^R$	0.93, 0.97	Boz et al. (2022)
Intra-R export DCP share	37.5%	$\widehat{\gamma}_R^R$	0.09	Boz et al. (2022)
R bank \$-assets/total assets	15%	$\epsilon_{R,\alpha}$	0.55	Adrian & Xie (2020)
R bank \$-liabilities/total assets	25%	$\kappa_{R,\alpha,\ell}$	2.74	Aldasoro et al. (2021)
U external debt/GDP	86%	$\bar{\delta}_R$	0.68	Data mean
Exorbitant privilege	1%	$\bar{\Gamma}_U^{CBDL}$	0.30	Bertaut et al. (2024)
Treasury convenience yield	1.5%	Γ_R^{GB}	0.00	Jiang et al. (2024)

Notes: Parameters and calibration targets for dollar dominance. Targets are in many cases mutually dependent and generally depend on all parameter values; table associates parameters with targets which they influence strongly.

4 Quantitative model assessment

We next solve the model numerically to document its quantitative performance before we study the transmission of shocks. We approximate the model around its deterministic steady state.

4.1 Calibration

We distinguish three sets of parameters. The first set of parameters relates to household preferences, intermediate, final and capital good production, monetary policy, and financial sector parameters. The second set of parameters relates to dollar dominance. The third set of parameters relates to the volatility of five shock processes. We generally allow parameters to differ between R and U.

For the first set of parameters we draw on earlier work and/or direct empirical evidence. To save space, we provide an overview of these parameter values in Table D.4.

Conditional on this first set of parameters, we calibrate the parameters that relate to dollar dominance. We determine their values by targeting the degree of dollar dominance in the data and documented in existing literature. We summarize the calibration targets in Table 2.

We start with dollar dominance in trade. The share of R firms that invoices exports to U in dollars is $\widehat{\gamma}_U^R = 1 - \gamma_U^R$ to 93%, in line with invoicing shares documented in Gopinath (2015). Based on the calculations in Georgiadis & Schumann (2021), we set the share of U firms that price in dollars when exporting to R ($\widehat{\gamma}_R^U = 1 - \gamma_R^U$) to 97%. Consistent with the invoicing shares of Boz et al. (2022), we first target a fraction of intra-R *exports* that are priced in dollar of 37.5%, which implies that the share of total intra-R *sales* priced in dollar ($\widehat{\gamma}_R^U = 1 - \gamma_R^R$)

is 9%.[17]

Next we turn to the parameters that relate to the degree of dollar dominance in cross-border credit and safe assets. In particular, for R banks, we jointly determine the parameters $\epsilon_{R,\alpha}$ and $\kappa_{R,\alpha,\ell}$ to target a portfolio that invests 15% of total assets in U Treasuries, while cross-border dollar loans account for 25% of liabilities (Aldasoro et al. 2021; Adrian & Xie 2020). On the one hand, the dollar asset share of 15% is close to the average for non-US banks (Adrian & Xie 2020) and, when combined with our assumption on the steady-state size of R banks' balance sheet governed by $\overline{\delta}_R$, implies a U gross external-debt-to-GDP ratio of 86%, which is approximately the average in the data over 1990-2024. On the other hand, the dollar liability share of 25% is close to the number for non-US banks in BIS data (Aldasoro et al. 2021), and is also close to (estimated) values in the literature (Cesa-Bianchi et al. 2024; Akinci & Queralto 2024).[18]

We set the asset-specific risk weight on U Treasuries Γ_R^{GB} to zero, implying that R banks do not need to hold additional equity to hold U Treasuries, in line with Basel III regulations. When combined with our assumption on the country-specific discount factors (steady-state interest rates, see Table D.4) and the parameters governing dollar portfolio shares ($\epsilon_{R,\alpha}$ and $\kappa_{R,\alpha,\ell}$), this implies an annualized steady-state convenience yield of 1.5%, which strikes a balance between the values in Jiang et al. (2021) and Jiang et al. (2024).

For the parameters related to the portfolio choice of U banks, we target a cross-border credit spread that, given the convenience yield, implies an annualized steady-state "exorbitant privilege" (Gourinchas & Rey 2007) of 1%, close to the time average in Bertaut et al. (2024). This pins down $\bar{\Gamma}_U^{CBDL}$, which, conditional on the remaining parameters for U banks, determines the excess return from cross-border dollar lending to R banks.[19]

[17]We first target the average intra-R exports-to-GDP ratio for R ($\approx$ 24%). Next, we use the average share of global exports invoiced in dollars from Boz et al. (2022) and subtract the fraction of U in global trade to arrive at 37.5%. Multiplying the two numbers we arrive at about 9%. Analogously, we calibrate the share of intra-R PCP *exports* in total intra-R PCP *sales* targeting the fraction of total intra-R exports-to-GDP for R, which amounts to setting $\widetilde{\omega}_R^R$ to 0.165.

[18]Combined with the assumption that banks are the only entities that engage in cross-border lending, our calibration implies that R has a *negative* net dollar exposure and is a net debtor to U ($\alpha_R^{TREAS} - \ell_R^{CBDL} < 0$). While this is in line with the net dollar exposures of the RoW *banking sector* in the data as documented by Shin (2012), the RoW *as a whole* has a *positive* net dollar exposure and is a net creditor to the US. In Section F.1 we consider an extension in which R is a net creditor of U with a positive net dollar exposure.

[19]This spread is closely linked to the risk weight attached to cross-border dollar loans, which is given by the sum of a constant risk weight and a term that depends on the R bank's leverage ratio (see Equation (7)). To distribute between these two terms we target a credit spread of 0.6% for an R bank with a leverage ratio of zero. This roughly corresponds to the average of the quarterly spread between the dollar-based Libor and the 3-month Treasury bill rate over 1990-2024. These two targets pin down $\bar{\Gamma}_U^{CBDL}$ and $\Phi_{U,\phi}$.

Table 3: Calibration targets for shock variances

FX-Puzzle	Moment	Data	Trinity Model
Exchange Rate Disconnect	$\sigma(\Delta\mathcal{E})/\sigma(\Delta Z_R)$	5.32	5.32
PPP-Puzzle	$corr(\Delta\mathcal{E}, \Delta RER)$	0.95	0.99
Backus-Smith Puzzle	$\sigma(\Delta\mathcal{E})/\sigma(\Delta Z_R)$	-0.40	-0.40
Fama-Puzzle	β in Fama-regression	-0.37	-0.37
Std. Global Output	$\sigma(\Delta Z_G)$	0.44	0.44

Notes: We compute the model implied moments by simulating 10000 periods of data from the model. To estimate the relative variances, we numerically optimize over the root-mean-square error, where we take into account the different scales of the targets by rescaling the deviations from the target in terms of percentages from the corresponding targeted value. $\mathcal{E}$ represents the nominal exchange rate, Z_R describes R GDP. Δ refers to quarter-on-quarter log changes of the variables. We use quarterly data from 1990 to 2025 and exclude the first two quarters of 2020 due to the enormous volatility in output induced by the Pandemic. We calculate the corresponding statistics based on US and aggregate RoW data provided by Martínez-García et al. (2015) whenever available. For the Backus-Smith puzzle, we follow Itskhoki & Mukhin (2021) and use the average estimate from Corsetti et al. (2008), which is representative of the conventional value in the literature. "Fama β" refers to the regression coefficient in a Fama-style UIP regression of the realized change in the nominal effective dollar exchange rate on the US-RoW interest rate differential.

Our calibration implies that the U steady-state trade-deficit-to-GDP ratio is 2.1%, and the steady-state global trade-to-GDP ratio is 47%. Both are close to their values in the data. Furthermore, in the steady state U finances its trade deficit with a positive net financial income, which results from higher returns on cross-border dollar lending to R than interest payments on R holdings of Treasuries. Therefore, U affords a higher steady-state per capita consumption than R as a direct consequence of the exorbitant privilege. In Section F.1 we extend the model to also feature an "exorbitant duty" (Gourinchas & Rey 2007).

Finally, we calibrate a third set of parameters related to the standard deviations of five shock processes to study the quantitative performance of the trinity model regarding the variation and co-movement between the three cycles and the dollar exchange rate. We assume that the model features standard U and R technology and monetary policy shocks as well as a U risk aversion shock, which we interchangeably refer to as risk shock for short.[20] We calibrate the standard deviations of these shocks by targeting key exchange rate moments. These moments have plagued the literature for some time, and are often referred to as puzzles, given the difficulties of international macro models to account for them. Recent work by Itskhoki & Mukhin (2021), however, shows that a model with

[20] We assume technology shocks follow an AR(1) process with a persistence of 0.9, monetary policy shocks to be *i.i.d*. because of interest-rate smoothing, and calibrate the persistence of the risk aversion shocks to match the VAR dynamics in Figure 7.

fragmented international financial markets—like ours—can account for these moments based on financial shocks that generate UIP deviations. Rather than relying on exogenous financial shocks, the trinity model matches these moments based on an *endogenous* response of the UIP wedge to generally *all* types of—including monetary policy or productivity—shocks. The precise response of the UIP deviation differs across shocks, and hence the relative importance of the different shocks matters to match the exchange rate moments.

Table 3 lists the four moments that summarize the major exchange rate puzzles along the lines of Itskhoki & Mukhin (2021) and that we target to pin down the relative standard deviations of the shocks: the volatility of the dollar exchange rate relative to R output, the correlation of changes in the nominal and in the real exchange rate, the correlation of real exchange rate changes with the cross-country consumption differential (Backus-Smith), the coefficient estimate of a Fama regression, and, to set the scale, the volatility of global output. In Georgiadis et al. (2025) we discuss in detail how the trinity model matches these exchange rate moments, with a particular focus on the role of endogenous UIP deviations.

4.2 Model performance

We first consider the co-movement of the global cycles with the dollar as well as the co-movement across U and R. Second, as motivated in Section 2, we consider the adjustment dynamics triggered by U risk and monetary policy shocks.

We generate artificial data from the model and compute the unconditional moments for the model analogues of the three global cycles depicted in Figure 1 (see notes to Table 4). As shown in columns (3) (U MP) to (7) (U TFP) of Table 4, the trinity model matches the positive co-movement between the three global cycles as well as their negative correlation with the dollar exchange rate for each shock in the data. Moreover, the trinity model also matches the international co-movement across U.S. and RoW variables. As such dollar trinity implies a common propagation mechanism for all these shocks that is centered around the dollar (see Figure B.9 for an illustration). Column (8) shows that also when all shocks are switched on simultaneously, the trinity model matches the moments of the global cycles and the dollar exchange rate as well as the international co-movement across the U.S. and RoW, despite those not being part of the calibration.

Next, we consider dynamics conditional on U risk and monetary policy shocks. Figure 7 compares the impulse responses to U risk and monetary policy shocks from the trinity model (dots) to the estimates from the VAR model in Section 2

Table 4: Trinity model quantitative performance in unconditional moments of global cycles and the dollar exchange rate

		Individual Shocks					All shocks
Moment	Data	U MP	R MP	U risk	R TFP	U TFP	
A. Global cycles							
$corr(\Delta Z_G, \Delta GFCyc)$	0.69	0.60	0.55	0.51	0.69	0.71	0.51
$corr(\Delta Z_G, \Delta T_G^G/Z_G)$	0.76	0.62	0.71	0.57	0.43	0.38	0.50
$corr(\Delta GFCyc, \Delta T_G^G/Z_G)$	0.56	1.00	0.97	0.99	0.87	0.92	0.93
B. Global cycles and dollar exchange rate							
$corr(\Delta\mathcal{E}, \Delta GFCyc)$	-0.42	-0.95	-0.93	-0.94	-0.44	-0.95	-0.87
$corr(\Delta\mathcal{E}, \Delta Z_G)$	-0.41	-0.78	-0.77	-0.74	0.20	-0.61	-0.61
$corr(\Delta\mathcal{E}, \Delta T_G^G/Z_G)$	-0.39	-0.96	-0.98	-0.97	-0.64	-0.92	-0.96
C. International co-movement							
$corr(\Delta Q_R, \Delta Q_U)$	0.82	0.99	0.99	0.99	0.96	0.96	0.96
$corr(\Delta T_R/Z_R, \Delta T_U/Z_U)$	0.81	0.99	0.65	0.99	0.15	0.98	0.95
$corr(\Delta Z_R, \Delta Z_U)$	0.80	0.94	0.98	0.97	0.90	0.92	0.74

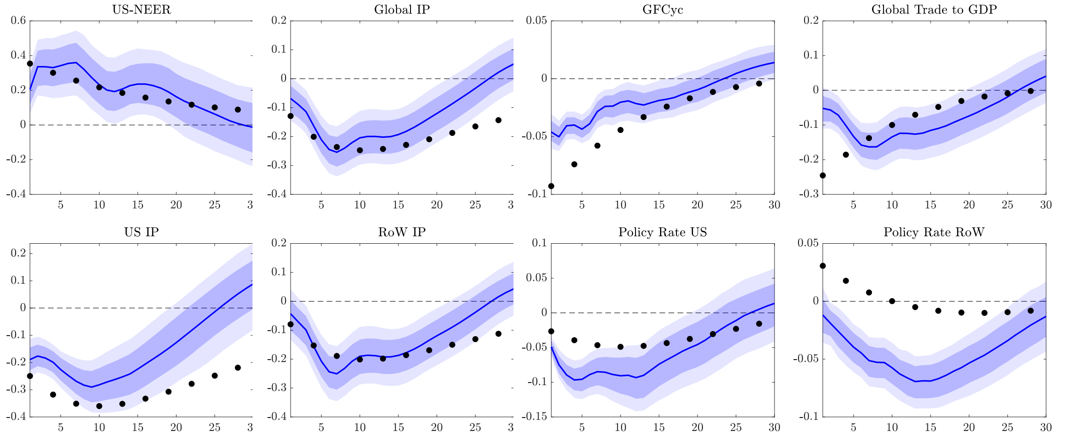
Notes: Each column reports moments based on 10,000 simulated periods for model versions with different (combinations of) shocks. "**Δ**" refers to year-on-year log changes of the variables. Our empirical measures for the global financial cycle, global business cycle and global trade cycle correspond to the updated global financial cycle estimate of Miranda-Agrippino & Rey (2020) as well as global GDP and the global trade-to-GDP ratio based on data from Martínez-García et al. (2015). We use quarterly data from 1990 to 2025 and exclude the first two quarters of 2020 due to the enormous volatility in output induced by the COVID-19 pandemic. In the trinity model, GFCyc represents the global financial cycle, which, as in the data, we measure in the model using the first principal component of changes in U and R asset prices. Z_G and T_G^G/Z_G correspond to global GDP and the global trade-to-GDP ratio, which we construct as a country-size-weighted average (see (D.68) and (D.69)). $\mathcal{E}$ corresponds to the nominal dollar exchange rate. Q_R and Q_U represent the price of capital in R and U, respectively.

(solid lines).[21] The impulse responses in the trinity model align well with their

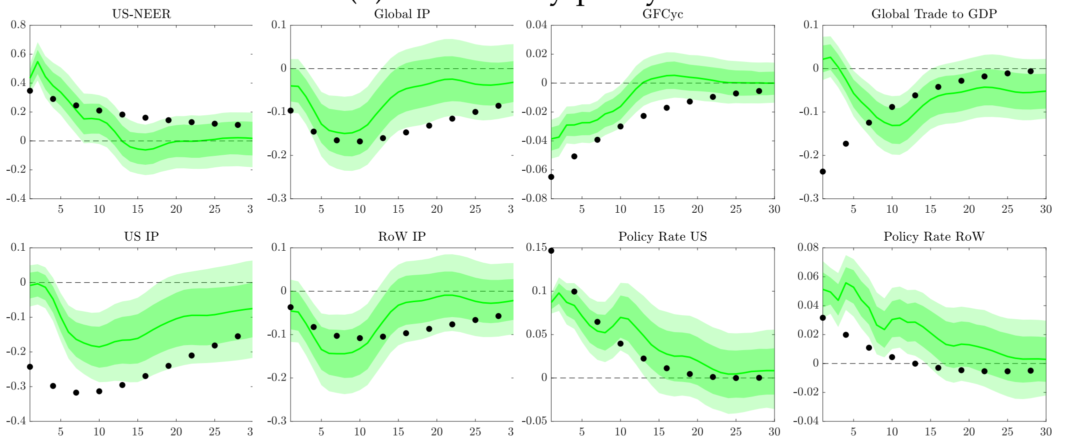
[21] We make several adjustments to render the impulse responses comparable. First, the structural model is calibrated to quarterly data, while the VAR model is estimated on monthly data. Therefore, the impulse responses from the structural model in Figure 7 are only plotted every three months. To make percentage deviations of flow variables—-such as output—from the quarterly trinity model comparable to those from the monthly VAR model, we report the corresponding three-month trailing moving average of the latter's impulse responses as suggested by Born & Pfeifer (2014). Second, while the structural model features real GDP, the VAR model includes industrial production, which is about 2.5 times more volatile in quarterly data (see Georgiadis et al. (2024) for a discussion). We adjust the real GDP response in the structural model accordingly. Third, our model does not include a direct analogue to the global financial cycle measure of Miranda-Agrippino & Rey (2020). However, Miranda-Agrippino & Rey (2020) calculate that a " 40% impact fall [in the global financial cycle measure] would roughly translate into a 8% impact decrease in the local stock market". We compare changes in the level of global asset prices Q_G from the trinity model to changes in the global financial cycle measure along

Figure 7: Trinity model quantitative performance conditional on U risk and U monetary policy shocks

(a) U risk shock



(b) U monetary policy shock



Note: Solid blue (green) lines show VAR model responses and the shaded areas 68/90% credible sets. Black dots show impulse responses of the trinity model. We scale the impulse responses from the trinity model such that the dollar on average appreciates by the same amount over the first year as in the VAR model responses. Footnote 21 provides further details on the scaling of the impulse responses. To save space we report the responses of U.S. consumer prices, the U.S. credit spread, and the level of global asset prices as measured by the Dow Jones World Index in Figure B.4 of the Appendix.

empirical counterparts.

these lines. In doing so, we take into account the fact that Miranda-Agrippino & Rey (2020) use an non-standardized global financial cycle time series to do these calculations, while in the VAR model we use their standardized time series. As shown in Figure B.4, this transformation is not crucial, as the model-implied changes in the level of global asset prices are also close to the shock-induced changes in the Dow Jones World index.

5 Understanding trinity

To understand the role of dollar trinity for generating and synchronizing the global cycles we first benchmark the transmission mechanism in the baseline model against a counterfactual without any dollar dominance. We then trace the difference between the trinity and no-dominance models to the contributions of the three dimensions of individual dollar dominance and—importantly—their interaction.

5.1 A counterfactual without any dollar dominance

The counterfactual model without any dollar dominance is nested in the trinity model laid out in Section 3.

First, to remove dollar dominance in trade, we assume that prices of U-R trade and intra-R sales are sticky in the producer's currency ($\widehat{\gamma}_R^U = \widehat{\gamma}_R^R = 0$ and $\widehat{\gamma}_U^R = 1$).

Second, to remove dollar dominance in cross-border credit, we assume that R banks do not have an incentive to borrow dollar loans from U banks in steady state. We do so by setting the interest rate on cross-border dollar loans equal to that for domestic funding.[22] In U, we assume that cross-border credit is frictionless. This means that U banks merely act as intermediaries (Γ^{CBDL}, $\Phi_{U,\phi} = 0$) and do not generate any profits from doing so.

Finally, to remove dollar dominance in safe assets, we assume that R banks do not have an incentive to hold U Treasuries in steady state. In particular, Treasuries no longer feature an advantage in terms of liquidity ($\epsilon_{R,\alpha} = 0$), nor act as a hedge for dollar-denominated liabilities ($\kappa_{R,\alpha,\ell} = 0$). This means that the convenience yield is zero.[23]

To the first order this no-dominance model is indistinguishable from a model in which export prices are sticky in the producer's currency, UIP holds due to unconstrained households trading international bonds, and financial sectors being segmented internationally.

We next focus on the U risk shock to illustrate the mechanics of dollar trinity. Figure 8 presents the responses of selected variables; results are similar for other shocks, in particular the U monetary policy shock (see Figure B.5). The red

[22] In particular, the R government taxes cross-border loans on the R banks balance sheet, such that the cost of cross-border dollar borrowing equals the cost of local borrowing.

[23] We assume that the R government subsidizes the returns R banks generate from holding U Treasuries such that in steady state they equal the R risk-free rate. To induce determinacy, we assume that the balance-sheet constraint tightens with the share of un-hedged dollar loans along the lines of (Schmitt-Grohé & Uribe (2003)), so that $\kappa_{R,\alpha,\ell}$ is only approximately zero.

lines with circles depict the adjustment in the trinity model and the blue lines with diamonds the adjustment in the no-dominance model. The difference is stark. In the trinity model, the U risk shock pushes up the convenience yield for the reasons discussed in Section 3.5, which induces the dollar to appreciate. In contrast, without any dollar dominance, there is no convenience yield (upper-left panel). As a consequence, there is also no appreciation of the dollar and if anything a slight depreciation on impact.

The responses of financial variables are much stronger in the trinity model because of the global financial accelerator. As R banks' leverage ratio increases when the dollar appreciates, U banks' balance-sheet constraints tighten so that they curtail cross-border lending. The drop in cross-border dollar credit alongside the increase in their leverage ratio following a dollar appreciation forces R banks to deleverage too, which is partly achieved by a reduction in their financing of domestic investment and leads to a rise in credit spreads. This raises the convenience yield, which further appreciates the dollar via Equation (11).

Figure 8 shows that without any dollar dominance, there is little international co-movement in terms of real and financial variables. RoW real GDP is largely insulated, and the induced contraction of global real GDP largely stems from the slowdown of the US business cycle. Finally, without any dollar dominance and associated dollar appreciation, global trade hardly responds, and if anything, increases.

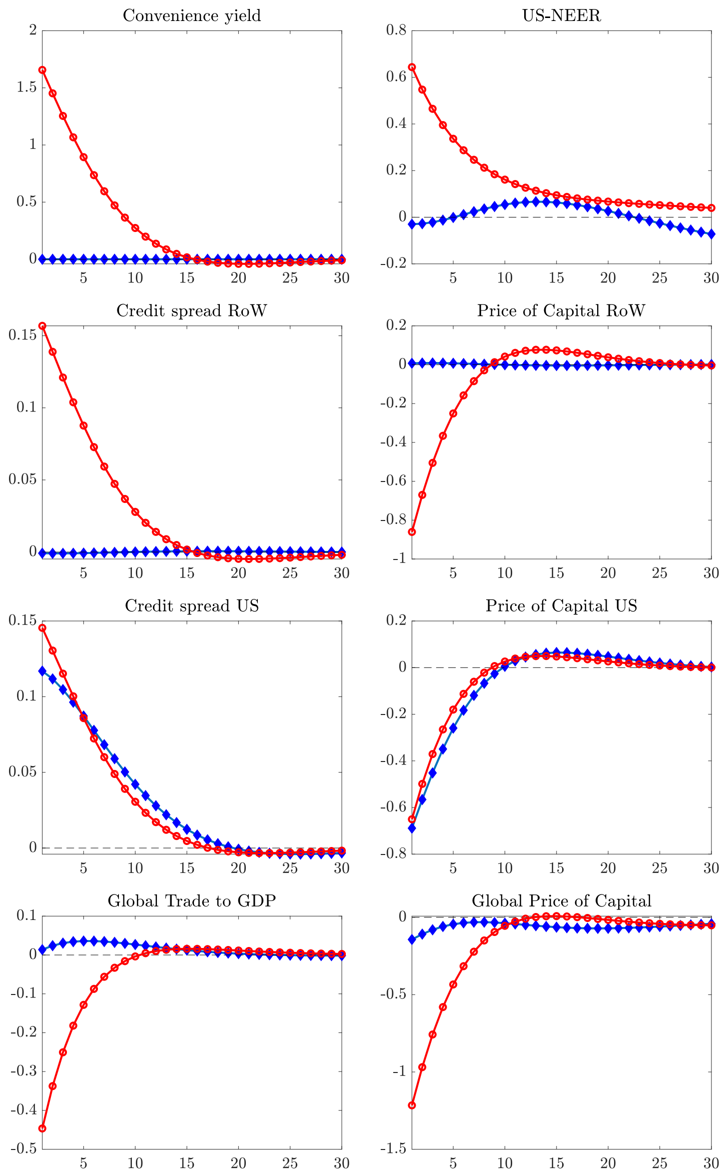
5.2 Trinity is more than the sum of its parts

To illustrate how the individual trinity dimensions and especially how their interaction shapes global cycles and international co-movement through the dollar exchange rate, we next decompose the effects of a U risk shock in the trinity model into the components that arise in counterfactual model versions with only one dollar dominance dimension and—by construction—a residual. The latter reflects the role of the interactions between the individual dollar dominance dimensions for giving rise to the effects in the trinity model.

Consider the trinity model (ℓ =T), a model with no dollar dominance at all (ℓ =NOD), a model with dollar dominance *only* in trade (ℓ =DCP), *only* in cross-border debt (ℓ =DCD), and *only* in safe assets (ℓ =DCA). Denote by $\boldsymbol{\theta}^{\ell}$ the response of the variables to a U risk shock from model ℓ. We then have the identity:

$$\underbrace{\boldsymbol{\theta}^{\mathrm{T}} - \boldsymbol{\theta}^{\mathrm{NOD}}}_{\substack{\text{total}\\\text{trinity effect}}} = (\underbrace{\boldsymbol{\theta}^{\mathrm{DCP}} - \boldsymbol{\theta}^{\mathrm{NOD}}}_{\text{DCP effect}}) + (\underbrace{\boldsymbol{\theta}^{\mathrm{DCD}} - \boldsymbol{\theta}^{\mathrm{NOD}}}_{\text{DCD effect}}) + (\underbrace{\boldsymbol{\theta}^{\mathrm{DCA}} - \boldsymbol{\theta}^{\mathrm{NOD}}}_{\text{DCA effect}}) + \underbrace{\mathcal{I}}_{\substack{\text{trinity inter-}\\\text{action effect}}}, \quad (15)$$

Figure 8: Responses to U risk shock in the trinity (red circle) and no-dominance (blue diamond) models



Note: Red lines with circles show the impulse responses of the trinity model and, blue lines with diamonds of the no-dominance model. The U risk shock is normalized to increase the U bank's balance-sheet risk weight by 1%. The global price of capital is given by the country-size weighted average of the prices of capital in U and R (see Equation (D.69)) expressed in dollar and U per capita terms. The global trade-to-GDP ratio is calculated as the ratio of global trade, as given by the sum of $U-R$ and $R-U$ and intra R export, relative to global GDP as given by the country size weighted average of U and R GDP (see Equation (D.68)).

where $\mathcal{I}$ is a residual that makes the left-hand side equal the sum of the first three terms on the right-hand side. Each of the first three terms on the right-hand side reflects the effect of a U risk shock in a model with a single dollar dominance dimension relative to the no-dominance model. The last term on the right-hand side is non-zero if the dollar dominance dimensions interact beyond the sum of their individual effects to produce the effects of a U risk shock in the trinity model on the left-hand side.

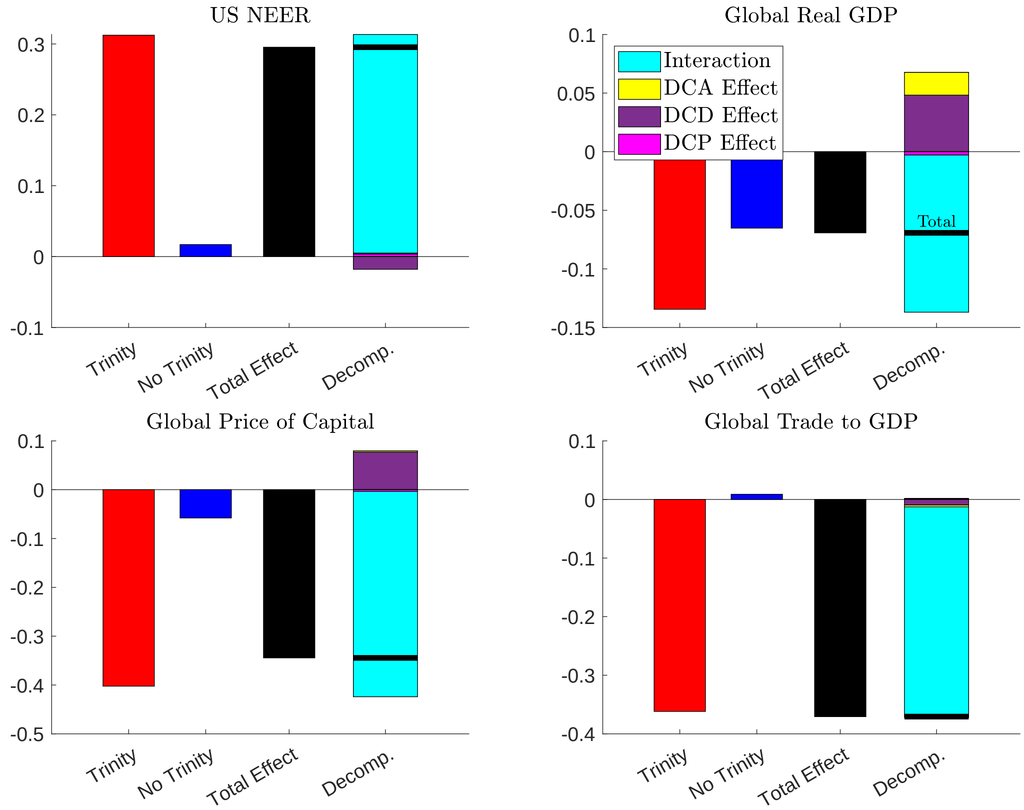
In other words, suppose we start with the effects of a U risk shock in the no-dominance model $\boldsymbol{\theta}^{\text{NOD}}$, add the difference in the effects relative to the dominance in trade model $\boldsymbol{\theta}^{\text{DCP}} - \boldsymbol{\theta}^{\text{NOD}}$, then the difference in the effects relative to the dominance in cross-border debt model $\boldsymbol{\theta}^{\text{DCD}} - \boldsymbol{\theta}^{\text{NO}}$, and then also the difference in the effects relative to the dominance in safe assets model $\boldsymbol{\theta}^{\text{DCA}} - \boldsymbol{\theta}^{\text{NO}}$. We could then see how close this sum gets to the effects of a U risk shock in the trinity model $\boldsymbol{\theta}^{\text{T}}$. If there remains a discrepancy $\mathcal{I}$, this must be because the individual dollar dominance dimensions interact to produce the effects of a U risk shock in the trinity model.

The last bar in in each panel in Figure 9 shows the decomposition of the difference between the trinity impulse responses to a U risk shock ($\boldsymbol{\theta}^{T}$) and the no-dominance impulse responses ($\boldsymbol{\theta}^{NOD}$) from Equation (15). The horizontal black line represents the total trinity effect ($\boldsymbol{\theta}^{T} - \boldsymbol{\theta}^{NOD}$); this horizontal line is the difference between the effect in the trinity model represented by the first bar ('Trinity', red) and the effect in the model without any dollar dominance represented by the second bar ('No Trinity', blue). In the last bar in each panel, the yellow, purple, and magenta bars show the effect of dollar dominance in safe assets (DCA), dominance in cross-border debt (DCD), and dominance in trade (DCP) relative to the no-dominance impulse responses, respectively, that is, $\boldsymbol{\theta}^{DCA} - \boldsymbol{\theta}^{NOD}$, $\boldsymbol{\theta}^{DCD} - \boldsymbol{\theta}^{NOD}$, and $\boldsymbol{\theta}^{DCP} - \boldsymbol{\theta}^{NOD}$. The cyan bars indicate the—residual—trinity interaction effect $\mathcal{I}$. The decomposition is similar for the U monetary policy shock (Figure B.7).

For example, the first panel shows that relative to the case with no dollar dominance, the dollar exchange rate appreciates much more in the trinity model (third, black bar). Moreover, the dollar exchange rate does not appreciate more when there is only dominance in safe assets (DCA) relative to the no dominance model (yellow area in the last bar). When there is only dominance in cross-border debt (DCD), the dollar exchange rate appreciates somewhat less relative to the no dominance model (purple area in the last bar).

Overall, three observations stand out in Figure 9. First, dollar dominance in trade (DCP) alone plays essentially no role in producing the total trinity effect. This is because with dominance in trade only, the dollar exchange rate does not appreciate, and hence prices of dollar-invoiced imports do not rise relative to the case with no dominance. As a result, with dollar dominance in trade only, there

Figure 9: Unpacking the role of individual dollar dominance dimensions for the U risk shock



Note: Black bars show the average difference between the effect of a U risk shock in the trinity model and the no-dominance model, $\boldsymbol{\theta}^T - \boldsymbol{\theta}^{NOD}$ over the first 3 years. Yellow, purple, and magenta bars show the effects of moving from the trinity to the models with dominance in safe assets ($\boldsymbol{\theta}^{\text{DCA}} - \boldsymbol{\theta}^{\text{cf}}$), cross-border debt ($\boldsymbol{\theta}^{\text{DCD}} - \boldsymbol{\theta}^{\text{cf}}$), and dominant in trade ($\boldsymbol{\theta}^{\text{DCP}} - \boldsymbol{\theta}^{\text{cf}}$), respectively. Turquoise bars indicate the trinity interaction effect ($\mathcal{I}$). The U risk shock is normalized to increase the U balance-sheet-specific risk weight by 1%. The global price of capital is a country-size weighted average of the prices of capital in U and R (see Equation (D.69)). The global trade-to-GDP ratio is calculated as the ratio of global trade, as given by the sum of $U - R$ and $R - U$ and intra R export, relative to global GDP as given by the country size weighted average of U and R GDP (see Equation (D.69)). The corresponding dynamics impulse responses are shown in Figure B.6 of the Appendix.

is no stronger expenditure switching or any other differential adjustment relative to the case with no dollar dominance.

Second, dollar dominance in safe assets (DCA) and in cross-border debt (DCD) alone render the output effects of a U risk shock more *benign* relative to the case with no dollar dominance. In particular, with dollar dominance in safe assets (DCA) only, R banks can use U Treasuries to diversify their steady state portfolio away from claims on domestic capital, the price of which falls in response to the U risk shock. U Treasuries provide a good hedge against this, as their price (the dollar) remains roughly stable. As a result, R banks' net worth declines

Table 5: Unpacking the role of individual dollar dominance dimensions for the unconditional moments of the global cycles

Moment	Data	Trinity	No dominance	DCP	DCD	DCA
A. Global cycles						
$corr(\Delta Z_G, \Delta GFCyc)$	0.69	0.51	0.26	0.26	0.3	0.21
$corr(\Delta Z_G, \Delta T_G^G / Z_G)$	0.76	0.5	-0.11	-0.12	0.44	0.00
$corr(\Delta GFCyc, \Delta T_G^G / Z_G)$	0.56	0.93	-0.45	0.2	0.72	-0.45
B. Global cycles and dollar						
$corr(\Delta \mathcal{E}, \Delta GFCyc)$	-0.42	-0.87	-0.17	-0.25	0.72	-0.36
$corr(\Delta \mathcal{E}, \Delta Z_G)$	-0.41	-0.61	0.17	0.09	0.22	-0.02
$corr(\Delta \mathcal{E}, \Delta T_G^G / Z_G)$	-0.39	-0.96	0.43	-0.85	0.71	0.31
C. International co-movement						
$corr(\Delta Q_R, \Delta Q_U)$	0.82	0.96	0.05	0.05	-0.22	-0.05
$corr(\Delta T_R / Z_R, \Delta T_U / Z_U)$	0.8	0.95	-1	0.11	-1.00	-1.00
$corr(\Delta Z_R, \Delta Z_U)$	0.8	0.74	0.09	0.14	-0.09	0.1
D. Model fit						
RMSE rel. Trinity		1	2.66	1.72	3.05	2.57

Notes: See notes to Table 4.

less relative to the version where they don't have access to these assets, and so their lending and economic activity contract less. Intuitively, despite treasuries being the global safe asset, their convenience yield does not rise, and hence the dollar does not appreciate because R banks are largely insulated from the shock and are thus not seeking to buy additional safe assets. Similarly, dollar dominance in cross-border debt (DCD) alone also dampens the effect of a U risk shock. In this case, this is because R banks have access to another funding source: cheap dollar-denominated cross-border debt contracts provided by U banks. This allows U banks to diversify their portfolio and shield their net-worth from the induced fall in U equity prices. Because, without dollar trinity, the dollar does not appreciate, and R banks are largely insulated, lending dollars to R banks provides U banks with a good hedge. But if the dollar appreciates — as it does under dollar trinity— the dollar debt puts pressure on RoW banks' balance sheets, tightening the balance sheet constraint of R banks and U banks, outweighing the aforementioned effect.

Third, and most importantly, for all global cycles it is by far the interaction between the individual dollar dimensions that generates almost the entire effects of a U risk shock in the trinity model. A similar picture emerges for the U monetary shock (see Figure B.7).

Analogously to the adjustments in response to a U risk shock, Table 5 shows that the unconditional co-movement of the three cycles and the dollar exchange rate as well as the international co-movement across U and R variables, match those in the data only in the trinity model, with no individual dimension being able to provide an even remotely close fit as measured by the root mean square error. This holds true, even if we re-optimize over the variances of the shocks (see C.2). Again, the individual dollar dominance dimensions interact to produce the total trinity effect.

6 Conclusion

The world economy exhibits three cycles: a global financial cycle, a global trade cycle, and a global business cycle. These cycles are mutually correlated but also co-move with the dollar exchange rate. We show that these cycles are intimately interrelated *because* of the dollar exchange rate. Moreover, we establish that the key role of the dollar exchange rate in driving these cycles is rooted in its role as a dominant currency in global trade, finance, and safe assets—dollar trinity.

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A Online Appendix - Identification of shocks in the BPSVAR

A.1 Identifying the U.S. Main Business Cycle shock

It is well known that without further assumptions, the matrix A_0 in Equation (2.1) as well as its inverse A_0^{-1}, which captures the contemporaneous effect of structural shocks on the endogenous variables are not uniquely identified. As shown for instance in Arias et al. (2021) this identification problem can be restated by decomposing the impact matrix as $A_0^{-1'} = \boldsymbol{SQ}$ where $\boldsymbol{S}$ is well identified lower-triangular matrix, which orthogonalizes the reduced form residuals and $\boldsymbol{Q}$ represents an unidentified, orthonormal matrix, where each column is linked to a specific structural shock. Given stationarity of the SVAR system, it allows for an SVMA representation of the form

$$\boldsymbol{y}_t = \boldsymbol{\Theta}(\boldsymbol{L})\boldsymbol{\epsilon} = \boldsymbol{C}(\boldsymbol{L})\boldsymbol{Q}\boldsymbol{\epsilon}_t, \tag{A.1}$$

with $\boldsymbol{\Theta}(\boldsymbol{L})$ as an infinite polynomials capturing the structural impulse responses to the (unidentified) structural shocks, while $\boldsymbol{C}(\boldsymbol{L})$ captures the (identified) impulse responses under the triangularized system defined by the matrix $\boldsymbol{S}$. Given this decomposition, each column $\boldsymbol{q}$ of the matrix $\boldsymbol{Q}$ can be related to a specific structural shock and, as shown by Angeletos et al. (2020), the contribution of this shock to the spectral density of the variable d over the frequency band $[\underline{\omega}, \bar{\omega}]$ can be written as

$$\boldsymbol{\Gamma}(q; d, \underline{\omega}, \bar{\omega}) = q' \boldsymbol{\Phi}(d, \underline{\omega}, \bar{\omega}) q = q' \int_{\underline{\omega}}^{\bar{\omega}} \overline{\boldsymbol{C^d}(e^{-i\omega})} \boldsymbol{C^d}(e^{-i\omega}) d\omega \, q, \tag{A.2}$$

with $\boldsymbol{C^d}$ as the impulse responses of the triangularized system that correspond to the variable of interest d. $\overline{x}$ indicates the complex conjugate transpose of x.[24] Lastly the matrix $\Phi(d, \underline{\omega}, \bar{\omega})$ expresses the entire volatility of the variable d in terms of the the shocks in the triangularized system as described by the matrix $\boldsymbol{S}$ and can be recovered from the data without any identifying assumptions. The U.S. Main Business Cycle shock is then identified by solving for the unit length vector $\boldsymbol{q}$ that maximizes the contribution of the corresponding shock to the volatility of US industrial production over the business cycle as defined in Equation (A.2). This boils down to computing the matrix $\Phi(d, \underline{\omega}, \bar{\omega})$ for the dollar and defining the column vector q that represents the MDS as the eigenvector

[24]We choose $\underline{\omega}$ and $\bar{\omega}$ such that, at quarterly frequency, the frequency band is given by $[\underline{\omega}, \bar{\omega}] = [\frac{2\pi}{6}, \frac{2\pi}{32}]$ which is the frequency band typically associated with the business cycle (Stock & Watson (1999), Angeletos et al. (2020))

associated with the largest eigenvalue of $\Phi(d, \underline{\omega}, \bar{\omega})$.

A.2 Identifying the risk and monetary policy shocks

To achieve identification the BPSVAR framework exploits a $k \times 1$ vector of observed proxy variables—or, in alternative jargon, external instruments—$\boldsymbol{p}_t$. The proxy variables are assumed to be correlated with the k unobserved structural shocks of interest $\boldsymbol{\epsilon}_t^*$ (relevance condition) and orthogonal to the remaining unobserved structural shocks $\boldsymbol{\epsilon}_t^o$ (exogeneity condition):

$$E[\boldsymbol{p}_t \boldsymbol{\epsilon}_t^{*\prime}] = \boldsymbol{V}, \qquad E[\boldsymbol{p}_t \boldsymbol{\epsilon}_t^{o\prime}] = \boldsymbol{0}. \tag{A.3}$$

Our analysis closely builds on Georgiadis et al. (2024).
For the US risk, we use intra-daily changes in the price of gold around the time stamps of narratively selected events. The latter were originally selected by Bloom (2009), later updated by Piffer & Podstawski (2018) and Bobasu et al. (2021). To identify the U.S. risk shocks, we use all events that were labeled as U.S.-related events.
For the U.S. monetary policy shock we follow the industry standard and use intra-daily changes in three-month Federal (Fed) funds futures around FOMC announcements (Gertler & Karadi 2015; Miranda-Agrippino & Rey 2020). We account for the possible presence of central bank information effects by keeping only the interest-rate surprises for FOMC meetings for which the associated equity-price surprises have the opposite sign (Jarociński & Karadi 2020).

A.2.1 Identifying assumptions

Denote by ϵ_t^r the US risk aversion shock and by ϵ_t^{mp} the US monetary policy shock, and define $\boldsymbol{\epsilon}_t^* \equiv (\epsilon_t^r \epsilon_t^{mp})'$. Further denote by p_t^g the monthly time series of the intra-daily gold-price surprises on the narratively selected events, by p_t^i monthly time series of the intra-daily Fed-funds-futures surprises around FOMC meetings, and define $\boldsymbol{p}_t \equiv (p_t^g, p_t^i)'$. The relevance and exogeneity conditions are

$$E[\boldsymbol{\epsilon}_t^* \boldsymbol{p}_t'] = \begin{pmatrix} E[p_t^g \epsilon_t^r] & E[p_t^i \epsilon_t^r] \\ E[p_t^g \epsilon_t^{mp}] & E[p_t^i \epsilon_t^{mp}] \end{pmatrix} = \boldsymbol{V}, \tag{A.4a}$$

$$E[\boldsymbol{\epsilon}_t^o \boldsymbol{p}_t'] = \begin{pmatrix} E[p_t^g \boldsymbol{\epsilon}_t^o] & E[p_t^i \boldsymbol{\epsilon}_t^o] \end{pmatrix} = \boldsymbol{0}. \tag{A.4b}$$

First, in the relevance condition in Equation (A.4a) we assume that US risk shocks drive gold-price surprises in intra-daily windows around the narratively selected events, that is $E[p_t^g \epsilon_t^r] \neq 0$ and $E[p_t^g \epsilon_t^u] \neq 0$. Intuitively, an increase in US risk aversion up the price of gold as the archetypal safe asset (Baur & McDermott 2010). Piffer & Podstawski (2018) provides evidence that gold-price surprises are relevant instruments for risk/uncertainty shocks based on *F*-tests and Granger-causality tests. Ludvigson et al. (2021) use gold-price changes as a proxy variable in a similar context; and Engel & Wu (2018) use the gold price as a proxy for risk. Regarding the exogeneity condition $E[p_t^g \epsilon_t^o] = 0$ in Equation (A.4b), Piffer & Podstawski (2018) document that the intra-daily gold-price surprises on the narratively selected events are not systematically correlated with a range of measures of non-risk aversion/uncertainty shocks.[25]

Second, we assume that US monetary policy shocks drive the Fed-funds-futures surprises in intra-daily windows around FOMC announcements in the relevance condition in Equation (A.4a), $E[p_t^i \epsilon_t^{mp}] \neq 0$ (Gertler & Karadi 2015; Jarociński & Karadi 2020; Miranda-Agrippino & Rey 2020). Regarding the exogeneity condition $E[p_t^i \epsilon_t^o] = 0$ in Equation (A.4b), it is plausible that around FOMC meetings—especially after cleansing from central bank information effects—Fed-funds-futures surprises are driven only by monetary policy shocks.

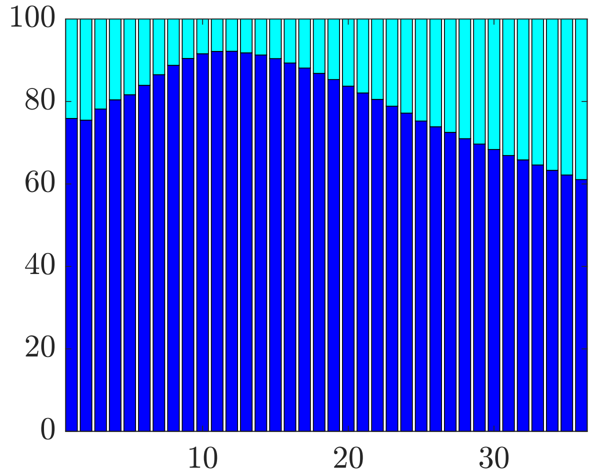
Third, we follow (Georgiadis et al. 2024) and impose an additional restriction to disentangle US risk from US monetary shocks. In particular, we impose the additional restriction that Fed-funds-futures surprises on FOMC meeting days are not driven by US risk shocks, that is $E[p_t^i \epsilon_t^r] == 0$ in Equation (A.4a). This additional restriction is implicitly maintained in the literature on the effects of monetary policy (Gertler & Karadi 2015; Jarociński & Karadi 2020; Miranda-Agrippino & Rey 2020; Miranda-Agrippino & Ricco 2021).[26]

[25]Note that the exogeneity condition $E[p_t^g \epsilon_t^o] = 0$ does not state that on every narratively selected event only risk aversion and uncertainty shocks occurred. Instead, the exogeneity condition states that only risk aversion shocks *systematically* across *all* narratively selected events.

[26]It would be natural to impose the analogous additional restriction that gold-price surprises on the narratively selected events are not driven by US monetary policy shocks, that is $E[p_t^g \epsilon_t^{mp}] = 0$ in Equation (A.4a). However, in the estimation algorithm of Arias et al. (2021) such over-identifying restrictions cannot be implemented. Therefore, we do not impose this additional restriction.

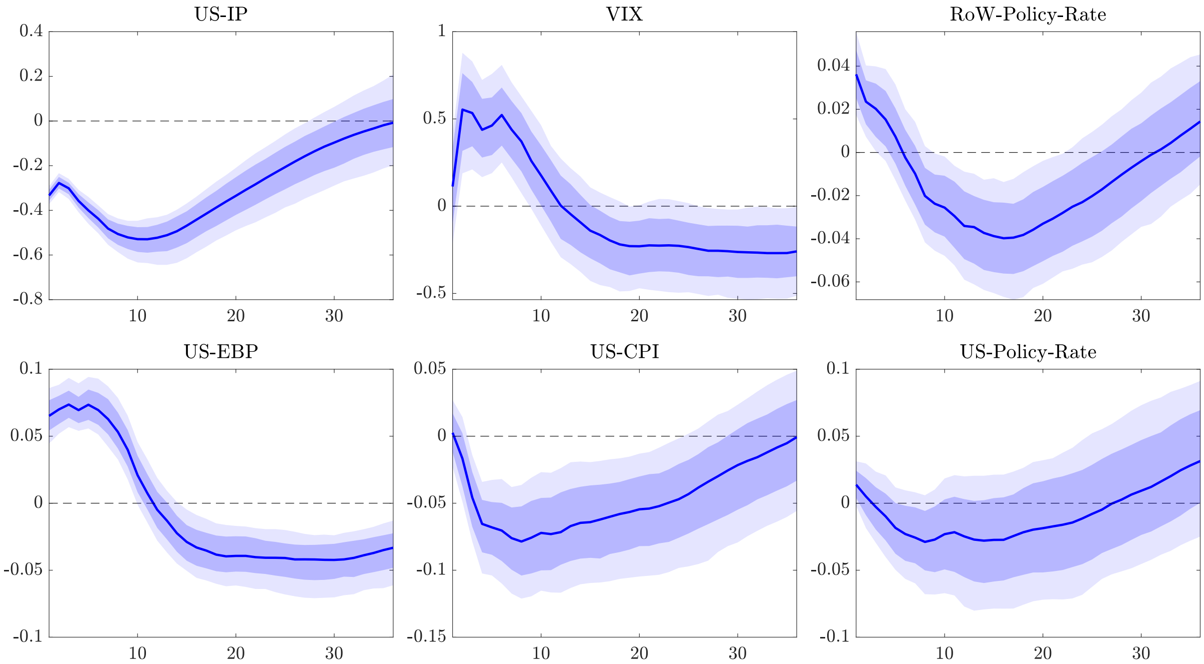
B Online appendix - Additional figures

Figure B.1: Role of the MBCS in the Forecast Error Variance of the US-Industrial Production



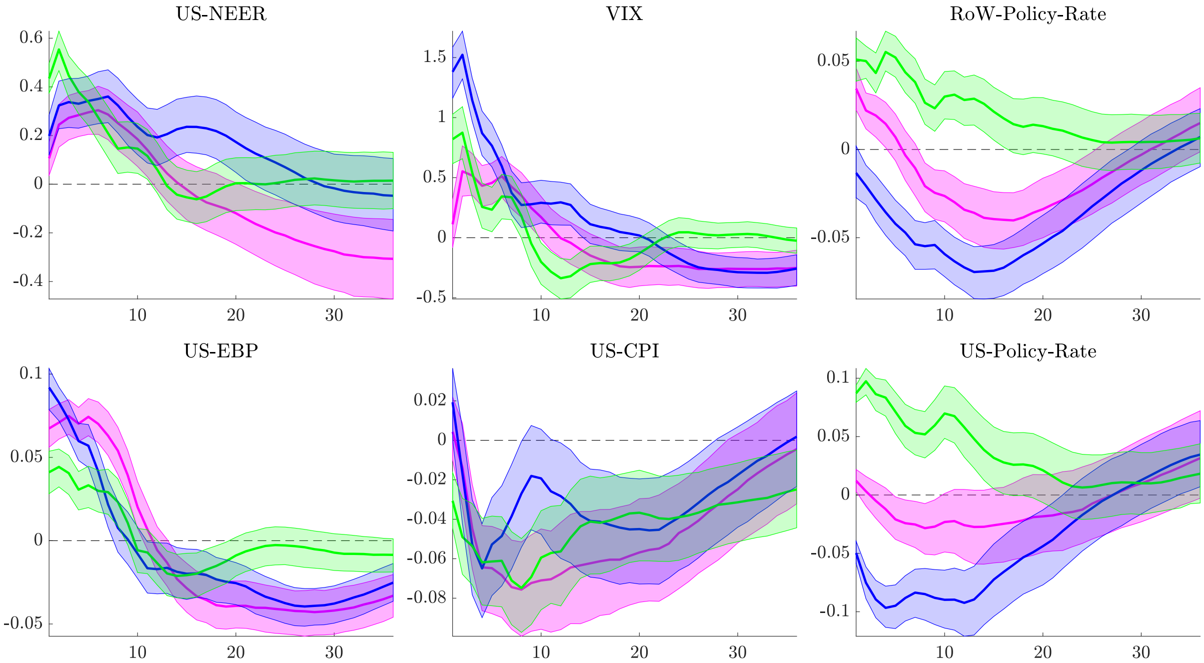
Note: The figure shows the point-wise median of the estimated contribution of the MBCS for the Forecast Error Variance of the US-NEER at different horizons. The blue (torqouise) bars measures the corresponding contribution of the MBCS (other shocks).

Figure B.2: Remaining IRFs to the US Main Business Cycle Shock



Note: The horizontal axis denotes time in months. Blue solid lines represent point-wise posterior means and shaded areas 68/90% equal-tailed, point-wise credible sets.

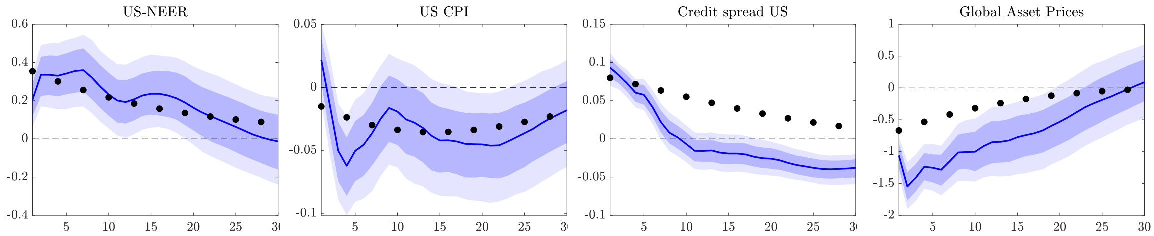
Figure B.3: Remaining IRFs for US risk (blue), US monetary policy (green), and US main business cycle shock (magenta)



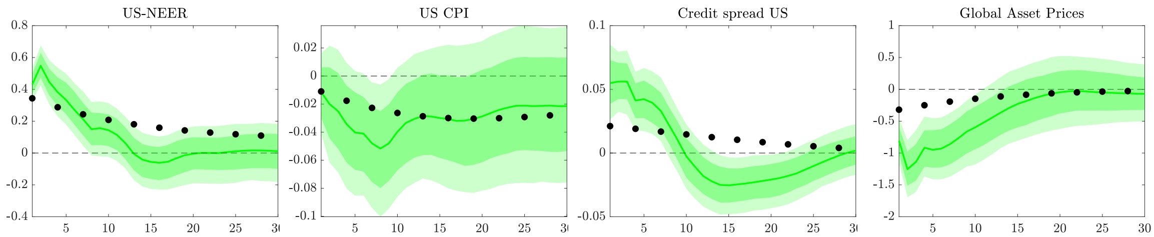
Note: Responses to a US risk aversion (blue), US monetary policy (green) shock, and the US main business cycle Shock (magenta). The horizontal axis denotes time in months. The vertical axis deviation from pre-shock level in percent or annualized percentage rates (for interest rates and credit spreads). The size of shock is one standard deviation.

Figure B.4: The global transmission mechanism—Trinity v VAR (add. variables)

a) US risk shock

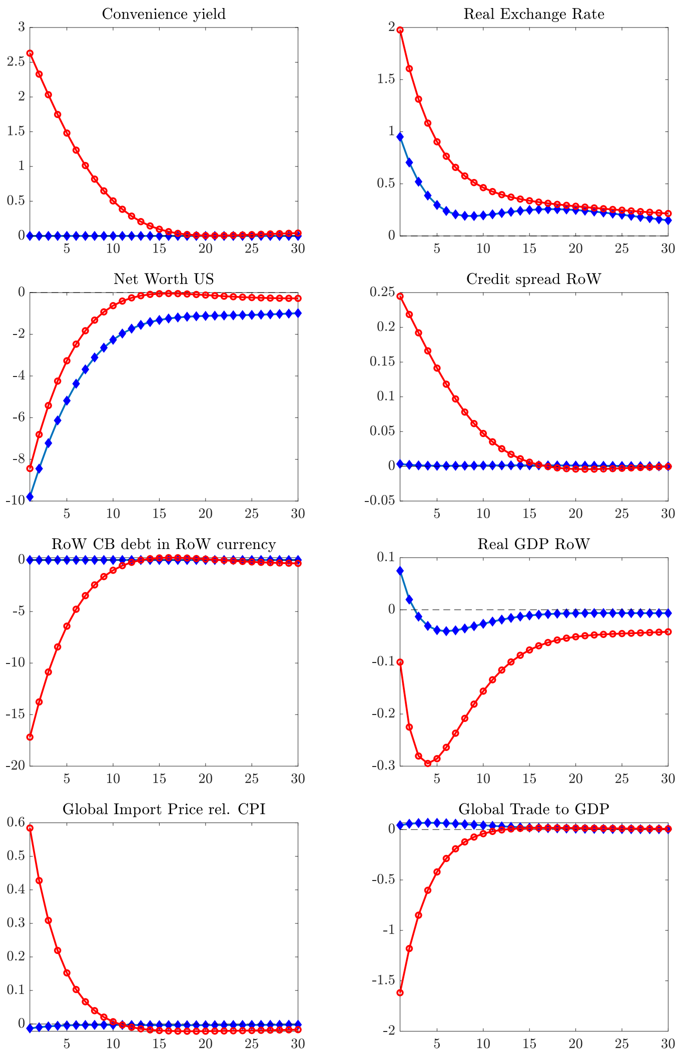


b) U.S. Monetary policy shock



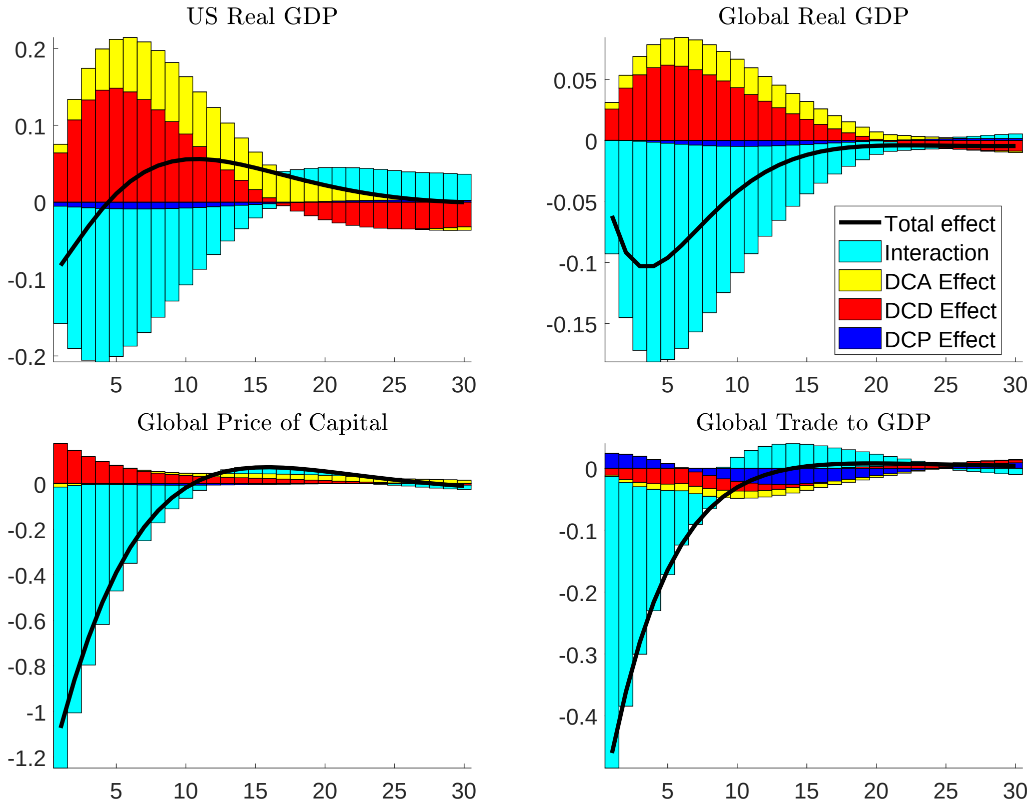
Note: Solid blue lines show BPSVAR model responses. Red dots show impulse responses of trinity model. Footnote 21 provides further details on the scaling of impulse responses. The Dow Jones World Index was added to the baseline BPSVAR to construct another measure for the global financial cycle that does not suffer from the scaling issues that plague the GFCyc of Miranda-Agrippino & Rey (2020).

Figure B.5: Responses to a US monetary policy shock with (red circles) and without (blue diamonds) dollar trinity



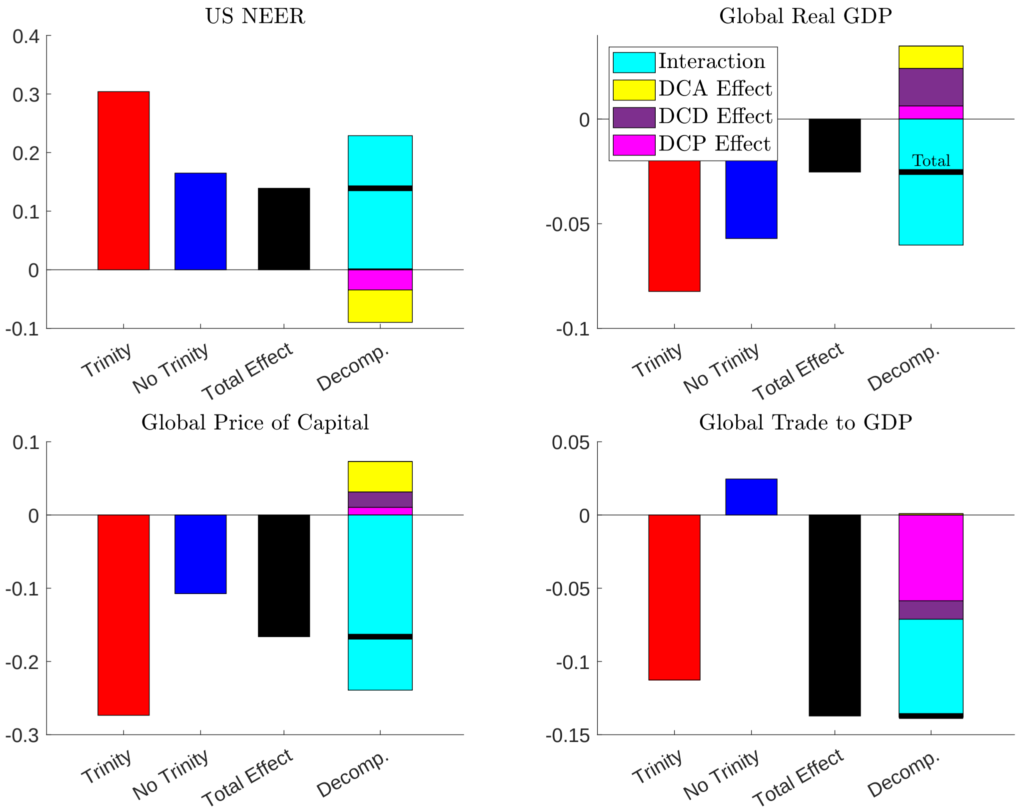
Note: The red lines with circles show the impulse responses of baseline model and the blue lines with diamonds from an alternative model in which we switch off dollar trinity. The US monetary policy shock aversion shock is normalized to increase the US policy rate by 25 basis points.

Figure B.6: Dynamics the role of individual dollar dominance dimensions for the US risk shock



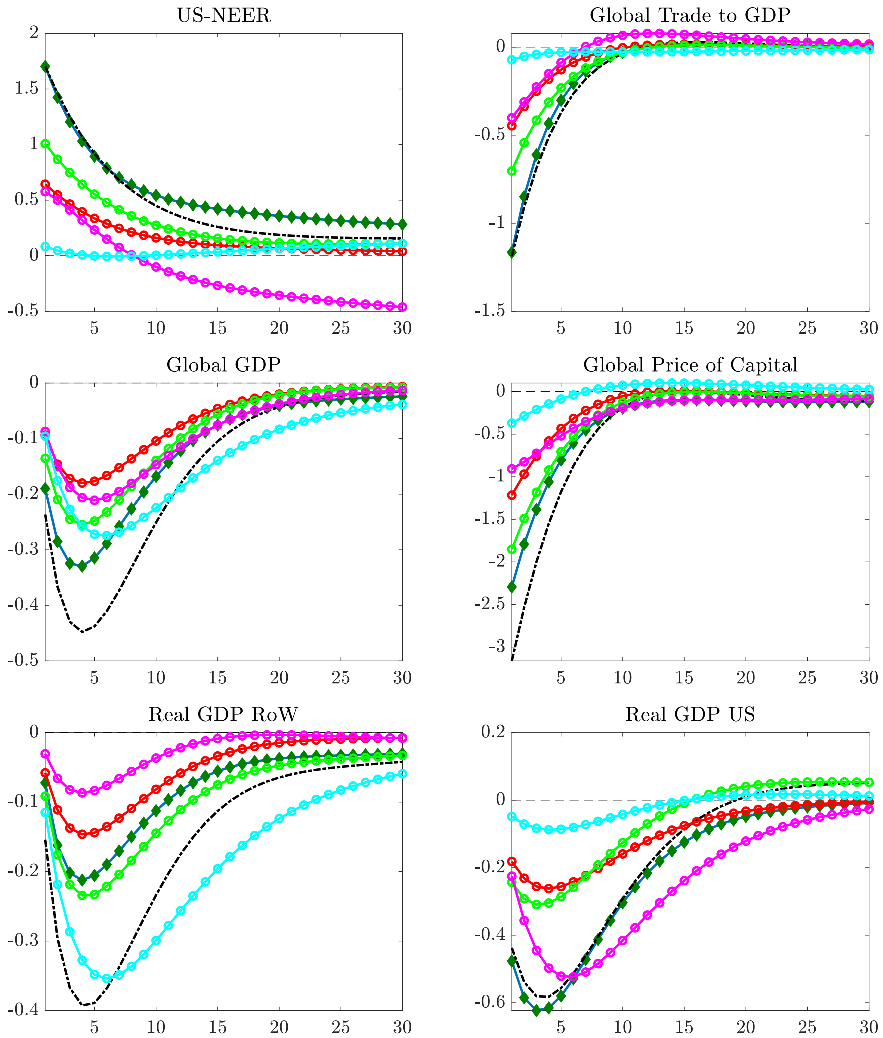
Note: Black lines show the difference between the effect of a US risk shock in the trinity model and the no-dominance model, $\boldsymbol{\theta}^{T} - \boldsymbol{\theta}^{NOD}$. Yellow, red, and blue bars show the effects of moving from the trinity to the models with dominance in safe assets ($\boldsymbol{\theta}^{\mathrm{DCA}} - \boldsymbol{\theta}^{\mathrm{cf}}$), cross-border debt ($\boldsymbol{\theta}^{\mathrm{DCD}} - \boldsymbol{\theta}^{\mathrm{cf}}$), and dominant in trade ($\boldsymbol{\theta}^{\mathrm{DCP}} - \boldsymbol{\theta}^{\mathrm{cf}}$), respectively. Turquoise bars indicate the trinity interaction effect ($\mathcal{I}$). The shock is normalized to increase the US balance-sheet-specific risk weight by 1%. The global price of capital is a country-size weighted average of the prices of capital in U and R (see Equation (D.69)). The global trade-to-GDP ratio is calculated as the ratio of global trade, as given by the sum of $U - R$ and $R - U$ and intra R export, relative to global GDP as given by the country size weighted average of U and R GDP (see Equation (D.69))

Figure B.7: Unpacking the role of individual dollar dominance dimensions for the US monetary policy shock shock



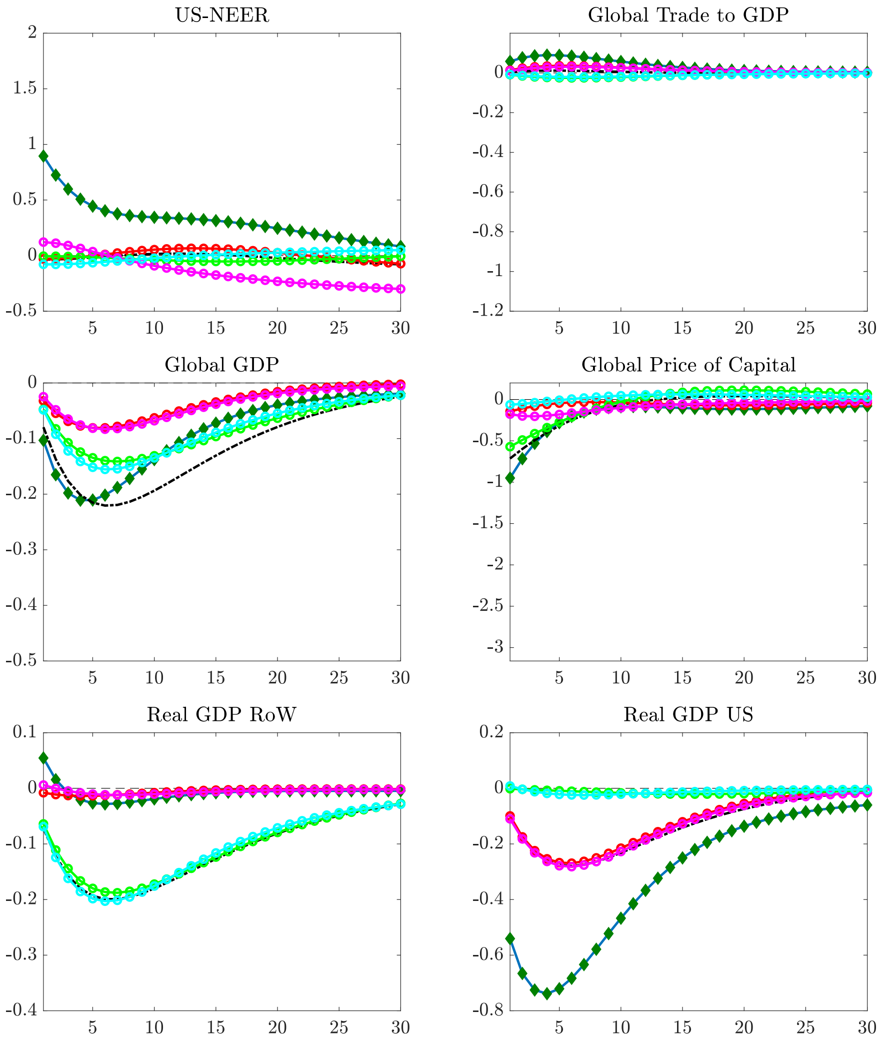
Note: Black bars show the average difference between the effect of a U Monetary Policy Shock in the trinity model and the no-dominance model, $\boldsymbol{\theta}^{T} - \boldsymbol{\theta}^{NOD}$ over the first 3 years. Yellow, purple, and magenta bars show the effects of moving from the trinity to the models with dominance in safe assets ($\boldsymbol{\theta}^{\text{DCA}} - \boldsymbol{\theta}^{\text{cf}}$), cross-border debt ($\boldsymbol{\theta}^{\text{DCD}} - \boldsymbol{\theta}^{\text{cf}}$), and dominant in trade ($\boldsymbol{\theta}^{\text{DCP}} - \boldsymbol{\theta}^{\text{cf}}$), respectively. Turquoise bars indicate the trinity interaction effect ($\mathcal{I}$). The UMonetary Policy Shock is normalized to increase the U policy rate by 25 basis points on impact. The global price of capital is a country-size weighted average of the prices of capital in U and R (see Equation (D.69)). The global trade-to-GDP ratio is calculated as the ratio of global trade, as given by the sum of $U - R$ and $R - U$ and intra R export, relative to global GDP as given by the country size weighted average of U and R GDP (see Equation (D.69)). The corresponding dynamics impulse responses are shown in Figure B.6 of the Appendix.

Figure B.8: Responses to a global risk aversion shock (black dashed), a US local risk aversion shock (red circled), RoW local risk aversion shock (light green circles), US monetary policy shock (green diamonds), US TFP shock (magenta circles), RoW TFP (cyan circles)



Note: The global risk (a correlated shock to US and RoW balance sheet constraints) and US local risk shocks are normalized to increase the US bank-specific risk weight by 1% on impact. The RoW local risk shock increases the RoW balance-sheet-specific risk weight by 1% on impact. US monetary policy is normalized to appreciate the dollar by as much as the global risk aversion shock on impact. The US (RoW) TFP shock is normalized to, on average, decrease US (RoW) GDP over the first 3 years by as much as the global risk aversion shock .

Figure B.9: No $-Trinity: Responses to a global risk aversion shock (black dashed), a US local risk aversion shock (red circled), RoW local risk aversion shock (light green circles), US monetary policy shock (green diamonds), US TFP shock (magenta circles), RoW TFP (cyan circles)



Note: The global risk shock (a correlated shock to US and RoW balance sheet constraints) and US local risk shocks are normalized to increase the US bank-specific risk weight by 1% on impact. The RoW local risk shock increases the RoW balance-sheet-specific risk weight by 1% on impact. US monetary policy is normalized to appreciate the dollar by as much as the global risk shock on impact. The US (RoW) TFP shock is normalized to, on average, decrease US (RoW) GDP over the first 3 years by as much as the global risk shock .

C Online appendix - Additional tables

Table C.1: Data description

Variable	Description	Source	Coverage
US 1-year TB rate	1-year Treasury Bill yield at constant maturity	US Treasury/Haver	1990m1 - 2019m12
US IP	Industrial production excl. construction	FRB/Haver	1990m1 - 2019m12
US CPI	US consumer price index	BLS/Haver	1990m1 - 2019m12
US EBP		Favara et al. (2016)	
Broad, AE, EME US dollar NEER	Nominal broad trade-weighted Dollar index	FRB/Haver	1990m1-2019m12
RoW, AE, EME IP	Industrial production, see Martínez-García et al. (2015)	Dallas Fed Global Economic Indicators/Haver	1990m1 - 2019m12
RoW, AE, EME CPI	Consumer price index	Dallas Fed Global Economic Indicators/Haver (Martínez-García et al. 2015)	1990m1 - 2019m12
RoW, AE, EME policy rate	Short-term official/policy rate, see Martínez-García et al. (2015)	Dallas Fed Global Economic Indicators/Haver	1990m1 - 2019m12
US cross-border bank credit	External claims on all sectors of banks owned by US nationals	BIS Locational Banking Statistics, Table A7/Haver	1990q1-2019q2, interpolated to monthly frequency
EMBI spread	EMBI Brady bonds sovereign spread	JP Morgan Emerging Markets Bond Indexes /Haver	1993m12-2019m12
US Treasury premium	Deviation from covered interest parity between US and G10 government bond yields	Du et al. (2018)	1991m4-2019m12
Foreign Treasury security purchases	Estimated transactions, change in holdings cleansed from valuation effects	Bertaut & Tryon (2007), Bertaut & Judson (2014, 2022)	1990m1-2011m6, 2012m1-2019m12, interpolated for 2011m7-2011m12
Global factor in risky asset prices		Miranda-Agrippino et al. (2020)	1990m1 - 2019m4
US macroeconomic uncertainty index	One-month ahead forecast-error variance	Jurado et al. (2015)	1990m1-2019m12

Notes: BLS stands for Bureau of Labour Statistics, FRB for Federal Reserve Board, BEA for Bureau of Economic Analysis, and BIS for Bank for International Settlements.

Table C.2: Unpacking the role of individual dollar dominance dimensions for the unconditional moments of the global cycles (**re-optimizing over variances**)

Moment	Data	Trinity	No dominance	DCP	DCD	DCA
A. Global cycles						
$corr(\Delta Z_G, \Delta GFCyc)$	0.69	0.51	0.45	0.41	0.2	0.58
$corr(\Delta Z_G, \Delta T_G^G / Z_G)$	0.76	0.5	-0.91	0.21	-0.3	0.93
$corr(\Delta GFCyc, \Delta T_G^G / Z_G)$	0.56	0.93	-0.49	0.95	-0.83	0.47
B. Global cycles and dollar						
$corr(\Delta \mathcal{E}, \Delta GFCyc)$	-0.42	-0.87	-0.19	-0.91	-0.96	-0.35
$corr(\Delta \mathcal{E}, \Delta Z_G)$	-0.41	-0.61	-0.23	-0.35	-0.25	-0.3
$corr(\Delta \mathcal{E}, \Delta T_G^G / Z_G)$	-0.39	-0.96	0.34	-0.9	0.9	-0.2
$corr(\Delta \mathcal{E}, PC_1^{cycles})$	-0.48	-0.94	0.3	-0.91	0.94	-0.31
C. International co-movement						
$corr(\Delta Q_R, \Delta Q_U)$	0.82	0.96	-0.01	0.25	0.02	-0.09
$corr(\Delta T_R / Z_R, \Delta T_U / Z_U)$	0.80	0.95	-0.99	0.37	-1.00	-1.00
$corr(\Delta Z_R, \Delta Z_U)$	0.81	0.74	0.23	0.2	-0.16	0.31
D. Model fit						
RMSE rel. Trinity		1	3.01	1.4	3.4	2.07

Notes: See notes to Table 4.

D Online Appendix - Additional model details

D.1 Model structure

The model consists of two economies, the US denoted by U, and a RoW block denoted by R, which are linked through trade, cross-border bank lending and investment in US Treasuries. The model features standard real and nominal frictions such as sticky prices and wages, habit formation in consumption, investment adjustment costs and variable capital utilization. At the heart of the model are US and RoW banks that engage in leveraged domestic and cross-border lending and borrowing. We assume the structure of frictions is (up to parametrization) symmetric for the US and the RoW; the key exceptions are financial frictions and global trade. In particular on the financial side, we assume US banks intermediate domestic dollar funds to the RoW and that US Treasuries are the global safe asset. Regarding international trade we assume that (i) for trade between the US and the RoW is largely prices are largely sticky in US$ and (ii) a fraction of intra RoW trade is also sticky in US$. The latter comes about because the RoW block is supposed to be an aggregate of countries and as document by Gopinath et al. (2020), even if the US is not directly involved in the trade, countries tend to invoice a lot of their trade in US$. Figure D.1 gives a schematic overview of the model structure. As frictions are largely symmetric for the two blocks, we lay out the equations for the RoW block unless indicated otherwise.

Figure D.1: Schematic overview of the model

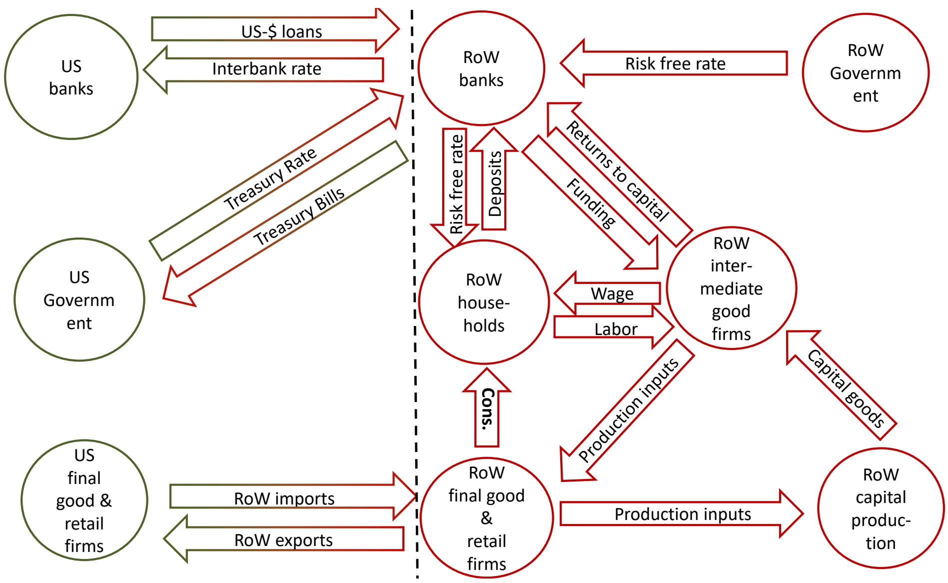
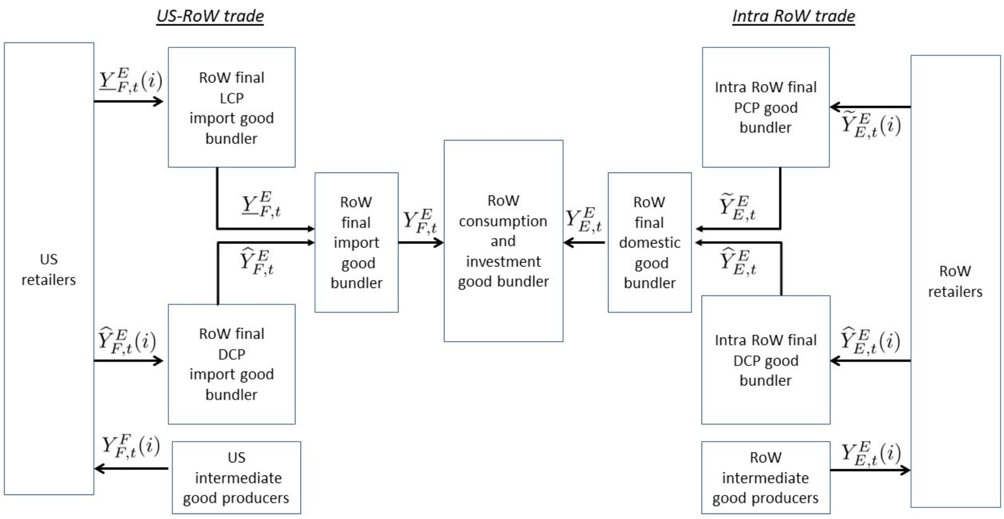


Figure D.2: Multi-layered production structure for the RoW consumption and investment good



Note: The figure lays out the multi-layered production structure in the structural model, focusing on the RoW consumption and investment good.

D.2 Households and unions

In each period a household consumes a non-traded final good subject to habit formation in consumption. Furthermore each households is a monopolistic supplier of a differentiated labor service $L_{R,t}(h)$ and sells this to a perfectly competitive union that transforms it into an aggregate labor supply using a constant elasticity of substitution (CES) technology. Households satisfy demand for labor given the wage rate $W_{R,t}$, with wage setting being subject to frictions à la Calvo. The period-by-period utility function is given by

$$U(C_{R,t}, L_{R,t}) = \frac{1}{1-\sigma^c}(C_{R,t} - h_R C_{R,t-1})^{1-\sigma^c} - \frac{\kappa_{R,w}}{1+\varphi} L_{R,t}^{1+\varphi}. \tag{D.1}$$

with $\sigma^c, \varphi, h_R, \kappa_{R,w}$ as the intertemporal elasticity of substitution, the inverse Frisch elasticity of labor supply, the habit formation parameter and an exogenous labor scale parameter respectively. Households maximize utility subject to the following budget constraint

$$\frac{B^n_{R,t}}{P^C_{R,t}} + C_{R,t} = \frac{B^n_{R,t-1} R_{R,t-1}}{P^C_{R,t}} + \frac{W_{R,t}(h) L_{R,t}(h) + IS_{R,t}(h)}{P^C_{R,t}} + \frac{\Pi^C_{R,t}}{P^C_{R,t}} + \frac{\Pi^R_{R,t}}{P^C_{R,t}},$$

where we chose the final consumption and investment good price $P^C_{R,t}$ as the numeraire. $R_{R,t-1}$ is the predetermined domestic risk-free rate paid on nominal deposits with domestic banks $B^n_{R,t}$. $IS_{R,t}$ furthermore denotes an income stream from domestic state-contingent securities ensuring that all households will choose the same consumption and savings plans, despite temporarily receiving different wages due to the assumption of Calvo-type wage setting. Lastly $\Pi^C_{R,t}$ and $\Pi^R_{R,t}$ represent nominal profits from domestic (RoW) capital producing and retail firms respectively. The first-order condition of the household with respect to the choice of consumption is given by

$$\Lambda_{R,t} = (C_{R,t} - h_R C_{R,t-1})^{-\sigma_c} - \beta_R h_R \mathbb{E}_t[(C_{R,t+1} - h_R C_{R,t})^{-\sigma_c}] \tag{D.2}$$

with $\Lambda_{R,t}$ as the marginal utility of consumption. The intertemporal optimality conditions for the individual holdings of deposits with the local bank reads as

$$\Lambda_{R,t} = \mathbb{R}_t\Big[\beta_R \Lambda_{R,t+1} \frac{R_{R,t}}{1 + \pi^C_{R,t+1}}\Big]. \tag{D.3}$$

where $\pi^C_{R,t+1}$ corresponds to the net inflation rate of the final consumption good. The working part of the household also sells its differentiated labor services $L_{R,t}(h)$ to a competitive union, which combines the differentiated labor services into a composite labor good using CES technology. Lastly the union leases the combined labor service to the intermediate good firms at the aggregate nominal wage rate $W_{R,t}$. The worker optimally chooses its wage given labor demand by the union taking into account that wage setting is subject to frictions à la Calvo, meaning that in each period they face a constant probability $(1 - \theta_{w,R})$ of being able to adjust their nominal wage. As such the aggregate real wage index evolves as

$$w^{1-\psi_w}_{R,t} = (1 - \theta_{w,R}) \tilde{w}^{1-\psi_w}_{R,t} + \theta_{w.R}(1 + \pi^C_{R,t})^{\psi_w - 1} w^{1-\psi_w}_{R,t-1} \tag{D.4}$$

with $\tilde{w}_{R,t}$ as the optimal reset wage and $w_{R,t}$ as the economy wide real wage.

D.3 Financial Intermediation

D.3.1 RoW financial intermediaries

We assume RoW banks raise funds through domestic deposits and cross-border dollar loans from US banks and use them to finance claims on domestic capital and holdings of US Treasuries. Specifically, consider RoW bank j and let $K_{R,j,t}$ be its claims on domestic capital in period t, $Q_{R,t}$ the price of such a claim relative to the price of the RoW final consumption good $P^C_{R,t}$, $GB_{R,j,t}$ holdings of US Treasuries, $B_{R,j,t}$ deposits from households, $CBDL_{R,j,t}$ funding through cross-border dollar loans, and $N_{R,j,t}$ net worth. The bank's balance sheet identity in real terms is

$$Q_{R,t}K_{R,j,t} + RER_t GB_{R,j,t} = B_{R,j,t} + RER_t CBDL_{R,j,t} + N_{R,j,t}, \tag{D.5}$$

where $RER_t = \mathcal{E}_t P^C_{U,t} / P^C_{R,t}$ represents the real exchange rate in terms of relative consumer-price levels and $\mathcal{E}_t$ the nominal exchange rate defined as the price of a dollar in units of RoW currency; an increase in $\mathcal{E}_t$ thus represents an appreciation of the dollar.

On the asset side of the RoW bank's balance sheet in Equation (D.5), claims on domestic capital $K_{R,j,t}$ earn the rate $R^K_{R,t}$, and—when converted to RoW currency—holdings of US Treasuries $GB_{R,j,t}$ earn the rate $D\mathcal{E}_t R^{GB}_{U,t-1}$, $D\mathcal{E}_t \equiv \mathcal{E}_t / \mathcal{E}_{t-1}$. On the liability side, deposits of domestic households $B_{R,j,t}$ cost the rate $R_{R,t-1}$—which we assume equals the RoW risk-free, central bank rate—and cross-border dollar loans from US banks $CBDL_{R,j,t}$ the rate $D\mathcal{E}_t R^{CBDL}_{U,t-1}$. The law of motion for the RoW bank's net worth is

$$N_{R,j,t} = \frac{1}{1+\pi^C_{R,t}} \Big\{ R_{R,t-1} N_{R,j,t-1} + \Big[(1-\alpha^{GB}_{R,j,t-1}) R^K_{R,t} + \alpha^{GB}_{R,j,t-1} D\mathcal{E}_t R^{GB}_{U,t-1} \tag{D.6}$$
$$- (1-\ell^{CBDL}_{R,j,t-1}) R_{R,t-1} - \ell^{CBDL}_{R,j,t-1} D\mathcal{E}_t R^{CBDL}_{U,t-1} \Big] AS_{R,j,t-1} \Big\},$$

where $AS_{R,j,t} \equiv Q_{R,t}K_{R,j,t} + RER_t GB_{R,j,t}$ denotes the bank's total assets, $\alpha^{GB}_{R,j,t} \equiv RER_t GB_{R,j,t} / AS_{R,j,t}$ the share of total assets accounted for by US Treasuries, and $\ell^{CBDL}_{R,j,t} \equiv RER_t CBDL_{R,j,t} / AS_{R,j,t}$ the share of total assets funded by cross-border dollar loans.

Equation (D.6) shows that a RoW bank's net worth generally fluctuates with the dollar exchange rate. In particular, even when returns on US Treasuries equal the costs of cross-border dollar loans ($R^{GB}_{U,t-1} = R^{CBDL}_{U,t-1}$), if the share of assets funded by cross-border dollar loans exceeds the asset share of Treasuries ($\ell^{CBDL}_{R,j,t} - \alpha^{GB}_{R,j,t} > 0$) the bank's net worth drops when the dollar appreciates ($D\mathcal{E}_t > 0$).

The objective of a RoW bank is to maximize the discounted value of current and expected future equity streams. The bank's value function is

$$V_{R,j,t} = \max \mathbb{E}_t \sum_{s=0}^{\infty} (1-\theta_B) \Theta_{R,t,t+s} N_{E,j,t+1+s}, \tag{D.7}$$

where $\Theta_{R,t,t+s}$ is the household's real stochastic discount factor.

In order to put a ceiling on the amount of leverage a RoW bank can take on we assume it faces a balance-sheet constraint in the spirit of Gertler & Karadi (2011). We motivate this balance-sheet constraint as an eligibility requirement the bank needs to satisfy in order for creditors to provide funding. In particular, for the bank to attract creditors and be able to leverage, the sum of its discounted current and expected future equity streams has to be larger than a risk-weighted sum of its current assets

$$V_{R,j,t} \geq \delta_{R,j,t}(Q_{R,j,t}K_{R,j,t} + \Gamma_R^{GB} RER_t GB_{R,j,t}). \tag{D.8}$$

We assume creditors apply two types of risk weights in the balance-sheet constraint in Equation (D.8). First, the *asset-specific* risk weight Γ_R^{GB} represents the perceived riskiness of Treasuries relative to claims on domestic capital (for a similar interpretation see Karadi & Nakov 2021; Coenen et al. 2018). In particular, we assume that US Treasuries are perceived to be less risky than claims on domestic capital ($\Gamma_R^{GB} < 1$).
Second, the *balance-sheet-specific* risk weight $\delta_{R,j,t}$ represents the perceived riskiness of the bank's relative *asset and liability* composition. The balance-sheet constraint in Equation (D.8) thus shows how creditors weigh the perceived riskiness of the size and structure of the bank's asset and liability portfolio on the right-hand side against its discounted current and expected future level of equity on the left-hand side.[27] In particular, we assume the balance-sheet-specific risk weight varies with the asset and liability shares according to

$$\delta_{R,j,t}\left(\ell_{R,j,t}^{CBDL}, \alpha_{R,j,t}^{GB}\right) = \bar{\delta}_R\left[1 + \frac{\kappa_{R,\alpha,\ell}}{2}\left(\alpha_{R,j,t}^{GB} - \ell_{R,j,t}^{CBDL}\right)^2 - \epsilon_{R,\alpha}\alpha_{R,j,t}^{GB}\right] + \epsilon_t^{\delta_R}, \tag{D.9}$$

where $\epsilon_t^{\delta_R}$ is an exogenous shock which we interpret as a shock to the willingness of creditors to provide funding for a given level of net worth. In other words we assume that this shock raises the risk aversion of creditors. Because we are interested in a *global* risk aversion shock, we assume that for each country i, the shock $\epsilon^{\delta_{i,B}}$ has a factor structure with a domestic component $\eta_t^{\delta_i}$ and a global component $\eta_t^{\delta_G}$ and evolves as

$$\epsilon_t^{\delta_{i,B}} = \rho_\delta \epsilon_{t-1}^{\delta_{i,B}} + \eta_t^{\delta_i} + \eta_t^{\delta_G}. \tag{D.10}$$

The specification of the balance-sheet-specific risk weight in Equation (D.9) is key

[27] The balance-sheet constraint in Equation (D.8) is algebraically very similar to that postulated in Gertler & Karadi (2011), who motivate it referring to the idea that the banker can 'abscond' with a fraction of assets.

for the transmission mechanisms in the model. First, cross-border dollar loan funding increases the balance-sheet-specific risk weight as long as it is not met by corresponding dollar assets in terms of holdings of US Treasuries ($\kappa_{R,\alpha,\ell} > 0$). We make this assumption because unhedged cross-border dollar borrowing exposes the RoW bank's net worth to fluctuations in the exchange rate and dollar funding shortages.[28] Second, apart from hedging funding through cross-border dollar loans, holding US Treasuries reduces the balance-sheet-specific risk weight ($\epsilon_{R,\alpha} > 0$). We make this assumption because Treasuries are viewed as the safe asset whose market price is relatively stable so that it can be sold with limited losses or even gains on its face value in times of stress in order to provide liquidity buffer in any type of funding shortage (Bianchi et al. 2021). In other words, Equation (D.9) incorporates a general and a dollar-specific incentive for holding Treasuries as liquidity-buffer.[29]

It can be shown that the value function of a bank, just like the law of motion its equity, is linear in its components. In particular after guessing the value function can be written as

$$V_{R,j,t} = \Big[(1-\alpha^{GB}_{R,j,t})v_{R,t} + \alpha^{GB}_{R,j,t}v^{GB}_{R,t} - \ell_{R,j,t}u_{R,t})\Big]AS_{R,j,t} + n_{R,t}N_{R,j,t} \tag{D.11}$$

its possible to verify procedure the solution to the bankers problem can be characterized by the following set of equations.

$$v_{R,t} = \mathbf{E}_t\Big(\Omega_{R,t,t+1}(R_{R,k,t+1} - R_{R,t})\Big) \tag{D.12}$$

$$v^{GB}_{R,t} = \mathbf{E}_t\Big(\Omega_{R,t,t+1}(\mathcal{E}_{t+1}/\mathcal{E}_t R^{GB}_{R,t} - R_{R,t})\Big) \tag{D.13}$$

$$n_{R,t} = \mathbf{E}_t\Big(\Omega_{E,t,t+1}(R_{R,t})\Big) \tag{D.14}$$

$$u_{R,t} = \mathbf{E}_t\Big(\Omega_{R,t,t+1}\mathcal{E}_{t+1}/\mathcal{E}_t R^{CBDL}_{U,t} - R_{E,t}\Big) \tag{D.15}$$

$$\Omega_{R,t,t+1} = \mathbf{E}_t\Big(\frac{\beta_R\Lambda_{R,t+1}}{\Lambda_{R,t}(1+\pi^c_{R,t+1})}\Big[(1-\theta_B) \tag{D.16}$$

$$+\theta_B([v_{R,t+1}(1-\alpha^{GB}_{R,j,t+1}) + v^{GB}_{R,t+1}\alpha^{GB}_{R,j,t+1} - u_{R,t+1}\ell^{CBDL}_{R,j,t+1}]\phi_{R,j,t+1} + n_{R,t+1})\Big]$$

[28]Under the 'absconding' interpretation of the balance-sheet constraint of Gertler & Karadi (2011) this assumption entails that the amount of assets the bank can run away with increases with the unhedged share of funding through cross-border dollar loans. This assumption may be motivated by the observation that bankruptcy laws are biased towards domestic lenders (Akinci & Queralto 2024).

[29]Note that strictly speaking Equation (D.9) states that also a positive net dollar exposure ($\alpha^{GB}_{R,j,t} - \ell^{CBDL}_{R,j,t} > 0$) increases the balance-sheet-specific risk weight. Thus, Equation (D.9) can also be read as stating that the bank has an incentive to take on cross-border dollar loans to hedge holdings of Treasuries. However, as we discuss in the calibration below, in the steady state the bank has a *negative* net dollar exposure.

Equations D.12, D.13, D.14, D.15, represent the discounted excess returns from borrowing domestically and lending domestically, the discounted excess returns from borrowing domestically and investing into US government bonds, the discounted excess costs of borrowing in US-$ instead of acquiring domestic deposits and the discounted marginal value of an additional unit of equity. Equation D.16 is the bankers "augmented" real stochastic discount factor, which accounts for marginal value of funds internal to the financial intermediary and the fact that the bank may have to close with a probability of $1 - \theta_B$. Lastly $\phi_{R,j,t} = AS_{R,j,t}/N_{R,j,t}$ corresponds to the optimal leverage ratio of the RoW bank described below.
With a closed form solution for $V_{R,j,t}$ at hand its straightforward to derive the first order conditions taking into account the balance sheet constraint in Equation (D.8).Regarding the choice of the optimal composition of asset side its possible to show that this the following first order condition.

$$\mathbf{E}_t \left[\Omega_{R,j,t,t+1} \left(D\mathcal{E}_{t+1} R^{GB}_{U,t} - R_{R,t} \right) \right] + CY_{R,j,t} = RP^{GB}_{R,j,t}. \tag{D.17}$$

The first term on the left-hand side coincides with the UIP condition in a standard model without financial frictions and safe asset demand. In particular, in a standard setup, in order to rule out arbitrage profits for RoW banks the exchange-rate-adjusted return of Treasuries—whose dollar-return equals the US risk-free rate $R^{GB}_{U,t} = R_{U,t}$ by assumption—has to equal the cost of funding through domestic deposits in terms of the risk-free rate $R_{R,t}$. Equation (D.17) shows that our model gives rise to two UIP deviations $CY_{R,j,t}$ and $RP^{GB}_{R,j,t}$.
The first UIP deviation is given by

$$RP^{GB}_{R,j,t} = \Gamma^{GB}_R \mathbf{E}_t \Big[\Omega_{R,j,t,t+1} \Big(R^K_{R,t+1} - R_{R,t} \Big) \Big], \tag{D.18}$$

and arises because optimal portfolio choice requires that in equilibrium the overall, exchange-rate-adjusted excess return of US Treasuries on the left-hand side in Equation (D.17) has to equal the risk-weight-adjusted excess return of the alternative investment in domestic capital on the right-hand side in Equation (D.17).
The second UIP deviation is given by

$$CY_{R,j,t} = -\frac{\partial \delta_{R,j,t} / \partial \alpha^{GB}_{R,j,t}}{\delta_{R,j,t}} \left[(1 - \alpha^{GB}_{R,j,t}) + \Gamma^{GB}_R \alpha^{GB}_{R,j,t} \right] \mathbf{E}_t \Big[\Omega_{R,j,t,t+1} \Big(R^K_{R,t+1} - R_{R,t} \Big) \Big], \tag{D.19}$$

and arises because in our setup the *overall* return of US Treasuries for a RoW bank on the left-hand side is made up of the direct component $R^{GB}_{U,t}$ and an additional, *indirect* component: Holding Treasuries loosens a RoW bank's balance-sheet constraint in Equations (D.8) and (D.9), thereby allows it to leverage more, exploit more investment opportunities and generate additional profits. In other words, because of their dominant safe asset property, holding Treasuries may be optimal for a RoW bank even if their direct, expected, exchange-rate-adjusted return is lower than the risk-weight-adjusted return of domestic capital $RP^{GB}_{R,j,t}$. We interpret this indirect return $CY_{R,j,t}$ as a convenience yield.

Equation (D.19) shows that the magnitude of the convenience yield is pinned down by the degree to which holding Treasuries reduces a RoW bank's balance-sheet-specific risk weight, how the freed leverage translates into additional claims on domestic capital, and the corresponding excess return. For example, when domestic credit spreads are high, holding additional Treasuries and thereby relaxing a RoW bank's balance-sheet constraint is particularly profitable, and hence the convenience yield is high. Note that Equation (D.17) instills a structural interpretation to the convenience yield in the UIP condition in the no-arbitrage finance framework in Krishnamurthy & Lustig (2019). Apart from the risk premium $RP^{GB}_{R,j,t}$, Equation (D.17) also coincides with the UIP condition in the structural model of Jiang et al. (2024). However, in their setup the convenience yield is introduced *ad hoc* as a UIP deviation that is assumed to decline in the global stock of safe assets. In contrast, in our model the convenience yield and its relation to global financing conditions emerge endogenously from the optimal portfolio choice of RoW banks.

As a UIP condition Equation (D.17) pins down the evolution of the dollar exchange rate. First, for a given RoW domestic deposit rate ($R_{R,t}$), in standard UIP logic an increase in the US risk-free rate and hence by assumption the return on Treasuries ($R^{GB}_{U,t}$) requires an expected depreciation of the dollar ($D\mathcal{E}_{t+1}$ declines), which is in part achieved by a contemporaneous appreciation. Second, for a given RoW domestic deposit rate ($R_{R,t}$) and US risk-free rate ($R^{GB}_{U,t}$), an increase in the convenience yield ($CY_{R,j,t}$) has to be accompanied by an expected depreciation of the dollar ($D\mathcal{E}_{t+1}$ declines), which is again in part achieved by a contemporaneous appreciation.

Regarding the optimal choice of the liability composition, it can be shown that the total returns on cross border dollar loans $R^{CBDL}_{U,t}$ have to equal the costs of domestic funding up to an endogenous wedge.

$$\mathbf{E}_t\left(\Omega_{R,j,t,t+1}R_{R,t}\right) = \mathbf{E}_t\left(\Omega_{R,j,t,t+1}D\mathcal{E}_{t+1}R^{CBDL}_{U,t}\right) + RP^{CBDL}_{R,j,t}, \tag{D.20}$$

with

$$RP^{CBDL}_{R,j,t} = \frac{\partial \delta_{R,j,t} / \partial \ell^{CBDL}_{R,j,t}}{\delta_{R,j,t}} \mathbf{E}_t \Omega_{R,j,t,t+1} \big[(1-\alpha^{GB}_{R,j,t})(R^K_{R,t+1} - R_{R,t}) \tag{D.21}$$

$$+ \alpha^{GB}_{R,j,t} \left(D\mathcal{E}_{t+1} R^{GB}_{U,t} + CY_{R,j,t} - R_{R,t} \right) \big]. \tag{D.22}$$

Cross-border dollar borrowing has an additional, *indirect* cost, as it tightens the RoW bank's balance-sheet constraint in Equations (D.8) and (D.9), thereby limits its leverage and thus reduces profits. This risk premium implies that in order for the RoW bank to borrow cross-border dollar funds the *direct* cost has to be lower than for domestic deposits. Thus, consistent with the data, in our model cross-border dollar borrowing is—or at least appears to be—cheap compared to domestic funding (Caramichael et al. 2021; Gutierrez et al. 2023). Analogous to the UIP condition in Equation (D.17), also Equation (D.20) provides intuition for the evolution of the dollar exchange rate. For example, when global financing conditions tighten so that domestic credit spreads rise, the risk premium on cross-border dollar loans increases. Equation (D.20) shows that for a given deposit rate and cross-border dollar credit rate this rise in the risk premium has to be accompanied by an expected depreciation of the dollar. This is partly accomplished by a contemporaneous appreciation. This mechanism is similar to the "two-way feedback between balance sheets and exchange rates" in Akinci & Queralto (2024, p.3).

The remaining equations of the RoW banking block are fairly standard. In particular, we impose market clearing for domestic capital, US treasuries and specify the start-up funds for a newly entering bank n as a fraction of last period's portfolio, $N_{R,n,t} = \omega_R AS_{R,t-1}$. In equilibrium all banks choose the same portfolio structure as they face the same returns and costs. The law of motion for aggregate net worth of the RoW banking sector is given by

$$N_{R,t} = \frac{\theta_B}{1+\pi^C_{R,t}} \Big\{ R_{R,t-1} N_{R,t-1} + \Big[(1-\alpha^{GB}_{R,t-1}) R^K_{R,t} + \alpha^{GB}_{R,t-1} D\mathcal{E}_t R^{GB}_{U,t-1} \tag{D.23}$$

$$- (1-\ell^{CBDL}_{R,t-1}) R_{R,t-1} - \ell^{CBDL}_{R,t-1} D\mathcal{E}_t R^{CBDL}_{U,t-1} \Big] AS_{R,t-1} \Big\} + \omega_R AS_{R,t-1}$$

When the model is parameterized so that the balance-sheet constraint in Equation (D.8) binds in a neighbourhood of the steady-state, the maximum equilibrium leverage ratio is given by

$$\phi_{R,j,t} \equiv \frac{AS_{R,j,t}}{N_{R,j,t}} = \frac{n_{R,j,t}}{\mathcal{R}_{R,j,t} - \mathcal{P}_{R,j,t}}, \tag{D.24}$$

where

$$\mathcal{R}_{R,j,t} \equiv \delta_{R,j,t} \left[(1 - \alpha^{GB}_{R,j,t}) + \Gamma^{GB}_{R} \alpha^{GB}_{R,j,t} \right], \tag{D.25}$$

$$\begin{aligned} \mathcal{P}_{R,j,t} \equiv \mathbf{E}_t \Omega_{R,j,t,t+1} \Big[& (1 - \alpha^{GB}_{R,j,t}) R^{K}_{R,t+1} + \alpha^{GB}_{R,j,t} D\mathcal{E}_{t+1} R^{GB}_{U,t} \\ & - (1 - \ell^{CBDL}_{R,j,t}) R_{R,t} - \ell^{CBDL}_{R,j,t} D\mathcal{E}_{t+1} R^{CBDL}_{U,t} \Big], \end{aligned} \tag{D.26}$$

are the RoW bank's asset-share-weighted bank and asset-specific risk weight and its expected profitability, respectively; the terms $\Omega_{R,j,t,t+1}$ and $n_{R,j,t}$ denote the bank's stochastic discount factor and the expected discounted returns to equity respectively. Equation (D.24) shows that the RoW bank's maximum leverage is pinned down by its portfolio's expected profitability and perceived riskiness in terms of risk weights. In particular, the RoW bank can attain a higher leverage ratio, thereby exploit more investment opportunities and generate more profits if (i) the perceived riskiness in terms of $\mathcal{R}_{R,j,t}$ is low, (ii) its expected profitability in terms of $\mathcal{P}_{R,j,t}$ is high, and/or (iii) expected discounted returns to equity in terms of $n_{R,j,t}$ are large.

D.3.2 US financial intermediaries

US banks differ from RoW banks in four ways. First, a US bank acts as cross-border lender rather than borrower, and so dollar loans appear on the asset side of its balance sheet

$$Q_{U,t} K_{U,j,t} + CBDL_{U,j,t} = B_{U,j,t} + N_{U,j,t}, \tag{D.27}$$

where $K_{U,j,t}$, $CBDL_{U,j,t}$, $B_{U,j,t}$ and $N_{U,j,t}$ are the total amount of claims on domestic capital, cross-border dollar loans, domestic deposits and net worth, respectively, deflated by the price of the US consumption good.

Second, for simplicity and in order to focus on the RoW, we assume US banks do not hold Treasuries. In contrast to RoW banks a US bank's net worth

$$\begin{aligned} N_{U,j,t} = & \frac{1}{1 + \pi^{C}_{U,t}} \Big[(R^{K}_{U,t} - R_{U,t-1}) Q_{U,t-1} K_{U,j,t-1} \\ & + (R^{CBDL}_{U,t-1} - R_{U,t-1}) CBDL_{U,j,t-1} + R_{U,t-1} N_{U,j,t-1} \Big], \end{aligned} \tag{D.28}$$

is not affected by exchange rate valuation effects as its liabilities and assets are all denominated in dollar.
Third, for a US bank we assume the balance-sheet constraint

$$V_{U,j,t} \geq \delta_{U,j,t}(Q_{U,t}K_{U,j,t} + \Gamma^{CBDL}_{U,t}CBDL_{U,j,t}), \tag{D.29}$$

with the asset-specific risk weight creditors attach to cross-border dollar loans

$$\Gamma^{CBDL}_{U,t} = \bar{\Gamma}^{CBDL}_{U} + \Phi_{U,\phi}\phi_{R,j,t}, \tag{D.30}$$

and where $\phi_{R,j,t}$ is the leverage ratio of RoW banks from Equation (D.24). Specifically, in Equation (D.30) we assume cross-border dollar lending is perceived to be more risky by a US bank's creditors when RoW banks are more leveraged. The motivation for this specification is that while RoW banks lend to the US government (the least risky borrower by assumption) and US firms (which pledge the entire return to capital), US banks also lend to leveraged and thus risky RoW banks, whose leverage (and thereby riskiness) endogenously fluctuates with the state of the economy.
Fourth, in contrast to RoW banks, a US bank does not engage in foreign-currency borrowing so that there is no asset-liability currency mismatch creditors may be concerned about. Therefore, we assume the balance-sheet-specific risk weight $\delta_{U,j,t}$ for a US bank does not vary endogenously and is given by

$$\delta_{U,j,t} = \overline{\delta}_U + \epsilon^{\delta_U}_t, \tag{D.31}$$

where $\epsilon^{\delta_U}_t$ is an exogenous risk aversion shock discussed previously.
We assume for simplicity that the return on US Treasuries equals the risk-free, monetary policy rate: $R^{GB}_{U,t} = R_{U,t}$. [30].
As in the RoW case, the objective of the US banker is to maximize the discounted value of current and future equity streams subject to the balance sheet constraint. The bank's value function is

$$V_{U,j,t} = \max \mathbb{E}_t \sum_{s=0}^{\infty}(1-\theta_B)\Theta_{U,t,t+s}N_{U,j,t+1+s}, \tag{D.32}$$

where $\Theta_{U,t,t+s}$ is the household's real stochastic discount factor.
Defining $\alpha^{CBDL}_{U,j,t} = \frac{CBDL_{U,j,t}}{AS_{U,j,t}}$ as the asset ratio of cross border dollar loans to

[30] This would result endogenously if we assumed US banks can hold Treasuries, if the corresponding asset-specific risk weight in the balance-sheet constraint in Equation (D.29) was zero, and if the balance-sheet-specific risk weight in Equation (D.31) was independent of these holdings

total assets of the banks assuming that the value function $V_{U,j,t}$ is linear in the components of the LOM for net worth its possible to show that

$$V_{U,j,t} = \Big[(1-\alpha^{CBDL}_{U,j,t})v_{U,t} + \alpha^{CBDL}_{U,j,t}v^{CBDL}_{U,t})\Big]AS_{U,j,t} + n_{U,t}N_{U,j,t} \tag{D.33}$$

$$v_{U,t} = \mathbb{E}_t\Big(\Omega_{U,t,t+1}(R^K_{U,t+1} - R_{U,t})\Big) \tag{D.34}$$

$$v^{CBDL}_{U,t} = \mathbb{E}_t\Big(\Omega_{U,t,t+1}(R^{CBDL}_{U,t} - R_{U,t})\Big) \tag{D.35}$$

$$n_{U,t} = \mathbb{E}_t\Big(\Omega_{U,t,t+1}(R_{U,t})\Big) \tag{D.36}$$

$$\Omega_{U,t,t+1} = \mathbb{E}_t\Big(\frac{\Theta_{U,t,t+1}}{(1+\pi^c_{U,t+1})}\times \Big[(1-\theta_B) + \theta_B\Big([(1-\alpha^{CBDL}_{U,j,t+1})v_{U,t+1} + \alpha^{CBDL}_{U,j,t+1}v^{CBDL}_{E,t+1}]\phi_{U,j,t+1} + n_{U,t+1}\Big)\Big]\Big). \tag{D.37}$$

With $V_{U,j,t}, v_{U,t}, v^{CBDL}_{U,t}, n_{U,t}$ and $\Omega_{F,t,t+1}$ as the slightly different versions of their RoW counterparts touched up on the previous section.
As in the RoW case the optimal portfolio choice of US banks choice requires

$$\Gamma^{CBDL}_{U,t}\mathbb{E}_t\Big[\Omega_{U,j,t,t+1}(R^K_{U,t+1} - R_{U,t})\Big] = \mathbb{E}_t\Big[\Omega_{U,j,t,t+1}\Big(R^{CBDL}_{U,t} - R_{U,t}\Big)\Big] - RP^{CBDL}_{U,j,t}, \tag{D.38}$$

stating that the expected risk-weight-adjusted excess returns on domestic capital on the left-hand side and cross-border dollar loans on the right-hand side have to equalize.
Apart from the term $RP^{CBDL}_{U,j,t}$, Equation (D.38) coincides with the equilibrium condition in a standard model without financial frictions on cross-border dollar lending and borrowing. In particular, in a standard setup expected, risk-weight-adjusted returns of different assets have to equalize. In Equation (D.38) this means that the expected, risk-weight-adjusted excess returns on claims on domestic capital have to equal the expected excess returns on cross-border lending. Equation (D.38) shows that in our model the *direct* expected excess return of cross-border dollar lending has to be higher than the risk-weight-adjusted excess return of claims on domestic capital due to a risk premium $RP^{CBDL}_{U,j,t}$.

In particular, this risk premium on cross-border lending is given by

$$RP^{CBDL}_{U,j,t} = \frac{\partial \Gamma^{CBDL}_{U,t}}{\partial \alpha^{CBDL}_{U,j,t}} \alpha^{CBDL}_{U,j,t} \mathbf{E}_t \Omega_{U,j,t,t+1} \Big[(1-\alpha^{CBDL}_{U,j,t})(R^K_{U,t+1} - R_{U,t}) + \alpha^{CBDL}_{U,j,t}(R^{CBDL}_{U,t} - R_{U,t}) \Big], \tag{D.39}$$

and arises because the US bank's cross-border dollar lending raises the RoW bank's leverage, which feeds back and raises the US bank's asset-specific risk weight (see Equation (D.30)) and thereby has an additional, *negative indirect* return: It tightens the US bank's balance-sheet constraint in Equations (D.29) and (D.30), which limits its leverage and thus reduces profits.[31]

Equation (D.39) shows that the magnitude of this risk premium is pinned down by the degree to which cross-border dollar lending raises the US bank's asset-specific risk weight on cross-border dollar lending, how the ensuing reduction in the bank's leverage cuts into claims on domestic capital and cross-border dollar lending, and their corresponding excess returns. For example, when domestic credit spreads are high, the foregone profits implied by the tightening in the bank's balance-sheet constraint due to cross-border dollar lending are particularly high, and hence the risk premium on cross-border dollar lending is high.

The remaining equations of the US banking block are fairly standard. In particular, we impose market clearing for domestic capital, cross border dollar loans and specify the start-up funds for a newly entering bank n as a fraction of last period's portfolio, $N_{U,n,t} = \omega_U AS_{U,t-1}$. The law of motion for aggregate net worth of the US banking sector is given by

$$N_{U,t} = \frac{\theta_B}{1+\pi^C_{U,t}} \Bigg\{ R_{U,t-1} N_{U,t-1} + \Big[(1-\alpha^{CBDL}_{U,t-1})(R^K_{U,t} - R_{U,t-1}) + \alpha^{CBDL}_{U,t-1}(R^{GB}_{U,t-1} - R_{U,t-1}) \Big] AS_{U,t-1} \Bigg\} + \omega_U AS_{U,t-1} \tag{D.40}$$

When the model is parameterized so that the balance-sheet constraint in Equation (D.8) binds in a neighbourhood of the steady-state, the maximum equilibrium

[31] Using the market clearing conditions alongside the balance sheets of the two banks it can be shown that $\frac{\partial \Gamma^{CBDL}_{U,t}}{\partial \alpha^{CBDL}_{U,j,t}} = \Phi^F_{U,\phi} \frac{\frac{1-s}{s} RER_t AS_{U,t}}{N_{R,t}}$

leverage ratio again reflects a risk-profitability trade-off

$$\phi_{U,j,t} \equiv \frac{AS_{U,j,t}}{N_{U,j,t}} = \frac{Q_{U,t}K_{U,j,t} + CBDL_{U,j,t}}{N_{U,j,t}} = \frac{n_{U,j,t}}{\mathcal{R}_{U,j,t} - \mathcal{P}_{U,j,t}}, \tag{D.41}$$

where

$$\mathcal{R}_{U,j,t} = \delta_{U,j,t}\left[(1-\alpha^{CBDL}_{U,j,t}) + \Gamma^{CBDL}_{U,t}\alpha^{CBDL}_{U,j,t}\right], \tag{D.42}$$

$$\mathcal{P}_{U,j,t} = \mathbf{E}_t\Omega_{U,j,t,t+1}\left[(1-\alpha^{CBDL}_{U,j,t})R^K_{U,t+1} + \alpha^{CBDL}_{U,j,t}R^{CBDL}_{U,t} - R_{U,t}\right], \tag{D.43}$$

D.4 Intermediate good firms

In each economy there exists a continuum of perfectly competitive intermediate goods firms that sell their output to domestic retailers. We assume that at the end of period t but before the realization of shocks the intermediate good firm acquires capital for use in next period's production. To do so, the intermediate good firm i claims equal to the number of units of capital acquired, and prices each claim at the real price of a unit of capital $Q_{R,t}$. The production function is

$$Z_{R,i,t} = e^{A_R}\left(U_{R,i,t}K_{R,i,t-1}\right)^{\alpha} L^{(1-\alpha)}_{R,i,t}, \tag{D.44}$$

with $Z_{R,i,t}$ the amount of output produced by the individual RoW intermediate good firm in period t, $L_{R,i,t}$ the labor used in production, and $U_{R,i,t}$ the employed utilization rate of capital. Finally A_R represents the exogenous (log) level of TFP, which evolves according to an AR(1) process.
Cost minimization yields the standard equations for the optimal amount of production inputs

$$MC^r_{R,t} = \frac{w^{1-\alpha}_{R,t}\tau_{R,t}(U_{R,t})'^{\alpha}}{e^{A_R}(1-\alpha)^{(1-\alpha)}\alpha^{\alpha}}. \tag{D.45}$$

$$\frac{w_{R,t}}{\tau_{R,t}(U_{R,t})'} = \frac{1-\alpha}{\alpha}\frac{(U_{R,t}K_{R,t-1})}{L_{R,t}}, \tag{D.46}$$

where $MC^r_{R,t}$ denote the real marginal costs of the intermediate good firms deflated by the RoW final good price $P^C_{R,t}$ and $\tau_{R,t}(U_{R,t})'$ as the derivative of the adjustment cost function, which maps a change in utilization rate into a change in the depreciation rate[32]. The optimal choice of capital gives the resulting gross nominal returns on capital, which are transferred to the bank in exchange for

[32]The adjustment cost function is given by $\tau_{R,t}(U_{R,t}) = \tau_{R,ss,scale} + \zeta_{R,1}\frac{U_t^{1+\zeta_2}}{1+\zeta_2}$ with $\tau_{R,ss,scale}$ as an exogenous scale parameter in order to normalize utilization in the steady state.

funding

$$R_{K,E,t} = (1+\pi^c_{R,t}) \frac{\left(MC^r_{R,t}\alpha\frac{Z_{R,t}}{K_{t-1}}\right) + (Q_{R,t} - \tau_{R,t}U_{R,t})}{Q_{R,t-1}}. \tag{D.47}$$

D.5 Capital producers

Capital-producing firms buy and refurbish depreciated capital from the intermediate goods firm at price $P^C_{R,t}$ and also produce new capital using the RoW final good, which consists of domestically produced and imported retail goods, as an input. Furthermore we assume that they face quadratic adjustment costs on net investment and that profits, which arise outside of the steady state, are distributed lump sum to the households.[33] The optimal choice of investment yields the familiar *Tobins Q* relation for the evolution of the relative price of capital

$$\begin{aligned} Q_{R,t} = 1 &+ \frac{\Psi}{2}\Big(\frac{In_{R,t}+Iss_R}{In_{R,t-1}+Iss_R}-1\Big)^2 + \Psi\Big(\frac{In_{R,t}+Iss_R}{In_{R,t-1}+Iss_R}-1\Big)\frac{In_{R,t}+Iss_R}{In_{R,t-1}+Iss_R} \\ &- \beta\frac{\Lambda_{E_{t+1}}}{\Lambda_{E_t}}\Psi\Big(\frac{In_{R,t+1}+Iss_R}{In_{R,t}+Iss_R}-1\Big)\Big(\frac{In_{R,t+1}+Iss_R}{In_{R,t}+Iss_R}\Big)^2 \end{aligned} \tag{D.48}$$

alongside the law of motion for capital

$$K_{R,t} = K_{R,t-1} + In_{R,t} \tag{D.49}$$

D.6 Goods bundling and pricing

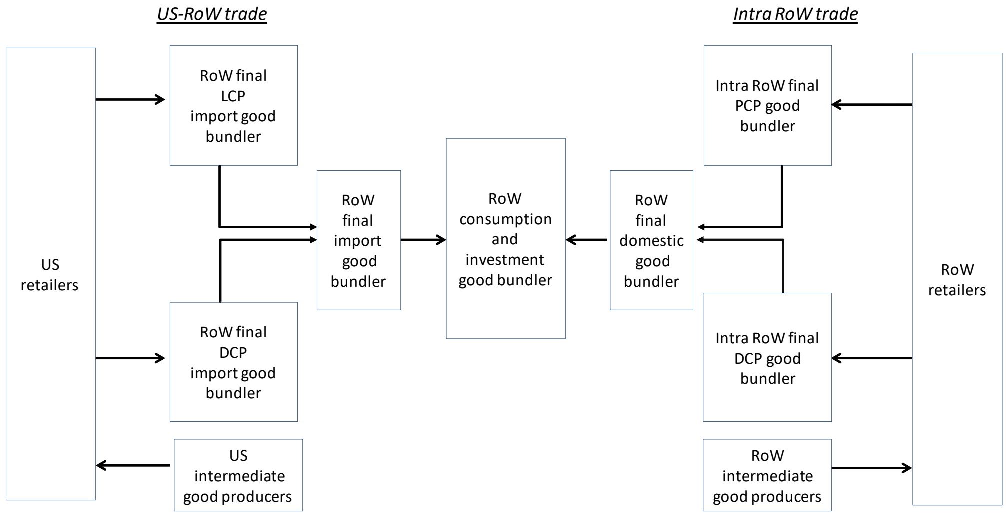
The third key element in our model is dollar dominance in terms of DCP in bilateral trade between the US and the RoW, following the seminal work of Gopinath et al. (2020). This means that the prices of both US and RoW exports are sticky in dollar.

In our model we go beyond DCP in bilateral trade between the US and the RoW and assume that prices of a share of domestic sales in the RoW are also sticky in dollar. In particular, Boz et al. (2022) document that a large share of trade among countries in the RoW is also priced in dollar; this is the actual meaning of a dominant—in the context of trade also often termed 'vehicle'—currency. It implies that when the dollar appreciates expenditure switching does not only affect imports from the US, but imports in general. Therefore, dollar pricing in third-country trade—in our model captured by domestic sales in the RoW—may

[33] Following Gertler & Karadi (2011) we assume that adjustment costs are only present when changing net investment in order for the optimal choice of the utilization rate to be independent from fluctuations in the relative price of capital $Q_{R,t}$

be consequential for the effects of dollar appreciation in the context of a global risk aversion shock. To incorporate dollar pricing of a share of domestic sales in the RoW, we consider a multi-layered production structure in the spirit of Georgiadis & Schumann (2021) and depicted in Figure D.3

Figure D.3: Multi-layered production structure for the RoW consumption and investment good



Note: The figure lays out the multi-layered production structure in the structural model, focusing on the RoW consumption and investment good.

D.6.1 Final consumption and investment good

This sector operates at the top layer of this producttion structure and is populated by a continuum of firms that operate under perfect competition and combine a final domestically produced good $Y^R_{R,t}$ and a final import good $Y^R_{U,t}$ into a combined final good, employing the following CES technology

$$Y^C_{E,t} = \left[n_R^{\frac{1}{\psi_f}} Y^R_{R,t}{}^{\frac{\psi_f - 1}{\psi_f}} + (1 - n_R)^{\frac{1}{\psi_f}} Y^R_{U,t}{}^{\frac{\psi_f - 1}{\psi_f}} \right]^{\frac{\psi_f}{\psi_f - 1}}. \tag{D.50}$$

The parameter n_R governs the share of domestically produced goods and thereby the degree of home bias in the assembling process[34]. The parameter ψ_f on

[34]The home bias parameter is adjusted in order to take into account the differences in country size as in Sutherland (2005). In particular, given a degree of general trade openness op_R and the relative country size of the RoW s, the parameter n_R takes the value $n_R = 1 - op_R(1 - s)$ with a similar adjustment for the US counterpart

the other hand corresponds to the elasticity of substitution between the final domestic and import good.

Taking the prices of the domestic final good $P^R_{R,t}$ and the price of the final import good expressed in domestic currency $(\mathcal{E}_t P^R_{U,t})$[35] as well as total demand from consumers and capital producers as given, the optimal demand for goods produced domestically and abroad is governed by

$$Y^R_{R,t} = n_R \Big(\frac{P^R_{R,t}}{P^C_{R,t}}\Big)^{-\psi_f} Y^C_{R,t} \tag{D.51}$$

$$Y^R_{U,t} = (1-n_R)\Big(\frac{\mathcal{E}_t P^R_{U,t}}{P^C_{R,t}}\Big)^{-\psi_f} Y^C_{R,t}. \tag{D.52}$$

Lastly note that the three equations above imply that the price of the final consumption and investment good in the RoW $P^C_{E,t}$ is (up to first order) a weighted average of the prices of the final domestic and import good

$$P^c_{E,t} = \Big[n_E P^{E^{1-\psi_f}}_{E,t} + (1-n_E)(\mathcal{E}^F_E P^E_{F,t})^{1-\psi_f}\Big]^{\frac{1}{1-\psi_f}}. \tag{D.53}$$

D.6.2 RoW domestically produced and sold final good

We assume markets are partly segmented and firms set different prices in different markets depending on demand conditions. We assume a fraction of RoW firms $1-\gamma^R_R$ sets their prices for domestic sales in dollar, while the remaining prices are sticky in RoW currency. As in Gopinath et al. (2020), we assume firms cannot choose their pricing currency, but are assigned to it exogenously and do not change it over time.

The firms that put together the RoW final domestic good $Y^R_{R,t}$ shown on the right side in Figure D.3 operate under perfect competition and combine inputs $\widetilde{Y}^R_{R,t}$ and $\widehat{Y}^R_{R,t}$ using a CES technology. The inputs are produced by two branches of firms that also operate under perfect competition and combine RoW retail goods. The firms in the first branch combine RoW retail goods $\widehat{Y}^R_{R,t}(i)$ priced in dollar (DCP goods) into the RoW final DCP good $\widehat{Y}^R_{R,t}$; analogously, the firms in the second branch combine RoW retail goods $\widetilde{Y}^R_{R,t}(i)$ priced in the producer's currency (PCP goods) into the RoW final PCP good $\widetilde{Y}^R_{R,t}$.

The next layer consists of RoW retail-goods-producing firms which buy and repackage RoW intermediate goods. These firms operate under monopolistic competition and serve the RoW as well as the US market; for simplicity Figure

[35]Note that because of the pricing-to-market assumption the price for US exports expressed in US-\$ $P^R_{U,t}$ will in general be different from the price charged for US goods sold in the US $P^U_{U,t}$.

Table D.1: RoW domestic sales bundling

Production function/Price index	Demand functions
RoW domestically produced final good	
$Y^R_{R,t} = \left[\gamma_R^{R\,\frac{1}{\psi_i}} \tilde{Y}^{R\,\frac{\psi_i-1}{\psi_i}}_{R,t} + (1-\gamma_R)^{R\,\frac{1}{\psi_i}} \hat{Y}^{R\,\frac{\psi_i-1}{\psi_i}}_{R,t}\right]^{\frac{\psi_i}{\psi_i-1}}$ $P^R_{R,t} = \left[\gamma^R_R \tilde{P}^{R\,1-\psi_i}_{R,t} + (1-\gamma^R_R)\left(\mathcal{E}_t \hat{P}^R_{R,t}\right)^{1-\psi_i}\right]^{\frac{1}{1-\psi_i}}$	$\tilde{Y}^R_{R,t} = \gamma^R_R \left(\frac{\tilde{P}^R_{R,t}}{P^R_{R,t}}\right)^{-\psi_i} Y^R_{R,t}$ $\hat{Y}^R_{R,t} = (1-\gamma^R_R)\left(\frac{\mathcal{E}_t \hat{P}^R_{R,t}}{P^R_{R,t}}\right)^{-\psi_i} Y^R_{R,t}$
RoW domestically sold PCP good	
$\tilde{Y}^R_{R,t} = \left[\left(\frac{1}{\gamma^R_R}\right)^{\frac{1}{\psi_i}} \int_0^{\gamma^R_E} \tilde{Y}^R_{R,t}(i)^{\frac{\psi_i-1}{\psi_i}} di\right]^{\frac{\psi_i}{\psi_i-1}}$ $\tilde{P}^R_{R,t} = \left[\frac{1}{\gamma^R_R} \int_0^{\gamma^R_R} \tilde{P}^R_{R,t}(i)^{1-\psi_i} di\right]^{\frac{1}{1-\psi_i}}$	$\tilde{Y}^R_{R,t}(i) = \frac{1}{\gamma^R_R}\left(\frac{\tilde{P}^R_{R,t}(i)}{\tilde{P}^R_{R,t}}\right)^{-\psi_i} \tilde{Y}^R_{R,t}$ $= \left(\frac{\tilde{P}^R_{R,t}(i)}{P^R_{R,t}}\right)^{-\psi_i} Y^R_{R,t}$
RoW domestically sold DCP good	
$\hat{Y}^R_{R,t} = \left[\left(\frac{1}{1-\gamma^R_R}\right)^{\frac{1}{\psi_i}} \left(\int_{\gamma^R_R}^1 \hat{Y}^R_{R,t}(i)^{\frac{\psi_i-1}{\psi_i}} di\right)\right]^{\frac{\psi_i}{\psi_i-1}}$ $\mathcal{E}_t \hat{P}^R_{R,t} = \left[\frac{1}{(1-\gamma^R_R)} \int_{\gamma^R_R}^1 (\mathcal{E}_t \hat{P}^R_{R,t}(i))^{1-\psi_i} di\right]^{\frac{1}{1-\psi_i}}$	$\hat{Y}^R_{R,t}(i) = \frac{1}{1-\gamma^R_R}\left(\frac{\mathcal{E}_t \hat{P}^R_{R,t}(i)}{\mathcal{E}_t \hat{P}^R_{R,t}}\right)^{-\psi_i} \hat{Y}^R_{R,t}$ $= \left(\frac{\mathcal{E}_t \hat{P}^R_{R,t}(i)}{P^R_{R,t}}\right)^{-\psi_i} Y^R_{R,t}$

D.3 only shows their domestic sales. The share of RoW retail-goods-producing firms whose domestic sales prices are sticky in dollar is given by $(1-\gamma^R_R)$. Therefore, $(1-\gamma^R_R)$ also reflects the degree to which movements in the dollar exchange rate cause fluctuations in the RoW aggregate producer-price index $P^R_{R,t}$. Table D.1 provides an overview of the core equations and first order conditions for the multistage bundling process.

D.6.3 Import good bundling

As shown on the left side in Figure D.3, the RoW import good $Y^R_{U,t}$ is produced analogously to the RoW final domestic good $Y^R_{R,t}$. [36] In particular, RoW final import good producers use inputs from two branches of firms that operate under perfect competition and aggregate goods from US retail goods producers. The latter operate under monopolistic competition and set prices that are either sticky in the producer's currency (PCP goods) or in the importer's currency (LCP goods). Likewise, we assume that when exporting a fraction $(1-\gamma^R_U)$ of RoW and $(1-\gamma^U_R)$ of US retailers faces prices that are sticky in the currency of the importer, while the prices of the remaining firms are sticky in the producer's currency.

Table D.2 provides an overview of the core equations and first order conditions for the multistage bundling process of the final import good in the US. Equations are analogues for the RoW import good bundling process.

[36]Notice that the subscript indicates the country where the good is produced and the superscript the country where it is consumed.

Table D.2: US import good bundling

Production function/Price index	Demand functions
US final import goods	
$Y^U_{R,t} = \left[\gamma^{R\,\frac{1}{\psi_i}}_U \tilde{Y}^{U\,\frac{\psi_i-1}{\psi_i}}_{R,t} + (1-\gamma_U)^{R\,\frac{1}{\psi_i}} \hat{Y}^{U\,\frac{\psi_i-1}{\psi_i}}_{R,t}\right]^{\frac{\psi_i}{\psi_i-1}}$ $P^{R^I}_{U,t} = \left[\gamma^E_F \left(\frac{\tilde{P}^F_{E,t}}{\mathcal{E}^F_{E,t}}\right)^{1-\psi_i} + (1-\gamma^E_F)\hat{P}^{F^{1-\psi_i}}_{E,t}\right]^{\frac{1}{1-\psi_i}}$	$\tilde{Y}^U_{R,t} = \gamma^R_U \left(\frac{\tilde{P}^R_{U,t}}{\mathcal{E}_t P^{R^I}_{U,t}}\right)^{-\psi_i} Y^U_{R,t}$ $\hat{Y}^U_{R,t} = (1-\gamma^R_U)\left(\frac{\hat{P}^U_{R,t}}{P^{R^I}_{U,t}}\right)^{-\psi_i} Y^U_{R,t}.$
US imported PCP good	
$\tilde{Y}^U_{R,t} = \left[\left(\frac{1}{\gamma^E_F}\right)^{\frac{1}{\psi_i}} \left(\int_0^{\gamma^R_U} \tilde{Y}^U_{R,t}(i)^{\frac{\psi_i-1}{\psi_i}} di\right)\right]^{\frac{\psi_i}{\psi_i-1}}$ $\frac{\tilde{P}^U_{R,t}}{\mathcal{E}_t} = \left[\frac{1}{\gamma^R_U} \int_0^{\gamma^R_U} (\frac{\tilde{P}^U_{R,t}(i)}{\mathcal{E}_t})^{1-\psi_i} di\right]^{\frac{1}{1-\psi_i}}$	$\tilde{Y}^U_{R,t}(i) = \frac{1}{\gamma^R_U}\left(\frac{\tilde{P}^U_{R,t}(i)}{\tilde{P}^U_{U,t}}\right)^{-\psi_i} \tilde{Y}^U_{R,t}$ $= \left(\frac{\tilde{P}^U_{R,t}(i)}{\mathcal{E}_t P^{R^I}_{U,t}}\right)^{-\psi_i} Y^U_{R,t}$
US imported DCP good	
$\hat{Y}^U_{R,t} = \left[\left(\frac{1}{1-\gamma^R_U}\right)^{\frac{1}{\psi_i}} \left(\int_{\gamma^R_U}^1 \hat{Y}^U_{R,t}(i)^{\frac{\psi_i-1}{\psi_i}} di\right)\right]^{\frac{\psi_i}{\psi_i-1}}$ $\hat{P}^U_{R,t} = \left[\frac{1}{(1-\gamma^R_U)} \int_{\gamma^E_F}^1 \hat{P}^U_{R,t}(i))^{1-\psi_i} di\right]^{\frac{1}{1-\psi_i}}$	$\hat{Y}^U_{R,t}(i) = \frac{1}{1-\gamma^R_U}\left(\frac{\hat{P}^U_{R,t}(i)}{\hat{P}^U_{R,t}}\right)^{-\psi_i} \hat{Y}^U_{R,t}$ $= \left(\frac{\hat{P}^U_{R,t}(i)}{P^{R^I}_{U,t}}\right)^{-\psi_i} Y^U_{R,t}$

D.7 Retail good pricing

There exists a continuum of firms that operate under monopolistic competition and use intermediate goods to produce a retail good that is eventually sold to the specialized branches of the firm. Each retail firm sells its product in the domestic and foreign markets; as mentioned above, for simplicity we only show sales to RoW in Figure D.3. When selling in the RoW (i.e. domestic) market, a fraction γ^R_R of RoW retail-goods-producing firms sets prices in RoW currency, while the remaining $(1-\gamma^R_R)$ share of firms sets their prices in dollar. A similar setting exists in the market for US imports, with γ^R_U indicating the fraction of RoW firms that price their exports in the producer's currency. Regardless of the pricing currency, all firms use the same production technology and face the same factor costs. Because firms are subject to Calvo-style price-setting frictions and can only change their price with a probability $(1-\theta^R_p)$ each period, the mark-up of a firm whose price is sticky in dollar fluctuates with the exchange rate. As RoW firms serving domestic and US markets, respectively, set their prices optimally and as in each market they use different pricing currencies, their profit functions differ as shown in table D.3. As standard in Calvo-style price setting, firms choose their optimal reset price given demand and their pricing currency while taking into account that they might not be able to reset their price in the future. For instance the optimal price choice of a DCP firm i for its sales in the RoW market, taking into account the fact that it may not be able to reset its US-$ denominated price $\hat{P}^E_{E,t}(i)$, can be written as

$$\max_{\hat{P}^E_{E,t}(i)} \mathbb{E}_t \sum_{s=0}^{\infty} \theta_p^{E^s} \Theta_{E_{t,t+s}} \Big[\mathcal{E}^E_{E,t} \hat{P}^E_{E,t}(i) Y^E_{E,t}(i) - MC_{E,t} Y^E_{E,t}(i) \Big]. \tag{D.54}$$

It is possible to show that the optimal reset price of a firm that sets its price for the RoW market in US-$, relative to the aggregate RoW DCP sales price index $\hat{P}^E_{E,t}$, is given by

$$\frac{\hat{P}^E_{E,t}(i)}{\hat{P}^E_{E,t}} = \hat{p}^E_{E,t} = \frac{\psi_i}{(\psi_i - 1)} \frac{\hat{x}^E_{E,1,t}}{\hat{x}^E_{E,2,t}}. \tag{D.55}$$

The auxiliary recursive variables $\hat{x}^E_{E,1,t}$ and $\hat{x}^E_{E,2,t}$ read as

$$\hat{x}^E_{E,1,t} = \Lambda_{E,t} \Big(\frac{\mathcal{E}^F_{E,t} \hat{P}^E_{E,t}}{P^E_{E,t}} \Big)^{-\psi_i} Y^E_{E,t} \frac{P^E_{E,t}}{P^C_{E,t}} MC^{rp}_{E,t} + \beta \theta_p \mathbb{E}_t \hat{x}^E_{E,1,t+1} (1 + \hat{\pi}^E_{E,t+1})^{\psi_i} \tag{D.56}$$

$$\hat{x}^E_{E,2,t} = \Lambda_{E,t} \Big(\frac{\mathcal{E}^F_{E,t} \hat{P}^E_{E,t}}{P^E_{E,t}} \Big)^{-\psi_i} Y^E_{E,t} \Big(\frac{\mathcal{E}^F_{E,t} \hat{P}^E_{E,t}}{P^C_{E,t}} \Big) + \beta \theta^E_p \mathbb{E}_t \hat{x}^E_{E,1,t+1} (1 + \hat{\pi}^E_{E,t+1})^{\psi_i - 1}, \tag{D.57}$$

with $MC^{rp}_{E,t}$ as marginal costs deflated in by the aggregate producer price $P^E_{E,t}$. It becomes apparent that not only does the exchange rate $\mathcal{E}^F_{E,t}$ impact the optimal DCP price setting decision as it determines the demand for DCP goods via the relative price $\frac{\mathcal{E}^F_{E,t} \hat{P}^E_{E,t}}{P^E_{E,t}}$, it also impacts the optimal reset price via the term $\frac{\mathcal{E}^F_{E,t} \hat{P}^E_{E,t}}{P^C_{E,t}}$, which translates the local currency revenues that a DCP firm makes from selling one unit of its good $\mathcal{E}^F_{E,t} \hat{P}^E_{E,t}$ into the unit of account that the firm's owners (households) care about $P^C_{E,t}$. Everything else equal, an appreciation of the US-$ exchange rate, will cause the local currency revenues per unit of DCP good sold to rise, while the input costs, which are denominated in the RoW currency, remain roughly stable. Thus the mark-up rises above the optimal mark-up and a DCP good firm would like to lower its US-$ price in response to an appreciation of the US-$ over and above what the induced fall in RoW demand for the DCP good would dictate. It is easy to verify that when aggregating across intra RoW sales of RoW DCP firms the inflation rate of the aggregate RoW sales DCP price (expressed in US-$) is given by

$$1 = (1 - \theta_p) \hat{p}^{E^{1-\psi_i}}_{E,t} + \theta_p (1 + \hat{\pi}^E_{E,t})^{(\psi_i - 1)}, \tag{D.58}$$

where $\hat{p}^E_{E,t}$ denotes the ratio of the optimal reset price relative to the aggregate price index. Using the profit functions in table D.3 its easy its easy to show similar equations hold for the optimal price of RoW retail firms that set their

Table D.3: Market and pricing paradigm specific profit functions of RoW firms

Type of firm and market	Profit function
RoW market PCP firm	$\tilde{\Pi}^E_{E,t}(i) = \tilde{P}^E_{E,t}(i)\tilde{Y}^E_{E,t}(i) - MC_{E,t}\tilde{Y}^E_{E,t}(i)$
RoW market DCP firm	$\hat{\Pi}^E_{E,t}(i) = \mathcal{E}^F_{E,t}\hat{P}^E_{E,t}(i)\hat{Y}^E_{E,t}(i) - MC_{E,t}\hat{Y}^E_{E,t}(i)$
US import market PCP firm	$\tilde{\Pi}^F_{E,t}(i) = \tilde{P}^F_{E,t}(i)\tilde{Y}^F_{E,t}(i) - MC_{E,t}\tilde{Y}^F_{E,t}(i)$
US import market DCP firm	$\hat{\Pi}^F_{E,t}(i) = \mathcal{E}^F_{E,t}\hat{P}^F_{E,t}(i)\hat{Y}^F_{E,t}(i) - MC_{E,t}\hat{Y}^F_{E,t}(i)$

prices in the US import market in US-$ as well as, with slight adaptions, for PCP firms.

D.7.1 Fiscal and monetary policy

We assume the US government issues new bonds, raises taxes and transfers the accrued funds to households in a lump-sum fashion. The US government's balance sheet reads as

$$GB_{U,t} + \tau_{U,t} = TRA_{U,t} + R^{GB}_{U,t-1}GB_{U,t-1}. \tag{D.59}$$

Central banks set the nominal risk-free rate according to a standard Taylor-rule

$$\hat{r}_{i,t} = \rho_{i,r}\hat{r}_{i,t-1} + (1-\rho_{i,r})(\phi_{i,\pi}\hat{\pi}^c_{i,t} + \phi_{i,z}\hat{z}_{i,t}) + \sigma^r_{i,\varepsilon}\varepsilon^r_{i,t}, \quad i \in U, R, \tag{D.60}$$

where $\pi^C_{i,t}$ is final (consumption) good inflation, $Z_{i,t}$ real GDP, $\varepsilon^r_{i,t}$ is a monetary policy shock, and hats denote deviations from steady state.

D.8 Market clearing and the aggregate budget constraint

Turning to the market clearing conditions, aggregate demand for the domestic consumption good $Y^C_{E,t}$ is given by the sum of individual demand from all sources that either consume the good or use it as an input in production

$$Y^C_{R,t} = C_{R,t} + I_{R,t} + \frac{\Psi}{2}\Big(\frac{In_{R,t} + Iss_R}{In_{R,t-1} + Iss_R} - 1\Big)^2(In_{R,t} + Iss_R). \tag{D.61}$$

Aggregating across all intermediate and retail goods firms and imposing market clearing yields the aggregate production function of the economy

$$Z_{R,t} = (U_{R,t}K_{R,t-1})^{\alpha}L^{(1-\alpha)}_{R,t} = \delta^R_{R,t}Y^R_{R,t} + \delta^F_{R,t}Y^F_{R,t}, \tag{D.62}$$

with $\delta^R_{R,t}$ and $\delta^F_{R,t}$ as price dispersion terms which are zero up to a first-order approximation. $Y^R_{R,t}$ corresponds to the aggregate domestic demand for the final *domestically produced* RoW good given by

$$Y^R_{R,t} = n_R \Big(\frac{P^R_{R,t}}{P^C_{R,t}}\Big)^{-\psi_f} Y^C_{R,t}, \tag{D.63}$$

with $Y^C_{R,t}$ as the households and firms demand for the final good.
This demand is distributed across intra-RoW DCP and PCP goods according to

$$\widehat{Y}^R_{R,t} = (1-\gamma^E_E)\Big(\frac{\widehat{P^R_{R,t}}}{P^R_{R,t}}\Big)^{-\psi_i} Y^R_{R,t}, \tag{D.64}$$

and

$$\widetilde{Y}^R_{R,t} = (1-\gamma^E_E)\Big(\frac{\widetilde{P^R_{R,t}}}{P^R_{R,t}}\Big)^{-\psi_i} Y^R_{R,t}. \tag{D.65}$$

Total intra-RoW Exports are then given by

$$X^R_{R,t} = \widehat{Y}^R_{R,t} + \widetilde{\omega}^R_R \widetilde{Y}^R_{R,t} \tag{D.66}$$

, with $\widetilde{\omega}^R_R$ as the fraction of intra-RoW exports in total intra-RoW PCP sales.
Furthermore, the aggregate demand for RoW goods produced for exports reads as

$$Y^U_{R,t} = \frac{1-s}{s}(1-n_F)\Big(\frac{\mathcal{E}_t P^F_{R,t}}{P^C_{F,t}}\Big)^{-\psi_f} Y^C_{F,t}, \tag{D.67}$$

where it is important to note that variables are expressed in per capita terms and therefore, following Sutherland (2005), the relative population size has to be taken into account when aggregating across countries as indicated by the ratio $\frac{1-s}{s}$.
Given that we not only explicitly model US and RoW trade but also intra-RoW trade, we can define global exports ($\mathcal{T}^G_{G,t}$) as the sum of the of all (country-size adjusted) global exports

$$\mathcal{T}^G_{G,t} = \Big[Y^R_{US,t} + \frac{s}{1-s}\Big(Y^{US}_{R,t} + \widehat{Y}^R_{R,t} + (1-\widetilde{\omega}^R_R)\widetilde{Y}^R_{R,t}\Big)\Big],$$

where $\widehat{Y}^R_{R,t}$ and $\widetilde{Y}^R_{R,t}$ corresponds to total intra-RoW DCP and PCP sales respectively, and $\widetilde{\omega}^R_R$ measures to the fraction of intra-RoW PCP *exports* in total intra-RoW PCP *sales*.[37] Our model analog of the global trade to global GDP ratio

[37]We compute a corresponding global import price index using the steady-state shares of the different import categories.

is then given by

$$\frac{\mathcal{T}^G_{G,t}}{Z_{G,t}} = \frac{\mathcal{T}^G_{G,t}}{Z_{U,t} + \frac{s}{1-s} Z_{R,t}}. \tag{D.68}$$

with $Z_{U,t}$ and $Z_{R,t}$ describing US and RoW GDP respectively.
Analogously, we can define the global capital price measured in dollars as

$$Q_{G,t} = Q_{U,t} + \frac{s}{1-s}\Big(\frac{Q_{R,t}}{RER_t}\Big) \tag{D.69}$$

We assume financial markets clear, which implies $GB_{U,t} = \frac{s}{1-s} GB_{R,t}$ and $CBDL_{U,t} = \frac{s}{1-s} CBDL_{R,t}$, where s is the relative country size parameter. When aggregating across budget constraints in the RoW, we recover the national accounting identity

$$RER_t\Big[\Big(GB_{R,t} - \frac{R^{GB}_{U,t-1}}{1+\pi^C_{U,t}} GB_{R,t-1}\Big) - \Big(CBDL_{R,t} - \frac{R^{CBDL}_{U,t-1}}{1+\pi^C_{U,t}} CBDL_{R,t-1}\Big)\Big] = \tag{D.70}$$

$$\frac{P^R_{R,t}}{P^C_{R,t}} Y^R_{R,t} + \frac{\mathcal{E}_t P^F_{R,t}}{P^C_{R,t}} Y^U_{R,t} - Y^C_{R,t}.$$

The left-hand side represents the sum of the changes in the RoW net foreign asset position and the net financial account, while the right-hand side is the trade balance (taking into account that prices charged differ across domestically produced and exported goods). Importantly, and in contrast to Akinci & Queralto (2024), Devereux et al. (2020) and many others, we explicitly model *gross* rather than only net financial flows. As a consequence, the national accounting identity does not dictate the evolution of all financial flows as in a net-flows model. In a net-flow model, where, for instance, RoW banks can only borrow in dollars but not hold dollar assets (i.e. gross liabilities equal net liabilities), the trade balance and costs of funds borrowed in the previous period determine uniquely the foreign banking sector's liability position in the next period. In contrast, in our model the national accounting identity only uniquely determines the *sum of the changes* in gross assets and liabilities has to equal the sum of the trade balance and the financial account.

D.9 Calibration

As discussed in the main text of the paper, we distinguish between three parameter groups. While the second (third) one summarizes the parameters that govern the degree of dollar dominance in the model (volatility of the shock processes) and has been discussed in detail, we deferred the first one, which groups the "conventional" parameters where we can draw on ample evidence from earlier work, to the appendix. Below we discuss our calibration for the parameters that are most important for our results and provide a comprehensive overview all of parameters in table D.4.

We generally allow parameter values to differ across the US and the RoW (see Table D.4). For parameters that govern standard model elements, to the extent possible we draw on estimates from existing literature. In particular, for US parameters we rely on Justiniano et al. (2010) whenever possible. For the RoW it is more difficult to find suitable estimates, as it reflects an aggregate of countries. Since the euro area accounts for more than one-quarter of the RoW in the data in terms of output, we use the estimates in Coenen et al. (2018) for many of the RoW parameters.

Regarding international trade, we calibrate the relative country size s such that the steady-state share of US real GDP in global output is 25%. Given the country sizes, we set the general RoW openness vis-à-vis the US (op_R) such that the steady-state share of imports from the US in the aggregate RoW bundle ($1 - \eta_R$) is roughly 5.1%, in line with the data over 1990-2019. In the same vein, we set US trade openness (op_U) such that the share of imports in the US bundle ($1 - \eta_U$) is roughly 14%. We set the fraction of intra-RoW PCP *sales* that are counted as intra-RoW PCP *exports* ($\widetilde{\omega}_R^R$) to 0.165 to achieve an Intra-RoW exports to GDP ratio of 24% in line with Worldbank data. We set the trade-price elasticity for trade between the US and the RoW to 1.12, which is the value estimated in Coenen et al. (2018) and lies in the ballpark of the values used in the literature.

Regarding domestic and international financial intermediation we follow Akinci & Queralto (2024) and assume a (risk-weight adjusted) steady-state leverage ratio of five, a conventional value in the literature. Furthermore, we impose that the steady-state domestic credit spread ($R_i^K - R_i$) equals 200 basis points, which roughly corresponds to the average of the GZ-spread of Gilchrist & Zakrajsek (2012) and also closely corresponds to the values used by Akinci & Queralto (2024) and Coenen et al. (2018). These two assumptions imply the country-specific values for the bank's start-up fund parameter (ω_B) and the constants in balance-sheet-specific risk weights ($\bar{\delta}$) shown in Table D.4. We set $\theta_{U,B} = \theta_{R,B}$ of 0.9667 so that the average bank planning horizon is 7.5 years, which is between the 10 years in Gertler & Karadi (2011) and the 5 years in Akinci & Queralto (2024), respectively. In the cross-border loan credit spread is closely credit spread is given by the sum of a constant risk weight and a variable term that depends on the leverage ratio of the borrower (see Equation (7)). To distribute between

these two terms we aim for a credit spread of 0.6% in the case of a borrower with very low counter-party risk (a leverage ratio of zero). This roughly corresponds to the sample average of the quarterly spread between the dollar-based Libor and the 3-month treasury bill rate and pins down $\Phi_{U,\phi}$.
Finally, we impose that the US and RoW steady-state risk-free rates are 2% and 3.5%, respectively. These values roughly correspond to the averages in the data and pin down the discount factors β_U and β_R. Our calibration endogenously implies the US steady-state trade-deficit-to-GDP ratio is 2.1%, and the steady state global trade-to-GDP ratio amounts to 46.2%. Both of these are close to the average in the data. Furthermore, the US finances this trade deficit by a positive net financial income, which results from the US earning higher returns from cross-border dollar lending to the RoW than it pays for Treasuries held by the RoW. Therefore, the US maintains a higher steady-state per capita consumption than the RoW as a direct consequence of the exorbitant privilege.

Table D.4: Parameter values for parameter set 1

Param.	Val.	Description	Source
		International trade	
op_R	0.200	General trade openness RoW	$\eta_R \approx 0.95$
op_U	0.185	General trade openness US	$\eta_U \approx 0.86$
n	0.750	Share of RoW in global economy	$1 - \frac{GDP_{US}}{GDP_{RoW}}$
ψ_f	1.120	Trade price elasticity	CKSW(2018)
		RoW financial intermediaries	
ω_B^U	0.0004	Start up funds RoW	endogenous in SS
θ_B^U	0.9667	Survival probability of Banks RoW	avg(AQ(2024),GK(2011))
		US financial intermediaries	
ω_B^U	0.0003	Start-up funds parameter US	endogenous in SS
θ_B^U	0.966	Survival probability of Banks US	avg(AQ(2024),GK(2011))
$\bar{\delta}_{B,U}$	1.0468	Constant in incentive constraint (IC)	endogenous in SS
$\Phi_{\Gamma,U}$	0.1012	semielasticity of Γ_U^{CBDL} wrt $\phi_{R,t}$	endogenous in SS
		Households	
h_R	0.620	Consumption Habits RoW	CKSW(2018) [a]
h_U	0.790	Consumption Habits US	JPT(2010)
σ_c	1.002	Intertemporal elasticity of substitution	$\approx$ log utility
φ	2.000	Inverse Frisch elasticity of labor	CKSW(2018)
β_U	0.995	Discount factor US	2% ann. US rate
β_R	0.9913	Discount factor RoW	3.5% ann. RoW rate
		Wage decision	
ψ_w	6.000	Elasticity of substitution labor services	20% wage mark up
θ_w^R	0.780	Calvo parameter wages RoW	CKSW(2018)
θ_w^U	0.840	Calvo parameter wages US	JPT(2010)
		Intermediate goods production	
α	0.333	Share of capital in production	AQ(2024)
ζ_2	5.800	Elast. of depreciation wrt. to util.	JPT(2010)
$\tau_{R,ss}$	0.020	Normalization depreciation RoW	endogenous in SS
ζ_1^R	0.035	Normalization of utilization RoW	endogenous in SS
ζ_1^U	0.035	Normalization of utilization US	endogenous in SS
$\tau_{U,ss}$	0.020	Normalization of depreciation US	endogenous in SS
		Retail good pricing	
θ_P^R	0.820	Calvo parameter retail firms RoW	CKSW(2018)
θ_P^U	0.840	Calvo parameter retail firms US	JPT(2010)

Table D.4 –

Param.	Val.	Description	Source
$\widetilde{\omega_R^R}$	0.165	Intra-RoW PCP export in all PCP *sales*	24% Intra-RoW exports/GDP.
ψ_i	3.500	Elasticity of substitution retail goods	40% mark up
		Capital goods production	
Ψ_R	5.770	Investment adjustment costs RoW	CKSW(2018)
Ψ_U	2.950	Investment adjustment costs US	JPT(2010)
		Monetary Policy	
$\rho_{U,r}$	0.930	RoW interest rate smoothing	CKSW(2018)
$\phi_{U,\pi}$	2.740	RoW Taylor Rule coefficient inflation	CKSW(2018)
$\phi_{U,z}$	0.030	RoW Taylor Rule coefficient output	CKSW(2018)
$\rho_{R,r}$	0.810	US interest rate smoothing	JPT (2010)
$\phi_{R,\pi}$	1.970	US Taylor Rule coefficient inflation	JPT(2010)
$\phi_{R,z}$	0.050	US Taylor Rule coefficient output	JPT(2010)
		Shock persistence	
$\rho_{R,A}$	0.9	Persistence RoW TFP shock	IM(2021)
$\rho_{U,A}$	0.9	Persistence US TFP shock	IM(2021)
ρ_δ	0.95	Persistence Global Risk shock	SVAR dynamics
		Steady State targets	
$L_{R,ss}$	0.333	Labor scaling RoW	GK(2011)
U_{ss}	1.000	Utilization rate RoW and US	JPT(2010)
τ_{ss}	0.025	Depreciation rate target RoW and US	JPT(2010)
$S_{R,ss}$	2%	Credit spread RoW (annualized in %)	≈ CKSW(2018)
$S_{U,ss}$	2%	Credit spread US (annualized in %)	≈ avg. GZ spread
$\phi_{R,ss}$	5.00	RoW leverage ratio (risk-weighted)	≈ AQ(2024)
$\phi^F_{U,ss}$	5.00	US leverage ratio (risk-weighted)	AQ(2024)
X^R_R/Y^R_R	0.24	intra RoW exp. over intra RoW sales	≈ WB data average

[a] GK(2011), JPT(2010), CKSW(2018), GZ(2012), JKL(2021),JKL(2024), AQ(2019), G(2015), AX(2020), AEH(2021), BSFO(2024), IM(2021) represent abbreviations for Gertler & Karadi (2011), Justiniano et al. (2010), Coenen et al. (2018), Gilchrist & Zakrajsek (2012), Jiang et al. (2021), Jiang et al. (2024), Akinci & Queralto (2024), Gopinath (2015), Adrian & Xie (2020), Aldasoro et al. (2021), Bertaut et al. (2024) and Itskhoki & Mukhin (2021) respectively.

E Online Appendix - List of all model equations

This section contains all the relevant model equations of the Trinity model of Georgiadis et al. (2023) as they appear in the corresponding code.[38]

E.1 Households

Marginal Utility RoW

$$\Lambda_{Rt} = exp\left(\varepsilon^{\beta}_{Rt}\right)\,\left(C_{Rt} - h_R\,C_{Rt-1}\right)^{(-\sigma_c)} - \beta_R\,h_R\,\left(exp\left(\varepsilon^{\beta}_{Rt+1}\right)\,C_{Rt+1} - C_{Rt}\,h_R\right)^{(-\sigma_c)} \tag{E.1}$$

Euler equation RoW

$$\Lambda_{Rt} = \beta_R\,\left(1 + R_{Rt}\right)\,\frac{\Lambda_{Rt+1}}{1 + \pi^C_{Rt+1}} \tag{E.2}$$

Demand shock RoW

$$\varepsilon^{\beta}_{Rt} = \rho^{\beta}\,\varepsilon^{\beta}_{Rt-1} + \frac{\eta^{\beta}_{Rt}}{100} \tag{E.3}$$

Marginal Utility US

$$\Lambda_{Ut} = exp\left(\varepsilon^{\beta}_{Ut}\right)\,\left(C_{Ut} - h_U\,C_{Ut-1}\right)^{(-\sigma_c)} - \beta_U\,h_U\,\left(exp\left(\varepsilon^{\beta}_{Ut+1}\right)\,\left(C_{Ut+1} - C_{Ut}\,h_U\right)\right)^{(-\sigma_c)} \tag{E.4}$$

Euler equation US

$$\Lambda_{Ut} = \beta_U\,\left(1 + R_{Ut}\right)\,\frac{\Lambda_{Ut+1}}{1 + \pi^C_{Ut+1}} \tag{E.5}$$

Demand Shock US

$$\varepsilon^{\beta}_{Ut} = \rho^{\beta}\,\varepsilon^{\beta}_{Ut-1} + \frac{\eta^{\beta}_{Ut}}{100} \tag{E.6}$$

UIP deviation

$$\widehat{UIP}_t = \left(1 + R_{Ut}\right)\,\left(1 + D\mathcal{E}_{t+1}\right) - \left(1 + R_{Rt}\right) \tag{E.7}$$

E.2 RoW financial intermediaries

Discounted excess return to investing in domestic capital RoW

$$v_{Rt} = \Omega_{Rt+1}\,\left(R_{K,R_{t+1}} - \left(1 + R_{Rt}\right)\right) \tag{E.8}$$

Discounted return to equity RoW

$$n_{Rt} = \left(1 + R_{Rt}\right)\,\Omega_{Rt+1} \tag{E.9}$$

[38]The corresponding *DYNARE* file is available upon request

Aggregate Net worth RoW financial sector

$$N_{Rt} = N_{R,e_t} + N_{R,n_t} \tag{E.10}$$

RoW credit spread

$$S_{Rt} = R_{K,R_{t+1}} - (1 + R_{Rt}) \tag{E.11}$$

RoW capital price expressed in dollars

$$Q_{R,US\$_t} = \frac{Q_{Rt}}{RER_t} \tag{E.12}$$

Aggregate Assets RoW (taking into account that $\phi_{R,t}$ is the *risk adjusted* leverage ratio in the code)

$$AS_{Rt} = \frac{N_{Rt}\,\phi_{Rt}}{(1-\alpha_R^{GB})_t + \Gamma_R^{GB}\,\alpha_R^{GB}{}_t} \tag{E.13}$$

Net Worth of new banks RoW

$$N_{R,n_t} = \omega^R\ (AS_{R,t-1}) \tag{E.14}$$

Discounted excess costs of borrowing in Dollars

$$u_{Rt} = \Omega_{Rt+1}\left((1 + D\mathcal{E}_{t+1})\ R_{U,t}^{CBDL} - (1 + R_{Rt})\right) \tag{E.15}$$

RoW banks stochastic discount factor

$$\Omega_{Rt} = \beta_R\,\frac{\Lambda_{Rt}}{\Lambda_{Rt-1}}\,\frac{1}{1+\pi_{Rt}^C}\left(1 - \theta_B^R + \theta_B^R\left(n_{Rt} + \left(v_{Rt}\,(1-\alpha_R^{GB})_t + \alpha_R^{GB}{}_t\,v_R^{GB}{}_t - u_{Rt}\,\ell_{R,t}^{CBDL}\right)\frac{\phi_{Rt}}{(1-\alpha_R^{GB})_t + \Gamma_R^{GB}\,\alpha_R^{GB}{}_t}\right)\right) \tag{E.16}$$

FOC optimal liability choice RoW

$$-u_{Rt} = \frac{\delta'_{R,\ell_t}}{\delta_{R,B_t}}\left(v_{Rt}\,(1-\alpha_R^{GB})_t + \alpha_R^{GB}{}_t\left(v_R^{GB}{}_t + CV_{Rt}\right)\right) \tag{E.17}$$

Risk weight adjusted optimal leverage ratio RoW

$$\phi_{Rt} = \frac{n_{Rt}\ \left((1-\alpha_R^{GB})_t + \Gamma_R^{GB}\,\alpha_R^{GB}{}_t\right)}{u_{Rt}\,\ell_{R,t}^{CBDL} + (1-\alpha_R^{GB})_t\,\delta_{R,B_t} + \alpha_R^{GB}{}_t\,\Gamma_R^{GB}\,\delta_{R,B_t} - v_{Rt}\,(1-\alpha_R^{GB})_t - \alpha_R^{GB}{}_t\,v_R^{GB}{}_t} \tag{E.18}$$

Time varying balance sheet specific risk weight RoW

$$\delta_{R,B_t} = \bar{\delta}_R\left(1 - \alpha_R^{GB}{}_t\,\epsilon_{R,\alpha} + \frac{\kappa_{R,\alpha,\ell_t}}{2}\left(\alpha_R^{GB}{}_t - \ell_{R,t}^{CBDL}\right)^2\right)e\left(\epsilon^{\delta^R}{}_t\right) \tag{E.19}$$

Risk aversion shock RoW

$$\epsilon^{\delta^R}{}_t = \rho^\delta\,\epsilon^{\delta^R}{}_{t-1} + \sigma_\eta^{\delta_R}\,\eta_{Rt}^\delta + \sigma_\eta^{\delta_G}\,\eta_{Gt}^\delta \tag{E.20}$$

LOM aggregate equity of existing banks RoW banking sector

$$N_{R,e_t} = \frac{1}{1+\pi^C_{Rt}} \theta^R_B \Big[\Big\{ \left(R_{K,R_t} - (1+R_{R,t-1}) \right) (1 - \alpha^{GB}_{R,t-1}) \\ + \Big((1+D\mathcal{E}_t)\; R^{GB}_{R,t-1} - (1+R_{R,t-1}) \Big) \alpha^{GB}_{R,t-1} \\ - \Big((1+D\mathcal{E}_t)\; R^{CBDL}_{U,t-1} - (1+R_{R,t-1}) \Big) \ell^{CBDL}_{R,t-1} \Big\} AS_{R,t-1} \\ + (1+R_{R,t-1})\, N_{R,t-1} \Big] \tag{E.21}$$

Definition of CBDL portfolio share

$$\ell^{CBDL}_{R,t} = \frac{RER_t\, CBDL_{R,t}}{AS_{Rt}} \tag{E.22}$$

Aggregate assets RoW banking sector

$$AS_{Rt} = Q_{Rt}\, K_{Rt} + RER_t\, GB_{Rt} \tag{E.23}$$

Definition of US treasury portfolio share RoW

$$\alpha^{GB}_{R\;t} = \frac{GB_{R,val\,t}}{AS_{Rt}} \tag{E.24}$$

Definition of domestic investment portfolio share RoW (redundant)

$$(1 - \alpha^{GB}_R)_t = \frac{Q_{Rt}\, K_{Rt}}{AS_{Rt}} \tag{E.25}$$

Total value of US treasuries held by RoW banks

$$GB_{R,val\,t} = RER_t\, GB_{Rt} \tag{E.26}$$

Return on treasuries (in US-$)

$$R^{GB}_{R\;t} = 1 + R_{Ut} \tag{E.27}$$

Discounted excess returns (in RoW currency) from investing in US treasuries

$$v^{GB}_{R\;t} = \Omega_{Rt+1} \Big((1+D\mathcal{E}_{t+1})\; R^{GB}_{R\;t} - (1+R_{Rt}) \Big) \tag{E.28}$$

Derivative of time varying balance sheet specific risk weight wrt. CBDL share

$$\delta'_{R,\ell_t} = \bar{\delta}_R \left(\underbrace{\epsilon_{R,\ell}}_{0 \text{ in baseline}} \left(\ell^{CBDL}_{R,t} - \bar{\ell}_R \right) + \kappa_{R,\alpha,\ell_t} \left(\ell^{CBDL}_{R,t} - \alpha^{GB}_{R\;t} \right) \right) \tag{E.29}$$

Derivative of time varying balance sheet specific risk weight wrt. treasury share

$$\delta'_{R,\alpha_t} = \bar{\delta}_R \left(\kappa_{R,\alpha,\ell_t} \left(\alpha^{GB}_{R\;t} - \ell^{CBDL}_{R,t} \right) - \epsilon_{R,\alpha} \right) \tag{E.30}$$

Convenience yield from investing in treasuries RoW banks

$$CV_{R\,t} = v_{R\,t}\,\left(-\left((1-\alpha_R^{GB})_t + \Gamma_R^{GB}\,\alpha_R^{GB}{}_t\right)\right)\,\frac{\delta'_{R,\alpha\,t}}{\delta_{R,B\,t}} \tag{E.31}$$

FOC asset choice

$$v_R^{GB}{}_t = v_{R\,t}\,\Gamma_R^{GB} - CV_{R\,t} \tag{E.32}$$

E.3 US financial intermediaries

Discounted returns to investing domestically US

$$v_{U\,t} = \Omega_{U\,t+1}\,\left(R_{K,U\,t+1} - (1+R_{U\,t})\right) \tag{E.33}$$

Discounted returns to equity US

$$n_{U\,t} = (1+R_{U\,t})\,\Omega_{U\,t+1} \tag{E.34}$$

US balance sheet specific risk weight (constant up to shock)

$$\delta^U{}_t = \overline{\delta_U}\,exp\left(\epsilon_{U\,t}^{\delta}\right) \tag{E.35}$$

US risk aversion shock

$$\epsilon_{U\,t}^{\delta} = \sigma_\eta^{\delta_G}\,\eta_{G\,t}^{\delta} + \rho^{\delta}\,\epsilon_{U\,t-1}^{\delta} + \sigma_\eta^{\delta_U}\,\eta_{R\,t}^{\delta} \tag{E.36}$$

Aggregate equity US financial sector

$$N_{U\,t} = N_{U,e\,t} + N_{U,n\,t} \tag{E.37}$$

Credit spread US

$$S_{U\,t} = R_{K,U\,t+1} - (1+R_{U\,t}) \tag{E.38}$$

Aggregate equity US financial sector

$$N_{U,n\,t} = \omega^U\,AS_{U,t-1} \tag{E.39}$$

Time varying asset specific risk weight of cross border lending

$$\Gamma_{U_t}^{CBDL} = \Gamma_{R,ss}^{CBDL}\,exp\,(\epsilon_{\Gamma\,t}) + \Phi_U^{\Gamma}\,(\phi_{R\,t} - (\bar{\phi_R})) \tag{E.40}$$

Shock to asset specific risk weight of cross border dollar lending

$$\epsilon_{\Gamma\,t} = \rho_\Gamma\,\epsilon_{\Gamma\,t-1} + \sigma_\eta^{\Gamma}\,\eta_{U\,t}^{\Gamma} \tag{E.41}$$

Ratio of total CBDL to dometic lending (This is equivalent to $\ell_{U,t}^{CBDL}/(1-\ell_{U,t}^{CBDL})$)

$$\xi_{U_t}^{CBDL} = \frac{AS_{Rt}\,\ell_{R,t}^{CBDL}\,\frac{s}{1-s}}{RER_t\,Q_{Ut}\,K_{Ut}} \tag{E.42}$$

Ratio of total CBDL to dometic lending excluding valuation effects

$$\xi_{U,real,t}^{CBDL} = \frac{AS_{Rt}\,\ell_{R,t}^{CBDL}\,\frac{s}{1-s}}{RER_t\,K_{Ut}} \tag{E.43}$$

Stochastic discount factor US Banks

$$\Omega_{Ut} = \beta_U\,\frac{\Lambda_{Ut}}{\Lambda_{Ut-1}}\,\frac{1}{1+\pi_{Ut}^C}\,\left(1-\theta_B^U+\theta_B^U\,\left(n_{Ut}+\frac{v_{Ut}+\xi_{U,t}^{CBDL}\,v_{U,t}^{CBDL}}{1+\Gamma_{U,t}^{CBDL}\,\xi_{U,t}^{CBDL}}\,\phi_{Ut}\right)\right) \tag{E.44}$$

Discounted excess returns from cross border lending

$$v_{U,t}^{CBDL} = \Omega_{Ut+1}\,\left(R_{U,t}^{CBDL}-(1+R_{Ut})\right) \tag{E.45}$$

CBDL risk premium in Dollar

$$RP_{U,t}^{CBDL} = \Phi_U^{\Gamma}\,\left(v_{Ut}+\xi_{U,t}^{CBDL}\,v_{U,t}^{CBDL}\right)\,\frac{K_{Ut}\,Q_{Ut}\,RER_t\,\frac{(1-s)}{s}\,\xi_{U,t}^{CBDL}}{N_{Rt}} \tag{E.46}$$

FOC optimal asset choice US

$$v_{U,t}^{CBDL} = RP_{E,b_t}^{F} + v_{Ut}\,\Gamma_{U,t}^{CBDL} \tag{E.47}$$

Existing banks equity US

$$\begin{aligned} N_{U,e_t} =& \frac{1}{1+\pi_{Ut}^C}\,\theta_B^U\,\Big(K_{Ut-1}\,\Big(R_{K,U_t}-(1+R_{Ut-1})+\Big(R_{U,t-1}^{CBDL}-(1+R_{Ut-1})\Big)\,\xi_{U,t-1}^{CBDL}\Big)\,Q_{Ut-1} \\ &+(1+R_{Ut-1})\,N_{Ut-1}\Big) \end{aligned} \tag{E.48}$$

Definition of aggregate assets US banks

$$AS_{Ut} = K_{Ut}\,Q_{Ut}\,\left(1+\xi_{U,t}^{CBDL}\right) \tag{E.49}$$

Definition of of portfolio share of domestic investment (redundant)

$$(1-\alpha_{U,t}^{CBDL}) = \frac{Q_{Ut}\,K_{Ut}}{AS_{Ut}} \tag{E.50}$$

Definition of of portfolio share of CBDL investment US

$$\alpha_{U,t}^{CBDL} = \frac{CBDL_{Rt}\,\frac{s}{1-s}}{AS_{Ut}} \tag{E.51}$$

Risk weight adjusted optimal leverage ratio US

$$\phi_{U_t} = \frac{n_{U\,t}\,\left((1-\alpha^{CBDL}_{U,t}) + \Gamma^{CBDL}_{U,t}\alpha^{CBDL}_{U,t}\right)}{\delta^{U}_{\;t}\,\left((1-\alpha^{CBDL}_{U,t}) + \Gamma^{CBDL}_{U,t}\,\alpha^{CBDL}_{U,t}\right) - v_{U,t}\,(1-\alpha^{CBDL}_{U,t}) - v^{CBDL}_{U,t}\,\alpha^{CBDL}_{U,t}} \tag{E.52}$$

Aggregate Assets US (taking into account that $\phi_{U,t}$ is the *risk adjusted* leverage ratio in the code)

$$AS_{U_t} = \frac{N_{U\,t}\,\phi_{U_t}}{(1-\alpha^{CBDL}_{U,t}) + \Gamma^{CBDL}_{U,t}\,\alpha^{CBDL}_{U,t}} \tag{E.53}$$

Cross border lending spread (in US-$)

$$S^{CBDL}_{U,t} = R^{CBDL}_{U,t} - (1 + R_{U\,t}) \tag{E.54}$$

E.4 Wage setting

Numerator Calvo style wages RoW

$$X^{w}_{1,R_t} = \kappa^{R}_{w}\,exp\left(\epsilon^{W}_{R\;t}\right)\,w_{R_t}^{\psi_w\,(1+\varphi)}\,L_{R_t}^{1+\varphi} + \beta_R\,\theta^{R}_{w}\,\left(1+\pi^{C}_{R\,t+1}\right)^{\psi_w\,(1+\varphi)}\,X^{w}_{1,R_{t+1}} \tag{E.55}$$

Denominator Calvo style wages RoW

$$X^{w}_{2,R_t} = L_{R\,t}\,\Lambda_{R\,t}\,w_{R_t}^{\psi_w} + \beta_R\,\theta^{R}_{w}\,\left(1+\pi^{C}_{R\,t+1}\right)^{\psi_w-1}\,X^{w}_{2,R_{t+1}} \tag{E.56}$$

Optimal real reset wage RoW

$$\tilde{w}_{R_t}^{1+\psi_w\,\varphi} = \frac{X^{w}_{1,R_t}\,\frac{\psi_w}{\psi_w-1}}{X^{w}_{2,R_t}} \tag{E.57}$$

Evolution real wage RoW

$$w_{R_t}^{1-\psi_w} = \left(1-\theta^{R}_{w}\right)\,\tilde{w}_{R_t}^{1-\psi_w} + \theta^{R}_{w}\,\left(1+\pi^{C}_{R\,t}\right)^{\psi_w-1}\,w_{R_{t-1}}^{1-\psi_w} \tag{E.58}$$

Labor supply shock RoW (redundant)

$$\epsilon^{W}_{R\;t} = \rho_w\,\epsilon^{W}_{R\;t-1} + \frac{\eta^{W}_{R\;t}}{100} \tag{E.59}$$

Numerator Calvo style wages US

$$X^{w}_{1,U_t} = \kappa^{U}_{w}\,exp\left(\epsilon^{W}_{U\;t}\right)\,w_{U_t}^{\psi_w\,(1+\varphi)}\,L_{U_t}^{1+\varphi} + \beta_U\,\theta^{U}_{w}\,\left(1+\pi^{C}_{U\,t+1}\right)^{\psi_w\,(1+\varphi)}\,X^{w}_{1,U_{t+1}} \tag{E.60}$$

Denominator Calvo style wages US

$$X^{w}_{2,U_t} = L_{U\,t}\,\Lambda_{U\,t}\,w_{U_t}^{\psi_w} + \beta_U\,\theta^{U}_{w}\,\left(1+\pi^{C}_{U\,t+1}\right)^{\psi_w-1}\,X^{w}_{2,U_{t+1}} \tag{E.61}$$

Optimal real reset wage US

$$\tilde{w}_{U_t}^{1+\psi_w \varphi} = \frac{\frac{\psi_w}{\psi_w - 1} X^w_{1,U_t}}{X^w_{2,U_t}} \tag{E.62}$$

Evolution of real wage US

$$w_{U_t}^{1-\psi_w} = \left(1 - \theta^U_w\right) \tilde{w}_{U_t}^{1-\psi_w} + \theta^U_w \left(1 + \pi^C_{Ut}\right)^{\psi_w - 1} w_{U_{t-1}}^{1-\psi_w} \tag{E.63}$$

Labour Supply Shock US (redundant)

$$\epsilon^W_{U\,t} = \rho_w\, \epsilon^W_{U\,t-1} + \frac{\eta^W_{U\,t}}{100} \tag{E.64}$$

E.5 Final Good Bundler

RoW demand for domestically produced goods

$$Y^R_{R\,t} = \eta_{R,t}\, exp\left(\epsilon^\eta_{Rt}\right) IP_{R_t}^{(-\psi_f)}\, Y^C_{R\,t} \tag{E.65}$$

RoW demand for import good from the US

$$Y^R_{Ut} = Y^C_{R\,t} \frac{n}{1-n} \left(1 - \eta_{R,t}\, exp\left(\epsilon^\eta_{Rt}\right)\right) \left(IP_{Rt}\, IT^U_{R\,t}\right)^{(-\psi_f)} \tag{E.66}$$

RoW home bias shock (redundant)

$$\epsilon^\eta_{Rt} = \rho_\eta\, \epsilon^\eta_{Rt-1} + \frac{\eta^\eta_{Rt}}{100} \tag{E.67}$$

US demand for domestically produced goods

$$Y^U_{U\,t} = \eta_{F,t}\, exp\left(\epsilon^\eta_{Ut}\right) IP_{U_t}^{(-\psi_f)}\, Y^C_{Ut} \tag{E.68}$$

US demand for for import good from RoW

$$Y^U_{R\,t} = Y^C_{Ut} \frac{1-n}{n} \left(1 - \eta_{F,t}\, exp\left(\epsilon^\eta_{Ut}\right)\right) \left(IP_{Ut}\, IT^R_{Ut}\right)^{(-\psi_f)} \tag{E.69}$$

Definition of US imports (in US per capita units)

$$Imp_{Ut} = Y^C_{Ut} \left(1 - eta_{F,t}\, exp\left(\epsilon^\eta_{Ut}\right)\right) \left(IP_{Ut}\, IT^R_{Ut}\right)^{(-\psi_f)} \tag{E.70}$$

US home bias shock (redundant)

$$\epsilon^\eta_{Ut} = \rho_\eta\, \epsilon^\eta_{Ut-1} + \frac{\eta^\eta_{Ut}}{100} \tag{E.71}$$

Definition of US export import ratio

$$\frac{Exp}{imp}_{Ut} = \frac{Y_{U,t}{}^{R}}{Imp_{Ut}} \tag{E.72}$$

E.6 Intermediate Goods producers

Depreciation Function RoW

$$\tau_{Rt} = \tau_{R,ss,scale} + \frac{\zeta_1^R U_{R_t}^{1+\zeta_2}}{1+\zeta_2} \tag{E.73}$$

Derivative Depreciation Function RoW

$$\tau'_{Rt} = \zeta_1^R U_{R_t}^{\zeta_2} \tag{E.74}$$

Optimal RoW capital services to labor ratio (implicitly defining optimal utilization)

$$\frac{w_{Rt}}{\tau'_{Rt}} = \frac{\frac{1-\alpha}{\alpha} K_{Rt-1} U_{Rt}}{L_{Rt}} \tag{E.75}$$

Real marginal costs in CPI terms RoW

$$MC^r_{Rt} = \frac{w_{R_t}^{1-\alpha} \tau'^{\alpha}_{Rt}}{(1-\alpha)^{1-\alpha} \alpha^{\alpha}} \tag{E.76}$$

Real marginal costs in PPI terms RoW

$$MC^{rp}_{R\,t} = \frac{MC^r_{Rt}}{IP_{Rt}} \tag{E.77}$$

RoW gross returns to capital

$$R_{K,R_t} = \left(1 + \pi^C_{Rt}\right) \frac{Q_{Rt} + \frac{\alpha MC^r_{Rt} Z_{Rt}}{K_{Rt-1}} - \tau_{Rt}}{Q_{Rt-1}} \tag{E.78}$$

Depreciation Function US

$$\tau_{Ut} = \tau_{U,ss,scale} + \frac{\zeta_1^U U_{U_t}^{1+\zeta_2}}{1+\zeta_2} \tag{E.79}$$

Derivative Depreciation Function US

$$\tau'_{Ut} = \zeta_1^U U_{U_t}^{\zeta_2} \tag{E.80}$$

Optimal US capital services to labor ratio (implicitly defining optimal utilization)

$$\frac{w_{Ut}}{\tau'_{Ut}} = \frac{\frac{1-\alpha}{\alpha} K_{Ut-1} U_{Ut}}{L_{Ut}} \tag{E.81}$$

Real marginal costs in US CPI

$$MC^{r}_{U\,t} = \frac{{w_{U\,t}}^{1-\alpha}\, {\tau'_{U\,t}}^{\alpha}}{(1-\alpha)^{1-\alpha}\ \alpha^{\alpha}} \tag{E.82}$$

Real marginal costs in US PPI terms

$$MC^{rp}_{U\,t} = \frac{MC^{r}_{U\,t}}{IP_{U\,t}} \tag{E.83}$$

US gross returns to capital

$$R_{K,U_t} = \left(1 + \pi^{C}_{U\,t}\right) \frac{Q_{U\,t} + \frac{\alpha\, MC^{r}_{U\,t}\, Z_{U\,t}}{K_{U\,t-1}} - \tau_{U\,t}}{Q_{U\,t-1}} \tag{E.84}$$

E.7 RoW Capital Goods Producers

RoW Tobins Q/RoW Price of Capital

$$\begin{aligned} Q_{R\,t} =& 1 + \frac{\Psi_R}{2} \left(\frac{In_{R\,t} + (\bar{I_R})}{(\bar{I_R}) + In_{R\,t-1}} - 1\right)^2 + \frac{In_{R\,t} + (\bar{I_R})}{(\bar{I_R}) + In_{R\,t-1}}\, \Psi_R \left(\frac{In_{R\,t} + (\bar{I_R})}{(\bar{I_R}) + In_{R\,t-1}} - 1\right) \\ & - \Psi_R\, \frac{\beta_R\, \Lambda_{R\,t+1}}{\Lambda_{R\,t}} \left(\frac{(\bar{I_R}) + In_{R\,t+1}}{In_{R\,t} + (\bar{I_R})} - 1\right) \left(\frac{(\bar{I_R}) + In_{R\,t+1}}{In_{R\,t} + (\bar{I_R})}\right)^2 \end{aligned} \tag{E.85}$$

RoW LOM for capital

$$K_{R\,t} = K_{R\,t-1} + In_{R\,t} \tag{E.86}$$

Definition of net investment

$$In_{R\,t} = I_{R\,t} - K_{R\,t-1}\, \tau_{R\,t} \tag{E.87}$$

US Tobins Q/US Price of Capital

$$\begin{aligned} Q_{U\,t} =& 1 + \frac{\Psi_U}{2} \left(\frac{In_{U\,t} + (\bar{I_U})}{(\bar{I_U}) + In_{U\,t-1}} - 1\right)^2 + \frac{In_{U\,t} + (\bar{I_U})}{(\bar{I_U}) + In_{U\,t-1}}\, \Psi_U \left(\frac{In_{U\,t} + (\bar{I_U})}{(\bar{I_U}) + In_{U\,t-1}} - 1\right) \\ & - \Psi_U\, \frac{\beta_U\, \Lambda_{U\,t+1}}{\Lambda_{U\,t}} \left(\frac{(\bar{I_U}) + In_{U\,t+1}}{In_{U\,t} + (\bar{I_U})} - 1\right) \left(\frac{(\bar{I_U}) + In_{U\,t+1}}{In_{U\,t} + (\bar{I_U})}\right)^2 \end{aligned} \tag{E.88}$$

US LOM for capital

$$K_{U\,t} = K_{U\,t-1} + In_{U\,t} \tag{E.89}$$

US definition of net investment

$$In_{U\,t} = I_{U\,t} - K_{U\,t-1}\, \tau_{U\,t} \tag{E.90}$$

E.8 Intra RoW retail good pricing

Numerator Calvo pricing PCP intra RoW sales

$$\tilde{X}^R_{R,1_t} = Y^R_{R\,t}\, MC^{rp}_{R\,t}\, IP_{Rt}\, \Lambda_{Rt}\, \widetilde{CP}^{R(-\psi_i)}_{Rt} + \beta_R\, \theta^R_P\, \left(1 + \tilde{\pi}^R_{Rt+1}\right)^{\psi_i}\, \tilde{X}^R_{R,1_{t+1}} \tag{E.91}$$

Denominator Calvo pricing PCP intra RoW sales

$$\tilde{X}^R_{R,2_t} = Y^R_{R\,t}\, IP_{Rt}\, \Lambda_{Rt}\, \widetilde{CP}^{R\,1-\psi_i}_{Rt} + \beta_R\, \theta^R_P\, \left(1 + \tilde{\pi}^R_{Rt+1}\right)^{\psi_i - 1}\, \tilde{X}^R_{R,2_{t+1}} \tag{E.92}$$

Optimal reset price Calvo pricing PCP intra RoW sales

$$\tilde{p}^R_{Rt} = \frac{\tilde{X}^R_{R,1_t}\, \frac{\psi_i}{\psi_i - 1}}{\tilde{X}^R_{R,2_t}} \tag{E.93}$$

RoW domestic sales PCP retailers inflation

$$1 = \left(1 - \theta^R_P\right)\, \tilde{p}^{R\,1-\psi_i}_{Rt} + \theta^R_P\, \left(1 + \tilde{\pi}^R_{Rt}\right)^{\psi_i - 1} \tag{E.94}$$

Numerator Calvo pricing DCP intra RoW sales

$$\hat{X}^R_{R,1_t} = Y^R_{R\,t}\, MC^{rp}_{R\,t}\, IP_{Rt}\, \Lambda_{Rt}\, \widehat{CP}^{R(-\psi_i)}_{Rt} + \beta_R\, \theta^R_P\, \left(1 + \hat{\pi}^R_{Rt+1}\right)^{\psi_i}\, \hat{X}^R_{R,1_{t+1}} \tag{E.95}$$

Denominator Calvo pricing DCP intra RoW sales

$$\hat{X}^R_{R,2_t} = Y^R_{R\,t}\, IP_{Rt}\, \Lambda_{Rt}\, \widehat{CP}^{R\,1-\psi_i}_{Rt} + \beta_R\, \theta^R_P\, \left(1 + \hat{\pi}^R_{Rt+1}\right)^{\psi_i - 1}\, \hat{X}^R_{R,2_{t+1}} \tag{E.96}$$

Optimal reset price Calvo pricing DCP intra RoW sales

$$\hat{p}^R_{Rt} = \frac{\frac{\psi_i}{\psi_i - 1}\, \hat{X}^R_{R,1_t}}{\hat{X}^R_{R,2_t}} \tag{E.97}$$

RoW domestic sales DCP retailers inflation

$$1 = \left(1 - \theta^R_P\right)\, \hat{p}^{R\,1-\psi_i}_{Rt} + \theta^R_P\, \left(1 + \hat{\pi}^R_{Rt}\right)^{\psi_i - 1} \tag{E.98}$$

E.9 Intra US retail good pricing

Numerator Calvo pricing intra US sales

$$X^U_{U,1_t} = Y^U_{U\,t}\, MC^{rp}_{U\,t}\, \Lambda_{Ut}\, IP_{Ut} + \beta_U\, \theta^U_P\, \left(1 + \pi^U_{Ut+1}\right)^{\psi_i}\, X^U_{U,1_{t+1}} \tag{E.99}$$

Denominator Calvo pricing intra US sales

$$X^U_{U,2_t} = Y^U_{U\,t}\, \Lambda_{Ut}\, IP_{Ut} + \beta_U\, \theta^U_P\, \left(1 + \pi^U_{Ut+1}\right)^{\psi_i - 1}\, X^U_{U,2_{t+1}} \tag{E.100}$$

Optimal reset price Calvo pricing intra US sales

$$\overline{p}^{U}_{U\,t} = \frac{\frac{\psi_i}{\psi_i-1}\, X^{U}_{U,1_t}}{X^{U}_{U,2_t}} \tag{E.101}$$

US domestic retail good price inflation

$$1 = \left(1-\theta^{U}_{P}\right)\, \overline{p}^{U\,1-\psi_i}_{U\,t} + \theta^{U}_{P}\, \left(1+\pi^{U}_{U\,t}\right)^{\psi_i-1} \tag{E.102}$$

E.10 Export Pricing

Numerator Calvo Pricing RoW PCP exports to US

$$\tilde{X}^{U}_{R,1_t} = Y^{U}_{R\,t}\, IP_{R\,t}\, MC^{rp}_{R\,t}\, \Lambda_{R\,t}\, \widetilde{CP}^{U(-\psi_i)}_{R\,t} + \beta_R\, \theta^{R}_{P}\, \left(1+\tilde{\pi}^{U}_{R\,t+1}\right)^{\psi_i}\, \tilde{X}^{U}_{R,1_{t+1}} \tag{E.103}$$

Denominator Calvo Pricing RoW PCP exports to US

$$\tilde{X}^{U}_{R,2_t} = Y^{U}_{R\,t}\, IP_{R\,t}\, \Lambda_{R\,t}\, \widetilde{CP}^{U(-\psi_i)}_{R\,t}\, \widetilde{EM}^{U}_{R\,t} + \beta_R\, \theta^{R}_{P}\, \left(1+\tilde{\pi}^{U}_{R\,t+1}\right)^{\psi_i-1}\, \tilde{X}^{U}_{R,2_{t+1}} \tag{E.104}$$

Optimal reset price Calvo Pricing RoW PCP exports to US

$$\tilde{p}^{U}_{R\,t} = \frac{\frac{\psi_i}{\psi_i-1}\, \tilde{X}^{U}_{R,1_t}}{\tilde{X}^{U}_{R,2_t}} \tag{E.105}$$

PCP price inflation RoW exports to US

$$1 = \left(1-\theta^{R}_{P}\right)\, \tilde{p}^{U\,1-\psi_i}_{R\,t} + \theta^{R}_{P}\, \left(1+\tilde{\pi}^{U}_{R\,t}\right)^{\psi_i-1} \tag{E.106}$$

Numerator Calvo Pricing RoW DCP exports to US

$$\hat{X}^{U}_{R,1_t} = Y^{U}_{R\,t}\, IP_{R\,t}\, MC^{rp}_{R\,t}\, \Lambda_{R\,t}\, \widehat{CP}^{U(-\psi_i)}_{R\,t} + \beta_R\, \theta^{R}_{P}\, \left(1+\hat{\pi}^{U}_{R\,t+1}\right)^{\psi_i}\, \hat{X}^{U}_{R,1_{t+1}} \tag{E.107}$$

Denominator Calvo Pricing RoW DCP exports to US

$$\hat{X}^{U}_{R,2_t} = Y^{U}_{R\,t}\, IP_{R\,t}\, \Lambda_{R\,t}\, \widehat{CP}^{U(-\psi_i)}_{R\,t}\, \widehat{EM}^{U}_{R\,t} + \beta_R\, \theta^{R}_{P}\, \left(1+\hat{\pi}^{U}_{R\,t+1}\right)^{\psi_i-1}\, \hat{X}^{U}_{R,2_{t+1}} \tag{E.108}$$

Optimal reset price Calvo Pricing RoW DCP exports to US

$$\hat{p}^{U}_{R\,t} = \frac{\frac{\psi_i}{\psi_i-1}\, \hat{X}^{U}_{R,1_t}}{\hat{X}^{U}_{R,2_t}} \tag{E.109}$$

DCP price inflation RoW exports to US

$$1 = \left(1-\theta^{R}_{P}\right)\, \hat{p}^{U\,1-\psi_i}_{R\,t} + \theta^{R}_{P}\, \left(1+\hat{\pi}^{U}_{R\,t}\right)^{\psi_i-1} \tag{E.110}$$

Numerator Calvo Pricing US DCP exports to RoW

$$\tilde{X}^R_{U,1\,t} = Y^R_{U\,t}\, IP_{U\,t}\, MC^{rp}_{U\,t}\, \Lambda_{U\,t}\, \widetilde{CP}^{R\,(-\psi_i)}_{U\,t} + \beta_U\, \theta^U_P \left(1+\tilde{\pi}^R_{U\,t+1}\right)^{\psi_i} \tilde{X}^R_{U,1\,t+1} \tag{E.111}$$

Denominator Calvo Pricing US DCP exports to RoW

$$\tilde{X}^R_{U,2\,t} = Y^R_{U\,t}\, IP_{U\,t}\, \Lambda_{U\,t}\, \widetilde{CP}^{R\,(-\psi_i)}_{U\,t}\, \widetilde{EM}^R_{U\,t} + \beta_U\, \theta^U_P \left(1+\tilde{\pi}^R_{U\,t+1}\right)^{\psi_i-1} \tilde{X}^R_{U,2\,t+1} \tag{E.112}$$

Optimal reset price Calvo Pricing US DCP exports to RoW

$$\tilde{p}^R_{U\,t} = \frac{\frac{\psi_i}{\psi_i-1}\, \tilde{X}^R_{U,1\,t}}{\tilde{X}^R_{U,2\,t}} \tag{E.113}$$

DCP price inflation US exports to RoW

$$1 = \left(1-\theta^U_P\right) \tilde{p}^{R\,1-\psi_i}_{U\,t} + \theta^U_P \left(1+\tilde{\pi}^R_{U\,t}\right)^{\psi_i-1} \tag{E.114}$$

Numerator Calvo Pricing US LCP exports to RoW

$$\underline{X}^R_{U,1\,t} = Y^R_{U\,t}\, IP_{U\,t}\, MC^{rp}_{U\,t}\, \Lambda_{U\,t}\, \underline{CP}^{R\,(-\psi_i)}_{U\,t} + \beta_U\, \theta^U_P \left(1+\underline{\pi}^R_{U\,t+1}\right)^{\psi_i} \underline{X}^R_{U,1\,t+1} \tag{E.115}$$

Denominator Calvo Pricing US LCP exports to RoW

$$\underline{X}^R_{U,2\,t} = Y^R_{U\,t}\, IP_{U\,t}\, \Lambda_{U\,t}\, \underline{CP}^{R\,(-\psi_i)}_{U\,t}\, \underline{EM}^R_{U\,t} + \beta_U\, \theta^U_P \left(1+\underline{\pi}^R_{U\,t+1}\right)^{\psi_i-1} \underline{X}^R_{U,2\,t+1} \tag{E.116}$$

Optimal reset price Calvo Pricing US LCP exports to RoW

$$\underline{p}^R_{U\,t} = \frac{\frac{\psi_i}{\psi_i-1}\, \underline{X}^R_{U,1\,t}}{\underline{X}^R_{U,2\,t}} \tag{E.117}$$

LCP price inflation US exports to RoW

$$1 = \left(1-\theta^U_P\right) \underline{p}^{R\,1-\psi_i}_{U\,t} + \theta^U_P \left(1+\underline{\pi}^R_{U\,t}\right)^{\psi_i-1} \tag{E.118}$$

E.11 Monetary Policy

RoW Taylor rule

$$\frac{1+R_{R\,t}}{1+R_{E,SS}} = \left(\frac{1+R_{R\,t-1}}{1+R_{E,SS}}\right)^{\rho_{R,r}} \left(\left(\frac{1+\pi^C_{R\,t}}{1+(\bar{\pi^C_R})}\right)^{\phi_{R,\pi}} \left(\frac{Z_{R\,t}}{(\bar{Z_R})}\right)^{\phi_{R,z}}\right)^{1-\rho_{R,r}} exp\left(\varepsilon^R_{R\,t}\right) \tag{E.119}$$

US Taylor rule

$$\frac{1+R_{U\,t}}{1+RSS_{F,ss}} = \left(\frac{1+R_{U\,t-1}}{1+R_{F,ss}}\right)^{\rho_{U,r}} \left(\left(\frac{1+\pi^C_{U\,t}}{1+(\bar{\pi^C_U})}\right)^{\phi_{U,\pi}} \left(\frac{Z_{U\,t}}{(\bar{Z_U})}\right)^{\phi_{U,z}}\right)^{1-\rho_{U,r}} exp\left(\varepsilon^R_{U\,t}\right) \tag{E.120}$$

RoW MP shock

$$\varepsilon^R_{R\,t} = \rho^r_\epsilon\, \varepsilon^R_{R\,t-1} + \sigma^r_{R,\epsilon}\, \eta^r_{R\,t} \tag{E.121}$$

US MP shock

$$\varepsilon^R_{U\,t} = \rho^r_\epsilon\, \varepsilon^R_{U\,t-1} + \frac{\sigma^r_{U,\epsilon}}{100}\, \eta^r_{U\,t} \tag{E.122}$$

E.12 Relative Prices

Relative price of RoW domestic DCP sales and RoW domestic PCP sales

$$\hat{IT}^R_{R\,t} = \hat{IT}^R_{R\,t-1}\, \frac{(1 + D\mathcal{E}_t)\, \left(1 + \hat{\pi}^R_{R\,t}\right)}{1 + \tilde{\pi}^R_{R\,t}} \tag{E.123}$$

Relative price of RoW domestic PCP sales to Aggregate RoW PPI

$$\widetilde{CP}^R_{R\,t} = \left(\gamma^{R,PCP}_R + \left(1 - \gamma^{R,PCP}_R\right)\, \hat{IT}^{R\,1-\psi_i}_{R\,t}\right)^{\frac{1}{\psi_i - 1}} \tag{E.124}$$

Relative price of RoW domestic DCP sales to Aggregate RoW PPI

$$\widehat{CP}^R_{R\,t} = \widetilde{CP}^R_{R\,t}\, \hat{IT}^R_{R\,t} \tag{E.125}$$

Aggregate RoW PPI inflation as a function of domestic PCP and DCP prices

$$1 + \pi^R_{R\,t} = \left(1 + \tilde{\pi}^R_{R\,t}\right)\, \frac{\widetilde{CP}^R_{R\,t-1}}{\widetilde{CP}^R_{R\,t}} \tag{E.126}$$

Export margins for DCP exports from RoW to US in RoW currency (price of DCP exports over domestic sales price

$$\widehat{EM}^U_{R\,t} = \widehat{EM}^U_{R\,t-1}\, \frac{(1 + D\mathcal{E}_t)\, \left(1 + \hat{\pi}^U_{R\,t}\right)}{1 + \pi^R_{R\,t}} \tag{E.127}$$

Export margins for PCP exports from RoW to US in RoW currency (price of DCP exports over domestic sales price

$$\widetilde{EM}^U_{R\,t} = \widetilde{EM}^U_{R\,t-1}\, \frac{1 + \tilde{\pi}^U_{R\,t}}{1 + \pi^R_{R\,t}} \tag{E.128}$$

Aggregate margins for exports from RoW to US in RoW currency (agg. export price over domestic sales PPI)

$$EM^U_{R\,t} = \left(\gamma^{R,PCP}_{U,t}\, \widetilde{EM}^{U\,1-\psi_i}_{R\,t} + \left(1 - \gamma^{R,PCP}_{U,t}\right)\, \widehat{EM}^{U\,1-\psi_i}_{R\,t}\right)^{\frac{1}{1-\psi_i}} \tag{E.129}$$

Import price inflation of US imports from the RoW in US-D

$$1 + \pi^{R^I}_{U\,t} = \frac{\left(1 + \pi^R_{R\,t}\right)\, \frac{EM^U_{R\,t}}{EM^U_{R\,t-1}}}{1 + D\mathcal{E}_t} \tag{E.130}$$

Export margins for PCP exports from the US to RoW in US-D (price of PCP exports over domestic sales price)

$$\widetilde{EM}_{Ut}^{R} = \widetilde{EM}_{Ut-1}^{R} \frac{1 + \tilde{\pi}_{Ut}^{R}}{1 + \pi_{Ut}^{U}} \tag{E.131}$$

Export margins for LCP exports from the US to RoW in US-D (price of LCP exports over domestic sales price)

$$\underline{EM}_{Ut}^{R} = \frac{\left(1 + \underline{\pi}_{Ut}^{R}\right) \frac{\underline{EM}_{Ut-1}^{R}}{1+D\mathcal{E}_t}}{1 + \pi_{Ut}^{U}} \tag{E.132}$$

Aggregate margins for exports from US to RoW in US-D currency (agg. export price over domestic sales PPI)

$$EM_{Ut}^{R} = \left(\gamma_{E,t}^{F,PCP} \widetilde{EM}_{Ut}^{R\,1-\psi_i} + \left(1 - \gamma_{E,t}^{F,PCP}\right) \underline{EM}_{Ut}^{R\,1-\psi_i}\right)^{\frac{1}{1-\psi_i}} \tag{E.133}$$

Import price inflation of RoW imports from the US in RoW currency

$$1 + \pi_{R\ t}^{U^I} = (1 + D\mathcal{E}_t) \left(1 + \pi_{Ut}^{U}\right) \frac{EM_{Ut}^{R}}{EM_{Ut-1}^{R}} \tag{E.134}$$

Interior terms of trade RoW (US exports prices (in RoW currency) relative to RoW PPI)

$$IT_{R\ t}^{U} = IT_{R\ t-1}^{U} \frac{1 + \pi_{R\ t}^{U^I}}{1 + \pi_{Rt}^{R}} \tag{E.135}$$

Interior Producer Price RoW (PPI over CPI)

$$IP_{Rt} = \left(\eta_{R,t} + (1 - \eta_{R,t})\ IT_{R\ t}^{U\,1-\psi_f}\right)^{\frac{1}{\psi_f - 1}} \tag{E.136}$$

RoW CPI inflation

$$1 + \pi_{Rt}^{C} = \left(1 + \pi_{Rt}^{R}\right) \frac{IP_{Rt-1}}{IP_{Rt}} \tag{E.137}$$

Interior terms of trade US (RoW exports prices (in US-D currency) relative to US PPI)

$$IT_{Ut}^{R} = \frac{EM_{R\ t}^{U}\, EM_{Ut}^{R}}{IT_{R\ t}^{U}} \tag{E.138}$$

Interior Producer Price US (PPI over CPI)

$$IP_{Ut} = \left(\eta_{U,t} + (1 - \eta_{U,t})\ IT_{Ut}^{R\,1-\psi_f}\right)^{\frac{1}{\psi_f - 1}} \tag{E.139}$$

US consumer price inflation

$$1 + \pi_{Ut}^{C} = \left(1 + \pi_{Ut}^{U}\right) \frac{IP_{Ut-1}}{IP_{Ut}} \tag{E.140}$$

Definition of the Real exchange rate (in terms of CPI baskets)

$$RER_t = \frac{IP_{Rt}\, EM^U_{R\,t}}{IP_{Ut}\, IT^R_{U\,t}} \tag{E.141}$$

PCP export price over agg. US import price

$$\widetilde{CP}^U_{R\,t} = \frac{IP_{Rt}\, \frac{\widetilde{EM}^U_{R\,t}}{IT^R_{U\,t}}}{IP_{Ut}} \frac{1}{RER_t} \tag{E.142}$$

DCP export price over agg. US import price

$$\widehat{CP}^U_{R\,t} = \frac{1}{RER_t} \frac{IP_{Rt}\, \frac{\widehat{EM}^U_{R\,t}}{IT^R_{U\,t}}}{IP_{Ut}} \tag{E.143}$$

DCP export price over agg. RoW import price

$$\widetilde{CP}^R_{U\,t} = RER_t \frac{IP_{Ut}\, \frac{\widetilde{EM}^R_{U\,t}}{IT^U_{R\,t}}}{IP_{Rt}} \tag{E.144}$$

LCP export price over agg. RoW import price

$$\underline{CP}^R_{U\,t} = RER_t \frac{IP_{Ut}\, \frac{EM^R_{U\,t}}{IT^U_{R\,t}}}{IP_{Rt}} \tag{E.145}$$

E.13 Market Clearing

Agg. demand for RoW final composite good

$$Y^C_{R\,t} = C_{Rt} + I_{Rt} + (In_{Rt} + (\bar{I_R}))\, \frac{\Psi_R}{2} \left(\frac{In_{Rt} + (\bar{I_R})}{(\bar{I_R}) + In_{Rt-1}} - 1 \right)^2 \tag{E.146}$$

Agg. demand for US final composite good

$$Y^C_{U\,t} = C_{Ut} + I_{Ut} + (In_{Ut} + (\bar{I_U}))\, \frac{\Psi_U}{2} \left(\frac{In_{Ut} + (\bar{I_U})}{(\bar{I_U}) + In_{Ut-1}} - 1 \right)^2 \tag{E.147}$$

RoW aggregate production function

$$Z_{Rt} = (K_{Rt-1}\, U_{Rt})^\alpha \; L_{R\,t}^{1-\alpha} \tag{E.148}$$

US aggregate production

$$Z_{Ut} = (K_{Ut-1}\, U_{Ut})^\alpha \; L_{U\,t}^{1-\alpha} \tag{E.149}$$

RoW market clearing

$$Z_{Rt} = Y^R_{R\,t}\, \delta^R_{R\,t} + Y^U_{R\,t}\, \delta^U_{R\,t} \tag{E.150}$$

US market clearing

$$Z_{U\,t} = Y^{U}_{U\,t}\,\delta^{U}_{U\,t} + Y^{R}_{U\,t}\,\delta^{U}_{R\,t} \tag{E.151}$$

E.14 Price dispersion terms (constant up to first order)

$$\tilde{\delta}^{R}_{R\,t} = \left(1-\theta^{R}_{P}\right)\,\tilde{p}^{R\,(-\psi_i)}_{R\,t} + \theta^{R}_{P}\,\left(1+\tilde{\pi}^{R}_{R\,t}\right)^{\psi_i}\,\tilde{\delta}^{R}_{R\,t-1} \tag{E.152}$$

$$\hat{\delta}^{R}_{R\,t} = \left(1-\theta^{R}_{P}\right)\,\hat{p}^{R\,(-\psi_i)}_{R\,t} + \theta^{R}_{P}\,\left(1+\hat{\pi}^{R}_{R\,t}\right)^{\psi_i}\,\hat{\delta}^{R}_{R\,t-1} \tag{E.153}$$

$$\delta^{R}_{R\,t} = \tilde{\delta}^{R}_{R\,t}\,\widetilde{CP}^{R\,(-\psi_i)}_{R\,t}\,\gamma^{R,PCP}_{R,t} + \hat{\delta}^{R}_{R\,t}\,\widehat{CP}^{R\,(-\psi_i)}_{R\,t}\,\left(1-\gamma^{R,PCP}_{R,t}\right) \tag{E.154}$$

$$\tilde{\delta}^{U}_{R\,t} = \left(1-\theta^{R}_{P}\right)\,\tilde{p}^{U\,(-\psi_i)}_{R\,t} + \theta^{R}_{P}\,\left(1+\tilde{\pi}^{U}_{R\,t}\right)^{\psi_i}\,\tilde{\delta}^{U}_{R\,t-1} \tag{E.155}$$

$$\hat{\delta}^{U}_{R\,t} = \left(1-\theta^{R}_{P}\right)\,\hat{p}^{U\,(-\psi_i)}_{R\,t} + \theta^{R}_{P}\,\left(1+\hat{\pi}^{U}_{R\,t}\right)^{\psi_i}\,\hat{\delta}^{U}_{R\,t-1} \tag{E.156}$$

$$\delta^{U}_{R\,t} = \tilde{\delta}^{U}_{R\,t}\,\widetilde{CP}^{U\,(-\psi_i)}_{R\,t}\,\gamma^{R,PCP}_{U,t} + \hat{\delta}^{U}_{R\,t}\,\widehat{CP}^{U\,(-\psi_i)}_{R\,t}\,\left(1-\gamma^{R,PCP}_{U,t}\right) \tag{E.157}$$

$$\delta^{U}_{U\,t} = \left(1-\theta^{U}_{P}\right)\,\overline{p}^{U\,(-\psi_i)}_{U\,t} + \theta^{U}_{P}\,\left(1+\pi^{U}_{U\,t}\right)^{\psi_i}\,\delta^{U}_{U\,t-1} \tag{E.158}$$

$$\tilde{\delta}^{R}_{U\,t} = \left(1-\theta^{U}_{P}\right)\,\tilde{p}^{R\,(-\psi_i)}_{U\,t} + \theta^{U}_{P}\,\left(1+\tilde{\pi}^{R}_{U\,t}\right)^{\psi_i}\,\tilde{\delta}^{R}_{U\,t-1} \tag{E.159}$$

$$\underline{\delta}^{R}_{U\,t} = \left(1-\theta^{U}_{P}\right)\,\underline{p}^{R\,(-\psi_i)}_{U\,t} + \theta^{U}_{P}\,\left(1+\underline{\pi}^{R}_{U\,t}\right)^{\psi_i}\,\underline{\delta}^{R}_{U\,t-1} \tag{E.160}$$

$$\delta^{R}_{U\,t} = \tilde{\delta}^{R}_{U\,t}\,\widetilde{CP}^{R\,(-\psi_i)}_{U\,t}\,\gamma^{U,PCP}_{R,t} + \underline{\delta}^{R}_{U\,t}\,\underline{CP}^{R\,(-\psi_i)}_{U\,t}\,\left(1-\gamma^{U,PCP}_{R,t}\right) \tag{E.161}$$

E.15 Balance of Payments

RoW Current account in RoW currency

$$CA^{F}_{R,nom\,t} = Y^{R}_{R\,t}\,IP_{R\,t} + Y^{U}_{R\,t}\,IT^{R}_{U\,t}\,RER_{t}\,IP_{U\,t} - Y^{C}_{R\,t} \tag{E.162}$$

Balance of Payments

$$RER_t \left(GB_{Rt} - \frac{R_{R\ t-1}^{GB}}{1+\pi_{Ut}^{C}} \left(GB_{Rt-1}\right) \right) - RER_t \left(CBDL_{Rt} - CBDL_{Rt-1} \frac{R_{U,t-1}^{CBDL}}{1+\pi_{Ut}^{C}} \right) = CA_{R,nom\,t}^{F} \tag{E.163}$$

Trade Balance RoW

$$TB_{Rt} = Y_{R\ t}^{U} - \frac{(1-n)\ Y_{Ut}^{R}}{n} \tag{E.164}$$

Change in the NFA (including valuation effects) relative to RoW GDP

$$\Delta NFA_{Rt} = \frac{RER_t\ (GB_{Rt-1}) - (GB_{Rt-1})\ RER_{t-1} - RER_t\, CBDL_{Rt-1} + CBDL_{Rt-1}\, RER_{t-1}}{(\bar{Z_R})} \tag{E.165}$$

E.16 Model local variables

Share of PCP goods in US Import Basket

$$\gamma_U^{R,PCP} = 1 - \hat{\gamma}_U^R$$

Share of PCP goods in RoW Import basket

$$\gamma_R^{U,PCP} = 1 - \tilde{\gamma}_R^U$$

Share of PCP goods in RoW Local Basket

$$\gamma_R^{R,PCP} = 1 - \hat{\gamma}_R^R$$

RoW steady state net interest rate

$$R_{R,SS} = \frac{1}{\beta_R} - 1$$

US steady state net interest rate

$$R_{R,SS} = \frac{1}{\beta_U} - 1$$

Size adjusted import share RoW

$$\eta_R = (1 - op_R)\,(1 - s)$$

Size adjusted import share US

$$\eta_{US} = (1 - op_U) s$$

F Online Appendix - Model Extensions

F.1 Exorbitant Duty

In the data the aggregate RoW has a positive net dollar position vis-à-vis the US. This partly underlies the US's 'exorbitant duty' (Gourinchas et al. 2012; Gourinchas & Rey 2022): When risk aversion increases and the dollar appreciates, the US (RoW) experiences a negative (positive) exchange-rate valuation effect on its external balance sheet.[39] In contrast, in the calibration of our baseline trinity model the RoW has a *negative* net dollar position vis-à-vis the US. As a result, there is no wealth transfer from the US to the RoW due to an exchange-rate valuation effect when risk increases and the dollar appreciates.

However, we argue the absence of this exorbitant duty in the baseline trinity model is inconsequential for the transmission of the GFCyc. In particular, the RoW's positive net foreign asset position vis-à-vis the US in the data is to a large extent accounted for by entities that are arguably not sensitive to short-term exchange rate valuation effects (i.e. not short-term leverage-constrained) as for example foreign exchange reserve managers, pension and sovereign wealth funds—so that they simply absorb exchange-rate valuation effects over time without contributing to a global financial accelerator.[40]

In order to illustrate the implications of this, we consider an extension in which we introduce an unconstrained RoW government entity that holds dollar assets such that the *aggregate* RoW has a positive net foreign asset position vis-à-vis the US, while the RoW banking sector continues to be net short in dollar. In particular, we assume that in the RoW there exists a continuum of entities—which we refer to as sovereign wealth funds (SWFs) for simplicity—that in each period take on deposits $D^{SWF}_{R,j,t}$ from RoW households at the rate $R_{R,t-1}$ which they use to purchase US Treasuries $GB^{SWF}_{R,j,t}$. As bank deposits return the same rate as deposits with the SWFs, RoW households are indifferent between the two. After each period, SWFs transfer profits or losses from these operations to households. The balance sheet of SWF j in real terms reads as

$$RER_t GB^{SWF}_{R,j,t} = D^{SWF}_{R,j,t}, \tag{F.1}$$

[39] According to Gourinchas & Rey (2022) the largest part of the overall valuation effect arises because the US is the 'global venture capitalist': Its foreign liabilities are tilted towards instruments—e.g. Treasury securities—whose prices rise when risk aversion increases while the prices of its foreign assets—e.g. foreign equity—fall.

[40] Sufficiently detailed data on the composition of US-RoW cross-border positions by counterparty country and sector, currency and instrument necessary to document this does not exist. However, at least some circumstantial evidence can be inferred from existing but less detailed data. For example, according to data from US Treasury International Capital RoW (quasi-)government—including sovereign wealth fund—holdings of US debt and equity securities amounted to 28% of US annual GDP over 2005 to 2019, while according to the data from Benetrix et al. (2020) over the same period the US net foreign asset position amounted to -30%. Similarly, the IMF's Currency Composition of Official Foreign Exchange Reserves (COFER) data suggest that global official dollar-denominated foreign exchange reserves amounted to 37% of US annual GDP over 1991 to 2019 (assuming the same dollar share for un-allocated as for allocated reserves), compared to a US net foreign asset position of -20%. While not conclusive, this data suggests a non-trivial share of the RoW's holdings of US assets making up its net foreign asset position is held by arguably unconstrained entities.

and the period-by-period flow-of-funds constraint can be written as

$$\frac{R_{R,t-1}}{(1+\pi^C_{R,t})} D^{SWF}_{R,t-1} + RER_t GB^{SWF}_{R,j,t} = \frac{R^{GB}_{U,t-1}}{(1+\pi_{U,t})} RER_t GB^{SWF}_{R,j,t-1} + D^{SWF}_{R,t}. \tag{F.2}$$

In contrast to the baseline, we assume that the supply of Treasuries is fixed at $\overline{GB}_U$, which is calibrated to yield a negative US net-foreign-asset-to-GDP-ratio in line with the data.[41] Market clearing then determines the optimal amount of US Treasuries $GB_{R,t}$ held by the RoW SWFs as

$$GB^{SWF}_{R,t} = \frac{(1-s)}{s} \overline{GB}_U - GB_{R,t}, \tag{F.3}$$

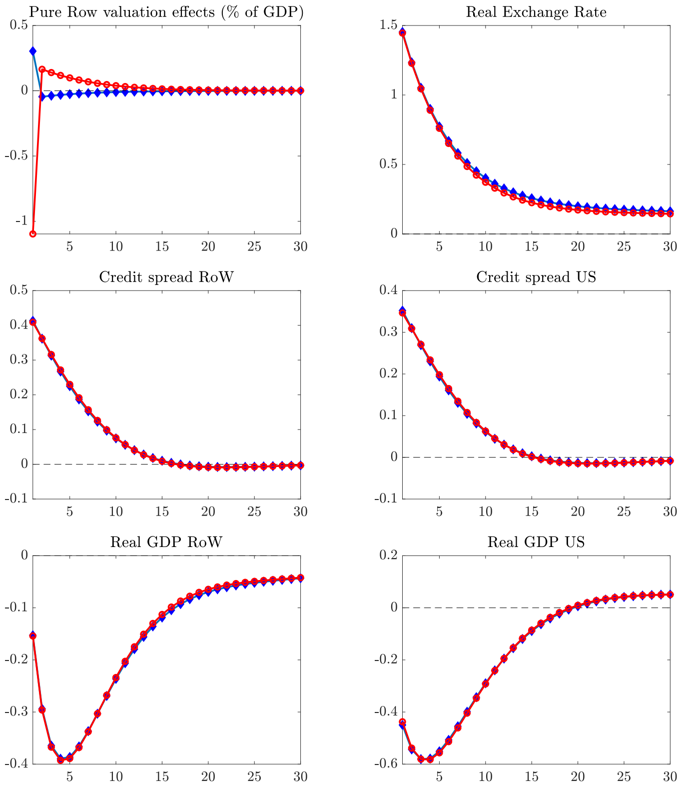
where s denotes relative country size. One way to think of this set-up is that given a fixed supply of Treasuries, RoW banks purchase Treasuries to optimally manage the riskiness of their balance sheets, and RoW SWFs just absorb the residual. After imposing market clearing and aggregating across budget constraints of RoW firms and households, the aggregate RoW budget constraint (i.e. the national accounting identity) in Equation (**??**) includes an additional term which tracks the evolution of US Treasuries holdings of RoW SWFs.

The first panel in Figure F.1 shows that in this setup the RoW experiences a exchange-rate valuation gain of roughly 0.4% of GDP following a dollar appreciation due to a risk aversion shock. Most importantly, however, the responses of the remaining variables are virtually unchanged relative to the baseline trinity model.

This is because as long as the RoW entity that accounts for the positive net foreign asset position vis-à-vis the US is unconstrained and profits are distributed lump-sum to unconstrained households, exchange-rate valuation effects hardly affect consumption and savings choices (Kaplan et al. 2018). Thus, the overall RoW net foreign asset position vis-à-vis the US is not key for the transmission of the GFCyc. What matters is the net foreign asset position of constrained RoW banks.

[41]While our baseline calibration implies the US has a positive net foreign asset position of 46% of GDP, here we calibrate $\overline{GB}_U$ to roughly match the average in the sample used in the empirical analysis in Section 2 at -14%.

Figure F.1: Responses to a risk aversion shock with (red circles) and without (blue diamonds) exorbitant duty



Note: The red lines with circles show the impulse responses of baseline model and the blue lines with diamonds from an alternative model in which we add unconstrained RoW sovereign wealth funds which hold enough US dollar denominated assets, such that the RoW is a net creditor to the US.