Intermediary Balance Sheets and UIP Deviations in Emerging Markets*

Alex Carrasco — MIT

Cesar Vasquez — University of Maryland

April 11, 2026

Please click here for the latest version

Abstract

Emerging market economies are highly exposed to global financial shocks because they rely more heavily on foreign currency borrowing and operate with shallower domestic financial markets. This paper studies how such shocks affect deviations from uncovered interest parity. Using local projections in a panel of advanced and emerging economies, we show that UIP deviations rise persistently after a U.S. monetary tightening in emerging markets but fall in advanced economies. This differential response is stronger in countries whose banking sectors hold larger short foreign currency positions. We develop a dynamic small open economy model with financial frictions and market segmentation to interpret these facts. Banks borrow in foreign currency and lend domestically, subject to balance sheet constraints and forward looking portfolio decisions. Exchange rate movements revalue intermediary net worth, alter intermediation capacity, and generate endogenous UIP premia. The model matches the asymmetric response of UIP deviations to foreign monetary shocks and highlights intermediary balance sheets as a key determinant of international monetary transmission.

*Carrasco: MIT (alexcm@mit.edu). I thank my advisors Iván Werning, Martin Beraja, and Christian Wolf for guidance throughout this project. Vasquez: University of Maryland (cesarv93@umd.edu). I thank my advisors Pierre De Leo, Thomas Drechsel, and John Shea for guidance throughout this project. Comments and suggestions from Ricardo Caballero, Robert M. Townsend, Rohan Kekre, Diego Perez, and David Florián-Hoyle, as well as participants at the MIT Macro Seminar are greatly appreciated.

1 Introduction

Some of the main features that distinguish emerging market economies from advanced economies are that they rely more heavily on foreign-currency borrowing, exhibit higher financial dollarization, and operate with shallower domestic financial markets.[1] These features make them especially vulnerable to changes in global funding conditions and amplify the domestic transmission of external monetary shocks, particularly those originating from U.S. monetary policy. As a result, domestic interest rates and exchange rates in emerging markets respond markedly differently to these shocks than their counterparts in advanced economies. A key manifestation of this asymmetry is the behavior of deviations from uncovered interest parity (UIP): in emerging markets, these deviations are larger, more persistent, and more sensitive to global funding conditions.[2] Understanding what drives UIP deviations in response to external shocks is therefore central both to explaining exchange rate dynamics in emerging markets and to tracing the international transmission of U.S. monetary policy.

This paper makes two contributions. Empirically, it documents a robust asymmetry in the behavior of UIP deviations after U.S. monetary policy shocks and relates that asymmetry to cross country differences in banks' foreign currency exposure. Theoretically, it provides a framework in which UIP deviations are endogenous objects shaped by the joint evolution of exchange rates, intermediary net worth, and intertemporal portfolio decisions. More broadly, the paper shows that in economies with limited financial depth, UIP deviations are not merely pricing anomalies. They are equilibrium outcomes that encode how global shocks are transmitted through domestic balance sheets.

On this regard, the paper argues that there is a missing ingredient in recent models of UIP deviations: the interaction between foreign-currency funding and the balance sheets of financial intermediaries. While the role of balance sheets in amplifying exchange rate dynamics has a long history in open-economy macroeconomics, and the importance of intermediary balance sheets for asset pricing is well established in closed-economy settings, their joint implications for UIP deviations in emerging markets remain unexplored in the more recent literature, such as Gabaix and Maggiori (2015), Liu and Spiegel (2015) and Itskhoki and Mukhin (2021).[3] The empirical motivation is straightforward. Using survey-based exchange rate expectations from Consensus Economics in a panel of advanced and emerging market economies, we document that a U.S. monetary tightening raises UIP deviations

[1] For studies documenting these features see Calvo and Reinhart (2002), Eichengreen et al. (2007), Caballero et al. (2008), Ize and Levy-Yeyati (2003), and Levy-Yeyati (2006).

[2] See Rey (2015), Bruno and Shin (2015), Engel (2016), Miranda-Agrippino and Rey (2020), Kalemli-Özcan (2019), Lustig et al. (2011), and Cormún and De Leo (2025). Some of these asymmetries also appear in deviations from covered interest parity; see Du et al. (2018).

[3] The seminar references of balance sheet effects in macroeconomics see Krugman (1999), Calvo (1998), Aghion et al. (2004), and Cespedes et al. (2004)

in emerging markets but lowers them in advanced economies. We further show that this asymmetry is systematically stronger in countries where financial intermediaries are more frequently in short foreign-currency positions. Together, these findings point to a balance sheet channel in which exchange rate movements induced by external monetary policy shocks compress intermediaries' net worth and, in turn, raise the risk premia required to hold domestic assets.

To interpret these facts, we begin by considering a simplified environment in which exchange rate revaluation effects are absent. This allows us to focus on the core intermediation structure linking domestic borrowers, financial intermediaries, and international lenders, and to isolate how foreign interest rate shocks affect domestic credit conditions. We present a general setup in which households demand credit and intermediaries supply it by borrowing abroad and examine how the equilibrium spread responds to foreign rate shocks through the relative elasticities of demand and supply. In this setting, the cost of foreign borrowing in domestic currency is directly tied to the foreign interest rate, so any spread that emerges is a result of financial frictions. This framework clarifies which features of credit market equilibrium can and cannot generate a positive response of UIP deviations to an increase in the foreign interest rate. A key insight is that static or myopic intermediation is not sufficient. In the benchmark cases, a rise in foreign rates tends to reduce the equilibrium spread. Even models with dynamic intermediation (but without balance sheet effects) can barely match responses observed in the data. Reversing this prediction requires a genuinely dynamic supply side, where changes in intermediaries' net worth and intermediation capacity shape the response.

We then study open economy models with real exchange rate movements and foreign currency liabilities. Households consume tradable and nontradable goods, which makes the real exchange rate relevant for both intratemporal allocation and intertemporal borrowing decisions. Banks borrow abroad in foreign currency and lend domestically, so exchange rate movements change the domestic currency value of their liabilities and feed directly into net worth. As a result, the effective foreign funding cost is no longer pinned down by the foreign interest rate alone. It is jointly determined by foreign rates, intermediary balance sheets and exchange rate dynamics.

The main theoretical result is that the sign of the UIP response depends on the financial structure of intermediation. When banks are static and there is no meaningful balance sheet propagation, a rise in the foreign interest rate lowers UIP deviations. When banks are dynamic and exposed to revaluation effects, the same shock can raise UIP deviations on impact, depreciate the exchange rate, and reduce foreign currency borrowing by banks. The section also shows that the strength of the response depends on how forward-looking intermediaries are, and it decomposes the general equilibrium responses into a static component, a forward-looking component, and a balance sheet component. Quantitatively, the forward-looking channel is important for the dynamics of the UIP premium and the exchange rate, while the balance sheet channel is especially important for explaining the contraction in foreign currency borrowing.

Related literature. This paper contributes to several closely related literatures in international macroeconomics and international finance. First, the paper contributes to the literature on the international transmission of U.S. monetary policy and the global financial cycle. Bruno and Shin (2015) and Miranda-Agrippino and Rey (2020) highlight the role of intermediary balance sheets, dollar funding conditions, and global risk taking in transmitting U.S. shocks across countries. Related empirical work by Kalemli-Özcan and Varela (2021) and Kalemli-Özcan et al. (2024) shows that UIP premia are driven by local risk and respond asymmetrically to U.S. monetary tightening. This paper complements that literature by bringing UIP deviations to the center of the analysis. Rather than focusing on broad financial conditions or asset prices, it studies how external monetary shocks affect currency risk premia and identifies foreign currency mismatch as a key state variable governing that response. The main empirical contribution is to connect the global financial cycle literature to the behavior of UIP deviations measured using survey expectations.

Second, the paper contributes to the portfolio balance and limited arbitrage literature on exchange rate determination. The starting point is the portfolio balance view that exchange rates depend not only on interest differentials, but also on the relative supplies and demands for assets when those assets are imperfect substitutes. Building on the earlier contributions of Kouri (1976) and Branson and Henderson (1985), Gabaix and Maggiori (2015) provided a particularly influential microfoundation for this mechanism by showing how intermediary frictions can generate exchange rate risk premia.[4] This paper builds directly on that insight, but departs from the standard static or quasi static formulation in two important ways. It embeds the portfolio balance mechanism in a dynamic open economy environment with endogenous credit demand and supply, and it gives intermediaries evolving net worth and forward looking portfolio decisions. This framework makes it possible to study how dynamic intermediation and balance sheet effects shape the response of UIP premia to changes in global funding conditions.

Third, the paper contributes to the literature on financial intermediation and balance sheet constraints in macroeconomics. The banking block is closely related in spirit to intermediary models such as Gertler and Kiyotaki (2010) and Gertler and Karadi (2011), where net worth affects leverage and the ability to intermediate assets. The contribution here is to place that logic in an open economy setting in which banks borrow in foreign currency and lend domestically, so exchange rate movements directly revalue their liabilities and therefore their intermediation capacity. Aoki et al. (2025) and Carrasco and Florián Hoyle (2025) use related mechanisms to study the role of financial intermediaries in emerging market business cycles. Their focus, however, is on macroeconomic stabilization

[4]Several recent studies have developed quantitative versions of this framework to address open economy macroeconomic questions. See Cavallino (2019), Fanelli and Straub (2021), Itskhoki and Mukhin (2021), and Itskhoki and Mukhin (2023).

policy rather than on asymmetric UIP responses.[5]

On this regard, the paper relies on the literature highlighting the importance of intermediary balance sheets for asset pricing is well established in closed-economy settings (See He and Krishnamurthy (2013) Brunnermeier and Pedersen (2009) and Adrian and Shin (2014)). More related, Kekre et al. (2024) show that in segmented bond markets monetary policy affects term premia through wealth revaluation of duration exposed intermediaries. Our paper applies the same broad insight to international macroeconomics: when banks are exposed to foreign currency risk, U.S. monetary tightening revalues intermediary balance sheets, alters risk bearing capacity, and raises UIP premia in emerging markets.

Finally, the paper uses recent sequence space approach to macro finance. Using the sequence space logic of Auclert et al. (2021) and Wolf (2021), it summarizes the open economy financial block through elasticities that map foreign interest rate shocks into endogenous spreads, exchange rates, and balance sheet dynamics. This yields a tractable way to connect empirical impulse responses to a theoretically disciplined mechanism. More broadly, the paper shows how sequence space methods can be used not only for closed economy heterogeneous agent models, but also for open economy environments in which exchange rates, financial intermediation, and external balance sheet exposure jointly determine the transmission of global shocks.

Outline. The remainder of the paper is organized as follows. Section 2 presents the empirical evidence on the response of UIP deviations to U.S. monetary policy shocks and documents the role of banking sector foreign currency exposure. In Section 3, we describe the class of models that we explore in the paper. Section 4 develops a benchmark framework without exchange rate balance sheet effects and clarifies why standard or static intermediary models struggle to generate the empirical response. Section 5 introduces real exchange rate dynamics and intermediary balance sheets, and characterizes competitive equilibrium in the full model. Section 6 concludes.

2 Empirical analysis

U.S. monetary policy shocks generate sharply different responses in uncovered interest parity (UIP) deviations across countries. Following a U.S. tightening, UIP deviations increase in emerging market economies (EMEs) but decrease in advanced economies (AEs). Moreover, this response is systematically stronger in countries whose banking sectors are exposed to foreign currency risk.

[5]Our paper also shares the emphasis on net worth dynamics and currency mismatches of Korinek (2011) and Bocola and Lorenzoni (2020) but differs in focus: rather than studying the emergence of dollarization or the case for prudential regulation, we ask how, given an existing currency mismatch on intermediaries' balance sheets, external monetary policy shocks transmit into UIP deviations through the net worth channel.

From an economic perspective, uncovered interest parity implies that differences in interest rates across countries should be offset by expected exchange rate movements. In other words, if a country offers a higher interest rate than the United States, its currency is expected to depreciate so that investors earn the same return across currencies. Deviations from UIP capture violations of this condition and can be interpreted as currency risk premia: when UIP deviations are positive, investors require additional compensation to hold local currency assets because they expect losses from exchange rate movements.

UIP Deviations. We measure UIP deviations as the difference between the nominal interest rate differential and expected exchange rate depreciation over a one-year horizon, using survey-based expectations. The use of survey data to measure exchange rate expectations and the study of UIP deviations dates back to the seminal work of Frankel and Froot (1987), who show that survey expectations provide a direct measure of expected depreciation. In that sense, the UIP deviation for country c at time t is given by:

$$\text{UIPDev}_{c,t} = \log(1 + i_{c,t}) - \log(1 + i_t^{US}) - (\log S^e_{c,t+12} - \log S_{c,t}) \tag{1}$$

where $S^e_{c,t+12}$ is the twelve-months expected exchange rate obtained from Consensus Economics surveys, $S_{c,t}$ is the spot nominal exchange rate from the IMF's International Financial Statistics, and $i_{c,t}$ is the twelve-month money market interest rates from Bloomberg.

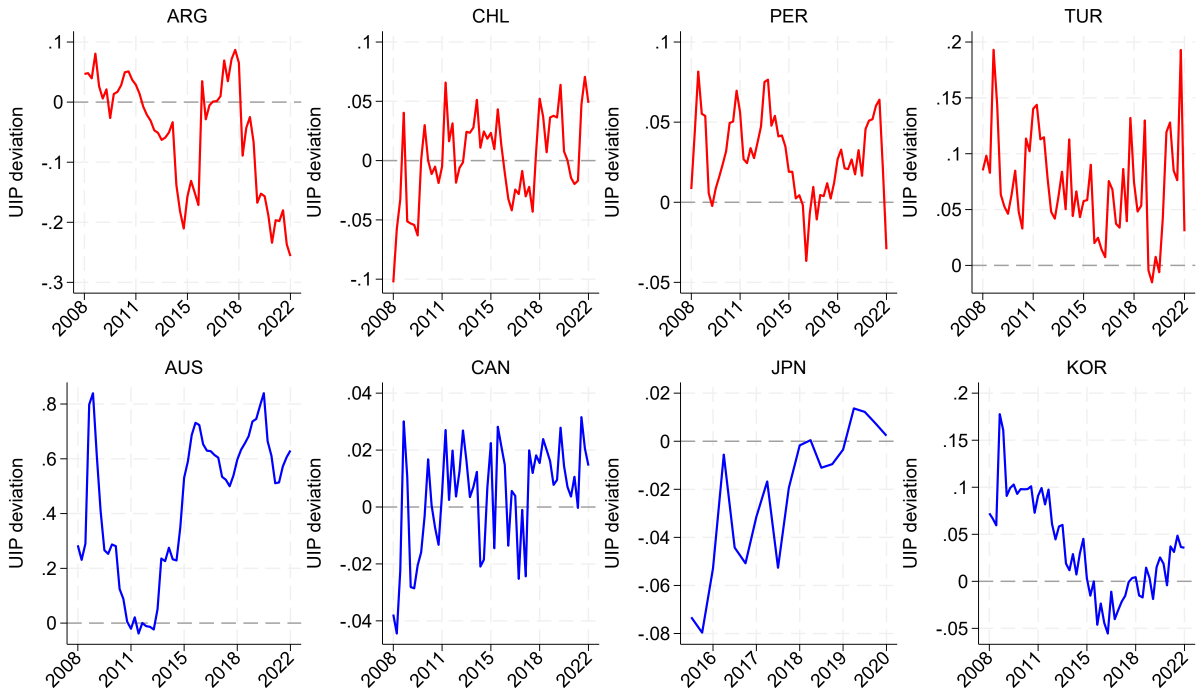
We begin by documenting that UIP deviations exhibit substantial heterogeneity across countries. Figure 1 plots the time series of UIP deviations for a set of advanced and emerging economies, showing large differences in both levels and volatility, even within the same income group. Table 1 confirms this pattern in the full sample: while average UIP deviations differ modestly across groups, dispersion is substantial, particularly in advanced economies. At the same time, both groups display economically large and persistent deviations from parity. Taken together, these results indicate that UIP deviations are not small or transitory anomalies, but rather a pervasive feature of international financial markets, pointing to an important role for country-specific factors beyond common global shocks.

Table 1: Descriptive statistics of UIP deviations

	N	*Mean*	*SD*	*P25*	*Median*	*P75*	*Min*	*Max*
Total	1415	-0.02	0.27	-0.10	0.00	0.05	-1.30	1.26
EME	741	0.00	0.10	-0.02	0.02	0.06	-0.43	0.25
AE	674	-0.04	0.37	-0.22	-0.01	0.02	-1.30	1.26

FX liabilities. We then turn to study these patterns from the perspective of a balance sheet channel in the international transmission of monetary policy. When intermediaries hold net short positions

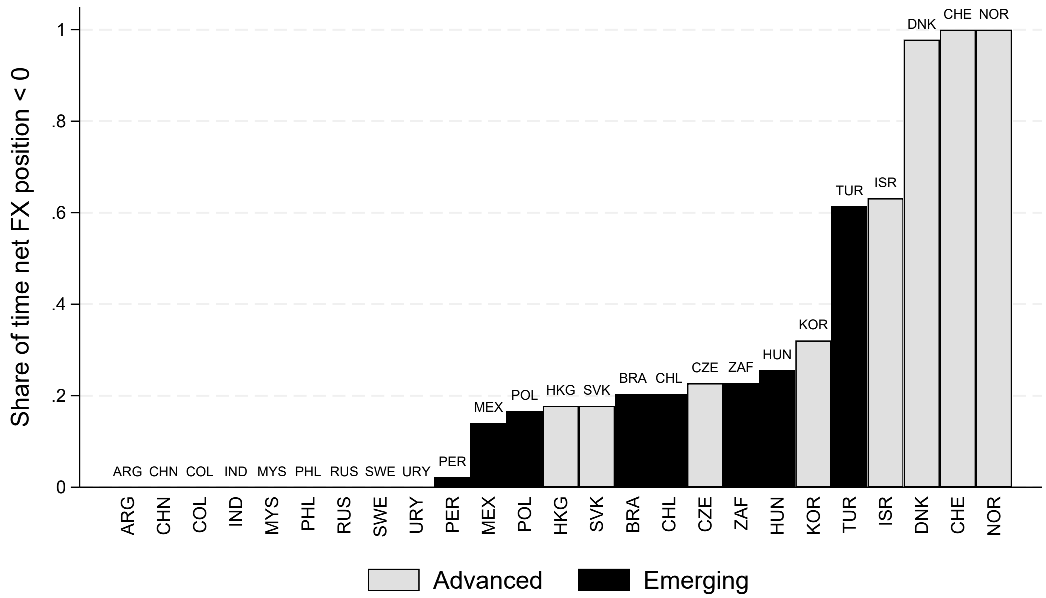
Figure 1: UIP Deviations Across Emerging and Advanced Economies



in foreign currency, exchange rate movements induced by U.S. shocks affect their net worth and amplify the risk premia embedded in UIP deviations, consistent with models of global financial cycles and intermediary-based transmission (Bruno and Shin (2015) and Miranda-Agrippino and Rey (2020)). To characterize cross-country differences in balance sheet exposure, we construct a measure of foreign currency mismatch in the banking sector. Using data from the IMF Financial Soundness Indicators, we compute the net open FX position of banks relative to capital and aggregate it at the country level. A negative value indicates that banks are net short in foreign currency, that is, their foreign currency liabilities exceed their assets, making them vulnerable to balance sheet losses upon depreciation. Figure 2 reports the share of time each country's banking sector is in a net short foreign currency position. There is substantial dispersion in this measure across countries, with some economies spending a large fraction of time in short FX positions, while others are rarely exposed. This cross-sectional heterogeneity motivates the classification of countries into high and low balance sheet constraint groups used in the analysis below.

To understand the comovement between UIP deviations and the net FX position, we plot the average UIP deviation and the average net foreign currency position across countries over time, which can be seen in Figure 3. This illustrates that periods of elevated UIP deviations tend to coincide with changes in aggregate FX exposure, suggesting a potential link between balance sheet conditions and exchange rate risk premia.

Figure 2: Cross-Country Frequency of Short FX Positions



Responses to US monetary policy shock. We now move on to analyze the response of UIP deviations to U.S monetary policy shocks. The empirical analysis is conducted using a country–time panel dataset that combines macroeconomic and financial data with survey-based measures of exchange rate expectations. We work with a quarterly, unbalanced panel covering 35 countries (16 AEs, 19 EMEs) [6] and between 2008Q1 and 2025Q3. The main variable of interest is a twelve-month measure of UIP deviations, constructed in logs as the difference between the nominal interest rate differential and expected exchange rate depreciation over a one-year horizon, We restrict the sample to countries operating under managed or freely floating exchange rate regimes, following Kalemli-Özcan and Varela (2021) and Kalemli-Özcan et al. (2024), excluding economies with hard pegs or dual exchange rate systems based on the classification of Ilzetzki et al. (2022).

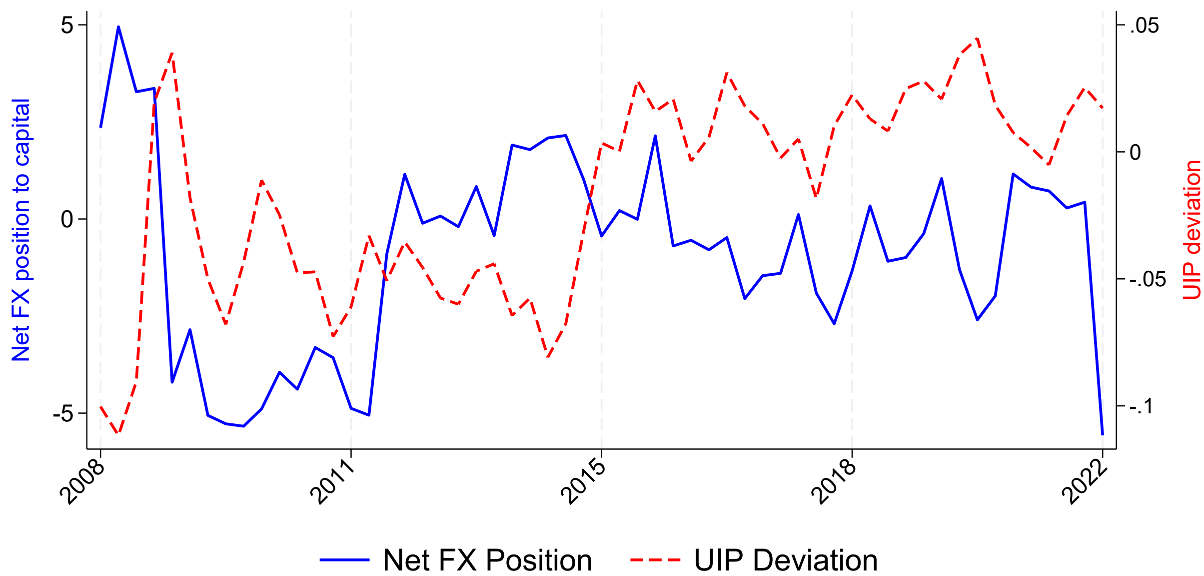
To estimate the dynamic impact of U.S. monetary policy shocks on UIP deviations, we use local projections following Jordà (2005). For each horizon $h = 0, ..., 8$ we estimate

$$y_{c,t+h} = \alpha_c + \beta_h \cdot \mathrm{MP}_t^{US} + \sum_{i=1}^{4} \eta_i \cdot x_{c,t-i} + \varepsilon_{c,t+h} \tag{2}$$

where $y_{c,t+h}$ is the UIP deviation, MP_t^{US} is the U.S. monetary policy shock $x_{c,t-i}$, includes lags of the dependent variable, inflation differentials relative to the U.S., and GDP growth, α_c denotes

[6] AE: Australia Canada Switzerland Czech Republic Denmark United Kingdom Hong Kong Special Administrative Region, People's Republic of China Israel Japan Korea, Republic of Norway New Zealand Singapore Slovak Republic Sweden United States, list EME: Argentina Brazil Chile China, People's Republic of Colombia Hungary Indonesia India Mexico Malaysia Peru Philippines Poland, Republic of Russian Federation Thailand Tunisia Türkiye, Republic of Uruguay South Africa)

Figure 3: Average Net FX Position and UIP Deviations

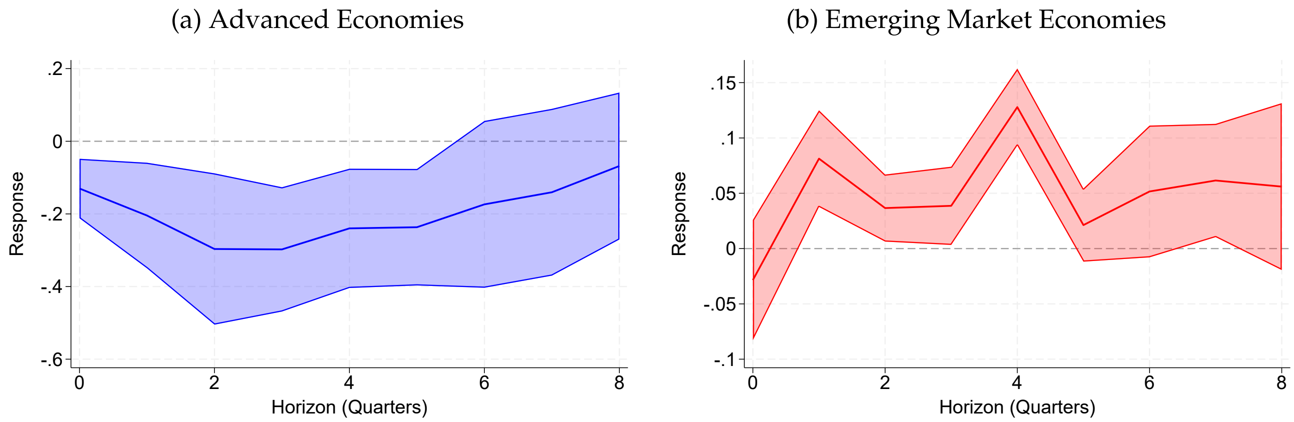


country fixed effects. Real GDP data are taken from the World Economic Outlook and consumer price indices from the IFS. For identification, we rely on high-frequency monetary policy surprises constructed around FOMC announcements, orthogonalized following Bauer and Swanson (2023) to remove predictable components driven by publicly available macroeconomic information prior to each announcement. Specifically, the orthogonalized surprises remove predictable components by purging the raw series of first principal component of 30-minute changes in money market futures rates of the variation explained by publicly available economic and financial information prior to the announcements, yielding a cleaner measure of the new information conveyed by monetary policy decisions. The identifying assumption is that policy actions are predetermined within the announcement window and thus orthogonal to contemporaneous macroeconomic and financial conditions.

Figure 4 presents the baseline results. There is a clear contrast between emerging market economies and advanced economies. In EMEs, a positive U.S. monetary policy shock leads to a significant increase in UIP deviations. In contrast, for advanced economies, the response of UIP deviations to a U.S. monetary policy shock is negative.

To investigate the mechanisms behind this asymmetry, we examine whether banks' balance sheet exposure to foreign currency risk shapes the heterogeneous transmission documented above. To capture the extent of exposure, we construct a country-level measure equal to the share of time a country's banking sector is in a net short FX position. This measure reflects how frequently banks operate under conditions of currency mismatch. We then split countries at the median of this

Figure 4: Local Projections: UIP Deviation Response to MP Shock



distribution (computed among countries that exhibit some short FX exposure): those with a higher frequency of short FX positions are classified as high balance sheet constraint (high BSC) countries, while those with lower frequency or no short FX exposure are classified as low BSC countries.

Figure 5 presents the split-sample results. The responses within each group are not straightforward to interpret in isolation. Countries with high BSC display a response that starts negative on impact, recovers over the following quarters, and turns positive in the short to medium run before subsiding. Countries with low BSC also start negative but remain so for longer, with a more gradual recovery. The difference in the shape and timing of these responses across groups is suggestive of heterogeneous transmission, but the individual IRFs do not cleanly isolate the role of balance sheet exposure on their own.

Figure 5: Local Projections: UIP Response to MP Shock by Short FX

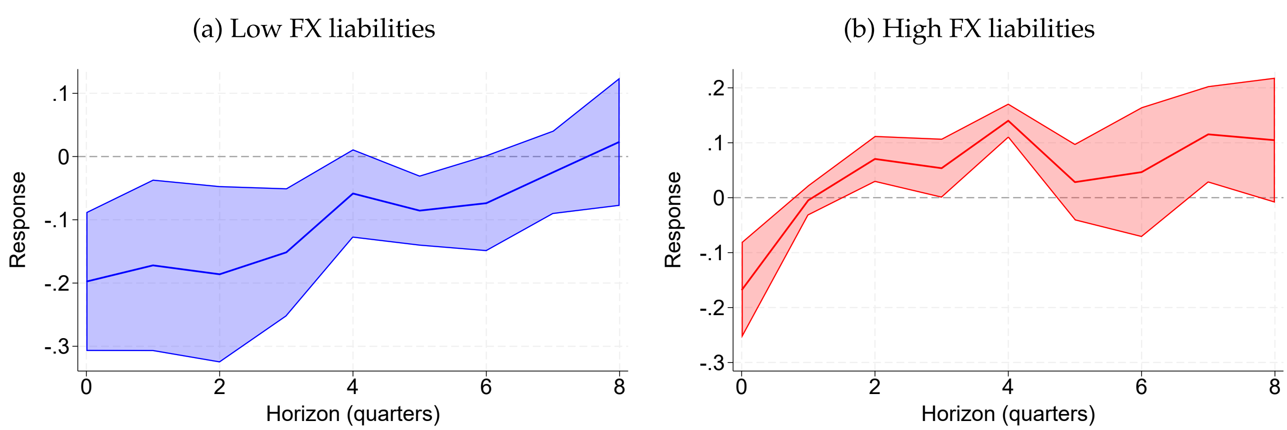
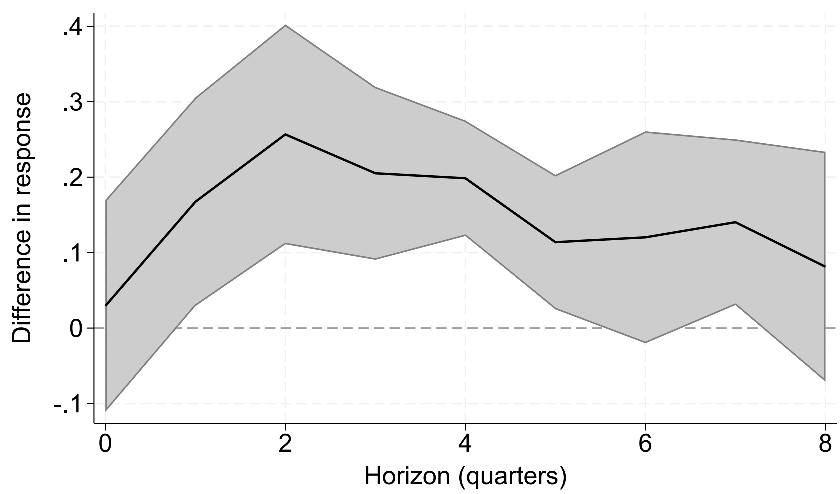


Figure 6 addresses this by plotting the differential IRF, defined as the difference between the high and low BSC impulse responses at each horizon. This differential is positive and statistically significant in the periods immediately following the shock, peaking in the first couple of quarters before gradually declining and becoming indistinguishable from zero after about 6 quarters. The differential isolates the incremental effect of balance sheet exposure: conditional on the common factors driving both groups, countries with greater short FX positions in their banking sector experience a systematically larger increase in UIP deviations following a U.S. monetary tightening. This is consistent with a balance sheet amplification channel in which exchange rate depreciation erodes banks' net worth and raises the risk premium embedded in UIP deviations, a mechanism that is weaker or absent in economies where banks are hedged or long FX.

Figure 6: Differential UIP Response to MP Shock: High vs Low Short FX



Together, these findings establish two empirical facts that discipline our theoretical framework. First, U.S. monetary policy shocks lead to an increase in UIP deviations in EMEs and a decrease in AEs. Second, across all countries, this response is stronger among those whose banking sectors carry significant short FX positions, pointing to balance sheet exposure as a key driver of heterogeneous transmission. Both facts directly motivate the model developed in the next section.

3 Modeling approach

Section 2 showed that U.S. monetary tightening raises UIP deviations in emerging markets and that the response is stronger when banks hold larger short foreign currency positions. The purpose of this section is to introduce a common framework that nests the environments studied in Section 4 and Section 5 and isolates the mechanism governing the response of the UIP premium to a foreign interest rate shock. In the model, the UIP premium is the theoretical counterpart of the empirical UIP deviation: it is the wedge between domestic lending returns and the effective domestic-currency cost of foreign funding.

This section proceeds in three steps. First, it describes the common financial structure shared by all the models in the paper. Second, it defines equilibrium in the domestic credit market and introduces the key elasticities that summarize demand and supply responses. Third, it derives a general equilibrium representation that decomposes the UIP premium response into direct and indirect effects.

3.1 General model structure

All models in the paper share the same intermediation structure. Households borrow domestically from financial intermediaries. Intermediaries fund themselves in international markets and transform foreign funding into domestic credit. The key price that links both sides is the UIP premium, defined as the wedge between the domestic lending return and the effective foreign funding cost measured in domestic currency. This wedge summarizes the degree of financial segmentation in the economy.

This representation is useful because it nests both environments studied later in the paper. In the benchmark model without exchange-rate revaluation, the effective foreign funding cost is pinned down by the foreign interest rate. In the richer model with foreign-currency liabilities, that funding cost also depends on exchange-rate movements, since exchange-rate changes revalue the domestic-currency cost of banks' foreign debt.

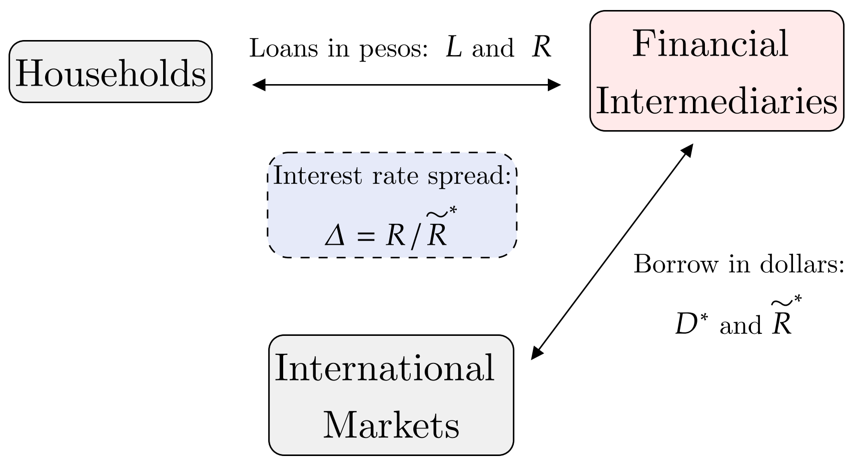
Figure 7 summarizes this common structure. Households borrow in domestic currency from financial intermediaries, with the quantity of loans denoted by L and the corresponding lending rate by R. Financial intermediaries, in turn, obtain funding from international markets by borrowing abroad, with foreign debt denoted by D^* and the corresponding effective borrowing cost by $\widetilde{R}^*$.

We formulate equilibrium from the perspective of the domestic credit market. This is mainly a matter of analytical convenience. Since intermediaries connect domestic borrowers with foreign lenders, the same allocation can also be characterized from the external funding market. We focus on the domestic credit market because it provides the clearest lens for studying how foreign shocks pass through to local borrowing conditions, credit, and UIP premia.

3.2 The domestic credit market model

Throughout the paper, time is indexed by $t = 0, 1, \ldots, T \in \mathbb{N} \cup \{\infty\}$. For any variable z, let $\boldsymbol{z}_t \equiv \{z_{t+s}\}_{s=0}^{T-t}$ denote its path from date t onward. To simplify notation, we write $\boldsymbol{z} \equiv \boldsymbol{z}_0$ for the date-0 path and $\boldsymbol{z}_+ \equiv \boldsymbol{z}_1$ for the path starting at date 1.

Figure 7: Model structure



We now formalize the competitive equilibrium concept used throughout the paper. Given a path for foreign interest rates, equilibrium can be described in three blocks. First, households generate a demand for domestic credit. Second, banks generate a supply of domestic credit by borrowing abroad and lending at home. Third, the exchange-rate block maps domestic returns into the real exchange rate. A competitive equilibrium is therefore a path of UIP premia such that domestic credit demand equals domestic credit supply period by period.

To capture both classes of models, let the effective foreign funding cost be denoted by $\widetilde{R}^*_{t+1} \equiv \mathcal{R}\left(R^*_{t+1}, E_{t+1}/E_t\right)$ where R^*_{t+1} is the foreign interest rate from period t to period $t+1$ and E_t is the real exchange rate. In models without exchange-rate movements, this object is simply the foreign borrowing cost expressed in domestic currency. In models with exchange-rate movements, it also reflects the effect of exchange-rate changes on the domestic-currency cost of foreign debt. The UIP premium is then defined as the wedge between the domestic lending rate and this effective foreign funding cost, $\Delta_{t+1} = R_{t+1}/\widetilde{R}^*_{t+1}$ where R_{t+1} is the domestic interest rate from period t to period $t+1$.

Credit demand. Credit demand is represented by a schedule $\mathcal{L}^d_t(\boldsymbol{R}_+, \boldsymbol{E})$ for all $t = 0, 1, \ldots, T-1$, which depends on the relevant sequence of domestic borrowing conditions and, in the richer environment, on the exchange rate.

Credit supply. Credit supply is represented by a schedule $\mathcal{L}^s_t(\boldsymbol{\Delta}_+, \widetilde{\boldsymbol{R}}^*_+, E_0)$ for all $t = 0, 1, \ldots, T-1$, which depends on the UIP premium, on effective foreign funding costs, and potentially on the initial exchange rate through balance-sheet effects.

Exchange rate. The exchange-rate block closes the system by linking domestic returns and the exchange rate, $\mathcal{E}_t(\boldsymbol{R}_+)$ for all $t = 0, 1, \ldots, T$.

This formulation is deliberately general. It allows the demand side to depend on domestic interest rates and exchange-rate movements, and it allows the supply side to depend on the UIP premium, the effective foreign funding cost, and the initial exchange rate. The benchmark model in Section 4 and the balance-sheet model in Section 5 differ in how these objects are pinned down, but both fit into the same equilibrium structure.

Competitive equilibrium. Given these objects, equilibrium requires that, for each date t, the quantity of loans demanded by households equals the quantity of loans supplied by intermediaries. Thus, a competitive equilibrium is a path for the UIP premium such that, given the exogenous path for the foreign interest rate, the credit market clears. Formally, given $\boldsymbol{R}^*_+$, the equilibrium path$\boldsymbol{\Delta}_+$solves

$$\mathcal{L}^d_t(\boldsymbol{R}_+, \boldsymbol{E}) = \mathcal{L}^s_t(\boldsymbol{\Delta}_+, \widetilde{\boldsymbol{R}}^*_+, E_0) \;\; \text{for all} \;\; t = 0, \ldots, T-1 \tag{3}$$

where $E_t = \mathcal{E}_t(\boldsymbol{R}_+)$, $R_{t+1} = \Delta_{t+1}\widetilde{R}^*_{t+1}$, and $\widetilde{R}^*_{t+1} \equiv \mathcal{R}\left(R^*_{t+1}, E_{t+1}/E_t\right)$.

To study how the equilibrium reacts to foreign monetary shocks, we summarize the demand and supply schedules with semi-elasticities. On the demand side, $\mathbf{D}^r_{t,k} \equiv \frac{\partial \mathcal{L}^d_t}{\partial R_{k+1}} R_{k+1}$ measures the response of credit demand at date t to the domestic interest rate at date $k+1$, while $\mathbf{D}^e_{t,k} \equiv \frac{\partial \mathcal{L}^d_t}{\partial E_k} E_k$ measures the response of credit demand to the exchange rate at date k. On the supply side, $\mathbf{S}^\delta_{t,k} \equiv \frac{\partial \mathcal{L}^s_t}{\partial \Delta_{k+1}} \Delta_{k+1}$ measures the response of credit supply to the UIP premium, $\mathbf{S}^{r^*}_{t,k} \equiv \frac{\partial \mathcal{L}^s_t}{\partial R^*_{k+1}} R^*_{k+1}$ measures the response to effective foreign funding costs, and $\mathbf{bs}_t \equiv \frac{\partial \mathcal{L}^s_t}{\partial E_0} E_0$ captures the response to the initial exchange rate through balance-sheet revaluation. The last object is central in what follows because it captures shifts in bank credit supply driven by changes in intermediary net worth rather than by standard carry incentives alone.

To use a matrix formulation of the problem, it is worth collecting the semi-elasticities into matrices, so let $\mathbf{Z} \equiv [\mathbf{Z}_{t,k}]$ for any set of elasticities $\mathbf{Z}_{t,k}$. Under this notation, the upper (lower) triangular block of these matrices captures the forward-looking (backward-looking) component of the corresponding schedule.

3.3 General equilibrium effects

We now study the response of the equilibrium to small unexpected changes in the foreign interest rate. The object of interest is the path of the UIP premium following that shock. The challenge is that the shock can operate through several channels at once: it affects domestic borrowing conditions, it changes the effective cost of foreign funding, and, when exchange rates move, it may also affect intermediary balance sheets. The matrix representation below is useful because it organizes these channels in a compact way. We define $x_t \equiv \frac{\partial X_t}{X_t}$ as the percentage changes of variable X_t at time t. Then, we are interested in characterizing the equilibrium path $\boldsymbol{\delta}_+$ for a exogenously given $\boldsymbol{r}^*_+$.

Lemma 1. *The path of the real exchange rate can be written as*

$$\boldsymbol{e} = \boldsymbol{E} \cdot (\boldsymbol{\delta}_+ + \boldsymbol{r}^*_+) \tag{4}$$

where $\boldsymbol{E}$ is a matrix that depends on the elasticities of $\mathcal{E}_t(\cdot)$. Moreover, $\boldsymbol{r}_+ = (\boldsymbol{I} + \boldsymbol{FE})(\boldsymbol{\delta}_+ + \boldsymbol{r}^*_+)$ and $\widetilde{\boldsymbol{r}}^*_+ = \boldsymbol{FE}\boldsymbol{\delta}_+ + (\boldsymbol{I} + \boldsymbol{FE})\boldsymbol{r}^*_+$ where $\boldsymbol{F}$ is a first-order difference matrix defined in Appendix A.1.

Lemma 1 shows that exchange-rate movements can be written as a linear function of the joint path of UIP premia and foreign interest rates. This is useful because it allows all exchange-rate effects to be substituted into the credit-market equilibrium conditions. As a result, the problem can be summarized in terms of how foreign shocks shift credit demand and credit supply, both directly and indirectly through the exchange rate.

Perturbating the system around an equilibrium state yields

$$\mathbf{S}^{\delta} \cdot \boldsymbol{\delta}_+ + \mathbf{S}^{r^*} \cdot \widetilde{\boldsymbol{r}}^*_+ + \mathbf{bs} \cdot e_0 = \mathbf{D}^r \cdot \boldsymbol{r}_+ + \mathbf{D}^e \cdot \boldsymbol{e}. \tag{5}$$

In our discussion below, $\mathbf{bs}$ plays an important role as it generates credit supply shifts that cannot be obtained with standard models. Combining (5) and (4) leads to the following lemma.

Lemma 2. *Let $\boldsymbol{D} \equiv \boldsymbol{D}^r(\boldsymbol{I} + \boldsymbol{FE}) + \boldsymbol{D}^e\boldsymbol{E}$, $\boldsymbol{S} \equiv \boldsymbol{S}^{\delta} + \boldsymbol{S}^{r^*}\boldsymbol{FE} + \boldsymbol{bsE}_{0,\bullet}$, and $\boldsymbol{X} = \boldsymbol{S}^{r^*}(\boldsymbol{I} + \boldsymbol{FE}) + \boldsymbol{bsE}_{0,\bullet}$ where $\mathbf{E}_{0,\bullet}$ is the first row of matrix $\mathbf{E}$. Moreover, let $\boldsymbol{M} \equiv \boldsymbol{S}^{-1} \cdot \boldsymbol{D}$ and suppose $\boldsymbol{I} - \boldsymbol{M}$ is invertible. Then, the equilibrium response of interest rate spreads is pinned down by*

$$\boldsymbol{\delta}_+ = \boldsymbol{G} \cdot \boldsymbol{r}^*_+ \quad \text{with} \quad \boldsymbol{G} \equiv \widetilde{\boldsymbol{M}} \cdot \boldsymbol{H} \tag{6}$$

where $\widetilde{\boldsymbol{M}} \equiv (\boldsymbol{I} - \boldsymbol{M})^{-1}\boldsymbol{M}$ where $\boldsymbol{H} \equiv \boldsymbol{I} - \boldsymbol{D}^{-1}\mathbf{X}$.

Lemma 2 shows that the response of the UIP premium depends on relative elasticities. Matrix $\mathbf{D}$ summarizes how a foreign interest rate shock affects credit demand, both directly through domestic borrowing conditions, $\mathbf{D}^r$, and indirectly through exchange-rate movements affecting credit conditions, $\mathbf{D}^r\mathbf{FE}$, and the trade balance, $\mathbf{D}^e\mathbf{E}$. Matrix $\mathbf{S}$, by contrast, summarizes how changes in the UIP premium affect credit supply, directly, $\mathbf{S}^{\delta}$, and indirectly by exchange-rate movements affecting the effective foreign funding cost, $\mathbf{S}^{r^*}\mathbf{FE}$, and the balance-sheet channel, $\mathbf{bsE}_{0,\bullet}$. Similarly, $\mathbf{X}$ captures the direct effect of foreign shocks on credit supply. The sign of the UIP response therefore depends on whether the contraction in credit demand or the contraction in credit supply dominates at each horizon.

Notice that the k-th column of this matrix $\mathbf{G}$, say $\mathbf{G}_{\bullet,k}$, denotes the impulse response function for a news shock of a temporary movement in foreign interest rate at date $k+1$. As we are interested in characterizing matrix $\mathbf{G}$, Lemma 2 suggests that the key object is the matrix of relative elasticities $\mathbf{M}$. The key equilibrium object is $\widetilde{\mathbf{M}}$ which captures the general equilibrium dynamic interactions.

Lemma 3. *Let* $\max_t \sum_{j\neq t} \frac{|\mathbf{M}_{t,j}|}{|1-\mathbf{M}_{t,t}|} < 1$*. Up to second-order approximation, the matrix* $\widetilde{\mathbf{M}}$ *is characterized by*

$$\widetilde{\mathbf{M}}_{t,k} \simeq \frac{1}{1-\mathbf{M}_{t,t}} \times \left[\underbrace{\frac{\mathbf{M}_{t,k}}{1-\mathbb{1}_{k\neq t}\cdot \mathbf{M}_{k,k}}}_{\text{Direct effect}} + \underbrace{\sum_{j\neq t,k} \frac{\mathbf{M}_{t,j}\mathbf{M}_{j,k}}{(1-\mathbf{M}_{j,j})(1-\mathbf{M}_{k,k})}}_{\text{Indirect effect}} \right]. \tag{7}$$

Moreover, for an upper or lower triangular matrix $\mathbf{M}$*, the matrix* $\widetilde{\mathbf{M}}$ *inherits this property and equation* (7) *is exact for* $k \in \{t-2, t-1, t, t+1, t+2\}$*.*

Lemma 3 provides the key economic decomposition of the equilibrium response captured in $\widetilde{\mathbf{M}}$. Direct effects capture how the UIP premium responds at a given date when one looks only at that market in isolation. For instance, $\mathbf{M}_{t,t}$ measures the static responses of δ_{t+1} to movements to r^*_{t+1}. Indirect effects capture the propagation of the shock through other dates and state variables. For example, $\frac{\mathbf{M}_{t,j}\mathbf{M}_{j,t}}{(1-\mathbf{M}_{j,j})(1-\mathbf{M}_{t,t})}$ measures the roundabout effect of r^*_{t+1} on δ_{t+1} operating through changes in δ_{j+1}. This is where dynamics matter. A model with little intertemporal propagation behaves essentially like a static model. A model with strong intertemporal linkages can produce richer responses, but the sign of the response depends on which side of the market carries the relevant state variable. In this paper, the crucial state variable is intermediary net worth.

Example. In a two-period credit market model (i.e., $T=2$),

$$\widetilde{\mathbf{M}}_{t,t} = \frac{1}{1-\mathbf{M}_{t,t}} \left[\mathbf{M}_{t,t} + \frac{\mathbf{M}_{0,1}\mathbf{M}_{1,0}}{(1-\mathbf{M}_{0,0})(1-\mathbf{M}_{1,1})}\omega \right] \quad \text{and} \quad \widetilde{\mathbf{M}}_{t,k} = \frac{\mathbf{M}_{t,k}}{(1-\mathbf{M}_{0,0})(1-\mathbf{M}_{1,1})}\omega \tag{8}$$

where $\omega \equiv \left[1 - \frac{\mathbf{M}_{0,1}\mathbf{M}_{1,0}}{(1-\mathbf{M}_{0,0})(1-\mathbf{M}_{1,1})}\right]^{-1}$ is the correcting factor. Approximation (7) works well as long as $\omega \simeq 1$.[7] $\square$

Although we need further structure to fully characterize $\mathbf{G}$, a well-defined behavior for demand and supply schedules is that demand schedule is "downward sloping" and supply schedule is "upward sloping".

Assumption 1. *The demand and supply of credit are such that* $\mathbf{D}_{t,k} \leq 0 \leq \mathbf{S}_{t,k}$ *for all* $t \leq k$*.*

Under Assumption 1, it follows that upper triangular blocks of $\mathbf{D}$ and $\mathbf{S}$ are nonpositive and nonnegative, respectively. Next, we characterize $\mathbf{G}$ under different market structures. We argue that

[7] Equivalently, matrix $\mathbf{M}$ has a strong diagonal dominance which is the assumption in Lemma 3.

most of the models considered in this paper satisfy this well-behaved assumption. Throughout this paper, we assume that matrix $\mathbf{S}$ and $\mathbf{D}$ are invertible.

The framework above already suggests the main message of the paper. If a foreign interest rate shock primarily reduces domestic credit demand, the UIP premium tends to fall after a foreign tightening. Reversing that prediction requires supply-side forces that offset or dominate this effect. Section 4 and Section 5 study that issue in two steps. Section 4 shuts down exchange-rate revaluation and shows that static or myopic intermediation is generally not enough to produce the empirical response. Section 5 then reintroduces exchange-rate movements and foreign-currency liabilities, generating a balance-sheet channel through intermediary net worth that can raise the UIP premium after a foreign tightening.

4 A model without balance-sheet effects

This section studies a benchmark environment without exchange-rate revaluation. In this case, the effective foreign funding cost is pinned down by the foreign interest rate, so the UIP premium is simply the wedge between the domestic lending return and the foreign borrowing cost. This benchmark is useful because it isolates the core intermediation structure linking domestic borrowers, intermediaries, and foreign lenders, without the additional amplification that operates through intermediary net worth.

The goal of the section is to ask whether dynamic demand or dynamic supply alone can generate the positive UIP response observed in the data. The answer is generally no. Once exchange-rate revaluation is shut down, a rise in the foreign interest rate tends to lower the UIP premium. We show this first in a reduced-form environment and then in a microfounded model.

4.1 Some general results

Absent exchange-rate movements, the effective foreign funding cost equals the foreign interest rate. Competitive equilibrium is therefore determined by a path for the UIP premium such that domestic credit demand equals domestic credit supply at each date. Using the notation from Section 3, the framework studied in this section is one where the exchange-rate block is one with $\boldsymbol{E} = \mathbf{0}$ and $\widetilde{\boldsymbol{R}}^*_+ = \boldsymbol{R}^*_+$, and semi-elasticity matrices are given by $\mathbf{D} = \mathbf{D}^r$, $\mathbf{S} = \mathbf{S}^\delta$, and $\mathbf{X} = \mathbf{S}^{r^*}$.

This benchmark isolates a simple question: if a rise in the foreign interest rate affects domestic borrowing conditions only through the credit market, what happens to the UIP premium? The basic force is straightforward. For a given premium, a higher foreign interest rate raises the domestic lending rate and depresses household credit demand. Unless credit supply shifts strongly in the opposite direction, market clearing requires the UIP premium to fall.

Static supply model. Consider an economy where $\mathbf{X} = \mathbf{0}$ and $\mathbf{S}$ is a diagonal matrix, i.e.,

$$\mathbf{S} = \operatorname{diag}\left(\mathbf{S}_{0,0}, \mathbf{S}_{1,1}, \ldots, \mathbf{S}_{T-1,T-1}\right) \tag{9}$$

but the demand block matrix $\mathbf{D}$ is only restricted by Assumption 1. This economy captures models with fully fledged dynamic consumers, but static or myopic banks. These are the more popular models in the open macro literature explaining UIP deviations and their dynamics, so this is a good starting point.

Proposition 1. *Suppose $\boldsymbol{S}$ is diagonal (as in (9)) and Assumption 1 holds. Then, for all $k \geq t$, $\boldsymbol{G}_{t,k} \leq 0$ if*

$$\sum_{j \neq t,k} \frac{\boldsymbol{M}_{t,j}\boldsymbol{M}_{j,k}}{(1-\boldsymbol{M}_{j,j})(1-\boldsymbol{M}_{k,k})} < \frac{|\boldsymbol{M}_{t,k}|}{1 - \mathbb{1}_{k \neq t} \cdot \boldsymbol{M}_{k,k}}. \tag{10}$$

Moreover, if $\boldsymbol{D}$ is upper triangular, then both the impact response and the one period ahead anticipated response are negative, i.e., $\boldsymbol{G}_{t,t}, \boldsymbol{G}_{t,t+1} < 0$.

Proposition 1 formalizes the static logic of the benchmark. When banks are static or myopic, foreign tightening reduces domestic credit demand at the prevailing premium and generates excess supply in the domestic credit market. The equilibrium adjustment is therefore a decline in the UIP premium. This is the basic benchmark prediction that the rest of the section keeps coming back to.

Fully static model. As a special case, suppose demand is also static (i.e., $\mathbf{D}$ is diagonal too), so both sides of the credit market respond only contemporaneously. Proposition 1 implies that interest rate spreads always respond in the opposite direction of the foreign interest rate movement. This fully static benchmark makes the sign of the result transparent: a higher foreign rate reduces credit demand at the prevailing spread, creates excess supply in the domestic credit market, and therefore requires a lower equilibrium spread.

A two-period model. The important question is whether dynamics alone can overturn this result. The two-period case is useful because it shows exactly where such a reversal could come from. If supply remains static, then the only candidate force is a sufficiently strong intertemporal feedback from the demand side. That is a very restrictive route to getting a positive response, and the discussion below shows why.

Proposition 1 is particularly powerful in a two-period setting. The first part of this proposition suggests that a forward-looking dynamic block is not enough to generate a positive response of interest rate spreads. So if anything, in the two-period dynamic model, the only way to obtain positive responses in δ_{t+1} is by a backward looking component of $\mathbf{D}$.

Let us suppose that the economy is such that $\mathbf{D}$ is a full matrix. As we maintain the assumption that $\mathbf{S}$ is diagonal, the relative-elasticity matrix is given by $\mathbf{M}_{t,k} = \frac{\mathbf{D}_{t,k}}{\mathbf{S}_{t,t}}$ for all t, k. Based on (7), we know that $\mathbf{G}_{t,k} \leq 0$ iff $\mathbf{D}_{t,k} \leq 0$ for $k \neq t$, while $\mathbf{G}_{t,t} < 0$ if

$$\frac{\mathbf{M}_{0,1}\mathbf{M}_{1,0}}{(1-\mathbf{M}_{0,0})(1-\mathbf{M}_{1,1})} < |\mathbf{M}_{t,t}|.$$

Since $\mathbf{M}_{0,1} < 0$, the only problematic case is when $\mathbf{M}_{1,0} < 0$ which may emerge when the demand system is heavily backward-looking.

4.2 A microfounded model

The reduced-form analysis shows that dynamics do not automatically overturn the benchmark sign. We now make that result more concrete in a simple microfounded model. The purpose is not yet to introduce the balance-sheet mechanism that drives the full model, but to isolate how dynamic borrowing decisions and dynamic intermediation affect the UIP premium when exchange-rate revaluation is absent.

4.2.1 The demand of credit: Households

There is a representative household that lives for $T+1$ periods and values consumption over time. Given an initial debt $R_0 L_{-1}$ and the path for domestic interest rates $\boldsymbol{R}_{+}$, the household chooses the consumption and borrowing $\boldsymbol{C}$ and $\boldsymbol{L}$ to maximize

$$\sum_{\tau=0}^{T} \beta^{\tau} \frac{C_{\tau}^{1-\gamma}-1}{1-\gamma} \quad \text{subject to:} \;\; C_{\tau} + R_{\tau} L_{\tau-1} = Y + L_{\tau}$$

for $\tau = 0, \ldots, T$, where $\beta \in (0,1)$ is the subjective discount factor and Y_{τ} the households' endowment income. We constrain households' behavior by the No-Ponzi scheme terminal condition, $L_T \leq 0$. The optimality condition is captured by the Euler equation

$$(C_{t+1}/C_t)^{\gamma} = \beta R_{t+1}. \tag{11}$$

The key implication of the household problem is a credit-demand schedule. In particular, combining (11) and the household's budget constraint leads to $L_t^d(\boldsymbol{R}_{+})$. Thus, borrowing today depends not only on the current lending rate, but also on future lending conditions through the Euler equation. This is the source of dynamic demand in this benchmark model.

4.2.2 The supply of credit: Banks

To maintain generality, let us formulate the supply side using the effective cost of foreign borrowing, $\widetilde{R}_t^*$.

"Short-run" banks. We begin with the simplest supply side. Short-run banks behave myopically: they do not accumulate net worth and care only about current carry-trade profits. At each date, they borrow abroad and lend domestically, but their balance-sheet size is limited by an intermediation friction of the Gabaix and Maggiori (2015) type. In this case, the supply of credit is static in the sense that it depends only on the current premium, not on future conditions. At each date $t = 0, \ldots, T-1$, their problem is

$$V_t \equiv \max_{L_t} \frac{1}{\widetilde{R}^*_{t+1}} (R_{t+1} - \widetilde{R}^*_{t+1}) L_t \ \text{ subject to: } \ \Theta L_t^2 \leq V_t.$$

The solution for this model is simply

$$L_t = \Theta^{-1}(\Delta_{t+1} - 1). \tag{12}$$

"Long-run" banks. We next allow banks to be long-lived. This adds two elements to the supply side. First, current lending decisions depend on expected future franchise values, which introduces forward-looking behavior. Second, aggregate net worth evolves over time, which introduces a state variable into credit supply. These are genuine dynamic supply forces, but they are not yet balance-sheet revaluation effects, since exchange-rate movements remain shut down in this section.

Consider a bank that lives up to T periods, but faces a mortality rate of $1 - \sigma \in (0, 1)$ each period. To separate some mechanisms in the model, we assume that the subjective survival probability is $\widetilde{\sigma}$ but they never learn about the true probability σ. This is useful to isolate the backward-looking and forward-looking component of the supply side of the economy. Banks start with an initial capital N_0 and rebate all the cumulated financial returns upon death to foreign households. Given any capital N_t, the balance sheet imposes the restriction

$$L_t = N_t + D^*_t \tag{13}$$

where D^*_t denotes the debt from foreign households. The evolution of net worth is

$$N_{t+1} = R_{t+1} L_t - \widetilde{R}^*_{t+1} D^*_t. \tag{14}$$

I assume that they face a constraint similar to Gertler and Karadi (2011), limiting their intermediation capacity:

$$\Theta L_t \leq V_t(N_t) \tag{15}$$

where Θ is the degree of the financial friction and $V_t(N_t)$ denote the continuation value of a surviving individual bank with capital N_t at date t.

Agency problem. At the beginning of each period, bankers can act honestly or divert funds from their assets. If bank managers act honestly, assets will be retained until payoffs are realized in the next period, allowing them to repay their liabilities to creditors. Conversely, if bank managers divert funds, those assets are secretly redirected from lending and consumed by their households. To ensure that creditors are willing to supply funds to the banker, any financial arrangement satisfies an incentive constraint:$V_t \geq \Theta L_t$ whereV_t is the continuation value of banks, L_t denotes their balance sheet size, and $\Theta \in (0,1)$ is the fraction of divertable assets. □

Given $V_T = 0$, the individual bank's problem is: For $t = 0, \dots, T-1$

$$V_t(N_t) \equiv \max_{L_t, D_t} \frac{1}{\widetilde{R}^*_{t+1}} \left[(1-\widetilde{\sigma})N_{t+1} + \widetilde{\sigma} \cdot V_{t+1}(N_{t+1})\right]$$

subject to (13), (14), and (15). Defining $\psi_t \equiv V(N_t)/N_t$, we can show that whenever the IC constraint binds

$$\psi_t = \frac{\Theta(1-\widetilde{\sigma}+\widetilde{\sigma}\psi_{t+1})}{\Theta - (\Delta_{t+1}-1)(1-\widetilde{\sigma}+\widetilde{\sigma}\psi_{t+1})} \text{ with } \psi_T = 0. \tag{16}$$

Solving this system leads to $\psi_t(\mathbf{\Delta}_{t+1})$. Given this value-net worth ratio, we can recover the optimal leverage ratio as:

$$\phi_t(\mathbf{\Delta}_{t+1}) = \frac{1-\widetilde{\sigma}+\widetilde{\sigma}\psi_{t+1}(\mathbf{\Delta}_{t+1})}{\Theta - (\Delta_{t+1}-1)\left(1-\widetilde{\sigma}+\widetilde{\sigma}\psi_{t+1}(\mathbf{\Delta}_{t+1})\right)}. \tag{17}$$

At the aggregate level, banks exiting the financial market are replaced by a continuum of new bankers with initial capital ζ. Therefore, the evolution of the aggregate net worth is

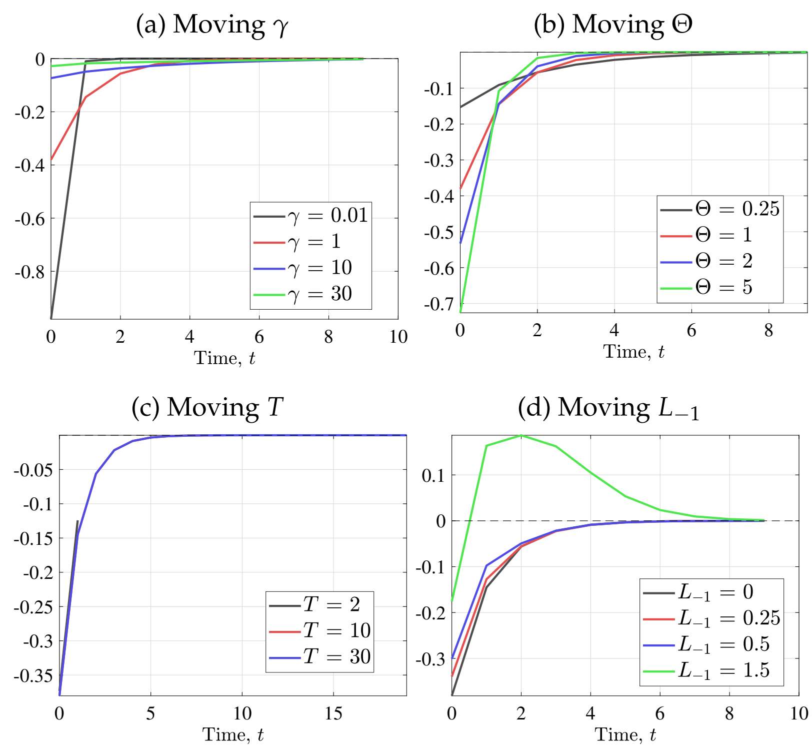
$$N_t = \sigma \widetilde{R}^*_t \left((\Delta_t - 1)L_{t-1} + N_{t-1}\right) + (1-\sigma)\zeta. \tag{18}$$

The financial dynamics are governed by two parameters. On the one hand, $\widetilde{\sigma}$ controls how strongly individual banks value future franchise profits, and therefore how forward-looking their lending decisions are. On the other hand, σ controls the persistence of aggregate net worth by determining how much of the existing banking sector remains active over time. In this way, $\widetilde{\sigma}$ governs the forward-looking component of supply, while σ governs the backward-looking component through net-worth dynamics.

4.3 "Static" supply and dynamic demand

We first ask whether dynamic credit demand, by itself, can overturn the benchmark prediction. Figure 8 reports the response of the UIP premium to a foreign interest rate shock when households are forward looking but banks remain short run. This case isolates the role of intertemporal borrowing decisions on the demand side while shutting down dynamic adjustment in intermediary balance sheets and franchise values.

Figure 8: Dynamic demand and "short run" banks



The main result is that dynamic demand, by itself, does not provide a robust explanation for the empirical response of UIP deviations. Across most parameterizations, the UIP premium falls on impact after a rise in the foreign interest rate. The reason is the same benchmark force emphasized above: for a given premium, higher foreign rates raise domestic borrowing costs and reduce credit demand, generating excess supply in the domestic credit market. Market clearing therefore requires a lower premium on impact.

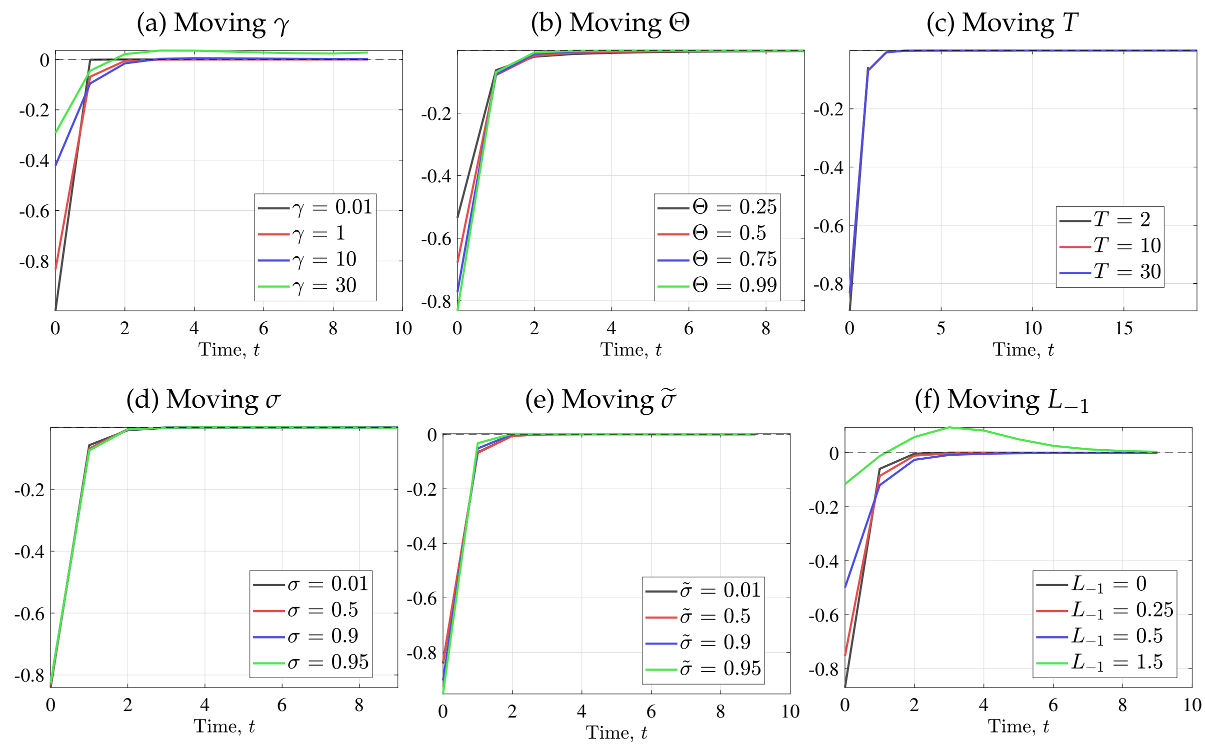
The only case in which the dynamics become less standard is when inherited debt is sufficiently large. In that case, borrowing decisions become more backward looking, which can generate a hump-shaped or mildly non-monotonic adjustment path and, in some specifications, a temporary positive response at later horizons. But this is not the central margin in the model. Even when debt dynamics make the response more persistent or less monotone, the impact effect remains negative. The conclusion is therefore that dynamic demand can modify the shape of the transition, but it does not overturn the benchmark sign in a robust way.

4.4 Dynamic supply and dynamic demand

We next allow the supply side to be dynamic as well by introducing long-lived banks that accumulate net worth and value future profits. This extension adds forward-looking behavior to credit supply and introduces net worth as a state variable at the aggregate level. Importantly, however, the model still shuts down exchange-rate revaluation effects, so this subsection isolates dynamic intermediation without the balance-sheet channel that will be central in Section 5.

Figure 9 shows that adding dynamic supply leaves the main qualitative conclusion largely unchanged. After a rise in the foreign interest rate, the UIP premium still falls on impact in every specification and then gradually converges back toward steady state. Relative to the short-run banking case, long-lived banks modify the transition path and can make the response somewhat more persistent, but they do not overturn the benchmark sign.

Figure 9: Dynamic demand and "long run" banks



This is an important negative result for the paper. A forward-looking intermediary sector is not enough, by itself, to generate the positive response of UIP deviations observed in the data. In the class of models studied in this section, the dominant force remains the contraction in domestic credit demand induced by tighter foreign funding conditions. Dynamic supply changes how the economy moves back to equilibrium, but not the basic direction of the initial adjustment. This is precisely why the next section introduces exchange-rate movements and foreign-currency liabilities: without balance-sheet revaluation, even genuinely dynamic intermediaries are generally unable to match the empirical response.

5 A model with balance-sheet effects

We next enrich the model by introducing real exchange rate movements and the associated balance sheet effects on financial intermediaries. This extension is central for the analysis, since foreign currency borrowing implies that exchange rate fluctuations directly affect the domestic currency value of intermediaries' liabilities. Through their effect on net worth and borrowing capacity, these valuation changes alter the supply of domestic credit and the equilibrium response of spreads and UIP deviations to external shocks.

Relative to the benchmark model, the key difference is that the effective foreign funding cost is no longer pinned down solely by the foreign interest rate. Instead, it also reflects exchange rate dynamics, which introduce an additional source of amplification in the transmission mechanism. The section studies this richer environment and shows how exchange rate movements and financial frictions jointly shape the response of the economy to foreign monetary disturbances.

Notation. Below, I use the following notations: $\boldsymbol{z}_t \equiv \{z_{t+s}\}_{s\geq 0}$. For simplicity, I use $\boldsymbol{z} \equiv \boldsymbol{z}_0$ and $\boldsymbol{z}_+ \equiv \boldsymbol{z}_1$. Moreover, $\underline{Z}^*$ is the domestic-currency value of any variable Z^* priced in foreign currency.

5.1 Households

We assume that there is a representative household that derives utility from consumption of tradable and non-tradable, C_t^T and C_t^N. This household gets endowments of each type of goods, Y^T and Y^N. The representative household can borrow in short-term assets that are denominated in domestic currency (pesos), L_t^{nom}, with a nominal return i_t. Let P_t be the consumer price index which is a composite of the price of tradable P_t^T and nontradable goods, P_t^N. Given prices and initial bond's holdings L_{-1}^{nom}, the representative households solves the following problem

$$\max_{\boldsymbol{C}^T,\boldsymbol{C}^N,\widetilde{\boldsymbol{L}}} \sum_{t=0}^{\infty} \beta^t \frac{C_t^{1-\gamma}-1}{1-\gamma}$$

subject to

$$P_t C_t \equiv P_t^T C_t^T + P_t^N C_t^N = P_t^T Y^T + P_t^N Y^N + L_t^{\text{nom}} - (1+i_{t-1}) L_{t-1}^{\text{nom}}$$

where C_t is the consumption-basket aggregator

$$C_t = \mathbb{C}(C_t^T, C_t^N) \equiv \left(\omega^{\frac{1}{\eta}} (C_t^T)^{\frac{\eta-1}{\eta}} + (1-\omega)^{\frac{1}{\eta}} (C_t^N)^{\frac{\eta-1}{\eta}}\right)^{\frac{\eta}{\eta-1}}. \tag{19}$$

Optimal intratemporal decision and real exchange rate. The household effectively solves the following intratemporal problem

$$\min_{C_t^T,\, C_t^N} \; P_t^T C_t^T + P_t^N C_t^N \quad \text{subject to:} \quad C_t = \mathbb{C}(C_t^T, C_t^N).$$

The first-order condition is $Q_t \equiv \frac{P_t^T}{P_t^N} = \frac{\partial_T \mathbb{C}(C_t^T, C_t^N)}{\partial_N \mathbb{C}(C_t^T, C_t^N)}$ where Q_t measures the price of tradable goods relative to the price of nontradable goods. Under the functional form (19), the national price index (i.e., the Lagrange multiplier) is given by $P_t = \left(\omega (P_t^T)^{1-\eta} + (1-\omega)(P_t^N)^{1-\eta}\right)^{\frac{1}{1-\eta}}$.

Tradable goods are homogeneous and there is not trade costs, so that the price of tradable goods verifies the law of one price: $P_t^T = \mathcal{E}_t P_t^{*,T}$ where $\mathcal{E}_t$ denotes the nominal exchange rate and $P_t^{*,T}$ is the price of tradable goods in the international markets. The rest of the world is infinitely large relative to the domestic economy and foreign households only consume tradable goods, implying that $P^{*,T} = P^*$. Thus, the real exchange rate $E_t \equiv \frac{\mathcal{E}_t P_t^*}{P_t}$ is pinned down by

$$E_t = \left(\omega + (1-\omega) Q_t^{\eta-1}\right)^{\frac{1}{\eta-1}} \quad \Longrightarrow \quad Q_t = \left(\frac{E_t^{\eta-1} - \omega}{1-\omega}\right)^{\frac{1}{\eta-1}} \tag{20}$$

playing the role of the relevant relative price of goods. As a result, household's intratemporal optimal decisions are characterized by

$$C_t^N = (1-\omega)\left(Q_t / E_t\right)^{\eta} C_t \tag{21}$$

$$C_t^T = \omega E_t^{-\eta} C_t. \tag{22}$$

Optimal intertemporal decisions. Given the optimal intratemporal decisions, the budget constraint of the households can be written as

$$C_t = E_t Y^T + \frac{E_t}{Q_t} Y^N + L_t - R_t L_{t-1}$$

where $L_t \equiv L_t^{\text{nom}} / P_t$ is debt in real terms and $R_t \equiv \frac{1+i_{t-1}}{P_t/P_{t-1}}$ is the gross real interest rate. As a results, the optimal intertemporal decisions are determined with the standard Euler equation $C_t^{-\gamma} = \beta R_{t+1} C_{t+1}^{-\gamma}$ and the transversality condition, $\lim_{t\to\infty} \left(\beta^t \prod_{k=0}^t R_k^{-1}\right) C_t^{-\gamma} = 0$. Using (22), this intertemporal optimal condition can be written in terms of the allocation of tradable goods

$$\left(C_{t+1}^T / C_t^T\right)^{\gamma} = \beta R_{t+1} \left(\frac{E_{t+1}}{E_t}\right)^{-\eta\gamma}. \tag{23}$$

5.2 Financial intermediaries

All international capital flows are intermediated by specialized financial intermediaries who reside in the foreign country. Contrary to the previous model, the UIP deviations now are given by $\Delta_{t+1} = R_{t+1} / \widetilde{R}_{t+1}^*$ where $\widetilde{R}_{t+1}^* \equiv R_{t+1}^* E_{t+1} / E_t$ is the effective cost of foreign funds expressed in domestic currency.

Individual banks' decisions. As in the previous section, let $1-\sigma$ be the exit rate of an individual bank. To separate some mechanisms in the model, we assume that the subjective survival probability is $\widetilde{\sigma}$ but they never learn about the true probability σ. This is useful to isolate the backward-looking and forward-looking component of the supply side of the economy. Banks start with an initial capital N_t and rebate all the cumulated financial returns upon death to foreign households.

Given N_t, they solve the following optimization problem

$$V_t(N_t) \equiv \max_{L_t, D_t} \frac{1}{\widetilde{R}^*_{t+1}} \left[(1-\widetilde{\sigma}) N_{t+1} + \widetilde{\sigma} \cdot V_{t+1}(N_{t+1}) \right] \tag{24}$$

subject to: (i) the bank's balance sheet:

$$L_t = N_t + E_t D^*_t, \tag{25}$$

(ii) evolution of individual net worth:

$$N_{t+1} = R_{t+1} L_t - R^*_{t+1} E_{t+1} D^*_t, \tag{26}$$

and (iii) the incentive compatibility constraint (15). Thus, the solution are the infinite-horizon counterparts for (16) and (17), which leads to the recursion for the optimal leverage ratio

$$\phi_t = \frac{1-\widetilde{\sigma}+\widetilde{\sigma}\Theta\phi_{t+1}}{\Theta - (\Delta_{t+1}-1)\left(1-\widetilde{\sigma}+\widetilde{\sigma}\Theta\phi_{t+1}\right)}. \tag{27}$$

leading to $\phi_t(\boldsymbol{\Delta}_{t+1})$.

Financial aggregates. At the aggregate level, banks exiting the financial market are replaced by a continuum of new bankers with initial capital ζ. Therefore, the evolution of the aggregate net worth is

$$N_t = \sigma \left(R_t L_{t-1} - R^*_t E_t D^*_{t-1} \right) + (1-\sigma)\zeta.$$

which rearranging leads to (18). The key difference relative to the model discussed in Section 4 is that Δ_0 is not longer exogenous, but it can change through movements in E_0.

5.3 Competitive equilibrium

Given a path of foreign interest rate $\boldsymbol{R}^*_+$, a competitive equilibrium is given by an allocation $\{\boldsymbol{C}^T, \boldsymbol{C}^N, \boldsymbol{L}\}$ and price system $\{\boldsymbol{\Delta}_+, \boldsymbol{R}_+, \boldsymbol{E}\}$ such that (i) households and financial intermediaries behave optimally, and (ii) markets clear. Two clearing market conditions are key: (a) non-tradable goods $C^N_t = Y^N$ for all $t \geq 0$, and (b) credit markets: $L_t = L^d_t = L^s_t$ for all $t \geq 0$.

Note that we omit a clearing market condition of tradable goods as, at the macroeconomic level, any trade balance will be funded by international capital flows which is going to be in equilibrium as long as the non-tradable goods and credit markets are.

Credit demand. In this economy, the non-financial block includes the households' *intertemporal* optimal decisions and the *clearing market conditions in the non-tradable goods*. That is, the demand of credit is pinned down by (23) and

$$E_t C_t^T = E_t Y^T + L_t - R_t L_{t-1}.$$

From this system, we can solve the key schedule of this non-financial block, $L_t^d(\widetilde{\boldsymbol{R}}_+, E_0)$ where $\widetilde{R}_{t+1} \equiv R_{t+1}\left(\frac{E_{t+1}}{E_t}\right)^{-\eta\gamma}$ is the effective interest rate for tradable good expenses. The difference between this schedule relative to the one we used in Section 4 is that now L_t^d also depends on $\boldsymbol{E}$ through valuation effects of trade balance and expenditure switching that affects the effects intertemporal cost of debt.

Supply of credit. We can write the supply side of credit in this economy as

$$L_t^s(\boldsymbol{\Delta}_+, \widetilde{\boldsymbol{R}}_+^*, E_0) = \phi_t(\boldsymbol{\Delta}_{t+1}) \cdot N_t(\boldsymbol{\Delta}_+, \widetilde{\boldsymbol{R}}_+^*, E_0). \tag{28}$$

Note that there are two aspects of the supply of credit in this model relative to the one in Section 4. First, the cost of foreign debt $\widetilde{\boldsymbol{R}}_+^*$ is endogenous now as it is affected by the real depreciation rate. Second, the initial exchange rate will affect the credit market conditions through unanticipated balance sheet effects.

Exchange rate block. In this model, the optimal intratemporal decisions of households determine the relative prices. Using C_t^T given in (23) and the intratemporal optimality conditions lead to

$$\beta R_{t+1} = (E_{t+1}/E_t \cdot Q_t/Q_{t+1})^{\gamma\eta} \tag{29}$$

where Q_t is given by (20). Moreover, using (29) together with the definition of the UIP deviation we can get the exchange rate path as a function of foreign interest rate and UIP deviations:

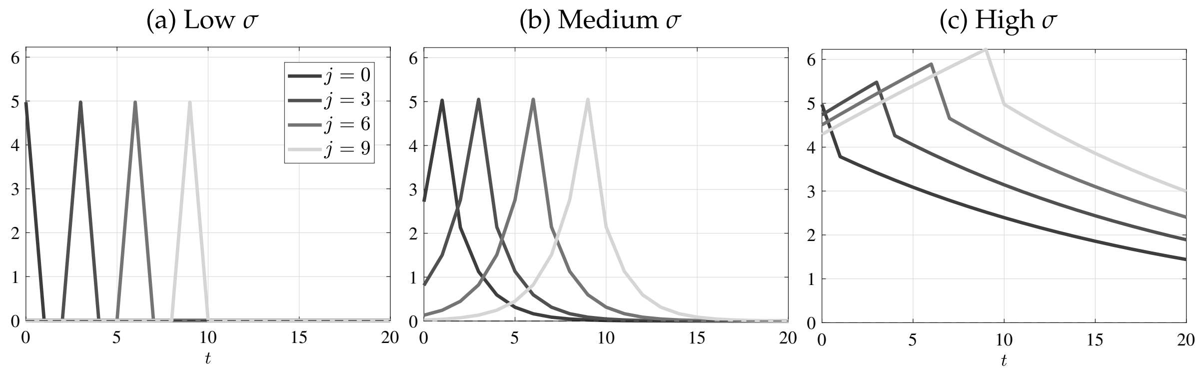
$$E_t = E_t^b(\boldsymbol{\Delta}_+, \boldsymbol{R}_+^*, E_0). \tag{30}$$

Competitive equilibrium. Merging the demand and supply schedule, given the path of foreign interest rate $\boldsymbol{R}_+^*$, the competitive equilibrium is given by $\boldsymbol{\Delta}_+$ such that (i) the credit markets clear

$$L_t^s(\boldsymbol{\Delta}_+, \widetilde{\boldsymbol{R}}_+^*, E_0) = L_t^d(\widetilde{\boldsymbol{R}}_+, \boldsymbol{E}_t) \;\text{ for all } t = 0, 1, \ldots \tag{31}$$

where $\widetilde{R}_{t+1}^* = R_{t+1}^* \frac{E_{t+1}}{E_t}$ and $\widetilde{R}_{t+1} \equiv R_{t+1}\left(\frac{E_{t+1}}{E_t}\right)^{-\eta\gamma}$ are the effective interest rates, and (ii) the exchange rate is given by (30).

Figure 10: Dynamic responses to transitory movements in δ_+ at horizon k



Matrix representation. Perturbating the system around the steady state leads to: credit market block

$$\mathbf{S} \cdot \boldsymbol{\delta}_+ + \mathbf{X} \cdot \widetilde{\boldsymbol{r}}^*_+ + \mathbf{bs} \cdot e_0 = \mathbf{D} \cdot \widetilde{\boldsymbol{r}}_+ + \mathbf{B} \cdot \boldsymbol{e}$$

and the exchange rate block

$$\boldsymbol{e} = \mathbf{E}^{\delta} \cdot \boldsymbol{\delta}_+ + \mathbf{E}^{r^*} \cdot \boldsymbol{r}^*_+ + \mathbf{E}^{e} \cdot e_0$$

where $\widetilde{r}^*_{t+1} = r^*_{t+1} + e_{t+1} - e_t$ and $\widetilde{r}_{t+1} = r_{t+1} - \eta\gamma(e_{t+1} - e_t)$.

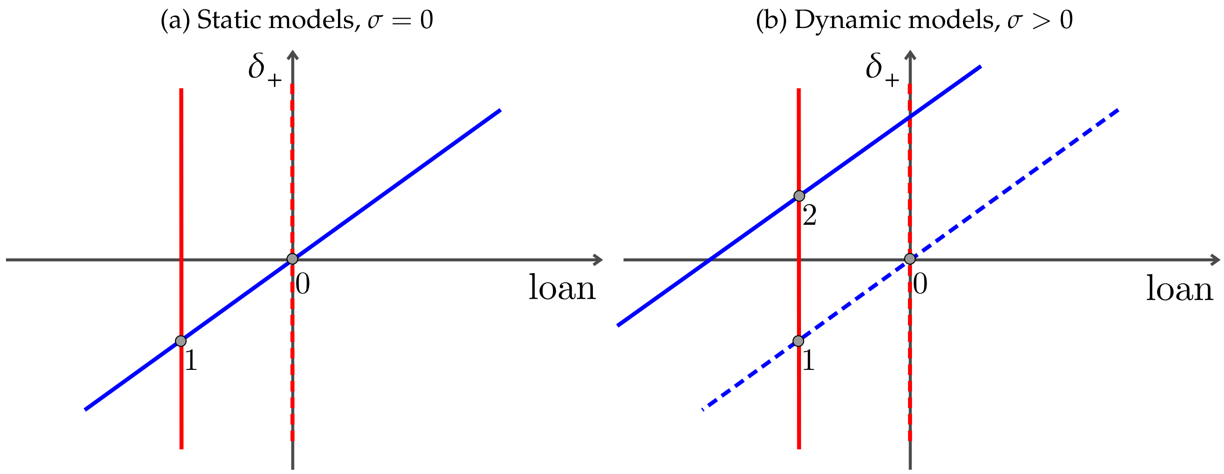
5.4 Studying the responses to foreign interest rate shocks

Proposition 2. *Consider a rise in the foreign interest rate. Then, $e_0 > 0$. If $\sigma = 0$, $\delta_{t+1} < 0$ for all $t \geq 0$. However, if $\sigma > 0$, there exists $\overline{\Xi}$ such that, in response to a rise in the foreign interest rate, we have $\delta^*_{t+1} > 0$ for $t = 1, \ldots, \tau$ and $\delta^*_{t+1} < 0$ for $t = \tau + 1, \ldots$.*

Figure 11 illustrates the intuition behind Proposition 2 through the equilibrium determination in the FX market. Point 0 denotes the initial equilibrium before the foreign interest rate shock. The increase in the foreign interest rate reduces the availability of external funding in the domestic FX market, which is represented by the shift in the vertical red schedule from the dashed line to the solid line. The blue schedule summarizes the banking sector's desired foreign borrowing for a given FX market condition. In the static case, when $\sigma = 0$, this schedule does not shift after the shock because banks respond only to current conditions. As a result, the economy moves from point 0 to point 1, implying a decline in foreign borrowing, that is, $\delta_{t+1} < 0$.

The logic is different in the dynamic case, when $\sigma > 0$. Now banks are forward looking, so the foreign interest rate shock affects not only current borrowing costs but also the expected future gains from taking positions today. This additional intertemporal force shifts the blue schedule upward. For sufficiently strong forward looking effects, the new equilibrium is given by point 2 rather than

Figure 11: Equilibrium in the FX market in response to foreign interest rate shock

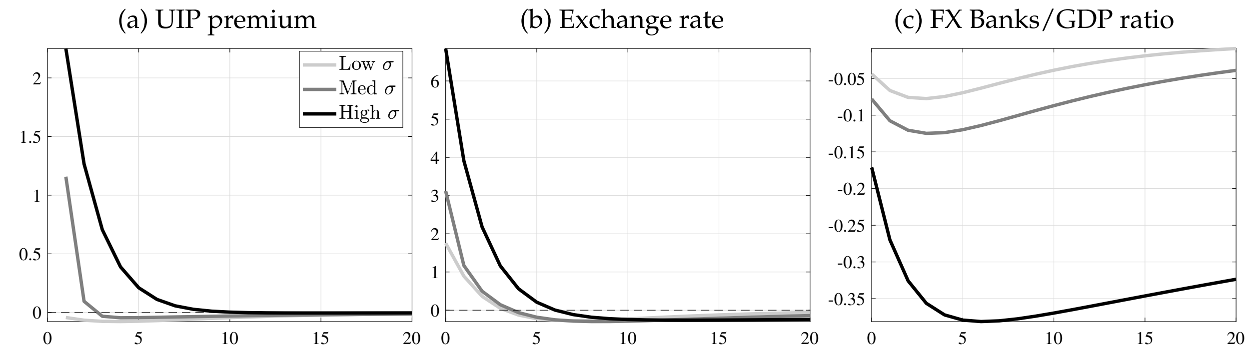


point 1, so foreign borrowing rises on impact even though the shock is contractionary. In other words, the immediate tightening in the FX market is more than offset by banks' incentive to borrow today in anticipation of future returns. Over time, as this dynamic force weakens, the response reverts and foreign borrowing eventually becomes negative, which is exactly the pattern described in Proposition 2.

Our mechanism is closely related to Kekre et al. (2024)'s analysis of monetary policy and the term structure. They show that in segmented bond markets, policy shocks affect term premia by revaluing the wealth of duration exposed intermediaries and thereby changing their capacity to bear risk. We apply the same logic to international financial intermediation. In our model, the relevant exposure is foreign currency mismatch rather than duration, so a foreign monetary tightening moves UIP premia by changing exchange rates, intermediary net worth, and the effective supply of cross border funding. This connection helps place our results in a broader asset pricing perspective: both term premia and UIP deviations can be understood as endogenous risk premia shaped by intermediary balance sheets, but in our setting the open economy dimension makes currency exposure the key state variable.

Illustration. Figure 12 reports the general equilibrium responses to a positive foreign interest rate shock under alternative values of the parameter that governs the degree of backward versus forward looking behavior on the banking supply side. Panel (a) shows the response of the UIP premium, panel (b) the exchange rate, and panel (c) the ratio of foreign currency bank borrowing to GDP. Across all specifications, the shock generates a rise in the UIP premium, a depreciation of the exchange rate, and a decline in banks' foreign borrowing relative to GDP. The main difference across lines is not the qualitative direction of the responses, but their size and persistence.

Figure 12: General equilibrium responses to foreign interest rate shock



The figure shows that the banking supply parameter is quantitatively important for the transmission of the shock. When the banking side places more weight on future conditions, the responses become much stronger: the UIP premium jumps more on impact, the exchange rate depreciates more sharply, and banks reduce their foreign borrowing by more, with the contraction in external funding remaining more persistent over time. By contrast, when the banking side is more backward looking, the responses are much more muted and die out quickly. This pattern illustrates that forward looking behavior in financial intermediation amplifies the effect of foreign interest rate shocks in general equilibrium, because banks adjust their balance sheets not only in response to current borrowing conditions, but also in anticipation of the future path of returns and funding costs.

Decomposing the channels. To clarify the mechanisms behind the general equilibrium response of the UIP premium, we decompose the impulse responses into economically meaningful components. Let z denote any equilibrium object of interest, such as the UIP premium, the exchange rate, or the ratio of foreign currency bank borrowing to GDP. We first isolate the balance sheet component by comparing the full model response with the response obtained when the balance sheet channel is shut down. Formally, we define the balance sheet effect as $\boldsymbol{z}^{\text{BS}} = \boldsymbol{z} - \boldsymbol{z}|_{\boldsymbol{x}^E=0}$ where $\boldsymbol{z}|_{\boldsymbol{x}^E=0}$ is the response when intermediaries are not exposed to balance sheet revaluation effects. This object measures how much of the total response is accounted for by the feedback from exchange rate movements to intermediaries' net worth and borrowing capacity.

We then isolate the forward looking component within the financial block. Specifically, we define the forward looking effect as $\boldsymbol{z}^{\text{FL}} = \boldsymbol{z}|_{\boldsymbol{x}^E=0} - \boldsymbol{z}|_{\text{static}}$ where $\boldsymbol{z}|_{\text{static}}$ is the response obtained in a static version of the model in which intermediaries do not adjust their decisions intertemporally, so only the contemporaneous elements of the financial block remain active. This decomposition is useful because it separates two distinct amplification mechanisms. The first operates through valuation effects on balance sheets, while the second operates through the anticipation of future returns, spreads, and funding conditions. The remaining component, labeled static, captures the direct contemporaneous effect of the shock in the absence of both balance sheet amplification and dynamic financial adjustment. By construction, the total response can therefore be interpreted as the sum of a static component, a forward looking component, and a balance sheet component.

Figure 13: Decomposition of general equilibrium responses to foreign interest rate shocks

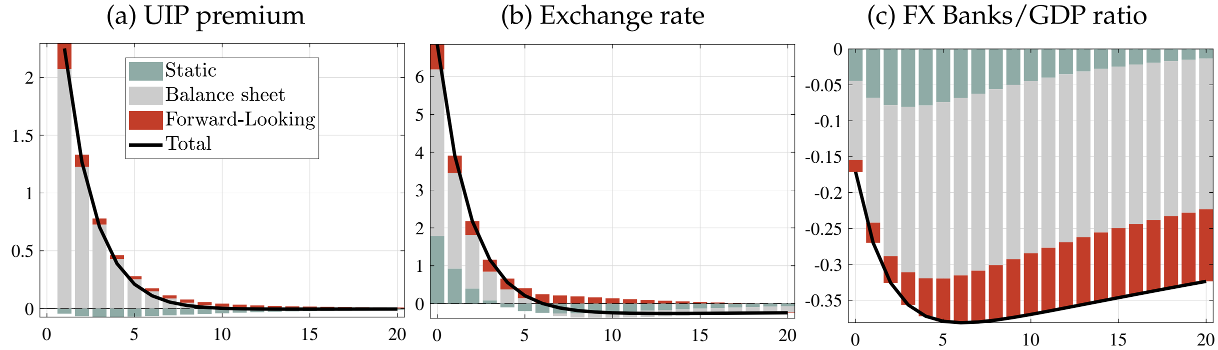


Figure 13 implements this decomposition for the main general equilibrium responses to a foreign interest rate shock. Panel (a) shows the decomposition for the UIP premium, panel (b) for the exchange rate, and panel (c) for the ratio of foreign currency bank borrowing to GDP. In each panel, the black line corresponds to the total response, while the stacked bars separate the contribution of the static, forward looking, and balance sheet channels. This quantitative exercise makes it possible to assess not only whether a given variable responds strongly to the shock, but also which mechanism is responsible for that response at each horizon.

The figure shows that the forward looking channel is a central driver of the dynamics. In both the UIP premium and the exchange rate, the red bars account for an important fraction of the overall response, especially beyond the initial periods, indicating that dynamic portfolio adjustment by intermediaries substantially amplifies the effect of the foreign interest rate shock. The balance sheet channel, shown in light gray, also contributes positively, particularly on impact, but its role is more complementary than dominant in these two variables. By contrast, in the response of foreign currency bank borrowing relative to GDP, the balance sheet channel is quantitatively much more important. There, the decomposition shows that valuation effects on intermediaries' net worth are crucial for understanding the contraction in external borrowing, while forward looking behavior shapes the persistence and gradual adjustment of the response over time. Overall, the decomposition confirms that the rise in the UIP premium after a foreign monetary tightening is not driven by a single mechanism, but by the interaction of a direct static tightening effect, an intertemporal amplification channel, and balance sheet effects operating through the financial sector.

6 Concluding remarks

This paper studies how external monetary shocks shape uncovered interest parity deviations in economies with limited financial depth. Empirically, it documents a sharp asymmetry in the transmission of U.S. monetary policy shocks: following a U.S. tightening, UIP deviations rise in emerging market economies but fall in advanced economies, and this differential response is stronger in countries whose banking sectors are more exposed to short foreign currency positions. These findings suggest that balance sheet exposure is not a peripheral feature of the data, but a central determinant of how global financial shocks are transmitted across countries.

More broadly, the paper points to a view of UIP deviations as equilibrium objects shaped by the financial structure of the economy rather than as isolated anomalies in asset pricing. In economies where intermediaries are exposed to currency mismatch and face binding balance sheet constraints, exchange rate movements and credit market conditions become tightly interconnected, and global shocks are amplified through the domestic financial sector. This perspective helps explain why similar external disturbances can have very different effects across countries, and why emerging markets are particularly vulnerable to shifts in global dollar funding conditions.

Several extensions remain for future work. On the empirical side, it would be useful to further distinguish the role of bank exposure from other forms of external vulnerability, including corporate foreign currency borrowing, sovereign balance sheet risk, and differences in hedging capacity. On the theoretical side, a natural next step is to embed the financial block in a fuller quantitative environment with richer nominal rigidities, policy rules, and endogenous risk taking, so as to study not only positive comovement but also optimal stabilization policy. These directions would help clarify how monetary, macroprudential, and foreign exchange policies should jointly respond when global financial shocks interact with domestic balance sheet fragilities.

References

Adrian, T. and Shin, H. S. (2014). Procyclical leverage and endogenous financial fragility. *Annual Review of Economics*, 6:33–58.

Aghion, P., Bacchetta, P., and Banerjee, A. (2004). A corporate balance-sheet approach to currency crises. *Journal of Economic Theory*, 119(1):6–30.

Aoki, K., Benigno, G., and Kiyotaki, N. (2025). Monetary and financial policies in emerging markets. Unpublished manuscript, revised November 2025.

Auclert, A., Bardoczy, B., Rognlie, M., and Straub, L. (2021). Using the sequence-space jacobian to solve and estimate heterogeneous-agent models. *Econometrica*, 89(5):2375–2408.

Bauer, M. D. and Swanson, E. T. (2023). An alternative explanation for the "fed information effect". *American Economic Review*, 113(3):664–700.

Bocola, L. and Lorenzoni, G. (2020). Financial crises, dollarization, and lending in foreign currency. *American Economic Review*, 110(8):2453–2484.

Branson, W. H. and Henderson, D. W. (1985). Chapter 15 the specification and influence of asset markets. volume 2 of *Handbook of International Economics*, pages 749–805. Elsevier.

Brunnermeier, M. K. and Pedersen, L. H. (2009). Market liquidity and funding liquidity. *Review of Financial Studies*, 22(6):2201–2238.

Bruno, V. and Shin, H. S. (2015). Capital flows and the risk-taking channel of monetary policy. *Journal of Monetary Economics*, 71:119–132.

Caballero, R. J., Farhi, E., and Gourinchas, P.-O. (2008). An equilibrium model of global imbalances and low interest rates. *American Economic Review*, 98(1):358–393.

Calvo, G. A. (1998). Capital flows and capital-market crises: The simple economics of sudden stops. *Journal of Applied Economics*, 1(None):35–54.

Calvo, G. A. and Reinhart, C. M. (2002). Fear of floating. *Quarterly Journal of Economics*, 117(2):379–408.

Carrasco, A. and Florián Hoyle, D. (2025). External shocks and fx intervention policy in financially dollarized economies. *Journal of Macroeconomics*, 84:103672.

Cavallino, P. (2019). Capital flows and foreign exchange intervention. *American Economic Journal: Macroeconomics*, 11(2):127–70.

Cespedes, L. F., Chang, R., and Velasco, A. (2004). Balance sheets and exchange rate policy. *American Economic Review*, 94(4):1183–1193.

Cormún, V. and De Leo, P. (2025). Global financial shocks in emerging markets. Working Paper.

Du, W., Tepper, A., and Verdelhan, A. (2018). Deviations from covered interest rate parity. *Journal of Finance*, 73(3):915–957.

Eichengreen, B., Hausmann, R., and Panizza, U. (2007). Currency mismatches, debt intolerance, and the original sin: Why they are not the same and why it matters. In Edwards, S., editor, *Capital Controls and Capital Flows in Emerging Economies: Policies, Practices, and Consequences*, pages 121–169. University of Chicago Press.

Engel, C. (2016). Exchange rates, interest rates, and the risk premium. *American Economic Review*, 106(2):436–474.

Fanelli, S. and Straub, L. (2021). A Theory of Foreign Exchange Interventions. *The Review of Economic Studies*, 88(6):2857–2885.

Frankel, J. A. and Froot, K. A. (1987). Using survey data to test standard propositions regarding exchange rate expectations. *American Economic Review*, 77(1):133–153.

Gabaix, X. and Maggiori, M. (2015). International liquidity and exchange rate dynamics. *Quarterly Journal of Economics*, 130(3):1369–1420.

Gertler, M. and Karadi, P. (2011). A model of unconventional monetary policy. *Journal of Monetary Economics*, 58(1):17–34. Carnegie-Rochester Conference Series on Public Policy: The Future of Central Banking April 16-17, 2010.

Gertler, M. and Kiyotaki, N. (2010). Chapter 11 - financial intermediation and credit policy in business cycle analysis. volume 3 of *Handbook of Monetary Economics*, pages 547–599. Elsevier.

He, Z. and Krishnamurthy, A. (2013). Intermediary asset pricing. *American Economic Review*, 103(2):732–770.

Ilzetzki, E., Reinhart, C. M., and Rogoff, K. S. (2022). Rethinking exchange rate regimes. 6:91–145.

Itskhoki, O. and Mukhin, D. (2021). Exchange rate disconnect in general equilibrium. *Journal of Political Economy*, 129(8):2183–2232.

Itskhoki, O. and Mukhin, D. (2023). Optimal exchange rate policy. Working Paper 31933, National Bureau of Economic Research.

Ize, A. and Levy-Yeyati, E. (2003). Financial dollarization. *Journal of International Economics*, 59(2):323–347.

Jordà, Ò. (2005). Estimation and inference of impulse responses by local projections. *American Economic Review*, 95(1):161–182.

Kalemli-Özcan, Ş. (2019). US monetary policy and international risk spillovers. *NBER Working Paper*, (26297).

Kalemli-Özcan, Ş., Cristi, J., Sans, M., Unsal, F., and Varela, L. (2024). Global spillovers from fed hikes and a strong dollar: The risk channel. *AEA Papers and Proceedings*, 114:157–162.

Kalemli-Özcan, Ş. and Varela, L. (2021). Five facts about the uip premium.

Kekre, R., Lenel, M., and Mainardi, F. (2024). Monetary policy, segmentation, and the term structure. NBER Working Paper 32324, National Bureau of Economic Research. Revised March 2025.

Korinek, A. (2011). The new economics of prudential capital controls: A research agenda. *IMF Economic Review*, 59(3):523–561.

Kouri, P. J. K. (1976). The exchange rate and the balance of payments in the short run and in the long run: A monetary approach. *The Scandinavian Journal of Economics*, 78(2):280–304.

Krugman, P. (1999). Balance sheets, the transfer problem, and financial crises. In Isard, P., Razin, A., and Rose, A. K., editors, *International Finance and Financial Crises: Essays in Honor of Robert P. Flood Jr.*, pages 31–55. Kluwer Academic Publishers.

Levy-Yeyati, E. (2006). Financial dollarization: Evaluating the consequences. *Economic Policy*, 21(45):61–118.

Liu, Z. and Spiegel, M. M. (2015). Optimal monetary policy and capital account restrictions in a small open economy. *IMF Economic Review*, 63(2):298–324.

Lustig, H., Roussanov, N., and Verdelhan, A. (2011). Common risk factors in currency markets. *Review of Financial Studies*, 24(11):3731–3777.

Miranda-Agrippino, S. and Rey, H. (2020). Us monetary policy and the global financial cycle. *Review of Economic Studies*, 87(6):2754–2776.

Rey, H. (2015). Dilemma not trilemma: The global financial cycle and monetary policy independence. *NBER Working Paper*, (21162). Proceedings of the Federal Reserve Bank of Kansas City Economic Symposium at Jackson Hole, 2013.

Wolf, C. K. (2021). Interest Rate Cuts vs. Stimulus Payments: An Equivalence Result. NBER Working Papers 29193, National Bureau of Economic Research, Inc.

Appendix

A Proofs

A.1 Proof of Lemma 1

Whenever the model includes a real exchange rate, it is partially determined by $E_t = \mathcal{E}_t(\boldsymbol{R}_+)$, $R_{t+1} = \Delta_{t+1}\widetilde{R}^*_{t+1}$, and $\widetilde{R}^*_{t+1} \equiv \mathcal{R}\left(R^*_{t+1}, E_{t+1}/E_t\right)$. Up to first-order, this system solves

$$e_t = \sum_{k=0}^{T-1} \frac{\partial \mathcal{E}_t}{\partial R_{k+1}} \frac{R_{k+1}}{E_t} \cdot r_{k+1}, \quad r_{t+1} = \delta_{t+1} + \widetilde{r}^*_{t+1}, \quad \text{and} \quad \widetilde{r}^*_{t+1} = r^*_{t+1} + e_{t+1} - e_t.$$

In matrix form,

$$\boldsymbol{e} \equiv \widetilde{\mathbf{E}} \cdot \boldsymbol{r}_+ \text{ and } \boldsymbol{r}_+ = \boldsymbol{\delta}_+ + \boldsymbol{r}^*_+ + \mathbf{F} \cdot \boldsymbol{e}$$

where $\widetilde{\mathbf{E}}_{t,k} = \frac{\partial \mathcal{E}_t}{\partial R_{k+1}} \frac{R_{k+1}}{E_t}$ and $\mathbf{F}$ is a first-order difference matrix, i.e.,

$$\mathbf{F}_{t,k} = \begin{cases} 1 & k = t+1 \\ -1 & k = t \\ 0 & \text{otherwise} \end{cases}.$$

Solving this linear equation leads to

$$\boldsymbol{e} \equiv (\mathbf{I} - \widetilde{\mathbf{E}}\mathbf{F})^{-1}\widetilde{\mathbf{E}} \cdot (\boldsymbol{\delta}_+ + \boldsymbol{r}^*_+).$$

Defining $\mathbf{E} \equiv (\mathbf{I} - \widetilde{\mathbf{E}}\mathbf{F})^{-1}\widetilde{\mathbf{E}}$ and rearranging yields (4).

A.2 Proof of Lemma 2

The equilibrium response to foreign interest rate movements satisfies

$$\sum_{k=0}^{T-1} \mathbf{S}^{\delta}_{t,k} \cdot \delta_{k+1} + \sum_{k=0}^{T-1} \mathbf{S}^{r^*}_{t,k} \cdot \widetilde{r}^*_{k+1} + \mathbf{bs}_t \cdot e_0 = \sum_{k=0}^{T-1} \mathbf{D}^{r}_{t,k} \cdot r_{k+1} + \sum_{k=0}^{T} \mathbf{D}^{e}_{t,k} \cdot e_k$$

for all $t = 0, \ldots, T-1$. Using the matrix formulation together iwth the real exchange rate blovk yields the following equilibrium system

$$\mathbf{S}^{\delta} \cdot \boldsymbol{\delta}_+ + \mathbf{S}^{r^*} \cdot \widetilde{\boldsymbol{r}}^*_+ + \mathbf{bs} \cdot e_0 = \mathbf{D}^{r} \cdot \boldsymbol{r}_+ + \mathbf{D}^{e} \cdot \boldsymbol{e}$$

$$\boldsymbol{e} = \mathbf{E} \cdot (\boldsymbol{\delta}_+ + \boldsymbol{r}^*_+)$$

$$\boldsymbol{r}_+ = (\mathbf{I} + \mathbf{FE}) \cdot (\boldsymbol{\delta}_+ + \boldsymbol{r}^*_+)$$

$$\widetilde{\boldsymbol{r}}^*_+ = \mathbf{FE} \cdot \boldsymbol{\delta}_+ + (\mathbf{I} + \mathbf{FE}) \cdot \boldsymbol{r}^*_+$$

Solving this linear system

$$\begin{gathered}\mathbf{S}^{\delta}\cdot\delta_{+}+\mathbf{S}^{r^*}\left(\mathbf{FE}\cdot\delta_{+}+(\mathbf{I}+\mathbf{FE})\cdot\boldsymbol{r}^*_{+}\right)+\mathbf{bsE}_{0,\bullet}\cdot(\delta_{+}+\boldsymbol{r}^*_{+})=\mathbf{D}\cdot(\delta_{+}+\boldsymbol{r}^*_{+})\\ \left(\mathbf{S}^{\delta}+\mathbf{S}^{r^*}\mathbf{FE}+\mathbf{bsE}_{0,\bullet}-\mathbf{D}\right)\cdot\delta_{+}=\left(\mathbf{D}-\mathbf{S}^{r^*}(\mathbf{I}+\mathbf{FE})-\mathbf{bsE}_{0,\bullet}\right)\cdot\boldsymbol{r}^*_{+}\\ (\mathbf{S}-\mathbf{D})\cdot\delta_{+}=(\mathbf{D}-\mathbf{X})\cdot\boldsymbol{r}^*_{+}\end{gathered}$$

where $\mathbf{D}\equiv\mathbf{D}^r(\mathbf{I}+\mathbf{FE})+\mathbf{D}^e\mathbf{E}$ is the matrix for the total foreign-interest-rate elasticity, $\mathbf{S}\equiv\mathbf{S}^{\delta}+\mathbf{S}^{r^*}\mathbf{FE}+\mathbf{bsE}_{0,\bullet}$ is the matrix for the total interest-rate-spread elasticity of supply, and $\mathbf{X}=\mathbf{S}^{r^*}(\mathbf{I}+\mathbf{FE})+\mathbf{bsE}_{0,\bullet}$ is the matrix for the total foreign-interest-rate elasticty of supply. Premultipliying the resulting system by $\mathbf{S}^{-1}$ and rearranging yields to the main result in the lemma.

A.3 Proof of Lemma 3

Define $\mathbf{M}=\Lambda+\mathbf{U}+\mathbf{L}$ where Λ is the diagonal part, $\mathbf{U}$ the strictly uper-triangular part and $\mathbf{L}$ the strictly lower-triangular part. Let $\widetilde{\mathbf{M}}\equiv\widetilde{\Lambda}\cdot(\mathbf{U}+\mathbf{L})$ where

$$\widetilde{\Lambda}\equiv(\mathbf{I}-\Lambda)^{-1}=\operatorname{diag}\left(\frac{1}{1-\mathbf{M}_{0,0}},\frac{1}{1-\mathbf{M}_{1,1}},\ldots,\frac{1}{1-\mathbf{M}_{T-1,T-1}}\right)$$

. Thus,

$$(\mathbf{I}-\mathbf{M})^{-1}=\left(\mathbf{I}-\widetilde{\mathbf{M}}\right)^{-1}\widetilde{\Lambda}=\sum_{j=0}^{\infty}\widetilde{\mathbf{M}}^{j}\cdot\widetilde{\Lambda}.$$

For a second-order approximation we use is $\mathbf{G}\simeq\widetilde{\Lambda}\mathbf{H}+\widetilde{\mathbf{M}}\widetilde{\Lambda}\mathbf{H}+\widetilde{\mathbf{M}}^2\widetilde{\Lambda}\mathbf{H}$. Characterizing the firt term is easy: $(\mathbf{M}-\mathbf{I})_{t,t}=\frac{\mathbf{X}_{t,t}}{1-\mathbf{X}_{t,t}}$ and $(\mathbf{M}-\mathbf{I})_{t,k}=0$ for $t\neq k$. The second term $(\widetilde{\mathbf{M}}\widetilde{\Lambda})_{t,k}=\widetilde{\Lambda}_{t,t}\widetilde{\Lambda}_{k,k}(\mathbf{U}+\mathbf{L})_{t,k}$. The third term is

$$(\widetilde{\mathbf{M}}^2\widetilde{\Lambda})_{t,k}=\sum_{j=0}^{T-1}\left(\widetilde{\Lambda}(\mathbf{U}+\mathbf{L})\right)_{t,j}\left(\widetilde{\Lambda}\mathbf{U}+\mathbf{L})\right)_{j,k}\widetilde{\Lambda}_{k,k}=\sum_{j=0}^{T-1}\widetilde{\Lambda}_{t,t}\widetilde{\Lambda}_{j,j}\widetilde{\Lambda}_{k,k}(\mathbf{U}+\mathbf{L})_{t,j}(\mathbf{U}+\mathbf{L})_{j,k}.$$

Adding the first and third terms for $k=t$ yields $\mathbf{G}_{t,t}$. Adding the second and third term for $k\neq t$ yields $\mathbf{G}_{t,k}$. Without loss of generality, suppose $\mathbf{L}=\mathbf{0}$ so that $\mathbf{X}$ is upper triangular. As a result, $\mathbf{N}$ is nilpotent and $\mathbf{G}$ has ta exact form

$$\mathbf{G}=\mathbf{M}-\mathbf{I}+\mathbf{N}\mathbf{M}+\mathbf{N}^2\mathbf{M}+\cdots+\mathbf{N}^{T-1}\mathbf{M}.$$

Since, for a strictly upper triangular matrix $\mathbf{N}$, the term $\mathbf{N}^m\mathbf{M}$ can only affect entries on the $m-$th and higher superdiagonals, the exact expression for $\mathbf{G}_{t,k}$ coincides with its second order approximation for $k=t,t+1,t+2$, while $\mathbf{G}_{t,k}=0$ for all $k<t$. The lower triangular case is symmetric. Hence, for an upper or lower triangular matrix $\mathbf{X}$, the formula is exact for $k\in\{t-2,t-1,t,t+1,t+2\}$.

A.4 Proof of Proposition 1

As $\mathbf{S}$ is diagonal, $\mathbf{M}_{t,k} = \mathbf{D}_{t,k}/\mathbf{S}_{t,t}$ for all t, k. Then, the direct effect of $\mathbf{G}_{t,k}$ is negative and we need to bound the indirect effect properly. if $\mathbf{D}$ is upper triangular then there is not indirect effects for $\mathbf{G}_{t,t}$ and $\mathbf{G}_{t,t+1}$.

A.5 Proof of Proposition 2

If $\text{NFA}^*_{ss} = 0$ and $\sigma \to 0$, then $\psi \to \psi_e + S^*_{ss}/\beta^* > 0$ and

$$e_0 = -\psi^{-1}\left(\Xi^*_{\Delta^*}\delta^*_1 - \Xi^*_{R^*}r^*_1\right)$$

for some $\Xi^*_{\Delta^*}, \Xi^*_{R^*} > 0$.

B Derivations for Section 4

B.1 Households

There is a representative household that lives for $T+1$ periods and derives utility from consuming final goods. Given the initial debt $R_0 L_{-1}$ and the path for domestic interest rates $\boldsymbol{R}_+$, the household chooses the consumption path $\boldsymbol{C}$ to maximize

$$\sum_{\tau=0}^{T} \beta^{\tau} \frac{C_{\tau}^{1-\gamma} - 1}{1-\gamma}$$

subject to

$$C_{\tau} + R_{\tau} L_{\tau-1} = Y_{\tau} + L_{\tau} \quad \text{for} \quad \tau = 0, \dots, T$$

where $\beta \in (0,1)$ is the subjective discount factor and Y_{τ} the households' endowment income. We constraint households' behavior by the No-Ponzi scheme terminal condition, $L_T \leq 0$. Combining all the budget constraints, we can write the lifetime budget constraint as

$$\sum_{\tau=0}^{T} q_{\tau} C_{\tau} = W \equiv \sum_{\tau=0}^{T} q_{\tau} Y_{\tau} - R_0 L_{-1}$$

where q_{τ} is the financial discount factor: $q_{\tau} = 1/\prod_{\tau'=0}^{\tau-1} R_{\tau'+1}$ for all $\tau = 1, \dots, T$ and $q_0 = 1$. The solution to this problem is $C_{\tau} = \mathcal{M}_{\tau} \cdot W$ where $\mathcal{M}_{\tau} \equiv \frac{q_{\tau}^{-1/\gamma} \beta^{\tau/\gamma}}{\sum_{\tau'=0}^{T} q_{\tau'}^{1-1/\gamma} \beta^{\tau'/\gamma}}$ is the marginal propensity to consume at date t out of wealth. Thus, the demand for credit is given by

$$L_t^d(\boldsymbol{R}_+) = \sum_{\tau=0}^{t} \frac{q_{\tau}}{q_t} \cdot (\mathcal{M}_{\tau} W - Y_{\tau}) + \frac{R_0 L_{-1}}{q_t} \quad \text{for all } t = 0, 1, \dots, T-1 \tag{B.1}$$

To measure the semi-elasticities of credit demand, we need the semi-elasticities of the q's variables:

$$\frac{\partial q_{\tau}}{\partial R_{k+1}} R_{k+1} = \begin{cases} -q_{\tau} & \tau > k \\ 0 & \text{otherwise} \end{cases} \quad \text{and} \quad \frac{\partial (q_{\tau}/q_t)}{\partial R_{k+1}} R_{k+1} = \begin{cases} q_{\tau}/q_t & \tau \leq k \leq t-1 \\ 0 & \text{otherwise} \end{cases}.$$

Taking first-order derivatives, we can show that the semi-elasticities of demand of credit at date t with respect to changes in the domestic interest rates at date k are

$$\frac{\partial L_t^d}{\partial R_{k+1}} R_{k+1} = \sum_{\tau=0}^{t} \left[\frac{q_{\tau}}{q_t} \left(W \frac{\partial \mathcal{M}_{\tau}}{\partial R_{k+1}} R_{k+1} + \mathcal{M}_{\tau} \frac{\partial W}{\partial R_{k+1}} R_{k+1} \right) + (\mathcal{M}_{\tau} W - Y_{\tau}) \frac{\partial (q_{\tau}/q_t)}{\partial R_{k+1}} R_{k+1} \right] - \frac{R_0 L_{-1}}{q_t^2} \frac{\partial q_t}{\partial R_{k+1}} R_{k+1}$$

where

$$\frac{\partial W}{\partial R_{k+1}} R_{k+1} = \sum_{\tau'=0}^{T} Y_{\tau'} \frac{\partial q_{\tau'}}{\partial R_{k+1}} R_{k+1} = - \sum_{\tau'=k+1}^{T} Y_{\tau'} q_{\tau'}$$

$$
\begin{aligned}
\frac{\partial \mathcal{M}_\tau}{\partial R_{k+1}} R_{k+1} &= \mathcal{M}_\tau \cdot \left[-\frac{1}{\gamma} q_\tau^{-1} \frac{\partial q_\tau}{\partial R_{k+1}} R_{k+1} - \left(1 - \frac{1}{\gamma}\right) \sum_{\tau'=0}^{T} \mathcal{M}_{\tau'} \frac{\partial q_{\tau'}}{\partial R_{k+1}} R_{k+1} \right] \\
&= \mathcal{M}_\tau \cdot \left[\frac{1}{\gamma} \mathbb{1}_{\tau > k} + \left(1 - \frac{1}{\gamma}\right) \sum_{\tau'=k+1}^{T} q_{\tau'} \mathcal{M}_{\tau'} \right]
\end{aligned}
$$

The elasticity matrix. The elasticity matrix is pinned down

$$
\frac{\partial L_t^d}{\partial R_{k+1}} R_{k+1} = \sum_{\tau=0}^{t} \frac{q_\tau}{q_t} \left(W \cdot \frac{\partial \mathcal{M}_\tau}{\partial R_{k+1}} R_{k+1} + \mathcal{M}_\tau \cdot \frac{\partial W}{\partial R_{k+1}} R_{k+1} \right) + \frac{q_k}{q_t} L_k^d \cdot \mathbb{1}_{t > k}.
$$

B.2 Financial Intermediaries

I describe two types of financial intermediaries: short-run and long-run banks.

B.2.1 Short-run banks

Financial intermediaries do not have capital and, at each date, rebate all the cumulated financial returns to foreign households who are the owners of these banks. However, in order to lend to domestic residents they face a constraint captured by Gabaix and Maggiori (2015)'s friction. Then, at each date $t = 0, \ldots, T-1$, their problem is

$$
V_t \equiv \max_{L_t} \frac{1}{R_{t+1}^*} (R_{t+1} - R_{t+1}^*) L_t \;\text{ subject to: }\; \widetilde{\Theta}_t L_t \leq V_t
$$

where $\widetilde{\Theta}_t = \Theta_t L_t$. Banks are going to leverage as much as they can, leading to the following supply schedule

$$
L_t^s(\boldsymbol{\Delta}_+) = \Theta_t^{-1} (\Delta_{t+1} - 1). \tag{B.2}
$$

The elasticity matrix. the elasticity matrix is very simple in this case:

$$
\frac{\partial L_t^s}{\partial \Delta_{k+1}} \Delta_{k+1} = \begin{cases} \Theta_t^{-1} \Delta_{t+1} & t = k \\ 0 & t \neq k \end{cases}.
$$

B.2.2 Long-run banks

Individual's bank problem. Now let us assume that each bank lives up to $T+1$ periods. To have a natural infinite-horizon extension of this structure, I assume that banks die with probability $1 - \sigma_{t+1} \in (0, 1)$. To separate some mechanisms in the model, we assume that the subjective survival probability is $\widetilde{\sigma}_{t+1}$ but they never learn about the true probability σ_{t+1}. This is useful to isolate the backward-looking and forward-looking component of the supply side of the economy.

Banks start with an initial capital N_0 and rebate all the cumulated financial returns upon death to foreign households. Given any capital N_t, the balance sheet imposes the restrictionwhere D_t^* denotes the debt from foreign households. Given $\widetilde{\sigma}_T = 0$, the individual's problem is: For $t = 0, \ldots, T-1$

$$V_t(N_t) \equiv \max_{L_t, D_t} \frac{1}{R_{t+1}^*} \left[(1 - \widetilde{\sigma}_{t+1})N_{t+1} + \widetilde{\sigma}_{t+1} \cdot V_{t+1}(N_{t+1})\right]$$

subject to

$$L_t = N_t + D_t^*$$
$$N_{t+1} = R_{t+1}L_t - R_{t+1}^* D_t^*$$
$$\Theta_t L_t \leq V_t(N_t)$$

Combining the first and second equation yields

$$N_{t+1} = (R_{t+1} - R_{t+1}^*)L_t + R_{t+1}^* N_t.$$

Let $\psi_t \equiv V_t(N_t)/N_t$ be the unit franchise value of the bank and $\phi_t \equiv L_t/N_t$ be the leverage ratio. Then, the franchise value evolves according to

$$\psi_t = \left(1 - \widetilde{\sigma}_{t+1} + \widetilde{\sigma}_{t+1}\psi_{t+1}\right)\left(1 + (\Delta_{t+1} - 1)\phi_t\right)$$

with $\psi_T = 0$. It follows that the supply schedule has two regimes: (i) the unconstrained regime: Whenever $\Delta_{t+1} = 1$, the bank is indifferent to hold any $\phi \in (0, \underline{\phi}_t)$ where

$$\underline{\phi}_t = \Theta_t^{-1}(1 - \widetilde{\sigma}_{t+1} + \widetilde{\sigma}_{t+1}\psi_{t+1});$$

and (ii) the constrained regime: When $\Delta_{t+1} > 1$, then

$$\phi_t = \frac{1 - \widetilde{\sigma}_{t+1} + \widetilde{\sigma}_{t+1}\psi_{t+1}}{\Theta_t - (\Delta_{t+1} - 1)(1 - \widetilde{\sigma}_{t+1} + \widetilde{\sigma}_{t+1}\psi_{t+1})}.$$

Given this analysis, the evolution of ψ_t is described by

$$\psi_t = \frac{\Theta_t(1 - \widetilde{\sigma}_{t+1} + \widetilde{\sigma}_{t+1}\psi_{t+1})}{\Theta_t - (\Delta_{t+1} - 1)(1 - \widetilde{\sigma}_{t+1} + \widetilde{\sigma}_{t+1}\psi_{t+1})}.$$

Thus, this justifies to write the leverage ratio as completely forward-looking term function: $\phi_t(\boldsymbol{\Delta}_{t+1})$.

Aggregate net worth. Banks exiting the financial market are replaced by a continuum of new bankers with initial capital ζ. Therefore, the evolution of the aggregate net worth is

$$N_t = \sigma_t R_t^* \left((\Delta_t - 1)L_{t-1} + N_{t-1}\right) + (1 - \sigma_t)\zeta.$$

Note that the evolution of net worth is ruled by the true survival rate, σ_t, instead of the bank's perceived one. As a result,

$$L_t^s(\mathbf{\Delta}_+, \boldsymbol{R}_+^*) = \phi_t(\mathbf{\Delta}_{t+1}) \cdot N_t(\mathbf{\Delta}_+, \boldsymbol{R}_+^*).$$

The elasticity matrix. Note first that

$$\frac{\partial N_t}{\partial \Delta_{k+1}}\Delta_{k+1} = \sigma_t R_t^* L_{t-1}\Delta_{k+1}\mathbb{1}_{k+1=t} + \sigma_t R_t^* \left[(\Delta_t - 1)\frac{\partial L_{t-1}^s}{\partial \Delta_{k+1}}\Delta_{k+1} + \frac{\partial N_{t-1}}{\partial \Delta_{k+1}}\Delta_{k+1}\right]$$

$$\frac{\partial N_t}{\partial R_{k+1}^*}R_{k+1}^* = \sigma_t R_t^* \left((\Delta_t - 1)L_{t-1} + N_{t-1}\right)\mathbb{1}_{k+1=t} + \sigma_t R_t^* \left[(\Delta_t - 1)\frac{\partial L_{t-1}^s}{\partial R_{k+1}^*}R_{k+1}^* + \frac{\partial N_{t-1}}{\partial R_{k+1}^*}R_{k+1}^*\right]$$

The elasticity matrix is more complicated in this case

$$\frac{\partial L_t^s}{\partial \Delta_{k+1}}\Delta_{k+1} = N_t\frac{\partial \phi_t}{\partial \Delta_{k+1}}\Delta_{k+1} + \phi_t\frac{\partial N_t}{\partial \Delta_{k+1}}\Delta_{k+1}$$

$$\frac{\partial L_t^s}{\partial R_{k+1}^*}R_{k+1}^* = \phi_t\frac{\partial N_t}{\partial R_{k+1}^*}R_{k+1}^*.$$

This system can be solved recursively once we compute, under the assumption of binding constraints,

$$\frac{\partial \phi_t}{\partial \Delta_{k+1}} = \Theta_t^{-1}\frac{\partial \psi_t}{\partial \Delta_{k+1}}$$

where

$$\frac{\partial \psi_t}{\partial \Delta_{k+1}} = \psi_t^2\left[\Theta_t^{-1} + \frac{\widetilde{\sigma}_{t+1}}{(1 - \widetilde{\sigma}_{t+1} + \widetilde{\sigma}_{t+1}\psi_{t+1})^2}\frac{\partial \psi_{t+1}}{\partial \Delta_{k+1}}\right].$$

B.3 Competitive equilibrium

Given the foregin interest rate path $\boldsymbol{R}_+^*$, the interest rate spread of equilibrium $\mathbf{\Delta}_+$ solves

$$L_t^s(\mathbf{\Delta}_+, \boldsymbol{R}_+^*) = L_t^d(\boldsymbol{R}_+) \;\text{ for all }\; t = 0, 1, \ldots, T-1$$

where $R_{t+1} = \Delta_{t+1}R_{t+1}^*$. As a benchmark, let us compute the stationary equilibrium in the infinite horizon model. Suppose $T = +\infty$ and $R_t^* = R^*$ for all $t = 0, 1, \ldots$ and let us compute that steady state in the model with short- and long-run banks. By definition this equilibrium is given by a UIP deviation Δ such that $L_t^d = L_t^s = L$ for all t under $\Delta_t = \Delta$ and $R_t^* = R^*$ for all t. We assume that $\beta^{-1} > R^*$.

Households. From the demand side, stationarity requires $R = \beta^{-1}$ and households hold the same initial debt throughout their lifetime, $L_t = L_{-1}$. Thus, the spread is given by $\Delta = \frac{1}{\beta R^*}$ and the level of debt is pinned down by the supply side of the economy.

Short-run banks. In this model, $L = \Theta^{-1}(\Delta - 1)$ with $\Delta = \frac{1}{\beta R^*}$.

Long run banks. Under these conditions, we can solve for ψ by the following fixed-point equation:

$$\psi = \frac{\Theta(1 - \widetilde{\sigma} + \widetilde{\sigma}\psi)}{\Theta - (\Delta - 1)(1 - \widetilde{\sigma} + \widetilde{\sigma}\psi)}.$$

Then, $\phi = \Theta^{-1}\psi$ and the net worth is computed by

$$N = \frac{(1-\sigma)\zeta}{1 - \sigma R^* \left(1 + (\Delta - 1)\phi\right)}.$$

As a result, $L = \phi N$.

B.4 Additional characterization

Although the structure is very complicated for this casem, we can partially characterize this system as follows.

B.4.1 Demand side

Assumption 2. *Domestic and foreign interest rates are constant: $R_\tau = R$ and $R^*_\tau = R^*$ for all $\tau = 0, 1, \ldots, T+1$. Income endowment is constant: $Y_\tau = Y$ for all $\tau = 0, 1, \ldots, T$.*

Lemma B.1. *Given a positive debt $R_0 L_{-1} \geq 0$, the demand for credit is positive every period if and only if*

$$\frac{\sum_{\tau=0}^{t} q_\tau^{1-1/\gamma} \beta^{\tau/\gamma}}{\sum_{\tau'=0}^{T} q_{\tau'}^{1-1/\gamma} \beta^{\tau'/\gamma}} \geq \frac{\sum_{\tau=0}^{t} q_\tau Y_\tau - R_0 L_{-1}}{\sum_{\tau'=0}^{T} q_{\tau'} Y_{\tau'} - R_0 L_{-1}} \quad \text{for all } t = 0, \ldots, T-1 \tag{B.3}$$

Moreover, under Assumption 2 and $a \equiv R^{-(1-1/\gamma)}\beta^{1/\gamma} \in (0,1)$ and $b \equiv R^{-1} \in (0,1)$,

$$1 < R \leq \beta^{-1} \tag{B.4}$$

is a sufficient condition for (B.3).

Proof. The demand for credit is positive if and only if $\sum_{\tau=0}^{t} q_\tau \cdot (\mathcal{M}_\tau W - Y_\tau) + R_0 L_{-1} \geq 0$ for all $t = 0, \ldots, T-1$. Rearranging yields (B.3). Moreover, under Assumption 2, $q_\tau = b^\tau$ and (B.3) becomes

$$\frac{\sum_{\tau=0}^{t} a^\tau}{\sum_{\tau'=0}^{T} a^{\tau'}} = \frac{1 - a^{t+1}}{1 - a^{T+1}} \geq \frac{1 - b^{t+1} - (1-b)R_0 \frac{L_{-1}}{Y}}{1 - b^{T+1} - (1-b)R_0 \frac{L_{-1}}{Y}} = \frac{Y \sum_{\tau=0}^{t} b^\tau - R_0 L_{-1}}{Y \sum_{\tau'=0}^{T} b^{\tau'} - R_0 L_{-1}}.$$

Note that the function $H(x) = \frac{1-x^t}{1-x^T}$ (with $1 \le t < T$) is decreasing in $x \in (0,1)$.[8] Throughout this paper, I assume that $a \in (0,1)$ and $b \in (0,1)$, so that under $a \le b$,

$$H(a) = \frac{1-a^{t+1}}{1-a^{T+1}} \ge \frac{1-b^{t+1}}{1-b^{T+1}} = H(b) \ge \frac{1-b^{t+1}-(1-b)R_0\frac{L_{-1}}{Y}}{1-b^{T+1}-(1-b)R_0\frac{L_{-1}}{Y}}.$$

Then, the restriction on R is $R^{-(1-1/\gamma)}\beta^{1/\gamma} \le R^{-1} < 1$ which rearranging yields (B.4). □

The marginal propensity to consume and weatlh are

$$\mathcal{M}_\tau = \frac{(R\beta)^{\tau/\gamma}}{\sum_{\tau'=0}^{T} a^{\tau'}} = \frac{1-a}{1-a^{T+1}}\left(\frac{a}{b}\right)^\tau \quad \text{and} \quad W = Y\frac{1-b^{T+1}}{1-b} - R_0 L_{-1}.$$

The demand of credit is

$$L_t^d = \left[\frac{1-a^{t+1}}{1-a^{T+1}} - \frac{1-b^{t+1}}{1-b}\frac{Y}{W} + \frac{R_0 L_{-1}}{W}\right]\cdot b^{-t}W \quad \text{for } t = 0,1,\ldots,T-1.$$

Proposition B.1. *Under Assumption 2 and $a \equiv R^{-(1-1/\gamma)}\beta^{1/\gamma} \in (0,1)$ and $b \equiv R^{-1} \in (0,1)$, the semi-elasticities of the demand for credit are*

$$\frac{\partial L_t^d}{\partial R_{k+1}} R_{k+1} = \begin{cases} \left(S_{t,k} + \widetilde{S}_{t,k} + \frac{R_0 L_{-1}}{W}\right)\cdot b^{-t}W & t > k \\ S_{t,k}\cdot b^{-t}W & t \le k \end{cases} \tag{B.5}$$

where

$$S_{t,k} \equiv \left[\left(1-\frac{1}{\gamma}\right)\frac{a^{k+1}-a^{T+1}}{1-a^{T+1}} - \frac{Y}{W}\frac{b^{k+1}-b^{T+1}}{1-b}\right]\frac{1-a^{t+1}}{1-a^{T+1}}$$
$$\widetilde{S}_{t,k} \equiv \frac{1}{\gamma}\frac{a^{k+1}-a^{t+1}}{1-a^{T+1}} + \frac{1-a^{k+1}}{1-a^{T+1}} - \frac{Y}{W}\frac{1-b^{k+1}}{1-b}.$$

Moreover, whenever $b \ge a$, we can show that $S_{t,k} < 0$ for all $t,k = 0,1,\ldots,T-1$.

---

[8] Let $H(x) = \frac{1-x^t}{1-x^T}$ for any $x \in (0,1)$. Taking derivatives

$$H'(x) = \frac{1}{(1-x^T)^2}\left[-tx^{t-1}(1-x^T) + Tx^{T-1}(1-x^t)\right]$$
$$= \frac{x^{t-1}}{(1-x^T)^2}S(x)$$

where $S(x) \equiv -t + Tx^{T-t} - (T-t)x^T$. Note that $S'(x) = (T-t)Tx^{T-t-1}(1-x^t) > 0$ for all $x \in (0,1)$. Then, $S(x)$ is increasing from $-t$ to 0, i.e., $S(x) < 0$. Thus, $H'(x) < 0$.

Proof. Note that

$$\sum_{\tau'=k+1}^{T} q_{\tau'} Y_{\tau'} = Y \sum_{\tau'=k+1}^{T} b^{\tau'} = Y \frac{b^{k+1} - b^{T+1}}{1-b}$$

$$\sum_{\tau'=k+1}^{T} q_{\tau'} \mathcal{M}_{\tau'} = \frac{1-a}{1-a^{T+1}} \sum_{\tau'=k+1}^{T} a^{\tau'} = \frac{a^{k+1} - a^{T+1}}{1-a^{T+1}}.$$

Then, importar semi-elasticities are

$$\frac{\partial W}{\partial R_{k+1}} R_{k+1} = -Y \frac{b^{k+1} - b^{T+1}}{1-b}$$

$$\frac{\partial \mathcal{M}_\tau}{\partial R_{k+1}} R_{k+1} = \mathcal{M}_\tau \left[\frac{1}{\gamma} \mathbb{1}_{\tau > k} + \left(1 - \frac{1}{\gamma}\right) \frac{a^{k+1} - a^{T+1}}{1-a^{T+1}} \right].$$

As a result,

$$\begin{aligned}
\frac{\partial L_t^d}{\partial R_{k+1}} R_{k+1} &= \sum_{\tau=0}^{t} \frac{q_\tau}{q_t} \left(W \frac{\partial \mathcal{M}_\tau}{\partial R_{k+1}} R_{k+1} + \mathcal{M}_\tau \frac{\partial W}{\partial R_{k+1}} R_{k+1} \right) + \frac{q_k}{q_t} L_k^d \mathbb{1}_{t>k} \\
&= b^{-t} W \left(\frac{1}{\gamma} \sum_{\tau=0}^{t} b^\tau \mathcal{M}_\tau \mathbb{1}_{\tau > k} + \left[\left(1 - \frac{1}{\gamma}\right) \frac{a^{k+1} - a^{T+1}}{1-a^{T+1}} - \frac{Y}{W} \frac{b^{k+1} - b^{T+1}}{1-b} \right] \sum_{\tau=0}^{t} b^\tau \mathcal{M}_\tau \right) + b^{k-t} L_k^d \mathbb{1}_{t>k}
\end{aligned}$$

Rearranging this expression yields (B.5). For the remaining of this proof, suppose $b > a$. We can bound $S_{t,k}$ as follows

$$S_{t,k} < \frac{a^{k+1} - a^{T+1}}{1-a^{T+1}} - \frac{b^{k+1} - b^{T+1}}{1-b^{T+1}} \leq 0$$

where the last inequality comes from the fact that $L(x) = \frac{x^{k+1} - x^{T+1}}{1-x^{T+1}} = 1 - H(x)$ is increasing in x and $b \geq a$. Now, using $A = \frac{1-a^{t+1}}{1-a^{T+1}}$ and $B = \frac{a^{k+1} - a^{T+1}}{1-a^{T+1}}$, rewrite $S_{t,k} + \widetilde{S}_{t,k}$ as follows

$$S_{t,k} + \widetilde{S}_{t,k} = 1 - (1-A) \left[B + \frac{1-B}{\gamma} \right] - \frac{Y}{W} \frac{(b^{k+1} - b^{T+1})A + 1 - b^{k+1}}{1-b}.$$

□

It is important to study the elasticities in some special cases. As we are interested in a model for credit markets, it will be assumed that (B.4) holds.

1. **Model's Horizon.** Depending on T, we may have more structure on the semi-elasticities. Let me focus on three special cases. First, suppose that the model implies a static credit market, i.e., $T = 1$. In this model, the only elasticity that matter is

$$\frac{\partial L_0^d}{\partial R_1} R_1 = \left[\left(1 - \frac{1}{\gamma}\right) \frac{a}{1+a} - \frac{Y}{W} b \right] \frac{W}{1+a}.$$

Third, let us consider an infinite-horizon model (i.e., $T \to \infty$). Then the elasticities are characterized by (B.5) with

$$S_{t,k} = \left[\left(1 - \frac{1}{\gamma}\right) a^{k+1} - \frac{Y}{W}\frac{b^{k+1}}{1-b}\right](1 - a^{t+1})$$
$$\widetilde{S}_{t,k} = \frac{1}{\gamma}(a^{k+1} - a^{t+1}) + 1 - a^{k+1} - \frac{Y}{W}\frac{1-b^{k+1}}{1-b}.$$

2. **Zero Credit.** Suppose $L_{-1} = 0$ and $a = b$. This implies $a = b = \beta$ and $L_t^d = 0$ for all $t = 0, 1, \ldots, T-1$. Then, $\frac{Y}{W} = \frac{1-b}{1-b^{T+1}}$ and the elasticities are characterized by (B.5) with

$$S_{t,k} = -\frac{1}{\gamma}\frac{1-\beta^{t+1}}{1-\beta^{T+1}}\frac{\beta^{k+1} - \beta^{T+1}}{1-\beta^{T+1}}$$
$$\widetilde{S}_{t,k} = \frac{1}{\gamma}\frac{\beta^{k+1} - \beta^{t+1}}{1-\beta^{T+1}}.$$

3. **Logistic Preferences.** Suppose $\gamma = 1$. Then, the elasticities are characterized by (B.5) with

$$S_{t,k} = -\frac{Y}{W}\frac{b^{k+1} - b^{T+1}}{1-b}\frac{1-a^{t+1}}{1-a^{T+1}}$$
$$\widetilde{S}_{t,k} \equiv \frac{1-a^{t+1}}{1-a^{T+1}} - \frac{Y}{W}\frac{1-b^{k+1}}{1-b}.$$

In a standard macroeconomic model, it is assumed that the model is infinite-horizon, logistic preferences and zero credit. As a result

$$S_{t,k} \equiv -\left(1 - \beta^{t+1}\right)\beta^{k+1} \quad \text{and} \quad \widetilde{S}_{t,k} \equiv \beta^{k+1} - \beta^{t+1}.$$

C Derivations for Section 5

Throughout all the models considered in this section, we have the exchange rate block equations and other extra defitions given by

$$
\begin{aligned}
C_t^T &= \frac{\omega}{1-\omega} Q_t^{-\eta} Y^N \\
\beta R_{t+1} &= \left(E_{t+1}/E_t \cdot Q_t/Q_{t+1}\right)^{\gamma\eta} \\
Q_t &= \left(\frac{E_t^{\eta-1} - \omega}{1-\omega}\right)^{\frac{1}{\eta-1}} \\
\Delta_{t+1} &= \frac{R_{t+1}}{\widetilde{R}^*_{t+1}} \\
\widetilde{R}^*_{t+1} &= R^*_{t+1} \frac{E_{t+1}}{E_t} \\
\widetilde{R}_{t+1} &= R_{t+1} \left(\frac{E_{t+1}}{E_t}\right)^{-\eta\gamma}.
\end{aligned}
$$

Moreover, the demand side of the economy is

$$
\begin{aligned}
E_t C_t^T &= E_t Y^T + L_t - R_t L_{t-1} \\
\left(C_{t+1}^T / C_t^T\right)^{\gamma} &= \beta \widetilde{R}_{t+1}.
\end{aligned}
$$

We can define the net foregin asset possition as $\underline{\mathrm{NFA}}_t = -E_t D_t^*$ and the gross domestic product as $\mathrm{GPD}_t = Y_t^T + Q_t^{-1} Y_t^N$.

Steady states. Note that in all steady states: $\beta R_{ss} = 1$, $\Delta_{ss} = R_{ss}/R_{ss}^* = \beta^*/\beta$ and $E_{ss+1}/E_{ss} = 1$. The models are going to differ in the supply side which is going to pin down L_{ss}. Then, given L_{ss}, the exchange rate level is determined by the aggregate resource constraint

$$
E_{ss} C^T(E_{ss}) - E_{ss} Y^T = (1 - R_{ss}) L_{ss}.
$$

Moreover, the net foreign asset possition is $\underline{\mathrm{NFA}}_{ss} = N_{ss} - L_{ss}$ and the gross domestic product as $\mathrm{GDP}_{ss} = Y_{ss}^T + Q_{ss}^{-1} Y_{ss}^N$.

Linearized exchange rate block. Log-linearizing the exchange rate block yields

$$
\begin{aligned}
r_{t+1} &= -\gamma\eta \left(e_{t+1} - e_t + q_t - q_{t+1}\right) \\
q_t &= \frac{1-\omega}{1-\omega E^{1-\eta}} e_t \\
\delta_{t+1} &= r_{t+1} - \widetilde{r}^*_{t+1} \\
\widetilde{r}^*_{t+1} &= r^*_{t+1} + e_{t+1} - e_t \\
\widetilde{r}_{t+1} &= r_{t+1} - \eta\gamma(e_{t+1} - e_t)
\end{aligned}
$$

Solving for exchange rate depreciation

$$e_{t+1} - e_t = -\frac{1}{1+\kappa}(r^*_{t+1} + \delta_{t+1}) \tag{C.1}$$

where $\kappa \equiv \eta\gamma\left(1 - \frac{1-\omega}{1-\omega E^{1-\eta}}\right)$. As a result,

$$\begin{aligned}
\boldsymbol{e} &= \mathbf{E}^{\delta} \cdot \boldsymbol{\delta}_+ + \mathbf{E}^{r^*} \cdot \boldsymbol{r}^*_+ + \mathbf{E}^{e} \cdot e_0 \\
\widetilde{\boldsymbol{r}}^*_+ &= \frac{\kappa}{1+\kappa} \cdot \boldsymbol{r}^*_+ - \frac{1}{1+\kappa} \cdot \boldsymbol{\delta}_+ \\
\widetilde{\boldsymbol{r}}_+ &= \frac{\eta\gamma + \kappa}{1+\kappa} \cdot (\boldsymbol{r}^*_+ + \boldsymbol{\delta}_+)
\end{aligned}$$

where $\mathbf{E}^{\delta} = \mathbf{E}^{r^*} = -\frac{1}{1+\kappa} \cdot \boldsymbol{\Sigma}$, $\mathbf{E}^{e} = \mathbf{1}$, and $\boldsymbol{\Sigma}_{t,k} = \mathbb{1}_{t>k}$.

Linearized demand system.

C.1 Short-run banks

Dynamic System. The nonlinear system is given by the exchange rate block together with

$$L_t = \Theta^{-1}(\Delta_{t+1} - 1).$$

The net foregin asset possition as $\underline{\mathrm{NFA}}_t = -L_t$.

Steady State. The steady state level of loans is $L_{ss} = \Theta^{-1}(\Delta_{ss} - 1)$.

Linearized supply side. Log-linearizing yields

$$L_{ss} l_t = \Theta^{-1}\Delta_{ss}\delta_{t+1} \Longrightarrow l_t = \frac{\Delta_{ss}}{\Delta_{ss} - 1} \cdot \delta_{t+1}.$$

C.2 Long-run banks

Dynamic System. The nonlinear system is given by the exchange rate block together with

$$\begin{aligned}
\phi_t &= \frac{1 - \widetilde{\sigma} + \widetilde{\sigma}\Theta\phi_{t+1}}{\Theta - (\Delta_{t+1} - 1)\left(1 - \widetilde{\sigma} + \widetilde{\sigma}\Theta\phi_{t+1}\right)} \\
N_t &= \sigma \widetilde{R}^*_t N_{t-1}\left(1 + (\Delta_t - 1)\phi_{t-1}\right) + (1-\sigma)\zeta.
\end{aligned}$$

Steady State. The leverage ratio of banks ϕ_{ss} solve the following-fixed point equation (from (27) at the steady state):

$$\phi_{ss}\left[\Theta - (\Delta_{ss} - 1)(1 - \widetilde{\sigma} + \widetilde{\sigma}\Theta\phi_{ss})\right] = 1 - \widetilde{\sigma} + \widetilde{\sigma}\Theta\phi_{ss}.$$

The net worth is

$$N_{ss} = \frac{(1-\sigma)\zeta}{\sigma R^*_{ss}\left(1 + (\Delta_{ss} - 1)\phi_{ss}\right)} \Longrightarrow L_{ss} = \phi_{ss} N_{ss}.$$

Then, the exchange rate level is determined by the aggregate resource constraint

$$E_{ss} C^T(E_{ss}) - E_{ss} Y^T = (1 - R_{ss}) L_{ss}.$$

Moreover, the net foreign asset possition is $\underline{\text{NFA}}_{ss} = N_{ss} - L_{ss}$ and the gross domestic product as $\text{GDP}_{ss} = Y^T_{ss} + Q^{-1}_{ss} Y^N_{ss}$.

Linearized supply side. Log-linearizing yields

$$\Phi_{ss}\phi_t = \frac{1 - \widetilde{\sigma} + \widetilde{\sigma}\Theta\phi_{ss}}{\left[\Theta - (\Delta_{ss} - 1)\left(1 - \widetilde{\sigma} + \widetilde{\sigma}\Theta\phi_{ss}\right)\right]^2}\left(-\left(1 - \widetilde{\sigma} + \widetilde{\sigma}\Theta\phi_{ss}\right)\right)\Delta_{ss} \cdot \delta_{t+1}$$

C.3 Calibration: Finding parameters

We follow the same strategy for most of the models consider in this paper. The targeted moments are R^*_{ss}, R_{ss}, E_{ss}, C^T_{ss}, $\frac{\underline{\text{NFA}}^*_{ss}}{4\text{GDP}_{ss}}$, and $\frac{L_{ss}}{4\text{GDP}_{ss}}$. We can find the right paramteres as follows

1. Given R_{ss} and R^*_{ss}, we can compute $\beta = 1/R_{ss}$, $\beta^* = 1/R^*_{ss}$, and $\Delta_{ss} = \beta^*/\beta$.

2. Given E_{ss} and C^T_{ss}, we can find Q_{ss} and $Y^N_{ss} = \frac{1-\omega}{\omega} Q^{\eta}_{ss} C^T_{ss}$.

3. Given $\frac{L_{ss}}{4\text{GDP}_{ss}}$, Q_{ss}, Y^N_{ss} and C^T_{ss}, we can compute Y^T_{ss} by using

$$\frac{L_{ss}}{4\text{GDP}_{ss}} \times 4(E_{ss} Y^T_{ss} + E_{ss} Q^{-1}_{ss} Y^N_{ss}) \times (1 - R_{ss}) = E_{ss} Y^T_{ss} - E_{ss} C^T_{ss}$$
$$\Longrightarrow Y^T_{ss} = \frac{1}{1 - 4(1 - R_{ss})\frac{L_{ss}}{4\text{GDP}_{ss}}}\left(4(1 - R_{ss}) \times \frac{L_{ss}}{4\text{GDP}_{ss}} \times Q^{-1}_{ss} Y^N_{ss} + C^T_{ss}\right).$$

4. We can compute L_{ss}, $\underline{\text{NFA}}^*_{ss}$, and N_{ss} as

$$L_{ss} = \frac{L_{ss}}{4\text{GDP}_{ss}} \times 4(E_{ss} Y^T_{ss} + E_{ss} Q^{-1}_{ss} Y^N_{ss})$$
$$\underline{\text{NFA}}^*_{ss} = \frac{\underline{\text{NFA}}^*_{ss}}{4\text{GDP}} \times 4(E_{ss} Y^T_{ss} + E_{ss} Q^{-1}_{ss} Y^N_{ss})$$
$$N_{ss} = L_{ss} + \underline{\text{NFA}}^*_{ss}.$$

5. Given $\phi_{ss} = N_{ss}/L_{ss}$, we can compute ζ as

$$\zeta = \frac{\sigma}{1-\sigma} N_{ss} R^*_{ss}\left(1 + (\Delta_{ss} - 1)\phi_{ss}\right).$$

Moreover, Θ is inferred from the steady state equation of ϕ_{ss} in each possible model:

(a) Under the "short-run banks" setting this is

$$\Theta = \frac{\Delta_{ss} - 1}{L_{ss}}.$$

(b) Under the "long-run banks" setting this is

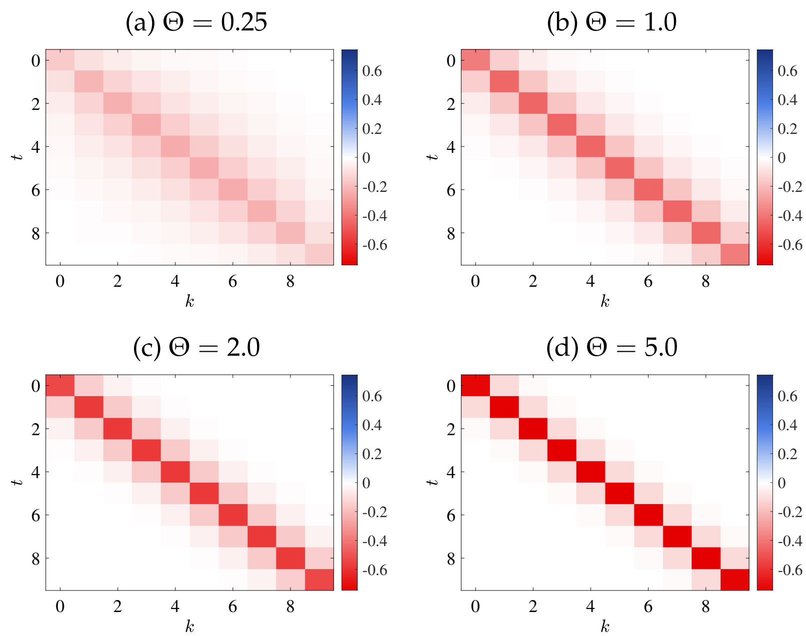
$$\Theta = (1 - \widetilde{\sigma}) \frac{1 + (\Delta_{ss} - 1)\phi_{ss}}{1 - \widetilde{\sigma}\left(1 + (\Delta_{ss} - 1)\phi_{ss}\right)}.$$

D Quantitative exploration

D.1 Model without balance sheet

D.1.1 Short run banks

Figure D.1: Dynamic demand and "short run" banks: Moving Θ



D.1.2 Long run banks

Figure D.2: Dynamic demand and "short run" banks: Moving L_{-1}

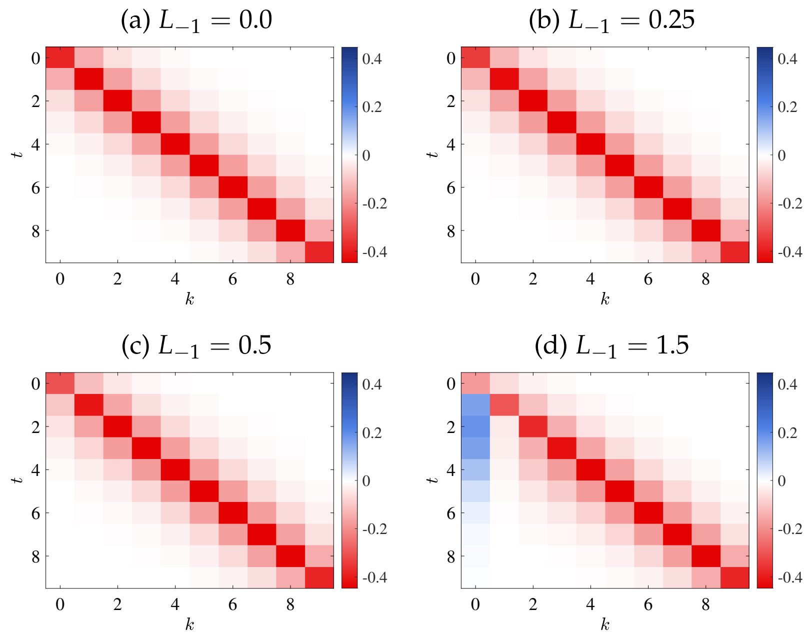


Figure D.3: Dynamic demand and "long run" banks: Moving Θ

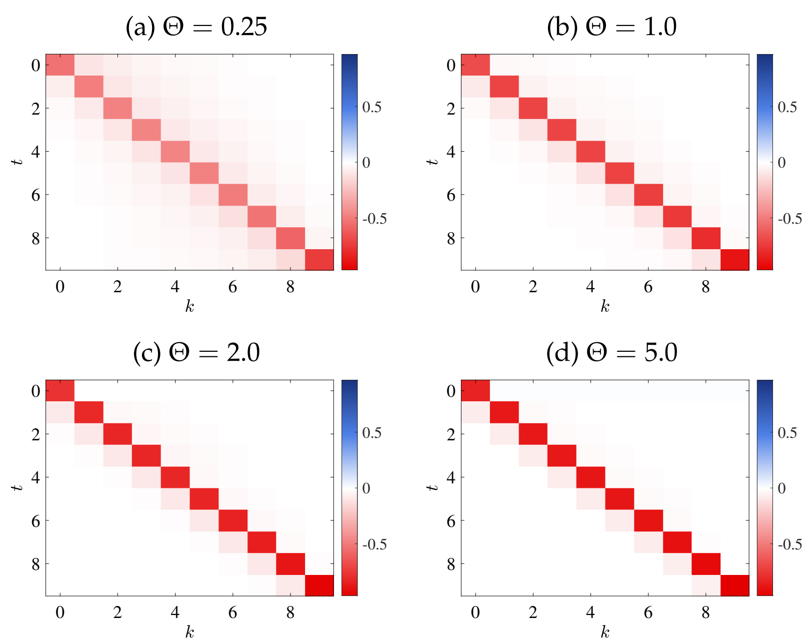


Figure D.4: Dynamic demand and “long run” banks: Moving L_{-1}