Currency Depreciations, Credit Spreads, and Imported Inputs

Juan Ignacio Di Naro*

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Abstract

This paper studies the interaction between exchange rate fluctuations and domestic financial intermediation in small open economies. Using aggregate statistics and microdata on banks' returns, I document that currency depreciations are recessionary, temporarily inflationary, and significantly reduce banks' equity valuations. I also find that these dynamics differ between emerging and advanced small-open economies, and that the former group reacts more strongly to currency depreciations than the latter. I develop a general equilibrium model with a banking sector and a production technology that requires imported inputs, where exchange rate variations are an endogenous outcome of shocks. The key element of the model is testing the interaction of two propagation mechanisms for currency depreciations: a cost channel through the cost of imported materials, and a credit channel. Model simulations show foreign interest rate hikes and net-worth shocks to banks generate real depreciations, persistent recessions, and hump-shaped inflation dynamics. Greater openness amplifies volatility and raises the trade-off between international integration and macroeconomic stability.

*Department of Economics, Western University.
Email:jdinaro@uwo.ca; website:https://jidinaro.github.io/.

1 Introduction

Exchange rate fluctuations shape the aggregate dynamics of small-open economies. Depreciation pass-through to domestic prices is incomplete (Nakamura and Zerom, 2009). Depreciations harm banks' balance sheets, which leads to stricter financial conditions, and results in less investment and lower output (Aguiar, 2005; Akinci and Queralto, 2023). Finally, banks' exposure, measured as the degree of change in their profits due to the interaction between their debt structure and a change in exchange rates, has been widely studied (Allayannis and Weston, 2001; Bodnar, Dumas, and Marton, 2002; Agarwal, 2025), where they find that, even with the usage of financial derivatives, profits decreased amid a currency shock. While these studies have been essential for understanding the complexity of exchange rate fluctuations and their impact on economic variables, systematic analyses of how small advanced and emerging economies might respond differently to exchange rate variations remain relatively limited. Moreover, on the theoretical side, the literature has focused on modelling the transmission of currency shocks, but has devoted much less attention to extending these frameworks to explicitly account for heterogeneity between advanced and emerging economies. My analysis then introduces a relevant modification in an attempt to capture why these groups of countries may exhibit different responses to exchange rate shocks.

The aim of this paper is then twofold. First, I document and explain the heterogeneous effects of exchange rate depreciations across advanced and emerging economies, with a particular focus on the banking sector. On the empirical side, I combine aggregate and bank-level microdata to examine both macroeconomic and financial responses. The evidence suggests that emerging economies experience sharper output contractions, stronger inflationary pressures, and more persistent increases in domestic interest rates following depreciations, whereas advanced economies exhibit more muted, and in some cases opposite responses. At the micro level, bank stock returns decline significantly in response to exchange rate depreciations, with higher losses concentrated in emerging markets. These findings suggest that the interaction between exchange rate shocks and financial intermediation might be key to understanding why emerging economies are more vulnerable to currency fluctuations.

Secondly, motivated by these findings, I develop a dynamic small open economy model that explicitly introduces imported materials as an input in domestic production, creating a direct cost channel that interacts with the financial channel. Final goods are produced using labor, capital, and imported inputs, so exchange rate variations directly affect firms' production decisions by altering the relative cost of domestic versus foreign factors. At the same time, banks intermediate credit to finance domestic inputs but face net-worth constraints, which implies that depreciations also tighten financial conditions. To distinguish between an emerging economy and an advanced economy in the model, I modify the correlation of shocks; more specifically, I allow foreign interest rate shocks to be correlated with the domestic technology process. The key contribution of the model is then to show that exchange rate shocks propagate through two reinforcing mechanisms: higher imported input costs and tighter bank credit conditions, which may explain why emerging economies react more strongly to exchange rate fluctuations.

Related literature:

An extensive empirical literature documents key facts about exchange rate volatility and other aggregate variables. Firstly, depreciation passes through to domestic prices imperfectly because of expenditure switching between domestic and imported inputs by producers, as well as markup adjustments, see, among others, Campa and Goldberg, 2002; Corsetti and Dedola, 2002; Burstein, Neves, and Rebelo, 2003; Nakamura and Zerom, 2009. In my framework, however, I generate imperfect pass-through with input substitution and its interaction with the credit channel.

Secondly, empirical studies have quantified how exchange rate movements are transmitted to the real economy through balance sheets and their impact on credit supply. Using a cross-country data panel, Shousha (2019) presents macro evidence supporting that a stronger dollar depresses output, investment, and private credit in emerging economies, mainly through financial conditions, while dominant-currency invoicing and global value-chain integration weaken the trade channel and raise imported-input costs. Caballero (2021) explores the effect of depreciations on investment when firms hold foreign currency debt, showing how currency depreciations increase the domestic currency value of liabilities compared to assets, and how that reduction in net worth weakens balance sheets and leads to tighter financial conditions. In addition, event studies exploiting large FX surprises show that banks' net foreign-currency positions shape lending and investment responses, as detailed by Agarwal (2025). Appreciation of domestic currency expands lending and enables firms to invest more. My work differs from these papers in that it provides a theoretical framework that emphasizes both the bank balance sheet channel and imported inputs, as well as their interaction during currency shocks.

Also, my work relates to papers highlighting the balance-sheet channel of exchange rate fluctuations. For example, Céspedes, Chang, and Velasco (2004) and Aguiar (2005) have studied how depreciations affect balance sheets, which relates to tighter financial conditions, affecting thus investment and thus output, particularly for emerging economies. I also expand on Akinci and Queralto (2023), who pose a model with financial frictions and dollar-denominated debt to study how U.S. monetary tightening spills over abroad, emphasizing the role of foreign-denominated assets, balance sheets, and their propagation to the real economy. The difference between their framework and mine is that I embed an imported input cost channel in marginal costs, so depreciation directly raises production costs. I study whether and how dual propagation (cost *and* credit) of exchange rate shocks can produce significant differences in overall economic stability between emerging and small advanced economies.

The rest of the paper is organized as follows. Section 2 presents the empirical analysis. Using country data, I first establish the association between exchange rate fluctuations and aggregate variables. Secondly, I quantify the impact of depreciations on banks' returns using Compustat data. I then bring together these results and extract a general conclusion that provides further support for the choice of methodological framework. Section 3 formalizes the aforementioned choice in a structural model. Section 4 shows both analytical results and quantitative impulse responses. Section 5 concludes.

2 Empirical Analysis

This section documents the relationship between exchange rate fluctuations and GDP growth, inflation, domestic interest rates, and banks' capital (stock returns). I subdivide this section into four subsections. The first subsection describes the data employed for my analysis. The second subsection examines how exchange rate fluctuations impact key macroeconomic variables and whether these effects are heterogeneous across countries. The third subsection examines how exchange rates affect the banks' profits. Finally, I tie together the main findings from these case studies and extract from them that depreciations have a greater impact on output, inflation, interest rates, and banks' returns in emerging economies, likely reflecting their less developed financial markets.

2.1 Data

I construct two complementary datasets. I first use data from the Bank for International Settlements (BIS), International Monetary Fund (IMF), Federal Reserve Bank of St. Louis (FRED), Organisation for Economic Co-operation and Development (OECD), and World Bank to build an unbalanced quarterly macro dataset covering 51 countries (30 small advanced economies and 21 emerging economies), with observations from 1990Q1 to 2023Q4.[1] This dataset includes the central bank policy rate, the bilateral exchange rate against the U.S. dollar, the consumer price index (CPI), the GDP deflator, and the effective federal funds rate. Prior to estimation, I winsorize the bottom and top 1 percentiles of the distribution of bilateral depreciations to mitigate the influence of extreme outliers (e.g., around the euro introduction). These variables are then used to estimate the impulse responses of GDP growth, inflation, and interest rates to exchange rate fluctuations using both VAR and local-projection techniques.

Second, I assemble a quarterly bank-level dataset to study how exchange rate fluctuations affect banks' stock returns via a fixed-effects panel regression. The equity return series correspond

[1] Appendix A.1 provides details on country coverage and the specific source for each indicator.

to banks headquartered in country c and listed on that country's domestic exchange. For cross-listed banks, I use the primary domestic listing and measure returns in local currency; observations without a domestic listing are excluded. The dependent variable is the realized ex-post real return of each bank, computed from Compustat nominal stock return deflated by realized CPI inflation from the IMF:

$$R_{i,t} \equiv \frac{1 + R^{\text{nom}}_{i,t}}{1 + \pi_{c(i),t}} - 1, \qquad \pi_{c(i),t} \equiv \Delta \ln \text{CPI}_{c(i),t}.$$

Explanatory variables include (i) the percentage change in the bilateral exchange rate, $\Delta e_{c(i),t} \equiv \Delta \ln(\text{domestic currency per U.S. dollar})$, so positive values denote a depreciation; (ii) the ex-post real return of the domestic stock market (Compustat market return deflated by realized CPI inflation); (iii) the ex-post domestic real interest rate $r^{\text{real}}_{c,t} = r^{\text{nominal}}_{c,t} - \pi_{c,t}$ constructed from the BIS policy rate $r^{\text{nominal}}_{c,t}$ and IMF CPI inflation; and (iv) the ex-post U.S. real interest rate $r^{*\text{real}}_{t} = r^{*}_{t} - \pi^{*}_{t}$ using the effective federal funds rate and U.S. CPI from FRED. All variables are aligned at the quarterly frequency. As in the macro specification, I winsorize the bottom and top 1 percentiles of the bank-level real-return distribution to reduce the influence of outliers.[2]

2.2 Exchange Rate Fluctuations and Aggregate Variables

I employ two methodologies commonly used in empirical macroeconomics to study the effects of exchange rate fluctuations on output, inflation, and domestic policy rates. Firstly, I run a VAR model, which relies on estimating an endogenous time-series system of equations. Secondly, I employ a local projection method, which involves a semi-parametric approach to estimating the effects of exchange rate fluctuations on aggregate variables. Despite methodological differences, these approaches are closely related and, under standard conditions, deliver equivalent impulse responses—see Jordà (2005) and Montiel Ólea, Plagborg-Møller, Qian, and Wolf (2025). Consistent with this equivalence, both techniques yield similar results: exchange rate depreciations have

[2] Appendix A.2 provides further information regarding the banking micro data.

a greater impact on emerging economies, resulting in larger output declines, higher inflation, and stronger interest rate responses.

2.2.1 VAR

For each country i, I assume the structural representation of the system:

$$B_i Y_{i,t} = \Gamma_{i,1} Y_{i,t-1} + \ldots + \Gamma_{i,p} Y_{i,t-p} + \varepsilon_{i,t} \tag{2.1}$$

where $Y_{i,t} = \begin{bmatrix} \Delta \ln GDP_{i,t} & \Delta \ln CPI_{i,t} & \Delta r_{i,t} & \Delta \ln FX_{i,t} & \Delta r_t^* \end{bmatrix}'$ is the stacked vector of variables for country i in period t. Each variable stands, respectively, for the log difference of the GDP deflator, the log difference of the consumer price index, the change in the domestic policy rate, the log difference of the exchange rate with the U.S. dollar as numeraire, and the change in the Fed's rate. $B_i \in \mathbb{R}^{5\times5}$ represents the contemporaneous impact matrix, and $\varepsilon_{i,t} \in \mathbb{R}^5$ are the structural shocks assumed to be white noise. To recover the structural errors needed for computing the IRFs, I apply a Cholesky decomposition to B_i, that is, setting it to be upper-triangular, as done by Kim and Roubini (2000). More specifically:

$$B_i = \left[\begin{array}{c|ccccc} & \text{GDP} & \text{CPI} & r & \text{FX} & r^* \\ \hline \text{GDP} & 1 & b_{1,2} & b_{1,3} & b_{1,4} & b_{1,5} \\ \text{CPI} & 0 & 1 & b_{2,3} & b_{2,4} & b_{2,5} \\ r & 0 & 0 & 1 & b_{3,4} & b_{3,5} \\ \text{FX} & 0 & 0 & 0 & 1 & b_{4,5} \\ r^* & 0 & 0 & 0 & 0 & 1 \end{array}\right]$$

In this specification, the upper–triangular B_i with ordering $[\text{GDP}, \text{CPI}, r, \text{FX}, r^*]$ delivers a right-to-left contemporaneous flow. The foreign policy rate r^* is contemporaneously exogenous to country i. Exchange rates can move within the quarter with r^*, while the domestic policy rate r can react within the quarter to r^* and to the exchange rate. Prices (CPI) are allowed to comove contemporaneously with financial conditions through import-cost and administered-price channels, and real activity (GDP) is modeled as an intra-quarter absorber of information so it can respond on impact to financial and external shocks. By contrast, GDP and CPI do not contemporaneously feed back into r, FX, or r^*, and, crucially, the same-quarter domestic policy surprise does not move FX on impact in this scheme.

This last restriction reflects identification for exchange rate shocks. Quarterly policy measures are scheduled and heavily anticipated, so the unanticipated component of r is small relative to FX variation driven by global news and expected policy paths. The structure thus isolates external monetary innovations as the primary driver, allowing domestic policy to react contemporaneously to external and exchange-rate conditions, and enables prices and quantities to register these financial conditions within the quarter. Note, however, that these restrictions relate to the *contemporaneous*, not lagged, behaviour on the structural parameters of the system.

Finally, the lag order p is chosen for each country by minimizing the Akaike Information Criterion (AIC) over lag lengths 1 through 5, with the cap preventing over-parametrization in short samples.

	Emerging Market Economies			**Small-open Advanced Economies**		
Horizon	Δr	$\Delta \ln \mathrm{CPI}$ (%)	$\Delta \ln \mathrm{GDP}$ (%)	Δr	$\Delta \ln \mathrm{CPI}$ (%)	$\Delta \ln \mathrm{GDP}$ (%)
2 quarters	-2.64 (21.72)	0.25^* (0.19)	-0.42 (1.66)	-6.23^* (5.46)	-0.02 (0.12)	-0.19 (0.40)
4 quarters	5.52 (40.42)	0.36 (0.39)	-0.47 (1.07)	-6.98 (11.09)	-0.04 (0.23)	-0.27 (0.72)
8 quarters	5.96 (59.54)	0.44 (0.60)	-0.56 (1.66)	-9.16 (16.47)	-0.07 (0.34)	-0.23 (1.03)

Table 1: Cumulative IRFs to a 10% exchange-rate depreciation. CPI and GDP are expressed in percentages, whereas the interest rate is given in basis points. Bootstrap standard errors in parentheses. Entries show coefficient with significance (***, **, *) for 5%, 10%, 30% levels.

Table 1 summarizes the results of the VAR model. It shows that interest rates and inflation increase in emerging economies following a currency devaluation. The reaction in advanced economies is the opposite one. The table also shows that, while currency devaluations are followed by GDP contractions in both groups, the magnitudes are significantly larger in emerging economies. For example, GDP in emerging economies accumulates a fall of 0.56% one year after a currency depreciation of 10%. In contrast, GDP accumulates a fall of 0.27% in advanced economies.

2.2.2 Local Projections

Jordà (2005) utilizes Local Projection (LPs) methods to estimate IRFs. The main advantage of this approach is that, by imposing a semi-parametric form, one avoids the issue of misspecification and can easily address state dependency, non-linearities, and endogeneity problems that are often found in the data. In addition, controlling for unobserved individual heterogeneity can simply be accomplished by using fixed-effects techniques.

Regarding the estimation procedure, I follow Ramey (2016) and for each country I first estimate the "exchange rate shock "as the forecast error of an autoregressive process. Formally, the shock is defined as $\hat{\varepsilon}_t^{FX} \equiv \Delta \ln FX_t - \mathbb{E}[\Delta \ln FX_t | \mathcal{F}_{t-1}]$. By construction, $\hat{\varepsilon}_t^{FX}$ is mean-independent of anything measurable at time $t-1$, i.e., it is uncorrelated with past values. I then use this residual as the regressor to measure the effect of *unexpected* exchange rate variations on output, inflation, and domestic interest rates. The empirical model, for each country i and quarter h, is then

$$\begin{aligned}\Delta^h y_{i,t} = \alpha_i^h + \gamma_t^h + \beta_1^h \widehat{\varepsilon}_{i,t}^{FX} + \beta_2^h \left(\widehat{\varepsilon}_{i,t}^{FX} \times EM_i\right) \\ + \sum_{l=1}^{L} \delta_l^h \Delta^{h-l} y_{i,t-l} + \sum_{l=0}^{L} (\theta_l^h)' \Delta^{h-l} Z_{i,t-l} + \sum_{l=0}^{L} \phi_l^h \Delta R_{t-l}^* + u_{i,t+h}^y \end{aligned} \tag{2.2}$$

where $\Delta^h y_{i,t} \equiv y_{i,t+h} - y_{i,t-1}$ denotes the h-period-ahead *cumulative* change in the dependent variable, α_i^h are country fixed effects, and γ_t^h are time effects. The dependent variables to be studied are: (i) $\ln GDP$; (ii) $\ln CPI$; (iii) Interest rate. To capture differential responses across country groups, the specification interacts the exchange rate shock with an indicator EM_i, which equals one for emerging economies, thereby allowing the estimated impulse responses to vary between emerging and advanced economies. $Z_{i,t}$ denotes controls (domestic interest rate, inflation, or output, depending on the variable to be projected), and R_t^* denotes the FED's rate. In addition, lagged values of the dependent and control variables are included up to order $L = 6$ to account for persistence.

The key identification assumption is that $\mathbb{E}[\hat{\varepsilon}_t^{FX} u_{t+h}] = 0 \quad \forall h \geq 0$. Economically, this means the "exchange rate shock" is an unanticipated movement—driven by news/risk-premium forces—that moves the exchange rate today but carries no independent predictive content for the unmodeled future disturbances in output, prices, or policy rates. Any effect on future y_{t+h} operates only through the channels captured in the projection (and the included controls), not through omitted future disturbances, captured by u_{t+h}. As an illustration, $\Delta^3 \ln GDP_{Argentina,t} \equiv \ln GDP_{Argentina,t+3} - \ln GDP_{Argentina,t-1}$ represents the quarter $t+3$ *cumulative percentage change*[3] of Argentina's GDP in response to, for example, an exchange rate shock at time t. Finally, when inflation and the domestic policy rate appear as controls, their forward values are also projected in $t+h$ so that the conditional path of these variables is held fixed when tracing the response of $y_{i,t}$ to an exchange rate shock.

Figure 1 displays the *cumulative* responses of the dependent variables amid a 1% exchange rate shock for both groups of economies. The graph clearly indicates that emerging economies react significantly more in response to exchange rate shocks than advanced economies. For example, in a typical emerging economy, output falls by -0.1% on impact, and inflation rises almost 0.1% on impact after a 1% depreciation shock. Interest rate responses exhibit hump-shaped dynamics in response to a currency shock. See, for instance, that the interest rate increases by 4 basis points (0.04%) immediately after a 1% exchange rate shock. For a typical advanced economy, however, the magnitude of the dynamic response for all variables is small; regardless, they are statistically different than 0. More details on the estimated coefficients are presented in Table 7 and Figure 8

[3] I abuse notation and interchange log differences with percentage changes.

in the Appendix.

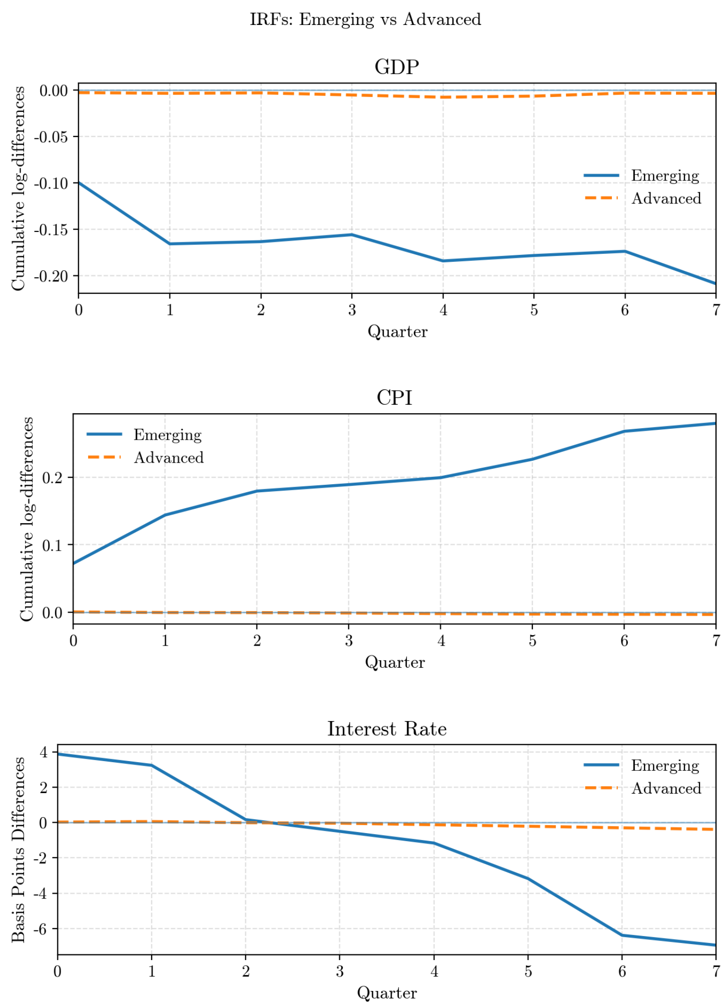

Figure 1: LP IRFs for Emerging and Advanced Economies. The scale is percentage points for CPI and GDP values, whereas the interest rate is in basis points.

2.2.3 Results and Methodological Comparisons

The results of this study indicate that emerging economies react more strongly to exchange rate depreciations, with output falling more, inflation rising more, and policy rates increasing more persistently, compared to advanced economies, where the effects are milder and sometimes even deflationary. In both groups, however, depreciations are recessionary, with sharper magnitudes in emerging economies.

Regarding the choice of methodology, one may question the rationale for using VARs over local projections, or vice versa. Asymptotically, both techniques should converge to the same impulse response coefficient, provided the lag structure is correctly specified.[4] Each method, however, comes with its own drawback. For VARs, the general problem is that one lacks sufficient information to choose the potentially large optimal lag level, and misspecification compounds over the estimated impulse responses, thereby biasing the results. Local projections, by contrast, are estimated horizon by horizon, so the bias is smaller. Yet this comes at the cost of higher variance, reflected in wider confidence intervals.[5] For the purposes of this paper, what matters is that both methods consistently point to the same qualitative patterns discussed above.

2.3 Exchange Rate Fluctuations and the Banking Industry

This subsection examines the impact of real depreciations on banks' real stock returns and whether these effects differ significantly between banks in emerging and advanced economies. I do so by relying on a panel of microdata that covers 294,504 bank–quarter observations across 40 countries between Q1 1986 and Q1 2025. Each observation corresponds to a bank's quarterly stock return in real terms.

I then estimate equation (2.3), which measures how banks' real stock returns react to a real depreciation and other real control variables. Following Bodnar, Dumas, and Marton (2002) and Bodnar and Wong (2003), I interpret an increase in the banks' stock returns as an increase in the present discounted value of future profits. This matters for balance sheets because realized profits mechanically raise retained earnings and thus book equity (reported stock price), while higher expected profits lift the market value of equity, both strengthening banks' net-worth position. The specification also controls for the real return on the domestic stock market index, real domestic interest rates, and the real FED's funds rate.

[4] See Jordà (2005).

[5] This arises because the dependent variable in an LP at horizon h is y_{t+h}, leaving only $T-h$ usable observations. As the variance of an OLS estimator is inversely proportional to sample size, the standard error of $\hat{\beta}_h$ increases with h. A VAR, in contrast, always uses the full T observations, which explains its tighter confidence bands as h grows.

As an illustration, consider the case where i is Banco Macro, an Argentinian bank ($c(i) = Argentina$). Its real return at time t, $R_{\text{Banco Macro},t}$, is modeled as depending on:

- the real depreciation of Argentina, $\Delta\% FX_{Argentina,t}$;
- its interaction with the emerging-market dummy, $EM_{Argentina} \times \Delta\% FX_{Argentina,t}$;
- the real return on Merval, the Argentinian Stock Index, $R_{Argentina,t}$;
- the real central bank policy rate of Argentina, $R^f_{Argentina,t}$;
- the FED's real interest rate, R^*_t.

To recover the parameter values, the empirical approach involves a panel fixed-effects regression, which enables me to net out time-invariant country- and bank-specific characteristics. The key parameters of interest are the coefficient on the real depreciation (β) and its interaction with an emerging-market dummy (δ), where I explicitly test whether these effects are statistically significant. The empirical model is then:

$$R_{i,t} = \alpha_i + \beta \Delta\% FX_{c(i),t} + \delta (EM_{c(i)} \Delta\% FX_{c(i),t}) + \gamma_0 R_{c(i),t} + \gamma_1 R^f_{c(i),t} + \gamma_2 R^*_t + \varepsilon_{i,t} \quad (2.3)$$

Table 2 shows that banks' real stock returns fall after a real currency depreciation, in *both* emerging and advanced economies; yet, the magnitude of that effect is *bigger* in the former group. Consistent with this, the equality restriction $\beta = \delta$ is rejected by the Wald test $F(1, 5092) = 49.67$[6], $p < 0.001$, rejecting the null hypothesis that the two coefficients are equal. Moreover, all the coefficients of the aggregate variables are statistically significant and have logical signs. The return on the index correlates positively with the return on banks, which means better returns when the overall economy is growing. Secondly, exchange rate depreciation negatively affects banks' returns. Finally, the last two variables, the real returns of domestic and foreign "safe" assets, are negatively associated with banks' real returns. This relationship is also intuitive, as it reflects

[6] 1 stands for the number of restrictions, whereas $5,092$ are the degrees of freedom used to compute the F-value.

	Coefficient	**Coefficient** (Excludes Japan & UK)
Real Return Index	0.430***	0.365***
	(0.043)	(0.042)
Real Depreciation	-0.045***	-0.066***
	(0.014)	(0.013)
Real Depreciation × EM	-0.403***	-0.416***
	(0.047)	(0.047)
Real Domestic Interest Rate	-0.003**	-0.003***
	(0.001)	(0.001)
Real FED Interest Rate	-0.278***	-0.118**
	(0.050)	(0.053)
Constant	0.024***	0.024***
	(0.001)	(0.001)
Observations	288,580	200,889
R^2	0.064	0.061
Adjusted R^2	0.047	0.042
Fixed effects	Country-Firm	Country-Firm

Notes: Fixed effects regression. Standard errors in parentheses, clustered at the firm level.
***, ** denote significance at 1%, 5% level respectively. The second column excludes Japan and the United Kingdom.

Table 2: Fixed effects regression of real returns on real depreciation and controls.

the opportunity cost associated with other investments. As a robustness check, I re-estimate the same regression *excluding* Japan and the United Kingdom. Although they are currently classified as small advanced economies, they have had a relevant role in financial markets at the end of the 20th century, which could bias the results. Nevertheless, the coefficients on real depreciation and its interaction remain similar in both sign and magnitude across both regressions. The only notable change is that the coefficient on the FED's interest rate becomes smaller and marginally less significant, which is consistent with the idea that banks in advanced economies are relatively more elastic or substitutable with respect to U.S. interest rate movements.

3 Model

I develop a small open economy general-equilibrium model based on the environment described by Akinci and Queralto (2023) (hereafter AQ). The model features a banking sector and final-good producers that are exposed to currency fluctuations. A key difference between my model and AQ lies in the production technology. My framework enables goods-producing firms that combine domestic value-added and imported materials using a CES aggregator. This makes marginal costs directly dependent on domestic factor prices and the cost of imported inputs, which are influenced by the exchange rate. Moreover, I also depart from their sticky-price framework in order to abstract from the allocative distortions caused by inflation.

Importantly, this supply-side aspect interacts with financial intermediation as described in AQ. Banks transform funding into domestic credit and charge an endogenous credit premium that depends on their balance-sheet strength. Consequently, shocks that trigger a currency depreciation, such as a foreign interest rate hike, can propagate through two reinforcing channels: a cost channel (via imported inputs) and a credit channel (via bank spreads). This interaction can potentially lead to a stronger pass-through effect and larger and faster movements in real quantities, such as output and investment, for a given shock.

In summary, while the macroeconomic environment aligns with AQ, my paper focuses on how the production structure interacts with the financial sector and how this interaction affects costs and the propagation of shocks.

3.1 Households

There is a unit measure continuum of identical households. Within each household, a fraction $f \in (0,1)$ are *bankers* and the remaining $1-f$ are *workers*. Perfect intra-household insurance implies that household members pool resources and make joint decisions. The representative household then chooses state-contingent sequences of the consumption index $\{C_t, C_t^H, C_t^F\}$, working time $\{L_t\}$, and portfolio allocations $\{D_t, B_t\}$ to maximize expected lifetime utility:

$$\max_{\left\{C_t, C_t^H, C_t^F, L_t, D_t, B_t\right\}_{t=0}^{\infty}} \mathbb{E}_0\left[\sum_{t=0}^{\infty} \beta^t\left(\log\left(C_t\right)-\frac{L_t^{(1+\chi)}}{1+\chi}\right)\right]$$

Subject to an intertemporal budget constraint:

$$B_t + P_t C_t + P_t D_t = W_t L_t + P_t R_t D_{t-1} + \Pi_t + R_t^f B_{t-1} + T_t$$

where B_t is the risk-free domestic debt already in domestic currency, with corresponding nominal gross rate R_t^f, D_t is the amount of domestic bank deposits and corresponding deposit real gross rate R_t, Π_t are the profits from firms and banks rebated to households, and T_t are the transfers from the government. Moreover, the consumption index C_t is a CES aggregate of domestic and imported goods:

$$C_t = \left[(1-\omega)^{\frac{1}{\eta}} \left(C_t^H \right)^{\frac{\eta-1}{\eta}} + \omega^{\frac{1}{\eta}} \left(C_t^F \right)^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}} \tag{3.1}$$

With $\omega \in (0,1)$ being the share of foreign goods, $\eta > 1$ the elasticity of substitution between domestic and foreign goods, and P_t being the consumption basket price index, obtained from the expenditure minimization problem, composed of both domestic and foreign prices:

$$P_t = \left[(1-\omega) \left(P_t^H \right)^{1-\eta} + \omega \left(P_t^F \right)^{1-\eta} \right]^{\frac{1}{1-\eta}} \tag{3.2}$$

The first order conditions below describe households' optimal decisions:

$$\frac{W_t}{P_t} = L_t^{\chi} C_t \tag{3.3}$$

$$\mathbb{E}_t \left[\frac{C_{t+1}}{C_t} \right] = \beta R_{t+1} \tag{3.4}$$

$$\mathbb{E}_t \left[\frac{C_{t+1}}{C_t} \frac{P_{t+1}}{P_t} \right] = \beta R_{t+1}^f \tag{3.5}$$

$$C_t^F = \omega \left(\frac{P_t^F}{P_t} \right)^{-\eta} C_t \tag{3.6}$$

$$C_t^H = (1-\omega) \left(\frac{P_t^H}{P_t} \right)^{-\eta} C_t \tag{3.7}$$

3.2 Banks

Households own banks, and a fraction f of households are bankers who manage them. Each banker survives into the next period with probability θ_p; those who do not survive exit, transfer resources back to the household, and become workers. Following Gertler and Karadi (2011) and

AQ (2023), I keep the banker share constant by setting the conditional probability that a worker at t becomes a banker at $t+1$ to $\Pr(b'|w) = \frac{(1-\theta_p)f}{1-f}$.[7]

More specifically, a banker j chooses assets $A_{j,t}$, domestic deposits $D_{j,t}$, and foreign-currency deposits $D^*_{j,t}$ to maximize exit net worth $N_{j,t}$. The bank's balance sheet in real terms is

$$N_{j,t} = Q_t A_{j,t} - D_{j,t} - S_t D^*_{j,t}, \tag{3.8}$$

where Q_t is the price of the asset claim and S_t is the real exchange rate. The budget constraint linking revenues and funding is

$$Q_t A_{j,t} + R_t D_{j,t-1} + S_t R^*_t D^*_{j,t-1} = \frac{Z_t}{P_t} A_{j,t-1} + (1-\delta) Q_t A_{j,t-1} + D_{j,t} + S_t D^*_{j,t}, \tag{3.9}$$

where Z_t denotes the asset payoff, δ is the depreciation rate, and R_t and R^*_t are the domestic and foreign gross deposit rates. The left-hand side collects uses of funds (new asset purchases and repayment of deposits with interest), while the right-hand side collects sources of funds (asset payoffs net of depreciation and new deposit issuance, domestic and foreign). Combining (3.9) with the balance-sheet identity (3.8) yields:

$$N_{j,t} = A_{j,t-1}\left(\frac{Z_t}{P_t} + (1-\delta)\, Q_t\right) - \left(R_t D_{j,t-1} + S_t R^*_t D^*_{j.t-1}\right) \tag{3.10}$$

By adding and subtracting $R_t Q_{t-1} A_{j,t-1}$ and $R_t S_{t-1} D^*_{j,t-1}$ into (3.10), and defining the (predetermined) capital credit spread as $R^K_t \equiv \underbrace{\frac{Z_t}{P_t Q_{t-1}} + \frac{(1-\delta)\, Q_t}{Q_{t-1}}}_{R^k} - R_t$, one derives the evolution of banks' net worth as:

$$N_{j,t} = R^K_t Q_{t-1} A_{j,t-1} + \left(R_t S_{t-1} - R^*_t S_t\right) D^*_{j,t-1} + R_t N_{j,t-1} \tag{3.11}$$

[7] This choice enforces stationarity of the banker share: $f_{t+1} = \theta_p f_t + \Pr(b'|w)(1-f_t)$, which yields $\Pr(b'|w) = \frac{(1-\theta_p)f}{1-f}$ in steady state.

which implies, over time, any increase in bankers' net worth above the risk-free rate arises from the capital spread and the differential between domestic and foreign interest rates. All things being equal, a real devaluation decreases bankers' net worth value, as captured by $\frac{\partial N_{jt}}{\partial S_t} = -R_t^* D_{j,t-1}^*$.

The bankers' problem can now be formally described as:

$$V_{j,t} = \max_{A_t, D_t, D_t^*} \mathbb{E}_t \left[\sum_{i=1}^{\infty} \Lambda_{t,t+i} \overbrace{(1-\theta_p)}^{\text{Exit prob.}} \underbrace{\theta_p^{i-1}}_{\text{Survival prob. up to } i-1} N_{j,t+i} \right] \tag{3.12}$$

subject to (3.11) and an incentive constraint:

$$V_{j,t} \geq \Theta \left(\frac{S_t D_{j,t}^*}{Q_t A_{j,t}} \right) Q_t A_{j,t} \tag{3.13}$$

The term $\Lambda_{t,t+i} = \beta^i \frac{U_{C_{t+i}}}{U_{C_t}}$ refers to the household stochastic discount factor between periods t to $t+i$. As explained in Gertler and Kiyotaki (2010) and Gertler and Karadi (2011), the incentive constraint arises because positive interest rate differentials on capital and foreign assets lead banks to borrow unlimited resources from households. Thus, the constraint allows for an endogenous way of limiting banks' funding requirements. Additionally, $\Theta(\cdot) \in (0,1)$ is a divertibility function that captures the idea that bankers are more capable of diverting resources when the proportion of foreign assets is larger. This points out that domestic assets hold less value as collateral.

I solve for the value function of bankers from the following Bellman equation

$$V_{j,t} = \mathbb{E}_t \left[\Lambda_{t,t+1} (1-\theta_p) N_{j,t+1} + \Lambda_{t,t+1} \theta_p V_{j,t+1} \right] \tag{3.14}$$

by guessing the value takes the form $V_{j,t} = \Psi_t N_{j,t}$, where Ψ_t is a time-varying coefficient independent of bank-specific characteristics,

$$\Psi_t = \mathbb{E}_t \left[\frac{\Lambda_{t,t+1} N_{j,t+1}}{N_{jt}} (1 - \theta_p + \theta_p \Psi_{t+1}) \right] \tag{3.15}$$

Defining $x_{j,t} \equiv \frac{S_t D^*_{j,t}}{Q_t A_{j,t}}$ and $\phi_{j,t} \equiv \frac{Q_t A_{j.t}}{N_{j,t}}$ as the proportion of foreign liabilities to assets and the bank's leverage respectively, the continuation value can be expressed as a function of those ratios,

$$\Psi_t = \max_{x_{jt},\, \phi_{jt}} \; \big(\sigma_t + \zeta_t x_{jt}\big)\phi_{jt} + \varrho_t$$

subject to

$$\Psi_t = \Theta(x_{j,t})\phi_{j,t}$$

where

$$\sigma_t = \mathbb{E}_t\big[\Lambda_{t,t+1}\Omega_{t+1}R^K_{t+1}\big], \tag{3.16}$$

$$\zeta_t = \mathbb{E}_t\left[\Lambda_{t,t+1}\Omega_{t+1}\left(R_{t+1} - \frac{R^*_{t+1}}{S_t}S_{t+1}\right)\right], \tag{3.17}$$

$$\varrho_t = \mathbb{E}_t\big[\Lambda_{t,t+1}\Omega_{t+1}R_{t+1}\big], \tag{3.18}$$

$$\Omega_{t+1} = 1 - \theta_p + \theta_p\Psi_{t+1}. \tag{3.19}$$

Note that ϱ_t, σ_t, ζ_t depend only on aggregate variables rather than idiosyncratic bank characteristics, and $x_{j,t}$ is determined by them, so $x_{j,t} = x_t \forall j$. Using the incentive constraint and taking FOC with respect to x_t, results in

$$\zeta_t = \frac{\Theta'(x_t)}{\Theta(x_t) - \Theta'(x_t)\,x_t}\sigma_t \tag{3.20}$$

the leverage ratio also depends only on aggregate (economy-wide) conditions; thus, using the bankers' value function and the incentive constraint, it can be expressed as:

$$\phi_t = \frac{\varrho_t}{\Theta(x_t) - \sigma_t - \zeta_t x_t} \tag{3.21}$$

Since the leverage ratio has to be positive, and given $\varrho_t > 0,\ \Theta(x_t) > 0,\ x_t > 0$, the incentive constraint binds if the denominator is positive, i.e.: $0 < \sigma_t + \zeta_t x_t < \Theta(x_t)$.

Given that all bankers have the same solution to an identical optimization problem, so $\frac{1}{f} A_t = A_{j,t}$, $\frac{1}{f} D_t^* = D_{j,t}^*$ and $\frac{1}{f} N_t = N_{j,t}$. Consequently, the aggregates satisfy the following:

$$Q_t A_t = \phi_t N_t \tag{3.22}$$

$$S_t D_t^* = x_t Q_t A_t \tag{3.23}$$

It is worthwhile decomposing the net worth evolution into the part coming from new and existing bankers:

$$N_t = N_t^E + N_t^N$$

As in Gertler and Karadi (2011), I assume the startup funds for new bankers are equal to a small fraction of the value of assets previously transferred from exiting bankers. Letting ξ be that fraction of endowment, aggregate banks' net worth evolution can be expressed as:

$$N_t = \theta_p \left(R_t^K Q_{t-1} A_{t-1} + \left(R_t S_{t-1} - R_t^* S_t \right) D_{t-1}^* + R_t N_{t-1} \right) + (1 - \theta_p) \xi Q_t A_{t-1} \tag{3.24}$$

3.3 Non-Financial Firms

The real sector of the domestic economy comprises competitive capital-goods producers, a measure one continuum of monopolistically competitive final goods producers, and a domestic final goods aggregator.

3.3.1 Capital-Goods Producer

The capital goods producer is a representative domestic firm that invests, subject to adjustment costs. Producing I_t units of new capital require paying $I_t + \frac{\psi}{2} \left(\frac{I_t}{K_t} - \delta \right)^2 K_t$. Their problem is then

$$\Pi_t^K = \max_{I_t} \left\{ Q_t I_t - I_t - \frac{\psi}{2} \left(\frac{I_t}{K_t} - \delta \right)^2 K_t \right\}.$$

The optimality condition and the law of motion for capital require:

$$Q_t = 1 + \psi \left(\frac{I_t}{K_t} - \delta \right) \tag{3.25}$$

$$K_{t+1} = I_t + (1 - \delta) K_t \tag{3.26}$$

3.3.2 Goods Producers

There is a unit measure of differentiated home sectors indexed by $s \in [0, 1]$. Domestic final home output aggregates sectoral home varieties $\{y^H_{s,t}\}_{s\in[0,1]}$ with elasticity of substitution $\epsilon > 1$:

$$Y^{AH}_t = \left[\int_0^1 \left(y^H_{s,t} \right)^{\frac{\epsilon-1}{\epsilon}} ds \right]^{\frac{\epsilon}{\epsilon-1}} \tag{3.27}$$

Let P^H_t denote the corresponding CES price index. Cost minimization implies the home demand for each sectoral variety:

$$y^H_{s,t} = \left(\frac{P^H_{s,t}}{P^H_t} \right)^{-\epsilon} Y^{AH}_t \tag{3.28}$$

Sector Technology: In the spirit of Edmond, Midrigan and Xu (2023), each sector s produces output using a CES aggregator over *value added* $v_{s,t}$ and *imported materials* $m_{s,t}$:

$$y_{s,t} = \Gamma_t \left[(1 - \omega)^{\frac{1}{\eta}} \, v_{s,t}^{\frac{\eta-1}{\eta}} + \omega^{\frac{1}{\eta}} \, m_{s,t}^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}} \tag{3.29}$$

where Γ_t is a (sector-neutral) exogenous productivity shifter. Value added is Cobb–Douglas in capital $k_{s,t}$ and labor $l_{s,t}$:

$$v_{st} = k^{\alpha}_{st} l^{1-\alpha}_{st}, \qquad \alpha \in (0, 1) \tag{3.30}$$

Given the Cobb–Douglas form, the unit cost of value added at time t is

$$P^V_t = \left(\frac{W_t}{1 - \alpha} \right)^{1-\alpha} \left(\frac{Z_t}{\alpha} \right)^{\alpha} \tag{3.31}$$

Cost-minimizing factor demands for a given $v_{s,t}$ are

$$k_{s,t} = \alpha\, P_t^V\, \frac{v_{s,t}}{Z_t}, \qquad l_{s,t} = (1-\alpha)\, P_t^V\, \frac{v_{s,t}}{W_t}. \tag{3.32}$$

For the CES composite in (3.29), with prices P_t^V (for v) and P_t^F (for m), the associated unit cost index is

$$PPI_t = \left[(1-\omega)\,(P_t^V)^{1-\eta} + \omega\,(P_t^F)^{1-\eta}\right]^{\frac{1}{1-\eta}} \tag{3.33}$$

Define $\widetilde{y}_{s,t} \equiv y_{s,t}/\Gamma_t$. Optimal conditional input demands are

$$v_{s,t} = (1-\omega)\left(\frac{P_t^V}{PPI_t}\right)^{-\eta} \widetilde{y}_{s,t}, \qquad m_{s,t} = \omega\left(\frac{P_t^F}{PPI_t}\right)^{-\eta} \widetilde{y}_{s,t} \tag{3.34}$$

The sectoral total cost of producing $y_{s,t}$ is linear in effective output:

$$TC_{s,t} = (1-\omega)P_t^V\left(\frac{P_t^V}{PPI_t}\right)^{-\eta} \widetilde{y}_{s,t} + \omega\, P_t^F\left(\frac{P_t^F}{PPI_t}\right)^{-\eta} \widetilde{y}_{s,t} = \frac{PPI_t}{\Gamma_t}\, y_{s,t}$$

so that profits can be written as:

$$\max_{p_{s,t}} \Pi_{s,t}^G = p_{s,t}y_{s,t} - PPI_t\frac{y_{s,t}}{\Gamma_t}$$

Firms can sell goods to both domestic and foreign consumers. Since technology exhibits constant returns to scale, the purpose of maximizing profits can be viewed independently for both domestic and international sales. In addition, each firm posts a *single* producer price $p_{s,t}^H$ (home currency), which means that domestic buyers face $p_{s,t}^H$ whereas foreign buyers pay the same producer price converted into foreign currency via the nominal exchange rate e_t, which has foreign currency as numeraire (e.g., 1 USD = 1500 ARS[8])

$$\text{foreign-currency price} = \frac{p_{s,t}^H}{e_t}$$

[8] ARS is the symbol for Argentine Pesos.

This implies that sellers cannot discriminate between domestic and foreign consumers. Thus, under the domestic-oriented price-setting assumption, firm s chooses $p^H_{s,t}$ to solve

$$\Pi^{G_H}_{s,t} = p_{s,t}\, y^H_{s,t} - \frac{PPI_t}{\Gamma_t}\, y^H_{s,t}, \quad \text{s.t. } y^H_{s,t} = \left(\frac{p^H_{s,t}}{P^H_t}\right)^{-\epsilon} Y^{AH}_t.$$

The FOC determines the optimal price, which is set as a markup over the marginal cost

$$p^H_{s,t} = \mu\, \frac{PPI_t}{\Gamma_t}, \qquad \mu \equiv \frac{\varepsilon}{\varepsilon - 1} > 1. \tag{3.35}$$

Turning to exports, their supply is perfectly elastic, implying that they are determined by export demand. Let P^*_t be the foreign price index, Y^*_t foreign aggregate expenditure, and ε^* the foreign elasticity of substitution across varieties and foreign goods. Exports demand for each sector is assumed to be:

$$c^{H_*}_{s,t} = \left(\frac{p^H_{s,t}}{e_t P^*_t}\right)^{-\varepsilon^*} Y^*_t. \tag{3.36}$$

The optimal price is not sector-specific; instead, it depends solely on common macroeconomic conditions and the aggregate demand elasticity. Consequently, prices are symmetric across sectors, and so are quantities $\{y_{s,t}, v_{s,t}, m_{s,t}, k_{s,t}, l_{s,t}, c^{H_*}_{s,t}\}$, which hints that aggregates satisfy:

$$P^H_t = \mu\, \frac{PPI_t}{\Gamma_t} \tag{3.37}$$

$$V_t = \int_0^1 v_{st} ds = (1-\omega)\left(\frac{P^V_t}{PPI_t}\right)^{-\eta} \frac{Y^{AH}_t}{\Gamma_t} \tag{3.38}$$

$$M_t = \int_0^1 m_{st} ds = \omega\left(\frac{P^F_t}{PPI_t}\right)^{-\eta} \frac{Y^{AH}_t}{\Gamma_t} \tag{3.39}$$

$$\frac{K_t}{L_t} = \frac{\int_0^1 k_{st} ds}{\int_0^1 l_{st} ds} = \frac{\alpha W_t}{(1-\alpha) Z_t} \tag{3.40}$$

$$Y^{AH}_t = \Gamma_t \left[(1-\omega)^{\frac{1}{\eta}} \left(K^\alpha_t L^{1-\alpha}_t\right)^{\frac{\eta-1}{\eta}} + \omega^{\frac{1}{\eta}} M_t^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}} \tag{3.41}$$

$$C^{H*}_t = \left(\frac{P^H_t}{e_t P^*_t}\right)^{-\epsilon^*} Y^*_t \tag{3.42}$$

3.4 Monetary Authority

The central bank implements a Taylor-type rule that targets the *domestic* inflation component only:

$$R^f_{t+1} = \frac{\left(\pi^H_t\right)^\gamma}{\beta}\varepsilon^{Rf}_t \tag{3.43}$$

where $\gamma > 1$ is the interest rate sensitivity to domestic inflation $\pi^H_t = \frac{P^H_t}{P^H_{t-1}}$, and ε^{Rf}_t follows an AR(1) in logs. Also, the government uses lump-sum taxes (transfers) to rebate the losses (benefits) from debt creation: $B_t - R^f_t B_{t-1} = T_t$.

3.5 Foreign Economy

In the context of a small open economy, I assume that foreign output and price level are exogenous. In addition, the law of one price holds, which means:

$$P^F_t = P^*_t e_t \tag{3.44}$$

As a consequence, the real exchange rate, domestic and foreign prices are linked in the form:

$$S_t = \frac{P^*_t e_t}{P_t} \tag{3.45}$$

Drawing on the work of Schmitt-Grohé and Uribe (2003), the interest rate on foreign currency is impacted by a premium that relates the real level of debt to a steady state benchmark, highlighting the dynamics at play in global finance

$$R^*_t = R^W_t \exp\left\{\kappa\left(\frac{D^*_t}{P^*_t} - \bar{D}^*\right)\right\} \tag{3.46}$$

where R^W_t is the exogenous foreign interest rate, and $\bar{D}^*$ is an average real value of domestic debt denominated in foreign currency.

3.6 Market Clearing and Equilibrium Definition

The supply of loanable capital (claims) must be equal to the choice (demand) of capital

$$A_t = K_{t+1} = (1-\delta)\,K_t + I_t \tag{3.47}$$

Secondly, goods clearing requires

$$Y_t^{AH} = C_t^H + C_t^{H*} + I_t + \left(\frac{I_t}{K_t} - \delta\right)^2 K_t \tag{3.48}$$

Thirdly, the balance of payments identity is established by aggregating the profits of bankers and firms, which are then incorporated into the budget constraint of households

$$S_t\left(D_t^* - R_t^* D_{t-1}^*\right) = \frac{P_t^* e_t}{P_t}(C_t^f + M_t) - \frac{P_t^H}{P_t} C_t^{H*} \tag{3.49}$$

Finally, a dynamic equilibrium is a set of quantities $\{\, Y_t^{AH}, C_t, C_t^H, C_t^F, L_t, I_t, K_{t+1}, V_t, M_t, C_t^{H*}, A_t, D_t^*, N_t \,\}$, prices $\{\, P_t, P_t^H, P_t^F, \mathrm{PPI}_t, P_t^V, W_t, Z_t, R_{t+1}^f, R_{t+1}, S_t, e_t, Q_t, R_t^* \,\}$, banks' coefficients $\{\, \sigma_t, \zeta_t, \varrho_t, \Omega_t, \phi_t, x_t \,\}$, and exogenous processes $\{\, \Gamma_t, P_t^*, Y_t^*, R_t^W, \varepsilon_t^{R^f} \,\}$, such that, given the exogenous processes, quantities, prices, and banks' coefficients, solve (3.2)–(3.7), (3.16)–(3.26), (3.31), (3.32), (3.37)–(3.49); a system of 32 equations in 32 variables.

4 Model Results

This section has two parts. First, I present the *analytical results*, which include formal propositions from the model's structure, highlighting key theoretical mechanisms and their implications. Second, I discuss the *quantitative results*, evaluating the model's fit, and conducting counterfactual scenarios to assess the relevance of the identified mechanisms.

4.1 Analytical Results

Proposition 1 (Imperfect Equilibrium Exchange-Rate Pass-Through)**.** *Let* $S_V \equiv \frac{\partial \ln PPI_t}{\partial \ln P_t^V}$ *and* $S_F \equiv \frac{\partial \ln PPI_t}{\partial \ln(e_t P_t^*)}$ *denote the unit-cost shares of value added and imported materials, respectively (so* $S_V + S_F = 1$*). Along any differentiable equilibrium path,*

$$\frac{d\ \ln P_t^H}{d\ \ln e_t} = S_V \frac{d\ \ln P_t^V}{d\ \ln e_t} + S_F$$

Proof. Under regularity, the Implicit Function Theorem yields a differentiable mapping $P_t^V = P_t^V(e_t)$ evaluated at the equilibrium. Substituting this derivative into $d \log p_t^H$ and the share decomposition delivers the stated formula. A complete derivation is provided in the Appendix B.

□

Intuitively, this Proposition highlights the fact that the degree of impact of exchange rate variation on the price level is influenced not only by the change itself, but also by the weighted change in the materials substitutes' price, P^V. This sheds light on the fact that pass-through can be imperfect, in the sense that the elasticity of the producer price with respect to the nominal exchange rate can be greater or smaller than 1, with the novelty that general equilibrium effects can attenuate or boost the change. To grasp some intuition, Figure 2 illustrates the trade-off faced by domestic producers that combine domestic and imported inputs. A depreciation raises the price of imported materials, steepening the isocost and shifting the tangency point from A (orange point) to B (blue point), which captures the substitution away from foreign inputs towards domestic ones. If, however, the depreciation simultaneously erodes banks' net worth, credit spreads rise, and the cost of financing domestic inputs also increases. In this case, the isocost rotates further, producing a new tangency such as B' (green point). The comparison between points B (blue point) and B' (green point) emphasizes the amplification role of financial intermediation: while the direct cost channel already raises marginal costs through imported inputs, the credit channel compounds this effect by increasing the domestic component of production costs. A

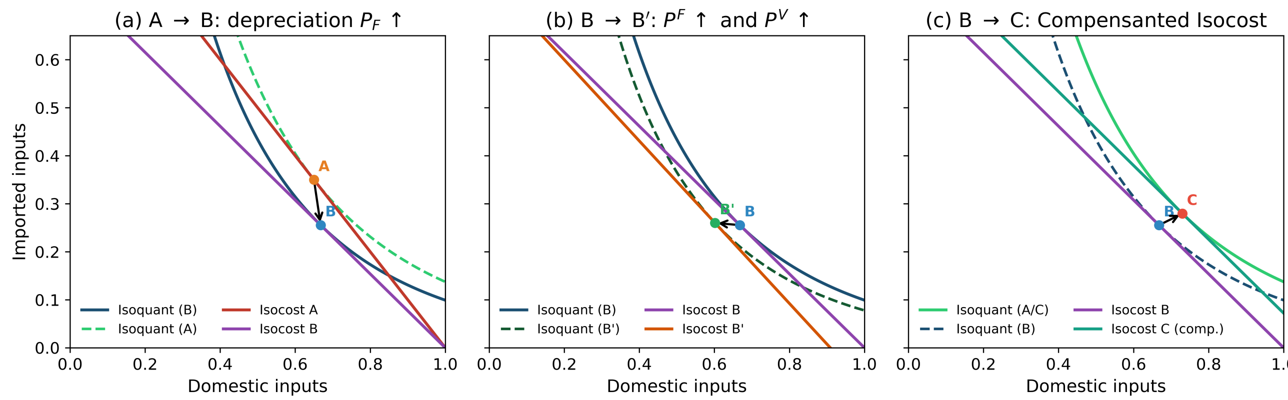

Figure 2: Trade-off between domestic and imported inputs

fully compensated isocost, point C (red point), shows how much additional expenditure would be required to maintain the initial output level, acknowledging the link between exchange rate movements, banks' balance sheets, and inflation.

Proposition 2 (UIP Premia). *Let* $\tau_t \equiv \frac{\Theta'(x_t)}{\Theta(x_t)-\Theta'(x_t)x_t}$, *and denote* $\hat{X}_t \equiv \ln(X_t) - \ln(\bar{X})$, *where* $\bar{X}$ *symbolizes* X*'s steady state value; then, up to a first order,*

$$\hat{S}_t = \mathbb{E}_t\left[\sum_{j=1}^{\infty} \hat{R}_{t+j} - \hat{R}^*_{t+j}\right] \underbrace{- \bar{\tau}\mathbb{E}_t\left[\sum_{j=1}^{\infty} \hat{R}^k_{t+j} - \hat{R}_{t+j}\right]}_{\textit{Premia}}$$

Proof. Combining bankers' optimality conditions and first-order log-linearization around their stationary state values yields the result. Appendix C supplies the derivation. □

The main insight of this Proposition is emphasizing the influence of domestic credit spread differentials on the real exchange rate. As long as $\bar{\tau} > 0$, domestic credit spreads becoming more flat imply a *real depreciation today*. This happens because credit spreads decrease when the required real return on domestic assets drops, which may occur, for instance, due to stronger balance sheets. As a result, the exchange rate is expected to appreciate, which leads to a depreciation today. This adjustment compensates for the lower risk premiums required for domestic assets.

4.2 Quantitative Results

I use Argentina's data and target the variables related to the banking sector. Moreover, I specify the exogenous processes and the primary difference in the model at the moment of characterizing a small advanced economy and an emerging economy. Second, I evaluate the model's fit by showing that it replicates some of the differences between emerging and advanced economies. Third, I present counterfactual scenarios by analyzing how the model economy reacts to shocks, assessing the mechanisms that account for the differences in responses across emerging and advanced economies.

4.2.1 Parametrization

It is useful to specify the assumed functional forms of the diversion function and the exogenous processes first. Regarding the former, I assume the function is

$$\Theta(x) = \theta_0 \left(\theta_1 + \frac{\theta_2}{2} x^2 \right) \tag{4.1}$$

In relation to the exogenous processes, I assume the exogenous variables follow an AR(1) in logs, as described below:

$$\ln \frac{\Gamma_t}{\bar{\Gamma}} = \rho_\Gamma \ \ln \frac{\Gamma_{t-1}}{\bar{\Gamma}} + \varepsilon_{\Gamma,t}, \tag{4.2}$$

$$\ln \frac{R_t^W}{\bar{R}^W} = \rho_{R^W} \ \ln \frac{R_{t-1}^W}{\bar{R}^W} + \varepsilon_{R^W,t}, \tag{4.3}$$

$$\ln \frac{Y_t^*}{\bar{Y}^*} = \rho_{Y^*} \ \ln \frac{Y_{t-1}^*}{\bar{Y}^*} + \varepsilon_{Y^*,t}, \tag{4.4}$$

$$\ln \frac{P_t^*}{\bar{P}^*} = \rho_{P^*} \ \ln \frac{P_{t-1}^*}{\bar{P}^*} + \varepsilon_{P^*,t}, \tag{4.5}$$

$$\ln \frac{\varepsilon_t^{R^f}}{\bar{\varepsilon}^{R^f}} = \rho_{\varepsilon_R^f} \ \ln \frac{\varepsilon_{t-1}^{R^f}}{\bar{\varepsilon}^{R^f}} + u_{\varepsilon^{R^f},t}. \tag{4.6}$$

Using the information that I have gathered from the banking industry, I discipline the model to match steady-state values. The average annualized credit spread, $(1+R^K)^4-1$, in Argentina is 2%. This implies a steady-state quarterly credit spread of 50 basis points. The parameters governing domestic intermediation were chosen in accordance with the procedure used by AQ (2023). The leverage ratio, ϕ, was set to 5. The ratio between *real* foreign debt $\left(\frac{SD^*}{D}\right)$ and domestic debt is equalized to 0.3. Combining these two values, and using the balance sheet identity, yields a steady value for the ratio of foreign liabilities to assets, x, of 18%.

I normalize the CPI price level, P, to be equal to 1 as well as the steady state values for $\bar{P}^*, \bar{\Gamma}, \bar{\varepsilon}^{R^f}$. Following, the quarterly foreign interest rate, R^W, was set to match a yearly level of 2%. I set $\frac{D^*}{P^*} = \bar{D}^*$. Finally, to capture the difference between a typical emerging and advanced economy, I assume that in the former group the correlation between the technology process and the foreign interest rate is different than zero.

These targets and normalizations have implications that influence the values of the parameters. Table 3 presents the breakdown of those parameter values.

4.2.2 Model's Fit

The first step is to verify whether the model can reproduce data patterns similar to the ones I have reported in Section 2. To that end, I compute simulated panels from the model and re-run the Local Projection IRF equation 2.2. I find that the model's fit is partial, as it can match relative patterns from emerging and advanced economies, but it fails at capturing their differences in relative volatilities. In addition, while the local projection correctly captures the sign of the exchange rate shock and the dummy that interacts with it, the results are not as significant as in the data.

Regarding the process, I run simulations for two types of economies: (i) an emerging economy (EM); and (ii) a small advanced economy (AE). For each type, I simulate the economy for $2,000$ quarters, dropping the first 200. I then pick the last 40 quarters of both groups to compare the model's moments against the data moments. Using the model's simulated data,[9] I compute

[9] I use Dynare 6.4 to do this.

Parameter	Symbol	Value (AE)	Value (EM)	Source/Target
Household preferences				
Discount factor	β	0.9925		Annualized SS $R \approx 3\%$
Labour disutility	χ	2		SS labor $\approx 30\%$
Preference weight on foreign goods	ω	0.35		Benchmark Value
Substitution elasticity home/foreign goods	η	1.3		Standard in literature
Production				
Sector elasticity of substitution	ϵ	11		Markup of 10%
Capital share	α	0.33		Standard in literature
Capital depreciation rate	δ	0.025		Standard in literature
Adjustment cost sensitivity	ψ_I	10		AQ (2023)
Financial intermediaries				
Survival rate	θ_p	0.95	0.95	AQ (2023)
Divertability Parameter 1	θ_0	0.52	0.52	Derived from SS targets
Divertability Parameter 2	θ_1	0.41	0.41	Derived from SS targets
Home bias in bank funding	θ_2	2.06	2.06	Derived from SS targets
Transfer rate to new entrants	ξ	0.067	0.067	AQ (2023)
Monetary policy rule				
Response to inflation	γ	1.5		Standard in literature
Rest of the World				
Foreign demand elasticity	ϵ^*	0.3		Small Value
Debt elasticity of foreign interest rate	κ	0.001		Small Value
Exogenous Processes				
Technology autoregressive parameter	ρ_Γ	0.9	0.9	Persistent process
Foreign interest rate autoregressive parameter	ρ_{R^W}	0.5	0.5	Moderate persistence
Foreign output autoregressive parameter	ρ_{Y^*}	0.5	0.5	Moderate persistence
Foreign price level autoregressive parameter	ρ_{P^*}	0.5	0.5	Moderate persistence
Taylor Rule shock autoregressive parameter	$\rho_{\varepsilon_{Rf}}$	0.5	0.5	Moderate persistence
Correlation of Γ and R^W shocks	$\text{Corr}(\varepsilon_\Gamma, \varepsilon_{R^W})$	0	-0.5	Difference between EM-AE

Note: AE = Advanced Economies; EM = Emerging Markets. Rows with a single value show *common* values across groups.

Table 3: Parameter values.

moments and, since the model is not calibrated, I evaluate whether it delivers qualitatively reasonable patterns in *relative* terms, not absolute terms. Table 4 shows that, without calibration, the model reproduces some core asymmetries: exchange rates (nominal and real) are more volatile in EM, and the inflation volatility is stronger in EM. As is, however, the model under-delivers on

	AE		**EM**		**Bigger?**		
Moments	Data	Model	Data	Model	Data	Model	Match
$\sigma(\Delta\% \, FX)$	3.8%	2.3%	4.3%	2.8%	EM	EM	✓
$\sigma(\Delta\% \, RER)$	3.8%	1.3%	4.1%	1.5%	EM	EM	✓
$\sigma(\Delta\% CPI)$	0.9%	1.2%	2.3%	1.3%	EM	EM	✓
$\sigma(\Delta\% \text{ GDP})$	2.6%	2.9%	4.0%	2.3%	EM	AE	X
$\sigma(R)$	2.9%	0.8%	11.0%	0.6%	EM	AE	X
$\sigma(\Delta\% FX)/\sigma(\Delta\% CPI)$	4.12	1.84	1.90	2.10	AE	EM	X
$\sigma(\Delta\% FX)/\sigma(\Delta\% \, GDP)$	1.45	0.80	1.09	1.22	AE	EM	X
$\sigma(\Delta\% FX)/\sigma(R)$	1.33	3.08	0.39	4.84	AE	EM	X

Table 4: Data vs. model moments.

the relative volatility of GDP and nominal interest rates, and it only partially matches relative volatility. In summary, the baseline parametrization effectively captures the qualitative AE–EM gap in currency and price dynamics; however, it falls short in terms of financial volatility.

Figure 3 contrasts LP–IRFs from the model data. Three patterns stand out. First, the EM dummy amplifies the effects in the model in the same direction as in the data: GDP falls more, CPI rises more, and interest rates rise more in EM than in AE. Second, for EM, the shapes are quite close, since output falls and inflation displays a persistent rise. On the downsides, the largest discrepancy is again in the interest rate: in both economies, the model reproduces a more "hawkish" path relative to the data. On impact, however, the model captures the qualitative rise in EM, but with a different hump. Overall, the model reproduces the EM–AE gap in output and prices, but misses the policy-rate dynamics, especially for advanced economies.

A note of caution is due here, since the projections on model-simulated data did not reproduce a statistical difference between emerging and advanced economies as significant as the one found in actual data. It is possible that these results are limited because the only difference between the AE and EM specifications arises from a single exogenous parameter, the correlation

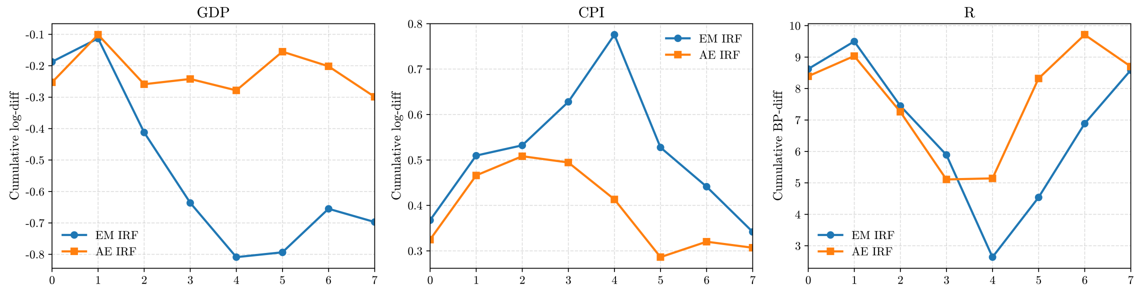

Figure 3: LP IRFs to a 1% exchange rate depreciation.The scale is percentages for CPI and GDP values, whereas the interest rate is in basis points.

between R^W and Γ, while no calibration was performed to account for other country-group heterogeneities. As a result, the model is not fine-tuned to replicate the magnitude of cross-country differences observed in the data, and the estimated coefficients inherently appear less significant. More details on the estimated coefficients, their standard errors, and their statistical significance can be found in Table 8 in the Appendix.

4.2.3 Counterfactual Analysis

Turning now to the experimental evidence of the model, I compute three different scenarios. The first two try to disintangle the role of financial intermediation when the economy faces a foreign interest rate shock. Lastly, I evaluate the model's response under different levels of openness.

Prior to the experiments, it is convenient to specify the exogenous shocks that account for most of the variance in some relevant variables. Table 5, which expresses the variance decomposition of the system, indicates that the foreign interest rate shock explains the majority of the variation in consumption C, interest rates R, R^K, Investment I, and output Y^{AH}. The price level P is mostly driven by the monetary policy shock $u_{\varepsilon^{Rf}}$.

Experiment 1: Perfect intermediation

To better understand the role of financial intermediation, I compute simulations for a counterfactual scenario in which financing occurs directly from households to firms. This implies a set of changes with respect to the benchmark model. First, the banking equations are no longer

Variable	ε_Γ	ε_{R^W}	ε_{y^*}	ε_{P^*}	$u_{\varepsilon^{R^f}}$	Total
C	40	58	2	0	0	100
P	4	0	0	0	96	100
R	9	86	5	0	0	100
I	20	79	1	0	0	100
y^{AH}	41	58	0	0	0	100
R^K	18	79	3	0	0	100

Table 5: Variance decomposition in percent, one shock at a time.

relevant; second, households now choose the amount of assets, A_t, and directly perceive the nominal return, Z_tQ_t, per unit of asset. Investment structure is the same as the benchmark scenario, where a representative capital goods producer invests, subject to adjustment costs and the law of motion of capital. Thus, the modified budget constraint for households is:

$$A_t + B_t + P_tC_t + S_tD_t^* = W_tL_t + \Pi_t + R_t^f B_{t-1} + T_t + S_tD_{t-1}^* R_t^* + Z_tQ_tK_t \quad (4.7)$$

As a result of the modified problem, the asset choices' optimality conditions are now:

$$\mathbb{E}_t\left[\frac{C_{t+1}}{C_t}\frac{P_{t+1}}{P_t}\right] = \beta R_{t+1}^f \quad (4.8)$$

$$\mathbb{E}_t\left[\frac{C_{t+1}}{C_t}\frac{P_{t+1}}{P_t}\right] = \beta \mathbb{E}_t\left[R_{t+1}^*\frac{S_{t+1}}{S_t}\right] \quad (4.9)$$

$$\mathbb{E}_t\left[\frac{C_{t+1}}{C_t}\frac{P_{t+1}}{P_t}\right] = \beta(1-\delta+Z_{t+1}Q_{t+1}) \quad (4.10)$$

In equilibrium, $A_t = K_{t+1}$ as before.

Figure 4 shows that, while a 1% shock to the foreign interest rate is *on impact* more recessionary, inflationary, and depreciates the currency more, the recovery is faster in the scenario without banks. This is aligned with the "financial accelerator", where adverse shocks to the economy may be amplified by worsening financial market conditions (prices). The difference, however, lies in the fact that with banks, investment falls more on impact, which is why the economy takes longer to recover. Regarding the transmission mechanism of the shock, it is through the UIP equation.

An increase in the foreign rate R^W induces an appreciation path for the domestic currency, which in turn provokes a depreciation today. With the domestic credit spreads also increasing, savings grow and consumption decreases. These two factors combined translate into lower production,

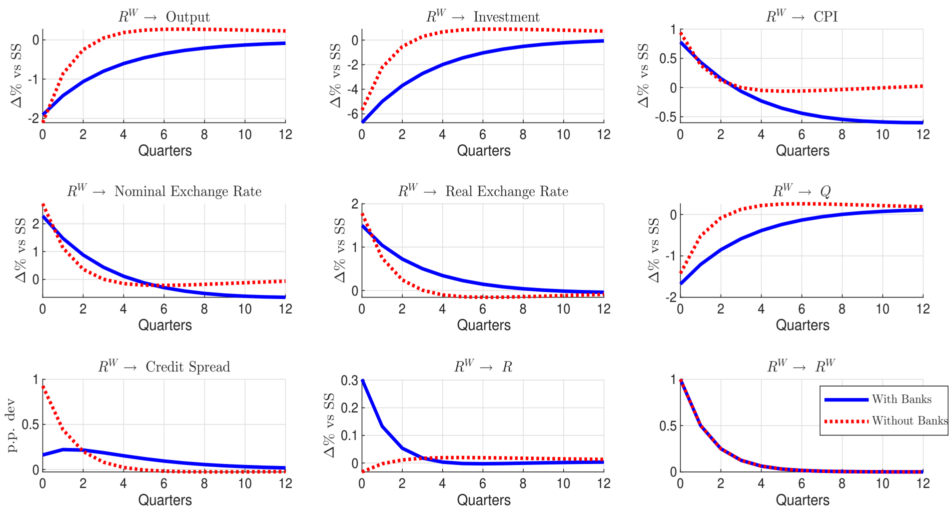

Figure 4: Foreign interest rate shock

lower demand for labour, and thus lower wages. Despite lower demand, inflation exhibits hump-shaped dynamics, characterized by an initial increase followed by a subsequent decline. The initial rise is due to the exchange rate pass-through, which is greater in the economy without banks, primarily because of the *credit* mechanism (the credit spread is larger in this scenario). Nevertheless, later, there is downward pressure due to the recession.

Note, however, this does not mean that asset intermediation is lower without banks than with banks; in fact, the opposite occurs. Without banks, the credit spread adjusts faster, implying that the financial support provided to firms is greater. Thus, it is possible that the reason emerging economies react more to exchange rates, as shown in the figure above, is that asset intermediation is insufficient due to less developed financial markets.

Experiment 2: Shock to banks' net-worth

Several factors influence banks' net worth amid shocks. A useful way to disentangle the effect on the economy caused by a direct change in banks' equity is by assuming the net worth is affected by an exogenous i.i.d. shock of the form

$$N_t = (1+\varepsilon_t^N)\left[\theta_p\left(R_t^K Q_{t-1}A_{t-1} + \left(R_t S_{t-1} - R_t^* S_t\right) D_{t-1}^* + R_t N_{t-1}\right) + (1-\theta_p)\,\xi Q_t A_{t-1}\right]$$

The findings of a 1% negative shock to ε_t^N are depicted in Figure 5. Directly decreasing banks'

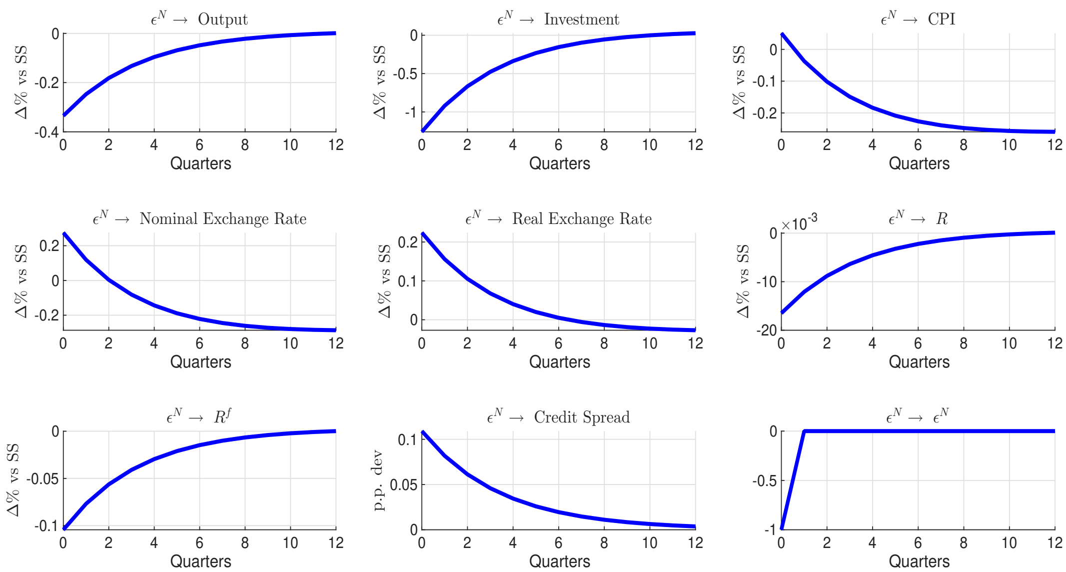

Figure 5: Banks' net worth shock

net worth depreciates the currency and induces a recession. A negative 1-period shock tightens leverage constraints, leading to an increase in the credit spread, which affects the price level via the credit channel, even in the face of a recession. However, as the economy starts recovering, asset values (Q) and capital rental rates (Z) also start rebounding, which allows banks to recompose their net-worth, and thus the spread starts mean-reverting. The effects are strong and long-lasting, as it takes almost six quarters for the economy to recover after a one-quarter negative shock.

Experiment 3: Shock to foreign interest rate under different degrees of openness

To assess whether the degree of openness of the economy makes it more vulnerable to fluctuations in international financial markets, I analyze the dynamic responses of the system to a foreign interest rate shock for different values of openness, ω. As before, Figure 6 shows that a 1% shock to the foreign interest rate R^W is recessionary and produces hump-shaped dynamics for inflation.

However, there are some small differences in the dynamic responses among the three economies. For the most open economy, the price level remains higher than its original steady value, whereas for the other two systems, inflation is not only transitory, as in the former scenario, but also the price level falls below its steady-state value. An explanation for this phenomenon, as suggested by Proposition 1, is that the magnitude of pass-through is increasing in the share of foreign exposure. Moreover, what also stands out in this experiment is the highly volatile IRFs of the highest value of ω compared to the smaller ones. A further difference emerges in the dynamics of net foreign

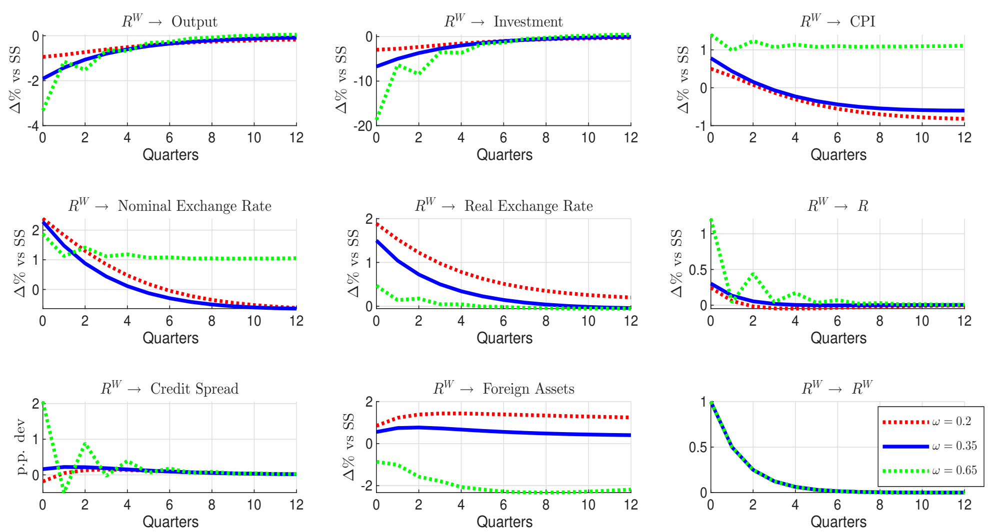

Figure 6: Foreign interest rate shock under different openness values

asset (NFA) accumulation. After the shock, the most open economy ends up with fewer dollar assets, while less open economies gain more. This occurs for two reasons. As mentioned before, a larger import share magnifies pass-through and raises marginal costs, comprising cash flows, especially when outside funding becomes more expensive. This stress makes people use their foreign exchange (FX) assets or incur more FX debt, worsening the NFA. Second, in less open economies, the balance-sheet effects are weaker, and the expenditure switching between domestic and foreign goods dominates. Thus, a real depreciation improves the trade balance, resulting in current-account surpluses that are invested in foreign assets.

Taken together, these outcomes suggest that the higher the degree of openness, the higher the economic costs the economy faces. Therefore, one possible implication is that there may be a potential trade-off between international trade and aggregate volatility, which then might provide a role for strategic policy analysis.

Limitations:

The framework I have studied isolates two amplification channels for which currency shocks propagate: (i) imported-input costs and (ii) banks' net worth. These channels interact, shaping the economy's dynamics. However, the current environment does not endogenize the features that differentiate emerging from advanced economies. I cannot quantify the separate contributions of each channel in the mechanisms that make emerging economies more vulnerable to exchange rate shocks than advanced economies: Is it banks in emerging economies that are particularly constrained? Or is it that the technological process of emerging economies is more volatile? All I can say is that the interaction mechanism increases the propagation effects of exchange rates into the economy. Likewise, the openness experiments raise the weight of imported inputs and foreign funding exogenously, without modeling how openness co-determines sectoral input shares and banks' foreign exchange funding choices. These simplifications make the mechanisms simpler, but they imply that I understate the feedback loops between production, banks' balance sheets, and exchange-rate dynamics.

5 Conclusion

This paper provides both empirical and theoretical evidence on how exchange rate fluctuations interact with financial intermediation in small open economies. The empirical analysis reveals three robust facts: (i) exchange rate depreciations are contractionary across countries, (ii) the effects are stronger and more inflationary in emerging markets relative to advanced economies, and (iii) banks' equity valuations are negatively exposed to depreciations, consistent with balance sheet vulnerabilities.

The general equilibrium model rationalizes these findings through the joint operation of a cost channel, via imported materials, and a credit channel, via bank net-worth constraints. Analytical results indicate that exchange rate pass-through is imperfect and influenced by the interaction between value-added and imported input shares, while deviations from uncovered interest parity reflect domestic credit premia. Quantitative simulations indicate that foreign interest rate hikes and net-worth shocks lead to real depreciations, rise-and-fall inflation dynamics, and persistent output losses. These findings support the idea that emerging economies may be more vulnerable to exchange rate volatility due to their less developed financial markets and their interconnection with the production structure.

A limitation of this study is that there is no endogenous mechanism rationalizing the production structure or the optimal degree of openness of the economy. Notwithstanding this drawback, the paper suggests that greater openness amplifies volatility, indicating a trade-off between the benefits of international integration and macroeconomic stability. Another possible area of future research would then be to investigate the potential use of an optimal policy that balances between openness and volatility.

References

AGARWAL, I. (2025). “Banks’ Foreign Currency Exposure and the Real Effects of Exchange Rate Shocks”. Review of Financial Studies, revise and resubmit. (2025).

AGUIAR, M., (2005), “Investment, Devaluation and Foreign Currency Exposure: The Case of Mexico”, in *Journal of Development Economics*, **78**(1), pp. 95–113.

AKINCI, Ö. and A. QUERALTO, (2023), “Exchange Rate Dynamics and Monetary Spillovers with Imperfect Financial Markets”, in *The Review of Financial Studies*, **37**(2), pp. 309–355, https://doi.org/10.1093/rfs/hhad078.

ALLAYANNIS, G. and J. P. WESTON, (2001), “The Use of Foreign Currency Derivatives and Firm Market Value”, in *The Review of Financial Studies*, **14**(1), pp. 243–276.

AUER, R., A. BURSTEIN, and S. M. LEIN, (2021), “Exchange Rates and Prices: Evidence from the 2015 Swiss Franc Appreciation”, in *American Economic Review*, **111**(2), pp. 652–686.

BARTRAM, S. M., G. W. BROWN, and J. CONRAD, (2011), “The Effects of Derivatives on Firm Risk and Value”, in *Journal of Financial and Quantitative Analysis*, **46**(4), pp. 967–999.

BERNANKE, B. S., M. GERTLER, and S. GILCHRIST (1999). “The Financial Accelerator in a Quantitative Business Cycle Framework”. In: *Handbook of Macroeconomics*. Ed. by J. B. TAYLOR and M. WOODFORD. Vol. 1A. Elsevier, (1999). Chap. 21, pp. 1341–1393. ISBN: 978-0-444-50155-1. DOI: 10.1016/S1574-0048(99)10034-X.

BODNAR, G. M., B. DUMAS, and R. C. MARSTON, (2002), “Pass-Through and Exposure”, in *Journal of Finance*, **57**, pp. 199–231, https://ssrn.com/abstract=309159.

BODNAR, G. M. and M. H. F. WONG, (2003), “Estimating Exchange Rate Exposures: Issues in Model Structure”, in *Financial Management*, **32**(1), pp. 35–67, https://www.jstor.org/stable/3666203.

BURSTEIN, A. T., J. C. NEVES, and S. REBELO, (2003), "Distribution Costs and Real Exchange Rate Dynamics during Exchange-Rate-Based Stabilizations", in *Journal of Monetary Economics*, **50**(6), pp. 1189–1214.

CABALLERO, J., (2021), "Corporate dollar debt and depreciations: All's well that ends well?", in *Journal of Banking & Finance*, **130**, p. 106185, https://www.sciencedirect.com/science/article/pii/S0378426621001448.

CAMPA, J. M. and L. S. GOLDBERG (May 2002). Exchange Rate Pass-Through into Import Prices: A Macro or Micro Phenomenon? Working Paper 8934. National Bureau of Economic Research, (2002). DOI: 10.3386/w8934. http://www.nber.org/papers/w8934.

CÉSPEDES, L. F., R. CHANG, and A. VELASCO, (2004), "Balance Sheets and Exchange Rate Policy", in *American Economic Review*, **94**(4), pp. 1183–1193, https://www.aeaweb.org/articles?id=10.1257/0002828042002589.

COPELAND, T. E. and Y. JOSHI, (1996), "Why derivatives don't reduce FX risk", in *Risk Management*, **43**(7), pp. 76+, https://link.gale.com/apps/doc/A18481236/AONE?u=lond95336&sid=bookmark-AONE&xid=2440069a.

CORSETTI, G. and L. DEDOLA (2002). Macroeconomics of International Price Discrimination. Tech. rep. 744. International Finance Discussion Paper, (2002). https://ssrn.com/abstract=3882339.

DEVEREUX, M. B. and C. ENGEL, (2002), "Exchange rate pass-through, exchange rate volatility, and exchange rate disconnect", in *Journal of Monetary Economics*, **49**(5), pp. 913–940, https://ideas.repec.org/a/eee/moneco/v49y2002i5p913-940.html.

EDMOND, C., V. MIDRIGAN, and D. Y. XU, (2023), "How Costly Are Markups?", in *Journal of Political Economy*, **131**(7), pp. 1619–1675, https://doi.org/10.1086/722986.

ENGEL, C., (2002), "The Responsiveness of Consumer Prices to Exchange Rates: A Synthesis Of Some New Open Economy Macro Models", in *The Manchester School*, **70**(S1), pp. 1–15.

ENGEL, C., (2016), "Exchange Rates, Interest Rates, and the Risk Premium", in *American Economic Review*, **106**(2), pp. 436–474.

GERTLER, M. and P. KARADI, (2011), "A model of unconventional monetary policy", in *Journal of Monetary Economics*, **58**(1), pp. 17–34, https://doi.org/10.1016/j.jmoneco.2010.10.004.

GERTLER, M. and N. KIYOTAKI (2010). "Chapter 11 - Financial Intermediation and Credit Policy in Business Cycle Analysis". In: ed. by B. M. FRIEDMAN and M. WOODFORD. Vol. 3. Handbook of Monetary Economics. Elsevier, (2010), pp. 547–599. DOI: https://doi.org/10.1016/B978-0-444-53238-1.00011-9. https://www.sciencedirect.com/science/article/pii/B9780444532381000119.

HAGELIN, N. and B. PRAMBORG, (2004), "Hedging Foreign Exchange Exposure: Risk Reduction from Transaction and Translation Hedging", in *Journal of International Financial Management and Accounting*.

JORDÀ, Ò., (2005), "Estimation and Inference of Impulse Responses by Local Projections", in *American Economic Review*, **95**(1), pp. 161–182, https://www.aeaweb.org/articles?id=10.1257/0002828053828518.

JORDÀ, Ò. and A. M. TAYLOR, (2025), "Local Projections", in *Journal of Economic Literature*, **63**(1), pp. 59–110, https://www.aeaweb.org/articles?id=10.1257/jel.20241521.

KIM, S. and N. ROUBINI, (2000), "Exchange rate anomalies in the industrial countries: A solution with a structural VAR approach", in *Journal of Monetary Economics*, **45**(3), pp. 561–586, https://www.sciencedirect.com/science/article/pii/S0304393200000106.

NAKAMURA, E. and D. ZEROM, (2010), "Accounting for Incomplete Pass-Through", in *The Review of Economic Studies*, **77**(3), pp. 1192–1230, https://doi.org/10.1111/j.1467-937X.2009.589.x.

OLEA, J. L. M. et al. (Jan. 2025). Local Projections or VARs? A Primer for Macroeconomists. (2025). DOI: None. https://ideas.repec.org/h/nbr/nberch/15140.html.

RAMEY, V. A. (2016). “Macroeconomic Shocks and Their Propagation”. In: *Handbook of Macroeconomics*. Ed. by J. B. TAYLOR and H. UHLIG. Vol. 2A. Elsevier, (2016). Chap. 2, pp. 71–162. ISBN: 978-0-444-53452-8. DOI: 10.1016/bs.hesmac.2016.03.003.

SCHMITT-GROHÉ, S. and M. URIBE, (2003), “Closing Small Open Economy Models”, in *Journal of International Economics*, **61**(1), pp. 163–185.

SHOUSHA, S. (2019). The Dollar and Emerging Market Economies: Financial Vulnerabilities Meet the International Trade System. International Finance Discussion Papers 1258. Washington, DC: Board of Governors of the Federal Reserve System, (2019). https://www.federalreserve.gov/econres/ifdp/files/ifdp1258.pdf.

A Data Appendix

A.1 Macro Data

For the aggregate data, the total number of observations is 5,426. Each observation is a tuple country-quarter. I have unbalanced data across 44 countries, with the earliest observation in 1990-Q1 and the latest in 2023-Q4. More details are below:

Country	# Obs
Argentina	80
Australia	136
Austria	116
Belgium	99
Brazil	112
Canada	236
Chile	108
China, P.R.: Mainland	112
Colombia	76
Croatia, Rep. of	100
Cyprus	100
Czech Rep.	113
Denmark	132
Finland	100
France	136
Germany	132
Greece	116
Hungary	116
India	79
Indonesia	64
Ireland	100
Israel	116
Italy	116

Country	# Obs
Japan	84
Korea, Rep. of	99
Latvia	100
Lithuania	100
Luxembourg	99
Malaysia	36
Malta	100
Mexico	101
Netherlands, The	116
New Zealand	136
North Macedonia, Republic of	88
Norway	136
Poland, Rep. of	116
Portugal	116
Romania	84
Russian Federation of	107
South Africa	124
Spain	116
Sweden	124
Switzerland	116
Thailand	56
Türkiye, Rep of	88
United Kingdom	116

Table 6: Number of observations by country. The total number of observations across all countries is 5,213.

A.1.1 VAR Estimates

Figure 7 shows the VAR estimation results for every country in the dataset.

10% Depreciation Shock		Cumulative IRF for 2 quarters			Cumulative IRF for 4 quarters			Cumulative IRF for 8 quarters			Cumulative IRF for 12 quarters		
Economy Classification	**Country**	**Δr**	**Δ ln CPI**	**Δ ln GDP**	**Δr**	**Δ ln CPI**	**Δ ln GDP**	**Δr**	**Δ ln CPI**	**Δ ln GDP**	**Δr**	**Δ ln CPI**	**Δ ln GDP**
Emerging Market Economies	**Argentina**	-0.40	-2.32%	-0.78%	0.04	-5.94%	-0.09%	0.15	-6.47%	0.03%	0.21	-6.72%	0.09%
Advanced Economies	**Australia**	-0.04	0.06%	-0.71%	-0.09	-0.22%	-1.19%	-0.11	-0.45%	-1.23%	-0.11	-0.82%	-1.12%
Advanced Economies	**Austria**	0.00	0.03%	-0.10%	0.00	0.05%	-0.01%	0.00	0.05%	-0.04%	0.00	0.04%	-0.04%
Advanced Economies	**Belgium**	0.00	-0.01%	-0.06%	0.00	-0.01%	-0.08%	-0.01	-0.01%	-0.08%	-0.01	-0.01%	-0.08%
Emerging Market Economies	**Brazil**	0.03	0.47%	-1.75%	-0.06	0.64%	-1.86%	-0.03	0.75%	-1.71%	-0.04	0.82%	-1.90%
Advanced Economies	**Canada**	-0.10	0.13%	-2.05%	-0.12	-0.37%	-2.67%	-0.13	-0.59%	-2.25%	-0.14	-0.96%	-2.26%
Emerging Market Economies	**Chile**	-0.13	-0.48%	-1.26%	-0.24	-1.00%	0.30%	-0.23	-0.99%	0.29%	-0.23	-0.99%	0.24%
Emerging Market Economies	**China**	0.05	0.99%	-3.98%	0.11	1.63%	-3.05%	0.11	1.08%	0.07%	0.10	1.25%	-0.49%
Emerging Market Economies	**Colombia**	-0.01	0.34%	-1.22%	0.13	0.84%	-3.36%	0.07	0.69%	-3.57%	-0.02	0.49%	-3.11%
Advanced Economies	**Croatia, Rep. of**	-0.13	-0.17%	-2.60%	-0.35	-0.83%	-3.25%	-0.32	-1.06%	-2.92%	-0.38	-1.67%	-2.81%
Advanced Economies	**Cyprus**	0.01	-0.24%	-0.87%	-0.04	-1.16%	-0.90%	-0.05	-1.44%	-0.60%	-0.05	-1.65%	-0.25%
Advanced Economies	**Czech Rep.**	0.03	0.56%	-0.41%	0.01	0.69%	-0.50%	-0.03	0.58%	-0.61%	-0.03	0.60%	-0.56%
Advanced Economies	**Denmark**	-0.15	0.04%	-0.02%	-0.07	-0.03%	0.02%	-0.07	-0.03%	0.09%	-0.08	-0.02%	-0.01%
Advanced Economies	**Finland**	-0.05	-0.22%	-0.44%	-0.10	-0.51%	-0.52%	-0.11	-0.56%	-0.51%	-0.11	-0.60%	-0.51%
Advanced Economies	**France**	0.00	-0.01%	-0.11%	-0.01	-0.04%	-0.16%	-0.01	-0.06%	-0.16%	-0.01	-0.07%	-0.16%
Advanced Economies	**Germany**	0.01	-0.04%	-0.15%	0.02	-0.04%	-0.16%	0.02	-0.04%	-0.16%	0.02	-0.04%	-0.16%
Advanced Economies	**Greece**	0.00	0.01%	-0.06%	0.00	-0.02%	-0.14%	0.00	-0.02%	-0.17%	0.00	-0.04%	-0.18%
Emerging Market Economies	**Hungary**	-0.01	0.59%	-2.13%	-0.15	0.82%	-2.17%	-0.17	0.97%	-1.67%	-0.18	1.31%	-1.73%
Advanced Economies	**Iceland**	-0.05	0.32%	-0.85%	-0.27	-0.46%	-1.06%	-0.26	-0.75%	-1.09%	-0.24	-1.10%	-0.69%
Emerging Market Economies	**India**	-0.09	0.12%	-4.16%	-0.30	0.89%	-4.41%	-0.18	0.68%	-2.77%	-0.18	0.52%	-3.72%
Emerging Market Economies	**Indonesia**	0.00	-0.74%	-1.76%	-0.01	-1.56%	-3.38%	0.01	-1.90%	-4.41%	0.02	-2.27%	-4.80%
Advanced Economies	**Ireland**	-0.05	-0.57%	1.36%	-0.10	-1.08%	2.38%	-0.11	-1.15%	2.51%	-0.11	-1.19%	2.58%
Advanced Economies	**Israel**	-0.01	-0.53%	0.37%	0.07	-1.46%	-0.82%	0.05	-1.38%	-1.55%	0.08	-1.87%	-1.43%
Advanced Economies	**Italy**	0.00	0.00%	-0.01%	0.00	0.00%	-0.01%	0.00	0.00%	-0.01%	0.00	0.00%	-0.01%
Advanced Economies	**Japan**	0.00	0.30%	-0.01%	0.00	0.33%	0.00%	0.00	0.33%	0.00%	0.00	0.33%	0.00%
Advanced Economies	**Korea, Rep. of**	-0.03	-0.14%	-1.02%	-0.05	-0.38%	-1.11%	-0.06	-0.50%	-1.03%	-0.05	-0.58%	-0.97%
Advanced Economies	**Latvia**	-0.03	0.05%	-1.64%	-0.05	0.00%	-1.96%	-0.05	-0.02%	-1.99%	-0.05	-0.03%	-2.01%
Advanced Economies	**Lithuania**	0.00	-0.16%	-0.14%	-0.01	-0.24%	0.00%	-0.01	-0.26%	0.03%	-0.01	-0.28%	0.06%
Advanced Economies	**Luxembourg**	-0.03	-0.06%	-1.11%	0.03	0.06%	-0.68%	0.02	0.06%	-0.67%	0.02	0.06%	-0.66%
Emerging Market Economies	**Malaysia**	-0.06	0.24%	-7.33%	0.01	3.09%	3.13%	-0.03	2.60%	0.96%	-0.04	2.79%	2.33%
Advanced Economies	**Malta**	0.01	0.08%	0.28%	-0.05	-0.11%	-0.36%	-0.04	-0.08%	-0.80%	-0.04	-0.12%	-0.50%
Emerging Market Economies	**Mexico**	-0.14	-0.09%	-0.56%	-0.15	-0.09%	0.17%	-0.13	-0.13%	0.28%	-0.14	-0.12%	0.23%
Advanced Economies	**Netherlands, The**	0.02	0.04%	-0.01%	0.04	0.06%	0.06%	0.04	0.07%	0.06%	0.04	0.07%	0.07%
Advanced Economies	**New Zealand**	-0.12	-0.08%	-0.73%	-0.14	-0.15%	-0.73%	-0.14	-0.15%	-0.73%	-0.14	-0.15%	-0.73%
Emerging Market Economies	**North Macedonia**	0.02	0.59%	-1.53%	0.17	0.87%	-1.20%	0.19	0.98%	-2.33%	0.21	0.99%	-2.09%
Advanced Economies	**Norway**	-0.11	-0.12%	-1.55%	-0.14	-0.20%	-1.36%	-0.14	-0.20%	-1.35%	-0.14	-0.20%	-1.35%
Emerging Market Economies	**Peru**	0.16	1.08%	4.16%	0.42	2.69%	-1.97%	0.41	3.23%	-4.55%	0.41	3.64%	-1.53%
Emerging Market Economies	**Philippines**	0.03	0.50%	-0.09%	0.04	0.42%	-0.27%	0.04	0.42%	-0.26%	0.04	0.42%	-0.27%
Emerging Market Economies	**Poland, Rep. of**	0.03	0.64%	-0.74%	0.01	0.57%	-1.25%	-0.04	0.28%	-0.86%	0.01	0.20%	-0.75%
Advanced Economies	**Portugal**	0.00	0.00%	0.00%	0.00	0.00%	-0.01%	0.00	0.00%	-0.01%	0.00	0.00%	-0.01%
Emerging Market Economies	**Romania**	0.12	0.55%	-2.17%	0.27	0.84%	-2.24%	0.30	0.84%	-2.22%	0.32	0.84%	-2.21%
Emerging Market Economies	**Russian Federation**	-0.11	0.80%	-2.49%	-0.10	0.13%	-2.48%	-0.08	0.08%	-2.52%	-0.07	0.16%	-2.55%
Emerging Market Economies	**Serbia, Rep. of**	0.01	2.09%	-1.49%	0.13	2.83%	-1.05%	0.15	3.07%	-1.07%	0.15	3.14%	-1.06%
Emerging Market Economies	**South Africa**	0.00	0.27%	-0.30%	-0.01	0.32%	-0.38%	-0.01	0.32%	-0.38%	-0.01	0.31%	-0.38%
Advanced Economies	**Spain**	0.00	-0.01%	0.00%	0.00	-0.01%	-0.01%	0.00	-0.01%	-0.01%	0.00	-0.01%	-0.01%
Advanced Economies	**Sweden**	-0.02	0.00%	0.01%	0.10	0.25%	-0.30%	0.09	0.23%	-0.42%	0.06	0.17%	-0.39%
Advanced Economies	**Switzerland**	-0.03	-0.39%	-0.22%	0.05	-0.34%	-0.22%	0.05	-0.26%	-0.02%	0.05	-0.24%	0.03%
Emerging Market Economies	**Türkiye, Rep of**	0.20	2.87%	-1.29%	0.56	5.67%	-1.92%	0.41	5.91%	-2.12%	0.37	6.40%	-1.75%
Emerging Market Economies	**Thailand**	-0.03	-0.66%	-1.59%	-0.05	-0.78%	-1.18%	-0.05	-0.79%	-1.16%	-0.05	-0.79%	-1.15%
Advanced Economies	**United Kingdom**	-0.07	-0.26%	-0.48%	-0.08	-0.23%	-1.35%	-0.08	-0.22%	-1.44%	-0.08	-0.29%	-1.31%

Figure 7: Cumulative IRFs from shocks to the Exchange Rate for each country.

A.1.2 Local Projections

Table 7 and 8 provide the breakdown of the Local Projections conducted in (2.2) for actual and model-simulated data, respectively.

Horizon	GDP			CPI			Interest Rate		
	β_1	β_2	$\beta_1+\beta_2$	β_1	β_2	$\beta_1+\beta_2$	β_1	β_2	$\beta_1+\beta_2$
0	-0.003	-0.097**	-0.100***	0.000	0.072***	0.072***	0.025	3.850	3.875
	(0.002)	(0.039)	(0.039)	(0.001)	(0.021)	(0.021)	(0.038)	(2.545)	(2.524)
1	-0.004*	-0.162***	-0.166***	-0.000	0.144***	0.144***	0.054	3.184	3.238
	(0.002)	(0.043)	(0.043)	(0.001)	(0.042)	(0.042)	(0.050)	(2.008)	(2.007)
2	-0.003	-0.160**	-0.164***	-0.001	0.180***	0.180***	-0.012	0.174	0.162
	(0.003)	(0.063)	(0.063)	(0.001)	(0.044)	(0.044)	(0.078)	(2.491)	(2.488)
3	-0.005**	-0.151**	-0.156**	-0.001	0.190***	0.189***	-0.040	-0.459	-0.499
	(0.003)	(0.076)	(0.076)	(0.001)	(0.047)	(0.047)	(0.110)	(2.458)	(2.464)
4	-0.008**	-0.176*	-0.184**	-0.002***	0.201***	0.199***	-0.125	-1.037	-1.162
	(0.003)	(0.090)	(0.090)	(0.001)	(0.060)	(0.060)	(0.123)	(3.024)	(3.035)
5	-0.007**	-0.172	-0.178*	-0.003***	0.229***	0.227***	-0.211	-2.962	-3.173
	(0.003)	(0.105)	(0.105)	(0.001)	(0.073)	(0.073)	(0.157)	(3.575)	(3.591)
6	-0.003	-0.171	-0.174	-0.003***	0.271***	0.268***	-0.300*	-6.084	-6.384
	(0.003)	(0.113)	(0.113)	(0.001)	(0.083)	(0.083)	(0.168)	(4.640)	(4.655)
7	-0.004	-0.205*	-0.209*	-0.003**	0.283***	0.280***	-0.389**	-6.556	-6.945
	(0.002)	(0.114)	(0.114)	(0.001)	(0.100)	(0.100)	(0.199)	(5.323)	(5.331)

Notes: Entries show coefficient with significance (***, **, *) for 5%, 10%, 30% levels, and robust standard errors in parentheses. β_1 is the FX shock, β_2 is its interaction with EM_i, and $\beta_1 + \beta_2$ is their sum.

Table 7: Local Projections: Coefficients and standard errors by horizon.

Horizon	GDP			CPI			Interest Rate		
	β_1	β_2	$\beta_1+\beta_2$	β_1	β_2	$\beta_1+\beta_2$	β_1	β_2	$\beta_1+\beta_2$
0	-0.253	0.065	-0.187	0.325***	0.043	0.367	8.389***	0.230	8.620
	(0.157)	(0.195)	(0.126)	(0.067)	(0.085)	(0.059)	(2.591)	(3.387)	(2.314)
1	-0.101	-0.012	-0.113	0.466***	0.044	0.510	9.034***	0.464	9.498
	(0.206)	(0.249)	(0.169)	(0.142)	(0.171)	(0.126)	(2.680)	(3.349)	(2.402)
2	-0.259	-0.153	-0.412	0.508**	0.024	0.532	7.257***	0.190	7.447
	(0.246)	(0.302)	(0.203)	(0.206)	(0.260)	(0.184)	(2.732)	(3.490)	(2.457)
3	-0.242	-0.394	-0.636	0.494*	0.133	0.628	5.108*	0.781	5.889
	(0.292)	(0.352)	(0.229)	(0.282)	(0.349)	(0.237)	(2.819)	(3.495)	(2.358)
4	-0.279	-0.530	-0.809	0.413	0.362	0.776	5.142*	-2.505	2.637
	(0.315)	(0.390)	(0.259)	(0.328)	(0.412)	(0.294)	(2.720)	(3.431)	(2.374)
5	-0.155	-0.638	-0.794	0.286	0.241	0.527	8.319***	-3.782	4.537
	(0.338)	(0.416)	(0.263)	(0.373)	(0.476)	(0.327)	(3.024)	(3.865)	(2.612)
6	-0.202	-0.453	-0.655	0.320	0.121	0.441	9.710***	-2.826	6.884
	(0.369)	(0.439)	(0.277)	(0.407)	(0.501)	(0.340)	(3.056)	(3.900)	(2.559)
7	-0.299	-0.398	-0.697	0.307	0.035	0.342	8.699***	-0.115	8.584
	(0.384)	(0.463)	(0.300)	(0.424)	(0.522)	(0.356)	(3.190)	(4.043)	(2.674)

Notes: Entries show coefficient with significance (***, **, *) for 5%, 10%, 30% levels, and robust standard errors in parentheses. β_1 is the FX shock, β_2 is its interaction with EM_i, and $\beta_1 + \beta_2$ is their sum. This table uses **model simulated data**.

Table 8: Local Projections: Coefficients and standard errors by horizon.

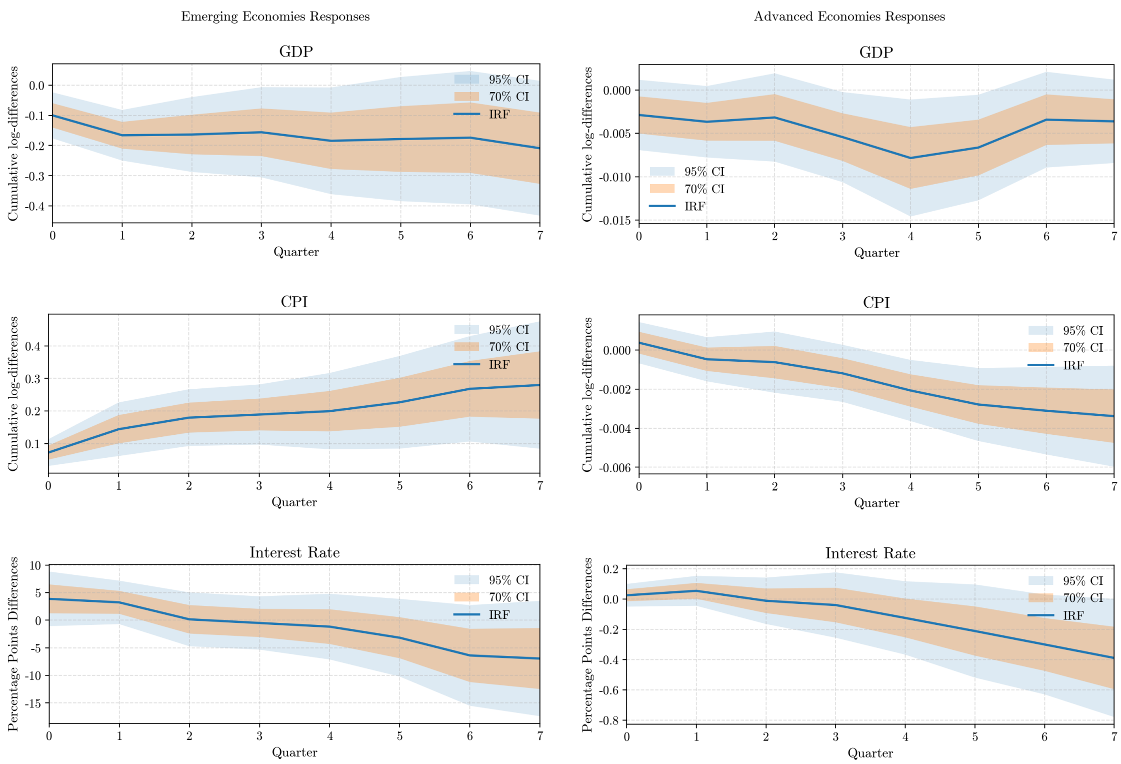

Figure 8: LP IRFs for Emerging and Advanced Economies. The scale is percentage points for CPI and GDP values, whereas the interest rate is in basis points.

Data Sources. The data sources for the macro dataset are listed below:

- Bank for International Settlements (2025), *Central bank policy rates*, BIS WS_CBPOL 1.0 (dataset), accessed May 27, 2025.
- Bank for International Settlements (2025), *Locational banking statistics*, BIS WS_LBS_D_PUB 1.0 (dataset), accessed May 27, 2025.
- Bank for International Settlements (2025), *Bilateral and effective exchange rates*, BIS WS_XRU 1.0 and BIS WS_EER 1.0 (datasets), accessed May 27, 2025.
- International Monetary Fund (2025), *Consumer Price Index (CPI)*, IMF STA:CPI (dataset), various vintages, accessed May 2025.
- International Monetary Fund (2025), *International Financial Statistics*, GDP deflator, seasonally adjusted index (1950–2023).
- World Bank (2025), *GDP deflator (NY.GDP.DEFL.ZS.AD)* and *Real GDP (NY.GDP.MKTP.KD)* (datasets).
- OECD (2025), *Quarterly national accounts*, seasonally adjusted GDP growth.
- U.S. Federal Reserve Bank of St. Louis, FRED database: *Federal Funds Rate* (FEDFUNDS), *Commodity Price Index* (PALLFNFINDEXQ), and *VIX* (VIXCLS).
- World Bank (2025), *Country and Lending Groups*, income classifications.

A.2 Banking Data

Table 9 provides details of the original banking micro database:

Country	# Obs	Country	# Obs
Argentina	637	Japan	24,948
Australia	18,015	Korea, Rep. of	8,937
Austria	2,118	Luxembourg	1,393
Belgium	3,360	Malaysia	5,684
Brazil	4,220	Malta	625
Chile	3,367	Mexico	2,159
China, P.R.: Hong Kong	6,144	Netherlands, The	3,367
China, P.R.: Mainland	9,176	New Zealand	1,773
Colombia	1,161	Norway	4,436
Croatia, Rep. of	1,074	Peru	362
Denmark	5,772	Philippines	2,169
Finland	1,264	Poland, Rep. of	7,232
France	10,941	Portugal	944
Germany	16,086	Russian Federation	448
Greece	2,909	South Africa	5,257
India	33,722	Spain	4,377
Indonesia	5,890	Sweden	5,187
Ireland	932	Switzerland	8,290
Israel	6,874	Thailand	4,152
Italy	4,410	United Kingdom	64,692

Table 9: Number of observations by country. Total observations across all countries = 294,504.

Vendor and access: S&P Global Market Intelligence (Compustat) via Wharton Research Data Services (WRDS), last accessed on June 5, 2025.[10]

Queries:

- *Compustat Daily Updates — Security Daily*: daily security-level quotes and returns (prices, returns, corporate actions). **Use**: bank equity returns and price series.
- *Banks Fundamentals*: bank-level fundamentals (balance sheet, income statement). **Use**: size, leverage, and balance-sheet controls.

[10] General portal: https://wrds-www.wharton.upenn.edu/. Access requires an institutional license.

- *Index Prices Daily (North America)*: daily market index quotes. **Use**: domestic market benchmark for North American banks.
- *Index Prices Daily*: global/regional daily index quotes. **Use**: foreign or broad benchmarks outside North America.
- *Securities Returns — Financial Sector*: sector-filtered security returns universe. **Use**: verification and coverage cross-check for financials.
- *Finance Industry Fundamentals*: sector/industry classification and fundamentals for financials. **Use**: industry mapping (GICS/SIC) and sectoral controls.

Note: All merges at the security level use standard Compustat identifiers (e.g., `GVKEY`). Classification follows financial sector mappings from *Finance Industry Fundamentals*.

B Proof of Proposition 1

Proof of Proposition 1. Taking log derivatives from (3.37), the domestic goods producers' optimal price, with respect to the nominal exchange rate, yields

$$\begin{aligned}\frac{\partial \ln P^H}{\partial \ln e} &= \frac{\partial\left[\ln PPI + \ln \mu - \ln \Gamma\right]}{\partial \ln e} \\ &= \frac{\partial PPI}{\partial \ln(e) PPI} \\ &= \frac{1}{1-\eta} PPI^{\eta-1}\left[(1-\omega)\frac{\partial (P^V)^{1-\eta}}{\partial \ln e} + \frac{\omega \partial (P^F)^{1-\eta}}{\partial \ln e}\right]\end{aligned}$$

Assuming the derivatives exist and there is a unique solution that solves that equation, then the implicit function theorem applies. Replacing $P^F = P^* e$, the expression can be rewritten as:

$$\frac{\partial \ln P^H}{\partial \ln e} = \frac{(1-\omega)(P^V)^{1-\eta}}{PPI^{1-\eta}} \frac{\partial \ln P^V}{\partial \ln e} + \frac{\omega (P^* e)^{1-\eta}}{PPI^{1-\eta}} \left(\underbrace{\frac{\partial \ln P^*}{\partial \ln e}}_{=0} + \frac{\partial \ln e}{\partial \ln e} \right)$$

$$\boxed{\frac{\partial \ln P^H}{\partial \ln e} = S_V \frac{\partial \ln P^V}{\partial \ln e} + S_F} \tag{B.1}$$

□

C Proof of Proposition 2

Proof of Proposition 2. Start from equations (3.16), (3.17) and (3.20). Recall $\tau_t \equiv \frac{\Theta'(x_t)}{\Theta(x_t) - \Theta'(x_t) x_t}$, and define $R^S_{t+1} \equiv R_{t+1} - R^*_{t+1} \frac{S_{t+1}}{S_t}$

$$\mathbb{E}_t \left[\Lambda_{t,t+1} \Omega_{t+1} R^S_{t+1} \right] \ = \ \tau_t \, \mathbb{E}_t \left[\Lambda_{t,t+1} \Omega_{t+1} R^K_{t+1} \right] \tag{C.1}$$

Expanding the product within the expectation operator, and acknowledging that in a first-order log-linearization the covariance terms vanish, yields

$$\begin{aligned}
\mathbb{E}_t[\bar{\Lambda}(1+\hat{\Lambda}_{t+1})]\mathbb{E}_t[\bar{\Omega}(1+\hat{\Omega}_{t+1})]\mathbb{E}_t[R^S_{t+1}] &= \tau_t \mathbb{E}_t[\bar{\Lambda}(1+\hat{\Lambda}_{t+1})]\mathbb{E}_t[\bar{\Omega}(1+\hat{\Omega}_{t+1})]\mathbb{E}_t[R^K_{t+1}] \\
\bar{R}\mathbb{E}_t(1+\hat{R}_{t+1}) - \left[\bar{R}^* \mathbb{E}_t(1+\hat{R}^*_{t+1}) \frac{\mathbb{E}_t(1+\hat{S}_{t+1})}{1+\hat{S}_t} \right] &= \tau_t \mathbb{E}_t[\bar{R}^k(1+\hat{R}^k_{t+1}) - \bar{R}(1+\hat{R}_{t+1})] \\
\bar{R}\mathbb{E}_t(1+\hat{R}_{t+1}) - \left[\bar{R}^* \mathbb{E}_t(1+\hat{R}^*_{t+1}) \mathbb{E}_t(1+\hat{S}_{t+1} - \hat{S}_t) \right] &\simeq \tau_t \mathbb{E}_t[\bar{R}^k(1+\hat{R}^k_{t+1}) - \bar{R}(1+\hat{R}_{t+1})]
\end{aligned}$$

Around the steady state, gross returns differences ($\bar{R} \simeq \bar{R}^* \simeq \bar{R}^k$), and products of deviations are small; hence

$$\mathbb{E}_t \big[\hat{R}_{t+1} - \hat{R}^*_{t+1} - \hat{S}_t + \hat{S}_{t+1} \big] \ = \ \tau_t \, \mathbb{E}_t \big[\hat{R}^k_{t+1} - \hat{R}_{t+1} \big] \tag{C.2}$$

A first–order Taylor expansion of τ_t around $\bar{x}$ gives

$$\tau_t = \underbrace{\tau(\bar{x})}_{\bar{\tau}} + \tau_x(\bar{x})\,(x_t - \bar{x}),$$

Again, ignoring the product of deviations, (C.2) becomes

$$\hat{S}_t \;=\; -\,\bar{\tau}\,\mathbb{E}_t\big[\hat{R}^k_{t+1} - \hat{R}_{t+1}\big] \;+\; \mathbb{E}_t\big[\hat{R}_{t+1} - \hat{R}^*_{t+1}\big] \;+\; \mathbb{E}_t[\hat{S}_{t+1}]. \tag{C.3}$$

Iterating (C.3) forward J times, letting $J \to \infty$ and using the transversality condition $\lim_{J\to\infty} \mathbb{E}_t\left[\hat{S}_{t+J}\right] = 0$

$$\boxed{\hat{S}_t = \mathbb{E}_t\Big[\sum_{j=1}^{\infty}\big(\hat{R}_{t+j} - \hat{R}^*_{t+j}\big)\Big] \;-\; \bar{\tau}\,\mathbb{E}_t\Big[\sum_{j=1}^{\infty}\big(\hat{R}^k_{t+1} - \hat{R}_{t+1}\big)\Big]} \tag{C.4}$$

□