Global Shocks and Local Response: Currency Risk and Monetary Policy*

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Abstract

An economy's response to global shocks shapes the riskiness of its currency. In countries where the exchange rate provides weaker insulation from global risks, currency depreciations become more recessionary. In these economies, countercyclical exchange rates erode the value of local currency assets during downturns, prompting investors to demand higher excess returns. To analyze these dynamics, we develop a small open economy model in which high export dollar invoicing and significant dollar-denominated debt in the banking system amplify currency risk, increasing exchange rate volatility and deepening the recessionary effects of global shocks. As a result, investors require larger excess returns to compensate for heightened risk. Additionally, firms raise markups as a precautionary measure, contributing to structurally high inflation. Our findings highlight how financial and trade structures shape currency risk and offer important implications for monetary policy in economies exposed to global financial fluctuations.

Key words:currency returns, monetary policy, inflation, small open economies, dominant currency pricing
JEL Codes: E44, F32, F41, G15

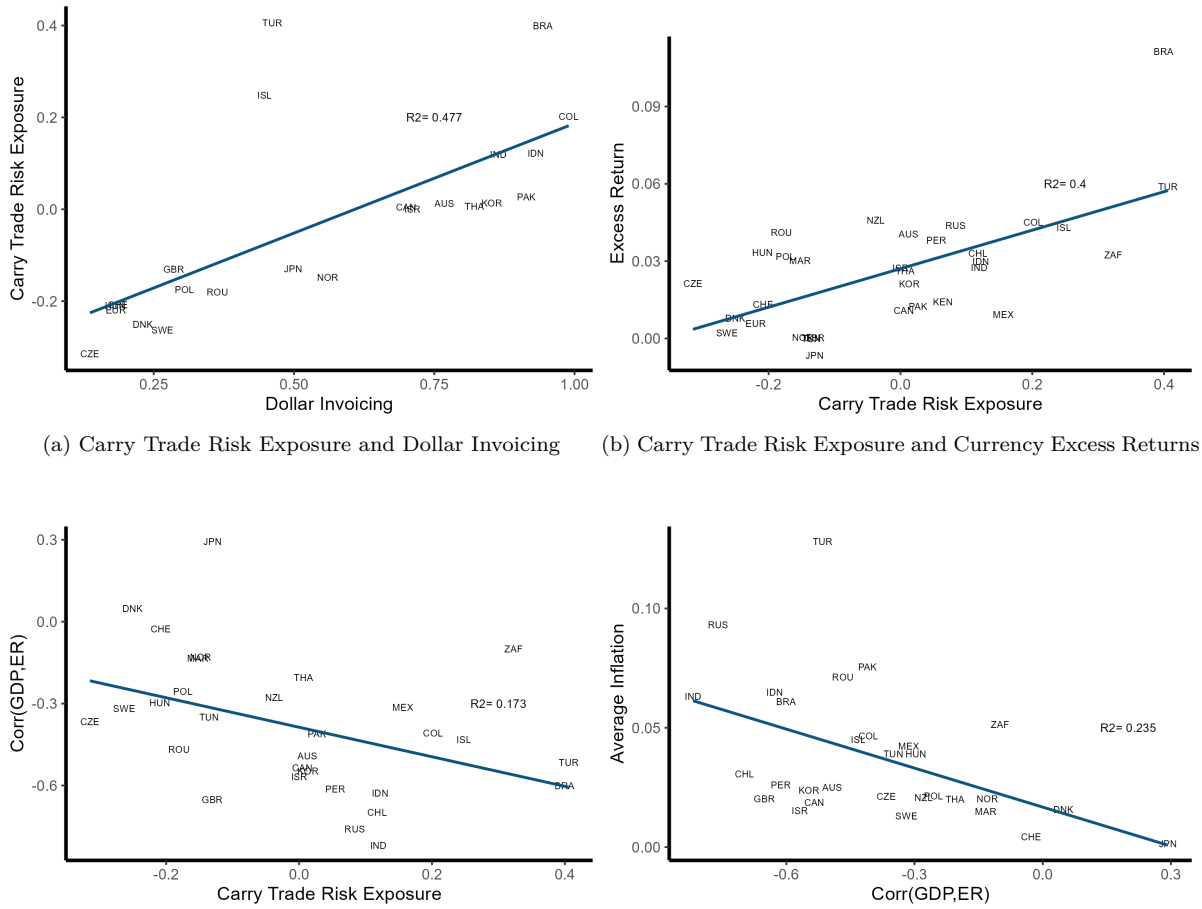
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1 Introduction

Currencies exhibit significant differences in their risk-free returns that cannot be fully explained by predictable currency depreciation, sovereign default risk, or inflation differentials (Hassan and Zhang (2020)). Instead, these variations are closely tied to the risk characteristics of exchange rates. This paper argues that an economy's response to global shocks determines the riskiness of its currency. In particular, two key factors—the invoicing currency of exports and the denomination of foreign debt—play a crucial role in shaping exchange rate risk. Countries whose exports are predominantly invoiced in dollars and that hold substantial dollar-denominated debt are more vulnerable to global shocks. In these economies, the exchange rate provides weak insulation through the trade channel, making depreciations more likely to be recessionary. Since the exchange rate is countercyclical, local currency assets tend to lose value during downturns, prompting investors to demand higher returns to hold these assets (Dalgic (2024)).

In this paper, we first present novel empirical evidence linking excess currency returns to foreign debt levels in the banking system and the share of exports invoiced in U.S. dollars. We begin by estimating the principal components of excess returns and, consistent with Lustig et al. (2011), identify two critical factors. A currency's exposure to these components is strongly associated with its average returns. The first component, "Dollar Risk", is highly correlated with global asset prices, while the second, "Carry Trade Risk", is linked to the share of exports invoiced in dollars. We find that exposure to Dollar Risk is closely related to the level of foreign debt in the banking system, whereas exposure to Carry Trade Risk is associated with the trade balance and the covariance between GDP and the exchange rate. Figure 1aillustrates that countries with high export dollar invoicing tend to have riskier currencies, while Figure 1bshows that these countries provide higher average returns. Additionally, economies with greater exposure to Carry Trade Risk typically exhibit countercyclical exchange rates (Figure 1c) and higher average inflation (Figure 1d). Because these currencies depreciate during global downturns, they provide poor insurance for international investors, leading to higher required returns. Using exchange rate expectations data, we further show that currencies with high exposure to Carry Trade Risk offer higher expected excess returns, indicating that international investors demand a premium for holding currencies that tend to depreciate during global downturns.



(a) Carry Trade Risk Exposure and Dollar Invoicing

(b) Carry Trade Risk Exposure and Currency Excess Returns

(c) Carry Trade Risk Exposure and GDP-ER Correlation

(d) Average Inflation and GDP-ER Correlation

Figure 1: Carry Trade Risk, Currency Returns and Inflation

Data source: FX4Casts, IMF IFS, Gopinath et al. (2020). Carry trade exposure is estimated as the 2nd principal component of currency returns following Lustig et al. (2011). Currency returns are from 25 countries between 02/2003 - 11/2018 (See Section 2.1) . Cyclicality of the exchange rate (GDP-ER correlation) is estimated by regressing Δ logGDP on $\Delta \log \frac{S}{P}$, S is the Dollar exchange rate and P is the CPI (see Section 2.2).

Building on these empirical findings, we develop a small open economy model to analyze the underlying transmission mechanisms. First, we incorporate a leveraged financial intermediary that borrows in foreign currency to finance domestic capital, similar to Ozhan (2020). Second, to account for deviations from uncovered interest rate parity (UIP), we introduce segmented markets where agents conduct transactions in different currencies (similar to Camara et al. (2024)). Third, we assume that both exports and imports are invoiced in the rest-of-the-world currency and are subject to price stickiness, as in Gopinath et al. (2020). Our main experiment consists of studying the effects of an exchange rate depreciation brought about by an increase in the foreign interest rate. When the exchange rate depreciates, the real burden of foreign currency debt increases, generating a decline in the net worth of financial and nonfinancial firms, which can cause a severe contraction in economic activity. Similarly, if the exports are invoiced in dollars, this mutes the expenditure switching channel and prevents exports from simulating demand. These two factors, export dollar invoicing and high dollar debt in the banking system, create currency risk; exchange rate becomes more volatile and global shocks have stronger recessionary effects. Elevated currency risk leads investors require large average excess returns. Additionally, firms raise their average markups as a precautionary

response to this uncertainty, contributing to persistently high inflation.

Unlike in the classical Dornbusch model, an increase in the interest rates of a country does not lead to an immediate appreciation followed by a depreciation but instead, the currencies with high interest rate continues to appreciate, which creates opportunities for carry trade (Fama (1984)) . Still, Hansen and Hodrick (1980) document that there is not a significant average currency returns among developed economies. The recent work focuses not only on developed economies but also developing economies and documents average excess returns (Hassan (2013); Lustig and Verdelhan (2007); Richmond (2019)). Lustig et al. (2011) also uncover two factors, one them is related to average currency returns, the other one is related to the return difference between currencies with high vs low interest rates. Verdelhan (2018) shows that these two factors jointly explain a significant portion of currency returns. In this paper, we show how the two factors co-move with outside macroeconomic variables. Hassan (2013) argues that the size of the economy matters in terms of currency returns. Currencies of larger economies provide income insurance during global downturns. In our dataset, we find some limited evidence in favor of this hypothesis. In particular, when additional controls are added, the effect of nominal USD GDP disappears. Maggiori (2012) argues that the depth of the financial system matters. In our data set we proxy the depth of the financial system by the sum of foreign assets and liabilities of the banking system as a share of GDP ((FL+FA)/GDP). A deeper and more connected system will have higher financial intermediation with the rest of the world. Richmond (2019) argues that trade networks matter for average currency returns. He shows that countries that are central to trade networks tend to have lower currency returns. One possible interpretation is that countries with diverse trade partners are not subject to large swings in trade, which makes the exchange rate more stable. Lustig and Verdelhan (2007) show that average currency returns are related to the correlation between US durable good consumption and the exchange rate. In this work, we use a related concept, the correlation between local real GDP growth and the exchange rate. A negative correlation means that the currency returns are low when the economy is in recession. Low returns during a bad performing economy is undesirable from the perspective of risk averse agents, who demand high returns from those currencies (Christiano et al. (2020); Dalgic (2024)). Engel et al. (2021) shows that between developed economies, UIP violations are not stable. In particular, they do not find significant violations following 2007 and ZLB period. They show that inflation differential can be used to predict currency returns. This paper is also related to idea of rare disasters, currencies which are subject to long run rare risks should command higher returns even though an econometrician might not observe the event happening in the data (Farhi and Gabaix (2016)). Still, we observe that certain currencies tend to depreciate more during global downturns (Wiriadinata (2018)) and these currencies offer higher average returns. Bacchetta and van Wincoop (2019) argue that portfolio adjustment costs can explain major puzzles in currency markets. Ready et al. (2017) show that currencies of commodity exporters yield higher returns compared to manufacturing exporters. Gourinchas et al. (2022) explain UIP deviations using a model of preferred habitat.

Our results are also related to the idea that international investors require positive excess returns to invest in currencies since it is difficult to diversify currency risk because during global downturns, USD tends to appreciate against other currencies (Gourinchas et al. (2017)). We provide evidence that currencies that are more exposed to common factors yield higher returns on average. These currencies tend to lose against USD during global downturns. There is some evidence that emerging market sovereigns are able to borrow in their own currencies (Du and Schreger (2016)) yet most advanced economy investors still invest in their home currencies("currency bias", Maggiori et al. (2020)). Still, a lot of small economy currencies tend to depreciate a lot during global downturns (Hofmann et al. (2022)).

We show that the negative comovement between GDP and the exchange rate can be partially explained by trade invoicing. Countries whose exports are mostly invoiced in dollars see a muted response of exports following an exchange rate depreciation (Goldberg and Tille (2008); Gopinath et al. (2020)), which leads to more adverse effects following a rise in USD interest rates (Akinci and Queralto (2018); Camara et al. (2024)). Similarly, large dollar liabilities accumulated in the financial system creates negative comovement between GDP and the exchange rate because of balance sheet effects.

The limits on monetary policy as a result of free capital flows is underlined by Rey (2015), also by Kalemli-Ozcan (2019). Recent literature finds a link between dollar invoicing and currency returns (Goldberg and Tille (2008)). Gopinath and Stein (2020) argue that the dominant role of the US dollar as the main currency of invoicing leads to lower returns for dollar denominated assets. Dollar invoicing and it's implications about monetary policy are discussed in Gopinath et al. (2020), they show that domestic monetary policy cannot stimulate exports via monetary policy shocks but otherwise silent about the implications about asset returns and portfolio choices, Zhang (2022) estimates response of US monetary shocks on different countries based on dollar-invoicing ratio, he also argues that dollar-invoicing countries have limited monetary policy.

In this paper, we examine average currency returns and show that excess currency returns are linked to an economy's vulnerability to global shocks. Kalemli-Özcan and Varela (2021a) analyze the UIP premium in time series and argue that in emerging markets, local risks play a more significant role than global risks in explaining the UIP premium, though both are important. Building on this idea, we explore how local risk factors shape an economy's response to global shocks and, in turn, influence the currency's exposure to global risk factors. This distinction is crucial because purely local risks can be diversified by investing across multiple currencies. However, if local economic conditions influence how an economy reacts to global shocks, they will also shape the currency's exposure to global risks and directly impact the risk premium.

Camara et al. (2024) show that UIP premium rises following US monetary policy shocks due to large exchange rate depreciation, which leads to eventual appreciation of local currencies. Dalgic (2024) and Akinci et al. (2022) show that uncertainty shocks can drive up interest rate spread in the time series.

2 Data

Excess currency returns can be largely explained by two principal components: the Dollar Risk Factor and the Carry Trade Risk Factor. In our analysis, we review several determinants of currency returns that have been widely discussed in the literature. Our findings suggest that countries with greater exposure to Carry Trade Risk tend to exhibit a negative comovement between GDP and the exchange rate, meaning that exchange rate depreciations in these economies are often associated with recessions. Additionally, countries with high foreign liabilities in the banking system are more exposed to Dollar Risk, as their currencies tend to depreciate more sharply when global asset prices decline.

2.1 Currency Returns

We collect data from 25 countries between 02/2003 - 11/2018. The data is from FX4casts, which includes short term interest rates as well as exchange rates. My definition of currency returns are the difference between exchange rate adjusted short term interest rates., ,

$$R_t^L \frac{S_t}{S_{t+1}} - R_t^{US} \tag{1}$$

From a macroeconomics perspective, the object that we am interested in is the unconditional average returns and the determinants of unconditional returns,

$$\mathbb{E}\left(R_t^L \frac{S_t}{S_{t+1}} - R_t^{US}\right)$$

We further add 8 countries using forward returns. In section D we show how to derive currency returns using forward contracts.

2.2 Comovement between GDP and Exchange Rate

We measure the response of the economy to exchange rate as the comovement between GDP and exchange rate by calculating. For each country, we estimate the correlation between log real GDP changes and log changes in nominal dollar exchange rate divided by CPI, which corresponds to running the following regression,

$$\frac{\Delta GDP_t}{\sigma_{GDP}} = \alpha + \rho \frac{\Delta \frac{S_t}{P_t}}{\sigma_{S/P}} + \epsilon_i$$

The estimate $\hat{\rho}$ corresponds to the correlation coefficients. Countries in our dataset have widely different volatilies of GDP growth and exchange rate and correlation coefficient suitably scales variables by their respective standard deviations. Another benefit of using correlation coefficient is that it is direction invariant, which variable is used as left hand side variable do not change the estimates. Here, we do not claim any causality between GDP or exchange rate movements so that the correlation coefficient is the appropriate measure to estimate the comovement between GDP and exchange rate.

A negative correlation between GDP growth and the exchange rate indicates that the local currency returns go down when the economy is in recession, which makes local currency risky from the perspective of local residents. In these economies, dollar assets provide a better insurance against business cycle fluctuations, which lowers demand for local currency assets. Local residents require higher returns to invest in local currency assets(Christiano et al. (2020); Dalgic (2024)). Figure 1 plots excess returns against the correlation between GDP and exchange rate movements after controlling for size, centrality, average trade balance and FL/FA.

2.3 Global Risk Factors

Following Lustig et al. (2014), we estimate the principal components of currency returns and identify two key components that are highly correlated with these returns. As in Lustig et al. (2011),we refer to the first component as the "Dollar Risk Factor" and the second as the "Carry Trade Risk Factor." The Dollar Risk Factor reflects the value of the U.S. dollar and how other currencies perform relative to it, whereas the Carry Trade Risk Factor captures the performance of low-interest "safe" currencies relative to high-interest "risky" currencies. Exposure to the Carry Trade Risk Factor is strongly correlated with average excess returns. In Table 1, we show that a currency's average excess returns are positively related to its loadings on these two factors. Similarly, in figure 2 we plot excess returns against factor loadings.

	Dependent variable:		
	Excess Returns		
	(1)	(2)	(3)
Dollar Risk Exposure	0.012*		0.011**
	(0.006)		(0.005)
Carry trade Risk Exposure		0.007***	0.007***
		(0.002)	(0.002)
Constant	0.0001	0.002***	0.0003
	(0.001)	(0.0003)	(0.001)
Observations	25	25	25
R^2	0.136	0.458	0.571
Adjusted R^2	0.098	0.435	0.532
Residual Std. Error	0.002 (df = 23)	0.002 (df = 23)	0.001 (df = 22)
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 1: Average excess returns vs component loadings

Data source: FX4Casts. Left hand variable is the average monthly currency returns of 25 countries between 02/2003 - 11/2018. Right hand variables are the coefficients of each country for the two principal component of currency returns. Both components are scaled such that a positive coefficient means positive covaraince with the returns.

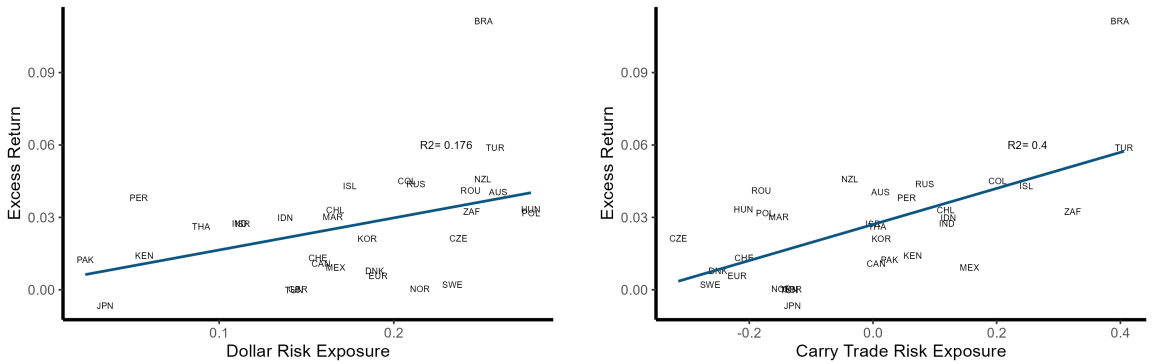


Figure 2: Average excess returns vs component loadings

Data source: FX4Casts. Y-axis variable is the average currency return of 25 countries between 02/2003 - 11/2018. X-axis variables are the coefficients of each country for the two principal component of currency returns. Both components are scaled such that a positive coefficient means positive covaraince with the returns.

In Table 2, we regress currency returns of 5 countries on principle components. Note that except for Japan, regressions have very high R^2, which indicates that common factors drive significant portion of currency returns.

	Dependent variable:				
	Turkey	Chile	Mexcio	Euro Area	Japan
	(1)	(2)	(3)	(4)	(5)
Dollar Risk Exposure	0.258***	0.167***	0.167***	0.191***	0.035
	(0.025)	(0.016)	(0.014)	(0.005)	(0.028)
Carry trade Risk Exposure	0.406***	0.118***	0.156***	−0.219***	−0.130**
	(0.093)	(0.028)	(0.041)	(0.029)	(0.051)
Constant	0.005**	0.003***	0.001	0.0005	−0.001
	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)
Observations	190	190	190	190	190
R^2	0.599	0.460	0.553	0.876	0.097
Adjusted R^2	0.595	0.454	0.548	0.874	0.087
Residual Std. Error (df = 187)	0.033	0.024	0.021	0.010	0.027
Note:					*p<0.1; **p<0.05; ***p<0.01

Table 2: Excess returns vs Risk Factors

Data source: FX4Casts. Left hand variable is the returns of selected currencies between 02/2003 - 11/2018. Right hand variables are the two principal component of currency returns. Both components are scaled such that a positive coefficient means positive covaraince with the returns.

The key question now is: what do these components represent? Unfortunately, principal component analysis does not provide direct insights into their economic interpretation. In Table 3, we regress the Dollar Risk and Carry Trade Risk factors on S&P 500 returns, log changes in the VIX index, and changes in the Global Financial Cycle (GFC) as defined by Miranda-Agrippino and Rey (2020). Notably, the first component is strongly correlated with S&P 500 returns, while the second component is linked to changes in the VIX index.

	Dependent variable:	
	Component 1	Component 2
	(1)	(2)
$S\&P$ 500 Returns	1.533***	−0.080
	(0.341)	(0.110)
Δlog(VIX)	−0.070	−0.085***
	(0.053)	(0.032)
ΔGFC	−0.013	0.001
	(0.009)	(0.004)
Observations	190	190
R^2	0.306	0.045
Adjusted R^2	0.299	0.035
Residual Std. Error (df = 187)	0.105	0.058
Note:	*p<0.1; **p<0.05; ***p<0.01	

Table 3: Risk Factors

Data source: FX4Casts, Ken French dataset, CBOE. Right hand variables are the two principal components of currency returns of 25 countries between 02/2003 - 11/2018. Left hand variables are the returns of S&P500 and log change in VIX index.

2.4 Determinants of Excess Returns

In this section, we look at determinants of excess currency returns discussed in the literature. We consider are external balance (Della Corte et al. (2016)), foreign assets in the banking system (Yeyati (2006); Christiano et al. (2020)), GDP-ER comovement (Dalgic (2024); Christiano et al. (2020)), size(Hassan (2013)) and trade network centrality (Richmond (2019)). In Appendix Section A, we look at each of these variables in isolation. Table 4 runs a regression of average returns on the variables discussed. Similar to Hassan and Zhang (2020), including GDP to the regression makes trade centrality insignificant, this is in line with Richmond (2019) which argues that either size or connectedness makes an economy central to international trade.

	Dependent variable:				
	Average Return				
	(1)	(2)	(3)	(4)	(5)
FL/FA	0.006^{***}	0.005^{**}		0.005	0.004
	(0.002)	(0.002)		(0.004)	(0.004)
Net Foreign Assets/GDP	-0.019^{**}	-0.016^{*}		-0.016^{**}	-0.017^{***}
	(0.009)	(0.009)		(0.007)	(0.006)
GDP(Share of US)	0.005	0.005			0.014^{*}
	(0.005)	(0.005)			(0.008)
Reserves/GDP	0.048^{*}	0.025	0.028	0.030	0.116^{*}
	(0.029)	(0.035)	(0.027)	(0.033)	(0.068)
Corr($\Delta GDP, \Delta S/P$)		-0.032^{***}	-0.031^{***}	-0.024^{*}	-0.040^{**}
		(0.012)	(0.011)	(0.012)	(0.018)
Trade Centrality			-5.417^{***}	-2.292	-9.035^{*}
			(1.305)	(2.214)	(5.251)
Constant	0.023	0.021	0.029^{***}	0.010	0.067^{*}
	(0.018)	(0.019)	(0.011)	(0.018)	(0.040)
Observations	29	28	19	16	16
R^2	0.219	0.360	0.510	0.697	0.770
Adjusted R^2	0.089	0.214	0.412	0.546	0.617
Residual Std. Error	0.022 (df = 24)	0.021 (df = 22)	0.013 (df = 15)	0.012 (df = 10)	0.011 (df = 9)
Note:					*p<0.1; **p<0.05; ***p<0.01

Table 4: Determinants of Returns

Data source: FX4Casts, Ken French dataset, CBOE. Right hand variables are the two principal components of currency returns of 25 countries between 02/2003 - 11/2018. Left hand variables are the returns of S&P500 and log change in VIX index.

2.4.1 Determinants of Component Exposures

In this Section, we aim to understand what determines a currency's exposure to risk factors. In Table 5, we regress currency exposure to these risk factors on key determinants of currency returns. The first factor exposure is highly correlated with the ratio of foreign liabilities to foreign assets (FL/FA), while the second factor exposure is strongly associated with the external balance relative to GDP and the correlation between GDP growth and the exchange rate.

Overall, these results suggest that countries with high foreign liabilities in the banking system have greater exposure to the Dollar Risk Factor, which closely tracks global asset price movements. Currencies of countries with high foreign debt tend to depreciate more when global asset prices decline. At the same time, a negative covariance between GDP growth and exchange rates increases a currency's exposure to the Carry Trade Risk

Factor. These currencies tend to lose value when global uncertainty, as measured by the VIX, rises. Investors expect higher average returns from currencies that have high exposure to Carry Trade Risk.

	Dependent variable:	
	Exposure 1	Exposure 2
	(1)	(2)
FL/FA	0.023^{**}	-0.026
	(0.011)	(0.025)
Net Foreign Assets/GDP	-0.025	-0.097
	(0.037)	(0.072)
Reserves/GDP	-0.048	-0.700
	(0.254)	(0.534)
Corr($\Delta GDP, \Delta S/P$)	-0.027	-0.245^{***}
	(0.080)	(0.092)
GDP(Nominal USD)	0.016	0.021
	(0.019)	(0.030)
Constant	0.192^{**}	0.130
	(0.086)	(0.133)
Observations	28	28
R^2	0.201	0.249
Adjusted R^2	0.020	0.078
Residual Std. Error (df = 22)	0.075	0.186
Note:	*p<0.1; **p<0.05; ***p<0.01	

Table 5: Determinants of Exposures
Data source: FX4Casts, Ken French dataset, CBOE. Right hand variables are the two principal components of currency returns of 25 countries between 02/2003 - 11/2018. Left hand variables are the returns of S&P500 and log change in VIX index.

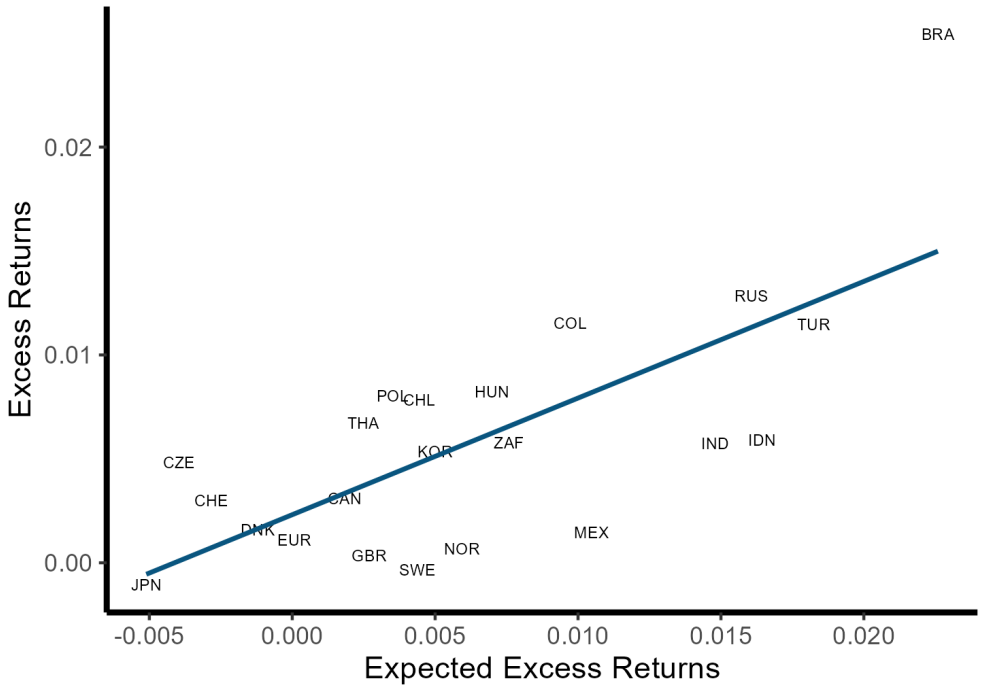
3 Currency Return Expectations

In this section, we make use of the exchange rate expectations provided by FX4Casts. Quarterly exchange rate expectations start ranges between 2003Q1-2018Q4. Using the same dataset, Ince and Molodtsova (2017) looks at the accuracy of forecasts in the time series. Kalemli-Ozcan and Varela (2021b) construct UIP premium series using a similar expectation data. Figure 3 plots average quarterly realized excess returns against quarterly expectations, countries that have high realized returns also have high expected returns. We define expected excess returns as

$$\mathbb{E}_t UIP_t = R_t^L \frac{S_t}{\mathbb{E}_t \left(S_{t+1}\right)} - R_t^{US} \tag{2}$$

where $\mathbb{E}_t S_{t+1}$ are the professional forecasts.

Figure 3: Average Expected vs Realized Returns



Similar to realized returns, we apply principal component analysis to currency return expectations. In Table 6, we regress average excess returns on the loadings of two risk factors derived from principal component analysis using return forecasts. The results indicate that investors anticipate higher returns when investing in currencies with greater exposure to carry trade risk.

Figure 4: Expected average currency return principle vs component loadings

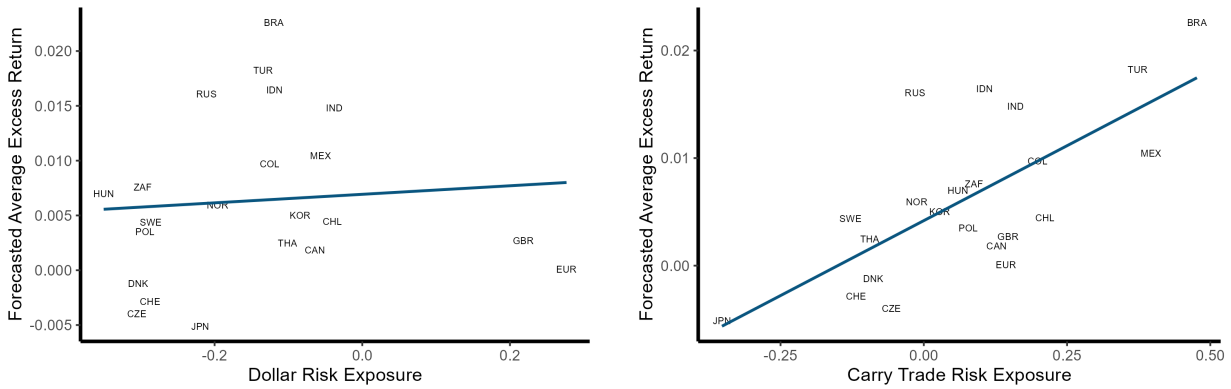


Table 6: Average excess returns vs component loadings

	Dependent variable:		
	Excess Returns		
	(1)	(2)	(3)
Dollar Risk Factor	0.008		−0.007
	(0.011)		(0.008)
Carry Trade Risk Factor		−0.028***	−0.031***
		(0.005)	(0.005)
Constant	0.009***	0.005***	0.004**
	(0.002)	(0.001)	(0.002)
Observations	26	26	26
R^2	0.028	0.467	0.484
Adjusted R^2	−0.012	0.445	0.439
Residual Std. Error	0.007 (df = 24)	0.006 (df = 24)	0.006 (df = 23)
Note:			*p<0.1; **p<0.05; ***p<0.01

Data source: FX4Casts, Ken French dataset, CBOE. Right hand variables are the two principal components of currency returns of 25 countries between 02/2003 - 11/2018. Left hand variables are the returns of S&P500 and log change in VIX index.

4 Model

So far we have established that the covariance between economic performance and the exchange rate is a significant driver of interest rate spreads across countries and this covariance term is significantly related to dollar invoicing. In countries where most exports are denominated in dollars, expenditure switching channel is weaker because depreciations cannot stimulate exports. With export response muted, economic performance is weaker following a depreciation. In this section, we build a small open economy New Keynesian model based on Camara et al. (2024) , in which exports are priced in dollars and the export price stickiness will influence the strength of the expenditure switching channel and influence the interest rate spreads.

4.1 Households

Households in the model supply labor and capital to firms and save in dollars. They maximize

$$E_0 \sum_{t=0}^{\infty} \beta^t \left(u\left(C_t\right) - \exp\left(\tau_t\right) \frac{l_t^{1+\varphi}}{1+\varphi} - \frac{1}{2}\gamma\left(\Theta_t - \Upsilon_t\right)^2 \right)$$

Θ_t denotes dollarization; share of USD assets in the portfolio. The last term is non-pecuniary costs associated with deviating from the target portfolio(Υ_t).These costs can be thought of coming from a preferred habitat model (Gourinchas et al. (2022)). Household budget,

$$D_t + S_t D_t^* + P_t^c C_t = +D_{t-1} R_{d,t-1} + S_t R_{d,t-1}^* D_{t-1}^* + W_t l_t + \Pi_t$$

where D_t,D_t^*, and K_t are peso and dollar deposits, and capital respectively. S_t. P_t^c and P_t^k are the nominal exchange rate, consumer price index and the price of capital.

4.2 Goods Production

Domestic homogenous good is combined with imported inputs to produce consumption, investment and export goods.

4.2.1 Domestic Homogeneous Goods

Domestic homogenous good Y_t is produced from intermediate domestic goods and is used as a input for consumption, investment and export goods.

$$Y_t = \left[\int_0^1 Y_{i,t}^{\frac{\varepsilon-1}{\varepsilon}} di\right]^{\frac{\varepsilon}{\varepsilon-1}}, \varepsilon > 1$$

Market clearing in homogeneous goods is

$$Y_t = I_t^d + C_t^d + X_t^d$$

where $\left(I_t^d,\, C_t^d,\, X_t^d\right)$ are domestic goods to produce final investment, consumption and export goods respectively.

4.2.2 Intermediate Goods

Intermediate goods are produced by monopolists using capital and labor, Production function of intermediate good firms:

$$Y_{i,t} = K_{i,t-1}^{\alpha} \left(A_t l_{i,t}\right)^{1-\alpha}$$

where A_t is exogenous technology. Intermediate good producing firms are subject to the Calvo Price-Setting Friction, only a share of $(1-\theta)$ of them are allowed to change their prices, the rest keep their old price.

4.2.3 Final Consumption Goods

Consumption good is produced by a representative, competitive firm using domestic homogenous good and imported foreign inputs, they are consumed by domestic households.

$$C_t = \left[(1-\omega_c)^{\frac{1}{\eta_c}} \left(C_t^d\right)^{\frac{\eta_c-1}{\eta_c}} + \omega_c^{\frac{1}{\eta_c}} \left(C_t^m\right)^{\frac{\eta_c-1}{\eta_c}}\right]^{\frac{\eta_c}{\eta_c-1}}$$

Consumer price index is defined as

$$P_t^c = \left[(1-\omega_c)\, P_t^{1-\eta_C} + \omega_c \left(P_t^m\right)^{1-\eta_c}\right]^{\frac{1}{1-\eta_c}} \tag{3}$$

where $P_t^m = S_t P_t^f$ is the import price in local currency, where P_t^f is the exogenous dollar price of imported goods and S_t is the exchange rate. Since import prices directly enter consumer price index, there is a strong and immediate exchange rate passthrough especially for low η_c, in which case substitution between imported and domestically produced goods is hard. A large depreciation will reduce real incomes in consumption units if the wages do not increase as much as the consumption price index. For low values of η_c, a depreciation leads to a large increase in consumer prices and leads to a decline in consumption via real income channel of exchange rate depreciations (Auclert et al. (2021)).

4.2.4 Capital Goods and Investment

Capital is produced from domestic homogenous ($I_{d,t}$) and foreign ($I_{m,t}$) inputs.

$$I_t = \left[\gamma_I^{\frac{1}{\nu_I}} I_{d,t}^{\frac{\nu_I - 1}{\nu_I}} + (1-\gamma_I)^{\frac{1}{\nu_I}} I_{m,t}^{\frac{\nu_I - 1}{\nu_I}} \right]^{\frac{\nu_I}{\nu_I - 1}}$$

Similar to equation 3, price of capital depends on the exchange rate. Evolution of capital is subject to capital adjustment costs.

$$K_t = (1-\delta) K_{t-1} + \left[1 - S\left(\frac{I_t}{I_{t-1}} \right) \right] I_t.$$

4.2.5 Exports

Similar to consumption and Investment, exports are produced from intermediate export goods and imported inputs

$$X_t = \left[\gamma_x^{\frac{1}{\eta_x}} \left(X_t^d \right)^{\frac{\eta_x - 1}{\eta_x}} + (1-\gamma_x)^{\frac{1}{\eta_x}} \left(X_t^m \right)^{\frac{\eta_x - 1}{\eta_x}} \right]^{\frac{\eta_x}{\eta_x - 1}},$$

where X_t^d is a domestically produced input to exports with dollar price, $P_t^{d,x}$ and X_t^m is an imported good with dollar price, P_t^f. Export good is produced using both goods and sold at dollar price P_t^x

Foreigner demand local export goods is given by

$$X_t = \left(\frac{P_t^x}{P_t^f} \right)^{-\eta_f} Y_t^f \tag{4}$$

where Y_t^f is foreign demand. The domestic input is produced by a competitive firm using the following production function:

$$X_t^d = \left[\int_0^1 X_{i,t}^{\frac{\varepsilon_x - 1}{\varepsilon_x}} di \right]^{\frac{\varepsilon_x}{\varepsilon_x - 1}} \tag{5}$$

where $X_{i,t}$ is produced using domestic homogenous good by monopolists for price $P_{i,t}^x$. These monopolists face Calvo sticky prices, they can only change their price with with probability $(1-\theta_x)$. In the absence of export price stickiness ($\theta_x = 0$), monopolists will set $P_t^{d,x} = P_t$. In that case, export prices will depend only on P_t^m, which is the local currency price of foreign goods.

4.3 Financial System

The financial system is composed of banks that intermediate between households, foreigners, and firms. Both households and foreigners deposit funds in local currency and dollars. Figure 5 shows the financial system.

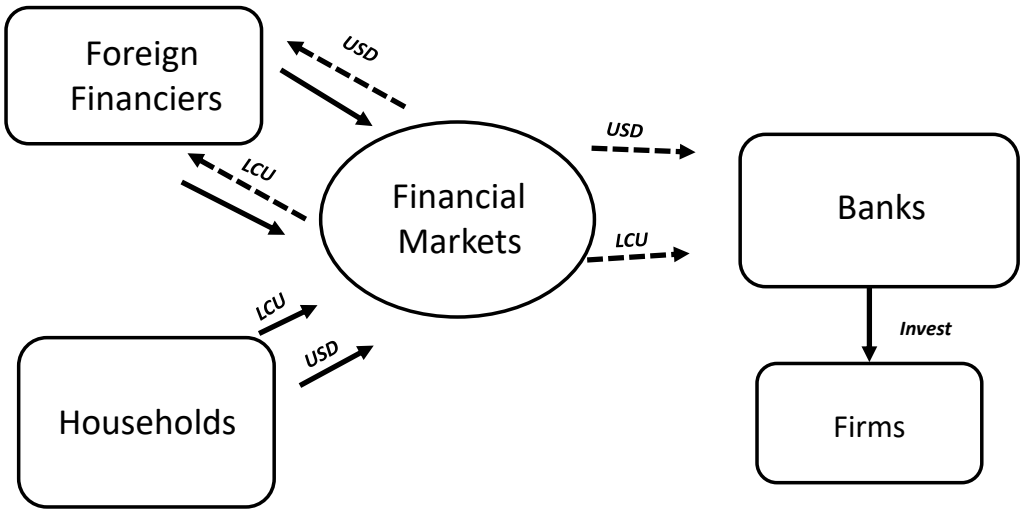


Figure 5: Financial Markets

4.3.1 Banks

Banks borrow funds from households and foreigners to finance firm investments, but their borrowing is constrained by financial frictions in the spirit of Gertler and Karadi (2011), which limit the amount they can borrow based on an incentive constraint. Banks with higher equity have greater borrowing capacity. They can choose to borrow in either local currency (LC) or USD, with a preference for the cheaper option. However, they also aim to maintain a balanced portfolio that aligns with their target. Bankers intermediate between households and non-financial firms. Households are standard except it's the bankers who buy and operate the capital. Bankers issue issue deposits and buy claims on non-financial firms and earn returns from capital. We derive banker equations in Appendix Section E.

4.3.2 Foreign Financiers

Foreign financiers borrow in USD and lend in local currency (LCU), operating under an incentive constraint as described by Gabaix and Maggiori (2015). While they have a preferred habitat, they may deviate from their target portfolio if excess returns are available. However, this incentive constraint becomes tighter when exchange rate volatility increases, as noted by Gabaix and Maggiori (2015).

$$(B_t^* - B^*) = \frac{\mathbb{E}_t^j \left(\frac{R_t S_t}{S_{t+1}} \right) - R_t^*}{\lambda(\mathbb{V} s_{t+1})} \tag{6}$$

where B_t^* is the dollar amount of investment in local assets, $B_t^F = B_t^* S_t$ is defined as the local currency amount of these investments.

4.3.3 Financial Markets Clearing

Local currency financial market clearing condition,

$$B_t^F + D_t = B_t^{LC}$$

where D_t is the amount of local currency deposits by households, B_t^F is local currency investments by foreigners and B_t^{LC} is the amount of total bank borrowing in local currency. The only constraint is $B_t^{LC} \geq 0$, foreigners or local can also have negative position. Dollar market clearing condition,

$$B_t^{F,*} + D_t^* = B_t^{FC}$$

similarly, $B_t^{F,*}$, D_t^* are foreign and local dollar deposits and B_t^{FC} is bank dollar borrowing (in terms of local currency). For foreigners, dollar lending/borrowing is riskless and at the exogenous risk free dollar interest rate R_t^* so that their position ($B_t^{F,*}$) is the difference between household and bank positions.

4.4 Balance of Payments

Net Financial Asset position of the economy is $-\left(B_t^F + B_t^{F,*}\right)$. Net exports $(X_t - M_t)$ equal to change in net foreign asset position (which includes interest income earned by foreigners)

$$X_t - M_t = -\left(B_t^{F,*} - B_{t-1}^{F,*} R_{t-1}^* \frac{S_t}{S_{t-1}}\right) - \left(B_t^F - B_t^F R_{t-1}\right)$$

4.5 Monetary Policy

Central bank in the model follows a Taylor rule,

$$\log\left(R_t/\bar{R}\right) = \rho_R \log\left(R_{t-1}/\bar{R}\right) + r_\pi \log\left(\pi_t/\bar{\pi}\right) + r_y \log\left(y_t/\bar{y}\right) + \epsilon_{R,t}$$

where r_π and r_y are inflation and output coefficients. According to De Leo et al. (2022), Taylor rule is a good approximation for both EME and AE central bank policies. Following Camara et al. (2024), we use domestic good inflation (as opposed to consumer price inflation) as the target. In the model simulations, we use the same Taylor coefficients and targets so that any systemic change in the response of monetary policy reflects endogenous response to economic fundamentals.

4.6 Parameters

Table 7 presents parameter values. We use standard parameters in the literature, close to estimates by Camara et al. (2024), who estimate them for a set of EME. Elasticity of substitution between imported and domestic goods in consumption is less than 1, which means exchange rate depreciations lead to consumption drop because foreign inputs are not easily replaced, creating real income channel of exchange rate discussed by Auclert et al. (2021). We use relatively low home biases indicating that the economy is relatively open.

Variable	Description	Value
β	Discount Factor	0.995
α	Capital Share	0.340
δ	Depreciation	0.020
φ	Inverse Frisch	1.000
r_π	Taylor Inflation Coefficient	1.500
r_y	Taylor Output Coefficient	0.100
r_S	Taylor Exchange Rate Coefficient	0.020
ϵ	Elasticity of Substitution, intermediate goods	6.000
θ	Calvo Parameter, intermediate goods	0.750
ϵ^x	Elasticity of Substitution, export goods	6.000
γ	Target Portfolio Cost (UIP Friction)	-1.500
θ^x	Export Calvo Stickiness	0.950
κ	Investment Adjustment Cost	5.000
η_c	C, Elasticity of Substitution	0.500
$1-\omega_c$	Home Bias, C	0.600
ω_i	Home Bias, I	0.600
γ_x	Home Bias, X	0.500
η^f	Elasticity of Demand, Exports	1.500
η_i	I, Elasticity of Substitution	0.800
η_x	X, Elasticity of Substitution	1.500
ρ_R	MP Persistence	0.900
ϕ	Target Credit Dollarization	0.500
Υ	Target Deposit Dollarization	0.200

Table 7: Parameter Values

5 Results

In the classical Mundell-Fleming (M-F) framework, exchange rate depreciations act as a shock absorber, mitigating the impact of global shocks. Following a foreign interest rate shock (R_t^*), the exchange rate depreciates, boosting exports and countering recessionary effects. In this section, we are going to consider two key features that weaken this shock-absorbing function: export dollar invoicing and dollar-denominated debt. When export prices are sticky in dollars, exchange rate depreciations fail to stimulate exports, reducing their counter-cyclical effectiveness. Additionally, in economies with high levels of dollar debt, depreciation leads to financial losses, constraining risk-taking capacity of the financial system and reducing lending, which in turn causes a sharp decline in investment. Together, these factors make an economy more vulnerable to global shocks. In response to a foreign interest rate hike, the exchange rate depreciates significantly, shrinking the economy and generating losses for local asset holders, which in turn creates a demand for ex-ante risk premium. Furthermore, high macroeconomic volatility—particularly in inflation and exchange rates—pushes firms to increase markups as a precautionary measure, resulting in structurally high inflation.

5.1 Response to Foreign Interest Rate Shock

Figure 6 illustrates the model's response to a foreign interest rate shock under different levels of export price stickiness ($\theta^x = [0.01, 0.9]$) and dollar debt ($\bar{\phi} = [0.1, 0.6]$). The results highlight that economies with both high dollar debt and sticky export prices experience the most severe consequences, with significantly larger exchange rate depreciations compared to others. Notably, a positive UIP spread emerges only in scenarios with high dollar debt (see also Kalemli-Ozcan (2019)), reflecting the increased risk premium demanded by investors. When dollar invoicing is low and dollar debt is minimal, monetary policy responds aggressively to the shock by raising interest rates, effectively stabilizing exchange rate volatility. In contrast, when export prices are highly sticky and dollar debt is elevated, monetary policy is constrained, leading to sharp currency depreciations that impose substantial losses on local asset holders. Note that monetary policy follows the same Taylor rule (described in Section 4.5) so that the difference is the endogenous response of monetary policy to economic fundamentals. These findings emphasize the crucial role of both price flexibility and liability composition in shaping macroeconomic resilience to external shocks.

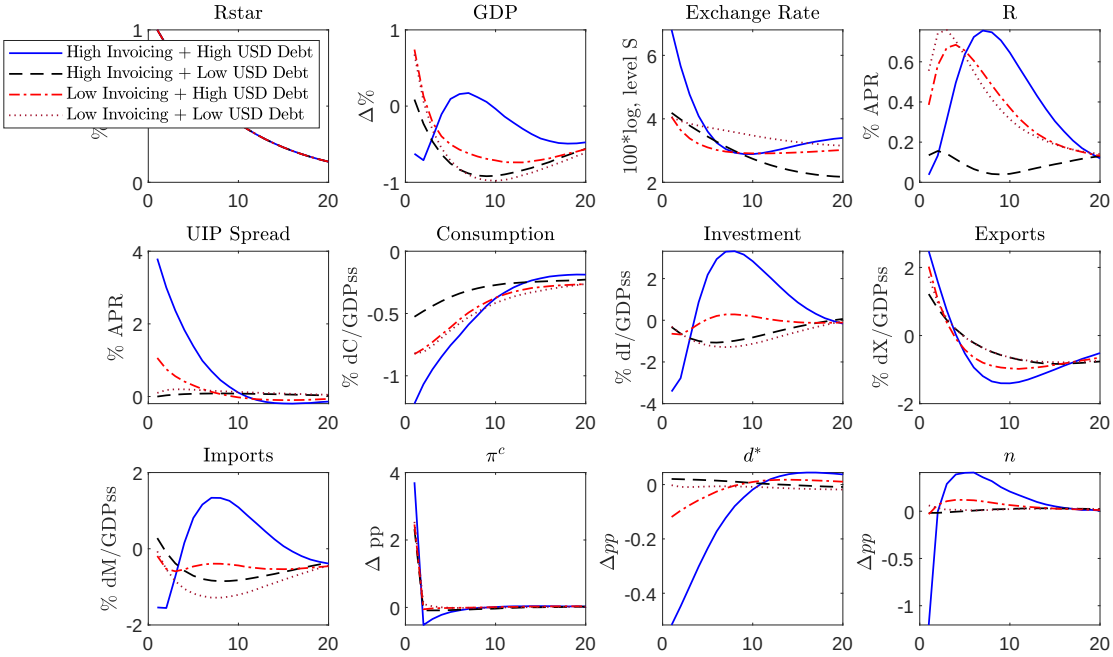


Figure 6: Response of the economy following a foreign interest rate shock

Mechanism

Figure 7 plots the UIP spread and export prices (in USD) following an increase in foreign interest rates. The results show that the UIP spread rises only in economies with significant dollar debt, as losses in the financial sector force the economy to attract more capital inflows, leading to disproportionately higher returns. The response of export prices plays a crucial role in shaping the macroeconomic adjustment. When export prices are flexible, they decline in USD terms, making exports more competitive, stimulating demand, and boosting production. In contrast, when export prices are sticky in dollars, they remain unchanged, preventing

an increase in exports despite currency depreciation. This rigidity has significant implications for the UIP spread. In the presence of sticky export prices, the UIP spread rises sharply because the primary channel of expenditure switching occurs through imports rather than exports. Consequently, a much larger currency depreciation is required, severely weakening financial sector balance sheets and exacerbating economic distress. These findings underscore the importance of both liability composition and pricing flexibility in shaping how economies adjust to external shocks.

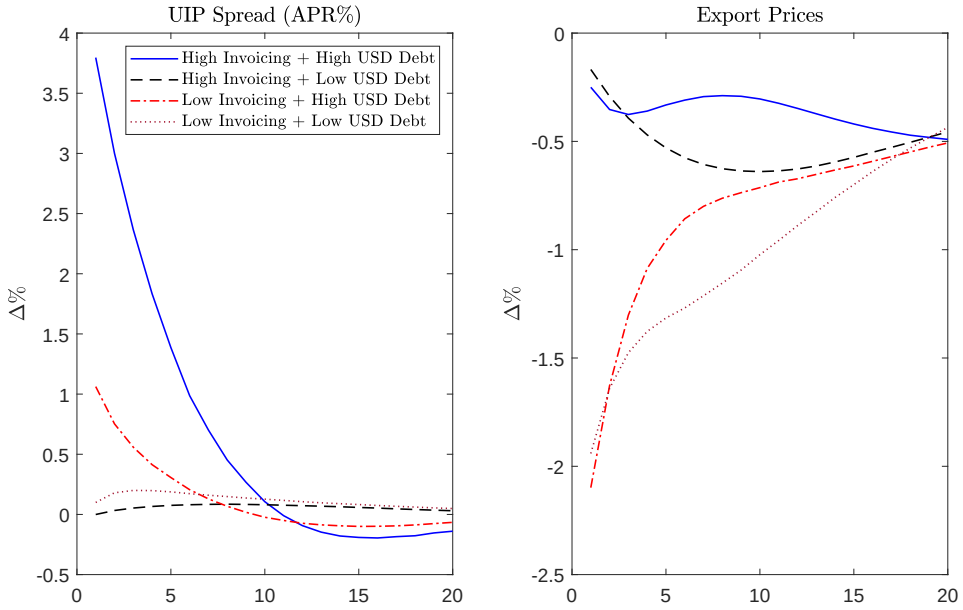


Figure 7: UIP Spread and Export Prices

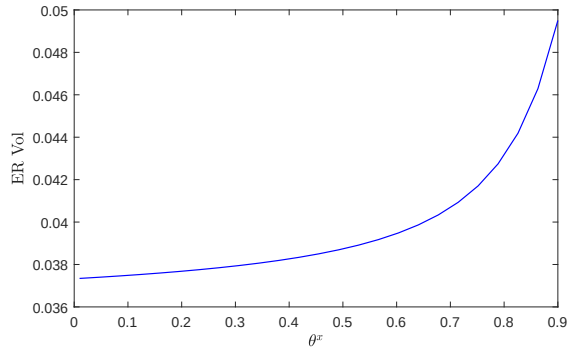
5.2 Steady State Results

In this section, we examine the steady state of the economy as a function of export price stickiness (θ_x) and ratio of dollar debt (ϕ) separately. We solve the model using a third-order approximation around the non-stochastic steady state, which allows the simulation averages to deviate from it. In the stochastic steady state, stickier export prices and high dollar debt result in a more volatile exchange rate and more negative correlation between output and the exchange rate (Figure 8). Risk-averse investors demand a risk premium to hold local assets for: (i) foreign investors are averse to exchange rate volatility, and (ii) local investors prefer dollar assets, which appreciate during recessions. As a result, steady state UIP premium rises (Figure 9). Volatile macroeconomic environment makes firms increase markups due to precautionary measure, which increases steady state inflation (Figure 10).

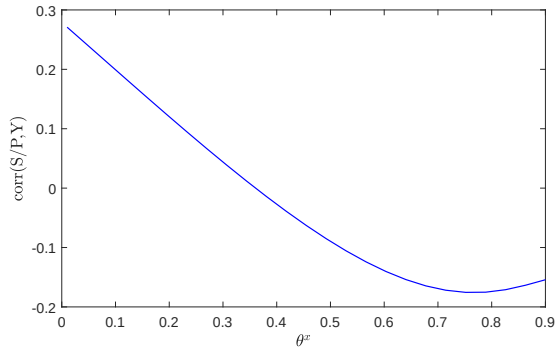
Volatility and Cyclicality of Exchange Rate

Under dollar invoicing and high dollar-denominated debt, the exchange rate becomes highly sensitive to external shocks. When exports are priced in dollars, sticky prices prevent an increase in export volumes following a depreciation. As a result, the exchange rate must depreciate significantly to restore current account balance. Similarly, in a financial system with substantial dollar debt, exchange rate losses increase the

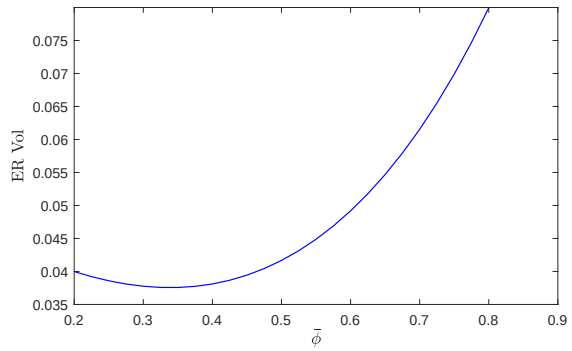
need for capital inflows, further exacerbating depreciation. In both cases, exchange rate volatility rises, and currency depreciations coincide with economic downturns, strengthening the negative comovement between GDP and the exchange rate.



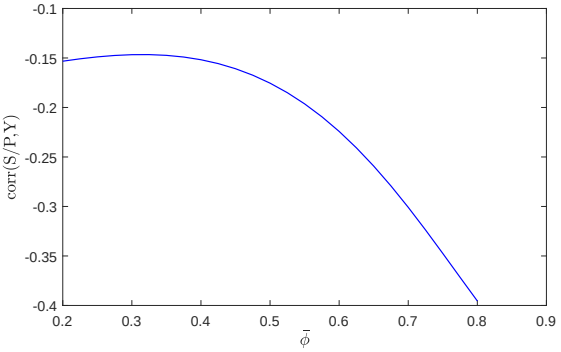
(a) Exchange rate volatility and export dollar price stickiness (θ_x)



(b) Output and exchange rate comovement and export dollar price stickiness (θ_x)



(c) Exchange rate volatility and dollar debt (ϕ)

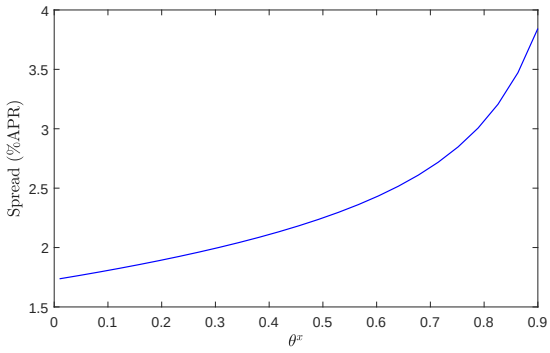


(d) Output and exchange rate comovement and dollar debt (ϕ)

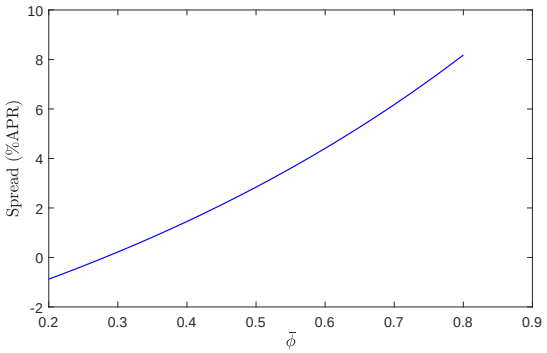
Figure 8: Steady State Volatility and Cyclicality of the Exchange Rate

Risk Premium

When GDP and the exchange rate exhibit strong negative comovement, local assets provide poor insurance compared to dollar assets (Christiano et al. (2020)), which tend to appreciate in value during downturns. As a result, households prefer to invest in dollar assets, which offer better protection against external shocks, leading to a higher risk premium on local assets. Similarly, heightened exchange rate volatility discourages foreign investors from holding local assets (Equation 6). Together, these forces imply that as the comovement between GDP and the exchange rate becomes more negative, the UIP premium in the steady state increases (Dalgic (2024)).



(a) UIP Premium and export dollar price stickiness (θ^x)

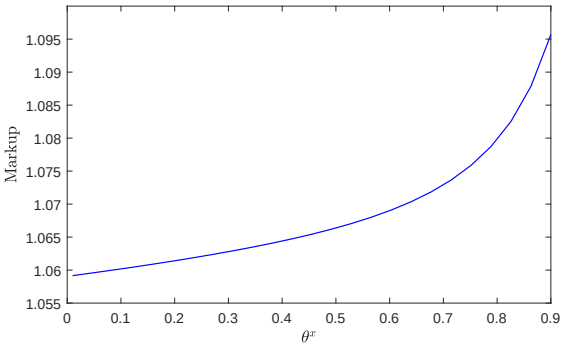


(b) UIP premium and dollar debt (ϕ)

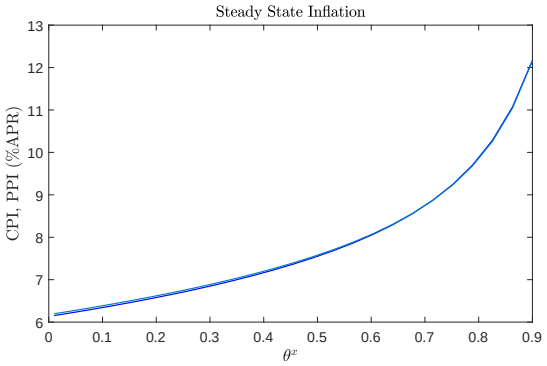
Figure 9: Steady State UIP Premium

Markups and Inflation

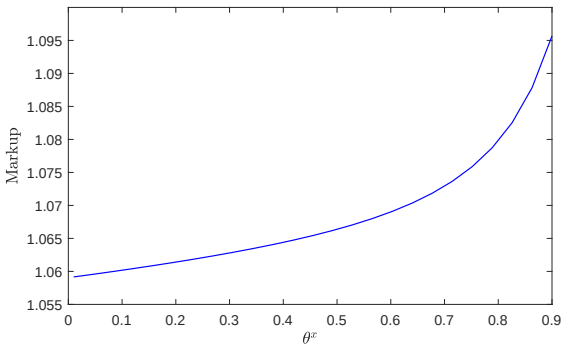
Under dollar invoicing and high dollar debt, exchange rate volatility amplifies price fluctuations, increasing uncertainty for firms. In response, firms that can adjust prices raise markups as a precautionary measure to protect profit margins. These elevated markups contribute to structurally higher inflation in the steady state.



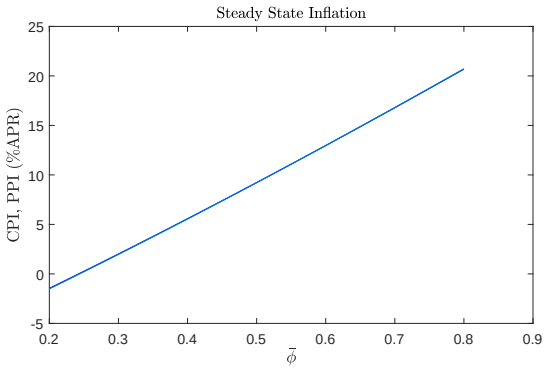
(a) Steady state markup and export price stickiness



(b) Steady state inflation and export price stickiness



(c) Steady state markup and dollar debt

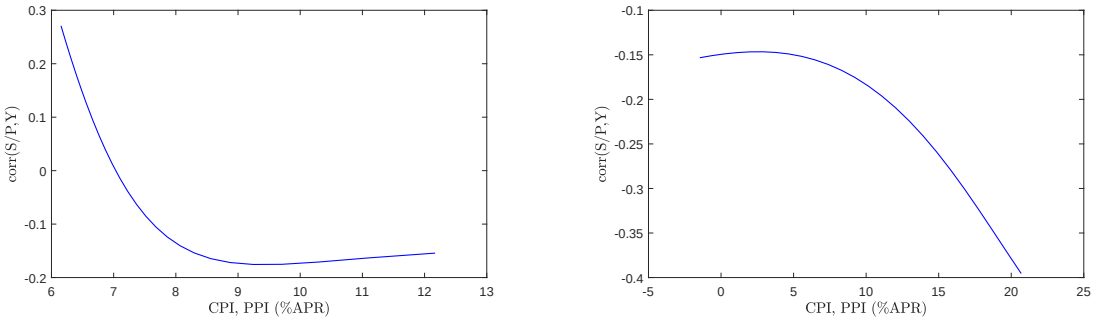


(d) Steady state inflation and dollar debt

Figure 10: Steady State Markup and Inflation

5.2.1 Inflation and GDP-ER Co-movement

In this section, we use above simulations to generate the realtionship between GDP-ER comovement and inflation. Figure 11 replicates the Figure 1d, the model is able to capture the negative relationship between average inflation and the comovement between output and the exchange rate along both dollar debt and dollar invoicing. In countries with negative comovement between GDP and ER, exchange rate is not able to insulate the economy against external shocks; which makes inflation and output more volatile. As a response, firms increase their markup with precautionary motive, leading to high average inflation.



(a) Along export prices stickiness (θ^x)

(b) Along Dollar Debt ($\bar{\phi}$)

Figure 11: Inflation and GDP-ER Co-movement

6 Conclusion

This paper examines how an economy's response to global shocks shapes the riskiness of its currency, highlighting the joint role of trade and financial structures. We show that countries with a high share of exports invoiced in dollars experience weaker exchange rate insulation, making currency depreciations more recessionary. Similarly, financial systems with significant dollar-denominated debt are more vulnerable to external shocks, as depreciations amplify balance sheet losses, constrain credit supply, and weaken investment. Together, these factors increase exchange rate volatility and contribute to a more negative comovement between GDP and the exchange rate, reinforcing currency risk.

Using a small open economy model, we formalize these mechanisms and show that both high export dollar invoicing and significant dollar debt amplify the risk premium required by investors. When exchange rate depreciations coincide with economic downturns, local currency assets become riskier relative to dollar assets, prompting investors to demand higher excess returns. Furthermore, high exchange rate volatility discourages foreign investment in local assets, further raising the UIP premium. These dynamics suggest that the structure of trade invoicing and financial liabilities has a direct influence on currency risk and international capital flows.

An important macroeconomic consequence of these mechanisms is persistently high inflation. When exchange rate fluctuations drive economic instability, firms respond by raising markups as a precautionary measure, embedding inflationary pressures into the economy. This structural inflation makes monetary policy more challenging, particularly in economies where exchange rate pass-through to prices is strong. Even in the absence of traditional fiscal or monetary imbalances, the interaction between trade and financial structures can create persistent macroeconomic instability.

Our findings have several policy implications. First, monetary authorities in economies with high dollar invoicing and significant dollar debt should account for the fact that exchange rate movements may not provide the expected countercyclical benefits. Policies that reduce the reliance on dollar invoicing—such as promoting local currency pricing—could help strengthen the shock-absorbing function of exchange rates. Second, macroprudential policies that mitigate excessive foreign currency debt exposure in the banking system can reduce financial vulnerabilities that amplify exchange rate volatility. Finally, inflation-targeting regimes must recognize that high macroeconomic volatility can itself contribute to inflation persistence, making it crucial to stabilize exchange rate fluctuations through well-calibrated monetary and financial policies.

Overall, this paper underscores the importance of trade and financial structures in shaping the riskiness of currencies. By identifying the key channels through which global shocks propagate to exchange rates, investment, and inflation, we provide a framework for understanding why some currencies are inherently riskier than others. Future research could explore how firms and financial institutions endogenously adjust their invoicing and debt structures in response to exchange rate volatility, further enriching our understanding of currency risk in an interconnected global economy.

References

Akinci, Ozge and Albert Queralto, "Exchange Rate Dynamics and Monetary Spillovers with Imperfect Financial Markets," Staff Reports 849, Federal Reserve Bank of New York June 2018.

_ , Şebnem Kalemli-Özcan, and Albert Queralto, "Uncertainty Shocks, Capital Flows, and International Risk Spillovers," NBER Working Papers 30026, National Bureau of Economic Research, Inc May 2022.

Auclert, Adrien, Matthew Rognlie, Martin Souchier, and Ludwig Straub, "Exchange Rates and Monetary Policy with Heterogeneous Agents: Sizing up the Real Income Channel," *NBER Working Papers*, May 2021, (28872).

Bacchetta, Philippe and Eric van Wincoop, "Puzzling Exchange Rate Dynamics and Delayed Portfolio Adjustment," Technical Report, National Bureau of Economic Research, Cambridge, MA September 2019.

Bocola, Luigi and Guido Lorenzoni, "Financial Crises, Dollarization, and Lending of Last Resort in Open Economies," 2019, *53* (9), 1689–1699.

Camara, Santiago, Lawrence Christiano, and Hüsnü Dalgic, "The International Monetary Transmission Mechanism," in "NBER Macroeconomics Annual 2024, Volume 39," University of Chicago Press, July 2024.

Christiano, Lawrence, Husnu C Dalgic, and Armen Nurbekyan, "Financial Dollarization in Emerging Markets : Efficient Risk Sharing or Prescription for Disaster?," Technical Report 2020.

Corte, Pasquale Della, Steven J. Riddiough, and Lucio Sarno, "Currency Premia and Global Imbalances," *Review of Financial Studies*, 2016, *29* (8), 2161–2193.

Dalgic, Husnu C., "Financial Dollarization in Emerging Markets: An Insurance Arrangement," *International Economic Review*, 2024, *65* (3), 1189–1219.

Du, Wenxin and Jesse Schreger, "Sovereign Risk, Currency Risk, and Corporate Balance Sheets," Harvard Business School Working Papers 17-024, Harvard Business School September 2016.

Engel, Charles, Ekaterina Kazakova, Mengqi Wang, and Nan Xiang, "A Reconsideration of the Failure of Uncovered Interest Parity for the U.S. Dollar," Technical Report, National Bureau of Economic Research, Cambridge, MA January 2021.

Fama, Eugene F., "Forward and Spot Exchange Rates," *Journal of Monetary Economics*, November 1984, *14* (3), 319–338.

Farhi, Emmanuel and Xavier Gabaix, "Rare Disasters and Exchange Rates *," *The Quarterly Journal of Economics*, February 2016, *131* (1), 1–52.

Gabaix, Xavier and Matteo Maggiori, "International Liquidity and Exchange Rate Dynamics*," *The Quarterly Journal of Economics*, August 2015, *130* (3), 1369–1420.

Gertler, Mark and Peter Karadi, "A Model of Unconventional Monetary Policy," *Journal of Monetary Economics*, 2011, *58* (1), 17–34.

Goldberg, Linda S. and Cédric Tille, "Vehicle Currency Use in International Trade," *Journal of International Economics*, December 2008, *76* (2), 177–192.

Gopinath, Gita and Jeremy C Stein, "Banking, Trade, and the Making of a Dominant Currency*," *The Quarterly Journal of Economics*, October 2020.

_ , Emine Boz, Camila Casas, Federico J. Díez, Pierre-Olivier Gourinchas, and Mikkel Plagborg-Møller, "Dominant Currency Paradigm," *American Economic Review*, March 2020, *110* (3), 677–719.

Gourinchas, Pierre-Olivier, Hélène Rey, and Nicolas Govillot, "Exorbitant Privilege and Exorbitant Duty," *UC Berkeley Discussion Paper*, 2017, (695722), 1–74.

_ , Walker D. Ray, and Dimitri Vayanos, "A Preferred-Habitat Model of Term Premia, Exchange Rates, and Monetary Policy Spillovers," NBER Working Papers 29875, National Bureau of Economic Research, Inc March 2022.

Hansen, Lars Peter and Robert J. Hodrick, "Forward Exchange Rates as Optimal Predictors of Future Spot Rates: An Econometric Analysis," *Journal of Political Economy*, October 1980, *88* (5), 829–853.

Hassan, Tarek A., "Country Size, Currency Unions, and International Asset Returns," *Journal of Finance*, 2013, *68* (6), 2269–2308.

Hassan, Tarek Alexander and Tony Zhang, "The Economics of Currency Risk," Technical Report, National Bureau of Economic Research, Cambridge, MA September 2020.

Hofmann, Boris, Nikhil Patel, and Steve Pak Yeung Wu, "Original Sin Redux: A Model-Based Evaluation," BIS Working Papers 1004, Bank for International Settlements February 2022.

Ince, Onur and Tanya Molodtsova, "Rationality and Forecasting Accuracy of Exchange Rate Expectations: Evidence from Survey-Based Forecasts," *Journal of International Financial Markets, Institutions and Money*, March 2017, *47*, 131–151.

Kalemli-Ozcan, Sebnem, "U.S. Monetary Policy and International Risk Spillovers," NBER Working Papers 26297, National Bureau of Economic Research, Inc September 2019.

Kalemli-Özcan, Şebnem and Liliana Varela, "Five Facts about the UIP Premium," Technical Report w28923, National Bureau of Economic Research, Cambridge, MA June 2021.

Kalemli-Ozcan, Sebnem and Liliana Varela, "Five Facts About the Uip Premium," June 2021.

Leo, Pierre De, Gita Gopinath, and Şebnem Kalemli-Özcan, "Monetary Policy and the Short-Rate Disconnect in Emerging Economies," September 2022.

Lustig, Hanno and Adrien Verdelhan, "The Cross Section of Foreign Currency Risk Premia and Consumption Growth Risk," *The American Economic Review*, 2007, *March.*

_ , Nikolai Roussanov, and Adrien Verdelhan, "Common Risk Factors in Currency Markets," *Review of Financial Studies*, 2011, *24* (11), 3731–3777.

_ , _ , and _ , "Countercyclical Currency Risk Premia," *Journal of Financial Economics*, 2014, *111* (3), 527–553.

Maggiori, Matteo, "The U.S. Dollar Safety Premium," *SSRN Electronic Journal*, 2012, (March).

_ , Brent Neiman, and Jesse Schreger, "International Currencies and Capital Allocation," *Journal of Political Economy*, 2020.

Miranda-Agrippino, Silvia and Hélène Rey, "U.S. Monetary Policy and the Global Financial Cycle," *The Review of Economic Studies*, 2020, *87* (6), 2754–2776.

Ozhan, Galip Kemal, "Financial Intermediation, Resource Allocation, and Macroeconomic Interdependence," *Journal of Monetary Economics*, November 2020, *115*, 265–278.

Ready, ROBERT, Nikolai Roussanov, and Colin Ward, "Commodity Trade and the Carry Trade: A Tale of Two Countries," *The Journal of Finance*, December 2017, *72* (6), 2629–2684.

Rey, Hélène, "Dilemma Not Trilemma: The Global Financial Cycle and Monetary Policy Independence," NBER Working Papers 21162, National Bureau of Economic Research, Inc May 2015.

Richmond, Robert J., "Trade Network Centrality and Currency Risk Premia," *Journal of Finance*, 2019, *74* (3), 1315–1361.

Verdelhan, Adrien, "The Share of Systematic Variation in Bilateral Exchange Rates," *Journal of Finance*, 2018, *73* (1), 375–418.

Wiriadinata, Ursula, "External Debt, Currency Risk, and International Monetary Policy Transmission," *SSRN Electronic Journal*, 2018.

Yeyati, Eduardo Levy, "Financial Dollarization: Evaluating the Consequences," *Economic Policy*, 2006, *21* (45), 61–118.

Zhang, Tony, "Monetary Policy Spillovers through Invoicing Currencies," *The Journal of Finance*, 2022, *77* (1), 129–161.

A Determinants of Currency Returns

A.1 Foreign Assets and Liabilities of the Banking System

First variable we consider is the ratio of foreign liabilities over foreign assets in the banking system (FL/FA). FL/FA is found to be a good predictor of banking crises (Yeyati (2006); Christiano et al. (2020)). High foreign liabilities can make the banking system susceptible to panics and roll-over problems, which will be accompanied by currency depreciation and low returns for investors ; against which the investors will ask for higher returns(Wiriadinata (2018); Bocola and Lorenzoni (2019)). In 12, we plot average excess returns against average FL/FA. In economies where the banking system carries high foreign debt, we see higher expected currency returns.

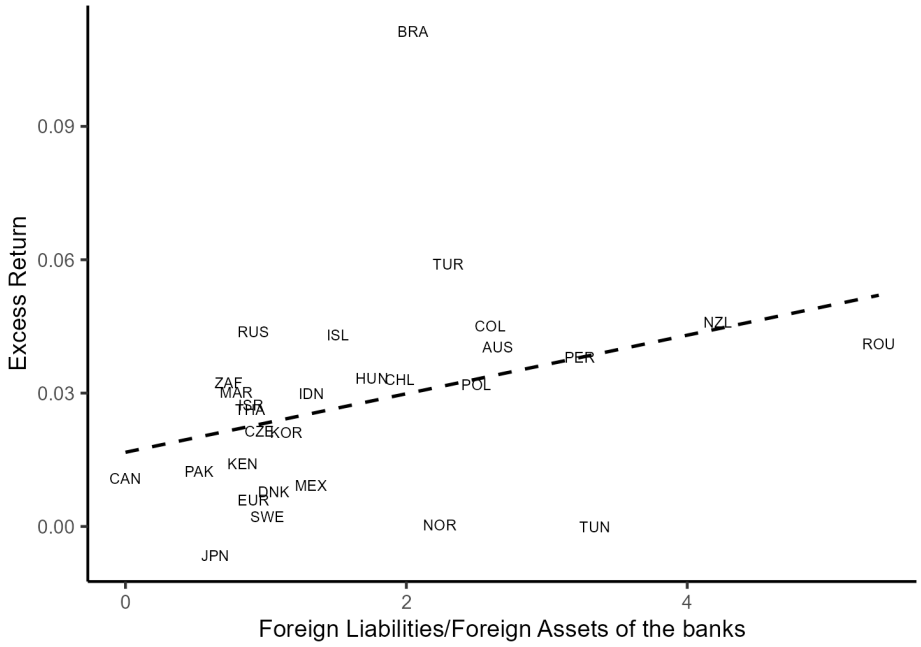


Figure 12: FL/FA and excess returns

Data source: FX4Casts, IMF IFS. Y-axis variable is the average currency return of 25 countries between 02/2003 - 11/2018. X-axis variable is the ratio of foreign liabilities to foreign assets in the banking system

A.2 Reserves

Against foreign borrowing, central banks can hold reserves, which should reduce the risk of rollover crises. However, we do not see a significant relationship between reserves and average excess returns. In figure 13, we plot average excess returns against reserves as a share of GDP

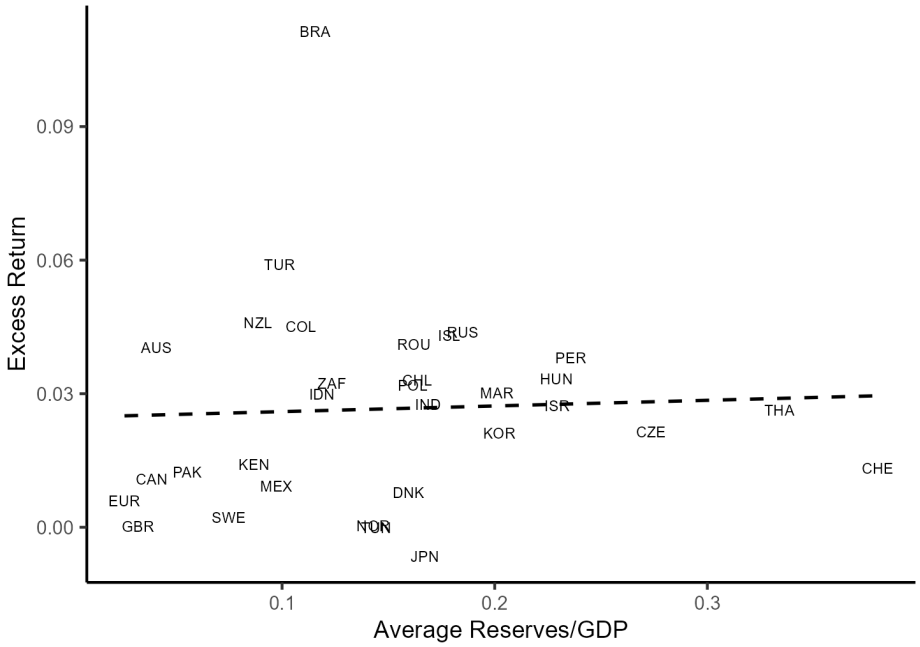


Figure 13: Reserves and excess returns

Data source: FX4Casts, IMF IFS. Y-axis variable is the average currency return of 25 countries between 02/2003 - 11/2018. X-axis variable is the reserves as a share of GDP

A.3 External Balance

The third variable we consider is external balance as a share of GDP, which is a proxy for net investment position of a country which is found to be an important determinant of currency returns(Della Corte et al. (2016)) . There is a clear negative relationship between

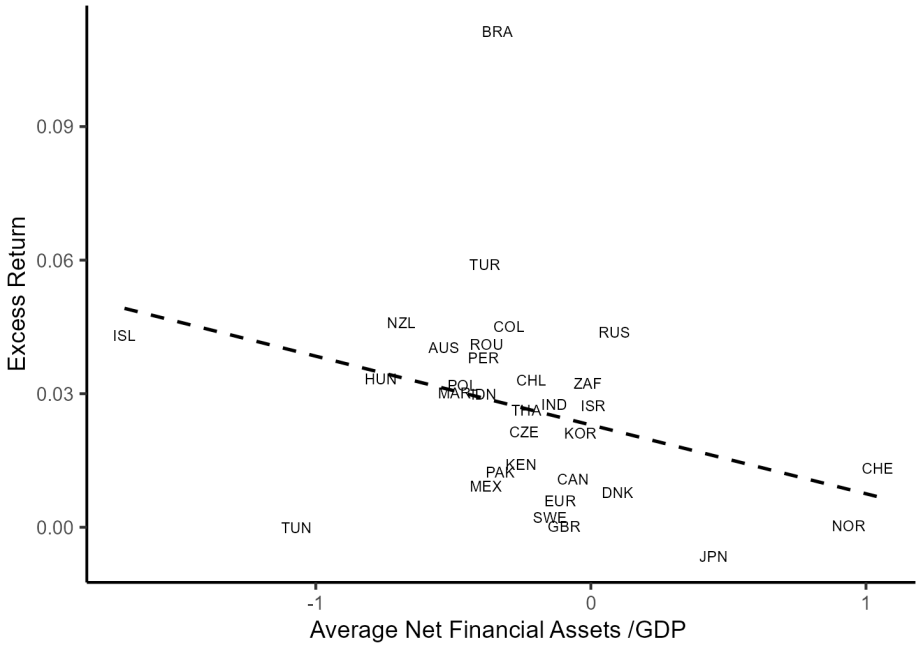


Figure 14: Reserves and excess returns

Data source: FX4Casts, IMF IFS. Y-axis variable is the average currency return of 25 countries between 02/2003 - 11/2018. X-axis variable is the average net external balance as a share of GDP,

A.4 Size and Trade Centrality

Country size (Hassan (2013)) and trade network centrality (Richmond (2019)) is found to be significant determinants of excess currency returns. Shocks to larger and/or to more central economies affect smaller economies but shocks to smaller economies do not spill over to larger economies. Then, assets of larger or more central economies provide insurance not only against country specific shocks, but also against global shocks. Thus, local currency assets of larger and/or more central economies should provide lower returns since there is high demand for them. Figure 15

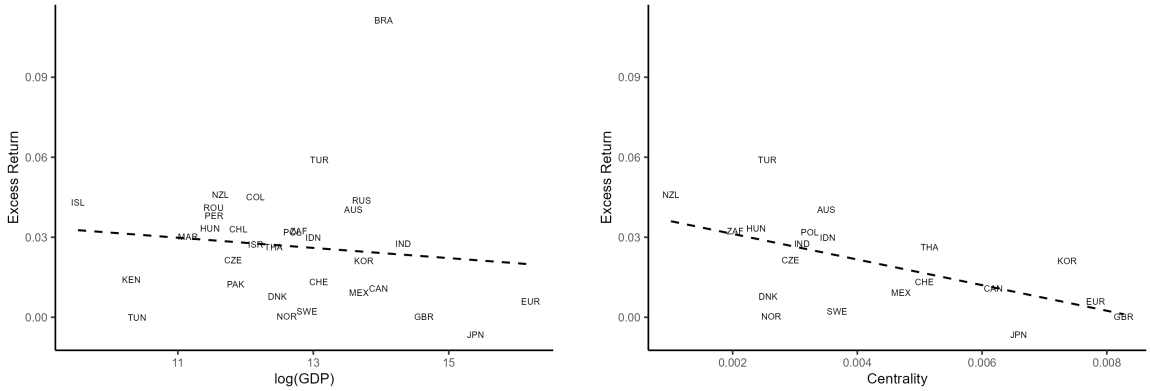


Figure 15: Size, centrality and excess returns

Data source: FX4Casts, IMF IFS, Richmond (2019). Y-axis variable is the average currency return of 25 countries between 02/2003 - 11/2018. X-axis variables is the average log nominal GDP and average trade network centrality

A.5 Financial Depth and Currency Returns

Figure 16 plots total foreign assets and liabilities as a share of GDP, a proxy for financial depth, against excess returns. Maggiori (2012) argues that countries whose financial system is deep can intermediate large amounts of flows and carry a safety premium. Net external balance and financial depth are highly correlate, one is that the financial depth is driven mostly by assets rather than liabilities which are accumulated by giving large external surpluses

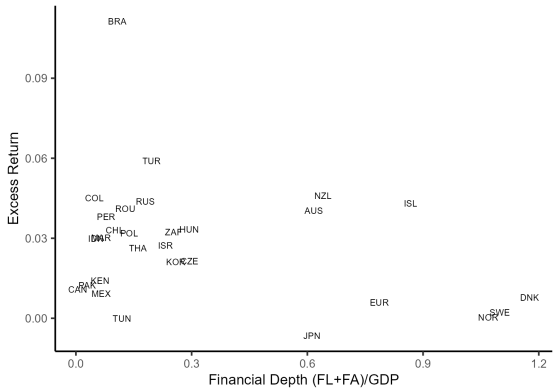
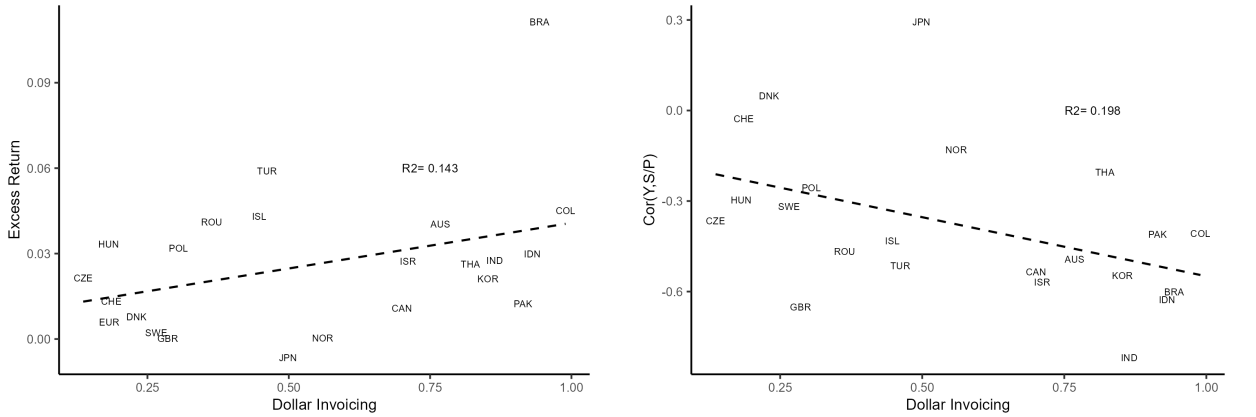


Figure 16: Excess returns vs Financial Depth

Data source: FX4Casts. Y-axis variable is the average currency return of 25 countries between 02/2003 - 11/2018. X-axis variables is the sum of foreign assets and liabilities of the banking system as a share of GDP, proxy for financial depth.

A.6 Dollar Invoicing

In Figure 17a, we show the positive relation between share of dollar invoicing in imports and average currency returns. In 17b, we show that the correlation between GDP and the exchange rate is highly related to dollar invoicing. In countries where the imports are mostly invoiced in dollars, we tend to see more countercyclical exchange rate.



(a) Dollar Invoicing and average excess returns

(b) Dollar invoicing and Correlation of the exchange rate with GDP

Figure 17: Dollar Invoicing, Currency Returns and GDP-ER Comovement

Data source: FX4Casts, Gopinath et al. (2020). Y-axis variable is the average currency return of 25 countries between 02/2003 - 11/2018. X-axis variable is the average dollar invoicing share of imports.

B Quarterly Returns

Here, We replicate the results in the previous section using quarterly returns. Why do We need to present quarterly results? First, my expectation data is in quarters. Second, there might be high frequency movements that are cancelled out when aggregated to quarters. Under tables 8 and 9, We show that the two principal components are present in the quarterly data as well. Similarly, S&P500 is related to the first component whereas VIX is mostly related to the second.

	Dependent variable:		
	Excess Returns		
	(1)	(2)	(3)
Component 1	0.032*		0.027
	(0.018)		(0.017)
Component 2		0.012***	0.011**
		(0.004)	(0.004)
Constant	−0.0002	0.006***	0.001
	(0.003)	(0.001)	(0.003)
Observations	23	23	23
R^2	0.169	0.195	0.313
Adjusted R^2	0.130	0.157	0.245
Residual Std. Error	0.006 (df = 21)	0.005 (df = 21)	0.005 (df = 20)
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 8: Average excess returns vs component loadings

Data source: FX4Casts. Left hand variable is the average quarterly currency returns of 25 countries between 02/2003 - 11/2018. Right hand variables are the coefficients of each country for the two principal component of currency returns. Both components are scaled such that a positive coefficient means positive covaraince with the returns.

	Dependent variable:				
	Turkey	Chile	Mexcio	Euro Area	Japan
	(1)	(2)	(3)	(4)	(5)
Component 1	0.259***	0.197***	0.172***	0.189***	0.030
	(0.029)	(0.025)	(0.028)	(0.015)	(0.057)
Component 2	−0.195**	0.082*	0.076	−0.237***	−0.045
	(0.080)	(0.049)	(0.070)	(0.042)	(0.075)
Constant	0.011*	0.008**	0.001	0.001	−0.001
	(0.006)	(0.003)	(0.004)	(0.002)	(0.007)
Observations	62	62	62	62	62
R^2	0.521	0.528	0.500	0.869	0.022
Adjusted R^2	0.505	0.512	0.483	0.864	−0.011
Residual Std. Error (df = 59)	0.057	0.042	0.039	0.018	0.050
Note:					*p<0.1; **p<0.05; ***p<0.01

Table 9: Average excess returns vs component loadings

Data source: FX4Casts. Left hand variable is the returns of several currencies between 02/2003 - 11/2018. Right hand variables are the two principal component of currency returns. Both components are scaled such that a positive coefficient means positive covaraince with the returns.

	Dependent variable:		
	S&P 500 Returns	Δlog(VIX)	ΔGFC
	(1)	(2)	(3)
Component 1	0.200***	−0.641***	1.923***
	(0.051)	(0.116)	(0.391)
Component 2	0.091	−0.803***	0.714*
	(0.060)	(0.191)	(0.411)
Constant	0.024**	−0.003	−0.006
	(0.010)	(0.021)	(0.055)
Observations	62	62	62
R^2	0.420	0.356	0.667
Adjusted R^2	0.400	0.334	0.656
Residual Std. Error (df = 59)	0.053	0.212	0.304
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 10: Average excess returns vs component loadings
Data source: FX4Casts, Ken French dataset, CBOE. Right hand variables are the two principal components of currency returns of 25 countries between 02/2003 - 11/2018. Left hand variables are the returns of S&P500 and log change in VIX index.

	Dependent variable:	
	Component 1	Component 2
	(1)	(2)
S&P 500 Returns	−1.465***	−0.086
	(0.490)	(0.358)
Δlog(VIX)	−0.009	−0.111
	(0.051)	(0.071)
ΔGFC	0.511***	−0.010
	(0.054)	(0.043)
Constant	0.038*	0.002
	(0.023)	(0.011)
Observations	62	62
R^2	0.695	0.074
Adjusted R^2	0.679	0.026
Residual Std. Error (df = 58)	0.124	0.081
Note:	*p<0.1; **p<0.05; ***p<0.01	

Table 11: Average excess returns vs component loadings
Data source: FX4Casts, Ken French dataset, CBOE. Right hand variables are the two principal components of currency returns of 25 countries between 02/2003 - 11/2018. Left hand variables are the returns of S&P500 and log change in VIX index.

C Inflation and GDP-ER Co-movement

In countries where the exports are mostly invoiced in USD, expenditure switching channel is muted. In these economies, the monetary policy faces a dilemma following external shocks. Economies with flexible export prices can respond to external shocks that cause exchange rate depreciations (capital flight, foreign interest rate shock etc.) by increasing exports which stimulates the economy. On the other hand, in countries with

sticky export prices, external shocks are more contractionary because of weak response of exports.

Figure 18 plots average inflation against GDP-ER correlation. In countries with high inflation we tend to see countercyclical exchange rate

Figure 19 plots average inflation against average excess returns. In countries with high average inflation, demand for local currency assets is low, which drives up local currency interest rates.

Figure 20 plots export dollar invocing against average inflation. In line with our theory, in countries with high dollar invoicing, monetary policy cannot react sharply against external shocks because exchange rate shcoks are recessionary. In these economies, we see high average inflation.

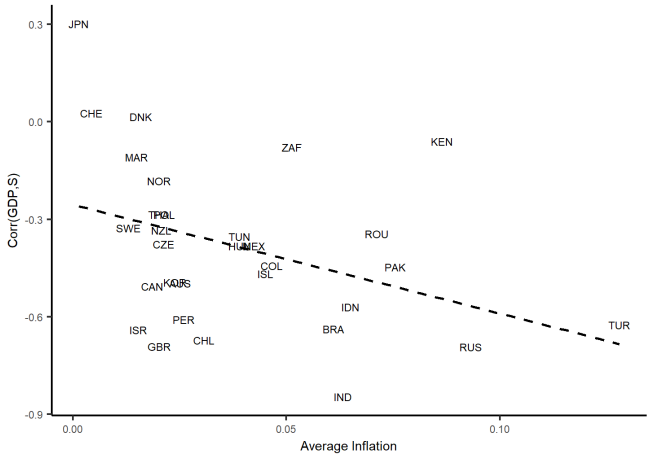


Figure 18: Average Inflation vs GDP-ER Correlation

Data source: FX4Casts, IMF IFS. Y-axis variable is the average currency return of 25 countries between 02/2003 - 11/2018. X-axis variables are Δ logGDP and $\Delta \log \frac{S}{P}$. S is the Dollar exchange rate and P is the CPI.

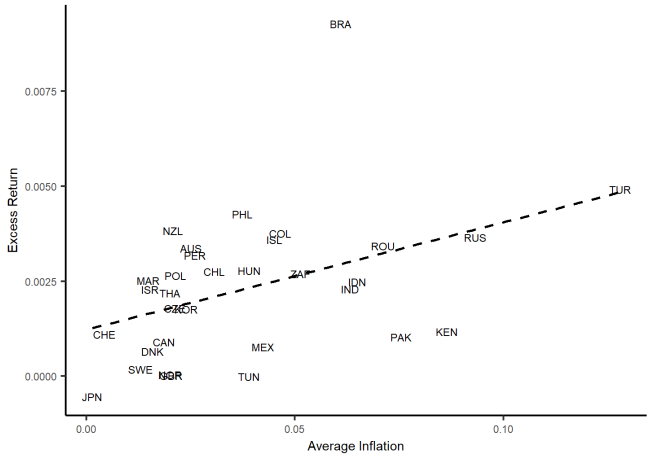


Figure 19: Average Inflation vs Average Excess Returns

Data source: FX4Casts, IMF IFS. Y-axis variable is the average currency return of 25 countries between 02/2003 - 11/2018. X-axis variables are Δ logGDP and $\Delta \log \frac{S}{P}$. S is the Dollar exchange rate and P is the CPI.

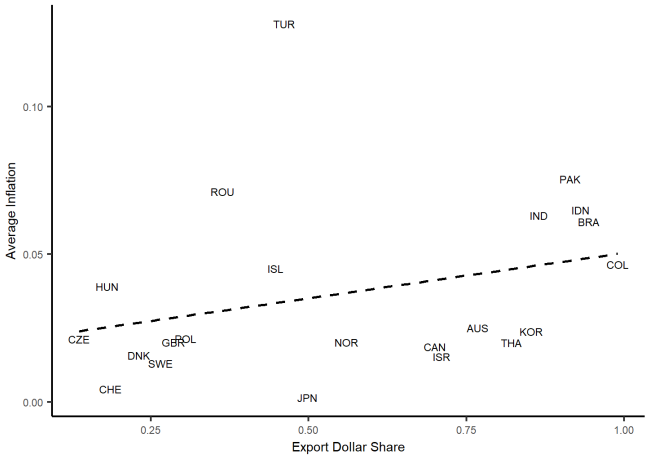


Figure 20: Average Inflation vs Dollar invoicing in exports

Data source: IMF, IFS, Gopinath et al. (2020). Y-axis variables are Δ logGDP and $\Delta \log \frac{S}{P}$. S is the Dollar exchange rate and P is the CPI. X-axis variable is the average dollar invoicing share of imports.

In addition to average inflation, we also look at price level volatility[1]. The results are virtually the same.

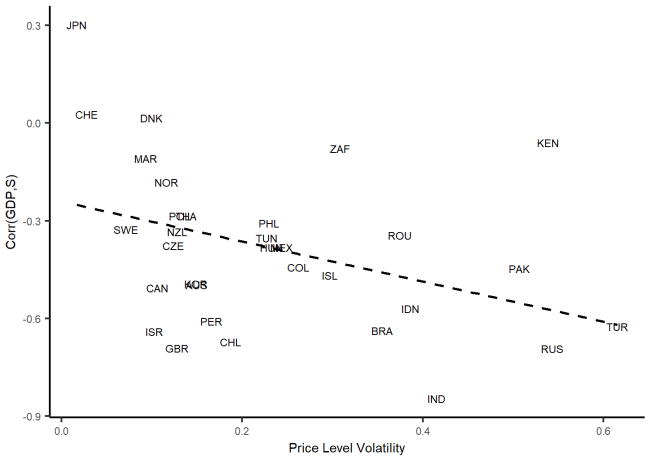


Figure 21: Price Level Volatility vs GDP-ER Correlation

Data source: FX4Casts, IMF IFS. Y-axis variable is the average currency return of 25 countries between 02/2003 - 11/2018. X-axis variables are Δ logGDP and $\Delta \log \frac{S}{P}$. S is the Dollar exchange rate and P is the CPI.

[1] we estimate price level volatility as the standard deviation of $\log(P_t)$, where P_t is the CPI index

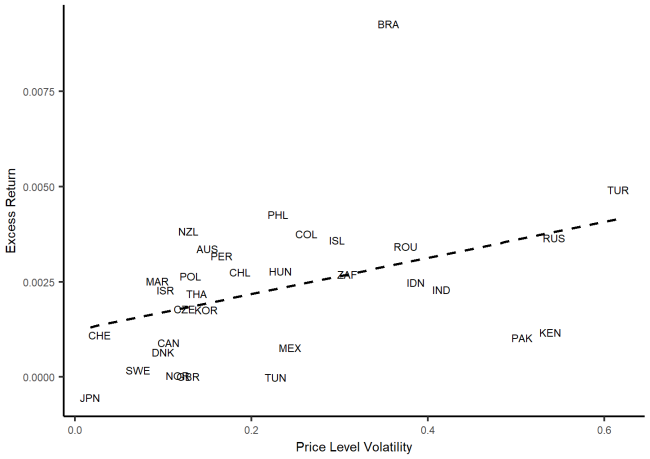


Figure 22: Price Level Volatility vs Average Excess Returns

Data source: FX4Casts, IMF IFS. Y-axis variable is the average currency return of 25 countries between 02/2003 - 11/2018. X-axis variables are Δ logGDP and $\Delta \log \frac{S}{P}$. S is the Dollar exchange rate and P is the CPI.

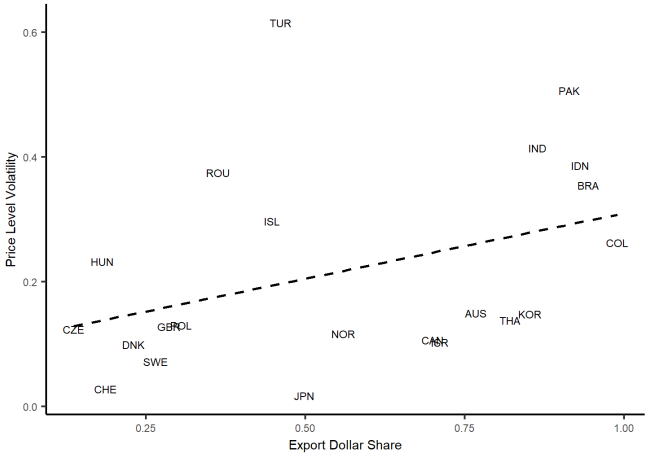


Figure 23: Price Level Volatility vs Dollar invoicing in exports

Data source: IMF, IFS, Gopinath et al. (2020). Y-axis variables are Δ logGDP and $\Delta \log \frac{S}{P}$. S is the Dollar exchange rate and P is the CPI. X-axis variable is the average dollar invoicing share of imports.

D Forward Returns

Covered interest rate parity gives us an alternative measure for currency returns. Denote F_t as the price of a forward contract. No arbitrage condition requires that the return to a hedged currency position financed by USD should be equal to the return to USD returns.

$$\frac{S_t}{F_t} R_t^L = R_t^{US} \tag{7}$$

We can replace R_t^L inside the equation 1 using the equation 7,

$$R_t^{US} \left(\frac{F_t}{S_{t+1}} - 1 \right) \tag{8}$$

Equation 8 allows us to overcome the problem of finding compatible interest rates across countries as well as accounting for trading costs using different ask/bid prices. One big potential issue with the forward returns is there are documented large CIP deviations. Verdelhan (2018) notes that in CIP holds most of the time in the monthly data. Still, buying forward contracts is the most straightforward strategy to invest in other currencies. Forward returns are by themselves valid returns, irrespective of whether they are a good proxy for actually borrowing in USD and investing in local currency interest rates.

E Banker Problem

Bankers are part of the household, with probability θ, they stay bankers and with probability $(1-\theta)$ they retire and become workers. Bankers maximize,

$$V_{j,t} = \max \mathbb{E}_t \sum_{i=0}^{\infty} (1-\theta)\theta^i \beta^{i+1} \Lambda_{t,t+i+1} N_{j,t+i+1}$$

We can write $V_{j,t}$ recursively

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

Evolution of net worth,

$$N_{j,t+1} = R^k_{t+1} Q_t S_{jt} - R_t B^{LC}_{j,t} - R^F_t \frac{S_{t+1}}{S_t} B^{FC}_{j,t}$$

We want to scale the above expression by $N_{j,t}$

$$\frac{N_{j,t+1}}{N_{j,t}} = R^k_{t+1} \frac{Q_t S_{jt}}{N_{j,t}} - R_t \frac{B^{LC}_{j,t}}{N_{j,t}} - R^F_t \frac{S_{t+1}}{S_t} \frac{B^{FC}_{j,t}}{N_{j,t}}$$

Define $\phi_t \in [0,1]$ as the share of net worth allocated to borrowing in dollars, which leaves $(1-\phi)$ share to be allocated to local currency borrowing. Define leverage ratios, $\left(L^{LC}_t, L^{FC}_t\right)$ as the ratio of assets that are funded by local currency and dollars respectively

$$\begin{aligned} B^{FC}_{j,t} &= \left(L^{FC}_{j,t} - 1\right) \phi_{j,t} N_{j,t} \\ B^{LC}_{j,t} &= \left(L^{LC}_{j,t} - 1\right) (1-\phi_{j,t}) N_{j,t} \end{aligned}$$

Evolution of net worth becomes

$$\frac{N_{j,t+1}}{N_{j,t}} = \left[\left(R^k_{t+1} - R_t\right) L^{LC}_{j,t} (1-\phi_{j,t}) + \left(R^k_{t+1} - R^F_t \frac{S_{t+1}}{S_t}\right) L^{USD}_{j,t} \phi_{j,t} + R_t(1-\phi_t) + R^F_t \frac{S_{t+1}}{S_t} \phi_{j,t}\right]$$

Bankers can divert λ fraction of the assets. In that case, they run away with the money. Understanding this, bankers lend to banks only if the value of being a banker exceeds the diverted assets. We assume that bankers get two separate loans in local currency and in dollars. The implication is that bankers can independently run away with local currency or dollar loans so that the incentive constraint need to bind for both types of borrowing,

$$V_{j,t}^{LC} \geq \lambda L_{j,t}^{LC} N_{j,t}^{LC}$$
$$V_{j,t}^{FC} \geq \lambda L_{j,t}^{FC} N_{j,t}^{FC}$$

where$N_{j,t}^{LC}$ and $N_{j,t}^{FC}$ are net worh allocated to local currency and dollar borrowing respectively $N_{j,t}^{LC}+N_{j,t}^{FC} = N_{j,t}$ and,

$$V_{j,t}^{LC} = \mathbb{E}_t \left[\beta(1-\theta) \left[L_{j,t}^{FC} N_{j,t}^{LC} \left(R_{t+1}^k - R_t\right) + R_t(1-\phi_{j,t}) N_{j,t}^{LC}\right] + \beta\theta\Lambda_{t,t+1} V_{j,t+1}^{LC}\right]$$
$$V_{j,t}^{FC} = \mathbb{E}_t \left[\beta(1-\theta) \left[L_{j,t}^{FC} N_{j,t}^{FC} \left(R_{t+1}^k - R_t^F \frac{S_{t+1}}{S_t}\right) + R_t^F \frac{S_{t+1}}{S_t} N_{j,t}^{FC}\right] + \beta\theta\Lambda_{t,t+1} V_{j,t+1}^{FC}\right]$$

so that $V_{j,t}^{LC} + V_{j,t}^{FC} = V_{j,t}$

Scale recursive net worth for dollar borrowing,

$$\frac{V_{j,t}^{FC}}{N_{j,t}^{FC}} = \mathbb{E}_t \left[\beta(1-\theta) \left[L_{j,t}^{FC} \left(R_{t+1}^k - R_t^* \frac{S_{t+1}}{S_t}\right) + R_t^* \frac{S_{t+1}}{S_t}\right] + \beta\theta\Lambda_{t,t+1} \frac{V_{j,t+1}^{FC}}{N_{j,t+1}^{FC}} \frac{N_{j,t+1}^{FC}}{N_{j,t}^{FC}}\right]$$

where $\frac{N_{j,t+1}^{FC}}{N_{j,t}^{FC}} = \left[L_{j,t}^{FC} \left(R_{t+1}^k - R_t^* \frac{S_{t+1}}{S_t}\right) + R_t^* \frac{S_{t+1}}{S_t}\right]$ is the amount of equity a dollar borrowing bank expect to have at the end of the period. Simplifying,

$$\psi_t^{FC} = \mathbb{E}_t \left[\left[\beta(1-\theta) + \beta\theta\Lambda_{t,t+1}\psi_{t+1}^{FC}\right] \left[L_{j,t}^{FC} \left(R_{t+1}^k - R_t^* \frac{S_{t+1}}{S_t}\right) + R_t^* \frac{S_{t+1}}{S_t}\right]\right]$$

similarly for local currency borrowing

$$\psi_t^{LC} = \mathbb{E}_t \left[\left[\beta(1-\theta) + \beta\theta\Lambda_{t,t+1}\psi_{t+1}^{LC}\right] \left[L_{j,t}^{LC} \left(R_{t+1}^k - R_t\right) + R_t\right]\right]$$

Since the last equations are independent of j, all bankers make the same choice so we can remove j subscript.

E.1 Banker Optimization

A banker who borrows in dollars solve,

$$\psi_t^{FC} = \max_{L_t^{FC}} \mathbb{E}_t \left[\beta \left[(1-\theta) + \Lambda_{t,t+1}\theta\psi_{t+1}^{FC}\right] \left[L_t^{FC} \left(R_{t+1}^k - R_t^* \frac{S_{t+1}}{S_t}\right) + R_t^* \frac{S_{t+1}}{S_t}\right]\right]$$

subject to the incentive constraint

$$\psi_t^{FC} \geq \lambda L_t^{FC}$$

Solution satisfies

$$L_t^{FC} = \frac{\nu_t^{FC}}{\lambda - \eta_t^{FC}}$$

$$\begin{aligned}
\eta_t^{FC} &= \mathbb{E}_t \left[\beta \Lambda_{t,t+1} \Omega_{t+1}^{FC} \left(R_{t+1}^k - R_t^* \frac{S_{t+1}}{S_t} \right) \right] \\
\nu_t^{FC} &= \mathbb{E}_t \left[\beta \Lambda_{t,t+1} \Omega_{t+1}^{FC} R_t^* \frac{S_{t+1}}{S_t} \right] \\
\Omega_{t+1}^{FC} &= (1-\theta) + \theta \psi_{t+1}^{FC} \\
\psi_t^{FC} &= \lambda L_t^{FC}
\end{aligned}$$

similarly local currency borrowing satisfies,

$$L_t^{LC} = \frac{\nu_t^{LC}}{\lambda - \eta_t^{LC}}$$

$$\begin{aligned}
\eta_t^{LC} &= \mathbb{E}_t \left[\beta \Lambda_{t,t+1} \Omega_{t+1}^{LC} \left(R_{t+1}^k - R_t \right) \right] \\
\nu_t^{LC} &= \mathbb{E}_t \left[\beta \Lambda_{t,t+1} \Omega_{t+1}^{LC} R_t \right] \\
\Omega_{t+1}^{LC} &= (1-\theta) + \theta \psi_{t+1}^{LC} \\
\psi_t^{LC} &= \lambda L_t^{LC}
\end{aligned}$$

E.2 Currency Choice

Bankers allocate net worth according to

$$\max_{\phi_t} \phi_t \psi_t^{LC} + (1-\phi_t) \psi_t^{USD} - \frac{\epsilon}{2} (\phi_t - \bar{\phi})^2$$

where the last term denotes preferred habitat (or regulation) so that banks do not move their portfolios too much away from the target credit dollarization.

$$\begin{aligned}
\psi_t^{LC} - \epsilon(\phi_t - \bar{\phi}) &= \psi_t^{USD} \\
L_t^{LC} - \frac{\epsilon}{\lambda}(\phi_t - \bar{\phi}) &= L_t^{USD} \\
\phi_t &= \frac{\lambda}{\epsilon} \left(L_t^{LC} - L_t^{USD} \right) + \bar{\phi}
\end{aligned}$$