Business Cycle Insurance and Currency Returns*

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Abstract

In economies where the real exchange rate is counter-cyclical[1], local currency has poor business cycle insurance properties as it loses value when the economy is in a recession and the residents require high returns to invest in local currency assets. In this paper, we offer the co-movement of local economic performance and the real exchange rate as an important determinant of average currency returns. We find that the correlation between GDP and the real exchange rate movements is a significant determinant of average local currency excess returns even after controlling for other well known determinants. We argue that this correlation is driven by trade invoicing. We build an open economy general equilibrium model in which the residents and the foreigners trade in financial assets for insurance as well as speculative purposes. The simple insurance view in the model is able to generate key facts about excess currency returns in the data. In the model, business cycle properties of the exchange rate determine the relative insurance demand of agents which governs average excess currency returns.

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[1] Throughout the paper exchange rate is defined as local currency per dollar

1 Introduction

In this paper, we show that the co-movement between local economic conditions and the exchange rate is a crucial factor explaining average excess currency returns. In economies where the real exchange rate is counter-cyclical, dollar assets provide good income insurance because they appreciate in economic downturns. In these economies, residents tend to invest more in dollar denominated assets and they require higher returns to invest in local currency (Dalgic (2018)). We show that the covariance between GDP and the exchange rate emerge as a key determinant of excess currency returns even after controlling for other key determinants such as foreign debt in the banking system, average current account balance, trade centrality and size. In Figure 1, we plot the average excess returns against the correlation between real GDP growth and real exchange rate, a high and negative correlation between GDP and the real exchange rate is associated with significantly higher average excess returns. Similarly, we find that currencies which tend to depreciate in global downturns also yield higher returns as they have bad insurance properties for international investors. In line with Lustig et al. (2011), we find that two principal components drive significant portion of currency returns. The exposure of a currency to these two components are significantly related to the average currency returns. We find that the first components is highly correlated with global asset prices while the second component is related to VIX index. Exposure to the first component is highly correlated with foreign debt in the banking system whereas the exposure to the second component is related to average trade balance as well as the covariance between GDP and the exchange rate. We provide a model of currency returns which will deliver the key empirical patterns. The model takes the view of currency markets as insurance markets. In the model, the residents and the foreigners have different income streams and trade in currency markets to get business cycle insurance. The model is able to generate the data facts, the main determinants of interest rate spreads are the foreign debt and the covariance of exchange rate with local consumption as well as global shocks.

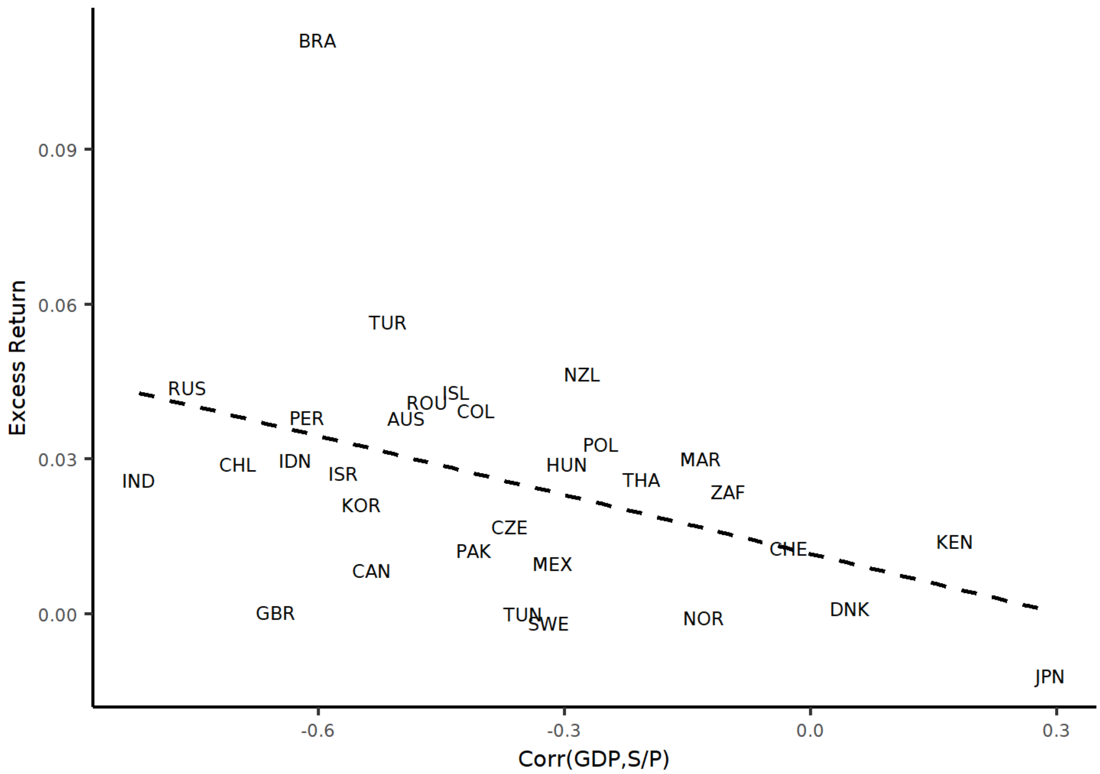


Figure 1: Correlation (GDP,ER) and Excess Returns controlled for other determinants
Data source: FX4Casts, IMF IFS. Y-axis variable is the average currency return of 25 countries between 02/2003 - 11/2018. X-axis variables are Δ logGDP and $\Delta \log \frac{S}{P}$. S is the Dollar exchange rate and P is the CPI.

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(Fama (1984)). Instead, the currency with high interest rate continues to appreciate, which creates opportunities for carry trade . 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 (Lustig and Verdelhan (2007); Hassan (2013); 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 my 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 my 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. Figure 16 verifies that there is a significant negative correlation between average currency returns and the depth of the financial system. Net external balance and financial depth are highly correlated. My interpretation is that the financial depth is driven mostly by assets rather than liabilities which are accumulated by giving large external surpluses.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. We will interpret his results differently, my 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 (Dalgic (2018); Christiano et al. (2020)).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); Lustig and Verdelhan (2007)) 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.

2 Currency Returns: Monthly Data

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 E we show how to derive currency returns using forward contracts.

2.1 Comovement between GDP and Exchange Rate

We measure the comovement between GDP and exhcange rate by calculating 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 exhcange rate movements so that the correlation coefficient is the appropriate measure to estimate the comovement between GDP and exchange rate.

3 Data Results: Determinants of Currency Returns

In this section, we discuss variables that explain average excess currency returns and also the sensitivity of a currency to the two factors uncovered in the previous section.

3.1 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 2, 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.

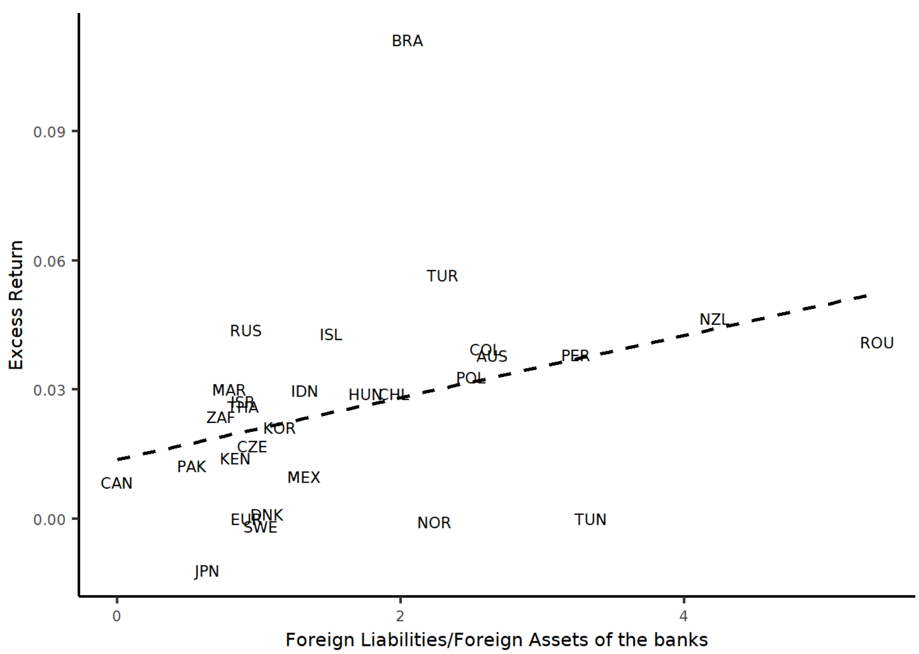


Figure 2: FL/FA and excess returns

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

3.2 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 3, we plot average excess returns against reserves as a share of GDP

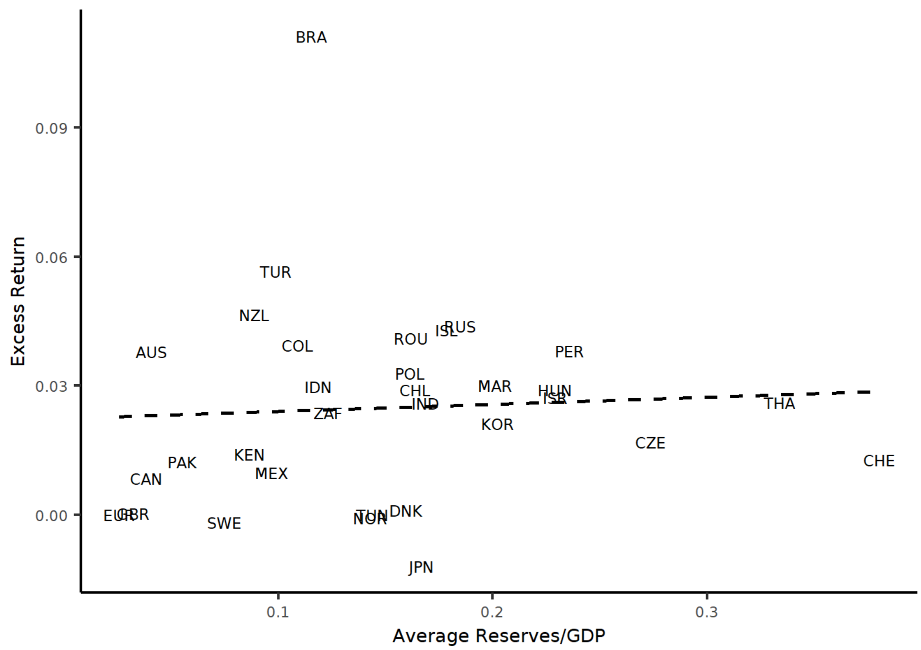


Figure 3: Reserves and excess returns

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

3.3 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

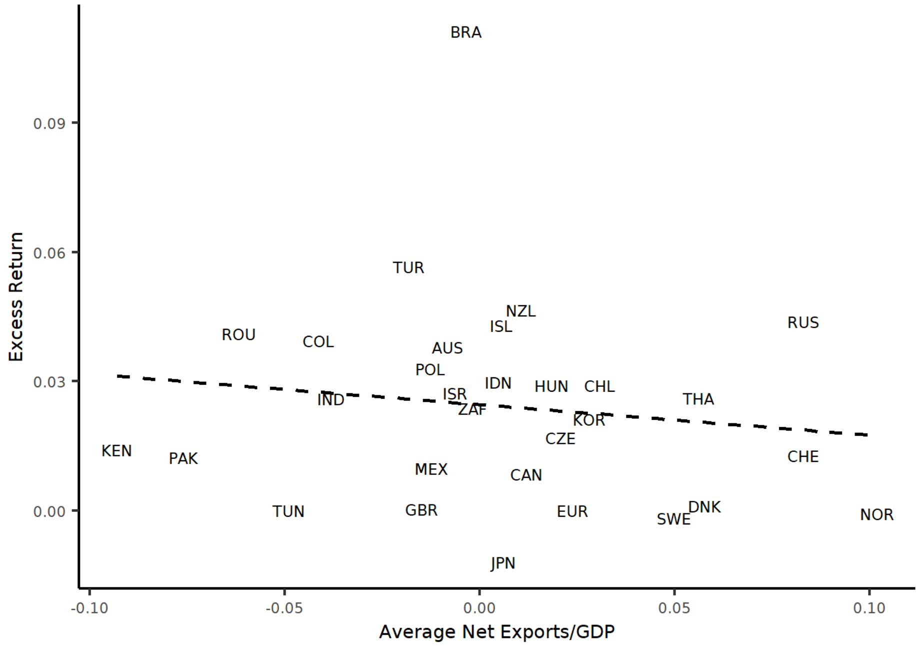


Figure 4: Reserves and excess returns
Data source: FX4Casts, IMF IFS. Y-axis variable is the average currency return of 25 countries between 02/2003 - 11/2018. X-axis variable is the average net external balance as a share of GDP,

3.4 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 5

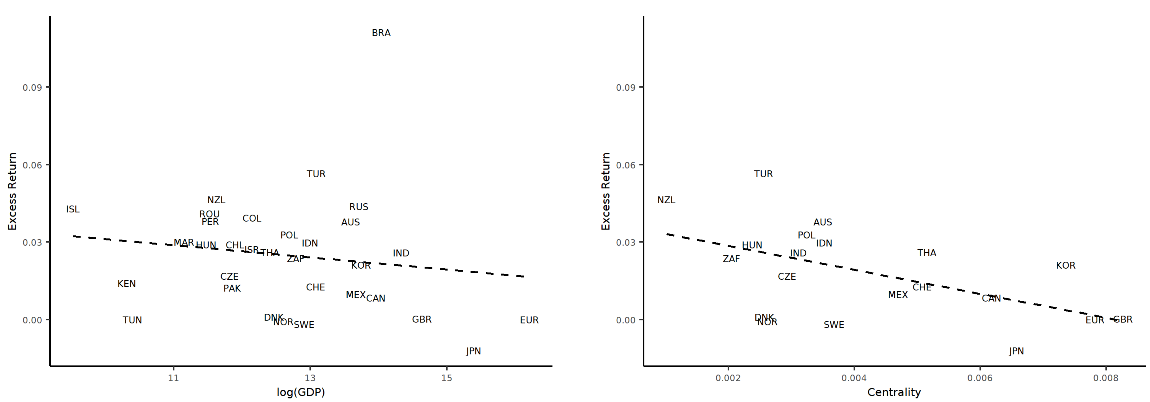


Figure 5: Size, centrality and excess returns
Data source: FX4Casts, IMF IFS, Richmond (2019). Y-axis variable is the average currency return of 25 countries between 02/2003 - 11/2018. X-axis variables is the average log nominal GDP and average trade network centrality

3.5 Correlation of the exchange rate with GDP

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(Dalgic (2018); Christiano et al. (2020)). Figure 6 plots excess returns against the correlation between GDP and exchange rate movements after controlling for size, centrality, average trade balance and FL/FA.

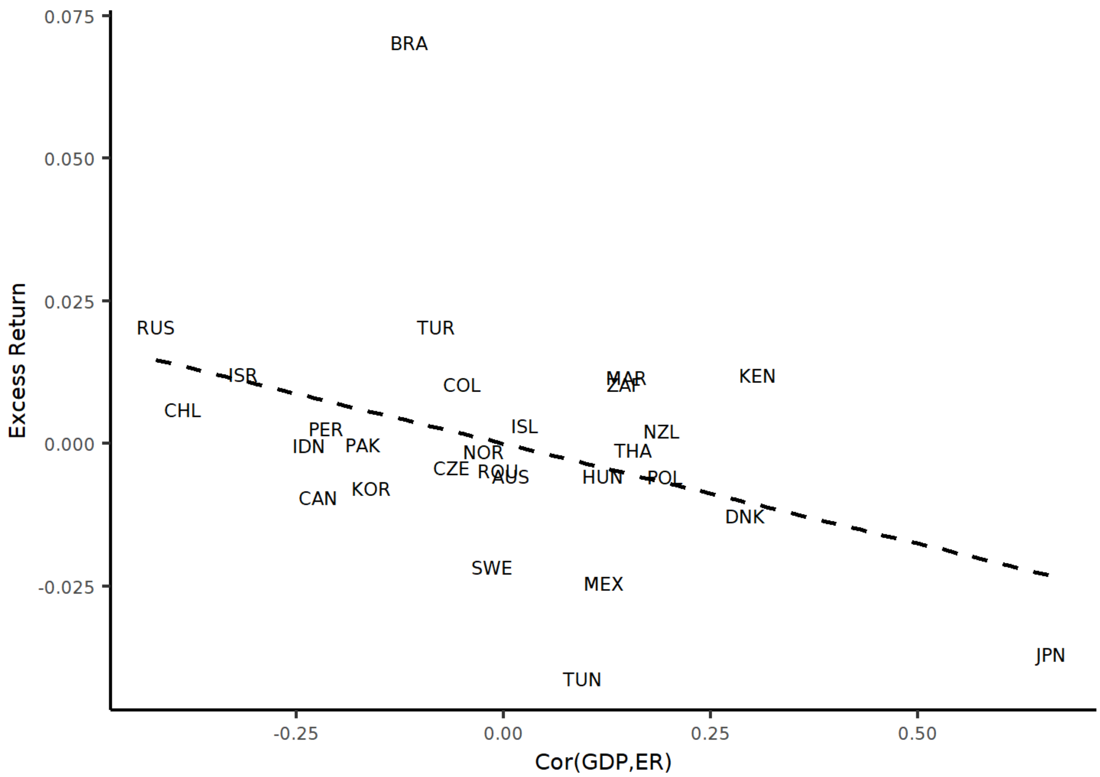


Figure 6: Correlation of the exchange rate with GDP and excess returns after controlling for other determinants

Data source: FX4Casts, IMF IFS. Data covers 02/2003 - 11/2018. Y-axis variable is the residuals from regressing average currency return on on net external balance as a share of GDP, the ratio of foreign liabilities to foreign assets in the banking system, average trade centrality, log(GDP). X-axis variable is the residuals from regressing the correlation between $\Delta\,\log\mathrm{GDP}$ and $\Delta\log\frac{S}{P}$ on the same set of explanatory variables as the Y-axis. S is the Dollar exchange rate and P is the CPI index. Net external balance, GDP, foreign assets and liabilities of the banking system are from IMF IFS dataset. Centrality measure is taken from Richmond (2019).

3.6 Determinants of Excess Returns

Table 1 runs a regression of average returns on the variables discussed in the previous section. 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	0.007***	0.005**		0.007**	0.007*
	(0.002)	(0.002)		(0.004)	(0.004)
Net Foreign Assets/GDP	−0.021**	−0.017*		−0.015**	−0.017***
	(0.009)	(0.009)		(0.006)	(0.005)
GDP(Share of US)	0.005	0.005			0.013
	(0.005)	(0.005)			(0.008)
Reserves/GDP	0.052*	0.027	0.034	0.037	0.118*
	(0.030)	(0.037)	(0.030)	(0.034)	(0.068)
Corr($\Delta GDP, \Delta S/P$)		−0.035***	−0.036***	−0.029***	−0.045***
		(0.013)	(0.012)	(0.011)	(0.017)
Trade Centrality			−5.108***	−1.277	−7.629
			(1.394)	(2.028)	(4.881)
Constant	0.019	0.017	0.023**	−0.003	0.051
	(0.019)	(0.019)	(0.011)	(0.017)	(0.037)
Observations	29	28	19	16	16
R^2	0.238	0.393	0.501	0.756	0.815
Adjusted R^2	0.112	0.255	0.401	0.634	0.692
Residual Std. Error	0.022 (df = 24)	0.021 (df = 22)	0.014 (df = 15)	0.011 (df = 10)	0.010 (df = 9)
Note:					*p<0.1; **p<0.05; ***p<0.01

Table 1: 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.

4 Why Foreign Investors do not Invest more?

In the previous section, we established several variables which predict average excess currency returns. In principle, deep-pocket international investors can invest in diversified portfolio of currencies and make excess returns. However, the literature shows that currency returns demonstrate significant correlation. Here, we run a principal component analysis on currency returns against the US Dollar. In line with Lustig et al. (2011), there are two components highly correlated with currency returns. In table 2, we show that average excess returns are positively related to a currency's loading on the two components. Similary, in figure 7 we plot excess returns against component loadings.

	Dependent variable:		
	Excess Returns		
	(1)	(2)	(3)
Component 1	0.012*		0.011**
	(0.006)		(0.005)
Component 2		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 2: 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.

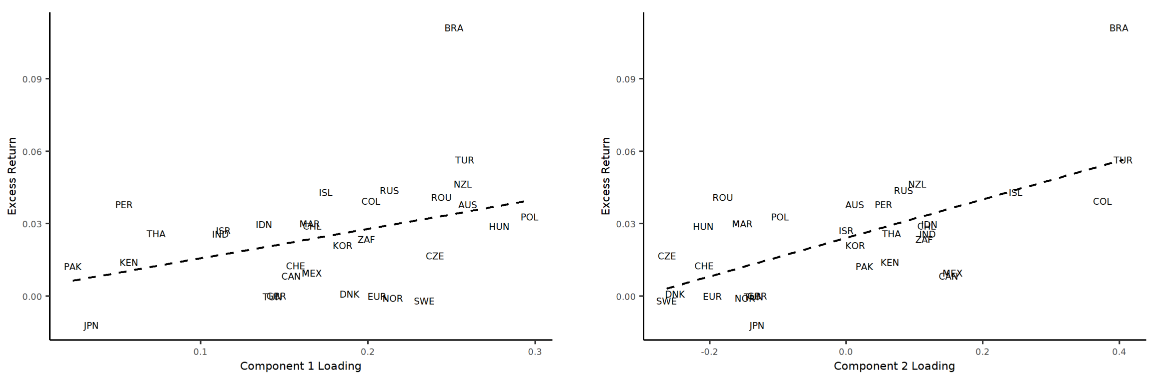


Figure 7: Average excess returns vs component loadings
Data source: FX4Casts. Y-axis variable is the average currency return of 25 countries between 02/2003 - 11/2018. X-axis variables are the coefficients of each country for the two principal component of currency returns. Both components are scaled such that a positive coefficient means positive covaraince with the returns.

In table 3, we regress currency returns of 5 countries on principle components. Note that except for Japan, regression 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)
Component 1	0.258***	0.167***	0.167***	0.191***	0.035
	(0.025)	(0.016)	(0.014)	(0.005)	(0.028)
Component 2	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 3: Average excess returns vs component loadings
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.

Now the question is what are these components? Unfortunately, principal component analysis does not tell us much about these factors. In table 4, we regress returns of S&P500 index, log changes in VIX index and the change in Global Financial Cycle (GFC, Miranda-Agrippino and Rey (2020)) on the two principal components. Note that the first component is highly correlated with S&P500 returns and GFC while the second component is somewhat correlated with changes in VIX index.

	Dependent variable:		
	S&P 500 Returns	Δlog(VIX)	ΔGFC
	(1)	(2)	(3)
Component 1	0.175***	−0.532***	1.455***
	(0.027)	(0.085)	(0.202)
Component 2	0.063	−0.589**	0.719*
	(0.059)	(0.283)	(0.418)
Constant	0.009***	−0.001	−0.003
	(0.003)	(0.007)	(0.017)
Observations	190	190	190
R^2	0.309	0.199	0.494
Adjusted R^2	0.302	0.191	0.488
Residual Std. Error (df = 187)	0.033	0.151	0.190
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 4: 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	1.533***	−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 5: 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.

4.1 Determinants of Component Exposures

Similarly in table 6, we regress exposures to principal components on the variables discussed. First factor exposure is highly correlated with FL/FA whereas the second factor exposure is highly correlated with external balance / GDP and the correlation between GDP growth and the exchange rate.

Overall, the interpretation of these results is that countries which have high foreign liabilities in the banking system have higher exposure to the first principal component, which co-moves highly with global asset price returns. Currencies of countries with high foreign debt depreciate more when global asset prices fall. Then, foreign investors are willing to invest in these currencies only if they yield high returns. Exposure the ratio of foreign liabilities to foreign assets in the banking system to the second component is related to current account deficits and negative covariance between GDP and exchange rates.

	Dependent variable:	
	Exposure 1	Exposure 2
	(1)	(2)
FL/FA	0.025**	−0.016
	(0.011)	(0.026)
Net Foreign Assets/GDP	−0.028	−0.114
	(0.038)	(0.070)
Reserves/GDP	−0.049	−0.726
	(0.260)	(0.557)
Corr($\Delta GDP, \Delta S/P$)	−0.030	−0.261***
	(0.078)	(0.079)
GDP(Nominal USD)	0.016	0.028
	(0.019)	(0.030)
Constant	0.189**	0.150
	(0.084)	(0.116)
Observations	28	28
R^2	0.231	0.301
Adjusted R^2	0.057	0.142
Residual Std. Error (df = 22)	0.074	0.178
Note:	*p<0.1; **p<0.05; ***p<0.01	

Table 6: 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.

5 Currency Invoicing and GDP-ER Co-movement

Recent literature finds a link between dollar invoicing and currency returns. 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. Gopinath et al. (2020) find that dollar invoicing is related to inflation pass through. In figure 8, we show the positive relation between share of dollar invoicing in imports and average currency returns. In 9, 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.

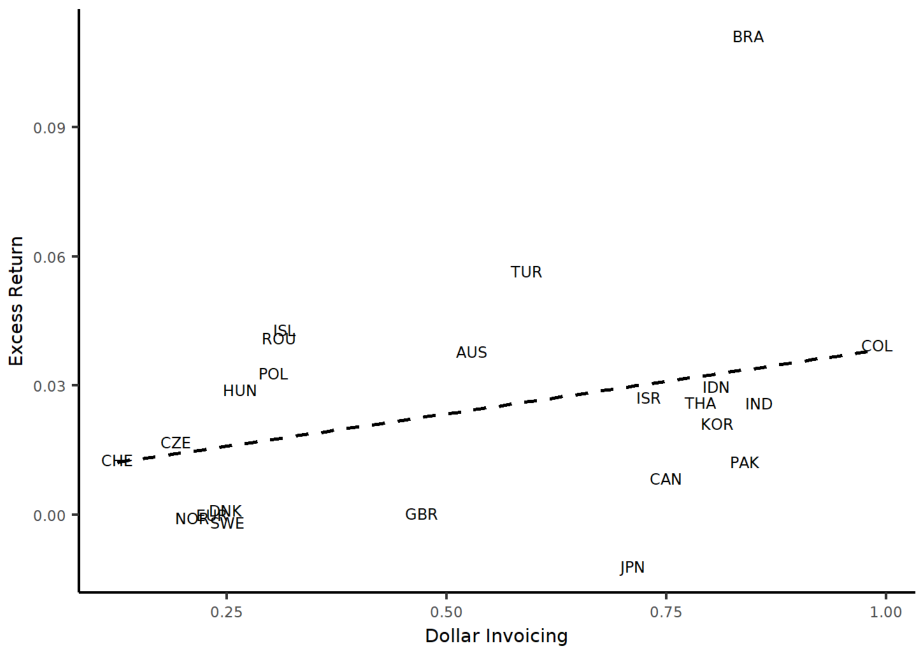


Figure 8: Dollar Invoicing and average excess returns
Data source: FX4Casts, Gopinath et al. (2020). Y-axis variable is the average currency return of 25 countries between 02/2003 - 11/2018. X-axis variable is the average dollar invoicing share of imports.

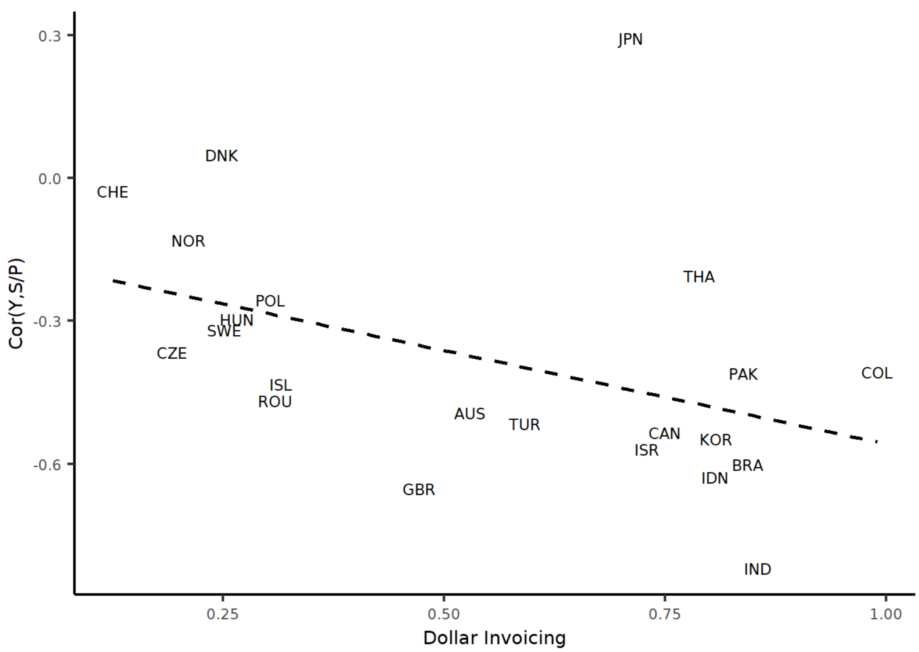


Figure 9: Dollar invoicing and Correlation of the exchange rate with GDP
Data source: IMF, IFS, Gopinath et al. (2020). Y-axis variables are Δ logGDP and $\Delta \log \frac{S}{P}$. S is the Dollar exchange rate and P is the CPI. X-axis variable is the average dollar invoicing share of imports.

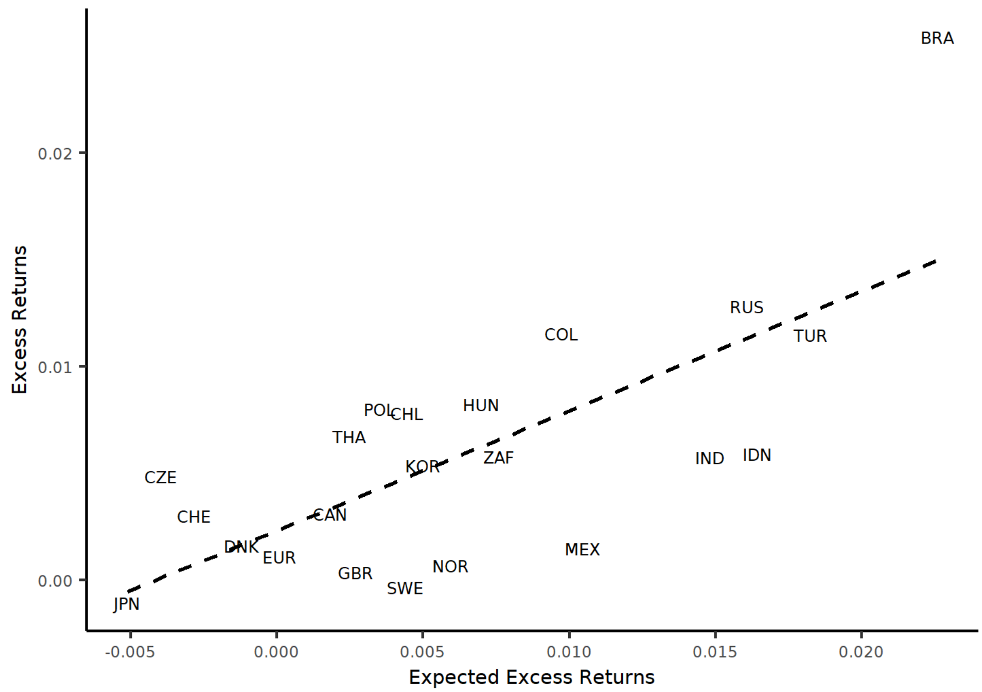
6 Currency Return Expectations

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. Here, we are going to look at whether investors consider the

6.1 Expected vs Realized Returns

Figure 10 plots average quarterly realized excess returns against quarterly expectations. Here, our focus is on the average forecasted vs realized returns.

Figure 10: Average Expected vs Realized Returns



Similar to realized returns, we employ principle component analysis on currency return expectations. In table

Figure 11: Expected average currency return principle vs component loadings

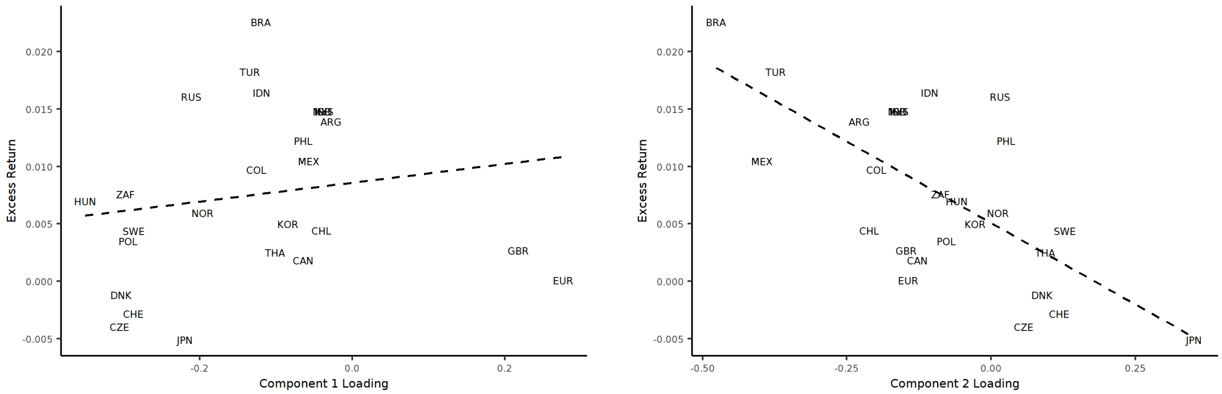


Table 7 regresses average excess returns on the loadings on principal components obtained from return forecasts.

Table 7: Average excess returns vs component loadings

	Dependent variable:		
	Excess Returns		
	(1)	(2)	(3)
Component 1	0.008		−0.007
	(0.011)		(0.008)
Component 2		−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.

In table,

Table 8: Component Determinants

	Dependent variable:		
	$S\&P$ 500 Returns	Δlog(VIX)	ΔGFC
	(1)	(2)	(3)
Component 1	0.148**	0.708**	0.332
	(0.062)	(0.316)	(0.577)
Component 2	−0.550***	−0.353	−3.608**
	(0.190)	(0.389)	(1.582)
Constant	0.023**	−0.003	−0.007
	(0.010)	(0.023)	(0.074)
Observations	63	63	63
R^2	0.103	0.026	0.068
Adjusted R^2	0.073	−0.007	0.037
Residual Std. Error (df = 60)	0.065	0.258	0.505
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.

Table 9: Exposure Determinants

	Dependent variable:	
	Exposure 1	Exposure 2
	(1)	(2)
FL/FA	0.008	−0.095**
	(0.028)	(0.046)
Net Foreign Assets/GDP	0.055	0.131
	(0.063)	(0.083)
Reserves/GDP	0.327	0.414
	(0.313)	(0.520)
Corr($\Delta GDP, \Delta S/P$)	−0.256**	0.322**
	(0.115)	(0.139)
GDP(Nominal USD)	0.037	−0.013
	(0.022)	(0.047)
Constant	−0.194**	0.065
	(0.079)	(0.156)
Observations	20	20
R^2	0.380	0.565
Adjusted R^2	0.158	0.409
Residual Std. Error (df = 14)	0.098	0.149
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.

7 The Model

The model is based on Christiano et al. (2020). There are two periods in the model, first period is planning and investment and the second period is consumption. There are two goods in the economy, Home good is produced locally and exported, while Foreign good is imported. The economy features two assets, dollar asset which gives $R^{\$}$ units of foreign good in period 2 and Peso asset which gives R units of consumption good

Capital and consumption good require imported inputs,

$$k = k_h^{\omega_k} k_f^{1-\omega_k}$$
$$c_2 = c_{2.h}^{\omega} c_{2,f}^{1-\omega}$$

Import Demand

Expenditure minimization problem,

$$\min\ k_h + S_1 k_f$$
$$k_h^{\omega_k} k_f^{1-\omega_k} = k$$

$$k_h = \omega_k P^k k \tag{2}$$

$$k_f = (1-\omega_k)\frac{P^k}{S_1}k \tag{3}$$

$$P^k = \left(\frac{1}{1-\omega_k}S_1\right)^{1-\omega_k}\left(\frac{1}{\omega}\right)^{\omega_k} \tag{4}$$

In the second period, we scale the prices such that $P_2 = 1$.

$$P_2^h = \omega\left(\frac{S_2}{1-\omega}\right)^{-\frac{1-\omega}{\omega}}$$

7.1 Household Problem

Households maximize mean-variance utility,

$$\max \mathbb{E}c_2 - \frac{\lambda}{2}\mathbb{V}c_2$$

$$c_2 = dR + fR^* \frac{S_2}{S_1} + wl + kR^k \tag{5}$$

$$d + P^k k + f = Y \tag{6}$$

household maximization problem leads to the following dollar asset and capital choice,

$$f = \frac{\mathbb{E}\left(R^{\$}\frac{S_2}{S_1} - R\right)}{\lambda \mathbb{V}\left(R^{\$}\frac{S_2}{S_1}\right)} - \frac{cov\left(R^{\$}\frac{S_2}{S_1}, Y_2\right)}{\mathbb{V}\left(R^{\$}\frac{S_2}{S_1}\right)} \tag{7}$$

$$P^k k = \frac{\mathbb{E}\left(\frac{R^k}{P^k} - R\right)}{\lambda \mathbb{V}\left(\frac{R^k}{P^k}\right)} - \frac{cov\left(R^{\$}\frac{S_2}{S_1}f, \frac{R^k}{P^k}\right) + cov\left(w, \frac{R^k}{P^k}\right)}{\mathbb{V}\left(\frac{R^k}{P^k}\right)} \tag{8}$$

7.2 Interest Rate Spread

Manipulating equation 7 leads to the following interest rate spread,

$$\mathbb{E}\left(R^{\$}\frac{S_2}{S_1} - R\right) = \lambda cov\left(R^{\$}\frac{S_2}{S_1}, c_2\right) \tag{9}$$

Similarly, using equation 8, we get equity premium

$$\mathbb{E}\left(\frac{R^k}{P^k} - R\right) = \lambda cov\left(\frac{R^k}{P^k} - R, c_2\right) \tag{10}$$

7.3 Foreign Speculator

Foreign speculator has an outside income Y_2^f, and invests in the local assets. The problem,

$$\max \mathbb{E}c_2^f - \frac{\lambda^f}{2}\mathbb{V}c_2^f$$
$$c_2^f = x^D\left(\frac{S_1}{S_2}R^L - R^{\$}\right) + Y_2^f$$

$$x^D = \frac{\left(\frac{S_1}{S_2}R^L - R^{\$}\right)}{\lambda^f \mathbb{V}\left(\frac{S_1}{S_2}R^L - R^{\$}\right)} - \frac{cov\left(\frac{S_1}{S_2}R^L - R^{\$}, Y_2^f\right)}{\mathbb{V}\left(\frac{S_1}{S_2}R^L - R^{\$}\right)} \tag{11}$$

7.4 Equilibrium

Financial Markets Clearing

$$d + x^D = 0 \tag{12}$$
$$f + x^{\$} = 0 \tag{13}$$

Export Demand

$$c_1^* = S_1^\eta Y_1^* \tag{14}$$

$$c_2^* = \left(\frac{S_2}{P_2^h}\right)^\eta Y_2^* \tag{15}$$

Goods Market Equilibrium

$$c_1^* + k_h = Y_1 \tag{16}$$

$$c_2^* + c_2^h = Y_2 \tag{17}$$

$$Y_2 = Ak^\alpha \tag{18}$$

Balance of Payments

$$c_1^* - S_1 k_f = d + f = -x^\$ - x^D \tag{19}$$

$$P_2^h c_2^* - S_2 c_{2,f} = -dR^L - \frac{S_2}{S_1} R^\$ f = x^D R^L + x^\$ \frac{S_2}{S_1} R^\$ \tag{20}$$

Factor prices

$$w = P_2^h (1-\alpha) k^\alpha$$

$$R^k = P_2^h \alpha k^{\alpha - 1}$$

Shocks and Uncertainty

In the second period, there are two idiosyncratic shocks,

$$Y_2^*, A$$

We assume that the foreign speculator income is a combination of the Trade shock and exogenous income shock

$$Y_2^f = sY_2^* + Y_2^x$$

Shocks are distributed independently with means (μ_A, μ_{Y^*}) and standard deviations (σ_A, σ_{Y^*})

8 Model Predictions

In this section, We simulate the model for different values of parameters and plot the expected spread against several factors that are found to be significant determinants of currency returns.

8.1 Correlation of the exchange rate with GDP

Figure 12 plots the correlation of the exchange rate with income in the model. A negative covariance between GDP and the exchange rate is associated with high average returns(Dalgic (2018)). As households see a more negative correlation, they reduce demand for local assets as the local assets become a poor insurance instrument against consumption risk. Lower demand for local assets drives the local interest rates up and creates average excess returns.

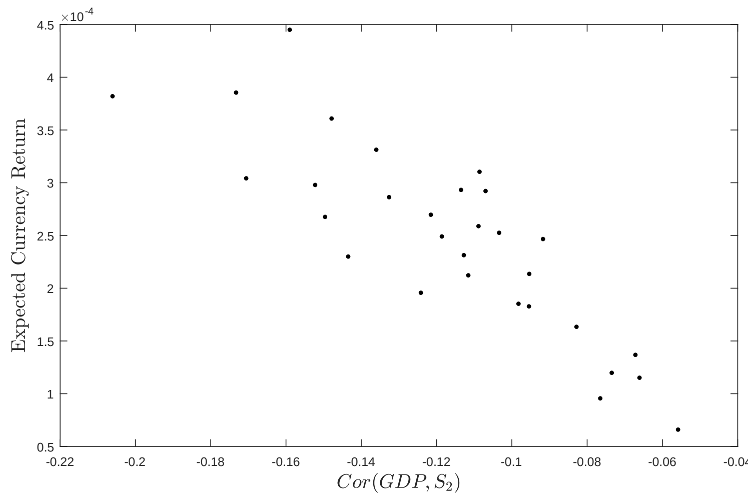


Figure 12: Correlation of the exchange rate with consumption and excess returns

8.2 Correlation of the exchange rate with foreign exogenous income

Similarly, high covariance between foreign income and the exchange rate is also associated with high returns (Lustig and Verdelhan (2007)). If the exchange rate tends to depreciates more during global turmoils, local currency assets have poor insurance properties for international investors. Then, investors require high returns to carry exchange rate risk because the exchange rate risk is correlated with their income.

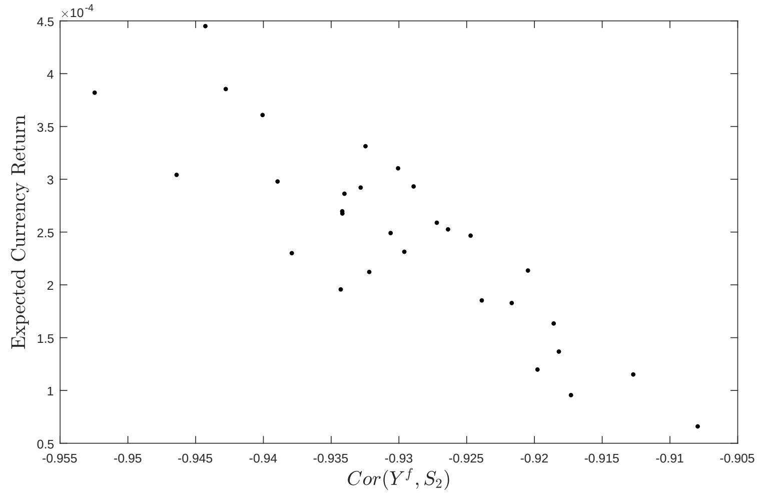


Figure 13: Correlation of the exchange rate with foreign exogenous income and excess returns

8.3 Trade balance and net foreign asset position

Trade balance, or net asset position is also related to average excess returns(Della Corte et al. (2016)). Similar to Wiriadinata (2018), high foreign debt leads to high sensitivity of the exchange rate to shocks We.e. exchange rate jumps more during economic downturns, drives covariance between consumption and the exchange rate more negative. Note that in this model, We do not have balance sheet effects so the effect is coming from pure transfer of wealth. A more indebted country needs to transfer more during downturns, which amplifies the comovement of the exchange rate with the economy. To insure themselves against shocks, households demand more foreign assets, which lowers demand for local assets and drives up the interest rate.

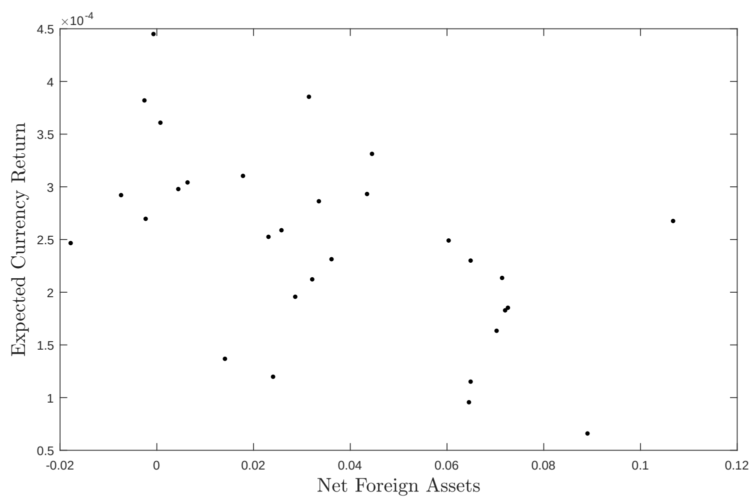


Figure 14: Net exports and excess returns

8.4 Standard deviation of the exports

We use standard deviation of exports as a proxy for centrality. The idea is that a well-connected economy will have lower volatility of export revenues and the model delivers low currency returns.

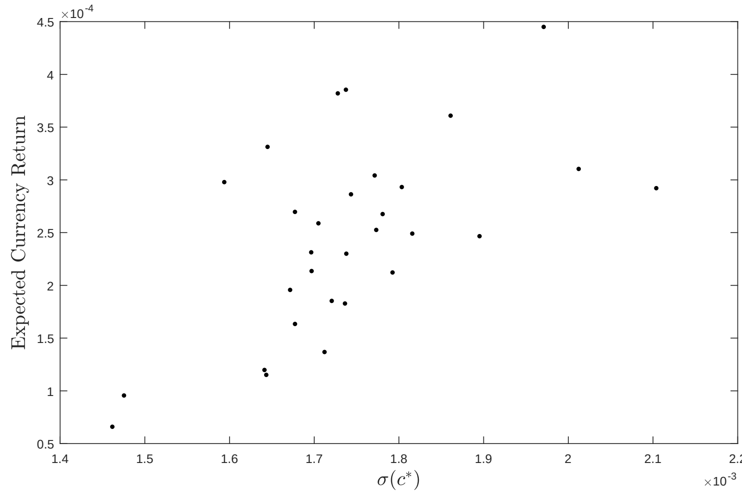


Figure 15: Standard deviation of exports and excess returns

8.5 Determinants of Excess Returns in the Model

We simulate the model by simulating parameter values. We randomly draw $Y_1^*, s, \lambda, \lambda^f, Y_1$, $\mu_A, \mu_{Y^*}, \sigma_A, \sigma_{Y^*}$. The model is simulated 30 times using different set of parameters. In Table 10, we report the regression of the expected local returns on net foreign asset position and the correlation between GDP and the exchange rate.

Table 10: Determinants of Excess Returns in the Model

	Dependent variable:
	Expected Return
Net Foreign Assets/GDP	-0.076^{***}
	(0.019)
$\text{Corr}(\Delta GDP, \Delta S/P)$	-0.193^{***}
	(0.026)
Constant	0.005
	(0.003)
Observations	30
R^2	0.788
Adjusted R^2	0.773
Residual Std. Error	0.004 (df = 27)
Note:	*p<0.1; **p<0.05; ***p<0.01

9 Conclusion

In this paper, we offer the co-movement of local economic conditions and the exchange rate as a driver of average excess currency returns. In countries where the exchange rate tends to depreciate in recessions, dollar assets provide income insurance since they gain value during recessions. In these countries, residents would like to hold dollar assets and require a premium to hold local currency assets. Correlation between real GDP and real exchange rate movements appears as a significant determinant of average excess returns, even after controlling for key determinants in the literature. We build a small open economy model where the residents and the foreigners trade in FX markets for insurance as well as speculative reasons. The simple insurance view built in the model can generate key determinants of average currency returns in the data.

A 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.

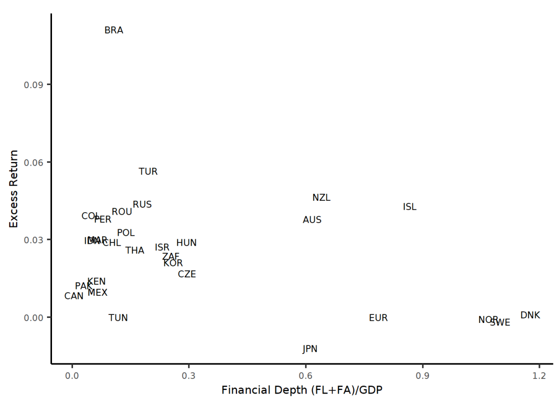


Figure 16: Excess returns vs Financial Depth
Data source: FX4Casts. Y-axis variable is the average currency return of 25 countries between 02/2003 - 11/2018. X-axis variables is the sum of foreign assets and liabilities of the banking system as a share of GDP, proxy for financial depth.

B Model Equations

Households maximization problem

$$\max_{d,f,k} \mathbb{E}\left(dR + fR^{\$}\frac{S_2}{S_1} + wl + kR^k\right) - \frac{\lambda}{2}\mathbb{V}\left(dR + fR^{\$}\frac{S_2}{S_1} + wl + kR^k\right)$$

$$\begin{aligned}\mathbb{V}c_2 = f^2\mathbb{V}\left(R^{\$}\frac{S_2}{S_1}\right) + \mathbb{V}w + k^2\mathbb{V}R^k + \\ 2cov\left(w, R^{\$}\frac{S_2}{S_1}\right)f + \\ 2cov\left(R^{\$}\frac{S_2}{S_1}, R^k\right)kf + \\ 2cov\left(w, R^k\right)k\end{aligned}$$

FOC d :

$$\mathbb{E}R - \mu$$

FOC f:

$$\mathbb{E}\left(R^{\$}\frac{S_2}{S_1}\right) - \lambda f \mathbb{V}\left(R^{\$}\frac{S_2}{S_1}\right) - \lambda cov\left(w, R^{\$}\frac{S_2}{S_1}\right) - \lambda cov\left(R^{\$}\frac{S_2}{S_1}, R^k k\right) - \mu$$

FOC k :

$$\mathbb{E}R^k - k\lambda\mathbb{V}R^k - \lambda cov\left(R^{\$}\frac{S_2}{S_1}f, R^k\right) - \lambda cov\left(w, R^k\right) - \mu P^k$$

$$\mathbb{E}\left(\frac{R^k}{P^k}\right) - P^k k\lambda\mathbb{V}\left(\frac{R^k}{P^k}\right) - \lambda cov\left(R^{\$}\frac{S_2}{S_1}f, \frac{R^k}{P^k}\right) - \lambda cov\left(w, \frac{R^k}{P^k}\right) - \mu$$

Foreign Speculator Problem

$$\max \mathbb{E}\left(x^D\left(\frac{S_1}{S_2}R^L - R^{\$}\right) + Y_2^f\right) - \frac{\lambda^f}{2}\mathbb{V}\left(x^D\left(\frac{S_1}{S_2}R^L - R^{\$}\right) + Y_2^f\right)$$

$$\mathbb{V}c_2^f = \left(x^D\right)^2\mathbb{V}\left(\frac{S_1}{S_2}R^L - R^{\$}\right) + \mathbb{V}Y_2^f + 2x^D cov\left(\frac{S_1}{S_2}R^L - R^{\$}, Y_2^f\right)$$

FOC:

$$\left(\frac{S_1}{S_2}R^L - R^{\$}\right) - \lambda^f x^D\mathbb{V}\left(\frac{S_1}{S_2}R^L - R^{\$}\right) - \lambda^f cov\left(\frac{S_1}{S_2}R^L - R^{\$}, Y_2^f\right)$$

C 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 11 and 12, 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 11: 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 12: 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 13: 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 14: 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.

D Data on Expectation

E 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.

$$\frac{S_t}{F_t} R_t^L = R_t^{US} \tag{21}$$

We can replace R_t^L inside the equation 1 using the equation 21,

$$R_t^{US} \left(\frac{F_t}{S_{t+1}} - 1 \right) \tag{22}$$

Equation 22 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.

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