"Linking net foreign portfolio debt and equity to exchange rate movements"
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Linking net foreign portfolio debt and equity to exchange rate movements

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Abstract

Many currencies, especially those of countries with negative net foreign assets, tend to depreciate during times of financial turbulence. Using a panel of 26 currencies over the period 1/1997-6/2016, I show that the composition of net foreign assets matter for the exchange rate sensitivity to changes in global financial market risk tolerance, where debt financing increases it and equity financing reduces it. Thus, currencies of countries with large negative net external portfolio debt are more vulnerable to changes in financial market uncertainty than currencies with the equivalent net external equity. Ownership matters too, private net foreign debt liabilities heighten the exchange rate sensitivity much more than public. The relationship between banking sector risk intolerance, net external asset positions and exchange rates has, moreover, become stronger since the credit crisis.

Keywords:
Exchange rates, excess currency returns, net foreign assets, external imbalances, net foreign portfolio debt, financial market risk tolerance, panel data

JEL Codes:
F31, F32, G15, G20, C23
1. Introduction

There have been large swings in both the financial sector’s risk appetite and in exchange rates during the past 10 years, and many countries with large negative net foreign asset positions have seen their currencies depreciate sharply during times of global financial market turbulence. Several central banks, especially in emerging markets, responded to this by conducting substantial currency interventions to dampen the exchange rate movements and volatility. Different types of external capital are however heterogeneously influenced by global risk, and the country’s underlying foreign debt and asset structure might affect the way the exchange rate reacts to financial market turmoil. This paper therefore empirically disentangles how the composition of net foreign assets impacts the sensitivity of exchange rates to global financial market uncertainty. As many central banks are concerned about the impact of global financial market shocks on their countries’ exchange rates, a full understanding of these mechanisms are important for both policy design and evaluation, and for predicting future exchange rate movements.

Gabaix and Maggiori 2015 recently proposed a theory of exchange rate determination based on global imbalances and resulting capital flows in imperfect financial markets. Financiers absorb the global currency demand imbalances and currency risk stemming from international trade and financial flows. As the financiers’ risk-bearing capacity is limited, currencies of countries with large external debts must offer high expected returns to compensate for the resulting currency risk. Balance sheet changes of the financial institutions will impact the pricing (or level) of foreign currency lending, which in turn affects the exchange rate.\(^1\) Della Corte et al. (2016) indirectly prove the theory of Gabaix and Maggiori (2015) by showing that countries’ external imbalances can explain cross-sectional variation in currency excess returns. They hypothesize that net debtor countries must offer a currency risk premium in order to compensate investors for taking on the risk and financing the negative external imbalances, as their currencies tend to depreciate when risk taking is limited. The vulnerabilities are moreover larger for countries with large foreign currency liabilities, as currencies of countries with difficulties issuing local currency debt tend to be riskier. Habib and Stracca (2012) also empirically confirm that currencies with large external imbalances are more vulnerable to swings in the global risk sentiment. This can also be related to the sudden stop literature that looks at the factors giving rise to sudden capital flow reversals. That literature has established that external “push” factors are the main drivers of capital flows, whereas the magnitude of such flows are determined by domestic “pull” factors (see e.g. Calvo et al., 1993; Fernandez-Arias, 1996; Ghosh et al., 2014).

\(^1\) Gabaix and Maggiori (2015) note that active exchange rate risk taking is greatly concentrated among a small number of large financial firms. About 80% of the exchange rate flows in 2014 was concentrated among the 10 largest banks, and currency risks also account for a large share of these institutions’ overall respective risk taking. According to Deutsche Bank’s and Citigroup’s regulatory findings, currency risk accounted for 17-35% of total stressed value at risk in 2003. Hence, changes in the risk-bearing capacity of these large financial institutions can have potentially large impacts on the foreign exchange markets. Moreover, there is some evidence in the previous literature that financial institutions absorb a part of the currency risk, see e.g. Tai (2005) or Martin and Mauer (2003).
The empirical literature has argued that international capital flows to both advanced and emerging market economies are procyclical and tend to amplify business cycle fluctuations. However, not all types of capital flows are equally procyclical. Brunnermeier et al. (2012) note that aggregate FDI and net portfolio equity flows are generally fairly stable over the business cycle. This is partly due to a different investor base, but mainly because in a financial crisis the foreign equity investors absorb the valuation losses, which combined with a local currency depreciation discourages portfolio equity outflows. Foreign subsidiaries moreover often maintain access to credit through their parent companies during crises, which ameliorates the capital outflow and exchange rate effect (Blalock and Gertler, 2008). Debt flows, on the other hand, portray strong procyclicalities. A large share of the debt inflow is intermediated by banks, and bank lending responds not only to the credit worthiness of the project, but also to the bank's balance-sheet capacity. Moreover, debt is subject to maturity mismatch risk as investors may choose to not roll over maturing debt under uncertain market conditions. Consequently, currencies of countries with large outstanding net debt liabilities tend to be more vulnerable to changes in the banking sector risk bearing capacity or the global risk sentiment than countries with the equivalent net portfolio equity and FDI liabilities. The crash risk for the currency with large negative net portfolio debt positions should therefore be higher, which would translate into a higher currency risk premia. Within the sudden stop literature Levchenko and Mauro (2007) find that especially FDI but also portfolio equity flows are fairly stable during sudden capital flow stops, whereas portfolio debt and other flows (such as bank loans and trade credits) experience substantial reversals.

This paper extends the empirical exchange rate and excess currency return literature that focusses on the impact of global imbalances and the financial sector risk-bearing capacity in several ways. Studies such as Brunnermeier et al. (2012), Lustig et al. (2011), Menkhoff et al. (2012) have documented a significant relationship between global risk and excess currency returns or currency movements. Many previous studies have looked at the exchange rate impact of international capital flows, but fewer studies have looked at the exchange rate impact of a change in the global risk tolerance, conditional on this country's net foreign asset position. To the best of my knowledge, no study has yet properly looked at how the composition of net foreign assets affects the impact of financial market uncertainty on the exchange rate.

In a panel study of 25 exchange rates against the USD over the period 1/1997-6/2016, I identify which types of net foreign assets that increase the exchange rate sensitivity to global risk intolerance. I disentangle how the relationship between the financial sector risk bearing capacity and different types of foreign capital, such as portfolio debt, equity, FDI and other investments, affects currency excess returns and the exchange rate. I differentiate between private and public net foreign assets and

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3 E.g. Gourinchas and Rey (2007), Alquist and Chinn (2008), Della Corte et al. (2012), Aizenman and Binici (2015) all suggest that net foreign assets have an impact on nominal exchange rates. Ricci et al. (2013) and many others have investigated the same impact on real exchange rates.
investments, as both public and private investors, but also investors in private and public debt, generally have different investment horizons and risk bearing capacities. I moreover show how the relationship between risk intolerance, net foreign assets and exchange rates differ between G10 and emerging market currencies, and finally I determine how this relationship has changed over the sample period.

My main findings are that the composition of the net foreign asset position matter for both the excess currency return and exchange rate sensitivity to changes in global financial market risk tolerance. Currencies of countries with large net external debt liabilities, and especially portfolio debt liabilities, are most sensitive to changes in the financial market risk appetite and banking sector risk. These currencies tend to depreciate far more in response to a surge in financial market risk intolerance than countries with smaller net external debt liabilities. Moreover, I find that currencies of countries with the equivalent negative net foreign equity position are much less affected by changes in the global risk sentiment. Due to these offsetting exchange rate effects of the external debt and equity positions, the negative impact of financial market imbalances is underestimated if we look only at the total net foreign assets. Secondly, I find that the ownership of the net foreign assets affects the exchange rate sensitivity. Private net foreign liabilities, and especially private net foreign debt, increase the exchange rate vulnerability much more than public net foreign debt. Thirdly, although the emerging market currencies are in general more sensitive to changes in the global financial market volatility index VIX, the net foreign asset position has a smaller impact on the total effect of a change in risk intolerance on the exchange rate. Thus, emerging market currencies seem to react more to a change in risk intolerance, regardless of their underlying net foreign asset position. Finally, I find that the relationship between banking sector risk intolerance, net external assets and exchange rates has become stronger over time, and especially after the great financial crisis.

These results are important for risk calculations and hedging decisions, but they also have important policy implications. In the past, many central banks\(^4\) have engaged in currency interventions in order to smooth exchange rate volatility during times of financial turmoil. These results suggest that policy makers concerned about a high exchange rate sensitivity to global financial uncertainty could reduce this vulnerability by facilitating a shift from debt to equity liabilities. As there are substantial differences in how debt and equity investments are taxed in most countries, there is ample scope for intervention.

These results are also important for the evaluation of financial market reforms. Many emerging market economies have substantial restrictions on foreign ownership of debt, but especially equity products. When evaluating the costs and benefits of opening up the local financial markets to foreign investors, like for example Saudi Arabia is currently doing, these findings provide important information on the

\(^4\) This includes among others the central banks of Mexico, Brazil, India, Malaysia, Indonesia, Russia, Poland, Japan and Switzerland.
heterogeneous impacts of foreign debt and equity ownership on the exchange rate. From a financial stability perspective it is crucial for policy makers to know which types of liabilities that increase the exchange rate vulnerability to the global financial markets, and which types of assets have a palliative impact. Finally, my findings are also interesting from a corporate finance perspective. Modigliani and Miller (1958) state that if financial markets are complete, the liability structure should not affect the value of a firm. If this logic is transferred to the aggregate level, the value of a country’s assets should not depend on its debt/equity ratio. However, as the price that investors are willing to pay for a country’s currency depends on the underlying capital structure in the economy, this implies that the Modigliani-Miller theorem does not hold on the aggregate level.

The rest of the paper is structured as follows: Section 2 describes the theoretical framework underlying the model and how different types of capital might affect the relationship between global risk tolerance and exchange rates. Section 3 describes the method and models, Section 4 describes the data, Section 5 presents and discusses the results and Section 6 concludes.

2. Theoretical framework

Gabaix and Maggiori's (2015) exchange rate model

The empirical model for this study is inspired by Gabaix and Maggiori's (2015) two country model with imperfect markets, where exchange rates are financially determined by capital flows and the financial sector's risk bearing capacity. In their model, households produce tradeable and nontradeable goods, trade in the frictionless international goods market and invest with financiers in nominally risk-free bonds. The international capital flows resulting from households’ investment decisions are intermediated by financiers, who bear the resulting currency risk.

The exchange rate $s$ is determined by the demand and supply of capital denominated in the different currencies, where $s$ is defined as the quantity of U.S. dollars bought by 1 unit of foreign currency. Thus, $s$ determines the strength of the foreign currency and $\Delta s > 0$ implies an appreciation of the foreign currency. The financiers are subject to financial constraints, which limit their risk-bearing capacity and induce them to demand a premium for taking on the currency risk. Financiers’ ability to bear risk is denoted by $\Gamma$, where a higher $\Gamma$ (i.e. lower $1/\Gamma$) implies lower financier risk-bearing capacity.

This imperfect risk-bearing capacity creates a demand function for foreign assets. By solving the financiers’ constrained optimization problem for a two period model, they arrive at the financiers’ aggregate demand for assets:

$$Q_0 = \frac{1}{\Gamma} E \left[ s_0 - s_1 \frac{R_s}{R} \right]$$

(1)
The financiers aggregate demand for dollar assets \( Q_0 \) is decreasing in the strength of the dollar \((s_0)\) and the foreign risk-free interest rate \( R^* \), and is increasing in the U.S. interest rate \( R \) and the expected future value of the dollar, \( s_1 \).

U.S. exports to the foreign country in time \( t \) are denoted as \( \xi_t \), and \( \iota \) are the time \( t \) U.S. imports from the foreign country, and the dollar value of the exports is \( \xi_t s_t \). Total U.S. net foreign assets or net exports in the two period model are thereby defined as \( NFA_t = \xi_t - \iota_t \), where a surplus in the first period has to be offset by a deficit in the second. The market clearing conditions (and the equilibrium USD “flow” demand) in period 0 and 1 for the USD against the foreign currency, which states that the net demand for dollar must be zero, are:

\[
\xi_0 s_0 - \iota_0 + Q_0 = 0 \quad \text{and} \quad \xi_1 s_1 - \iota_1 + R Q_0 = 0 \quad (2)
\]

By combining equations (1) and (2) and making the simplifying assumptions \( R^* = R = 1 \) and \( \xi = 1 \) for \( t=0,1 \) to focus on the key results, Gabaix and Maggiori (2015) reach the following expression for the period 0 exchange rate:

\[
s_0 = \frac{(1 + \Gamma) \xi_0 + E[\xi_1]}{2 + \Gamma} \quad (3)
\]

The exchange rate is thus affected by the foreign asset position \((\iota_0 \text{ and } \iota_1)\) and the financial sector risk intolerance \( \Gamma \). The net foreign asset position at the end of the period 0 can be rewritten as \( NFA_0 = \xi_0 s_0 - \iota_0 = (E[\xi_1] - \iota_0) / (2+\Gamma) \). This implies that if the U.S. has a positive \( NFA_0 \), and is thereby financing the deficit in the foreign country, the financiers are long the foreign (debtor) currency and short the creditor currency, i.e. the US dollar. The financiers need compensation for taking on this resulting risk, and for them to be willing to absorb the currency risk they must expect the foreign currency to appreciate. This "required" appreciation can occur if the foreign currency depreciates in time 0.

According to their Proposition 2, the impact of a change in the financial sector risk bearing capacity \( \Gamma \) on the exchange rate \( s_0 \) is thus the following:

\[
\frac{\partial s_0}{\partial \Gamma} = -\frac{NFA_0}{2 + \Gamma} \quad (4)
\]

This result implies that if there is a sudden worsening of the financier’s risk-bearing capacity or a financial disruption, i.e. \( \Gamma \uparrow \), countries with a negative net foreign asset position \( (NFA_0<0) \) see a currency depreciation against the foreign currency \( (s \uparrow) \), whereas countries with positive net foreign

---

\(^5\) This can be related to the carry trade, where investors borrow in a low interest rate currency and invest it abroad under the expectation of obtaining both an interest rate and currency return.
assets appreciate. If we consider NFA fixed and treat equation (3) as a function of only $\Gamma$, $f(\Gamma)$, by using approximation by differentials we can use $ds_0 \approx \Delta s_0$, where

$$\Delta s_0 = f'(\Gamma) \Delta \Gamma = \frac{-NFA_0}{2 + \Gamma} \Delta \Gamma$$  \hspace{1cm} (5)

The same results are reached if $R^* \neq R \neq 1$ is assumed and when the time frame is extended to three periods. A positive interest rate difference between the debtor and creditor countries would provide incentives for the international investors to finance the imbalance. During times of worsening funding conditions, the resulting exchange rate depreciation would thus be dampened by a higher debtor interest rate.

**Different types of foreign capital**

There are many different types of foreign assets that differ both in their investor base and sensitivity to global risk tolerance. Gabaix and Maggiori's (2015) conclusion that the net foreign asset position affects the way currencies react to changes in the financial sector risk bearing capacity holds also when different types of net foreign assets are considered. When foreign debt is added to the model, the impact of a change in $\Gamma$ on $s$ is:

$$\frac{\partial s_0}{\partial \Gamma} = \frac{-NFA^L_0}{2 + \Gamma} + \frac{-NFA^D_0}{2 + \Gamma}$$

where $NFA^L_0$ denotes the net foreign loans and $NFA^D_0$ the net foreign debt position needed to finance the imbalance at the end of period 0.

Foreign assets are often separated into debt and equity instruments, or into more granular classifications such as direct investment, portfolio equity, portfolio debt and so called "other" investments which includes bank loans etc. Although equity can be thought of as a debt instrument with infinite maturity, there are however some substantial differences between these two external sources of financing. Debt creates leverage, whereas equity does not. Equity financing involves more risk and profit sharing than debt financing, and debt provides external financing at a fixed cost whereas for equity the cost of capital varies.

Not all types of foreign assets are equally influenced by the global risk sentiment or the financial sector risk bearing capacity. Brunnermeier et al. (2012) explain that foreign debt flows tend to be much more influenced by the global financial cycle than FDI and foreign equity flows. One reason for this is the different investor base. A large share of the debt inflow is intermediated by banks, and bank lending responds not only to the credit worthiness of the project, but also to the bank's balance-sheet capacity. During times of higher global risk intolerance, less external debt is therefore issued. Moreover, during
times of high global risk intolerance some of the existing foreign debt is not rolled over when maturing, but instead repatriated to the foreign financial institution causing capital outflows. Portfolio debt issued by banks might also be more affected by business cycle fluctuations than trade credits, which might make currencies of countries with large foreign debt liabilities more sensitive to global financial market turbulence. Consequently, debt intermediated by the banking sector is highly procyclical and more volatile than non-bank debt flows. Additionally, as equity investments allows for greater risk sharing between creditor and borrower than debt investments, this increases the riskiness of (portfolio) debt investments compared to equity and makes debt investments more susceptible to outflows during times of low financial market risk tolerance.

Foreign equity flows are much less affected by the global risk sentiment. In a crisis, the foreign equity investors suffer both valuation losses, often in combination with a weaker local currency, which discourages portfolio equity outflows. FDI investments are often sunk in more illiquid assets, and equity related to FDI is likely to be done by investors with longer term investment horizons and is therefore less influenced by the business cycle than portfolio investments. Moreover, FDI and equity investors, often corporations, pension funds or mutual funds, are typically less or not at all leveraged, which reduces the risk of sudden stops or reversals. As international debt liabilities are more affected by global risk intolerance than international equity liabilities, an increase in global risk aversion will lead to much larger capital outflows from countries with large debt liabilities than from countries with large equity liabilities. This explains why, consequently, currencies of countries with large outstanding net portfolio debt are more vulnerable to changes in the banking sector risk bearing capacity or the global risk sentiment than countries with the same amount of net portfolio equity and FDI. When considering the impact of financial market risk intolerance on the exchange rate, it is therefore necessary to take into account the type of assets and liabilities making up a countries’ net foreign asset position.

Net foreign assets generally consist of both private and public foreign assets and liabilities. The foreign creditors financing public and private debt are also likely to differ, as private foreign debt is generally perceived as being riskier than government debt. The higher risk excludes many pension funds and other low risk investors that generally are less leveraged from investing in the private debt market. Moreover, many insurance or pension funds are required to invest a substantial share of their holdings in low risk government bonds. If the investor base for government bonds and liabilities is less leveraged or has a longer investment horizon than the investor base for private debt, this might lead to smaller international capital flows in response to higher risk intolerance. This would in turn mean that the exchange rate is also less affected by sudden financial market turbulence, which is indeed what I find.

\* Investments in safe haven currencies such as the JPY, USD and CHF tend however to be exceptions.
3. Method

This section outlines the empirical strategy for studying the dynamics between changes in risk intolerance, different types of global imbalances and the exchange rate or excess currency returns. As demonstrated in equation (4), the impact of a change in risk intolerance on the exchange rate depends on the net foreign asset position (NFA) of the country. This study tests this hypothesis empirically with help of an interaction model that disentangles the exchange rate effect of a change in risk intolerance, $RI$, given the net foreign asset position, where $RI$ can be thought of as a proxy for $\Gamma$. After having done this, the NFA position is split into Net Total Debt and Net Total Equity investments, and finally into different net portfolio, net FDI and net other assets, in order to see whether the underlying asset structure has an effect on the exchange rate impact.

The variable $s_t$ stands for the log spot exchange rate in the period $t$ in units of USD (home currency) per foreign currency. Thus, $\Delta s > 0$ implies an appreciation of the foreign currency against the USD. $f_t$ denotes the log forward rate in month $t$, $\Delta s_{t+1} = s_{t+1} - s_t$ and $fd_t = f_t - s_t$ represents the forward discount. If the covered interest rate parity (CIP) holds, the forward discount is approximately equal to the interest differential between the two countries, i.e. $f_t - s_t \approx i_{US} - i$. Monthly unconditional currency excess returns $rx_{t+1}$ in period $t+1$ are defined as the return from buying a foreign currency in the forward market and then selling it in the spot market in the next period $t$:

$$
rx_{t+1}^u = s_{t+1} - f_t = s_{t+1} - s_t + s_t - f_t = \Delta s_{t+1} - fd_t
$$

The conditional excess currency returns, $rx_{t+1}$, are defined as the returns from assuming a long position in the foreign currency, $rx_{t+1} = s_{t+1} - f_t$, if $fd_t = f_t - s_t < 0$, (or $i_{US} > i$ if CIP holds), and a assuming a short position if $fd_t > 0$. Thus

$$
rx_{t+1} = \begin{cases} 
  s_{t+1} - f_t & \text{if} \quad fd_t = f_t - s_t < 0 \\
  f_t - s_{t+1} & \text{if} \quad fd_t > 0
\end{cases}
$$

If CIP holds, then this trade is equivalent to the carry trade of going long the foreign currency and short the USD if $i_{US} > i$ and vice versa.
Net foreign assets

The basic panel regression equations that look at the interaction of net foreign assets and financial sector risk intolerance on exchange rate changes $\Delta s_{i,t}$ and excess returns $r_{x_{i,t}}$ of currency $i$ against USD in period $t$ are based on equation (5), where the equation has been augmented with the constitutive terms of the interaction between net foreign assets to GDP ($nfa_{i,t}$) and the change in the global financial sector risk intolerance ($\Delta RI_t$) and additional control variables. The baseline exchange rate and excess return models are thus:

$$\Delta s_{i,t} = \beta_0 + \beta_1 \Delta RI_t + \beta_2 (nfa_{i,t} \Delta RI_t) + \beta_3 nfa_{i,t} + \delta x_{i,t} + \gamma_i + \epsilon_{i,t}$$  \hspace{1cm} (7)

$$\Delta r_{x} = \beta_0 + \beta_1 \Delta RI_t + \beta_2 (nfa_{i,t} \Delta RI_t) + \beta_3 nfa_{i,t} + \delta x_{i,t} + \gamma_i + \epsilon_{i,t}$$  \hspace{1cm} (8)

where $x_{i,t}$ is a vector containing the control variables, the $\beta$'s and $\delta$ contain the estimated coefficients, $\gamma_i$ is the currency fixed effect and $\epsilon_{i,t}$ is the error term. It is however possible that it is not only the net foreign asset position that affects the exchange rate, but that the exchange rate also has an impact on the external debts and liabilities. In order to avoid this simultaneity problem, the beginning of period values of the net foreign asset positions are used.\(^8\)

As we have an interaction model, the estimated coefficient $\beta_1$ tells us the exchange rate (and excess return) impact of $\Delta RI_t$ when $nfa_{i,t}$ is zero. During times of low financial risk tolerance, most currencies, with the exception of a number of so called "safe haven currencies", tend to depreciate and excess returns are lower. Therefore, we expect $\beta_1<0$. The estimated coefficient on the interaction term $\beta_2$ is expected to be positive according to Proposition 2 (equation (4)) of Gabaix and Maggiori (2015); countries with negative $nfa$ react stronger to increases in risk intolerance and depreciate more (remember that $\Delta s<0$ implies foreign currency depreciation against the USD). When the risk bearing capacity of the financial sector is good ($RI$ is low), then the excess returns of the net debtor currencies (i.e. countries with $nfa<0$) are positive. However, during times of financial distress when risk intolerance increase, currencies with negative net external debt positions depreciate due to foreign capital outflows. Typically, this reduces excess returns as well. Thus, $\beta_2>0$ would indicate that negative net debt positions increases the exchange rate sensitivity to increases in risk intolerance. The total impact of $\Delta RI$ on exchange rate changes or excess returns is $\beta_1+\beta_2 \overline{nfa}$, where $\overline{nfa}$ is the average $nfa$.\(^9\)

\(^7\) As the indices for risk tolerance used in this study are decreasing in the level of risk bearing capacity, it is more intuitive for the interpretation of the results to talk about a risk intolerance index rather than risk tolerance.

\(^8\) The results are also robust to the use of further lags of the net foreign assets.

\(^9\) The standard error of this term is $se(\beta_1+\beta_2 \overline{nfa}) = \sqrt{var(\beta_1) + \overline{nfa}^2 var(\beta_2) + 2 \overline{nfa} cov(\beta_1,\beta_2)}$