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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.

JEL Classifications: F31, F32, G15, G20, C23

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

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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

[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).

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; Fernández-Arias, 1996; Ghosh et al., 2014).

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.[2] 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 financial 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 signif-

[2]See Kaminsky et al. (2004), Brunnermeier et al. (2012) Bluedorn et al. (2013), Araujo et al. (2015)

icant 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[3], 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 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

[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.

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 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-to-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.

[4]This includes among others the central banks of Mexico, Brazil, India, Malaysia, Indonesia, Russia, Poland, Japan and Switzerland.

2 Theoretical framework

2.1 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_t is determined by the demand and supply of capital denominated in the different currencies, where s_t is defined as the quantity of U.S. dollars bought by 1 unit of foreign currency. Thus, s_t 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 Γ, where a higher Γ (i.e. lower $\frac{1}{\Gamma}$) 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:

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

The financiers aggregate demand for dollar assets Q_0 is decreasing in the strength of the dollar (s_0, where a higher s implies a weaker USD) 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 ξ_t, $\imath_t$ 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 $NFA_t = \xi_t s_t - \imath_t$, 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:

$$\xi_0 s_0 - \imath_0 + Q_0 = 0 \qquad \text{and} \qquad \xi_1 s_1 - \imath_1 + RQ_0 = 0 \tag{2}$$

By combining equations (1) and (2) and making the simplifying assumptions $R^* = R = 1$ and $\xi_t = 1$ for $t = 0, 1$ to focus on the key results, Gabaix and

Maggiori (2015) reach the following expression for the period 0 exchange rate:

$$s_0 = \frac{(1+\Gamma)\imath_0 + E[\imath_1]}{2+\Gamma} \tag{3}$$

The exchange rate is thus affected by the foreign asset position ($\imath_0$ and $\imath_1$) and the financial sector risk intolerance Γ. The net foreign asset position at the end of the period 0 can be rewritten as $NFA_0 = \xi_0 s_0 - \imath_0 = \frac{E[\imath_1]-\imath_0}{2+\Gamma}$. 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.[5] 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 Γ on the exchange rate s_0 is thus the following:

$$\frac{\partial s_0}{\partial \Gamma} = \frac{-NFA_0}{2+\Gamma} \tag{4}$$

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 assets appreciate. If we consider NFA fixed and treat (3) as a function of only Γ, $f(\Gamma)$, by using approximation by differentials we can use $ds_0 \approx \Delta s_0$, where

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

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.

2.2 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's and Maggiori's (2015) conclusion that the net foreign asset position affects the way currencies react to

[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.

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 Γ on s is:

$$\frac{\partial s_0}{\partial \Gamma} = \frac{-NFA_0^L}{2+\Gamma} + \frac{-NFA_0^D}{2+\Gamma}$$

where NFA_0^L denotes the net foreign loans and NFA_0^D 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.[6] 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.

3 Method

This section outlines the empirical strategy for studying the dynamics between changes 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 Γ. After having done this, the NFA position is split into Net Total Debt and Net Total Equity investments, and finally into

[6] Investments in safe haven currencies such as the JPY, USD and CHF tend however to be exceptions.

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^u_{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:

$$rx^u_{t+1} = s_{t+1} - f_t = s_{t+1} - s_t + s_t - f_t = \Delta s_{t+1} - fd_t$$

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 $i > i_{US}$ if CIP holds), and a assuming a short position if $fd_t > 0$. Thus

$$rx_{t+1} = \begin{cases} s_{t+1} - f_t & \text{if } \; fd_t = f_t - s_t < 0 \\ f_t - s_{t+1} & \text{if } \; fd_t > 0 \end{cases} \tag{6}$$

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

3.1 Net foreign assets

The basic panel regression equations that look at the interaction of net foreign assets and financial sector risk intolerance[7] on exchange rate changes $\Delta s_{i,t}$ and excess returns $rx_{i,t}$ 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 (ΔRI_t) and additional control variables. The baseline exchange rate and excess return models are thus:

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

$$rx_{i,t} = \beta_0 + \beta_1 \Delta RI_t + \beta_2 (nfa_{i,t} \Delta RI_t) + \beta_3 nfa_{i,t} + \delta x_{i,t-1} + \gamma_i + \varepsilon_{i,t} \tag{8}$$

[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.

where x_{it} is a vector containing the control variables, the β's and δ contain the estimated coefficients, γ_i is the currency fixed effect and $\varepsilon_{i,t}$ 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 β_1 tells us the exchange rate impact of ΔRI_t when $nfa_{i,t}$ is zero. During times of low financial risk tolerance, most currencies, with the exception of a few of so called "safe haven currencies", tend to depreciate and excess returns are lower. Therefore, I expect $\beta_1 < 0$.

The estimated coefficient on the interaction term β_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 ΔRI on exchange rate changes or excess returns is $\beta_1 + \beta_2\overline{nfa}$, where $\overline{nfa}$ is the average nfa.[9]

The estimated coefficient β_3 on the constituent term $nfa_{i,t}$ tells us the exchange rate impact of $nfa_{i,t}$ when $\Delta RI_t = 0$. If negative net foreign asset positions lead to currency depreciation or lower excess currency returns when $\Delta RI_t = 0$, then $\beta_3 > 0$. However, if large negative net foreign asset positions leads to investors demanding consistently higher currency risk premias when $\Delta RI_t = 0$, $\beta_3 < 0$.

Control variables

Several control variables are included to ensure that the impact of changes in risk sentiment is correctly identified. As deviations from relative/absolute/trend PPP give rise to excess currency returns according to among others Coakley and Fuertes (2001), Habib and Stracca (2012), Jorda and Taylor (2012) and Hossfeld and MacDonald (2015), relative PPP ($PPP_{i,t}$) is also included. As mentioned

[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 $se(\beta_1 + \beta_2\overline{nfa}) = \sqrt{var(\beta_1) + \overline{nfa}^2 var(\beta_2) + 2\overline{nfa}\ cov(\beta_1, \beta_2)}$

in Rossi (2013), interest rate and inflation differentials have an impact on the exchange rate. Moreover, differences in economic outlooks might also affect the potential return differences in the stock market, which could also have an impact on the exchange rate. The difference in local stock market performance versus the US ($\Delta stock_{i,t} - \Delta S\&P$), inflation differentials ($\pi_{i,t} - \pi_{US,t}$) and 3 month interbank rate differentials ($i_{i,t} - i_{US,t}$) (or $fd_{i,t}$) are therefore included to control for yield differentials. To account for carry trade reversals, an interaction term between the interest differential and risk intolerance (here proxied by VIX), $(i_{i,t} - i_{US,t}) * VIX_t$, is also included like in Habib and Stracca (2012). Finally, log changes in central bank currency reserves ($\Delta Res_{i,t}$) are included to capture central bank currency interventions. As the exchange rate might have an effect on inflation, interest rates and stock markets, lags of all the control variables are used instead of the contemporaneous values to avoid possible simultaneity issues.[10]

3.2 Different types of foreign capital

3.2.1 Net total foreign debt and net total foreign equity

As explained above, not all types of foreign capital flows are procyclical and equally influenced by the global risk sentiment. To distinguish between the impact of different types of net foreign assets on the exchange rate change and excess returns, the variable nfa is split into 3 components; net total debt[11] ($nTotDebt$), net total equity[12] ($nTotEquity$) and foreign reserve assets (res). Net total debt and net total equity are the variables of interest and the change in central bank currency reserves, ΔRes, is included as a control variable in x. The empirical model for the exchange rate impact is presented below. The same model is also used to study the impact of different types of net foreign assets and risk intolerance on excess returns (rx).

$$\begin{aligned}\Delta s_{i,t} = \beta_1 \Delta RI_t + \beta_2 (nTotDebt_{i,t} \Delta RI_t) + \beta_3 (nTotEquity_{i,t} \Delta RI_t) \\ + \beta_4 nTotDebt_{i,t} + \beta_5 nTotEquity_{i,t} + \delta x_{i,t-1} + \gamma_i + \varepsilon_{i,t}\end{aligned} \quad (9)$$

Currencies with negative net foreign debt assets are expected to be most affected by the global financial business cycle, as foreign banks often repatriate their capital during times of low risk tolerance, whereas equity investors are dis-

[10] As inflation and the stock market returns are forward looking variables, it might be that current values of these are correlated with future nfa. To ensure that the results are not driven by inflation, stock market or interest rate expectations, for robustness further lags of these are also included in the model.

[11] Total debt assets include portfolio debt, FDI debt and other debt such as bank loans and deposits, other loans, trade credits and other accounts payable and receivable.

[12] Total equity assets include Portfolio equity, FDI equity and other equity.

couraged to sell their assets due to the depressed equity prices. The estimated coefficient on the interaction term including net total foreign debt is therefore expected to be positive, i.e. $\beta_2 > 0$. Moreover, I also expect β_2 to be larger in magnitude than β_3, as I expect net foreign equity liabilities to have a much smaller destabilizing exchange rate impact. The β_1 is again expected to be negative. The total effect of a change in global risk intolerance RI, as proxied either by VIX or TED, is thus $\beta_1 + \beta_2 \overline{nTotDebt} + \beta_3 \overline{nTotEquity}$, where the bar denotes the averages of the series. β_4 and β_5 tell us the impact of $nTotDebt_{i,t}$ and $nTotEquity_{i,t}$ on $\Delta s_{i,t}$ when RI is unchanged.

3.2.2 Portfolio debt and equity

There are also substantial differences between different types of debts and equity. Equity related to FDI is likely to be done by investors with longer term investment horizons and could therefore be less influenced by the business cycle than portfolio equity. Also, portfolio debt issued by banks might also be more sensitive to business cycle fluctuations than trade credits. The net total debt and net total equity are therefore split into 4 components; net portfolio equity ($nPEquity$), net portfolio debt ($nPDebt$), net FDI ($nFDI$) and net "other" investment ($nOther$). The variables $nPDebt$, $nPEquity$, $nOther$ and $nFDI$ and their interaction with ΔRI are our variables of interest. The model allowing for a differential impact on exchange rate changes Δs (or excess returns rx) of the different assets is:

$$\begin{aligned} \Delta s_{i,t} &= \beta_1 \Delta RI_t + \beta_2 (nPDebt_{i,t} \Delta RI_t) + \beta_3 (nPEquity_{i,t} \Delta RI_t) \\ &+ \beta_4 (nFDI_{i,t} \Delta RI_t) + \beta_5 (nOther_{i,t} \Delta RI_t) + \beta_6 nPDebt_{i,t} \\ &+ \beta_7 nPEquity_{i,t} + \beta_8 nFDI_{i,t} + \beta_9 nOther_{i,t} + \delta x_{i,t-1} + \gamma_i + \varepsilon_{i,t} \end{aligned} \tag{10}$$

The total impact of a change in RI_t on $\Delta s_{i,t}$ is $\beta_1 + \beta_2 \overline{nPDebt} + \beta_3 \overline{nPEquity} + \beta_4 \overline{nFDI} + \beta_5 \overline{nOther}$, where the bars again signify averages. If portfolio debt is more highly affected by the risk bearing capacity of the financial market than portfolio equity and FDI, then the exchange rate of a country with larger net debt would react more strongly to a change in financial market risk intolerance. Therefore, the estimated β_2 on the interaction term including $nPDebt$ should be much larger than β_3 with $nPEquity$ and β_4 with $nFDI$. The category "other investment" includes a large share of bank loans. As new bank loans are highly influenced by banking sector risk tolerance, the estimated coefficient on the interaction term including $nOther$, β_5, is also expected to be positive and larger than β_3 and β_4.

3.2.3 Public and private net foreign debt

The net foreign assets consist of both private and public foreign assets and liabilities. The foreign creditors financing public and private debt are also likely to differ, both in their risk tolerance and investment horizon. 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 global risk intolerance. This, would in turn mean that the exchange rate would also be less affected by sudden financial market turbulence. Alfaro et al. (2014) also note that net public debt flows (sovereign-to-sovereign flows) are negatively correlated with growth in developing countries, whereas the correlation between net private capital inflows and growth is instead positive. As the different sources and recipients of external financing are heterogeneously related to the real economy, it could be that the exchange rate response is also affected by the ownership structure of the net foreign asset position. The exchange rate impact of the size of private ($PRIV$) and general government ($GOVT$) net foreign assets, net total debt, net portfolio debt and net other investments on the exchange rate is therefore considered separately as well. Finally as financial institutions might have different investment objectives than households and other corporations, the private net foreign assets are also separated into net foreign assets held by deposit taking financial institutions, $BANK$, and non-bank sectors (including households), $OSECT$.

3.2.4 Emerging markets versus G10 currencies

Bluedorn et al. (2013) note that net capital flows have been roughly equally volatile for emerging market and advanced economies since 1980. Emerging Market investments, both debt, equity and other investments, are however generally perceived as being riskier than investments in most of the advanced economies. The higher risk of emerging market investments compared to similar investments in the G10 currency countries[13] might attract a different foreign investor base and at the same time excludes some low risk investors that generally are less leveraged. Moreover, Bluedorn et al. (2013) note that net capital flows to emerging markets are driven primarily by foreign investors, whereas in advanced economies the net flows are driven by both foreign and domestic financiers. If the international investor base in the emerging markets is very different from the one in advanced economies, more leveraged or affected by the global financial business cycle, this might lead to larger international capital flows in response to higher risk intolerance. This, would in turn mean that

[13]The G10 currency countries are Australia (AUD), Canada (CAD), Eurozone (EUR), Japan (JPY), New Zealand (NZD), Norway (NOK), Sweden (SEK), Switzerland (CHF), UK (GBP) and USA (USD).

the exchange rates of the emerging markets would be more affected by sudden financial market turbulence. The sample is therefore split into a G10 currency and an Emerging Market currency sample as well.

3.2.5 An evolving relationship

It is possible that the relationship between imbalances, risk-bearing capacity and exchange rates has changed over time for several reasons. First, financial innovation has led to a wider range of financial products, which allows for different investment (and hedging) opportunities, which could have an effect on the above mentioned relationship. Second, changes in financial openness, financial reforms and financial integration has also altered the characteristics of the capital flows between countries. Third, changes in banking regulations (both global and domestic) after the recent financial crisis has also changed the amount and type of risk taking allowed by financial institutions. Finally, the global role of the emerging market economies has evolved over time, which could have had impacted the international capital flow dynamics. Also, it might be that the impact of financial market uncertainty was stronger during the financial crisis than in normal times due to additional negative spill over effects. I therefore investigate whether these dynamics have changed over time, and in particular during and after the financial crisis. The sample is therefore split into a pre financial crisis sample (1/1997–3/2007), a financial crisis sample (4/2007–12/2009) and a post-crisis sample (1/2010–6/2016).

4 Data

The analysis is done using monthly data for an unbalanced panel of 26 advanced (G10) and Emerging Market (EM) currencies over the period 1/1997 to 6/2016. The included countries and currencies are listed in Appendix A. Bilateral (end of period) exchange rates and 1 month forward rates against the USD are downloaded from Bloomberg. The included currencies are freely floating or at least subject to a managed float for most of the sample period. The observations for currencies which were temporarily subject to exchange rate pegs or strict capital controls, such as the 1.20 floor on EUR/CHF during 2011-2014, are excluded. The INR is excluded from 1/2014 onward due to the strict capital controls implemented by the Indian government since then. EUR is included from 1/1999 onwards. The excess returns rx are computed as outlined in 3 and the cross-sectional averages for both Δs and rx are presented in Figure 1. The correlation between Δs and rx in the sample is 0.66.

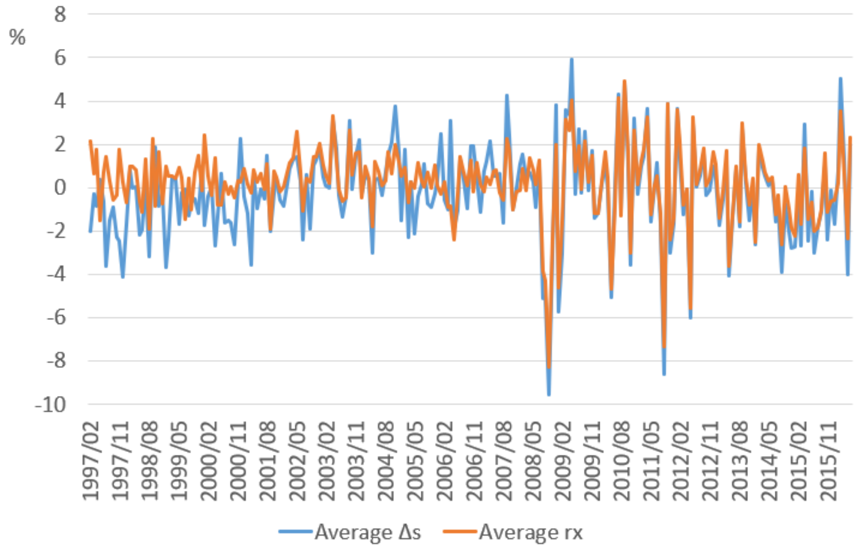

Figure 1: Average Δs and rx

External assets and liabilities

Data on total external assets and liabilities, FDI, external portfolio debt assets and liabilities and the subcomponents are collected from IMF's Balance of Payments and International Investment Position Statistics (BoP-IIP, 2016). As these data are only available at a quarterly frequency, the last known value is used until the data is updated next quarter. External assets is the USD value of the assets a country owns abroad, and external or foreign liabilities refers to the USD value of domestic assets owned by foreigners. Net foreign assets (nfa) is the difference between external assets and liabilities relative to GDP. Net total debt ($nTotDebt$), net total equity ($nTotEquity$), net portfolio debt ($nPDebt$), net portfolio equity ($nPEquity$), net FDI assets ($nFDI$) and net other investments ($nOther$) are defined in a similar manner and depicted in Figures 2 and 3. Net Total Debt consists of Portfolio investment: Debt securities, Direct investment: Debt instruments and Other investment: Currency and deposits, loans, Other accounts receivable, Trade credits and advances. Net Total Equity is in turn made up of portfolio investment: Equity and investment fund shares, Direct investment: Equity and investment fund shares, and Other investment: Other equity. Data for the holders of foreign liabilities and assets are also available for many of the countries in the sample. The underlying net foreign asset positions can therefore be split into net foreign assets or investments held either by the private sector (nfa^{PRIV}) or the general government (nfa^{GOVT}). The privately held net assets are in turn made up of assets and liabilities held by deposit taking corporations, labeled $BANK$, and other sectors, $OSECT$, which includes nonfinancial corporations, households, other financial corporations and other sectors. The private net foreign position is created by subtracting the private foreign liabilities from the private foreign assets, and the same applies to the other ownership positions.

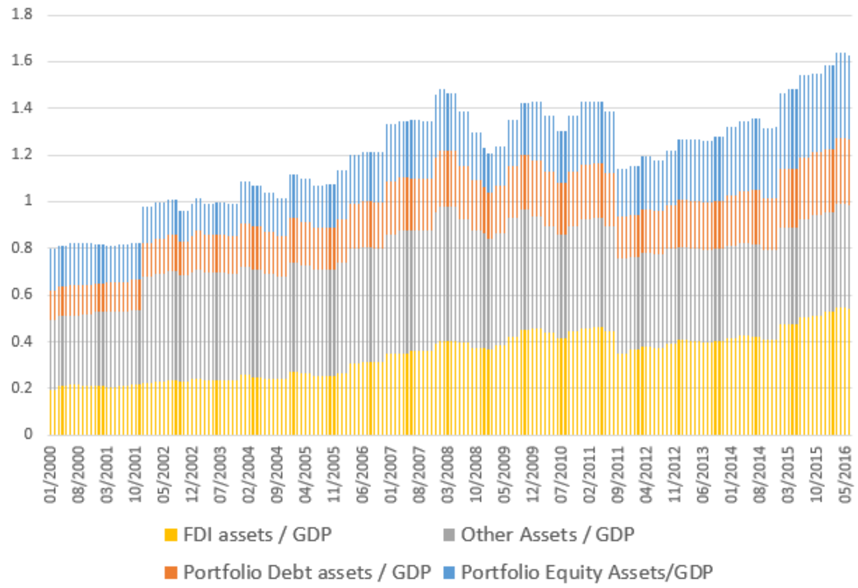

Figure 2: Different types of foreign assets in the sample

Risk intolerance

This paper uses two different proxies for global financial sector risk intolerance, the VIX index and the TED spread. The volatility index VIX of the Chicago Board Options Exchange (CBOE) is a commonly used measure of financial sector risk, which measures the implied volatility of S&P 500 index options. Several papers have found that the VIX is closely related to different types of financial market risk and risk intolerance (Collin-Dufresn et al., 2001). A surge in the VIX index ($\Delta VIX > 0$) implies higher financial market volatility and typically higher market uncertainty and risk intolerance. The TED spread is generally used as a measure of the banking sector risk intolerance. The TED spread is the difference between the 3 month interest rates on interbank loans (LIBOR) and short-term government debt (T-bills). The TED spread can be seen as an indicator of credit or banking sector risk, as the short-term government debt can be considered risk free, whereas the interbank rate reflects the credit risk of borrowing to banks. An surge in the TED spread ($\Delta TED > 0$)

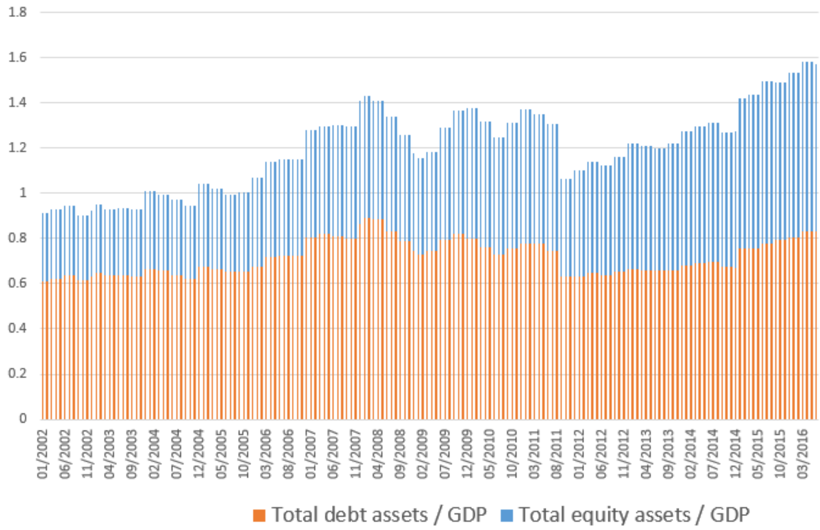

Figure 3: Total foreign debt vs. total foreign equity in the sample

signals increased interbank default risks, which implies that the banking sector risk bearing capacity is lower and risk intolerance is higher. This paper uses a weighted TED spread which combines the TED spreads of the US, UK, the Eurozone (Germany), Canada, Switzerland and Japan. The contribution of each country to the weighted TED spread is determined by their relative GDP. Data for the TED spreads and the VIX index are downloaded from Bloomberg. To make the VIX and TED series comparable, they are normalized to have a mean of 0 and a standard deviation of 1.

Control variables

As for the control variables, 3 month interbank interest rates and 1 year swap rates, inflation (CPI), output (GDP), PPP and stock market data are downloaded from Bloomberg. The interest rate differential is the 3 month interbank rate difference[14] between the foreign country and the US. The 1 year swap rate difference is used for robustness. The stock market differential captures the monthly differences between the main stock market index of the foreign country versus the US, and the inflation differential is the difference between foreign and US CPI.[15] The change in foreign currency reserves is defined as the change in foreign reserve assets relative to GDP.

[14]For Chile the 1 year swap rate difference is used instead of the interbank rate difference.

[15]To ensure that the results are not driven by a correlation with nfa and future inflation or stock market returns, as these might be forward looking, in the robustness check the models are also estimated with 4 month lags of the inflation and stock market return differentials.

5 Results

The results from models (7) - (10), which regress exchange rate changes or excess currency returns on net foreign assets, changes in risk intolerance and the interaction of these two are presented below. The models are estimated both without and with control variables[16] for the full sample, and for the subsamples of G10 and Emerging Market (EM) currencies. As it is possible that the impact of external assets and liabilities has changed over time due to either changes in financial market integration or regulation, or because the relationship might have been different during the great financial crisis, the sample is also split into three subperiods, one before the financial crisis, 1/1997–3/2007, a crisis period 4/2007–12/2009 and one after the financial crisis, 1/2010–6/2016.

5.1 Net foreign assets

First, the results from models (7) and (8) that look at the impact of total nfa on the exchange rate or excess returns are presented below. As can be seen from Table 1, the coefficients on the change in global risk intolerance ΔRI, as proxied either by an increase in financial market volatility, ΔVIX, or banking sector uncertainty, ΔTED, and on the interaction terms of nfa and a change in risk intolerance, are significant and of the expected sign. The negative estimated coefficient on ΔRI, $\hat{\beta}_1$, implies that an increase in RI leads to a significant currency depreciation against the USD (as $\Delta s < 0$ imply foreign currency depreciation) and a reduction in currency excess returns rx in countries with zero net foreign assets.[17] When the sample is split into G10 and EM currencies, the same conclusion can be drawn and the Chow tests[18] does not reject the null hypothesis of no structural differences between the two subsamples.

The interaction effect of a change in risk intolerance, as measured either by ΔVIX or ΔTED, and nfa on both Δs and rx is significant in both the full, crisis and the post-crisis sample, and the coefficient on the interaction term is positive. The positive coefficients imply that countries with negative net foreign assets ($nfa < 0$) pay lower excess currency returns and depreciate in case of a sudden worsening of the financial market sentiment (ΔVIX or $\Delta TED > 0$). Countries with a positive net foreign asset position, on the other

[16]For the sake of space the control variables are not presented in the tables included in the text. The full tables with the control variables for a selection of the models can be found in the appendix.

[17]A lagged dependent variable was initially included in the models, but as it was in most cases close to zero and rarely significant, and the panel Durbin Watson test indicates the absence of serial correlation, it was excluded. When lags of the interaction terms are added to the models, the sign of the estimated coefficients on lagged interaction variables are in most cases positive but insignificant.

[18]The Chow test for structural stability tests whether the true coefficients of the linear regressions on different datasets are identical.

hand, experience a much smaller currency depreciation (if at all any) and pay relatively higher excess currency returns when risk intolerance increase.[19]

The total estimated impact on Δs or rx of a change in RI is $\hat{\beta}_1 + \hat{\beta}_2 \overline{nfa}$. As an illustration, the results in column (ii) suggest that a one standard deviation increase in the VIX volatility index would depreciate currencies with no net foreign assets by 1.44 % against the USD. However, countries with negative net foreign assets will experience a much larger depreciation. For example Mexico, which has an average negative nfa among the net debtor countries, would depreciate by an additional 0.27 %-points against USD, so in total by 1.7 %. The exchange rate impact of the increase in VIX is thus almost 20 % larger for the MXN than for a country with zero net foreign assets. The effect on a net creditor currency like the Swiss franc, CHF, is the opposite. Due to its positive net foreign asset, the effect of a one standard deviation increase in the VIX index is much smaller and results in CHF depreciating by only 0.48 % against the USD. The total impact of a change in risk intolerance on the dependent variable, Avg. ΔRI impact, for the average nfa position is also reported in the tables. As the average nfa position in the sample is rather small (and globally it should be zero), the average ΔRI impact is however fairly close to the estimated impact of ΔRI for when $nfa = 0$.

The estimated interaction coefficients including ΔTED are all much smaller in magnitude compared to the ones including ΔVIX for the full sample, and the average impact of a change in VIX is in most cases twice as large compared to the same change in TED. The $\bar{R}^2$ is also substantially higher for the models using VIX to proxy risk intolerance as compared to the ones using TED. It thus seems like in the full sample between 1997-2016, the main channel through which large external debt positions affect the exchange rate or excess returns is via the change in financial market volatility and the uncertainty resulting from that, rather than via banking sector uncertainty. The same conclusion holds for the G10 and EM subsamples, presented in the lower panel of Table 1.

However, when the sample period is split into pre-, crisis and post-crisis periods in Table 2, this changes, and the Chow test points to structural instabilities in the relationship. After the financial crisis, the change in the TED spread seems to have a much larger exchange rate impact than before the crisis, and of similar magnitude as the VIX, as both the interaction coefficient in columns (x) and (xii) are much larger than in the pre-crisis and crisis models, and the $\bar{R}^2$

[19]Proposition 7 in GM (2015) states that low risk bearing capacity in period 0 implies that the required expected currency returns must be higher for the financiers to be willing to undertake the investment. Lags of the change in the risk intolerance are used to test whether a drop in the risk bearing capacity in the previous period leads to higher excess currency returns. The results are however insignificant and not reported here.

is also higher.[20] Thus, the impact of banking sector risk for the exchange rate vulnerability seems to have increased since the financial crisis. These results thus imply that a policy maker concerned about exchange rate volatility should be more alert when the private net foreign liabilities are large. Also, as the impact of the banking sector uncertainty has become stronger in the past years, this also warrants more attention now than 20 years ago.

The net foreign assets are finally split into private (nfa^{PRIV}) and general government holdings (nfa^{GOVT}), with the results for the full and the post-crisis sample presented in Table 3. The coefficients for the full and the post-crisis estimates are not significantly different from each other in the estimations involving ΔVIX, but the coefficients on the models including ΔTED are somewhat larger in the post-crisis period than in the full sample. The impact of private negative net foreign assets on the exchange rate sensitivity is much larger than that of negative public ones, as is suggested by the much larger and more significant coefficients on the interaction terms involving the private net external assets. Instead, negative government nfa holdings seem to ameliorate the exchange rate response to an increase in the TED spread, as suggested by the significantly negative interaction coefficient in column (*iii*) (although this is no longer the case in the post-crisis sample). When the positions are split into private net foreign assets held by the banking sector (nfa^{BANK}) and other sectors (nfa^{OSECT}), the results suggest that the effect is the largest for net foreign liabilities held by the banking sector. Thus, negative private net foreign assets seem to be the channel through which the vulnerability arises.

[20] Similar results are also obtained if the post-crisis sample starts in 2011 or 2012 after the onset and worst part of the European debt crisis.

	Full sample							
Dep. Var	Δs				rx			
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
ΔVIX	-1.520***	-1.438***			-1.602***	-1.449***		
	(0.090)	(0.086)			(0.091)	(0.087)		
ΔTED			-0.810***	-0.772***			-0.854***	-0.788***
			(0.114)	(0.116)			(0.118)	(0.119)
ΔVIX*nfa	0.882***	0.803***			0.911***	0.800***		
	(0.133)	(0.127)			(0.134)	(0.127)		
ΔTED*nfa			0.403**	0.401**			0.436**	0.421**
			(0.172)	(0.167)			(0.175)	(0.170)
nfa	0.228	-0.014	0.269	0.000	0.233	-0.017	0.274	0.006
	(0.227)	(0.235)	(0.231)	(0.242)	(0.233)	(0.240)	(0.237)	(0.247)
Avg.ΔRI impact	-1.606***	-1.516***	-0.849***	-0.810***	-1.690***	-1.527***	-0.897***	-0.829***
	(0.10)	(0.09)	(0.12)	(0.12)	(0.10)	(0.09)	(0.13)	(0.13)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
N	25	25	25	25	25	25	25	25
T	233	233	233	233	233	233	233	233
Obs	5,175	4,861	5,175	4,861	4,959	4,752	4,959	4,752
$\bar{R}^2$	0.082	0.115	0.012	0.053	0.092	0.132	0.013	0.070
DW	1.97	2.05	1.94	2.01	1.98	2.06	1.95	2.02

	G10 currencies				**EM**			
Dep. Var	Δs		rx		Δs		rx	
	(ii)	(iii)	(vi)	(vii)	(ii)	(iii)	(vi)	(vii)
ΔVIX	-1.208***		-1.209***		-1.623***		-1.647***	
	(0.134)		(0.135)		(0.106)		(0.107)	
ΔTED		-0.537***		-0.535***		-0.977***		-1.023***
		(0.167)		(0.167)		(0.158)		(0.166)
ΔVIX*nfa	1.048***		1.051***		0.517***		0.502***	
	(0.233)		(0.233)		(0.130)		(0.129)	
ΔTED*nfa		0.558*		0.557*		0.145		0.156
		(0.316)		(0.316)		(0.169)		(0.173)
nfa	-0.711*	-0.784*	-0.740*	-0.813**	0.361	0.409	0.625**	0.716**
	(0.395)	(0.406)	(0.396)	(0.406)	(0.293)	(0.300)	(0.300)	(0.308)
Avg.ΔRI impact	-1.185***	-0.525***	-1.186***	-0.523***	-1.718***	-1.003***	-1.739***	-1.052***
	(0.10)	(0.09)	(0.10)	(0.09)	(0.15)	(0.15)	(0.25)	(0.22)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	9	9	9	9	16	16	16	16
T	233	233	233	233	233	233	233	233
Obs	1,930	1,930	1,930	1,930	2,931	2,931	2,822	2,822
$\bar{R}^2$	0.093	0.047	0.096	0.049	0.136	0.065	0.162	0.091
DW	2.04	2.01	2.04	2.00	2.06	2.01	2.07	2.03
Chow	1.19	1.16	1.16	1.13	1.19	1.16	1.16	1.13

Note: White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. A constant and currency fixed effects are included. Avg. ΔRI impact=$\hat{\beta}_1 + \hat{\beta}_2 \, \overline{nfa}$, where RI is proxied either by VIX or TED. DW refers to the panel Durbin-Watson test statistic for serial correlation and Chow to the Chow test for poolability of the EM and G10 sample, with H_0 : no structural difference between the samples.

Table 1: Panel regression of models (1) and (2)

Dep. Var	Before the crisis, 1/1997–3/2007				Crisis, 4/2007–12/2009				After the crisis, 1/2010–6/2016			
	Δs		rx		Δs		rx		Δs		rx	
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)	(xi)	(xii)
ΔVIX	-0.363**		-0.372***		-2.524***		-2.551***		-1.418***		-1.432***	
	(0.142)		(0.144)		(0.247)		(0.247)		(0.119)		(0.119)	
ΔTED		-0.341**		-0.351**		-1.088***		-1.100***		-1.383***		-1.387***
		(0.141)		(0.151)		(0.213)		(0.213)		(0.348)		(0.348)
ΔVIX*nfa	1.014***		0.966***		0.843***		0.852***		0.603***		0.606***	
	(0.218)		(0.215)		(0.299)		(0.298)		(0.165)		(0.165)	
ΔTED*nfa		0.068		0.059		0.404*		0.404*		0.853		0.848
		(0.235)		(0.241)		(0.237)		(0.237)		(0.548)		(0.547)
nfa	0.859***	0.872***	0.939***	0.950***	3.082**	3.819**	3.096**	3.845**	1.247*	1.496*	1.257*	1.510*
	(0.317)	(0.316)	(0.305)	(0.304)	(1.540)	(1.589)	(1.534)	(1.584)	(0.753)	(0.781)	(0.753)	(0.781)
Avg. ΔRI	-0.46***	-0.35**	-0.50***	-0.359**	-2.587***	-1.12***	-2.61***	-1.13***	-1.46***	-1.45***	-1.48***	-1.45***
	(0.15)	(0.15)	(0.16)	(0.16)	(0.25)	(0.00)	(0.25)	(0.22)	(0.12)	(0.35)	(0.12)	(0.35)
N	25	25	25	25	25	25	25	25	25	25	25	25
T	122	122	122	122	33	33	33	33	78	78	78	78
Obs	2,174	2,174	2,065	2,065	812	812	812	812	1,875	1,875	1,875	1,875
$\bar{R}^2$	0.043	0.034	0.068	0.060	0.245	0.142	0.242	0.135	0.194	0.114	0.194	0.112
DW	2.04	2.02	2.03	2.00	2.14	2.01	2.13	2.00	2.28	2.26	2.28	2.27
Chow	9.01***	8.68***	7.67***	7.23***	9.01***	8.68***	7.67***	7.23***	9.01***	8.68***	7.67***	7.23***

Note: White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. A constant, control variables and currency fixed effects are included. Avg. ΔRI impact=$\hat{\beta}_1 + \hat{\beta}_2\ \overline{nfa}$, where RI is proxied either by VIX or TED. DW refers to the panel Durbin-Watson test statistic for serial correlation. Chow refers to the Chow test for structural stability of the parameters in the different subsamples, with H_0 : structural stability.

Table 2: Panel regression of models (1) and (2) for the different time periods

5.2 Different types of foreign capital

Net total debt and net total equity

As not all types of capital are equally affected by the business cycle, the foreign assets are first split into two components, net total debt, ($nTotDebt$) and net total equity ($nTotEquity$). This allows us to see whether net external debt, consisting of portfolio debt, bank loans and "other debt", has a different impact on the exchange rate than net foreign equity (portfolio equity, direct investment equity and "other equity"). Moreover, it tells us whether currencies with negative net foreign total debt are more sensitive to risk sentiment changes than countries with similar net foreign total equity positions. As the results for using Δs and rx as dependent variables are fairly similar and rarely significantly different from each other, only the results using Δs are presented for the sake of space. The conclusions regarding the relationship between net foreign assets, ΔRI and Δs thus also apply for the excess currency returns.

As can be seen from Tables 4 and 5, in both the full sample and in the subsamples, the estimated coefficients on the ΔRI proxies are all negative and in most cases significant. The negative coefficients on the ΔRI terms again

	Full sample 1/1997–6/2016				Post-crisis sample 1/2010–6/2016			
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
ΔVIX	-1.0649***	-0.9028***			-0.9671***	-0.7918***		
	(0.117)	(0.130)			(0.157)	(0.183)		
ΔTED			-0.8619***	-0.7249***			-0.6716	-0.3205
			(0.172)	(0.172)			(0.512)	(0.556)
ΔVIX*nfa^{PRIV}	1.6200***				1.3484***			
	(0.264)				(0.402)			
ΔVIX*nfa^{GOVT}	0.1924	0.5642*			0.2552	0.5886*		
	(0.286)	(0.307)			(0.280)	(0.325)		
ΔVIX*nfa^{OSEC}		1.4388***				1.0950**		
		(0.291)				(0.473)		
ΔVIX*nfa^{BANK}		3.3893***				3.2025***		
		(0.774)				(1.052)		
ΔTED*nfa^{PRIV}			1.0561***				2.5263**	
			(0.298)				(1.273)	
ΔTED*nfa^{GOVT}			-1.6458**	-1.2587			-0.3404	0.1451
			(0.779)	(0.879)			(0.939)	(1.048)
ΔTED*nfa^{OSEC}				1.1958***				2.2536
				(0.324)				(1.404)
ΔTED*nfa^{BANK}				1.4422				5.7234*
				(0.957)				(3.085)
N	21	21	21	21	20	20	20	20
T	233	233	233	233	78	78	78	78
Obs	3,209	3,629	3,209	3,629	1,382	1,437	1,382	1,437
$\bar{R}^2$	0.12	0.12	0.06	0.05	0.18	0.19	0.11	0.12
DW	2.09	2.08	2.04	2.04	2.26	2.27	2.23	2.26

Note: Dependent variable: Δs. White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant, constitutive terms, control variables and currency fixed effects included.

Table 3: Panel regression of model (1) for the full and post-crisis sample

imply that countries with zero net total debt and equity experience a currency depreciation against the USD when global risk intolerance increases. The interaction terms including $nTotDebt$ and the change in either VIX or the TED spread are positive and significant in almost all models (with the exception of column (*iv*) in the EM sample and (*vi*) for the pre-crisis period in Table 5). The positive and significant interaction terms imply that negative net total debt positions increase the exchange rate sensitivity to surges in risk intolerance so that the currency depreciates even further, whereas countries with positive net total debt depreciate much less or not at all. Alternatively, in case the risk sentiment improves ($\Delta RI < 0$), currencies of countries with positive net debt positions appreciate more against the USD than currencies with negative debt positions. The impact of net equity positions on the exchange rate sensitivity is small and insignificant in most cases, however for the EM currencies the results indicate that currencies of countries with net equity liabilities tend to appreciate rather than depreciate when the global risk intolerance increases.

Dep. Var:	Δs			
	(i)	(ii)	(iii)	(iv)
ΔVIX	-1.201***	-1.227***		
	(0.095)	(0.091)		
ΔTED			-0.717***	-0.729***
			(0.125)	(0.115)
ΔVIX*nTotDebt	1.368***	1.338***		
	(0.205)	(0.204)		
ΔVIX*nTotEquity	0.229			
	(0.281)			
ΔTED*nTotDebt			0.599**	0.499**
			(0.244)	(0.246)
ΔTED*nTotEquity			0.565	
			(0.459)	
Avg. ΔRI impact	-1.492	-1.492	-0.885	-0.828
N	25	25	25	25
T	233	233	233	233
Obs	4,703	4,888	4,703	4,888
$\bar{R}^2$	0.116	0.117	0.052	0.053
DW	2.07	2.05	2.03	2.01

Note: White SE in parentheses. Symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. A constant, constitutive terms, control variables and currency fixed effects are included. Avg. ΔRI impact=$\hat{\beta}_1 + \hat{\beta}_2\ \overline{nTotDebt} + \hat{\beta}_3\ \overline{nTotEquity}$.

Table 4: Panel regression of model (3) for the full sample

When the sample is split into G10 and EM currencies in Table 5, two observations can be made. First, the coefficients on both ΔVIX and ΔTED are much larger for the EM than for the G10 currencies, implying that EM countries with no net debt or equity experience much larger depreciations against the USD than the G10 currencies. The average impact of a change in risk intolerance on the exchange rate is moreover significantly larger for the EM than for the G10 currencies, even though the interaction term on total debt and risk intolerance is smaller. This suggests that the EM currencies are much more vulnerable to changes in the global risk sentiment than the G10 currencies, regardless of their net foreign debt or equity positions.

When the sample is divided into a pre-crisis, crisis and a post-crisis sample to see whether the relationship between Δs, ΔRI and $nTotDebt$ has stayed constant over time, the Chow test again suggest that there are structural differences between the samples. As can be seen from columns (v) to (x) in Table 5, the impact of changes in VIX has been fairly constant over the full currency sample, which raises suspicions that the significant Chow statistic is driven by some large residuals during the crisis period. The impact of banking sector uncertainty, TED, is however much larger after the crisis. The interaction effect between net total debt and the TED spread is much stronger in the post-crisis sample, which suggests a tighter relationship between the banking sector and foreign exchange markets now than during the beginning of this millennium. My results thus suggest that the interaction between net total debt and banking sector risk intolerance has a much larger impact on the exchange rate since the financial crisis. The substantially higher $\bar{R}^2$ also confirm that the factors included in the models explain a larger share of the variation in Δs since the credit crisis.

The total exchange rate or excess return impact of a change in risk intolerance, RI, is $\hat{\beta}_1 + \hat{\beta}_2\ \overline{nTotDebt} + \hat{\beta}_3\ \overline{nTotEquity}$. As the average net debt and net equity position in the sample are rather small (as the sample consists of both net debtor and net creditors), the average total impact of a change in risk intolerance is fairly close to the impact for $nTotDebt$ and $nTotEquity$=0. Figure 4 therefore illustrates how the different currencies in the sample respond to changes VIX and TED. According to the figure, reactions between the different currencies vary substantially. An increase in the VIX index or the TED spread causes the CHF to appreciate against the USD, whereas the HUF, NZD and TRY depreciate the most due to their countries' large negative net debt positions. Again can be seen that the impact of the banking sector risk intolerance, the TED spread, has a much smaller impact on the exchange rate and excess returns than a change in the VIX index.

When the net total debt positions are split into private and public holdings Table 6, the results suggest that private net total debt increases the exchange rate sensitivity to the VIX index more than two times more than private net total debt in both the full and the post-crisis period. The estimates including VIX are not significantly different in the full and post-crisis sample, but the

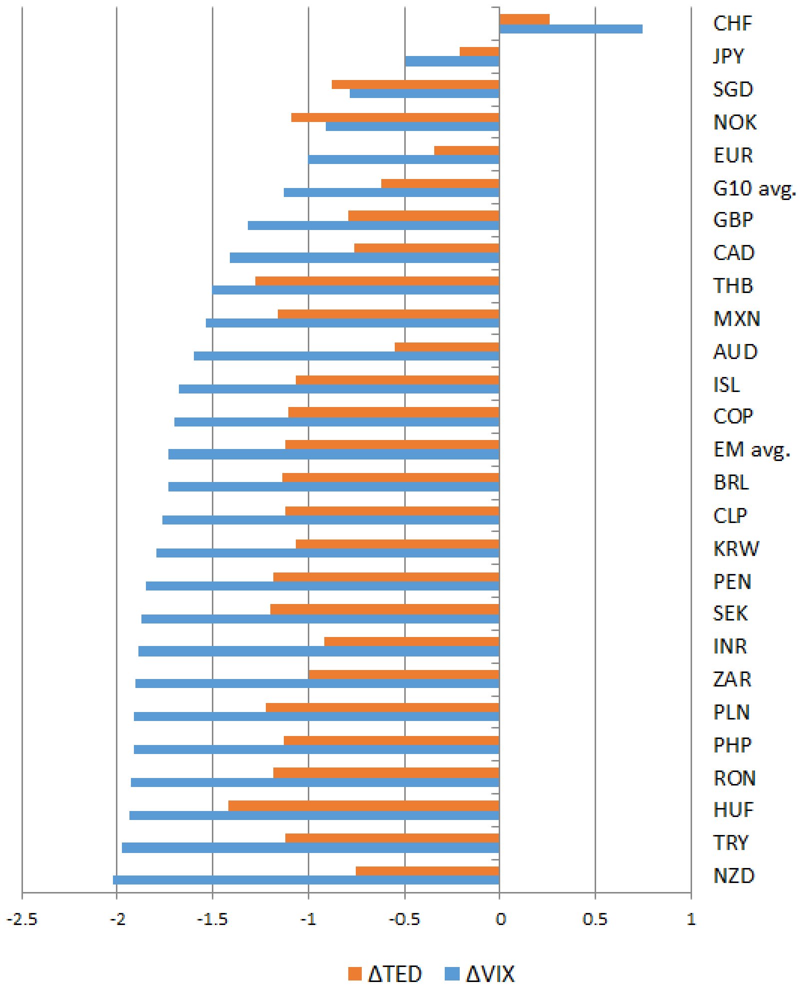

Figure 4: Total effect of ΔRI taking the impact of nTotDebt and nTotEquity into account

	G10 currencies		Emerging Markets		Before the crisis, 1/1997–3/2007		Crisis, 4/2007–12/2009		After the crisis, 1/2010–6/2016	
	1/1997–6/2016									
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)
ΔVIX	-0.786***		-1.849***		-0.107		-2.414***		-1.152***	
	(0.159)		(0.200)		(0.150)		(0.277)		(0.131)	
ΔTED		-0.314*		-0.905***		-0.352**		-1.036***		-0.958**
		(0.185)		(0.287)		(0.151)		(0.227)		(0.405)
ΔVIX*nTotDebt	1.554***		1.083***		1.203***		1.290***		1.262***	
	(0.309)		(0.267)		(0.253)		(0.468)		(0.310)	
ΔVIX*nTotEquity	-0.114		-1.466**		0.877		-0.120		-0.050	
	(0.400)		(0.719)		(0.626)		(0.908)		(0.324)	
ΔTED*nTotDebt		0.611*		0.270		-0.048		0.700*		2.061**
		(0.336)		(0.355)		(0.291)		(0.380)		(1.001)
ΔTED*nTotEquity		-1.345		0.715		1.168*		0.065		-0.292
		(0.882)		(0.930)		(0.620)		(0.719)		(1.037)
Avg. ΔRI impact	-1.132	-0.616	-1.732	-1.119	-0.404	-0.447	-2.610	-1.155	-1.465	-1.456
N	9	9	16	16	24	24	24	24	25	25
T	233	233	231	231	122	122	33	33	78	78
Obs	1,930	1,930	2,773	2,773	2,064	2,064	779	779	1,860	1,860
$\bar{R}^2$	0.100	0.049	0.139	0.066	0.044	0.039	0.237	0.133	0.195	0.113
DW	2.05	2.01	2.09	2.04	2.09	2.06	2.15	2.02	2.27	2.27
Chow	1.38*	1.28	1.38*	1.28	8.59***	8.33***	8.59***	8.33***	8.59***	8.33***

Note: Dependent variable: Δs. White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant, constitutive terms, control variables and currency fixed effects included. Avg. ΔRI impact$=\hat{\beta}_1 + \hat{\beta}_2\ \overline{nTotDebt} + \hat{\beta}_3\ \overline{nTotEquity}$, where RI is proxied either by VIX or TED. DW refers to the panel Durbin-Watson test statistic for serial correlation. Chow refers to the Chow test for structural stability of the parameters in the different subsamples, with H_0 : structural stability.

Table 5: Panel regression of model (3) for the different currency samples and time periods

TED estimates in column (x) are somewhat larger. The results in column (v) indicate that only private net debt makes the exchange rate respond stronger to a change in banking sector risk bearing capacity, although the reaction is much smaller than compared to the change in VIX. When the net private debt is split into banking sector holdings and non-bank holdings, the interaction between non-bank holdings and the VIX seem to move the exchange rate the most.

My findings that large debt liabilities increase the exchange rate sensitivity to financial market risk intolerance are in line with Gabaix's and Maggiori's (2015) exchange rate theory, which hypothesizes that currencies of net debtor countries depreciate in case of a sudden deterioration in the market sentiment. They posit that the main channel which this effect operates through is the balance sheet channel of banks. If there is a deterioration in the bank's risk bearing capacity, this leads the bank to reprice their currency lending which in turn affects both capital flows and the exchange rate. If that was the case here, one would expect especially the coefficient on the interaction between ΔTED and nfa to be positive and significant, and of much larger magnitude than the coefficients on the terms including VIX. Although the coefficient was mostly significant and positive as expected, it is only in the post-crisis period that TED has had a larger impact on the exchange rate vulnerability than VIX. Also, in all the models that use the TED spread as the measure of risk intolerance produced substantially smaller $\bar{R}^2$'s than the same models that use VIX instead. This would suggest that it is not only the banking sector risk bearing capacity that plays a role, but also the risk bearing capacity of other financial market players. My finding that the influence of ΔTED has become stronger after the financial crisis however gives support to Gabaix and Maggiori's (2015) theory that the exchange rate vulnerability originates from changes in the international financial sector risk bearing capacity.

	Full sample 1/1997–6/2016						Post-crisis sample 1/2010–6/2016			
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)
ΔVIX	-0.897***	-1.052***	-1.285***				-0.697***	-1.149***		
	(0.164)	(0.197)	(0.123)				(0.187)	(0.164)		
ΔTED				-1.112***	-1.325***	-0.909***			-0.565	-0.829*
				(0.279)	(0.306)	(0.173)			(0.693)	(0.474)
ΔVIX*nTotDebt^{PRIV}	3.203***						3.078***			
	(0.618)						(0.756)			
ΔVIX*nTotDebt^{GOVT}	1.336*	1.206*					1.466**			
	(0.692)	(0.692)					(0.719)			
ΔVIX*nTotDebt^{OSEC}		5.295***	4.417***					4.139***		
		(1.253)	(0.978)					(1.379)		
ΔVIX*nTotDebt^{BANK}		2.228**	2.199***					2.074**		
		(0.895)	(0.762)					(1.010)		
ΔTED*nTotDebt^{PRIV}				1.747*						
				(0.948)						
ΔTED*nTotDebt^{GOVT}				-1.677	-1.331				0.392	
				(1.651)	(1.660)				(2.190)	
ΔTED*nTotDebt^{OSEC}					5.568***	1.748			6.412	8.682**
					(1.888)	(1.348)			(4.805)	(4.196)
ΔTED*nTotDebt^{BANK}					0.041	1.022			4.653	4.308
					(1.244)	(0.959)			(3.228)	(2.866)
Avg. ΔRI impact	-0.90	-1.05	-1.28	-1.11	-1.32	-0.91	-0.70	-1.15	-0.57	-0.83
N	12	12	19	12	12	19	12	19	12	19
T	233	233	233	233	233	233	78	78	78	78
Obs	1,690	1,690	3,250	1,690	1,690	3,250	867	1,405	867	1,405
$\bar{R}^2$	0.143	0.143	0.129	0.080	0.081	0.061	0.190	0.199	0.114	0.122
DW	2.11	2.11	2.07	2.07	2.07	2.03	2.23	2.27	2.23	2.26

Note: Dependent variable: Δs. White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant, constitutive terms, control variables and currency fixed effects included. Avg. ΔRI impact=$\hat{\beta}_1 + \hat{\beta}_2\ \overline{nTotDebt} + \hat{\beta}_3\ \overline{nTotEquity}$, where RI is proxied either by VIX or TED.

Table 6: Panel regression of model (3) for the full and post-crisis sample

Net portfolio debt and equity, net FDI and net Other investment

The net foreign assets are eventually split into four different components, net portfolio debt ($nPDebt$), net portfolio equity ($nPEquity$), net portfolio FDI ($nFDI$) and net other investment ($nOther$), where the "other investments" include among other items bank loans and trade credits. As can be seen from the results in Table 7, the positive interaction coefficients on $nPDebt$ and $nOther$ suggest that negative net foreign portfolio debt and negative net foreign other investments lead to a significantly larger currency depreciation during times of financial turbulence than countries with positive net positions in the full sample. The less cyclical net external portfolio equity holdings seems to insulate the exchange rate from an increase in financial market risk aversion, as suggested by the negative coefficients on the interaction terms including $nPEquity$ and VIX in columns (i) and (ii). These results imply that currencies of countries with large negative portfolio debt holdings and negative net other investments (which consists to a large extent of bank loans) are the most vulnerable to a sudden worsening in the global financial market risk sentiment. Currencies of countries that have the same amount of outstanding external liabilities in portfolio equity are however not affected by swings in the market sentiment to the same extent. Thus, negative net external portfolio debt increases the exchange rate vulnerability to financial market volatility, whereas external portfolio equity reduces this impact somewhat. As a large share of the portfolio debt inflow is intermediated via foreign banks whose risk bearing capacity decreases during times of financial uncertainty, an increase in risk intolerance translates into larger currency depreciation for countries with large portfolio debt liabilities and bank loans. The result that changes in banking sector risk, as measured by ΔTED gives support to this hypothesis. However, as the exchange rate impact of ΔTED is again much smaller than ΔVIX, this suggests that it is not only the banking sector risk that matter for the exchange rate sensitivity to global risk aversion, but that risk intolerance of other financial market players matter as well.

The sensitivity of the currencies in the sample to changes in global financial market risk intolerance are illustrated in Figure 5. Again, the CHF is associated with only a tiny exchange rate depreciation (appreciation) in case of a sudden increase (decrease) in RI, whereas the reaction of the NZD, HUF and CLP to changes in VIX is over 50 % larger than for the average currency in the sample. The impact of a change in banking sector risk intolerance, as measured by ΔTED, on the exchange rate is much smaller than for ΔVIX, and moreover less significant, especially when the sample is split into subsamples or subperiods in Table 8.

When I look at how the relationship between different types of net foreign assets, global risk intolerance and exchange rates has changed over time (Table 8), I again find that the impact of banking sector risk bearing capacity, TED, has become stronger after the financial crisis, although it is only significant at the 10 % significance level. There is also some weak evidence pointing to negative net foreign portfolio equity reducing the exchange rate sensitivity to swings in global risk tolerance. The significantly higher $\bar{R}^2$ after the crisis also point to global risk intolerance and external imbalances playing a much bigger role for both exchange rate movements and excess currency returns. As the Chow test indicates structural instability in the series over time, more weight should be given to the post-crisis results.

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
ΔVIX	-1.089***	-1.188***	-1.279***	-1.456***				
	(0.127)	(0.123)	(0.117)	(0.087)				
ΔTED					-0.562***	-0.667***	-0.846***	-0.698***
					(0.165)	(0.147)	(0.116)	(0.146)
ΔVIX*nPDebt	1.139***	1.184***	1.081***	1.183***				
	(0.237)	(0.232)	(0.219)	(0.216)				
ΔVIX*nPEquity	-0.631*	-0.939***						
	(0.372)	(0.320)						
ΔVIX*nFDI	0.687							
	(0.427)							
ΔVIX*nOther	3.112***	1.995***	1.703**					
	(1.060)	(0.735)	(0.717)					
ΔTED*nPDebt					0.083	0.345	0.494*	
					(0.287)	(0.281)	(0.275)	
ΔTED*nPEquity					-0.222			
					(0.668)			
ΔTED*nFDI					1.006*			
					(0.549)			
ΔTED*nOther					2.638*	1.593*		0.906
					(1.464)	(0.875)		(0.964)
Avg. ΔRI impact	-1.58	-1.48	-1.52	-1.50	-0.99	-0.87	-0.86	-0.81
N	23	24	25	25	23	25	25	25
T	233	233	233	233	233	233	233	233
Obs	4,414	4,640	4,814	4,814	4,414	4,814	4,814	4,888
$\bar{R}^2$	0.118	0.113	0.115	0.114	0.054	0.053	0.052	0.052
DW	2.07	2.07	2.06	2.06	2.03	2.02	2.02	2.01

Note: Dependent variable Δs. White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant, constituent terms, controls and currency fixed effects included. Avg. ΔRI impact$=\hat{\beta}_1 + \hat{\beta}_2\ \overline{nPDebt} + \hat{\beta}_3\ \overline{nPEquity} + \hat{\beta}_4\ \overline{nFDI} + \hat{\beta}_5\ \overline{nOther}$, where RI is proxied either by VIX or TED.

Table 7: Panel regression of model (4) for the full sample

	G10		EM		Before the crisis, 1/1997–3/2007		Crisis, 4/2007–12/2009		After the crisis, 1/2010–6/2016	
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)
ΔVIX	-0.834***		-1.720***		-0.136		-2.590***		-1.087***	
	(0.154)		(0.213)		(0.195)		(0.357)		(0.161)	
ΔTED		-0.392**		-1.081***		-0.343*		-0.939***		-0.701
		(0.195)		(0.297)		(0.186)		(0.274)		(0.494)
ΔVIX*nPDebt	1.304***		1.596***		1.533***		1.541**		0.926***	
	(0.365)		(0.572)		(0.330)		(0.599)		(0.316)	
ΔVIX*nPEquity	-0.538		-1.523*		-0.354		-1.976*		-0.792**	
	(0.417)		(0.810)		(0.809)		(1.170)		(0.379)	
ΔVIX*nOther	4.714**		-0.373		1.744*		0.664		2.318**	
	(2.086)		(1.000)		(0.946)		(2.070)		(1.123)	
ΔTED*nPDebt		-0.045		-0.172		-0.184		0.686		1.729*
		(0.480)		(0.797)		(0.382)		(0.469)		(1.046)
ΔTED*nPEquity		-1.514*		0.715		0.071		-0.907		-2.379*
		(0.915)		(1.649)		(0.924)		(0.972)		(1.239)
ΔTED*nOther		3.560		0.039		0.696		2.395		4.674
		(3.221)		(1.158)		(0.860)		(2.015)		(3.270)
Avg. ΔRI impact	-1.15	-0.53	-1.68	-1.09	-0.42	-0.43	-2.66	-1.19	-1.43	-1.43
N	9	9	15	15	24	24	24	24	24	24
T	233	233	231	231	122	122	33	33	78	78
Obs	1,930	1,930	2,710	2,710	2,064	2,064	779	779	1,797	1,797
$\bar{R}^2$	0.104	0.055	0.132	0.065	0.044	0.035	0.235	0.130	0.186	0.109
DW	2.06	2.02	2.09	2.04	2.09	2.06	2.15	2.01	2.27	2.27
Chow	1.35*	1.37*	1.35*	1.37*	7.54***	7.04***	7.54***	7.04***	7.54***	7.04***

Dep. var: Δs. White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant, constituent terms, controls and currency fixed effects included. Avg. ΔRI impact$=\hat{\beta}_1 + \hat{\beta}_2\ \overline{nPDebt} + \hat{\beta}_3\ \overline{nPEquity} + \hat{\beta}_4\ \overline{nFDI} + \hat{\beta}_5\ \overline{nOther}$, where RI is proxied either by VIX or TED.

Table 8: Panel regression of model (4) for the different subsamples

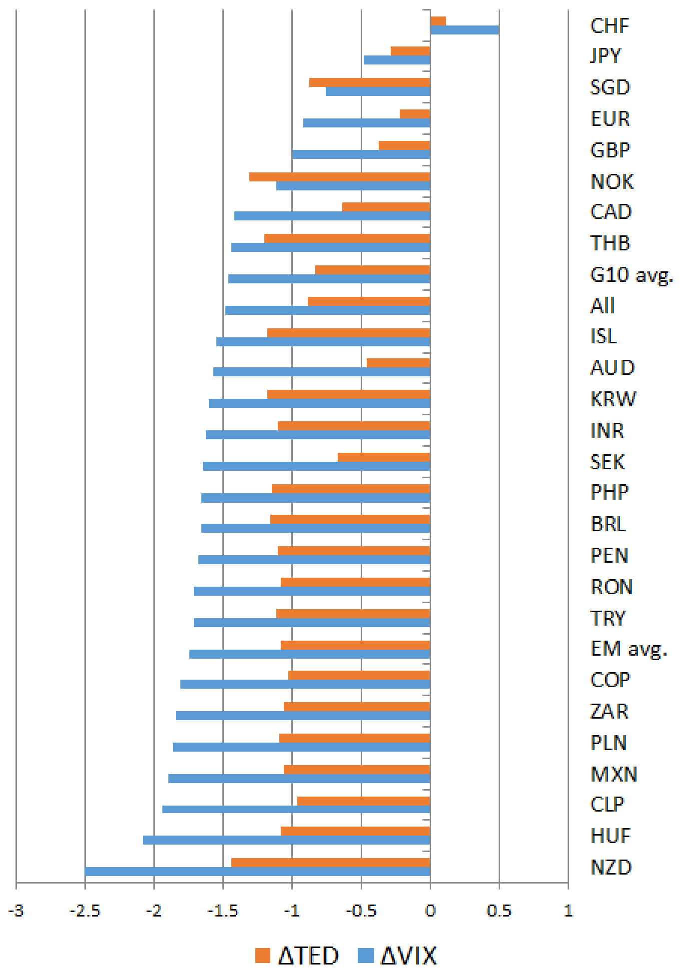

Figure 5: Total effect of ΔRI on Δs taking the impact of net portfolio debt, equity and other investments into account

5.3 Robustness

Finally, some robustness tests are conducted to confirm that the results are not driven by the choice of base currency, some underlying time trend or outliers. The results from the robustness tests are presented in Appendix C.

Base currency and endogeneity concerns

What matters from a policy maker's perspective is not necessarily currency movements against the USD, but the currency movements against the country's most important trading partners. The results of using the trade weighted currency basket as dependent variable can therefore be found in Table 12 in Appendix C. When the analysis is done using the change in the trade weighted currency basket as dependent variable instead of the currency pairs against the USD, the same conclusions as before can be drawn. The biggest difference to the main results are that the impact of ΔTED is much stronger and comparable to the impact of ΔVIX.

As the USD is used as the base currency and the VIX Index is a risk intolerance measure originating from stock options on U.S. stocks, there is the potential risk that a change in USD has an impact on the VIX. To exclude this possibility, the analysis is done with different G10 currencies and the bigger EM currencies like KRW as base currency, while excluding USD from the sample. Changes in GBP and EUR, but especially changes in smaller currencies like the SEK and KRW against all other currencies, are very unlikely to have a significant impact on the VIX or TED spread. The results for using EUR, GBP, SEK and KRW as base currency can be found in Tables 13 and 14. From there can be seen that when using different base currencies and excluding USD from the sample, the same conclusion as in the main analysis can be drawn. Therefore, it seems very unlikely that the results and conclusions are driven by the impact of USD on VIX. Finally, one could argue that a big change in USD could have an impact on VIX via JPY and CHF against other currencies, as USD, JPY and CHF all tend to move in the same direction in case of an increase in financial market turbulence due to their (perceived) 'safe haven' status. As the original conclusion also prevails even after excluding USD, JPY and CHF from the sample, this strongly suggests that the results are not driven by reverse causality. These results are not reported for the sake of space, but are available upon request.

Regarding endogeneity concerns between the net foreign asset position and exchange rate changes, I reach the same conclusion even if I condition the exchange rate response on the net foreign asset position from over a year back, i.e. if I use the asset positions lagged by 12 months.

Impact of RI instead of ΔRI

In Gabaix's and Maggiori's (2015) model, an increase in the financial sector risk intolerance leads to a depreciation of the net debtor currency against the net creditor one. It is however also possible that net debtor currencies depreciate whenever the risk bearing capacity is low (i.e. risk intolerance is high), instead of only being affected by the change in risk intolerance. The analysis is therefore repeated using the levels of VIX and the TED spread instead of changes. The results in Table 15 reveal that a higher VIX index, i.e. higher financial market uncertainty, is also associated with weaker exchange rates in negative net foreign asset countries. However, once I include both the risk sentiment level and change in the model, only the interaction terms with the net foreign assets and ΔVIX or ΔTED are significant, and the interaction terms with VIX or TED and the net foreign assets are insignificant.[21] This suggests that the baseline specification is more appropriate than the one in Table 15.

Gross foreign asset and liability positions

Forbes and Warnock (2012) show that gross foreign capital inflows can behave very differently from net foreign capital inflows during sudden capital flow stops. Although looking at the relationship between gross capital flows or gross positions and exchange rates is a fundamentally different question, I show that my conclusions based on the net positions hold also for gross positions. To see how the underlying stock of assets and liabilities affect the impact of ΔRI on Δs and rx, the net total foreign debt and equity positions in equation (9) are split into total foreign debt assets $TotDebtAs$, total foreign debt liabilities $TotDebtLiab$, total foreign equity assets $TotEquityAs$ and total foreign equity liabilities $TotEquityLiab$. In this way, we are able to disentangle the separate effects of gross foreign asset and liability stocks on the exchange rate sensitivity to risk intolerance. Fairly similar conclusions can be drawn from the results presented in Table 16 in Appendix C as from the analysis on net foreign assets. The significantly negative coefficients for the gross total debt liabilities and most of the gross total equity liabilities imply that both foreign debt and equity liabilities are associated with weaker currencies against the USD and lower excess currency returns. Total debt liabilities significantly increase the sensitivity of the foreign currency to changes in the financial market risk intolerance, as measured either by an increase in the TED spread or VIX index. Total foreign debt

[21] These results are not reported here but are available upon request.

assets on the other hand, decrease the exchange rate vulnerability to changes in RI, whereas foreign equity assets increase the exchange rate sensitivity to changes in VIX. These conclusions are thus generally supporting the claim that higher foreign debt liabilities makes the exchange rate more sensitive to changes in VIX or TED, and this negative effect is offset by holding foreign debt assets.

Time fixed effects or time trend

As both the VIX index and the weighted TED spread are global indices, the inclusion of time fixed effects is not possible as the time fixed effect and the risk intolerance measure would be linearly dependent. In order to circumvent this problem and confirm that the results are not driven by some underlying time trend, the (global) weighted TED spread, (which includes the GDP weighted average of the TED spreads for UK, EMU, Japan, Switzerland, Canada and the US) is made into country-specific foreign TED spreads. This is done by excluding the contribution of the own-country TED spread from the global average for the global weighted TED spreads for the countries that the weighted TED spread is made up of. Thereby, the weighted foreign country TED spread for the GBP, EUR, JPY, CHF, CAD and the USD are not identical to the weighted TED spreads for the rest of the currencies included in the sample. The results presented in Table 17 show that the previous conclusions hold and are robust to the inclusion of time fixed effects. The conclusions are also robust to the inclusion of currency specific time trends (not reported here), where the time trends are allowed to have a different impact on the different currency pairs.

Final robustness tests

Finally, some additional robustness checks are done.[22] To ensure that the results are not driven by extreme outliers the analysis is conducted using winzorized data.[23] The same conclusions can be drawn as in the main analysis. Also, if the covered interest rate parity (CIP) holds, then the forward discount $fd_t = f_t - s_t \approx i^{US} - i$. When I use fd as a control variable instead of the interest rate difference, my results do not change much. Moreover, as inflation and the stock market returns are forward looking variables, it might be that current values of these are correlated with future net foreign assets. To ensure that the results are not driven by inflation, stock market or interest rate expectations, further lags of these are also included in the model to confirm this. Additionally, as the

[22]These final robustness tests are not reported for the sake of space, but are available upon request.

[23]A 95 % winsorization involves computing the lowest 2.5 and 97.5 quantiles of the data, and replacing the values in these quantiles by the respective 2.5 and 97.5 cutoff values.

log change in central bank reserves are related to the actual reserves to GDP (which are included in the total nfa position but not in the decompositions into debt and equity), I also confirm that the results and conclusions do not change if I exclude ΔRes from the control variables or if I exclude the reserves from the net foreign asset position. Also, to rule out that the results are driven by omitted variable bias because I use lagged control variables, I confirm that my conclusions hold also when the contemporaneous values of the control variables are used. The conclusions are also robust to the deletion of single countries from the sample as well as to the use data on total net foreign assets, net foreign debt and net foreign equity instead of the ratios of these to the countries' GDP.

6 Conclusion

In this panel study of 25 advanced economy and emerging market currency pairs against the USD over the time period 1/1997 – 6/2016, I show that the composition of net foreign assets affects the way exchange rates and excess currency returns react to financial market uncertainty.

Gabbaix and Maggiori's (2015) exchange rate theory predicts that the exchange rates of countries with net foreign liabilities are more sensitive to reductions in financial market risk bearing capacity. I find that this is indeed the case, but more importantly, I show that different types of net foreign assets have different effects on this exchange rate vulnerability. Net foreign debt liabilities, and in particular private and portfolio debt liabilities, increase the exchange rate sensitivity to especially changes in financial market uncertainty. Net foreign equity liabilities, on the other hand, seem to ameliorate the negative exchange rate and excess currency return impact of financial market uncertainty somewhat. Due to these offsetting exchange rate effects of the different types of net foreign assets, if one only considers the impact of the total net foreign asset position, the negative impact of different external imbalances on exchange rate stability is underestimated. Thus, the exchange rates of countries with large net foreign debt liabilities depreciate much more in response to a drop in the global risk sentiment than countries with the equivalent net foreign equity position. This phenomenon can partially be explained by the observation that net debt investments are more procyclical than net equity investments, owing to both a different investor base, different degrees of risk sharing, the fact that a large share of foreign debt is issued and intermediated by international banks and the debt roll-over risk. Net FDI positions do not have any significant impact on the relationship between risk intolerance and the exchange rate, which can be explained by FDI flows being less influenced by the global financial cycle.

Another important finding of this paper is that private and public net foreign assets have different effects on the exchange rate vulnerability. The sensitivity of the exchange rate to global financial market uncertainty seems to be driven largely by private foreign investment, whereas public net foreign assets do not add to the exchange rate vulnerability to the same extent. This can be explained by the lower risk associated with government debt as compared to corporate, which makes it easier for governments to attract financing during crisis times than corporations. Moreover, private investors are often more leveraged than public ones, which suggests that the investors are more affected by both banking sector and general financial market uncertainty. I also find that emerging market currencies are overall more influenced by the global risk sentiment than the G10 currencies. The interaction effect between different types of net foreign assets and risk intolerance is nevertheless smaller for the emerging market currencies than for the G10 currencies. In this paper I only briefly look at the separate impact of gross foreign assets and liabilities, but as the foreign and domestic capital flows tend to behave differently, it would be interesting to take a closer look at the relationship between the gross asset positions and exchange rate movements in the future.

Although the currencies react to changes in global banking sector uncertainty, as measured by the TED spread, I find that the impact of global financial market risk intolerance, as proxied by the VIX index, is much larger. This suggests that not all of the impact is coming from the change in the banking sector's risk bearing capacity, but also via non-bank investors and additional channels. My results suggest that the relationship between the exchange rates, different net foreign assets and global financial market uncertainty, as measured by the VIX index, has remained fairly constant over the sample period, although the Chow test points to some structural instability in the full sample. The exchange rate impact of the TED spread, and the interaction effect with different types of net foreign assets, has nevertheless become larger and stronger after the financial crisis of 2007-2008. Currencies of countries with negative net debt respond more strongly to changes in banking sector risk now than before the credit crisis.

My findings are of importance for central banks that are worried that their exchange rates are too sensitive to the global financial business cycle, and for the evaluation of the impact of financial reforms. My results imply that a policy maker concerned about exchange rate volatility should be more alert when the net foreign private and portfolio debt liabilities are large. As the impact of the banking sector uncertainty has become stronger in the past six years, this also warrants more attention than at the beginning of the millennium. The finding that foreign debt liabilities reduce exchange rate stability whereas foreign equity liabilities even marginally supports it, weakens the justification for levying lower taxes on debt investments than on equity investments. My results suggest that policy makers could reduce the exchange rate sensitivity to fluctuations in the financial market risk sentiment by reducing their dependence on debt financing and shifting towards more equity financing. Finally, knowledge of the differential impact of net foreign debt equity on the exchange rate vulnerability is furthermore important for the countries that are currently considering reducing restrictions on foreign ownership of both equity and debt instruments.

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7 Appendix

Appendix A. List of countries, currencies and nfa variables

Australia (AUD), Brazil (BRL), Canada (CAD), Chile (CLP), Colombia (COP), Euro Area (EUR), Hungary (HUF), India (INR), Israel (ISL), Japan (JPY), Korea (KRW), Mexico (MXN), New Zealand (NZD), Norway (NOK), Peru (PEN), Philippines (PHP), Poland (PLN), Romania (RON), Singapore (SGD), South Africa (ZAR), Sweden (SEK), Switzerland (CHF), Thailand (THB), Turkey (TRY), United Kingdom (GBP), and United States (USD).

Variable	**Description**
nfa	Net foreign assets
nfa^{PRIV}	Net foreign assets held by the private sector
nfa^{GOVT}	Net foreign assets held by the government
nfa^{OSEC}	Net foreign assets held by nonfinancial corporations, households and NPISH
nfa^{BANK}	Net foreign assets held by deposit taking corporations
nTotDebt	Net total foreign debt assets
nTotEquity	Net total foreign equity assets
nToTDebt^{PRIV}	Net total foreign debt assets held by the private sector
nToTDebt^{GOVT}	Net total foreign debt assets held by the government
nToTDebt^{OSEC}	Net total foreign debt assets held by nonfinancial corporations, households and NPISH
nToTDebt^{BANK}	Net total foreign debt assets held by deposit taking corporations
nPDebt	Net foreign portfolio debt assets
nPEquity	Net foreign portfolio equity assets
nFDI	Net foreign direct investment
nOther	Net foreign other investment

Table 9: A description of the net foreign asset variables

Appendix B. Full tables for selected models

	Full sample, 1/1997–6/2016		Before the crisis, 1/1997–3/2007		Crisis, 4/2007–12/2009		After the crisis, 1/2010–6/2016	
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
Constant	0.2635	0.1326	-10.07***	-10.04***	-14.94	-20.56**	18.80***	23.93***
	(0.914)	(0.940)	(2.064)	(2.090)	(9.798)	(10.48)	(4.358)	(4.350)
ΔVIX	-1.44***		-0.3631**		-2.52***		-1.4180***	
	(0.086)		(0.142)		(0.247)		(0.119)	
ΔTED		-0.7716***		-0.3414**		-1.0879***		-1.3826***
		(0.116)		(0.141)		(0.213)		(0.348)
nfa	-0.0140	0.0001	0.8589***	0.8723***	3.0822**	3.8190**	1.2473*	1.4961*
	(0.235)	(0.242)	(0.317)	(0.316)	(1.540)	(1.589)	(0.753)	(0.781)
ΔVIX*nfa	0.8032***		1.014***		0.8426***		0.6029***	
	(0.127)		(0.218)		(0.299)		(0.165)	
ΔTED*nfa		0.4006**		0.0685		0.4041*		0.8528
		(0.167)		(0.235)		(0.237)		(0.548)
ΔRes_{-1}	3.684***	3.570***	2.673***	2.124**	0.5648	2.649	7.295***	8.518***
	(0.835)	(0.901)	(1.019)	(1.020)	(1.80)	(2.17)	(2.25)	(2.25)
$(stock - stock^{US})_{-1}$	4.983***	5.716***	3.530**	3.350**	3.304	3.866	6.104***	9.994***
	(1.15)	(1.17)	(1.68)	(1.70)	(2.37)	(2.55)	(1.86)	(1.95)
$(\pi - \pi^{US})_{-1}$	0.0386*	0.0402*	0.0456	0.0468	0.0774	0.1131*	0.0999*	0.0817
	(0.023)	(0.024)	(0.030)	(0.031)	(0.065)	(0.068)	(0.054)	(0.055)
$(i - i^{US})_{-1}$	0.1771***	0.2531***	0.1675**	0.1916***	0.1267	0.3329**	0.6498***	0.8935***
	(0.045)	(0.048)	(0.068)	(0.070)	(0.132)	(0.145)	(0.122)	(0.120)
$(i - i^{US})_{-1} * VIX_{-1}$	-0.0090***	-0.0120***	-0.0037	-0.0047*	-0.0167***	-0.0227***	-0.0258***	-0.0360***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)	(0.005)	(0.005)
PPP_{-1}	-0.195	-0.135	6.15***	6.14***	8.88*	11.85**	-9.87***	-12.48***
	(0.49)	(0.505)	(1.24)	(1.26)	(5.38)	(5.77)	(2.19)	(2.19)
Avg.ΔRI impact	-1.516***	-0.810***	-0.495***	-0.350**	-2.587***	-1.118***	-1.462***	-1.445***
N	25	25	25	25	25	25	25	25
T	233	233	122	122	33	33	78	78
Obs	4,861	4,861	2,174	2,174	812	812	1,875	1,875
$\bar{R}^2$	0.115	0.053	0.043	0.034	0.245	0.142	0.194	0.114
DW	2.05	2.01	2.04	2.02	2.14	2.01	2.28	2.26

Note: Dependent variable Δs. White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Currency fixed effects included. Avg. ΔRI impact=$\hat{\beta}_1 + \hat{\beta}_2\ \overline{nfa}$, where RI is proxied either by VIX or TED. DW refers to the panel Durbin-Watson test statistic for serial correlation.

Table 10: Panel regression of models (1) and (2) with constitutive terms and controls presented (Tables 1 and 2)

	Full sample		Post-crisis sample		G10 currencies		EM currencies	
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
Constant	0.196	0.067	17.792***	22.509***	-0.117	0.009	0.666	0.439
	(0.893)	(0.920)	(4.411)	(4.415)	(1.246)	(1.270)	(1.264)	(1.308)
ΔVIX	-1.201***		-1.152***		-0.786***		-1.849***	
	(0.095)		(0.131)		(0.159)		(0.200)	
ΔTED		-0.717***		-0.958**		-0.314*		-0.905***
		(0.125)		(0.405)		(0.185)		(0.287)
nTotDebt	0.683**	0.664*	1.471	1.572	0.516	0.549	1.023**	1.039**
	(0.330)	(0.350)	(0.977)	(1.035)	(0.558)	(0.603)	(0.406)	(0.427)
nTotEquity	-0.434	-0.410	0.442	0.644	-0.949**	-0.999**	-0.523	-0.381
	(0.328)	(0.334)	(0.832)	(0.851)	(0.428)	(0.436)	(0.553)	(0.569)
ΔVIX*nTotDebt	1.368***		1.262***		1.554***		1.083***	
	(0.205)		(0.310)		(0.309)		(0.267)	
ΔVIX*nTotEquity	0.229		-0.050		-0.114		-1.466**	
	(0.281)		(0.324)		(0.400)		(0.719)	
ΔTED*nTotDebt		0.599**		2.061**		0.611*		0.270
		(0.244)		(1.001)		(0.336)		(0.355)
ΔTED*nTotEquity		0.565		-0.292		-1.345		0.715
		(0.459)		(1.037)		(0.882)		(0.930)
ΔRes_{-1}	3.459***	3.196***	6.890***	8.177***	1.976*	1.559	4.850***	5.093***
	(0.799)	(0.886)	(2.213)	(2.249)	(1.055)	(1.154)	(1.201)	(1.338)
$(stock - stock^{US})_{-1}$	4.056***	5.026***	6.060***	9.972***	7.619***	8.706***	3.162***	4.226***
	(0.974)	(1.012)	(1.868)	(1.963)	(2.296)	(2.352)	(1.061)	(1.105)
$(\pi - \pi^{US})_{-1}$	0.029	0.030	0.121**	0.105*	0.249***	0.253***	0.004	0.002
	(0.022)	(0.023)	(0.057)	(0.059)	(0.071)	(0.072)	(0.024)	(0.025)
$(i - i^{US})_{-1}$	0.185***	0.258***	0.638***	0.866***	0.518***	0.668***	0.164***	0.240***
	(0.043)	(0.046)	(0.121)	(0.120)	(0.132)	(0.140)	(0.045)	(0.049)
$(i - i^{US})_{-1} * VIX_{-1}$	-0.009***	-0.012***	-0.026***	-0.036***	-0.022***	-0.029***	-0.008***	-0.010***
	(0.002)	(0.002)	(0.005)	(0.005)	(0.006)	(0.006)	(0.002)	(0.002)
PPP_{-1}	-0.106	-0.045	-9.201***	-11.587***	0.494	0.409	-0.339	-0.240
	(0.486)	(0.501)	(2.210)	(2.216)	(1.102)	(1.123)	(0.543)	(0.563)
Avg. ΔRI impact	-1.492	-0.885	-1.465	-1.456	-1.132	-0.616	-1.732	-1.119
N	25	25	25	25	9	9	16	16
T	233	233	78	78	233	233	231	231
Obs	4,703	4,703	1,860	1,860	1,930	1,930	2,773	2,773
$\bar{R}^2$	0.116	0.052	0.195	0.113	0.100	0.049	0.139	0.066
DW	2.07	2.03	2.27	2.27	2.05	2.01	2.09	2.04

Note: Dependent variable: Δs. White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant, constitutive terms, control variables and currency fixed effects included. Avg. ΔRI impact=$\hat{\beta}_1 + \hat{\beta}_2\ \overline{nTotDebt} + \hat{\beta}_3\ \overline{nTotEquity}$, where RI is proxied either by VIX or TED.

Table 11: Panel regression of model (3) with control variables and constitutive terms presented (Tables 4 and 5)

Appendix C. Additional Results

	Full sample						G10		EM	
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)
ΔVIX	-1.438***		-1.201***		-1.188***		0.048		-0.497***	
	(0.086)		(0.095)		(0.123)		(0.093)		(0.126)	
ΔTED		-0.296***		-0.190**		-0.266***		-0.008		-0.267
		(0.076)		(0.077)		(0.094)		(0.112)		(0.218)
ΔVIX*nfa	0.803***									
	(0.127)									
ΔTED*nfa		0.478***								
		(0.101)								
ΔVIX*nTotDebt			1.368***				0.201		0.308**	
			(0.205)				(0.142)		(0.131)	
ΔVIX*nTotEquity			0.229				-0.153		-0.671	
			(0.281)				(0.228)		(0.426)	
ΔTED*nTotDebt				0.553***				0.654***		0.165
				(0.133)				(0.187)		(0.166)
ΔTED*nTotEquity				0.865***				0.500		1.108
				(0.240)				(0.484)		(0.696)
ΔVIX*nPDebt					1.184***					
					(0.232)					
ΔVIX*nPEquity					-0.939***					
					(0.320)					
ΔVIX*nOther					1.995***					
					(0.735)					
ΔTED*nPDebt						0.614***				
						(0.152)				
ΔTED*nPEquity						-0.284				
						(0.316)				
ΔTED*nOther						0.676				
						(0.528)				
Avg. ΔRI impact	-1.52	-0.34	-1.49	-0.37	-1.48	-0.37	-0.01	-0.08	-0.41	-0.55
N	25	25	25	25	24	24	10	10	16	16
T	233	233	233	233	233	233	233	233	231	231
Obs	4,861	4,861	4,703	4,703	4,640	4,640	2,163	2,163	2,773	2,773
$\bar{R}^2$	0.115	0.053	0.116	0.051	0.113	0.049	0.037	0.043	0.063	0.063

Note: Dep. Var: Δ Trade weighted currency basket. White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant, constitutive terms, control variables and currency fixed effects included. Avg. ΔRI impact=$\hat{\beta}_1 + \hat{\beta}_2\ \overline{nTotDebt} + \hat{\beta}_3\ \overline{nTotEquity}$, where RI is proxied either by VIX or TED.

Table 12: Panel regression of models (1), (3) and (4) for a trade weighted currency basket

Base currency:	EUR						GBP					
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)	(xi)	(xii)
ΔVIX	-0.363***		-0.142		-0.093		-1.010***		-0.772***		-0.725***	
	(0.086)		(0.095)		(0.123)		(0.091)		(0.102)		(0.133)	
ΔTED		-0.259**		-0.192		-0.165		-0.121		-0.062		-0.032
		(0.114)		(0.119)		(0.159)		(0.119)		(0.128)		(0.155)
ΔVIX*nfa	0.813***						0.953***					
	(0.129)						(0.127)					
ΔTED*nfa		0.434***						0.435***				
		(0.137)						(0.167)				
ΔVIX*nTotDebt			1.286***						1.372***			
			(0.169)						(0.204)			
ΔVIX*nTotEquity			0.177						0.209			
			(0.227)						(0.266)			
ΔTED*nTotDebt				0.557***						0.559**		
				(0.181)						(0.237)		
ΔTED*nTotEquity				0.358						0.552		
				(0.394)						(0.463)		
ΔVIX*nPDebt					1.203***						1.173***	
					(0.200)						(0.235)	
ΔVIX*nPEquity					-0.957***						-0.507	
					(0.293)						(0.310)	
ΔVIX*nOther					2.042***						2.391***	
					(0.734)						(0.793)	
ΔTED*nPDebt						0.417*						0.346
						(0.227)						(0.276)
ΔTED*nPEquity						-0.591						-0.297
						(0.530)						(0.581)
ΔTED*nOther						1.225						1.382
						(0.982)						(0.931)
N	24	24	24	24	23	23	24	24	24	24	23	23
T	220	220	220	220	220	220	233	233	233	233	233	233
Obs	4,564	4,564	4,419	4,419	4,356	4,356	4,628	4,628	4,470	4,470	4,407	4,407
$\bar{R}^2$	0.034	0.021	0.034	0.020	0.034	0.020	0.055	0.010	0.054	0.010	0.053	0.010
DW	2.00	1.99	2.01	2.00	2.01	2.00	2.02	2.03	2.04	2.05	2.04	2.05

Note: Dependent variable: Δs. White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant, constitutive terms, control variables and currency fixed effects included. Avg. ΔRI impact=$\hat{\beta}_1 + \hat{\beta}_2\ \overline{nTotDebt} + \hat{\beta}_3\ \overline{nTotEquity}$, where RI is proxied either by VIX or TED.

Table 13: Panel regression of models (1), (3) and (4) using EUR and GBP as base currency

Base currency:			SEK						KRW			
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)	(xi)	(xii)
ΔVIX	0.058		0.245**		0.222*		0.064		0.324***		0.370**	
	(0.090)		(0.099)		(0.127)		(0.110)		(0.123)		(0.166)	
ΔTED		-0.126		-0.110		-0.079		0.838***		0.869***		0.962***
		(0.121)		(0.129)		(0.172)		(0.148)		(0.164)		(0.205)
ΔVIX*nfa	0.789***						0.888***					
	(0.143)						(0.154)					
ΔTED*nfa		0.458***						0.447**				
		(0.158)						(0.227)				
ΔVIX*nTotDebt			1.368***						1.438***			
			(0.201)						(0.234)			
ΔVIX*nTotEquity			-0.059						0.168			
			(0.254)						(0.281)			
ΔTED*nTotDebt				0.671***						0.593*		
				(0.226)						(0.314)		
ΔTED*nTotEquity				-0.015						0.302		
				(0.488)						(0.556)		
ΔVIX*nPDebt					1.415***						1.328***	
					(0.254)						(0.262)	
ΔVIX*nPEquity					-1.249***						-1.130***	
					(0.334)						(0.335)	
ΔVIX*nOther					1.341*						2.166**	
					(0.767)						(0.997)	
ΔTED*nPDebt						0.571**						0.394
						(0.286)						(0.399)
ΔTED*nPEquity						-0.566						-0.915
						(0.594)						(0.721)
ΔTED*nOther						1.068						1.805
						(1.010)						(1.200)
N	24	24	24	24	23	23	24	24	24	24	23	23
T	233	233	233	233	233	233	233	233	233	233	233	233
Obs	4,654	4,654	4,496	4,496	4,433	4,433	4,719	4,719	4,561	4,561	4,498	4,498
$\bar{R}^2$	0.014	0.008	0.017	0.008	0.019	0.008	0.006	0.008	0.009	0.008	0.009	0.008
DW	2.02	2.02	2.05	2.05	2.05	2.05	2.07	2.07	2.06	2.06	2.06	2.06

Note: Dependent variable: Δs. White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant, constitutive terms, control variables and currency fixed effects included. Avg. ΔRI impact=$\hat{\beta}_1 + \hat{\beta}_2\ \overline{nTotDebt} + \hat{\beta}_3\ \overline{nTotEquity}$, where RI is proxied either by VIX or TED.

Table 14: Panel regression of models (1), (3) and (4) using SEK and KRW as base currency

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
VIX	-0.263***		-0.204***		-0.256***	
	(0.062)		(0.065)		(0.082)	
TED		-0.144**		-0.154**		-0.190**
		(0.059)		(0.065)		(0.082)
VIX*nfa	0.186**					
	(0.094)					
TED*nfa		0.063				
		(0.085)				
VIX*nTotDebt			0.303**			
			(0.139)			
VIX*nTotEquity			0.215			
			(0.232)			
TED*nTotDebt				0.142		
				(0.126)		
TED*nTotEquity				-0.185		
				(0.236)		
VIX*nPDebt					0.303*	
					(0.158)	
VIX*nPEquity					-0.241	
					(0.270)	
VIX*nOther					0.156	
					(0.467)	
TED*nPDebt						0.133
						(0.155)
TED*nPEquity						-0.018
						(0.295)
TED*nOther						-0.230
						(0.465)
Avg. *RI* impact	-0.28	-0.15	-0.28	-0.17	-0.29	-0.17
N	25	25	25	25	24	24
T	233	233	233	233	233	233
Obs	4,861	4,861	4,703	4,703	4,640	4,640
$\bar{R}^2$	0.047	0.043	0.045	0.041	0.045	0.041
DW	1.99	2.00	2.01	2.02	2.01	2.02

Note: Dependent variable: Δs. White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant, constitutive terms, control variables and currency fixed effects included. Avg. RI impact=$\hat{\beta}_1 + \hat{\beta}_2\ \overline{nTotDebt} + \hat{\beta}_3\ \overline{nTotEquity}$, where RI is proxied either by VIX or TED.

Table 15: Panel regression of models (1), (3) and (4) for the level of RI instead of ΔRI

Dep. Var	Δs				rx			
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
ΔVIX	0.069	-0.317			-0.560	-0.496		
	(0.760)	(0.717)			(0.738)	(0.719)		
ΔTED			0.335	0.255			0.429	-0.035
			(0.818)	(0.814)			(0.861)	(0.840)
ΔVIX*TotDebt As	6.498***	6.230***			6.626***	6.071***		
	(0.939)	(0.954)			(0.974)	(0.970)		
ΔVIX*TotEquity As	-2.161***	-2.411***			-2.059***	-2.092***		
	(0.531)	(0.552)			(0.545)	(0.569)		
ΔVIX*TotDebt Liab	-4.602***	-4.331***			-4.803***	-4.382***		
	(1.261)	(1.228)			(1.301)	(1.251)		
ΔVIX*TotEquity Liab	-1.085	-0.365			-0.417	-0.241		
	(1.176)	(1.080)			(1.102)	(1.080)		
ΔTED*TotDebt As			2.015*	2.364**			2.127*	2.145*
			(1.077)	(1.161)			(1.175)	(1.267)
ΔTED*TotEquity As			-0.113	-0.144			0.248	0.241
			(0.520)	(0.618)			(0.554)	(0.711)
ΔTED*TotDebt Liab			-0.764	-0.221			-0.618	-0.339
			(1.668)	(1.647)			(1.792)	(1.734)
ΔTED*TotEquity Liab			-2.416*	-3.165**			-3.127**	-2.824**
			(1.251)	(1.252)			(1.253)	(1.248)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
N	25	25	25	25	25	25	25	25
T	233	233	233	233	233	233	233	233
Obs	5,003	4,700	5,003	4,700	4,798	4,591	4,798	4,591
$\bar{R}^2$	0.088	0.118	0.015	0.054	0.102	0.140	0.022	0.077

Note: White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant and currency fixed effects included.

Table 16: Panel regression with gross assets and liabilities instead of net

	Full sample				
	(i)	(ii)	(iii)	(iv)	(v)
ΔTED	1.024	1.098	1.096	0.498	2.179**
	(0.932)	(0.934)	(0.936)	(0.866)	(1.043)
ΔTED*nfa	0.508***				
	(0.150)				
ΔTED*nTotDebt		0.713***	0.716***		
		(0.219)	(0.220)		
ΔTED*nTotEquity		0.309			
		(0.421)			
ΔTED*nfa^{PRIV}				1.119***	
				(0.278)	
ΔTED*nfa^{GOV}				-2.034***	
				(0.718)	
ΔTED*nTotDebt^{PRIV}					1.852**
					(0.911)
ΔTED*nTotDebt^{GOV}					-0.278
					(1.593)
N	25	25	25	21	12
T	184	184	184	184	184
Obs	4,355	4,244	4,365	2,880	1,618
$\bar{R}^2$	0.462	0.463	0.463	0.484	0.500

Note: Dep. var: Δs White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant, constitutive terms, control variables, currency and time fixed effects included.

Table 17: Models including time fixed effects and using a 'country specific' TED spread