Currency Premia and Global Imbalances*†

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Abstract

Global imbalances are a fundamental economic determinant of currency risk premia. We propose a factor that captures exposure to countries' external imbalances – termed the global imbalance risk factor – and show that it explains most of the cross-sectional variation in currency excess returns. The economic intuition of this factor is simple: net foreign debtor countries offer a currency risk premium to compensate investors willing to finance negative external imbalances. Investment currencies load positively on the global imbalance factor while funding currencies load negatively, implying that carry trade investors are compensated for taking on global imbalance risk.

Keywords: Carry Trade, Currency Risk Premium, Global Imbalances.

JEL Classification: F31; F37; G12; G15.

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1 Introduction

We propose a currency risk factor, based on global imbalances, that can explain the average excess return between baskets of high and low interest rate currencies, and thus support a risk-based interpretation of carry trade returns. The carry trade is a popular strategy that involves an investor borrowing in currencies with low interest rates – funding currencies – and simultaneously lending in currencies with high interest rates – investment currencies. By engaging in this strategy the carry trader earns a positive excess return on average, which violates the predictions of the uncovered interest rate parity (UIP) condition. According to this economic hypothesis, in a world of risk-neutral and rational investors, the profits gained from cross-country interest rate differentials will be exactly offset by the losses due to the appreciation of the funding currencies. Most of the time, however, exchange rates do not adjust to offset the extra yield of investment currencies, resulting in the carry trade being profitable on average (Hansen and Hodrick, 1980; Bilson, 1981; Fama, 1984; Lustig, Roussanov and Verdelhan, 2011; Burnside, Eichenbaum, Kleshchelski and Rebelo, 2011). If returns to carry trades are not a free lunch, then a risk-based explanation requires that investment currencies offer an excess return as reward for higher risk exposure. Likewise, funding currencies have negative expected returns to reflect their role as insurance currencies (e.g. Lewis, 1995; Engel, 1996).

Our paper builds on the recent literature proposing a risk-based explanation to currency premia. In one strand of this literature, Lustig, Roussanov and Verdelhan (2011) and Menkhoff, Sarno, Schmeling and Schrimpf (2012), have both found a global risk factor in currency excess returns. But while these global risk factors provide valuable information on the properties of currency returns, the question as to what fundamental economic forces drive the factors and, hence, currency risk premia, remains unanswered. In a second strand of literature, a 'crash' premium has been proposed to explain currency excess returns. This 'crash' or disaster risk has been shown to explain, at least in part, the excess return to the carry trade.[1] While at first blush this is a compelling theory, it raises a problematic circular argument: (i) High interest rate currencies require a high expected return. (ii) The higher return is

[1] See, for example, Brunnermeier, Nagel and Pedersen (2009); Farhi and Gabaix (2009); Farhi, Fraiberger, Gabaix, Ranciere and Verdelhan (2009) and Jurek (2009).

compensation for the risk of a large and sudden drawdown. (iii) High interest rate currencies experience this 'crash' and thus require a higher return because they are the riskiest. The question as to *why* high yielding currencies are the riskiest is not resolved. Both strands of literature, therefore, leave us tantalisingly close to a more complete understanding of currency premia, but do so without the economic interpretation necessary for a fully satisfying conclusion.[2] This paper tackles exactly this issue by shedding empirical light on the *macroeconomic* forces driving currency premia and crashes in the currency market.

Our main contribution to the literature is to consider a risk factor that captures exposure to global imbalances – termed 'Global Imbalance Risk' – and show it plays a major role in determining currency risk premia. The risk factor is motivated principally by the theoretical model of international financial adjustment by Gourinchas and Rey (2007).[3] Gourinchas and Rey show that current external imbalances must predict either net export growth or positive returns on the net foreign asset portfolio, or both.[4] Currency fluctuations play a major role in adjusting external imbalances through two channels: first by making a country more or less competitive in international goods markets, and second by altering the differential in rates of return between assets and liabilities denominated in different currencies. For instance, a country running a negative external imbalance will experience a future currency depreciation that contributes to the process of international financial adjustment through future current account surpluses and/or higher returns on the net foreign asset portfolio. Foreign investors will then demand a currency risk premium to hold the currencies of countries running large negative external imbalances.

The model of Gourinchas and Rey is not, however, the full story. It relies upon an assumption that the majority of a country's liabilities are denominated in home currency. While this is largely true of the United States, for many other (especially emerging) economies, the

[2]Brunnermeier, Nagel and Pedersen (2009) argue that in times of low liquidity, funding constraints could result in the undwinding of a leveraged carry trade. While this theory provides an explanation for the 'crash', the argument does not resolve the question of what economic rationale there is for some currencies requiring a depreciation.

[3]Joslin, Priebsch and Singleton (2010) ask the question, which unspanned macro risks play a major role in driving the Treasury market but are orthogonal to output growth and inflation? The authors posit that global imbalances may be the answer and should be tested in future empirical work.

[4]The external position of a country refers to both current account flows and net foreign assets of countries, thus including both private and public debt. Therefore, the external position is different from a country's debt to GDP ratio, which refers only to public debt.

majority of foreign assets are denominated in foreign currencies. Gourinchas (2008) presents a two-country model to highlight the contrast of an economic shock (e.g. a permanent fall in demand for the home good) if a debtor country issues most of its debt in domestic versus foreign currency. The model indicates that a currency depreciation will be initially *destabilizing* if the underlying economy has predominately foreign currency denominated liabilities. The immediate loss of wealth from an increased stock of liabilities weakens the net foreign asset (NA) position. To restore balance of the external account, the exchange rate needs an even larger depreciation or 'crash', overshooting its long run equilibrium value, to enable a sufficient improvement in the trade balance. In contrast, in the case of countries with mostly home currency denominated liabilities, the exchange rate depreciation has a positive and *stabilizing* impact on both trade *and* valuation channels, leading us back to the initial implications of the Gourinchas and Rey model. Motivated by the insights of the Gourinchas-Rey (2007) and Gourinchas (2008) models, we test empirically whether a risk factor that captures the combination of spread in external imbalances and propensity to issue external liabilities in foreign currency can explain the excess returns of currency portfolios in a linear asset pricing framework. We find that our global imbalance risk factor explains over 90 percent of currency excess returns, thus supporting a risk-based view of exchange rate determination that is based on macroeconomic fundamentals.[5]

In the empirical analysis we sort currencies into five portfolios according to their forward premia as pioneered in Lustig and Verdelhan (2007).[6] This is equivalent to using the interest rate differential relative to the US dollar to rank foreign currencies because no-arbitrage requires that forward premia are equal to interest rate differentials. The first portfolio contains the funding currencies of a carry trade strategy (lowest forward premia or interest rate dif-

[5]Despite the existence of theoretical models that link exchange rates to external imbalances, there have hardly been any attempts to relate currency risk premia *cross-sectionally* to currencies' sensitivity to external imbalances. When the FX literature has investigated the empirical link between exchange rates and external imbalances, the analysis was carried out in a time series setting (e.g. Alquist and Chinn, 2008; Della Corte, Sarno and Sestieri, 2012; Habib and Stracca, 2012). It thus seems quite natural to employ a cross-sectional perspective on the role of global imbalances to help understand currency risk premia in general, and carry trades in particular.

[6]While a number of studies on the *time series* properties of UIP deviations have been unable to relate empirically currency excess returns to risk premia, a recent literature has switched the analysis to the *cross-section* of currency excess returns, and our paper builds on this literature; see Burnside, Eichenbaum, Kleshchelski, and Rebelo (2011), Lustig, Roussanov, and Verdelhan (2011), and Menkhoff, Sarno, Schmeling and Schrimpf (2012).

ferential), while the last portfolio contains the investment currencies in a carry trade strategy (highest forward premia or interest rate differential). We then show that the carry trade returns can be understood as compensation for risk by relating their cross-section to the global imbalance factor. This factor is an easily constructed variable. We first split currencies into two baskets using the net foreign asset position to GDP ratio, and then sort currencies within each basket by the underlying country's percentage share of external liabilities in domestic currency. The reordered currencies, beginning with creditors whose external liabilities are primarily denominated in domestic currency (the safest currencies) and moving to debtors whose external liabilities are primarily denominated in foreign currency (the riskiest currencies), are grouped into quintiles. These quintiles form our five NA portfolios. The global imbalance factor is simply constructed as the difference between the excess returns on the extreme portfolios. It is equivalent to a high-minus-low strategy that buys the currencies of debtor nations with mainly foreign currency denominated external liabilities and sells the currencies of creditor nations with mainly domestic currency denominated external liabilities. We refer to the global imbalance risk factor as HML_{NA}.

Our empirical evidence suggests that the global imbalance factor accounts for most of the cross-sectional dispersion in currency excess returns. This equates to global imbalances being a plausible macroeconomic candidate for explaining carry trade returns. The economic intuition of this factor is simple: investors demand a risk premium to hold the currency of debtor countries funded principally in foreign currency, as a reward for an expected exchange rate depreciation following an external shock. High interest rate currencies load positively on the global imbalance factor, and thus deliver low returns following an external shock, when the process of international financial adjustment requires their depreciation. Low interest rate currencies are negatively related to the global imbalance factor, and thus provide a hedge by yielding positive returns after an external shock. This result suggests that returns to carry trades are compensation for time-varying fundamental risk, and thus carry traders can be viewed as taking on global imbalance risk.

We examine the robustness of our main result in the following specifications: (i) We run cross-sectional asset pricing tests on yearly data using interest rate sorted portfolios, for both HML_{NA} and HML_{FX}. We find HML_{NA} is still priced in the cross-section while HML_{FX} is not. (ii) We show that sorting currencies on their beta with HML_{NA} yields portfolios with a significant difference in returns. These portfolios are related, but not identical, to our base test assets of currency portfolios sorted on forward premia. (iii) We test the pricing power of the global imbalance risk factor for currency excess returns sorted by real (as opposed to nominal) interest rate differential . (iv) We depart from our base scenario of a US-based investor and run calculations using alternative base currencies, taking the viewpoint of a British, Japanese, Euro-based and Swiss investor. (v) We test the HML_{NA} risk factor on portfolios formed from the 20 most liquidly traded developed and emerging currencies. (vi) We also run cross-sectional asset pricing tests for individual currencies' excess returns. Overall, we find that our results are robust to each of these specifications, corroborating our core finding that global imbalance risk is a key fundamental driver of risk premia in the FX market.

Related Literature Our paper is most closely related to the recent literature seeking to explain currency risk premia in a cross-sectional asset pricing setting. Lustig, Roussanov, and Verdelhan (2011) rationalize returns to the carry trade using two risk factors, in line with the Arbitrage Pricing Theory of Ross (1976). The authors find that the first two principal components of currency portfolios explain most of the variation in currency returns. The first principal component is equivalent to the average excess return on all currency portfolios, and is denoted as the dollar factor (DOL). The second principal component is essentially the carry trade return – a long position in the last portfolio funded by a short position in the first portfolio. This factor is constructed in a similar vein to the Fama and French (1993) high-minus-low factor, and is named the slope factor (HML_{FX}). High interest rate currencies are positively exposed to this risk, while low interest rate currencies are negatively exposed. Since average excess returns increase monotonically across portfolios and DOL has no pricing power, the slope factor is the only risk factor that explains the cross-section of portfolio returns.

We show that HML_{NA} and HML_{FX} are driven by a common component and that sorting currencies into portfolios on the basis of their exposure to HML_{NA} is very similar to sorting on forward premia. We find evidence that there is no additional pricing information in HML_{FX} beyond HML_{NA}. Furthermore, Menkhoff, Sarno, Schmeling and Schrimpf (2012) find that average carry trade returns are compensation for exposure to global FX volatility risk. In times of high unexpected volatility, high-interest currencies deliver low returns, whereas low-interest currencies perform well. We show that HML_{NA} also replicates reasonably well the information in global FX volatility risk, which has no additional information beyond our global imbalance risk factor for pricing carry trade returns.[7]

The remainder of the paper is organized as follows. Section 2 briefly describes the theoretical background of our analysis. In Section 3 we describe the data and provide details of how portfolios are constructed. We present a set of preliminary results in Section 4, before formally running cross-sectional asset pricing tests in Section 5. In Section 6 we present a number of robustness exercises, before concluding in Section 7.

2 Global Imbalance Risk in the FX Market

Exchange rates are theoretically linked to external imbalances.[8] Starting with a country's intertemporal budget constraint, Gourinchas and Rey (2007) show that current external imbalances must predict net export growth or returns on the net foreign asset portfolio. Since the exchange rate plays a critical role in determining both future net exports and returns on external assets and liabilities, it follows that today's imbalances contain valuable information about future exchange rate changes. Intuitively, a depreciation of the domestic currency contributes to the process of international adjustment through future trade surpluses. This is the *trade channel*, a standard implication of the intertemporal approach to the current account (Sachs, 1982; Obstfeld and Rogoff, 2005). However, the external adjustment can also take place through a different mechanism, since a domestic currency depreciation may increase the value of foreign assets (denominated in foreign currency) relative to foreign liabilities (denominated in domestic currency). The change in net foreign asset returns causes a transfer of wealth from the rest of the world to the domestic country, thus contributing to the external adjustment. This mechanism is the *valuation channel*, the driver of international financial adjustment suggested by Gourinchas and Rey (2007). For instance, a country with negative external imbalances must either run future current account surpluses or earn future higher

[7]Related to this literature, Christiansen, Ranaldo and Söderlind (2011) further show that the risk exposure of carry trade returns to stock and bond markets depends on the level of FX volatility. Burnside, Eichenbaum, Kleshchelski and Rebelo (2011) investigate whether carry trade returns reflect a peso problem, which is a low probability of large negative returns. Although the authors do not find evidence of peso events in their sample, they argue that investors still attach great importance to these events and require compensation for them.

[8]Note that we use 'global imbalances' as synonymous with 'external imbalances' throughout.

returns on its foreign assets vis-à-vis its foreign liabilities. Gourinchas and Rey (2007) find that a substantial part of US cyclical external imbalances are eliminated via the valuation channel.

In order to understand the interaction between the trade and valuation channels, we start by defining the net foreign asset position at time t as NA_t. The change in the net foreign asset position between times t and $t+1$ is defined by the following accumulation equation:

$$NA_{t+1} = R_{t+1}NA_t + NX_{t+1}$$

where NX_{t+1} is the balance on goods, services and net transfers between times t and $t+1$, and R_{t+1} represents the gross portfolio return on the net foreign portfolio between times t and $t+1$. By adding and subtracting the net investment income balance NI_{t+1} between times t and $t+1$, we obtain

$$\begin{aligned} NA_{t+1} - NA_t &= (R_{t+1} - 1)NA_t - NI_{t+1} + NX_{t+1} + NI_{t+1} \\ &= [(R_{t+1} - 1)NA_t - NI_{t+1}] + CA_{t+1} \\ &\equiv VA_{t+1} + CA_{t+1} \end{aligned}$$

where CA_{t+1} is the current account balance defined as $CA_{t+1} = NX_{t+1} + NI_{t+1}$. The change in net foreign assets equals the current account, CA_{t+1} (the trade channel), plus a valuation adjustment, VA_{t+1} (the valuation channel). The valuation channel tracks capital gains and losses on the net foreign asset portfolio, i.e., the total net return minus income, dividends, and earnings distributed.

Building on Gourinchas and Rey (2007), Gourinchas (2008) studies the exchange rate behavior implied by the currency denomination of liabilities, comparing the cases of domestic and foreign currency borrowing. The key difference with respect to Gourinchas and Rey (2007) is in the adjustment process to the external account. When external liabilities are denominated in foreign currency, the valuation channel can have a destabilizing rather than a stabilizing effect. As a consequence, in this case, the trade channel must play a dominant role through a sharp currency depreciation in order to balance the external account. This adjustment leads the exchange rate to overshoot its equilibrium exchange rate and can also explain the fact that countries with a high share of foreign currency-denominated liabilities tend to display a higher propensity to experience sharp currency depreciations or ‘crashes’.

From a risk perspective, when expected current account surpluses becomes insufficient to cover a debtors' external account, an exchange rate depreciation works to rebalance the present value equation that satisfies sustainability of the external position. Given an expected exchange rate depreciation, investors will require a premium to hold the currency of debtor nations, and in theory this currency premium is approximately equal to the interest rate differential (see also Alvarez, Atkeson and Kehoe, 2009). This implies that debtor countries with a reliance on foreign currency denominated liabilities have a greater propensity to offer higher interest rates, in order to attract foreign savings to fund domestic investment. If this is the case, we would expect a strong relationship between carry trade returns – the slope risk factor as defined by Lustig, Roussanov, and Verdelhan (2011) – and a risk factor capturing exposure to countries' external imbalances.[9]

3 Data and Currency Portfolios

This section describes the data on exchange rates, external assets and liabilities as well as the total share of external liabilities denominated in domestic currency, employed in the empirical analysis. We go on to describe the construction of currency portfolios, and our global imbalance risk factor.

Data on Spot and Forward Exchange Rates. We collect daily spot and 1-month forward exchange rates vis-à-vis the US dollar (USD) from Barclays and Reuters via Datastream. The empirical analysis uses monthly data obtained by sampling end-of-month rates from October 1983 to December 2011. Our sample consists of the following 60 countries: Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, China, Colombia, Croatia, Cyprus, Czech Republic, Denmark, Egypt, Estonia, Euro Area, Finland, France, Germany, Greece, Hong Kong, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Japan, Kazakhstan, Kuwait, Latvia, Lithuania, Malaysia, Mexico, Morocco, Netherlands, New Zealand,

[9] Ferrero (2010) shows that external imbalances are primarily determined by differentials in productivity growth and demographic patterns across countries. Capital tends to flow towards economies that are relatively young and rapidly growing. In this paper we do not focus on the key determinants of external imbalances but rather on the relationship between external imbalances and currency risk premia. In related empirical work, Habib and Stracca (2012) find that net financial assets are the most consistent estimator of whether a currency is a safe haven. They find interest rates have no explanatory power once net foreign assets are included in the model.

Norway, Philippines, Poland, Portugal, Russia, Saudi Arabia, Singapore, Slovakia, Slovenia, South Africa, South Korea, Spain, Sweden, Switzerland, Taiwan, Thailand, Tunisia, Turkey, Ukraine, United Kingdom, and Venezuela. We call this sample 'All Countries'.

A number of currencies in this sample are pegged or subject to capital restrictions. In reality, investors may not easily trade some of these currencies in large amounts even though quotes on forward contracts (deliverable or non-deliverable) are available.[10] Hence, we also consider a subset of 15 countries which we refer to as 'Developed Countries'. This sample includes: Australia, Belgium, Canada, Denmark, Euro Area, France, Germany, Italy, Japan, Netherlands, New Zealand, Norway, Sweden, Switzerland, and the United Kingdom. After the introduction of the euro in January 1999, we exclude the eurozone countries and replace them with the Euro Area.[11] As in Lustig, Roussanov, and Verdelhan (2011), we remove data when we observe large deviations from the covered interest rate parity (CIP) condition.[12]

Data on External Assets and Liabilities. Turning to macroeconomic data, we obtain end-of-year series on foreign assets and liabilities, and gross domestic product (GDP) from Lane and Milesi-Ferretti (2007), kindly provided by Gian Maria Milesi-Ferretti. Foreign (or external) assets refer to the value of the assets that a country owns abroad, while foreign (or external) liabilities indicate the value of the domestic assets owned by foreigners. The data for all countries included in our study are until the end of 2011.

For each country, we measure external imbalances using the net foreign asset position relative to the size of the economy, that is the difference between foreign assets and foreign liabilities relative to GDP. This measure reflects the indebtedness of a country to foreigners.

[10] According to the Triennial Survey of the Bank for International Settlements (2010), the top 10 currencies account for 90 percent of the average daily turnover in FX markets.

[11] Our sample of Developed Countries matches both Lustig, Roussanov, and Verdelhan (2011), and Menkhoff, Sarno, Schmeling and Schrimpf (2012). The sample of All Countries, instead, comprises a wider set of countries than previous studies. We also consider a set of 35 countries as in Lustig, Roussanov, and Verdelhan (2011), and 48 countries as in Menkhoff, Sarno, Schmeling and Schrimpf (2012). Qualitatively, the results remain largely the same.

[12] Specifically, we eliminate the following observations from our sample: Argentina from August 2008 to April 2009; Malaysia from April 1998 to July 1999 and from June 2005 to December 2010; Indonesia from June 1997 to March 1998, from January 2001 to September 2002, and from November 2008 to February 2009; Italy from August 1992 to September 1992; Japan from May 1998 to July 1998; Kazakhstan from October 2008 to February 2009; Kuwait from March 2001 to April 2001; Norway from July 1998 to August 1998; Russia from November 2008 to April 2009; South Africa from July 1985 to August 1985 and from December 2001 to May 2004; Sweden from July 1998 to August 1998; Thailand from April 1997 to June 1997; and Turkey from January 2001 to November 2001.

We provide a simple graphical analysis of external imbalances by presenting in Figure 1 the distribution of the net foreign asset positions relative to GDP as of December 2011. This illustrates some of the large external imbalances of the current time. *Prima facie*, we observe that countries with large external imbalances are associated with some of the classic carry trade currencies, which we document more rigorously below.

End of year series on the the proportion of external liabilities denominated in domestic currency are from Lane and Shambaugh (2010), available on Philip Lane's website. The data is available from 1990 to 2004. We maintain the 2004 proportions through until the end of 2011 and the 1990 proportions back until 1983. A time series of the average share of foreign liabilities issued in domestic currency is presented in Figure 2 for both Developed and Non-Developed Countries. We also report 90th and 10th percentile bands. Since the early 1990s there has been a trend higher for countries, in both Developed and Emerging markets to issue external liabilities in domestic currency. In order to avoid any 'look ahead bias', we retrieve monthly observations for external imbalances and the proportion of foreign currency denominated liabilities by keeping end-of-period data constant until a new observation becomes available. A detailed description of the methodologies used to construct the two macroeconomic databases can be found in Lane and Milesi-Ferretti (2004, 2007) and Lane and Shambaugh (2010).

Currency Excess Returns. We denote time-t spot and forward exchange rates as S_t and F_t, respectively. Exchange rates are defined in units of foreign currency per US dollar such that an increase in S_t is an appreciation of the home currency. The excess return on buying a foreign currency in the forward market at time t and then selling it in the spot market at time $t+1$ is computed as

$$RX_{t+1} = \left(F_t - S_{t+1}\right)/S_t$$

which is equivalent to the forward premium minus the spot exchange rate return $RX_{t+1} = \left(F_t - S_t\right)/S_t - \left(S_{t+1} - S_t\right)/S_t$. According to the CIP condition, the forward premium approximately equals the interest rate differential $\left(F_t - S_t\right)/S_t \simeq i_t^* - i_t$, where i_t and i_t^* represent the domestic and foreign riskless rates respectively, over the maturity of the forward contract. Since CIP holds closely in the data at daily and lower frequency (e.g., Akram, Rime and Sarno, 2008), the currency excess return is approximately equal to the interest rate differential minus the exchange rate change

$$RX_{t+1} \simeq i_t^* - i_t - (S_{t+1} - S_t) / S_t.$$

We compute currency excess returns adjusted for transaction costs using bid-ask quotes on spot and forward rates. The net excess return for holding foreign currency for a month is computed as $RX_{t+1}^l \simeq (F_t^b - S_{t+1}^a)/S_t^b$, where a indicates the ask price, b the bid price, and l a long position in a foreign currency. This is equivalent to selling the dollar at the bid price F_t^b at time t in the forward market and buying dollars at the ask price S_{t+1}^a in the spot market at time $t+1$. This net excess return reflects the full round-trip transaction cost occurring when the foreign currency is purchased at time t and sold at time $t+1$. If the investor buys foreign currency at time t but decides to maintain the position at time $t+1$, the net excess return is computed as $RX_{t+1}^l \simeq (F_t^b - S_{t+1})/S_t^b$. Similarly, if the investor closes a position in foreign currency at time $t+1$ already existing at time t, the net excess return is defined as $RX_{t+1}^l \simeq (F_t - S_{t+1}^a)/S_t^b$. The net excess return for holding domestic currency for a month is computed as $RX_{t+1}^s \simeq -\left(F_t^a - S_{t+1}^b\right)/S_t^a$, where s denotes a short position on a foreign currency. This is equivalent to buying dollars at the ask price F_t^a at time t in the forward market and selling dollars at the bid price S_{t+1}^b in the spot market at time $t+1$. If the domestic currency enters the strategy at time t and the position is rolled over at time $t+1$, the net excess return is computed as $RX_{t+1}^s \simeq -\left(F_t^a - S_{t+1}\right)/S_t^a$. Similarly, if the domestic currency leaves the strategy at time $t+1$ but the position was already opened at time t, the net excess return is computed as $RX_{t+1}^s \simeq -\left(F_t - S_{t+1}^b\right)/S_t^a$. In short, excess returns are adjusted for the full round-trip transaction cost in the first and last month of our sample period.

Currency Portfolios. We construct five currency portfolios and re-balance them at the end of each month. We will refer to these portfolios as FX portfolios. At the end of each period t, we allocate currencies to five portfolios on the basis of their forward premia $(F_t - S_t)/S_t$. Sorting on forward premia is equivalent to sorting currencies on the basis of the interest rate differential $i_t^* - i_t$ via the CIP condition. This exercise implies that currencies with the lowest forward premia (or lowest interest rate differential relative to the US) are assigned to Portfolio 1, whereas currencies with the highest forward premia (or highest interest rate differential relative to the US) are assigned to Portfolio 5. We then compute the excess return for each portfolio as an equally weighted average of the currency excess returns within that portfolio. For the purpose of computing portfolio returns net of transaction costs, we assume that investors go short on foreign currencies in Portfolio 1 and long on foreign currencies in the remaining portfolios.

The total number of currencies in our portfolios changes over time. We only include currencies for which we have bid and ask quotes on forward and spot exchange rates in the current and subsequent period. The group of All Countries starts with 8 countries at the beginning of the sample in 1983, and ends with 45 countries at the end of the sample in 2011. The set of Developed Countries starts with 6 countries in 1983, and ends with 10 countries in 2011. The maximum number of currencies managed during the sample is 50 in the All sample and 14 in the Developed sample.

Lustig, Roussanov, and Verdelhan (2011) study these currency portfolio returns using the first two principal components. The first principal component implies an equally weighted strategy across all portfolios. This average return is simply the outcome of a strategy that borrows in the US money market and invests in foreign money markets. This zero-cost portfolio is called the dollar risk factor, abbreviated to DOL. The second principal component is equivalent to a long position in Portfolio 5 and a short position in Portfolio 1. This is the carry trade strategy that borrows in the money markets of low yielding currencies and invests in the money markets of high yielding currencies. This high-minus-low portfolio is called the slope factor, and is denoted as HML_{FX}. We construct DOL and HML_{FX} as in Lustig, Roussanov, and Verdelhan (2011).

Global Imbalance Risk Factor. Motivated by the model of international financial adjustment of Gourinchas and Rey (2007) and Gourinchas (2008), we construct a global imbalance risk factor that captures exposure to countries' external imbalances as follows. At the end of each period t, we first group currencies into two baskets using the net foreign asset position relative to GDP, then reorder currencies within each basket using the percentage share of external liabilities denominated in foreign currency, and finally allocate this set of double-sorted currencies into five portfolios. Portfolio 1 corresponds to creditor countries whose external liabilities are primarily denominated in domestic currency (safest currencies) whereas Portfolio 5 comprises debtor countries whose external liabilities are primarily denominated in foreign currency (riskiest currencies). We refer to these five portfolios as the external imbalances portfolios, abbreviated to NA portfolios.[13] We then compute the excess return for each portfolio as an equally weighted average of individual currency excess returns within the portfolio. For the purpose of computing portfolio returns net of transaction costs, we assume that investors go short foreign currencies in Portfolio 1 and long foreign currencies in the remaining portfolios. We construct the global imbalance risk factor as the difference between Portfolio 5 and Portfolio 1. It is equivalent to a high-minus-low strategy that buys the currencies of debtor countries with mainly foreign currency denominated external liabilities and sells the currencies of creditor nations with mainly domestic currency denominated external liabilities. We refer to the global imbalance risk factor as HML_{NA}.

4 Preliminary Analysis

This section presents a preliminary analysis of the relationship between currency excess returns and the global imbalance risk factor, before turning to formal cross-sectional asset pricing tests in the next section.

Descriptive Statistics. Table 1 presents summary statistics for the five currency portfolios. The first panel displays the results for All Countries, while the second panel refers to Developed Countries. We report results based on monthly rebalancing on the left hand side and for yearly rebalancing on the right. DOL denotes the average return on the five currency portfolios while HML denotes a long-short strategy that is long in Portfolio 5 (the investment currencies in the carry trade) and short in Portfolio 1 (the funding currencies in the carry trade). In the final two columns, we report DOL and HML adjusted for transaction costs (τ). For HML, returns for Portfolio 1 are adjusted for transactions costs occurring in a short position and returns for Portfolio 2 through Portfolio 5 are adjusted for transaction costs occurring in a long position. All figures are annualized.

Average excess returns display an increasing pattern when moving from Portfolio 1 to Portfolio 5 for both samples. The annualized average excess return on Portfolio 1 is about

[13] We construct five rather than six portfolios due to the limited number of available currencies into the Developed sample and, more importantly, to make our analysis comparable to the existing literature.

-1.79 percent per annum for All Countries, and -1.46 percent per annum for Developed Countries. Portfolio 5 exhibits an annualized average excess return of 6.53 percent per annum for All Countries, and 5.61 percent per annum for Developed Countries. In the All Countries sample, the average excess return from holding an equally weighted portfolio of foreign currencies (DOL portfolio) is 1.82 (0.61) percent per annum before (after) transaction costs, and 1.78 (0.97) percent per annum before (after) transaction costs in the Developed Countries sample. These figures, taken together, suggest that a US investor would demand a low but positive risk premium for holding foreign currency while borrowing in the US money market. The average excess return from a long-short strategy that borrows in low-interest rate currencies and invests in high-interest rate currencies (essentially the HML_{FX} portfolio) is around 8.32 (5.44) percent per annum before (after) transaction costs for All Countries, and 7.08 (5.25) percent per annum before (after) transaction costs for Developed Countries. A similar pattern emerges for the yearly rebalanced average returns. Likewise, both median and kurtosis display a slope pattern across the five portfolios, while standard deviations fail to show any systematic pattern. At monthly rebalancing we find almost no skewness in Portfolio 1 but this becomes increasingly negative as we move towards Portfolio 5, consistent with the findings of Brunnermeier, Nagel, and Pedersen (2009) who suggest that investment currencies (or high yielding currencies) may be subject to 'crash' risk. We find evidence of some negative skewness in Portfolio 1 when rebalancing yearly and of positive autocorrelation, especially for Portfolio 5, which includes high interest rate currencies.

The realized Sharpe ratio (SR) is equal to the average excess return of a portfolio divided by the standard deviation of the portfolio returns. The SR simply measures the excess return per unit of volatility. The SR increases systematically when moving from Portfolio 1 to Portfolio 5. For instance, the annualized SR for All Countries ranges from -0.23 (Portfolio 1) to 0.67 (Portfolio 5). The results are largely comparable for Developed Countries. We also report the maximum drawdown (MDD), which is the maximum cumulative loss from the strategy's peak to the following trough. The MDD is large in both samples, reflecting the large-scale unwinding of carry trade positions following the bankruptcy of Lehman Brothers in September 2008. Finally, we report the frequency of currency portfolio switches ($Freq$), computed as the ratio between the number of portfolio switches and the total number of currencies at each date. Overall, there is little variation in the composition of these portfolios, which is not surprising given that interest rates are known to be very persistent.

In Table 2 we present the same summary statistics for the five NA portfolios, as well as the DOL and HML_{NA} strategies. When rebalancing monthly, the average excess return is monotonically increasing from Portfolio 1 (−0.03 percent per annum) to Portfolio 5 (4.02 percent per annum) in Developed Countries and systematically upward sloping for All Countries. We also find similar patterns to FX portfolios in skewness and kurtosis, albeit with higher absolute statistics on Portfolio 4 rather than Portfolio 5. Compared with the FX portfolios we find far less variation in the portfolio compositions of NA portfolios, reflecting the persistent cross-sectional ordering of macroeconomic variables. When we compare SRs, we observe that HML_{FX} has a higher risk-adjusted return than HML_{NA} for All Countries (0.94 compared to 0.75 before transaction costs). For Developed Countries, instead, this difference is virtually eliminated as the SR is equal to 0.64 for HML_{FX}, and 0.62 for HML_{NA}. Strategies based on forward premia, however, are not immediately comparable to strategies based on external imbalances when monthly rebalanced portfolios are taken into consideration. This happens because forward premia are observed every month, whereas new information on countries' external imbalances only arrives at the end of each year. For this reason, we also consider yearly rebalanced strategies. In this case, the difference is flipped around: HML_{NA} has an after transaction cost Sharpe ratio of 0.47 compared to 0.25 for HML_{FX} for All Countries. Similarly for Developed Countries, the after transaction cost Sharpe ratio for HML_{NA} is 0.46 but only 0.17 for HML_{FX}. In sum the two sets of summary statistics line up well with one another. There are some differences but this is not overly surprising given the two-speed nature of the variables. Given this dynamic, it is perhaps surprising that the risk-adjusted NA strategy performs almost as well as the dynamic FX strategy when rebalancing at a monthly frequency.

Sorting on Forward Premia and External Imbalances. If investment currencies deliver low returns during bad times, then carry trade returns simply compensate investors for taking on higher risk-exposure, and UIP deviations reflect time-varying risk premia. The final goal of our empirical work is to assess this risk-based explanation by relating currency excess returns to an economically meaningful risk factor. In Figure 3, we present preliminary evidence on the relationship between HML_{FX} and HML_{NA} by grouping into quintiles HML_{FX} returns conditional on the distribution of HML_{NA} returns. The excess returns show a clear monotonic pattern associated with strong positive correlation between the two factors. When returns to the HML_{NA} factor are high, the carry trade has its best overall performance, with an excess return of almost 4 percent per annum in All Countries. The same pattern emerges for Developed Countries, albeit with higher excess return of around 5 percent per annum.

In Figure 4 we present further evidence on the relationship between HML risk factors by showing one–year rolling SR for HML_{FX} and HML_{NA}. This is a simple graphical exercise to visualize the similarity between a long/short strategy on forward premia and a long/short strategy on external imbalances. The top panel refers to All Countries, while the bottom panel to Developed Countries. The two series show a high degree of correlation, and since the mid 1990s the general pattern of peaks and troughs in HML_{FX} has been exactly replicated by HML_{NA}. This result is particularly promising if one considers that forward premia are observed at monthly intervals while net foreign assets are only recorded at the end of each calendar year. Throughout the sample we observe a few deviations between HML_{FX} and HML_{NA}, which are easily identifiable and straightforward to explain as they generally tend to be episodes of major central bank interventions. The first episode occurs in the aftermath of the Plaza Accord in September 1985 when the governments of France, West Germany, Japan, the US and the UK coordinated an intervention in the currency markets to depreciate the US dollar against other major currencies, ultimately to help the US economy to recover from a serious recession that began in the early 1980s. In February 1987, the then G-6 nations of West Germany, France, Great Britain, Japan, Canada and the United States signed the Louvre Accord to stabilize the international currency markets and prevent any further depreciation of the US dollar caused by the Plaza Accord. The beginning of the 1990s started with the collapse of the Japanese stock market, which was preceded by a lowering of interest rates by the Bank of Japan. A few months later in August 1990, the Gulf War took place, volatility rose and the US dollar sharply appreciated. Indeed, the dollar went up against major currencies since July 1990 in a rally caused by heightened fears over tension in the Middle East. In the early 1990s, the Swedish financial crisis led the Swedish Central Bank to hike rates to over 20 percent in November 1992. During the same period, Italy and the UK were forced to defend their currencies in the European Exchange Rate Mechanism (ERM) via higher interest rates. At the beginning of 1994, to prevent a further devaluation of the Mexican peso, the Mexican central bank undertook a tight monetary policy which roughly doubled interest rates. This crisis affected other Latin American countries. Other episodes include the Internet bubble which burst between 2000 and 2001, the terrorist attack in New York on September 11, 2001, the wars in Afghanistan and Iraq, the collapse of Lehman Brothers in September 2008, and more recently the European sovereign crisis.[14] Notwithstanding these episodes of short-term deviations, this preliminary evidence suggests that HML_{NA} and HML_{FX} move closely together and reflect very similar portfolios. We now turn to a more formal investigation of this similarity using the standard SDF methodology and asset pricing tests.

5 Asset Pricing Tests

This section presents the cross-sectional asset pricing tests between the five currency portfolios and the global imbalance factor, and empirically documents that carry trade returns can be thought of as compensation for time-varying global imbalance risk.

Methods. We closely follow the cross-section asset pricing methodology described in Cochrane (2005) and used, among others, by Lustig, Roussanov, and Verdelhan (2011) and Menkhoff, Sarno, Schmeling and Schrimpf (2012). We denote the discrete excess returns on portfolio j in period $t+1$ as RX^j_{t+1}. To avoid the assumption of joint log-normality of returns and the pricing kernel, we run all asset pricing tests on discrete excess returns, not log excess returns.[15] In the absence of arbitrage opportunities, risk-adjusted excess returns have a price of zero and satisfy the following Euler equation

$$E[M_{t+1}RX^j_{t+1}] = 0 \tag{1}$$

with an SDF M_{t+1}, linear in the pricing factors f_t, given by

$$M_{t+1} = 1 - b'(f_t - \mu) \tag{2}$$

[14]Baba, Packer and Nagano (2009) report evidence of large and persistent deviations from covered interest parity conditions during the recent crisis following lack of liquidity in the FX swap market.

[15]Note that Lustig, Roussanov, and Verdelhan (2011) and Menkhoff, Sarno, Schmeling and Schrimpf (2012) also use discrete returns for asset pricing tests, although they take logs in the main text for expositional simplicity. Here, we use discrete returns throughout the paper.

where b is the vector of factor loadings, and μ denotes the factor means. This specification implies a beta pricing model where the expected excess return on portfolio j is equal to the factor risk price λ times the risk quantities β^j. The beta pricing model is defined as

$$E[RX^j] = \lambda' \beta^j \tag{3}$$

where the market price of risk $\lambda = \Sigma_f b$ can be obtained via the factor loadings b, $\Sigma_f = E\left[(f_t - \mu)(f_t - \mu)'\right]$ is the variance-covariance matrix of the risk factors, and β^j are the regression coefficients of each portfolio's excess return RX_t^j on the risk factors f_t.

The factor loadings b entering equation (1) are estimated via the Generalized Method of Moments (GMM) of Hansen (1982). To implement GMM, we use the pricing errors as a set of moments and a prespecified weighting matrix. Since the objective is to test whether the model can explain the cross-section of expected currency excess returns, we only rely on unconditional moments and do not employ instruments other than a constant and a vector of ones. The first-stage estimation (GMM_1) employs a prespecified identity weighting matrix. The weighting matrix tells us how much attention to pay to each moment condition. With an identity matrix, GMM attempts to price all currency portfolios equally well. The second-stage estimation (GMM_2) uses an optimal weighting matrix based on a heteroskedasticity and autocorrelation consistent (HAC) estimate of the long-run covariance matrix of the moment conditions. We employ the Newey and West (1987) procedure with the number of lags in the Bartlett kernel determined by the method of Andrews (1991). In this case, since currency portfolio returns have different variances and may be correlated, the optimal weighting matrix will attach more weight to linear combinations of moments about which the data are more informative (Cochrane, 2005). In the tables, we report estimates of b and implied λ, the cross-sectional R^2, the square-root of mean-squared errors $RMSE$, and the p-value of the χ^2 test for the null hypothesis of zero pricing errors, i.e., the difference between expected and predicted excess returns.[16]

[16]We estimate μ and Σ_f using the sample average and the sample covariance matrix of the risk factors (e.g., Lustig, Roussanov, and Verdelhan, 2011), respectively. However, we also implement a first-stage GMM where factor means μ and the individual elements of the covariance matrix of risk factors Σ_f are jointly estimated with the factor loadings b. In doing so, we account for estimation uncertainty associated with the fact that factor means and the factor covariance matrix have to be estimated (Burnside, 2011; Menkhoff, Sarno, Schmeling and Schrimpf, 2012). The results remain qualitatively similar, and we do not report them to save space.

The estimation of the portfolio betas β^j and factor risk price λ in Equation (3) is undertaken using a two-pass ordinary least squares regression following Fama and MacBeth (FMB, 1973). In the first stage, we run a time-series regression of portfolio returns against the risk factors, and estimate the betas. In the second step, we run cross-sectional regressions of portfolio returns on the betas, and estimate the factor risk prices. In the second stage of the FMB estimation, we do not add any constant that captures the common over- or underpricing in the cross section of returns. Since the DOL factor displays no cross-sectional relation with currency returns, it actually works as a constant that allows for a common mispricing.[17] We report standard errors with both the Shanken (1992) correction and Newey and West (1987) adjustment, setting the optimal lag length according to Andrews (1991).

The most recent literature on currency asset pricing has considered a two-factor pricing kernel defined as

$$M_{t+1} = 1 - b_1 X_{1,t+1} - b_2 X_{2,t+1}$$

where the first risk factor $X_{1,t+1}$ is typically the expected market excess return, approximated by the average excess return on a portfolio strategy that is long on all foreign currencies with equal weights and short on the domestic currency – the DOL factor. For the second factor $X_{2,t+1}$ the literature has employed several return-based factors, e.g. the slope risk factor HML_{FX} (Lustig, Roussanov, and Verdelhan, 2011) or a global volatility risk factor (Menkhoff, Sarno, Schmeling and Schrimpf, 2012). Regardless of its parsimony and the likely omission of other potential factors, this simple empirical model has delivered important insights on the relationship between global risk and expected currency returns. However, global risk factors used by the literature to date are built on financial variables that are themselves endogenously determined, which begs the question of what are the fundamental economic forces that drive global risk factors. Following the literature, we employ the above SDF model with DOL as the first factor, $X_{1,t+1}$. For the second risk factor, $X_{2,t+1}$ we use global imbalance risk in an attempt to assess the validity of the theoretical prediction that exchange rates are linked to external imbalances, and that currencies more exposed to global imbalance risk offer a risk premium related to interest rate differentials.

Cross-Sectional Regressions: Empirical Evidence. Panel A of Table 3 presents the

[17] See Burnside (2011) and Lustig and Verdelhan (2007) for a detailed discussion of this issue.

cross-sectional asset pricing results with monthly rebalanced portfolios. The excess returns to currency portfolios $RX^j_{FX,t}$, for $j = 1, \ldots, 5$, serve as test assets whereas the dollar factor DOL and the global imbalance factor HML_{NA} enter as risk factors. Both test assets and risk factors are adjusted for transactions costs. The SDF is defined as

$$M_{t+1} = 1 - b_{DOL}\,(DOL_{t+1} - \mu_{DOL}) - b_{NA}\,(HML_{NA,t+1} - \mu_{NA}) \tag{4}$$

where μ_{DOL} and μ_{NA} denotes the factor means. Panel A reports estimates of factor loadings b, the market prices of risk λ, the cross-sectional R^2, the square-root of mean-squared errors $RMSE$, the p-values of the χ^2 test. Newey and West (1987) corrected standard errors with lag length determined according to Andrews (1991) are reported in parentheses, while Shanken corrected standard errors are in brackets. The results are reported for All Countries (left panel) and Developed Countries (right panel) using GMM_1, GMM_2, and FMB approach.

We focus our interest on the sign and the statistical significance of λ_{NA}, the market price of risk attached to the global imbalance risk factor. We find a positive and significant estimate of λ_{NA}. The global imbalance risk premium is 7 percent per annum for All Countries, and 5 percent per annum for Developed Countries when we use the first-stage GMM, and the FMB procedure. The results remain largely unaffected when using the second-stage GMM, with only a small shift lower in the point estimate of the factor risk price for All Countries (6 percent per annum). For this set of currencies, however, the $RMSE$ increases from 182 to 190 basis points when moving from GMM_1 to GMM_2. A positive estimate of the factor price of risk implies higher risk premia for currency portfolios whose returns co-move positively with the global imbalance factor, and lower risk premia for currency portfolios exhibiting a negative covariance with the global imbalance factor. The standard errors of the risk prices are approximately equal to 2 percent for all estimation methods. Overall, the risk price is more than two standard deviations from zero, and thus highly statistically significant. Further support in favor of these results comes from the observed strong cross-sectional fit, with an R^2 revolving around 90 percent for both samples, and from the fact that we are unable to reject the null hypothesis that the pricing errors are jointly zero, with large p-values of the χ^2 test for both samples.

The DOL factor has a risk price of 1 percent per annum, in line with the findings of Lustig, Roussanov, and Verdelhan (2011). Since all currency portfolios have a beta close to one with respect to DOL, this factor does not have power in explaining the cross-sectional variation in currency excess returns. Indeed, we record a standard error approximately twice as big as the estimate of the risk price. Although the DOL factor does not explain any of the cross-sectional dispersion in expected returns, it is important for the level of average returns: there is no need to add a constant in the cross-sectional regression as the DOL factor serves as the constant. Therefore, the strong explanatory power is delivered entirely by HML_{NA}.

In Figure 5 we show graphically the fit of the model. We plot the actual average excess returns along the vertical axis and the fitted average excess returns implied by our model along the horizontal axis. The model-predicted excess returns lie very close to the 45 degree line, suggesting that global imbalance risk explains the spread in average carry trade returns reasonably well, for All Countries (left panel) and Developed Countries (right panel).

Time-Series Regressions: Empirical Evidence. In Panel B of Table 3, we report the least squares estimates obtained from running time-series regressions of currency excess returns on a constant and risk factors for each of the five currency portfolios (for $j = 1, \ldots, 5$)

$$RX^j_{FX,t+1} = \alpha^j + \beta^j_{DOL} DOL_{t+1} + \beta^j_{NA} HML_{NA,t+1} + \varepsilon^j_{t+1}.$$

This exercise allows us to identify which of the currency portfolios provide a hedge against global imbalance risk. The estimate of the betas for the DOL factor are essentially all equal to one as this factor does not capture any of the dispersion in average excess returns across currency portfolios. The estimates of the betas for the global imbalance risk factor, β_{NA} are positive for currencies with a high forward premium (high interest rate differential), and negative for currencies with a low forward premium (low interest rate differential). These betas increase monotonically from -0.32 for the first portfolio to 0.45 for the last currency portfolio for All Countries. Results for Developed Countries are largely comparable. Finally, the last column reports the time-series R^2, which ranges from 71 to 84 percent for All Countries, and from 75 to 86 percent for Developed Countries.[18] Investors demand a premium for

[18] We also investigate whether the unconditional betas in Panel B of Table 4 are determined by the covariance between exchange rate changes and risk factors, or between interest rate differential and risk factors. The conditional covariance between the currency returns and the global imbalance risk factor is only driven by the spot exchange rate changes $Cov_t[RX^j_{FX,t+1}, HML_{NA,t+1}] = -Cov_t\left[\left(S_{t+1} - S_t\right)/S_t, HML_{NA,t+1}\right]$. We regress discrete exchange rate returns, adjusted for transaction costs, on DOL and HML_{NA} for each portfolio. We find estimates of betas largely comparable to the betas for currency portfolio returns (when multiplied by

holding high-yielding currencies (high forward premia) because these currencies are associated with large global imbalance risk, whereas they accept a low return for holding low-yielding currencies as these currencies provide a hedge against global imbalance risk.[19]

Removing Illiquid Currencies. Table 4 displays the cross-sectional asset pricing results when currencies with limited liquidity are removed from the pool of available currencies. Using the latest *BIS Triennial Survey*, we select the top 20 most liquid currencies and name this sample 'Developed and Emerging Countries'.[20] We hypothesise that while forward rates may be available for a large basket of currencies, there would have been virtually no liquidity in many of them. Additionally, the imposition of capital controls in a number of the emerging market nations would have made it almost impossible to engage in a carry trade strategy in the foreign exchange market. If this is the case we would anticipate that the asset pricing results for a limited subset of the most liquid currencies would show an improvement over and above the All Countries sample. In addition we would expect the link between HML_{NA} and HML_{FX} to grow stronger once we exclude the most illiquid currencies. The economic intuition is that while, on paper, higher interest rates are exploitable the market reality is very different. This could result in high interest rates but without any significant impact on net foreign assets. In Panel A we report cross-sectional asset pricing results. We find a market price of risk for HML_{NA} equal to approximately 6 percent per annum, in line with our earlier results for All Countries and Developed Countries. Moreover the standard error remains around 2 percent per annum, resulting in λ_{NA} being highly statistically significant. Again we find a DOL price of risk of around 1 percent per annum but, as before, the risk-factor is not priced in the cross section. We find high p values of the χ^2 test suggesting we

minus one). For instance, the estimates of betas (times minus one) range from −0.31 to 0.43 for All Countries, and from −0.50 to 0.55 for Developed Countries.

[19]In Appendix A, we present additional asset pricing results. In Table A1, we report cross-sectional asset pricing tests without bid-ask spreads and find no qualitative difference with respect to Table 3. In Table A2, instead, we use NA portfolios as test assets and find that HML_{NA} is statistically priced with an average cross-sectional R^2 above 90 percent for both samples. In Appendix B, we present descriptive statistics and asset pricing results when external imbalance portfolios are only sorted on the net foreign asset position. Results weaken: HML has a negative spread for All Countries, α's are not zero in the time-series pricing exercise, while λ_{NA} is significantly larger than the average HML_{NA}, all suggesting that we need to incorporate data on the currency denomination of external liabilities to fully capture the information in the global risk factor.

[20]The currency pool matches the set of currencies employed by Deutsche Bank, the largest player in the FX markets, for its global carry trade (Global Currency Harvest) strategy. Table A4 in Appendix reports the descriptive statistics for this set of currencies.

cannot reject the null of zero pricing errors. In Panel B we show similar results to Table 3. α's are not statistically different from zero, β_{DOL} is approximately equal to one for all portfolios and we see a monotonic increase in β_{NA} from -0.41 on Portfolio 1 to 0.45 on Portfolio 5. The R^2 statistics are all high, ranging from 70 percent to 87 percent. In Figure 6 we present the rolling one-year Sharpe ratio for HML_{FX} and HML_{NA} based on Developed and Emerging Countries. Strikingly, the two series almost perfectly overlap, suggesting our earlier conjecture is valid: the returns to a carry trade strategy (or HML_{FX}) are based, at least in part, on illiquid currencies.[21]

Yearly Rebalanced Portfolios. In Table 5 we change the rebalancing frequency and focus on portfolio returns and risk factors based on yearly rebalanced strategies. Panel A presents cross-sectional asset pricing results whereas Panel B reports time-series estimates for the All Countries sample. The test assets are five portfolios sorted yearly on the basis of the forward premia. On the left-hand side, we use DOL and HML_{FX} as risk factors. On the right-hand side, we replace HML_{FX} with HML_{NA}. We uncover that λ_{FX}, the market price of risk attached to the slope factor, is not priced in the cross-section. In contrast, λ_{NA}, the market price of global imbalance risk, is statistically significant at around 5 percent per annum. This is not dissimilar from our earlier results in Table 3 and 4. In addition, we also find that the GLS R^2 statistic when incorporating HML_{FX} is in fact *minus* 21 percent, compared with 69 percent when using HML_{NA}. The results suggest that HML_{NA} has a strong ability to price carry trade portfolios across rebalancing frequencies. This is more than a trivial mechanical statement, as manifest by the poor pricing performance of HML_{FX} at this lower frequency.

The Relation between HML_{NA}, HML_{FX} and VOL_{FX}. In this section we compare the global imbalance risk factor to the existing risk factors in the literature, HML_{FX} and VOL_{FX}, to show that global imbalance risk contains no less information for the purpose of pricing carry trade returns.

Panel A of Table 6 presents the cross-sectional asset pricing results when our global imbalance risk factor is compared to the slope risk factor of Lustig, Roussanov and Verdelhan (2011).

[21] We also test for this effect by starting with All Countries and then systematically remove pegged and crawling pegged currencies using the classification of Ilzetzki, Reinhart and Rogoff (2008). Our asset pricing results remain largely unaffected and so we present this results in Table A5 in Appendix A.

Since these factors are highly correlated, we mitigate the effect of multicollinearity as follows. Firstly, we take the first principal component (PC) between HML_{FX} and HML_{NA}, and report (left panel) cross-sectional asset pricing results when the pricing kernel includes DOL and PC. The estimates of λ and b are statistically different from zero, the cross-sectional R^2 is high, and the χ^2 test cannot reject the null of zero pricing errors. This exercise simply shows that PC is a perfect substitute for the high-minus-low factors as it prices the cross-section of the carry trade portfolios equally well. Secondly, we orthogonalize HML_{FX} and HML_{NA} with respect to PC, and use them as additional risk factors in the pricing kernel. Moving along Panel A, the middle panel presents results when the pricing kernel includes DOL, PC and $HML_{FX}^{\perp}$, the orthogonal component of HML_{FX} with respect to PC; the right panel replaces $HML_{FX}^{\perp}$ with $HML_{NA}^{\perp}$, the orthogonal component of HML_{NA} with respect to PC. The goal of these two exercises is to test whether the orthogonal components of either factor is priced, while avoiding the statistical inference problem that multicollinearity may cause. Indeed, we find that neither $HML_{FX}^{\perp}$ nor $HML_{NA}^{\perp}$ is priced in the cross-section of the carry trade returns. Overall, we conclude that HML_{NA} replicates reasonably well HML_{FX} and there is no additional information in HML_{FX} that is not captured by our global imbalance risk factor.[22]

Panel B of Table 6 repeats the exercise using our global imbalance risk factor and the volatility factor of Menkhoff, Sarno, Schmeling and Schrimpf (2012). We find that HML_{NA} is largely comparable to VOL_{FX} as HML_{NA} reproduces the pricing information content of VOL_{FX}. In essence, the discussion of the results in Panel A applies also to the results in Panel B.

6 Further Analysis

In this section, we present a battery of additional exercises that support the risk-based interpretation of currency excess returns proposed in the previous section.

Portfolios based on HML_{NA} Betas. We provide evidence on the explanatory power

[22] We also run these cross-sectional regressions with all factors without orthogonalizations, but we find that none of the factors price currency excess returns (i.e. are statistically insignificant), because of the inherent multicollinearity. These results are similar to the ones reported in Lustig, Roussanov, and Verdelhan (2011), and Menkhoff, Sarno, Schmeling and Schrimpf (2012).

of the global imbalance risk factor for currency excess returns from a different viewpoint. We form portfolios based on individual currency's exposure to global imbalance risk, and investigate whether these portfolios have similar return distributions to portfolios sorted on forward premia. If global imbalance risk is a priced factor, then currencies sorted according to their exposure to global imbalance risk should yield a cross section of portfolios with a significant spread in average currency returns. Currencies that hedge global imbalance risk should trade at a discount, whereas currencies that give exposure to global imbalance risk should trade at a premium.

We regress individual currency excess return at time t on a constant and the global imbalance risk factor using a 36-month rolling window that ends in period $t-1$, and denote this slope coefficient as $\beta^i_{NA,t}$. This exercise provides currency i exposure to HML_{NA} only using information available at time t. We then rank currencies according to $\beta^i_{NA,t}$ and allocate them to five portfolios at time t. Portfolio 1 contains the currencies with the strongest negative exposure to the global imbalance factor (lowest betas), while Portfolio 5 contains the most positively exposed currencies (highest betas). Table 7 summarizes the descriptive statistics on these portfolios. We find that buying currencies with a low beta (i.e., insurance against global imbalance risk) yields a significantly lower return than currencies with a high beta (i.e., high exposure to global imbalance risk). The spread between the last portfolio and the first portfolio is around 3 percent per annum for All Countries and 5 percent per annum for Developed Countries. Average excess returns generally increase, albeit not always monotonically, when moving from the first to the last portfolio. We also find that beta-sorted portfolios have a skewness pattern similar to the currency portfolios in Table 2. High beta currencies show a greater propensity to experience large return drawdowns than low beta currencies. Moreover, we also find a clear monotonic increase in both average *pre*-formation and *post*-formation betas when moving from Portfolio 1 to Portfolio 5: they line up perfectly well with the cross-section of average excess returns in Table 2. Average *pre*-formation betas vary from -0.32 to 1.19 for All Countries, and from -1.04 to 0.62 for Developed Countries. *Post*-formation betas are calculated by regressing realized excess returns of beta-sorted portfolio j on DOL and HML_{NA}. These figures range from -0.36 to 0.26 for All Countries, and from -0.58 to 0.57 for Developed Countries. Overall, these results confirm that global imbalance risk is important for understanding the cross-section of currency excess return.

FX **Portfolios versus** NA **Portfolios.** We now present further evidence on the relationship between carry trade and exernal imbalances portfolios. We run the following time-series regressions

$$RX^j_{FX,t+1} = \alpha^j + \beta RX^j_{NA,t+1} + \varepsilon^j_{t+1}$$

where $RX_{FX,t+1}$ indicates the portfolio excess returns obtained at time $t+1$ by sorting currencies into five groups at time t using their one-month forward premia (i.e. FX portfolios), and $RX_{NA,t+1}$ indicates the portfolio excess returns realized at time $t+1$ by sorting currencies into five groups at time t using the net foreign assets position to GDP ratio (NA portfolios) and the percentage share of external liabilities in domestic currency; $j = 1, \ldots, 5$ indicates one of the five portfolios. Table 8 reports the least squares estimates of the above regressions for each of Portfolios 1 to 5, and suggests that currency excess returns are systematically explained by the external imbalances portfolios. Low interest rate currencies are associated with net creditor nations whereas high interest rate currencies are linked to net debtor nations. Estimates of β are all statistically different from zero and are in the range between 0.75 and 0.93 for All Countries, and 0.66 and 0.72 for Developed Countries. We also report estimates of α in percent per annum. For Developed Countries, estimates of α are always statistically insignificant, suggesting that risk exposure to external imbalances fully explains the time-series variation in currency portfolio returns. For All Countries, we find that 4 out of 5 estimates of α are not statistically different from zero. These results are corroborated by the R^2, which ranges from 54 to 77 percent for All Countries, and from 66 to 72 percent for Developed Countries. In addition to the R^2, we also report the sample correlation for the full sample and two sub-samples. We find that the relationship between carry trade portfolios and the external imbalances portfolios has improved, especially for All Countries, over time. This higher degree of comovement between the two sets of portfolios in the second half of the sample is not surprising as it reflects less stringent capital controls as well as an increase in trading activity for some of the emerging market currencies. In short, all five FX and NA portfolio returns tend to move together.[23] From the perspective of HML factors, we find a strong positive correlation between HML_{NA} and HML_{FX} ranging from 54 percent

[23] Table A3 in Appendix A reports the portfolio composition for both FX and NA portfolios. Panel A (Panel B) reports the top six currencies for each of the FX (NA) portfolios. Panel C reports the probability that a given currency enters simultaneously the same FX and NA portfolio. For corner portfolios, this probability ranges from 45 to 36 percent for All Countries and from 44 to 35 percent for Developed Countries.

for All Countries to 62 percent for Developed Countries, suggesting that the strength of our asset pricing results are not artificially driven by the underlying factor structure of currency returns.[24]

Real Returns. In Table 9, we show that our results are robust to inflation-adjusted returns. At time t, we allocate currencies to five portfolios according to their inflation-adjusted forward premia $(F_t - S_t)/S_t - E_t(\pi^*_{t+1} - \pi_{t+1})$, where π^*_{t+1} and π_{t+1} denote the one-month foreign and domestic inflation rates at time $t+1$, respectively, and E_t is the conditional expectations operator given information at time t. This is equivalent to sorting currencies according to their real, rather than nominal, interest rate differential. Since π^*_{t+1} and π_{t+1} are not observed at time t, we construct inflation forecasts by simply using current inflation, that is we set $E_t(\pi^*_{t+1} - \pi_{t+1}) = \pi^*_t - \pi_t$.[25] Currencies with the lowest real interest rate differential are assigned to Portfolio 1, whereas currencies with the highest real interest rate differential are assigned to Portfolio 5. At time $t+1$, for each currency portfolio we compute either nominal excess returns (left panels) or inflation-adjusted excess returns (right panels) using the inflation rate at time $t+1$ from the perspective of the domestic investor. Note that we use the same DOL and HML_{NA} as in Table 3 as risk factors. Panel A reports cross-sectional results whereas Panel B displays time-series estimates. The global imbalance risk premium remains positive and statistically different from zero: the estimate of λ_{NA} is about 8 percent per annum for both nominal and real returns, and strongly statistically significant. The cross-sectional R^2 remains large, at around 95 percent for both sets of test assets, and the null hypothesis that the pricing errors are zero cannot be rejected on the basis of the χ^2 test. The DOL risk factor is still not priced in the cross section but turns negative when pricing the real excess returns, possibly indicating the existence of a small inflation premium within DOL. Overall, these results are largely comparable to our core findings in Table 3. We confirm higher risk premia for currency portfolios whose returns co-move positively with the global imbalance factor, and lower risk premia for currency portfolios exhibiting a negative

[24] Lewellen, Nagel and Shanken (2010) show that a strong factor structure in test asset returns can lead to misleading results in empirical work. If the risk factor has a small (but non zero) correlation with the 'true' factor, the cross-sectional R^2 could still be high suggesting an impressive model fit. Here, we show that the correlation between our factor and HML_{FX} is indeed reasonably high and has improved over the last decade.

[25] While this assumption is obviously strong, it is empirically motivated since inflation is a very persistent process and current inflation is highly correlated with future inflation at the monthly frequency.

covariance with the global imbalance factor.

Different Base Currencies In Table 10, we use alternative base currencies as an additional robustness check, taking the perspective of a Swiss, Euro-based, British and Japanese investor. Panel A presents cross-sectional regressions while Panel B reports time-series regressions for All Countries. The estimates of λ and b remain statistically different from zero and largely comparable to the core results in Table 8. The cross-sectional fit continues to be high as the R^2 moves from 61 percent to 75 percent, and the χ^2 test cannot reject the null of zero pricing errors. Overall, our results appear to be robust to this additional check.

Individual Currencies In Table 11, we test our global imbalance risk factor on individual currencies' excess returns. The set of currencies is now unbalanced and we only report estimates of time-series betas, market prices of risk, and factor loadings obtained via the FMB regressions. More importantly, since individual excess returns may be contaminated by large outliers for currencies with less trading activity, least square estimates can be severely distorted and fail to deliver unbiased estimates. We deal with this problem by using the least absolute deviation (LAD) estimator which is robust to thick-tailed errors and is not sensitive to atypical data points (Bassett and Koenker, 1978; Koenker and Bassett, 1982a; 1982b). In short, we use the Fama-MacBeth procedure with robust regressions in the first and second step to account for outliers in individual currency excess returns. We report standard errors corrected for heteroskedasticity and serial correlation (Weiss, 1990) with Andrews (1991) optimal lag selection in parentheses, and bootstrapped standard errors obtained via 10,000 repetitions in brackets.[26] Panel A reports cross-sectional asset pricing results when individual currencies' excess returns are used as test assets, and DOL and HML_{NA} as risk

[26]To calculate the standard errors by means of bootstrap, we simulate the following data generating process (DGP) with the same length as in our sample:

$$r_{i,t} = \alpha_i + \beta_i F_t + \varepsilon_{i,t}$$
$$F_t = \mu + \sum_{i=1}^{p} A_i F_{t-i} + u_t$$

where $r_{i,t}$ is the return on the i-th portfolio, α_i is the constant, β_i is the vector of factor loadings, F_t is the vector of factors following a p-order VAR process, $\varepsilon_{i,t}$ are idiosyncratic residuals, and $u_t \sim N(0, \Sigma)$. We estimate this system, and use the parameter estimates to generate 10,000 time-series by jointly resampling $\varepsilon_{i,t}$ and u_t. Since the panel is unbalanced, we carefully resample the same dates across all individual currencies, and then remove the missing value before running FMB regressions.

factors. We consider three sets of currencies: All, Developed and Emerging, and Developed. We find positive and statistically significant estimates of λ_{NA}, which are largely comparable to the estimates reported in Table 3 and Table 4. The cross-sectional R^2 is reasonably high, ranging from 72 percent for Developed Countries to 40 percent for All Countries, but lower than the R^2 for portfolio returns. This is expected as individual excess returns are far more noisy than portfolio returns. Panel B replaces HML_{NA} with HML_{FX}, whereas Panel C refers to VOL_{FX}. While estimates of market prices of risk are statistically significant for All Countries and Developed and Emerging Countries, for Developed Countries we uncover statistically insignificant estimates of λ_{FX} and λ_{VOL}.

7 Conclusions

The massive depreciation of high-interest currencies in the aftermath of the Lehman Brothers' collapse has revived interest in the risk-return profile of the carry trade, a popular strategy that exploits interest rate differentials across countries. If high-interest rate currencies deliver low returns when consumption is low, then currency excess returns simply compensate investors for higher risk exposure and carry trade returns reflect time-varying risk premia (Fama, 1984; Engel, 1996). In a recent attempt to validate this risk-based explanation, Lustig, Roussanov, and Verdelhan (2011) propose a return-based factor that helps explain the difference in the average returns between baskets of high and low interest rate currencies. While this approach establishes that there is systematic risk in carry trades, it is silent about the economic determinants underlying currency premia. Related work has posited the existence of a 'crash' premium to compensate investors for large and sudden drawdowns in carry trades. But again, this explanation provides limited intuition surrounding the economic rationale for why a currency depreciation is required.

This paper tackles exactly this issue by shedding empirical light on the *macroeconomic* forces driving currency premia and crashes in the currency market. Motivated by the models of Gourinchas and Rey (2007) and Gourinchas (2008), we construct a risk factor that captures exposure to global imbalances and the currency denomination of external liabilities, and show that it explains the bulk of excess returns in a standard asset pricing model. The economic intuition for our factor is as follows: debtor countries offer a currency risk premium to compensate investors willing to finance negative external imbalances. Following an external shock, debtor nations experience a sharp currency depreciation to restore balance in their net foreign asset position - a depreciation that is amplified in countries with predominately foreign currency denominated liabilities. This suggests that carry trade investors can be viewed as taking on global imbalance risk.

Overall, we provide empirical support for the oft empirically rejected link between exchange rate returns and macroeconomic fluctuations. The global risk factor previously identified in the currency market can be viewed as global imbalance risk: a fundamental and theoretically motivated source of risk driving currency returns.

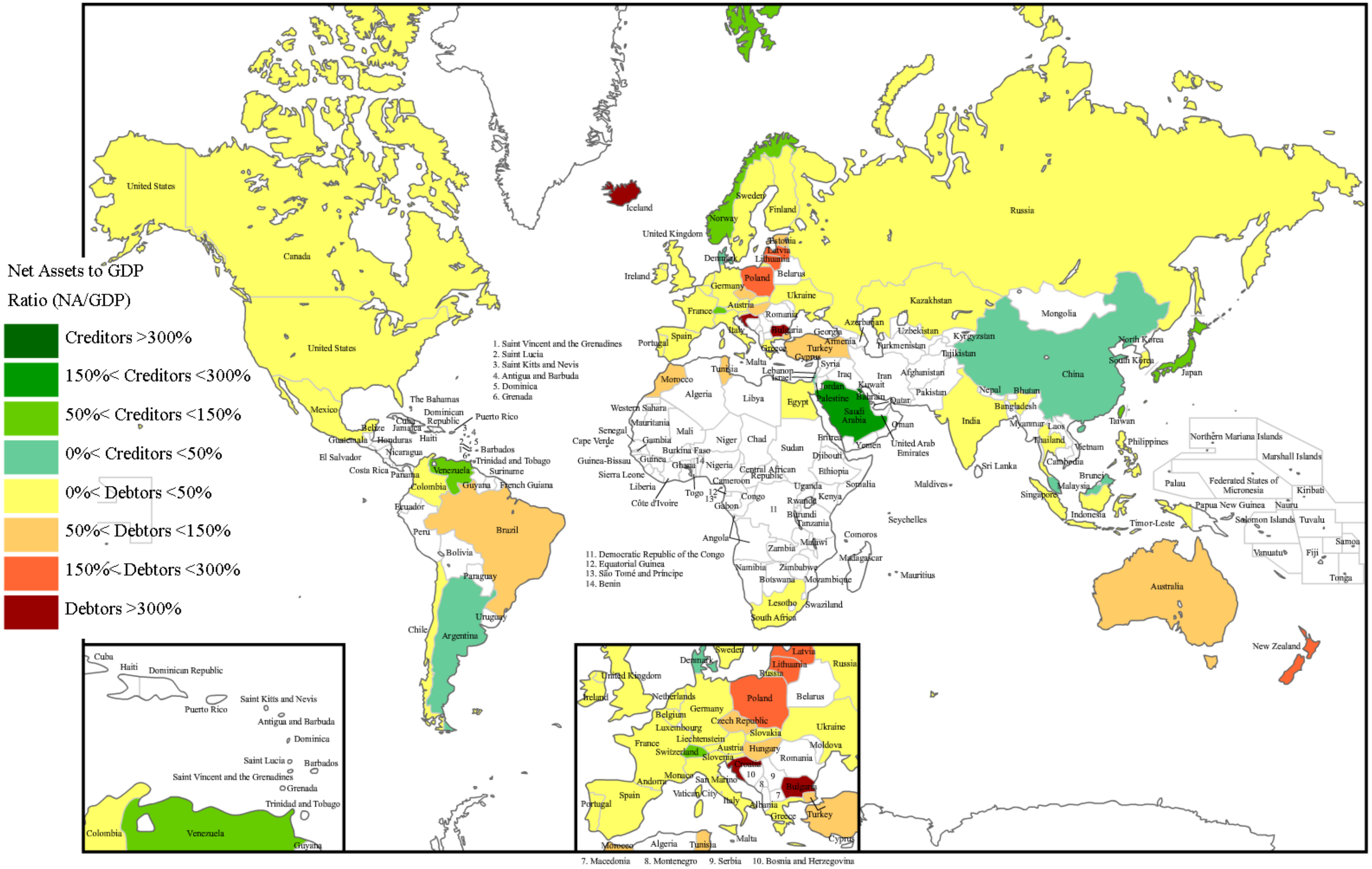

Figure 1. The World Distribution of External Imbalances

The figure presents the net foreign asset position relative to gross domestic product of all countries included in our sample. We report the distribution of external imbalances as of December 2011 using data from the *International Financial Statistics* database. We build the map using P&P World Map (http://edit.freemap.jp/en/).

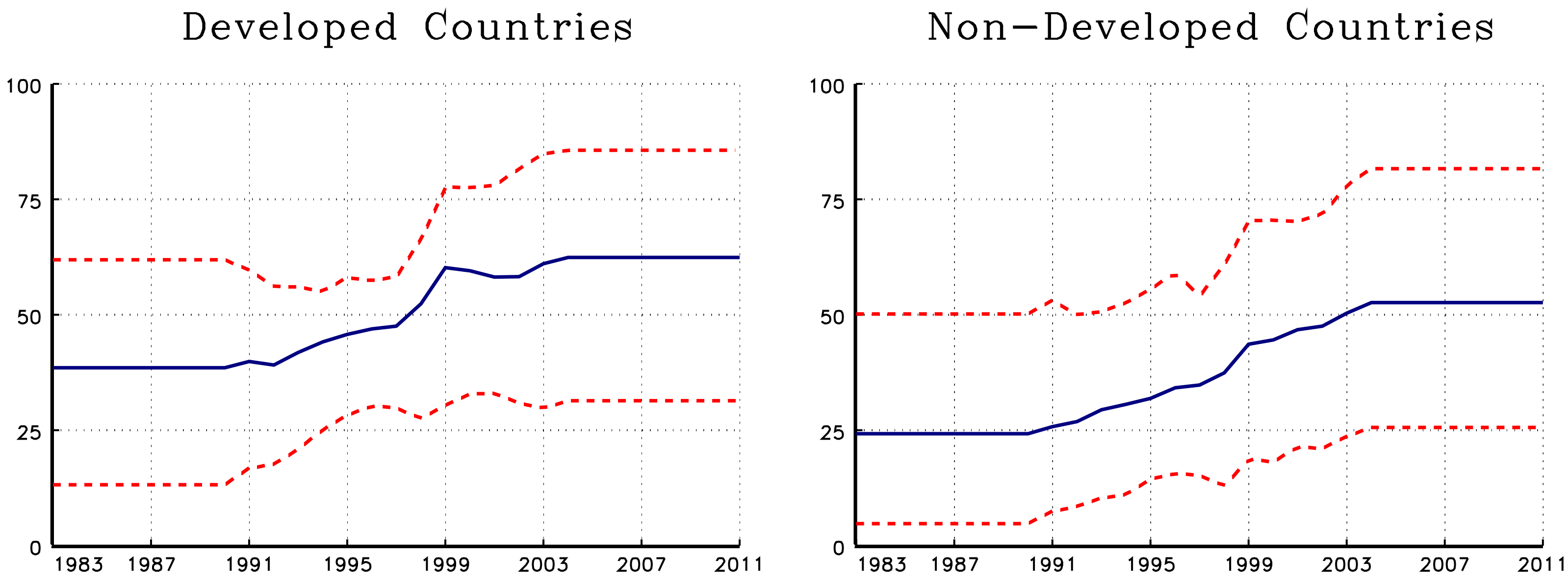

Figure 2. Share of Foreign Liabilities in Domestic Currency

The figure presents the average share of foreign liabilities issued in domestic currency (*solid line*) and the 90th and 10th percentile (*dashed line*). The dataset is from Lane and Shambaugh (2010) and comprises yearly estimates from 1990 through 2004. We retrieve monthly data by keeping end-of-period data constant until a new observation becomes available. Data prior to 1990 are set to equal to the first available observation.

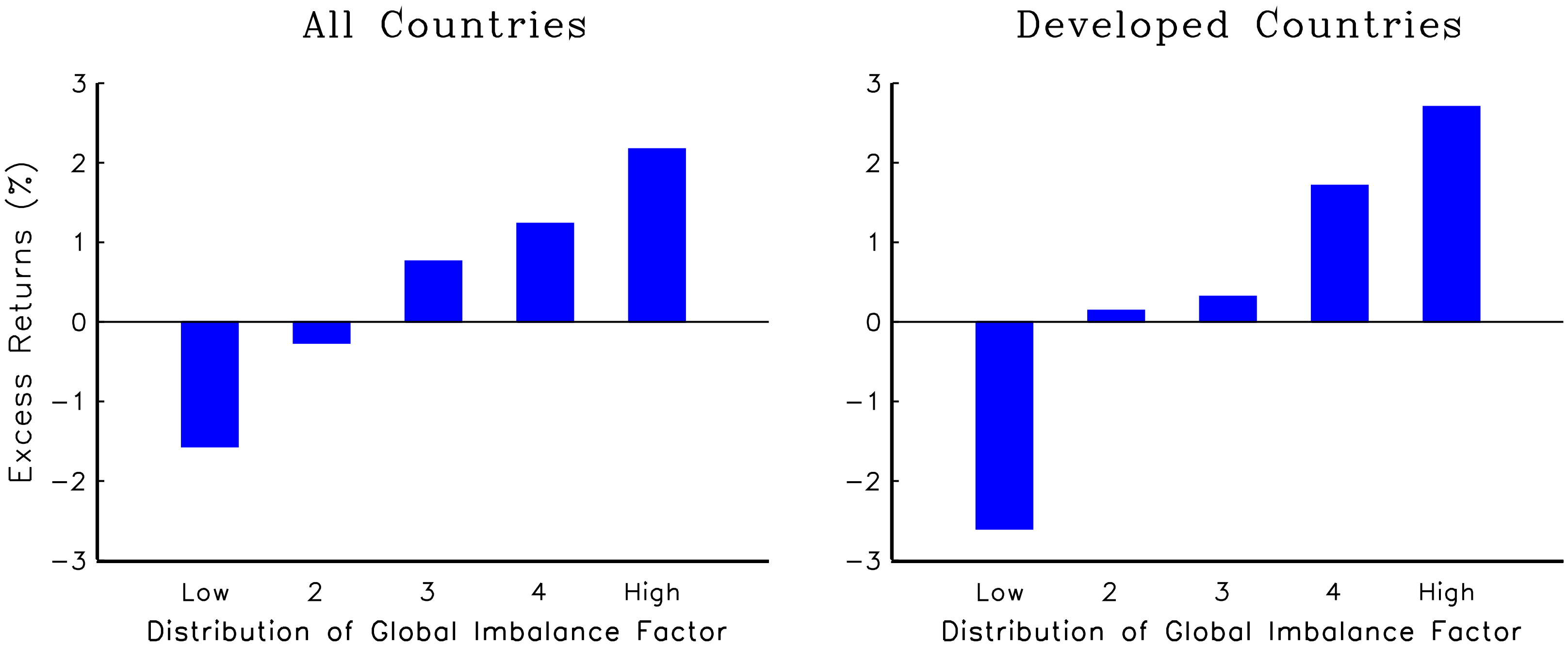

Figure 3. Currency Excess Returns and External Imbalances

The figure presents mean excess returns for carry trade portfolios conditional on 'external imbalances' being within the lowest to highest quintile of its sample distribution. The bars show average excess returns for being long in Portfolio 5 (largest forward premia) and short in Portfolio 1 (lowest forward premia). The global imbalance risk factor is constructed as a long-short strategy that buys the currencies of debtor nations with the lowest share of foreign liabilities in domestic currency and sells the currencies of creditor nations with the highest share of foreign liabilities in domestic currency. Excess returns are expressed in percentage per annum and adjusted for transaction costs. The portfolios are rebalanced monthly from October 1983 to December 2011. Exchange rates are from Datastream. Yearly data on GDP, foreign assets and liabilities are from Lane and Milesi-Ferretti (2007). Yearly data on the share of external liabilities in domestic currency are from Lane and Shambaugh (2010). Monthly observations are retrieved by keeping end-of-period data constant until a new observation becomes available.

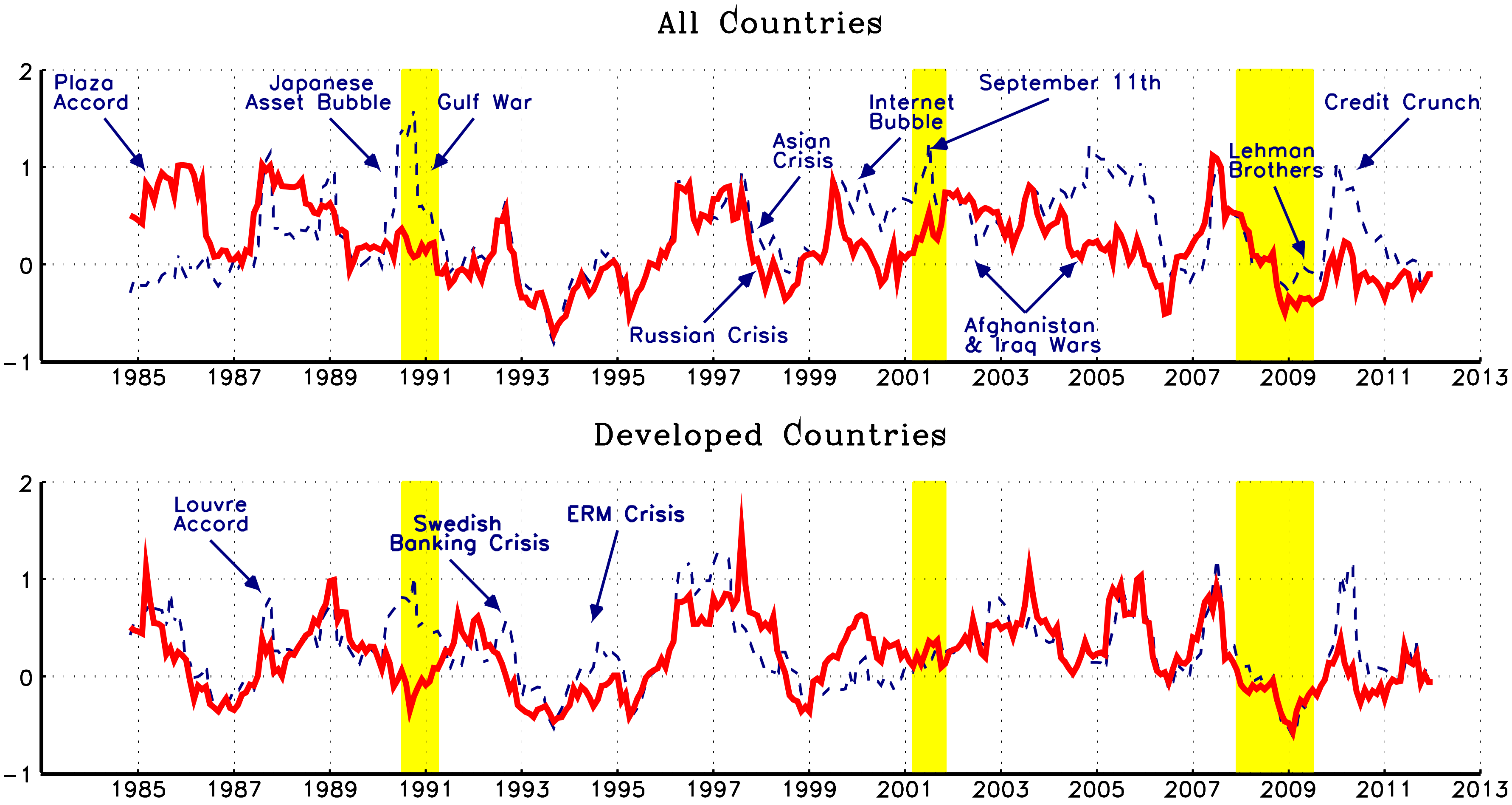

Figure 4. Rolling Sharpe Ratios

The figure presents the one-year rolling Sharpe ratios, net of transaction costs, for HML_{FX} (*dashed*) and HML_{NA} (*solid*). HML_{FX} denotes a long-short strategy that buys the currencies with the highest forward premia and sells the currencies with the lowest forward premia. HML_{NA} is long-short strategy that buys the currencies of debtor countries with the lowest share of foreign liabilities in domestic currency and sells the currencies of creditor countries with the highest share of foreign liabilities in domestic currency. The Shaded areas are the NBER recession periods for the US. The strategies are rebalanced monthly from October 1983 to December 2011. Exchange rates are from Datastream. Yearly data on GDP, foreign assets and liabilities are from Lane and Milesi-Ferretti (2007). Yearly data on the share of external liabilities in domestic currency are from Lane and Shambaugh (2010). Monthly observations are retrieved by keeping end-of-period data constant until a new observation becomes available.

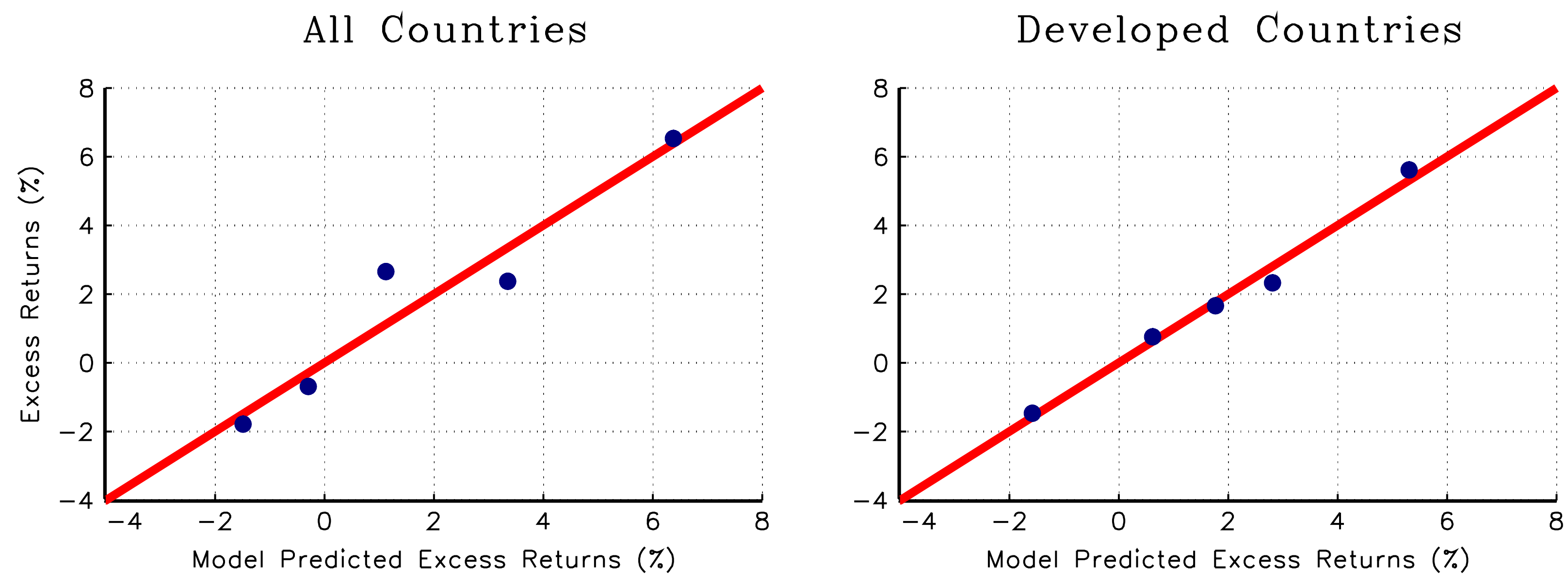

Figure 5. Pricing Errors Plots

The figure presents cross-sectional pricing errors for the linear factor model based on the dollar (DOL) and global imbalance risk (HML_{NA}) factors. The test assets are excess returns to currency (FX) portfolios obtained by sorting currencies into five groups using the one-month forward premia (nominal interest rate differentials). Portfolio 1 contains currencies with the lowest forward premia (funding currencies) whereas Portfolio 5 contains currencies with the highest forward premia (investment currencies). DOL is the average return across these portfolios. HML_{NA} denotes a long-short strategy that buys the currencies of debtor nations with the lowest share of foreign liabilities in domestic currency and sells the currencies of creditor nations with the highest share of foreign liabilities in domestic currency. Excess returns are expressed in percentage per annum. The portfolios are rebalanced monthly from October 1983 to December 2011. Exchange rates are from Datastream. Yearly data on GDP, foreign assets and liabilities are from Lane and Milesi-Ferretti (2007). Yearly data on the share of external liabilities in domestic currency are from Lane and Shambaugh (2010). Monthly observations are retrieved by keeping end-of-period data constant until a new observation becomes available.

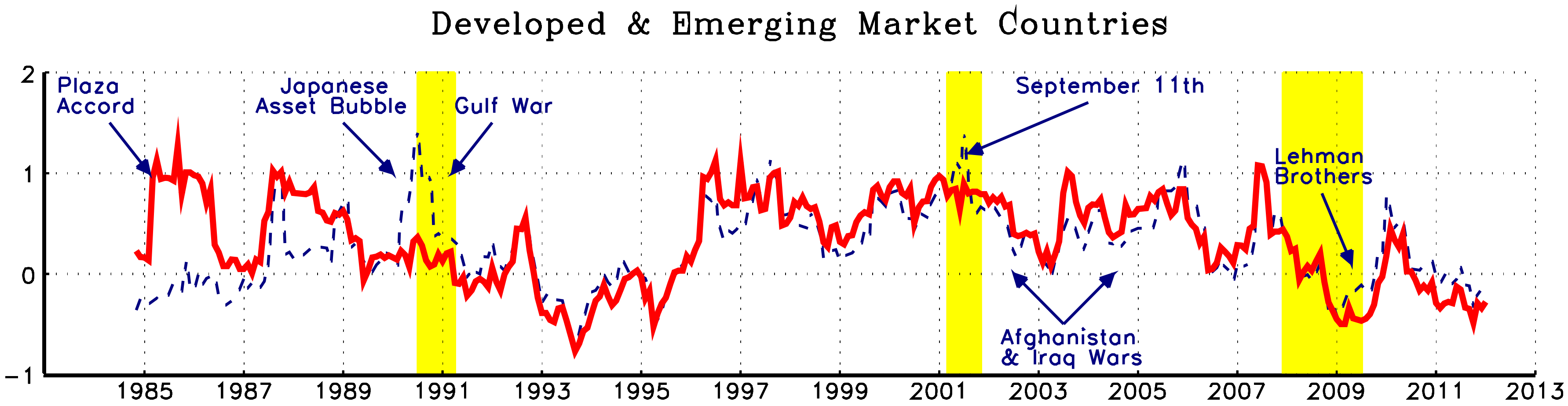

Figure 6. Rolling Sharpe Ratios

The figure presents the one-year rolling Sharpe ratios, net of transaction costs, for HML_{FX} (*dashed*) and HML_{NA} (*solid*) when the top 20 most liquid currencies are selected (*Developed and Emerging Market Countries*). HML_{FX} denotes a long-short strategy that buys the currencies with the highest forward premia and sells the currencies with the lowest forward premia. HML_{NA} is long-short strategy that buys the currencies of debtor countries with the lowest share of foreign liabilities in domestic currency and sells the currencies of creditor countries with the highest share of foreign liabilities in domestic currency. The Shaded areas are the NBER recession periods for the US. The strategies are rebalanced monthly from October 1983 to December 2011. The sample includes developed economies and the most Exchange rates are from Datastream. Yearly data on GDP, foreign assets and liabilities are from Lane and Milesi-Ferretti (2007). Yearly data on the share of external liabilities in domestic currency are from Lane and Shambaugh (2010). Monthly observations are retrieved by keeping end-of-period data constant until a new observation becomes available.

Table 1. Descriptive Statistics: FX Portfolios

This table presents descriptive statistics of five currency portfolios sorted on forward premia (nominal interest rate differentials). The first portfolio ($P1$) contains currencies with the lowest forward premia while the last portfolio ($P5$) contains currencies with the highest forward premia. DOL denotes the average across all portfolios. HML is a long-short strategy that buys $P5$ and sells $P1$. The table also reports the first order autocorrelation coefficient (AC_1), the annualized Sharpe ratio (SR), the maximum drawdown (MDD), and the frequency of portfolio switches ($Freq$). Excess returns are expressed in percentage per annum. The superscript τ denotes excess returns adjusted for transaction costs. *Panel A* (*Panel B*) presents portfolios rebalanced at the end of each month (year) using $t-1$ one-month (one-year) forward premia. The sample runs from October 1983 to December 2011. Exchange rates are from *Datastream*.

Panel A: Monthly Rebalancing

	$P1$	$P2$	$P3$	$P4$	$P5$	DOL	HML	DOL^{τ}	HML^{τ}
					All Countries				
$Mean$	−1.79	−0.69	2.66	2.37	6.53	1.82	8.32	0.61	5.44
Med	−1.02	1.99	3.27	4.02	9.30	3.46	11.51	2.28	8.42
$Sdev$	7.86	7.93	8.19	8.92	9.76	7.41	8.88	7.41	8.86
$Skew$	−0.07	−0.62	−0.44	−0.90	−0.79	−0.57	−1.02	−0.58	−1.06
$Kurt$	4.17	5.26	4.44	6.30	5.66	4.45	5.25	4.45	5.20
AC_1	0.03	0.05	0.09	0.08	0.19	0.10	0.14	0.10	0.14
SR	−0.23	−0.09	0.32	0.27	0.67	0.24	0.94	0.08	0.61
MDD	−38.9	−38.0	−32.9	−33.1	−33.1	−25.3	−27.1	−30.2	−31.4
$Freq$	19.8	29.3	32.1	33.2	17.6	26.4	37.3	26.4	37.3
					Developed Countries				
$Mean$	−1.46	0.76	1.66	2.33	5.61	1.78	7.08	0.97	5.25
Med	−2.18	2.96	4.25	3.89	6.94	3.20	11.12	2.61	8.62
$Sdev$	10.10	9.82	9.42	9.78	11.41	8.82	11.04	8.82	11.04
$Skew$	0.16	−0.21	−0.35	−0.75	−0.51	−0.33	−1.13	−0.34	−1.14
$Kurt$	3.52	3.70	4.41	5.74	4.82	3.79	6.07	3.78	6.09
AC_1	0.02	0.08	0.10	0.07	0.14	0.09	0.09	0.09	0.10
SR	−0.15	0.08	0.18	0.24	0.49	0.20	0.64	0.11	0.48
MDD	−46.8	−45.9	−38.0	−32.4	−35.7	−36.9	−38.9	−39.9	−40.2
$Freq$	12.3	26.4	31.7	25.2	14.3	22.0	26.5	22.0	26.5

Panel B: Yearly Rebalancing

	$P1$	$P2$	$P3$	$P4$	$P5$	DOL	HML	DOL^{τ}	HML^{τ}
					All Countries				
$Mean$	−1.26	0.69	0.56	2.76	3.83	1.32	5.09	0.99	4.22
Med	1.57	1.71	2.10	1.91	9.51	2.68	8.86	2.45	8.00
$Sdev$	9.98	8.60	11.39	10.19	19.23	10.12	17.20	10.10	16.96
$Skew$	−0.35	−0.42	−0.89	0.01	−1.52	−0.74	−0.55	−0.74	−0.59
$Kurt$	2.57	2.45	3.44	1.80	5.30	3.17	2.71	3.16	2.73
AC_1	0.00	0.05	−0.04	0.07	0.20	−0.04	0.37	−0.04	0.36
SR	−0.13	0.08	0.05	0.27	0.20	0.13	0.30	0.10	0.25
MDD	−37.1	−32.5	−50.4	−33.4	−61.7	−27.9	−50.8	−29.4	−51.7
$Freq$	36.9	57.1	59.1	56.2	36.7	49.2	73.5	49.2	73.5
					Developed Countries				
$Mean$	0.24	0.80	2.07	1.60	3.04	1.55	2.80	1.39	2.42
Med	2.17	3.52	1.90	2.72	2.37	1.24	3.23	1.09	2.99
$Sdev$	12.27	11.67	9.80	12.96	13.01	10.42	13.81	10.41	13.87
$Skew$	−0.41	−0.21	−0.02	−0.79	−0.06	−0.15	−0.72	−0.16	−0.71
$Kurt$	2.14	1.82	2.19	3.41	2.79	2.11	4.09	2.11	4.05
AC_1	0.07	0.05	0.06	−0.02	0.03	0.06	−0.05	0.06	−0.05
SR	0.02	0.07	0.21	0.12	0.23	0.15	0.20	0.13	0.17
MDD	−44.9	−46.0	−30.3	−33.1	−34.1	−33.9	−37.0	−34.5	−37.3
$Freq$	16.1	56.5	67.9	53.0	36.9	46.1	53.0	46.1	53.0

Table 2. Descriptive Statistics: NA Portfolios

This table presents descriptive statistics of five currency portfolios sorted on external imbalances (net foreign assets to GDP ratio) and the share of foreign liabilities in domestic currency. The first portfolio ($P1$) contains currencies with positive external imbalances (creditor nations) and the highest share of foreign liabilities in domestic currency while the last portfolio ($P5$) contains currencies with negative external imbalances (debtor nations) and the lowest share of foreign liabilities in domestic currency. DOL denotes the average across all portfolios. HML is a long-short strategy that buys $P5$ and sells $P1$. The table also reports the first order autocorrelation coefficient (AC_1), the annualized Sharpe ratio (SR), the maximum drawdown (MDD), and the frequency of portfolio switches ($Freq$). Excess returns are expressed in percentage per annum. The superscript τ denotes excess returns adjusted for transaction costs. *Panel A* (*Panel B*) presents portfolios rebalanced at the end of each month (year) using $t-1$ one-month (one-year) forward premia. The sample runs from October 1983 to December 2011. Exchange rates are from *Datastream.* Yearly data on GDP, foreign assets and liabilities are from Lane and Milesi-Ferretti (2007). Yearly data on the share of foreign liabilities in domestic currency are from Lane and Shambaugh (2010). Monthly observations are retrieved by keeping end-of-period data constant until a new observation becomes available.

Panel A: Monthly Rebalancing

	$P1$	$P2$	$P3$	$P4$	$P5$	DOL	HML	DOL^{τ}	HML^{τ}
					All Countries				
$Mean$	−0.16	1.79	0.76	2.23	4.54	1.83	4.70	0.70	2.31
Med	0.76	1.35	2.59	4.88	6.09	3.45	6.02	2.54	4.24
$Sdev.$	7.81	9.19	6.82	8.62	9.70	7.39	6.25	7.39	6.25
$Skew$	−0.32	−0.43	−1.23	−1.16	−0.55	−0.58	−0.23	−0.59	−0.37
$Kurt$	3.74	4.54	9.07	8.15	4.86	4.44	6.59	4.44	6.59
AC_1	0.09	0.08	0.12	0.05	0.14	0.10	0.21	0.10	0.21
SR	−0.02	0.19	0.11	0.26	0.47	0.25	0.75	0.09	0.37
MDD	−49.4	−31.8	−35.0	−31.4	−29.3	−24.7	−19.0	−29.5	−23.4
$Freq$	3.3	4.2	3.9	3.6	3.3	3.7	6.7	3.7	6.7
					Developed Countries				
$Mean$	−0.03	0.89	2.05	2.38	4.02	1.86	4.05	1.10	2.61
Med	1.20	1.34	3.06	4.26	5.87	3.33	5.99	2.75	4.53
$Sdev.$	10.08	10.76	9.14	9.49	10.03	8.92	6.51	8.92	6.51
$Skew$	−0.15	−0.33	−0.44	−0.63	−0.49	−0.35	−0.82	−0.35	−0.81
$Kurt$	3.40	3.90	4.56	7.14	4.21	3.74	5.88	3.74	5.90
AC_1	0.05	0.05	0.10	0.11	0.08	0.09	0.01	0.09	0.02
SR	0.00	0.08	0.22	0.25	0.40	0.21	0.62	0.12	0.40
MDD	−58.2	−39.9	−36.9	−38.1	−27.1	−37.2	−26.0	−39.9	−27.4
$Freq$	2.4	3.1	3.0	3.6	3.0	3.0	5.3	3.0	5.3

Panel B: Yearly Rebalancing

	$P1$	$P2$	$P3$	$P4$	$P5$	DOL	HML	DOL^{τ}	HML^{τ}
					All Countries				
$Mean$	−0.51	1.18	2.07	0.84	3.87	1.49	4.38	1.15	3.64
Med	0.67	0.97	1.75	1.86	6.63	3.03	3.81	2.68	3.15
$Sdev.$	10.11	10.32	8.42	11.92	13.87	9.73	7.97	9.69	7.81
$Skew$	−0.75	0.03	−0.69	−1.19	−0.50	−0.59	−0.46	−0.58	−0.53
$Kurt$	2.86	2.51	3.76	4.54	2.46	2.65	3.26	2.64	3.26
AC_1	0.02	−0.01	−0.14	0.08	−0.05	−0.04	0.19	−0.04	0.20
SR	−0.05	0.11	0.25	0.07	0.28	0.15	0.55	0.12	0.47
MDD	−40.9	−32.4	−21.7	−39.1	−34.5	−28.4	−16.4	−29.9	−17.1
$Freq$	25.2	35.1	28.8	29.0	27.3	29.1	52.5	29.1	52.5
					Developed Countries				
$Mean$	−0.34	0.86	1.54	2.08	3.67	1.56	4.01	1.40	3.71
Med	0.51	0.98	2.44	3.88	2.86	1.21	3.30	1.07	3.04
$Sdev.$	12.62	11.07	10.77	11.22	11.41	10.50	8.02	10.49	8.02
$Skew$	−0.31	−0.10	−0.13	−0.52	−0.19	−0.15	−0.24	−0.15	−0.25
$Kurt$	1.93	2.43	2.13	3.01	2.12	2.00	3.39	1.99	3.38
AC_1	0.09	−0.03	0.16	0.04	0.01	0.07	−0.03	0.07	−0.02
SR	−0.03	0.08	0.14	0.19	0.32	0.15	0.50	0.13	0.46
MDD	−49.2	−31.9	−39.3	−35.9	−23.0	−36.2	−17.4	−36.7	−17.9
$Freq$	25.0	31.5	23.8	32.1	27.4	38.0	52.4	38.0	52.4

Table 3. Asset Pricing: External Imbalances (with b-a)

This table reports cross-sectional asset pricing results. The linear factor model includes the dollar (DOL) and global imbalance risk (HML_{NA}) factors whereas the test assets are excess returns to five currency (FX) portfolios sorted on the one-month forward premia (nominal interest rate differentials). The first portfolio ($P1$) contains currencies with the lowest forward premia while the last portfolio ($P5$) contains currencies with the highest forward premia. DOL denotes the average return across the FX portfolios. HML_{NA} is a long-short strategy that buys the currencies of debtor nations with the lowest share of foreign liabilities in domestic currency and sells the currencies of creditor nations with the highest share of foreign liabilities in domestic currency. *Panel A* reports GMM and Fama-MacBeth (FMB) estimates of the factor loadings b, the market price of risk λ, the cross-sectional R^2, and the *p-value* of the χ^2 test for the null hypothesis of zero pricing errors. *Panel B* reports least-squares estimates of time series regressions. The *p-values* and the standard errors reported in parentheses are based on Newey and West (1987) with Andrews (1991) optimal lag selection. Shanken (1992) standard errors are reported in brackets. Excess returns are expressed in percentage per annum and adjusted for transaction costs that occur in a short position ($P1$) and long position ($P2$-$P5$). The portfolios are rebalanced monthly from October 1983 to December 2011. Exchange rates are from *Datastream*. Yearly data on GDP, foreign assets and liabilities are from Lane and Milesi-Ferretti (2007). Yearly data on the share of external liabilities in domestic currency are from Lane and Shambaugh (2010). Monthly observations are retrieved by keeping end-of-period data constant until a new observation becomes available.

Panel A: Factor Prices

	b_{DOL}	b_{NA}	λ_{DOL}	λ_{NA}	R^2	$RMSE$	χ^2	b_{DOL}	b_{NA}	λ_{DOL}	λ_{NA}	R^2	$RMSE$	χ^2
	All Countries							*Developed Countries*						
GMM_1	−0.22	1.61	0.01	0.07	0.84	1.87	0.22	0.07	0.95	0.01	0.05	0.93	1.02	0.84
	(0.31)	(0.61)	(0.02)	(0.02)				(0.23)	(0.52)	(0.02)	(0.02)			
GMM_2	−0.17	1.63	0.01	0.06	0.83	1.97	0.22	0.09	1.04	0.01	0.05	0.93	1.02	0.85
	(0.30)	(0.61)	(0.02)	(0.02)				(0.22)	(0.50)	(0.02)	(0.02)			
FMB	−0.22	1.60	0.01	0.07	0.84	1.87	0.22	0.07	0.95	0.01	0.05	0.93	1.02	0.84
	(0.26)	(0.50)	(0.02)	(0.02)				(0.20)	(0.41)	(0.02)	(0.02)			
	[0.24]	[0.49]	[0.01]	[0.02]				[0.18]	[0.39]	[0.02]	[0.02]			

Panel B: Factor Betas

	α	β_{DOL}	β_{NA}	R^2	α	β_{DOL}	β_{NA}	R^2
$P1$	−0.01	0.98	−0.32	0.78	−0.01	0.95	−0.51	0.75
	(0.01)	(0.05)	(0.04)		(0.01)	(0.05)	(0.07)	
$P2$	−0.02	0.99	−0.21	0.79	−0.01	1.01	−0.18	0.82
	(0.01)	(0.04)	(0.04)		(0.01)	(0.04)	(0.04)	
$P3$	0.01	1.03	−0.07	0.84	0.01	0.99	0.01	0.86
	(0.01)	(0.04)	(0.04)		(0.01)	(0.03)	(0.04)	
$P4$	0.01	1.07	0.15	0.84	0.01	1.00	0.16	0.83
	(0.01)	(0.04)	(0.06)		(0.01)	(0.03)	(0.05)	
$P5$	0.03	0.94	0.45	0.71	0.02	1.05	0.53	0.79
	(0.01)	(0.07)	(0.08)		(0.01)	(0.04)	(0.06)	

Table 4. Asset Pricing: Liquid Currency (with b-a)

This table reports cross-sectional asset pricing results for *Developed and Emerging Market Countries.* This subset only includes the top 20 most liquid currencies. The linear factor model includes the dollar (DOL) and global imbalance risk (HML_{NA}) factors whereas the test assets are excess returns to five currency (FX) portfolios sorted on the one-month forward premia (nominal interest rate differentials). The first portfolio ($P1$) contains currencies with the lowest forward premia while the last portfolio ($P5$) contains currencies with the highest forward premia. DOL denotes the average return across the FX portfolios. HML_{NA} is a long-short strategy that buys the currencies of debtor nations with the lowest share of foreign liabilities in domestic currency and and sells the currencies of creditor nations with the highest share of foreign liabilities in domestic currency. *Panel A* reports GMM and Fama-MacBeth (FMB) estimates of the factor loadings b, the market price of risk λ, the cross-sectional R^2, and the *p-value* of the χ^2 test for the null hypothesis of zero pricing errors. *Panel B* reports least-squares estimates of time series regressions. The *p-values* and the standard errors reported in parentheses are based on Newey and West (1987) with Andrews (1991) optimal lag selection. Shanken (1992) standard errors are reported in brackets. Excess returns are expressed in percentage per annum and adjusted for transaction costs that occur in a short position ($P1$) and long position ($P2$-$P5$). The portfolios are rebalanced monthly from October 1983 to December 2011. Exchange rates are from *Datastream.* Yearly data on GDP, foreign assets and liabilities are from Lane and Milesi-Ferretti (2007). Yearly data on the share of external liabilities in domestic currency are from Lane and Shambaugh (2010). Monthly observations are retrieved by keeping end-of-period data constant until a new observation becomes available.

Panel A: Factor Prices

	b_{DOL}	b_{NA}	λ_{DOL}	λ_{NA}	R^2	$RMSE$	χ^2
GMM_1	−0.03	0.91	0.01	0.06	0.80	1.94	0.34
	(0.25)	(0.47)	(0.02)	(0.02)			
GMM_2	0.07	1.15	0.01	0.06	0.79	1.98	0.42
	(0.23)	(0.44)	(0.02)	(0.02)			
FMB	−0.03	0.91	0.01	0.06	0.80	1.94	0.34
	(0.21)	(0.38)	(0.02)	(0.02)			
	[0.20]	[0.37]	[0.02]	[0.02]			

Panel B: Factor Betas

	α	β_{DOL}	β_{NA}	R^2
$P1$	0.01	0.95	−0.41	0.78
	(0.01)	(0.05)	(0.06)	
$P2$	−0.01	1.00	−0.15	0.83
	(0.01)	(0.04)	(0.04)	
$P3$	0.01	0.98	0.00	0.87
	(0.01)	(0.03)	(0.03)	
$P4$	−0.01	1.11	0.10	0.85
	(0.01)	(0.04)	(0.05)	
$P5$	0.02	0.96	0.45	0.70
	(0.01)	(0.09)	(0.06)	

Table 5. Asset Pricing: Yearly Rebalanced Portfolios (with b-a)

This table reports cross-sectional asset pricing results for two linear factor models: the dollar (DOL) and slope risk (HML_{FX}) factors (*left-hand side*), and the dollar (DOL) and global imbalance risk (HML_{NA}) factors (*right-hand side*). The test assets are excess returns to five currency (FX) portfolios sorted on the one-year forward premia (nominal interest rate differentials). The first portfolio ($P1$) contains currencies with the lowest forward premia while the last portfolio ($P5$) contains currencies with the highest forward premia. DOL denotes the average return across the FX portfolios. HML_{FX} denotes a long-short strategy that buys $P5$ and $P1$. HML_{NA} is a long-short strategy that buys the currencies of debtor nations with the lowest share of foreign liabilities in domestic currency and sells the currencies of creditor nations with the highest share of foreign liabilities in domestic currency. *Panel A* reports GMM and Fama-MacBeth (FMB) estimates of the factor loadings b, the market price of risk λ, the cross-sectional R^2, and the *p-value* of the χ^2 test for the null hypothesis of zero pricing errors. *Panel B* reports least-squares estimates of time series regressions. The *p-values* and the standard errors reported in parentheses are based on Newey and West (1987) with Andrews (1991) optimal lag selection. Shanken (1992) standard errors are reported in brackets. Excess returns are expressed in percentage per annum and adjusted for transaction costs that occur in a short position ($P1$) and long position ($P2$-$P5$). The portfolios are rebalanced yearly from December 1983 to December 2011. Exchange rates are from *Datastream*. Yearly data on GDP, foreign assets and liabilities are from Lane and Milesi-Ferretti (2007). Yearly data on the share of external liabilities in domestic currency are from Lane and Shambaugh (2010).

Panel A: Factor Prices

	b_{DOL}	b_{FX}	λ_{DOL}	λ_{FX}	R^2	$RMSE$	χ^2	b_{DOL}	b_{NA}	λ_{DOL}	λ_{NA}	R^2	$RMSE$	χ^2
	All Countries							*All Countries*						
GMM_1	0.37	1.04	0.01	0.03	0.55	2.29	0.28	−1.83	9.10	0.01	0.05	0.71	1.85	0.79
	(2.13)	(1.56)	(0.02)	(0.04)				(2.04)	(4.69)	(0.02)	(0.02)			
GMM_2	0.37	1.96	0.01	0.07	−0.22	3.96	0.33	−2.05	9.94	0.01	0.05	0.69	1.90	0.80
	(2.09)	(1.45)	(0.02)	(0.04)				(2.01)	(4.19)	(0.02)	(0.02)			
FMB	0.36	1.01	0.01	0.03	0.55	2.29	0.27	−1.76	8.78	0.01	0.05	0.71	1.85	0.77
	(1.98)	(1.40)	(0.02)	(0.04)				(2.19)	(3.88)	(0.02)	(0.02)			
	[2.05]	[1.26]	[0.02]	[0.03]				[2.38]	[4.48]	[0.02]	[0.02]			

Panel B: Factor Betas

	α	β_{DOL}	β_{FX}	R^2	α	β_{DOL}	β_{NA}	R^2
$P1$	−0.01	1.01	−0.28	0.87	−0.01	0.96	−0.42	0.75
	(0.01)	(0.10)	(0.05)		(0.01)	(0.09)	(0.11)	
$P2$	0.01	0.87	−0.09	0.93	0.01	0.84	−0.08	0.91
	(0.01)	(0.03)	(0.02)		(0.01)	(0.05)	(0.06)	
$P3$	0.01	1.11	−0.18	0.81	−0.01	0.94	0.14	0.75
	(0.01)	(0.17)	(0.08)		(0.02)	(0.12)	(0.15)	
$P4$	0.02	1.00	−0.16	0.82	0.01	0.79	0.30	0.81
	(0.01)	(0.10)	(0.05)		(0.01)	(0.15)	(0.17)	
$P5$	−0.01	1.01	0.72	0.97	0.01	1.46	0.06	0.59
	(0.01)	(0.10)	(0.05)		(0.03)	(0.34)	(0.38)	

Table 6. Asset Pricing: HML_{NA}, HML_{FX}, and VOL_{FX} (with b-a)

This table reports cross-sectional asset pricing results for the linear factor models based on the dollar (DOL), slope (HML_{FX}), volatility (VOL_{FX}) and global imbalance risk (HML_{NA}) factors. The test assets are excess returns to five currency (FX) portfolios sorted on the one-month forward premia (nominal interest rate differentials). The first portfolio ($P1$) contains currencies with the lowest forward premia while the last portfolio ($P5$) contains currencies with the highest forward premia. DOL denotes the average return across the FX portfolios. HML_{FX} denotes a long-short strategy that buys $P5$ and $P1$. VOL_{FX} denotes the factor mimicking portfolio of volatility innovations that loads negatively on $P5$ and positively on $P1$. HML_{NA} is a long-short strategy that buys the currencies of debtor nations with the lowest share of foreign liabilities in domestic currency and and sells the currencies of creditor nations with the highest share of foreign liabilities in domestic currency. In *Panel A* (*Panel B*), PC denotes the first principal component between HML_{NA} and HML_{FX} (VOL_{FX}) whereas $\perp$ indicates the orthogonal component with respect to PC. The table reports GMM and Fama-MacBeth (FMB) estimates of the factor loadings b, the market price of risk λ, the cross-sectional R^2, and the *p-value* of the χ^2 test for the null hypothesis of zero pricing errors. The *p-values* and the standard errors reported in parentheses are based on Newey and West (1987) with Andrews (1991) optimal lag selection. Shanken (1992) standard errors are reported in brackets. Excess returns are expressed in percentage per annum and adjusted for transaction costs that occur in a short position ($P1$) and long position ($P2$-$P5$). The portfolios are rebalanced monthly from October 1983 to December 2011. Exchange rates are from *Datastream*. Yearly data on GDP, foreign assets and liabilities are from Lane and Milesi-Ferretti (2007). Yearly data on the share of external liabilities in domestic currency are from Lane and Shambaugh (2010). Monthly observations are retrieved by keeping end-of-period data constant until a new observation becomes available.

							Panel A: HML_{NA} vs. HML_{FX}							
	DOL	PC	R^2	χ^2	DOL	PC	$HML^{\perp}_{FX}$	R^2	χ^2	DOL	PC	$HML^{\perp}_{NA}$	R^2	χ^2
							All Countries							
b	0.01	−0.31	0.87	0.15	−0.04	−0.33	−0.05	0.83	0.08	−0.04	−0.33	0.03	0.83	0.09
	(0.02)	(0.12)			(0.39)	(0.16)	(0.26)			(0.39)	(0.16)	(0.14)		
λ	0.12	−0.13			0.01	−0.13	−0.04			0.01	−0.13	0.08		
	(0.19)	(0.04)			(0.02)	(0.05)	(0.19)			(0.02)	(0.05)	(0.35)		
							Developed Countries							
b	0.01	−0.21	0.94	0.84	0.07	−0.22	−0.01	0.92	0.68	0.07	−0.22	0.01	0.92	0.66
	0.02	(0.12)			(0.23)	(0.16)	(0.51)			(0.23)	(0.16)	(0.23)		
λ	0.15	−0.09			0.01	−0.09	−0.01			0.01	−0.09	0.01		
	(0.22	(0.04)			(0.02)	(0.06)	(0.32)			(0.02)	(0.06)	(0.72)		
							Panel B: HML_{NA} vs. VOL_{FX}							
	DOL	PC	R^2	χ^2	DOL	PC	$VOL^{\perp}_{FX}$	R^2	χ^2	DOL	PC	$HML^{\perp}_{NA}$	R^2	χ^2
							All Countries							
b	−0.02	0.45	0.82	0.18	−0.09	0.65	0.19	0.83	0.16	−0.09	0.65	0.40	0.83	0.16
	(0.03)	(0.17)			(0.36	(0.32)	(0.21)			(0.35)	(0.32)	(0.44)		
λ	0.12	0.17			0.01	0.26	0.22			0.01	0.27	0.12		
	(0.19)	(0.05)			(0.02)	(0.11)	(0.20)			(0.02)	(0.11)	(0.10)		
							Developed Countries							
b	0.01	0.27	0.89	0.68	0.16	0.44	0.14	0.99	0.90	0.16	0.44	0.30	0.99	0.90
	(0.02)	(0.15)			(0.25)	(0.21)	(0.12)			(0.24)	(0.21)	(0.26)		
λ	0.15	0.12			0.01	0.19	0.18			0.01	0.19	0.09		
	(0.22)	(0.05)			(0.02)	(0.07)	(0.14)			(0.02)	(0.07)	(0.06)		

Table 7. Portfolios Sorted on Betas

This table presents descriptive statistics of β-sorted currency portfolios. Each β is obtained by regressing individual currency excess returns on HML_{NA} using a 36-period moving window that ends in period $t-1$. The first portfolio contains currencies with the lowest betas whereas the last portfolio contains currencies with the highest betas. HML_{NA} denotes a long-short strategy that buys the currencies of debtor countries with the lowest share of foreign liabilities in domestic currency and sells the currencies of creditor countries with the highest share of foreign liabilities in domestic currency. The table also reports the first order autocorrelation coefficient (AC_1), the annualized Sharpe ratio (SR), the maximum drawdown (MDD), the *pre*- and *post*-formation βs, and the *pre*- and *post*-formation forward premia (fp), and the frequency of portfolio switches ($Freq$). Standard errors are reported in parentheses and standard deviations in brackets. Excess returns are expressed in percentage per annum. The sample runs from October 1983 to December 2011. Exchange rates are from *Datastream*. Yearly data on GDP, foreign assets and liabilities are from Lane and Milesi-Ferretti (2007). Yearly data on the share of external liabilities in domestic currency are from Lane and Shambaugh (2010). Monthly observations are retrieved by keeping end-of-period data constant until a new observation becomes available.

	$P1$	$P2$	$P3$	$P4$	$P5$	DOL	HML	$P1$	$P2$	$P3$	$P4$	$P5$	DOL	HML
	All Countries							*Developed Countries*						
$Mean$	−0.56	2.07	2.17	1.92	2.27	1.57	2.84	−0.21	2.37	1.00	1.69	4.52	1.87	4.73
Med	0.07	2.34	3.81	2.39	3.94	3.09	4.78	−0.10	3.55	3.36	3.51	6.25	3.42	5.32
$Sdev$	7.29	7.99	8.63	9.46	9.46	7.15	9.76	9.89	10.25	10.02	9.15	10.04	8.51	10.94
$Skew$	−0.88	−0.26	−0.84	−0.59	−0.99	−0.61	−0.43	−0.20	−0.39	−0.31	−0.82	−0.83	−0.40	−0.23
$Kurt$	8.73	4.91	5.38	4.82	6.79	4.76	5.66	3.77	3.92	3.93	5.08	7.75	4.04	4.25
AC_1	0.15	0.08	0.14	0.11	0.17	0.15	0.11	0.11	0.10	0.12	0.13	0.11	0.13	0.11
SR	−0.08	0.26	0.25	0.20	0.24	0.22	0.29	−0.02	0.23	0.10	0.18	0.45	0.22	0.43
MDD	−52.8	−28.7	−22.9	−33.8	−36.7	−31.3	−27.7	−55.4	−42.8	−42.3	−36.2	−36.0	−36.2	−37.5
pre-fp	−0.74	0.90	2.01	2.34	4.08			−1.40	0.08	1.17	1.52	2.83		
post-fp	−0.73	0.89	1.99	2.37	3.99			−1.37	0.06	1.19	1.50	2.76		
pre-β	−0.32	0.03	0.45	0.72	1.19			−1.04	−0.62	−0.36	0.00	0.62		
	[0.44]	[0.55]	[0.72]	[0.79]	[0.79]			[0.98]	[0.94]	[0.86]	[0.67]	[0.59]		
post-β	−0.36	−0.31	−0.03	0.03	0.26			−0.58	−0.14	0.04	0.17	0.57		
	(0.06)	(0.04)	(0.06)	(0.05)	(0.07)			(0.05)	(0.04)	(0.05)	(0.06)	(0.06)		
$Freq$	8.0	11.3	16.0	18.9	9.0			8.1	14.6	15.8	11.5	4.3		

Table 8. FX versus NA Portfolios (with b-a)

This table presents least squares estimates of the regression $y_t = \alpha + \beta x_t + \varepsilon_t$ where y_t (x_t) denotes the excess returns to the FX (NA) portfolios. The FX portfolios are obtained by sorting currencies into five groups using the one-month forward premia (nominal interest rate differentials). The first portfolio ($P1$) contains currencies with the lowest forward premia whereas last portfolio ($P5$) contains currencies with the highest forward premia. The NA portfolio are obtained by sorting currencies into five groups using countries' external imbalances (net foreign assets to GDP ratio) and the share of foreign liabilities in domestic currency. $P1$ contains currencies with positive external imbalances (creditor nations) and the highest share of foreign liabilities in domestic currency. $P5$ contains currencies with negative external imbalances (debtor nations) and the lowest share of foreign liabilities in domestic currency. HML denotes a long-short strategy that buys $P5$ and sells $P1$. $Corr$ denotes the sample correlation for the full sample. $\{\cdot\}$ denotes sub-sample correlations. LM_p indicates the Breusch-Godfrey Lagrange Multiplier test for the null hypothesis of no serial correlation up to p lags. Newey and West (1987) standard errors with Andrews (1991) optimal lag selection are reported in parentheses, and *p-values* in brackets. Excess returns are expressed in percentage per annum and adjusted for transaction costs that occur in a short position ($P1$) and long position ($P2$-$P5$). The portfolios are rebalanced monthly from October 1983 to December 2011. Exchange rates are from *Datastream*. Yearly data on GDP, foreign assets and liabilities are from Lane and Milesi-Ferretti (2007). Yearly data on the share of external liabilities in domestic currency are from Lane and Shambaugh (2010). Monthly observations are retrieved by keeping end-of-period data constant until a new observation becomes available.

	$P1$	$P2$	$P3$	$P4$	$P5$	HML	$P1$	$P2$	$P3$	$P4$	$P5$	HML
	All Countries						*Developed Countries*					
α	−1.51	−2.10	1.76	0.41	2.20	3.68	−1.27	−0.09	−0.15	0.25	1.53	2.50
	(0.80)	(0.80)	(1.06)	(1.18)	(1.19)	(1.42)	(1.06)	(0.98)	(1.06)	(1.06)	(1.21)	(1.68)
β	0.89	0.75	0.93	0.77	0.78	0.76	0.84	0.77	0.86	0.85	0.92	1.05
	(0.05)	(0.04)	(0.06)	(0.07)	(0.05)	(0.10)	(0.05)	(0.05)	(0.04)	(0.03)	(0.06)	(0.10)
R^2	0.77	0.74	0.60	0.54	0.60	0.29	0.70	0.72	0.69	0.68	0.66	0.38
$Corr$	0.88	0.86	0.77	0.74	0.78	0.54	0.84	0.85	0.83	0.82	0.81	0.62
{1983-1997}	0.89	0.87	0.65	0.59	0.70	0.44	0.87	0.89	0.76	0.77	0.72	0.54
{1998-2011}	0.86	0.89	0.90	0.89	0.87	0.66	0.80	0.80	0.89	0.88	0.92	0.71
LM_3	5.39	3.30	6.10	2.17	3.51	2.62	1.23	3.20	13.49	1.93	3.78	2.98
	[0.15]	[0.35]	[0.11]	[0.54]	[0.32]	[0.45]	[0.75]	[0.36]	[0.00]	[0.59]	[0.29]	[0.40]

Table 9. Asset Pricing: Real Interest Rates (with b-a)

This table reports cross-sectional asset pricing results. The linear factor model includes the dollar (DOL) and global imbalance risk (HML_{NA}) factors. The test assets are nominal excess returns (*left-hand side*) and real excess returns (*right-hand side*) to five currency (FX) portfolios sorted on the one-month inflation-adjusted forward premia (real interest rate differentials). The first portfolio ($P1$) contains currencies with the lowest inflation-adjusted forward premia while the last portfolio ($P5$) contains currencies with the highest inflation-adjusted forward premia. DOL denotes the average return across the FX portfolios. HML_{NA} is a long-short strategy that buys the currencies of debtor nations with the lowest share of foreign liabilities in domestic currency and sells the currencies of creditor nations with the highest share of foreign liabilities in domestic currency. *Panel A* reports GMM and Fama-MacBeth (FMB) estimates of the factor loadings b, the market price of risk λ, the cross-sectional R^2, and the *p-value* of the χ^2 test for the null hypothesis of zero pricing errors. *Panel B* reports least-squares estimates of time series regressions. The *p-values* and the standard errors reported in parentheses are based on Newey and West (1987) with Andrews (1991) optimal lag selection. Shanken (1992) standard errors are reported in brackets. Excess returns are expressed in percentage per annum and adjusted for transaction costs that occur in a short position ($P1$) and long position ($P2$-$P5$). The portfolios are rebalanced monthly from October 1983 to December 2011. The results are presented for all countries. Exchange rates are from *Datastream*. Yearly data on GDP, foreign assets and liabilities are from Lane and Milesi-Ferretti (2007). Yearly data on the share of external liabilities in domestic currency are from Lane and Shambaugh (2010). Monthly observations are retrieved by keeping end-of-period data constant until a new observation becomes available.

Panel A: Factor Prices

	b_{DOL}	b_{NA}	λ_{DOL}	λ_{NA}	R^2	$RMSE$	χ^2	b_{DOL}	b_{NA}	λ_{DOL}	λ_{NA}	R^2	$RMSE$	χ^2
	Nominal Excess Returns							*Real Excess Returns*						
GMM_1	−0.27	1.86	0.01	0.08	0.95	0.69	0.85	−0.76	2.03	−0.02	0.08	0.95	0.68	0.88
	(0.35)	(0.90)	(0.02)	(0.03)				(0.33)	(0.91)	(0.02)	(0.03)			
GMM_2	−0.29	1.92	0.01	0.08	0.95	0.70	0.85	−0.82	2.05	−0.02	0.08	0.95	0.69	0.83
	(0.34)	(0.78)	(0.02)	(0.03)				(0.32)	(0.77)	(0.02)	(0.03)			
FMB	−0.26	1.85	0.01	0.08	0.95	0.69	0.85	−0.75	2.03	−0.02	0.08	0.95	0.68	0.88
	(0.27)	(0.6)	(0.02)	(0.03)				(0.28)	(0.60)	(0.02)	(0.03)			
	[0.26]	[0.64]	[0.01]	[0.03]				[0.26]	[0.65]	[0.01]	[0.03]			

Panel B: Factor Betas

	α	β_{DOL}	β_{NA}	R^2	α	β_{DOL}	β_{NA}	R^2
$P1$	0.01	0.85	0.02	0.64	−0.02	0.86	0.02	0.64
	(0.01)	(0.05)	(0.07)		(0.01)	(0.05)	(0.07)	
$P2$	−0.01	1.01	−0.22	0.86	−0.04	1.01	−0.22	0.85
	(0.01)	(0.03)	(0.03)		(0.01)	(0.03)	(0.03)	
$P3$	0.01	1.06	−0.09	0.85	−0.03	1.07	−0.09	0.85
	(0.01)	(0.04)	(0.04)		(0.01)	(0.04)	(0.04)	
$P4$	0.01	1.00	0.05	0.79	−0.03	1.01	0.06	0.79
	(0.01)	(0.04)	(0.04)		(0.01)	(0.04)	(0.04)	
$P5$	0.02	1.05	0.28	0.77	−0.01	1.05	0.28	0.77
	(0.01)	(0.05)	(0.08)		(0.01)	(0.05)	(0.08)	

Table 10. Asset Pricing: Other Base Currencies (with b-a)

This table reports cross-sectional asset pricing results for different base currencies. The linear factor model includes the dollar (DOL) and global imbalance risk (HML_{NA}) factors whereas the test assets are excess returns to five currency (FX) portfolios sorted on the one-month forward premia (nominal interest rate differentials). The first portfolio ($P1$) contains currencies with the lowest forward premia while the last portfolio ($P5$) contains currencies with the highest forward premia. DOL denotes the average return across the FX portfolios. HML_{NA} is a long-short strategy that buys the currencies of debtor nations with the lowest share of foreign liabilities in domestic currency and sells the currencies of creditor nations with the highest share of foreign liabilities in domestic currency. *Panel A* reports GMM and Fama-MacBeth (FMB) estimates of the factor loadings b, the market price of risk λ, the cross-sectional R^2, and the *p-value* of the χ^2 test for the null hypothesis of zero pricing errors. *Panel B* reports least-squares estimates of time series regressions. The *p-values* and the standard errors reported in parentheses are based on Newey and West (1987) with Andrews (1991) optimal lag selection. Shanken (1992) standard errors are reported in brackets. Excess returns are expressed in percentage per annum and adjusted for transaction costs that occur in a short position ($P1$) and long position ($P2$-$P5$). The portfolios are rebalanced monthly from October 1983 to December 2011. The results are presented for all countries. Exchange rates are from *Datastream*. Yearly data on GDP, foreign assets and liabilities are from Lane and Milesi-Ferretti (2007). Yearly data on the share of external liabilities in domestic currency are from Lane and Shambaugh (2010). Monthly observations are retrieved by keeping end-of-period data constant until a new observation becomes available.

Panel A: Factor Prices

	b_{DOL}	b_{NA}	λ_{DOL}	λ_{NA}	R^2	$RMSE$	χ^2	b_{DOL}	b_{NA}	λ_{DOL}	λ_{NA}	R^2	$RMSE$	χ^2
	CHF							*DEM/EUR*						
GMM_1	−0.31	1.59	0.01	0.07	0.69	2.08	0.15	−0.29	1.61	−0.01	0.07	0.67	2.43	0.11
	(0.25)	(0.78)	(0.01)	(0.03)				(0.30)	(0.71)	(0.01)	(0.02)			
GMM_2	−0.28	1.31	0.01	0.05	0.61	2.34	0.16	−0.40	1.62	−0.01	0.05	0.61	2.65	0.12
	(0.24)	(0.77)	(0.01)	(0.03)				(0.30)	(0.71)	(0.01)	(0.02)			
FMB	−0.31	1.59	0.01	0.07	0.69	2.08	0.16	−0.28	1.60	−0.01	0.07	0.67	2.43	0.11
	(0.22)	(0.58)	(0.01)	(0.03)				(0.29)	(0.54)	(0.01)	(0.02)			
	[0.23]	[0.61]	[0.01]	[0.03]				[0.28]	[0.53]	[0.01]	[0.02]			

Panel B: Factor Betas

	α	β_{DOL}	β_{NA}	R^2	α	β_{DOL}	β_{NA}	R^2
$P1$	−0.01	0.91	−0.27	0.76	0.01	0.90	−0.33	0.69
	(0.01)	(0.04)	(0.04)		(0.01)	(0.06)	(0.04)	
$P2$	−0.01	0.95	−0.14	0.77	−0.02	0.93	−0.17	0.67
	(0.01)	(0.05)	(0.05)		(0.01)	(0.06)	(0.05)	
$P3$	0.01	0.86	−0.02	0.79	0.01	0.78	−0.02	0.67
	(0.01)	(0.03)	(0.04)		(0.01)	(0.04)	(0.03)	
$P4$	0.01	0.94	0.16	0.78	0.01	0.87	0.20	0.64
	(0.01)	(0.03)	(0.06)		(0.01)	(0.05)	(0.06)	
$P5$	0.04	1.28	0.31	0.75	0.04	1.49	0.32	0.72
	(0.01)	(0.06)	(0.09)		(0.01)	(0.10)	(0.05)	

Continued

Table 10. Asset Pricing: Other Base Currencies (with b-a) *(Continued)*

Panel A: Factor Prices

	b_{DOL}	b_{NA}	λ_{DOL}	λ_{NA}	R^2	$RMSE$	χ^2	b_{DOL}	b_{NA}	λ_{DOL}	λ_{NA}	R^2	$RMSE$	χ^2
				GBP							*JPY*			
GMM_1	−0.36	1.44	−0.02	0.07	0.75	2.17	0.14	−0.26	1.63	−0.01	0.06	0.74	2.02	0.07
	(0.24)	(0.67)	(0.01)	(0.03)				(0.21)	(0.72)	(0.02)	(0.02)			
GMM_2	−0.45	1.55	−0.02	0.06	0.72	2.28	0.15	−0.12	1.12	−0.01	0.05	0.69	2.21	0.08
	(0.22)	(0.64)	(0.01)	(0.03)				(0.26)	(0.67)	(0.02)	(0.02)			
FMB	−0.36	1.43	−0.02	0.07	0.75	2.17	0.14	−0.26	1.62	−0.01	0.06	0.74	2.02	0.07
	(0.21)	(0.51)	(0.01)	(0.03)				(0.17)	(0.55)	(0.02)	(0.02)			
	[0.21]	[0.51]	[0.01]	[0.03]				[0.16]	[0.61]	[0.02]	[0.02]			

Panel B: Factor Betas

	α	β_{DOL}	β_{NA}	R^2	α	β_{DOL}	β_{NA}	R^2
$P1$	0.01	1.00	−0.30	0.79	−0.01	0.89	−0.28	0.87
	(0.01)	(0.04)	(0.05)		(0.01)	(0.02)	(0.04)	
$P2$	−0.02	1.01	−0.21	0.80	−0.02	0.98	−0.19	0.89
	(0.01)	(0.03)	(0.04)		(0.01)	(0.03)	(0.04)	
$P3$	0.01	0.94	−0.04	0.80	0.01	1.00	−0.09	0.90
	(0.01)	(0.03)	(0.05)		(0.01)	(0.02)	(0.04)	
$P4$	0.01	0.93	0.18	0.76	0.01	0.98	0.15	0.88
	(0.01)	(0.03)	(0.07)		(0.01)	(0.04)	(0.06)	
$P5$	0.03	1.03	0.37	0.65	0.03	1.07	0.38	0.79
	(0.01)	(0.06)	(0.10)		(0.01)	(0.05)	(0.11)	

Table 11. Asset Pricing: Individual Currencies

This table reports cross-sectional asset pricing results for individual currencies. The linear factor model includes the dollar (DOL), global imbalance (HML_{NA}), slope (HML_{FX}), and volatility (VOL_{FX}) risk factors. The test assets are excess returns to individual currencies sorted on the one-month forward premia (nominal interest rate differentials). The table reports estimates of the market price of risk λ and the cross-sectional R^2 obtained via Fama-MacBeth procedure with robust regressions in the first and second step to account for outliers in individual currency excess returns. Standard errors robust to heteroskedasticity and serial correlation (Weiss, 1990) with Andrews (1991) optimal lag selection are reported in parentheses. Bootstrapped standard errors obtained via 10,000 repetitions are reported in brackets. The currencies are rebalanced monthly from October 1983 to December 2011. Exchange rates are from *Datastream*. Yearly data on GDP, foreign assets and liabilities are from Lane and Milesi-Ferretti (2007). Yearly data on the share of external liabilities in domestic currency are from Lane and Shambaugh (2010). Monthly observations are retrieved by keeping end-of-period data constant until a new observation becomes available.

Panel A			Panel B			Panel C		
λ_{DOL}	λ_{NA}	R^2	λ_{DOL}	λ_{FX}	R^2	λ_{DOL}	λ_{VOL}	R^2
			All Countries					
0.03	0.08	0.40	0.03	0.06	0.51	0.02	−0.43	0.46
(0.01)	(0.02)		(0.01)	(0.02)		(0.01)	(0.17)	
[0.02]	[0.03]		[0.02]	[0.03]		[0.02]	[0.17]	
			Developed & Emerging Countries					
0.03	0.08	0.64	0.03	0.09	0.54	0.02	−0.54	0.36
(0.02)	(0.03)		(0.02)	(0.03)		(0.02)	(0.21)	
[0.02]	[0.03]		[0.02]	[0.03]		[0.02]	[0.23]	
			Developed Countries					
0.02	0.05	0.72	0.02	0.05	0.32	0.02	−0.47	0.55
(0.02)	(0.02)		(0.02)	(0.03)		(0.01)	(0.26)	
[0.02]	[0.02]		[0.02]	[0.03]		[0.02]	[0.28]	

Table A1. Asset Pricing: External Imbalances (without b-a)

This table reports cross-sectional asset pricing results. The linear factor model includes the dollar (DOL) and global imbalance risk (HML_{NA}) factors whereas the test assets are excess returns to five currency (FX) portfolios sorted on the one-month forward premia (nominal interest rate differentials). The first portfolio ($P1$) contains currencies with the lowest forward premia while the last portfolio ($P5$) contains currencies with the highest forward premia. DOL denotes the average return across the FX portfolios. HML_{NA} is a long-short strategy that buys the currencies of debtor nations with the lowest share of foreign liabilities in domestic currency and sells the currencies of creditor nations with the highest share of foreign liabilities in domestic currency. *Panel A* reports GMM and Fama-MacBeth (FMB) estimates of the factor loadings b, the market price of risk λ, the cross-sectional R^2, and the *p-value* of the χ^2 test for the null hypothesis of zero pricing errors. *Panel B* reports least-squares estimates of time series regressions. The *p-values* and the standard errors reported in parentheses are based on Newey and West (1987) with Andrews (1991) optimal lag selection. Shanken (1992) standard errors are reported in brackets. Excess returns are expressed in percentage per annum. The portfolios are rebalanced monthly from October 1983 to December 2011. Exchange rates are from *Datastream*. Yearly data on GDP, foreign assets and liabilities are from Lane and Milesi-Ferretti (2007). Yearly data on the share of external liabilities in domestic currency are from Lane and Shambaugh (2010). Monthly observations are retrieved by keeping end-of-period data constant until a new observation becomes available.

Panel A: Factor Prices

	b_{DOL}	b_{NA}	λ_{DOL}	λ_{NA}	R^2	$RMSE$	χ^2	b_{DOL}	b_{NA}	λ_{DOL}	λ_{NA}	R^2	$RMSE$	χ^2
	All Countries							*Developed Countries*						
GMM_1	−0.23	2.24	0.02	0.10	0.92	1.90	0.14	0.11	1.26	0.02	0.06	0.99	0.61	0.95
	(0.34)	(0.67)	(0.02)	(0.02)				(0.25)	(0.56)	(0.02)	(0.02)			
GMM_2	−0.17	2.37	0.02	0.08	0.89	2.20	0.14	0.10	1.27	0.02	0.06	0.97	1.01	0.95
	(0.34)	(0.66)	(0.02)	(0.02)				(0.23)	(0.53)	(0.02)	(0.02)			
FMB	−0.23	2.24	0.02	0.10	0.92	1.90	0.14	0.11	1.26	0.02	0.06	0.99	0.61	0.95
	(0.26)	(0.50)	(0.02)	(0.02)				(0.20)	(0.41)	(0.02)	(0.02)			
	[0.24]	[0.50]	[0.01]	[0.02]				[0.18]	[0.40]	[0.02]	[0.02]			

Panel B: Factor Betas

	α	β_{DOL}	β_{NA}	R^2	α	β_{DOL}	β_{NA}	R^2
$P1$	−0.02	0.98	−0.32	0.79	−0.01	0.95	−0.51	0.75
	(0.01)	(0.05)	(0.04)		(0.01)	(0.05)	(0.07)	
$P2$	−0.02	0.99	−0.21	0.79	0.01	1.01	−0.18	0.82
	(0.01)	(0.04)	(0.04)		(0.01)	(0.04)	(0.04)	
$P3$	0.01	1.03	−0.07	0.84	0.01	0.99	0.00	0.86
	(0.01)	(0.04)	(0.04)		(0.01)	(0.03)	(0.04)	
$P4$	0.01	1.07	0.14	0.84	0.00	0.99	0.16	0.83
	(0.01)	(0.04)	(0.06)		(0.01)	(0.03)	(0.05)	
$P5$	0.03	0.94	0.46	0.71	0.02	1.05	0.53	0.79
	(0.01)	(0.07)	(0.08)		(0.01)	(0.04)	(0.06)	

Table A2. Asset Pricing: External Imbalance Portfolios priced by HML$_{NA}$

This table reports cross-sectional asset pricing results. The linear factor model includes the dollar (DOL) and global imbalance risk (HML_{NA}) factors whereas the test assets are excess returns to five currency (NA) portfolios sorted on external imbalances (net foreign assets to GDP ratio) and the share of foreign liabilities in domestic currency. The first portfolio ($P1$) contains currencies with positive external imbalances (creditor nations) and the highest share of foreign liabilities in domestic currency while the last portfolio ($P5$) contains currencies with negative external imbalances (debtor nations) and the lowest share of foreign liabilities in domestic currency. DOL denotes the average return across the NA portfolios. HML_{NA} is long-short strategy that buys the currencies of debtor nations and and sells the currencies of creditor nations. *Panel A* reports GMM and Fama-MacBeth (FMB) estimates of the factor loadings b, the market price of risk λ, the cross-sectional R^2, and the *p-value* of the χ^2 test for the null hypothesis of zero pricing errors. *Panel B* reports least-squares estimates of time series regressions. The *p-values* and the standard errors reported in parentheses are based on Newey and West (1987) with Andrews (1991) optimal lag selection. Shanken (1992) standard errors are reported in brackets. Excess returns are expressed in percentage per annum. The portfolios are rebalanced monthly from October 1983 to December 2011. Exchange rates are from *Datastream*. Yearly data on GDP, foreign assets and liabilities are from Lane and Milesi-Ferretti (2007). Yearly data on the share of external liabilities in domestic currency are from Lane and Shambaugh (2010). Monthly observations are retrieved by keeping end-of-period data constant until a new observation becomes available.

Panel A: Factor Prices

	b_{DOL}	b_{NA}	λ_{DOL}	λ_{NA}	R^2	$RMSE$	χ^2	b_{DOL}	b_{NA}	λ_{DOL}	λ_{NA}	R^2	$RMSE$	χ^2
	All Countries							*Developed Countries*						
GMM_1	0.07	0.93	0.02	0.04	0.92	0.98	0.64	0.15	0.74	0.02	0.04	0.86	1.14	0.61
	(0.28)	(0.33)	(0.02)	(0.01)				(0.22)	(0.39)	(0.02)	(0.01)			
GMM_2	0.09	1.05	0.02	0.05	0.90	1.15	0.67	0.17	0.86	0.01	0.02	0.73	1.83	0.65
	(0.27)	(0.3)	(0.02)	(0.01)				(0.22)	(0.32)	(0.02)	(0.01)			
FMB	0.07	0.93	0.02	0.04	0.92	0.98	0.63	0.15	0.74	0.02	0.04	0.86	1.14	0.61
	(0.25)	(0.29)	(0.02)	(0.01)				(0.2)	(0.26)	(0.02)	(0.01)			
	(0.22)	[0.27]	[0.01]	[0.01]				[0.18]	[0.27]	[0.02]	[0.01]			

Panel B: Factor Betas

	α	β_{DOL}	β_{NA}	R^2	α	β_{DOL}	β_{NA}	R^2
$P1$	0.01	1.03	−0.41	0.88	0.01	1.02	−0.62	0.91
	(0.01)	(0.04)	(0.04)		(0.01)	(0.04)	(0.05)	
$P2$	0.01	1.19	−0.20	0.86	−0.01	1.14	−0.12	0.89
	(0.01)	(0.04)	(0.04)		(0.01)	(0.03)	(0.04)	
$P3$	−0.01	0.78	0.01	0.71	0.01	0.92	0.11	0.82
	(0.01)	(0.07)	(0.07)		(0.01)	(0.03)	(0.04)	
$P4$	0.00	0.98	0.00	0.70	0.00	0.90	0.25	0.77
	(0.01)	(0.06)	(0.04)		(0.01)	(0.05)	(0.06)	
$P5$	0.01	1.03	0.59	0.92	0.01	1.02	0.38	0.91
	(0.01)	(0.04)	(0.04)		(0.01)	(0.04)	(0.05)	

Table A3. Portfolio Composition

This table presents the top six currencies in each of the five FX (*Panel A*) and NA portfolios (*Panel B*). *Panel C* presents the probability that the same currency enters simultaneously the same FX and NA portfolio. The FX portfolios are obtained by sorting currencies on the one-month forward premia (nominal interest rate differentials). The first portfolio ($P1$) contains currencies with the lowest forward premia while the last portfolio ($P5$) contains currencies with the highest forward premia. The NA portfolios are obtained by sorting currencies on external imbalances (net foreign assets to GDP ratio) and the share of foreign liabilities in domestic currency. The first portfolio ($P1$) contains currencies with positive external imbalances (creditor nations) and the highest share of foreign liabilities in domestic currency while the last portfolio ($P5$) contains currencies with negative external imbalances (debtor nations) and the lowest share of foreign liabilities in domestic currency. Probabilities are reported in brackets. The portfolios are rebalanced monthly from October 1983 to December 2011. Exchange rates are from *Datastream*. Yearly data on GDP, foreign assets and liabilities are from Lane and Milesi-Ferretti (2007). Yearly data on the share of foreign liabilities in domestic currency are from Lane and Shambaugh (2010). Monthly observations are retrieved by keeping end-of-period data constant until a new observation becomes available.

	Panel A: FX Portfolios									
	$P1$	$P2$	$P3$	$P4$	$P5$	$P1$	$P2$	$P3$	$P4$	$P5$
			All Countries					*Developed Countries*		
Top 1	JPY [0.18]	DKK [0.08]	GBP [0.08]	AUD [0.09]	ZAR [0.14]	JPY [0.43]	NLG [0.15]	DKK [0.22]	GBP [0.18]	NZD [0.34]
Top 2	CHF [0.17]	CAD [0.07]	NOK [0.06]	NZD [0.07]	TRY [0.10]	CHF [0.42]	EUR [0.11]	CAD [0.14]	AUD [0.15]	AUD [0.23]
Top 3	SGD [0.13]	EUR [0.06]	DKK [0.06]	GBP [0.06]	MXN [0.06]	DEM [0.07]	CAD [0.11]	GBP [0.11]	SEK [0.14]	ITL [0.13]
Top 4	HKD [0.08]	SGD [0.05]	CAD [0.06]	INR [0.05]	NZD [0.06]	CAD [0.03]	DEM [0.11]	NOK [0.11]	NOK [0.13]	NOK [0.11]
Top 5	CNY [0.06]	HKD [0.05]	HKD [0.05]	PHP [0.05]	HUF [0.05]	NLG [0.02]	SEK [0.08]	SEK [0.10]	CAD [0.11]	GBP [0.09]
Top 6	SEK [0.04]	NLG [0.05]	SEK [0.05]	NOK [0.05]	BRL [0.05]	SEK [0.01]	FRF [0.08]	FRF [0.08]	DKK [0.08]	SEK [0.06]
	Panel B: NA Portfolios									
Top 1	SGD [0.15]	GBP [0.13]	AUD [0.15]	NZD [0.15]	DKK [0.11]	CHF [0.23]	CHF [0.22]	AUD [0.29]	CAD [0.25]	DKK [0.35]
Top 2	CHF [0.11]	CHF [0.09]	NOK [0.11]	HUF [0.10]	TRY [0.10]	JPY [0.22]	GBP [0.20]	NOK [0.27]	NZD [0.24]	NZD [0.18]
Top 3	JPY [0.10]	NLG [0.08]	MYR [0.09]	CAD [0.09]	PHP [0.09]	DEM [0.20]	NLG [0.17]	JPY [0.13]	SEK [0.22]	SEK [0.18]
Top 4	EUR [0.09]	JPY [0.07]	HKD [0.08]	ZAR [0.08]	SEK [0.09]	EUR [0.13]	FRF [0.13]	ITL [0.11]	NOK [0.10]	GBP [0.17]
Top 5	HKD [0.09]	CAD [0.06]	DKK [0.07]	PLN [0.07]	IDR [0.09]	CAD [0.11]	DKK [0.09]	EUR [0.09]	AUD [0.10]	ITL [0.07]
Top 6	DEM [0.09]	FRF [0.06]	ITL [0.05]	MXN [0.06]	HRK [0.06]	FRF [0.09]	JPY [0.08]	GBP [0.04]	ITL [0.04]	CAD [0.05]
	Panel B: Joint Probability									
	[0.45]	[0.24]	[0.22]	[0.23]	[0.36]	[0.44]	[0.25]	[0.18]	[0.26]	[0.35]
	[0.62]			[0.60]		[0.67]			[0.57]	

Table A4. Descriptive Statistics: Liquid Currencies (G20)

This table presents descriptive statistics of five currency portfolios for *Developed and Emerging Market Countries* - the top 20 most liquid currencies. The FX portfolios are sorted sorted on forward premia (interest rate diffential): the first portfolio ($P1$) contains currencies with the lowest forward premia while the last portfolio ($P5$) contains currencies with the highest forward premia. DOL denotes the average across all portfolios. HML is a long-short strategy that buys $P5$ and sells $P1$. The NA portfolios are sorted on external imbalances (net foreign assets to GDP): the first portfolio ($P1$) contains currencies with positive external imbalances (creditor nations) and the highest share of foreign liabilities in domestic currency while the last portfolio ($P5$) contains currencies with negative external imbalances (debtor nations) and the lowest share of foreign liabilities in domestic currency. DOL denotes the average across all portfolios. HML is a long-short strategy that buys $P5$ and sells $P1$. The table also reports the first order autocorrelation coefficient (AC_1), the annualized Sharpe ratio (SR), the maximum drawdown (MDD), and the frequency of portfolio switches ($Freq$). Excess returns are expressed in percentage per annum. The superscript τ denotes excess returns adjusted for transaction costs. *Panel A* (*Panel B*) presents portfolios rebalanced at the end of each month (year) using $t-1$ one-month (one-year) forward premia. The sample runs from October 1983 to December 2011. Exchange rates are from *Datastream*. Yearly data on GDP, foreign assets and liabilities are from Lane and Milesi-Ferretti (2007). Yearly data on the share of foreign liabilities in domestic currency are from Lane and Shambaugh (2010). Monthly observations are retrieved by keeping end-of-period data constant until a new observation becomes available.

	Panel A: Monthly Rebalancing									Panel B: Yearly Rebalancing								
	$P1$	$P2$	$P3$	$P4$	$P5$	DOL	HML	DOL^{τ}	HML^{τ}	$P1$	$P2$	$P3$	$P4$	$P5$	DOL	HML	DOL^{τ}	HML^{τ}
	FX Portfolios									*FX Portfolios*								
Mean	−1.22	0.41	2.78	2.12	6.66	2.15	7.88	1.07	5.25	−0.05	0.80	0.12	1.96	5.46	1.66	5.51	1.39	4.78
Med	−2.08	3.39	4.34	6.19	11.10	4.23	11.15	3.08	9.24	2.93	1.47	2.72	3.45	8.38	2.48	5.84	2.03	5.21
Sdev.	9.13	9.31	9.05	10.58	11.54	8.64	11.03	8.64	11.01	10.43	11.19	12.90	12.54	17.98	10.81	17.34	10.77	17.18
Skew	0.10	−0.45	−0.31	−1.18	−1.62	−0.67	−1.44	−0.68	−1.46	−0.54	−0.17	−1.53	−0.03	−1.59	−0.58	−0.62	−0.58	−0.65
Kurt	3.84	4.12	4.37	7.57	10.57	4.81	7.21	4.81	7.23	2.47	1.93	5.47	1.98	6.45	2.91	3.05	2.91	3.06
AC_1	−0.01	0.10	0.06	0.09	0.09	0.09	0.05	0.09	0.05	0.02	0.00	0.03	0.01	0.23	−0.02	0.29	−0.02	0.28
SR	−0.13	0.04	0.31	0.20	0.58	0.25	0.71	0.12	0.48	0.00	0.07	0.01	0.16	0.30	0.15	0.32	0.13	0.28
MDD	−0.53	−0.44	−0.35	−0.38	−0.44	−0.29	−0.32	−0.30	−0.38	−0.44	−0.37	−0.60	−0.47	−0.62	−0.30	−0.51	−0.32	−0.52
Freq	14.0	26.8	29.0	25.7	13.1	21.7	27.1	21.7	27.1	25.0	52.7	56.3	52.7	32.7	43.9	57.7	43.9	57.7
	NA Portfolios									*NA Portfolios*								
Mean	0.19	1.25	1.23	1.96	7.05	2.33	6.85	1.28	4.72	−0.36	1.54	1.69	0.37	4.98	1.64	5.34	1.38	4.78
Med	1.48	0.99	3.06	3.99	9.68	4.09	8.67	3.27	7.22	2.03	0.97	3.02	1.19	6.70	2.46	6.46	2.01	6.16
Sdev.	8.99	9.95	8.81	9.63	10.63	8.57	7.56	8.57	7.53	10.96	11.12	11.02	14.41	15.48	10.81	11.23	10.76	11.03
Skew	−0.09	−0.31	−0.63	−1.16	−1.05	−0.63	−0.94	−0.64	−0.97	−0.77	−0.28	−0.47	−2.21	−0.43	−0.53	−0.50	−0.53	−0.58
Kurt	3.19	4.18	5.20	8.07	5.95	4.73	7.92	4.73	7.92	2.58	2.53	2.77	10.16	3.32	2.79	4.20	2.79	4.24
AC_1	0.09	0.06	0.08	0.08	0.11	0.09	0.25	0.09	0.25	0.14	−0.03	−0.07	0.20	−0.11	−0.02	0.15	−0.02	0.14
SR	0.02	0.13	0.14	0.20	0.66	0.27	0.91	0.15	0.63	−0.03	0.14	0.15	0.03	0.32	0.15	0.48	0.13	0.43
MDD	−0.54	−0.42	−0.31	−0.35	−0.36	−0.27	−0.32	−0.30	−0.36	−0.56	−0.33	−0.25	−0.61	−0.35	−0.31	−0.30	−0.32	−0.31
Freq	2.6	3.1	3.0	3.1	2.7	2.9	5.3	2.9	5.3	25.6	34.2	30.4	26.2	26.8	28.6	52.4	28.6	52.4

Table A5. Asset Pricing: Floating Currencies (with b-a)

This table reports cross-sectional asset pricing results for *All Countries minus Pegged Currencies.* This subset of currencies excludes all pegged and crawling pegged currencies using the classification of Ilzetzki, Reinhart and Rogoff (2008). The linear factor model includes the dollar (DOL) and global imbalance risk (HML_{NA}) factors whereas the test assets are excess returns to five currency (FX) portfolios sorted on the one-month forward premia (nominal interest rate differentials). The first portfolio ($P1$) contains currencies with the lowest forward premia while the last portfolio ($P5$) contains currencies with the highest forward premia. DOL denotes the average return across the FX portfolios. HML_{NA} is a long-short strategy that buys the currencies of debtor nations with the lowest share of foreign liabilities in domestic currency and and sells the currencies of creditor nations with the highest share of foreign liabilities in domestic currency. *Panel A* reports GMM and Fama-MacBeth (FMB) estimates of the factor loadings b, the market price of risk λ, the cross-sectional R^2, and the *p-value* of the χ^2 test for the null hypothesis of zero pricing errors. *Panel B* reports least-squares estimates of time series regressions. The *p-values* and the standard errors reported in parentheses are based on Newey and West (1987) with Andrews (1991) optimal lag selection. Shanken (1992) standard errors are reported in brackets. Excess returns are expressed in percentage per annum and adjusted for transaction costs that occur in a short position ($P1$) and long position ($P2$-$P5$). The portfolios are rebalanced monthly from October 1983 to December 2011. Exchange rates are from *Datastream*. Yearly data on GDP, foreign assets and liabilities are from Lane and Milesi-Ferretti (2007). Yearly data on the share of external liabilities in domestic currency are from Lane and Shambaugh (2010). Monthly observations are retrieved by keeping end-of-period data constant until a new observation becomes available.

Panel A: Factor Prices

	b_{DOL}	b_{NA}	λ_{DOL}	λ_{NA}	R^2	$RMSE$	χ^2
GMM_1	0.10	0.47	0.02	0.14	0.92	1.90	0.67
	(0.24)	(0.25)	(0.02)	(0.05)			
GMM_2	0.11	0.46	0.03	0.14	0.92	1.90	0.67
	(0.24)	(0.24)	(0.02)	(0.05)			
FMB	0.10	0.47	0.02	0.14	0.92	1.90	0.67
	(0.22)	(0.19)	(0.02)	(0.05)			
	[0.20]	[0.19]	[0.02]	[0.05]			

Panel B: Factor Betas

	α	β_{DOL}	β_{NA}	R^2
$P1$	−0.01	0.90	−0.21	0.45
	(0.02)	(0.12)	(0.04)	
$P2$	0.01	0.92	−0.15	0.63
	(0.01)	(0.06)	(0.03)	
$P3$	−0.02	1.13	−0.08	0.69
	(0.01)	(0.06)	(0.04)	
$P4$	0.01	1.00	0.07	0.55
	(0.02)	(0.06)	(0.05)	
$P5$	0.05	1.05	0.36	0.61
	(0.02)	(0.07)	(0.08)	

Table B1. Descriptive Statistics: NA Portfolios

This table presents descriptive statistics of five currency portfolios sorted solely on external imbalances (net foreign assets to GDP ratio). The first portfolio ($P1$) contains currencies with positive external imbalances (creditor nations) while the last portfolio ($P5$) contains currencies with negative external imbalances (debtor nations). DOL denotes the average across all portfolios. HML is a long-short strategy that buys $P5$ and sells $P1$. The table also reports the first order autocorrelation coefficient (AC_1), the annualized Sharpe ratio (SR), the maximum drawdown (MDD), and the frequency of portfolio switches ($Freq$). Excess returns are expressed in percentage per annum. The superscript τ denotes excess returns adjusted for transaction costs. *Panel A* (*Panel B*) presents portfolios rebalanced at the end of each month (year) using $t-1$ one-month (one-year) forward premia. The sample runs from October 1983 to December 2011. Exchange rates are from *Datastream*. Yearly data on GDP, foreign assets and liabilities are from Lane and Milesi-Ferretti (2007). Monthly observations are retrieved by keeping end-of-period data constant until a new observation becomes available.

	Panel A: Monthly Rebalancing									Panel B: Yearly Rebalancing								
	$P1$	$P2$	$P3$	$P4$	$P5$	DOL	HML	DOL^{τ}	HML^{τ}	$P1$	$P2$	$P3$	$P4$	$P5$	DOL	HML	DOL^{τ}	HML^{τ}
	All Countries									*All Countries*								
$Mean$	1.23	0.85	2.66	2.57	1.95	1.85	0.72	0.72	−1.67	0.69	0.67	3.06	2.07	0.18	1.34	−0.52	1.02	−1.20
Med	1.17	1.26	4.66	4.96	4.52	3.46	4.97	2.59	2.44	0.26	2.45	3.81	4.01	4.33	2.57	2.42	2.21	1.52
$Sdev$	6.35	9.00	8.73	7.63	9.86	7.22	8.34	7.22	8.35	6.06	9.82	10.49	10.39	16.99	9.32	15.12	9.31	15.16
$Skew$	−0.89	−0.42	−0.57	−0.88	−0.71	−0.57	−0.72	−0.58	−0.77	0.49	−0.35	−0.82	−0.35	−1.96	−0.70	−2.46	−0.70	−2.49
$Kurt$	9.58	4.36	4.81	6.36	6.08	4.49	7.08	4.48	7.09	2.58	2.62	3.73	2.20	6.93	3.08	9.52	3.08	9.69
AC_1	0.07	0.10	0.09	0.12	0.11	0.10	0.06	0.10	0.07	0.17	−0.11	−0.10	0.06	−0.15	−0.05	−0.10	−0.05	−0.08
SR	0.19	0.09	0.31	0.34	0.20	0.26	0.09	0.10	−0.20	0.11	0.07	0.29	0.20	0.01	0.14	−0.03	0.11	−0.08
MDD	−0.30	−0.44	−0.27	−0.28	−0.33	−0.24	−0.31	−0.29	−0.48	−0.22	−0.36	−0.24	−0.25	−0.61	−0.25	−0.66	−0.26	−0.69
$Freq$	2.0	3.4	3.9	4.1	2.6	3.2	5.2	3.2	5.2	16.8	35.1	35.6	34.3	24.2	29.2	46.0	29.2	46.0
	Developed Countries									*Developed Countries*								
$Mean$	0.81	0.64	2.51	0.92	4.56	1.89	3.75	1.11	1.87	0.24	0.80	2.07	1.60	3.04	1.55	2.80	1.38	2.40
Med	0.99	1.96	3.55	3.56	6.30	3.47	5.79	2.75	3.91	2.17	3.52	1.90	2.72	2.37	1.24	3.23	1.08	2.99
$Sdev$	11.30	9.45	9.66	8.76	10.94	8.78	10.43	8.78	10.43	12.27	11.67	9.80	12.96	13.01	10.42	13.81	10.41	13.87
$Skew$	−0.22	−0.11	−0.41	−0.57	−0.59	−0.33	−0.31	−0.34	−0.31	−0.41	−0.21	−0.02	−0.79	−0.06	−0.15	−0.72	−0.15	−0.72
$Kurt$	3.33	3.31	4.44	4.46	5.86	3.79	3.84	3.78	3.84	2.14	1.82	2.19	3.41	2.79	2.11	4.09	2.11	4.04
AC_1	0.09	0.04	0.09	0.08	0.07	0.09	0.06	0.09	0.06	0.07	0.05	0.06	−0.02	0.03	0.06	−0.05	0.05	−0.05
SR	0.07	0.07	0.26	0.11	0.42	0.21	0.36	0.13	0.18	0.02	0.07	0.21	0.12	0.23	0.15	0.20	0.13	0.17
MDD	−0.50	−0.49	−0.31	−0.33	−0.42	−0.37	−0.30	−0.40	−0.36	−0.47	−0.46	−0.30	−0.33	−0.34	−0.34	−0.37	−0.34	−0.37
$Freq$	2.2	3.1	3.6	3.2	1.6	2.7	4.9	2.7	4.9	25.0	30.4	35.1	29.8	13.7	26.8	51.8	26.8	51.8

Table B2. Asset Pricing: External Imbalances (with b-a)

This table reports cross-sectional asset pricing results. The linear factor model includes the dollar (DOL) and global imbalance risk (HML_{NA}) factors whereas the test assets are excess returns to five currency (FX) portfolios sorted on the one-month forward premia (nominal interest rate differentials). The first portfolio ($P1$) contains currencies with the lowest forward premia while the last portfolio ($P5$) contains currencies with the highest forward premia. DOL denotes the average return across the FX portfolios. HML_{NA} is long-short strategy that buys the currencies of debtor nations and sells the currencies of creditor nations. *Panel A* reports GMM and Fama-MacBeth (FMB) estimates of the factor loadings b, the market price of risk λ, the cross-sectional R^2, and the *p-value* of the χ^2 test for the null hypothesis of zero pricing errors. *Panel B* reports least-squares estimates of time series regressions. The *p-values* and the standard errors reported in parentheses are based on Newey and West (1987) with Andrews (1991) optimal lag selection. Shanken (1992) standard errors are reported in brackets. Excess returns are expressed in percentage per annum and adjusted for transaction costs that occur in a short position ($P1$) and long position ($P2$-$P5$). The portfolios are rebalanced monthly from October 1983 to December 2011. Exchange rates are from *Datastream*. Yearly data on GDP, foreign assets and liabilities are from Lane and Milesi-Ferretti (2007). Monthly observations are retrieved by keeping end-of-period data constant until a new observation becomes available.

Panel A: Factor Prices

	b_{DOL}	b_{NA}	λ_{DOL}	λ_{NA}	R^2	$RMSE$	χ^2	b_{DOL}	b_{NA}	λ_{DOL}	λ_{NA}	R^2	$RMSE$	χ^2
	All Countries							*Developed Countries*						
GMM_1	−0.71	1.60	0.01	0.10	0.87	1.60	0.28	0.28	0.64	0.01	0.08	0.95	0.90	0.77
	(0.48)	(0.7)	(0.02)	(0.03)				(0.26)	(0.32)	(0.02)	(0.03)			
GMM_2	−0.81	1.63	0.01	0.09	0.87	1.60	0.29	0.25	0.55	0.01	0.07	0.94	0.99	0.80
	(0.47)	(0.69)	(0.02)	(0.03)				(0.24)	(0.28)	(0.02)	(0.03)			
FMB	−0.71	1.59	0.01	0.10	0.87	1.60	0.28	0.27	0.64	0.01	0.08	0.95	0.90	0.77
	(0.33)	(0.5)	(0.02)	(0.03)				(0.21)	(0.24)	(0.02)	(0.03)			
	[0.36]	[0.53]	[0.01]	[0.03]				[0.19]	[0.26]	[0.02]	[0.03]			

Panel B: Factor Betas

	α	β_{DOL}	β_{NA}	R^2	α	β_{DOL}	β_{NA}	R^2
$P1$	−0.02	1.01	−0.22	0.75	−0.01	0.87	−0.25	0.71
	(0.01)	(0.07)	(0.06)		(0.01)	(0.07)	(0.06)	
$P2$	−0.02	0.95	−0.09	0.76	−0.01	0.98	−0.09	0.82
	(0.01)	(0.07)	(0.07)		(0.01)	(0.04)	(0.04)	
$P3$	0.01	0.99	−0.03	0.84	0.00	0.97	−0.10	0.87
	(0.01)	(0.03)	(0.03)		(0.01)	(0.04)	(0.03)	
$P4$	0.01	1.14	−0.01	0.83	0.00	1.03	0.10	0.83
	(0.01)	(0.06)	(0.06)		(0.01)	(0.04)	(0.04)	
$P5$	0.04	0.90	0.35	0.71	0.03	1.16	0.35	0.80
	(0.01)	(0.07)	(0.08)		(0.01)	(0.04)	(0.06)	

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