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by Maria Gelman, Axel Jochem, Stefan Reitz and Mark P. Taylor

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JEL-Code: F31, G15, E58
Keywords: Real Effective Exchange Rate, Capital Flows, Financial Markets

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1. Introduction

The real effective exchange rate (REER) is a pivotal variable in open economy macroeconomics. With the expansion in trade in goods and services, the REER has emerged as a prime indicator of price competitiveness of economies in the economic policy arena. With its roots in the law of one price among integrated international goods markets, the theoretical concept of the REER as well as its practical impact on countries' output and wealth have been extensively studied in the literature (Aghion et al., 2009; Bleaney and Greenaway, 2001). With ongoing globalisation and financial integration, however, capital flows now account for a major share of cross-border transactions (Hau and Rey, 2004). Given that expected future cash flows determine current asset prices it may be assumed that their cross-country ratios, computed in the same currency, provide a measure of price competitiveness of a country's assets relative to its foreign competitors, just as the REER provides a measure of the price competitiveness of a country's goods and services. While permanent shocks to this 'real effective financial exchange rate' (REFER) signal a fundamental reappraisal of future returns and indicate changing shares of a country's assets in the portfolio of international investors, temporary variations may be interpreted as overvaluation or undervaluation of domestic asset prices relative to foreign assets. In general, moreover, it seems reasonable to assume that the REFER should reflect foreign investors' willingness to hold a country's assets. Further, given that capital movements will generate a price impact on assets and/or nominal exchange rates, we may derive an equilibrium relationship between the REFER and foreign investors' holdings of a country's assets, net of domestic holdings of foreign assets (NFH).

By doing so, we explicitly consider Lane and Shambaugh's (2010) observation that the trade-weighted exchange rate indices are insufficient to provide a full understanding of the financial impact of currency movements. These authors create a financially weighted exchange rate index based on the composition of foreign assets and liabilities in order to investigate the impact of currency movements on the capital gains and losses of foreign assets and liabilities. In contrast, the proposition of a real effective exchange rate that is not only financially weighted but also deflated on the basis of financial market prices should fully reveal the causes and consequences of exchange rate movements in international capital market transactions.

In this paper, a panel of 15 leading national stock markets is used to construct and empirically investigate the index of real effective financial market exchange rates. While, at the first stage, nominal bilateral exchange rates are deflated by MSCI stock market indices to obtain real bilateral financial market exchange rates, weights based on bilateral cross-holdings of equity securities as reported in the IMF's Coordinated Portfolio Investment Survey (CPIS) data set are used to calculate the REFER as a geometric average of bilateral values at the second stage. This indicator therefore reflects the relative attractiveness of a country's financial assets as compared to those of its capital market competitors. The empirical results are encouraging at least in two important ways. First, we find that a country's net foreign asset position in equity securities is cointegrated with its REFER. Second, the resulting dynamic error correction analysis provides empirical support for uncovered return parity developed by Capiello and De Santis (2007) and De Santis and Sarno (2008) as well as investors' portfolio rebalancing behaviour as discussed in Bohn and Tesar (1996) and Hau and Rey (2009).

The remainder of the paper is organised as follows. In Section 2 we briefly review the literature on the relationship between exchange rates and capital flows. In Section 3 we offer a theoretical framework for the linkages between the REFER and net foreign assets. In Section 4 we describe the data, while in Section 5 we describe the methodology for calculating the REFER. In Section

6 we provide a description of the econometric framework and report the empirical results, before offering some concluding remarks in a final section.

2. Exchange Rate Dynamics, Capital Flows and Asset Prices

Numerous studies such as Portes and Rey (2005), Bekaert et al. (2002), and Brooks et al. (2004) have analysed the linkage between exchange rate dynamics, capital flows and asset prices. Based on the now widely accepted microstructure proposition that foreign exchange order flow drives exchange rates (at least contemporaneously; e.g. Lyons, 2006), the theoretical approach of Hau and Rey (2004, 2006) suggests that higher returns in the home equity market relative to the foreign equity market are associated with home currency depreciation. Subsequent empirical studies generally provide support for this negative relationship. For instance, Heimonen (2009) indicates that an increase in Euro area equity returns with respect to US equity returns causes an equity capital outflow from the Euro area to the US, leading to an appreciation of US dollar. Investigating high frequency data from emerging Thailand, Gyntelberg et al. (2009) are able to provide further support for this framework. Their results are based on two comprehensive, daily-frequency datasets of foreign exchange and equity market capital flow transactions undertaken by nonresident investors in Thailand in 2005 and 2006. Net purchases of Thai equities by nonresident investors lead to an appreciation of the Thai baht; in addition, higher returns in the Thai equity market relative to a reference stock market are associated both with net sales of Thai equities by these investors, with a consequent depreciation of the Thai baht. Chai-Anant et al. (2008) examine foreign investors' daily transactions in six emerging Asian equity markets and their relationship with local market returns and exchange rate changes over the period 1999-2006. In line with the above studies, these authors find that equity market returns matter for net equity purchases, and vice versa; in addition, while currency returns tend to show little influence over foreign investors' demand for Asian equities, net equity purchases do have some explanatory power over near-term exchange rate changes.

While these studies essentially concentrate on the short-run dynamics of bilateral exchange rates using country-specific time series, in the present study we aim at deriving a long-run equilibrium relationship between the REFER and cross-country asset holdings based on a large panel of countries. Thus, our analysis is more closely related to a strand of literature going back at least to the so-called stock-flow approach of Faruqee (1995), where the REER is explained by the stock and flow of assets across borders. Based on data for the United States and Japan since World War II, Faruquee revealed a cointegrating relationship between the net foreign asset position and the REER for the US, although not for Japan. Aglietta et al. (1998) and Alberola et al. (1999, 2002) extended this model by including non-price competitiveness and a non-tradables sector, respectively; estimating the equilibrium REER for a panel of developed countries, these authors found evidence to suggest that if a country has accumulated current account surpluses in the past, its net foreign position increases together with an appreciation of its REER. The relationship between net foreign asset positions and exchange rates was also investigated in the context of the Behavioural Equilibrium Exchange Rate (BEER) models suggested by MacDonald (1997) and Clark and MacDonald (1998). The BEER approach explains movements of the REER in short, medium and long-run equilibrium levels using net foreign assets and some other fundamentals as explanatory variables. Based on the data for US, Germany and Japan, Clark and MacDonald (1998) provide empirical evidence for the following equilibrating mechanism: a rise in net foreign assets implies an increase in the real exchange rate which will tend to counteract the change in net foreign assets via the deterioration in the trade balance, and vice versa. Bénassy-

Quéré et al. (2004) follow the methodology of Alberola et al.(2002) and analyse the long-run effects of net foreign assets on the REER for the G-20 countries for the period 1980–2002. Using a panel cointegration approach, they find that a decrease in net foreign assets in emerging economies caused an appreciation of the REER in the second half of the sample. Using the same technique, Égert et al. (2004) showed that an improvement in the net foreign asset position leads to a real appreciation in small open OECD economies. In contrast, in the case of transition economies the deterioration in the net foreign assets is consistently associated with a real appreciation; the authors suggest that the difference in the sign of the estimated coefficient may be due to the fact that the 30-year period used for the OECD countries captures the long run, while the decade of data available for the transition countries can only be informative about the medium run.[1]

There is also an issue as to which types of capital flows to include in the analysis. Hau and Rey (2006) relate exchange rates to equity flows, while Siourounis (2004) conducts the empirical analysis also for the impact of bond flows on exchange rates, revealing that net cross-border equity flows have a significant effect on exchange rate movements while bond flows are immaterial. Brooks et al. (2004) consider various kinds of capital flows, such as foreign direct investment flows, portfolio flows and debt flows, for the euro and the yen against the dollar. The authors show that net portfolio flows between the Euro Area and the United States can closely track movements of their exchange rate, while foreign direct investment flows appear to be less

[1] This is in line with considerations that high expected returns in catching-up countries attract foreign capital which entails both, an accumulation of foreign liabilities and a currency appreciation. In the long run, however, a country having a negative value of net foreign assets must have a trade surplus to finance interest and dividend payments. This is delivered by a depreciation of the country's real exchange rate. For a theoretical foundation of this argument see Dornbusch and Fischer (1980), Hooper and Morton (1982) and Gavin (1992).

significant for exchange rate volatility. On the other hand, movements in the yen versus the dollar are explained more by the current account and interest differential.

More recently, Lane and Shambaugh (2010) indicate that the trade-weighted exchange rate indices used in these studies were insufficient to fully understand the financial impact of currency movements. This is particularly true in the face of growing importance of the valuation effect in the recent years with rapid growth in cross-border financial holdings. These authors document the diverse behaviour of trade-weighted and financially-weighted exchange rates, generally indicating that trade weighted exchange rates are not informative with regard to the financial impact of currency movements. Tille (2003) and Lane and Milesi-Ferretti (2007b) also emphasise the role of financial-variable weights and their studies indicate that the trade weights and financial currency weights are quite different for the United States.

In the present study, while considering financial market weights to calculate an effective exchange rate as suggested in much of the previous literature, we also use financial market prices to deflate the incorporated nominal bilateral exchange rates. A panel of 15 countries, which together account for roughly 65% of global cross-border equity security holdings (assets and liabilities), is used to construct real effective financial exchange rates. This new indicator is evaluated analysing its relationship with capital flows among these countries.

3. A Portfolio Balance Interpretation of the Real Financial Market Exchange Rates

Portfolio balance models in the tradition of Adler and Dumas (1983) and Branson and Henderson (1985) are well-understood in describing an equilibrium relationship between the stock of assets held by international investors and the price of assets in different currencies. We use this framework to show in Section 3.1 that the real effective financial exchange rate has an intuitive fundamental value determined by the relative asset holdings of international investors. From an empirical point of view, the existence of the portfolio balance equilibrium should materialize in a statistically significant cointegrating relationship between the real effective financial exchange rate and relative asset holdings of international investors. Since a cointegrating relationship implies the existence of a dynamic error correction adjustment process (Engle and Granger, 1987), we also estimate and provide an economic interpretation of the short-run adjustment processes.

In Section 3.2, we show that the error correction equation of the real effective exchange rate implicitly tests for a risk premium in the uncovered return relationship, as derived in Capiello and De Santis (2007) and De Santis and Sarno (2008). Secondly, in Section 3.3, the empirical evidence on the error correction equation of relative asset holdings is used to shed light on international investors' behavior with respect to portfolio rebalancing and return chasing, as discussed, for instance, in Bohn and Tesar (1996).

3.1 Exchange Rates and Net Foreign Holdings of a Country's Assets

We consider a model in which there are N investors, one for each country, allocating their wealth to the real assets of *N* countries, including the real domestic assets of country *i*, $F_{i,t}^{i}$, and *N-1* real foreign assets $F_{j,t}^{i}$. In contrast to the standard portfolio model we do not incorporate money or bond holdings of the investor. Moreover, we explicitly focus on short-run portfolio dynamics and do not consider a change of the real supply of foreign asset due to current account imbalances.[2] As a result, the real supply of domestic and foreign assets is assumed to be fixed. The nominal wealth of the country *i* investor defined in terms of the domestic currency is

$$W_t^i = \sum_{j=1}^{N} \frac{P_{j,t} \cdot F_{j,t}^i}{S_{ij,t}}, \qquad j = 1,..,i,..,N \qquad (1)$$

where $P_{i,t}$ and $P_{j,t}$ are the domestic currency price of the domestic asset and the foreign currency prices of the *N-1* foreign assets, respectively. The exchange rate $S_{ij,t}$ is defined as the price of the domestic currency in units of the foreign currency and $S_{ii,t} \equiv 1$. The nominal stock of country *i*'s assets F_i are either held by the domestic investor *i* or the *N-1* foreign investors:

$$P_{i,t} \cdot F_i = \sum_{j=1}^{N} P_{i,t} \cdot F_{i,t}^j, \qquad j = 1,..,i,..,N \qquad (2)$$

Each country *i* representative investor is assumed to be endowed with the entire set of domestic equities before engaging in international portfolio diversification. This implies that at any future point in time the number of country-*j* assets in investor *i*'s portfolio can only be increased by decreasing the number of domestic or other foreign assets in her portfolio. To what extent assets can be exchanged depends on relative prices. The resulting budget constraint for investor *i* states that the value of net sales of domestic assets must equal the value of net purchases of foreign assets:

[2] Hooper and Morton (1982) develop a model in which exogenous shocks to trade result in changes in net foreign assets and, in the long run, in a positive correlation between net foreign asset and real exchange rates. In a more complex theoretical model, Gavin (1992) shows that exogenous shocks to wealth entail a positive correlation between net foreign assets and real exchange rates, if the Marshall-Lerner condition is satisfied.

$$\sum_{j=1}^{N} P_{i,t} \cdot \Delta F_{i,t}^{j} = \sum_{j=1}^{N} \frac{P_{j,t} \cdot \Delta F_{j,t}^{i}}{S_{ij,t}}, \qquad \forall j \neq i \qquad (3)$$

The investors' portfolios are in equilibrium if the domestic-currency nominal supplies of assets equal their desired shares of nominal wealth. Thus, there are N^2 equilibrium conditions of the form:

$$\frac{P_{j,t} \cdot F_{j,t}^{i}}{S_{ij,t}} = \omega_{j,t}^{i} W_t^i, \qquad \forall i, j \qquad (4)$$

where $\omega_{j,t}^{i}$ denotes the desired share of country *j*'s assets in investor *i*'s portfolio so that

$$\sum_{j=1}^{N} \omega_{j,t}^{i} = 1, \qquad \forall i.$$

The vector of each investor's portfolio weights is typically derived from first order conditions of mean-variance optimization

$$\boldsymbol{\omega}_{\boldsymbol{t}}^{\boldsymbol{i}} = a^i \boldsymbol{\Sigma}_t^{-1} \boldsymbol{\mu}_t^i, \qquad (5)$$

where a^i denotes investor *i*'s risk aversion, $\boldsymbol{\Sigma}_t^{-1}$ is the covariance matrix of returns, and $\boldsymbol{\mu}_t^i$ is the vector of investor *i*'s time *t* expectations about asset returns until time *t*+1.

From rearranging the equilibrium conditions for assets (eq. 4) we may write

$$\frac{P_{j,t}}{S_{ij,t}} = \frac{\omega_{j,t}^{i} W_t^i}{F_{j,t}^{i}}, \qquad \forall i, j. \qquad (4')$$

For each portfolio *i* there are *N-1* ratios of cross-country holdings denominated in country *j* currency

$$\frac{P_{i,t} \cdot S_{ij,t}}{P_{j,t}} = \frac{\omega_{i,t}^{j} W_t^{j} S_{ji,t} / F_{i,t}^{j}}{\omega_{j,t}^{i} W_t^{i} / F_{j,t}^{i}}, \qquad (6)$$

where $S_{ij,t} = 1/S_{ji,t}$.

Equation (6) states that in equilibrium the asset price ratio denominated in country-*j* currency equals the ratio of nominal demands per unit of real assets. The latter reflects the importance of market capitalization in the domestic as well as in the foreign asset market. For instance, if the number of domestic asset shares is large relative to the number of foreign asset shares, a given change in the portfolio composition should exhibit a lower price impact than a more balanced market capitalization across borders.

In the following, the asset price ratio on the left-hand side of equation (6) will be interpreted as currency *i*'s (asset-based) real bilateral exchange rate vis-á-vis currency j. An increase in the real exchange rate reflects a relative appreciation of country *i*'s asset. Assuming that the law of one price holds on international asset markets ($P_{i,t} \cdot S_{ij,t}/P_{j,t} = 1$), we find that

$$\frac{\omega_{i,t}^{j}}{\left(\frac{F_{i,t}^{j}}{W_t^{j}/P_{j,t}}\right)} = \frac{\omega_{j,t}^{i}}{\left(\frac{F_{j,t}^{i}}{W_t^{i}/P_{i,t}}\right)}. \qquad (6')$$

This implies that under these circumstances the desired portfolio shares can only deviate from real asset shares in an internationally symmetric fashion, including the portfolio equilibrium case where the $\omega_{i,t}^{j}$ exactly match real asset shares (Solnik, 1974; De Santis, 2010).

By weighting *N-1* real exchange rates we may calculate currency *i*'s real *effective* financial exchange rate (*REFER*) as:

$$\prod_{j=1}^{N}\left(\frac{P_{i,t}\cdot S_{ij,t}}{P_{j,t}}\right)^{\theta_j^i}=\prod_{j=1}^{N}\left(\frac{\omega_{i,t}^{j}W_t^{j}S_{ji,t}/F_{i,t}^{j}}{\omega_{j,t}^{i}W_t^{i}/F_{j,t}^{i}}\right)^{\theta_j^i}, \qquad \forall j\neq i \tag{7}$$

where the θs are constant weights derived from the cross-country holdings of investors *i* and *j* in a base period:[3]

$$\theta_j^i=\frac{\omega_{j,2004}^{i}W_{2004}^{i}+\omega_{i,t}^{j}W_{2004}^{j}/S_{ji,2004}}{\sum_{j=1}^{N}\omega_{j,2004}^{i}W_{2004}^{i}+\sum_{j=1}^{N}\omega_{i,2004}^{j}W_{2004}^{j}/S_{ji,2004}}, \qquad \forall j\neq i \tag{8}$$

so that $\sum_{j=1}^{N}\theta_j^i=1,\forall i.$

Because the weights θ incorporate both assets as well as liabilities of country *i* vis-á-vis country *j* relative to the sum of assets and liabilities, they reflect the importance of country *j* in the

[3] Constant weights help identifying the relationship between relative asset prices and cross-country holdings of assets and liabilities. The left-hand side of equation (7) is similar to the construction of CPI-based real effective exchange rates as comprehensively discussed in Buldorini et al. (2002) and updated by Schmitz et al. (2012). In contrast to the ECB construction of real effective exchange rates we do not consider any third market effects.

portfolio of country *i*. Thus, the right-hand side of equation (7) represents the weighted average of net foreign holdings of country *i*'s assets in the portfolios of foreign investors corrected for capital market sizes, or net foreign holdings (*NFH*) for short. The log real effective exchange rate of country *i* is

$$\sum_{j=1}^{N} \theta_j^i \left(p_{i,t} + s_{ij,t} - p_{j,t}\right) = \sum_{j=1}^{N} \theta_j^i \left(d_{i,t}^j - d_{j,t}^i\right), \qquad \forall j \neq i \tag{9}$$

where $d_{i,t}^j \equiv log\left(\omega_{i,t}^j W_t^j S_{ji,t}/F_{i,t}^j\right)$ and $d_{j,t}^i \equiv log\left(\omega_{j,t}^i W_t^i/F_{j,t}^i\right)$, and lower case letters denote logarithms.

3.2 Return Differentials, Expectations and Risk Premia: Short-Run Exchange Rate Adjustment

The underlying assumption of risk aversion forces international investors to demand a risk premium in case the actual net foreign holdings of a country's assets in a given portfolio exceed their optimal share. In our framework, this risk premium can be derived from the empirical counterpart of the equilibrium condition represented in equation (9):

$$nfh_t = nfh_t^* + u_{1t}, \tag{9'}$$

where the optimal level of (log) net foreign holdings $nfh_t^* \equiv \alpha_0 + \alpha_1 refer_t^*$ is a linear function of the country's (log) real effective financial exchange rate. From equation (9), following Hau and Rey (2006), we expect the coefficient α_1 to be significantly positive, i.e. net foreign assets and the real effective exchange rate are positively correlated. If equation (9) is perceived to represent a useful equilibrium relationship, any deviation u_{1t} should die out over time or, in statistical terms, have a constant mean and finite variance. This error correction can be provided by an appropriate adjustment of either net foreign holdings or the real effective financial exchange rate. With respect to the adjustment of the REFER this error correction is of the form

$$\Delta refer_{t+1} = \gamma_{10} + \gamma_{11}(nfh_t - nfh_t^*) + \gamma_{12}\Delta refer_t + \gamma_{13}\Delta nfh_t + \varepsilon_{t+1}. \qquad (10)$$

where $\Delta refer_{t+1} = \sum_{j=1}^{N} \theta_j^i \left(\Delta s_{ij,t} + \Delta p_{i,t} - \Delta p_{j,t}\right)$ can be interpreted as the excess return of country *i*'s assets over the average return of their foreign counterparts. Of course, estimating equation (10) implies a specific test of the joint hypothesis of uncovered return parity—i.e.:

$$E_t[\Delta refer_{t+1}|\Omega_t] = \gamma_{11}(nfh_t - nfh_t^*) \qquad (11)$$

—and rational expectations on the part of international investors such that their expectations for time *t+1* are the true mathematical expectations based on information available at time *t*. The concept of uncovered return parity has been developed by Capiello and De Santis (2007) and De Santis and Sarno (2008) where, similar to the regular uncovered interest rate parity condition, the equilibrium condition of uncovered return parity arises from a standard no-arbitrage framework relating expected excess returns from international equity investments to the conditional covariances between equity returns and the stochastic discount factor, and the conditional covariance between the foreign equity return and the exchange rate return.[4] In contrast to this equation (11) implicitly assumes constant (unconditional) covariances, but allows for time-varying risk stemming from inferior shares of a country's assets in the portfolios of international investors. In fact, Adler and Dumas (1983) showed that mean-variance optimization leads to a linear relationship between risk premia and efficient portfolio shares. As a result, our version of the uncovered return parity states that expected excess return of a country's assets are positively related to *excess* net foreign holdings.

3.3 Rebalancing versus Return Chasing: Short-Run Adjustment of Net Foreign Holdings

Examining the role of net purchases in an international capital asset-pricing model, Bohn and Tesar (1996) decompose net purchases into transactions that are necessary to maintain a balanced portfolio and net purchases that are triggered by expected international return differentials. Their empirical results show that U.S. transactions in foreign equities are primarily driven by the return-chasing effect, which means that investors tend to move into markets where returns are expected to be high and retreat from markets when predicted returns are low. More recently, Hau and Rey (2009) examine the dynamics of international portfolios with a microdata set on the stock allocations of a large set of international equity funds during a five-year period; these authors find strong support for the hypothesis that managers rebalance their portfolios towards their desired weights aiming at stabilizing exchange rate risk and equity risk exposure.[5]

[4] Empirical research has consistently rejected uncovered interest parity; for surveys see Engel (1996) and Taylor (1995). It is now considered a stylized fact that higher interest rate currencies tend to appreciate when uncovered interest parity predicts them to depreciate. This finding is commonly referred to as the `forward bias puzzle'.
[5] This is confirmed by Calvet et al. (2009) who investigate whether Swedish households adjust their risk exposure in response to the portfolio returns during the period 1999-2002. They examine the rebalancing between the risky share

In our framework, this portfolio adjustment appears in the error correction equation of net foreign holdings. Again we start from the empirical counterpart of the equilibrium condition represented in equation (9):

$$refer_t = refer_t^* + u_{2t}, \qquad (9'')$$

where the equilibrium level of the (log) exchange rate $refer_t^* \equiv -a_0/a_1 + 1/a_1\, nfh_t^*$ is a linear function of the country's (log) net foreign holdings. The corresponding error correction of net foreign holdings is of the form

$$\Delta nfh_{t+1} = \gamma_{20} + \gamma_{21}(refer_t - refer_t^*) + \gamma_{22}\Delta refer_t + \gamma_{23}\Delta nfh_t + \varepsilon_{t+1}. \qquad (12)$$

where Δnfh_t, defined as the percentage change of country *i*'s net foreign holdings, can be approximately decomposed into two components:

$$\Delta nfh_t = \sum_{j=1}^{N} \theta_j^i \left(\Delta ln\omega_{i,t}^j - \Delta ln\omega_{j,t}^i\right) + \sum_{j=1}^{N} \theta_j^i \left(\Delta ln\left(\frac{W_t^j S_{ji,t}}{F_{i,t}^j}\right) - \Delta ln\left(\frac{W_t^i}{F_{j,t}^i}\right)\right) \qquad (12')$$

of households portfolios and riskless assets revealing portfolio rebalancing especially for the most educated and wealthiest households.

The *first* component in round parentheses on the right-hand side of (12') represents the percentage change of the desired portfolio shares of international investors relative to the percentage change of the domestic investor's desired portfolio shares of the foreign assets. Based on the derivation of portfolio shares from mean-variance optimization in equation (5) and assuming that investor *i*'s return expectation depends linearly on the current mispricing of the respective country's assets, the first component corresponds to the error correction term in equation (12). Observing a significant reaction of investors' portfolios to a disequilibrium relative asset price can be interpreted as evidence in favor of return chasing (Bohn and Tesar, 1996), whereby a negative γ_{21} is consistent with a buy low/sell high strategy and a positive γ_{21} results from a sell under-performers/buy over-performers strategy.

The *second* component on the right-hand side of (12') consists of the average growth differential between foreign and domestic investors' wealth per share of real assets and represents the valuation effect of relative asset price changes on net foreign holdings. From rearranging the above decomposition, it follows that in order to leave portfolio shares unchanged the growth rate of net foreign holdings has to match differences in growth rates of investors' wealth.[6] If time-*t* valuation effects on investors' wealth trigger portfolio *rebalancing* transactions estimation of equation (12) should result in a negative γ_{22} coefficient.

4. Data

The data are constructed at annual frequency for the sample of periods 1993-2012 and include fifteen countries: Australia, Brazil, Canada, Germany, Spain, France, Hong Kong, Italy, Japan,

[6] A similar portfolio rebalancing argumentation is provided by Bohn and Tesar (1996) where net purchases of an asset is also driven by the performance of the asset itself relative to the performance of the overall portfolio.

Korea, Mexico, Portugal, Singapore, United Kingdom, and United States. Cross-holdings of equities are derived from Kubelec and Sa (2012) and the IMF's CPIS data set. Unlike the database constructed by Lane and Milesi-Ferretti (2007a), the data set used in our study provides information on the equity stocks of bilateral cross-holdings of assets. The *Geographic Breakdown of Total Portfolio Investment* (Table 8 of CPIS) comprises data from the individual economy's residents holdings of securities issued by non-residents (reported data), and the data for non-residents' holdings of securities issued by residents (derived data), while Lane and Milesi-Ferretti database does not make the geographic breakdown of the portfolio of investments and only reports total portfolio equity assets of a country.

The data published by Kubelec and Sa (2012) cover the periods 1993-2005 and data from CPIS cover the periods 2006-2012. While equity cross-holdings of major industrialized countries such as the US are the same across data sets, Kubelec and Sa fill gaps in the CPIS framework by estimated values from a gravity model. The CPIS survey covers equity assets of investors from currently roughly 75 countries. In our study data limitations did not allow us to include data about all countries. For instance, China does not report its outgoing investments. So, we narrowed down the sample to 15 leading countries, which still represent the majority of cross holdings. The circle of 15 countries used in our study reflects roughly 65% of global equity securities documented in the CPIS. The CPIS data were also used to calculate constant country weights based on cross-holdings of 2004, as this year is associated neither with the new economy bubble nor with the current financial crisis. The weights are computed in a way, that they reveal the most important partner countries and existing financial ties. Table 1 shows the overall weights at which the individual countries are included in the real effective financial market exchange rate.

From the United States perspective, United Kingdom (27.3%), Japan (20.6%) and Canada (14.1%) are the most important for the stock market exchange rate. While for Germany the largest weights have the United States (38.5%), France (21.3%) and United Kingdom (18.4%). In general, the financial tie with United States is the most important for all countries, except for Hong Kong SAR, where United Kingdom is dominating with a weight of 43.7%.

Monthly bilateral exchange rates were obtained from the Deutsche Bundesbank's database. For the period from 1999 onwards, hypothetical exchange rates for DM, French Franc and other former EU currencies were derived based on euro-dollar rates, with the average of these data taken in order to obtain annual data. To arrive at real effective financial exchange rates, the nominal bilateral exchange rates were deflated using Morgan Stanley Capital International (MSCI) stock market indices. The MSCI Global Investable Market Indices (GIMI) methodology classifies each company and its securities in one and only one country, which allows for a distinctive sorting of each company by its respective country ruling out problems of equity cross-listing.[7] Figure 1 displays a comparison between the real effective financial exchange rates for Germany and United States and real effective exchange rates based on goods market prices for the same set of countries, where an increase in the real effective financial exchange rate implies a relative appreciation of the country's equities. The graph shows that, for instance, Germany entered European Monetary Union at a relatively high exchange rate, which devalued in the early 2000s. Subsequently, an increase of the German REFER can be observed until the recent crisis most likely reflecting increased price competitiveness of German firms due to decreasing unit labor costs. Regarding the US REFER, Figure 1 shows a sharp appreciation between 1994 and 1998, which was associated with a strong influx of capital. The technology boom and

[7] See http://www.msci.com/eqb/methodology/meth_docs/MSCI_Nov13_GIMIMethod.pdf.

expectations of higher US productivity growth led to elevated stock market valuations and a strong dollar appreciation[8]. Since 2001, however, the enthusiasm for US dollar investments substantially decreased accounting for a depreciation of the dollar's REFER of 35 percent by 2008.

[Figure 1 about here]

Fig. 2 shows that real effective financial exchange rates exhibit strong fluctuations over time. Comparing time-series variances we find that, in general, the *REFER* of emerging market countries have greater variances than those of industrialized economies. Except for the Japanese Yen, which, according to the index, was relatively high in the beginning of 1990s, experienced a considerable decline of its *REFER* in mid-1990s and remained at the lower level afterwards. In contrast, the *REER* exhibits smaller fluctuations over time due to the stickiness of goods prices.

[Figure 2 about here]

In order to control for the price impact of relative capital market sizes as documented in equation (6) we used the data on market capitalization obtained from the Worldbank database (World Development Indicators – WDI).

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[8] See Blanchard and Milesi-Ferretti (2009).

5. Estimation results

To analyze the long-term relationship between real financial exchange rates and net foreign holdings, we perform standard panel cointegration analyses.[9] As a starting point, panel unit root (Philipps-Perron) tests are applied to the levels of REFER and NFH, respectively. The Fisher χ^2 test statistics of 20.49 and 41.39 do not reject the null hypothesis of *non-stationarity* at conventional levels.[10] When looking at logs, test statistics of 19.98 and 33.20 do not reject the unit root behavior of both variables, either. Having established that both variables were *I(1)* we move on to testing for cointegration. As suggested by Pedroni (2004) and Kao (1999) ordinary least squares (OLS) regressions are estimated and stationarity of the resulting residuals are tested using the Engle-Granger framework:[11] The associated panel ADF-statistics are significant at the one percent level rejecting the null hypothesis of no cointegration for variables in logarithms.

The subsequent error correction models are based on the long-run relationship (standard errors in parentheses):

$$refer_{i,t} = \underset{(0.09)^{***}}{4.97} + \underset{(0.08)^{***}}{0.35} \cdot nfh_{i,t} + u_{i,t}. \qquad (13')$$

The coefficients in equation (13') are derived from a dynamic OLS (DOLS) estimation where the real effective financial exchange rate is regressed on a constant, net foreign holdings, the current and lagged change of net foreign holdings, the lead change of net foreign holdings, and two

[9] All estimates are conducted using EViews 7.1.

[10] See Fisher (1932) and Maddala and Wu (1999). The number of lags is automatically determined using the Schwarz info criterion. Furthermore, we allow for fixed effects in the individual cross sections.

[11] See Pedroni (2004) as well as Kao (1999).

autoregressive terms (Kao and Chiang, 2000).[12] The computed variance-covariance matrices are robust against cross-section correlation and heteroskedasticity using panel corrected standard errors (PCSE). The results are in line with Hau and Rey (2006) claiming that the pricing on modern international financial markets can be characterized as order-driven in the sense that net buying of a country's assets lead to rising prices and/or currency appreciation. This is also present in a high-frequency study by Dunne et al. (2010) showing that asset returns are strongly and positively influenced not only by own market order flow, but also by the order flow in the overseas market. In addition, Heimonen (2009) finds that net equity flows from the US to the Euro Area led to an appreciation of the euro (US dollar depreciation). These findings are also consistent with the work of Gyntelberg et al. (2009), who provide evidence of a positive relationship between net purchases of Thai equities by foreign investors and baht exchange rates. Apart from this order-flow argumentation, positive correlation between the two variables may also arise from a valuation effect depending on whether or not investors are fully rebalancing their portfolios.[13]

As detailed in Sections 3.2 and 3.3, the error correction equations (10) and (12) are used to empirically investigate uncovered return parity and portfolio adjustment behavior of international investors. The estimation results represented in Table 2 are based on OLS regressions with fixed cross section and fixed time effects. Panel A shows the parameter estimates of the model with the *refer* and *nfh* variables. In order to fully assess the empirical performance of the new index we also estimated the traditional model using a standard real effective exchange rate based on

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[12] When looking at Phillips-Perron statistics of the Pedroni test no-cointegration can also be rejected at the one percent level.

[13] The following error correction analyses give detailed information on this issue from an empirical perspective.

consumer price indices. The resulting coefficients of the empirical model are contained in Panel B of Table 2.

[Table 2 about here]

According to Panel A of Table 2, both variables provide significant error correction. In case of a positive deviation from the long-run equilibrium implying that the current *refer* is higher than its equilibrium value a depreciation of the real effective financial exchange rate proportional to the current error can be expected to restore equilibrium. Although highly significant, an error correction coefficient of 17 percent translates into a half-life of adjustment of 3.7 years, implying only a moderate speed of adjustment of international asset prices. Compared to the standard real effective exchange rate (Panel B), the new index does not seem to perform better in terms of adjustment rates or the overall fit of the error correction model. However, the error correction equation of the *refer* has a straightforward uncovered return parity interpretation. As outlined in Section 3.2, the error correction term reflects the reaction of excess returns of a country's assets to current excess net foreign holdings revealing a significant average risk premium.[14] These results are consistent with those of Cappiello and de Santis (2005), who approximated risk premia by a number of business cycle variables, and of Cappiello and de Santis (2007), who report an economically significant role for risk premia in the uncovered return parity condition. Within the framework of standard uncovered interest parity, Sarno et al. (2012) reveal that time-varying risk premiums are capable of producing unbiased predictions for excess returns and

[14] Note that the negative sign is based on the equilibrium relationship (13') instead of equation (10) as used in section 3.2.

hence conclude that accounting for risk premiums can be sufficient to resolve the forward bias puzzle without additionally requiring departures from rational expectations.

We now turn to the second error correction equation. While the standard real effective exchange rate (Table 2; Panel B) does not reveal any significant reaction of net foreign holdings at all, the estimation results on the new index answers the question whether managers rebalance their portfolios towards their desired weights and/or increase their exposure to expected increasing asset returns. First, we find a significant reaction of *nfh* to a given deviation from the long-run equilibrium. The estimated error correction coefficients in the second column of Table 2 are based on a rearranged equation (13') and can be directly interpreted as a nine percent error correction provided by the change of net foreign holdings. Thus, a positive error reflects a higher-than-equilibrium share of a country's assets and triggers capital outflows thereby lowering net foreign holdings. Against the backdrop of the above discussion in section 3.3, however, the standard formulation of equation (13') should be employed leading to a significant positive coefficient in equation (12). This means that if the relative price of a country's assets is lower than in equilibrium international investors seem to expect lower returns and decrease its portfolio share consistent with a sell under-performers/buy over-performers strategy. Using US transactions in foreign equities between 1980 and 1994 Bohn and Tesar (1996) found that investors tend to move into markets where returns are expected to be high and retreat from markets when predicted returns are low. However, expected returns are calculated from a set of regressors and would have, ex post, led to portfolio losses. Given that a lower-than-equilibrium relative asset price is the result of lower average past returns than abroad this strategy is also consistent with positive return chasing. The result of positive return chasing has been also reported in a number of contributions. For instance, Brennan and Cao (1997) support this hypothesis by their finding of positive correlation between US purchases of equities in foreign markets and their stock returns. Choe et al. (1999) argue that foreign investors pursued a positive feedback trading strategy on Korea's stock market before the 1997 Asian crisis in the sense that trades of foreign investors were affected by past returns. Furthermore, by analyzing daily international portfolio flows into and out of 44 countries Froot et al. (2001) provide evidence for positive feedback trading of international investors, while Grinblatt and Keloharju (2000) report that foreign investors tend to buy recent winners and sell recent losers in the Finnish stock markets.

Second, the negative coefficient of the lagged change of the *refer* indicates a decrease of net foreign holdings when investors have observed a higher return on a country's assets than abroad. As outlined in section 3.3 this behavior may be termed 'portfolio rebalancing', which implies targeting long-run country shares in investors' portfolios. These results are consistent with Hau and Rey (2009) finding strong support for portfolio rebalancing behavior concluding that managers aimed at stabilizing exchange rate risk and equity risk exposure around desired levels.[15]

6. Robustness

To provide insights into the robustness of the empirical findings we re-estimate the model using levels instead of log variables, distinguish between pre-crisis and crisis observations, and, finally, look at the influence of capital market distances to account for gravity-type effects of international capital flows.

[15] In contrast, Bohn and Tesar (1996) do not find significant portfolio rebalancing of US investors.

Levels

It is standard practice in the empirical international finance literature to use variables in logarithmic form, because the resulting coefficients are reasonably interpretable as elasticities and deviations from equilibrium values are reported in percentages. In policy circles, however, developments of international asset markets and exchange rates are often represented and discussed using levels. When testing for cointegration in levels using the procedure suggested by Pedroni (2004) and Kao (1999),

$$REFER_{i,t} = \underset{(8.49)^{***}}{86.66} + \underset{(4.86)^{***}}{22.99} \cdot NFH_{i,t} + u_{i,t}. \qquad (13')$$

we find that the associated panel ADF-statistics are significant at the one percent level, rejecting the null hypothesis of no-cointegration.

[Table 3 about here]

The associated error correction equations differ from those of the log variable estimations as the adjusted R^2 increases substantially for the exchange rate equation, while the equation of the change of net foreign holdings shows no significant influence of either the misalignment or the recent excess return. This is perhaps not surprising as absolute price changes or misalignments might not be appropriate in a panel data framework.

Sub-sample estimation

The global financial crisis clearly affected international investors' asset allocation. Compared to pre-crisis times global liquidity shortages spurred a process of deleveraging and diminishing risk appetite unfolded substantial safe haven flows. To fully assess the different behavior of international investors we split up the sample into a pre-crisis period ranging from 1993 to 2007 and a crisis period ranging from 2008 to 2012. Again applying DOLS techniques a cointegration relationship between the logs of the *refer* and *nfh* can be found for both sub-samples.[16] The related error correction equations are reported in the following Table 4.

[Table 4 about here]

When looking at Table 4 the following observations are worth mentioning. The estimation results of the pre-crisis period are largely consistent with the full sample estimation as both the significant risk premium as well as the portfolio rebalancing behavior remain valid. However, the error correction coefficient of net foreign holdings decreased and became statistically insignificant. This implies that during the first sample investors did not systematically adjust portfolio weights in the presence of changing misalignments. Regarding the second sub sample the risk premium in the exchange rate equation became statistically insignificant. Although the coefficient remains in the neighborhood of the full-sample estimation large asset price movements together with the associated capital flows have led to multicolinearity problems. The

[16] Note that in order to deal with the relatively short time dimension of the second sub-sample we applied a more parsimonious version of the DOLS equation.

variables $\Delta refer_t$ and Δnfh_t are proven to be positively correlated in this particular period resulting in higher standard errors of the estimated coefficients. In fact, removing Δnfh_{t-1} from the regression restores statistical significance of the error correction term at the one percent level.[17]

Moreover, the error correction equation of the net foreign holding shows that portfolio managers moved from a portfolio rebalancing strategy to a significant sell under-performers/buy over-performers return chasing strategy. This finding might be explained by the observed cutting down of portfolio exposures in financial hubs in the US and in Europe resulting in a comovement of decreasing asset prices capital outflows in the rest of the world. As noted by Rey (2013), the fundamentally changed risk sentiment of US and European investors and the need to adjust their international portfolios according to new accountancy rules have triggered a deleveraging process that entailed a general withdrawal of investors from foreign markets, irrespective of expected earnings or the exchange rate. This idea is also supported by Forbes and Warnock (2012) finding that extreme capital flow episodes are mainly explained by global factors, especially by global risk. Taken together, the sub-sample analysis lends support to our approach as the dramatic change in the investors' behavior during the financial crisis is reflected in the estimations.

The influence of geographical distances between capital markets

In the literature, it is argued that the geography of information is one of the main determinants of international transactions while there is often weak support for the diversification motive, once controlled for the informational friction. Portes and Rey (2005) show that a gravity model

[17] At the same time the estimated error correction coefficient is back to roughly 24 percent, while the adjusted R^2 remains at 46 percent.

explains international transactions in financial assets at least as well as goods trade transactions. The authors reveal that gross transaction flows depend on market size in source and destination country as well as trading costs, in which both information and the transaction technology play a role. Assuming that that the degree of informational asymmetry between domestic and foreign investors or the efficiency of transactions may be approximated by the geographical distance between capital markets (Portes and Rey, 2005), the role of information costs may be investigated within the above framework by interacting the error correction term with an appropriate distance measure, $dist_i$:

$$\Delta nfh_{i,t} = \beta_{20} + \beta_{21} \cdot u_{i,t-1} + \beta_{22} \cdot dist_i \cdot u_{i,t-1} + \beta_{23} \cdot \Delta refer_{i,t-1} + \beta_{24} \cdot \Delta nfh_{i,t-1} + \varepsilon_{2i,t}. \quad (14)$$

The equation assumes that the error correction coefficient is now a decreasing function of the distance between capital markets, where the latter is constructed as the weighted average of air-line distances between a country's capital and all other countries' capitals in the sample.[18] From the above interpretation of the error correction term this implies testing the null hypothesis that equity returns of distant markets are as hard to predict as those of neighborhood markets.

[Table 5 about here]

[18] The weights to compute an arithmetic average are taken from the calculation of the real effective financial exchange rates. Thus, the variable $dist_i$ (logarithm of distance in kilometers) varies across countries but is of course constant over time.

Re-estimation of the model reveals no influence of the distance measure on the error correction of net foreign holdings revealing that investors' asset allocation does not suffer from distance-approximated information costs.[19]

7. Conclusion

This paper proposes a new integrated approach to investigate empirically the interaction between asset prices, exchange rates and capital flows. Based on the standard international capital asset pricing model, we derive an equilibrium relationship between a country's net foreign holdings and its relative asset prices vis-á-vis an average of competitor markets. The latter variable is interpreted as an index of real effective exchange rates based on asset price deflators and can be viewed as the price competitiveness of a country's assets. The empirical results are encouraging in the sense that we find the two variables to be cointegrated in a panel of fifteen of the most important global asset markets in the period from 1993 to 2012. We also show that the related error correction equations have a straightforward economic intuition: while the error correction equation of this newly defined real effective financial exchange rate investigates the influence of risk premia on excess returns, thereby testing for uncovered return parity, the error correction equation of net foreign holdings informs about investors' behavior with respect to portfolio rebalancing and return chasing. Our empirical results suggest a better performance of the new index than traditional real effective exchange rates based on goods market prices, which have been applied in the literature so far. A number of robustness checks such as sub-sample

[19] We also tested for the influence of the distance variable in the error correction equation of the real effective financial exchange rate revealing also little evidence for its importance. The results are available from the authors upon request.

estimation or the consideration of information costs are also performed, confirming the major results.

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Table 1. Countries' weights in the real effective financial exchange rate

Investments from / Investments in	Australia	Brazil	Canada	Germany	Spain	France	Hong Kong SAR	Italy	Japan	Korea	Mexico	Portugal	Singapore	United Kingdom	United States
Australia	0.0%	0.0%	3.4%	2.4%	0.6%	0.7%	1.6%	0.8%	9.0%	0.6%	0.0%	0.0%	1.4%	17.1%	62.4%
Brazil	0.0%	0.0%	2.3%	0.1%	3.2%	1.8%	0.0%	2.3%	0.3%	0.0%	0.0%	0.6%	0.2%	10.1%	79.1%
Canada	1.5%	0.3%	0.0%	1.8%	1.0%	3.1%	1.0%	1.2%	6.9%	0.7%	0.5%	0.1%	0.3%	5.3%	76.4%
Germany	1.0%	0.0%	1.6%	0.0%	5.9%	21.3%	0.4%	6.6%	5.3%	0.3%	0.0%	0.4%	0.2%	18.4%	38.5%
Spain	0.5%	0.9%	2.2%	13.9%	0.0%	21.4%	0.1%	4.7%	3.3%	0.0%	0.0%	2.8%	0.1%	14.7%	35.5%
France	0.2%	0.2%	2.4%	17.3%	7.4%	0.0%	0.7%	8.7%	6.4%	0.2%	0.1%	0.4%	0.2%	19.6%	36.1%
Hong Kong SAR	2.0%	0.0%	2.8%	1.2%	0.1%	2.7%	0.0%	0.8%	8.7%	1.5%	0.0%	0.0%	5.4%	43.7%	31.1%
Italy	0.6%	0.5%	2.0%	12.1%	3.7%	19.8%	0.4%	0.0%	6.8%	0.5%	0.1%	0.6%	0.2%	17.7%	35.0%
Japan	2.2%	0.0%	3.9%	3.2%	0.9%	4.8%	1.7%	2.2%	0.0%	0.2%	0.0%	0.1%	0.8%	17.1%	63.1%
Korea	1.0%	0.0%	3.1%	1.6%	0.0%	1.4%	2.3%	1.2%	1.4%	0.0%	0.0%	0.0%	3.4%	18.4%	66.1%
Mexico	0.0%	0.0%	4.2%	0.4%	0.1%	0.8%	0.0%	0.6%	0.2%	0.0%	0.0%	0.0%	0.1%	13.4%	80.0%
Portugal	0.3%	1.3%	1.5%	7.1%	22.9%	9.9%	0.0%	6.2%	1.9%	0.0%	0.0%	0.0%	0.0%	21.9%	26.8%
Singapore	3.8%	0.1%	2.1%	1.5%	0.2%	1.8%	11.4%	0.8%	8.5%	4.9%	0.1%	0.0%	0.0%	19.1%	45.8%
United Kingdom	2.6%	0.4%	1.9%	7.1%	2.4%	9.3%	5.3%	3.7%	10.8%	1.5%	0.5%	0.4%	1.1%	0.0%	52.8%
United States	4.9%	1.8%	14.1%	7.6%	3.0%	8.8%	2.0%	3.8%	20.6%	2.8%	1.6%	0.3%	1.4%	27.3%	0.0%

Table 2. Estimation results of the error correction models
Panel data from 1993 to 2012 over a cross-section of 15 countries

Panel A: Real Effective Financial Exchange Rate

Dependent Variable	$\Delta refer_t$	Δnfh_t
Constant	-0.004 (0.009)	0.009 (0.031)
Error Correction	-0.170*** (0.035)	-0.091** (0.041)
$\Delta refer_{t-1}$	0.118* (0.061)	-0.478** (0.206)
Δnfh_{t-1}	0.046** (0.021)	-0.041 (0.072)
R^2-*adj*	0.25	0.01

Notes: The second column reports estimation results of the error correction equation (10), while the third column reports results of equation (12) in the text. * (**,***) denote significance at the 10% (5%, 1%) level.

Panel B: Real Effective CPI Exchange Rate

Dependent Variable	$\Delta reer_t$	Δnfh_t
Constant	0.003 (0.004)	0.003 (0.031)
Error Correction	-0.230*** (0.038)	0.011 (0.033)
$\Delta reer_{t-1}$	0.268*** (0.059)	-0.377 (0.444)
Δnfh_{t-1}	0.021** (0.010)	-0.127* (0.073)
R^2-*adj*	0.26	-0.02

Notes: * (**,***) denote significance at the 10% (5%, 1%) level

Table 3. Estimation results of the error correction models using levels
Panel data from 1993 to 2012 over a cross-section of 15 countries

Panel A: Real Effective Financial Exchange Rate

Dependent Variable	$\Delta REFER_t$	ΔNFH_t
Constant	-0.844 (0.896)	0.003 (0.073)
Error Correction	-0.225^{***} (0.029)	-0.048 (0.055)
$\Delta REFER_{t-1}$	0.335^{***} (0.053)	0.006 (0.004)
ΔNFH_{t-1}	1.02 (0.864)	-0.407^{***} (0.070)
R^2-*adj*	0.46	0.13

Notes: The second column reports estimation results of the error correction equation (10), while the third column reports results of equation (12) in the text. * (**, ***) denote significance at the 10% (5%, 1%) level.

Panel B: Real Effective CPI Exchange Rate

Dependent Variable	$\Delta REER_t$	ΔNFH_t
Constant	0.334 (0.451)	0.015 (0.073)
Error Correction	-0.244^{***} (0.038)	0.041 (0.039)
$\Delta REER_{t-1}$	0.329^{***} (0.059)	0.006 (0.009)
ΔNFH_{t-1}	0.773^{*} (0.416)	-0.457^{***} (0.067)
R^2-*adj*	0.28	0.13

Notes: * (**, ***) denote significance at the 10% (5%, 1%) level.

Table 4. Subsample Estimation of the error correction models using logs
Panel data over a cross-section of 15 countries

Panel A: Real Effective Financial Exchange Rate

Sample	1993 – 2007		2008 – 2012	
Dependent Variable	$\Delta refer_t$	Δnfh_t	$\Delta refer_t$	Δnfh_t
Constant	0.010 (0.012)	0.016 (0.037)	-0.016* (0.009)	0.003 (0.059)
Error Correction	-0.253*** (0.048)	-0.051 (0.035)	-0.146 (0.111)	-0.626*** (0.225)
$\Delta refer_{t-1}$	0.124* (0.073)	-0.565** (0.221)	0.137 (0.129)	-0.701 (0.849)
Δnfh_{t-1}	0.058** (0.028)	0.106 (0.086)	0.028 (0.026)	-0.162 (0.170)
R^2-*adj*	0.28	-0.03	0.46	0.25

Notes: The first column of each subsample reports estimation results of the error correction equation (10), while the second column reports results of equation (12) in the text. * (**, ***) denote significance at the 10% (5%, 1%) level.

Panel B: Real Effective CPI Exchange Rate

Sample	1993 – 2007		2008 – 2012	
Dependent Variable	$\Delta reer_t$	Δnfh_t	$\Delta reer_t$	Δnfh_t
Constant	0.006 (0.005)	0.023 (0.038)	No cointegration	
Error Correction	-0.261*** (0.050)	0.008 (0.039)		
$\Delta reer_{t-1}$	0.280*** (0.072)	-0.197 (0.508)		
Δnfh_{t-1}	0.015 (0.013)	0.019 (0.089)		
R^2-*adj.*	0.24	-0.07		

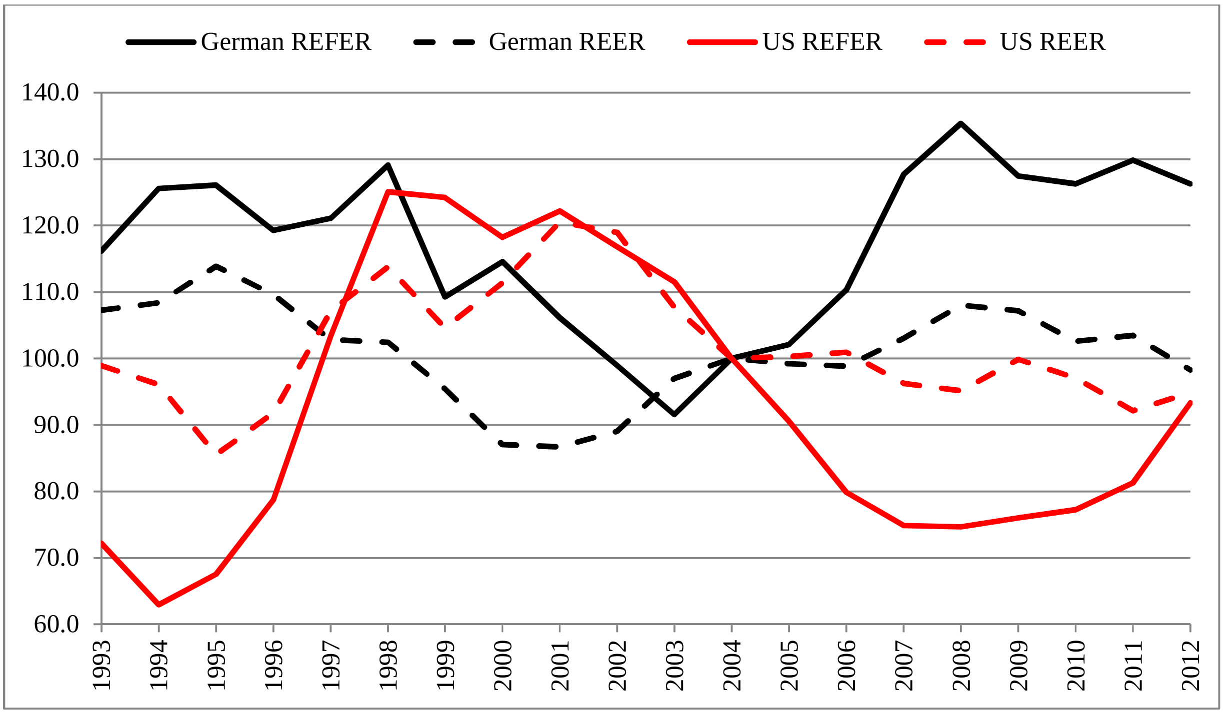
Notes: * (**, ***) denote significance at the 10% (5%, 1%) level.

Table 5. Error correction of net foreign holdings considering airline distances
Panel data over a cross-section of 15 countries (log distances)

Sample	*1993 – 2012*	*1993 – 2007*	*2008 – 2012*
Constant	0.008 (0.031)	0.019 (0.038)	0.012 (0.061)
Error Correction	-0.004 (0.583)	-0.209 (0.507)	-2.689 (2.922)
Error Correction · $DIST_i$	-0.010 (0.069)	0.019 (0.060)	0.232 (0.328)
$\Delta REFER_{t-1}$	-0.479** (0.207)	-0.565** (0.222)	-0.733 (0.854)
ΔNFH_{t-1}	-0.041 (0.072)	0.109 (0.087)	-0.140 (0.173)
R^2 *adj*	0.01	-0.03	0.24

Notes: The columns report estimation results of the augmented error correction equation (14) in the text. * (**, ***) denote significance at the 10% (5%, 1%) level.

Figure 1. Real effective exchange rates deflated by MSCI and CPI values



Notes: REFER denotes the real effective financial exchange rate; REER denotes the standard real effective exchange rate based on CPI deflators

Figure 2. Standard deviations of real effective financial exchange rates