What explains the surprising negative correlation between the stock return differential and currency: risk-rebalancing or source status?

ABSTRACT

We show that Hau and Rey's (2006) empirical evidence does not support their risk-rebalancing hypothesis as an explanation for the surprising negative correlation between the stock market return differential and currency. A simple model with home-wealth rebalancing and extrapolative expectations on the foreign stock predicts this negative correlation only when the host market is a source of international capital flows. We show via panel regressions that the *source status* of the economy (i.e., whether it is a net receiver or source of international capital) is a predictor of the stock return differential - currency correlation.

JEL Classification: F31, G12, G15.

Keywords: exchange rates; stock market return differentials; equity portfolio flows; portfolio rebalancing.

1. Introduction

Hau and Rey (2006, HR hereafter) present a model joint determination of stock market returns, exchange rates and equity portfolio flows, and provide empirical evidence, both of which suggest a negative correlation between the return differential of the host stock market over the US stock market and the host currency. This negative correlation "contradicts the conventional wisdom that a strong equity market comes with a strong currency".[1] The key mechanism that brings about such negative correlation in HR model is portfolio rebalancing by international equity investors to manage exchange rate risk. Accordingly, high returns in the host market should be associated with a depreciation of the host currency against the US dollar, since the consequent portfolio rebalancing by US investors to bring portfolio weights back to optimal levels will require selling the host currency. This risk-rebalancing behavior, combined with inelastic forex supply, produces the observed negative correlation. This notion has been termed as "uncovered equity parity (UEP)" in recent literature (Capiello and De Santis, 2005; Kim, 2011; Curcuru et al., 2014).

We first provide a reassessment of the empirical work provided by HR, which consists of a battery of contemporaneous correlations using daily, monthly and quarterly data. There is a missing link in the logical chain of empirical evidence provided by HR: they provide evidence for a negative correlation between return differentials of the host stock market over the US market and the host currency (vis-à-vis US dollar), and a positive correlation between net bilateral equity portfolio flows toward the host market and the host currency.

[1] The "conventional wisdom" is mainly based on the monetary model of exchange rate determination where a positive differential of the home country real growth rate over the foreign country is associated with home currency appreciation. It is well-known that stock market returns are positively associated with future real growth rate (e.g., Fama, 1990), and in several monetary models stock market returns are used as a proxy for money demand (e.g., Welfens and Borbély, 2004).

However, they do not provide any evidence that US equity investors negatively respond to return differentials of the host stock market; in other words, they do not provide any evidence of risk-rebalancing behavior. By examining this missing link, we assess whether the surprising negative correlation between the currency and the stock market return differential can really be explained by the price pressure resulting from rebalancing flows of unhedged equity portfolio investors. Using their data set and approach, we find that there is no evidence of rebalancing behavior at the aggregate level on either HR's sample or on a more recent and larger sample.

Next, we show that a simple model with home bias, home-wealth rebalancing and extrapolative expectations about the foreign stock predicts a negative stock return differential – currency correlation when the host market is a source of international capital flows. In this model, home-wealth rebalancing by host (i.e., foreign) investors induces a negative correlation, and extrapolative expectations of US investors induce a positive correlation between the return differential of the host stock market over the US market and the host currency. Based on this model, we propose the *source status* of an economy as a driver of the stock return differential - currency correlation. We define *source status* as an indicator of whether an economy has recently been more active as a source or receiver of international capital flows; it captures not only external balance but also host market characteristics such as information asymmetry, relative riskiness, wealth and size. HR model predicts the stock return differential – currency correlation to be always negative provided that equity portfolio investments are of significant size (thus, more negative for more developed markets). Empirical observations, however, suggest that this correlation is not uniformly negative: rather, it displays large variations across countries and subperiods, and is significantly positive for most emerging markets. Our model predicts it to be positive when the host market is a net receiver of international capital flows, and when US investors' expectations are more extrapolative. Under such conditions, outbound home-wealth rebalancing flows of host investors following a host market return shock will be small relative to inbound flows of US investors responding to new information. The correlation will be negative when the host market is a net supplier of international capital flows and US investors' expectations are less extrapolative. Our explanation is consistent with the observed variation in the stock market return differential – currency correlation. On a comprehensive panel, we find that our *source status* variable is a significant driver of the variation in this correlation.

The impact of equity portfolio reallocation on exchange rate dynamics has been a recent focus in international finance literature (e.g., Ding and Ma, 2013). Chang (2013) examines whether portfolio rebalancing can account for the forward premium puzzle. Two paths of this literature focus on HR's risk-rebalancing hypothesis. One of these paths attempts to refine the UEP: Chaban (2009) shows that HR's portfolio rebalancing story is not supported for commodity currencies. Kim (2011) attempts to explain the violations of UEP with equity market risk. Filipe (2012) presents a model that can explain why portfolio rebalancing is not important for commodity currencies, or more generally for currencies with higher fundamental volatility. The second path, which has the same motivation as the current study, addresses the

missing link in HR's empirical evidence: In their more recent work, Hau and Rey (2009) provide evidence for rebalancing behavior using fund-level data at semi-annual frequency. Gyntelberg et al. (2014) examine HR's hypotheses using data from Thailand. Ülkü and Karpova (2014) test the risk-rebalancing hypothesis using data from Greece. In a closely related (independent) work, Curcuru et al. (2014) employ Treasury Capital International (TIC) bilateral transactions data corrected for financial center bias (Bertaut et al., 2007) to test the rebalancing behavior. They provide evidence of a negative response of portfolio allocations to past (not current) returns; however, they attribute this behavior to tactical reallocation rather than risk-rebalancing.

The first contribution of the current paper to this literature is to empirically clarify the role of alleged risk-rebalancing in driving the currency. For this purpose, we first stick to HR's data set and methodology, which follows from their model implications; and address the link left missing in Hau and Rey (2006) on an extended sample. We find that the relation between equity portfolio flows and exchange rate changes is not robust across subperiods. More importantly, the contemporaneous response of portfolio reallocations to host return differentials is positive, instead of negative. A clear conclusion is that risk-rebalancing is unlikely to unconditionally explain the variation in the stock return differential – currency correlation in HR's data. We then characterize equity portfolio flows' behavior in HR's data. We show that US international investors display an extrapolative response to foreign host market returns that is not correlated with future macroeconomic information (even though host market returns are), in line with the models of Brennan and Cao (1997) and Griffin et al. (2004). Foreign investors' behavior appears to be characterized by rebalancing with respect to home wealth, in line with the model of Kodres and Pritsker (2002).

Our second main contribution is to introduce *source status* as a driver of portfolio flows' role in shaping this correlation, within a simple model that combines home-wealth rebalancing and informational disadvantages of international investors leading to extrapolative expectations. This approach provides an intuitive economic explanation for the observed cross-sectional variation in the stock return differential – currency correlation. Finally, we examine potential drivers of the stock return differential – currency correlation on our comprehensive panel. Panel regressions confirm *source status* as a significant driver of this correlation. They also provide strong support for Filipe's (2012) model variable, the volatility of the host market.

In Section 2, we reassess HR's empirical work and address the missing link. In Section 3, the alternative model is presented and the *source status* is introduced as a driver of the stock return differential – currency correlation. Then, a comprehensive panel is used to empirically investigate the drivers of this correlation. Conclusions are summarized in Section 4.

2. A reassessment of Hau and Rey's (2006) empirical work

2.1. Hau and Rey's risk-rebalancing hypothesis

HR's risk-rebalancing hypothesis predicts international equity portfolio investors to sell the outperforming host stock market and repatriate into their home currency to bring currency weights in their portfolio back to previous optimum levels. The motivation for the rebalancing behavior is unhedged international equity investors' desire to manage currency risk. The risk-rebalancing assumption is crucial for obtaining a negative stock return differential – currency correlation in HR's model.[2] However, the empirical analysis reported by HR does not include a direct test of the risk-rebalancing hypothesis.[3] They only refer to survey findings (Levich et al., 1999) that equity portfolio investors, unlike international bond investors, hold unhedged currency positions. They do not provide any evidence of international equity portfolio flows responding to the return differential in the hypothesized manner. Thus, there is a missing link in the logical chain of the empirical support provided in HR.

Whether international investors indeed display the alleged risk-rebalancing behavior has been examined in three recent papers. Using a data set of US mutual fund and institutional holdings for the 1997-2002 period at the semi-annual frequency, Hau and Rey (2009) present evidence of risk-rebalancing behavior at the fund-level. However, in order to produce the alleged negative correlation between stock return differentials and currency, the rebalancing must be at the aggregate level. Herding and positive feedback trading by funds can produce a positive response of net aggregate flows to stock return differentials even in the presence of risk-rebalancing at the investor-level; indeed, the model of Albuquerque et al. (2007), which emphasizes heterogeneity among international investors, predicts this to be the case. Extant empirical evidence on international investors' trading behavior points to a significantly positive response of aggregate net foreign

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[2] Proposition 4 in Hau and Rey (2006, p. 291) describes the home and foreign stock prices P_t^h and P_t^f, as a function of fundamental values F_t^h and F_t^f, respectively, and the dividend differential $\Delta_t = D_t^h - D_t^f$. (Note that, differently from our notation, *h* (*f*) denotes home (foreign) variables in HR). Home investors' foreign equity holdings is given as $K_t^f = \bar{K} - \frac{m_\Delta \Delta_t}{2\rho} - \frac{m_\Lambda \Lambda_t}{2\rho}$, where Δ_t and Λ_t are two state variables that depend on current and past relative dividend innovations (dw), m_Δ and m_Λ are coefficients and ρ is the risk aversion parameter. For high foreign market fundamentals, (i.e., $\Delta_t = D_t^h - D_t^f < 0$), home investors' holdings of foreign equity decreases by $-(1/2\rho)m_\Delta\Delta_t < 0$ where $m_\Delta < 0$ (derived on p. 292 from the inspection of proposition 4). In HR's model, any equity order flow directly translates into forex order flow, as investors are not allowed to hold foreign bonds, and "the dynamic equilibrium is characterized by constant rebalancing of the optimal portfolio" (p. 291). The main force driving exchange rates is the forex order flow. As equity portfolio investors hold unhedged currency positions, their rebalancing activities directly translate into net forex order flow (unlike the flows of bond investors which are offset by hedging operations). Thus, the model predicts a negative correlation between the net flows of home investors toward the foreign stock market and the return differential of the foreign market over the home market. This is the key feature of HR's model and called the *risk-rebalancing channel*, as its underlying motivation is to bring currency exposure back to optimum levels.

[3] They provide evidence for a negative correlation between the stock return differential of the host market over the home (US) market and the host currency's return (vis-à-vis US$), and evidence for a positive correlation between net bilateral equity portfolio flows into the host market and host currency value changes.

flows to local stock market return shocks (e.g., Griffin et al., 2004; Richards, 2005; Ülkü and Weber, 2014), consistent with Brennan and Cao's (1997) model that characterizes the response of informationally-disadvantaged international investors to host market information arrivals.

Curcuru et al. (2014) independently ask the same questions as in the current paper: "in order for portfolio rebalancing to lead to UEP condition, two distinct steps are needed; first, when host equity market outperforms the home market, home investors should repatriate some of their holdings in the host market to bring their host currency exposure back to original levels; second, the associated selling of host currency should lead to host currency depreciation. Evidence supporting the second step is abundant, however evidence supporting the first step does not exist." It is surprising that many papers in the UEP literature take the first step for granted.

Using adjusted TIC data (Bertaut et al., 2007) and employing a methodology that identifies portfolio weight reallocations instead of flows, Curcuru et al. (2014) find a negative response of US investors to host market returns lagged by 1-3 months. While this finding can be consistent with HR's risk-rebalancing hypothesis, lack of a similar response to increased exposure due to exchange rate changes and the ability of these reallocations to forecast future stock market returns lead them to conclude that this negative response is likely to be a tactical reallocation rather than risk-rebalancing. Thus, Curcuru et al.'s (2014) conclusions represent another challenge to HR's model even if US investors' response to host market return shocks is negative.

Several points deserve attention here, as Curcuru et al. (2014) do not attempt to match the rebalancing behavior with exchange rate changes, which is necessary for a complete addressing of HR's model. First, the negative correlation between the stock return differential and the host currency in HR's model is contemporaneous whereas the negative response of portfolio reallocations documented by Curcuru et al. (2014) is lagged. We examine in Section 2.3 the possibility that lagged rebalancing may lead to negative contemporaneous stock return differential – host currency correlation. Second, Curcuru et al.'s methodology using portfolio weight reallocations is perhaps more accurate in capturing rebalancing behavior; however, it is the price pressure of net forex order flow, not portfolio reallocations, that moves exchange rates in HR's model. For example, when US investors' international equity portfolio is overall increasing, the allocation to a country may decrease by simply not buying new stocks in this country. In Curcuru et al.'s empirical framework, this is a negative reallocation; however, it does not generate forex flows. Therefore, in our reassessment, we remain loyal to HR's empirical approach using flows data.

The third paper is Ülkü and Karpova (2014) which tests the risk-rebalancing hypothesis using foreign investor flows data from Greece with a breakdown based on the country of investor origin. They utilize a natural experiment enabled by Greece data: since Greece is a Eurozone member, only investors from non-Eurozone countries should exhibit risk-rebalancing behavior if such behavior is driven by a motivation to manage currency exposure as argued by HR. Thus, holding all other motivations to trade constant, they test

rebalancing behavior driven by currency exposure by comparing Eurozone and non-Eurozone investors' response to local return shocks. They find no evidence to support the risk-rebalancing hypothesis.

2.2. A new look at Hau and Rey's (2006) empirical work

The testable prediction of the HR model is a negative contemporaneous correlation between the net flows of US investors toward the host stock market and the return differential of the host stock market over the US market. Using bilateral equity portfolio flows data from TIC, HR documented a positive correlation between the net bilateral equity portfolio flows toward the host market and the host currency value. They further showed that this correlation had been increasing over time, allegedly in line with the increase in the size of international equity portfolio investments. However, they did not provide any evidence that net flows respond to the return differentials in the hypothesized manner.

We check the missing link using the same TIC data by investigating monthly correlations between stock market excess return differentials and net equity portfolio flows. We examine whether the negative stock market return differential – host currency correlation can be explained by net flows' correlation with stock return differentials. We first replicate HR's sample period and countries, then extend to a more recent sample period (2002-2011) for the same markets studied by HR and for a sample of major emerging markets. HR argue that the positive relationship between net bilateral equity portfolio flows and exchange rates would strengthen with the increase in international investments. In this analysis, we employ monthly country stock market indexes from MSCI-Barra, exchange rates from the Federal Reserve Bank, short-term interest rates from the OECD database and monthly bilateral equity portfolio flows from the TIC, as in HR. By employing the same data set, we maintain full comparability of our results with those of HR.[4] HR's sample includes countries listed in Table 1, which are all developed economies and OECD members. Our emerging markets extension includes countries listed in Table 4.[5]

2.2.1. A decomposition of Hau and Rey's (2006) results

We first elaborate on the positive relationship between net bilateral equity flows and the host currency reported by HR by replicating their table 5 (p. 305). Imperfect forex supply elasticity predicts a positive relationship. The third column of our Table 1 replicates the same results, notwithstanding trivial differences due to differences in data sources.[6] Note that in this table we employ two-tailed significance levels. The number of significant cases is lower under two-tailed significance.

[4] Negligible differences exist as our exchange rate data come from the Federal Reserve and interest rate data from OECD whereas their data are from Datastream.

[5] For countries for which Federal Reserve does not report exchange rate data, we use data from vendors such as *Reuters*. Similarly, OECD interest rate data were supplemented by IMF data for non-OECD countries.

[6] HR normalize net flows by average net flows over the previous 12 months. We confirmed that results do not substantially differ for developed markets under an alternative normalization by current market capitalization. Later,

Panel A of Table 1 provides further decomposition, not available in HR. The first block of Panel A reports the correlation between net US purchases of foreign stocks and changes in foreign currency value, and the second block that between net foreign purchases of US stocks and changes in foreign currency value. Thus, we explore which component(s) of bilateral equity portfolio flows drive(s) this positive correlation. Note that the expected correlation is positive for the first block and negative for the second block (as net foreign purchases of US stocks imply selling foreign currency). Our decomposition shows that HR's results were mainly driven by foreign net purchases of US stocks. US net purchases of foreign stocks, the key mechanism in HR's risk-rebalancing hypothesis, are not significantly correlated with exchange rate changes. HR's model does not offer an explanation for the asymmetry in this decomposition.

Panel B replicates the same analysis for the 2002-2011 period outside HR's sample. Unlike HR's sample period results, the correlations between net bilateral flows and changes in host currency value are near zero this time. Note that this time US flows toward the foreign market are significant with the correct sign, however foreign investor flows toward US equities have the wrong sign, so that net bilateral flows have insignificant correlation. These inconsistencies across subperiods suggest that it is hard to establish a straightforward cause-effect relationship between equity portfolio flows (at least those measured by TIC) and exchange rate changes.

Table 1. The correlation between net bilateral equity flows and exchange rate changes decomposed.
The first block reports the correlations between net buying of US investors in the foreign equity market and changes in the log local currency value (i.e., $-dE_t$ where E is the log of the exchange rate defined as the price of US$ in terms of the host currency). The second block reports the correlations between net buying of foreign investors in the US equity market and $-dE_t$. The third block, a replication of the last two columns of table 5 in Hau and Rey (2006, p. 305), reports the correlations between net bilateral flows (US investors' net buying of foreign stocks minus foreign investors' net buying of US stocks) and $-dE_t$. Each block consists of two columns that report the results for the 1990-2001 and 1995-2001 subperiods, respectively. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

Panel A. HR's subperiods

when studying emerging markets, we made a correction for several outlier observations that arise due to very small values of the normalization denominator.

Correlation with FX Returns						
	TIC flows (Foreign Equity)		TIC flows (US Equity)		TIC net bilateral flows	
	(1990-2001)	(1995-2001)	(1990-2001)	(1995-2001)	(1990-2001)	(1995-2001)
Australia	-0.0417	-0.0002	-0.0083	-0.0488	-0.0231	0.0268
Austria	0.2420***	0.1798	-0.0962	-0.2213**	0.1797**	0.2677**
Belgium	0.1098	0.0704	-0.2493***	-0.3832***	0.2084**	0.3727***
Denmark	-0.0217	-0.2677**	-0.0152	-0.2187**	0.0265	-0.0542
Finland	-0.0279	0.0393	-0.1936**	-0.0675	-0.0084	0.0344
France	-0.0695	-0.0873	-0.2688***	-0.2510**	0.1476*	0.1579
Germany	-0.1607*	-0.0479	-0.1211	-0.2766***	-0.0498	0.0871
Ireland	-0.1320	-0.2841***	-0.2933***	-0.2775***	0.1235*	0.0568
Italy	-0.0287	0.0762	-0.1370	-0.1810*	0.0613	0.1773**
Japan	0.0538	-0.0006	0.0690	0.1983*	0.0532	-0.0461
Netherlands	-0.0086	0.0397	-0.0055	0.0653	-0.0280	-0.0009
Norway	-0.1000	0.1410	-0.1080**	-0.1080	0.0290	0.0440
Portugal	0.1833**	0.1487	-0.0426	-0.0262	0.1933**	0.1540
Spain	0.0991	0.1178	-0.2431***	-0.2922***	0.1540*	0.2043*
Sweden	0.0595	0.3251***	0.0176	-0.0690	0.0354	0.3493***
Switzerland	-0.0777	0.0381	-0.2387***	-0.3677***	0.1836**	0.3672***
UK	-0.0887	0.0931	-0.1047	0.0561	0.0094	0.0552
Mean	-0.0006	0.0342	-0.1199	-0.1452	0.0762	0.1326
Pooled data	0.0146	0.0344	-0.0799***	-0.0926***	0.0661***	0.1171***

Panel B. 2002-2011 superiod. In this subperiod, Austria, Belgium, Finland, France, Germany, Ireland, Italy, Netherlands, Portugal and Spain are replaced by 'Eurozone'.

	Correlation with FX returns		
	TIC flows (Foreign Equity)	TIC flows (US Equity)	Net bilateral flows
Australia	0.1596*	0.0812	0.0794
Denmark	0.0051	0.1700*	-0.0314
Japan	-0.0381	0.2151**	-0.1119
Norway	0.1523*	-0.0015	0.0696
Sweden	0.1365	0.1116	-0.0208
Switzerland	0.1036	0.0917	-0.0359
UK	0.2635***	0.0718	0.1109
Eurozone	0.0002	0.1403	-0.1147
Mean	0.0978	0.1100	-0.0068
Pooled data	0.0898***	0.1035***	-0.0031

Panel C. The correlations between host currency value changes and stock market return differentials: 2002-2011.

Australia	-0.3591***
Denmark	-0.3847***
Japan	-0.2713***
Norway	0.1363
Sweden	-0.3182***
Switzerland	-0.5321***
UK	-0.4624***
Eurozone	-0.2116**
Mean	-0.3004
Pooled data	-0.2549***

HR argue that only their model can account for the intertemporal increase in the negative correlation between the stock market return differential and host currency (p. 304). Consistent with their argument, they report results which are stronger in their more recent 1995-2001 subperiod than in the whole sample. As the trend growth in international equity portfolio investments has continued beyond their sample period, a further strengthening of the positive relationship would be expected. Panel C of Table 1 suggests that the correlations between stock return differentials and currency returns are even more negative in the more recent 2002-2011 period. At face value, this appears consistent with HR's argument that "foreign equity excess returns became a more important determinant of exchange rate behavior in 1990s, presumably because of increased equity market development and integration". However, the insignificant correlations between net bilateral flows and host currency value, already reported in Panel B, make it impossible to attribute the increasingly more-negative host currency – stock return differential correlations to equity portfolio flows. If the price pressure of net bilateral flows was driver of the observed negative return differential – currency correlation, the net bilateral flows – host currency correlation should rather have increased.

2.2.2. Testing the missing link in Hau and Rey's (2006) results

HR's model rests on a chain of two connections to produce the observed negative relationship between stock market return differentials and currency returns: risk-rebalancing behavior and price pressure of equity-related flows in the foreign exchange market. HR's table 5 (our Table 1) supports only the second one of these two necessary links (and still not fully, as our breakdown and out-of-sample results above show). In order to produce the documented negative correlation between stock return differentials and host currency returns, net bilateral flows toward the host market should be negatively related to return differentials of the host stock market. HR do not provide any evidence on this also-necessary link.

Below, we investigate this missing link. Since HR's model implications involve contemporaneous relationships and their empirical work focuses on contemporaneous correlations, we look in this section at the contemporaneous correlations between stock market return differentials and net equity flows. As in HR, we normalize monthly TIC flows by their trailing 12-month averages in order to maintain comparability (see fn.

6). Results are presented in Table 2, which reports the correlations between the return differentials of the host (i.e., foreign)[7] equity market over the US equity market ($R^{For} - R^{US}$) and three measures of net flows: US investors' net buying in the foreign equity market (F), foreign investors' net buying in the US equity market (F^*) and net bilateral flow ($F - F^*$).

The first and second columns of Table 2 (Panel A) indicate that, as opposed to risk-rebalancing hypothesis, F are usually positively, rather than negatively, correlated with the return differential ($R^{For} - R^{US}$). The mean correlation is + 0.068 for the 1990-2001 period and +0.108 for the 1995-2001 period, pooled correlation is significantly positive in both subperiods. Thus, the alleged link that brings about a negative correlation between return differentials and exchange rate changes is missing. If anything, net US investor flows would induce a positive correlation between return differentials and host currency returns, in line with the "conventional wisdom".

The third and fourth columns (i.e., second block) of Table 2 report the correlation between net outbound flows of foreign investors (F^*) and the return differential ($R^H - R^{US}$), thus tests the rebalancing behavior of host (foreign) country investors. The rebalancing hypothesis now predicts a positive correlation. Consistent with the hypothesis, the mean correlation is positive at + 0.104 for the 1990-2001 period and +0.092 for the 1995-2001 period. The fifth and sixth columns of Table 2 show the correlation between net bilateral flows ($F - F^*$) and the return differential ($R^H - R^{US}$). The correlation is insignificant, as the two components offset each other.

Table 2. The correlation between net bilateral equity flows and stock market return differential decomposed. The first block reports the correlations between net flows of US (home) investors in the foreign equity market and the return differential of the foreign stock market over the US stock market ($R^{For} - R^{US}$). The second block reports the correlations between net flows of foreign investors in the US equity market and the return differential ($R^{For} - R^{US}$). The third block reports the correlations between net bilateral flows ($F - F^*$) and the return differential ($R^{For} - R^{US}$). Each block consists of two columns that report the results for the 1990-2001 and 1995-2001 subperiods, respectively. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

Panel A. HR's subperiods

[7] Throughout the paper, we use the terms 'host' and 'foreign' interchangeably. Our preferred terminology is 'host'. On the other hand, both HR and TIC use the term 'foreign', from a US perspective.

Correlation with Stock Return Differentials						
	TIC flows (Foreign Equity)		TIC flows (US Equity)		Net bilateral flows	
	(1990-2001)	(1995-2001)	(1990-2001)	(1995-2001)	(1990-2001)	(1995-2001)
Australia	-0.1563*	-0.2102*	-0.0463	-0.0977	-0.1204	-0.1546
Austria	-0.1817**	-0.1739	0.0482	-0.0247	-0.1071	-0.0656
Belgium	0.0159	0.1170	0.1342*	0.1177	-0.0791	-0.0423
Denmark	-0.0326	0.3665***	0.0926	0.2652**	-0.1395*	-0.0320
Finland	0.1944**	0.2673**	0.0897	0.0976	0.1857**	0.2398**
France	-0.0678	-0.1613	0.1385*	0.1196	-0.1477*	-0.1981*
Germany	0.2424***	0.3494***	0.2078**	0.3350***	0.0089	-0.0502
Ireland	-0.1126	0.0041	0.2800***	0.2432**	-0.2385***	-0.1568
Italy	0.1889**	0.1714	0.2122***	0.2258**	0.0101	-0.0710
Japan	0.3745***	0.3562***	-0.0012	0.0423	0.3494***	0.3195***
Netherlands	0.2199***	0.1418	0.0224	-0.1237	0.1373*	0.1397
Norway	-0.0581	0.0335	0.0968	-0.0425	-0.0708	0.0913
Portugal	0.0466	0.0705	0.0551	-0.0097	0.0247	0.0713
Spain	0.0531	0.0799	0.1795**	0.1854*	-0.0003	-0.0086
Sweden	0.1053	0.0717	0.0183	0.0022	0.0712	0.0063
Switzerland	0.2368***	0.2672**	0.0999	0.0979	0.0065	0.0038
UK	0.0891	0.0850	0.1444*	0.1283	-0.0368	-0.0323
Mean:	0.0681	0.1080	0.1042	0.0919	-0.0086	0.0036
Pooled data	0.0610***	0.1063***	0.0756***	0.0545**	0.0051	0.0252

Panel B. 2002-2011 subperiod

	Correlation with Stock Return Differentials		
	TIC flows (foreign equity)	TIC flows (US equity)	Net bilateral flows
Australia	0.1081	0.0568	0.0775
Austria	-0.0171	0.0060	-0.0337
Belgium	0.0075	0.2101**	-0.1378
Denmark	0.0683	0.0833	0.0123
Finland	-0.0642	0.1277	-0.1432
France	-0.0162	-0.0222	0.0162
Germany	0.2176**	0.1244	-0.0272
Ireland	0.0926	-0.0777	0.1014
Italy	0.1326	-0.0189	0.0156
Japan	0.2621***	-0.0010	0.1953**
Netherlands	0.1104	-0.0530	0.0973
Norway	0.1107	0.0328	0.0048
Portugal	0.0425	0.1940**	-0.1006
Spain	0.0878	-0.0041	0.0734
Sweden	0.1470*	0.0233	0.0556
Switzerland	-0.1041	0.0149	-0.0666
UK	-0.1558*	-0.0185	-0.0647
Mean	0.0606	0.0399	0.0044
Pooled data	0.0620***	0.0514**	-0.0016

Panel B reports the same analysis for the 2002-2011 period outside HR's sample. The first column shows that US investors again do not display the negative response, predicted by the risk-rebalancing hypothesis, to foreign stock market return differentials in this more recent subperiod. Rather, the correlation is still positive. Foreign investors' net flows toward US market are again positively correlated with stock return differentials, consistent with (home-wealth) rebalancing. Net bilateral flows' response to foreign stock return differentials is insignificant as in HR's sample period, as the two components offset each other. Thus, the alleged link to explain the negative stock market – currency correlations is still missing in this recent subperiod.

The message from Table 2 is that it is difficult to establish an association between net bilateral equity flows and host stock market returns differentials that would generate pressure in the forex market to explain the observed negative stock return differential – host currency correlations. Only net outbound flows of host country investors, not the flows US investors, are consistent with the rebalancing story proposed by HR. The way net US investor flows respond to return differentials is the opposite of what the risk-rebalancing hypothesis predicts, consistently in all subperiods. While our analysis cannot exclude risk-rebalancing behavior at the investor level, risk-rebalancing flows do not exist at the aggregate level, which matters to generate pressure in the FX market incorporated in HR's model.

2.2.3. Emerging markets

HR argue that developed equity markets are more pertinent for their model, and therefore focus on an OECD sample. We also extend HR's sample to include major emerging markets. As the countries in our emerging markets sample have quite active equity markets with substantial foreign investor participation during our 2002-2011 sample period and as currency risk is more relevant for emerging economies, we believe that the same model predictions should apply to these markets, as well. We ignore periods before 2002, during which emerging market equity portfolio flows were initially too small due to barriers and influenced by stepwise liberalization effects.

The results for emerging markets are reported in Table 3. Panel A shows that, unlike the developed markets, emerging currencies feature positive correlations with stock market return differentials, now consistent with "the conventional wisdom that a strong equity market comes with a strong currency". Two possibilities could potentially reconcile HR's model with this result: either US investors behave differently in these emerging markets or equity portfolio flows are unimportant for these markets. Neither of these possibilities are consistent with the facts: First, the first column of Panel C shows that US investors' response to host stock market return differentials is very similar in emerging markets to that in developed markets, both positive. (Now, the positive response is consistent with the sign of the stock return differential – currency correlation, but we have seen that a positive response coexists with both positive and negative stock return differential – currency correlations. Thus, equity flows do not appear to be the driver of this correlation).

Second, most of these emerging markets have reasonably developed capital markets with very high foreign investor participation rates, e.g., Hungary and Turkey where international investors hold 60-80% of domestic market capitalization. Thus, it is difficult to attribute these differences to the absence of equity portfolio flows.

The last column of Panel B shows that net bilateral flows are positively correlated with currency, in line with equity flows driving the exchange rate (price pressure). The same is true for US investor flows toward foreign stocks, shown in the first column. The second column shows that foreign investors' net buying of US equities is positively but insignificantly correlated with the currency value (a positive relation is against HR's model). Now, the relation between the currency and net bilateral flows appears to be dominated by US investor flows, perhaps expectedly as outbound equity flows of investors from emerging economies are relatively small.

Panel C shows that net US flows are positively correlated with stock market returns differentials (first column), again in sharp contrast to the rebalancing hypothesis. The correlation of foreign investors' net flows toward the US market with return differentials (second column) is positive but insignificant. To sum up, the results on emerging markets are consistent with US equity investor flows' price pressure on exchange rates, however, there is again no evidence of rebalancing behavior by the aggregate US investor.

Table 3. The results for emerging markets

Panel A. The correlation between FX rate changes and stock market return differentials

Emerging Markets	FX rate - stock return differential correlation
Brazil	0.1777**
Chile	-0.2035**
Czech Republic	-0.0521
Hungary	0.4157***
India	0.2793***
Indonesia	0.3404***
Korea	-0.0202
Mexico	-0.1317
Philippines	0.1176
Poland	0.2641***
Romania	0.1227
Russia	0.2336***
South Africa	-0.2496***
Thailand	0.3571***
Turkey	0.3922***
Ukraine	0.2036**
Mean	0.1404
Pooled data	0.1427***

Panel B. The correlation between net bilateral equity flows and exchange rate changes decomposed

	Correlation with FX returns		
	TIC flows (Foreign Equity)	TIC flows (US Equity)	Net bilateral flows
Brazil	0.1804**	0.0743	0.1666*
Chile	0.0030	0.0343	0.0367
Czech Republic	-0.0036	0.0772	-0.0800
Hungary	0.0752	0.0575	-0.0244
India	0.2302***	-0.0889	0.2247**
Indonesia	0.0889	0.1336	0.0566
Korea	0.1738*	0.0385	0.1675*
Mexico	-0.0469	0.0624	-0.0820
Philippines	0.2384***	-0.0679	0.1860**
Poland	0.0635	0.0626	0.0832
Romania	-0.0304	-0.0343	-0.0366
Russia	0.1176	0.0656	0.0807
South Africa	0.1899**	-0.0240	0.1810**
Thailand	0.2255**	0.0785	0.2113**
Turkey	0.1004	0.1180	0.0975
Ukraine	0.1278	0.0320	0.1759*
Mean	0.1084	0.0387	0.0903
Pooled data	0.1427***	0.0206	0.0869***

Panel C. The correlation between net bilateral equity flows and stock market return differential decomposed

	Correlation with Stock Return Differentials		
	TIC flows (Foreign Equity)	TIC flows (US Equity)	Net bilateral flows
Brazil	0.1169	-0.0884	0.0961
Chile	0.0474	-0.0075	-0.0041
Czech Republic	0.0813	0.0958	-0.0466
Hungary	-0.0311	0.1266	-0.1584
India	0.1601*	-0.1214	0.1757*
Indonesia	0.2250**	0.0403	0.1236
Korea	0.0857	0.1350	0.0729
Mexico	0.1388	0.0537	0.1283
Philippines	0.1422	-0.0612	0.0708
Poland	0.0795	0.1547*	0.0130
Romania	-0.0590	0.1575*	0.0348
Russia	0.2315***	0.1257	0.1729*
South Africa	0.1586*	0.0181	0.1443
Thailand	0.2232**	0.1965**	0.1941**
Turkey	0.0070	0.0935	-0.0126
Ukraine	-0.1254	-0.1222	-0.0776
Mean	0.0926	0.0496	0.0580
Pooled data	0.0961***	0.0251	0.0555**

Overall, our results suggest a positive, rather than negative, correlation of US investor flows with host stock market return differentials. This positive correlation may be due to international investors' extrapolative

response to host market information as in Brennan and Cao (1997) and Griffin et al. (2004) models or price pressure of flows in the equity market. The simultaneity between international investor flows and host equity market returns is a notorious problem in this literature, which makes it difficult to distinguish between these two alternatives. When one allows causality from flows to stock returns, however, one may also question why HR's model assumes inelastic supply in the forex market but not in the equity market.

2.3. A more general examination of equity flows' behavior

Above, we remained loyal to HR's empirical methodology based on unconditional contemporaneous correlations, which is fairly simplistic. Having documented a void in HR's empirical analysis, we can now revert to a more general analysis to understand aggregate equity flows' behavior. The analysis in this section is based on panel regressions and shaped by the following considerations.

Among several motivations for rebalancing proposed in the literature, we can make a contrast between HR's 'risk-rebalancing' away from outperforming foreign market, motivated by managing foreign exchange exposure, and buying (selling) in foreign markets following increases (decreases) in the home stock prices, which we call 'home-wealth rebalancing'. The latter is a main feature of more standard models such as Griffin et al. (2004), and not specific to HR's model. In HR's empirical setting, a negative correlation between net US flows into the foreign equity market and the return differential ($R^{For}-R^{US}$) could arise due to both home-wealth rebalancing and risk-rebalancing; and, without information on whether the return differential shock comes from the US- or foreign market, these two motivations for rebalancing cannot be differentiated. To shed light on the nature of rebalancing behavior, if any, we include in this section a specification in which HR's return differential variable is replaced with two variables R^{For} and R^{US}.

Our result that US investor flows are positively, rather than negatively, related to the return differential ($R^{For}-R^{US}$), which is robust across samples, however, implies that neither type of rebalancing characterizes aggregate US investor's behavior. If the US investor displays rebalancing behavior at the fund level (Hau and Rey, 2009), then, an additional mechanism, which induces the aggregate US investor to positively respond to host market return shocks, must dominate such rebalancing. This mechanism could be extrapolative expectations of informationally-disadvantaged international investors, as in Brennan and Cao (1997) and Griffin et al. (2004) models, coupled with heterogeneity among international investors as in Albuquerque et al. (2007) model. In our panel regressions, we examine the information content of aggregate US investor's positive response by using future output growth of the host country. We first find that US investor net flows do not forecast future returns of the host market (available from the authors), consistent with earlier findings (e.g., Bohn and Tesar, 1996). However, this, by itself, is not sufficient to argue that US investor net flows' positive correlation with host market returns is driven by expectations errors with no information content. To investigate the possibility that US investor flows incorporate macroeconomic information about future real

output, we use the average real industrial production growth rate over the six months forward, along the lines of stock market's forward-looking behavior documented, for example, in Fama (1990).

Recent empirical literature has provided some evidence of a negative response of US investor reallocations to past return differentials of the host market (Curcuru et al., 2011, 2014). Here, a key distinction needs to be made between the contemporaneous and lagged relation of net US investor flows to host market returns. The contemporaneous relation of international investors' net flows with local and world return shocks are both positive (Griffin et al., 2004; Richards, 2005; Ülkü and İkizlerli, 2012; Ülkü and Weber, 2014), but strictly diverge at sufficiently long lags: response to world returns is positive consistent with home-wealth rebalancing, whereas response to local returns is negative consistent with risk-rebalancing (Ülkü and İkizlerli, 2012; Porras and Ülkü, 2014). Portfolio rebalancing is a sluggish process. Thus, the contemporaneous relationship may be dominated by US investors' responding to new information and/or driven by the simultaneity between flows and returns, and rebalancing may appear at lags. Curcuru et al.'s (2011, 2014) finding that US investors decrease their portfolio allocations in past winners are driven by conditioning net flows on past (specifically previous three month's), as opposed to current, host market returns.[8] Hau and Rey's (2009) evidence in favor of rebalancing is obtained using data at the semi-annual frequency. Lagged rebalancing would appear 'contemporaneous' at the semi-annual frequency. They also report a significant but somewhat weaker rebalancing with respect to host returns over the previous 6-months. Given these findings, it is worthwhile to investigate whether HR's results might be accounted for by delayed risk-rebalancing.

To concisely report the results of the above examinations, we revert to a more parsimonious presentation in this subsection by reporting only panel regression estimates (individual country results are available from the authors). Table 4 reports *t*-statistics associated with regressor coefficients from various specifications (represented by blocks of rows) and samples (rows in each block). The first block reports the results when contemporaneous and lagged return differentials ($R^{For} - R^{US}$) are included together. Aggregate US investor net flows are significantly positively associated with contemporaneous return differentials in all samples, while lagged return differentials are insignificant except in one sample (notwithstanding some evidence of delayed rebalancing in the developed markets over the 1995-2001 period). The second block reports the results when future real output growth differential ($IP^{For} - IP^{US}$) is added to the previous regression. US investor flows are not significantly related to future output growth differentials (the coefficient has negative sign in three samples). Note that we report return differential's relation to future real output growth differentials in the fifth block, and find positive and usually significant relationship. Thus, stock market return differentials appear to have information content, whereas US investor flows, which are positively correlated

[8] Curcuru et al. (2011, 2014) use TIC transactions data adjusted for the 'financial center bias' (recall that HR use original TIC data which have been shown to contain biases). We find that Curcuru et al.'s (2011, 2014) result of a negative response owes to conditioning on past positive returns (i.e., excluding the contemporaneous month) and to considering relative reallocations rather than to the corrections in the TIC data. It is possible to obtain the negative response using raw TIC flows data.

with the differentials, do not. These results collectively suggest that US investors' contemporaneous response to return differentials is likely driven by extrapolative expectations driven by current returns and such response is completed in the contemporaneous month; yet, there is still no evidence of rebalancing with respect to lagged returns.

Third block replaces the return differential with US and foreign market returns entering the equation separately. Rebalancing hypothesis would predict a positive coefficient for R^{US} and a negative coefficient for R^{For} for the US investor. In the contemporaneous month, R^{For} gets significant positive coefficients, the opposite of rebalancing hypothesis' prediction, whereas R^{US} gets usually insignificant coefficients of mixed sign, still not in line with the rebalancing hypothesis. Lagged variables are relatively more supportive of the rebalancing hypothesis: R^{US} gets positive coefficients, albeit significant in only one sample, and results with R^{For} at least do not sharply contradict with the rebalancing hypothesis and support it in one sample. Given the mixed and insignificant results for R^{US}, we focus on foreign market variables in the fourth block: controlling for host market returns, net US flows fail to forecast future output growth of the host country, except in the 2002-11 developed markets sample. In the sixth block, we show that host market returns do a very good job of predicting host market output in all samples. Note that host market return – output growth relationship is much stronger than the return differential – output differential relationship, which is likely a symptom of global macroeconomic cycles.

In the seventh and eighth blocks, we describe foreign country investors' behavior. Seventh block shows that investors from developed countries respond positively to both the contemporaneous and lagged return differential, in line with the rebalancing hypothesis, albeit the lagged response loses its significance in the 2002-11 subperiod. The response of investors from emerging countries is insignificant. Eighth block shows that developed market investors' rebalancing behavior mainly comes from responding to R^{For}; R^{US} is significant with the correct (negative) sign in only the 1990-2001 subperiod. Thus, their behavior is mostly driven by home-wealth rebalancing, with only a modest (mostly insignificant) degree of risk-rebalancing. Investors from emerging countries display again insignificant response, though their response to US returns is correctly signed. In unreported results, we also find that foreign investors' flows have no ability to forecast US real output.

The above results suggest that US investors' rebalancing behavior, if any, is superseded by their extrapolative response to current information. Since both current information and the trigger for rebalancing is the same variable or R^{For}), it is not possible to decompose US investors' contemporaneous response and quantify any rebalancing behavior. However, if a component of US investor flows is positively correlated with host market returns (or return differentials) because both rationally incorporate macroeconomic information of the host country, it is possible to identify and isolate this component. Then, the remaining component of US flows can be tested for rebalancing. For this purpose, we obtain residuals from a regression of US flows on host country future output (IP^{For}) or output differential ($IP^{For} - IP^{US}$) –two versions-, which can be considered

as 'US flows purified from a rational response to host market information'. We then examine the purified US flows' response to host market returns or return differentials –two versions-. In all versions and samples, the results (available from the authors) are similar to previous ones: the purified US flows are still positively related to host market returns / return differentials contemporaneously (and insignificantly at lags), even in the 2002-2011 developed markets sample in which US investor flows had the ability to forecast future output of the host country. Thus, purifying a component that represents a rational response to host market macroeconomic information does not help detect rebalancing behavior. The remaining possibilities are: either extrapolative expectation errors of US investors supersede rebalancing action, or rebalancing action does not exist at the aggregate level.

One would expect the negative correlation between the stock market return differential and the host currency to be stronger at lags, if the exchange rate changes are driven by the mechanism proposed in HR model. This is because we documented above that equity flows are more negatively (i.e., much less positively) related to the lags of ($R^{For} - R^{US}$) than its current values. The last block in Table 4 depicts the association of the host currency ($-dE$) with ($R^{For} - R^{US}$) and lagged ($R^{For} - R^{US}$). In sharp contrast to this implication, the lagged relationships are not negative, rather mostly insignificant. This raises further doubt about whether the mechanism proposed in HR model is really a driver of exchange rate changes or not.

To summarize, the analysis in this section suggests that aggregate US investor's contemporaneous response to foreign market return differentials is positive, rather than negative, and lagged response still does not support a rebalancing view. Their contemporaneous response seems to be driven by extrapolation to current returns, without any information content. In most cases, foreign market returns alone have equal or more explanatory power than return differentials, suggesting that return differential is not a special variable in driving international investor flows. In sum, an inspection of HR's data and its out-of-sample extensions provide no support for HR's model mechanisms; they are rather supportive of more standard models with extrapolative expectations of US investors, and home-wealth rebalancing behavior by foreign country investors from other developed markets. This conclusion is true at least on the data set used by HR to support their model. Their end-point result (the coexistence of a negative correlation between return differentials and host currency and a positive correlation between net bilateral flows and host currency) appears to be only a coincidence.

Table 4. A general investigation of equity flows' behavior. Reported are heteroscedasticty-adjusted *t*-statistics associated with explanatory variables based on fixed effects panel regressions for various samples. The 'Sample' column specifies the sample period and countries where D represents 17 developed markets in HR's sample and E represents 16 emerging markets in our Table 3. TIC(A→B) denotes net flows of A investors toward country B. Each model specification is reported in blocks numbered in the last column. 'lag' in front of a variable implies the average of the previous three month's values. *IP* is the seasonally-adjusted industrial production growth rate averaged over the current and next six months). *, **, *** denote statistical significance at the 10&, 5% and 1% levels, respectively.

			Explanatory Variables								
Dependent Var.	Sample	*n*	$R^{For} - R^{US}$	lag $R^{For} - R^{US}$	R^{US}	lag R^{US}	R^{For}	lag R^{For}	$IP^{For} - IP^{US}$	IP^{For}	Block
TIC (US→Foreign)	1990-2001 / D	2397	+ 2.08*	− 0.20	--	--	--	--	--	--	1
	1995-2001 / D	1428	+ 3.52***	− 1.98*	--	--	--	--	--	--	
	2002-2011 / D	1989	+ 2.21**	+ 0.99	--	--	--	--	--	--	
	2002-2011 / E	1690	+ 2.34**	+ 0.34	--	--	--	--	--	--	
	1990-2001 / D	2115	+ 2.14*	+ 0.05	--	--	--	--	− 0.92	--	2
	1995-2001 / D	1260	+ 3.66***	− 1.83*	--	--	--	--	− 1.60	--	
	2002-2011 / D	1755	+ 2.33**	+ 0.66	--	--	--	--	+ 1.00	--	
	2002-2011 / E	1053	+ 2.98**	+ 0.14	--	--	--	--	− 1.46	--	
	1990-2001 / D	2397	--	--	− 1.35	+ 1.00	+ 2.12**	− 0.03	--	--	3
	1995-2001 / D	1428	--	--	− 2.00*	+ 3.13***	+ 3.41***	− 1.89*	--	--	
	2002-2011 / D	1989	--	--	− 0.56	+ 0.91	+ 2.09*	+ 0.67	--	--	
	2002-2011 / E	1690	--	--	+ 1.30	+ 1.71	+ 2.08*	− 0.43	--	--	
	1990-2001 / D	2115	--	--	--	--	+ 1.95*	+ 1 .17	--	− 0.19	4
	1995-2001 / D	1260	--	--	--	--	+ 3.16***	+ 0.43	--	− 1.66	
	2002-2011 / D	1755	--	--	--	--	+ 2.15**	+ 2.03*	--	+ 2.72**	
	2002-2011 / E	1053	--	--	--	--	+ 2.74**	− 0.73	--	− 0.85	
$R^{For} - R^{US}$	1990-2001 / D	2160	--	--	--	--	--	--	+ 1.92*	--	5
	2002-2011 / D	1800	--	--	--	--	--	--	+ 1.70	--	
	2002-2011 / E	1080	--	--	--	--	--	--	+ 2.55**	--	
R^{For}	1990-2001 / D	2160	--	--	--	--	--	--	--	+ 3.46***	6
	2002-2011 / D	1800	--	--	--	--	--	--	--	+ 7.20***	
	2002-2011 / E	1080	--	--	--	--	--	--	--	+ 5.01***	
TIC (Foreign→US)	1990-2001 / D	2397	+ 3.71***	+ 4.16***	--	--	--	--	--	--	7
	1995-2001 / D	1428	+ 2.45**	+ 2.64**	--	--	--	--	--	--	
	2002-2011 / D	1989	+ 2.02*	+ 1.18	--	--	--	--	--	--	
	2002-2011 / E	1690	− 0.36	+ 0.84	--	--	--	--	--	--	
	1990-2001 / D	2397	--	--	− 0.27	− 2.28**	+ 4.27***	+ 3.55***	--	--	8
	1995-2001 / D	1428	--	--	+ 0.31	− 1.70	+ 2.81**	+ 2.57**	--	--	
	2002-2011 / D	1989	--	--	− 0.10	− 0.83	+ 2.06*	+ 0.95	--	--	
	2002-2011 / E	1690	--	--	− 1.54	− 1.32	− 0.29	+ 1.08	--	--	
FX	1990-2001 / D	2448	- 8.16***	+ 2.70**	--	--	--	--	--	--	9
	1995-2001 / D	1428	- 5.59 ***	+ 0.01	--	--	--	--	--	--	
	2002-2011 / D	960	- 3.13**	+ 2.25*	--	--	--	--	--	--	
	2002-2011 / E	1735	+ 1.80*	- 0.59	--	--	--	--	--	--	

3. A new explanation

In Section 2, we have shown that, even though net bilateral equity flows are positively correlated with contemporaneous changes in the host currency value, the alleged risk-rebalancing behavior of US investors is not present in the contemporaneous month. HR's data do not support rebalancing with a lag, either, for the aggregate US investor. While investors from other developed markets display the rebalancing behavior, the correlation of the components of net bilateral flows with exchange rate changes is not stable across subperiods, making it difficult to establish a linear cause-effect relationship. Finally, we have reported that the stock return

differential – host currency correlations are not uniformly negative, but are positive for most emerging markets.[9] In sum, HR's uniform risk-rebalancing story does not appear to explain what their data indicate.

Recent work suggests alternative conditioning information to explain the variation in the stock return differential – host currency correlation. As mentioned by Chaban (2009), a positive correlation can be expected when equity flow shocks are the exogenous common driver of equity and currency returns. Kim (2011) proposes market risk as a driver of UEP differences, however his evidence is limited to four Asian emerging markets. Filipe's (2012) model characterizes this correlation as a function of the fundamental volatility of the host market relative to the home market. In this section, we propose an alternative explanation. Based on a more standard underlying model, we suggest that *source status* of the host country (i.e., whether it is a net receiver or net supplier of international capital flows) drives the variation in the stock return differentials – currency correlation. Essentially, source status is potentially related to the role of equity flow shocks as a driver of local markets.

Then, we utilize our combined sample for a comprehensive empirical investigation of the drivers of the correlation between stock return differentials and the host currency. We show that source status of the host country is able to account for a significant proportion of the variation in the stock return differential – currency correlation. A proxy for Filipe's (2012) relative fundamental volatility has good explanatory ability, however source status remains significant after controlling for relative volatility. Source status drives out market capitalization proposed by HR, which suggests that the role of market development in inducing negative stock return differential – currency correlation is subsumed by source status.

3.1. Source status as a driver of the stock return differential – currency correlation

Above, we have shown that home-wealth rebalancing by host country investors is highly significant whereas US investors' net flows are usually positively correlated with host market stock return differentials. In this section, we illustrate that a combination of US investors' positive response to host market returns, as predicted by more standard models such as Brennan and Cao (1997) and Griffin et al. (2004), and home-wealth rebalancing by host country investors can produce the observed variation in the stock return differential – currency correlation. In Section 3.2, we construct a simple model that formalizes this idea. The model combines home-wealth rebalancing with extrapolative expectations of international investors due to their informational disadvantages in the same manner as in Griffin et al. (2004). We derive forex order flow implications of this model and show how it can account for the cross-section of the stock return differential – currency correlation.

The model incorporates the following stylized observations from Section 2. Home-wealth rebalancing by host country investors induces a negative correlation between the stock return differential ($R^H - R^{US}$) and the

[9] Chaban (2009) and Filipe (2012) mention commodity currencies as another exception. However, the results on commodity currencies are not uniform across subperiods.

host currency since a positive ($R^H - R^{US}$) will induce net outbound flows by host investors. The response of US investors to host market information shocks induces a positive correlation because responding to new local information will generate net flows that are positively related to host market return shocks.[10] The question is which effect will dominate. We argue and show that the *source status* of the host economy determines which effect will dominate. If the host economy is a net supplier of international capital flows, the size of outbound gross flows of host investors will outweigh the size of inbound gross flows of US investors. The opposite will be true if the host economy is a net receiver of international capital flows.

We operationalize the concept of *source status* (*SS*) as a measure of the activity of residents investing abroad relative to that of nonresidents investing in the host country. Formally, it is the ratio of the mean absolute value of residents' net outbound flows to that of nonresidents' net inbound flows, both normalized by total exports, as shown in Eq. (1).

$$SS_H = \frac{\sum_{t=1}^{n} \left| NF_{F,t}^{H} / EX_{H,t} \right|}{n} \bullet \left[\frac{\sum_{t=1}^{n} \left| NF_{H,t}^{F} / EX_{H,t} \right|}{n} \right]^{-1} \quad (1)$$

where $NF_{H,t}^{F}$ is the net capital flows of nonresidents toward the host market, $NF_{F,t}^{H}$ is the net capital flows of residents toward the foreign markets and EX_H is the gross exports of the host country. A *SS* value of greater than 1 implies that the host country is a 'source' of international investment flows, whereas a value smaller than 1 implies 'receiver' status. *SS* can be defined for total flows as well as a specific component such as equity portfolio, FDI, debt securities or 'other' (i.e., bank lending). We calculate *SS* using quarterly balance of payments data from IMF. In our model, source status is a predictor of the direction of net bilateral flows in response to return differentials, as discussed below.

3.2. A simple model of the drivers of stock return differential – currency correlation

In this section, we show that a combination of the features incorporated in more standard models of equity portfolio flows, rather than HR's risk-rebalancing mechanism, can account for the cross-section of the stock return differential – currency correlation, and predict a negative correlation when the host economy is a 'source'. Our model is a straightforward extension of Griffin et al.'s (2004) model that captures rebalancing with respect to home wealth and extrapolative expectations of informationally-disadvantaged international investors. We incorporate HR's model assumption of imperfect forex supply elasticity to study the effect of equity portfolio flows on exchange rates.

[10] A positive (negative) differential of the host market over the US market may also result from a negative (positive) information shock of the US market and will induce negative (positive) home-wealth rebalancing flows by US investors. These flows will have the same effects as HR's risk-rebalancing. The difference is that US investors' home-wealth rebalancing flows will be highly correlated across countries when the stock return differentials are driven by US market information.

The justification for these features have been already discussed by Griffin et al. (2004), and further reinforced by more complex models that capture the same features and lead to the same conclusions [see Brennan and Cao (1997), Brennan et al. (2005) and Albuquerque et al. (2007) for extrapolative expectations of international investors; and Kyle and Xiong (2001) and Kodres and Pritsker (2002) for rebalancing with respect to home wealth]. Moreover, these conclusions have been strongly supported empirically: Griffin et al. (2004), Richards (2005), Ülkü and İkizlerli (2012), Ülkü and Weber (2014) present strong evidence of home-wealth rebalancing. Brennan and Cao (1997), Choe et al. (1999), Froot et al. (2001), Griffin et al. (2004), Richards (2005) and Ülkü and Weber (2014) present evidence of foreign investors' positive response to local return shocks.

Model setup is the same as in Griffin et al. (2004): an intertemporal continuous-time model with infinitely-lived investors. The world consists of two countries, US and host (*H*), with fixed outstanding supplies of N_{US} and N_H shares, respectively, and uncorrelated returns. The wealth of the US and host country investors (W^{US} and W^H, respectively, with world wealth $W = W^{US} + W^H$) is invested in US and host stocks and own-country risk-free asset. Let N_{US}^{US} and N_H^{US} be the number of US and host market shares, respectively, demanded by US investors. $\mu_{US}(t)$ [$\mu_H(t)$] is the instantaneous expected excess return and $\sigma_{US}^2(t)$ [$\sigma_H^2(t)$] is the instantaneous volatility of the US (host) stock at the end of period *t*. The prices of US and host stocks are P_{US} and P_H, respectively. US and host investors are equally risk averse, and risk aversion coefficient remains unchanged following stock price changes in either market.

The model incorporates the features of home bias, home-wealth rebalancing and extrapolative expectations. In the absence of these features, and with perfect international capital markets where risk aversion does not differ across countries, all investors hold the world market portfolio, changes in expected returns do not lead to equity flows, and rebalancing is absent. Following Stulz (1981) and Griffin et al. (2004), we assume that in the presence of barriers to international investments, the return of US investors in host market's stock is less than the return of host investors by a positive constant δ, which reflects additional costs of investing in a foreign market that lead to home bias.[11] Assuming away short positions, the equilibrium demand for host market's shares by the US investor is $N_H^{US} = \frac{(\mu_H - \delta)}{\gamma \sigma_H^2} \frac{W^{US}}{P_H}$, where γ is an absolute risk aversion coefficient. Thus, in the presence of barriers, δ is the main driver of the differences of portfolio allocations from the world portfolio. The numbers of host market's shares held by the US and host investors are

$$N_H^{US} = N_H \frac{W^{US}}{W} - \frac{\delta}{\gamma \sigma_H^2} \frac{W^H}{W} \frac{W^{US}}{P_H} \quad (2)$$

$$N_H^H = N_H \frac{W^H}{W} + \frac{\delta}{\gamma \sigma_H^2} \frac{W^{US}}{W} \frac{W^H}{P_H} \quad (3)$$

[11] Solnik and Zuo's (2014) relative optimism provides an alternative way of obtaining differential expectations of US and host country investors for the host market return. They also provide solid empirical evidence of a positive relationship between expectations and actual holdings of international investors, both in the cross-sectional and time dimension.

Eq. (2) and (3) imply that in equilibrium US investors will hold less host stock than world portfolio weight by an amount given by the second term and host investor will hold more host stocks by the same amount. Derivation of (2) and (3) is explained in Appendix A.

The second feature of the model is extrapolative expectations of US (host) investors for the host (US) stock return. This follows from informational disadvantages of investing in the foreign stock. Following an unexpected high return of the host stock US investors revise up their expected returns on host stock. This leads to higher equilibrium holdings and triggers net positive US flows toward the host market. At the same time, host investors, being better informed, do not need to revise their expectations and will sell due to home-wealth rebalancing. We denote such an extrapolation component of $\frac{\mu_H-\delta}{\gamma\sigma_H^2}$ by Δ_H^{US}, which is a function of P_H. The extrapolation component is proportional to the return differential $(\frac{\Delta P_H}{P_H}-\frac{\Delta P_{US}}{P_{US}})$. Assuming that return differential comes from the host market's return shock, Δ_H^{US} can be written as $q\frac{\Delta P_H}{P_H}$, where q is a constant. The differential expected return of US investors for the host stock is $DE=\delta-\Delta_H^{US}$. The difference of the number of host market's shares held by US investor from world portfolio will be a function of *DE*. The equilibrium holdings of host market stock by US investor are then given by:

$$N_H^{US}=N_H\frac{W^{US}}{W}-\frac{DE}{\gamma\sigma_H^2}\frac{W^H}{W}\frac{W^{US}}{P_H} \tag{4}$$

Symmetrically, and under the assumption that δ is equal across markets, the equilibrium holdings of US stock by host country investor are given by:

$$N_{US}^H=N_{US}\frac{W^H}{W}-\frac{DE}{\gamma\sigma_{US}^2}\frac{W^{US}}{W}\frac{W^H}{P_{US}} \tag{5}$$

An extension, we introduce, is to allow q to differ between US investor in the host market and host country investor in the US market. Such difference is justified by the likely differences in information asymmetry: US markets with possibly the highest degree of dissemination of both corporate and macroeconomic information, English being a common language and being possibly the most extensively studied market due to their role in leading other stock markets across the world are likely to pose a smaller degree of informational disadvantage for foreign investors. Thus, foreign investors investing in US markets would have less extrapolative expectations and a smaller q. This argument seems to be well-supported by our results in Table 4 (block 8).

We can now analyze the flows that will be induced by a host market return shock (holding US return zero, this is equivalent to a return differential). Taking the first derivative of the Eq. (4) and (5) with respect to P_H we obtain (6) and (7). Eq. (6) describes US investor flows toward the host market.

$$\frac{dN_H^{US}}{dP_H}=N_H\frac{\partial(W^{US}/W)}{\partial P_H}-\frac{\partial DE/\partial P_H}{\gamma\sigma_H^2}\frac{W^H}{W}\frac{W^{US}}{P_H}-\frac{DE}{\gamma\sigma_H^2}\frac{\partial(W^H/W)}{\partial P_H}\frac{W^{US}}{P_H}-\frac{DE}{\gamma\sigma_H^2}\frac{W^H}{W}\frac{\partial(W^{US}/P_H)}{\partial P_H} \tag{6}$$

Due to home bias, an increase in P_H will result in a decrease in the W^{US}/W ratio, thus the first term is negative. *DE* falls with an increase in P_H , thus the second term is positive. The signs of the third and fourth terms depend on the sign of *DE*. As W^H/W ratio will increase, the third term will be positive if $\Delta_H^{US} > \delta$, and negative otherwise. The fourth term will be negative if $\Delta_H^{US} > \delta$, and positive otherwise.

Next, we consider how host investors will behave in the US market following an increase in host stock's price. Here, a positive sign is consistent with home-wealth rebalancing.

$$\frac{dN_{US}^H}{dP_H} = N_{US}\frac{\partial(W^H/W)}{\partial P_H} - \frac{\partial DE/\partial P_H}{\gamma\sigma_{US}^2}\frac{W^{US}}{W}\frac{W^H}{P_{US}} - \frac{DE}{\gamma\sigma_{US}^2}\frac{\partial(W^{US}/W)}{\partial P_H}\frac{W^H}{P_{US}} - \frac{DE}{\gamma\sigma_{US}^2}\frac{W^{US}}{W}\frac{\partial(W^H/P_{US})}{\partial P_H} \qquad (7)$$

The first term is positive. The second term is also positive as *DE* falls with an increase in P_H. The signs of the third and fourth terms depend on the sign of *DE*. The third term will be negative if $\Delta_H^{US} > \delta$, and positive otherwise. The fourth term will be positive if $\Delta_H^{US} > \delta$, and negative otherwise.

The net bilateral flow resulting from a host stock price shock is $dN = dN_H^{US} - dN_{US}^H$. As investors can hold only their own country's risk-free asset, equity flow is equivalent to forex flow in both HR's and our model. When $dN > 0$ the host currency appreciates, and when $dN < 0$, host currency depreciates. The net order flow *dN* equals:

$$\frac{dN_H^{US} - dN_{US}^H}{dP_H} \equiv dN/dP_H = \frac{\partial(W^{US}/W)}{\partial P_H}(N_H + N_{US}) + \frac{\partial DE/\partial P_H}{\gamma}\frac{W^H}{W}W^{US}\left(\frac{1}{\sigma_{US}^2 P_{US}} - \frac{1}{\sigma_H^2 P_H}\right) + \frac{DE}{\gamma}\frac{\partial(W^{US}/W)}{\partial P_H}\left(\frac{W^{US}}{P_H\sigma_H^2} + \frac{W^H}{P_{US}\sigma_{US}^2}\right) + \frac{DE}{\gamma W}\left(\frac{W^{US}}{\sigma_{US}^2}\frac{\partial(W^H/P_{US})}{\partial P_H} - \frac{W^H}{\sigma_H^2}\frac{\partial(W^{US}/P_H)}{\partial P_H}\right) \qquad (8)$$

The first term has always a negative sign. The sign of the second term is determined by relative volatilities of host and US stocks: $\partial DE/\partial P_H$ is always negative; thus, assuming $P_H = P_{US} = 1$, it will be negative when $\sigma_H^2 > \sigma_{US}^2$ and vice versa. It will drop in case of equal volatilities. The second factor of the third term is negative due to home bias, and the third factor (the parenthesis part) is always positive. However, the first factor contains *DE*, the sign of which depends on the size of the extrapolative component Δ_H^{US} relative to δ. The parenthesis part of the fourth term is positive, and, again, the sign of *DE* determines the sign of the fourth term. In sum, *dN*, thus the correlation between stock return differential and the host currency, depends on W^H, W^{US}, N_H, N_{US}, σ_{US}, σ_H and *DE* which in turn depends on the constants *q*, δ and P_H. Some of these parameters, in particular *q*, (the revision in US investors' expectation of host stock return for a given increase in host stock price) which critically determines the sign of *DE*, are not empirically observable.

SS, introduced above, provides an empirical ex-post summary measure of the combined effect of these parameters. For example, a large W^H relative to $P_H N_H$ will lead to larger variance of dN_{US}^H , increasing the *SS* of the host country. A high *q* leads to a larger variance of dN_H^{US}, resulting in a lower *SS* of the host country (i.e., adding to receiving activity); but, its effect depends on its interaction with σ_H. A high σ_{US} value results in a lower level of host investor activity in US stock when $\gamma > 1$ (leading to a low *SS*) and a high σ_H value results

in a lower level of US investor activity in the host stock (increasing *SS*). On the other hand, σ_H has a direct effect on the expected size of dP_H and thus *dN*. The combined effect of these parameters is approximated by our *SS* variable which measures variability of outbound host investor flows relative to inbound foreign investor flows. We illustrate these mechanisms by numerical simulation in Appendix B. To sum up here, when $SS > 1$, the host country plays a role of net supplier and $\left|dN_{US}^{H}\right| > |dN_{H}^{US}|$. This may be due to external surplus, which makes W^H large relative to $P_H N_H$, lower σ_{US} relative to σ_H, a smaller q for the host stock (less extrapolative US investor expectations of the host stock return), or relatively lower costs (i.e., smaller δ) of investing in US stock. This, in turn, means $dN < 0$ upon a positive return shock of the host equity market, which leads the host currency to depreciate. When $SS < 1$, the host country plays a role of net receiver and $\left|dX_{US}^{H}\right| < |dX_{H}^{US}|$, thus, $dN > 0$. This may be due to external deficits, which makes W^H small relative to $P_H N_H$, lower σ_H relative to σ_{US}, or more informational asymmetry (i.e., larger q) for the host stock, etc. In this case the host currency appreciates upon a positive host equity market return shock. *dN*, thus, determines the stock return differential – currency correlation based on *SS*.

3.3. A comprehensive panel estimation of the drivers of stock return differential – currency correlation

We estimate explanatory ability of *SS* after controlling for other potential drivers of the stock market – currency linkage. Our sample covers 28 countries: 8 developed markets included in HR's sample (Eurozone treated as one country), 16 emerging markets listed in Table 4, two developed markets not included in HR's sample (Canada, New Zealand) and two more emerging markets (Croatia and Taiwan). The sample period spans from 1996 to 2011. We monitor the variation in the stock return differential – currency correlation over 3- year subperiods per country. This approach is justified by the fact that time variation in this correlation is substantial, and, at the same time, the factors hypothesized to shape this correlation, primarily our source status variable, are expected to gradually evolve over time. To avoid any potential endogeneity, we use lagged values of *SS* computed from the previous 3-year subperiod. Years 1996-98 are consumed to calculate the first lagged *SS*; thus, we have four subperiods per country, notwithstanding a few missing observations.

HR (p. 305-306) trace the negative stock market – currency correlation to market development and support their argument by documenting that "countries with higher equity market development tend to show more negative correlation…", which alternative explanations for a negative correlation could not account for. Our inclusion of emerging and developed markets in the panel provides rich variation that enables us to test HR's conjecture.

Panel regressions include the following control variables:

1) Log of market capitalization, *lnmc*, (or annual trading value) in US dollars. This variable is motivated by HR's assertion that market development would increase the size of equity portfolio flows, thus enhance the role of rebalancing effects to induce a more negative stock return differential – currency correlation. Note,

however, that this variable is also closely related to N_H and W^H in our model. To isolate market development, we also employ a size-adjusted measure of market development: (annual trading value / GDP) ratio (*tv/GDP*).

2) Trade openness (*to*) measured as (exports + imports) / GDP ratio. Inclusion of this variable aims to check the importance of the trade channel in affecting the stock market – currency linkage as per traditional goods market approach.

3) Interest rate differentials (*r*): this variable is the main driver of the forward premium puzzle, and Katechos (2011) provides evidence that interest rate differentials predict the sign of the stock market – currency correlation. We experimented with two versions: the host interest rate or the differential of the host interest rate over the US interest rate.

4) Subperiod volatility of the MSCI world index returns (*wv*). While this variable is highly correlated with US stock market volatility, which is captured in our model and supposed to be reflected in *SS*, it has a special role in Broner et al.'s (2006) model which predicts that increased risk aversion during turbulent times may intensify rebalancing behavior. As *SS* may not capture this variable directly, including it separately can be useful. More broadly, inclusion of this variable serves to capture potential regime-dependence of the stock return differential – currency correlation (see Christiansen et al., 2011).

5) The volatility of the host stock market returns relative to US stock market (*rcv*). This variable has a special role in Filipe's (2012) model in shaping the stock return differential – currency correlation: high host volatility leads to more positively correlated belief changes between the host and US investor, which translates into a positive correlation between host stock and host currency. This role of relative volatilities in Filipe's (2012) model has a sharp implication which is not present in our model. It is therefore important to assess the predictions of both models by including the volatility of the host market together with *SS*.

6) Net bilateral investment position of the host country (*nbip*). This variable is motivated by portfolio balance models that describe expected returns on currencies as a function of the build-up of net foreign asset (NFA) positions (Hooper and Merton, 1980; Frankel, 1983; Andrade and Bruneau, 2002). Accordingly, an economy with an increasingly negative NFA should offer a risk premium on its currency to attract sufficient foreign capital. This can be considered as a risk factor (i.e., economies with larger external deficits are riskier) and may add to currency's correlation with risky assets, thus can potentially affect the stock return differential – currency correlation. One may argue that our *SS* variable simply captures NFA position, which is not true as it also captures many other parameters such as extrapolative expectations (degree of information asymmetry), transaction costs of cross-border investing, relative size and relative volatility. Therefore, it is useful to compare the predictive ability of *SS* and *nbip*.[12]

[12] Note, however, that the use of this variable has been problematic due to valuation effects, and a large literature has built on this issue. We do not intend here to deal with these issues (see, for example, Devereux and Sutherland, 2010).

Annual trading volume, market capitalization, trading volume/GDP and trade openness ratios are obtained from the World Bank database. Bilateral net investment positions are obtained from the annual surveys reported in the TIC database. Summary statistics of these variables are presented in Appendix C.

The dependent variable ($\rho_{i,T}^{Dif,-dE}$) is the correlation between monthly return differential of the host stock market *i* over the US stock market ($Dif_{i,t} = R^i - R^{US}$) and the changes in the host currency value ($-dE_{i,t}$) in subperiod *T*. Our key explanatory variable, *SS*, is computed using quarterly international investment flows data from the balance of payments statistics provided by the IMF. Summary statistics and descriptive plots of *SS* are presented in Appendix C. We estimate the panel regression model:

$$\rho_{i,T}^{Dif,-dE} = \beta_{0,i,T} + \beta_1 SS_{i,T} + \beta_C X^C{}_{i,T} + e_{i,T} \qquad (9)$$

where $X^C_{i,T}$ is a vector of control variables such that X^C = (*lnmc*, *tv/GDP*, *to*, *r*, *wv*, *rcv*, *nbip*)'. We use a log transformation for *SS*, which is preferred for distribution properties, and focus on two versions: *SS-Total* which employs all financial account flows, and *SS-Equity* which employs equity portfolio flows in *SS* calculation. Eq. (9) is estimated using random effects (RE) estimator which has efficiency advantages. When a specific regression model employs variables that mainly characterize cross-sectional variation, such as *lnmc*, we employ between effects (BE) estimator which allows us to compare to HR's cross-sectional regressions. Our central hypothesis is $\beta_1 < 0$.

Results from estimating Eq. (9) under various specifications are presented in Table 6. We first describe the results for control variables. Column 2 provides a robustness test of HR's argument that market development leads to more negative $\rho_{i,T}^{Dif,-dE}$. In the BE regression presented in column 2, we use two alternative proxies for market development. *lnmc* is significant and negative, confirming HR's result presented in their fig. 1 (p. 306). The result with the log of annual trading value is similar. However, *tv/GDP*, the size-adjusted market development proxy, turns out to be insignificant. This casts doubt on HR's argument that the relationship is due to market development.

In column 3, we test the role of *nbip* alone. It turns out to be insignificant (the result with the RE estimator -not reported- is similar). Trade openness, reported in column 4, is also insignificant. Thus, variables proposed by macroeconomic models fail to account for the variation in the stock return differential – currency correlation. Interest rate differential has some predictive ability in the cross-sectional dimension (BE estimator yields t = +2.78), which becomes insignificant when other regressors are included (not in the table). The RE result for interest rate differential, reported in column 5, is insignificant. When interest rate, instead of interest rate differential, is used, the RE *t*-statistic is +1.78 when included alone, but becomes +0.46 when other regressors are included (not in the table). The fragile significance of interest rate variables, which disappears when *SS* and *rcv* are included, suggests that interest rate differentials may be related to *source status* and relative volatility.

Our main hypothesis is tested in columns 1.a and 1.b. *SS-Total* (*SS-Equity*) is significant at the 5% (1%) level with a negative sign. Thus, the stock return differential – currency correlation is more negative when a country is a net supplier of international capital flows, and particularly so when a country is a net supplier of equity portfolio flows. A potential explanation for the significance of lagged *SS* is that market participants learn the likely net out(in)flows that will follow positive (negative) return differential shocks in the contemporaneous as well as subsequent months and price currencies accordingly. The stronger explanatory ability of *equity portfolio flows source status* (despite the fact that equity portfolio flows are smaller than total capital flows) may stem either because equity portfolio flows are unhedged (consistent with FX order flow pressure argument) or due to special information content of equity portfolio flows. Distinguishing between these two alternatives can be a fruitful avenue for future research.

The subperiod volatility of MSCI world (or US, available from the authors) index (*wv*) is negatively related to $\rho_{i,T}^{Dif,-dE}$; that is, at turbulent times the stock return differential – currency correlation tends to become more negative. This is consistent with both Broner et al.'s (2006) conjecture and the regime dependency documented by Christiansen et al. (2011). However, Panel B of Table 5 suggests insignificant evidence of more intensive rebalancing behavior. Thus, while Broner et al. (2006) clearly document a tendency to revert to neutral weights at turbulent times at the fund level, this may not imply more intensive risk-rebalancing at the aggregate level captured by TIC data. On the other hand, it is worth noting that the correlation of net bilateral flows with the host currency significantly increases during more volatile periods.

Table 5. Panel regression results. Each regression, a version of Eq. (9), is presented in one column, with regressors listed in rows. *t*-statistics are reported below the coefficients in parenthesis. *, ** and *** denote statistical significance at 10%, 5% and 1%, respectively. When BE is used, only between-R^2 is reported; when RE is used, both between-R^2 and total-R^2 are reported.

Panel A. Dependent Variable: return differential – host currency correlation ($\rho_{i,T}^{Dif,-dE}$)

Model	1.a	1.b	2	3	4	5	6	7.a	7.b	8.a	8.b
SS-Total	-0.055	---	---	---	---	---	---	-0.038	---	-0.087	
	(-2.25)**							(-1.41)		(-1.93)*	
SS-Equity	---	-0.075	---	---	---	---	---	---	-0.064		-0.111
		(-5.24)***							(-4.31)***		(-5.47)***
wv	-2.767	-2.796	---	---	---	---	-4.367	-3.962	-4.034	---	---
	(-2.23)*	(-1.74)*					(-2.81)***	(-2.52)**	(2.44)**		
ln (mc)	---	---	-0.056	---	---	---	---	---	---	-0.004	-0.022
			(-2.41)**							(-0.16)	(-1.26)
tv/gdp	---	---	-0.001	---	---	---	---	---	---	---	---
			(-0.56)								
niip	---	---	---	-0.048	---	---	---	---	---	---	---
				(-0.34)							
to	---	---	---	---	-0.157	---	---	---	---	---	---
					(-1.21)						
r	---	---	---	---	---	-0.294	---	---	---	---	---
						(-0.88)					
rcv	---	---	---	---	---	---	13.087	10.239	9.989	14.443	5.513
							(3.20)***	(2.34)**	(2.46)**	(1.85)*	(0.61)
n	108	99	107	110	107	106	112	106	98	100	92
R^2 – betw.	0.389	0.633	0.218	0.001	0.053	0.236	0.423	0.397	0.637	0.490	0.733
R^2 – total	0.160	0.296	---	---	---	0.074	0.192	0.241	0.344	---	---

Panel B. Dependent Variable: host currency – net TIC flow ($\rho_{i,T}^{-dE,TIC}$) and return differential – net TIC flow ($\rho_{i,T}^{Dif,TIC}$) correlations

	Dependent Variable					
Regressors	***TIC* - *FX* Correlation**			***TIC* - ($R^{For}-R^{US}$) Correlation**		
SS-Total	0.010	---	---	-0.026	---	
	(0.64)			(-1.21)		
SS-Equity	---	0.013	---	---	-0.020	
		(1.20)			(-1.74)*	
wv	---	---	3.430	---	---	-1.170
			(2.42)**			(-0.81)
rcv	---	---	-1.967	---	---	3.015
			(-0.60)			(0.89)
ln (mc)	---	---	-0.002	---	---	0.025
			(-0.16)			(1.71)*
n	99	91	99	103	91	99
R^2 – betw.	0.025	0.168	0.242	0.024	0.170	0.194
R^2 – total	0.004	0.016	0.057	0.012	0.055	0.043

In column 6, we test relative country variance (*rcv*), the variable suggested by Filipe's (2012) model, controlling for world market volatility. It is significant at the 1% level with the expected sign: higher host market volatility leads to more positive stock return differential – currency correlation. This provides solid

support for Filipe's (2012) model from a different empirical setting and on a larger sample that includes emerging markets. The strong significance of *rcv* suggests that models with heterogeneous beliefs may have merit in this context. Filipe (2012) attempts to explain a country's fundamental volatility with the volatility of terms of trade, thus provides an explanation for commodity currencies' violation of UEP. We show that more support for Filipe's model comes from a sample that includes emerging markets, which is intuitive as emerging markets feature higher fundamental volatility.

Importantly, however, columns 7 and 8 show that *SS*, in particular *SS-Equity*, remains significant when *rcv* is included in the model. Thus, the *SS* variable we introduce in the current paper captures additional factors, employed in our model, that drive stock return differential – currency correlation. Column 8.b even shows that *SS-Equity* renders *rcv* insignificant in explaining cross-sectional variation in $\rho_{i,T}^{Dif,-dE}$. Finally, the BE result in column 8 shows that *lnmc* becomes insignificant when both *SS* and *rcv* are controlled for, suggesting that it may not be HR's market development variable which drives the correlation.

The bottom line from our panel regressions is threefold. First, high-*SS* countries tend to have a more negative stock return differential – currency correlation. Second, countries with more volatile stock markets tend to have a more positive stock return differential – currency correlation. Third, size-adjusted measures of market development do not predict a negative correlation.

4. Conclusions

We have highlighted a missing link in Hau and Rey's (2006) empirical presentation: the risk-rebalancing behavior is not present to explain the surprising negative correlations between the stock return differential and the currency in their data. Using an extended sample, we have shown that the stock return differential – currency correlation is not uniformly negative. Importantly, the variation in this correlation cannot be simply attributed to market development, while market development is somewhat correlated with the actual drivers. The positive relationship between the components of bilateral equity portfolio flows and the host currency is not stable across subperiods. Given these observations, it appears that it is not the negative response of US investors to host stock market return differentials that causes the surprising negative correlations between the stock return differential and the currency.

Our decompositions support the well-established home-wealth rebalancing behavior by host country investors. US investor flows are, rather, positively correlated with host stock market return differentials, which can be in line with models incorporating foreign investors' informational disadvantages and/or attributed to the simultaneity between flows and returns. These observations suggested that a combination of more standard features of international investor behavior, rather than HR's risk-rebalancing hypothesis, could explain the

stock return differential – currency correlation, when employed together with appropriate conditioning information.

We have proposed a model where a combination of two opposite effects, home-wealth rebalancing by host market investors and international investors' response to local information, drives the stock return differential – currency correlation. Which effect will outweigh is determined by the *source status* of the host country. Employing a comprehensive panel, we have investigated the drivers of the variation in the stock return differential – currency correlation. Results indicate that the *source status* of the host country has significant ability to explain the variation in the stock return differential – currency correlation, and it predicts a negative correlation when the host country is a net source of international capital flows. Market development loses its significance once source status and volatility are controlled for. Our empirical analysis also provides strong support for Filipe's (2012) relative fundamental volatility as a driver of the sign of the stock return differential – currency correlation.

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Appendix A

The expected return of US (host) investor in the host market is $\mu_H^{US} = \mu_H - \delta$ ($\mu_H^H = \mu_H$). The demand for host stock by the US (host) investor is $N_H^{US} = \frac{\mu_H^{US}}{\gamma\sigma_H^2}\frac{W^{US}}{P_H}$ ($N_H^H = \frac{\mu_H}{\gamma\sigma_H^2}\frac{W^H}{P_H}$). For the US stock, US (host) investor's demand equals to $N_{US}^{US} = \frac{\mu_{US}}{\gamma\sigma_{US}^2}\frac{W^{US}}{P_{US}}$ ($N_{US}^H = \frac{\mu_{US}^H}{\gamma\sigma_{US}^2}\frac{W^H}{P_{US}}$). We then assume $\frac{\mu_H}{\gamma\sigma_H^2} = \frac{\mu_{US}}{\gamma\sigma_{US}^2}$ or, given equal risk aversion coefficients, $\frac{\mu_H}{\sigma_H^2} = \frac{\mu_{US}}{\sigma_{US}^2}$, in order for the US and host investors to invest proportionally to their wealth.

If the US investor were the only one to decide by how many shares less to hold in the host market due to the international barriers she would reduce the "barrier-free" holdings in the host country by $\frac{\delta}{\gamma\sigma_H^2}\frac{W^{US}}{P_H}$ which we denote by *M*. However, this reduction must be equal to the amount of host shares by which host investor will exceed her optimal "barrier-free" holdings. This amount is proportional to $\frac{W^H}{W}$, which we define as $1-\Omega$, where $\Omega = \frac{W^{US}}{W}$. Exclusion of short positions leads to the market clearing condition $N_H^{US} + N_H^H = N_H$. Therefore, $N_H^H = N_H(1-\Omega) + M(1-\Omega)$ together with the market clearing condition gives us

$$N_H^{US} = N_H\Omega - M(1-\Omega) \qquad \text{(A.1)}$$

On the other hand, if the host investor were the only one to decide by how many shares more to hold in the host market, she would exceed her "barrier-free" holdings in the host country by $\frac{\delta}{\gamma\sigma_H^2}\frac{W^H}{P_H}$ which we denote by *K*. However, this increase must be equal to the amount of host shares by which US investor will reduce her optimal "barrier-free". Therefore, $N_H^{US} = N_H\Omega - K\Omega$ together with the market clearing condition gives us

$$N_H^H = N_H(1-\Omega) + K\Omega \qquad \text{(A.2)}$$

(A.1) and (A.2) form a system of two equations, solution of which yields the equilibrium condition $M(1-\Omega) = K\Omega$, which can be easily shown to be true by inserting *M*, *K* and *Ω*: $\frac{\delta}{\gamma\sigma_H^2}\frac{W^{US}}{P_H}\frac{W^H}{W} = \frac{\delta}{\gamma\sigma_H^2}\frac{W^H}{P_H}\frac{W^{US}}{W}$.

Now, having this system of (A.1) and (A.2) we check if the market clearing condition is satisfied. $N_H = N_H \frac{W^{US}}{W} - \frac{\delta}{\gamma\sigma_H^2}\frac{W^H}{W}\frac{W^{US}}{P_H} + N_H \frac{W^H}{W} + \frac{\delta}{\gamma\sigma_H^2}\frac{W^{US}}{W}\frac{W^H}{P_H}$. The second and fourth terms cancel out, and thus, we are left with $N_H = N_H \frac{W^{US}}{W} + N_H \frac{W^H}{W}$, which yields $1 = \frac{W^{US}}{W} + \frac{W^H}{W}$. Thus, market clearing condition is also satisfied.

Appendix B

We assume $P_H = P_{US} = 1$, $\delta = 0.03$, and measure *dN*, i.e., net bilateral flow in host currency, following a simulated increase in the host stock price, $\Delta P_H = 1$. The initial exchange rate is assumed to be equal to 1. Column *dN* indicates that the sign of *dN*, thus currency's correlation with the host stock return, changes under different numerical assumptions of model parameters and their interaction. An important point to note is that our model predicts a positive correlation, which is increasing in *q*, when host and US variances are equal. When σ_H is larger the correlation becomes negative. Filipe's (2012) model has the opposite prediction.

a) $W^H = W^{US} = 10$, $\gamma = 1$

σ_{US}^2	σ_H^2	N_H	N_{US}	*q*	*dN*
0.04	0.04	10	10	0	-2.64
0.04	0.04	10	10	0.1	6.15
0.04	0.04	10	10	0.2	14.94
0.02	0.04	10	10	0	-1.25
0.02	0.06	10	10	0	-0.68
0.02	0.06	10	10	0.1	-6.75
0.02	0.06	10	10	0.2	-12.83

b) $W^H = W^{US} = 10$, $\gamma = 5$

σ_{US}^2	σ_H^2	N_H	N_{US}	*q*	*dN*
0.04	0.04	10	10	0	-0.56
0.04	0.04	10	10	0.1	1.31
0.04	0.04	10	10	0.2	3.18
0.02	0.04	10	10	0	-0.75
0.02	0.06	10	10	0	-0.63
0.02	0.06	10	10	0.1	-1.87
0.02	0.06	10	10	0.2	-3.12

c) $W^H = 10$, $W^{US} = 40$, $\gamma = 5$

σ_{US}^2	σ_H^2	N_H	N_{US}	q	dN
0.04	0.04	10	10	0	-0.17
0.04	0.04	10	10	0.1	2.40
0.04	0.04	10	10	0.2	4.98
0.02	0.04	10	10	0	-0.20
0.02	0.06	10	10	0	-0.30
0.02	0.06	10	10	0.1	-1.97
0.02	0.06	10	10	0.2	-3.65
0.02	0.06	10	30	0	-0.96
0.02	0.06	10	30	0.1	-2.64
0.02	0.06	10	30	0.2	-4.32

Appendix C

Countries	**Equity *SS***	**Total *SS***
Australia	0.88	0.58
Brazil	0.18	0.18
Canada	1.08	1.26
Chile	6.30	0.83
Croatia	0.65	0.22
Czech Republic	1.15	0.32
Denmark	3.59	1.19
Hungary	0.30	0.30
India	0.02	0.31
Indonesia	0.11	0.22
Japan	0.34	1.19
Korea	0.42	0.79
Mexico		0.20
New Zealand	1.68	0.42
Norway	3.00	2.19
Philippines	0.06	0.31
Poland	0.59	0.19
Romania	1.10	0.06
Russia	0.06	0.61
South Africa	0.39	0.43
Sweden	2.35	1.74
Switzerland	1.83	3.46
Taiwan	0.65	1.33
Thailand	0.09	0.22
Turkey	0.08	0.27
United Kingdom	2.36	1.14
Ukraine	0.05	0.03
Eurozone	0.90	1.16
United States	1.27	0.50