# A Decomposition of International Capital Flows*

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**Abstract**

We propose a method to break down capital flows into portfolio growth and portfolio reallocation components and apply it to data on US equity and bond outflows. The decomposition is part of an integrated approach that decomposes purchases of any asset into portfolio growth and reallocation components. US equity and bond outflows depend not just on portfolio growth and the reallocation between US and foreign equity and bonds, but also on reallocation decisions higher up on the decision tree. This includes reallocation between portfolio and non-portfolio assets and between equity and bonds. We also consider the decomposition of US equity and bond outflows to individual foreign countries. The data shed light on the importance of the various components as drivers of capital flows in both the short and long run.

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# 1 Introduction

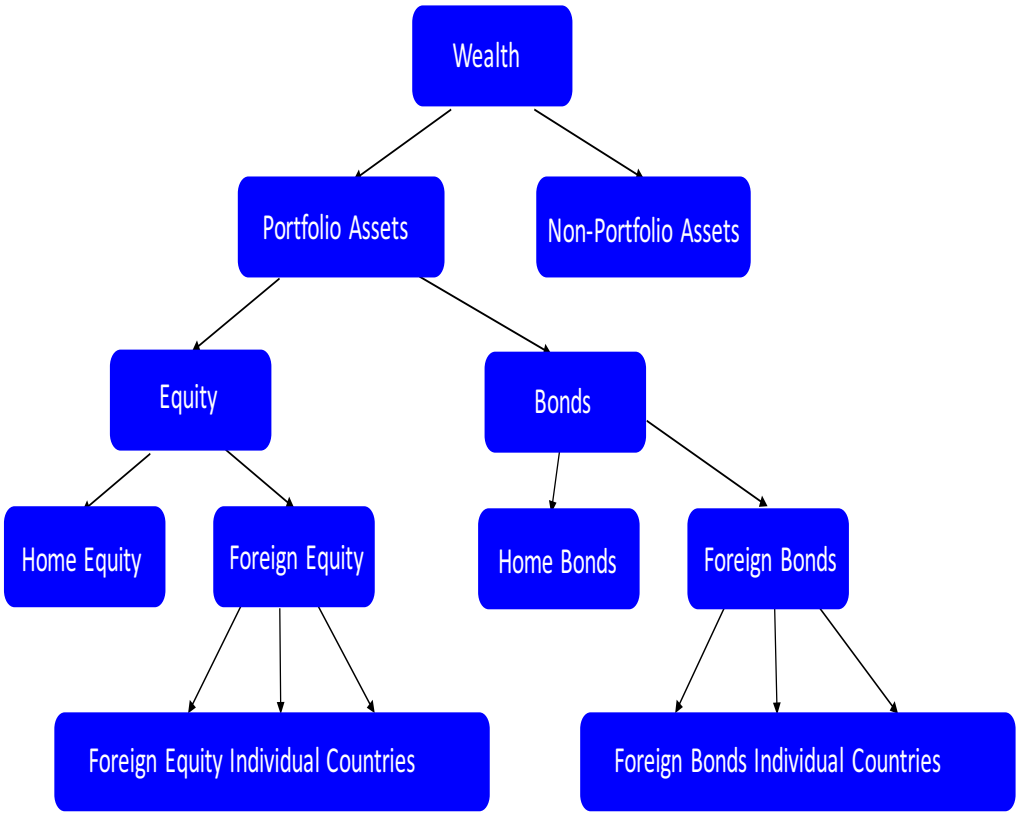
International capital flows play an increasingly important role in national and global business cycles. Understanding what drives capital flows is therefore a key research area. Rather than considering aggregate capital inflows and outflows, the empirical literature on international capital flows has increasingly focused on specific types of capital flows as their behavior can differ significantly. Usually capital outflows and inflows are broken down into foreign direct investment, portfolio equity, portfolio debt, banking flows and other flows. Sometimes just one or two of these types of flows are studied separately. The focus in the literature has been on questions such as what push and pull factors drive these flows, whether there are common global or regional components of these capital flows, and what accounts for the cyclicality of capital flows and the co-movement between capital inflows and outflows.[1] In this paper we further contribute to this literature by considering a different set of stylized facts, related to the decomposition of equity and bond outflows into portfolio growth and reallocation components. The portfolio growth component for capital outflows is associated with changes in the overall portfolio. It is equal to saving times the fraction invested abroad. Portfolio reallocation components are associated with changes in the portfolio shares allocated to various asset classes, but only to the extent that this is not the result of valuation effects.

Tille and van Wincoop (2010a) show how to break down total capital outflows and inflows (the sum of the different types of flows listed above) into a portfolio growth and reallocation component within the context of a model. Our objective is to empirically implement and significantly extend the decomposition proposed in Tille and van Wincoop (2010a). While Tille and van Wincoop (2010a) derive the decomposition for total capital outflows and inflows, as opposed to specific types of capital flows, we follow their overall methodology in decomposing equity and bond outflows into portfolio growth and portfolio reallocation components. Although our approach is methodologically similar, the decomposition we develop here goes well beyond that in Tille and van Wincoop (2010a). By considering both specific

[1]There are too many papers to list here that have documented such evidence related to these different types of capital flows. Some recent examples are Avdjiev et.al (2017), Broner et.al (2013), Bruno and Shin (2015), Cerutti, Claessens and Puy (2017), Cerutti, Claessens and Ratnovski (2017), Cerutti, Claessens and Rose (2017), Fratzscher (2012), Koepke (2015), Milesi-Ferretti and Tille (2011) and Sarno, Tsiakas and Ulloa (2016).

types of capital flows (equity and bond outflows) as well as bilateral capital flows to individual foreign countries, we find that equity and bond outflows are driven by a variety of reallocation components other than the reallocation between domestic and foreign assets featured in Tille and van Wincoop (2010a).

Figure 1: Households Decision Tree




The decomposition is part of an integrated approach to decompose purchases of any asset class into portfolio growth and reallocation components. The various reallocation components can be thought of as related to a series of decisions on asset allocation at various nodes of a decision tree, illustrated in Figure 1. At

the top of the tree investors need to make a decision how to allocate their wealth between portfolio assets (equity and bonds) and non-portfolio assets (all other assets). Going one step down the decision tree, investors need to decide how to allocate portfolio assets between equity and bonds. One step further down, agents need to decide how to allocate their equity (or bond) portfolio between domestic and foreign equity (or bonds). At the bottom of the tree we also consider reallocation across different foreign countries.

Portfolio reallocation decisions higher up the decision tree affect asset purchases further down. For example, when there is a portfolio shift from bonds to equity, this leads to more equity outflows even when saving (portfolio growth) does not change and the fraction of the equity portfolio allocated to Foreign equity does not change.

We consider the decomposition of equity and bond outflows from the perspective of the United States as the home country. We do so for both aggregate US equity and bond outflows and US equity and bond outflows to individual foreign countries. Aggregate equity (or bond) outflows are decomposed into a portfolio growth component (related to saving), a reallocation component between portfolio and non-portfolio assets, a reallocation component between equity and bonds, and a reallocation component between Home and Foreign equity (or bonds). Equity (or bond) outflows to individual foreign countries are decomposed into these same four components plus a reallocation component between foreign countries.

We do not claim that agents make portfolio decisions in the sequence suggested by Figure 1. Our approach here is atheoretical. There may be shocks to the economy that simultaneously set off multiple reallocation decisions. In a general equilibrium framework this is almost unavoidable. We take no position on what the deeper underlying drivers of the various reallocation components may be. We mainly aim to shed light on the relative importance of the various components, both in the short and long run.

Our approach is applied to quarterly data for the United States from 1994 to 2014. Empirical implementation of these decompositions is facilitated by high quality monthly data on U.S. external equity and bond holdings in various countries from Bertaut and Tryon (2007), who correct for inconsistencies between reported TIC survey position and flow data. The data have recently been used by Curcuru et al. (2008, 2010) and Curcuru et al. (2011) to analyze return differentials and the relationship between portfolio reallocations and past returns. We extend the

approach in Bertaut and Tryon (2007) to a longer sample from 1994 to 2014.

Some related papers are Ahmed et al. (2016), Curcuru et al. (2011) and Guo and Jin (2009). Ahmed et al. (2016) focus on US equity flows to emerging markets, which they decompose into a portfolio growth component and a residual. We will show that the latter is the sum of four different reallocation components in our decomposition. Curcuru et al. (2011) do not consider a complete decomposition of US equity outflows to foreign countries, but focus on a component of these flows that is analogous to what we refer to as the reallocation between different foreign countries. They investigate the relationship between this component with past and future relative returns of these countries.

Guo and Jin (2009) is also related, although they take a very different approach. Rather than looking at any specific type of capital inflows or outflows, they decompose changes in the overall net foreign asset position of a country into a "growth effect" and "composition effect." These are somewhat related to what we refer to as portfolio growth and Home-Foreign reallocation, but they are not the same. Changes in the value of asset holdings depend on valuation effects. Our decompositions instead focus on asset purchases. Another difference is that the composition effect, which is related to changes in the ratio of net foreign assets to total wealth, depends on portfolio decisions by both US investors (external assets) and foreign investors (external liabilities). Our focus will be on capital outflows and we therefore take the perspective of U.S. investors.[2]

The paper also connects to a growing literature that emphasizes portfolio allocation decisions as drivers of capital flows in open economy DSGE models with incomplete financial markets, where endogenous time variation in expected returns and risk lead to time variation in portfolio allocation.[3] It should be emphasized though that the stylized facts that we develop here are not easy to connect to the existing theoretical literature. Most models are two country models, which therefore have little to say about bilateral capital flows. Moreover, most models consider total capital inflows and outflows rather than the specific types of flows that a lot of the empirical literature has focused on. There is a literature on eq-

[2]See Tille and van Wincoop (2010b) for a further discussion on treating the ratio of net foreign assets to wealth as a portfolio share.

[3]Examples are Bacchetta and van Wincoop (2017), Davis and van Wincoop (2018), Devereux and Sutherland (2007, 2010), Didier and Lowenkron (2012), Evans and Hnatkovska (2014), Gabaix and Maggiori (2015), Hnatkovska (2010) and Tille and van Wincoop (2010a,b, 2014).

uity flows, but it usually makes special assumptions to ignore reallocation between equity and other asset classes.[4]

While empirics here is well ahead of theory, and it is therefore impossible to say if the stylized facts that we document will be consistent or inconsistent with specific theories, in Section 5 we provide a preliminary assessment of some of our findings from a theory perspective. Given the direction that the empirical capital flow literature has taken towards a breakdown into specific types of capital flows, there is a clear need for the theoretical literature to catch up to the various stylized facts that have been developed in the literature. This paper further adds to the body of empirical evidence as it relates specifically to portfolio flows, which is ultimately intended to guide and stimulate future theoretical work.

The remainder of the paper is organized as follows. Section 2 discusses the decomposition of equity and bond outflows. Section 3 discusses the data used to apply the decomposition to US portfolio flows. Section 4 discusses the empirical findings. Section 5 discusses the connection of our findings to related theoretical literature. Section 6 concludes.

# 2 Decomposition of Portfolio Outflows

In this section we discuss two decompositions of portfolio outflows. We first consider aggregate portfolio outflows, where aggregate refers to the sum of capital outflows to all foreign countries. After that we discuss a decomposition of capital outflows to individual foreign countries. We will throughout focus on equity outflows, although analogous decompositions also apply to bond outflows and will be discussed when applying the decompositions to the data in Section 4. We will throughout take the perspective of the Home country, which in the application will be the United States. Foreign always refers to the rest of the world.

[4]Some of the theoretical papers that have looked at equity flows include Albuquerque, Bauer and Schneider (2007,2009), Bacchetta and van Wincoop (2017), Brennan and Cao (1997), Dou and Verdelhan (2017) and Hau and Rey (2006).

## 2.1 Some Notation

It is useful to first introduce some basic notation. Let the wealth of the Home country be

$$A_t = \sum_{i=1}^{N} X_t^i Q_t^i \tag{1}$$

Here the superscript $i$ denotes an asset class, $X_t^i$ is the quantity held of asset $i$ and $Q_t^i$ is the price of asset $i$. The value of wealth next period is

$$A_{t+1} = \sum_{i=1}^{N} X_t^i Q_{t+1}^i + S_{t+1} \tag{2}$$

Here $S_{t+1}$ is saving, which equals asset plus non-asset income minus consumption and consumption of fixed capital.

Denoting $\Delta x_{t+1} = x_{t+1} - x_t$, we have

$$\Delta A_{t+1} = \sum_{i=1}^{N} k_t^i A_t \frac{\Delta Q_{t+1}^i}{Q_t^i} + S_{t+1} \tag{3}$$

where

$$k_t^i = \frac{X_t^i Q_t^i}{A_t} \tag{4}$$

is the portfolio share invested in asset $i$.

We will use superscripts to denote an asset class. Specifically, $i = p$ refers to portfolio assets, $i = np$ to non-portfolio assets, $i = e$ to equity, $i = b$ to bonds, $i = e, F$ for Foreign equity and $i = e, F, n$ for Foreign equity of country $n$. So $k_t^{e,F,n}$ is the portfolio share allocated to Foreign equity of country $n$. We also define portfolio shares within an asset class. For example, the portfolio share allocated to equity as a fraction of all portfolio assets (bonds plus equity) is denoted $k_t^{e|p}$. Analogously, the fraction of the equity portfolio allocated to Foreign equity is $k_t^{F|e}$ and the fraction of the Foreign equity portfolio allocated to country $n$ is $k_t^{n|e,F}$.

The relative change of the price for an asset class depends on relative price changes of the components of that asset class:

$$\frac{\Delta Q_{t+1}^p}{Q_t^p} = k_t^{e|p} \frac{\Delta Q_{t+1}^e}{Q_t^e} + (1 - k_t^{e|p}) \frac{\Delta Q_{t+1}^b}{Q_t^b} \tag{5}$$

$$\frac{\Delta Q_{t+1}^e}{Q_t^e} = k_t^{F|e} \frac{\Delta Q_{t+1}^{e,F}}{Q_t^{e,F}} + (1 - k_t^{F|e}) \frac{\Delta Q_{t+1}^{e,H}}{Q_t^{e,H}} \tag{6}$$

$$\frac{\Delta Q_{t+1}^{e,F}}{Q_t^{e,F}} = \sum_n k_t^{n|e,F} \frac{\Delta Q_{t+1}^{e,F,n}}{Q_t^{e,F,n}} \tag{7}$$

(5) relates the relative price change of portfolio assets to relative price changes of equity and bonds. (6) relates the relative price change of equity to relative price changes of Home and Foreign equity, while (7) relates the Foreign equity price change to price changes of equity of individual foreign countries.

We finally need to introduce the concept of passive changes in portfolio shares. These are related to valuation effects without any changes in the quantities of assets held. It is possible for example to hold a larger portfolio share in Foreign equity without this generating any capital flows when the higher portfolio share is entirely due to a higher relative price of Foreign to Home equity. As we will see, only changes in portfolio shares unrelated to such valuation effects induce capital flows. Consider for example the share of wealth invested in portfolio assets, which is

$$k_t^p = \frac{X_t^p Q_t^p}{X_t^p Q_t^p + X_t^{np} Q_t^{np}} \tag{8}$$

Denote $\Delta\tilde{k}_{t+1}^p$ as the change in this portfolio share due exclusively to valuation effects, changing $Q_t^p$ and $Q_t^{np}$, but not the quantities $X_t^p$ and $X_t^{np}$. Differentiating (8) with respect to the prices, we have

$$\Delta\tilde{k}_{t+1}^p = k_t^p(1-k_t^p)\left(\frac{\Delta Q_{t+1}^p}{Q_t^p} - \frac{\Delta Q_{t+1}^{np}}{Q_t^{np}}\right) \tag{9}$$

Similarly, passive changes in the share of portfolio assets allocated to equity, the share of equity allocated to Foreign equity, and the share of Foreign equity allocated to country $n$ Foreign equity are equal to

$$\Delta\tilde{k}_{t+1}^{e|p} = k_t^{e|p}(1-k_t^{e|p})\left(\frac{\Delta Q_{t+1}^e}{Q_t^e} - \frac{\Delta Q_{t+1}^b}{Q_t^b}\right) \tag{10}$$

$$\Delta\tilde{k}_{t+1}^{F|e} = k_t^{F|e}(1-k_t^{F|e})\left(\frac{\Delta Q_{t+1}^{e,F}}{Q_t^{e,F}} - \frac{\Delta Q_{t+1}^{e,H}}{Q_t^{e,H}}\right) \tag{11}$$

$$\Delta\tilde{k}_{t+1}^{n|e,F} = k_t^{n|e,F}\left(\frac{\Delta Q_{t+1}^{e,F,n}}{Q_t^{e,F,n}} - \frac{\Delta Q_{t+1}^{e,F}}{Q_t^{e,F}}\right) \tag{12}$$

## 2.2 Decomposition of Aggregate Portfolio Outflows

We can now derive an expression for aggregate equity outflows. Start from

$$k_t^{e,F} = k_t^p k_t^{e|p} k_t^{F|e} \tag{13}$$

This says that the portfolio share allocated to Foreign equity is the product of the portfolio share allocated to portfolio assets (equity and bonds), the fraction of portfolio assets allocated to equity and the fraction of equity assets allocated to Foreign equity. From this the holdings of Foreign equity is equal to

$$Q_t^{e,F} X_t^{e,F} = k_t^p k_t^{e|p} k_t^{F|e} A_t \tag{14}$$

In the Appendix we show that linearizing (14), and substituting (3), we obtain the following expression for equity outflows $Q_t^{e,F} \Delta X_{t+1}^{e,F}$:

$$\begin{aligned} Equity\ Outflows_{t+1} \quad = \quad & k_t^{e,F} S_{t+1} + \\ & k_t^{e,F} A_t \frac{\Delta k_{t+1}^p - \Delta \tilde{k}_{t+1}^p}{k_t^p} + \\ & k_t^{e,F} A_t \frac{\Delta k_{t+1}^{e|p} - \Delta \tilde{k}_{t+1}^{e|p}}{k_t^{e|p}} + \\ & k_t^{e,F} A_t \frac{\Delta k_{t+1}^{F|e} - \Delta \tilde{k}_{t+1}^{F|e}}{k_t^{F|e}} \end{aligned} \tag{15}$$

(15) shows the decomposition of equity outflows into four components. The first is the portfolio growth component, which is equal to the portfolio share allocated to Foreign equity times saving. The last three terms are reallocation terms. These are all due to changes in portfolio shares. Changes in passive portfolio shares are subtracted as they do not involve a change in the quantity of assets held and therefore do not generate portfolio flows. The first portfolio reallocation component is associated with the reallocation between portfolio and non-portfolio assets. A larger share allocated to portfolio assets leads to larger capital outflows even if the allocation of these portfolio assets to Foreign equity remains unchanged. The second reallocation component is shown in the third line. It captures the reallocation between equity and bonds. A larger share allocated to equity leads to larger equity outflows even if the share of the equity portfolio allocated to Foreign equity remains constant. Finally, the fourth line represents the reallocation between Home and Foreign equity. A larger share allocated to Foreign equity raises equity outflows. In all cases passive portfolio changes are subtracted.

## 2.3 Equity Outflows to Individual Countries

In order to consider equity outflows to individual foreign countries, start with the identity

$$k_t^{e,F,n} = k_t^p k_t^{e|p} k_t^{F|e} k_t^{n|e,F} \tag{16}$$

which implies that the holding of country $n$ equity is equal to

$$Q_t^{e,F,n} X_t^{e,F,n} = k_t^p k_t^{e|p} k_t^{F|e} k_t^{n|e,F} A_t \tag{17}$$

The Appendix shows that differentiating (17), using (3), gives the following expression for equity flows $Q_t^{e,F,n} \Delta X_{t+1}^{e,F,n}$ to country $n$:

$$\begin{aligned} Equity\ Outflows_{t+1}^n \;=\; & k_t^{e,F,n} S_{t+1} + \\ & k_t^{e,F,n} A_t \frac{\Delta k_{t+1}^p - \Delta \tilde{k}_{t+1}^p}{k_t^p} + \\ & k_t^{e,F,n} A_t \frac{\Delta k_{t+1}^{e|p} - \Delta \tilde{k}_{t+1}^{e|p}}{k_t^{e|p}} + \\ & k_t^{e,F,n} A_t \frac{\Delta k_{t+1}^{F|e} - \Delta \tilde{k}_{t+1}^{F|e}}{k_t^{F|e}} \\ & k_t^{e,F,n} A_t \frac{\Delta k_{t+1}^{n|e,F} - \Delta \tilde{k}_{t+1}^{n|e,F,n}}{k_t^{n|e,F}} \end{aligned} \tag{18}$$

(18) shows the decomposition of equity outflows to country $n$ into five components. The first is again the portfolio growth component, which is equal to the portfolio share allocated to country $n$ equity times saving. The last four terms are the reallocation components. The first three of these are familiar from the decomposition of aggregate equity outflows discussed above, capturing respectively the reallocation between portfolio and non-portfolio equity, between equity and bonds and between Home and Foreign equity. The last reallocation component is new, capturing equity flows to country $n$ associated with a reallocation of the Foreign equity portfolio towards country $n$. An increase in the portfolio share $k_t^{n|e,F}$ allocated to equity of foreign country $n$ within the Foreign equity portfolio, after subtracting valuation effects, implies increased equity outflows to country $n$.

Ahmed et al. (2016) decompose US equity outflows to emerging markets into a portfolio growth component and a residual. When $n$ is the sum of emerging markets, the residual is equal to the sum of the four reallocation components for

that $n$. It therefore reflects a variety of different types of reallocation. Curcuru et al. (2011) consider a portfolio reallocation term that corresponds to the fourth reallocation component shown in the last line of (18), representing the reallocation between foreign countries. They consider how this component is related to past and future relative returns. One needs to keep in mind though that this is only one of the four reallocation components that affect capital flows to individual countries.

# 3 Data

In order to implement the decompositions, we need data on purchases, returns and portfolio shares of various asset classes, as well as net private savings and household wealth. The asset classes are the aggregate of portfolio assets, equity and bonds separately, Foreign equity and bonds, and equity and bonds of individual foreign countries. We will use monthly data from April, 1994 to December, 2014. As we will discuss below, we aggregate to the quarterly frequency as some of the data are only available quarterly. We first describe the equity and bond outflow data as they pose the biggest challenge. After that we discuss data on asset returns, portfolio shares and purchases of all asset classes.

Our starting point for the capital outflow data is the dataset from Bertaut and Tryon (2007) on bilateral positions in equity and bonds. We first describe the approach followed by Bertaut and Tryon (2007) and then discuss how we use it to obtain capital outflow data. These take the form of purchases of foreign equity and bonds, both in aggregate and of individual foreign countries.[5]

## 3.1 Bertaut and Tryon (2007)

Bertaut and Tryon (2007) (henceforth BT) report monthly estimates of U.S. cross-border equity and bond positions by combining high-quality but low frequency TIC (Treasury International Capital) survey positions with high frequency TIC S flow data.[6] TIC periodic position surveys provide the most detailed and accurate information on bilateral securities holdings. However, these surveys are conducted relatively infrequently. They became annual surveys from 2004. Before that,

[5]We thank Frank Warnock for helping us understand the international position and flow data.

[6]The BT data are available at http://www.federalreserve.gov/pubs/ifdp/2007/910/ticdata.zip.

surveys were 2-4 years apart.[7] The flow data are monthly. The change in the position from one month to the next is equal to the flow plus valuation changes. Therefore data on the flows and valuation changes can be used to compute the positions for the months between surveys. A problem that arises though is that following this approach from one survey date to the next leads to inconsistencies with the survey position data.

To be precise, define $p_t^n$ as the naive position (defined below) and $p_t^s$ as the survey position. Since we only use data on external claims, these refer to the value of U.S. holdings of equity or bonds in individual foreign countries or the aggregate of all foreign countries. The naive position starts from a survey date, at which time it is set equal to the survey position, and then accumulates according to

$$p_{t+1}^n = p_t^n + flow_{t+1} + r_{t+1} p_t^n \tag{19}$$

Here $flow_{t+1}$ is the transaction flow (purchases of foreign equity or bonds) from TIC S and $r_{t+1}$ is the return (relative price change) during this month that gives rise to valuation changes.

By the time we reach the next survey date, $p_t^n$ tends to deviate from $p_t^s$. Since the survey data are very high quality, this happens because of either errors in the flow data or valuation data. BT discuss many of the problems with the flow data. One issue is "transaction bias" in that transactions are recorded according to the first cross-border counterparty (often broker-dealers) as opposed to the actual buyer or seller. This leads to a bias towards financial centers. The transaction data also miss flows that do not pass through standard TIC reporting channels, such as repayments of principal on asset-backed securities or acquisition of equity through merger-related stock swaps or re-incorporations.

One immediate adjustment that BT make is to add stock swap data to the TIC flow data. But this leaves other errors in the flow and valuation data that still cause a "gap" between $p_t^n$ and $p_t^s$ during the next survey date. BT then develop a procedure to allocate this gap to the individual months.[8] Their estimate of the position is then

$$p_t = p_t^n + gap_t \tag{20}$$

[7] The surveys of claims before 2004 took place 3/31/1994, 12/31/1997, 12/31/2001 and 12/31/2003.

[8] See the Appendix of BT for details.

where $gap_t$ is the gap that is allocated to month $t$ to make the monthly position data consistent with the less frequent survey data.

## 3.2 Capital Flows

BT take no position on whether the gap is a result of errors in the flow data or the valuation data. As a result, they do not report a capital flow series. The contribution of their work is rather the creation of a monthly position series $p_t$ as described above, which can be used for example to compute portfolio shares in individual foreign countries in a way that is less subject to problems such as the "transaction bias."

The first step in the approach we take is to apply the BT method to our entire sample of April, 1994, through December, 2014, to obtain monthly position data. The BT data are available online through December 2011. We therefore extend the BT method to a couple of years beyond their sample. The second step is to compute capital flow data. For this we take the approach advocated in Curcuru et al. (2011) to compute "restated capital flows."[9] Flows are computed as

$$flows_{t+1} = p_{t+1} - p_t - r_{t+1}p_t \tag{21}$$

In other words, flows are equal to the change in the estimated position, minus valuation effects, where the latter is the return times the previous position. We discuss the return series below. This essentially attributes the gap to the flows as the return data are considered to be reasonably accurate.

A couple of comments are in order about the data after 2011. Bertaut and Judson (2014) (from hereon BJ) extend the position series from BT to data beyond 2011. They use a different approach, using monthly TIC SLT survey data that were collected in response to dissatisfaction with delays in accurate position data during the global financial crisis. TIC introduced a new securities reporting form, the TIC SLT form, to address the shortcomings of TIC position surveys and TIC S flow data. It provides much more timely and frequent reports than TIC position surveys. Compared to TIC S flow data, TIC SLT provides information on the market value of actual holdings rather than flows. BJ adjust the monthly TIC

[9]See Warnock and Warnock (2009) for a related approach. We thank Frank Warnock for explaining to us in detail the approach used to compute restated flows in Curcuru et al.(2011).

SLT position data a bit to the extent that there is a deviation with the annual survey position, but overall the TIC SLT data are quite accurate.

Like BT, BJ do not report capital flow data. One could take their monthly position data and subtract monthly valuation changes, $r_{t+1}p_t$, to compute flows. This may seem to be analogous to the way we compute restated flows in (21), but it is not. In fact, it leads to a capital flow series that is excessively volatile at times. The problem is that the return data have some measurement problems as well, as discussed in BJ. When combining accurate position data with errors in the valuation changes, these valuation errors translate directly into errors in the estimated flows. This is much less the case in the approach we follow based on the BT estimated positions. If, for example, the return for a particular month is overstated, this will overstate the naive position as seen in (19), but then the same error is subtracted when computing the flows as in (21). It is only the average return measurement error between annual surveys that can lead to errors in our flow measure as it contributes to the gap that is allocated to individual months. These average return errors over a year are much smaller than the monthly errors. We therefore do not use the BJ position data and instead apply the BT method to our entire sample to compute position data and compute the capital flows as in Curcuru et al.(2011).[10]

## 3.3 Asset Returns, Portfolio Purchases and Portfolio Shares

So far we have discussed the purchases of assets of one particular asset class (foreign bonds and equity). To implement the decompositions we also need data on purchases of the broader asset classes as well as data on asset returns and portfolio shares for all asset classes. We turn to this now.

### 3.3.1 Portfolio Shares

We need data on 4 portfolio shares: the share $k_t^p$ allocated to portfolio assets, the share $k_t^{e|p}$ of the portfolio assets that is allocated to equity, the share $k_t^{F|e}$ of the equity portfolio that is allocated to Foreign equity and the share $k_t^{n|e,F}$ of the

[10]In addition, we have also computed all results reported in Section 4 when the sample ends in December, 2011, using the BT position data that are available online without extending their sample further. We find that this makes virtually no difference for the results.

Foreign equity portfolio that is allocated to a specific foreign country $n$. For the latter two we also need analogous portfolio shares for bonds.

We start with total wealth $A_t$, which is obtained from the Financial Accounts of the United States, measuring the net worth of households and nonprofit organizations.[11] We subtract consumer durables assets (line 8). This is because we use the NIPA measure of net private saving for $S_t$ from the BEA, which subtracts expenditures on consumer durables to compute saving. This is the only difference between the NIPA definition of saving and the definition in the Flow of Funds data. The change in $A_t$ is then equal to saving plus the change due to valuation effects. A rough description of $A_t$ is portfolio assets plus real estate, plus deposits at financial institutions minus borrowing from financial institutions.

To compute $k_t^p$ we first need to compute the total equity and bond portfolio of the United States. For the equity market we take the total U.S. equity market capitalization plus external equity assets minus external equity liabilities. U.S. equity market capitalization data are from the Financial Accounts of the United States.[12] We then use the BT and BJ position data described above to add external equity holdings and subtract external equity liabilities. For bond market capitalization we use BIS data, aggregating bonds issued by the general government, financial corporations and non-financial corporations.[13] We then use the BT and BJ position data to add external bond holdings and subtract external bond liabilities. $k_t^p$ is then computed as the sum of U.S. equity and bond holdings, divided by $A_t$.

The portfolio share $k_t^{e|p}$ is simply the ratio of equity holdings described above and the sum of equity plus bond holdings. The portfolio share $k_t^{F|e}$ is equal to the total external equity holdings from BT divided by total equity holdings. Finally, for $k_t^{n|e,F}$ we divide external equity holdings in country $n$ from BT by total foreign equity holdings from BT. These portfolio shares are analogously computed for bonds.

### 3.3.2 Asset Returns

We need data on portfolio returns $Q_{t+1}^p/Q_t^p$, equity returns $Q_{t+1}^e/Q_t^e$, bond returns, Foreign and Home equity returns $Q_{t+1}^{e,F}/Q_t^{e,F}$ and $Q_{t+1}^{e,H}/Q_t^{e,H}$, Foreign and Home

[11] This is equal to line 1 of Table B.100 of the Financial Accounts (total assets), minus line 31 (liabilities).

[12] We obtain the data from Table B.1, market value of domestic corporations.

[13] See BIS, Debt Securities Statistics.

bond returns, equity returns $Q_{t+1}^{e,F,n}/Q_t^{e,F,n}$ for foreign country $n$ and bond returns for foreign country $n$.[14]

It is easiest to start with the returns on foreign equity and bonds. For this we use estimates of the foreign equity and bond returns from BT and BJ. While they do not report their return series, it can easily be extracted from their reported data. BJ report the valuation changes, from which the return is simply computed by dividing by their position series. We use this from January 2012 to the end of the sample. Prior to that we use the valuation changes reported by BT. Their reported valuation changes apply to the naive position, so $r_{t+1}p_t^n$. We therefore divide by the naive position to get the return series. We adopt this approach for both individual foreign countries and the aggregate of foreign countries.[15]

We compute $Q_{t+1}^e/Q_t^e$ as a weighted average of U.S. and Foreign equity returns as in (6) with the portfolio share as discussed above. The Foreign equity return is described above. For the Home (U.S.) equity return we use the S&P stock return. $Q_{t+1}^b/Q_t^b$ is computed analogously, where we use the Barclays Capital Aggregate Bond Index to compute the U.S. bond return.[16] Finally, $Q_{t+1}^p/Q_t^p$ is computed as in (5), using the portfolio share $k_t^{e|p}$ and equity and bond returns described above.

### 3.3.3 Asset Purchases

We finally need data on purchases of various assets classes. We have already discussed Foreign equity and bond purchases, both the aggregate and that of individual countries. Total equity purchases, which includes U.S. plus foreign equity, are computed as the change in the nominal value of equity holdings minus the net portfolio return $[Q_{t+1}^e/Q_t^e]-1$ times equity holdings at time $t$. Bond purchases are computed analogously, while portfolio purchases are equal to the sum of equity and bond purchases.

[14] We do not need data on the return of non-portfolio assets. In all decompositions we treat the reallocation between portfolio and non-portfolio assets as a residual, after computing the portfolio growth component and other reallocation components.

[15] The latter is the All Countries and IROs row in BT, code 99996. It should be noted that for equity these returns are highly correlated with the MSCI. The average correlation in our sample is 0.9968.

[16] The latter includes Treasury securities, government agency bonds, mortgage-backed bonds, corporate bonds and a small amount of foreign bonds traded in US. Before November, 2008, it was called the Lehman Aggregate Bond Index.

### 3.4 Frequency of the Data

Some of the data are available at the monthly frequency, such as the equity and bond outflows. But we aggregate to the quarterly frequency as some of the data are only available quarterly (net private saving, total wealth and bond market capitalization). We compute changes in portfolio shares and asset prices from the end of the previous quarter to the end of the current quarter.

## 4 Results

We present the results in the form of a series of graphs and tables, with key features summarized in two sets of Empirical Findings. The tables and figures shed light on the importance of the various components of the equity and bond outflow decompositions in both the short and long run.

We will also compare the reallocation components to what they would have been under perfect rebalancing. The latter assumes that agents wish to keep their portfolio shares unchanged. In the theoretical reallocation components, this corresponds to assuming no change in the actual portfolio share, so that the reallocation is equal to minus the change in the passive portfolio share. If for example equity prices rise relative to bond prices, so that the passive portfolio share in equity increases, there would be a reallocation from equity to bonds if there were portfolio rebalancing. We can then compare the actual portfolio reallocation to what it would have been under perfect portfolio rebalancing.

Portfolio flows can be quite volatile at the quarterly frequency, which makes for ugly graphs. We therefore mainly show graphs of cumulative flows and two-year moving averages. Let $y_t$ be the quarterly equity or bond outflow, either the aggregate or to a specific country, and $x_{nt}$ a particular component of the decomposition. Then $y_t = \sum_{n=1}^{N} x_{nt}$. If the time interval is $[1, T]$, the graphs report the cumulative flows $\sum_{s=1}^{t} y_s$ and cumulative components $\sum_{s=1}^{t} x_{ns}$, for $t = 1$ to $t = T$, as well as two-year moving averages $\sum_{s=t-7}^{t} y_s/8$ and $\sum_{s=t-7}^{t} x_{ns}/8$ for $t = 8$ to $t = T$.

Starting with Table 3, the tables report various moments associated with equity and bond outflows and their components at the quarterly and annual frequencies. They also report variance decompositions, which attribute a fraction of the variance

of $y_t$ to component $n$ equal to

$$\frac{cov(x_{nt}, y_t)}{var(y_t)} \tag{22}$$

These fractions add to 1. In these tables, in contrast to the figures, we scale $y_t$ and $x_{nt}$ by the corresponding stock of external assets at the end of the quarter prior to the period over which the flows are measured to assure stationarity.

Tables 1 and 2 provide different information. Table 1 reports the fraction of the (unscaled) cumulative aggregate equity and bond outflows over the entire sample that can be attributed to component $n$. This is equal to $\sum_{s=1}^{T} x_{ns} / \sum_{s=1}^{T} y_s$. It provides insight into the role of various components over a longer period of time. Table 2 reports the correlation at the quarterly and annual frequencies between various portfolio reallocation components and what they would have been under perfect rebalancing.

Table 1: Cumulative Components Entire Sample as Share of Cumulative Equity and Bond Outflows

| **Components** | **Aggregate equity outflows** | **Aggregate bond outflows** |
|---|---|---|
| Portfolio growth | 0.52 | 0.45 |
| Portfolio - non-portfolio reallocation | 0.01 | -0.18 |
| Equity - bond reallocation | -0.32 | 0.24 |
| Home - Foreign reallocation | 0.79 | 0.49 |

*Notes:* All components and outflows are cumulative over the entire sample, 1994Q3 to 2014Q4.

Table 2: Correlation Between Various Reallocation Components and Perfect Rebalancing

| **Frequency** | **Portfolio - non-portfolio** | **Equity - bond** | **Bond - equity** | **H - F equity** | **H - F bond** |
|---|---|---|---|---|---|
| Quarterly | 0.550 | -0.125 | -0.076 | 0.222 | 0.030 |
| Annual | 0.778 | 0.053 | 0.154 | 0.428 | -0.074 |
| Bi-annual | 0.777 | 0.242 | 0.217 | 0.521 | -0.230 |

*Notes:* Perfect rebalancing refers to what reallocation would have been if agents keep their portfolio share constant. In the portfolio - non-portfolio reallocation, portfolio share refers to asset allocation between portfolio assets and non-portfolio assets; in the equity - bond and bond - equity reallocation, portfolio share refers to the allocation of portfolio assets to equity and bonds; in the Home - Foreign reallocation, portfolio share refers to the allocation of equity and bond portfolio between Home and Foreign equity and bonds. All reallocation and rebalancing components are scaled by asset holdings in the prior quarter.

## 4.1 Aggregate Equity and Bond Outflows

Figure 2 reports results related the decomposition for aggregate equity outflows. Panel A shows cumulative equity outflows and its four components, while panel B shows two-year moving averages. In order to avoid an excessive number of lines, the latter only shows equity outflows, the portfolio growth component and the reallocation between Home (U.S.) and Foreign equity.

Figure 2: Equity Outflows Decomposition

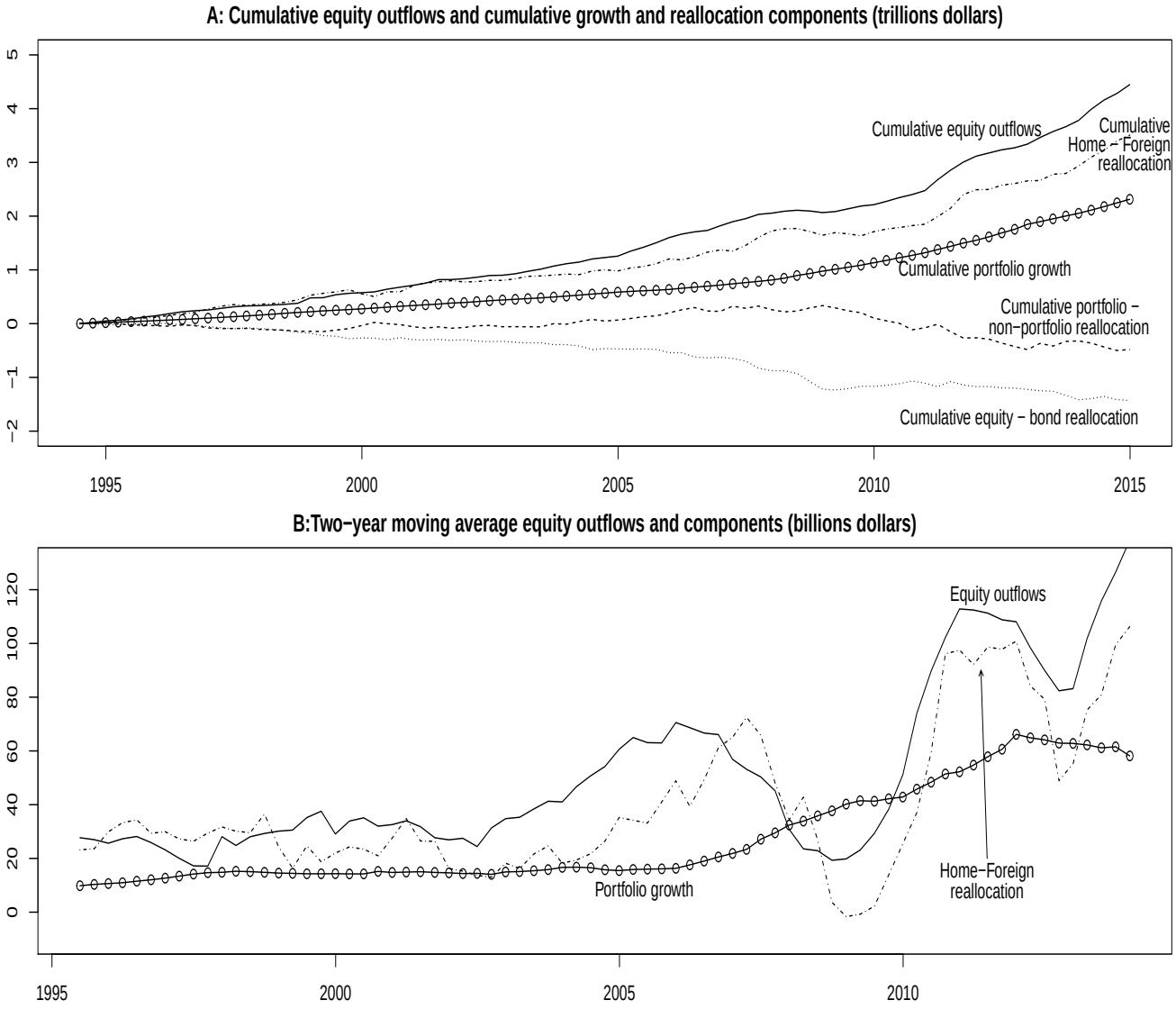


Table 3: Equity Outflows Decomposition Statistics

| Variable | Mean | Std. Dev. | Std. Dev. (relative to equity outflows) | Auto-correlation | Correlation with equity outflows | Variance decomposition |
|---|---|---|---|---|---|---|
| **Panel A. Quarterly data** | | | | | | |
| Equity outflows | 0.021 | 0.014 | 1.00 | 0.256 | 1.000 | 1.000 |
| Portfolio growth | 0.010 | 0.003 | 0.21 | 0.818 | 0.116 | 0.026 |
| Portfolio - non-portfolio reallocation | -0.002 | 0.016 | 1.14 | 0.200 | 0.115 | 0.130 |
| Equity - bond reallocation | -0.007 | 0.013 | 0.93 | 0.048 | 0.068 | 0.064 |
| Home - Foreign reallocation | 0.016 | 0.019 | 1.36 | 0.275 | 0.548 | 0.761 |
| **Panel B. Annual data** | | | | | | |
| Equity outflows | 0.088 | 0.044 | 1.00 | 0.270 | 1.000 | 1.000 |
| Portfolio growth | 0.042 | 0.013 | 0.30 | 0.726 | 0.457 | 0.133 |
| Portfolio - non-portfolio reallocation | -0.006 | 0.041 | 0.93 | 0.115 | 0.021 | 0.020 |
| Equity - bond reallocation | -0.028 | 0.030 | 0.68 | -0.127 | 0.034 | 0.024 |
| Home - Foreign reallocation | 0.070 | 0.051 | 1.16 | 0.079 | 0.746 | 0.867 |

*Notes:* The sample period is from 1994Q3 to 2014Q4. All components above are normalized by U.S. external equity holdings in the quarter prior to the measured flows. The variance decomposition shows the fraction of the variance of equity outflows accounted for by each component.

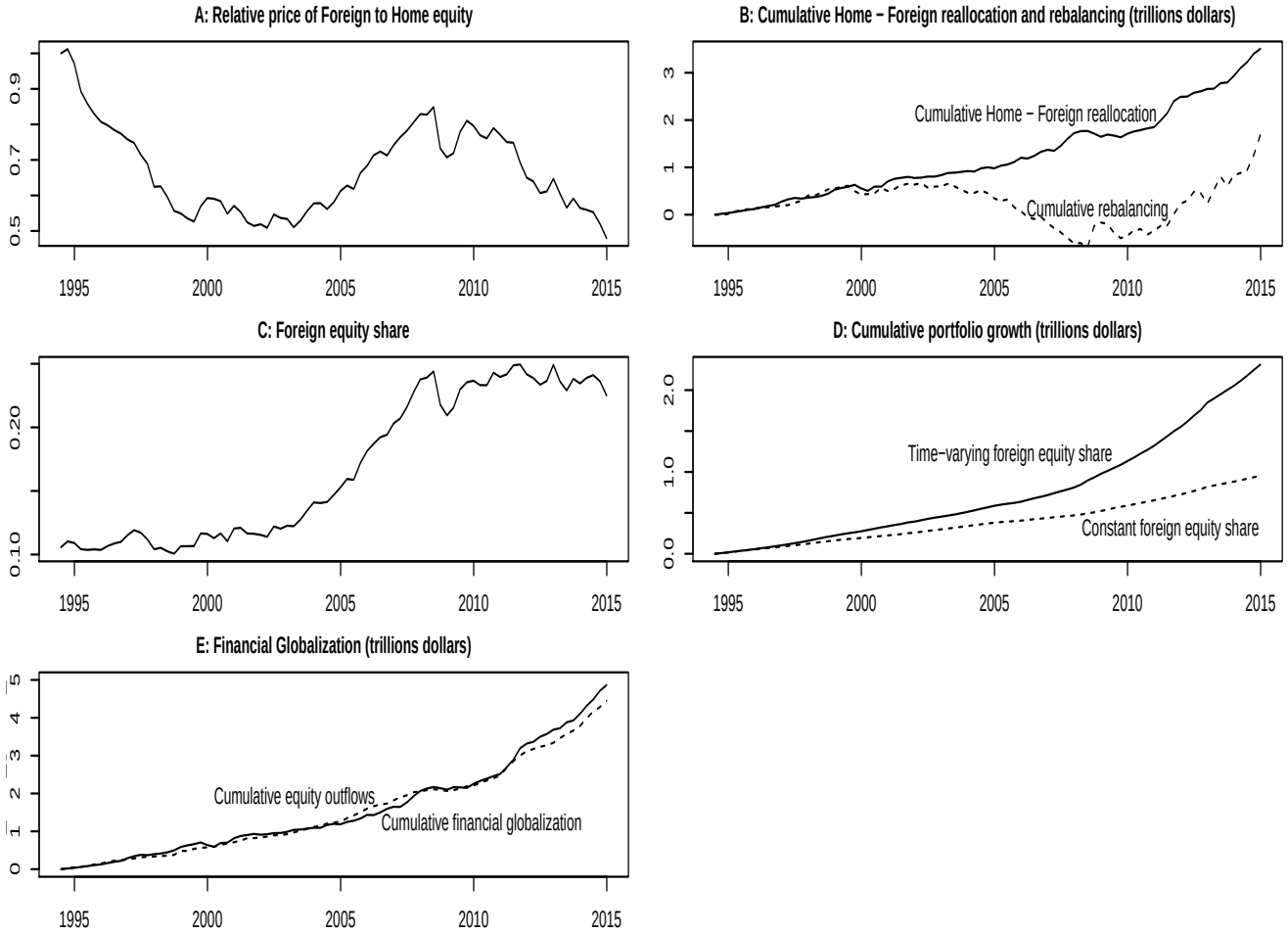
Panel A of Figure 2 shows that portfolio growth and reallocation between Home and Foreign equity are the key drivers of equity outflows over the entire sample. Table 1 shows that cumulative portfolio growth accounts for about half of the cumulative equity outflows during the sample, while cumulative reallocation from Home to Foreign equity accounts for 79 percent. The reallocation from equity to bonds plays an important role as well, reducing cumulative equity outflows by 32 percent.

Portfolio growth plays much less of a role at higher frequencies, as shown in Table 3. At the quarterly and annual frequencies, reallocation between Home and Foreign equity accounts for about 80 percent of the variance of equity outflows. Portfolio growth accounts for only 3 percent of the variance of equity outflows at the quarterly frequency and 13 percent at the annual frequency. This can also be seen graphically in panel B of Figure 2. Although they use a somewhat different approach, Guo and Jin (2009) also find that the "composition" effect (related to various types of reallocation) is a much more important driver of capital flows than the "growth effect" at high frequencies. They do not consider the role of portfolio growth in the long run.

The other two reallocation components, between equity and bonds and between portfolio and non-portfolio assets, have a volatility comparable to that of equity outflows itself at quarterly and annual frequencies. But they are not very correlated

with equity outflows and therefore account for very little of the variance of equity outflows at these frequencies. We also find that portfolio growth has much more persistence than all of the reallocation components, contributing to its importance in the long run.

Figure 3: Equity Globalization and Rebalancing




*Notes:* Cumulative rebalancing in chart B refers to what cumulative Home - Foreign equity reallocation would have been under perfect rebalancing, where agents hold constant the share of the equity portfolio allocated to Home and Foreign equity. Cumulative financial globalization in chart E equals cumulative Home - Foreign equity reallocation (chart B) plus the part of portfolio growth that is due to the increase in the portfolio share (difference between the two lines in chart D).

Figure 3 provides further insight into portfolio reallocation from Home to Foreign equity. Panel A shows the relative price of Foreign to Home equity. While this has fluctuated over the sample, overall the relative price of US equity has about doubled during the sample. Under rebalancing, this would lead to purchases of Foreign equity. But Panel B shows that the actual cumulative reallocation from

Home to Foreign equity is much larger than it would be based on rebalancing.

The finding that cumulative reallocation between Home and Foreign equity appears to have little relation with what it would be based on rebalancing does not necessarily imply that rebalancing is not important. Table 2 shows that the Home-Foreign equity reallocation component has a correlation with its perfect rebalancing counterpart of 0.43 at the annual frequency. Rebalancing clearly does play a role. But panel B of Figure 3 shows that over the entire two decade sample other factors are more dominant. Lane and Milesi-Ferretti (2008) attribute the increase in cross-border positions to factors such as capital account liberalization, financial deregulation, falling communication costs as well as financial innovation (e.g. securitization).

Table 1 also reports the correlation between the other two reallocation components, portfolio-non-portfolio reallocation and equity-bond reallocation, and what they would have been under perfect rebalancing. There is a strong association between the two for portfolio-non-portfolio reallocation, especially at the annual frequency, but not for equity-bond reallocation. Overall the importance of portfolio rebalancing for the reallocation components that make up equity outflows is clearly mixed.

Defining financial globalization as the process of reallocation from Home to Foreign assets, panels C, D and E of Figure 3 shed further light on the effect that it has on capital flows. If for whatever reason there is a portfolio reallocation from Home to Foreign equity, it raises capital outflows. This effect on capital outflows is temporary in the sense that it ends once the reallocation is completed. A lower cost of investing abroad, even if it is permanent, temporarily raises capital outflows during the process of reallocation. This reallocation goes back to zero once portfolios have settled at their new level. However, to the extent that changes in portfolio shares are persistent, the reallocation has a persistent effect on portfolio growth.

This persistent effect of portfolio reallocation is illustrated in panel D of Figure 3. Panel C shows that the share of the equity portfolio allocated to Foreign equity increased from about 10 percent at the start of the sample to 25 percent by the end of the sample. Panel D compares cumulative portfolio growth to what it would have been if the portfolio share in Foreign equity had remained constant at its level during the start of the sample. The difference between these two lines captures the persistent effect of financial globalization. Define equity outflows associated

with cumulative financial globalization as the sum of cumulative reallocation from Home to Foreign equity and the part of cumulative portfolio growth associated with financial globalization (difference between the two lines in panel D). Panel E shows that total cumulative equity outflows are about equal to that based on cumulative financial globalization.

Analogous results for bond outflows are reported in Figures 4 and 5 and Tables 1 and 4. Table 1 shows that over the entire sample portfolio growth and reallocation from Home to Foreign bonds both account for about half of bond outflows. The other two reallocation components, from equity to bonds and portfolio to non-portfolio assets, are not insignificant, but go in opposing directions. The reallocation from equity to bonds accounts for 24 percent of cumulative bond outflows, while the reallocation from portfolio to non-portfolio assets reduces cumulative bonds outflows by 18 percent. At quarterly and annual frequencies, Table 4 shows that reallocation between Home and Foreign bonds accounts for virtually all of the variance of bond outflows.

Figure 4: Bond Outflows Decomposition

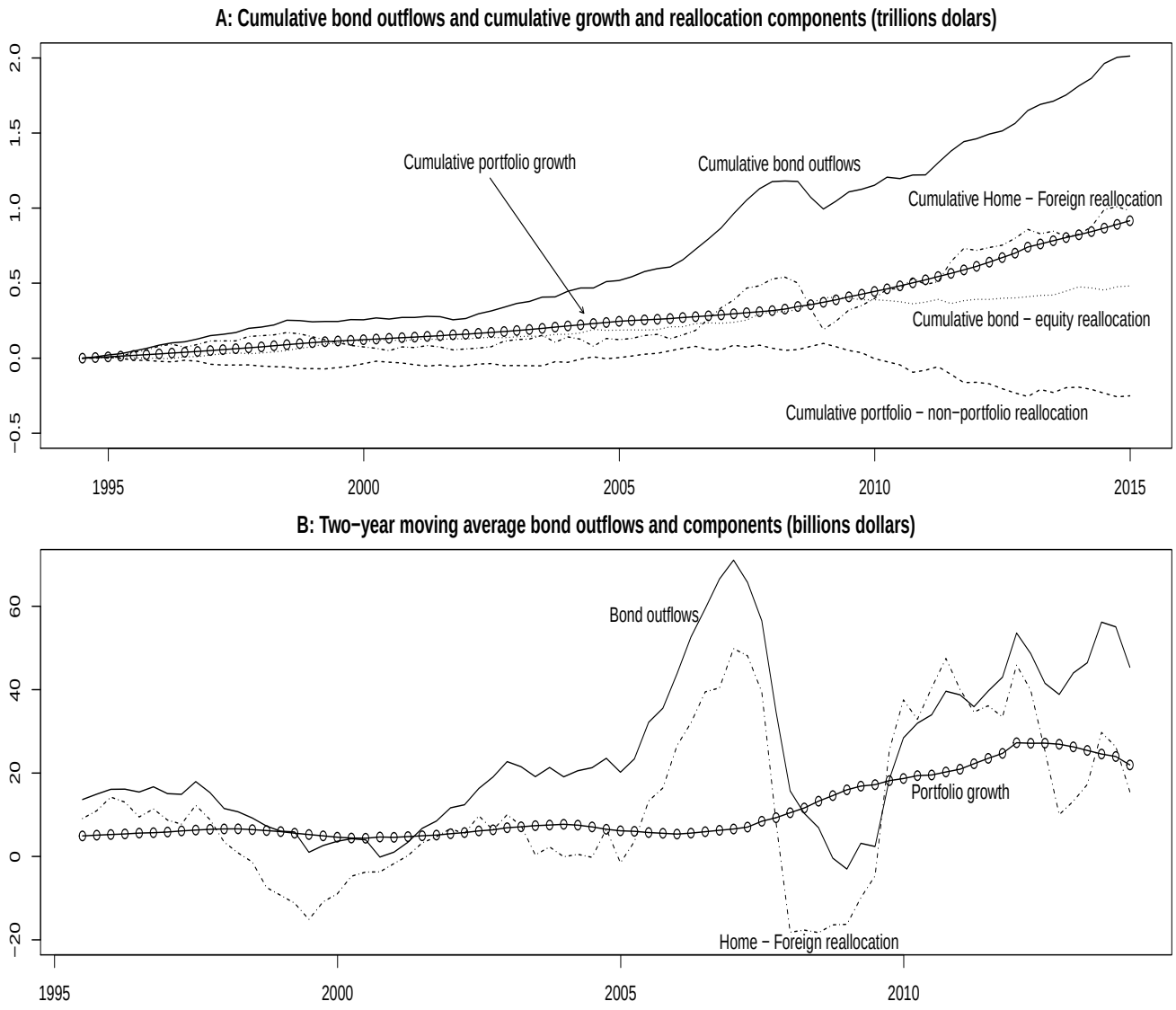
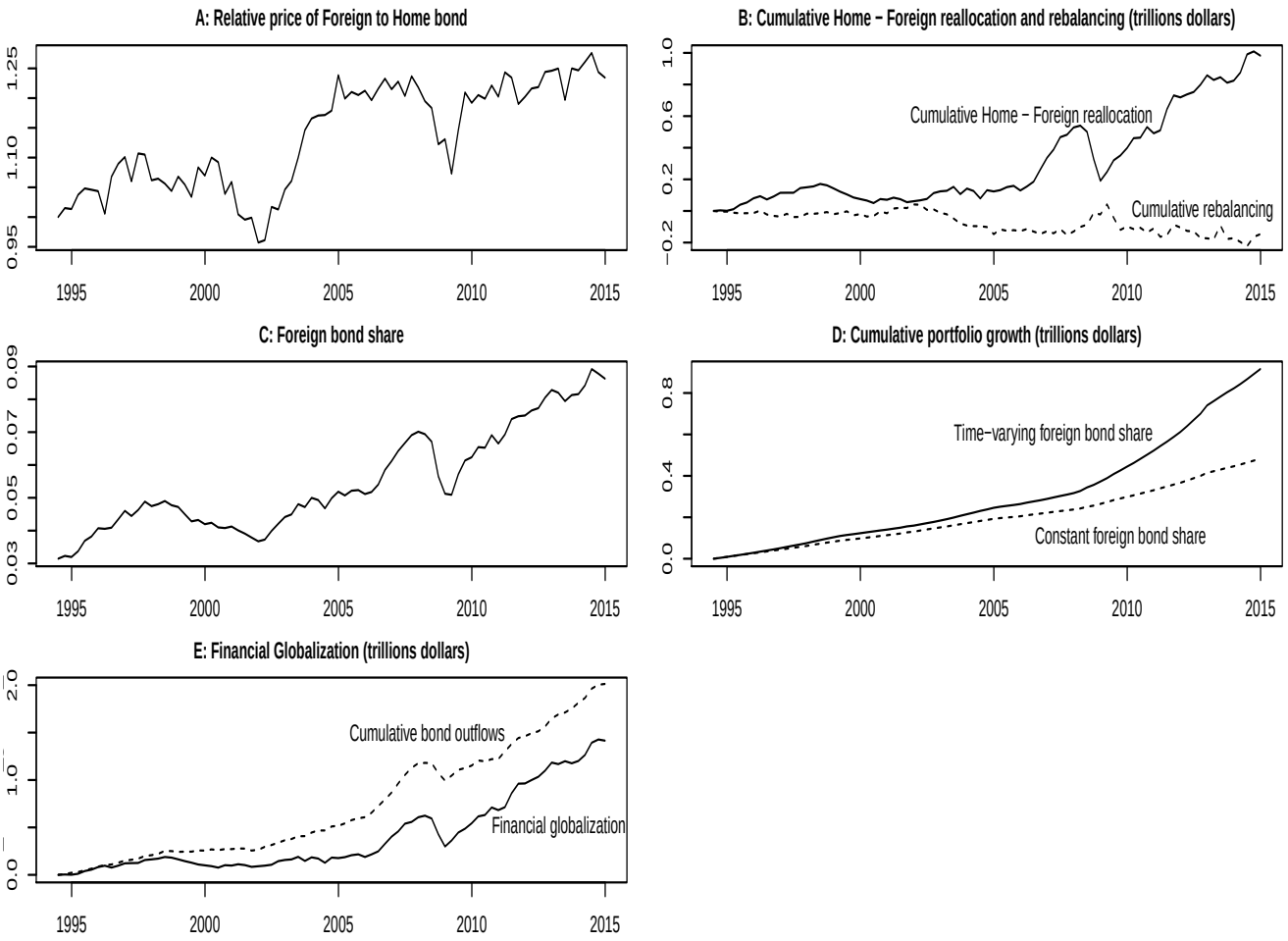



Figure 5 sheds further insight into the reallocation from Home to Foreign bonds. Since the relative price of Foreign bonds to Home bonds has not changed a lot (panel A), reallocation under portfolio rebalancing is not very large (panel B). As is the case for equity, the large cumulative portfolio reallocation from Home to Foreign bonds is therefore driven by factors other than rebalancing, such as reduced barriers to foreign bond investment. In contrast to equity, for bonds rebalancing does not play much of a role at higher frequencies either (Table 2).

Figure 5: Bond Globalization and Rebalancing




*Notes:* Cumulative rebalancing in chart B refers to what cumulative Home - Foreign bond reallocation would have been under perfect rebalancing, where agents hold constant the share of the bond portfolio allocated to Home and Foreign bond. Cumulative financial globalization in chart E equals cumulative Home - Foreign bond reallocation (chart B) plus the part of portfolio growth that is due to the increase in the portfolio share (difference between the two lines in chart D).

The increase in the share of the bond portfolio allocated to Foreign bonds during the sample (panel C) implies that again a large part of the cumulative portfolio growth component of bond outflows can be attributed to financial globalization (difference between the lines in panel D). Panel E shows that cumulative bond outflows is related to a large extent, though not entirely, to cumulative financial globalization as defined above.

Table 4: Bond Outflows Decomposition Statistics

| Variable | Mean | Std. Dev. | Std. Dev. (relative to bond outflows) | Auto-correlation | Correlation with bond outflows | Variance decomposition |
|---|---|---|---|---|---|---|
| **Panel A. Quarterly data** | | | | | | |
| Bond outflows | 0.023 | 0.025 | 1.00 | 0.444 | 1.000 | 1.000 |
| Portfolio growth | 0.010 | 0.003 | 0.12 | 0.818 | -0.015 | -0.002 |
| Portfolio - non-portfolio reallocation | -0.002 | 0.016 | 0.64 | 0.200 | -0.158 | -0.098 |
| Bond - equity reallocation | 0.006 | 0.012 | 0.48 | -0.013 | -0.286 | -0.131 |
| Home - Foreign reallocation | 0.011 | 0.036 | 1.44 | 0.268 | 0.819 | 1.170 |
| **Panel B. Annual data** | | | | | | |
| Bond outflows | 0.100 | 0.074 | 1.00 | 0.279 | 1.000 | 1.000 |
| Portfolio growth | 0.042 | 0.012 | 0.16 | 0.792 | -0.024 | -0.004 |
| Portfolio - non-portfolio reallocation | -0.007 | 0.038 | 0.51 | 0.115 | -0.104 | -0.054 |
| Bond - equity reallocation | 0.025 | 0.026 | 0.35 | 0.025 | -0.276 | -0.097 |
| Home - Foreign reallocation | 0.047 | 0.093 | 1.26 | -0.031 | 0.860 | 1.087 |

*Notes:* The sample period is from 1994Q3 to 2014Q4. All components above are normalized by U.S. external bond holdings in the quarter prior to the measured flows. The variance decomposition shows the fraction of the variance of bond outflows accounted for by each component.

We can summarize these findings as follows.

**Empirical Finding 1** *The following results apply to aggregate equity and bond outflows decomposition:*

- *Over the entire sample, equity and bond outflows are mostly driven by portfolio growth and reallocation between Home and Foreign equity/bonds.*
- *At quarterly and annual frequencies, portfolio reallocation between Home and Foreign equity/bonds accounts for virtually all of capital outflow volatility.*
- *Over the entire sample reallocation between Home and Foreign equity/bonds is largely driven by factors other than rebalancing.*
- *At the annual frequency, some reallocation components (portfolio-non-portfolio and Home-Foreign equity) are significantly related to rebalancing, while other reallocation components (equity-bond and Home-Foreign bond) are not.*
- *Portfolio growth is significantly more persistent than all reallocation components.*
- *A lasting impact of portfolio reallocation to Foreign equity/bonds is a significantly larger portfolio growth component.*

## 4.2 Capital Flows to Individual Countries

We next consider the decomposition of equity and bond outflows to individual countries. At the quarterly and annual frequencies the evidence clearly indicates that reallocation between foreign countries is the dominant driver of capital outflows to individual foreign countries. Figures 6 and 7 show quarterly equity and bond outflows to 12 individual foreign countries (solid line) as well as the part associated with reallocation between that country and other foreign countries (broken line). In contrast to previous graphs, these are actual quarterly flows, not cumulated flows. There is clearly a very close connection between the two.

This is confirmed in Tables 5 and 6, which show the variance decomposition for equity and bonds and related moments. The moments reported in Tables 5 and 6 are computed for each foreign country and then averaged across all foreign countries. Virtually all of the variance of quarterly and annual capital flows to individual countries is explained by the reallocation among foreign countries. This is the case for both equity (Table 5) and bonds (Table 6). This reallocation component is far more volatile than the other components and has an average correlation with equity flows and bond flows to individual countries of about 0.9.

A different picture emerges when we look at the cross-sectional aspect of the data, which captures more long term drivers of capital flows to individual countries. In Table 7 we report the cross-sectional variance decomposition of cumulative capital flows over the entire sample to individual countries. For both equity and bonds the main drivers of capital flows to individual foreign countries in the long run are portfolio growth and the reallocation between Home and Foreign countries. The other reallocation components, including reallocation between foreign countries, play a role as well, but are smaller.

One can also ask to what extent the reallocation between foreign countries is associated with portfolio rebalancing. We compute the correlation between foreign country reallocation and what it would have been based on perfect rebalancing. The average of this correlation across all countries is -0.07 for equity and 0.02 for bonds for quarterly data. This implies that at least at the high frequency there is virtually no rebalancing.

Figure 6: Equity Outflows to Individual Foreign Countries and Foreign Country Reallocation (Quarterly, millions of dollars)

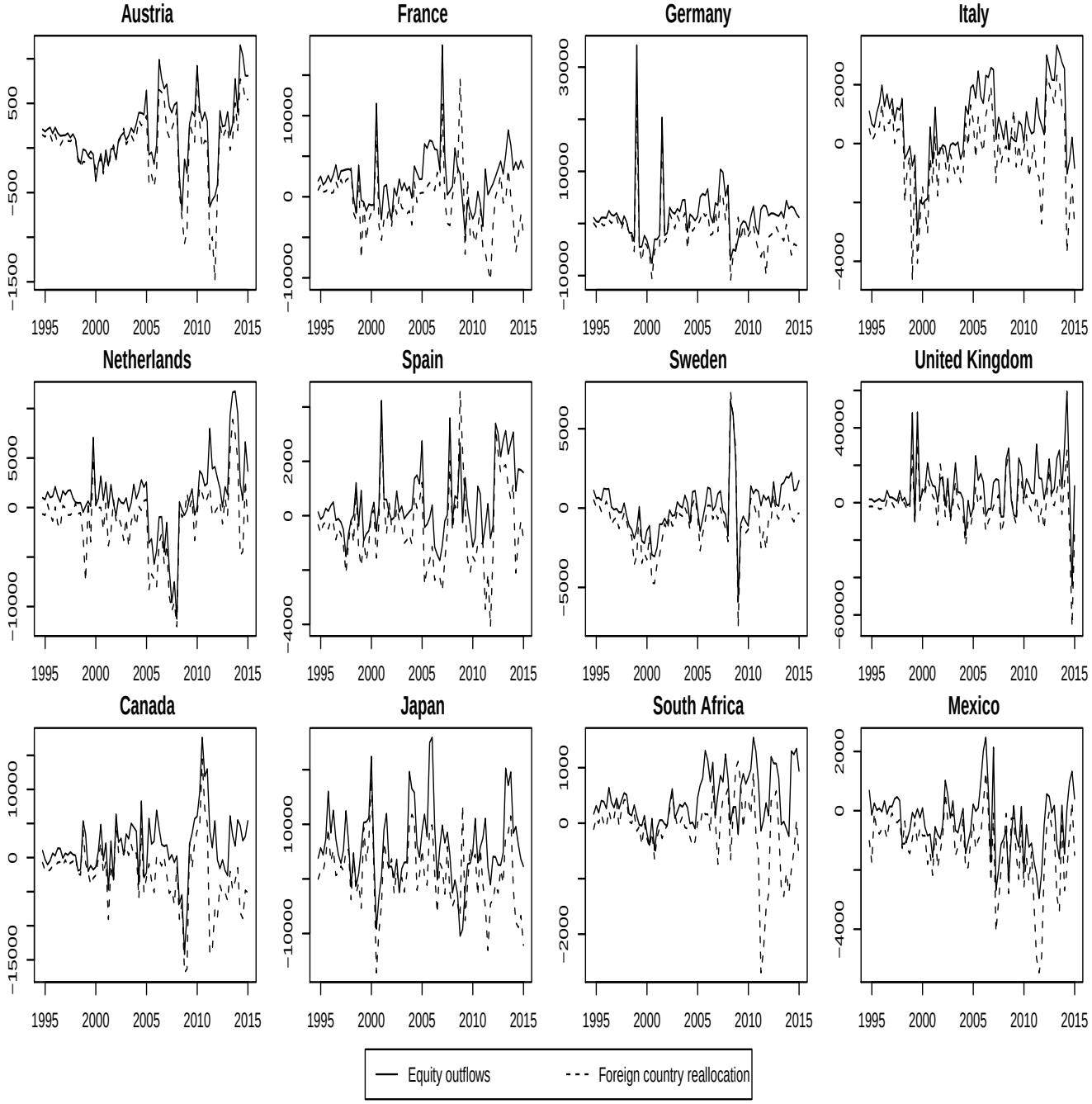
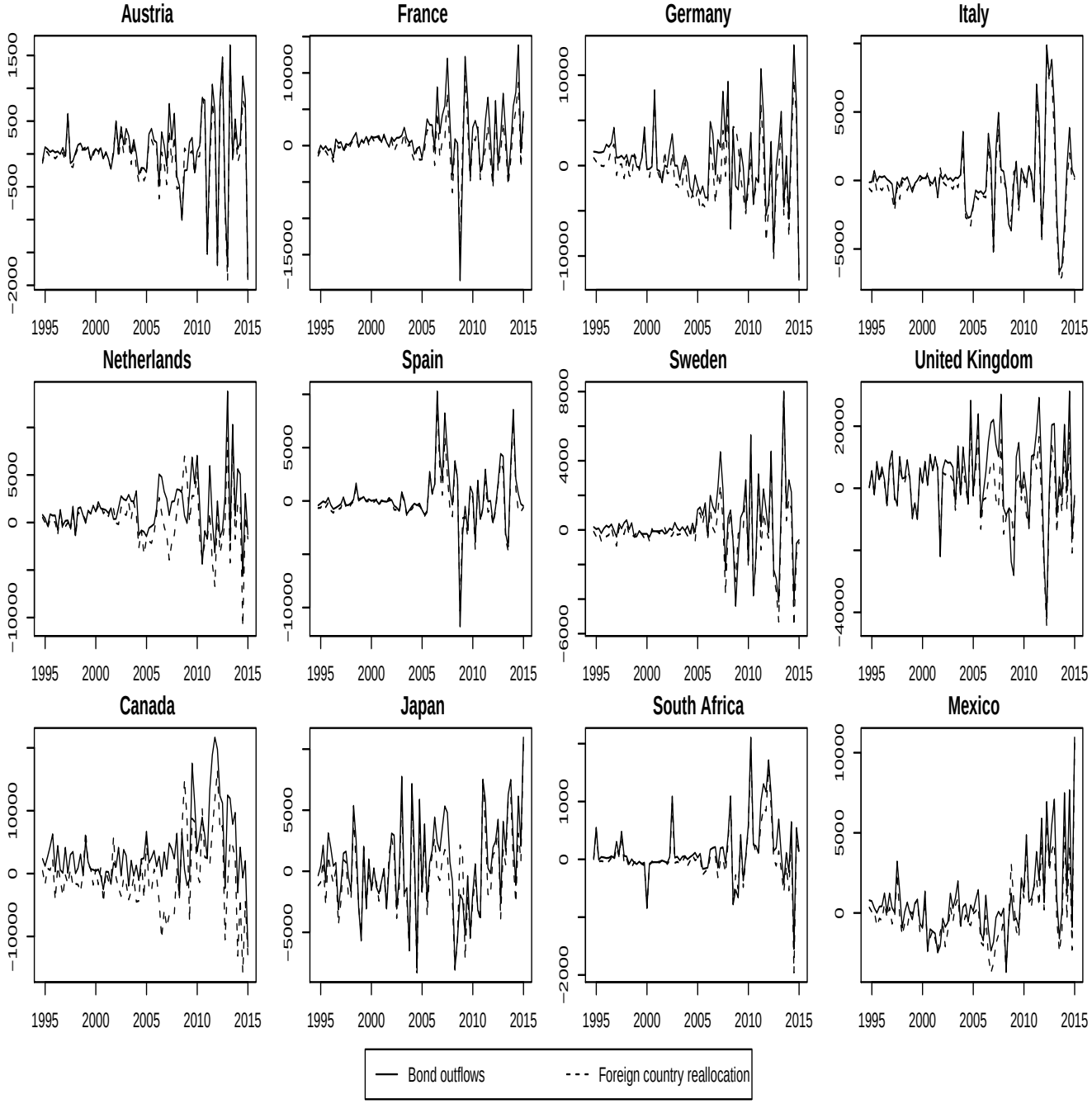


Figure 7: Bond Outflows to Individual Foreign Countries and Foreign Country Reallocation (Quarterly, millions of dollars)



## Table 5: Bilateral Equity Outflows Decomposition Statistics

| Variable | Mean | Std. Dev. | Std. Dev. (relative to equity outflows) | Auto-correlation | Correlation with equity outflows | Variance decomposition |
|---|---|---|---|---|---|---|
| **Panel A. Quarterly data** | | | | | | |
| Equity outflows | 0.060 | 0.294 | 1.00 | 0.392 | 1.000 | 1.000 |
| Portfolio growth | 0.010 | 0.003 | 0.01 | 0.818 | 0.143 | 0.011 |
| Portfolio - non-portfolio reallocation | -0.002 | 0.016 | 0.05 | 0.200 | -0.002 | 0.001 |
| Equity - bond reallocation | -0.007 | 0.013 | 0.04 | 0.048 | 0.026 | 0.007 |
| Home - Foreign reallocation | 0.016 | 0.019 | 0.06 | 0.275 | 0.133 | 0.069 |
| Foreign country reallocation | 0.036 | 0.284 | 0.97 | 0.314 | 0.895 | 0.878 |
| **Panel B. Annual data** | | | | | | |
| Equity outflows | 0.189 | 0.411 | 1.00 | 0.359 | 1.000 | 1.000 |
| Portfolio growth | 0.044 | 0.016 | 0.04 | 0.567 | 0.412 | 0.036 |
| Portfolio - non-portfolio reallocation | -0.006 | 0.045 | 0.11 | 0.129 | -0.103 | -0.015 |
| Equity - bond reallocation | -0.029 | 0.033 | 0.08 | -0.120 | -0.034 | -0.011 |
| Home - Foreign reallocation | 0.074 | 0.056 | 0.14 | 0.110 | 0.429 | 0.149 |
| Foreign country reallocation | 0.087 | 0.380 | 0.93 | 0.296 | 0.898 | 0.797 |

*Notes:* The sample period is from 1994Q3 to 2014Q4. All values above are averages across countries. All components above are normalized by equity holdings in individual foreign countries in the quarter prior to the measured flows. The variance decomposition shows the average fraction of the variance of equity outflows to individual foreign countries accounted for by each component.

## Table 6: Bilateral Bond Outflows Decomposition Statistics

| Variable | Mean | Std. Dev. | Std. Dev. (relative to bond outflows) | Auto-correlation | Correlation with bond outflows | Variance decomposition |
|---|---|---|---|---|---|---|
| **Panel A. Quarterly data** | | | | | | |
| Bond outflows | 0.026 | 0.099 | 1.00 | 0.105 | 1.000 | 1.000 |
| Portfolio growth | 0.010 | 0.003 | 0.03 | 0.818 | 0.049 | 0.005 |
| Portfolio - non-portfolio reallocation | -0.002 | 0.016 | 0.16 | 0.200 | -0.049 | -0.017 |
| Bond - equity reallocation | 0.006 | 0.012 | 0.12 | -0.013 | -0.075 | -0.016 |
| Home - Foreign reallocation | 0.011 | 0.036 | 0.36 | 0.268 | 0.247 | 0.134 |
| Foreign country reallocation | 0.002 | 0.093 | 0.94 | 0.094 | 0.911 | 0.863 |
| **Panel B. Annual data** | | | | | | |
| Bond outflows | 0.108 | 0.235 | 1.00 | 0.185 | 1.000 | 1.000 |
| Portfolio growth | 0.042 | 0.014 | 0.06 | 0.772 | 0.116 | 0.013 |
| Portfolio - non-portfolio reallocation | -0.008 | 0.038 | 0.16 | 0.129 | -0.152 | -0.041 |
| Bond - equity reallocation | 0.025 | 0.026 | 0.11 | 0.023 | -0.205 | -0.033 |
| Home - Foreign reallocation | 0.045 | 0.088 | 0.37 | -0.042 | 0.333 | 0.176 |
| Foreign country reallocation | 0.010 | 0.220 | 0.94 | 0.214 | 0.900 | 0.853 |

*Notes:* The sample period is from 1994Q3 to 2014Q4. All values above are averages across countries. All components above are normalized by bond holdings in individual foreign countries in the quarter prior to the measured flows. The variance decomposition shows the average fraction of the variance of bond outflows to individual foreign countries accounted for by each component.

Table 7: Cross Sectional Variance Decomposition

| **Component** | **Equity outflows** | **Bond outflows** |
|---|---|---|
| Portfolio growth | 0.330 | 0.385 |
| Portfolio - non-portfolio reallocation | -0.102 | -0.135 |
| Equity - bond reallocation | -0.197 | 0.194 |
| Home - Foreign reallocation | 0.453 | 0.447 |
| Foreign country reallocation | 0.188 | 0.122 |

*Notes:* The sample period is from 1994Q3 to 2014Q4. All outflows and components are cumulated over the entire sample, and are scaled by asset holdings at the beginning of the sample. The reported numbers measure the contribution of each component to the cross-sectional variance of cumulative equity and bond outflows.

Figure 8 sheds light on the long run relationship between rebalancing and reallocation between foreign countries. It reports on the horizontal axis the cumulative reallocation between a country and other foreign countries over the entire sample. On the vertical axis it shows what that reallocation would have been under perfect rebalancing.[17] There does not appear to be much of a relationship. This suggests that at both low and high frequencies the reallocation between foreign countries is mostly driven by factors unrelated to rebalancing.

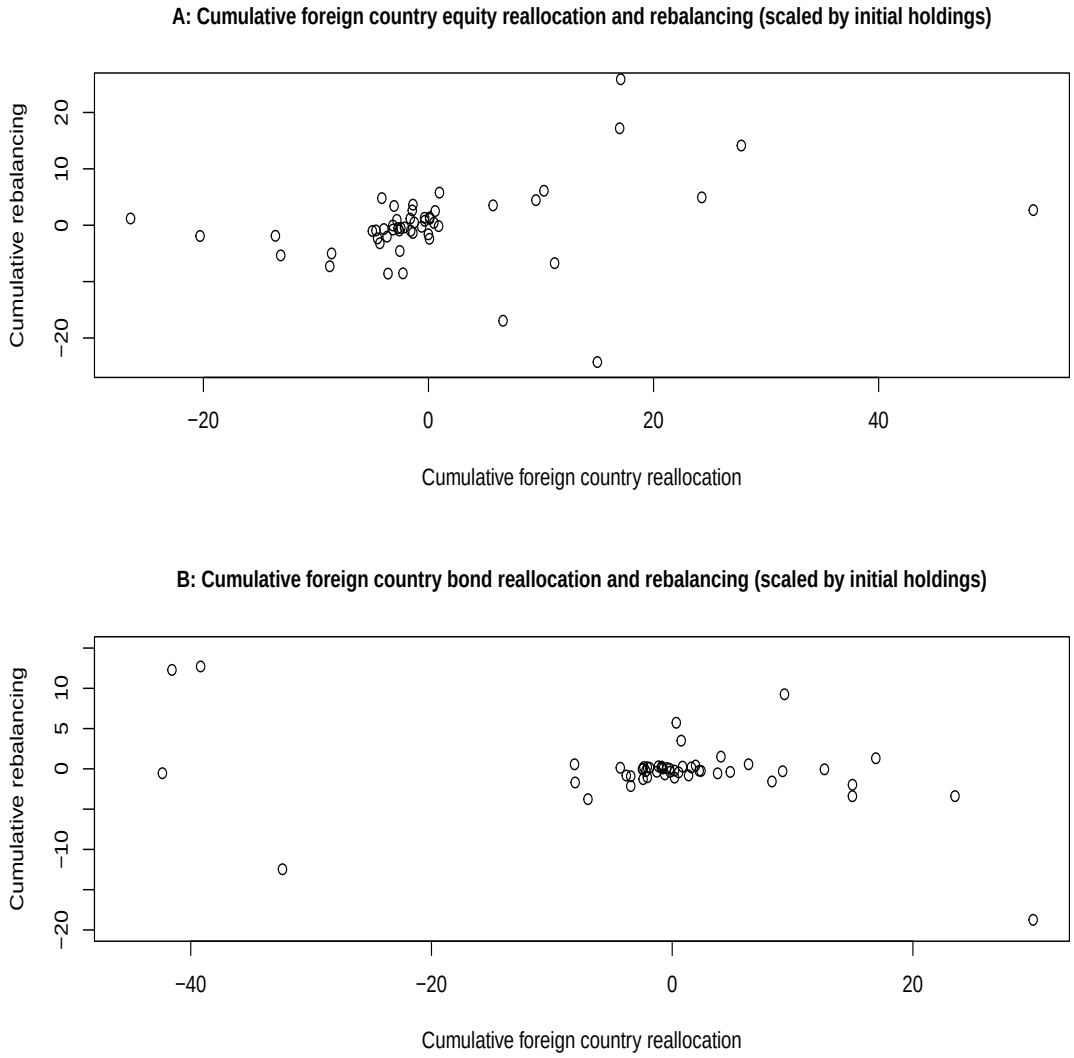
We can summarize these findings as follows.

**Empirical Finding 2** *The following results apply to bilateral equity and bond outflows decomposition:*

- *At the quarterly/annual frequency, reallocation between foreign countries accounts for virtually all of the variance of capital flows to individual countries.*
- *In the long run, portfolio growth and Home-Foreign reallocation (aggregate of foreign countries) account for most of capital flows to individual countries.*
- *Portfolio growth is much more persistent than all reallocation components.*
- *Reallocation between foreign countries is mostly driven by factors unrelated to portfolio rebalancing.*

[17]We have removed one extreme outlier for equity and 4 outliers for bonds. For equity the outlier is Russia. For bonds the outliers are Serbia and Montenegro, Poland, Panama and Ghana.

Figure 8: Cumulative Foreign Country Reallocation and Rebalancing




*Notes:* Each dot represents one foreign country. The top chart shows the cumulative foreign country equity reallocation over the entire sample and what it would have been under perfect rebalancing, where agents hold constant the share of the Foreign equity portfolio allocated to individual foreign countries. The bottom chart shows the cumulative foreign country bond reallocation over the entire sample and what it would have been under perfect rebalancing, where agents hold constant the share of the Foreign bond portfolio allocated to individual foreign countries. All reallocation and rebalancing components are normalized by asset holdings at the beginning of the sample.

# 5 Discussion

In order to connect the stylized facts discussed in the previous section to a theory of capital flows, what is needed is a multi-country general equilibrium model with different types of capital flows, containing at least equity and bond flows and an

aggregate of other flows. This is well beyond the existing literature, although it is a direction that the literature is likely to take in the future in order to connect to a growing body of empirical evidence on different types of capital flows. In this section our aim is much more modest. We will provide a preliminary theoretical assessment of some of the empirical results in the previous section, drawing on aspects of the existing theoretical capital flows literature. Specifically, we will comment on the relative importance of the portfolio growth versus reallocation components in the short-run and the long-run and on the drivers of the portfolio reallocation components.

## 5.1 Portfolio Growth versus Portfolio Reallocation

In the two-country DSGE model with portfolio choice in Tille and van Wincoop (2010a), capital outflows are the sum of a portfolio growth component and a single reallocation component. The latter is associated with the reallocation between Home and Foreign assets. It is shown that this reallocation component depends on changes in expected excess returns and changes the riskiness of the assets.[18] It is not quite as simple as this, as not all drivers of expected returns affect capital flows. Moreover, only changes in the riskiness of assets that affect domestic and foreign investors differentially lead to portfolio reallocation. Without going into further detail though, a couple of comments can be made that connect to our findings.

The first point to make is that in a steady state the reallocation components are all zero. In a steady state there are no changes in expected excess returns and the riskiness of assets (which depend on various second moments). Portfolio growth, on the other hand, will be non-zero in steady state in an economy with positive growth as this implies positive net saving. Cumulative capital flows will then be entirely driven by portfolio growth in the long run. This explains the importance of portfolio growth in the long run in all of the four decompositions.[19]

[18]Didier and Lowenkron (2012) provide evidence on the importance of time-varying expected returns for international portfolio reallocation. Evans and Hnatkovska (2014) use a DSGE open economy model with portfolio choice to show that time-varying equity risk premia are a key determinant of international bond and equity flows. Hnatkovska (2010) also develops an open economy DSGE model with portfolio choice to illustrate the role of time-varying risk and expected returns for international capital flows.

[19]Consistent with our findings, Ahmed et al. (2016) find that persistent flows from the US to

If we had an even longer sample, portfolio growth would dominate the reallocation components even more over the entire sample. Some of the reallocation components have a substantial non-zero mean during our sample. This is due both to the limited length of the sample (20 years) and the fact that the sample covers a period during which the economy was on a transition path towards substantial financial globalization. The share allocated to foreign equity and bonds increased substantially during the sample. This may well continue for another couple of decades, but eventually must end as there is an upper bound to the foreign portfolio share and a related lower bound to international financial frictions (zero). At that point the Home-Foreign reallocation component for both equity and bonds will still fluctuate, but will go back to a mean of zero.

Apart from its non-zero steady state mean, the other reason portfolio growth dominates the reallocation components in the long run is that it is significantly more persistent. Theoretically, the portfolio growth component depends on saving, as opposed to the change in saving. By contrast, the reallocation components depend on *changes* in expected excess returns and risk. Saving, expected excess returns and risk in general depend on the state variables of a model. In Tille and van Wincoop (2010a) the state variables are the wealth and productivity of the two countries. Since productivity is assumed very persistent in their numerical illustration, saving is very persistent as well, consistent with the data. This accounts for the persistence of the portfolio growth component. But while expected excess returns and risk (second moments) depend on these same state variables, Home-Foreign reallocation is not very persistent as the changes in expected excess returns and risk depend on the changes in the state variables.

## 5.2 Drivers of Portfolio Reallocation

The results shed light on the relationship between portfolio reallocation and portfolio rebalancing. We have seen that at the annual frequency portfolio-non-portfolio reallocation and Home-Foreign equity reallocation are significantly correlated with what they would be under perfect rebalancing, while equity-bond reallocation and Home-Foreign bond reallocation are not. To understand this, it is useful to realize that in theory the relationship between reallocation and rebalancing can be

emerging markets are driven by portfolio growth, while short-run volatility, such as during the global financial crisis, is associated with portfolio reallocation.

anything.

To illustrate this, consider the two-country, two-period portfolio choice model in Davis and van Wincoop (2018). There are four types of shocks: saving shocks (time-discount rate shocks), investment shocks, portfolio shocks and expected asset payoff shocks. Consider the last three shocks (a saving shock is essentially a portfolio growth shock). A shock that raises the relative investment of the Home country lowers the relative price of Home assets. Optimal rebalancing implies buying the Foreign asset. This is consistent with the actual portfolio reallocation towards the Foreign asset as the higher relative Home price lowers the expected relative return on the Home assets.

However, the other two shocks lead to a negative relationship between portfolio reallocation and rebalancing. Consider portfolio shocks that lead to a reallocation towards Foreign assets. They raise the relative price of Foreign assets, which implies selling Foreign assets for rebalancing purposes. An increase in the expected relative future payoff of Foreign assets has the same effect. Global shocks in the Davis and van Wincoop (2018) model also disconnect portfolio reallocation from rebalancing. In their symmetric two-country setup global shocks, such as for example a global retrenchment towards domestic assets, have no effect on relative prices. Such shocks involve Home-Foreign portfolio reallocation, but there is no need for rebalancing as relative prices have not changed.

Another aspect of our empirical results is that at quarterly and annual frequencies capital flows to individual foreign countries are almost entirely driven by reallocation among different foreign countries. This may be driven by country-specific factors, which for example affect country-specific expected returns and risk. But it may also be the result of global drivers. Specifically, changes in global risk or risk-aversion would lead to a reallocation from foreign countries with risky assets to foreign counties with less risky assets or from foreign countries with a volatile exchange rate relative to the dollar to countries with a less volatile exchange rate. Gourio et al. (2016) develop a model to discuss the impact of changing risk on capital flows. Although their model has only two countries, it illustrates that portfolios are shifted away from the more risky country when there is a global increase in risk.

The importance of global drivers of portfolio allocation among foreign countries is consistent with Sarno et al. (2016). They consider equity and bond flows from

the US to 55 countries.[20] They use a latent factor model to decompose these flows into a part associated with a global factor, a part associated with an asset-specific factor (bonds or equity) and a part associated with country-specific factor. Their key finding is that 80% of the variation in bond and equity flows is associated with the first two of these factors, which they refer to as global economic forces. This connects to a growing literature that has emphasized the importance of global drivers of capital flows.[21]

# 6 Conclusion

We have extended the capital flows decomposition in Tille and van Wincoop (2010a) and applied it to data for equity and bond outflows of the United States. The decomposition is part of a broader decomposition of financial flows into portfolio growth and reallocation components. Asset allocation decisions higher up on the decision tree affect financial flows lower down the tree. Specifically, we have seen that equity outflows not only depend on the reallocation between Home and Foreign countries, but also on reallocation between portfolio and non-portfolio assets and between equity and bonds.

Empirical implementation of the decomposition has been facilitated by high quality data on US external equity and bond holdings in various countries. This allows us to compute portfolio shares, which are combined with data on relative asset price changes to obtain reallocation components of capital flows.

Our empirical findings in the previous section relate to the role of the various portfolio reallocation components and the portfolio growth component as drivers of asset purchases. It should be emphasized that these findings apply to one country, the United States, over one particular two decade period. While insightful, we do not know how these results generalize to other countries or sample periods. Nonetheless a number of interesting themes have emerged that should provide guidance to future theoretical work. It should be emphasized though that this requires new models that allow for multiple asset classes (at least bonds, equity and other assets) and multiple countries.

[20] They consider net flows, so US outflows minus US inflows.

[21] See for example Barrot and Serven (2018), Forbes and Warnock (2012), Fratzscher (2012), Bruno and Shin (2015) and Avdjiev et. al (2017).

Several key conclusions can be drawn from the decompositions. First, portfolio reallocation components are much more important than portfolio growth at quarterly and annual frequencies. Capital flows to individual foreign countries are almost entirely driven by reallocation among foreign countries. Second, over the entire sample portfolio growth is a key driver of capital flows. Portfolio growth is also much more persistent than the reallocation components. Third, the relationship between portfolio reallocation and rebalancing is mixed. It appears to play a role for some of the reallocation components, but not for others. Finally, a lasting impact of portfolio reallocation to foreign equity/bonds is a significantly larger portfolio growth component. While we have used existing theory to shed some light on these findings, future research should aim to develop a multi-country DSGE model with portfolio choice and a variety of asset classes and shocks in order to better understand the drivers of the portfolio growth and reallocation components.

# Appendix

In this Appendix we derive the decompositions (15) and (18) of equity outflows. First consider the decomposition in Section 2.2. Differentiating (14), we have

$$Q_t^{e,F}\Delta X_{t+1}^{e,F} + X_t^{e,F}\Delta Q_{t+1}^{e,F} = k_t^{e,F}\Delta A_{t+1} + \left(\frac{\Delta k_{t+1}^{p}}{k_t^{p}} + \frac{\Delta k_{t+1}^{e|p}}{k_t^{e|p}} + \frac{\Delta k_{t+1}^{F|e}}{k_t^{F|e}}\right) k_t^{e,F} A_t \tag{A.1}$$

Using (3) we have

$$\Delta A_{t+1} = (1-k_t^p)\left(\frac{\Delta Q_{t+1}^{np}}{Q_t^{np}} - \frac{\Delta Q_{t+1}^{p}}{Q_t^{p}}\right) A_t + \frac{\Delta Q_{t+1}^{p}}{Q_t^{p}} A_t + S_{t+1} \tag{A.2}$$

Using (5)-(7), this can be written as

$$\Delta A_{t+1} = (1-k_t^p)\left(\frac{\Delta Q_{t+1}^{np}}{Q_t^{np}} - \frac{\Delta Q_{t+1}^{p}}{Q_t^{p}}\right) A_t + (1-k_t^{e|p})\left(\frac{\Delta Q_{t+1}^{b}}{Q_t^{b}} - \frac{\Delta Q_{t+1}^{e}}{Q_t^{e}}\right) A_t +$$
$$(1-k_t^{F|e})\left(\frac{\Delta Q_{t+1}^{e,H}}{Q_t^{e,H}} - \frac{\Delta Q_{t+1}^{e,F}}{Q_t^{e,F}}\right) A_t + \frac{\Delta Q_{t+1}^{e,F}}{Q_t^{e,F}} + S_{t+1} \tag{A.3}$$

We can use the definition of changes in passive portfolio shares to write this as

$$\Delta A_{t+1} = -\frac{\Delta \tilde{k}_{t+1}^{p}}{k_t^{p}} A_t - \frac{\Delta \tilde{k}_{t+1}^{e|p}}{k_t^{e|p}} A_t - \frac{\Delta \tilde{k}_{t+1}^{F|e}}{k_t^{F|e}} A_t + \frac{\Delta Q_{t+1}^{e,F}}{Q_t^{e,F}} A_t + S_{t+1} \tag{A.4}$$

Substituting this into (A.1), using that $X_t^{e,F}\Delta Q_{t+1}^{e,F} = k_t^{e,F} A_t \Delta Q_{t+1}^{e,F}/Q_t^{e,F}$, we obtain the decomposition of equity outflows $Q_t^{e,F}\Delta X_{t+1}^{e,F}$ in (15).

We can similarly derive the decomposition of equity outflows to individual countries. Differentiating (17), we have

$$Q_t^{e,F,n}\Delta X_{t+1}^{e,F,n} + X_t^{e,F,n}\Delta Q_{t+1}^{e,F,n} = k_t^{e,F,n}\Delta A_{t+1} +$$
$$\left(\frac{\Delta k_{t+1}^{p}}{k_t^{p}} + \frac{\Delta k_{t+1}^{e|p}}{k_t^{e|p}} + \frac{\Delta k_{t+1}^{F|e}}{k_t^{F|e}} + \frac{\Delta k_{t+1}^{n|e,F}}{k_t^{n|e,F}}\right) k_t^{e,F,n} A_t \tag{A.5}$$

We can write $X_t^{e,F,n}\Delta Q_{t+1}^{e,F,n} = k_t^{e,F,n} A_t \Delta Q_{t+1}^{e,F,n}/Q_t^{e,F,n}$. From (A.4) we have

$$k_t^{e,F,n}\Delta A_{t+1} - k_t^{e,F,n} A_t \frac{\Delta Q_{t+1}^{e,F,n}}{Q_t^{e,F,n}} = -\frac{\Delta \tilde{k}_{t+1}^{p}}{k_t^{p}} k_t^{e,F,n} A_t - \frac{\Delta \tilde{k}_{t+1}^{e|p}}{k_t^{e|p}} k_t^{e,F,n} A_t -$$
$$\frac{\Delta \tilde{k}_{t+1}^{F|e}}{k_t^{F|e}} k_t^{e,F,n} A_t - \frac{\Delta \tilde{k}_{t+1}^{n|e,F}}{k_t^{n|e,F}} k_t^{e,F,n} A_t + k_t^{e,F,n} S_{t+1} \tag{A.6}$$

Substituting this into (A.5) gives the decomposition of equity outflows $Q_t^{e,F,n}\Delta X_{t+1}^{e,F,n}$ to country $n$ shown in (18).

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