Granular Expectations and International Financial Spillovers

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Abstract

Using a unique dataset linking investors' cross-country GDP growth expectations to their investments into mutual funds and to the mutual funds' cross-country allocation, we show that, while the flows into the funds are sensitive to the investors' fund-specific aggregate expectations (computed using the fund's portfolio shares), the funds' allocation barely reacts to the country-level expectations. This gives rise to "co-ownership spillovers", whereby negative expectations about a country in which a fund invests can adversely affect capital flows to the other countries that are part of the fund's portfolio. Using a portfolio choice model with delegated investment, we show that these results arise naturally from a sticky portfolio friction. These spillovers matter in the aggregate only if the portfolio shares are granular. Finally, using our data-based estimates and our model, we quantify the aggregate implications of these spillovers and find that co-ownership spillovers account for 90% of the expectation-driven capital flow reallocations. Small countries are subject to larger co-ownership spillovers, while large countries are the biggest contributors to these spillovers.

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1 Introduction

Why do asset prices and business cycles comove in emerging economies? This comovement has been attributed to correlated fundamentals, global financial cycles, and real and financial contagion.[1] This study specifically examines the latter, and focuses on the role of equity investments by mutual funds, which manage a significant portion of capital flows schmidtyesin2022. Understanding how these intermediaries allocate their capital across countries, and whether this allocation is efficient, is critical.

More specifically, this paper studies whether changes in investments into mutual funds driven by investors' expectations generates comovements in capital flows across countries through "co-ownership spillovers".[2] Co-ownership spillovers can arise through the following mechanism. An investor can choose how much to invest in a variety of global, emerging, or regional mutual funds, which invest equity in different sets of countries, and they can also choose to invest in safer assets (cash or bonds). The investor controls how much capital is sent to the mutual funds, but not how the capital is allocated between the countries that are part of a fund's portfolio. Now suppose that the investor expects that one country's asset market is going to perform poorly. She will then take away capital from the funds that invest in that country. If the funds continuously update their portfolio shares, then the funds' capital will be reallocated to the other countries in the portfolio, and these countries will not be negatively affected. But if portfolio shares are sticky, the other countries will also undergo some capital retrenchment.

Using a unique dataset linking investors' cross-country GDP growth expectations to their investments into mutual funds and to the mutual funds' cross-country allocation, we show that while the flows into the funds are highly sensitive to the investors' fund-specific aggregate expectations (computed using the fund's portfolio shares), the funds' allocation reacts much less to the investor's country-level expectations. Using a simple delegated investment model, we show that this creates co-ownership spillovers, whereby negative expectations about one country that is part of a fund's portfolio can negatively impact investment in the countries that are part of the same portfolio through the mechanism described above.

But are these spillovers relevant at the aggregate level? That is, do they lead to a significant level of cross-country contagion? Our model shows that they do not necessarily do so. For instance, if the country-specific shocks to expectations (shocks that are uncorrelated across countries) average out in the aggregate, then these spillovers will be driven only by global shocks (shocks that are correlated across countries). In that case, the co-ownership

[1] See Forbes and Rigobon (2001), Karolyi (2003), Forbes (2012) and Rigobón (2019) for useful surveys.
[2] We borrow this expression from Jotikasthira et al. (2012).

spillovers are not inefficient, as they are driven by global shocks that are relevant for all countries. However, if some countries compose a disproportionate share of fund portfolios, then expectations shocks specific to these countries spill-over to the other countries because they affect capital flows into the funds in a non-negligible way. The "granularity" of fund shares will thus matter (Gabaix, 2011). We also show that only portfolio reallocation between countries is affected, not portfolio growth.

We show formally that co-ownership spillovers relate to the granular residual of the investors' fund-specific aggregate expectations and to a key elasticity parameter that we estimate using our data. We then quantify the contribution of the co-ownership spillovers to the capital flow reallocation, using the estimated key elasticity and the effective country shares and expectations from the data. The co-ownership spillovers account for 90% of the variance of expectation-driven capital flow reallocation in our sample. Interestingly, both small advanced countries and small emerging countries are typical recipients of these spillovers. Both large advanced and emerging countries, like the G7 and BRICS, are typical contributors. This channel of international financial contagion is different from the typical "funding" channels that have been documented so far, as it does not necessarily give rise to North-South transmission, but rather to a Large-Small one. As a result, some large emerging economies are important contributors and do not suffer from major spillovers, like China and South Korea.

We contribute to several strands of literature. First, we contribute to the large literature that examines how shocks, local or global, are transmitted by mutual funds. Coval and Stafford (2007) show that U.S. mutual funds redeem investments as a consequence of funding shocks that originate from their investor base, and that these forced redemptions significantly impact U.S. domestic equity prices. Jotikasthira et al. (2012) show that global funds, domiciled in developed markets, display the same forced trading behavior as US domestic funds. They show that this flow-induced trading has a significant effect on prices, country betas and return co-movement among emerging markets. In general, it has been established, using micro-evidence from mutual funds, that shocks to the investor base are an important driver of the comovement in emerging markets (Broner et al., 2006; Gelos, 2011; Raddatz and Schmukler, 2012; Puy, 2016). There is however scarce evidence on co-ownership spillovers and on their ability to generate contagion and undesired fluctuations in capital flows and asset prices. An exception is Jotikasthira et al. (2012), who identify co-ownership spillovers by calibrating their model to the data. We instead provide direct evidence for this phenomenon by using investor-level expectations to identify these spillovers. Our identification not only relies on the actual expectations to identifies this channel of contagion, but we also make use of the granular residual to disentangle contagion from global or regional shocks.

Second, we contribute to a growing literature estimating the elasticity of investments to real-life expectations using survey data. Vissing-Jorgensen (2003), Glaser and Weber (2005), Kézdi and Willis (2011) and Weber et al. (2012) focus on households' expectations and their stock holding behavior. Piazzesi and Schneider (2009) examine the role of expectations on the housing market and Malmendier and Nagel (2015) and Agarwal et al. (2022) investigate how inflation expectations affect households' portfolio choices. Giglio et al. (2021) use a survey administered to a large panel of wealthy retail investors to study the relation between the investors' beliefs and their trading activity, while Dahlquist and Ibert (2021) focus on large institutional investors. Finally, De Marco et al. (2021) study European banks' investments in sovereign bonds across the Euro area. To the best of our knowledge, we are the first to estimate how investors' beliefs affect the cross-country allocation of equity investments. Two results are worth emphasizing. The first one is that the investors' beliefs about GDP growth matter significantly for the allocation of resources across funds. Because funds specialize in different country groups and regions, this implies that GDP growth expectations matter for the allocation of resources across countries. However, funds themselves do not react significantly to the investors' expectations when allocating resources across countries within the fund. This finding is in line with the literature, which finds that expectations matter for portfolio decisions, but the elasticity is low compared to what models predict.

Finally, we contribute the literature that examines frictions in portfolio adjustment. Importantly, our model provides a simple mapping from the portfolio stickiness to the relative elasticity of capital flows to the country-specific expectation and to the fund-specific expectation. Hence, we find that mutual funds must update their portfolios every 22 months on average (every 16 months if we focus on active funds). Previous evidence of delayed portfolio adjustment has been based on imputed expectations (that is, expectations constructed from observables, such as past returns) or on the persistence of portfolios.[3] Our estimate is in the ballpark of the one to two-year spans that have been identified using macroeconomic data (see for instance Bacchetta and van Wincoop (2017)).

Section 2 discusses the data and Section 3 estimates the elasticity of investment into and out of the mutual funds to investor's expectations. Section 4 lays down a portfolio choice model with delegated investment and shows when co-ownership spillovers appear and matter for the aggregate level. Section 5 identifies the elasticity that is relevant to co-ownership spillovers by establishing a mapping from model to data. Finally, Section 6 quantifies the

[3]Bohn and Tesar (1996), Froot et al. (2001), find that international portfolio flows are highly persistent and strongly related to lagged returns, and more recently Bacchetta et al. (2020) test a delayed adjustment model using mutual fund data.

the co-ownership spillovers.

2 Data

Our dataset combines economic expectations data from Consensus Economics with investor and mutual fund data from Emerging Portfolio Fund Research (EPFR).

2.1 Expectation dataset: Consensus Economics Data

We use forecast data from Consensus Economics, a survey firm that polls individual professional forecasters on a monthly frequency. Each month, forecasters provide their current and following year forecasts of key macroeconomic indicators for a number of countries. The forecasts are available between 1989 and 2023. The key variable of interest are the forecasts for real GDP growth for 51 advanced and emerging countries. The Consensus Economics provides the name of the institution reporting each forecast. We extract and clean this institution and match it to the financial institution reporting investor and country allocations in the mutual fund data from EPFR.

2.2 Investor and mutual fund dataset: EPFR Data

The EPFR data is widely used to study cross-country investments in equity and bond markets. EPFR captures 5-20% of market capitalization in equity and bonds for most countries. It is a representative sample, as shown in Jotikasthira et al. (2012), who find a close similarity between the EPFR data and matched CRSP data in terms of assets under management and average returns. Miao and Pant (2012) compare portfolio flows generated using EPFR data to portfolio flows computed with BOP data, and find level differences due to the fact that only a subset of institution investors flows are captured by the EPFR data, but that EPFR funds flows are highly correlated with BOP capital flows into Emerging Markets. Schmidt and Yesin (2022) shows that coverage is improving rapidly over time, and in 2021 EPFR flows capture a significant share of cross-border equity flows.

The EPFR data consist of two different datasets. The first dataset is a monthly dataset that contains information about country allocations at the fund level, that is, the share of the total assets invested in each country, the share of total assets held in cash, and the total assets managed by the fund. The second dataset decomposes the weekly changes in assets under management of the mutual fund into weekly flows into the fund, and the weekly change in assets under management due to valuation changes. We aggregate this information to match the monthly frequency of the forecast data from Consensus Economics and the funds' monthly country allocations described below.

Both the weekly flow data and the monthly country allocation data contain information about the financial institution managing the fund. These fund managers are typically global banks, which we call "investors". We use this information to match the investors' name to the institution reported by Consensus Economics. The country allocations and flows of the funds managed by those investors can be matched to the forecast information for Consensus Economics for 52 countries and 64 investors. Note that we have expectations data for only for an average of 17% of countries into which our mutual funds invest. When we consider portfolio weights, only about 24% of countries into which mutual funds invest are reported in the Consensus Economics data. We address this potential issue with our empirical methodology outlined below.

As of January 2023, there are 17,260 mutual funds managing 14.1 trillion USD in assets reporting their weekly flows to EPFR and 1,605 mutual funds managing a total of 3 trillion USD in assets reporting their monthly allocations. Of the 1,605 mutual funds, 1095 funds managing 500 billion USD in assets are present in the matched EFPR and Consensus Economics data. The funds that we match to the Consensus Economics data seem quite representative to the rest of the EPFR sample both in terms of the distribution of assets under management and portfolio allocations.[4]

In our econometric analysis, we want to ensure that the variation in variables at the fund level is not driven by the variation in the sample countries used to compute these variables. Therefore, we limit entry and exit of a country in the data by excluding countries present in both the mutual fund allocation data and the forecast data for less than 90% of the observations of the best documented country in the fund. We also want the averages computed at the fund level to be economically and statistically relevant, so we exclude funds with fewer than 10 countries with forecast data, and we exclude funds for which we observe forecasts for less than 20% of the portfolio. In this cleaned sample, we have 9 investors, 102 funds, 47 countries and 5'400 fund-level observations. In the allocation sample, for each fund, we only keep countries that have forecast information and an allocation of at least 2.5% in the fund. In that sample, we have 48 investors, 787 funds, 39 countries and 130'000 allocation-level observations. Our results are not sensitive to our specific cleaning methodology.

[4]These results are available upon request.

3 Elasticity of Capital Flows to Expectations

The response of capital flows to investor expectations operates through two channels: the reaction of mutual fund flows and the reallocation of mutual fund portfolios in response to those expectations. We examine each channel in turn and document two principal findings. First, an increase in an investor's portfolio GDP growth expectations[5] is followed by a significant rise in inflows into the corresponding mutual fund. Second, the mutual fund's country allocation exhibits only a weak response to the investor's country-specific GDP growth expectations.

3.1 Investor expectations and flows to mutual funds

Define the portfolio expectation at the investor and fund level as the average growth expectation weighted by the past country allocations:

$$E_t^i g_p^{j,\text{next year}} = \sum_{k \in K(i,j)} w_{k,t-1}^{i,j} E_t^i g_{k,t}^{\text{next year}}, \tag{1}$$

where $w_{k,t-1}^{i,j}$ is mutual fund j's allocation to country k in month $t-1$, and $E_t^i g_{k,t}^{\text{next year}}$ is investor i's GDP growth expectation for the following year at date t, for country k, in percent. Subscript p denotes a portfolio-level growth expectation. $K(i,j)$ is the set of countries in which fund j invests and for which we observe expectations. The sum of the weights $w_{k,t-1}^{i,j}$ do not necessarily sum to 1, because we do not observe expectations for all countries. This generates some identification issues that we address below.

We run the panel fixed-effects regression,

$$\ln\left(A_t^{i,j}\right) = \beta E_t^i g_{p,t}^{j,\text{next year}} + \lambda^j + \lambda_t^i + \epsilon_t^{i,j}, \tag{2}$$

where $A_t^{i,j}$ are the total assets managed by fund j in month t, λ^j are fund fixed effects, λ_t^i are investor-time fixed effects, and $\epsilon_t^{i,j}$ is an error term.

Note, the share of investor assets allocated to mutual fund j can be written $a_t^{i,j} = \frac{A_t^{i,j}}{\Omega_t^i}$, where $A_t^{i,j}$ is the total investor allocation to fund j and Ω_t^i is the total assets of the investor (across all mutual funds). Because we include investor-time fixed effects, the above regression is equivalent to a regression with $\ln\left(a_t^{i,j}\right)$ as the dependent variable, where the investor's total assets are absorbed in the investor-time fixed effects. This specification helps us to estimate the impact of the expectations on the investor's allocation to the mutual fund without

[5]Defined as the GDP growth expectations for each country in the portfolio, weighted by the previous period's portfolio weights, as specified in 1.

observing the total wealth of the investor.

Including investor-time fixed effects has several other advantages. It captures unobserved developments at the investor level that could drive the investor's allocation to the mutual fund. Among those are global or investor-specific "funding shocks" that have been identified in the literature and could be correlated with expectations. Additionally, they capture global or investor-specific expectation shocks that could, for instance, lead the investor to reallocate wealth away from mutual equity funds and into bonds or cash. Fund fixed effects capture the investor-specific preference for a given fund. The identification of the role of expectations for investment into a fund comes from the relative evolution of the investor's expectation across funds (for example, if an investor's expectation about an Asian fund improves relative to a Latin American fund, then we should observe an increase in the assets managed by the Asian fund relative to the Latin American fund).

Table 1, column (1) reports the results for Equation (2). Investor expectations of future GDP growth are positively associated with the flows allocated to mutual funds. Investor expectations impact mutual fund flows in an economically meaningful way. An increase in the expected portfolio GDP growth by one percentage point is associated with an increase in investor allocations to the fund by about 36 percent.

Note that here we do not control for any fund-level time-specific development. Importantly, the portfolio expectations could be correlated with the portfolio equity returns at the fund level or equity price changes, as equity price changes and returns may be relevant signals used to form investor expectations. On the other hand, equity price changes generate valuation effects that may or may not be balanced by the fund. To address this issue, we use a measure of fund-level returns derived from the underlying asset prices of the investments in the portfolio, which we denote $\Delta \log(Q_t^j)$. This variable and its lag are added to specification (2) and the results, which are similar, are reported in column (2).[6]

Another important issue is that we do not observe the investor's expectations for all countries in the fund's portfolio, which might bias our estimates. To understand this, note that we can decompose the "true" aggregate expectation into an observable and an unobservable component:

$$E_t^{i,true}(g_{p,t}^{j,\text{next year}}) = \sum_{k \in K(i,j)} w_{k,t-1}^{i,j} E_t^i(g_{k,t}^{\text{next year}}) + \sum_{k \in \tilde{K}(i,j)} w_{k,t-1}^{i,j} E_t^i(g_{k,t}^{\text{next year}})$$

where $\tilde{K}(i,j)$ is the set of countries for which we do not observe expectations. The first term is what we use as a proxy for the true aggregate expectation. The second term is

[6]The results do not change if we construct $\Delta \log(Q_t^j)$ based on the country-level MSCI indices.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	$\log(A_t^{i,j})$	$\log(A_t^{i,j})$	$\log(A_t^{i,j})$	$\log(A_t^{i,j})$	$\log(A_t^{i,j})$
$E_t^i(g_p^{j,\text{next year}})$	0.364***	0.321***			
	(0.043)	(0.044)			
$\Gamma_t^{i,j}$			0.214***		
			(0.060)		
$\gamma_t^{i,j}$				0.286***	
				(0.100)	
$\bar{\gamma}_t^{i,j}$					0.272**
					(0.116)
$\Delta\log(Q_t^{i,j})$		-0.011***	-0.013***	-0.012***	-0.012***
		(0.004)	(0.004)	(0.005)	(0.005)
$\Delta\log(Q_{t-1}^{i,j})$		-0.012***	-0.013***	-0.011**	-0.011**
		(0.004)	(0.004)	(0.004)	(0.004)
Observations	4,591	4,127	4,127	4,127	4,127
R-squared	0.047	0.041	0.012	0.009	0.007
Fund FE	Yes	Yes	Yes	Yes	Yes
Investor-time FE	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1: Mutual Fund Flows and Investor Expectations

Note: The dependent variable $A_t^{i,j}$ is the log of investor i's allocation to fund j in logs, measured as the total assets under management of fund j during month t. Standard errors Driscoll-Kraay standard errors with 5 lags.

an unobservable component that will be captured in the error term. If the observed and unobserved component are positively correlated, which is the case if they are driven by common shocks, then there will be a positive missing variable bias.

To circumvent this issue, we add an assumption on the structure of expectations.

Assumption 3.1 *We assume that expectations $E_t^i g_{k,t}^{next\ year}$ are equal to the sum of a term common to the fund $W_t^{i,j}$ and an idiosyncratic country-specific one $l_{k,t}^i$:*

$$E_t^i g_{k,t}^{next\ year} = W_t^{i,j} + l_{k,t}^i$$

with $E(l_{k,t}^i) = 0$, $Cov(l_{k,t}^i, W_t^{i,j}) = 0$ and $Cov(l_{k,t}^i, l_{k',t}^i) = 0$ for all i, j and $k \neq k'$.

We then compute the average investor expectation and a granular residual defined as the weighted average of the differences between the country-specific expectation and an unweighted mean, along the lines of Gabaix (2011) and Gabaix and Koijen (2021):

$$\Gamma_t^{i,j} = \sum_{k \in K(i,j)} w_{k,t-1}^{i,j} \left[E_t^i g_{k,t}^{\text{next year}} - \frac{1}{N^{i,j}} \sum_{k \in K(i,j)} E_t^i g_{k,t}^{\text{next year}} \right]. \tag{3}$$

Under Assumption 3.1, the simple average is a good estimate of the fund-specific driver:

$$\frac{1}{N^{i,j}} \sum_{k \in K(i,j)} E_t^i g_{k,t}^{\text{next year}} \simeq W_t^{i,j}$$

and the granular component is only driven by the country-specific components:

$$\Gamma_t^{i,j} \simeq \sum_{k \in K(i,j)} w_{k,t-1}^{i,j} l_{k,t}^i$$

Since $Cov(l_{k,t}^i, W_t^{i,j}) = 0$ and $Cov(l_{k,t}^i, l_{k',t}^i) = 0$ for all $k' \in \tilde{K}(i,j)$, then $Cov(\Gamma_t^{i,j}, E_t^i(g_{k',t}^{\text{next year}})) = 0$. Thus, the granular residual is unaffected by the missing variable bias.

In Table 1, Column (3) reports the results where the granular residual $\Gamma_t^{i,j}$ is used instead of the aggregate expectation $E_t^i(g_{p,t}^{j,\text{next year}})$. The coefficient is positive and significant. Interestingly, the coefficient of the granular component is diminished by one third as compared to the coefficient of the aggregate expectation, which confirms the presence of a positive missing variable bias.

We address two further potential issues: The potential reverse causality from aggregate capital flows to growth and growth expectations, and the potential inelasticity of the local supply of capital. In the limit, if this supply is completely inelastic, then we would not capture a positive response of capital flows to expectations, because, in equilibrium, any increase in the demand for equity would be absorbed by an increase in equity prices. Yet, this would not mean that the response of the demand for equity is zero. Importantly, these effects, should they be present, would only concern the common drivers of expectations. We therefore make an additional assumptions on the structure of expectations:

Assumption 3.2 *We assume that the investor's country-specific component $l_{k,t}^i$ is the sum of a component common to all investors (denoted $l_{k,t}$) and an idiosyncratic component specific to investor i (denoted $\tilde{l}_{k,t}^i$):*

$$l_{k,t}^i = l_{k,t} + \tilde{l}_{k,t}^i$$

with $E(\tilde{l}_{k,t}^i) = 0$, $Cov(\tilde{l}_{k,t}^i, l_{k,t}) = 0$ and $Cov(\tilde{l}_{k,t}^i, l_{k,t}^{i'}) = 0$ for all k, and $i \neq i'$.

We construct an alternative granular residual, that removes the common components across all investors. This new granular residual, $\gamma_t^{i,j}$, is constructed by removing a granular term Γ_t^j computed using the consensus expectations from the investor-specific granular term $\Gamma_t^{i,j}$:

$$\gamma_t^{i,j} = \underbrace{\sum_{k \in K(i,j)} w_{k,t-1}^{i,j} \left[E_t^i g_{k,t}^{\text{next year}} - \frac{1}{N^{i,j}} \sum_{k \in K(i,j)} E_t^i g_{k,t}^{\text{next year}} \right]}_{\Gamma_t^{i,j}}$$
$$- \underbrace{\sum_{k \in K(i,j)} w_{k,t-1}^{i,j} \left[\bar{E}_t g_{k,t}^{\text{next year}} - \frac{1}{N^{i,j}} \sum_{k \in K(i,j)} \bar{E}_t g_{k,t}^{\text{next year}} \right]}_{\Gamma_t^j}. \tag{4}$$

where $\bar{E}_t g_{k,t}^{\text{next year}}$ is the median expectation for country k across all forecasters. We call $\gamma_t^{i,j}$ the super-granular component of expectations. Under Assumption 3.2, then Γ_t^j approximates the weighted average of the component of country-specific expectations that are common across investors:

$$\Gamma_t^j \simeq \sum_{k \in K(i,j)} w_{k,t-1}^{i,j} l_{k,t}$$

and the super-granular component is only driven by the component of country-specific expectations that is specific to the investor:

$$\gamma_t^{i,j} \simeq \sum_{k \in K(i,j)} w_{k,t-1}^{i,j} \tilde{l}_{k,t}^i$$

. It is orthogonal to the common component of expectations.

Column (4) reports the same regression but replaces $\Gamma_t^{i,j}$ with $\gamma_t^{i,j}$. The coefficient of $\gamma_t^{i,j}$ measures the reactions of the assets under management by the fund to expectations on the fund that are specific to the investor managing the fund and, in principle, if we assume that the funds and investors are too small to matter for the total capital flows into the countries that the fund invests in, are uncorrelated to the total capital flows into these countries and to asset prices. It can be interpreted as the partial equilibrium impact of expectations on capital flows. The coefficient becomes larger, suggesting that ignoring the inelasticity of supply and general equilibrium effects understates the expectation elasticity of the demand for equity, and that a part of the aggregate demand for equity actually translates into equity prices. In this specification, the elasticity of flows into a fund to a one percentage point increase in growth expectation is 29%. Growth expectations are thus very relevant to investors.

Finally, as a robustness check, we replace the lagged allocation $w_{k,t-1}^{i,j}$ with the fund-specific average $\bar{w}_k^{i,j}$ to compute an alternative super-granular component, which we call $\bar{\gamma}_t^{i,j}$.

The results, presented in Column (5), barely change.

3.2 Investor expectations and country allocations

Next, we test the relationship between investor expectations and the country allocation of the mutual funds. We run the following regression at the fund-country level,

$$\log\left(w_{k,t}^{i,j}\right) = \beta E_t^i g_k^{\text{next year}} + \lambda_{k,t} + \lambda_t^{i,j} + \lambda_k^{i,j} + \epsilon_{k,t}^{i,j}, \tag{5}$$

where $w_{k,t}^{i,j}$ is fund j's allocation to country k in percent of assets under management of investor i and $E_t^i x_{k,t+1}$ is investor i's expectations for future GDP growth in percent for country k. Fund-country fixed effects $\lambda_k^{i,j}$ capture heterogeneity in the funds' preferences for countries. Fund-time fixed effects $\lambda_t^{i,j}$ take into account global and investor-specific time-varying outside investment opportunities as well as global and investor-specific funding shocks.

Importantly, country-time fixed effects $\lambda_{k,t}$ take into account country-specific developments that simultaneously drive the country's supply of capital (and thus allocations $w_{k,t}^{i,j}$) and expectations, such as country growth, changes in local equity prices and monetary policy. They also capture reverse causality from capital flows to expectations, as capital flow surges may temporarily stimulate growth and growth expectations, or, on the opposite, increase the risks of a downturn. They also capture potential general equilibrium effects. The coefficient β is identified through the time variation in the idiosyncratic differences in investor expectations regarding a country relative to other countries.

Results of regression (5) are shown in Table 2. In Column (1), the response of mutual funds to the investor forecasts is significant but relatively small: a 1 percentage point rise in the investor's growth forecast regarding a country increases the share of wealth invested in that country by about 2.3% (so a country with an initial 10% share will benefit from a 0.23 percentage point increase). This is one order of magnitude lower than the response of flows into the funds reported in the two last columns of Table 1. For the majority of funds that are active, the response of the fund portfolio allocation to investor forecast is 3.2%, while passive funds do not respond, as one would expect (columns (2) and (3)).

VARIABLES	(1) $\log(w_{k,t}^{i,j})$ All funds	(2) $\log(w_{k,t}^{i,j})$ Passive	(3) $\log(w_{k,t}^{i,j})$ Active
$E_t^i(g_k^{\text{next year}})$	0.023***	0.007	0.032***
	(0.005)	(0.007)	(0.006)
Observations	107,256	23,336	83,060
R-squared	0.001	0.000	0.001
Country-fund FE	Yes	Yes	Yes
Country-time FE	Yes	Yes	Yes
Fund-time FE	Yes	Yes	Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2: Mutual Fund Allocations, Investor Expectations

Note: The dependent variable is the log of $w_{k,t}^{i,j}$, the share of fund j's assets under management that is allocated to country k in month t. Standard errors Driscoll-Kraay standard errors with 5 lags.

These results establish that, even though flows into funds respond to investors' expectations, the funds' cross-country allocations remain quite sticky in comparison.

4 Model

Motivated by the empirical evidence, the model presented in this section serves several purposes. First, it helps us understand how sticky portfolios at the mutual fund level affect the relation between expectations and capital flows at the country and fund level. Second, it enables us to discuss the aggregate consequences of the friction. Third, it will enable us to map relevant model parameters to the data, allowing us to quantify these aggregate consequences.

We outline a simple, two-period model of portfolio choice with delegated investment. There are M investors indexed by $i = 1, .., I$. Each investor i is paired with $J(i)$ equity mutual funds indexed by $j = 1, .., \mathcal{J}(i)$. There are K countries in which the mutual funds can invest, indexed by $k = 1, .., K$. Each fund potentially invests in a different set of countries. We denote by $\mathcal{S}(i, j)$ the set of countries in which fund j managed by investor i invests, and by $\mathcal{K}(i, j)$ the number of countries in which the fund invests.

In the first period, investor i chooses how to allocate its capital between a safe asset and the $\mathcal{J}(i)$ equity mutual funds, and equity mutual funds invest in the equity markets of N countries belonging to $\mathcal{S}(i, j)$. In the second period, portfolio returns are realized. Equity investments pay a stochastic dividend that is specific to the country. A fund's return thus depends on the country weights in the funds' portfolio. Investors and mutual funds maximize the same objective, which is the investors' utility.

Information and frictions in delegation are modeled as follows. In the first period, investors and mutual funds obtain information about the fundamental driving the stochastic dividend. We assume that investors and mutual funds share the same information and the same expectation formation process. Investors choose their portfolio allocation between the safe asset and the equity mutual fund conditional on that information, but cannot decide the mutual funds' allocation between countries. Mutual funds are subject to a allocation friction. We assume that a mutual fund is able to update its allocation rule conditional on the new information only with probability $p \leq 1$. With a probability $1-p$, the fund does not update its portfolio.

4.1 Country returns and expectations

An equity share held in country $k = 1, .., K$ is traded at price Q_k in the first period and pays a stochastic dividend in the second period, D_k, so that the return is $R_k = \frac{D_k}{Q_k}$. We log-linearize the dividends and the share price around the world' averages $\bar{D}$ and $\bar{Q}$, and we normalize $\bar{D}/\bar{Q} = 1$, so that the returns have a simple linear form:

$$R_k = \frac{D_k}{Q_k} = 1 + d_k - q_k \tag{6}$$

with $d_k = \log(D_k) - \log(\bar{D})$ and $q_k = \log(Q_k) - \log(\bar{Q})$.

We denote the vector of log-linearized dividends by $d = (d_1, .., d_k, .., d_K)'$, the vector of log-linearized asset prices by $q_t = (q_1, .., q_k, .., q_K)'$ and the vector of returns by $R = (R_1, .., R_k, .., R_K)'$. We assume that the log-linearized dividends are exogenous and follow a Gaussian distribution: $d \sim \mathcal{N}(\bar{d}, \Sigma)$, where $\bar{d} = (\bar{d}_1, .., \bar{d}_k, .., \bar{d}_N)'$ is the vector of the unconditional mean and Σ is the matrix of variance-covariance.

Investor i and the corresponding mutual funds $j = 1, .., \mathcal{J}(i)$ share the same information on the fundamental d. In the first period, we distinguish between the beginning-of-period information of investor i, $\bar{\mathcal{I}}^i$, and their end-of period information $\mathcal{I}^i$. We assume that $q \in \mathcal{I}^i$, since q is an observable equilibrium variable. We denote by $\bar{E}^i(.) = E(.|\bar{\mathcal{I}}^i)$ the expectations conditional on $\bar{\mathcal{I}}^i$, the beginning-of-period information, and by $E^i(.) = E(.|\mathcal{I}^i)$ the expectations conditional on the end-of-period information. We have a relationship between the expected returns and the expected fundamentals d

$$\bar{E}^i(R) = 1 + \bar{E}^i(d) - \bar{E}^i(q), \qquad E^i(R) = 1 + E^i(d) - q \tag{7}$$

We denote by $\bar{V}(.) = V(.|\bar{\mathcal{I}}^i)$ the variance conditional on $\bar{\mathcal{I}}^i$, and by $V(.) = V(.|\mathcal{I}^i)$ the variance conditional on $\mathcal{I}^i$. We denote by $\bar{V}^R$ and V^R the conditional variances of returns:

$$\bar{V}^R = \bar{V}(R), \qquad V^R = V(R) \tag{8}$$

It will be useful to make the following assumption on the structure of learning:

Assumption 4.1 $\bar{V}^R - V^R << V^R$.

This assumption states that the change in the conditional variance of returns between the beginning of period and the end of period is small compared to the conditional variance at the end of period.

4.2 Investors

Investor i enters the first period with initial wealth Ω^i and invests a share $a^{i,j}$ in equity fund j, $j = 1, .., \mathcal{J}(i)$, and the remaining share $1 - \sum_{j=1}^{\mathcal{J}(i)} a^{i,j}$ in a safe asset with return r. The decisions of the investor are taken after observing the new information $\mathcal{I}^i$, but before observing the country allocation of the fund.

In the second period, portfolio returns are realized and the investor consumes all remaining terminal wealth $\mathcal{R}_p^i \Omega^i$, where $\mathcal{R}_p^i$ is the return on the full portfolio of funds:

$$\mathcal{R}_p^i = \sum_{j=1}^{\mathcal{J}(i)} \frac{a^{i,j}}{\sum_{j=1}^{\mathcal{J}(i)} a^{i,j}} R_p^{i,j} = \frac{a^{i'} R_p^i}{\sum_{j=1}^{\mathcal{J}(i)} a^{i,j}} \tag{9}$$

The vector $a^{i'} = (a^{i,1}, .., a^{i,j}, .., a^{i,\mathcal{J}(i)})'$ collects the fund shares, the vector $R_p^{i'} = (R_p^{i,1}, .., R_p^{i,j}, .., R_p^{i,\mathcal{J}(i)})'$ collects the fund portfolio returns.

Investors have mean-variance preferences and choose the fund allocation a^i to maximize the mean-variance utility of one unit of wealth,

$$U^i = E^i \left\{ \mathcal{R}_p^i \left(\sum_{j=1}^{\mathcal{J}(i)} a^{i,j} \right) + r \left(1 - \sum_{j=1}^{\mathcal{J}(i)} a^{i,j} \right) \right\} - \frac{\gamma}{2} V \left\{ \mathcal{R}_p^i \left(\sum_{j=1}^{\mathcal{J}(i)} a^{i,j} \right) + r \left(1 - \sum_{j=1}^{\mathcal{J}(i)} a^{i,j} \right) \right\}, \tag{10}$$

where $E^i(.)$ and $V(.)$ are defined as the expectation and variance conditional on $\mathcal{I}^i$, subject to the global return definition (9), taking the distribution of returns R_p^i as given. As we will see below, these returns depend on the funds' country shares and on whether the mutual funds updates their portfolio or not, which the investor does not know when deciding a^i.

The results are summarized in the following Lemma:

Lemma 4.1 *Total equity investments must satisfy*

$$\sum_{j=1}^{\mathcal{J}(i)} a^{i,j} = \frac{E^i(\mathcal{R}_p^i) - r}{\gamma V^i} \tag{11}$$

with $V^i = V(\mathcal{R}_p^i)$, *and the optimal allocation to equity funds* j $a^{i,j}$ *must satisfy, for all* $j = 1, .., \mathcal{J}(i)$,

$$a^{i,j} = \frac{E^i(R_p^{i,j}) - r}{\gamma V^{i,j}} - Cov_{i,j}\left(\sum_{j=1}^{\mathcal{J}(i)} a^{i,j}\right) \tag{12}$$

where $V^{i,j} = Cov(R_p^{i,j}, R_p^{i,j} - \mathcal{R}_p^{i,j-})$ *and* $Cov_{i,j} = Cov(R_p^{i,j}, \mathcal{R}_p^{i,j-})/V^{i,j}$ *are constant terms, and* $\mathcal{R}_p^{i,j-} = \sum_{j',j'\neq j} a^{i,j'} R_p^{i,j'} / \left(\sum_{j'=1,j'\neq j}^{\mathcal{J}(i)} a^{i,j'}\right)$ *the return of the full portfolio of funds that excludes fund* j.

Proof. See proof in Appendix A.1. ■

The allocation to fund j by investor i depends on the expected excess return $E^i(R_p^{i,j}) = E^i(R_p^{i,j}) - r$, with an elasticity that depends on the variance of the returns and on risk aversion γ. It also depends on the hedging properties of fund j through the covariance between the fund excess return and the rest of the investor portfolio. This term is fixed and reflects the total equity investments across all mutual funds held by investor i.

4.3 Mutual Funds

In the beginning of period, we assume the share allocated by fund j managed by investor i to country k, which we denote by $w_k^{i,j}$, to be fixed to some predetermined value $\bar{w}_k^{i,j}$ that is conditional on the beginning of period information, $\bar{\mathcal{I}}^i$. At the end of period, after investor i has decided her fund shares a^i, each fund $j = 1, .., \mathcal{J}(i)$ allocates $a^{i,j}$ across the different countries, either according to the predetermined fund portfolio shares $\bar{w}_k^{i,j}$, or to updated shares $w_k^{i,j*}$ that take into account the investor's information $\mathcal{I}^i$.

More specifically, with probability $1 - p$, the fund does not update the portfolio shares. In that case, the shares remain fixed to the predetermined values $\bar{w}_k^{i,j}$ that are conditional on the beginning of period information, $\bar{\mathcal{I}}^i$.

With probability p, the fund updates its portfolio after observing $\mathcal{I}^i$. In that case, fund j chooses the country allocation $w_k^{i,j}$ that determines the fund portfolio return $R_p^{i,j}$:

$$R_p^{i,j} = \sum_{k \in \mathcal{S}(i,j)} w_k^{i,j} R_k = w^{i,j\prime} R \tag{13}$$

$w_k^{i,j}$ is the share of mutual fund j's portfolio that is invested in country k. The vector $w^{i,j} = (w_1^{i,j}, .., w_k^{i,j}, .., w_{K,t}^{i,j})'$ collects the country shares, where $w_k^{i,j} = 0$ if $k \notin \mathcal{S}(i,j)$. The fund chooses $w_k^{i,j}$ in order to maximize the same objective as the investor (10), subject to the return definitions (9) and (13), and to $\sum_{k \in \mathcal{S}(i,j)}^N w_k^{i,j} = 1$, taking the distribution of returns R as given.

We denote the resulting optimal allocation by $w^{i,j*}$.

Lemma 4.2 *The optimal allocation $w^{i,j*}$ is such that $a_k^{i,j*} = w_k^{i,j*} a^{i,j}$, the total investment share of investor i that is channeled to country k through fund j, satisfies, for all $k \in \mathcal{S}(i,j)$*

$$a_k^{i,j*} = \frac{E^i(R_k) - r}{\gamma V_k^{i,j}} - Cov_k^{i,j} \left(\sum_{j=1}^{\mathcal{J}(i)} a^{i,j} \right) - \Delta Cov_k^{i,j} a^{i,j} \tag{14}$$

where $V_k^{i,j} = Cov(R_k, R_k - R_{p,k-}^{i,j})$, $Cov_k^{i,j} = Cov(R_k, \mathcal{R}_p^{i,j-})/V_k^{i,j}$ and $\Delta Cov_k^{i,j} = \left(Cov(R_k, R_{p,k-}^{i,j}) - Cov(R_k, \mathcal{R}_p^{i,j-}) \right) / V_k^{i,j}$ are constant terms, and $R_{p,k-}^{i,j} = \sum_{k',k' \neq k} w_k^{i,j} R_{k'} / (1 - w_k^{i,j})$ is the return of the fund portfolio that excludes country k.

Proof. See proof in Appendix A.2. ■

The first two terms of this equation resemble (11). The optimal share of investor's wealth allocated to country k through fund j, $a_k^{*i,j}$, depends on the expected excess return of country k $E^i(R_k) - r$, with an elasticity that depends on the variance of the returns and on risk aversion γ. It also depends on the hedging properties of country k with respect to the the rest of the investor's portfolio through the covariance between the country excess return and the rest of the investor portfolio. This term is fixed and reflects the total equity investments.

An additional term depends on the hedging properties of country k with respect to the investor's exposure to fund j, $a^{i,j}$. This term is proportional to $a^{i,j}$, and it depends on $-\Delta Cov_k^{i,j}$, which can be interpreted as the fixed part of the share of the fund's allocation $a^{i,j}$ that goes to country k to hedge this exposure. Note that, when the investor increases the allocation to fund j ($a^{i,j}$ increases), the exposure to the rest of her portfolio decreases ($1 - a^{i,j}$ decreases). As a result, this fixed share, $-\Delta Cov_k^{i,j}$, depends negatively on the covariance between the excess return of country k and the return on the rest of the fund's portfolio, but positively on the covariance between the excess return of country k and the return on the rest of the investor's portfolio. Less of the capital that is allocated to j goes to country k when country k is a bad hedge to the rest of the *fund*'s portfolio, and more of it goes to country k when country k is a bad hedge to the rest of the *investor*'s portfolio.

4.4 Asset demand

Combining Equations (11) and (14), we can describe the asset demand by investor i that intermediates through fund j for each country $k \in \mathcal{S}(i,j)$. We define the expected share of wealth invested in country k, conditional on $\mathcal{I}^i$, as $a_k^{i,j} = \tilde{w}_k^{i,j} a^{i,j}$, where $\tilde{w}_k^{i,j} = p w_k^{i,j*} + (1-p)\bar{w}_k^{i,j}$ is the expected fund allocation to country k. These flows depend both on the share allocated to the fund $a^{i,j}$ by the investor and on the expected fund country allocation $\tilde{w}_k^{i,j}$. The final allocation to country k from investor i through fund j, $a_k^{i,j} = w_k^{i,j} a^{i,j}$, is then given by

$$a_k^{i,j} = p a_k^{*i,j} + (1-p)\bar{w}_k^{i,j} a^{i,j} \tag{15}$$

where $a_k^{*i,j}$ is given by Equation (14), $\bar{w}_k^{i,j}$ is predetermined, and $a^{i,j}$ follows Equation (11).

If we take into account the fund's optimal setting of the default portfolio shares, we obtain the following characterization of capital flows as a function of expectations:

Proposition 4.1 *Define the excess return news as the end-of-period updates in the return expectations:* $E^i(r_k) = E^i(R_k) - \bar{E}^i(R_k)$, $E^i(r_p^{i,j}) = E^i(R_p^{i,j}) - \bar{E}^i(R_p^{i,j})$ *and* $E^i(\mathfrak{r}_p^i) = E^i(\mathcal{R}_p^i) - \bar{E}^i(\mathcal{R}_p^i)$. *We assume that Assumption 4.1 is satisfied. In that case, the share of investor i 's wealth that is channeled to country k through fund j can be written as:*

$$\begin{aligned}
a_k^{i,j} =& p\frac{E^i(r_k)}{\gamma V_k^{i,j}} && \} \text{ Excess Return} \\
&+ (1-p)\frac{\bar{a}_k^{i,j}}{\bar{E}^i(a^{i,j})}\frac{E^i(r_p^{i,j})}{\gamma V^{i,j}} && \} \text{ Co-ownership} \\
&- \Delta Cov_k^{i,j}\frac{E^i(r_p^{i,j})}{\gamma V^{i,j}} && \} \text{ Hedging (fund-level)} \\
&- \widetilde{Cov}_k^{i,j}\frac{E^i(\mathfrak{r}_p^i)}{\gamma V^i} - (1-p)\left(\frac{\bar{a}_k^{i,j}}{\bar{E}^i(a^{i,j})}Cov^{i,j} - Cov_k^{i,j}\right)\frac{E^i(\mathfrak{r}_p^i)}{\gamma V^i} && \} \text{ Hedging (inv.-level)} \\
&+ \bar{E}(a_k^{i,j})
\end{aligned} \tag{16}$$

where $\widetilde{Cov}_k^{i,j} = Cov_k^{i,j} - Cov^{i,j}\Delta Cov_k^{i,j}$, $\bar{E}(a_k^{i,j}) = \bar{a}_k^{i,j} - \Delta Cov_k^{i,j}\bar{E}^i(a^{i,j})$, $\bar{a}_k^{i,j} = (\bar{E}^i(R_k) - r)/\gamma V_k^{i,j} - Cov_k^{i,j}(\bar{E}^i(\mathcal{R}_p^i) - r)/\gamma V^i$ *and* $\bar{E}^i(a^{i,j}) = (\bar{E}^i(R_p^{i,j}) - r)/\gamma V^{i,j} - Cov^{i,j}(\bar{E}^i(\mathcal{R}_p^i) - r)/\gamma V^i$

are constant terms.

Proof. See proof in Appendix A.3. ■

Capital flows to country k through fund j is equal to the ex-ante capital flow expectations $\bar{E}(a_k^{i,j})$, plus the contributions of the return news. The portfolio friction, measured by p, influences only the latter, because the excess return news are, by definition, not known at the beginning of period, when the default shares are determined.

As apparent through the first line in Equation (16), capital flows to country k react to country k's return news $E^i(r_k)$, but these capital flows are less elastic in the presence of the friction ($p < 1$). This is because channeling more capital flows to country k when the return $E^i(r_k)$ increases can happen only if the fund reallocates its portfolio shares towards country k, which is less likely when $p < 1$.

The second line corresponds to the co-ownership spillovers. It shows that, in the presence of portfolio frictions ($p < 1$), capital flows react to fund j' return news $E^i(r_p^{i,j})$. To understand, suppose that $p = 1$, so that there is no friction. In that case, the fund offsets any capital inflow into the fund that is unrelated to country k's returns, and that term disappears. For instance, if the investor expects higher returns in another country k' from the fund portfolio, she will increase her allocation to the equity fund $a^{i,j}$ as $E^i(r_p^{i,j}) > 0$ (see Equation (12)). If the equity fund does not update its information, then these extra resources will be channeled to country k according to its default weights, generating spillovers. But if the equity fund updates its portfolio, then it will increase the share that goes to country k'. This portfolio reallocation offsets the mechanical flow to country k due to the increased investment in the fund. If $p < 1$, then some of the funds destined to k' end up in k. This spillover is positive whenever the "default" portfolio share $\bar{w}_k^{i,j}$ is positive. Since funds typically don't take short positions, these co-ownership spillovers are positive.

The third line shows that capital flows to country k also depend on fund j's return update $E^i(r_p^{i,j})$ through the fund-wide hedging term. This term is independent of the portfolio friction p. Indeed, these spillovers arise automatically from the optimal "fixed" part of the portfolio share, which does not depend on new information. The co-ownership spillovers arise from the part of the portfolio share of k that is truly "sticky", i.e. the part that would be adjusted in the absence of portfolio stickiness.[7]

The fourth line corresponds to the investor-wide hedging. This hedging is affected, to some extent, by the portfolio friction as the second term shows. However, as we will see, this term can be neglected under some conditions. Indeed, when investors get a positive news

[7]Here, Assumption 4.1 ensures that the "fixed" part of the portfolio shares, which depends on the ratio of the conditional covariance to the variance, is invariant whether the fund updates its shares or not and that the default shares are not significantly affected by any precautionary behavior.

on the global return $E^i(\mathfrak{r}_p^i)$, they increase their equity investments globally, and updating funds adjust the allocation to country k to hedge the new equity investments. But, since the allocation to fund j responds to total equity investments as a result of hedging, then the allocation to country k of non-updating funds responds to it as well. An inefficient hedging arises only to the extent that hedging with respect to investor-wide investments is different at the country and fund level.

According to Proposition 4.1, the share of wealth invested in country k by investor i through fund j, $a_k^{i,j}$, can be decomposed into a term that depends on the expectation on the country-k return, a term that depends on the expectation on the fund-j return, a term that depends on the expectation on investor-i return. As a result, the surprise capital flows to country k by investor i through fund j can be written as a function of the surprise expected returns:

Corollary 4.1 *Equation 16 yields*

$$\frac{a_k^{i,j} - \bar{E}^i(a_k^{i,j})}{\bar{E}^i(a_k^{i,j})} = \beta_k^{i,j} E_t^i(r_k) + \delta_k^{i,j} E_t^i(r_{p,}^{i,j}) + \theta_k^{i,j} E^i(\mathfrak{r}_p^i) \tag{17}$$

$\beta_k^{i,j}$, $\delta_k^{i,j}$ and $\theta_k^{i,j}$ are the elasticities of capital flows to the country-specific expectations, to the fund-specific expectations, and to the investor-specific expectations. According to our model, these elasticities are $\beta_k^{i,j} = p/\gamma V_k^{i,j} \bar{E}^i(a_k^{i,j})$, $\theta_k^{i,j} = -[\widetilde{Cov}_k^{i,j} + (1-p)\left(Cov^{i,j} \bar{a}_k^{i,j} / \bar{E}^i(a^{i,j}) - Cov_k^{i,j}\right)]$ $/\gamma V^i \bar{E}^i(a_k^{i,j})$ *and:*

$$\delta_k^{i,j} = \eta_k^{i,j} - \phi_k^{i,j} \Delta Cov_k^{i,j} \tag{18}$$

with $\eta_k^{i,j} = (1-p)\bar{a}_k^{i,j} / \gamma V^{i,j} \bar{E}^i(a^{i,j}) \bar{E}^i(a_k^{i,j})$ *and* $\phi_k^{i,j} = 1/\gamma V^{i,j} \bar{E}^i(a_k^{i,j})$.

The first term, $\eta_k^{i,j}$, captures the co-ownership spillovers while the second term, $\phi_k^{i,j} \Delta Cov_k^{i,j}$, captures the hedging spillovers.

4.5 Aggregate capital flows

Consider total capital flows to country $k = 1,..,N$. These correspond to the sum over all investors and mutual funds $i = 1,..,M$, $j = 1, \mathcal{J}(i)$: $A_k = \sum_{i=1}^{M} \sum_{j=1}^{\mathcal{J}(i)} A_k^{i,j}$, where $A_k^{i,j} = a_k^{i,j} \Omega^i$ is the total flow from investor-fund i to country k. We will focus on $a_k = A_k / \Omega$, the share of total wealth $\Omega = \sum_{i=1}^{M} \Omega^i$ that goes to country k. We have

$$a_k = \sum_{i=1}^{M} \sum_{j=1}^{\mathcal{J}(i)} \frac{\Omega^i}{\Omega} a_k^{i,j} \tag{19}$$

The share of global wealth that is invested in country k is an average of the individual shares $a_k^{i,j}$, weighted by the investor contribution to total wealth.

We now focus on the unexpected investment share to k, scaled by the expected share, and show that it relates to the investor-level unexpected investment shares to k:

$$\frac{a_k - \bar{E}(a_k)}{\bar{E}(a_k)} = \sum_{i=1}^{M} \sigma_k^i \sum_{j=1}^{\mathcal{J}(i)} \sigma_k^{i,j} \frac{a_k^{i,j} - \bar{E}^i(a_k^{i,j})}{\bar{E}^i(a_k^{i,j})} \tag{20}$$

where $\sigma_k^{i,j} = \bar{E}^i(a_k^{i,j}) / \sum_{j=1}^{\mathcal{J}(i)} \bar{E}^i(a_k^{i,j}) = \bar{E}^i(A_k^{i,j})/\bar{E}^i(A_k^i)$ is the ex-ante share of fund j in the investments of investor i to country k, and $\sigma_k^i = \sum_{j=1}^{\mathcal{J}(i)} \bar{E}^i(a_k^{i,j})\Omega^i / \sum_{i=1}^{M} \sum_{j=1}^{\mathcal{J}(i)} \bar{E}^i(a_k^i)\Omega^i = \bar{E}^i(A_k^i)/\bar{E}^i(A_k)$ is the ex-ante share of investor i in the total investments to country k. We used the fact that, because the Ω^is are known in the beginning of period, $\bar{E}(a_k) = \sum_{i=1}^{M} \sum_{j=1}^{\mathcal{J}(i)} \frac{\Omega^i}{\Omega} \bar{E}^i(a_k^{i,j})$. As a result, surprises in capital flows are due to surprises in wealth allocation, not to surprises in wealth (funding), which has been the focus of the literature thus far. These fund-level surprises weigh more when the fund's average flows to k are relatively large.

Finally, it will be useful to decompose aggregate capital flows to country k into a portfolio reallocation component $\tilde{\Delta} a_k$(that results from the reallocation of equity to country k from other countries), and a portfolio growth component Δa (that results from the growth of all equity investments):

$$\frac{a_k - \bar{E}(a_k)}{\bar{E}(a_k)} = \underbrace{\frac{a_k - \bar{E}(a_k)}{\bar{E}(a_k)} - \frac{a - \bar{E}(a)}{\bar{E}(a)}}_{\tilde{\Delta} a_k} + \underbrace{\frac{a - \bar{E}(a)}{\bar{E}(a)}}_{\Delta a} \tag{21}$$

where $a = A/\Omega$, with A representing all the equity investments $A = \sum_{k=1}^{K} A_k$.

4.6 When Are Co-ownership Spillovers Inefficient?

Notice that, because the country-level and the portfolio-level expectations may be correlated, the funds received by country k through the co-ownership spillovers are not necessarily inefficient. At the limit, if all expectations are identical, capital flows generated by the co-ownership spillovers may still be related to expectations about fundamentals that are relevant to country k. It is therefore important to distinguish between the common component of expectations and their country-specific components. We thus make the following assumption on the structure of expectations:

Assumption 4.2 *We assume that expectations $E^i(r_k)$ are equal to the sum of a global component W^i and an idiosyncratic country-specific one l_k^i:*

$$E^i(r_k) = W^i + l_k^i \tag{22}$$

with $E(l_k^i) = 0$, $Cov(l_k^i, W^i) = 0$ and $Cov(l_k^i, l_{k'}^i) = 0$ for all i and and $k \neq k'$.

Under Assumption 4.2, W^i can be then be estimated as the simple average across countries of investor i's expectations: $W^i \simeq \frac{1}{\mathcal{K}(i,j)} \sum_{k \in \mathcal{S}(i,j)} [E^i(r_k) - \bar{E}^i(r_k)]$ and l_k^i as a country-specific residual: $l_k^i = E^i(R_k) - \bar{E}^i(R_k) - W^i$. Therefore, the portfolio return expectations can be decomposed into a global and a "granular" component:

$$E^i(r_p^{i,j}) = \Gamma^{i,j} + W^i \tag{23}$$

where the granular component $\Gamma^{i,j}$ is by construction the weighted average of the local components:

$$\Gamma^{i,j} = \sum_{k \in \mathcal{K}(i,j)} \left(w_k^{i,j} - \frac{1}{\mathcal{K}(i,j)} \right) E^i(r_k) \simeq \sum_{k \in \mathcal{K}(i,j)} w_k^{i,j} l_k^i = w^{i,j'} l^i \tag{24}$$

where $l^i = (l_k^i)'_{k \in \mathcal{K}(i,j)}$ is the vector of local components.

We can also decompose the investor-wide portfolio return expectations:

$$E^i(\mathfrak{r}_p^i) = \Gamma^i + W^i \tag{25}$$

where the granular component Γ^i is by construction the average of the local components, weighted by the country shares at the investor level:

$$\Gamma^i = \sum_{k=1}^{K} \left(w_k^i - \frac{1}{K} \right) E^i(r_k) \simeq \sum_{k=1}^{K} w_k^i l_k^i = w^{i'} l^i \tag{26}$$

where $w^i = (w_1^i, .., w_k^i, .., w_K^i)'$ is the vector of country shares at the investor level, with $w_k^i = \sum_{j=1}^{\mathcal{J}(i)} a_k^{i,j} / \sum_{j=1}^{\mathcal{J}(i)} \sum_{k \in \mathcal{S}(i,j)} a_k^{i,j}$.

We also make the following technical assumption:

Assumption 4.3 *Define $x_k^i = \sum_{j=1}^{\mathcal{J}(i)} \sigma_k^{i,j} x_k^{i,j}$, $x_k = \sum_{i=1}^{M} \sigma_k^i x_k^i$ and $x = \sum_{k=1}^{K} \sigma_k x_k$, with $\sigma_k = \bar{E}^i(a_k)/\bar{E}^i(a)$ the ex-ante share of country k in the total equity investments. For all $i = 1, .., M$ and for all $k = 1, .., K$, $\sum_{j=1}^{\mathcal{J}(i)} \sigma_k^{i,j}(\theta_k^{i,j} - \theta_k^i)\Gamma^{i,j}$, $\sum_{i=1}^{M} \sigma_k^i(\beta_k^i - \beta_k) l_k^i$, $\sum_{i=1}^{M} \sigma_k^i(\delta_k^i - \delta_k) \left(\sum_{j=1}^{\mathcal{J}(i)} \sigma_k^{i,j} \Gamma^{i,j} \right)$, $\sum_{i=1}^{M} \sigma_k^i(\theta_k^i - \theta_k)\Gamma^i$, $\sum_{i=1}^{M} \sigma_k^i(\Theta_k^i - \Theta_k)W^i$, $\sum_{k=1}^{K} \sigma_k(\beta_k - \beta) l_k$ and $\sum_{k=1}^{K} \sigma_k(\delta_k -$*

$\delta)\Gamma_k$ converge to zero faster than $\sum_{k\in\mathcal{S}(i,j)} w_k^{i,j} l_k^i$.

This assumption ensures that the granular residual remains relevant while allowing us to make useful approximations.

Using the model-implied investor-level capital flow surprises (17), the definition of aggregate capital flows (20) and their decomposition (21), the surprises in investor- and fund-level capital flows can be written as follows:

Proposition 4.2 *We assume that Assumptions 4.2 and 4.3 are satisfied. In that case, Equation* (20) *can be written as:*

$$\frac{a_k - \bar{E}(a_k)}{\bar{E}(a_k)} = \underbrace{\beta_k \left(\sum_{i=1}^{M} \sigma_k^i (l_k^i - \Gamma^i)\right) + \delta_k \left(\sum_{i=1}^{M} \sigma_k^i \sum_{j=1}^{\mathcal{J}(i)} \sigma_k^{i,j} (\Gamma^{i,j} - \Gamma^i)\right) + (\Theta_k - \Theta) \left(\sum_{i=1}^{M} \sigma^i (W^i + \Gamma^i)\right)}_{\tilde{\Delta} a_k}$$
$$+ \underbrace{\Theta \left(\sum_{i=1}^{M} \sigma^i (W^i + \Gamma^i)\right)}_{\Delta a} \tag{27}$$

where $\sigma_k^i = \sum_{j=1}^{\mathcal{J}(i)} \bar{E}^i(a_k^{i,j})\Omega^i / \sum_{i=1}^{M} \sum_{j=1}^{\mathcal{J}(i)} \bar{E}^i(a_k^i)\Omega^i = \bar{E}^i(A_k^i)/\bar{E}^i(A_k)$ is the ex-ante share of investor i in the total flows to country k and $\sigma^i = \bar{E}^i(a^i)\Omega^i/\bar{E}^i(a)\Omega = \bar{E}^i(A^i)/\bar{E}^i(A)$ is the ex-ante share of investor i in total equity investments.

Proof. See proof in Appendix A.4. ■

By construction, for a given investor, W^i and Γ^i are common terms that affect all the funds in the same way. They thus determine portfolio growth Δa. Portfolio reallocation $\tilde{\Delta} a_k$ depends on $l_k^i - \Gamma^i$, which is the excess return of country k relative to the whole investor portfolio, through a return motive (β_k). It also depends on $\Gamma^{i,j} - \Gamma^i$, which is the excess return of fund j relative to investor i's portfolio, through a hedging motive and the co-ownership spillovers (subsumed in δ_k). Finally, it depends on the extent to which the elasticity of country k capital flows to the common shocks, Θ_k, differs from the average Θ. This component can be neglected when the elasticities are homogeneous across countries.

We can compare the effective equilibrium capital flows to the "frictionless" capital flows that would hold in the absence of portfolio friction. Note that capital flow reallocation under-reacts to l_k^i, the expectations that are specific to country k, as β is lower than its frictionless value (with $p = 1$). On the opposite, capital flow reallocation over-reacts to the the granular residual of expectations $\Gamma^{i,j}$ as compared to their frictionless value, due to the co-ownership spillovers that affect δ_k.

While portfolio reallocation is clearly affected by the friction, it is not clear that portfolio growth is. Indeed, portfolio growth reacts to the common component $\Gamma^i + W^i$ through several channels: the reaction to the country expectation (with an elasticity β_k), the reaction to the fund expectation (with an elasticity δ_k) and the reaction to the investor expectation (with an elasticity θ_k). As a result, it is not clear whether there is an over- or an under-reaction to that component.

To go further, we make the following symmetry assumption:

Assumption 4.4 *For all $i = 1, .., M$, $j = 1, .., \mathcal{J}(i)$ and $(k, k') \in \mathcal{S}(i, j)^2$, $k \neq k$:*

(a) $\bar{E}^i(R_k) \simeq \bar{E}^i(R_{k'})$;

(b) $Cov(R_k, \mathcal{R}_p^{i,j-}) \simeq Cov(R_{k'}, \mathcal{R}_p^{i,j-})$ *and* $Cov(R_k, R^{i,j}_{p,k-}) \simeq Cov(R_{k'}, R^{i,j}_{p,k'-})$;

(c) $\sum_{i=1}^{M} \sum_{j=1}^{\mathcal{J}(i)} \left(\frac{\bar{E}^i(A_k^{i,j})}{\bar{E}^i(A_k)} - \frac{\bar{E}^i(A^{i,j})}{\bar{E}^i(A)} \right) \mu^{i,j} \simeq 0$, *where* $\mu^{i,j} = \sum_{k \in \mathcal{S}(i,j)} w_k^{i,j} \mu_k^{i,j}$ *for all* $\mu_k^{i,j} \in \{\beta_k^{i,j}, \eta_k^{i,j}, \delta_k^{i,j}, \theta_k^{i,j}\}$, .

Assumption 4.4 requires that two countries in a given fund (a) have close enough ex-ante return expectations and (b) close enough hedging properties with respect to the fund and the whole investor equity investments, and (c) that fund-level elasticities do not co-vary systematically with the share of a given fund in the total flows to the country (for instance, funds that invest more in the US do not have higher or lower elasticities).

We then derive the following corollary:

Corollary 4.2 *We assume that Assumption 4.4 is satisfied. In that case, the coefficients are homogeneous across countries:* $\beta_k \simeq \beta$, $\delta_k \simeq \delta$, $\eta_k \simeq \eta$, $\theta_k \simeq \theta$, *and* $\Theta_k \simeq \Theta$. *Besides,*

(i) β *is decreasing in* $1-p$, δ *is increasing in* $1-p$ *and is positive for a large* $1-p$,

(ii) Θ *is independent of* p,

(iii) $\beta/\eta = p/(1-p)$.

Proof. See proof in Appendix A.5. ■

Assumption 4.4 allows us to equalize the elasticities across countries. In that case, the third term in Equation (27) disappears. It also allows us to draw some implications on the role of the friction (results (i) to (iii)).

When $p < 1$, the elasticity of capital flows to the investors' country expectations, β, is lower than what it would be in the optimum (with $p = 1$), which means that the response of capital flows to the country-k specific expectations is too sticky as compared to the frictionless benchmark.

It is different for the granular term. Indeed, capital flows responds more positively to the granular component when the portfolio becomes more sticky (when p decreases). If $1-p$ is large, the co-ownership spillovers dominate the portfolio reallocation and δ becomes positive. In that case, a larger $1-p$ increases δ, and the granular component generates extra capital flow volatility. Therefore, as p declines (as portfolios becomes more sticky), the contribution of the country component of expectations to the country capital flows declines, while the contribution of the granular component increases.

Interestingly, the reaction to the common component of expectations, Θ does not depend on the friction and is equal to the optimal response. As a result, the comovement in capital flows across countries belonging to common portfolios increases when p declines, and this is due to the granular component of expectations, and not to the global component of expectations. In other words, capital flows to country k due to portfolio growth Δa are unaffected by the friction. The friction affects capital flows to k only through portfolio reallocation $\tilde{\Delta} a_k$.

The last result states that the ratio of β over η, that is, the elasticity to the country expectations over the co-ownership spillover coefficient, provides an approximation for the strength of the friction.

5 Identification

The purpose of this section is to identify the parameters β and δ. It will be useful to disentangle the contribution of η and ϕ to δ, as the latter is related to the efficient hedging reallocation while the former is related to the inefficient co-ownership spillovers. This analysis will also lead us to re-evaluate and interpret better our preliminary empirical results of Section 3. We will use these estimates to quantify the contribution of co-ownership spillovers to capital-flow reallocation in the next section.

5.1 A Mapping from Model to Data

We now add time subscripts and approximate surprises in returns at the country, fund, and investor level as follows

$$\begin{aligned} E_t^i(r_{k,t}) &= 1 + E_t^i(d_{k,t+1}) - \bar{E}^i(d_{k,t+1}) - q_{k,t} + \bar{E}^i(q_{k,t}) \\ E_t^i(r_{p,t+1}^{i,j}) &= 1 + E_t^i(d_{p,t+1}^{i,j}) - \bar{E}^i(d_{p,t+1}^{i,j}) - q_{p,t}^{i,j} + \bar{E}^i(q_{p,t}^{i,j}) \\ E_t^i(\mathfrak{r}_{p,t+1}^i) &= 1 + E_t^i(\mathfrak{d}_{p,t+1}^i) - \bar{E}^i(\mathfrak{d}_{p,t+1}^i) - \mathfrak{q}_{p,t}^i + \bar{E}^i(\mathfrak{q}_{p,t}^i) \end{aligned} \tag{28}$$

where we used the approximation of returns (6) with $d_{k,t+1} = \log(D_{k,t+1}) - \log(D)$, $q_{k,t} = \log(Q_{k,t}) - \log(Q)$ are the log-deviations of dividends and asset prices at the country level from their average, $d^{i,j}_{p,t+1} = \sum_{k=1}^{N} w^{i,j}_{k,t} d_{k,t+1}$ and $q^{i,j}_{p,t+1} = \sum_{k=1}^{N} w^{i,j}_{k,t} q_{k,t+1}$ are the fund-specific weighted averages, and $\mathfrak{d}^{i}_{p,t+1} = \sum_{j=1}^{J(i)} \frac{A^{i,j}_t}{\sum_{j=1}^{J(i)} A^{i,j}_t} d^{j}_{p,t+1}$ and $\mathfrak{q}^{i}_{p,t+1} = \sum_{j=1}^{J(i)} \frac{A^{i,j}_t}{\sum_{j=1}^{J(i)} A^{i,j}_t} q^{j}_{p,t+1}$ are the investor-specific weighted averages.

5.2 Allocation-level regressions

Noting that $\frac{a^{i,j}_{k,t} - \bar{E}^i(a^{i,j}_{k,t})}{\bar{E}^i(a^{i,j}_{k,t})}$ can be approximated as $\log(a^{i,j}_{k,t}) - \log(\bar{E}^i(a^{i,j}_{k,t}))$, and that $a^{i,j}_{k,t} = w^{i,j}_{k,t} a^{i,j}_t$, using the return expressions (28) and the homogeneity of coefficients, Equation(17) can be rewritten as:

$$\log(w^{i,j}_{k,t}) = \beta E^i_t(d_{k,t+1}) + \lambda_{k,t} + \lambda^{i,j}_t + \lambda^{i,j}_k + \epsilon^{i,j}_{k,t} \tag{29}$$

with

$$\begin{aligned}
\lambda_{k,t} &= -\beta q_{k,t} + \beta + \delta \\
\lambda^{i,j}_t &= \delta[E^i_t(d^{i,j}_{p,t+1}) - q^{i,j}_{p,t}] + \theta[E^i_t(\mathfrak{d}^i_{p,t+1}) - \mathfrak{q}^i_{p,t}] - \log(a^{i,j}_t) \\
\lambda^{i,j}_k &= -\beta[\bar{E}^i(d_{k,t+1}) - \bar{E}^i(q_{k,t})] - \delta[\bar{E}^i(d^{i,j}_{p,t+1}) - \bar{E}^i(q^{i,j}_{p,t})] - \theta[\bar{E}^i(\mathfrak{d}^i_{p,t+1}) - \bar{E}^i(\mathfrak{q}^i_{p,t})] + \log(\bar{E}^i(a^{i,j}_{k,t}))
\end{aligned}$$

$\lambda_{k,t}$ are country-time fixed effects that capture the impact of country-k asset prices, λ^i_t are fund-time fixed effects that capture the effect of the investor's expectations relative to her whole portfolio and the the fund's portfolio, and of the share of the investor's wealth invested in the fund, $\lambda^{i,j}_k$ are country-investor-fund fixed effects that capture the impact of investor ex ante expectations on country k and the impact of investor ex ante expectations on j's portfolio. The component of capital flows due to the expectations on country k is $\beta E^i_t(d_{k,t+1})$. Finally, $\epsilon^{i,j}_{k,t}$ is an error term.

This expression enables us to identify β. To do so, we can estimate a slightly modified version of Equation (29) where $E^i_t g^{\text{next year}}_k$ proxies for the expected dividends at the country level $E^i_t(d_{k,t+1})$. This allocation-level regression corresponds exactly to Equation (5) and to the analysis summarized in Table 2. Therefore, we can conclude that β is 2.3% or 3.2%, depending on whether we consider all funds or active funds only.

5.3 Fund-level regressions

Similarly, noting that $a^{i,j}_t = A^{i,j}_t / \Omega^i_t$, with $A^{i,j}_{k,t}$ the total capital invested by investor i in country k through fund j and Ω^i_t the total wealth of investor i, and aggregating Equation

(17) at the fund level, we can write:

$$\log(A_t^{i,j}) = (\beta+\delta)E_t^i(d_{p,t+1}^{i,j}) - (\beta+\delta)q_{p,t}^{i,j} + \lambda_t^i + \lambda_k^{i,j} + \epsilon_t^{i,j} \tag{30}$$

with

$$\begin{aligned}
\lambda_t^i \quad &= \theta[E_t^i(d_{p,t+1}^i) - q_{p,t}^i] + \log(\Omega_t^i) + \beta + \delta \\
\lambda^{i,j} \quad &= -(\beta+\delta)[\bar{E}^i(d_{p,t+1}^{i,j}) - \bar{E}^i(q_{p,t+1}^{i,j})] - \theta[\bar{E}^i(\mathfrak{d}_{p,t+1}^i) - \bar{E}^i(\mathfrak{q}_{p,t+1}^i)] + \log(\bar{E}^i(a_t^{i,j}))
\end{aligned}$$

λ_t^i are investor-time fixed effects that capture the effect of the investor's expectations relative to her whole portfolio and of the investor's wealth, $\lambda^{i,j}$ are investor-fund fixed effects that capture the impact of investor ex ante expectations on j's portfolio. $\beta E_t^i(d_{p,t+1}^{i,j})$ is the component of capital flows due to the expectations on the specific countries in the portfolio, but aggregated at the fund level, and $\delta E_t^i(d_{p,t+1}^{i,j})$ represents the spillovers arising from expectations on the other countries in the portfolio. We cannot account for $q_{p,t}^{i,j}$ through the fixed effects, so we add it as a control. Finally, $\epsilon_{k,t}^{i,j}$ is an error term.

We can use this expression to identify $\beta+\delta$. To do so, we estimate a slightly modified version of Equation (30), where $E_t^i g_p^{j,\text{next year}}$ proxies for the expected dividends at the fund level $E_t^i(d_{p,t+1}^{i,j})$, and the log-change in the fund-relevant equity price $\Delta\log(Q_{p,t}^{i,j})$ and its lag proxy for the log-deviation of equity prices from their average. This fund-level regression corresponds exactly to Equation (2) and to the analysis summarized in Table 1. Therefore, we can conclude that $\beta+\delta$ is 29%, which corresponds to our preferred estimate of Column (4). Therefore, $\delta = 27\%$, if we use the previous result that $\beta = 2.3\%$.

Disentangling portfolio and co-ownership spillovers However, remember that δ reflects both the hedging spillovers and the co-ownership spillovers, as highlighted by Equation (18). In order to disentangle the hedging spillovers from the co-ownership spillovers, we need to identify $\phi\Delta Cov$, the part of δ that is due to hedging. Using a measure of $\Delta Cov^{i,j}$ at the fund level, we can estimate the following modified version that includes an interaction term:

$$\log(A_t^{i,j}) = (\beta+\eta)E_t^i(d_{p,t+1}^{i,j}) - \phi\Delta Cov^{i,j}E_t^i(d_{p,t+1}^{i,j}) - (\beta+\delta)q_{p,t}^{i,j} + \lambda_t^i + \lambda_k^{i,j} + \epsilon_t^{i,j} \tag{31}$$

where $\Delta Cov^{i,j}$ is the weighted average of $\Delta Cov_k^{i,j}$ at the fund level. The spillovers arising from co-ownership are given by η while the spillovers arising from hedging are given by $\phi\Delta Cov^{i,j}$.

	(1)	(2)
	$\log(A_t^{i,j})$	$\log(A_t^{i,j})$
VARIABLES	All funds	All funds
$E_t^i(g_p^{j,\text{next year}})$	0.377***	
	(0.046)	
$\gamma_t^{i,j}$		0.511***
		(0.101)
$E_t^i(g_p^{j,\text{next year}}) - \gamma_t^{i,j}$		0.364***
		(0.047)
$\Delta Cov_t^{i,j}$	-4.137***	-4.096***
	(0.826)	(0.825)
$\Delta Cov_t^{i,j} \times E_t^i(g_p^{j,\text{next year}})$	-0.755***	-0.754***
	(0.201)	(0.200)
$\Delta \log(Q_t^{i,j})$	-0.011**	-0.011**
	(0.004)	(0.004)
$\Delta \log(Q_{t-1}^{i,j})$	-0.013***	-0.013***
	(0.004)	(0.004)
Observations	3,878	3,878
R-squared	0.082	0.084
Fund FE	Yes	Yes
Investor-time FE	Yes	Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3: Spillovers due to Portfolio Reallocation and Co-ownership

Note: The dependent variable in Columns (1) and (2) is the log total capital invested by investor i in fund j on month t. Columns (1) and (2) report results for regression Equation (32). Standard errors Driscoll-Kraay standard errors with 5 lags.

Substituting the variables with their empirical counterparts, we obtain an extension of Equation (2) that includes the interaction of our measured $\Delta Cov_k^{i,j}$ with the aggregate expectation of GDP growth in the following regression:

$$\ln\left(A_t^{i,j}\right) = (\beta+\eta)E_t^i g_{p,t}^{j,\text{next year}} - \phi \Delta Cov_t^{i,j} \times E_t^i g_{p,t}^{j,\text{next year}} \\ + \gamma_0 \Delta Cov_t^{i,j} + \gamma_1 \Delta \log(Q_{p,t}^j) + \gamma_2 \Delta \log(Q_{p,t-1}^j) + \lambda_t^i + \lambda^{i,j} + \epsilon_t^{i,j}. \tag{32}$$

The additional interaction term allows us to distinguish the portfolio reallocation spillover parameter ϕ from the co-ownership spillovers parameter η. Appendix B.1 provides details on how we compute $\Delta Cov_k^{i,j}$. $\Delta Cov_t^{i,j}$ is then a average of $\Delta Cov_k^{i,j}$ weighted by the portfolio shares. The summary statistics of $\Delta Cov^{i,j}$ are shown in Appendix B.2. Note that, because portfolio shares vary over time, $\Delta Cov_t^{i,j}$ is time-varying. We thus need to include the linear term $\Delta Cov_t^{i,j}$ in the regression.

We present the results in Table 3. In Column (1), the interaction term appears to be significantly negative at -0.75, which is consistent with the model and implies $\phi = 0.75$. Portfolio reallocation spillovers are therefore at play: investors do consider the covariance of returns and the potential for risk sharing (when ΔCov is negative), as well as arbitrage opportunities (when ΔCov is positive) when reacting to their expectations. Note that we face the same potential confounding factors as before, namely, asset supply shocks among the countries in which the fund invests, and general equilibrium effects that mitigate the coefficient of $E_t^i g_{p,t}^{j,\text{next year}}$. We are not worried about the identification of the interaction term, because the identification is driven also by fund-specific variation in the covariance term $\Delta Cov^{i,j}$. However, the linear term $E_t^i g_{p,t}^{j,\text{next year}}$ is subject to these confounding factors. Therefore, we use the super-granular residual $\gamma_t^{i,j}$, which is, as explained in Section 3, less subject to these confounders, and report the results in Column (2). Note that we add $E_t^i(g_p^{j,\text{next year}}) - \gamma_t^{i,j}$ as an additional control, so that the interaction term remains well-identified. The coefficient of $\gamma_t^{i,j}$ is higher than the one identified in Table 1. This implies that $\beta + \eta = 0.51$, so that $\eta = 0.51 - 0.02 = 0.49$, or $\eta = 0.51 - 0.03 = 0.48$, depending on whether we use the coefficient of β estimated for all funds or for active funds.[8]

Using our estimates of β and η, we can get an estimate of the portfolio friction parameter p. To do so, we apply Corollary 4.2's prediction that $\beta/\eta = p/(1-p)$. This yields $p = \beta/(\eta + \beta) = 0.023/0.51 = 0.045$. This means that mutual funds update their portfolios every 22 months on average. If we consider only active funds, then $p = \beta/(\eta+\beta) = 0.032/0.51 = 0.06$, which means that active funds update their portfolios every 16 months on average. As a comparison, Bacchetta and van Wincoop (2017) estimate that $p = 0.04$ using a model with a Calvo-type portfolio friction. This implies a an average portfolio updating span of two

[8] The fact that the estimated $\eta = 0.49$ is larger than the estimated $\delta = 0.27$ is consistent with the fact that the estimated ϕ is positive and that $\Delta Cov_t^{i,j}$ is positive on average (see Appendix B.2).

years, which is close to our estimates.

6 Quantifying Co-ownership Spillovers

In this section, we quantify the contribution of co-ownership spillovers to portfolio reallocation $\tilde{\Delta} a_k$. Indeed, Corollary 4.2 has established that portfolio growth is typically not affected by portfolio stickiness and that co-ownership spillovers are typically not relevant for portfolio growth. We combine the insights of Proposition 4.2 and Corollary 4.2 to write the following decomposition of portfolio reallocation:

$$\tilde{\Delta} a_k = \beta \tilde{l}_k - \phi \Delta Cov \Gamma_k + \eta \Gamma_k \tag{33}$$

with

$$\tilde{l}_k = \sum_{i=1}^{M} \sigma_k^i (l_k^i - \Gamma^i) \tag{34}$$

$$\Gamma_k = \sum_{i=1}^{M} \sigma_k^i \sum_{j=1}^{\mathcal{J}(i)} \sigma_k^{i,j} (\Gamma^{i,j} - \Gamma^i) \tag{35}$$

Equation (33) provides a decomposition of capital flow reallocation to country k (as a share of total portfolio reallocation) into the contribution of the country-specific excess return $\beta \tilde{l}_k$, the contribution of hedging $-\phi \Delta Cov \Gamma_k$ and the contribution of the co-ownership spillovers $\eta \Gamma_k$. Because capital flows reallocation have many drivers besides expectations on GDP growth, we call $\tilde{\Delta} a_k$ the expectation-driven capital flow reallocation.

Our model shows that the co-ownership spillovers are inefficient as they arise only in the presence of portfolio stickiness ($p < 1$). The data suggests that portfolio stickiness is pervasive, confirming a hypothesis that has been previously made in the theoretical literature and widely documented empirically. It is therefore highly relevant to evaluate the contribution of this friction to expectation-driven capital flow reallocation. Importantly, as Equation (33) shows, co-ownership spillovers impact capital flows through the coefficient η, which we have estimated in the previous section, and through the granular term Γ_k. Γ_k is a measure of the granular expectations relevant for country k. It is an average of the fund-specific granular residuals, weighted by $\sigma_k^{i,j}$, the contribution of the fund to the capital flows of country k.

We can estimate $\eta \Gamma_k$ using the data. $\Gamma_t^{i,j}$ is proxied as $\Gamma_t^{i,j} = \sum_{k \in \mathcal{K}(i,j)} w_{k,t}^{i,j} \left[E_t^i g_{k,t}^{\text{next year}} - \sum_{k \in \mathcal{K}(i,j)} E_t^i g_{k,t}^{\text{next year}} / K^{i,j} \right]$, and Γ_t^i is proxied as $\Gamma_t^i = \sum_{k=1}^{K} w_{k,t}^i \left[E_t^i g_{k,t}^{\text{next year}} - \sum_{k=1}^{K} E_t^i g_{k,t}^{\text{next year}} / K \right]$. To measure expectations, we use the growth expectations $E_t^i g_k^{\text{next year}}$.

However, since we have many missing expectations, we expand the expectation data as much as possible by imputing expectations when we do not observe them. To do so, we fit an ad hoc expectation process to our data and impute fictitious expectation data when that data is missing. See Appendix B.3 for details.[9] $\sigma^{i,j}_{t,k}$ can be estimated as the average share of fund j in the total investment in country k: $\sum_{t=1}^{T} A^{i,j}_{k,t} / \sum_{t=1}^{T} A_{k,t}$. We can then use Equation (35) to compute an estimate of $\Gamma_{k,t}$. Finally, the parameter η has been identified in Section 5 to be equal to 0.49 on average. We can then identify the contribution of co-ownership spillovers to the aggregate capital flow reallocation.

To compare these co-ownership spillovers to the total expectation-driven reallocation to country k, we compute also the expected return term $\beta \Delta \tilde{l}_{k,t}$, where $\tilde{l}_{k,t}$ is computed as $\tilde{l}_{k,t} = \sum_{i=1}^{M} \sigma^{i}_{k,t}(l^{i}_{k,t} - \Gamma^{i}_{t})$ and where $\beta = 0.023$, as in our estimation. We also take into account the hedging term $-\phi \Delta Cov \Delta \Gamma_{k,t}$, where $\phi = 0.75$, our estimate, and $\Delta Cov = -0.07$, the average of $\Delta Cov^{i,j}$ across all funds. Then, according to Equation (33), the innovation in the expectation-driven capital flow reallocation, $\tilde{\Delta} a_{k,t}$, is the sum of the excess return, hedging and co-ownership components. The contribution of $\beta \tilde{l}_{k,t}$, $-\phi \Delta Cov \Gamma_{k,t}$ and $\eta \Gamma_{k,t}$ to the variance of these expectation-driven flows is given in Table 4.

First, consider the upper part of Table 4, which focuses on the variance of expectations. The variance of the idiosyncratic, country-specific expectations, $\tilde{l}_{k,t}$, is larger than the variance of the granular term $\Gamma_{k,t}$. The cross-country average of the latter is .91, about nine times higher than the average of the former, at .11.

Now consider the lower part of Table 4, that describes the contributions of the different components to the expectation-driven capital flow reallocation. Because β is low relative to η, the co-ownership term has a much higher contribution relative to the excess-return term: co-ownership spillovers explain on average 93% of the variance, and the excess return term explains 6%. This means that co-ownership spillovers explain more than one tenth of the reallocation in capital flows due to expectations. The hedging component is almost irrelevant at 1%.

[9] Because there are some countries in which investor i invests and for which we do not have expectations (real or imputed), we use the formulas $\Gamma^{i,j}_{t} = \sum_{k \in \kappa(i,j)} w^{i,j}_{k,t} \left[E^{i}_{t} g^{\text{next year}}_{k,t} - \sum_{k \in \kappa(i,j)} E^{i}_{t} g^{\text{next year}}_{k,t} / \kappa^{i,j} \right]$, and $\Gamma^{i}_{t} = \sum_{k \in \kappa(i)}^{K} w^{i}_{k,t} \left[E^{i}_{t} g^{\text{next year}}_{k,t} - \sum_{k \in \kappa(i)}^{K} E^{i}_{t} g^{\text{next year}}_{k,t} / \kappa^{i} \right]$. where $\kappa(i)$ and $\kappa(i)$ are the set of countries for which we observe investor i's expectations or impute expectations, at the fund and investor level. The estimated co-ownership spillovers will thus be under-estimated. Our estimates of the variance of $\Gamma_{k,t}$ will thus be conservative.

Expectations			
Variance	$V\left(\tilde{l}_{k,t}\right)$	$V\left(\ \Gamma_{k,t}\right)$	
Value	.91	.11	
	[.17,1.82]	[.03,.21]	
Implied capital flows			
Coefficients	β	η	$-\phi\Delta Cov$
	.023	.49	$-.052$
Variance	$V\left(\beta\tilde{l}_{k,t}\right)$	$V\left(\eta\Gamma_{k,t})\right)$	$V\left(-\phi\Delta Cov_{k,t}\right)$
Value	.0005	.0142	.0002
	[.0001,.0012]	[.0019,.0308]	[.0000,.0004]
Contribution	6%	93%	1%
	[1%,13%]	[86%,98%]	[.9%,1%]
Variance	$V\left(\beta\tilde{l}_{k,t}+\eta\Gamma_{k,k,t}\right)$	$V\left(\eta\Gamma_{k,t}-\eta\Gamma_{k,k,t}\right)$	$V\left(-\phi\Delta Cov_{k,t}\right)$
Value	.0023	.0128	.0002
	[.0002,.0059]	[.0018,.0290]	[.0000,.0004]
Contribution	19%	80%	1%
	[2%,54%]	[46%,97%]	[.9%,1%]

Table 4: Variance decomposition of expectation-driven capital flow reallocation

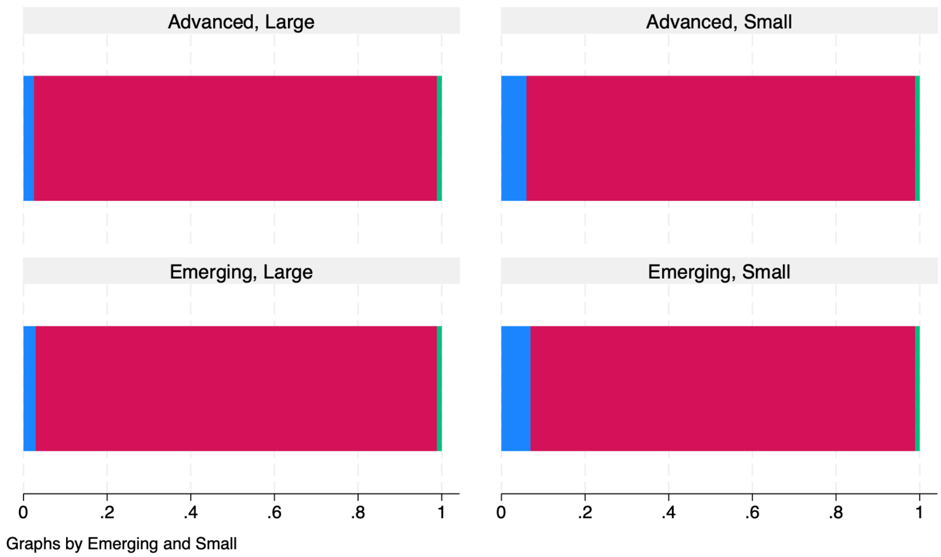
Note: We report the average variances of expectations and implied capital flow reallocation across countries, as well as the 10^{th} and 90^{th} percentile (in brackets). The contributions are the ratio of the variance to the total variance of expectation-driven flow reallocation.

Panel a) of Figure 1 shows the variance decomposition of expectations-driven flow reallocation for Emerging, Advanced, Small and Large countries. We define a country as "Large" when its average share in portfolios is in the top quartile (i.e., higher than 3.5%). The Large countries include the United States, the United Kingdom, Japan, Germany, France, Switzerland, the Russian Federation, South Korea, China, India, Mexico, and Brazil. Interestingly, the contribution of the excess return component is slightly larger for Small economies, both Emerging and Advanced. For these countries, the contribution of this term is 7% on average, against 3% only for Large countries.

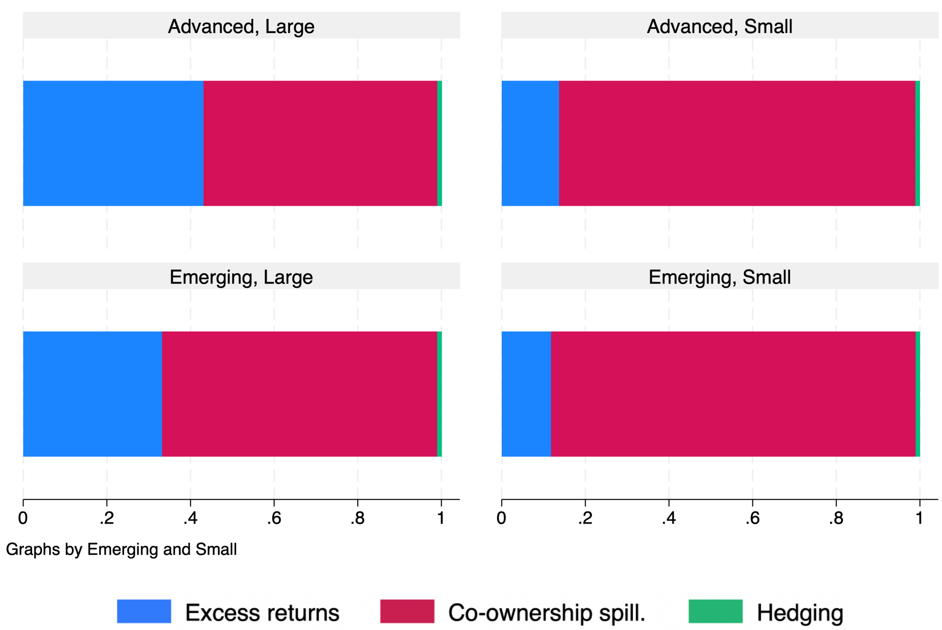
Note however that the large countries' granular term may not necessarily only reflect spillovers from other countries, because the granular term is precisely driven by the expectations about large countries. For instance, the investments of a fund in China could still reflect the expectations about China's growth even though the fund is inactive, just because

Figure 1: Variance decomposition of expectation-driven capital flows

a) Implied capital flows



b) Implied capital flows (adjusted)



Note: Panel a) represents the contribution of the variance of $\beta\tilde{l}_{k,t}$, $\eta\Gamma_{k,t}$ and $-\phi\Delta Cov_{k,t}$ to the variance of implied capital flow reallocation. Panel b) represents the contribution of the variance of $\beta\tilde{l}_{k,t} + \eta\Gamma_{k,k,t}$, $\eta\Gamma_{k,t} - \eta\Gamma_{k,k,t}$ and $-\phi\Delta Cov_{k,t}$ to the variance of implied capital flow reallocation.

the expectations about China have a non-trivial impact on the aggregate expectations that drive capital flows to the fund. We thus subtract from the granular term $\Gamma_{k,t}$ the following term:

$$\Gamma_{k,k,t} = \sum_{i=1}^{M} \sigma^i_{k,t} w^i_{k,t} (l^i_{k,t} - \Gamma^i_t) \tag{36}$$

This term reflects the impact of the investors' expectation on country k through the granular term. This term should actually be associated to the excess return term, not to the co-ownership spillover term. We thus compute a diminished co-ownership spillover term: $\tilde{\Delta} a^{co'}_{k,t} = \eta(\Gamma_{k,t} - \Gamma_{k,k,t})$, and an augmented excess return term: $\tilde{l}^{a'}_{k,t} = \beta \tilde{l}_{k,t} + \eta \Gamma_{k,k,t}$. The average contribution of the diminished co-ownership term is lower, at 80%, but the range of both the excess return and the co-ownership terms has also expanded, as we can see in Table 4, because it is relevant only for large countries. In Panel b) of Figure 1, we can see that the relative contribution of the co-ownership term becomes relatively smaller in Large Advanced and Emerging economies (from 96% down to 61%), while its relative size increases only slightly for Small countries (from 92% to 86%).

The role of co-ownership linkages Using the definition of $\Gamma^{i,j}_t$ and Γ^i_t, we can notice that $\Gamma^{i,j}_t - \Gamma^i_t$ is a weighted average of the idiosyncratic expectation shocks:

$$\Gamma^{i,j}_t - \Gamma^i_t = \sum_{k=1}^{K} \Delta w^{i,j}_{k,t} l^i_{k,t}$$

where $\Delta w^{i,j}_{k,t} = w^{i,j}_{k,t} - w^i_{k,t}$ is a relative allocation. It is the difference between the country portfolio share in the fund and in the full investor portfolio. What makes this term relevant is therefore the extent to which the fund portfolios are concentrated relative to the investor's portfolio.

The granular component that is relevant for country k can then be written as

$$\begin{aligned} \Gamma_{k,t} &= \sum_{k'=1}^{K} \sum_{i=1}^{M} l^i_{k',t} \left(\sum_{j=1}^{J(i)} \sigma^i_{k,t} \sigma^{i,j}_{k,t} \Delta w^{i,j}_{k',t} \right) \\ &= \sum_{k'=1}^{K} \sum_{i=1}^{M} \sigma^i_{k'} \Delta w^i_{k,k',t} l^i_{k',t} \end{aligned} \tag{37}$$

The investor i expectations about the countries that are co-owned by the same funds that invest in country k, $l^i_{k',t}$ are weighted by the following weights

$$\Delta w^i_{k,k',t} = \left(\sum_{j=1}^{J(i)} \sigma^{i,j}_{k,t} \Delta w^{i,j}_{k',t} \right) \tag{38}$$

$\Delta w^i_{k,k',t}$ is a measure of the potential contribution of country k' to the co-ownership spillovers to country k. It is a weighted average of country k''s relative allocations across investor i's funds, where the weights are represented by the importance of a given fund in the total flows of investor i to country k. It thus reflects the co-ownership linkages between country k and country k': investor i's idiosyncratic expectation shocks on country k' will matter to country k if the funds managed by i that invest in country k also invest a large share in country k'.

Country granularity versus investor granularity The idiosyncratic expectations $l^i_{k,t}$ are both country-specific and investor-specific. We therefore decompose them between the average country-specific component of expectations across investors for country k, $l_{k,t} = (\sum_{i=1}^{M} l^i_{k,t})/M$ and their investor-specific component $l^i_{k,t} - l_{k,t}$. We can then decompose the granular term into a term that is driven by "country granularity", and two terms that are driven by "investor granularity":

$$\begin{aligned} \Gamma_{k,t} = & \underbrace{\sum_{k'=1}^{K} \Delta w_{k,k',t} l_{k',t}}_{\Gamma^{country}_{k,t}} \\ & + \underbrace{\sum_{k'=1}^{K} \sum_{i=1}^{M} \sigma^i_{k,t} \left(\Delta w^i_{k,k',t} - \Delta w_{k,k',t} \right) \left(l^i_{k',t} - l_{k',t} \right) + \sum_{k'=1}^{K} \Delta w_{k,k',t} \sum_{i=1}^{M} \left(\sigma^i_{k,t} - \frac{1}{M} \right) \left(l^i_{k',t} - l_{k',t} \right)}_{\Gamma^{investor}_{k,t}} \end{aligned} \tag{39}$$

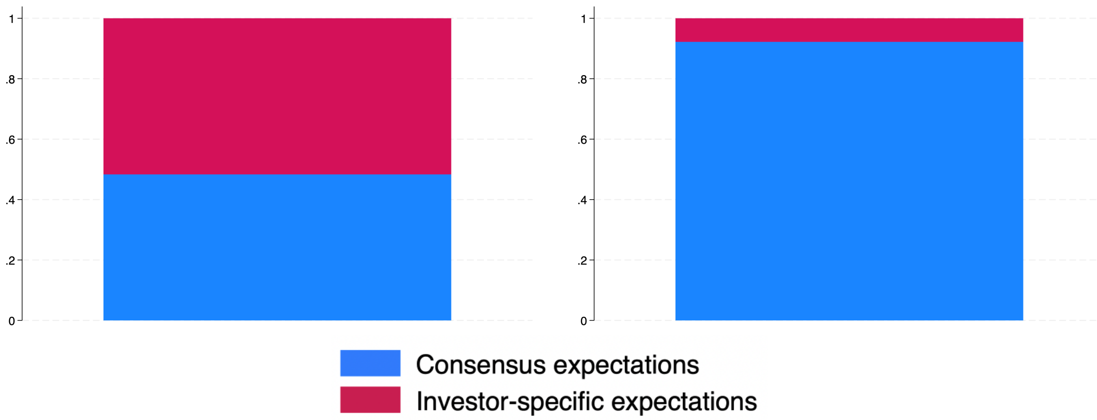
where $\Delta w_{k,k',t}$ is an average of the co-ownership linkages between country k and country k' across all investors, weighted by the importance of a given investor in the total flows to country k:

$$\Delta w_{k,k',t} = \left(\sum_{i=1}^{M} \sigma^i_{k,t} \Delta w^i_{k,k',t} \right) \tag{40}$$

The first term in Equation (39) shows that aggregate expectation shocks on country k' $l_{k',t}$, or "consensus expectations", will matter to country k if the funds that channel a large share of country k investment in general also invest a lot in country k' (if $\Delta w_{k,k',t}$ is large). We

Figure 2: Variance decomposition of expectations and co-ownership spillovers

a) Expectations b) Co-ownership spillovers



Note: The figure represents the relative contributions of consensus expectations $l_{k,t}$ and investor-specific expectations $l^i_{k,t} - l_{k,t}$, to expectations $l^i_{k,t}$ themselves (Panel a)), and to co-ownership spillovers (Panel b)). In Panel a), the contribution of consensus expectations $l_{k,t}$ to expectations $l^i_{k,t}$ is measured as $V(l_{k,t})/V(l^i_{k,t})$, and the contribution of investor-specific expectations $l^i_{k,t} - l_{k,t}$ to expectations $l^i_{k,t}$ is measured as $V(l^i_{k,t} - l_{k,t})/V(l^i_{k,t})$. In Panel b), the contribution of consensus expectations to co-ownership spillovers $\Gamma_{k,t}$ is measured as $V(\Gamma^{country}_{k,t})/V(\Gamma^i_{k,t})$, and the contribution of investor-specific expectations to co-ownership spillovers $\Gamma_{k,t}$ is measured as $V(\Gamma^{investor}_{k,t})/V(\Gamma^i_{k,t})$.

refer to this term as the "country granular component" because its importance is driven by the granularity of countries' portfolio shares. Investor-specific expectations about country k', $l^i_{k',t} - l_{k',t}$, will matter when the investor manages portfolios that are relatively more concentrated towards country k' (when $\Delta w^i_{k,k',t} - \Delta w_{k,k',t}$ is large), as the second term shows. They will also matter when the investor's contribution to country k capital flows is relatively large (when $\sigma^i_{k,t} - 1/M$ is large), as the third term shows. The second and third terms thus constitute the "investor granular component".

Figure 2 shows the relative contributions of consensus expectations $l_{k,t}$ and investor-specific expectations $l^i_{k,t} - l_{k,t}$, to expectations $l^i_{k,t}$ themselves (Panel a)), and to co-ownership spillovers (Panel b)). The variance of $l^i_{k,t}$ is due for almost equal shares to the consensus and investor-specific components. However, the contribution of investor-specific expectations to capital flow reallocation is reduced to less than 10%. As shown by Gabaix (2011), the aggregate relevance of idiosyncratic shocks depends on the nature of the distribution of the shares. In our context, the aggregate relevance of consensus expectations depends on the nature of the distribution of $\Delta w_{k,k',t}$. If the shares $\Delta w_{k,k',t}$ are granular, that is, if some countries have disproportionate weight in portfolios, then their country-specific expectation $l_{k',t}$ will matter to co-owned countries. Similarly, for the investor-specific expectations to matter, it is not enough that they are volatile. It is also important that the weights of investor-specific expectations ($\sigma^i_{k,t}(\Delta w^i_{k,k',t} - \Delta w_{k,k',t})$ and $\Delta w_{k,k',t}(\sigma^i_{k,t} - 1/M)$) are granular. The sufficient statistic for the aggregate impact of idiosyncratic shocks is the variance of the weights, that is, $\sum_i w_i^2$ (see Gabaix, 2011; di Giovanni et al., 2014). Figure C.2 in the Appendix shows the distribution of these weights and the estimated variances. The weights of the consensus expectations, $\Delta w_{k,k',t}$, have a much higher standard deviation (by a factor of 2 orders of magnitude) than the weights of the investor-specific expectations, which explains the disproportionate contribution of consensus expectations.

The contribution of investor-specific expectations and of the granularity of investors is therefore negligible. This is an important insight, as the "average" structure of portfolios is what matters most, not the distribution of that structure across investors, nor the distribution of investor wealth. This is especially important for the external validity of our approach, since we only observe a fraction of portfolio allocations. The external validity of our approach only requires that these portfolios are representative of global portfolios, namely, that the weights $\Delta w_{k,k',t}$ computed using our sample resemble the weights we would obtain using a broader sample of investors.[10]

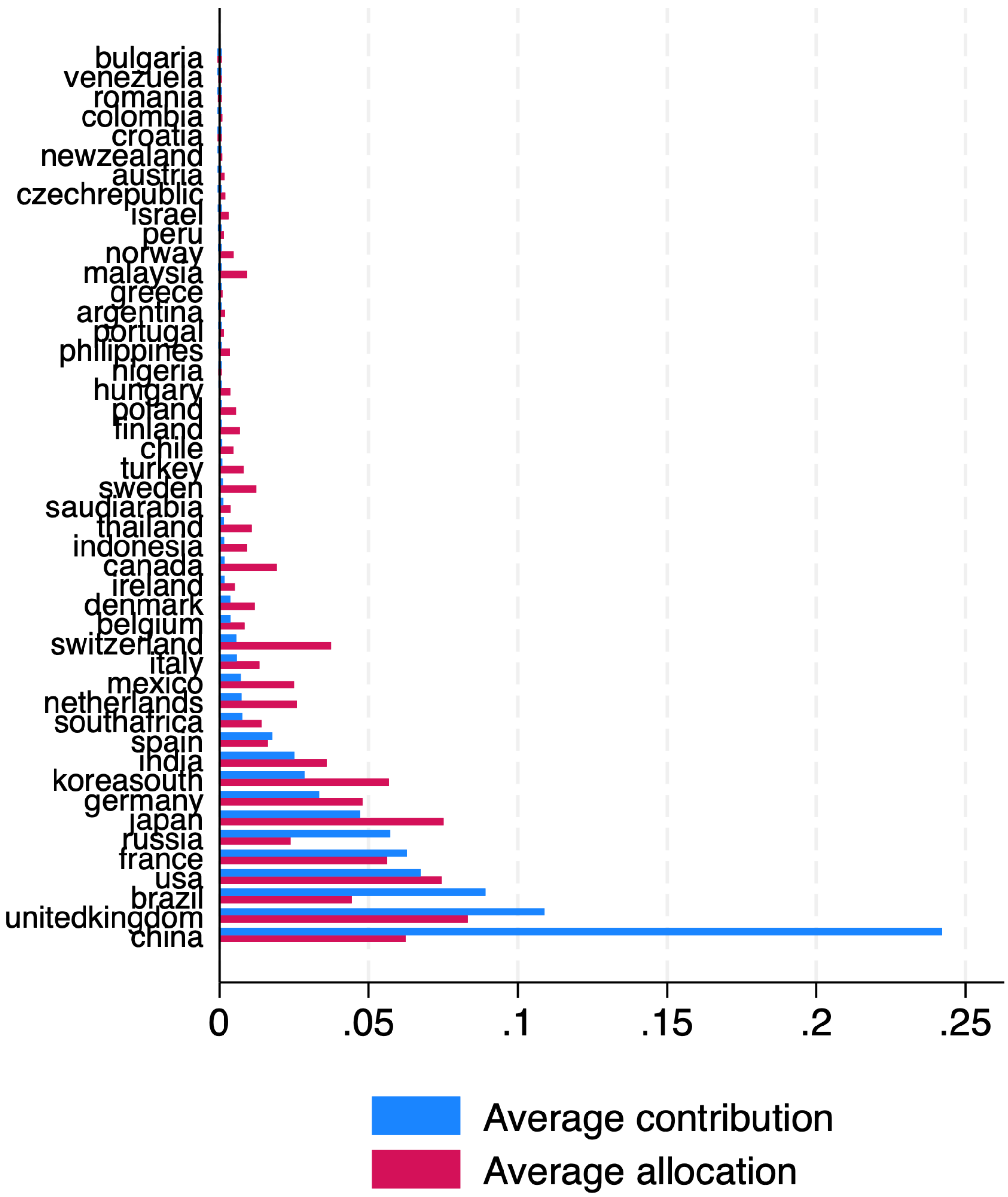
Contributors Some countries are important contributors to co-ownership spillovers. Noting that the variance of country k co-ownership spillovers can be written as $\eta^2 V(\Gamma_k)$, and that $V(\Gamma_k) = \sum_{l=1}^{K}(\Delta w_{k,l})^2 V(l_l)$, we compute a measure of the contribution of country k' to country k co-ownership spillovers as follows:

$$Contribution_{k,k'} = \frac{(\Delta w_{k,k'})^2 V(l_{k'})}{\sum_{l=1}^{K}(\Delta w_{k,l})^2 V(l_l)} \tag{41}$$

Figure 3 shows the average contribution of country k' across our sample, computed as $Contribution_{k'} = \sum_{k=1}^{K} \sigma_k Contribution_{k,k'}$. First, it appears that the large contributors are mostly countries with large allocations in portfolios. Among emerging economies, those are the BRICs (Brazil, Russian Federation, India, China), but also South Africa, South Korea and Mexico. Among advanced economies, those are the main G7 countries: UK, the US, France, Japan and Germany. Figures C.3 and C.4 explore the role of country size in portfolios. First, Figure C.3 shows that the variation in the contribution is driven mostly by the average absolute weights $|\Delta w_{k,k'}|$, not by the idiosyncratic volatility $V(l'_k)$. The country

[10] Assuming that the contribution of the investor-specific expectation will go to zero if the number of investors goes to infinity, the expectation-driven capital reallocation will only be due to the consensus expectations. We represent the corresponding decomposition obtained without the investor-specific component of our imputed expectations. This is done in Figure C.1 in the Appendix. The contribution of the co-ownership spillovers is very close to our baseline results.

Figure 3: Contributors to co-ownership spillovers



Note: The figure represents the scatter plot of the average weights $w_k = \sum_{i=1}^{M} \sigma_k^i w_k^i$ against the average contributions $Contribution_k = \sum_{k'=1}^{K} \sigma_{k'} Contribution_{k',k}$.

volatility is not per se a systematic source of contribution. For instance, Nigeria, Argentina, Greece and Venezuela, have volatile expectations but do not contribute meaningfully to co-ownership spillovers. On the opposite, the average absolute weights are a key driver of the contributions. These average absolute weights, on the other hand, are highly correlated with the average shares in portfolios, resulting in a high correlation between the average portfolio shares and the contributions, as Figure C.4 shows.

However, note that having a large share of portfolios is neither a sufficient nor a necessary condition to contribute meaningfully to co-ownership spillovers. Take Japan for instance. Japan has the second largest share in portfolios, with about 7.5% of the total allocations, and is only the seventh contributor. China, on the other hand, accounts for 23% of spillovers, with 6.5% of total allocations. This is partly due to differences in idiosyncratic volatility $V(l_k)$). Figure C.5 in the Appendix shows a similar figure when we assume that all countries have the same volatility. In that case, contributions are more directly in line with the average portfolio shares, with Japan rising to the fourth place. However, China, Brazil and Russia still have out-sized contributions relative to their average portfolio shares. This is because the spillovers do not depend directly on the total allocations, but on the deviation of the fund-level allocations from that total allocation. Countries that have a regional or emerging economy status will be part of more regional, specialized, and less diversified portfolios, and will have a relatively higher contribution.

Figure C.6 in the Appendix represents the detailed co-ownership linkages $\Delta w_{k',k}$ for selected big contributors. These co-ownership linkages can be negative or positive, because they are based on the difference between the allocation of contributor countries in a given fund $w_k^{i,j}$ and the share of that country in the whole investor portfolio w_k^i. A country will contribute positively to another country if it constitutes a large share in the co-owning funds, relative to the investor average. That is, when the contributor and recipient are typically co-owned by specialized funds. The UK, China and Brazil have large positive co-ownership linkages, reflecting their importance in regional funds. Indeed, the UK typically generates positive spillovers to other European countries, while China generates positive spillovers to Asian countries, and Brazil to Latin American countries. The US, because it is typically not involved in regional or specialized portfolios (except with Canada), does not generate large positive spillovers. On the contrary, it typically generate negative spillovers, because the US constitute a large share of investors' portfolios on average. A positive shock to the US drives capital away from other countries, and these capital outflows spill over to other countries. The larger a country share in global portfolios, the larger these negative spillovers.

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A Proofs

A.1 The investor's optimal asset allocation

We proceed to solving the investors' program and derive Equations (11) and (12).

Maximizing (10) with respect to $a^{i,j}$, subject to (9), yields the following first-order condition:

$$
\begin{aligned}
E^i(R_p^{i,j}) - r &= \gamma \sum_{j'=1}^{\mathcal{J}(i)} a^{i,j'} Cov(R_p^{i,j}, R_p^{i,j'}) \\
&= \gamma \left(a^{i,j} V(R_p^{i,j}) + \left(\sum_{j'=1}^{\mathcal{J}(i)} a^{i,j'} - a^{i,j} \right) \sum_{j'=1, j' \neq j}^{\mathcal{J}(i)} \frac{a^{i,j'}}{\sum_{j'=1,j'\neq j}^{\mathcal{J}(i)} a^{i,j'}} Cov(R_p^{i,j}, R_p^{i,j'}) \right) \\
&= \gamma \left(a^{i,j} V(R_p^{i,j}) + \left(\sum_{j'=1}^{\mathcal{J}(i)} a^{i,j'} - a^{i,j} \right) Cov \left(R_p^{i,j}, \underbrace{\sum_{j'=1, j' \neq j}^{\mathcal{J}(i)} \frac{a^{i,j'}}{\sum_{j'=1,j'\neq j}^{\mathcal{J}(i)} a^{i,j'}} R_p^{i,j'}}_{\mathcal{R}_p^{i,j-}} \right) \right)
\end{aligned} \tag{42}
$$

This yields Equation (12).

Equation (11) is obtained either by taking the sum of the above first-order condition across funds, weighted by $a^{i,j} / \sum_{j=1}^{\mathcal{J}(i)} a^{i,j}$, or by taking the derivative of (10) with respect to $\sum_{j=1}^{\mathcal{J}(i)} a^{i,j}$.

A.2 The fund's optimal asset allocation

We proceed to solving the fund's program and derive Equations (14).

Maximizing (10) with respect to $w_k^{i,j}$, subject to (9) and (13), yields the following first-order condition for any $(k, K) \in \mathcal{S}(i,j)^2$ pair of countries in the fund's portfolio:

$$
\begin{aligned}
\big(E^i(R_k) - E^i(R_K)\big) &= \gamma \sum_{j=j'}^{\mathcal{J}(i)} a^{i,j'} \left(\sum_{k' \in \mathcal{S}(i,j)} w_{k'}^{i,j'} Cov(R_k, R'_k) - \sum_{k' \in \mathcal{S}(i,j)} w_{k'}^{i,j'} Cov(R_K, R'_k) \right) \\
&= \gamma \sum_{j=j'}^{\mathcal{J}(i)} a^{i,j'} \left(\sum_{k' \in \mathcal{S}(i,j)} w_{k'}^{i,j'} Cov(R_k, R'_k) - \sum_{k' \in \mathcal{S}(i,j)} w_{k'}^{i,j'} Cov(R_K, R'_k) \right)
\end{aligned}
$$

Noting that this is true for all $K \in \mathcal{S}(i,j)$, this can be written in vector form as follows:

$$Id(i,j)\left[E^i(R_k) - E^i(R)\right] = \gamma Id(i,j)(V_k^R - V^R)W^i a^i \tag{43}$$

where $W^i = (w^{i,1}, .., w^{i,j}, .., w^{i,\mathcal{J}(i)}$ is a $K \times \mathcal{J}(i)$ matrix of portfolio weights, $Id(i,j)$ is a $K \times K$ diagonal matrix, where the k^{th} element of the diagonal is equal to one if $k \in \mathcal{S}(i,j)$, and zero otherwise. For $k' \notin \mathcal{S}(i,j)$, $w_{k'}^{i,j} = 0$. Therefore, $w^{i,j'} Id(i,j) = w^{i,j'}$.

Left-multiplying by $w^{i,j'}$, we obtain

$$E^i(R_k) - E^i(R_p^{i,j}) = \gamma w^{i,j'}(V_k^R - V^R)W^i a^i \tag{44}$$

Note that (42) can also be written in a vector form:

$$E^i(R_p^{i,j}) - r = \gamma w^{i,j'} V^R W^i a^i$$

Substituting into (44), we obtain

$$\begin{aligned}
&E^i(R_k) - r = \gamma w^{i,j'} V_k^R W^i a^i \\
&= \gamma \sum_{j'=1}^{\mathcal{J}(i)} a^{i,j'} \sum_{k' \in \mathcal{S}(i,j')} w_{k'}^{i,j'} Cov(R_k, R_{k'}) \\
&= \gamma \left(a^{i,j} \sum_{k' \in \mathcal{S}(i,j)} w_{k'}^{i,j} Cov(R_k, R_{k'}) + \left(\sum_{j'=1}^{\mathcal{J}(i)} a^{i,j'} - a^{i,j} \right) \underbrace{\sum_{j'=1, j' \neq j}^{\mathcal{J}(i)} \frac{a^{i,j'}}{\sum_{j'=1, j' \neq j}^{\mathcal{J}(i)} a^{i,j'}} \underbrace{\sum_{k' \in \mathcal{S}(i,j')} w_{k'}^{i,j'} Cov(R_k, R_{k'})}_{Cov(R_k, R_p^{i,j'})}}_{Cov(R_k, \mathcal{R}_p^{i,j-})} \right) \\
&= \gamma \left(a^{i,j} \left(w_k^{i,j} V(R_k) + (1 - w_k^{i,j}) \underbrace{\sum_{k' \in \mathcal{S}(i,j), k' \neq k} \frac{w_{k'}^{i,j}}{1 - w_k^{i,j}} Cov(R_k, R_{k'})}_{Cov(R_k, R_{p,k-}^{i,j})} \right) + \left(\sum_{j'=1}^{\mathcal{J}(i)} a^{i,j'} - a^{i,j} \right) Cov(R_k, \mathcal{R}_p^{i,j-}) \right)
\end{aligned}$$

This yields Equation (14).

A.3 Proof of Proposition 4.1

We follow similar steps as in A.2 to derive the default shares $\bar{w}_k^{i,j}$, taking into account the fact that the fund investments $a^{i,j}$ are not known:

$$\bar{w}^{i,j} = \frac{\bar{E}^i(R_k) - r}{\gamma \bar{V}_k^{i,j} \bar{E}^i(a^{i,j})} - \overline{Cov}_k^{i,j} \frac{\left(\sum_{j=1}^{\mathcal{J}(i)} \bar{E}^i(a^{i,j})\right)}{\bar{E}^i(a^{i,j})} - \overline{\Delta Cov}_k^{i,j}$$

with $\bar{V}_k^{i,j} = \overline{Cov}(R_k, R_k - R_{p,k-}^{i,j})$, $\overline{Cov}_k^{i,j} = \overline{Cov}(R_k, \mathcal{R}_p^{i,j-})/\bar{V}_k^{i,j}$ and $\overline{\Delta Cov}_k^{i,j} = \left(\overline{Cov}(R_k, R_{p,k-}^{i,j}) - \overline{Cov}(R_k, \mathcal{R}_p^{i,j-})\right)/\bar{V}_k^{i,j}$. $\bar{V}(.)$ and $\overline{Cov}(.)$ are the variance and covariance conditional on the beginning-of-period information $\bar{\mathcal{I}}^i$.

Under Assumption 4.1, this equation can be approximated as follows:

$$\bar{w}^{i,j} = \frac{\bar{E}^i(R_k) - r}{\gamma V_k^{i,j} \bar{E}^i(a^{i,j})} - Cov_k^{i,j} \frac{\left(\sum_{j=1}^{\mathcal{J}(i)} \bar{E}^i(a^{i,j})\right)}{\bar{E}^i(a^{i,j})} - \Delta Cov_k^{i,j} \tag{45}$$

Using the definition of $a_k^{i,j}$, (15), the optimal updated and ex ante allocations, (14) and (45), we obtain:

$$\begin{aligned}
a_k^{i,j} =& p\left(\frac{E^i(R_k) - r}{\gamma V_k^{i,j}} - Cov_k^{i,j}\left(\sum_{j=1}^{\mathcal{J}(i)} a^{i,j}\right) - \Delta Cov_k^{i,j} a^{i,j}\right) \\
&+ (1-p)\left(\frac{\bar{E}^i(R_k) - r}{\gamma V_k^{i,j} \bar{E}^i(a^{i,j})} - Cov_k^{i,j} \frac{\left(\sum_{j=1}^{\mathcal{J}(i)} \bar{E}^i(a^{i,j})\right)}{\bar{E}^i(a^{i,j})} - \Delta Cov_k^{i,j}\right) a^{i,j} \\
=& p\left(\frac{E^i(R_k) - r}{\gamma V_k^{i,j}} - Cov_k^{i,j}\left(\sum_{j=1}^{\mathcal{J}(i)} a^{i,j}\right)\right) \\
&+ (1-p)\left(\frac{\bar{E}^i(R_k) - r}{\gamma V_k^{i,j} \bar{E}^i(a^{i,j})} - Cov_k^{i,j} \frac{\left(\sum_{j=1}^{\mathcal{J}(i)} \bar{E}^i(a^{i,j})\right)}{\bar{E}^i(a^{i,j})}\right) a^{i,j} - \Delta Cov_k^{i,j} a^{i,j}
\end{aligned} \tag{46}$$

We take the beginning-of-period expectation, and subtract it:

$$
\begin{aligned}
a_k^{i,j} - \bar{E}^i(a_k^{i,j}) =& p\left(\frac{E^i(r_k)}{\gamma V_k^{i,j}} - Cov_k^{i,j}\left(\sum_{j=1}^{\mathcal{J}(i)} a^{i,j} - \sum_{j=1}^{\mathcal{J}(i)} E^i(a^{i,j})\right)\right)\\
&+ (1-p)\left(\frac{\bar{E}^i(R_k)-r}{\gamma V_k^{i,j}\bar{E}^i(a^{i,j})} - Cov_k^{i,j}\frac{\left(\sum_{j=1}^{\mathcal{J}(i)}\bar{E}^i(a^{i,j})\right)}{\bar{E}^i(a^{i,j})}\right)\left(a^{i,j} - \bar{E}^i(a^{i,j})\right)\\
&- \Delta Cov_k^{i,j}\left(a^{i,j} - \bar{E}^i(a^{i,j})\right)
\end{aligned}
$$

Using (11) and (12), we obtain:

$$
\begin{aligned}
a_k^{i,j} - \bar{E}^i(a_k^{i,j}) =& p\left(\frac{E^i(r_k)}{\gamma V_k^{i,j}} - Cov_k^{i,j}\frac{E^i(\mathfrak{r}_p^i)}{\gamma V^i}\right)\\
&+ (1-p)\left(\frac{\bar{E}^i(R_k)-r}{\gamma V_k^{i,j}\bar{E}^i(a^{i,j})} - Cov_k^{i,j}\frac{\left(\sum_{j=1}^{\mathcal{J}(i)}\bar{E}^i(a^{i,j})\right)}{\bar{E}^i(a^{i,j})}\right)\left(\frac{E^i(r_p^{i,j})}{\gamma V^{i,j}} - Cov^{i,j}\frac{E^i(\mathfrak{r}_p^i)}{\gamma V^i}\right)\\
&- \Delta Cov_k^{i,j}\left(\frac{E^i(r_p^{i,j})}{\gamma V^{i,j}} - Cov^{i,j}\frac{E^i(\mathfrak{r}_p^i)}{\gamma V^i}\right)\\
=& p\frac{E^i(r_k)}{\gamma V_k^{i,j}} + (1-p)\frac{\bar{a}_k^{i,j}}{\bar{E}^i(a^{i,j})}\frac{E^i(r_p^{i,j})}{\gamma V^{i,j}} - \Delta Cov_k^{i,j}\frac{E^i(r_p^{i,j})}{\gamma V^{i,j}}\\
&- \left(Cov_k^{i,j} - \Delta Cov_k^{i,j}Cov^{i,j}\right)\frac{E^i(\mathfrak{r}_p^i)}{\gamma V^i} - (1-p)\left(\frac{\bar{a}_k^{i,j}}{\bar{E}^i(a^{i,j})}Cov^{i,j} - Cov_k^{i,j}\right)\frac{E^i(\mathfrak{r}_p^i)}{\gamma V^i}
\end{aligned}
$$

with $\bar{a}_k^{i,j} = (\bar{E}^i(R_k)-r)/\gamma V_k^{i,j} - Cov_k^{i,j}\left(\sum_{j=1}^{\mathcal{J}(i)}\bar{E}^i(a^{i,j})\right)$.

Finally, the beginning-of-period expectation of $a_k^{i,j}$ obtained from (46) is $\bar{E}^i(a_k^{i,j}) = (\bar{E}^i(R_k)-r)/\gamma V_k^{i,j} - Cov_k^{i,j}\left(\sum_{j=1}^{\mathcal{J}(i)}\bar{E}^i(a^{i,j})\right) - \Delta Cov_k^{i,j}\bar{E}^i(a^{i,j})$. Then we take the beginning-of-period expectations of $a^{i,j}$ and $\sum_{j=1}^{\mathcal{J}(i)} a^{i,j}$ by using (12) and (11) and obtain $\bar{E}^i(a^{i,j}) = (\bar{E}^i(R_p^{i,j})-r)/\gamma V^{i,j} - Cov^{i,j}\left(\sum_{j=1}^{\mathcal{J}(i)}\bar{E}^i(a^{i,j})\right)$ and $\sum_{j=1}^{\mathcal{J}(i)}\bar{E}^i(a^{i,j}) = (\bar{E}^i(\mathcal{R}_p^i)-r)/\gamma V^i$. This yields Proposition 4.1.

A.4 Proof of Proposition 4.2

Using Assumption 4.2, the surprise capital flows (17) admit the following decomposition:

$$
\frac{a_k^{i,j} - \bar{E}^i(a_k^{i,j})}{\bar{E}^i(a_k^{i,j})} = \beta_k^{i,j} l_k^i + \delta_k^{i,j}\Gamma^{i,j} + \theta_k^{i,j}\Gamma^i + \Theta_k^{i,j} W^i
$$

with $\Theta_k^{i,j} = \beta_k^{i,j} + \delta_k^{i,j} + \theta_k^{i,j}$.

We replace in Equation (20):

$$\frac{a_k - \bar{E}(a_k)}{\bar{E}(a_k)} = \sum_{i=1}^{M} \sigma_k^i \sum_{j=1}^{\mathcal{J}(i)} \sigma_k^{i,j} \left(\beta_k^{i,j} l_k^i + \delta_k^{i,j} \Gamma^{i,j} + \theta_k^{i,j} \Gamma^i + \Theta_k^{i,j} W^i \right)$$
$$= \sum_{i=1}^{M} \sigma_k^i \beta_k^i l_k^i + \sum_{i=1}^{M} \sigma_k^i \sum_{j=1}^{\mathcal{J}(i)} \sigma_k^{i,j} \delta_k^{i,j} \Gamma^{i,j} + \sum_{i=1}^{M} \sigma_k^i \theta_k^i \Gamma^i + \sum_{i=1}^{M} \sigma_k^i \Theta_k^i W^i$$

Note that

$$\sum_{j=1}^{\mathcal{J}(i)} \sigma_k^{i,j} \delta_k^{i,j} \Gamma^{i,j} = \delta_k^i \sum_{j=1}^{\mathcal{J}(i)} \sigma_k^{i,j} \Gamma^{i,j} + \underbrace{\sum_{j=1}^{\mathcal{J}(i)} \sigma_k^{i,j} (\delta_k^{i,j} - \delta_k^i) \Gamma^{i,j}}_{\simeq 0}$$

where we used Assumption 4.3. Therefore:

$$\frac{a_k - \bar{E}(a_k)}{\bar{E}(a_k)} \simeq \sum_{i=1}^{M} \sigma_k^i \beta_k^i l_k^i + \sum_{i=1}^{M} \sigma_k^i \delta_k^i \left(\sum_{j=1}^{\mathcal{J}(i)} \sigma_k^{i,j} \Gamma^{i,j} \right) + \sum_{i=1}^{M} \sigma_k^i \theta_k^i \Gamma^i + \sum_{i=1}^{M} \sigma_k^i \Theta_k^i W^i$$

Take the first term:

$$\sum_{i=1}^{M} \sigma_k^i \beta_k^i l_k^i = \beta_k \sum_{i=1}^{M} \sigma_k^i l_k^i + \underbrace{\sum_{i=1}^{M} \sigma_k^i (\beta_k^i - \beta_k) l_k^i}_{\simeq 0}$$

where we used Assumption 4.3 again. We apply similar steps to the other terms, and we obtain, using Assumption 4.3:

$$\frac{a_k - \bar{E}(a_k)}{\bar{E}(a_k)} \simeq \beta_k \left(\sum_{i=1}^{M} \sigma_k^i l_k^i \right) + \delta_k \left(\sum_{i=1}^{M} \sigma_k^i \sum_{j=1}^{\mathcal{J}(i)} \sigma_k^{i,j} \Gamma^{i,j} \right) + \theta_k \left(\sum_{i=1}^{M} \sigma_k^i \Gamma^i \right) + \Theta_k \left(\sum_{i=1}^{M} \sigma_k^i W^i \right) \tag{47}$$

We aggregate the country flows using Equation (47):

$$
\begin{aligned}
&\frac{a-\bar{E}(a)}{\bar{E}(a)} \\
&\simeq \sum_{k=1}^{K}\sigma_k\left(\beta_k\left(\sum_{i=1}^{M}\sigma_k^i l_k^i\right)+\delta_k\left(\sum_{i=1}^{M}\sigma_k^i\sum_{j=1}^{\mathcal{J}(i)}\sigma_k^{i,j}\Gamma^{i,j}\right)+\theta_k\left(\sum_{i=1}^{M}\sigma_k^i\Gamma^i\right)+\Theta_k\left(\sum_{i=1}^{M}\sigma_k^i W^i\right)\right) \\
&\simeq \sum_{k=1}^{K}\sigma_k\beta_k\left(\sum_{i=1}^{M}\sigma_k^i l_k^i\right)+\sum_{k=1}^{K}\sigma_k\delta_k\left(\sum_{i=1}^{M}\sigma_k^i\sum_{j=1}^{\mathcal{J}(i)}\sigma_k^{i,j}\Gamma^{i,j}\right)+\sum_{k=1}^{K}\sigma_k\theta_k\left(\sum_{i=1}^{M}\sigma_k^i\Gamma^i\right)+\sum_{k=1}^{K}\sigma_k\theta_k\Theta_k\left(\sum_{i=1}^{M}\sigma_k^i W^i\right)
\end{aligned}
$$

Take the first term:

$$
\begin{aligned}
\sum_{k=1}^{K}\sigma_k\beta_k\left(\sum_{i=1}^{M}\sigma_k^i l_k^i\right) &= \beta\sum_{k=1}^{K}\sigma_k\left(\sum_{i=1}^{M}\sigma_k^i l_k^i\right)+\sum_{k=1}^{K}\sigma_k(\beta_k-\beta)\left(\sum_{i=1}^{M}\sigma_k^i l_k^i\right) \\
&= \beta\sum_{i=1}^{M}\sum_{k=1}^{K}\sigma_k\sigma_k^i l_k^i+\underbrace{\sum_{k=1}^{K}\sigma_k(\beta_k-\beta)l_k}_{\simeq 0} \\
&\simeq \beta\sum_{i=1}^{M}\sigma^i\sum_{k=1}^{K}w_k^i l_k^i=\beta\sum_{i=1}^{M}\sigma^i\Gamma^i
\end{aligned}
$$

Take the second term:

$$
\begin{aligned}
\sum_{k=1}^{K} \sigma_k \delta_k \left(\sum_{i=1}^{M} \sigma_k^i \sum_{j=1}^{\mathcal{J}(i)} \sigma_k^{i,j} \Gamma^{i,j} \right) &= \delta \sum_{k=1}^{K} \sigma_k \left(\sum_{i=1}^{M} \sigma_k^i \sum_{j=1}^{\mathcal{J}(i)} \sigma_k^{i,j} \Gamma^{i,j} \right) + \sum_{k=1}^{K} \sigma_k (\delta_k - \delta) \left(\sum_{i=1}^{M} \sigma_k^i \sum_{j=1}^{\mathcal{J}(i)} \sigma_k^{i,j} \Gamma^{i,j} \right) \\
&= \delta \sum_{k=1}^{K} \sum_{i=1}^{M} \sum_{j=1}^{\mathcal{J}(i)} \sigma_k \sigma_k^i \sigma_k^{i,j} \Gamma^{i,j} + \underbrace{\sum_{k=1}^{K} \sigma_k (\delta_k - \delta) \Gamma_k}_{\simeq 0} \\
&\simeq \delta \sum_{i=1}^{M} \sum_{j=1}^{\mathcal{J}(i)} \sigma^i \sigma^{i,j} \Gamma^{i,j} \underbrace{\sum_{k \in \mathcal{S}(i,j)} w_k^{i,j}}_{=1} \\
&\simeq \delta \sum_{i=1}^{M} \sigma^i \sum_{j=1}^{\mathcal{J}(i)} \sigma^{i,j} \sum_{k \in \mathcal{S}(i,j)} w_k^{i,j} l_k^i \\
&\simeq \delta \sum_{i=1}^{M} \sigma^i \sum_{j=1}^{\mathcal{J}(i)} \sum_{k \in \mathcal{S}(i,j)} \sigma^{i,j} w_k^{i,j} l_k^i \\
&\simeq \delta \sum_{i=1}^{M} \sigma^i \sum_{k=1}^{K} l_k^i \sum_{j=1}^{\mathcal{J}(i)} \sigma^{i,j} w_k^{i,j} \\
&\simeq \delta \sum_{i=1}^{M} \sigma^i \sum_{k=1}^{K} w_k^i l_k^i \\
&\simeq \delta \sum_{i=1}^{M} \sigma^i \Gamma^i
\end{aligned}
$$

Take the third term:

$$
\begin{aligned}
\sum_{k=1}^{K} \sigma_k \theta_k \left(\sum_{i=1}^{M} \sigma_k^i \Gamma^i \right) &= \theta \sum_{k=1}^{K} \sigma_k \left(\sum_{i=1}^{M} \sigma_k^i \Gamma^i \right) + \sum_{k=1}^{K} \sigma_k (\theta_k - \theta) \left(\sum_{i=1}^{M} \sigma_k^i \Gamma^i \right) \\
&= \theta \sum_{k=1}^{K} \sum_{i=1}^{M} \sigma_k \sigma_k^i \Gamma^i + \underbrace{\sum_{k=1}^{K} \sigma_k (\theta_k - \theta) \Gamma_k}_{\simeq 0} \\
&\simeq \theta \sum_{i=1}^{M} \Gamma^i \sum_{k=1}^{K} \sigma_k \sigma_k^i \\
&\simeq \theta \sum_{i=1}^{M} \sigma^i \Gamma^i
\end{aligned}
$$

We follow similar steps for the fourth term and find

$$\sum_{k=1}^{K} \sigma_k \Theta_k \left(\sum_{i=1}^{M} \sigma_k^i W^i \right) \simeq \Theta \sum_{i=1}^{M} \sigma^i W^i$$

Noting that $\Theta = \beta + \delta + \theta$, aggregate capital flows can be written as

$$\frac{a - \bar{E}(a)}{\bar{E}(a)} \simeq \Theta \sum_{i=1}^{M} \sigma^i (W^i + \Gamma^i) \tag{48}$$

Combining (47) and (48) yields the decomposition (27).

A.5 Proof of Corollary 4.2

Consider Assumption 4.4. Denote

$$\Delta^i \simeq \bar{E}^i(R_k) \simeq \bar{E}^i(R_p^{i,j}) \simeq \bar{E}^i(\mathcal{R}_p^i)$$

$$\rho^{i,j}(R_k, \mathcal{R}_p^{i,j-})(R_p^{i,j}, \mathcal{R}_p^{i,j-})$$

Then, notice that

$$V_k^{i,j} \bar{a}_k^{i,j} \simeq V^{i,j} \bar{E}^i(a^{i,j}) \simeq \frac{\Delta^i}{\gamma} \left(1 - \frac{\rho^{i,j}}{V^i}\right) \tag{49}$$

Similarly,

$$V_k^{i,j} Cov_k^{i,j} \simeq V^{i,j} Cov^{i,j} \simeq \rho^{i,j} \tag{50}$$

Consider $\beta_k^{i,j}$ and $\delta_k^{i,j}$ as defined in Corollary 4.1. $\beta_k^{i,j}$ is increasing in p and $\delta_k^{i,j}$ is decreasing in p. This will be true for any weighted average of $\beta_k^{i,j}$ and $\delta_k^{i,j}$, which proves (i).

To prove (ii), consider $\beta_k^{i,j} + \delta_k^{i,j}$:

$$\begin{aligned}
\beta_k^i + \delta_k^i =& \frac{pV^{i,j}\bar{E}^i(a^{i,j}) + (1-p)V_k^{i,j}\bar{a}_k^{i,j}}{\gamma V_k^{i,j} V^{i,j} \bar{E}^i(a_k^{i,j}) \bar{E}^i(a^{i,j})} - \frac{\Delta Cov_k^{i,j}}{\gamma V^{i,j} \bar{E}^i(a_k^{i,j})} \\
\simeq& \frac{p\frac{\Delta^i}{\gamma}\left(1 - \frac{\rho^{i,j}}{V^i}\right) + (1-p)\frac{\Delta^i}{\gamma}\left(1 - \frac{\rho^{i,j}}{V^i}\right)}{\gamma V_k^{i,j} V^{i,j} \bar{E}^i(a_k^{i,j}) \bar{E}^i(a^{i,j})} - \frac{\Delta Cov_k^{i,j}}{\gamma V^{i,j} \bar{E}^i(a_k^{i,j})}
\end{aligned}$$

where we used (49). Therefore,

$$\beta_k^i + \delta_k^i \simeq \frac{\Delta^i \left(1 - \frac{\rho^{i,j}}{V^i}\right)}{\gamma^2 V_k^{i,j} V^{i,j} \bar{E}^i(a_k^{i,j}) \bar{E}^i(a^{i,j})} - \frac{\Delta Cov_k^{i,j}}{\gamma V^{i,j} \bar{E}^i(a_k^{i,j})}$$

which is independent of p.

Now consider $\theta_k^{i,j}$:

$$\theta_k^{i,j} = -\frac{\widetilde{Cov}_k^{i,j} + (1-p)\left(Cov^{i,j}\bar{a}_k^{i,j}/\bar{E}^i(a^{i,j}) - Cov_k^{i,j}\right)}{\gamma V^i}$$

It is enough to show that $Cov^{i,j}\bar{a}_k^{i,j}/\bar{E}^i(a^{i,j}) - Cov_k^{i,j}$ is close to zero.

$$\begin{aligned}
Cov^{i,j}\frac{\bar{a}_k^{i,j}}{\bar{E}^i(a^{i,j})} - Cov_k^{i,j} &= \frac{V^{i,j}Cov^{i,j}V_k^{i,j}\bar{a}_k^{i,j} - V_k^{i,j}Cov_k^{i,j}V^{i,j}\bar{E}^i(a^{i,j})}{V^{i,j}V_k^{i,j}\bar{E}^i(a^{i,j})} \\
&\simeq \frac{\rho^{i,j}(V_k^{i,j}\bar{a}_k^{i,j} - V^{i,j}\bar{E}^i(a^{i,j}))}{V^{i,j}V_k^{i,j}\bar{E}^i(a^{i,j})} \\
&\simeq 0
\end{aligned}$$

where we used (49) and (50). Since $\Theta_k^{i,j} = \beta_k^{i,j} + \delta_k^{i,j} + \theta_k^{i,j}$, this proves implies that $\Theta_k^{i,j}$ is independent of p. This will be true for any weighted average of $\Theta_k^{i,j}$, which proves (ii).

Now we consider $\beta_k^{i,j}/\eta_k^{i,j}$:

$$\frac{\beta_k^{i,j}}{\eta_k^{i,j}} = \frac{p\frac{1}{\gamma V_k^{i,j}\bar{E}^i(a_k^{i,j})}}{(1-p)\frac{\bar{a}_k^{i,j}}{\gamma V^{i,j}\bar{E}^i(a^{i,j})\bar{E}^i(a_k^{i,j})}} = \frac{pV^{i,j}\bar{E}^i(a^{i,j})}{(1-p)V_k^{i,j}\bar{a}_k^{i,j}} \simeq \frac{p}{1-p}$$

where we used (49). Therefore, $(1-p)\beta_k^i \simeq p\eta_k^i$. This will be true of any weighted average of β_k^i and η_k^i, which proves result (iii).

Finally, note that under Assumption 4.4, the coefficients $\beta_k^{i,j}$, $\delta_k^{i,j}$, $\eta_k^{i,j}$, $\theta_k^{i,j}$ and $\Theta_k^{i,j}$ are homogeneous across countries $\beta_k^{i,j} \simeq \beta^{i,j}$, $\delta_k^{i,j} \simeq \delta^{i,j}$, $\theta_k^{i,j} \simeq \theta^{i,j}$, $\eta_k^{i,j} \simeq \eta^{i,j}$ and $\Theta_k^{i,j} \simeq \Theta^{i,j}$.

To prove coefficient homogeneity, note that Assumption 4.4 implies $V_k^{i,j}\Delta Cov_k^{i,j} = V_{k'}^{i,j}\Delta Cov_{k'}^{i,j}$ for all $k' \neq k$. Let's denote

$$V_k^{i,j}\Delta Cov_k^{i,j} = \Delta\rho^{i,j} \tag{51}$$

Now, we can rewrite the coefficients as follows

$$
\begin{aligned}
\beta_k^{i,j} =& \frac{p}{\gamma V_k^{i,j} \bar{E}^i(a_k^{i,j})} \simeq \frac{p}{\Delta^i \left(1 - \frac{\rho^{i,j}}{V^i}\right)} = \beta^{i,j} \\
\eta_k^{i,j} =& (1-p) \frac{\bar{a}_k^{i,j}}{\gamma V^{i,j} \bar{E}^i(a^{i,j}) \bar{E}^i(a_k^{i,j})} = (1-p) \frac{V_k^{i,j} \bar{a}_k^{i,j}}{\gamma V^{i,j} \bar{E}^i(a^{i,j}) V_k^{i,j} \bar{E}^i(a_k^{i,j})} \\
\simeq& \frac{1-p}{\gamma V_k^{i,j} \bar{E}^i(a_k^{i,j})} \simeq \frac{1-p}{\Delta^i \left(1 - \frac{\rho^{i,j}}{V^i}\right) - \Delta \rho^{i,j} \bar{E}^i(a^{i,j})} = \eta^{i,j} \\
\delta_k^{i,j} =& \eta_k^{i,j} - \frac{\Delta Cov_k^{i,j}}{\gamma V^{i,j} \bar{E}^i(a_k^{i,j})} = \eta_k^{i,j} - \frac{V_k^{i,j} \Delta Cov_k^{i,j}}{\gamma V^{i,j} V_k^{i,j} \bar{E}^i(a_k^{i,j})} \simeq \eta^{i,j} - \frac{\Delta \rho^{i,j}}{V^{i,j} \left(\Delta^i \left(1 - \frac{\rho^{i,j}}{V^i}\right) - \Delta \rho^{i,j} \bar{E}^i(a^{i,j})\right)} = \delta^{i,j} \\
\theta_k^{i,j} =& -\frac{\widetilde{Cov}_k^{i,j}}{\gamma V^i \bar{E}^i(a_k^{i,j})} - (1-p) \frac{Cov^{i,j} \bar{a}_k^{i,j} / \bar{E}^i(a^{i,j}) - Cov_k^{i,j}}{\gamma V^i \bar{E}^i(a_k^{i,j})} \simeq -\frac{\widetilde{Cov}_k^{i,j}}{\gamma V^i \bar{E}^i(a_k^{i,j})} \simeq -\frac{Cov_k^{i,j} - Cov^{i,j} \Delta Cov_k^{i,j}}{\gamma V^i \bar{E}^i(a_k^{i,j})} \\
\simeq& -\frac{V_k^{i,j} Cov_k^{i,j} - Cov^{i,j} V_k^{i,j} \Delta Cov_k^{i,j}}{\gamma V^i V_k^{i,j} \bar{E}^i(a_k^{i,j})} \simeq -\frac{\rho^{i,j} - Cov^{i,j} \Delta \rho^{i,j}}{V^i \left(\Delta^i \left(1 - \frac{\rho^{i,j}}{V^i}\right) - \Delta \rho^{i,j} \bar{E}^i(a^{i,j})\right)} = \theta^{i,j}
\end{aligned}
$$

which also implies that $\Theta_k^{i,j} = \beta_k^{i,j} + \delta_k^{i,j} + \theta_k^{i,j} \simeq \beta^{i,j} + \delta^{i,j} + \theta^{i,j} \simeq \Theta^{i,j}$. Within a fund, all the coefficients are homogeneous across countries.

We now aggregate the country-specific coefficients across funds. For country $k = 1, .., K$, we have

$$\beta_k = \sum_{i=1}^{M} \sigma_k^i \sum_{j=1}^{\mathcal{J}(i)} \sigma_k^{i,j} \beta_k^{i,j} \simeq \sum_{i=1}^{M} \sigma_k^i \sum_{j=1}^{\mathcal{J}(i)} \sigma_k^{i,j} \beta^{i,j} \simeq \beta + \sum_{i=1}^{M} \sigma_k^i \sum_{j=1}^{\mathcal{J}(i)} \sigma_k^{i,j} (\beta^{i,j} - \beta)$$

where

$$\beta = \sum_{k=1}^{K} \sigma_k \beta_k$$

Consider the second term:

$$\begin{aligned}
\sum_{i=1}^{M}\sigma_k^i\sum_{j=1}^{\mathcal{J}(i)}\sigma_k^{i,j}(\beta^{i,j}-\beta) &= \sum_{i=1}^{M}\sum_{j=1}^{\mathcal{J}(i)}\sigma_k^i\sigma_k^{i,j}\beta^{i,j}-\sum_{k'=1}^{K}\sigma_{k'}\sum_{i=1}^{M}\sum_{j=1}^{\mathcal{J}(i)}\sigma_{k'}^i\sigma_{k'}^{i,j}\beta^{i,j} \\
&= \sum_{i=1}^{M}\sum_{j=1}^{\mathcal{J}(i)}\underbrace{\sigma_k^i\sigma_k^{i,j}}_{\frac{\bar{E}^i(a_k^{i,j})\Omega^i}{\bar{E}^i(a_k)\Omega}}\beta^{i,j}-\sum_{i=1}^{M}\sum_{j=1}^{\mathcal{J}(i)}\beta^{i,j}\underbrace{\sum_{k'=1}^{K}\underbrace{\sigma_{k'}\sigma_{k'}^i\sigma_{k'}^{i,j}}_{\frac{\bar{E}^i(a_k^{i,j})\Omega^i}{\bar{E}^i(a)\Omega}}}_{\frac{\bar{E}^i(a^{i,j})\Omega^i}{\bar{E}^i(a)\Omega}} \\
&= \sum_{i=1}^{M}\sum_{j=1}^{\mathcal{J}(i)}\left(\frac{\bar{E}^i(a_k^{i,j})\Omega^i}{\bar{E}^i(a_k)\Omega}-\frac{\bar{E}^i(a^{i,j})\Omega^i}{\bar{E}^i(a)\Omega}\right)\beta^{i,j} \\
&= \sum_{i=1}^{M}\sum_{j=1}^{\mathcal{J}(i)}\left(\frac{\bar{E}^i(A_k^{i,j})}{\bar{E}^i(A_k)}-\frac{\bar{E}^i(A^{i,j})}{\bar{E}^i(A)}\right)\beta^{i,j} \\
&\simeq 0
\end{aligned}$$

where we used Assumption 4.4. Therefore, $\beta_k \simeq \beta$. The same steps apply to show that $\beta_k \simeq \beta$, $\eta_k \simeq \beta$, $\delta_k \simeq \beta$ and $\Theta_k \simeq \Theta$. This proves coefficient homogeneity.

B Data Appendix

B.1 Estimation of $\Delta Cov_k^{i,j}$

According to Lemma 4.2, $\Delta Cov_k^{i,j}$ is the difference between the scaled covariance of the country return k with the fund-level return excluding country k $Cov(R_k, R_{p,k^-}^{i,j})/V_k^{i,j}$ and the scaled covariance of the country return k with the investor-level return excluding fund j and $Cov(R_k, \mathcal{R}_{p,j^-}^{i,j})/V_k^{i,j}$, where $V_k^{i,j} = Cov(R_k, R_k - R_{p,k-}^{i,j})$. We proxy for these scaled covariances by using the country equity MSCI return data.

Define the aggregate fund-level return, the aggregate fund-level return excluding country

k and the aggregate investor-level return excluding fund j respectively as follows:

$$\begin{aligned}
R^{i,j}_{p,k-,t} &= \sum_{l\neq k, l\in\mathcal{S}(i,j)} \frac{w^{i,j}_{l,t}}{\sum_{l\neq k, l\in\mathcal{S}(i,j)} w^{i,j}_{l,t}} R_{l,t}, \\
R^{i,j}_{p,t} &= \sum_{l\in\mathcal{S}(i,j)} \frac{w^{i,j}_{l,t}}{\sum_{l\in\mathcal{S}(i,j)} w^{i,j}_{l,t}} R_{l,t}, \\
\mathcal{R}^{i}_{p,j-,t} &= \sum_{l\neq j, l=1}^{J(i)} \frac{A^{i,l}_{t}}{\sum_{l\neq j, l\in J(i)} A^{i,l}_{t}} R^{i,j}_{p,t},
\end{aligned} \tag{52}$$

where $w^{i,j}_{l,t}$ is mutual fund j's allocation to country l, $A^{i,l}_t$ is fund l total assets under management and $R_{l,t}$ is country l's equity MSCI return in month t. We then compute the covariances by country and fund pair, and compute $\Delta Cov^{i,j}_k$ as the differential

$$\Delta Cov^{i,j}_k = \frac{Cov(R_k, R^{i,j}_{p,k-})}{Cov(R_k, R_k - R^{i,j}_{p,k-})} - \frac{Cov(R_k, \mathcal{R}^{i,j}_{p,j-})}{Cov(R_k, R_k - R^{i,j}_{p,k-})}$$

and estimate $\Delta Cov^{i,j}$ as the weighted average at the fund-level:

$$\Delta Cov^{i,j}_t = \sum_{l\in K(i,j)} w^{i,j}_{l,t} \Delta Cov^{i,j}_k$$

where $w^{i,j}_{l,t}$ is the share of country l in the portfolio of fund j. In order to have a consistent estimation $\Delta Cov^{i,j}_t$, we exclude measures below the 5^{th} and above the 95^{th} percentiles. The sample size is only slightly reduced as compared to Table 1.

B.2 Summary Statistics for $\Delta Cov^{i,j}$

Table B.1: Summary Statistics for $\Delta Cov^{i,j}$

Variable	Mean	Median	S.D.	Min	Max
$\Delta Cov^{i,j}$	.07	.05	.17	-.31	.61

B.3 Imputation of Expectations

We assume that expectations are the sum of a year-specific term and a month-specific term that are independent from each other:

$$E_t^i(g_k^{\text{next year}}) = E_{year}^i(g_k^{\text{next year}}) + u_{year,month,k}^i \tag{53}$$

where $t = 12 \times year + month$. We make the identifying assumption that $E(u_{year,month,k}^i) = 0$, so that $E_{year}^i(g_k^{\text{next year}})$ can be estimated as $E_{year}^i(g_k^{\text{next year}}) = \frac{1}{12}\sum_{month=1}^{12} E_{year\times 12+month}^i(g_k^{\text{next year}})$, and $u_{year,month,k}^i = E_t^i(g_k^{\text{next year}}) - \frac{1}{12}\sum_{month=1}^{12} E_{year\times 12+month}^i(g_k^{\text{next year}})$.

The year-specific component $E_{year}^i(g_k^{j,\text{next year}})$ has three independent components: a country-time component, a country-investor component, and a year-country-investor-specific residual:

$$E_{year}^i(g_k^{\text{next year}}) = X_{k,year} + \zeta_k^i + v_{k,year}^i \tag{54}$$

Here as well, we make identifying assumption that $E(v_{k,year}^i) = 0$. We allow $v_{k,year}^i$ to be autocorrelated:

$$v_{k,year}^i = \rho^v v_{k,year-1}^i + \tilde{v}_{k,year}^i \tag{55}$$

with $v_{k,year}^i \sim N(0, \sigma_k^v)$. The autocorrelation parameter ρ^v is common across countries, but the variance of the innovation σ_k^v is country-specific.

We estimate Equation (54) using a fixed-effect regression. $X_{k,year}$ and ζ_k^i are estimated as the country-time and country-investor fixed effects. $v_{k,year}^i$ is estimated as the residual of the regression. We then fit the autoregressive process (55) on that residual to estimate ρ^v. The country-specific standard deviation σ_k^v is estimated as the standard deviation of the residuals of the autoregressive equation.

The month-specific component $u_{year,month,k}^i$ has two independent components: a country-time component and a residual specific to the investor:

$$u_{year,month,k}^i = Y_{year,month,k} + e_{year,month,k}^i \tag{56}$$

where we assume that both components are zero in expectations: $E(Y_{year,month,k}) = 0$ and $E(e_{year,month,k}^i) = 0$. We allow $e_{year,month,k}^i$ to be autocorrelated:

$$e_{year,month,k}^i = \rho^e e_{year,month-1,k}^i + \tilde{e}_{year,month,k}^i \tag{57}$$

with $e^i_{year,month,k} \sim N(0, \sigma^e_k)$. The autocorrelation parameter ρ^e is common across countries, but the variance of the innovation σ^e_k is country-specific.

We estimate Equation (56) using a fixed-effect regression. $Y_{k,year,month}$ are estimated as the country-time fixed effects. $e^i_{k,year,month}$ is estimated as the residual of the regression. We then fit the autoregressive process (57) on that residual to estimate ρ^e. The country-specific standard deviation σ^e_k is estimated as the standard deviation of the residuals of the autoregressive equation.

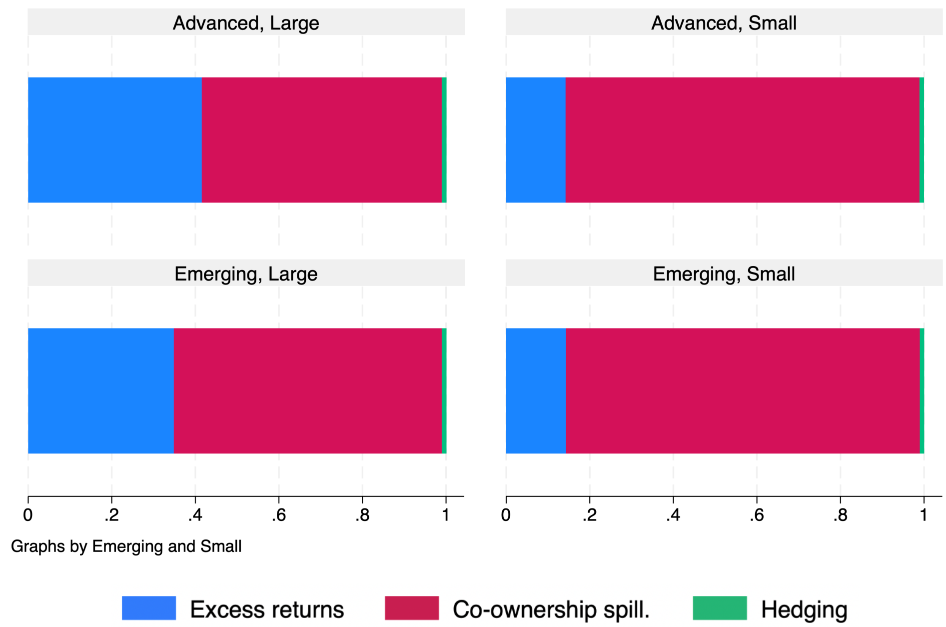
These estimations are performed on the subset of investors and countries for which we have expectation data. We then impute expectations for all the investors in our dataset as follows:

$$\widehat{E}^i_t(g_k^{\text{next year}}) = \widehat{X}_{k,year} + \widehat{v}^i_{k,year} + \widehat{Y}_{year,month,k} + \widehat{e}^i_{year,month,k} \tag{58}$$

where $\widehat{X}_{k,year}$ and $\widehat{Y}_{year,month,k}$ are the estimated fixed effects and $\widehat{v}^i_{k,year}$ and $\widehat{e}^i_{year,month,k}$ are either the residuals of Equations (54) and (56), if investor i has expectation data for country k, or they are simulated using the data-generating processes (55) and (57), using our estimates of ρ^v, ρ^e, σ^v_k and σ^e_k.

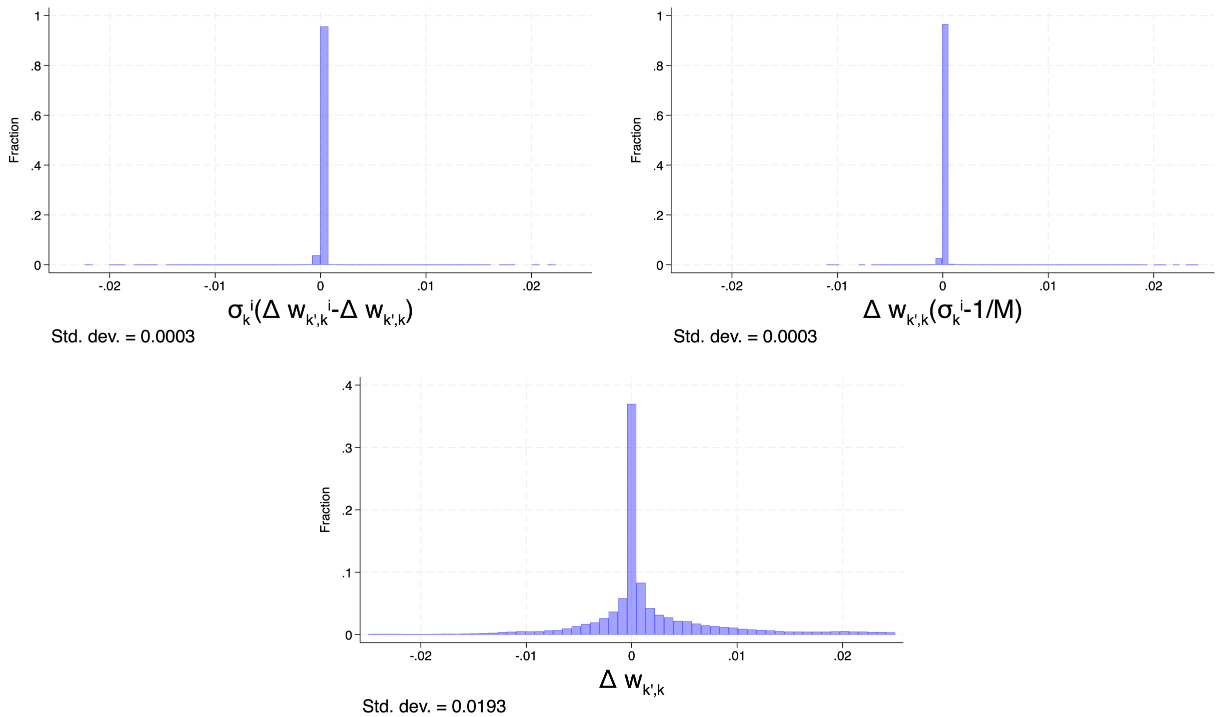
C Additional Figures

Figure C.1: Variance decomposition of expectation-driven capital flows - Consensus expectations



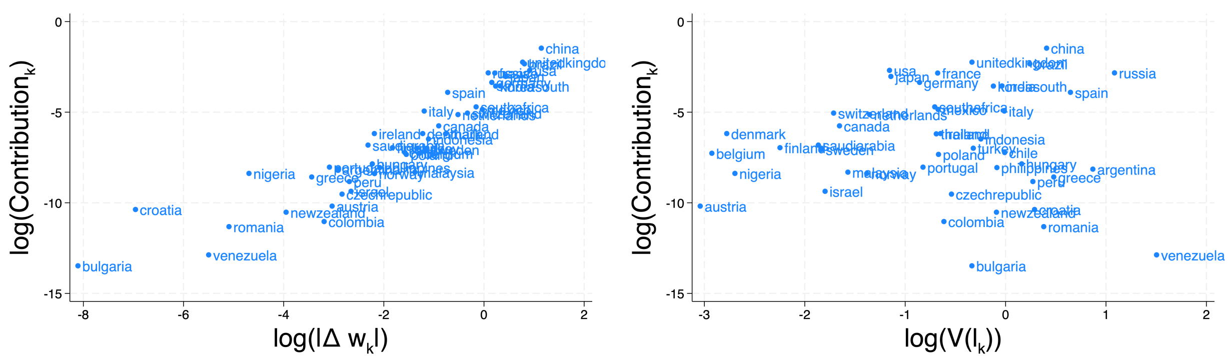
Note: The figure represents the contribution of the variance of $\beta\tilde{l}_{k,t} + \eta\Gamma_{k,k,t}$, $\eta\Gamma_{k,t} - \eta\Gamma_{k,k,t}$ and $-\phi\Delta Cov_{k,t}$ to the variance of implied capital flow reallocation, when we use consensus expectations.

Figure C.2: Distribution of weights



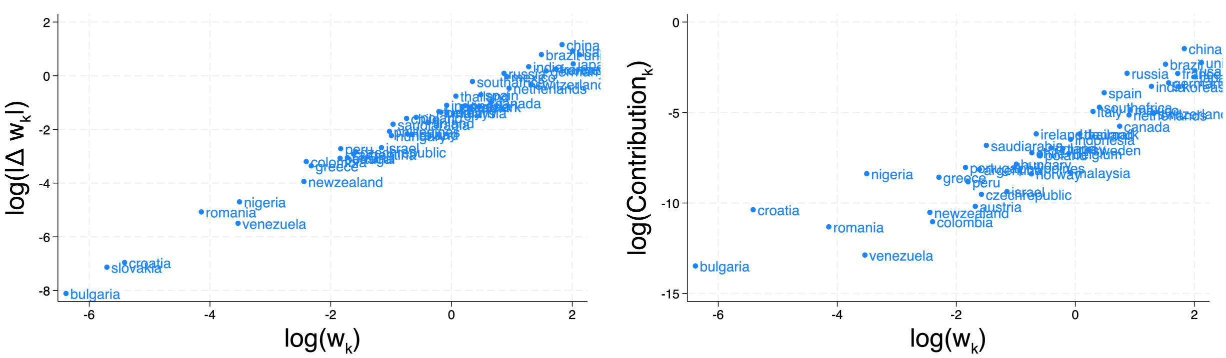
Note: The left panel represents the distribution and standard deviation of $\sigma_{k,t}^i(\Delta w_{k,k',t}^i - \Delta w_{k,k',t})$ across country pairs and investors. The right panel represents the distribution and standard deviation of $\Delta w_{k,k',t}(\sigma_{k,t}^i - 1/M)$ across country pairs and investors. The bottom panel represents the distribution and standard deviation of $\Delta w_{k,k',t}$ across country pairs.

Figure C.3: Role of weights and idiosyncratic volatility



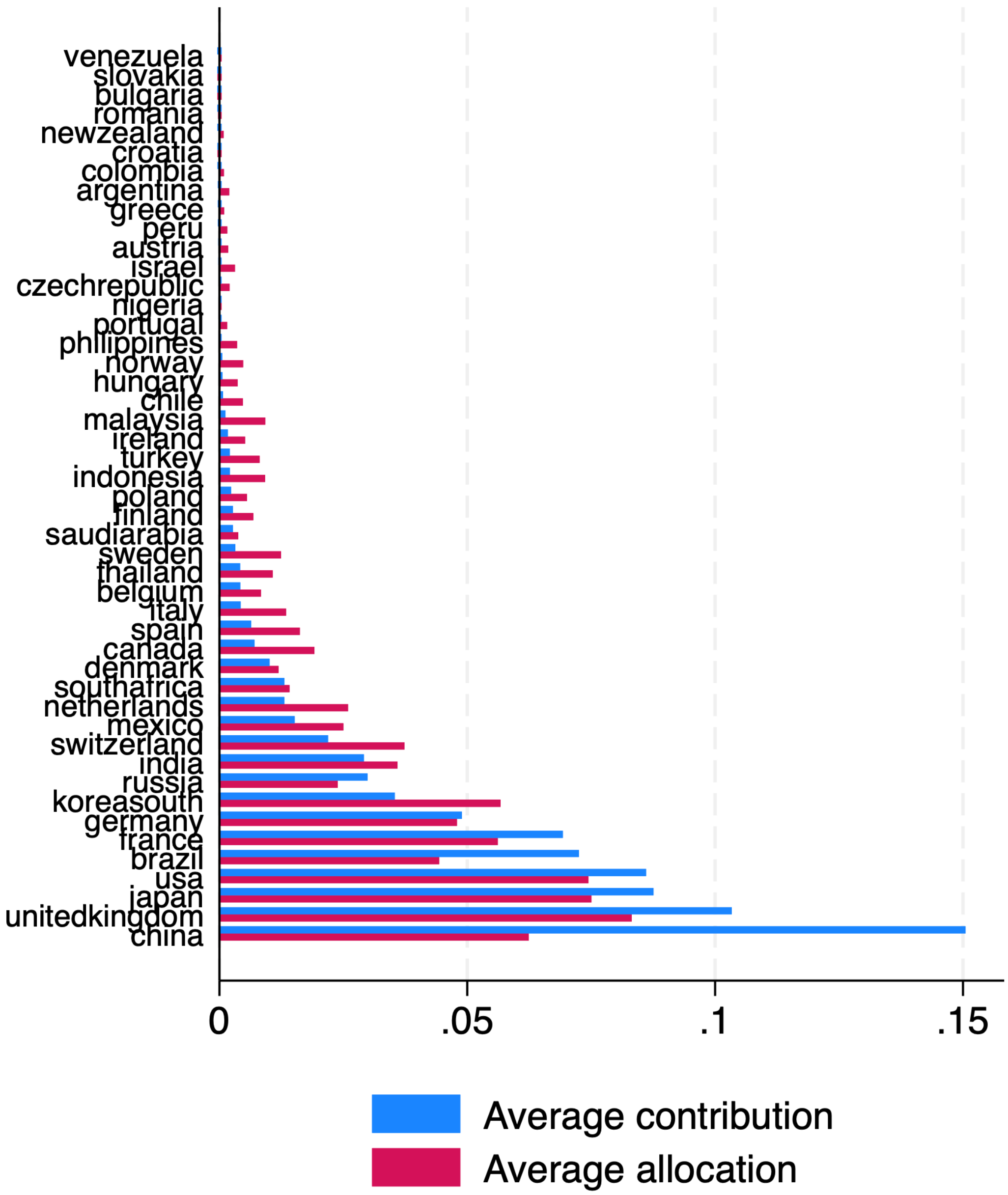
Note: The left panel represents the scatter plot of the log of the average absolute value of co-ownership linkages $|\Delta w_k| = \sum_{k'=1}^{K} \sigma_{k'} |\Delta w_{k',k}|$ against the log of average contributions $Contribution_k = \sum_{k'=1}^{K} \sigma_{k'} Contribution_{k',k}$. The right panel represents the scatter plot of the log of the variance of country-speicifc expectations $V(l_k)$ against the log of average contributions $Contribution_k = \sum_{k'=1}^{K} \sigma_{k'} Contribution_{k',k}$.

Figure C.4: Role of country average allocation



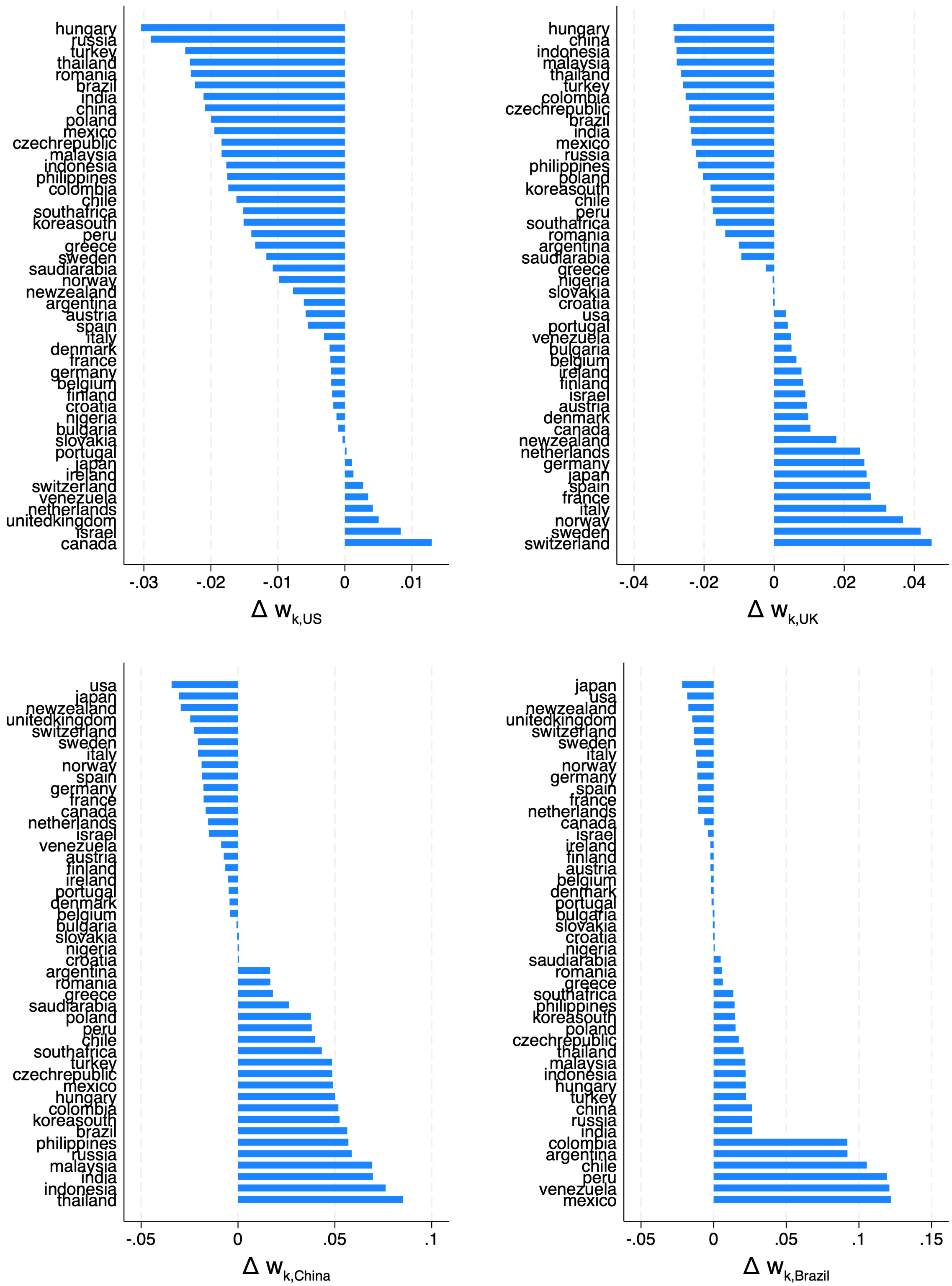
Note: The left panel represents the scatter plot of the average allocations $w_k = \sum_{i=1}^{M} \sigma_k^i w_k^i$ against the log of the average absolute value of co-ownership linkages $|\Delta w_k| = \sum_{k'=1}^{K} \sigma_{k'} |\Delta w_{k',k}|$. The right panel represents the scatter plot of the average allocations $w_k = \sum_{i=1}^{M} \sigma_k^i w_k^i$ against the log of average contributions $Contribution_k = \sum_{k'=1}^{K} \sigma_{k'} Contribution_{k',k}$.

Figure C.5: Contributors to co-ownership spillovers - Fixed $V(l_k)$



Note: The figure represents the average allocations $w_k = \sum_{i=1}^{M} \sigma_k^i w_k^i$ against the average contributions with fixed country-specific variances $\overline{Contribution}_k = \sum_{k'=1}^{K} \sigma_{k'} \overline{Contribution}_{k',k}$, where $\overline{Contribution}_{k',k} = \frac{(\Delta w_{k',k})^2}{\sum_{l=1}^{K} (\Delta w_{k',l})^2}$.

Figure C.6: Co-ownership linkages - Examples



Note: The figure represents the co-ownership linkages for the US ($\Delta w_{k,US}$), upper-left panel), for the UK ($\Delta w_{k,UK}$), upper-right panel), for China ($\Delta w_{k,China}$), lower-left panel) and for Brazil ($\Delta w_{k,Brazil}$), lower-right panel).