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Asset Pricing of International Equity under Cross-Border Investment Frictions

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Abstract

We develop a tractable asset pricing model of international equity markets to investigate the impact of frictions in cross-border financial investments on equity return dynamics and cross-border equity holdings across countries. We characterize the equilibrium of the model analytically at the limit as one country becomes large relative to all other countries. Our results clarify the distinct impact of cross-border holding costs, cash-flow fundamentals comovement, and preferences on cross-border portfolio holdings, return comovement, and risk premia. The model offers a unified explanation for key empirical regularities in the cross-section of equity markets regarding cross-country return correlations, CAPM pricing errors, and equity portfolio home bias, which we document using aggregate return and portfolio holdings data from the U.S. and a cross-section of 40 other countries. Overall, our results suggest that asset pricing tests for international equity markets should take into account differences across countries in the degree of cross-border frictions.

Keywords: Cross-border investment frictions, holding costs, cross-section of return correlations, cross-border portfolio holdings, international asset pricing, home bias

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1 Introduction

A large literature in international finance has established the relevance of a wide array of frictions in financial investments across borders leading to the concentration of equity investments within national borders (home bias in equity portfolios) and to large biases in the composition of investors' foreign equity portfolios (foreign bias). Yet, a systematic theoretical investigation of how the *cross-sections* of equity returns and portfolio holdings across countries are jointly shaped by investment frictions and other characteristics of individual countries or equity markets is still lacking. In this paper, we develop a tractable asset pricing model of international equity markets that clarifies the distinct impact on return dynamics and portfolio allocations of cross-border holding costs, comovement in cash-flow fundamentals, and preferences on equilibrium cross-border portfolio holdings, return comovement, and risk premia.

Our model offers a unified explanation for three robust empirical regularities in the cross-section of international equities:

1. The cross-section of equity return correlations Equity markets whose returns are more highly correlated with the global equity market also have greater foreign investor presence. As we document in Figure 1, the share of a stock market held by U.S. investors, henceforth referred to as the U.S. investor (cross-border) position, has strong explanatory power for the cross-country variation in correlations of an equity market's excess return with the U.S. market return. In our sample of 40 countries, the U.S. investor position in a country averaged over 2000-2017 explains about 40% of the cross-sectional variation in the return correlations over the same period.[1] Importantly, the relative size of the equity markets or indicators of real sector comovement, such as the size of bilateral trade and the GDP correlation between the country and the U.S., are unable to account for the cross-section of return comovement. These patterns are hard to reconcile with standard portfolio choice models under frictionless access to international equity markets, which typically predict that investors wish to avoid large positions in assets that are highly correlated with their overall portfolio return.

2. The cross-section of CAPM pricing errors Equity markets whose returns comove less with the global (or U.S.) equity market appear to have larger pricing errors with respect to the global Capital Asset Pricing Model (CAPM) and other multi-factor international asset pricing models, as shown in Figure 2. As result, the security market line (average returns versus betas) in global equity markets appears to be flat or even

[1] As we explain in greater detail later and in appendix C, our analysis uses the MSCI broad market indices (which exclude cross-listed stocks) of 40 countries plus the U.S. over 1985–2017.

negative, pointing to a puzzlingly low, or even negative, price of global market risk. Combining this regularity with the first stylized fact, international equity investors have low market positions in markets with high apparent expected returns and low global risk, an observation hard to reconcile with the predictions of frictionless portfolio choice models.

3. The cross-section of equity portfolio home bias Following the convention, define home bias as the degree to which the country's portfolio holdings in foreign markets fall short of the global market share of the foreign markets:

$$\text{Home Bias} = 1 - \frac{\text{Share of foreign equities in the country's portfolio}}{\text{Share of foreign equities in the world portfolio}}.$$

Empirically, investors based in countries that comove less with the global (or U.S.) equity market have equity portfolios that are more biased towards domestic stocks according to this measure.

To make sense of these patterns, we build a general-equilibrium model of the global economy featuring heterogeneity across countries in cross-border financial investment frictions. We model these frictions in reduced form as proportional holding costs, following Black (1974) and Stulz (1981a). Our model also allows for rich heterogeneity in other aspects that are potentially relevant for asset prices and portfolio choice, including the risk preferences of each country's investors and the cash-flow fundamentals of an equity market. Although the general model must be solved numerically, we derive a closed-form characterization of the equilibrium at the limit as all countries but one become small in size relative to the world economy. We argue that this is a reasonable approximation of the asymmetric structure of international equity markets over the past few decades, where one country, the U.S., constitutes more than 50% of the world's equity market capitalization.[2]

In our setting, the cross-border holding costs that foreign investors face in an equity market, normalized by investors' holdings, map directly into alphas with respect to the global CAPM model. We show that the activity of foreign investors in a country's equity market amplifies return volatility relative to volatility in cash-flow fundamentals and causes fluctuations in countries' valuation ratios. Importantly, the magnitude of this amplification is decreasing in the holding cost incurred by foreign investors, so that heterogeneity in holding costs across countries translates into heterogeneity in the degree of equity market return comovement with the large market.

Our model can rationalize the negative relationship between CAPM alphas and betas, because the high apparent average returns on the stock markets of countries with low return correlations are not in fact attain-

[2]The average share of global market capitalization across our 40 non-U.S. equity markets is only 1.5%; see Table 2.

able by foreign investors in these countries. Because countries with high holding costs, and thus high CAPM alphas, have endogenously low return correlations with global equity markets, a test of the standard market model, which only allows for a uniform intercept across all equity markets, yields a flat security market line and a deceptively low, or even negative, price of global market risk. Our results also imply that, to the extent that increasing financial integration implies a reduction in the cross-country dispersion of holding costs, the slope of the security market line should increase and eventually become positive. We emphasize that the impact on the security market line of heterogeneity across countries in holding costs is distinct from that of the average holding cost, which affects its intercept (Black (1974)).

Finally, high holding costs in a country's equity market imply a large degree of home bias in the equity portfolio of investors based in that country. The main reason is that high frictions to foreign investors in the local market in equilibrium translate into a comparative advantage of the local market relative to foreign markets as a financial investment for local investors. All else equal, local investors' home bias translates into a lower share of the market held. The impact of holding costs on the endogenous wealth of local investors amplifies the negative impact of local-investor home bias on the foreign position in the local equity market. The positive cross-sectional relationship between holding costs and home bias is amplified if countries with high barriers to investment for foreign investors are also countries where local investors face higher frictions in accessing global equity markets.

Our model also clarifies that heterogeneity in dividend comovement across equity markets, although empirically relevant, cannot be the primary determinant of the cross-sections of equity return moments and portfolio positions. An equity market whose dividends comove highly with those of the large market (the U.S.) will have a high and endogenously amplified return correlation with the large market. However, the expected returns to that market should be higher, in order to compensate investors for the higher global risk of the asset. Additionally, in the presence of cross-border holding costs, higher cash-flow comovement increases the local bias in investors' portfolios as the diversification benefits of foreign equity investment decline and reduces the share of the market held by foreigners in equilibrium. In other words, if cash-flow correlations rather than holding costs were the primary aspect of cross-country heterogeneity, the model would predict a counterfactually positive cross-sectional relationship between return correlations and average returns and a counterfactually negative relationship between return correlations and foreign investor positions. Thus, the joint restrictions implied by the cross-sections of return moments and cross-border portfolio holdings allow us to theoretically qualify the impact of certain potential determinants of cross-country dispersion in return comovement.

A methodological contribution of our paper is the development of a new solution method for heterogeneous-agent, multiple-asset macro-finance models based on an asymptotic expansion around a tractable limit point for the relative size of assets. We solve our model via an asymptotic expansion around the point where the size of all countries but one becomes infinitesimal relative to the size of the global economy. This method allows us to derive an analytical, closed-form characterization of the limit values of normalized equilibrium quantities such as the price-dividend ratios, return moments, and market shares of small countries.

Moreover, the approximate solution of the model by asymptotic expansion to higher orders allows us to turn a high-dimensional equilibrium-finding problem into sequence of smaller, more manageable problems, as the characterization of equilibrium to successive orders can be performed sequentially. Future drafts of this paper will present in detail the numerical solution scheme that we have developed. Our method shares similarities with that of Kogan (2001), who solves a model of irreversible investment via asymptotic expansion for a model parameter (rather than a subset of the equilibrium vector, as we do here) around zero.

A further theoretical contribution of the paper is the characterization of portfolio choice and equilibrium outcomes for incomplete-market settings where heterogeneous agents have external consumption habit preferences as in Campbell and Cochrane (1999). Such preferences have recently been employed by Santos and Veronesi (2019) to model agent heterogeneity, but only in the context of frictionless models that admit a representative agent.[3]

Related literature The asset pricing implications of cross-border investment frictions were previously examined in a number of papers, including Black (1974), Stulz (1981b), Stulz (1981a), Dumas (1992), Uppal (1993), and Bhamra, Coeurdacier, and Guibaud (2014). As in these papers, our goal is not provide new evidence on the source of cross-border frictions, but to take these frictions as given and study their asset pricing implications. The novel contribution of our paper relative to this theoretical literature is the development and empirical investigation of theoretical predictions for the joint cross-sections of return moments and cross-border portfolio holdings in a unified, highly-tractable general-equilibrium framework. A key prediction of our model is that, in the presence of large cross-sectional heterogeneity in cross-border investment frictions, the share of the equity market owned by global investors explains the cross-section of market return correlations with the global stock market. The importance of cross-border positions for return comovement has been documented in a large body of literature (e.g., Boyer, Kumagai, and Yuan (2006), Bartram et al. (2015), and Faias and Ferreira (2017)), but it is interesting to see that they play such a prominent role in determining the cross-country variation in return correlations.

Our results are also relevant for a large literature in international finance that attempts to explain the international home bias puzzle, that is, the empirical regularity that the share of financial capital invested

[3] Our characterization of agents' optimization problem under incomplete markets via the use of stochastic Pareto weights shares similarities with the multiplier approach of Chien, Cole, and Lustig (2011) in a discrete-time framework.

domestically is puzzlingly large relative to the apparent diversification benefits of international investments. Lewis (1995) and Coeurdacier and Rey (2013) offer comprehensive surveys of this literature. Part of this literature has offered explanations based on transaction costs faced by foreign investors, which share obvious similarities with our holding costs formulation of financial frictions. Although estimates of literal transaction costs, such as the different tax treatment of foreign investors relative to domestic investors, are generally deemed too small to justify the large degree of home bias, implicit costs such as informational asymmetries between foreign and local investors have similar implications for portfolio choice. For example, Gârleanu, Panageas, and Yu (2017) model portfolio bias as a result of information asymmetries about individual securities in a location, and show that their model with heterogeneous asset selection ability is isomorphic to a setting with investor- and asset-class-specific taxes. Bhamra, Uppal, and Walden (2019) explain local bias towards geographically close stocks via a model featuring ambiguity aversion by households that is increasing in the distance between households and firms. Bekaert (1995), and Bekaert et al. (2014), among others, emphasize other sources of implicit barriers to cross-border investments, such as low-quality regulatory and legal frameworks offering insufficient property rights protection, the lack of a sufficient number of large, liquid stocks, and the lack of cross-listed securities.

Our analysis also relates to a theoretical literature, especially Cochrane, Longstaff, and Santa-Clara (2008) and Martin (2013), studying the comovement between the returns of multiple assets held by the same agents, what one may refer to as the portfolio demand channel of return comovement. These models assume a representative agent who owns the entirety of all assets, and as a result feature no portfolio rebalancing in equilibrium. In these models, relative market size is the key determinant of return comovement. Instead, we emphasize that heterogeneity in cross-border positions across countries is essential in order for the portfolio demand channel to explain the observed cross-section of international equity return comovement.

Paper outline. Section 2 introduces the model of the paper, characterizes key features of the equilibrium, and formalizes the characterization of equilibrium by asymptotic expansion around the limit where all but one economies are small in size. Section 3 presents the predictions of the model for the cross-section of return correlations across countries and discusses some key features of this cross-section in the data. Section 4 addresses the determinants of the cross-section of return premia and world CAPM pricing errors in the model and discusses possible explanations for the flat global security market line observed empirically. Section 5 develops the implications of holdings costs and other country characteristics for cross-border portfolio holdings. Section 6 concludes.

2 The Model

In this section, we present a multi-country asset pricing model to investigate the implications for asset prices and for cross-border portfolio holdings of imperfect cross-border integration of equity markets. In the model, households can invest in the equity markets of other countries but incur proportional holding costs in their cross-border equity investments.

2.1 Setting

Endowments Consider a single-good, exchange economy with $N+1$ countries, indexed by $i = 0, \ldots, N$. The output of country i, Y_t^i, evolves as

$$\frac{dY_t^i}{Y_t^i} = \mu^i + \Sigma^{i\prime} dZ_t, \tag{1}$$

where Z_t is a K-dimensional Brownian motion, capturing the $K \geq N+1$ sources of risk affecting countries' outputs. μ^i and K-vector Σ^i are constants, and $\Sigma = [\Sigma^0, \Sigma^1, \ldots, \Sigma^N]$ has rank $N+1$.

We denote the country's output share relative to global output by

$$y_t^i \equiv \frac{Y_t^i}{Y_t} > 0, \tag{2}$$

where $Y_t = \sum_{i=0}^{N} Y_t^i$, and let the N-vector

$$\boldsymbol{y}_t \equiv \begin{bmatrix} y_t^1 \\ \cdots \\ y_t^N \end{bmatrix} \tag{3}$$

summarize the countries' relative endowments, with $y_t^0 \equiv 1 - \sum_{i=1}^{N} y_t^i$.

Preferences In each country, there is a unit of measure of households with identical preferences. The preferences of household h in country i over its time-t consumption relative to habit are given by the flow utility

$$u^i(C_{ht}^i; Y_t^i, s_t) = \exp(-\delta^i t) \log \left(C_{ht}^i - \left(1 - \frac{s_t}{\gamma^i}\right) Y_t^i \right), \tag{4}$$

for $t \in [0, \infty)$. Under this specification, time-variation in the household's consumption habit,

$$H_t^i \equiv \left(1 - \frac{s_t}{\gamma^i}\right) Y_t^i, \tag{5}$$

has a country-specific component, via its dependence on own-country aggregate output Y_t^i, as well as a global component via its dependence on variable s_t. Parameter γ^i controls the risk aversion of agents in country i.[4]

Variable s_t affects the state of the global economy by affecting the risk and intertemporal-consumption preferences of all households. We assume that it responds to shocks to global output growth, with high s corresponding to "good" times for the global economy. In particular, we posit the law of motion[5]

$$\frac{ds_t}{s_t} = \mu_s(s_t)dt + \Sigma_s(s_t)' dZ_t, \tag{6}$$

where

$$\mu_s(s_t) = k_s\left(\bar{s} - s_t\right) + \Sigma_s(s_t)'\Sigma_s(s_t) \tag{7}$$

$$\Sigma_s(s_t) = \nu\left(1 - \lambda s_t\right)\Sigma_Y(\vec{y}_t), \tag{8}$$

where $\lambda \geq 1$, $\bar{s} < \frac{1}{\lambda}$, and $\nu > 0$. Under these dynamics, the surplus fluctuates between 0 and a upper bound of $1/\lambda$, $s_t \in (0, s^{\max} = 1/\lambda]$ for all t. Parameter ν controls the sensitivity of the surplus to global output growth shocks, Σ_Y.

The choice of habit specification (5), positing that external consumption habit is proportional to aggregate output rather than aggregate consumption, as is more common in habit models, achieves two modeling goals: first, it ensures that a country's wealth and consumption remains cointegrated with that country's output in equilibrium under (largely) arbitrary heterogeneity in preferences, endowments, and financial technologies across countries; second, it allows us to introduce labor income in a tractable fashion. The law of motion (6) for surplus s_t is chosen so as to obtain closed-form solutions for equilibrium outcomes, including price-dividend ratios for equities that are affine functions of s_t, at the small-economy limit, discussed in the next section.[6]

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[4] We later show that γ^i is positively related to agents' relative risk aversion coefficient, $\widetilde{\gamma}_t$, which is time-varying under these preferences.

[5] Throughout, we employ the notational convention of denoting the proportional (respectively, absolute) instantaneous drift and volatility of a variable x by μ_x (respectively, $\widetilde{\mu}_x$) and Σ_x (respectively, $\widetilde{\Sigma}_x$). That is, $\widetilde{\mu}_x = x\mu_x$ and $\widetilde{\Sigma}_x = x\Sigma_x$.

[6] The inclusion of the term $\Sigma_s'\Sigma_s$ in the drift, (7), is needed to ensure this; it is a "linearity-generating twist" in the language of Gabaix (2009). This law of motion is also employed by Menzly, Santos, and Veronesi (2004) for the same reasons.

Financial technologies In each country i there is a Lucas tree yielding fraction $\omega^i \leq 1$ of the country's output stream Y_t^i. Ownership claims to this tree are traded in the country's equity market. We normalize the number of shares to Lucas tree (equity market) i to ω^i, and denote the per-share price at time t by P_t^i, so that the price-dividend ratio of equity i is $p_t^i \equiv P_t^i / Y_t^i$. Equities are the only financial assets in positive net supply at the global level.

The remaining fraction $1 - \omega^i$ of the output of country i accrues to households in i, equally across households, capturing labor income. We assume the parametric restriction

$$\omega^i - \frac{1}{\lambda \gamma^i} > 0, \tag{9}$$

ensuring that, at all times, consumption is both above habit (so that utility is well-defined), $C_{ht}^i > (1 - s_t/\gamma^i) Y_t^i$, and above labor income $C_{ht}^i > (1 - \omega^i) Y_t^i$. This implies that household financial wealth always remains positive and thus liquidity constraints never bind in our model.

We let W_{ht}^i denote the financial wealth of household h from country i, and $W_t^i \equiv \int_0^1 W_{ht}^i dh$ denote aggregate wealth in country i. At the initial date $t = 0$ households in each country are in aggregate endowed with the equity of their own country.[7] There are complete and frictionless financial markets *within* a country, that is, risk-sharing is perfect among households of the same country. Besides domestic financial markets, households also have frictionless access to a riskfree asset (short bond) traded internationally.

Households can also take long positions in foreign equity markets but incur holding costs for doing so, which vary across countries. In particular, a household from country i owning a share of the equity of country n incurs a flow cost of $c^{ni} P_t^n$, where $c^{ni} \geq 0$ is time-invariant and is treated as an exogenous parameter in our model.[8] Investors face zero holding costs domestically but positive holding costs abroad, $c^{ii} = 0$ and $c^{ni} \geq 0$ for $n \neq i$. Denoting the return in market n to local investors by dR_t^{nn}, the return to

[7] We allow for a non-degenerate distribution of financial wealth within a country at the initial date, in which case the within-country wealth distribution will be non-degenerate and stochastic in future dates as well. We show below that aggregation goes through even in this case, provided risk-sharing is perfect domestically. We only require that $W_{h,0}^i > W_0^i - Y_0^i f_0^i$, where variable f_t^i is introduced in Proposition 1 below, so that the maximization problem is well-defined for all households.

[8] We do not consider costs that are fixed (non-variable) because, if holding costs are not increasing with the level of a foreign investor's holdings, foreign investors could reduce and effectively eliminate these costs by aggregating their positions before entering the country. To examine the first-order implications of variable holding costs in a parsimonious way, we assume that holding costs in each country are time-invariant as a fraction of the per-share stock price, even though the latter is an endogenous object. Time-variation in proportional holding costs (e.g. c_t^{ni} that vary over time with the aggregate state $\mathcal{S}_t$) would yield additional interesting implications about the time-variation in volatility amplification and other equilibrium outcomes. Note, however, that if the level of holding costs is exactly constant in proportion to the level of dividends (rather than in proportion to the price level), then the second moments of valuation ratios and returns are unaffected by holding costs under scale-independent preferences (pricing kernel) like the ones of the present model.

foreign investors from country i is

$$dR_t^{ni} = \frac{Y_t^n - c^{ni} P_t^n}{P_t^n} + \frac{dP_t^n}{P_t^n} = dR_t^{nn} - c^{ni} dt. \tag{10}$$

We denote by $\pi_t^n \equiv \mathbb{E}_t[dR_t^{nn}]$ the risk premium attainable in market n by local investors. Under our formulation, holding costs are locally deterministic so they affect the return premium but not the return volatility, $\Sigma_R^n = \Sigma_P^n$.

We assume that cross-border holding costs are deadweight costs, although this assumption is not essential for any of our qualitative results.[9] That is, the single good in the economy, assumed to be frictionlessly traded across borders, is used either for consumption or to cover holding costs arising from cross-border positions. Market clearing in the goods market is thus:

$$\sum_{i=0}^{N} C_t^i + \sum_{n=0}^{N} \sum_{i=0}^{N} c^{ni} \omega^n P_t^n x_t^{ni} = Y_t \tag{11}$$

where $x^{ni} \in [0,1]$ denotes the share of equity market n held in aggregate by households from country i, and $C_t^i \equiv \int_0^1 C_{ht}^i dh$ is the aggregate consumption of agents from country i.

Because markets are complete and frictionless within each country, there is a unique stochastic discount factor dM_t^i / M_t^i in each country:

$$\frac{dM_t^i}{M_t^i} = -r_{ft} dt - \Xi_t^{i\prime} dZ_t, \tag{12}$$

where Ξ^i is the vector of risk prices in country i. Note that frictionless access to the international bond market implies that the real riskfree rate is the same for all countries.

The lack of holding costs to local investors and the dependence of consumption habit on own-country output implies that agents are always marginal with respect to their own equity market. As a result, we can write the share price of the latter as:

$$P_t^i = \mathbb{E}_t \left[\int_t^\infty \frac{M_\tau^i}{M_t^i} Y_\tau^i d\tau \right]. \tag{13}$$

Finally, the following parametric restrictions, which we assume throughout, suffice to ensure finite price-dividend ratios for all equity markets and for all values of the exogenous state variables $\boldsymbol{y}_t$ and s_t.

[9] The deadweight nature of holding costs also has zero quantitative impact for equilibrium to the first order; see Section 2.3.

Assumption 1 (Finite Price-Dividend Ratios)**.** Model parameters satisfy

$$\Phi^{ij} \equiv \delta^j + (\rho^{ij}\sigma^i - \sigma^j)\sigma^j - (\mu^i - \mu^j) > 0 \tag{14}$$

$$E^{ij} \equiv c^{ij} + \Phi^{ij} + (\rho^{ij}\sigma^i - \sigma^j)\nu\sigma^j + k_s\bar{s} > 0 \tag{15}$$

for all $i, j = 0, \ldots, N$, where $\sigma^i = \sqrt{\Sigma^{i\prime}\Sigma^i}$ and $\rho^{ij} = (\Sigma^{i\prime}\Sigma^j)/(\sigma^i\sigma^j)$.

These parametric restrictions are satisfied as long as the pure rate of time preference δ^i, $i = 0, \ldots, N$, is large enough in all countries, fixing other model parameters.

2.2 Equilibrium

We first state the definition of equilibrium in our setting.

Definition 1 (Equilibrium)**.** Given an endowment at the initial date $t = 0$ of ω_h^i shares to country i's Lucas tree for household h in country i, such that $\int_h \omega_h^i dh = \omega^i$ for all i, equilibrium in this economy is a set of household consumption levels C_{ht}^i, household financial wealth W_{ht}^i, riskfree rate r_{ft}, country-specific risk prices Ξ_t^i, aggregate market shares x_t^{ni}, and bond holdings B_t^i, for $i, n = 0, \ldots, N$, for all households h, and for every $t \geq 0$, such that:

1. Households at date 0 choose their consumption stream to maximize

$$\max_{[C_{ht}^i]_{t=0}^{\infty}} \mathbb{E}_0 \left[\int_0^{\infty} u^i(C_{ht}^i, Y_t^i, s_t) dt \right], \tag{16}$$

subject to the budget constraint

$$\mathbb{E}_0 \left[\int_0^{\infty} \frac{M_t^i}{M_0^i} \left(C_{ht}^i - (1 - \omega^i) Y_t^i \right) dt \right] \leq \omega_h^i P_0^i, \tag{17}$$

where u^i is given in (4), the pricing kernel M_t^i evolves according to (12), and P_t^i is given by (13).

2. Household financial wealth at time t is defined as

$$W_{ht}^i \equiv \mathbb{E}_t \left[\int_t^{\infty} \frac{M_\tau^i}{M_t^i} \left(C_{h\tau}^i - (1 - \omega^i) Y_\tau^i \right) d\tau \right] \tag{18}$$

and the aggregate wealth of country i is $W_t^i \equiv \int_0^1 W_{ht}^i dh$.

3. The aggregate market share $x_t^{ni} \in [0, 1]$ of equity n held by households from country i, and the

aggregate bond holdings B_t^i of country i satisfy

$$W_t^i = \sum_{n=0}^{N} x_t^{ni} \omega^i P_t^n + B_t^i. \tag{19}$$

4. The risk prices Ξ^i satisfy

$$c^{ni} \geq \Sigma_R^{n\prime} \left(\Xi_t^n - \Xi_t^i \right), \tag{20}$$

with equality if $x_t^{ni} > 0$.

5. The goods market clears, (11).

6. Each equity market n clears, $\sum_{i=0}^{N} x_t^{ni} = 1$.

7. The international bond market clears, $\sum_{i=0}^{N} B_t^i = 0$. Equivalently, $W_t \equiv \sum_{i=0}^{N} W_t^i = \sum_{n=0}^{N} \omega^n P_t^n$.

Proposition 1 (Aggregation within Country). *Household h in country i consumes*

$$C_{ht}^i = \left(1 - \frac{s_t}{\gamma^i}\right) Y_t^i + \delta^i \left(W_{ht}^i - Y_t^i f_t^i \right), \tag{21}$$

where

$$f_t^i = \mathbb{E}_t \left[\int_t^\infty \frac{M_\tau^i}{M_t^i} \left(\omega^i - \frac{s_\tau}{\gamma^i} \right) \frac{Y_\tau^i}{Y_t^i} d\tau \right] > 0. \tag{22}$$

There exists a representative agent for each country with the same preferences as individual households and wealth equal to average country wealth. That is, households' optimal financial investment policies can be implemented by trading only in domestic contingent-bond markets once aggregate country wealth is invested in international financial markets according to the representative agent's optimal portfolio policy.

Denoting the aggregate wealth-output ratio of country i by $\zeta_t^i \equiv W_t^i / Y_t^i$, the pricing kernel in country i can be written as

$$M_t^i = \exp(-\delta^i t)(Y_t^i \phi_t^i)^{-1}, \tag{23}$$

where

$$\phi_t^i \equiv \zeta_t^i - f_t^i > 0. \tag{24}$$

Aggregate consumption relative to output, $e_t^i \equiv C_t^i / Y_t^i$, satisfies

$$e_t^i - \left(1 - \frac{s_t}{\gamma^i}\right) = \delta^i \phi_t^i. \tag{25}$$

We refer to ϕ_t^i as country i's stochastic Pareto weight or as the (scaled) inverse pricing kernel. Note that the assumption of perfect risk-sharing domestically is essential for aggregation at the country level even when all households from the same country have the same preferences because habit preferences are not homothetic with respect to individual wealth, in contrast to standard CRRA (or Epstein-Zin) preferences.

The representative household of each country solves a portfolio choice problem involving the allocation of its financial wealth across $N+2$ international financial markets: the $N+1$ equity markets and the international bond market. We let $\theta_t^i \in \mathbb{R}_+^{N+1}$ denote the vector of portfolio weights of country i, with $(n+1)$th element

$$\theta_t^{ni} = \frac{x_t^{ni}\omega^i P_t^n}{W_t^i}. \tag{26}$$

Note that $\theta^{ni} \geq 0$ due to the short-selling constraint on cross-border equity investments.

To state portfolio choice results, we express certain parameters variables in vector form. We let the $(N+1)$-vector

$$\boldsymbol{c}^i \equiv \begin{bmatrix} c^{0i} \\ \cdots \\ c^{Ni} \end{bmatrix} \tag{27}$$

summarize the holding costs that investors from country i face across the $N+1$ equity markets. Similarly, we let $\boldsymbol{\pi}_t = [\pi_t^0, \pi_t^1, \ldots, \pi_t^N]'$ denote the vector of local-investor equity premia and $\boldsymbol{\Sigma}_{Rt} = [\Sigma_{Rt}^0, \ldots, \Sigma_{Rt}^N]$, a $K \times (N+1)$ matrix that we assume always has rank $N+1$.

Proposition 2 (Optimal Portfolio Choice in International Markets)**.** *The vector of aggregate portfolio weights of country i is given by*

$$\boldsymbol{\theta}_t^i = \frac{1}{\widetilde{\gamma}_t^i}\left(\boldsymbol{\Sigma}_{Rt}'\boldsymbol{\Sigma}_{Rt}\right)^{-1}\left[\boldsymbol{\pi}_t - \boldsymbol{c}^i + \boldsymbol{\lambda}_t^i + \left(\widetilde{\gamma}_t^i - 1\right)\boldsymbol{\Sigma}_{Rt}'\left(\Sigma^i + \Sigma_{ft}^i\right)\right], \tag{28}$$

where $\boldsymbol{\lambda}_t^i \in \mathbb{R}_+^{N+1}$ is a vector of Lagrange multipliers on the short-selling constraints for each equity market, defined through $\lambda_t^{ni}\theta_t^{ni} = 0$, $\widetilde{\Sigma}_{ft}^i$ is the proportional instantaneous volatility of variable f_t^i defined in (22), and

$$\widetilde{\gamma}_t^i \equiv \frac{\zeta_t^i}{\phi_t^i} = 1 + \frac{f_t^i}{\zeta_t^i - f_t^i} > 1 \tag{29}$$

is the coefficient of relative risk aversion of households in country i.

Corollary 1 (Financial Autarky)**.** *Under financial autarky, $C_t^i = Y_t^i$ and $W_t^i = \omega^i P_t^i$ for all t, the Pareto weight of country i is*

$$\phi_t^i = \frac{s_t}{\gamma^i \delta^i} \tag{30}$$

and its coefficient of relative risk aversion is

$$\widetilde{\gamma}_t^i = \frac{\gamma^i \omega^i}{\delta^i + k_s \overline{s}} \left[k_s + \delta^i \left(\frac{1}{s_t} \right) \right] \tag{31}$$

which is increasing in risk aversion parameter γ^i and decreasing in surplus s_t.

Markov equilibrium Because output growth is independent of the level of output and household preferences are scale-independent relative to aggregate output, appropriately scaled equilibrium prices and quantities in the model are functions of the $(2N+1)$-dimensional state vector

$$\mathcal{S}_t = (\boldsymbol{\zeta}_t, s_t, \boldsymbol{y}_t), \tag{32}$$

where

$$\boldsymbol{\zeta}_t \equiv \begin{bmatrix} \zeta_t^1 \\ \cdots \\ \zeta_t^N \end{bmatrix} \tag{33}$$

is the endogenously-evolving vector of wealth-output ratios ζ^i of countries $i = 1, \ldots, N$.[10]

We note that, under our endowment specification (1), whereby countries' output levels evolve according to imperfectly correlated geometric Brownian motions, output shares $\boldsymbol{y}_t$ converge to a degenerate distribution in the long-run; that is, with probability one, one of the countries will dominate all others as $t \to \infty$.[11] Nevertheless, our endogenous state variables $\boldsymbol{\zeta}$ are stationary conditional on a value of $\boldsymbol{y}$, for any value of the latter. That is, the long-run joint distribution (cumulative density function) of variables $\boldsymbol{z}$ and s conditional on a value $\boldsymbol{y}$,

$$\lim_{t\to\infty} G(\boldsymbol{\zeta}_t, s_t | \boldsymbol{y}_t = \boldsymbol{y}), \tag{35}$$

is well-defined and non-degenerate.

[10]Note that, by market clearing, the wealth-output ratio of country 0 is

$$\zeta_0(\mathcal{S}) = \omega^0 p^0(\mathcal{S}) - \sum_{i=1}^{N} \left(\zeta^i - \omega^i p^i(\mathcal{S}) \frac{y^i}{\sum_{i=1}^N y^i} \right). \tag{34}$$

[11]The use of imperfectly correlated geometric Brownian motions for dividends is common in asset pricing models featuring multiple assets; see Cochrane, Longstaff, and Santa-Clara (2008) and Martin (2013), among others. Just as we do here, these papers characterize equilibrium outcomes conditional on a particular value for the dividend shares of different assets, despite the fact that the latter have a degenerate long-run distribution.

Partial market integration Our specification of preferences and financial technologies implies that local agents will always invest in their own market, regardless of the relative size of their wealth or their country's output, and may even come to dominate their local market if they become wealthy enough, completely pushing out foreign investors from their market, whose short-selling constraints in these markets would become strictly binding. More formally, letting $\mathcal{S}^{-i}$ summarize all state variables in state vector $\mathcal{S}$ except for ζ^i, there exists a function (manifold) $\overline{\zeta}^i(\mathcal{S}^{-i})$, such that $x^{ii} < 1$ if $\zeta^i < \overline{\zeta}^i(\mathcal{S}^{-i})$ and $x^{ii} = 1$ if $\zeta^i \geq \overline{\zeta}^i(\mathcal{S}^{-i})$. In the latter case, the equity market in country i is completely *segmented* from international financial markets. Intuitively, complete market segmentation is a more likely equilibrium outcome if the holding costs of foreign investors for market i, c^{ij} for $j \neq i$, are high.

We refer to states $\mathcal{S}$ in which all agents are marginal in all equity markets as states where international equity markets are *partially integrated*. That is, cross-border investments are subject to positive holding costs, but the short-selling constraints $x^{ni} \geq 0$ do not bind for the representative agent of any country i. This situation of partial integration is the focus of our theoretical investigation.

Nature of market incompleteness The extent of market integration has implications for the extent to which intertemporal marginal rates of substitutions, or equivalently risk prices Ξ^i, differ across countries. We can rewrite the optimality restrictions on the risk prices Ξ^i in (37) in vector form as

$$\mathbf{\Sigma}_{Rt}' \left(\Xi_t^j - \Xi_t^i \right) = \left(\boldsymbol{c}^i - \boldsymbol{c}^j \right) - \left(\boldsymbol{\lambda}_t^i - \boldsymbol{\lambda}_t^j \right), \tag{36}$$

for all $i, j = 0, \ldots, N$, where $\boldsymbol{\lambda}_t^i$ are the vectors of Lagrange multipliers on the short-selling constraints from Proposition 2.

Equation (36) shows that there are two distinct sources of market incompleteness in the international financial markets of our model, limiting risk-sharing across borders.[12] First, there may be *incomplete spanning* of the K risks of the global economy by these markets. If $K > N+1$, risk prices may not be equalized across countries even without cross-border holding holds, $\boldsymbol{c}^i - \boldsymbol{c}^j = 0$, and without short-selling constraints, $\boldsymbol{\lambda}^i - \boldsymbol{\lambda}^j = 0$, because agents can only invest in $N+1$ risky assets outside their country. Even if $K = N+1$, so that matrix $\mathbf{\Sigma}_R$ appearing in equation (36) is invertible, spanning in international financial markets may be effectively incomplete if some equity markets are completely segmented, that is, if short-selling constraints prevent agents from entering certain foreign markets, $\boldsymbol{\lambda}^i - \boldsymbol{\lambda}^j \neq 0$.

A second distinct source of market incompleteness is the presence of *heterogeneous frictions among*

[12]This entire discussion assumes homogeneous beliefs. If the true source of holding costs is familiarity bias, that is, irrationally pessimistic beliefs about foreign market returns, then one should not interpret the wedges between risk prices as capturing market incompleteness.

active participants in a given market. This paper focuses on this latter source of incompleteness, captured by cross-border holding costs in our model, which are always zero for local investors and positive for foreign investors. In order to abstract from incomplete spanning, we can assume $K = N + 1$ and that all equity markets are partially integrated. In this case, we can express the wedge between the risk prices of two countries as

$$\Xi_t^j - \Xi_t^i = \left(\boldsymbol{\Sigma}_{Rt}^{-1}\right)' \left(\boldsymbol{c}^i - \boldsymbol{c}^j\right). \tag{37}$$

Cross-border holding costs, that is, asset return wedges, translate into wedges in intertemporal marginal rates of substitution, although the relationship between these wedges also hinges on the endogenous impact of holding costs on asset return volatilities Σ_R.

Model heterogeneity Taking stock, countries in our model are heterogeneous in their cross-border holding costs c^{ni}, their cash-flow fundamentals μ^i and Σ^i, their patience and risk preferences δ^i and γ^i, respectively and the financialization of their economies ω^i.

2.3 The Small-Economy Limit

2.3.1 Asymptotic Expansion

The model presented in the previous subsection has $2N + 1$ state variables $\mathcal{S} = (\boldsymbol{\zeta}, \boldsymbol{y}, s)$, N of which (the N wealth-output shares in $\boldsymbol{\zeta}$) are endogenous. To deal with the issue of solving a model with high dimensionality, we characterize equilibrium in this model for small values of the vector $\boldsymbol{y}$, that is, conditional on countries $i = 1, \ldots, N$ being small relative to country 0. To do this, we characterize equilibrium variables via an approximation around point $\boldsymbol{y} = \vec{0}$.[13] For example, the share of market $n = 1, \ldots, N$ held by agents from country $i = 0, 1, \ldots, N$ in state $\mathcal{S}$ can be approximated through the asymptotic expansion

$$x^{ni}(\mathcal{S}) = x_{[0]}^{ni}(\zeta^n, s) + \sum_{j=1}^{N} x_{[j]}^{ni}(\boldsymbol{\zeta}, s) y^j + \frac{1}{2} \sum_{j=1}^{N} \sum_{k=1}^{N} x_{[jk]}^{ni}(\boldsymbol{\zeta}, s) y^j y^k + \ldots \tag{38}$$

The term subscripted by $[0]$ captures the value of the equilibrium variable (here, the market share) at the limit $\boldsymbol{y} \searrow 0$. This term is non-zero for certain appropriately scaled equilibrium variables, such as price-dividend ratios and market shares, and captures equilibrium effects that do not vanish as countries $i =$

[13] Equilibrium is ill-defined at the *exact* value $\boldsymbol{y} = \vec{0}$, which is not admissible by the restriction $y^i > 0$ for all i in (2). However, equilibrium at the *limit* $\boldsymbol{y} \searrow \vec{0}$ is well-defined.

$1, \ldots, N$ become arbitrarily small.[14] We refer to such terms as "first-order" terms. Similarly, characterizing equilibrium to order k, where $k \geq 1$, amounts to solving for the terms involving up to $k-1$ powers of the output shares of the small countries.

Solution method Asymptotic expansions allow us to approximately solve this highly-dimensional problem numerically by turning it into a sequence of smaller, more manageable problems. Note, for example, from equation (38) that market share x^{ni} only depends on two state variables to first order, the capital-output ratio of country n, ζ^n, and global surplus s. Crucially, successive solution of equilibrium to higher order becomes feasible even for a large number of heterogeneous agents N, as solution of the equilibrium to order $k > 1$ requires the characterization of the law of motion of the endogenous state variables $\boldsymbol{\zeta}$ only up to order $k-1$, which is already obtained in the previous step of the computation.

An obvious caveat when employing this solution method is that the predictions of the approximately solved model will be close to the predictions of the exactly solved model only for values of the output share vector close to zero. Our setting of international equity markets is almost ideal in this regard, as the size of the average country's equity market, when excluding the U.S., is only around 1% of the global market.

We believe that this solution method can be very useful in other settings as well. A future version of this paper will present this suggested numerical solution scheme in detail, solve for the equilibrium of the present model numerically to higher orders, and address the issue of the size of the approximation error when the model is solved via asymptotic expansion.

2.3.2 First-Order Equilibrium

In the rest of this version of the paper, we characterize equilibrium to first order. To first-order, $C^0_{[0],t} = Y^0_{[0],t} = Y_{[0],t}$ and $W^0_{[0],t} = W_{[0],t}$, where we henceforth omit the subscript $[0]$ for notational simplicity. Therefore, the stochastic Pareto weight (scaled inverse pricing kernel) of country 0 is given by Corollary 1, $\phi^0(s_t) = s_t/(\gamma^0\delta^0)$. The riskfree rate (common across all countries) and the risk price of the large market are[15]

$$r_f(s) = \delta^0 + \mu^0 + k_s(\bar{s} - s_t) - (1 + \nu(1 - \lambda s_t))\Sigma^{0\prime}\Sigma^0 \tag{39}$$

$$\Xi^0(s) = \Sigma^0 + \Sigma_s(s_t) = (1 + \nu(1 - \lambda s_t))\,\Sigma^0. \tag{40}$$

[14] In the case of the market share, $x^{ni}_{[0]}$ can be strictly positive for $i = \{0, n\}$ and must be zero otherwise. The latter is an implication of the market-clearing restriction $x^{ni} < 1$ together with the fact that expansion (38) must hold for *all* admissible $\boldsymbol{y} > 0$.

[15] Equation (39) implies that the global riskfree rate is procyclical, as empirically observed, if $k_s < \nu\lambda\Sigma^{0\prime}\Sigma^0$.

To first order, market shares in market $i = 1, \ldots, N$ are non-zero only for representative agents i and 0 (this is an implication of market clearing; see footnote 14). That is, $x^{ii}(\zeta_t^i, s_t) = 1 - x^{i0}(\zeta_t^i, s_t)$. Recall from Section 2.2 that there is a cutoff level $\overline{\zeta}^i(s_t)$ for local investors' wealth relative to the country's output, such that market i is partially integrated when $\zeta^i < \overline{\zeta}^i(s_t)$, that is, foreign investment position x^{i0} is strictly positive. When $\zeta^i \geq \overline{\zeta}^i(s_t)$, market i is segmented, with $x^{i0} = 0$ and $x^{ii} = 1$.

In the partial-integration region, the market is priced by the SDF of foreign investors, which only varies with global surplus s_t to first order. It follows that price-dividend ratios $p^i(s_t)$ and return premia $\pi^i(s_t)$ and volatilities $\Sigma_R^i(s_t)$ are only functions of global surplus s. An implication of this is that the preferences or portfolio decisions of local investors do not have a first-order impact on return dynamics when the small market is integrated. However, the market shares of local and foreign investors are always a function of both ζ^i and s, and are affected by the portfolio decision of small-country investors.

In the segmentation region, $\zeta^i \geq \overline{\zeta}^i(s_t)$, the valuation ratio $p^i(\zeta_t^i, s_t)$ also varies with local investors' wealth-to-output ratio ζ_t^i and thus local investors' characteristics affect return dynamics in small countries to the first order. This situation offers a way to interpret the finding in the literature on the impact of foreign investors that individual stocks that are completely inaccessible to foreign investors are more sensitive to local factors than stocks that are partly held by foreign investors.

In the discussion that follows, we focus on the situation of partial integration, which we believe is more empirically relevant for international financial markets in recent decades. In particular, given an output share vector $\boldsymbol{y}$, we consider parametrizations of the model that imply

$$G^i(\overline{\zeta}^i(s_t)|s, \boldsymbol{y}) = 1, \tag{41}$$

for all $s \in [0, 1/\lambda]$, where G^i is the long-run conditional cumulative probability distribution of ζ^i. That is, all markets i are integrated at all times in equilibrium.

3 Return Comovement

In this and the next two sections, we characterize asset prices and financial portfolio allocations analytically at the limit as one country becomes large relative to all other countries, and bring the predictions of the model to the data.

By Ito's lemma, we can write the return volatility for equity i as the sum of cash-flow volatility and the endogenous volatility of the price-dividend ratio:

$$\Sigma^i_{Rt}(s_t) = \Sigma^i + \Sigma^i_{pt} \tag{42}$$

Because in our model cash-flow growth is identically and independently distributed over time, volatility in the valuation ratio is purely discount-rate-driven. In turn, to first order, variation in the valuation is driven by fluctuations in global surplus s:

$$\Sigma^i_p(s) = \underbrace{\frac{p^{i\prime}(s)}{p^i(s)}s}_{=\mathcal{E}^s_{p^i}} \Sigma_s(s). \tag{43}$$

To understand how characteristics of country i, such as the cross-border holding costs incurred by its foreign investors and its cash-flow covariance with the global market, affect return dynamics, we need to understand how these characteristics affect the elasticity $\mathcal{E}^s_{p^i}$ of the valuation ratio with respect to the global business cycle.

In the next proposition, we derive a closed-form solution for valuation ratios and the endogenous component of return volatility to first order. We let $\sigma^i = \sqrt{\Sigma^{i\prime}\Sigma^i}$ and $\rho^{i0} = (\Sigma^{i\prime}\Sigma^0)/\sigma^i\sigma^0$ denote the standard deviation of return i and the correlation between returns i and 0, respectively.

Proposition 3 (Endogenous Risk)**.** *To first order, the price-dividend ratios of markets $i = 0, \dots, N$ under integration are affine functions of surplus s:*

$$p^i(s_t) = \frac{1}{E^{i0}} + \frac{A^{i0}}{E^{i0}\left(c^{i0} + \Phi^{i0}\right)} s_t, \tag{44}$$

where

$$\Phi^{i0} \equiv \delta^0 + (\rho^{i0}\sigma^i - \sigma^0)\sigma^0 - (\mu^i - \mu^0) > 0 \tag{45}$$

$$A^{i0} \equiv (\rho^{i0}\sigma^i - \sigma^0)\sigma^0\nu\lambda + k_s \tag{46}$$

$$E^{i0} \equiv c^{i0} + \Phi^{i0} + (\rho^{i0}\sigma^i - \sigma^0)\sigma^0\nu + k_s\bar{s} > 0 \tag{47}$$

are constants.

The valuation ratios have volatilities

$$\Sigma^i_p(s_t) = \underbrace{\frac{A^{i0}s_t}{c^{i0} + \Phi^{i0} + A^{i0}s_t}}_{=\mathcal{E}^s_{p^i}} \Sigma_s(s_t) \tag{48}$$

If $A^{i0} > 0$ or, equivalently,

$$\rho^{i0} > \frac{\sigma^0}{\sigma^i}\left(1 - \frac{k_s}{\nu\lambda(\sigma^0)^2}\right), \tag{49}$$

the valuation ratio of country i is procyclical with respect to global surplus s, $\mathcal{E}^S_{p^i} > 0$, and the presence of foreign investors in equity market i amplifies return volatility with respect to global risks.

The magnitude of this amplification (elasticity $\mathcal{E}^S_{p^i}$) is decreasing in the holding cost c^{i0}, and increasing in the cash-flow correlation ρ^{i0} and in expected cash-flow growth μ^i.

Figures 5 and 6 depict the predictions of the model regarding the cross-section and cyclical dynamics of return correlations under heterogeneous holding costs across countries. To understand why return volatility amplification is decreasing in the holding cost c^{i0}, note that the holding cost c^{i0} is an additive component of the overall discount rate on asset i, $c^{i0} + r_{ft} + \pi^{i0}_t$, where the risk premium perceived by foreign investors is $\pi^{i0}_t = \Sigma^{i\prime}_{Rt}\Xi^0_t$. Therefore, any given cyclical fluctuations in the risk premium π^{i0}_t translate into larger fluctuations for the overall discount rate of the asset in proportional terms when the holding cost is lower.

Corollary 2 (Return Correlation)**.** *To first order, if condition (49) holds, the return correlation of market i with the large market 0 is decreasing in holding cost c^{i0} and increasing in the cash-flow correlation ρ^{i0}:*

$$\widetilde{\rho}^{i0}_R(s_t) = \widetilde{\rho}^{i0} + \frac{1}{\sqrt{1-(\rho^{i0})^2}}\frac{\sigma^0}{\sigma^i}\nu(1-\lambda s_t)\mathcal{E}^S_{p^i}(s_t; c^i), \tag{50}$$

where

$$\widetilde{\rho}^{i0}_R \equiv \frac{\rho^{i0}_R}{\sqrt{1-(\rho^{i0}_R)^2}} \tag{51}$$

and $\widetilde{\rho}^{i0}$ is defined similarly.

The endogenous component of return volatility is also increasing in the cash-flow correlation ρ^{i0}, so that higher cash-flow comovement of markets i and 0 unambiguously increases overall return comovement between these markets. Therefore, this cash-flow channel of return comovement is a potentially important determinant of the cross-section of equity return comovement. However, in the next two subsections we show that heterogeneity in cash-flow volatility alone has counterfactual implications for the cross-sections of both risk premia and cross-border positions in our model.

Proposition 3 also shows that return volatility is increasing in expected cash-flow growth, μ^i. The reason is that the pricing of cash flows far into the future is more sensitive to discount-rate fluctuations, and as a result the prices of assets with relatively higher cash flow duration have a larger proportional response to discount-rate fluctuations. Finally, note that, although valuation ratios are procyclical under the assumed parametric restriction (49), that is, they are increasing in surplus s_t, return volatilities do not have an unambiguously positive or negative relationship with the global business cycle, because the volatility of the surplus itself is countercyclical. The endogenous component of return volatility becomes zero at the end-points of the domain of s, where $s\Sigma_s = 0$, and is positive in the interior of its domain.

3.1 The Cross-Section of Return Correlations in the Data

We now discuss key features of the cross-section of equity return correlations in the data. As we explain in greater detail in the appendix, our analysis uses the MSCI broad market indices (excludes cross-listed stocks) of 40 countries other than the U.S. over 1985–2017. Tables 1 and 2 report the list of countries and descriptive statistics. Whenever appropriate, we use bootstrap standard errors that account for cross-country covariances in addition to the usual heteroskedasticity due to variances.

We estimate the following empirical model:

$$\rho_{US,j} = \boldsymbol{x}_j' \boldsymbol{b} + \epsilon_j, \tag{52}$$

where $\rho_{US,j}$ is the correlation of monthly excess returns to the stock markets of the U.S. and country j, and x_j is a vector of potential cross-sectional determinants of the return correlation such as the U.S. investor position in country j or a measure of the correlation of cash-flow fundamentals between the U.S. and country j.

Table 3 presents the results for our baseline sample period of 2000m1–2017m12, which proxies for the period with greater financial integration. The U.S. investor position (U.S. holdings of the country's equity normalized by the country's market capitalization) in the country has by far the strongest explanatory power. The explanatory power of U.S. investor position for the cross-section of return correlations remains strong after controlling for the country's position in the U.S. (holdings of the U.S. market by investors in a given country normalized by the market capitalization of that country), determinants related to cash-flow fundamentals, and relative equity market size. Figure 1 plots the strong positive relation between U.S. investor position and return correlation with the U.S.

Table 4 repeats the regression on the full sample period of 1986m1–2017m12 and for the earlier sample 1986m1–1999m12. In the full sample, we see that both the coefficient estimate for the U.S. investor position and the R^2 remain largely unchanged for all regression models when using the full sample period. In the earlier sample, which proxies for a period with less financial integration, cash flow correlations play a more important role than in the later sample, but cross-border investor positions are still significantly associated with return correlations with the U.S.

The strong positive cross-sectional relation between correlation with the U.S. stock market and U.S. investor position is hard to reconcile with the frictionless benchmark in which high correlation with the U.S., all else equal, would reduce the U.S. investor demand for the stock market. In contrast, in Section 5 we show that our model can account for this relationship.

Although it is possible that other risk factors explain this result, the global size and value factors of Fama and French (1998) do not explain the pattern. Furthermore, Figure 11 shows that high-U.S.-position countries suffered equally severe crash—if not worse—during the last financial crisis, a rare disaster event (Lustig and Verdelhan (2011)), implying that countries with greater U.S. position are not provide hedging against the disaster risk either. Instead, it appears that it is the U.S. investor demand itself that generates the large cross-sectional variation in the return correlation with the U.S. (Bekaert and Harvey (1995);Karolyi and Stulz (2003)). Table 5 shows that the cross-sectional correlation result holds with the correlation of changes in the valuation ratio, consistent with countries with lower cross-border frictions and high U.S. positions having greater discount rate exposures to the global business cycle (Campbell and Hamao (1992)).

4 Expected Returns

The response of the overall risk premium to c is generally ambiguous. Holding costs have a positive, direct effect on the risk premium but also a countervailing indirect effect, since they reduce return volatility and thus the required risk compensation of foreign investors. Differentiating the first-order condition of foreign investors

$$\pi^{ii}(s) = c^{i0} + \Xi^0(s)'\Sigma_R^i(s) \tag{53}$$

with respect to holding cost, we have

$$\frac{\partial \pi^{ii}(s_t)}{c^{i0}} = 1 - \underbrace{\frac{\Xi^0(s_t)'\Sigma_p^i(s_t)}{\Phi^{i0} + A^{i0}s_t}}_{\text{indirect effect}}. \tag{54}$$

Proposition 4 (Risk Premium)**.** *To first order, if market i is integrated, condition (49) holds, and*

$$(\Phi^{i0})^2 > \nu^2(1+\nu)\rho^{i0}\sigma^i(\sigma^0)^3, \tag{55}$$

the premium (expected excess return) $\pi^{ii}(S)$ to local investors in country i is increasing in the holding cost c^{i0}.

The premium is also increasing in the cash-flow correlation ρ^{i0} and in expected cash flow growth μ^i.

Condition (55) ensures that the positive direct effect dominates the indirect effect for all values of s_t. Note that, for condition (55) to hold, it suffices that $\nu^2(1+\nu)(\sigma^0)^2 < 1$. Intuitively, if the price of risk is extremely variable (ν is very large), the indirect effect will dominate the direct effect for intermediate values of s_t.

Proposition 5 (Adjusted World CAPM)**.** *To first order, the equity returns of integrated markets obey a conditional world CAPM after adjusting for holding costs (HCAPM):*

$$\pi^{ii}(s_t) - c^{i0} = \lambda_{HCARM}(s_t)\beta_R^{i0}(s_t), \tag{56}$$

where $\beta_R^{i0}(s_t) \equiv \Sigma_R^{i\prime}(s_t)\Sigma_R^0(s_t)$ *and the price of global market risk is*

$$\lambda_{HCAPM}(s_t) = (\sigma^0)^2\left(1+\nu(1-\lambda s_t)\right)\Big(1+\mathcal{E}_{p^0}^s(s_t)\nu(1-\lambda s_t)\Big) > 0. \tag{57}$$

Estimating the conditional world CAPM model in this economy,

$$\pi^{ii}(s_t) = \alpha_{CAPM}^i(s_t) + \lambda_{CAPM}(s_t)\beta_R^{i0}(s_t), \tag{58}$$

yields OLS population coefficients

$$\alpha_{CAPM}^i(s_t) = c^{i0} - \frac{Cov^*(c^{i0}, \beta_R^{i0}(s_t))}{Var^*(\beta_R^{i0}(s_t))}\beta_R^{i0} \tag{59}$$

$$\lambda_{CAPM}(s_t) = \frac{Cov^*(c^{i0}, \beta_R^{i0}(s_t))}{Var^*(\beta_R^{i0}(s_t))} + \lambda_{HCAPM}(s_t) \tag{60}$$

for the CAPM alphas of individual equity markets and for the price of global market risk, respectively. Here, the asterisk denotes cross-sectional moments.

If holding cost c^{i0} is the only source of heterogeneity across countries i, then $Cov^*(c^{i0}, \beta_R^{i0}(s_t)) < 0$. Hence, $\alpha_{CAPM}^i(s_t) > c^{i0}$ and $\lambda_{CAPM}(s_t) < \lambda_{HCAPM}(s_t)$.

It follows from Propositions 3, 4, and 5 that, if holding-cost heterogeneity is the key determinant of the cross-section of equity return comovement, return correlations and covariances should be negatively cross-sectionally related to both global CAPM alphas and, in certain conditions, even average excess market returns, as illustrated in Figure 7. Figures 2 and 3 show that the data are consistent with this prediction. In contrast, if heterogeneity across countries in their cash-flow comovement with the global equity market is the key determinant of correlations, equity premia should be positively cross-sectionally related to return correlations and covariances, as depicted in Figure 8, contradicting the empirical pattern of Figure 3.

Since U.S. stock return is a major determinant of the world stock market factor, a consequence of the negative cross-sectional relation between return correlation with the U.S. and risk-adjusted returns is a flattened relation between world market betas and expected excess returns. That is, large cross-sectional heterogeneity in cross-border investment frictions can generate a flat global security market line without relying on the borrowing rate/funding constraint argument of Black (1974) and Frazzini and Pedersen (2014). Figure 3 shows that the relation between world market betas and mean excess returns over 2000–2017 is indeed too flat and that this is reflected in low-beta markets having higher abnormal returns and vice versa.

The two-country model of Black (1974) already predicts that cross-border holding costs that are homogeneous across countries can shift the security market line vertically, changing the observed zero-beta rate. We see that the heterogeneity in holding costs affects the slope of the security market line. An implication is that as we approach full global financial integration, we expect the global security market line to steepen again.

5 Cross-Border Positions

Understanding the determinants of portfolio allocations and cross-border portfolio holdings is more complicated even to first order, because the portfolio weights of small-country agents, $\theta^{ni}(\zeta_t^i, s_t)$, are in general a function of their own wealth-output share, which evolves endogenously. The market share of foreign investors in the local market also depends directly on country i's wealth:

$$x^{i0}(\zeta_t^i, s_t) = 1 - x_t^{ii}(\zeta_t, s_t) = 1 - \frac{\zeta_t^i}{\omega^i p^i(s_t)}\theta^{ii}(\zeta_t, s_t). \tag{61}$$

Because in the first-order equilibrium small-country investors have non-zero positions in only two equity markets, their own country's equity market and the large equity market, we can equivalently characterize their portfolio-choice problem to first order by considering two (rather than K) sources of risk: global risk and country-specific risk. More formally, for each $i = 1, \ldots, N$ define the 2-dimensional Brownian motion

$$B_t^i = \begin{bmatrix} B_{(0)t} \\ B_{(i)t} \end{bmatrix} \tag{62}$$

where

$$dB_{(0)t} = \left(\sigma^0\right)^{-1} \Sigma^{0\prime} dZ_t \tag{63}$$

and $B_{(i)t}$ is a Brownian motion independent of $B_{(0)t}$ define through

$$\Sigma^{i\prime} dZ_t = \rho^{i0}\sigma^i dB_{(0)t} + \left(\sigma^i\sqrt{1-(\rho^{i0})^2}\right) dB_{(i)t}. \tag{64}$$

Although the qualitative results below go through more generally, we derive analytical characterizations for portfolio-choice outcomes in the special case where small-country investors have unfettered access to the large economy 0: $c^{0i} = 0$ for all $i = 1, \ldots, N$ and small-country investors can take short positions in the equity markets. In this special case, and for parametrizations of the model when equity market i is always integrated ($x^{i0} > 0$), equation (37) implies that the time-variation in the risk prices of country i is only due to time-variation in global surplus s_t:

$$\Xi^i(s_t) = \Xi^0(s_t) + \left(\Sigma_R(s_t)^{-1}\right)' \left(c^0 - c^i\right), \tag{65}$$

where risk prices and volatility matrix Σ_R are now 2×1 and 2×2 matrices, respectively.

Proposition 6 (Cross-Border Portfolio Holdings)**.** *Assume that parameters satisfy conditions (49), (55) and $c^{i0} < \sigma^i\sqrt{1-(\rho^{i0})^2}$, that country i investors, $i = 1, \ldots, N$ have frictionless access to the equity market of country 0 and that equity market i is always partially integrated in equilibrium. Then, to first order,*

$$f^i(s_t) = \omega^i p^i(s_t) - \frac{s_t}{\gamma^i\left(c^{i0} + \Phi^{i0}\right)} \tag{66}$$

and the (shadow) price of country-specific risk perceived by agents in country i is

$$\Xi^i_{(i)}(s_t) = \frac{c^{i0}}{\sigma^i\sqrt{1-(\rho^{i0})^2}}, \tag{67}$$

which is increasing in the holding cost c^{i0} that country 0 investors face when investing in country i and also increasing in the cash-flow ρ^{i0} between markets i and 0.

The average value of the portfolio weight of country i agents in their own country's equity market,

$$\theta^{ii}(\zeta_t, s_t) = \Xi^i_{(i)}(s_t) - \left(\widetilde{\gamma}(\zeta_t, s_t) - 1\right)\left(\Xi^i_{(i)}(s_t) - 1\right), \tag{68}$$

is increasing in holding cost c^{i0} and in the cash-flow correlation ρ^{i0}.

The average value of the foreign investor position (market share) in equity market i,

$$x^{i0}(\zeta^i_t, s_t) = 1 - \frac{\zeta^i_t}{\omega^i p^i(s_t)}\theta^{ii}(\zeta_t, s_t). \tag{69}$$

is decreasing in holding cost c^{i0} and in the cash-flow correlation ρ^{i0}.

Proposition 6 directly translates into prediction of a positive relationship between holding cost and home bias. The usual home bias measure (see e.g. Coeurdacier and Rey (2013)) is one minus the ratio of foreign equities' share in the total equity holdings of local investors divided by the share of foreign equities in the world market portfolio. Note that, to first order, the share of foreign equities in the world market portfolio is one.

Corollary 3 (Home Bias)**.** *Under the assumption of Proposition 6, to first order, the average degree of home bias in country i,*

$$HB_t^i \equiv 1 - \frac{\sum_{n=0\neq i}^{N} \theta_t^{ni}}{\sum_{n=0}^{N} \theta_t^{ni}} \tag{70}$$

is increasing in the holding cost c^{i0} that large-country investors incur when investing in country i and also increasing in the cash-flow correlation ρ^{i0}.

The intuition for these results is that, by Proposition 4, higher holding cost c^{i0} to foreign investors increases the risk premium that investors i attain in their local market, pushing up their optimal portfolio weight θ_t^{ii} of their local market, as well as the optimal weight of the local market in their risky portfolio, $\theta_t^{ii}/(1 - \sum_{n=0}^{N} \theta_t^{ni})$, all else equal.

The holding cost c^{i0} that large-country investors incur when investing in country i has a negative effect on foreign investor position through all three terms that appear on the right-hand-side of equation (69). First, higher c^{i0} implies a higher portfolio weight of local investors on the market $\theta^{ii}(s_t)$. Second, higher c^{i0} reduces the price-dividend ratio of country i, as can be seen in the closed-form solution for the latter in Proposition 3. Third, higher c^{i0} increases the conditional average level of country-i wealth relative to country-i output, $\zeta^{i*}(s_t)$, since it increases the risk premium that agents i attain in the local market, and thus overall from their international equity portfolio, all else equal.

Thus, the model produces a robust prediction of a negative relationship between the cross-border holding cost of foreign investors in the local market and foreign-investor position in the local market.

Note that, since $c^{0i} = 0$ by our assumption, these effects for home bias do *not* hinge on local investors in country i facing holding costs when investing abroad. Of course, home bias will be amplified if c^{i0} and c^{0i} are positively cross-sectionally correlated, that is, if agents based in countries where holding costs to foreign investors c^{i0} are high also tend to face higher costs c^{0i} when investing abroad.

Figure 4 shows that the home bias of the 40 countries has a strong negative cross-sectional relation to U.S. investor position, suggesting that cross-border frictions faced by the investors of a dominantly large country—the U.S.—is an important determinant of the observed level of home bias of the smaller countries. That is, greater demand by the U.S. investors due to low frictions increases the price of the stock market, which induces that country's investors to seek superior returns abroad. For this reason, home bias can appear to explain the country's return correlation with the U.S. stock market.

6 Conclusion

In this paper, we have offered a unified theoretical explanation for some robust empirical regularities in the cross-section of international equity markets, with respect to return dynamics as well as portfolio holdings. Our analysis in this version of the paper has been limited to first moments on the portfolio holdings side. However, our framework also makes interesting predictions about the impact of heterogeneity in cross-border investment frictions on the dynamics of portfolio choice over the global business cycle. Because second moments can be estimated more precisely than first moments even in a dataset with a short time-series, using information on the dynamics of portfolio positions can help yield more precise estimates of the heterogeneity in holding costs in equities and other assets traded internationally. In ongoing work, we use data on the portfolio holdings of international equity mutual funds to test these predictions.

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Tables and Figures

Table 1: **List of Countries**

The table lists the 40 countries used in the paper.

			Data availability									
			Monthly returns		U.S. investor position		Country's position in the U.S.		Total foreign position		Market cap	
No	Country	Label	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
1	AUS	Australia	1970m1	2018m8	1994	2017	1974	2017	1970	2017	1979	2017
2	AUT	Austria	1970m1	2018m8	1994	2017	1974	2017	1970	2017	1975	2017
3	BEL	Belgium	1970m1	2018m8	1994	2017	1974	2017	1970	2017	1975	2017
4	BRA	Brazil	1988m1	2018m8	1994	2017	1974	2017	1970	2017	1988	2017
5	CAN	Canada	1970m1	2018m8	1994	2017	1974	2017	1970	2017	1975	2017
6	CHL	Chile	1988m1	2018m8	1994	2017	1974	2017	1970	2017	1988	2017
7	CHN	China	1993m1	2018m8	1994	2017	1974	2017	1981	2017	1991	2017
8	COL	Colombia	1993m1	2018m8	1994	2017	1974	2017	1970	2017	1988	2017
9	DNK	Denmark	1970m1	2018m8	1994	2017	1974	2017	1970	2017	1975	2012
10	FIN	Finland	1988m1	2018m8	1994	2017	1974	2017	1970	2017	1982	2012
11	FRA	France	1970m1	2018m8	1994	2017	1974	2017	1970	2017	1975	2017
12	DEU	Germany	1970m1	2018m8	1994	2017	1974	2017	1970	2017	1975	2017
13	GRC	Greece	1988m1	2018m8	1994	2017	1974	2017	1986	2017	1988	2017
14	HKG	Hong Kong	1970m1	2018m8	1994	2017	1974	2017	1979	2017	1975	2017
15	HUN	Hungary	1991m2	2018m12	1994	2017	1974	2017	1984	2011	1991	2017
16	IND	India	1993m1	2018m8	1994	2017	1974	2017	1970	2017	1988	2017
17	IDN	Indonesia	1988m1	2018m8	1994	2017	1974	2017	1970	2017	1988	2017
18	ISR	Israel	1993m1	2018m8	1994	2017	1974	2017	1970	2017	1979	2017
19	ITA	Italy	1970m1	2018m8	1994	2017	1974	2017	1970	2017	1988	2014
20	JPN	Japan	1970m1	2018m8	1994	2017	1974	2017	1970	2017	1975	2017
21	KOR	Korea	1988m1	2018m8	1994	2017	1974	2017	1971	2017	1979	2017
22	MYS	Malaysia	1988m1	2018m8	1994	2017	1974	2017	1970	2017	1981	2017
23	MEX	Mexico	1988m1	2018m8	1994	2017	1974	2017	1970	2017	1975	2017
24	NLD	Netherlands	1970m1	2018m8	1994	2017	1974	2017	1970	2017	1975	2017
25	NZL	New Zealand	1988m1	2018m8	1994	2017	1974	2017	1970	2017	1985	2017
26	NOR	Norway	1970m1	2018m8	1994	2017	1974	2017	1970	2017	1981	2017
27	PAK	Pakistan	1993m1	2018m8	1994	2017	1974	2017	1970	2011	1988	2016
28	PER	Peru	1993m1	2018m8	1994	2017	1974	2017	1990	2017	1989	2017
29	PHL	Philippines	1988m1	2018m8	1994	2017	1974	2017	1970	2017	1988	2017
30	POL	Poland	1993m1	2018m8	1994	2017	1974	2017	1975	2017	1991	2017
31	PRT	Portugal	1988m1	2018m8	1994	2017	1974	2017	1971	2017	1977	2017
32	SGP	Singapore	1970m1	2018m8	1994	2017	1974	2017	1970	2017	1979	2017
33	ZAF	South Africa	1993m1	2018m8	1994	2017	1974	2017	1970	2017	1975	2017
34	ESP	Spain	1970m1	2018m8	1994	2017	1974	2017	1970	2017	1975	2017
35	SWE	Sweden	1970m1	2018m8	1994	2017	1974	2017	1970	2017	1975	2012
36	CHE	Switzerland	1970m1	2018m8	1994	2017	1974	2017	1970	2017	1975	2017
37	TWN	Taiwan	1988m1	2018m8	1994	2017	1974	2017	1976	2011	1962	2017
38	THA	Thailand	1988m1	2018m8	1994	2017	1974	2017	1970	2017	1988	2017
39	TUR	Turkey	1988m1	2018m8	1994	2017	1974	2017	1970	2017	1988	2017
40	GBR	United Kingdom	1970m1	2018m8	1994	2017	1974	2017	1970	2017	1975	2017

Table 2: **Descriptive Statistics**

All excess returns are in US dollars, in excess of the 1-month Treasury bill rate. U.S. investor position in a country is U.S. investors' aggregate holding of equity securities in that country, normalized by that country's stock market capitalization. A country's position in the U.S. is the country's holdings of equity securities in the U.S., normalized by the country's stock market capitalization. Total trade of a country with the U.S. is the sum of imports and exports with the U.S., normalized by the country's GDP. GDP correlation is the time-series correlation between real GDP growth rate shocks in a country and in the U.S., where GDP growth shocks are inferred from an AR(1) model. The size of equity market (vs. U.S.) is the country's stock market capitalization (cap) normalized by that of the U.S. Relative size of equity market is the country's stock market cap normalized by that of the world stock market, the latter proxied by the sum of the market caps of the U.S. and the other 40 countries in our sample. Relative output is the country's GDP over world GDP, the latter proxied by the sum of GDP levels of the U.S. and the other 40 countries in our sample. Home bias is 1 - (share of foreign equities in the country's portfolio / share of foreign equities in the world portfolio). All variables are time-series averages within the sample period except GDP correlation, which is already a cross-sectional variable.

	2000-2017 (Baseline)			1986-1999 (Pre-2000)			1986-2017		
	Mean	Median	Stdev	Mean	Median	Stdev	Mean	Median	Stdev
Equity return correlation with the US	0.630	0.628	0.136	0.371	0.391	0.160	0.510	0.498	0.135
US investor position	0.108	0.096	0.061	0.084	0.071	0.049	0.102	0.092	0.053
Total foreign position	0.300	0.260	0.157	0.154	0.134	0.098	0.235	0.215	0.122
Country's position in the US	0.077	0.048	0.092	0.033	0.022	0.040	0.063	0.038	0.067
Total trade with the US	0.083	0.043	0.089	0.084	0.042	0.098	0.083	0.041	0.091
GDP correlation	0.317	0.279	0.173	-0.063	-0.077	0.201	0.158	0.139	0.132
Size of equity market (vs. U.S.)	0.040	0.017	0.049	0.038	0.016	0.076	0.042	0.016	0.071
Relative size of equity market	0.015	0.006	0.019	0.016	0.005	0.039	0.016	0.006	0.026
Relative output	0.025	0.011	0.033	0.025	0.009	0.043	0.025	0.011	0.036
Home bias	0.730	0.772	0.217	0.839	0.910	0.323	0.785	0.827	0.180

Table 3: **Cross-section of Equity Market Return Correlations with the U.S. (2000-2017)**

$$\text{Baseline:} \quad \rho_{US,j} = b_0 + b_1 U.S.\ investor\ position_j + \epsilon_j$$

The table shows that cross-border positions explain the cross-section of the correlation between equity market excess returns and the U.S. stock market excess return. All excess returns are in US dollars, in excess of the 1-month Treasury bill rate. U.S. investor position is U.S. investors' aggregate portfolio holdings of equities in that country, normalized by that country's stock market capitalization. Foreign direct investment (FDI) is total FDI in the country normalized by the country's GDP. Country's holding of US equity is the country's holdings of equity securities in the U.S., normalized by the country's stock market capitalization. Total trade with the U.S. is the sum of imports and exports with the U.S., normalized by the country's GDP. GDP correlation is the time-series correlation between real GDP growth rate shocks in a country and in the U.S., where GDP growth shocks are inferred from an AR(1) model. Size of equity market is the country's stock market capitalization normalized by that of the U.S. All variables are time-series averages within the sample period except GDP correlation, which is already a cross-sectional variable. All variables are cross-sectionally demeaned. Reported in parentheses are t-statistics based on bootstrap standard errors that adjust for cross-country covariances in addition to heteroskedasticity due to variances. Asterisk(*) denotes significance at the 5% level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
US investor position	1.43*						1.40*	1.20*	1.46*	1.43*	1.32*	1.26*	1.22*
	(4.05)						(3.93)	(3.16)	(4.01)	(4.02)	(4.03)	(3.18)	(3.13)
Total foreign direct equity holding		0.04					0.04					0.04	0.03
		(0.88)					(1.32)					(1.08)	(0.96)
Country's holding of US equity			0.69*					0.34*				0.30	0.28
			(2.61)					(2.05)				(1.43)	(1.53)
Total trade with the US				0.08					-0.10			-0.20	
				(0.28)					(-0.48)			(-0.75)	
GDP correlation					0.04					0.05			0.00
					(0.39)					(0.53)			(0.01)
Size of equity market						1.07					0.81		
						(1.85)					(1.67)		
Constant	0.63*	0.63*	0.63*	0.63*	0.63*	0.63*	0.63*	0.63*	0.63*	0.63*	0.63*	0.63*	0.63*
	(16.38)	(15.87)	(16.31)	(15.67)	(15.97)	(15.85)	(16.25)	(16.50)	(16.17)	(16.37)	(16.25)	(16.00)	(16.22)
Observations	40	40	40	40	40	40	40	40	40	40	40	40	40
Adjusted R^2	0.38	0.03	0.19	-0.02	-0.02	0.12	0.41	0.41	0.37	0.37	0.45	0.43	0.41

Table 4: **Cross-section of Equity Market Return Correlations with the U.S. (Other Sample Periods)**

$$\text{Baseline:} \quad \rho_{US,j} = b_0 + b_1 U.S.\ investor\ position_j + \epsilon_j$$

The table shows that cross-border positions explain the cross-section of the correlation between equity market excess returns and the U.S. stock market excess return in other sample periods. All excess returns are in US dollars, in excess of the 1-month Treasury bill rate. U.S. investor position is U.S. investors' aggregate portfolio holdings of equities in that country, normalized by that country's stock market capitalization. Foreign direct investment (FDI) is total FDI in the country normalized by the country's GDP. Country's holding of US equity is the country's holdings of equity securities in the U.S., normalized by the country's stock market capitalization. Total trade with the U.S. is the sum of imports and exports with the U.S., normalized by the country's GDP. GDP correlation is the time-series correlation between real GDP growth rate shocks in a country and in the U.S., where GDP growth shocks are inferred from an AR(1) model. Size of equity market is the country's stock market capitalization normalized by that of the U.S. All variables are time-series averages within the sample period except GDP correlation, which is already a cross-sectional variable. All variables are cross-sectionally demeaned. Reported in parentheses are t-statistics based on bootstrap standard errors that adjust for cross-country covariances in addition to heteroskedasticity due to variances. Asterisk(*) denotes significance at the 5% level.

Panel A. Full sample period (2000m1–2017m12)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
US investor position	1.60*						1.50*	1.18*	1.57*	1.57*	1.57*	1.29*	1.24*
	(5.00)						(5.17)	(3.71)	(4.83)	(4.99)	(4.96)	(4.03)	(3.97)
Total foreign direct equity holding		0.33*					0.29*					0.25*	0.21*
		(2.55)					(3.34)					(2.68)	(2.22)
Country's holding of US equity			1.16*					0.74*				0.45	0.45
			(4.33)					(3.18)				(1.66)	(1.82)
Total trade with the US				0.26					0.12			-0.14	
				(0.98)					(0.56)			(-0.61)	
GDP correlation					0.27					0.23*			0.17
					(1.94)					(2.15)			(1.69)
Size of equity market						0.36					0.25		
						(0.39)					(0.31)		
Constant	0.51*	0.51*	0.51*	0.51*	0.51*	0.51*	0.51*	0.51*	0.51*	0.51*	0.51*	0.51*	0.51*
	(15.56)	(15.29)	(15.29)	(14.69)	(15.02)	(13.95)	(15.90)	(15.63)	(15.43)	(15.67)	(14.67)	(15.66)	(15.85)
Observations	40	40	40	40	40	40	40	40	40	40	40	40	40
Adjusted R^2	0.39	0.19	0.32	0.00	0.04	0.01	0.54	0.48	0.38	0.42	0.39	0.56	0.58

Panel B. Earlier sample period (1986m1–1999m12)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
US investor position	1.22*						1.18*	1.19*	1.25	1.27*	1.29*	1.20	1.24*
	(2.38)						(2.33)	(2.26)	(1.91)	(2.35)	(2.51)	(1.94)	(2.27)
Total foreign direct equity holding		0.24					0.24					0.14	0.22
		(1.00)					(1.09)					(0.58)	(0.94)
Country's holding of US equity			1.04					0.99				0.66	0.72
			(1.03)					(1.07)				(0.73)	(0.74)
Total trade with the US				0.60*					0.62*			0.40	
				(2.21)					(2.06)			(0.98)	
GDP correlation					0.03					0.08			0.11
					(0.21)					(0.61)			(0.87)
Size of equity market						0.36					0.45		
						(0.26)					(0.33)		
Constant	0.37*	0.37*	0.37*	0.37*	0.37*	0.37*	0.37*	0.37*	0.37*	0.37*	0.37*	0.37*	0.37*
	(6.64)	(6.41)	(6.47)	(6.54)	(6.55)	(6.18)	(6.51)	(6.55)	(6.58)	(6.62)	(6.25)	(6.37)	(6.43)
Observations	40	40	40	40	40	40	40	40	40	40	40	40	40
Adjusted R^2	0.11	0.13	0.04	0.11	-0.03	0.00	0.24	0.16	0.24	0.10	0.14	0.28	0.25

Table 5: **Cross-section of Correlations in Log Valuation Ratio Changes (2000-2017)**

$$\text{Baseline:} \quad \rho_{US,j} = b_0 + b_1 U.S.\ investor\ position_j + \epsilon_j$$

The table shows that cross-border positions explain the cross-section of the correlations between the log dividend-price ratio of a country with the log dividend-price ratio of the U.S. stock market. U.S. investor position is U.S. investors' aggregate portfolio holdings of equities in that country, normalized by that country's stock market capitalization. Foreign direct investment (FDI) is total FDI in the country normalized by the country's GDP. Country's holding of US equity is the country's holdings of equity securities in the U.S., normalized by the country's stock market capitalization. Total trade with the U.S. is the sum of imports and exports with the U.S., normalized by the country's GDP. GDP correlation is the time-series correlation between real GDP growth rate shocks in a country and in the U.S., where GDP growth shocks are inferred from an AR(1) model. Size of equity market is the country's stock market capitalization normalized by that of the U.S. All variables are time-series averages within the sample period except GDP correlation, which is already a cross-sectional variable. All variables are cross-sectionally demeaned. Reported in parentheses are t-statistics based on bootstrap standard errors that adjust for cross-country covariances in addition to heteroskedasticity due to variances. Asterisk(*) denotes significance at the 5% level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
US investor position	1.40*						1.32*	1.05*	1.36*	1.37*	1.30*	1.12*	1.09*
	(3.06)						(2.95)	(2.07)	(2.93)	(2.93)	(3.03)	(2.08)	(2.02)
Total foreign direct equity holding		0.24*					0.21*					0.16	0.14
		(2.27)					(2.00)					(1.13)	(1.04)
Country's holding of US equity			0.98*					0.60				0.41	0.41
			(3.41)					(1.93)				(0.99)	(1.04)
Total trade with the US				0.24					0.13			-0.06	
				(0.82)					(0.44)			(-0.20)	
GDP correlation					0.21					0.17			0.13
					(1.24)					(1.21)			(0.88)
Size of equity market						0.81					0.71		
						(0.78)					(0.75)		
Constant	0.42*	0.42*	0.42*	0.42*	0.42*	0.42*	0.42*	0.42*	0.42*	0.42*	0.42*	0.42*	0.42*
	(11.99)	(11.81)	(12.01)	(11.60)	(11.75)	(11.13)	(12.02)	(12.02)	(11.82)	(11.96)	(11.43)	(11.76)	(11.91)
Observations	40	40	40	40	40	40	40	40	40	40	40	40	40
Adjusted R^2	0.22	0.07	0.17	-0.00	0.01	0.12	0.27	0.26	0.21	0.23	0.32	0.26	0.27

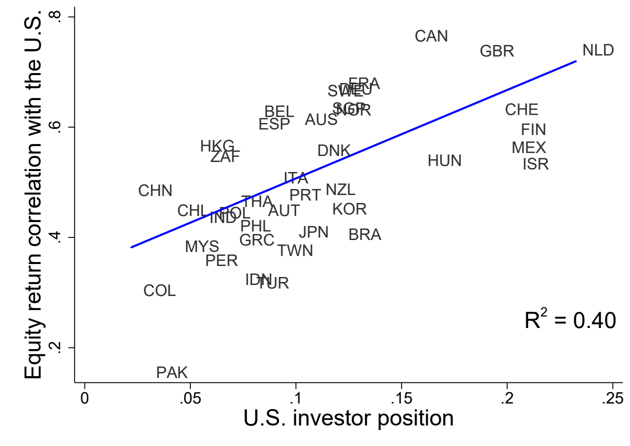

Figure 1: **Equity Return Correlation and U.S. Investor Position**

The figures show that, in a cross-section of 40 countries and over the baseline sample period, 2000m1-2017m12, the U.S. investor position in the country's equity market explains how correlated the country's equity excess return is with the U.S. equity excess return. All excess returns are in USD and are computed in excess of the one-month U.S. T-bill rate.

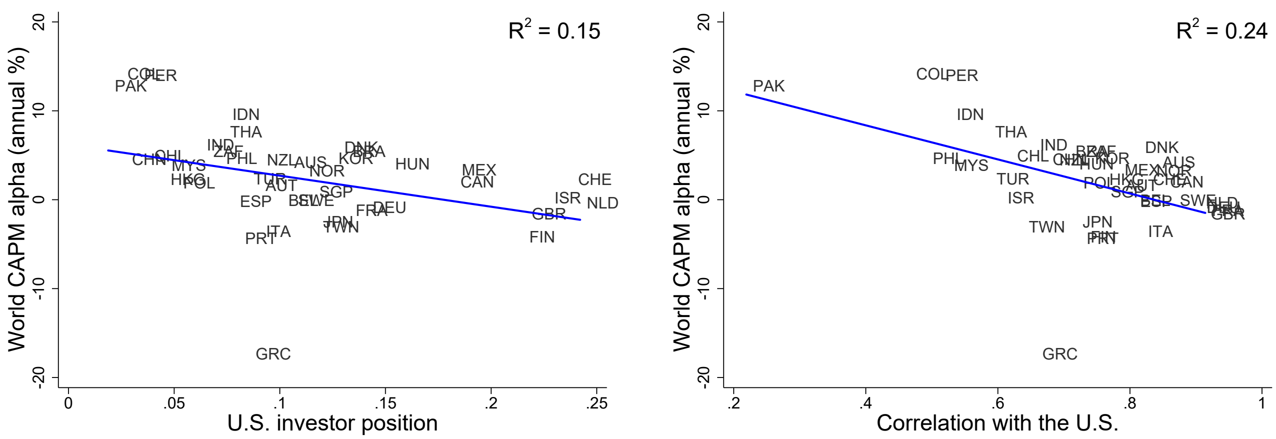

Figure 2: **World CAPM Alphas Are Related to Other Cross-Sectional Moments**

These figures show that the deviations from the world CAPM can be rationalized as holding costs, which in equilibrium are revealed by the cross-section of U.S. investor positions and correlations with the U.S. among others. The world stock market factor is from Kenneth French's website. Sample period: 2000m1–2017m12.

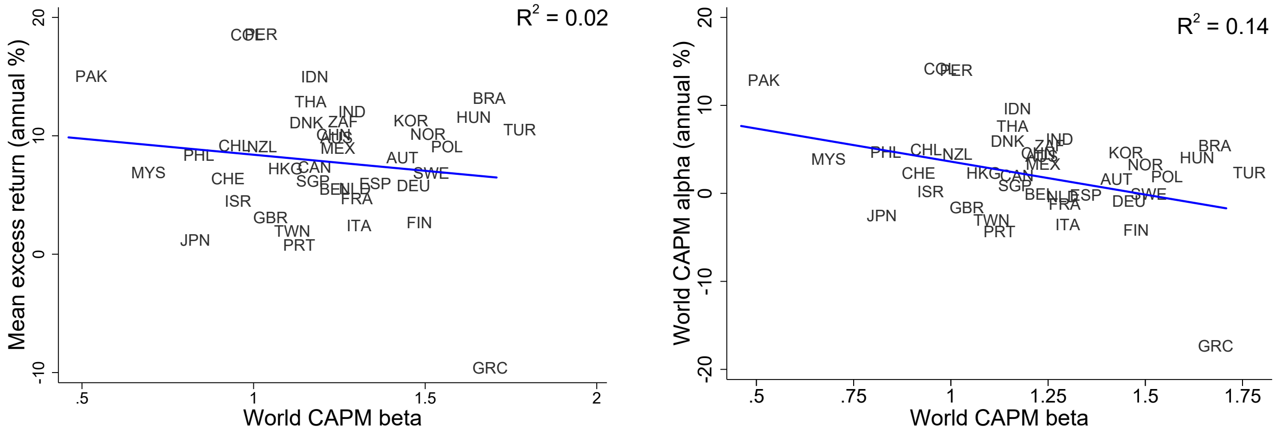

Figure 3: **The Global Security Market Line**

The figure shows that the cross-sectional relation between mean excess returns and world CAPM beta is flat. Sample period: 2000m1–2017m12

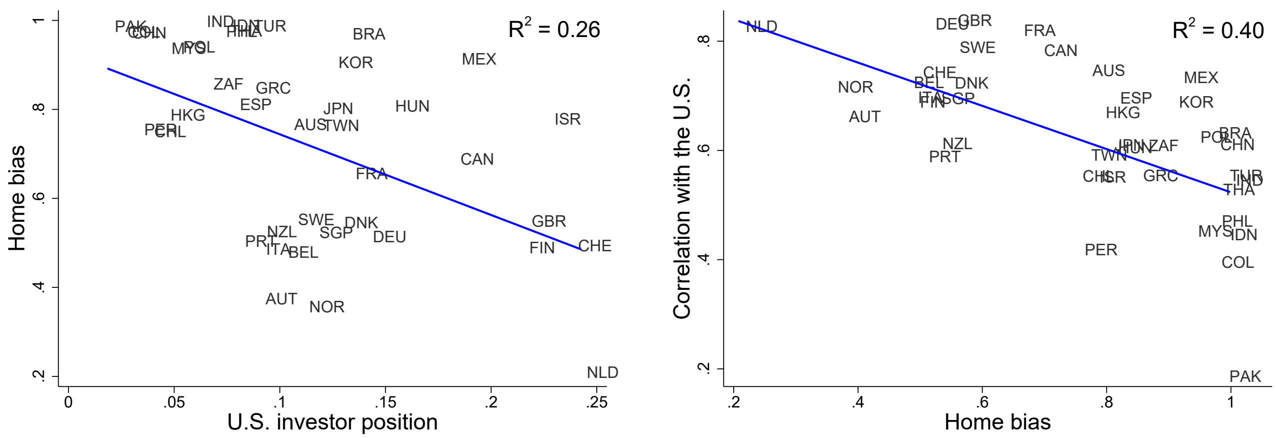

Figure 4: **Home Bias Is Related to Other Cross-Sectional Moments**

These figures show that the cross-sectional variation in the home bias of 40 countries is negatively related to U.S. investor positions and correlations with the U.S. among others. Home bias is calculated as one minus the share of foreign equities in the country's portfolio over the share of foreign equities in world portfolio. Sample period: 2000m1–2017m12.

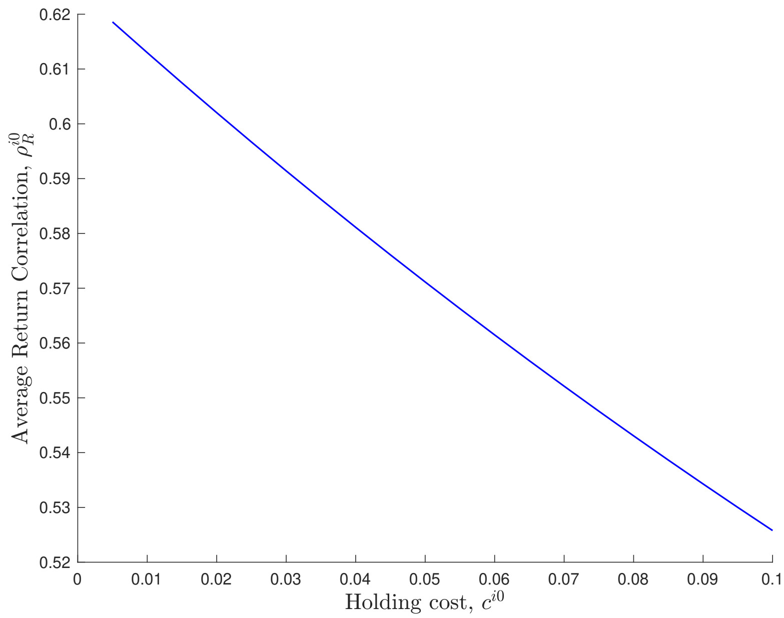

Figure 5: Return Correlations against Holding Costs in the Model

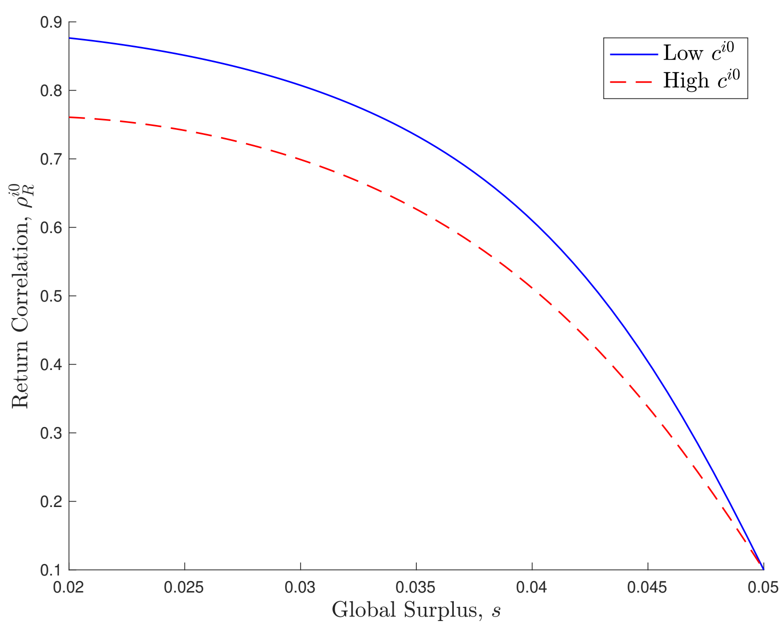

Figure 6: Return Correlations are Countercyclical in the Model

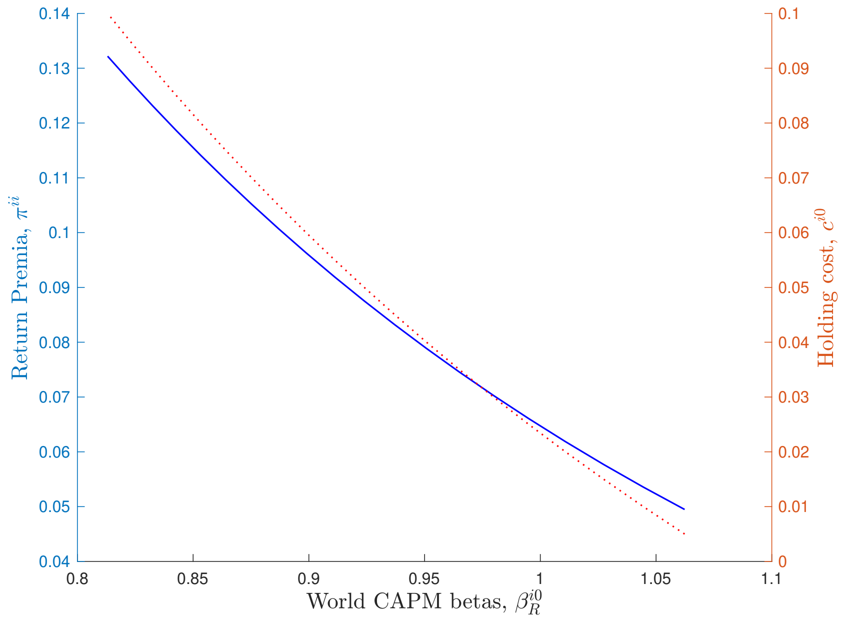

Figure 7: The Global Security Market Line in the Model

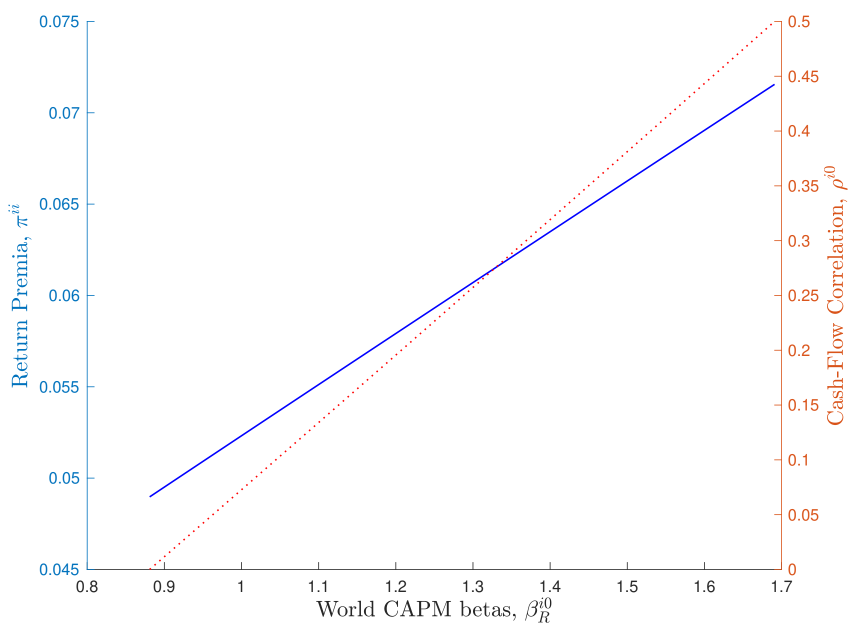

Figure 8: The Global Security Market Line under Cash-Flow Comovement Heterogeneity

A Theory Appendix

TO BE ADDED.

B Additional Figures

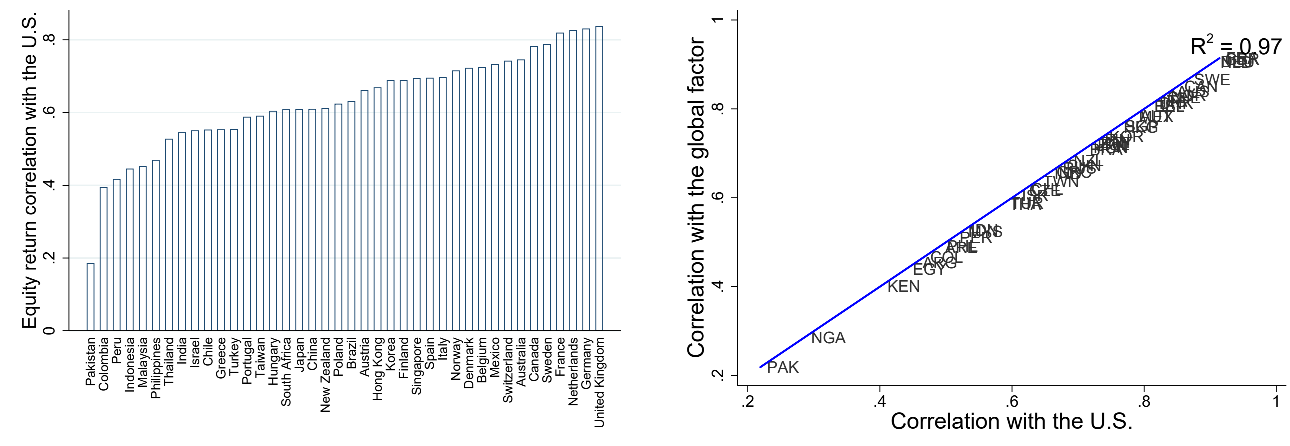

Figure 9: **Return Correlation with the U.S. (2000-2017)**

These figures show that there is a substantial cross-sectional variation in return correlations with the U.S. and that correlation with the global market factor is very similar to that with the U.S. stock market.

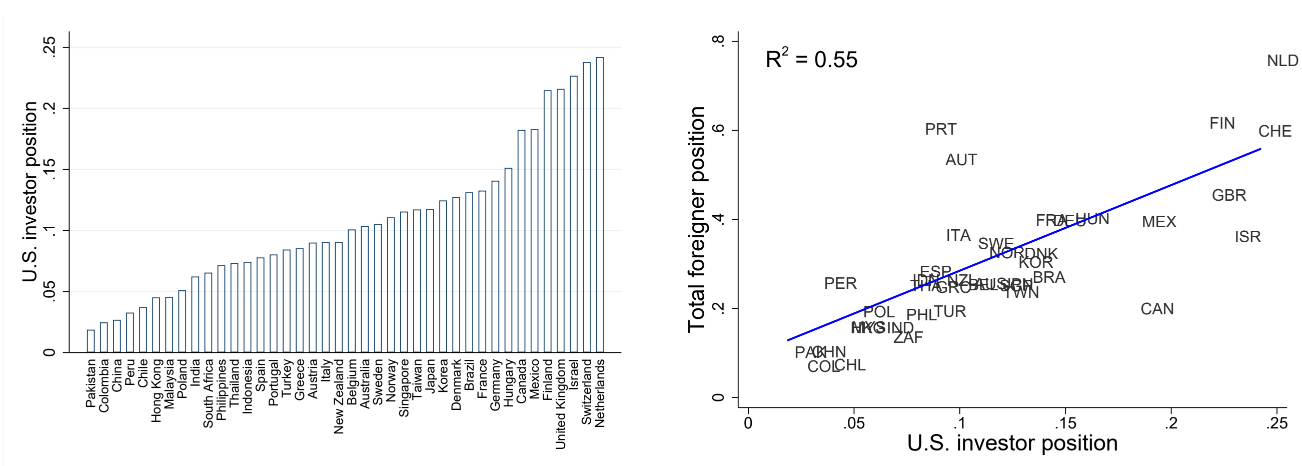

Figure 10: **U.S. Investor Positions (2000-2017)**

These figures show that there is a substantial cross-sectional variation in U.S. investor positions and that total foreigner positions have a strong positive relation to U.S. investor positions. U.S. investor position is the share of the market capitalization of the stock market held by U.S. investors.

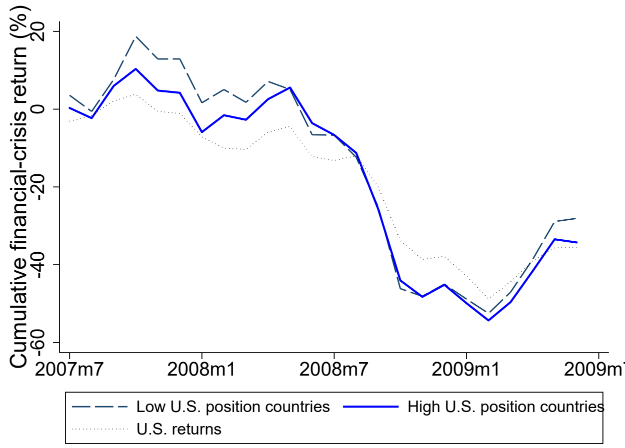

Figure 11: **Cumulative Returns to Low vs. High-U.S.-Position Countries (2007m7-2009m6)**

The figures plot the cumulative equal-weighted returns of 20 countries whose U.S. investor positions during 2000–2006 are below vs. above the median. It suggests that countries in which U.S. investor had a lower position did not underperformed others during the financial crisis period, a proxy for a rare disaster.

C Data Description

In this section, we introduce the main data sources, key variables, and return factor proxies used in the empirical analysis.

Sample period We focus on the sample period of 2000m1-2017m12, which we refer to the baseline sample period. This choice is driven by data availability. The data on U.S. investor cross-border positions in other countries (from the Treasury International Capital, see below), our key cross-sectional variable, are available at yearly frequency only from 2003. Before 2003, the data are available sparsely in 2001, 1997, and 1994. Similarly, the data on the countries' short-term Treasury bill rate, also important for our analysis, are available from around 2000 for many countries. In parts of the analysis, we also report results over the 1986m1-2017m12 period or the pre-2000 sample of 1986m1-1999m12 for comparison.

List of stock markets Our baseline analyses use a set of 40 stock markets in addition to the U.S. stock market, reported in Table 1. This is a comprehensive list of countries satisfying four criteria: (1) U.S. investors hold portfolio equity positions of $1 billion or more according to TIC, (2) the country is not considered a tax haven,[16] (3) data on monthly stock market returns, U.S. investor portfolio equity positions, and yearly market capitalizations used in the cross-sectional analysis are available since 1994 or earlier, and (4) the dividend-price ratio is available since 2006 or earlier. The list covers all major stock markets and includes a large number of emerging markets.

Return correlation Our baseline measure of international equity return comovement is the correlation between the monthly excess return to a country's stock market and the excess return to the U.S market. All returns are in USD.

Excess returns on stock markets The monthly excess returns to a country's stock market is the end-of-month MSCI broad country index return in USD (e.g., "MSUTDK$" for the United Kingdom) from Datastream minus the one-month U.S. Treasury bill rate from Kenneth French's website. The broad country index is the most comprehensive country index offered by the MSCI and is broader than the MSCI investable market index. The smallest and most illiquid stocks, however, are excluded from the broad country index.[17] Complete returns data for every country in our sample are available starting in 1993. The U.S. stock market return is the U.S. market portfolio from Kenneth French's website.

[16]This entails the exclusion of: Anguilla, Bahamas, Bermuda, British Virgin Islands, Cayman Islands, Curacao, Guernsey, Ireland, Isle of Man, Jersey, Luxembourg, Liberia, Panama, Panama, Marshall Islands, and Mauritius.

[17]For more details, see https://www.msci.com/index-methodology.

Measures of fundamental cash-flow exposure We consider two measures of a stock market's fundamental cash-flow exposure to the U.S. equity return. These are total trade with the U.S. and GDP correlation with the U.S., which we interpret as proxies for determinants of return comovement related to cash-flow fundamentals. *Total trade with the U.S.* is measured by the sum of the country's export and import with the U.S. as a fraction of the country's GDP. The resulting annual series is averaged over a given sample period to yield a measure used in the cross-sectional analysis. *GDP correlation* is the correlation of a country's real GDP growth shocks and the U.S.'s real GDP growth shocks, where the shocks are captured by the residuals from a country-specific AR(1) model, over a sample period. For the parts of the analysis where the foreigner-holdings-weighted average return is used in place of the U.S. return, GDP correlation is the correlation between a country's GDP residuals and a weighted average of all countries' GDP residuals, where the weights are given by foreign investors' relative holdings in a given country (same as weights used in the construction of the global investor portfolio proxy). The trade data are from the U.S. Census Bureau, the GDP data are from the World Bank and Global Financial Data (GFD), and the consumer price index data used to obtain the real GDP are from GFD.

Cross-border positions and market size We also consider cross-border position as an explanatory variable for return comovement. Since our main measure of return comovement is with respect to the U.S., our baseline measure of cross-border position is the fraction of a country's stock market owned by the U.S. investors. Specifically, the *U.S. investor position* in a country is the total portfolio equity position that U.S. residents hold in that country, as reported by the Treasury International Capital (TIC) data, divided by the country's stock market capitalization obtained from GFD. The data are available every year since 2003 and also during the years 2001, 1997, and 1994. The data for each country are time-averaged over a sample period to yield the measure used in the cross-sectional analysis.[18]

An alternative measure of cross-border position is total foreign position, which is defined as total portfolio equity liability in the international investment position of a country (equity holdings of foreign investors) normalized by the stock market capitalization of that country. Our total portfolio equity liability data augments the 1970-2011 series generously provided by Philip Lane (Lane and Milesi-Ferretti (2017)) to 2017 using data from the IMF's international investment position (IIP) statistics. We use these data to construct our home bias measure for each country. Also, if total portfolio equity liability is an approximately constant multiple of the U.S. position, the total foreign position series is a reasonable proxy for the U.S. position and is available for a longer time period than the latter. We also use the IMF's Coordinated Portfolio Investment Survey–Reported Portfolio Investment Assets by Economy of Nonresident Issuer to obtain data on pairwise cross-country positions.

Similar to the U.S. investor position in a country, the position taken by the country's residents in the U.S. market

[18]The TIC portfolio equity position includes limited partnership shares, which makes the data a poor representation of public equity positions in countries that are considered tax havens. We therefore exclude countries considered to be tax havens from our analysis. For the other countries, the public equity segment of the market is much larger than other segments of the equity market so that the equity positions from the TIC are a good proxy for public equity positions of U.S. residents.

can also contribute to return comovement with the U.S. For instance, if investors from foreign countries hold large positions in the US relative to the size of their stock market, a shock to the U.S. equity return could generate a rebalancing motive for these investors. To capture this effect, we consider *a country's position in the U.S.*, defined as the country's holdings of equity securities in the U.S., normalized by that country's stock market capitalization. These data are available from the TIC yearly since 2002 and also for the years 2000, 1994, 1989, 1978, and 1974.

Motivated by the fact that relative market size is an important determinant of asset return comovement in models of the portfolio demand channel (e.g. Martin (2013)), we also control for the *size of the equity market*, defined as the time-series average over a given sample period of the ratio of a country's stock market capitalization over that of the U.S. market. Our main source of market capitalization is the "market capitalization of listed countries (current US$)" from the Global Financial Data (GFD).[19] The data are available at the annual frequency for the sample period we consider, although there are exceptions. The data for the United Kingdom end early in 2012, so we use the European Central Bank data to find the growth rate of market capitalization from 2012. We apply this growth rate to obtain market capitalizations for 2013-2017. Some data in the 2010s are missing for other countries ll: Czech Republic, Denmark, Finland, Italy, Kenya, Pakistan, and Sweden. We do not make further adjustments for these countries. The standard GFD market capitalization data are unavailable for Taiwan, so we use "Taiwan SE Capitalization, Value Traded (USD) (SCTWNM)."

Descriptive statistics Table 2 describes the cross-sectional average of the different variables we construct for our baseline sample (2000m1-2017m12), the pre-2000 sample (1986m1–1999m12), and the full sample (1986m1-2017m12). It reveals a number of interesting patterns. First, U.S. investor position, the share of an equity market owned by U.S. investors, has a cross-sectional average of 10.8%, substantially lower than the share of world financial wealth owned by the U.S. (around 1/3). This suggests that despite the globalization of financial markets, U.S. investors still prefer investing in the U.S. market due to various frictions they face when investing in foreign equities. Similarly, a country's position in the U.S., the country's holding of U.S. equity as a fraction of its stock market capitalization, has a cross-sectional average of 7.7%, much lower than the world market share of the U.S. (around 1/2). This suggests that there are also substantial frictions that other countries face when investing in U.S. equity.

The table also reveals interesting time-series patterns. It shows that the average equity return correlation of the 40 countries with the U.S. has risen from an average of 0.37 in the pre-2000 period to 0.63 in the post-2000 period. At the same time, cross-sectional average cross-border positions have also increased over the two sample periods: from 8.4% to 10.8% for the U.S. position in other countries, from 15.4% to 30.0% for the total foreign position in the countries, and from 3.3% to 7.7% for the countries' positions in the U.S. equity market.

[19] The code is CM.MKT.LCAP.CD.XXX with "XXX" being the 3-digit country code.