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Endogenous asymmetric information and international equity home bias: The effects of portfolio size and information costs

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Abstract

Equity home bias is one of the major puzzles in international finance. This paper investigates the impact of asymmetric information on equity home bias in a rational expectation model where portfolio managers differ in their levels of initial portfolio size and information acquisition is endogenous. The model characterizes the information acquisition and investment decisions made by each portfolio manager, and the resulting equilibrium. We find that portfolio managers with larger portfolio size acquire information about the foreign asset; this is consistent with new evidence linking the degree of home bias across portfolio managers to portfolio size.
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1. Introduction

Equity home bias, the observation that individuals hold too little of their wealth in foreign assets, is one of the major puzzles in international finance. In the context of the standard capital asset pricing model, Levy and Sarnat (1970) and Solnik (1974) demonstrate theoretically the advantage of international diversification, and simulations by Lewis (1999) predict that

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American portfolios should have at least 40% of foreign assets. However, estimates of the actual proportion of foreign assets held by American investors range around 10% (French and Poterba, 1991; Cooper and Kaplanis, 1994; Tesar and Werner, 1995; Ahearne et al, 2004).[1]

There is a large literature that examines reasons for such equity home bias. One explanation of the home bias is that domestic equity provides a better hedge for risks that are specific to the home country (Lewis, 1999). However, empirical tests indicate rejection of the null hypothesis that home bias in equities is caused by investors trying to hedge real exchange risk (e.g., Cooper and Kaplanis, 1994; Vassalou, 2000). Further, the predicted home bias would be even more pronounced if we consider non-traded goods (Eldor et al., 1988; Stockman and Dellas, 1989; Baxter and Jermann, 1997).

A second explanation of home bias is that there exist international tax and transaction cost barriers in international capital markets (Black, 1974; Stulz, 1981a,b). Empirical tests do support this view that international taxes and government restrictions can affect equity home bias (Bonser-Neal et al., 1990; Hardouvelis et al, 1994; Claessens and Rhee, 1994; Errunza and Losq, 1985). This is especially the case with respect to foreign assets of a less-developed country, where there can exist significant international taxes and government restrictions on the capital account movements (Lewis, 1995, 1999). However, large transaction costs would not only lead to small holdings of foreign assets, but also to low turnover rates, and Tesar and Werner (1995) do not find that portfolio turnover rates are lower for foreign assets than for domestic assets; this view is reaffirmed by Warnock (2002).

A third rational for home bias that is widely cited is the existence of asymmetric information. For example, Gehrig (1993) and Brennan and Cao (1997) develop a noisy rational expectation model to show that home bias arises when domestic portfolio managers have an information advantage over foreign portfolio managers.[2] Kang and Stulz (1997) present some indirect evidence that foreign portfolio managers primarily invest in stocks of Japanese companies that are better known to them, even when the expected returns are lower than the returns on other Japanese stocks (Lewis, 1999). Similarly, Lang et al. (2003) and Ahearne et al. (2004) highlight the potential role that the cross-listing of securities (foreign firms listing their securities in the U.S.) can play in reducing asymmetric information for specific securities and thus reducing the extent of home bias for such securities.[3] These papers establish the important role that asymmetric information can play in explaining the home bias puzzle.

In this paper, we present a home bias model that relies on asymmetric information. However, we differ from earlier theoretical work on home bias in that our focus is on explaining differences we identify in the extent of home bias across portfolio managers. In Section 2, we present evidence that the extent of home bias depends on the size of the portfolio under management by portfolio managers. In particular, an examination of a 2003 survey of pension funds provided by *Pensions & Investment* indicates a significant negative relationship between the size of the portfolio and the extent of home bias, and this bias appears linked to the greater acquisition of information on foreign assets by large pension funds. We use these findings to motivate

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[1] Glassman and Riddick (1996), however, provide evidence suggesting that, to some extent, such measures of bias may be overstated.

[2] Hasan and Simaan (2000) develop a portfolio model that incorporates both the foregone gains from diversification and the informational constraints of international investing. They show that estimation errors for the mean and variance parameters induce a home bias.

[3] Asymmetric information is invoked in a similar fashion by Coval and Moskowitz (1999) to explain why U.S. investment managers exhibit a strong preference for locally headquartered firms in their domestic portfolios.

introducing complexity into the standard asymmetric information model for portfolio managers.

Section 3 develops a rational expectation model in which heterogeneous domestic portfolio managers (in terms of portfolio size) decide whether to acquire costly information on foreign assets.[4] In equilibrium, the market price reveals sufficient information such that the marginal portfolio manager in each country is indifferent between acquiring and not acquiring information. Our analysis adds to Gehrig's (1993) finding that informed portfolio managers have higher demands for foreign assets by linking the acquisition of information by portfolio managers in each country directly to portfolio size. The upshot is that our analysis predicts that portfolio managers with larger holdings of risky assets will have a higher proportion of such assets in foreign securities (less equity home bias).

In our analysis, portfolio managers can be viewed as either individual investors managing their own wealth or as fund managers hired to oversee the assets of many individuals. In the case where portfolio managers are viewed as individuals deciding on how to invest their wealth, our analysis assumes that wealthier individuals act as if they are less risk averse. The result is a direct relationship between wealth and risky assets holdings. This relationship is consistent with findings reported in the Federal Reserve's Survey of Consumer Finances. In the case where portfolio managers are viewed as fund managers hired by groups of investors, our analysis assumes that management size is directly related to fund size and that compensation packages depend on fund performance.[5] The result is again a direct relationship between fund size and risky asset holdings. Section 4 conducts a simulation to illustrate how the aggregate magnitude of the home bias can be affected by changes in various parameter values, in particular the cost of information.

2. Cross-sectional evidence on home bias differences

This section provides new empirical evidence on differences in home bias across portfolio managers. To do so, we examine 2003 cross-sectional survey data purchased from *Pension & Investments*. *Pensions & Investment*, founded in 1973, is the preeminent international financial newspaper for institutional investing and fund management.[6] Using their connection to the pension plan sponsors, portfolio managers, corporate executives, money managers and other institutional investors, they conduct a pension fund survey of the top 1000 funds, compile the data, and offer the survey data for sale. We purchased the 2003 survey that covered the top 1000 U.S. pension funds. These top 1000 U.S. pension funds reflect funds for private companies (62%), non-profits (2.2%), government employees (22.1%) and unions (13.9%). For each pension fund, asset allocation information was provided for defined benefit plans and, where applicable, defined contribution plans. For defined benefit plans, the assets are divided into the following 11 categories: the stock of the sponsoring company, domestic equity, domestic fixed income, international equity, international fixed income, cash, private equity, equity real estate, mortgages, and others. Combining the sponsoring company stock, domestic equity,

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[4] Our setting can be viewed as combining the analysis of the endogenous determination of informed agents that is contained in Grossman and Stiglitz (1980) and the analysis of the effect of asymmetric information on portfolio choice when there are multiple risky assets that is provided by Admati (1985).

[5] The form for compensation packages is suggested by Security Exchange Commission (SEC) regulations.

[6] *Pensions & Investments* reports on news developments that affect the investments and investment strategies of pension funds, endowments, foundations, mutual funds, insurance companies, investment advisers, trust departments and trust companies.

and international equity categories provides a measure of (public) equity holdings. Dividing this sum into the holdings of international equity provides a measure of the proportion of equity holdings that involves foreign assets.[7]

Of the 1000 top pension funds surveyed, 750 had defined benefit plans. Of these, 595 had positive international equity holdings. Table 1 provides standard statistics for the key variables collected for the sample of funds that contained some international equity holdings. Table 1 indicates that only 13.8% of portfolios are on average invested in international equity. If we adjust the portfolio such that the portfolio includes only international equity and domestic equity, then international equity makes up 23.5% of this adjusted portfolio of equity-only assets.

Table 2 presents estimates of the relationship between the existence and extent of international equity holdings. The first two columns present a logit model: the dependent variable equals one if the defined benefit plan had positive holdings of international equity, zero otherwise. Recall that 565 of the 750 plans held such assets. The independent variable is either the logarithm of total holdings in the defined benefit plan (column 1) or the logarithm of total equity holdings in the defined benefit plan (column 2). The estimation results of the logit model indicate that international equity holdings are more likely to exist in funds that are larger.

Columns 3–6 in Table 2 consider how the two measures of plan size affect the extent of international equity holdings among funds that hold a positive level of foreign equity. For this analysis, the dependent variable is the logarithm of the ratio of international equity to total equity holdings. Note that this ratio of foreign equity holdings is significantly and positively associated with the plan's portfolio size, either in terms of total holdings (column 3) or only equity holdings (column 5). However, as indicated in columns 4 and 6 of Table 2, such a relationship disappears or weakens when one includes the logarithm of the ratio of number of international equity fund managers to total fund managers.[8] The reason, confirmed by examining the correlation between the size of the portfolio and the proportion of fund managers who are international equity fund managers, is that larger funds employ relatively more international equity fund managers.

To summarize the above results, we find that portfolio managers with larger portfolios tend to exhibit less home bias. With respect to those with positive international holdings, this reduction in the extent of home bias at larger funds appears to reflect the fact that larger funds acquire greater information regarding foreign assets, as evidenced by the relatively greater resources in terms of international fund managers. In the next section we develop a model that introduces links among fund size, the acquisition of information regarding foreign assets, and the extent of home bias.

3. The model

The model to be developed can be viewed as combining a special case of Admati's (1985) noisy rational expectation model that incorporates multiple risky assets with the endogenous acquisition of information that has been considered in a single risky asset setting by Grossman and Stiglitz (1980). Like Gehrig's (1993) interpretation of Admati, as well as Brennan and Cao

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[7] We focus on the defined benefit plans as the breakdown of asset holdings for the defined contribution plans does not allow a clear measure of the fraction of equity holdings that involve international assets. Note that to some extent domestic equity holdings have an international component if the firm is a multinational. Unfortunately, we do not have a measure of the extent of that domestic equity holdings include international with foreign operations.

[8] Unfortunately, there are only 118 funds that reported such manager information.

Table 1
Description and summary of variables in pension survey

Variable	Obs.	Mean	Std. dev.	Min	Max
Plan asset values					
All plans assets	595	$5526	$12,282	$540	$128,678
Defined benefit assets	595	$4538	$11,739	$7	$128,461
Defined contribution assets	595	$988	$1944	$0	$16,949
Defined benefit composition (%)					
Domestic equity	595	45.5%	10.3%	0.0%	80.0%
Domestic fixed income	595	30.6%	11.1%	0.0%	92.0%
International equity	**595**	**13.8%**	**6.2%**	**1.4%**	**48.0%**
International fixed income	595	1.6%	4.2%	0.0%	50.0%
Cash	595	1.9%	3.7%	0.0%	45.0%
Private equity	595	2.1%	3.7%	0.0%	24.0%
Equity real estate	595	2.7%	3.7%	0.0%	15.0%
Mortgages	595	0.4%	1.8%	0.0%	18.0%
Other	595	1.6%	4.4%	0.0%	41.0%
Sum of the composition	595	100.0%			
Adjusted portfolio (%)					
International equity	595	23.5%	10.5%	2.2%	100.0%
Domestic equity	595	76.5%	10.5%	0.0%	97.8%

(1997), our analysis is set in the international capital markets. However, unlike these models, we not only introduce an explicit cost of information, but identify the characteristics of those in each country who acquire the information. To do so, we introduce heterogeneous portfolio managers. These managers are viewed as either individual investors managing their own wealth or as fund managers hired to oversee the assets of many individuals. A new equilibrium result

Table 2
Effect of portfolio size on the existence and extent of foreign equity holdings in defined benefit plans

Independent variables	Logit model for existence of foreign equity holdings in plan[a]		Regression model for extent of foreign equity holdings for plans with foreign equity holdings[a]			
	1	2	3	4	5	6
Log size of the total portfolio	0.494 (0.086)**		0.058 (0.016)**	−0.005 (0.033)		
Log size of the equity portfolio		0.627 (0.091)**			0.056 (0.016)**	−0.000 (0.033)
Log of the ratio of international fund managers				0.318 (0.078)**		0.315 (0.078)**
Constant	−2.073 (0.589)**	−2.600 (0.565)**	−1.988 (0.118)**	−1.044 (0.328)**	−1.939 (0.112)**	−1.088 (0.309)**
Observations	750	750	595	118	595	118
R-Squared			0.02	0.13	0.02	0.13

Standard errors in parentheses (*significant at 5%; **significant at 1%).
  [a] For the logit model, the dependent variable is one if plan has foreign equity holdings, zero otherwise. For the regression model, the dependent variable is log of the ratio of the foreign equity holdings to total equity holdings for plans with foreign equity holdings.

of our model is that in each country some portfolio managers acquire an information advantage over others concerning foreign markets. Thus our model differs from others in that we address the issue of differences in the degree of home bias across portfolio managers within a country.

We assume two symmetric markets: the home market and the foreign market. Each market has a large number of portfolio managers, such that each has an infinitesimal effect on the market. These managers are uniformly distributed over the range [0, 1] according to the level of their initial portfolio size. There are three available assets in the market: a risky asset issued by the home market, a risky asset issued by the foreign market, and a risk-free asset.

Each portfolio manager makes two sequential decisions: strategic information acquisition and investment. All portfolio managers are assumed to have information about their home market at zero cost. On the other hand, they need to decide whether to acquire information by paying a cost c or to remain uninformed about the foreign market. In order to focus on the information acquisition decision, we assume that there are no barriers to investment other than the cost of information, no currency and political risk, no deviations from purchasing power parity, and no interest rate differentials on average.

The decision to acquire information on foreign assets is based on a comparison of the expected utility when informed to the expected utility when uninformed. There are two types of portfolio managers in each market: the Informed (I) with information on their home and foreign markets, and the Uninformed (U) with home market information only. Below we identify a cutoff portfolio size $\overline{W}$, such that portfolio managers with initial portfolio size above this cutoff level become informed, and those with initial portfolio size below the cutoff portfolio size remain uninformed. A higher cutoff $\overline{W}$ implies a lower proportion of informed managers.

Both informed and uninformed portfolio managers make decisions about the demand for the assets. The demand of informed portfolio manager depends on the revealed information on asset returns and the asset prices. The demand of uninformed portfolio manager depends on the asset prices only. Equilibrium prices clear the international capital markets by equating asset supply to asset demand.

3.1. The asset investment decision

A portfolio manager has an initial portfolio size W_0 that can be invested in three types of securities: a risk-free asset, a risky home asset, and a risky foreign asset. Denote by X_j^{kl} the demand for country j's ($j = A, B$) risky asset by portfolio manager of type k ($k = I, U$) who lives in the country l ($l = A, B$). We adopt the standard assumption that the risk-free asset is available in limitless supply.[9] Then a portfolio manager of type k who lives in country l will borrow/lend an amount of the risk-free asset equal to

$$W_0 - \left(\rho c + X_A^{kl} P_A + X_B^{kl} P_B \right),$$

where ρ is a function that equals zero if the portfolio manager is uninformed ($k = U$) and one if the manager is informed ($k = I$), P_j is the price of country j's risky asset, and c is the information cost paid by an informed portfolio manager. Note that the price of the risk-free asset is normalized to one.

Denote the gross real returns on the country j's risky asset and the risk-free asset by R_j and r, respectively. The variable R_j is defined as

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[9] See, for instance, Coval (2003).

$$R_j = \theta_j + \varepsilon_j, \quad j = A, B, \tag{1}$$

where the random variable θ_j has a normal distribution with mean $\overline{\theta_j}$ and variance ϕ_j and the error term ε_j is normally distributed with zero mean and variance σ_j^2. The random variables θ_j and ε_j have a multivariate normal distribution with $E(\theta_j \varepsilon_j) = 0$ and $\mathrm{Var}(R_j|\theta_j) = \sigma_j^2$. θ_j is observable to all portfolio managers in their own country at no cost, and can be observed at cost c by the informed portfolio managers in the other country. To keep things concise, we assume the observed returns of the risky assets are uncorrelated, both within countries and across countries.[10] Thus, given the risk-free return r, a portfolio manager of type k who lives in country j with initial portfolio of size W_0 has a future portfolio size (in period one) W_1^{kl} of the following form:

$$W_1^{kj} = (W_0 - \rho c)r + X_A^{kj}(R_A - rP_A) + X_B^{kj}(R_B - rP_B).$$

We now characterize the maximization of expected utility for different types of portfolio managers in each country. We consider two cases. First consider the case where portfolio managers are individual investors. In this case, the initial portfolio size W_0 can be interpreted as the starting wealth of the individual investor. According to the Federal Reserve Survey of Consumer Finance, family holdings of risky financial assets rise significantly with income.[11] Assuming the investor's preferences regarding future wealth can be expressed by an exponential utility function, the demand for risky financial assets will rise with wealth if higher-wealth investors are less risk averse. If we adopt a simple inverse relationship between the coefficient of relative risk aversion and wealth, then we have[12]

$$V(W_1^{kj}) = -\exp(-aW_1^{kj}), \tag{2}$$

where $a = 1/W_0$ denotes an individual investor's coefficient of relative risk aversion.

Now consider the case where portfolio managers in each country have been hired by investors to invest their collective wealth. Bagnoli and Watts (2000) indicate that for funds that had more than 50% of their assets invested in stocks in 1995, a majority set the future compensation of their managers equal to a constant percentage of the future value of the managed assets.[13] We assume that as a fund's initial portfolio size W_0 increases, the proportion of the future value of the fund that is paid as compensation to one of the managers of the fund falls. That is, if we let t denotes the proportion of the fund's future value paid as compensation to one of its fund managers, we assume that $t'(W_0) < 0$.

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[10] When we introduce asset supply in next subsection, we further assume that the return θ_j, error term ε_j and supply x_j are mutually independent with a joint normal distribution. As Admati (1985) indicates, relaxing these assumptions introduces additional interesting and important features into the multi-asset rational expectations equilibrium.

[11] See reported survey results "Family Holdings of Financial Asset, by selected characteristics of families and type of asset", Table 5 in Federal Reserve Bulletins for the survey years 1992, 1995, 1998, and 2001.

[12] In our rational expectation model setting, a constant absolute risk aversion (CARA) utility function for the portfolio manager, be that person an employee of a fund or an individual investor, allows for an explicit demand function solution. For the individual investor, assuming the special function form $a(W_0) = 1/W_0$ simplifies calculations (specifically, see Eq. (7) and thereafter) as well as providing a functional form like that obtained for the case of portfolio managers hired by a fund.

[13] The most popular alternative was future compensation based on piecewise linear (and concave) functions of the future value of the managed assets. Bagnoli and Watts note that these compensation forms reflect Securities and Exchange Commission (SEC) regulations for fund manager compensation, and in particular the *Investment Company Amendments Act of 1970*, amended section 205.

We can obtain a simple expression for the proportion of the fund's future value paid as compensation to each manager as follows. First, assume a fund with a larger initial portfolio hires a larger staff of fund managers to oversee the portfolio. If there are constant returns to scale in portfolio management, then the ratio of the total number of portfolio managers to total initial portfolio size, denoted by n, is a positive constant, and the total number of portfolio managers at a fund with initial portfolio size W_0 equals nW_0.[14] Further, assume the total future compensation across all managers of a fund is a constant proportion v of the total future value of the fund. Then the future compensation to one of these fund managers, tW_1^{kj}, equals $(v/(nW_0))W_1^{kj}$, such that we have $t'(W_0) < 0$.

Assuming an exponential utility function for compensation, a representative portfolio manager (one of nW_0 managers) of type k ($k = I, U$) fund with initial total fund value W_0 in country j ($j = A, B$) anticipates utility $V(W_1^{kj})$ of the form:

$$V\left(W_1^{kj}\right) = -\exp\left(-aW_1^{kj}\right), \tag{3}$$

where $a = a'v/(nW_0)$ and a' is the coefficient of absolute risk aversion of a portfolio manager, which we assume to be the same across portfolio managers. Without loss of generality, we set the units of portfolio size such that $a'v/n = 1$ and thus $a = 1/W_0$.[15]

Comparing Eqs. (3) and (2), note that our two interpretations of portfolio managers, either as individual investors or as managers of funds, adopt assumptions that result in the same form for the objective function of a portfolio manager. These simplifications allow our subsequent analysis to be applicable to either case. That said, our discussion to follow adopts the context of portfolio managers hired by investors to oversee fund portfolios.

Informed and uninformed portfolio managers maximize expected utility. Given the information asymmetry across portfolio managers, the resulting asset demands can be viewed as a special case of Admati (1985). In particular, the maximization of expected utility yields the following demands by informed portfolio managers ($k = I$) in either country:

$$X_A^{ll} = \frac{\theta_A - rP_A}{a\sigma_A^2}; \quad X_B^{ll} = \frac{\theta_B - rP_B}{a\sigma_B^2}, \quad l = A, B. \tag{4}$$

The demands are positively related to the observed return, and negatively related to the price and the variance.

For the case where the portfolio is determined by a set of managers, the above demands represent the consensus among these managers with respect to the optimal fund portfolio.[16] By assuming that the number of fund managers increases in proportion to initial fund size

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[14] The assumption that n is a constant (i.e., $dn/dW_0 = 0$) is adopted for computational convenience. There likely are economics of scale in the management of a portfolio, such that $dn/dW_0 < 0$. Our results generalize to this situation as long as the total number of portfolio managers increases with portfolio size; that is, as long as $d(nW_0)/dW_0 > 0$, or $(-dn/dW_0)(W_0/n) < 1$.

[15] Note that the specific assumptions we have made result in the interests of the representative fund manager matching those of the representative investor in the fund. To see this, let there be m identical investors in a fund, such that the total fund size equals m times the wealth invested by one of the individual investors and the future value of this investor's holdings equal $1/m$ of the total future value of the fund. Substituting these expressions into Eq. (3) and noting that $a'v/n = 1$, it is clear that the objective function of a fund manager is identical to that of the representative investor in the fund.

[16] This follows as managers of a fund have identical preferences and compensation package, and thus will agree on the optimal portfolio that maximizes the expected utility derived from compensation.

and that the total fees collected by a fund to compensate managers equals a constant proportion of the future total value of the fund, this consensus has a scaling property, such that the managers' view of the optimal proportion of the fund's portfolio allocated to risky assets (domestic and foreign) is invariant to portfolio size.[17] However, at larger funds, each fund manager's loss in compensation from the acquisition of information on foreign assets is less because information costs are shared across a larger number of fund managers. The resulting lower average information costs per fund manager at larger funds (economies of scale) means that larger funds are the ones that acquire the costly information on foreign assets (become informed). Thus, as discussed below, larger funds will have optimal portfolios that contain a higher proportion of risky foreign assets.[18]

The uninformed portfolio managers ($k = U$) in country j can only observe their home asset return component θ_j. For the foreign asset with return component θ_j ($j \neq l$), the uninformed portfolio managers infer partial information about this realized asset return component from the price function $P_j^*(\theta_j, x_j)$, where x_j, the random per capita supply of the risky asset, is independent of the random variables θ_j and ε_j. Since the uninformed portfolio managers in country A can observe θ_A but not θ_B, the maximization of expected utility yields the following demands by an uninformed portfolio manager in country A:

$$X_A^{UA} = \frac{\theta_A - rP_A}{a\sigma_A^2}; \quad X_B^{UA} = \frac{E(R_B|P_B^* = P_B) - rP_B}{a\text{Var}(R_B|P_B^* = P_B)}, \quad a = \frac{1}{W_0} \tag{5}$$

and for an uninformed portfolio managers in country B, the demand functions for the two assets are

$$X_A^{UB} = \frac{E(R_A|P_A^* = P_A) - rP_A}{a\text{Var}(R_A|P_A^* = P_A)}; \quad X_B^{UB} = \frac{\theta_B - rP_B}{a\sigma_B^2}, \quad a = \frac{1}{W_0}, \tag{6}$$

where $E(R_j|P_j^*)$ denotes the expected return on asset j for an uninformed portfolio manager living in country $l \neq j$ based on the observed price.

Comparing Eq. (4) to either Eq. (5) or (6), note that the demand of uniformed portfolio managers for the foreign asset differs from that of the informed both in terms of the underlying variance in the return and in the expected return. The implications for relative demands of the informed versus the uniformed for the foreign asset are discussed in more detail in Section 3.4.

3.2. Equilibrium price distribution

Equilibrium prices equate supply to demand. The home asset is purchased not only by domestic portfolio managers but also by foreign informed and uninformed portfolio managers. For the moment, we take as given that there is a common cutoff initial portfolio size ($\overline{W}$) across

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[17] A similar result holds if portfolio managers are individual investors given our assumption that risk aversion is decreasing in wealth, and in particular that the coefficient of relative risk aversion takes the simple form $1/W_0$.

[18] If a fund's management is partially specialized, such that the compensation of some managers depends on the value of a subset of the entire fund's portfolio, we assume that those who decide whether or not to acquire the costly information on the foreign risky asset recognize the increased sharing in the burden of information acquisition costs, and resulting lower cost per manager, that accompanies an increase in fund size. Note that it is in the interest of the investors in a fund to institute manager incentive plans similar to those we assume, for doing so ensures that managers will recognize such economies of scale to information gathering that accompany an increase in fund size.

portfolio managers in each country, with only individuals in each country with portfolio size above $\overline{W}$ becoming informed. Thus the demand for each risky asset is the integral of portfolio managers' demand over the portfolio size distribution for foreign and domestic portfolio managers, and we have the following equilibrium conditions for the risky assets in countries A and B, respectively:

$$
\int_0^{\overline{W}} X_A^{UA} f(W_0) dW_0 + \int_{\overline{W}}^1 X_A^{IA} f(W_0) dW_0 + \int_{\overline{W}}^1 X_A^{IB} f(W_0) dW_0 + \int_0^{\overline{W}} X_A^{UB} f(W_0) dW_0
$$

$$
= 2 \int_0^1 x_A f(W_0) dW_0;
$$

$$
\int_0^{\overline{W}} X_B^{UA} f(W_0) dW_0 + \int_{\overline{W}}^1 X_B^{IA} f(W_0) dW_0 + \int_{\overline{W}}^1 X_B^{IB} f(W_0) dW_0 + \int_0^{\overline{W}} X_B^{UB} f(W_0) dW_0
$$

$$
= 2 \int_0^1 x_B f(W_0) dW_0,
$$

where x_A and x_B are per capita supply of the risky assets for countries A and B with means $\overline{x}_A, \overline{x}_B$ and variances χ_A, χ_B, respectively.[19] Recall that the density function for initial portfolio size W_0 is uniform over the interval $[0, 1]$. Together with the demand decisions based on Eqs. (4)−(6), the equilibrium conditions can be simplified as

$$
2x_A = \frac{\theta_A - rP_B}{\sigma_A^2} \left(\int_0^1 \frac{1}{a(W_0)} dW_0 + \int_{\overline{W}}^1 \frac{1}{a(W_0)} dW_0 \right)
$$

$$
+ \frac{E\left(R_A | P_A^* = P_A\right) - rP_A}{\text{Var}\left(R_A | P_A^* = P_A\right)} \int_0^{\overline{W}} \frac{1}{a(W_0)} dW_0,
$$

$$
2x_B = \frac{\theta_B - rP_B}{\sigma_B^2} \left(\int_0^1 \frac{1}{a(W_0)} dW_0 + \int_{\overline{W}}^1 \frac{1}{a(W_0)} dW_0 \right)
$$

$$
+ \frac{E\left(R_B | P_B^* = P_B\right) - rP_B}{\text{Var}\left(R_B | P_B^* = P_B\right)} \int_0^{\overline{W}} \frac{1}{a(W_0)} dW_0. \tag{7}
$$

Similar to Grossman and Stiglitz (1980), we define a prior price function w_j for each asset in order to characterize the equilibrium price. In our context, these prior price functions are defined as

$$
w_j(\theta_j, x_j) = \theta_j - \frac{2\sigma_j^2 (x_j - \overline{x}_j)}{1 - \frac{1}{2}\overline{W}^2}, \quad j = A, B, \tag{8}
$$

where $\overline{x}_j$ is the mean of random per capita supply of asset j. The price w_j equals the random variables θ_j plus a supply noise and an observation error as well, with its expectation

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[19] For simplicity, we assume the random components of supply are independent not only of each other, but of the other random elements in the model.

$E(w_j|\theta_j) = \theta_j$ and variance $\mathrm{Var}(w_j|\theta_j) = 4\sigma_j^4 \chi_j^2 / (1 - (1/2)\overline{W}^2)^2$. This variance measures how effective the uninformed portfolio managers infer information from the perceived price. Obviously, the observation error σ_j and supply noise χ_j affect the information precision for the uninformed portfolio managers.

Lemma. *Assuming that θ_j, ε_j and x_j $(j = A, B)$ are mutually independent with a joint normal distribution, there exist equilibrium prices such that the equations in (7) are satisfied. The particular forms of the prices are*

$$P_A = \frac{\frac{\left(1 - \frac{1}{2}\overline{W}^2\right)w_A(\theta_A, x_A)}{\sigma_A^2} + \frac{\frac{1}{2}\overline{W}^2 E(R_A|w_A(\theta_A, x_A))}{\mathrm{Var}(R_A|w_A(\theta_A, x_A))} - 2\overline{x}_A}{r\left(\frac{1 - \frac{1}{2}\overline{W}^2}{\sigma_A^2} + \frac{\frac{1}{2}\overline{W}^2}{\mathrm{Var}(R_A|w_A(\theta_A, x_A))}\right)},$$

$$P_B = \frac{\frac{\left(1 - \frac{1}{2}\overline{W}^2\right)w_B(\theta_B, x_B)}{\sigma_B^2} + \frac{\frac{1}{2}\overline{W}^2 E(R_B|w_B(\theta_B, x_B))}{\mathrm{Var}(R_B|w_B(\theta_B, x_B))} - 2\overline{x}_B}{r\left(\frac{1 - \frac{1}{2}\overline{W}^2}{\sigma_B^2} + \frac{\frac{1}{2}\overline{W}^2}{\mathrm{Var}(R_B|w_B(\theta_B, x_B))}\right)}. \tag{9}$$

Proof. Admati (1985) establishes the existence of a unique rational price equilibrium for many risky assets and a continuum of heterogeneous investors in terms of asset information. Our model setup is a special case involving two risky assets and the independence of random elements.[20] □

From Eq. (9), it can be shown that an increase in the information noise, observation error or supply noise decreases the informativeness of the price system. Further, it is easy to see that the market price reveals more information regarding the return if the cutoff $\overline{W}$ is lower, implying a higher proportion of portfolio managers who are informed.

3.3. Equilibrium and information acquisition decision

We now define the equilibrium cutoff portfolio size $\overline{W}$, such that for the marginal portfolio manager with portfolio size $\overline{W}$, the expected utility of becoming informed is equal to that of remaining uninformed. Given the above demand decisions and price functions, one can obtain the gain in expected utility from being informed versus being uninformed:

$$G = E\big(V\big(W_1^I\big)\big) - E\big(V\big(W_1^U\big)\big). \tag{10}$$

For the marginal portfolio manager, the expected gain of acquiring information is zero, or

$$E\big(V\big(W_1^I\big)|W_0 = \overline{W}\big) - E\big(V\big(W_1^U\big)|W_0 = \overline{W}\big) = 0. \tag{11}$$

The above condition defines the cutoff portfolio size $\overline{W}$. The following explicit form for Eq. (11) can be derived[21]:

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[20] The specific proof for our model is in a supplement to this paper available on request from the authors. Note that it can be demonstrated that the variance in the return for asset j, $\mathrm{Var}(R_j|w_j(\theta_j, x_j))$ depends on the variance in information noise (ϕ_j, $j = A, B$), observation error (σ_j, $j = A, B$), and supply noise (χ_j, $j = A, B$).

[21] A supplement available from the authors on request derives this explicit form.

$$\exp(a(\overline{W})rc)\sqrt{\frac{\mathrm{Var}(R_B|\theta_B)}{\mathrm{Var}(R_B|w_B)}} = 1, \quad \overline{W} \in (0,1]. \tag{12}$$

Given r, c and the variance parameters, we can solve Eq. (12) for the equilibrium $\overline{W}$. However, obtaining an explicit form for the solution is difficult; thus we rely on simulations in Section 4 to illustrate equilibria for various values of the parameters.

To better understand the above equilibrium, recall that an individual portfolio manager has infinitesimal effect on the market; therefore, he takes the equilibrium cutoff portfolio size and thus market prices as given when he calculates the expected gain of information acquisition. A portfolio manager becomes informed if $G > 0$. It can be shown that G is decreasing in c/W_0; the result is that portfolio managers with the lowest information cost per unit of portfolio size (hereafter referred to as the *information cost ratio*, c/W_0) will purchase the information first, and so on until the gain of acquiring information goes to zero and the equilibrium $\overline{W}$ is determined.[22] We thus have the following proposition.

Proposition 1. *Given our assumption of a uniform distribution of portfolio managers' portfolio size, information cost ratios are monotonically decreasing over the range $[0,1]$. There exists a cutoff information ratio, $c/\overline{W}$, such that an portfolio manager purchases information if and only if $c/W_0 \le c/\overline{W}$.*

Proposition 1 provides a characterization of which portfolio managers will acquire information concerning foreign assets; those portfolio managers with portfolio size $W_0 > \overline{W}$ become informed and the other portfolio managers remain uninformed. The intuition for this result is that the increase in holdings of risky assets that accompany an increase portfolio size makes it more advantageous to pay the fixed cost c to become informed regarding such risky assets. In other words, there are economies of scale to acquiring information on foreign assets.

Now consider the marginal portfolio manager, who is indifferent between being informed and uninformed in equilibrium. If we increase the information cost, then the gain of information for the original marginal portfolio manager will be negative, and the marginal portfolio manager will have a clear preference to remain uninformed. We thus have the following proposition with respect to the equilibrium cutoff level of initial portfolio size $\overline{W}$.[23]

Proposition 2. *Given the parameters defining the home and foreign markets, the equilibrium cutoff portfolio size, $\overline{W}$, is an increasing function of the information cost. That is, $\partial\overline{W}/\partial c \ge 0$.*

Proposition 2 has important implications for the discussion of the home bias in the next section.

3.4. Home bias

In this section, we first explore how costly information leads to home bias by comparing expected demands derived from Eqs. (4)–(6). Under the assumption of symmetric countries, informed portfolio managers have the same expected demands for the domestic and foreign assets; i.e., $E(X_A^{IA}) = E(X_B^{IA})$, $E(X_B^{IB}) = E(X_A^{IB})$, and there is no home bias for the informed.

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[22] See the supplement available on request from the authors for a proof of these statements.

[23] A supplement available on request from the authors provides a proof of Proposition 2.

Home bias arises due to the existence of the uninformed portfolio managers in each country. In particular, the expected demand for the foreign asset by an uninformed portfolio manager is less than his expected demand for the home asset, and the latter is less than the expected demand for risky assets (foreign or domestic) of informed portfolio managers. That is

$$E\big(X_B^{UA}\big) \leq E\big(X_A^{UA}\big) \leq E\big(X_A^{IA}\big) = E\big(X_B^{IA}\big), \tag{13}$$

where the first strict inequality holds if and only if the information cost is positive $(c > 0)$.[24] Intuitively, there are two factors that lead to the above results. First, the uninformed foreign portfolio managers can only infer partial market information through the asset prices, which results in larger potential risks that limit their investments. Second, the uninformed portfolio managers have smaller initial portfolio sizes. The above results lead to the following proposition.

Proposition 3. *With strictly positive information costs, home bias exists in that a country's expected proportion of total risky assets in domestic assets exceeds the proportion in foreign assets.*

To show Proposition 3, note that for country A, we can measure the total expected foreign asset holdings T_B and the total expected home asset holdings T_A, respectively, as follows:

$$T_B = \int_0^{\overline{W}} E\big(X_B^{UA}\big)\mathrm{d}W_0 + \int_{\overline{W}}^1 E\big(X_B^{IA}\big)\mathrm{d}W_0;$$

$$T_A = \int_0^{\overline{W}} E\big(X_A^{UA}\big)\mathrm{d}W_0 + \int_{\overline{W}}^1 E\big(X_A^{IA}\big)\mathrm{d}W_0.$$

Proposition 3 indicates that $T_A/(T_A + T_B) > T_B/(T_A + T_B)$, or $T_A > T_B$. This follows directly from Eq. (13). Similar results hold for country B.

Proposition 3 replicates for our model the results in Gehrig (1993) and Brennan and Cao (1997), who have shown that home bias can arise due to asymmetric information. However, our model has further testable implications. By presenting a dynamic information acquisition process for portfolio managers and explicitly introducing information costs, we can characterize the change in home bias caused by a change in information cost. The result is summarized in following proposition.

Proposition 4. *The home bias will be more pronounced if the information cost increases.*

Proof. The expected home bias for country A can be measured as

$$T_A - T_B = \int_0^{\overline{W}} \big(EX_A^{UA} - EX_B^{UA}\big)\mathrm{d}W_0.$$

Now suppose that the information cost c increases. Recall that in Proposition 2 we have shown that the cutoff portfolio size for the marginal portfolio managers $\overline{W}$ is an increasing function of information cost, and thus fewer portfolio managers become informed. In addition, the value of $(E(X_A^{UA}) - E(X_B^{UA}))$ increases as a result of the reduction in the number of informed

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[24] Gehrig (1993) provides a proof of this proposition. In particular, he shows that investors arbitrarily identified as informed will have higher demands than that of uninformed investors (see Eq. (9) on page 105). A specific proof of this claim in our context is provided in a working paper available on request from the authors.

individuals, as the price becomes less informative for the uninformed, and thus the risky foreign asset becomes less attractive to the uninformed.[25] As a result, country A's home bias $T_A - T_B$ will be more pronounced. $\square$

Proposition 4 provides a theoretical explanation for recent empirical findings (Portes et al., 2001; Ahearne et al., 2004). Portes et al. (2001) use the volume of telephone calls as a proxy for information costs, and find positive contribution to the gross flow of equity transactions. Ahearne et al. (2004) find that countries with a greater share of firms that have public U.S. listing (which mitigates information costs) tend to be less severely underweighted in U.S. equity portfolio.

Another new feature of our model that distinguishes it from Gehrig (1993) and Brennan and Cao (1997) is that we identify different degrees of home bias across domestic portfolio managers. We anticipate that portfolio managers with a relatively low information cost ratio will be less home biased:

Proposition 5. *Given the information cost for equity diversification, portfolio managers with larger portfolio size tend to exhibit less home bias.*

Proof. It is straightforward to see from Proposition 1 that the portfolio managers with a lower information cost ratio will be informed. Further, Proposition 3 shows that these informed portfolio managers have more foreign equity holdings. $\square$

In summary, the information cost ratio allows us to interpret the effect of asymmetric information on home bias in two ways. First, we expect the degree of home bias will be more pronounced if the information cost for foreign asset increases. This implication can be seen from the simulation in Section 4 to follow. Second, we have an explanation for the observations noted in Section 2 linking the extent of home bias to a portfolio managers' initial portfolio size.

4. Simulation: an example

The theoretical model has analyzed how asymmetric information leads to home bias. In this section, we investigate the effect of asymmetric information on the home bias (measured by the proportion of foreign asset holdings) via simulations. These simulations will also illustrate how changes in various parameters affect home bias.

In our simulation, the two countries are assumed to be symmetric and thus the parameters in both countries are identical. The simulation parameters for the model are shown in Table 3. The average return for risky assets is set equal to 13%, which is in line with the annualized monthly return in Lewis (1999). The return of risk-free asset is set at 1%, ensuring an attractive return for the risky assets. The variances of the return, observation error and asset supply are drawn from Coval (2003), but we adjust them such that almost all portfolio managers are informed when the information cost is close to zero. The total supply of each asset is 1 unit. The initial portfolio size is assumed to be uniform distribution in the model across the portfolio managers; however, we choose an array of the number between 0 and 1 so that we can describe the individual decisions.

For the information cost, we use a recurrence function $c_s = c_{s-1} + 0.25$ to generate a series of cost for the purpose of repeated simulations, where s is used to represent different simulations.

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[25] It is easy to see from our proof for Eq. (13) that $(E(X_A^{UA})/E(X_B^{UA})) = (\sigma^2 + \phi^2 - (\phi^4/\phi^2 + (4\sigma^4\chi^2/(1 - (1/2)W)^2))/\sigma^2) \geq 1$.

Table 3
Parameter values for the simulation

Parameters	Values
The return for risk-free asset	$r = 1.01$
The average return for risky assets	$E(\theta_j) = 1.13$
The variance for the return	$\phi_j = 0.5$
The variance of the observation error of the return	$\sigma_j = 0.4531$
The average supply of risky assets	$\bar{x}_j = 1$
The variance of the asset supply	$\chi_j = 0.5735$
The distribution of the initial portfolio size	[0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1]
Exponential utility function coefficient	$a_i = 1/W_{0i}$
The information cost	$c_s = c_{s-1} + 0.025$

The initial cost c_0 is chosen to be close to 0 so that we try to mimic the symmetric information and implied absence of home bias.[26] The simulations describe the information acquisition process and investment decision as well as the equilibrium with $\overline{W} \in [0, 1]$, where $\overline{W}$ is the cutoff initial portfolio size for the marginal portfolio manager, who is indifferent between being informed and being uninformed. We first generate 1000 observations of the asset returns and the total asset supplies, which are normally distributed with means and variances given in Table 3. To identify the information acquisition process, we first calculate the cutoff initial portfolio size for the marginal portfolio manager in equilibrium according to Eq. (12). Then each portfolio manager with different initial portfolio size decides to be informed or not informed based on the sign of the information value in Eq. (10). If the gain is positive, then the portfolio manager becomes informed. Otherwise he stays uninformed. Informed and uninformed portfolio managers make their investment decision based on the demand functions (4)−(6), where prices are calculated from Eq. (9). For the same draw of asset returns and supplies, we repeat the information acquisition and investment decisions at different information costs.

Table 4 reports the sign of the gain to information acquisition and the ratio of cumulative foreign asset holdings over total risky assets for the above simulations. When cost is as low as 0.004, the cutoff portfolio size is approximately 0.32. In an economy with the uniform distribution of the portfolio managers, this implies approximately 68% of portfolio managers become informed. A check indicates that the gain to information acquisition is negative for the portfolio managers with initial portfolio size less than 0.32, and positive for the portfolio managers with initial portfolio size higher than 0.32. We report the ratio of foreign asset holdings additively, i.e., the ratio of foreign asset holdings includes all the foreign assets of portfolio managers with the current initial portfolio size or lower. As we expected, the ratio of foreign asset holding is about 26% for the lowest portfolio size uninformed portfolio manager, and the cumulative ratio of foreign asset holdings rises to 40% when it includes the lowest portfolio size informed portfolio manager. As we can see in the last column, the total foreign asset holdings at a cost equal to 0.004 approaches 45%. Note that the aggregate home bias diminishes as one includes informed individuals, as these informed portfolio managers have larger portfolio sizes and there is no home bias in their portfolios.

The rest of Table 4 indicates that the proportion of informed portfolio managers and the foreign equity holdings decrease when the information costs increase. When the information

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[26] Note that we cannot consider the case when all the investors are informed ($\overline{W} = 0$) given the function form of $1/\overline{W}$ in the exponential utility function.

Table 4

Information acquisition decision and ratio of cumulative foreign asset holdings as cost changes

n	Cost	Cutoff portfolio size	Portfolio managers initial portfolio sizes									
			0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00
0	0.004	0.321	−0.26	−0.26	−0.26	+0.36	+0.40	+0.42	+0.43	+0.44	+0.45	+0.45
1	0.029	0.512	−0.25	−0.25	−0.25	−0.25	−0.25	+0.33	+0.37	+0.39	+0.41	+0.42
2	0.054	0.613	−0.24	−0.24	−0.24	−0.24	−0.24	−0.24	+0.31	+0.35	+0.38	+0.40
3	0.079	0.689	−0.23	−0.23	−0.23	−0.23	−0.23	−0.23	+0.31	+0.35	+0.38	+0.40
4	0.104	0.751	−0.22	−0.22	−0.22	−0.22	−0.22	−0.22	−0.22	+0.29	+0.34	+0.36
5	0.129	0.805	−0.21	−0.21	−0.21	−0.21	−0.21	−0.21	−0.21	−0.21	+0.28	+0.32
6	0.154	0.853	−0.20	−0.20	−0.20	−0.20	−0.20	−0.20	−0.20	−0.20	+0.28	+0.32
7	0.179	0.897	−0.20	−0.20	−0.20	−0.20	−0.20	−0.20	−0.20	−0.20	+0.27	+0.32
8	0.204	0.938	−0.19	−0.19	−0.19	−0.19	−0.19	−0.19	−0.19	−0.19	−0.19	+0.26
9	0.229	0.976	−0.19	−0.19	−0.19	−0.19	−0.19	−0.19	−0.19	−0.19	−0.19	+0.26

Note: "+" ("−") means gain (loss) to acquiring information. The number below the plus/minus sign is the ratio of the cumulative foreign risky asset holdings to the cumulative total risky asset holdings.

costs increase from 0.004 to 0.229, the cutoff initial portfolio size for the marginal portfolio managers increases from 0.32 to 0.98. That is, an increase in the information cost decreases the percentage of informed portfolio managers (notice the switch of the sign of the information value for each portfolio manager). The reduced number of informed portfolio managers decreases the informativeness of the price system. As a result, the uninformed portfolio managers have a more pronounced home bias (due to noisier prices). Both the fall in number of informed portfolio managers and the increase home bias among the uninformed lead to a fall in the ratio of foreign asset holdings to total holdings. In particular, as indicated in the last column, this ratio decreases from 45% to 26%.

Fixing the information cost, we now investigate how the change of parameters of variance changes the home bias. The 1000 observations are re-drawn under the new parameter settings. Similarly, we calculate the cutoff initial portfolio size for the marginal portfolio manager in equilibrium according to Eq. (12), estimate the sign of the information value based on Eq. (10) and make investment decisions based on the demand functions (4)–(6).

Table 5 illustrates the changes of information acquisition and investment decisions that occur with changes in the variances of returns or supplies change. In Table 5, the information cost is fixed at 0.05 so that we can focus on the effect of variance change. We consider three different cases: a decrease in the variance of the real return (ϕ^2), an increase in observation error (σ^2), and an increase in supply noise (χ^2).

A decrease in the variance of the real return (ϕ^2) increases the cutoff portfolio size from 0.60 to 0.82, which leads to a decrease in the proportion of portfolio managers who become informed. Intuitively, if the return becomes more stable, portfolio managers can better predict the return without acquiring further information. As a consequence, more portfolio managers remain uninformed. Interestingly, the simulation indicates that a lower ϕ^2 increases the foreign asset holdings of the uninformed and the profits the informed make at the expense of the uninformed are reduced. However, the aggregate ratio of foreign asset holdings is reduced due to a larger proportion of uninformed portfolio managers.

An increase in the variance of the observation error (σ^2) decreases the cutoff portfolio size from 0.60 to 0.41, which leads to an increase in the proportion of individuals becoming informed. There are now two offsetting effects determining the foreign asset holdings. An increase in σ^2 decreases the degree of informativeness of the price system and thus, other things

Table 5

Information acquisition decision and ratio of cumulative foreign asset holdings as variances change

	Control case		Reduce variance of the return by 0.25		Increase variance of the observation error by 1/3		Increase variance of the asset supply by 1/3	
Cost	0.05		0.05		0.05		0.05	
Cutoff portfolio size	0.60		0.82		0.41		0.46	
Gain of information acquisition and ratio of cumulative foreign asset holdings	Gain	Ratio	Gain	Ratio	Gain	Ratio	Gain	Ratio
Investor with portfolio size = 0.1	−	0.24	−	0.33	−	0.23	−	0.18
Investor with portfolio size = 0.2	−	0.24	−	0.33	−	0.23	−	0.18
Investor with portfolio size = 0.3	−	0.24	−	0.33	−	0.23	−	0.18
Investor with portfolio size = 0.4	−	0.24	−	0.33	−	0.23	−	0.18
Investor with portfolio size = 0.5	−	0.24	−	0.33	+	0.35	+	0.32
Investor with portfolio size = 0.6	+	0.34	−	0.33	+	0.40	+	0.38
Investor with portfolio size = 0.7	+	0.39	−	0.33	+	0.43	+	0.41
Investor with portfolio size = 0.8	+	0.41	−	0.33	+	0.45	+	0.43
Investor with portfolio size = 0.9	+	0.43	+	0.38	+	0.46	+	0.45
Investor with portfolio size = 1.0	+	0.45	+	0.41	+	0.47	+	0.46

Note: "+" ("−") means gain (loss) to acquiring information. The number to the right of the plus/minus sign is the ratio of the cumulative foreign risky asset holdings to the cumulative total risky asset holdings.

equal, the demand for foreign assets by the uninformed. However, the increased proportion of informed portfolio managers increases the degree of informativeness of the price system. Our simulation indicates that the latter effect dominates the former, which leads to relatively higher aggregate foreign equity holdings than the control case.

Finally, an increase in supply noise (χ^2) increases the proportion of informed portfolio managers. At any given cutoff portfolio size, an increase in noise reduces the informativeness of the price system (increasing the conditional variance of the return). Therefore, it increases the value of information and leads more individuals to become informed at new equilibrium. Our results indicate that the uninformed portfolio managers have more pronounced home bias, but the ratio of total foreign asset holdings is higher due to the larger number of informed portfolio managers.

In sum, the simulations above illustrate the effect of asymmetric information on the home bias. Holding other things constant, fewer portfolio managers are informed when the information cost increases, and thus the home bias is more pronounced. The simulations also illustrate that high volatility of asset return and asset supply, and bigger variance of observation error lead to a larger proportion of portfolio managers being informed. In this case, the home bias for the uninformed portfolio managers may be more pronounced; however, the aggregate home bias can fall because of the larger proportion of informed portfolio managers.

5. Concluding remarks

This paper explores the role of asymmetric information in explaining the important equity puzzle in international finance in general, and in particular the cross-sectional home bias among portfolio managers that we observed. Our model considers the endogenous information

acquisition process in a two-country model with heterogeneous portfolio managers. We demonstrate a direct link among portfolio size, the acquisition of information cost and the degree of home bias across portfolios with each country. As such, we provide an explanation for the differences in the extent of foreign equity holdings associated with portfolio size that we find for pension funds.

Currently we are collecting a data set, primarily for the years after 1998, that includes both individual (self-directed) pensions and pooled pension funds. Our theory suggests that if individuals aggregate their individual retirement savings into group pension funds, we should find an increase in the proportion of total equity assets devoted to foreign securities; this follows as the funds with a larger portfolio find it advantageous to acquire information on foreign assets, and thus eliminate the asymmetric information rationale for home bias. This appears to hold. For our preliminary sample of over 200 state pension funds, we find that the larger, pooled pension accounts within these funds have average foreign asset holdings equal to 15% of their portfolio, versus only 5% for self-managed accounts within these funds. This finding provides further evidence that, as the size of the portfolio increases, so too do the gains to acquiring information on foreign assets. In future work, we plan to expand this small data set of pension funds, as well as examine the differential degrees of home bias across various mutual fund families.

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