Equity Home Bias: Can Information Cost Explain the Puzzle?

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Most stock market investors heed the maxim "Don't put all your eggs in one basket" because they know that, ideally, an equity portfolio should be well diversified across different sectors and different stocks. The rationale for this diversification is that it lowers overall portfolio risk because the losses of one particular stock can be offset with gains from another; for example, losses from the recent bad performance in technology stocks might have been cushioned by the strong gains of oil companies.

The increasingly integrated international financial markets offer one such opportunity for diversification. Investors could significantly reduce their risk exposure if they held a portion of their asset portfolio in foreign stocks. Surprisingly, investors in all major industrialized countries do not exploit this risk-sharing opportunity but instead hold large shares of their portfolio in domestic stocks. This tendency is named *home bias* in the economic literature.

To measure how severe home bias is, this article introduces an economically sensible method of quantifying it. This method determines the economic shadow cost of foreign investment—that is, the perceived annual cost of foreign equity necessary to create a bias away from perfect international risk sharing and toward holding domestic equity. This annual cost can be thought of as a management fee that includes all possible costs related to the ownership of foreign equity. This method was first proposed by French and Poterba (1990, 1991), who showed that the calculated shadow costs of foreign equity are unrealistically large—up to a puzzling 500 basis points annually; therefore home bias is also called the home bias puzzle, or the French and Poterba puzzle.

This article also discusses a popular and widely referenced explanation for home bias: information cost. This theory argues that investors face lower costs for gathering information on their domestic assets than on foreign assets; the bias toward domestic equity is thus a result of asymmetric information. While this explanation is intuitive, it is unable to account for the patterns of home bias that can be observed both qualitatively and quantitatively. The findings in this article demonstrate that, in an economy where investors have better information on their domestic equity, they would indeed face a lower variance of returns, but their expected returns would also differ from those of foreign investors depending on whether domestic investors observed a signal indicating high or low returns on domestic stocks. Such informed investors would have to hold fewer domestic stocks than foreigners do if the information indicates a low-enough expected return. This ideal investment behavior is in stark contrast to actual observations on asset holdings, which indicate a continued home bias over decades in all industrialized countries.

Documenting the Bias

The bias in favor of home country equity is illustrated in Chart 1, which plots the percentage of domestic stocks in equity portfolios and the world market share of the domestic market of eleven industrialized countries in 2000.[1] In the chart, all countries appear heavily biased toward holding more of their domestic equity than foreign assets. The United States has one of the highest domestic shares of about 89 percent, topped only by Japan and two southern European countries, Italy and Spain, each with more than 90 percent shares. Canada, Australia, and the middle and northern European countries have lower domestic shares than the United States does, but their shares are still well above 70 percent. According to Lintner (1965), who employs a simple asset allocation model similar to the one presented in this article, each country should hold portfolios with identical proportions (but of course not necessarily identical sizes). This assertion, together with market clearing, implies that each country should hold a portfolio in which its country shares are equal to its shares in world market capitalization.[2] For example, each country's portfolio should contain roughly 48 percent U.S. stocks because the U.S. stock market represents 48 percent of the world market capitalization.

A more sensible way to measure home bias is to calculate the implicit, or shadow, cost on foreign assets necessary to skew the portfolio allocation away from the optimal toward the observed allocation.

Actual domestic shares are still extremely high relative to the predicted domestic shares. For example, even though Sweden has the lowest domestic share among the eleven countries, its 70 percent domestic asset holdings are much higher than its optimal portfolio weight of about 1.2 percent. On the other hand, the United States, which is usually considered to have a strong home bias, displays the smallest absolute difference from the optimal home share, namely, 89 percent versus 48 percent. Clearly, different measurement techniques yield different results as to which countries display high or low home bias. This variation in results suggests that it would be useful to develop a more sensible way of measuring home bias than comparing actual portfolio weights of domestic versus foreign assets.

A central factor for a useful home bias measure is the distribution of expected returns from the foreign and domestic portfolios. A simple scenario showing how this distribution works consists of a world with only two countries, a home country and a foreign country. Investors in the home country hold 100 percent of their portfolio in domestic stocks. Does this fact constitute a bias? The answer to this question crucially depends on the distribution of returns. If returns in both countries are always exactly identical, then 100 percent home share does not constitute a bias at all because no diversification is possible in the first place.

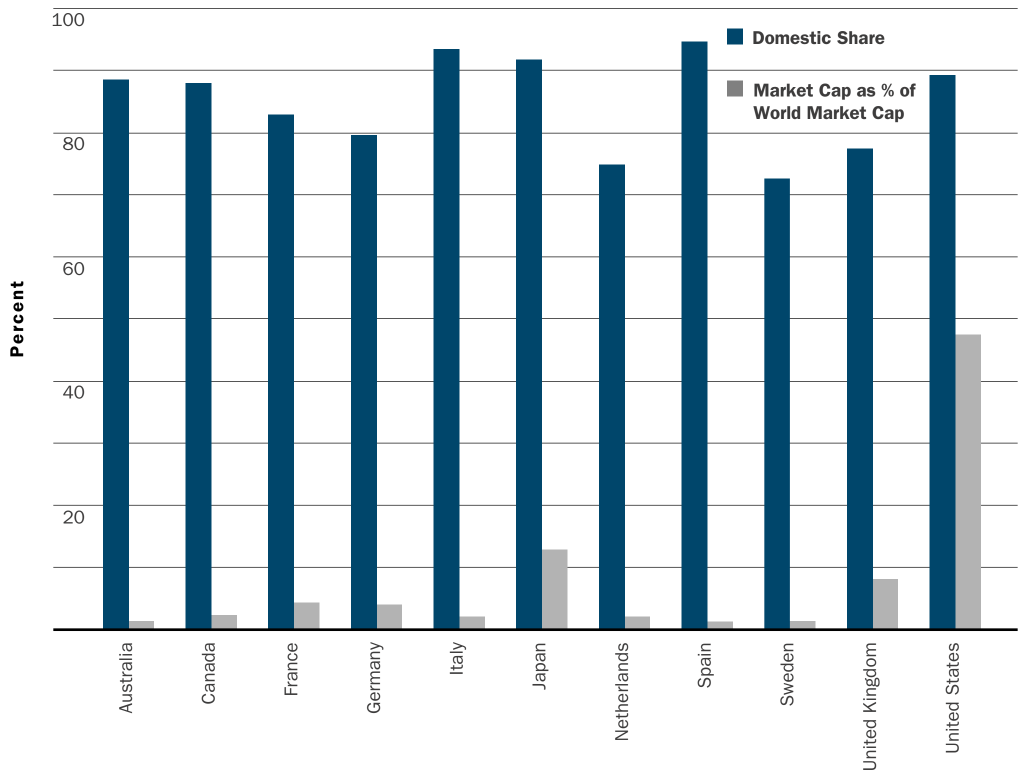
If returns in the two countries are not exactly equal but always very highly correlated because, for example, both countries specialize in producing the same particular good, it might take only a minute transaction cost or annual management fee for the administration of foreign assets to account for a zero share of foreign assets. This outcome would be likely because all investors who have the choice between two assets with very similar returns—the domestic asset with a low management cost and the foreign asset with a slightly higher management cost—would hold the domestic asset.

At the other extreme is a case in which home and foreign country returns are highly negatively correlated. The home country relies mainly on tourism and generates high profits only during sunny weather, and the foreign country relies mainly on agriculture and generates high profits only during rainy weather; furthermore, the two countries experience the same weather. Even if foreign equity carries transaction costs or a small management fee, domestic citizens would still find it worthwhile to buy foreign equity to cushion the risk of a rainy season. In particular, the management cost on foreign assets that would be necessary to discourage investors in the home country from holding any foreign assets at all is much larger than in the previous example with a positive correlation.

This example demonstrates that the raw data on domestic shares in equity portfolios are not helpful in measuring how averse investors are to holding foreign equity. A more sensible way to measure home bias is to calculate the implicit, or shadow, cost on foreign assets necessary to skew the portfolio allocation away from the optimal toward the observed allocation.

Before French and Poterba proposed a method to determine the implied cost of holding foreign assets and showed that it is unrealistically high, the

CHART 1
Domestic Stocks and Relative Market Caps, 2000



Source: International Monetary Fund and International Federation of Stock Exchanges

concept of a home bias puzzle did not exist; there is nothing puzzling about investors who allocate their portfolio away from assets with higher transaction costs and management fees. This article performs some of French and Poterba's calculations with more recent data and shows that the implied cost is still extremely large.

A Simple Asset Allocation Model

To calculate the implied cost of holding foreign assets, this study uses a simple asset allocation model that is essentially the two-country (home and foreign) example described earlier with slightly more structure. Returns on equity—u_H in the home country and u_F in the foreign country—are random, with expected values of μ_H and μ_F, respectively.

In this model, investors in the home country allocate their portfolios between the two assets. Essentially, they assign weights w_H and w_F to the two countries, and the two weights sum to one. Thus the realized return of an investor is $u = w_H u_H + w_F u_F$, the ex ante expected return is $E(u) = w_H \mu_H + w_F \mu_F$, and the variance of portfolio returns is $\mathrm{VAR}(u) = w_H^2 \sigma_H^2 + 2 w_H w_F \sigma_{HF} + w_F^2 \sigma_F^2$, where σ_H^2 and σ_F^2 are the respective variances and the covariance between equity returns is σ_{HF}.

Investors in this model, just like those in the real world, care about expected returns but are also averse to variance of returns. This aversion is reflected in the investors' objective function, $U = E(u) - (\lambda/2)\mathrm{VAR}(u)$, where λ is the parameter of risk aversion, indicating how strongly an investor dislikes variance in returns.[3] For the purpose of calculating numerical examples for

1. The home share was computed using market capitalization data from the International Federation of Stock Exchanges (FIBV), and the international investment positions were provided by the International Monetary Fund (IMF).
2. See Sharpe (1964) and Lintner (1965); the latter study proves the so-called proportionality result.
3. This objective function can be derived from a more fundamental model in which investors maximize over a concave utility function over final wealth levels. If returns are normal, then utility maximization is equivalent to maximizing the objective function used here.

the remainder of this article, it is assumed that $\lambda = 3$, as suggested by French and Poterba (1990).[4] An example provides an idea about the degree of risk aversion this parameter value implies. If an investor who exhibits a risk aversion coefficient of 3 holds a broad U.S. market index such as the Willshire 5000 with a volatility of around 16 percent annually, he or she, if offered a more risky investment opportunity, would ask for one additional basis point of return in exchange for each two basis points of additional volatility.

An investor who allocates his porftolio in order to maximize his objective function would then satisfy

$$\mu_H = \lambda(w_H\sigma_H^2 + w_F\sigma_{HF}) \text{ and}$$
$$\mu_F = \lambda(w_H\sigma_{HF} + w_F\sigma_F^2). \quad (1)$$

The two equations in (1) can also be represented in matrix notation: $\mu = \lambda\Sigma w$, where Σ is the so-called variance-covariance matrix containing the variances as the diagonal and the covariance as the off-diagonal elements. This notation makes it easier to solve for the optimal portfolio weights:

$$w = (1/\lambda)\Sigma^{-1}\mu. \quad (2)$$

The two equations (1) and (2) will be the only tools needed to quantify home bias for the purposes of this study, which restricts its attention to the eleven countries mentioned earlier. Each of these countries has a market capitalization of at least 1 percent of world equity market capitalization, the United States having the largest share, with 47.5 percent, and Sweden the smallest, 1.2 percent. For each country, domestic and foreign real returns (that is, returns in the corresponding home country currency deflated by the domestic consumer price index [CPI] inflation) are computed. Foreign returns are proxied by assuming that the rest of the world, from the point of view of each country, is a value-weighted portfolio consisting of the remaining ten countries. (The eleven countries considered account for an overwhelmingly large share of world market capitalization, and the remaining countries, which each have a capitalization of less than 1 percent, together account for only slightly more than 10 percent of the world market.)

Unfortunately, the underlying parameters—namely, the expected returns, μ, and the covariance matrix, Σ—are unknown. But the historical data for past returns are available for all the countries of interest. One way to document home bias, besides calculating the implicit shadow cost of foreign assets, would be to estimate the parameters of the distribution, calculate the optimal portfolio allocation using equation (2), and compare the allocation to the actual weights observed in the data. Merton (1980) shows that the variance-covariance matrix Σ can be estimated easily with high precision; however, he points out the difficulty that the expected returns can only be estimated with relatively large errors. For example, average monthly real returns for the United States are 0.477 percent, but the standard deviation is 4.519 percent (according to data from Morgan Stanley Capital International [MSCI] covering the years 1970 to 2000). These large errors, together with the fact that the optimal weights are highly sensitive to changes in expected returns, imply that historical data are essentially useless in estimating optimal portfolio weights. The sensitivity arises from the fact that returns of almost all industrialized countries are highly positively correlated and therefore the estimated matrix Σ is close to singular. Then multiplying by Σ^{-1} in equation (2) is the same as multiplying by a large number, which magnifies small changes in expected returns into large changes in optimal portfolio weights.

To illustrate this point, consider a numerical example with just two countries having equal variances in returns and a correlation of returns equal to 0.7, just like the correlation between the United States and Canada. If the true returns were 10 percent for each country, then because the two assets are symmetrical, the weights must be the same, $w_1 = w_2 = 0.5$. However, changing the return on asset 1 by only 2 percentage points to 8 percent—a very small change compared to the standard deviations usually observed in equity returns—would reduce its optimal portfolio weight to $w_1 = 0.18$. Clearly, a small variation in μ causes a large variation in the optimal weights, w.

To avoid relying on a measure with such imprecise estimates, French and Poterba (1991), instead of computing implied optimal portfolio weights, use the following procedure. They calculate the share of each country's stock market in the world equity market and propose that under perfect risk sharing each country should hold an equity portfolio with country weights equal to the countries' shares of market capitalization in the world market. Countries would hold portfolios that differ only in size but not in composition (that is, the relative weights would be identical across all countries). For example, because the share of German stocks in the world market is 4 percent, all countries should hold 4 percent of their portfolio in German stocks. Similarly, the U.S. equity share in the world market is 48 percent, so all countries should hold portfolios containing 48 percent U.S. equity.

This value-weighted portfolio serves as French and Poterba's benchmark portfolio. Instead of asking what the optimal weights are given μ and Σ using

TABLE 1
Implied Real Returns on Equity (Percent)

	Implied Real Returns (In Local Currency)				Perceived Excess Return on Domestic Equity	Perceived Excess Return on Foreign Equity	Home Bias
	Observed Portfolio		Value-Weighted Portfolio				
	Home	Foreign	Home	Foreign			
Australia	6.99	3.97	3.78	5.74	3.21	–1.77	4.98
Canada	7.40	4.22	4.22	4.87	3.18	–0.65	3.83
France	8.60	5.98	5.94	6.92	2.66	–0.94	3.60
Germany	8.59	5.64	5.45	7.03	3.14	–1.39	4.53
Italy	16.07	4.15	4.24	6.98	11.83	–2.83	14.66
Japan	11.53	3.46	4.52	6.24	7.01	–2.78	9.79
Netherlands	7.22	6.05	5.75	7.03	1.47	–0.98	2.45
Spain	13.46	6.42	6.49	7.00	6.97	–0.58	7.55
Sweden	14.38	6.99	7.11	6.99	7.27	0.00	7.27
United Kingdom	5.44	4.60	4.35	5.80	1.09	–1.20	2.29
United States	5.25	3.96	4.65	4.84	0.60	–0.88	1.48

Source: Calculated by the author from data from MSCI and International Financial Statistics (see footnote 5)

equation (2), they propose the optimal weights to be w^{val}, which are portfolio weights proportional to market capitalization. Then they use equation (1) to infer expected returns under these conditions. Essentially, French and Poterba compute the perceived returns that investors would expect in the absence of home bias.

Equation (1) can also be used to calculate the expected returns, μ^{act}, necessary to generate the actual portfolio allocation observed in each of the eleven countries. Table 1 reports the real returns of home and foreign equity implied by both the observed portfolio and the value-weighted portfolio.[5] For all eleven countries, the implied home country returns from the observed portfolio are higher than from the benchmark value-weighted portfolio and vice versa for foreign returns. This pattern means that investors in all countries perceive their domestic asset to perform better and the foreign asset to perform worse than the benchmark allocation without a bias would indicate. For example, the implied real return on U.S. stocks should have been 4.65 percent under the benchmark assumption that investors do not have any bias and diversify their portfolio as predicted by Lintner (1965).[6] However, in order to explain the observed portfolio allocation (roughly 89 percent domestic stocks and 11 percent foreign stocks) the domestic return would have to be 5.25 percent, 60 basis points higher than under the benchmark, and the foreign return would have to be 88 basis points lower (3.96 percent instead of 4.84 percent). The measure of home bias (in the last column of the table) is the sum of the perceived advantage of domestic equity and the perceived disadvantage of foreign assets. In a model without any other frictions or other causes of home bias, this number would reveal the shadow cost of foreign investment—how much an annual management fee for foreign assets would have to exceed the management fee for domestic assets to sway investors away from international equity toward domestic assets.

In the United States the home bias is almost 150 basis points per year, by far the lowest among the eleven countries. Canada, Australia, and most European countries display a home bias of between

4. French and Poterba choose this value so that the U.S. real returns that the model predicts will match observed returns. Using the data on U.S. returns available after their paper was published in 1991, their model would have needed a slightly higher value for λ of around 3.7 to match observed returns. To aid comparisons of this study's results to previous work, this article uses French and Poterba's original value. Increasing the value to 3.7 would make the home bias levels in this study even higher.
5. The figures are based on annualized monthly real returns for 1991–2000. Nominal returns for countries' equity markets were taken from MSCI (www.msci.com). Returns were then deflated by countries' CPI data (from International Financial Statistics) and converted into the corresponding country's home currency. Australia reports only quarterly CPI figures; therefore its monthly CPI inflation is calculated as one-third of the corresponding quarterly inflation. This conversion seems reasonable given that essentially all the volatility comes from stock market returns rather than monthly fluctuations in CPI inflation. In fact, for those countries that do report monthly CPI numbers, changing CPI inflation to quarterly averages does not make any noticeable difference in the estimate of the variance-covariance matrix.
6. This number is slightly too low compared to the actual long-term real return on U.S. equity ($\lambda = 3.7$), a value that would have increased the level of home bias (see footnote 4).

200 and 500 basis points, and Sweden, Spain, Japan, and Italy have a bias that could only be accounted for by annual costs in the range of 700 to 1,500 basis points.

Annual management fees of several hundred basis points annually are hard to rationalize and untenable in the financial market. In comparison, the iShare index funds available for most foreign countries (matching the corresponding MSCI country index and traded on the American Stock Exchange [AMEX]) have an expense ratio of 84 basis points annually compared to 20 basis points for a Russell 2000 index fund with domestic shares.[7] A difference of 64 basis points is not enough to account for even half of the home bias in the United States, or a tenth of the home bias of many other countries. This comparison shows that the calculation of shadow costs, even using an additional decade's worth of data that were unavailable to French and Poterba, still yields puzzling levels of home bias in all industrialized countries.

A more comprehensive measure of home bias, the implicit shadow cost of foreign investment, reveals that the United States has the lowest home bias among all industrialized nations.

Home Bias and Information Cost

Proponents of the asymmetric information theory might argue that the effect of differences in the kinds of information available to foreign and domestic investors justifies the findings of home bias. They claim that investors have more precise information on their domestic equity returns and therefore perceive volatility of domestic equity to be lower than that for foreign equity. This perceived disparity in volatility explains why investors hold such an overwhelming portion of domestic assets in their portfolios. Differences in accounting standards, industrial structure, regulation, and corporate composition may be key elements to such information asymmetries. For example, most U.S. investors find it hard to read German companies' balance sheets because they simply do not understand German or are unfamiliar with German accounting standards.

This study claims that the information cost argument is severely flawed at several levels. First, the reduction in perceived domestic volatility necessary to create home bias of the magnitude observed is unrealistically large for most countries. Second, in a carefully modeled environment, a better-informed investor would not always hold more domestic assets even if volatility were lower.

Reviewing previous studies on home bias and information cost provides a perspective on this article's analysis. Chart 2 presents two ways to interpret asymmetric information, each of which portrays probability distribution functions of returns for both informed and uninformed investors.

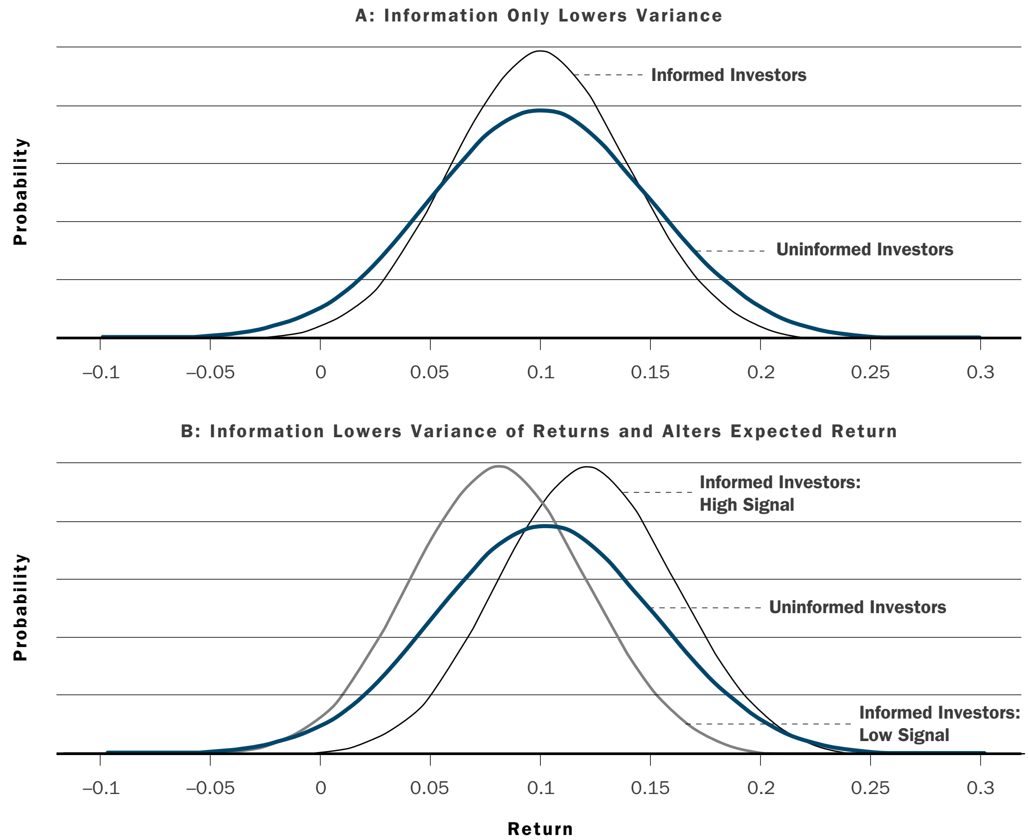
Panel A of Chart 2 shows the probability distribution function given the assumption that the only difference between informed and uninformed investors is the variance in returns while the mean returns on equity are the same for both. Obviously, if investors have a demand function for equity that depends positively on mean return but negatively on variance, the informed investors are going to hold more assets. This intuition is behind most studies that relate asymmetric information to home bias, such as Ahearne, Griever, and Warnock (2000) or Suh (2000). Instead of using a carefully worked out model, these authors look at anecdotal and econometric evidence. Sometimes information asymmetries have to serve as a residual explanation, as in Obstfeld and Rogoff (2000), in the sense that the authors concede that their explanation, transportation costs of traded goods, is most likely not the whole story and the remaining, unexplained portion of home bias would likely be due to information asymmetries.

Can this intuition quantitatively account for the home bias levels observed in the data? This study calculates how much the domestic variance in Chart 2A has to be reduced to give investors an informational advantage big enough to skew their portfolio toward the one observed. The necessary reduction in variances turns out to be unrealistically high for most countries.

Chart 2B represents how investors' beliefs about returns look in a rational expectations model with asymmetric information. As in the first panel, the variance is larger for uninformed investors since the probability distribution function is spread over a wide range of returns. However, the expected returns of foreign and domestic agents no longer have to be equal. For example, U.S. investors, as opposed to Germans, can gather information from U.S. balance sheets, and this information, called a signal on returns, can predict either a likely low or high return; the uninformed German investors, on the other hand, cannot rely on any U.S. balance sheet information, so their expected return is simply equal to the unconditional mean.

Gehrig's (1993) formal two-country model, in which domestic agents have more information on

CHART 2
Distribution of Returns



their own domestic assets than foreign agents do, exhibits a home bias in the sense that domestic agents would on average hold more domestic assets than foreign agents would. Gehrig's analysis is relevant here because it shows that the demand from informed investors is higher *on average* than that from uninformed investors. This article, however, shows that the domestic share in Gehrig's model can be below or above the predicted optimal share. In particular, if informed investors observe a low signal their demand must be lower than that of uninformed investors; that is, the home bias would be *reversed* in periods in which domestic investors gather a signal indicating low returns. This pattern is in stark contrast to decades of continued home bias not only in the United States but in every single country of interest.[8]

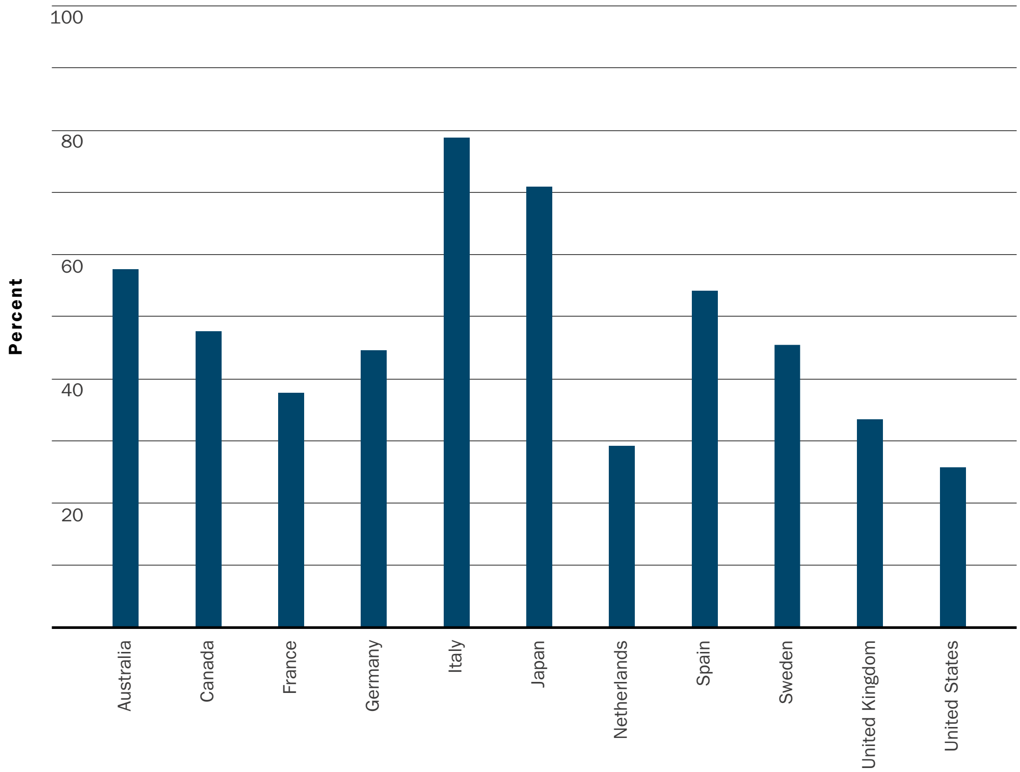
To quantify how much reduction of perceived domestic volatility is needed to account for home bias, the portfolio allocation model can be analyzed according to the probability distribution function in Chart 2A. Information cost would alter the variances of returns, Σ, rather than the expected returns, μ; in particular, it would lower domestic variances or increase foreign variances. Assuming that foreign equity risk and the correlation of domestic and foreign returns stay constant, it is possible to calculate to what degree the standard deviation of domestic equity returns has to decrease because of domestic investors' informational advantage to account for the observed home bias.

The result of this calculation, depicted in Chart 3, appears unsatisfactory as an explanation for home bias. Not surprisingly, the countries with a low home bias—the United States, the United Kingdom, and the Netherlands—require a relatively low reduction of domestic standard deviation to fully account for home bias. If U.S. investors perceive the standard deviation of domestic returns to be one-quarter lower than in the data (around 12 percent instead of 16 percent) because they believe the information on

7. These iShare index funds are listed on the AMEX Web site at www.amex.com/reference/view_index_shares.stm.

8. See Tesar and Werner (1998, 299) for a graph of home bias over time in the United States, the United Kingdom, Canada, Germany, and Japan.

CHART 3
Necessary Reduction in Domestic Standard Deviation



domestic equity they can gather would reduce risk in the domestic market, one could fully explain home bias in the United States. Even a smaller reduction of standard deviation could at least account for a large portion of home bias. For most of the other ten countries, however, the reduction in domestic risk necessary to account for home bias is unrealistically large. Few would believe that all Japanese investors are so well informed about their domestic stocks that they could eliminate 70 percent of their domestic volatility in equity returns.

A Rational Expectations Model

The previous analysis rules out asymmetric information as an explanation for home bias in most countries because the reduction in domestic volatility necessary to generate the extent of bias observed is unrealistically large. The analysis now turns to a rational expectations model like the one behind Chart 2B; the naive model in Chart 2A can be discarded because asymmetric information fails to account for home bias even in the remaining countries. The model in Chart 2B is essentially a simplified version of the Grossman and Stiglitz (1980) model, which was designed to address slightly different issues but can also help distinguish the behavior of domestic investors from that of foreign investors when information about a domestic asset is available only to domestic investors. The analysis based on this model shows that home bias cannot be created by asymmetric information in a rational expectations framework.

Suppose there are two assets, one riskless asset, say, a money market account yielding a fixed return, *R,* and a risky asset, such as stocks in one particular country. The supply of the risky asset is called x, which is also a random variable; that is, investors are uncertain about how many assets are being offered in the market. The return of the risky asset is a random variable, u, composed of two parts,

$$u = \theta + \varepsilon, \qquad (3)$$

where θ and ε are also random variables.

In this scenario, neither of the two types of investors, domestic nor international, knows the true values of u and x before investing. However, domestic investors observe θ, say, a domestic company's balance sheet, to get information on future returns. However, because balance sheets do not perfectly reveal future performance, the actual return is subject to further noise, ε. Foreign investors, on the other hand, find it more difficult to read these balance sheets—perhaps because of problems in understanding the language or the local accounting laws—and therefore cannot observe θ. Implicitly, this model thus assumes that the cost of gathering information on the risky asset is zero for domestic investors and infinitely high for foreign investors. This extreme assumption is made purely for convenience and simplicity. Qualitatively identical results could be derived in a more realistic setting in which both domestic and foreign investors incur a cost for gathering information but the cost is lower for domestic agents.

To simplify the model even further, it is assumed that each random variable (x, θ, ε) takes on only one of two alternative values. The supply x may be either x_H (high supply) or x_L (low supply), the signal for the informed domestic agents may be either θ_H (high signal) or θ_L (low signal), and the additional noise may be either $+\delta$ or $-\delta$, each with a probability of 0.5. This simplification allows a more straightforward representation of the analysis and the results. The key results will not change in a more general model with more realistic assumptions about distributions of supply, signal, and noise.

The timing of the model is illustrated in Chart 4. After supply has been realized, domestic investors observe their signal, θ. After that, prices are determined in such a way that demand from domestic and foreign investors equals supply. The demand of foreign investors depends on the observed price only while the demand of domestic investors is determined by both price and signal. After the price has been realized and assets have been traded, the actual return is realized, that is, the value of the noise is determined. The interesting stage is the point at which prices and the demand of investors are simultaneously determined. In the event of both high signal/high supply and low signal/low supply, the price of the asset is P_2. This outcome is intuitive: The effect on price of informed investors' lower demand in the case of a low signal is exactly offset by the lower supply of the asset.

The example highlights the significance of supply uncertainty. Without any supply uncertainty or any other type of uncertainty, domestic agents would not have any informational advantage over foreign investors because informed (domestic) investors' demand would affect the price of the risky asset; thus the uninformed (foreign) investors could infer the value of the signal just by observing the price, giving them essentially the same information as domestic investors. However, if supply uncertainty exists, foreign investors cannot infer the value of the signal just by observing price; that is, if the price is P_2, then informed investors can hide their signal behind the supply uncertainty.[9]

Economists call the behavior patterns in Chart 4 a pooling equilibrium, as opposed to a separating equilibrium where a distinct price prevails in each of the four nodes (after supply and signal have been realized). In order to give the asymmetric information any influence over outcomes, this model will analyze only pooling equilibria. Separating equilibria are not useful for the purposes of this article because they would perfectly reveal which signal the informed investors observed. In such scenarios, the portfolio choices of domestic and foreign investors would be identical and there could never be a home bias. Of course, in more sophisticated models in which both the supply and the signal can take values over a continuous set, as in Grossman and Stiglitz (1980), pooling equilibria would automatically exist. There would always be a whole set of supply and price pairs that generate one particular asset price.[10]

Asymmetric information can explain home bias only if domestic, informed investors have observed relatively high signals on domestic equity returns for more than 360 months in a row—an implausible occurrence.

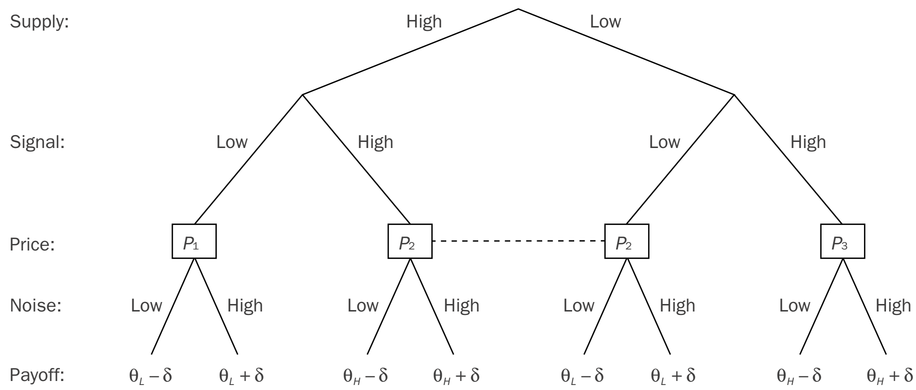
The purpose of this model is to show that, in the event of a price P_2, domestic investors who have an informational advantage over uninformed foreign investors do not hold more domestic stocks if they get a low signal. In other words, the discussion seeks to highlight the point that having more information on domestic assets does not necessarily lead to more ownership of domestic assets.

In the scenario where the supply and the signal are either both high or both low—the P_2 junctures in Chart 4—domestic investors are confronted with a lower variance of returns. Their only source of uncertainty is the additional noise whereas uninformed

9. In the other two cases with the price P_1 or P_3, uninformed investors can infer what signal the informed investors observed. These outcomes imply that the domestic investors have no informational advantage over foreign investors.

10. In fact, it is not straightforward to generate a pooling equilibrium in our simple example. Solving for a pooling equilibrium yields one more equation than unknowns. It turns out that the only way to achieve a pooling equilibrium here is to set parameter values in such a way that guarantees the existence of a pooling equilibrium. This problem does not arise in a more elaborate setup like that in Grossman and Stiglitz (1980) or Jeske (2001).

CHART 4
Timing of Rational Expectations Model



foreign investors face a higher variance, namely, uncertainty both from the noise and from not knowing whether the signal was high or low. Why then can domestic investors still hold less equity? They can hold less domestic equity because their expected return is exactly θ_L if they observe the low signal, which is lower than the return foreign investors expect.

Information asymmetries, therefore, not only alter variances of returns but also, by their very existence, allow the better-informed investors to make different judgments about expected returns than the uninformed individuals do. When informed investors have a lower expected return, as depicted in Chart 2B, they may hold less domestic equity precisely because they have more information. Supporters of the asymmetric information explanation for home bias have in mind a model in which demand positively depends on expected returns and negatively on the variance, but their theory overlooks the fact that information asymmetries not only lower the variance but also alter the expected returns.

The discussion so far has shown that demand from informed investors *can* be lower than demand from uninformed investors. The analysis will further demonstrate that demand *must* be lower for informed investors if they observe a low signal. One way to prove this result would be through tedious algebra.[11] A more elegant and intuitive way involves observing some particulars about the behaviors possible in the model: Information in this environment is valuable in the sense that if there were a market for buying the signal θ, the uninformed foreign investors would be willing to pay a positive price for it. If the signal is high, informed investors hold more equity because the expected return is higher and the variance is lower for them, and in this case foreign investors could prevent underinvesting in the risky asset.

Suppose now that even in the case of a low signal informed investors hold more equity. Say, for example, informed investors hold 100 shares if they observe a low signal and 200 if they observe a high signal, and uninformed investors hold 50 in each case because they observe only P_2 and cannot distinguish between the good and the bad signal. If uninformed investors would be willing to purchase the information domestic agents hold at a positive price, why should foreign investors not hold 100 shares instead of 50 to more closely mimic the portfolio of an informed individual, given that this action is completely free of charge? Or, stated differently, an uninformed investor who holds 50 shares knows that he will be underinvested no matter what the actual signal is. A rational, profit-maximizing individual would never do this. But even holding 100 shares is suboptimal for uninformed investors because they would still be underinvested half the time and only adequately invested in the risky asset half the time. Rational uninformed investors would increase their holding to the point at which the marginal gain from eliminating the underinvestment when the signal is high exactly equals the marginal cost of being overinvested when the signal is low. To reach this point uninformed investors necessarily would have to increase their holdings above 100 shares, the level held by informed investors who observed a low signal. In such a scenario, the uninformed investor is like a person who is baking muffins but cannot precisely remember the recipe. The person remembers that the recipe requires either one cup or two cups of flour, so he would never use half a cup of flour but instead would use an amount somewhere between one cup and two cups.

The intuition used in this discussion has much the same flavor as those in Akerlof's (1970) seminal paper on asymmetric information. Akerlof studies the market for used cars, where such cars can be either of good or bad quality. Clearly, sellers have more information about the car than the potential buyer does. In equilibrium, owners of good cars prefer to hold on to their cars while owners of lemons try to sell their cars. Consequently, the share of lemons among the cars for sale is far larger than the share of lemons among all cars—a circumstance economists call adverse selection. In this study's rational expectations model, an investor posts a low demand if the signal is low enough just as an owner sells his car if he knows it is a lemon.[12]

This discussion has established that informed investors will hold less equity if their signal is low enough. This result reveals that asymmetric information can explain home bias only if domestic, informed investors in all industrialized nations have observed relatively high signals on domestic equity returns, not for just one month, but for more than 360 months in a row—an implausible occurrence. The model and the results in this section therefore eliminate asymmetric information as a candidate for explaining home bias.

Conclusion

The purpose of this article is to raise the awareness of a number of empirical and theoretical issues concerning home bias in equity holdings. Generally, people believe that home bias in the United States is more severe than in other countries, basing their views on raw data about holdings of foreign assets. But a more comprehensive measure of home bias, the implicit shadow cost of foreign investment, reveals that the United States has the lowest home bias among all industrialized nations.

Even though home bias in the United States is smaller than in other countries, it is still too large to be accounted for by simple transaction or managing costs. Home bias levels of 150 basis points a year in the United States and several hundred basis points in other countries must have other explanations.

A frequently cited cause of home bias is the cost of information that investors face if they want to invest in foreign equity markets. A naive, back-of-the-envelope calculation seems to indicate that for some countries, including the United States, the perceived informational advantage from having better information on domestic assets can go a long way toward accounting for home bias. For most other countries, however, the perceived reduction of domestic risk is unrealistically large; therefore, information cost can never be a unifying explanation for worldwide home bias in asset holdings.

This article further demonstrates that this simple calculation is misleading because it disregards the possibility of low-enough signals leading to a reversal of home bias. In fact, one can show that in a model with asymmetric information, the demand of informed investors must be lower if their signal is low enough. If this model were accurate, it would then be difficult to understand why investors hold large shares of domestic equity over extended periods of thirty or more years. Therefore, home bias is still a puzzle, and asymmetric information cannot account for it.

11. See Jeske (2001) for a formal proof in a more general model.
12. One crucial difference between the models is that in this study's model all informed investors have the same information about one single asset whereas in Akerlof's model each owner has private information about his or her individual car.

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