The global case for strategic asset allocation and an examination of home bias

Vanguard Research

September 2016

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- Broadly diversified balanced funds with limited market timing tend, over time, to move in tandem with overall financial markets. Our empirical analysis, as well as that originally performed by Brinson, Hood, and Beebower (1986), illustrates the significance of a broadly diversified asset allocation.
- Active management has produced significant performance dispersion across portfolios. Our analysis, based on work first published by Jahnke (1997), also supports the possibility of outperformance based on an investor's selecting a "winning" actively managed fund. We found, on average, that active management reduces a portfolio's returns and increases its volatility compared with a passive index-based implementation of the portfolio's asset allocation policy. At the same time, our findings support the view that active management *can* create an opportunity for a portfolio to outperform.
- As a result, when building portfolios, market-capitalization-weighted global indexes are a valuable starting point for all investors. Yet we find that many investors tilt their portfolios away from market cap, either consciously or unconsciously. Perhaps the most prominent tilt investors make is toward a home bias. To the extent this is an unconscious choice, we provide a framework for considering the benefits of global diversification.

Acknowledgments: The authors thank Matthew Christopher Tufano, of Vanguard's Investment Strategy Group, for his contributions to this paper. It is a revised combination of two earlier papers: Vanguard research first published in 2006 as *The Asset Allocation Debate: A Review and Reconciliation* by Yesim Tokat, Nelson Wicas, and Francis M. Kinniry Jr. and revised in 2012 as *The Global Case for Strategic Asset Allocation* by Daniel W. Wallick and others; and *The Role of Home Bias in Global Asset Allocation Decisions* (2012) by Christopher B. Philips, Francis M. Kinniry Jr., and Scott J. Donaldson.

The seminal 1986 paper by Brinson, Hood, and Beebower (henceforth BHB), "Determinants of Portfolio Performance," concluded that asset allocation is the primary driver of a portfolio's return variability for broadly diversified portfolios. Yet disagreements or misunderstandings about the findings' relevance to investors still make the topic valuable to clarify for investors.

We examine two key questions: How does asset allocation affect your risk/return expectation? And how much home bias is reasonable? We analyze these questions in five major markets: the United States, Canada, the United Kingdom, Australia, and Japan. We briefly review two studies at the core of this debate: BHB's paper and Jahnke's "The Asset Allocation Hoax" (1997). We then expand upon Vanguard's past research, most notably *The Global Case for Strategic Asset Allocation* by Wallick et al. (2012). Finally, we discuss the role of home bias tilts in relation to asset allocation.

The ongoing asset allocation debate

In their landmark paper, BHB concluded that a portfolio's static target asset allocation explained the majority of a broadly diversified portfolio's return variability over time. These findings were confirmed by Vanguard and other research, including Ibbotson and Kaplan (2000), suggesting that a portfolio's investment policy is an important contributor to return variability (Hood, 2005). Investment advisors have generally interpreted this research to mean that selecting an appropriate asset allocation is more important than selecting the funds used to implement it. Vanguard's findings indicate that *both* are important, yet we suggest the following sequence for portfolio construction: Start with an asset allocation policy decision, then consider the implementation strategy.

In 1997, Jahnke argued that BHB's focus on explaining return variability over time ignored the wide dispersion of returns among broadly diversified active balanced funds over a specific time horizon. In other words, he maintained that a portfolio could achieve very different terminal wealth levels, depending on which (active) funds were selected. Jahnke's analysis emphasized

Notes on risk

All investments are subject to risk, including the possible loss of the money you invest. Past performance is no guarantee of future results. Investments in bond funds are subject to interest rate, credit, and inflation risk. Foreign investing involves additional risks including currency fluctuations and political uncertainty. Diversification does not ensure a profit or protect against a loss. There is no guarantee that any particular asset allocation or mix of funds will meet your investment objectives or provide you with a given level of income. The performance of an index is not an exact representation of any particular investment, as you cannot invest directly in an index.

that, as a result of active management strategies, actual returns earned should be examined across different active balanced funds within a set holding period. It is correct that the BHB study did *not* show that two funds with the same asset allocation can have very different holding-period returns. The research we report here confirms the findings of both studies and views them as separate analyses that ultimately helped us address this question: Can active management increase a portfolio's returns without increasing the volatility experienced?

Our analytical framework

Vanguard's latest research updates analysis from 2012. It covers the United States, Canada, the United Kingdom, Australia, and Japan from January 1990 to September 2015. Previous versions of this research analyzed a longer data history, but the current analysis was shortened to cover a common time period and include additional markets. This research confirms our earlier conclusions that, over time and on average, most of the return variability of a broadly diversified portfolio that engages in limited market timing is due to its underlying static asset allocation. Active investment decisions such as market timing and security selection had relatively little impact on return variability over time.

To determine the relative performance of asset allocation and active management, we needed to distinguish between a portfolio's policy return (or asset allocation return)—that is, what a portfolio could have earned if it recreated its policy allocation with passively managed index funds—and the actual return earned by the active balanced fund over the period. Our empirical case tested BHB's and Jahnke's studies on a global scale, using a greater number of balanced mutual funds.[1]

Time-series regression (per BHB, 1986)

Return variability measures the extent to which actual returns diverge from the policy returns. Therefore, greater variability in returns would suggest a wider possibility of returns and a lessened ability to predict results, inherently indicating increased portfolio volatility. The variation in the policy return that explains the percentage of variations in the actual return is measured by the adjusted R-squared (R^2) derived from a time-series regression analysis of the fund's actual return versus its policy return. A high adjusted R^2 would mean that variations in the policy return explained a high percentage of the variation in fund returns.

1 For our analysis, we selected balanced mutual funds from the Morningstar Direct database. The data included monthly net returns and fund characteristics such as expense ratios and turnover rates. To ensure reliability, we analyzed only funds with at least 48 months of return history. We constructed each balanced fund's policy portfolio using Sharpe-style analysis (1991). Among these funds, we selected total return funds, income funds, asset allocation funds, and traditional balanced funds. See the Appendix on page 15 for more details on our data and procedures.

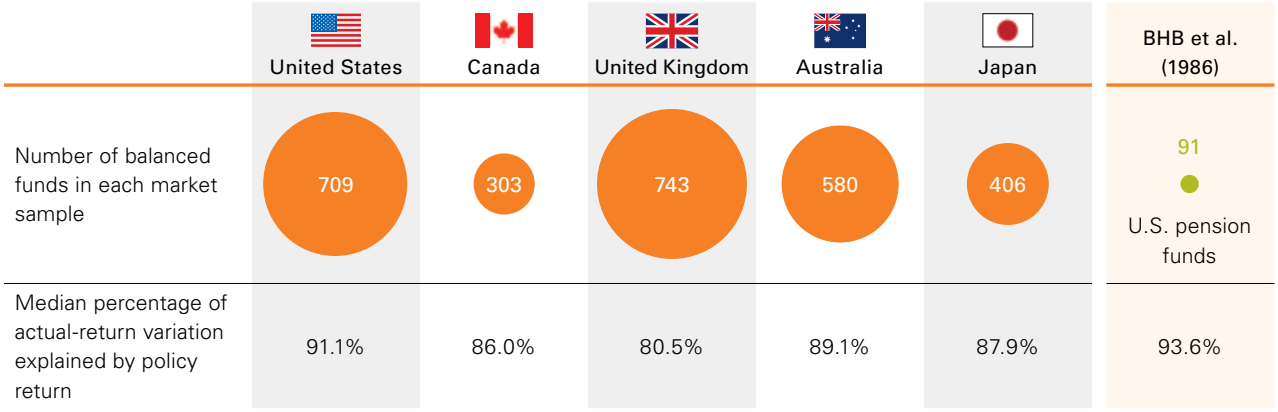
BHB's 1986 conclusions were derived from the results of a time-series analysis measuring the effect of asset allocation on return variability. Such an analysis compares the performance of a policy (long-term) asset allocation represented by market indexes with the actual performance of a portfolio over time. Our results confirmed BHB's findings that, on average and over time, most of the return variability of a broadly diversified portfolio that engages in limited market timing was attributable to the ups and downs of its policy asset allocation. Active investment decisions—such as market timing and security selection—had relatively little impact on return variability over time.

It is important to acknowledge that BHB's data set was pension funds, which were typically exposed to a high level of systematic market risk, resulting in high R^2 numbers versus the returns of their policy portfolios over time. BHB's analysis concluded that more than 90% of return variability over time could be explained by the asset allocation policy. Ibbotson and Kaplan (2000) and Vanguard research found similar results for the balanced mutual fund universes in the United States, Canada, the United Kingdom, Australia, and Japan, with percentages slightly lower than BHB's findings (see **Figure 1**).

As the figure shows, asset allocation largely contributed to return variability over time. As a result, asset allocation is key in managing the range, or variability (experienced volatility), of a portfolio's returns *over time*.

Figure 1. Role of asset allocation policy in return variation of balanced funds

Selected periods, January 1990–September 2015



Notes: For each fund in our sample, a calculated adjusted R^2 represented the percentage of actual-return variation explained by policy-return variation. Percentages shown in the figure—91.1% for the United States, 86.0% for Canada, 80.5% for the United Kingdom, 89.1% for Australia, and 87.9% for Japan—represent the median observation from the distribution of percentage of return variation explained by asset allocation for balanced funds. For the period January 1990–September 2015, the sample included: for the United States, 709 balanced funds; for Canada, 303; for the United Kingdom, 743; for Australia, 580; and for Japan, 406. Calculations were based on monthly net returns, and policy allocations were derived from a fund's actual performance compared with a benchmark using returns-based style analysis (as developed by William F. Sharpe) on a 36-month rolling basis. Funds were selected from Morningstar's Multi-Sector Balanced category. Only funds with at least 48 months of return history were considered in the analysis. The policy portfolio was assumed to have a U.S. expense ratio of 1.5 basis points per month (18 bps annually, or 0.18%) and a non-U.S. expense ratio of 2.0 bps per month (24 bps annually, or 0.24%).

Sources: Vanguard calculations, using data from Morningstar, Inc.

Cross-sectional regression (per Jahnke, 1997)

The adjusted R^2 derived from a cross-sectional regression analysis of the fund's actual return versus its policy return is used to measure the degree to which an asset allocation (passive) policy compared with an active management strategy and explains the dispersion of returns across funds over a set time horizon.

In considering Jahnke's emphasis on determining how much asset allocation affects actual portfolio return dispersion across funds, we ran a cross-sectional analysis to compare actual returns with policy returns. Both our and Jahnke's analyses resulted in lower R^2 numbers (see **Figure 2**). In other words, active management implemented by taking idiosyncratic risks and differential exposure to systematic risk factors (such as factor or tactical overweights) can create significant return dispersion across active balanced funds, resulting in a lower R^2. Jahnke believed that investors cared about actual returns and the range of possible investment outcomes at the end of their time horizons, rather than about return variability experienced over time. Jahnke's analysis confirmed that some individual actively managed funds can outperform their policy portfolios.

What matters most to investors: Return and risk

Vanguard's research supports both BHB's and Jahnke's findings. In fact, there is not really a debate between the two positions; rather, they refer to two different aspects of portfolio construction: Jahnke refers to holding-period return or terminal wealth, and BHB to day-to-day portfolio volatility, which can be defined as portfolio risk.

The risk interpretation of BHB's finding is that about 90% of the volatility of a broadly diversified balanced portfolio comes from its policy asset allocation decision and broad market movements. Jahnke's finding that actual portfolio returns can vary significantly over a specific investment horizon means that the selection of active managers and strategies can lead to outcomes very different from the policy asset allocation benchmark.

Thus, once the policy allocation has been determined, the portfolio's expected risk will not depend much on how it is implemented (passive index or active); however, the ultimate performance of the portfolio relative to the policy benchmark will depend critically on the selection of a particular active manager or strategy.

Figure 2. Role of asset allocation policy: Return dispersion of balanced funds

Selected periods, January 1990–September 2015

	United States	Canada	United Kingdom	Australia	Japan
Median dispersion explained by policy return	22.7%	27.9%	23.6%	35.5%	47.7%

Notes: See notes below Figure 1 for details of study sample for each country. The policy portfolio was assumed to have a U.S. expense ratio of 1.5 bps per month (18 bps annually, or 0.18%) and a non-U.S. expense ratio of 2.0 bps per month (24 bps annually, or 0.24%). A longer history for the United States dating back to January 1962 was available, for which we obtained a median R^2 of 43.2%.

Sources: Vanguard calculations, using data from Morningstar, Inc.

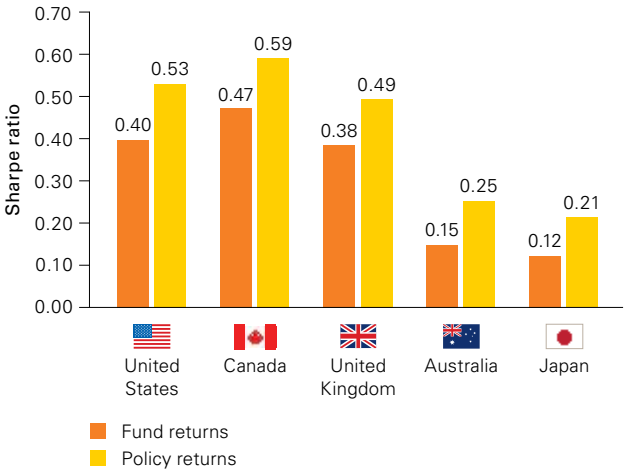
The question then comes down to the challenges in selecting managers or implementing active portfolio strategies that will prove to outperform the policy benchmark (See Wallick, Wimmer, and Balsamo, 2015). Manager selection is challenging—so much so that a reasonable starting point is to presume that an investor has average skill in selection and that a passive market-cap-weighted implementation is a valuable starting point for portfolio construction.

We examined actual return performance by comparing actual versus policy returns. We calculated the average return of a fund's asset allocation policy as a percentage of the fund's long-term average return and computed the ratio of a fund's policy volatility over its actual volatility. These two calculations helped us determine how both an investor's policy and active management strategies have performed in the past. We found that, on average, active funds added to volatility levels and underperformed the benchmark (as reflected in **Figures 3** and **4**). From January 1990 through September 2015, on an equal-weighted basis, only 4% of U.S. actively managed balanced funds produced statistically significant alpha. At the same time, the outperforming assets made up 17% of the assets under management.

We found that, on average, using an equal-weighted count methodology, a greater degree of active management reduced both time-series and cross-sectional R^2 but did not necessarily increase performance. On average, active management risk is not compensated (Sharpe, 1991), yet it is compensated if skill overcomes hurdles such as tendencies toward higher costs and turnover of active management. Indeed, Vanguard's research on active management (Wallick, Wimmer, and Balsamo, 2015) identifies three key components that improve the odds of success: identifying top talent, obtaining access to that talent at a reasonable cost, and being patient enough to hold the funds over time.

Figure 3. Sharpe ratio of median fund returns and policy (asset allocation) returns

Selected periods, January 1990–September 2015



Notes: The Sharpe ratio calculates return (reward) per unit of risk. For each fund, we calculated the Sharpe ratio as the arithmetic average of the time-series fund returns adjusted for each country's domestic cash rate, divided by the respective standard deviation for each fund. We did the same for each fund's policy returns and took the median across all funds for both the fund returns and the policy returns and annualized each figure by multiplying by the square root of 12. For each country's cash index, see the box on page 14. A longer history for the United States dating back to January 1962 was available, for which we obtained similar results (a fund Sharpe ratio of 0.40 and a policy Sharpe ratio of 0.53).

Sources: Vanguard calculations, using data from Morningstar, Inc.

The Sharpe ratio helps us measure the risk/return trade-off. The ratio is the equity-risk premium divided by the standard deviation, which provides a better measure of how much return we derive from every unit of risk taken. The higher the ratio, the better the risk-adjusted return you will have on the chosen investment. Figure 3 shows a clear spike in returns per unit of risk taken in the policy over the fund's actual returns. The higher risk taken in the fund relative to the policy comes from active management strategies such as market timing and security selection.

Characteristics of funds with positive and negative alpha

Vanguard's research shows that the average actively managed fund reduced returns and increased return variability compared with funds that passively tracked the policy benchmark. The analysis also highlighted some actively managed balanced funds that have significantly outperformed their policy benchmarks over time. What are the general characteristics of these "winning" funds? And how do they compare with the broader universe of balanced funds?

Figure 4 shows the results for Vanguard's study of balanced funds in the United States. (Results for Canada, the United Kingdom, Australia, and Japan were broadly similar and can be found in **Figure A-1** on pages 17–19 in the Appendix.) On average, the funds surveyed underperformed their policy benchmark by 1.48 percentage points. Of the 709 U.S. funds studied, only 28 delivered a statistically significant positive excess return, while 264 delivered a statistically significant negative excess return. A majority (417) had zero alpha. On average, the winning funds outperformed their benchmark portfolios by 2.50 percentage points per year, while the losing funds underperformed theirs by 3.12 percentage points per year. On an asset-weighted basis, the probability of outperformance changed noticeably, with a larger percentage (17%) of assets identified outperforming the policy benchmark.

Although manager skill plays a role in generating positive alpha, other important differences distinguish the winners from the losers. Vanguard's research found that the winning active funds had lower expenses and more assets under management than the consistently underperforming funds. In addition, within each category, the asset-weighted expense ratios were lower than the equal-weighted ones. This indicates that a greater percentage of investor assets are being directed to lower-cost active funds in each category. These winning fund characteristics generally held true in the other markets we analyzed, though the shift to lower-cost active funds is not as pronounced outside the United States.

Figure 4. Averages of fund characteristics across study's U.S. balanced funds

U.S. fund characteristics	All U.S. balanced funds	Funds with statistically significant positive alpha	Funds with statistically significant negative alpha	Funds with zero alpha
Risk and return (average across funds)				
Annualized alpha	–1.48%	2.50%	–3.12%	–0.71%
Policy return as percentage of actual return	109%	73%	121%	104%
Policy volatility as percentage of actual volatility	96%	90%	98%	95%
Average fund characteristics				
Number of funds	709	28	264	417
Net assets ($ millions)	2,231	7,816	713	2,989
Expense ratio	1.13%	0.87%	1.20%	1.09%
Asset-weighted fund characteristics				
Total assets ($ millions)	1,046,134	179,771	146,126	720,237
Asset-weighted percentage of assets by category		17%	14%	69%
Asset-weighted expense ratio by category		0.67%	0.97%	0.64%

Notes: Funds with consistent positive (or negative) excess return (alpha) had statistically significant alpha using a 95% one-sided *t*-test for statistical significance for the period January 1990–September 2015. Average and total fund characteristics are calculated from funds that reported expense ratio (701 funds), net assets (469 funds), and turnover (700 funds). Asset-weighted fund characteristics are calculated from funds that reported net assets (469 funds).

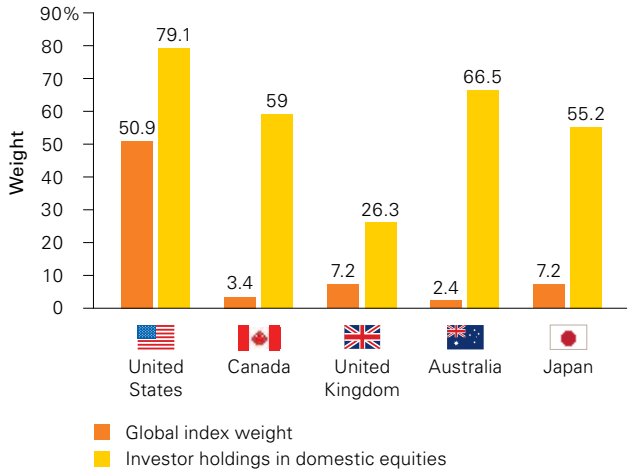
Sources: Vanguard calculations, using data from Thomson Reuters Datastream and Morningstar, Inc.

What is a reasonable starting point for building a portfolio?

To the extent a broadly diversified market-cap-weighted index fund is a valuable starting point for all investors, it could well follow that using a global market-cap-weighted fund is the most diversified option available and a reasonable default for investors. However, we find (as shown in **Figure 5**) that investors have, on average, a home-country bias, tending to own more equity of their resident country than the market-cap weighting would suggest.

For example, as of December 31, 2014, Canadian equities accounted for 3.4% of the global equity market. To the extent investors choose to invest in the global market regardless of their home country, they would hold 3.4% of their equity portfolio in Canadian stocks. But, on average, this was not the case among Canadian investors, who collectively held 59% at year-end in 2014. This situation was the same in each country that we analyzed.

Figure 5. Equity market home bias by country



Notes: Data as of December 31, 2014 (the latest available from the International Monetary Fund, or IMF) in U.S. dollars. Domestic investment is calculated by subtracting total foreign investment (as reported by the IMF) in a given country from its market capitalization in the MSCI All Country World Index. Given that the IMF data is voluntary, there may be some discrepancies between the market values in the survey and the MSCI ACWI.

Sources: Vanguard, based on data from the IMF's Coordinated Portfolio Investment Survey (2014), Barclays, Thomson Reuters Datastream, and FactSet.

Factors contributing to home bias

Several reasons can explain home-country bias—with inertia perhaps chief among them. To the extent the portfolio bias is a conscious decision, it is typically made for one of two major reasons: return expectations or risk mitigation. But to the extent the portfolio has been constructed incrementally over time, the home country bias results may have been unintended. For both types of investors, we offer a framework to assist with the home/global securities decision.

Indeed, home-country bias in global equity investing has been studied extensively.[2] Major reasons cited for why conscious home bias exists include:

- Expectations. In one of the earliest studies on the topic, French and Poterba (1991) identified investors' expectations about future returns in their home market as a key driver.
- Preference for the familiar. Investors generally feel more comfortable with their home market and allocate investments accordingly, even if it results in a poorer risk/return trade-off for their portfolio. For example, Strong and Xu (2003) showed that investors tend to be more optimistic about their domestic economies than foreign investors are.
- Corporate governance. Dahlquist et al. (2002) suggested that corporate governance practices have a major impact. High costs to access foreign securities may also encourage greater domestic investment.
- Liability hedging. Stockton and Bosse (2015) illustrated that the need to hedge certain liabilities may lead to a home-country bias, especially in fixed income, but also perhaps in equities. This is because the ability to fund a clearly defined liability is increased when using assets that move in tandem with those liabilities. Similarly, domestic investor spending is often influenced more by domestic inflation and interest rates. In these instances, the diversification benefits attained through adding foreign assets may actually decrease the portfolio's ability to meet its objective.
- Multinational companies. Investors may feel that through investment in multinational companies, they will attain as much global diversification as they will need. But as global economies become more interconnected, it's important to consider the extent to which investment in domestic companies provides exposure to foreign markets.[3]
- Currency. Many investors perceive foreign investments as inherently more risky than domestic holdings. For example, it is not uncommon to see investment providers' websites or literature list foreign equities among the riskiest assets, despite the well-documented diversification benefits of including foreign securities in a diversified portfolio. Much of the volatility in foreign investing can be attributed to exchange-rate fluctuations, and the desire to avoid the influence of such movements could be an additional reason why investors allocate greater percentages of their portfolios to domestic securities.

2 To simplify the analysis, the rest of this paper focuses on equity investors. Comparable data for global fixed income markets are not as readily available, depending on the market analyzed, so trying to include fixed income in our analysis could have required qualitative judgments about market conditions that are beyond this paper's scope.

3 Previous Vanguard research suggests that a company's performance has been more highly correlated to its domestic market, regardless of where business operations are conducted (Philips, 2012). LaBarge (2008) examined the impact of global sectors and countries on the returns of multinational firms and found that diversification across both country and sector remained relevant.

A framework for addressing home-country bias

To select an appropriate balance between domestic and foreign securities, investors often evaluate various factors and settle on a mixture that is appropriate for them. Certain investors may have predefined limits on how much foreign exposure is permitted in their portfolio—set perhaps by regulation or policy statements, or to maintain competitiveness within a peer group. In such scenarios, additional global diversification may be desirable but impracticable. Similarly, global diversification may be inappropriate for investors with a clearly defined domestic liability target.

Often, a holistic evaluation of various factors can help point to a reasonable balance between diversification, rational home-country bias, and awareness of the global opportunity set. **Figure 6** provides such a framework for this evaluation.

Return expectations

Returns over the near term can vary by country. To the extent an investor has a strong conviction that returns will be different, they may choose to tilt their portfolio. But to the extent an investor lacks a strong conviction about how returns will differ by country, a global exposure is a valuable approach.

Risk mitigation

To the extent an investor's home country has a more concentrated composition than the global market, these sector and issuer risks can be mitigated by greater global exposures. Indeed, many individual countries' market structures are less diversified than the global market in total. As a result, for investors interested in dampening concentration risk in their portfolios, global investing can provide a solution.

Figure 6. Factors affecting the decision to invest in foreign assets

	Validate home-bias decision	Reduce home bias
Risk and return impact of adding foreign securities	Limited benefits	Significant benefits
Concentration of home market by sector or issuer	Unconcentrated	Highly concentrated
Domestic transaction costs	Low	High
Domestic liquidity	High	Low
Domestic asset taxes	Advantages	Disadvantages
Other domestic market-risk factors	No impact	Significant risks
Additional considerations: regulatory limits and liability-matching systems	Impact unique to each investor	

Source: Vanguard.

Transaction costs and liquidity

Investment costs include direct transaction costs, taxes, and market impact costs. Investors in costly or generally illiquid markets may benefit significantly from increased global diversification because, all else being equal, this would entail greater investment in the U.S. equity market—the most liquid, lowest-cost market in the world.

Tax considerations

Although the role of taxes in the allocation decision is much debated, we posit that for many investors, the tax treatment of foreign versus domestic assets can be significant. Taxes generally fall into four categories: capital gains, dividends (from equities), interest income (from fixed income), and transaction or stamp taxes. In the Appendix, **Figure A-2** on the back page provides a high-level summary of some tax considerations by country. The degree to which an investor is exposed to these taxes could help determine whether it would be advantageous or disadvantageous to increase foreign exposure.

Other considerations

Other factors that may occur less frequently may also be important, depending on a country's locale, including political risk, the domestic regulatory framework (or lack of one), and investor protections. These can be difficult to quantify, but because they have the potential to add significant risk to a portfolio that is highly exposed to domestic securities, investors may want to incorporate these considerations into their decision process.

Conclusion

Results of Vanguard's latest research on U.S., Canadian, U.K., Australian, and Japanese funds were proportionally much the same in the degree to which asset allocation was found to explain return variability over time and the dispersion of returns across funds.

Our analysis—which expanded on BHB's work—reinforced the view that asset allocation explains the majority of a portfolio's return variability. For investors who held broadly diversified portfolios, asset allocation was the primary driver of return variability. In addition, we found that market-cap-weighted indexed policy portfolios provided higher returns and lower volatility than the *average* actively managed fund. We also found that those funds that were able to generate positive alpha tended to share two characteristics: larger average assets and lower costs.

Furthermore, we posit that global market-cap-weighted index funds are a valuable starting point for all investors. The portfolio construction process starts with investors choosing an asset allocation policy. An investor can then determine the strategy for implementing the policy decision, based on the investor's risk/return expectations.

At the same time, we note that the *average* investor in many locations takes on a home-country portfolio bias. This may occur for many reasons, but perhaps three are most prominent—inertia, return opportunity, and risk control. We provide a framework for investors to holistically consider the global-versus-local equity decision to help them determine the proper weighting between the two in their distinctive circumstances.

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Some key terms

Alpha. A risk adjusted measure of the "excess return" provided by an investment compared with a benchmark. Alpha can be positive, negative, or zero.

Expense ratio. A mutual fund's annual operating costs expressed as a percentage of net assets.

Net assets. The closing market value of a fund's assets minus its liabilities.

R-squared (R^2). A measure of how much of a portfolio's performance can be explained by the returns from the overall market (or a benchmark index).

Regression analysis. A statistical technique that can be used to explain the nature and strength of the relationship between a dependent variable (Y) and one or more independent variables.

Return dispersion. The difference in funds' cumulative returns. In this paper, return dispersion means the difference between multiple funds' returns over a specific time horizon relative to the funds' appropriate policy benchmarks. We use the term to discuss Jahnke's (1997) study, which measured return dispersion through a cross-sectional analysis.

Returns-based style analysis. A statistical method for inferring a fund's effective asset mix by comparing the fund's returns with the returns of asset-class benchmarks. Developed by William F. Sharpe, RBSA is a popular attribution technique because it doesn't require tabulating the actual asset allocation of each fund for each month over time; rather, it regresses the fund's return against the returns of asset-class benchmarks.

Return variability. The difference in returns between a balanced fund and its appropriate policy benchmark. We use this term in discussing the study by BHB (1986), which focused on measuring return variability through a time-series analysis.

Sharpe ratio. A measure of excess return per unit of deviation in an investment.

Systematic risk. A security's vulnerability to events that affect broad-market returns.

T-test. A statistical hypothesis test that is designed to test a mean sample to a known value for any significance. Throughout this paper, it is used to test the statistical significance of the average alpha of each balanced mutual fund.

Turnover. An indication of a fund's trading activity. Turnover represents the lesser of aggregate purchases or sales of securities divided by average net assets.

Benchmarks used in our analysis (all returns in local currency):

 United States. **Equities:** S&P 500 Index (January 1962–August 1974), Wilshire 5000 Total Market Index (September 1974–April 2005), MSCI US Broad Market Index (May 2005–September 2015). **Bonds:** S&P High Grade Corporate Index (January 1962–December 1968), Citigroup High Grade Index (January 1969–December 1972), Lehman Brothers U.S. Long Credit Aa Index (January 1973–December 1975), Barclays U.S. Aggregate Bond Index (January 1976–September 2015). **Cash:** Ibbotson U.S. 30-Day Treasury Bill Index (January 1962–December 1977), Citigroup 3-Month U.S. Treasury Bill Index (January 1978–September 2015).

 Canada. **Equities:** S&P/TSX Composite Index (January 1990–September 2015). **International equities:** MSCI All Country World Index ex-Canada (January 1990–September 2015). **Bonds:** DEX Universe Bond Index (January 1990–September 2015). **International bonds:** Barclays Global Aggregate Hedged Index converted from USD to CAD (January 1990–January 1999), Barclays Global Aggregate Hedged Index CAD (February 1999–September 2015). **Cash:** DEX Capital 91-Day T-Bills (January 1990–September 2015).

 United Kingdom. **Equities:** FTSE All-Share Index (pounds) (January 1990–September 2015). **International equities:** MSCI All Country World Index ex-UK converted from USD to GBP (January 1990–April 2005), MSCI All Country World Index ex-UK (pounds) (May 2005–September 2015). **Bonds:** FTSE British Government Fixed All Maturity Index (January 1990–March 2004), FTSE Sterling Corporate All Maturity Index (April 2004–September 2015). **International bonds:** Barclays Global Aggregate Hedged Index (January 1990–December 2000), Barclays Global Aggregate ex-GBP Hedged Index (January 2001–September 2015). **Cash:** 3-Month Sterling LIBOR Rate (January 1990–September 2015).

 Australia. **Equities:** S&P/ASX 300 Index (January 1990–September 2015). **International equities:** MSCI World ex-Australia Index (January 1990–September 2015). **Property:** S&P/ASX 300 Property Index (January 1990–September 2015). **Bonds:** UBS Australian Composite Bond Index (January 1990–September 2015). **Cash:** UBS Australian Bank Bill Index (January 1990–September 2015).

 Japan. **Equities:** Tokyo Stock Price Index (January 1990–September 2015). **International equities:** MSCI World ex-Japan Index (January 1990–September 2015). **Bonds:** Citigroup World Government Bond Index Japan All Maturities (January 1990–September 2015). **International Bonds:** Citigroup Non-JPY World Government Bond Index (January 1990–September 2015). **Cash:** Bank of Japan 3-month uncollateralized interest rate (January 1990–September 2015).

Appendix. Empirical methodology

1. Estimation of policy allocation

The policy weightings, or asset allocation, for each fund were estimated by performing returns-based style analysis over each fund's rolling three-year history. Style analysis (Sharpe, 1988) is a statistical method for inferring a fund's effective asset mix by comparing the fund's returns with returns of asset-class benchmarks. Style analysis is a popular attribution technique because it does not require tabulating the actual asset allocation of each fund for each month over time. Rather, style analysis facilitates return attribution by regressing the return of the fund against the returns of asset-class benchmarks.* The following regression was estimated:

$$r_t^{fund} = \alpha + w_s r_t^{stock} + w_b r_t^{bond} + w_c r_t^{cash} + \varepsilon_t$$

For our purposes, style analysis required not only that the asset-class weight parameters sum to 1, but also that each asset-class weight be positive (no short sales).

* Additional asset-class benchmarks may be used for non-U.S. mutual fund markets, expanding the equation with the appropriate added terms.

2. Calculation of policy return

$$r_t^{policy} = w_s r_t^{stock} + w_b r_t^{bond} + w_c r_t^{cash} - \text{cost}$$

Cost is the approximate expense ratio, as a percentage of assets, of replicating the policy mix using indexed mutual funds. The policy portfolio was assumed to have a U.S. expense ratio of 1.5 bps per month (18 bps annually, or 0.18%) and a non-U.S. expense ratio of 2.0 bps per month (24 bps annually, or 0.24%).

Formula components

w_s = policy allocation attributed to stocks, ranges from 0 to 1

w_b = policy allocation attributed to bonds, ranges from 0 to 1

w_c = policy allocation attributed to cash, ranges from 0 to 1

r_t^{stock} = return on the equity benchmark in period t

r_t^{bond} = return on the bond benchmark in period t

r_t^{cash} = return on the cash benchmark in period t

α = excess return of the fund that cannnot be attributed to benchmark returns

$\varepsilon_{t,i}$ = residual that cannot be explained by the asset-class returns

r_t^{fund} = total return of the fund in period t

r_t^{policy} = total return of the policy in period t

r_i^{fund} = total return across funds

r_i^{policy} = total return across policies

β = sensitivity of changes in the fund return to changes in the policy return

N = total number of monthly net returns for each fund

3. Time-series regression of actual returns against policy returns

To compare variation in the policy and actual returns, we calculated an R^2 for each fund by regressing its actual return against its policy return:

$$r_t^{fund} = \alpha + \beta r_t^{policy} + \varepsilon_t$$

4. Cross-sectional regression of actual returns against policy returns

To compare variation in the policy and actual returns across different funds, we calculated an R^2 in a given month by regressing the actual returns against the policy returns for all funds in that month:

$$r_i^{fund} = \alpha + \beta r_i^{policy} + \varepsilon_i$$

5. Ratio of the cumulative policy return to the cumulative actual return

The policy return as a percentage of the actual return of each fund is the ratio of its cumulative policy return to its cumulative actual policy return. When cumulative policy return is greater than cumulative actual return, this ratio is greater than 100%.

$$\prod_{t=1}^{N} \frac{(1+r_t^{policy})}{(1+r_t^{fund})}$$

6. Ratio of policy volatility to actual volatility

The policy volatility as a percentage of the actual return volatility of each fund is the ratio of the standard deviation of the policy return to the standard deviation of the actual return. When policy return volatility is smaller than actual return volatility, this ratio is less than 100%.

$$\frac{\sqrt{\frac{1}{N-1}\sum_{t=1}^{N}\left[r_t^{policy} - \frac{1}{N}\sum_{t=1}^{N} r_t^{policy}\right]^2}}{\sqrt{\frac{1}{N-1}\sum_{t=1}^{N}\left[r_t^{fund} - \frac{1}{N}\sum_{t=1}^{N} r_t^{fund}\right]^2}}$$

Figure A-1. Fund characteristics for non-U.S. funds and U.S. funds

January 1990–September 2015

Canadian fund characteristics	All Canadian balanced funds	Funds with statistically significant positive alpha	Funds with statistically significant negative alpha	Funds with zero alpha
Risk and return (average across funds)				
Average annualized alpha	–0.50%	2.60%	–1.75%	–0.36%
Policy return as percentage of actual return	106%	82%	120%	103%
Policy volatility as percentage of actual volatility	92%	91%	95%	90%
Average fund characteristics				
Number of funds	303	30	94	179
Net assets ($ millions)	828	1,929	813	619
Expense ratio	1.83%	1.37%	2.15%	1.75%
Asset-weighted fund characteristics				
Total assets ($ millions)	187,124	52,090	85,420	49,613
Asset-weighted percentage of assets by category		28%	26%	46%
Asset-weighted expense ratio by category		1.31%	2.14%	1.83%

U.K. fund characteristics	All U.K. balanced funds	Funds with statistically significant positive alpha	Funds with statistically significant negative alpha	Funds with zero alpha
Risk and return (average across funds)				
Average annualized alpha	–0.84%	3.83%	–3.58%	–0.62%
Policy return as percentage of actual return	105%	75%	126%	103%
Policy volatility as percentage of actual volatility	93%	87%	95%	93%
Average fund characteristics				
Number of funds	743	23	92	628
Net assets ($ millions)	374	525	273	381
Expense ratio	1.66%	0.87%	2.08%	1.62%
Asset-weighted fund characteristics				
Total assets ($ millions)	199,523	11,543	16,365	171,615
Asset-weighted percentage of assets by category		6%	8%	86%
Asset-weighted expense ratio by category		NA	NA	NA

(Continued on page 18)

Figure A-1 *(Continued).* Fund characteristics for non-U.S. funds and U.S. funds

January 1990–September 2015

Australian fund characteristics	All Australian balanced funds	Funds with statistically significant positive alpha	Funds with statistically significant negative alpha	Funds with zero alpha
Risk and return (average across funds)				
Average annualized alpha	–0.78%	1.86%	–2.11%	–0.50%
Policy return as percentage of actual return	107%	87%	120%	105%
Policy volatility as percentage of actual volatility	82%	94%	92%	91%
Average fund characteristics				
Number of funds	580	22	135	423
Net assets ($ millions)	296	384	222	313
Expense ratio	1.31%	0.94%	1.90%	1.31%
Asset-weighted fund characteristics				
Total assets ($ millions)	97,247	6,525	17,089	73,634
Asset-weighted percentage of assets by category		7%	17%	76%
Asset-weighted expense ratio by category		0.85%	1.77%	1.12%

Japanese fund characteristics	All Japanese balanced funds	Funds with statistically significant positive alpha	Funds with statistically significant negative alpha	Funds with zero alpha
Risk and return (average across funds)				
Average annualized alpha	–1.65%	3.30%	–5.87%	–0.44%
Policy return as percentage of actual return	114%	82%	151%	103%
Policy volatility as percentage of actual volatility	95%	94%	92%	96%
Average fund characteristics				
Number of funds	406	7	95	304
Net assets ($ millions)	5,068	5,266	2,922	5,787
Expense ratio	1.46%	1.23%	1.53%	1.44%
Asset-weighted fund characteristics				
Total assets ($ millions)	1,763,750	36,861	251,318	1,475,571
Asset-weighted percentage of assets by category		2%	14%	84%
Asset-weighted expense ratio by category		1.28%	1.80%	1.48%

(Continued on page 19)

Figure A-1 *(Continued).* Fund characteristics for non-U.S. funds and U.S. funds

January 1962–September 2015

U.S. fund characteristics	All U.S. balanced funds	Funds with statistically significant positive alpha	Funds with statistically significant negative alpha	Funds with zero alpha
Risk and return (average across funds)				
Average annualized alpha	–1.46%	2.27%	-3.12%	–0.70%
Policy return as percentage of actual return	110%	69%	123%	105%
Policy volatility as percentage of actual volatility	96%	92%	98%	94%
Average fund characteristics				
Number of funds	725	30	264	431
Net assets ($ millions)	2,231	14,393	716	2,194
Expense ratio	1.15%	0.84%	1.22%	1.12%
Asset-weighted fund characteristics				
Total assets ($ millions)	1,046,133	374,219	145,281	526,633
Asset-weighted percentage of assets by category		36%	14%	50%
Asset-weighted expense ratio by category		0.62%	0.97%	0.67%

Notes: Funds with consistently positive (or negative) excess return (alpha) had statistically significant alpha using a 95% one-sided t-test for statistical significance. Average fund and total fund characteristics are calculated from funds that reported expense ratio, net assets, and turnover: Canada—278, 303, and 303, respectively; United Kingdom—293, 538, and 488; Australia—531, 329, and 6; Japan—406, 348, and 0; and the United States—717, 469, and 715.

NA = not available (insufficient data to provide an accurate metric).

Sources: Vanguard calculations, using data from Thomson Reuters Datastream and Morningstar, Inc.

Figure A-2. Summary of equity tax implications by country

	United States	Canada	United Kingdom	Australia	Japan
Capital gains	Capital gains on foreign securities are taxed at U.S. rates.	Capital gains on foreign securities are taxed at Canadian rates.	Capital gains on foreign securities are taxed at U.K. rates.	Complex system, but capital gains on foreign securities are taxed at Australian rates.	Capital gains on foreign securities are taxed at Japanese rates.
Dividends	Tax treaties with many countries allow foreign dividends to be taxed at U.S. rates, but taxes are to be withheld at the foreign tax rate.	Domestic dividends receive favorable tax treatment through a tax credit up to a limited annual amount of dividend income. Foreign dividends are taxed at domestic personal tax rates.	Domestic dividends are taxed under a dividend imputation system. Investors pay taxes on dividend income above the tax-free dividend allowance. For foreign dividends, tax treaties with many countries prevent double taxation, but the domestic personal tax rate applies.	Imputation system is similar to the United Kingdom's. Investors can receive "franking credits" for the amount of tax paid by the domestic company and can receive a refund if the corporate tax exceeds the personal rate. For foreign dividends, tax treaties with many countries prevent double taxation, but the domestic personal tax rate applies.	Dividends on listed shares received through a Japanese paying agent are taxed at a reduced rate. Dividends on unlisted shares or not paid through a Japanese paying agent are taxed at a higher rate.
Transaction/stamp tax on securities	No.	No.	Yes—0.5% on securities purchased domestically. Favors international assets, depending on frequency of transactions.	No.	No.
Overall impact	Neutral.	Favors domestic assets, depending on amount of dividend income and marginal income tax rate.	Depends on amount of dividend income (favors domestic assets with higher dividend income) and frequency of transactions (favors international assets with higher number of transactions).	Favors domestic assets, depending on amount of dividend income and marginal income tax rate.	Neutral, as long as foreign securities are purchased and sold through a Japanese agent.

Source: Vanguard.

Notes: The summary presented herein does not constitute tax advice. We recommend that you consult a financial or tax advisor about your individual situation.