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Building a global core-satellite portfolio

Vanguard research

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Executive summary. The core-satellite approach to portfolio construction is a methodology used to combine actively managed funds with index funds in a single portfolio. The appeal of this approach is that it seeks to establish a risk-controlled portfolio while also securing some prospects of outperformance. The conventional view of the core-satellite methodology suggests it is prudent to use index funds for markets that are deemed efficient and to use active managers in areas considered to be inefficient, where the managers are presumed more likely to succeed. At Vanguard, we hold an alternative view of the core-satellite approach to portfolio construction. We conclude that indexing is a powerful strategy in all segments of the market, and that the active/index decision should therefore be predicated on an investor's ability to identify low-cost, talented managers, and not on the indiscriminate selection of active managers in market areas perceived to be inefficient.

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This paper reviews Vanguard’s interpretation of the core-satellite methodology and summarizes original analysis we conducted to quantify a reasonable active/index allocation for individuals with differing investing skill levels. Our analysis, which evaluated the 20 years ended December 31, 2009, reached the following conclusions:

- **Talent trumps location.** An investor’s skill level in identifying managers, not the fund’s asset-class location, is the most crucial factor in constructing a core-satellite portfolio. The process is not about simply investing in active funds in inefficient markets but about identifying low-cost talented managers wherever they may be.
- **Indexing is valuable for all investors.** Regardless of an investor’s skill level, indexing is a valuable starting point for all portfolios. In fact, over the time period we examined, practically all investors in this study would have benefited from having a *majority* of their portfolio in a market index. This reflects the significant interrelationship between risk and return. Investors should expect to be compensated for taking market risk; therefore, it is not only the level of return that matters, but, more important, the level of return per unit of risk.
- **Similar results apply globally.** These conclusions hold true across all equity markets examined in this study—the United States, the United Kingdom, and Australia.

Core-satellite methodology

The conventional view

Conventional wisdom often suggests that indexing works best in the most efficient segments of the market and that active management works best in the inefficient market segments. Such an approach assumes that in the most efficient markets, information is readily available, thus allowing securities to be effectively priced by all market participants in quick order and offering little opportunity to outperform. On the other hand, it is further assumed that, in inefficient markets, information is less readily available and that, as a result, greater opportunities exist for individual managers to outperform their market benchmarks. This leads many practitioners to conclude that the relatively more efficient large-capitalization portion of their portfolios should be indexed while the less efficient market areas, such as small-cap or emerging markets, are better served with active strategies. (See Figure 1.)

Some key terms

Alpha. A portfolio’s risk-adjusted excess return versus its effective benchmark.

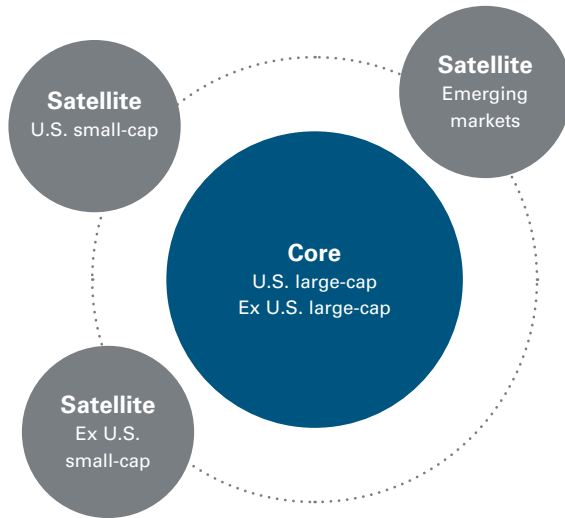
Beta. A measure of the volatility of a security or a portfolio relative to a benchmark.

Notes on risk: All investments are subject to risk. Past performance is no guarantee of future returns. The performance of an index is not an exact representation of any particular investment, as you cannot invest directly in an index. Diversification does not ensure a profit or protect against a loss in a declining market. Foreign investing involves additional risks, including currency fluctuations and political uncertainty. Stocks of companies in emerging markets are generally more risky than stocks of companies in developed countries. Prices of mid- and small-cap stocks often fluctuate more than those of large-company stocks.

Investment returns will fluctuate. Investments in bond funds and ETFs are subject to interest rate, credit, and inflation risk. ETF shares can be bought and sold only through a broker (who will charge a commission) and cannot be redeemed with the issuing fund. The market price of ETF shares may be more or less than net asset value.

Figure 1.

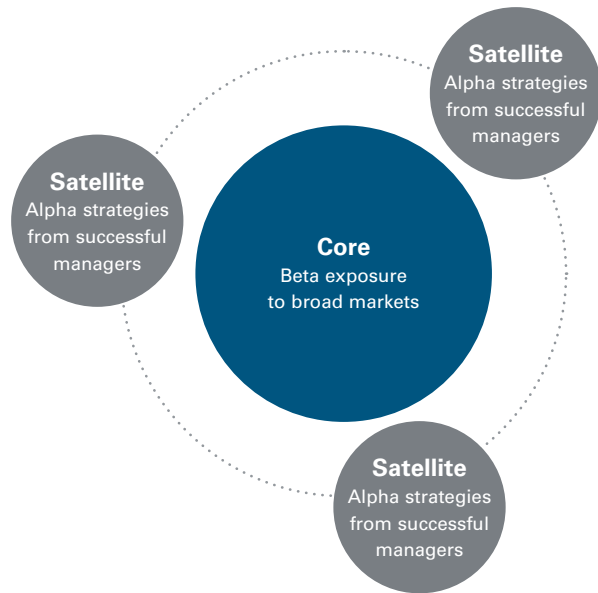
Traditional view of core-satellite portfolio construction based on degree of market efficiency



Source: Vanguard.

Figure 2.

Alternative view of core-satellite portfolio construction based on manager skill level



Source: Vanguard.

An alternative view

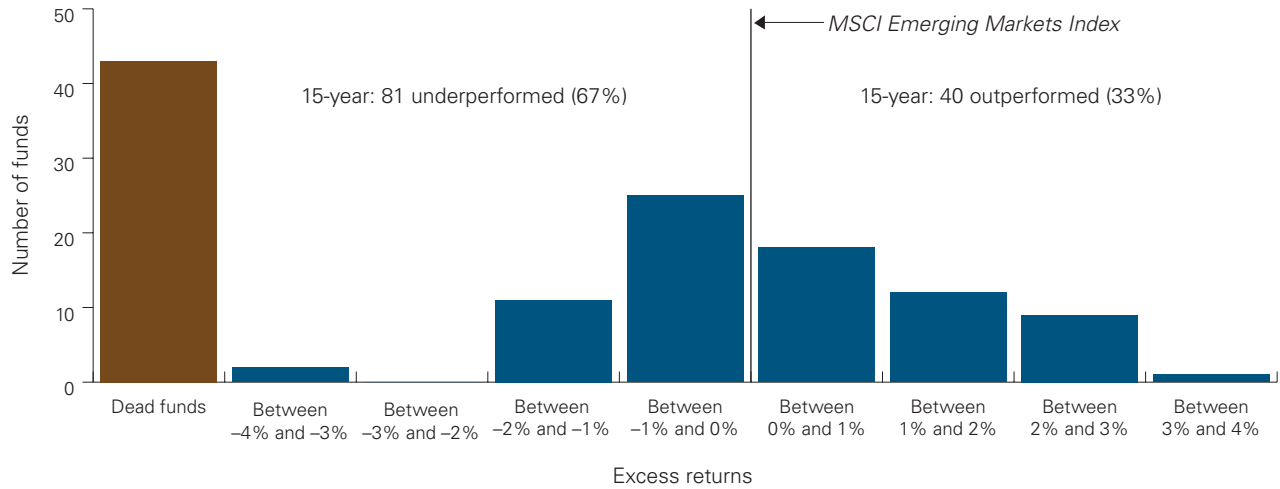
Vanguard subscribes to an alternative view of the core-satellite framework. We hold that the active/index decision should be based on an investor's ability to identify low-cost, expert managers, rather than on the location of a specific market segment. We conclude that although indexing has historically outperformed active management in aggregate over the long run, there may be some active managers who will outperform in all market segments. And although the dispersion in performance among managers within different market segments can vary widely, overall the *zero-sum* construct (see the description following) holds in each. (See Figure 2.) Talented managers, at a reasonable cost, regardless of the market segment, are by definition more likely to add value to a portfolio than other active managers selected indiscriminately from a presumably inefficient market.

The foundation of zero-sum investing is powerful. The concept of the zero-sum game begins with the assertion that at any point in time, the holdings in a particular market aggregate to form the market. Since all invested dollars are represented in these holdings, every dollar that outperforms the market has to be accompanied by a dollar that underperforms the market, to collectively form the market return (Sharpe, 1991). This, of course, assumes there are no fees and expenses. When expenses are accounted for, less than half of the market's invested dollars can outperform the market. The zero-sum concept has merit in all markets.¹

¹ For a more complete discussion of the zero-sum game, refer to Philips (2010a), for the U.S. market; and Marshall, Bhatia, and Wallick (2010), for the Australian market.

Figure 3. Active emerging market fund performance relative to MSCI Emerging Markets Index

Annualized excess returns, 1995–2009



Notes: To calculate the impact of survivor bias, all share classes were counted. All returns are for the 15 year period ended December 31, 2009. Dead funds are presumed to have underperformed; however, the extent to which they underperformed is unknown. Sample included 121 funds, all domiciled in the United States. U.S. domiciled funds were used due to an inadequate sample of UK domiciled funds that had targeted Emerging Market exposure.

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

Our research on the performance of mutual fund managers (a subset of all investors) is reflective of the zero-sum rule, even though zero-sum need not apply among a subset of the investors in a market. We found that, over the long run, index investing has outperformed a majority of actively managed funds in markets considered inefficient. Among emerging market equity funds domiciled in the United States, we found that of the 121 funds in existence as of December 31, 1994, only 33%, or 40 funds, survived and outperformed the index over the subsequent 15 years. A total of 67%, or 81 funds, either underperformed the benchmark or failed to survive the 15 years. These findings are illustrated in **Figure 3**.

The findings were similar for U.S. small-capitalization funds; of the 236 funds that began the period, 75 funds (32%) survived and outperformed their benchmark over the subsequent 20 years ended December 31, 2009. A total of 161 funds (68%) failed to outperform their benchmark or survive the entire period.² Again, our analysis concluded that most active managers will fail to outperform their respective benchmarks even in areas traditionally considered inefficient.

2 To calculate the impact of survivor bias, all share classes were counted. All returns (annualized) are for the 20 years ended December 31, 2009. The sample included 236 funds. Dead funds are presumed to have underperformed; however, the extent to which they underperformed is unknown. Equity indexes were represented by the following indexes: Small-cap blend: S&P SmallCap 600 Index, December 31, 1989, through November 2002 and MSCI US Small Cap 1750 Index thereafter; Small-cap value: S&P SmallCap 600 Value Index, December 31, 1989, through November 2002 and MSCI US Small Cap 1750 Value Index thereafter; Small-cap growth: S&P SmallCap 600 Growth Index, December 31, 1989, through November 2002 and MSCI US Small Cap 1750 Growth Index thereafter. (Sources: Vanguard calculations, using data from Morningstar, Inc., MSCI, and Standard & Poor's.)

Despite these calculations, the perception of inefficient markets lingers for many investors. To some extent, this may be the residual impact of ineffective benchmarking. In the past, the way in which certain benchmarks were constructed seems to have contributed to the appearance of consistent outperformance in a few market segments, most notably among small-cap equities. However, Davis, Kinniry, and Sheay's 2007 analysis effectively put an end to these misperceptions by pointing out that when the proper benchmark is considered, the perception of outperformance falls away substantially.

What is the right active/index mix in a portfolio?

How can an investor reconcile a desire to prudently include active management in his or her portfolio with evidence suggesting that a majority of managers will underperform, and that those who do succeed will not do so with a high degree of consistency? Or, in other words, what is the right mix of active and index funds in a portfolio? To answer this question, we conducted a four-step optimization exercise (see **Figure 4**, on page 7), reviewing fund performance in the United States, the United Kingdom, and Australia.³ For each of these markets, we filtered

country data using an ex post facto assessment of investors' skill levels—neutral, partial, perfect, or perfect but unlucky. We defined *neutral skill* as the absence of any positive or negative selection aptitude, effectively a random draw. We defined *partial skill* as the ability to identify managers who will survive regardless of performance. *Perfect skill* was the ability to identify those funds that will survive over time and outperform the broad market. And *perfect but unlucky skill* was the ability to identify those funds that will survive and outperform but which have a higher volatility than the market. This process resulted in our analyzing 12 separate pools of funds (i.e., three countries times four skill levels).

After quantifying these different skill levels for the 20-year period ended 2009, we found that the likelihood of an investor selecting an active portfolio that survived the period, without regard to performance (partial skill), was about 11% and that the probability of an investor's selecting a surviving active portfolio that outperformed the market index for the period (perfect skill) was approximately 5%, or 1 out of every 20 investors. After further segmenting the investor group with perfect skill, approximately 3% of the investor population fell into the perfect but unlucky skill category.

³ Using Morningstar mutual fund data, we reviewed the longest possible history for a meaningful quantity of funds. For the United States, this resulted in a 20-year time frame, while for the United Kingdom and Australia, the result was a 10-year time frame.

Methodology

Step One: For each individual skill level, we identified every possible combination of three active funds in our datasets.⁴ This exercise imposed no constraints on which funds could be chosen to make up the active portfolio—it was a random selection process. In certain cases, the three underlying active funds all came from the same market segment; in other instances, each underlying fund represented a different market segment.⁵ In the United States this process produced 79.7 million possible active fund portfolios; in the United Kingdom, 30.2 million possible active portfolios; and in Australia, 1.9 million possible active portfolios.⁶

Step Two: A uniquely shaped efficient frontier was created for each active portfolio, with every combination of the active portfolio and the market index examined in 1% increments, starting with a 100% active portfolio and ending with a 100% index portfolio. To the extent that an individual fund did not survive the full period in question, we assumed the investor realized a spliced return, receiving the active fund's return for the period the fund existed and reported results to the database and the market index return for the remainder of the period. For funds domiciled in the United States, this resulted in a total of 8 billion distinct portfolios; for the United Kingdom, 3 billion distinct portfolios; and for Australia, 189 million distinct portfolios.⁷

Step Three: We identified the optimal active/index allocation for each frontier by generating a capital allocation line, which intersected the vertical axis at the risk-free rate and had a slope equal to 0.5 at the point of tangency on the frontier, which corresponds to the average investor's risk tolerance. It is important to note that utilizing a steeper slope would be indicative of an investor who is more risk-averse and therefore willing to accept less risk per unit of return, which would generally translate to a lower active allocation in the quantitative exercise. Conversely, if a flatter slope had been used, this would be indicative of an investor who is less risk-averse and therefore willing to accept more risk per unit of return. This scenario would generally translate to a higher active allocation in the quantitative exercise.

Step Four: The active/index allocations of each optimal portfolio were aggregated into a distribution for each skill level, from which the median active/index allocation was identified.

4 We also examined several other combinations of underlying active funds as the basis for an active portfolio and found the relative impact on overall results of other combinations beyond three funds to be inconsequential.

5 Some investors may prefer to maintain a portfolio in a market-proportional framework to avoid systematic bets against certain market segments (e.g., small-cap or value). Other investors may be willing to deviate from a market-proportional framework to take systematic bets because they have strong convictions about managers in certain market segments. In interpreting these results, it is important to understand that if an investor has a strong preference for maintaining a market-proportional framework, the optimal portfolios would favor indexing to a greater extent for all skill levels, because the active portfolio would be constrained to the market weights of the underlying funds. Deviating from a market-cap framework allows for a larger active allocation but may increase a portfolio's tracking error versus a market index, for better or worse. On the other hand, maintaining a market-cap proportional portfolio may reduce the portfolio's tracking error, but may also limit the potential active exposure.

6 We evaluated the available diversified active equity funds included in Morningstar categories of large-, mid-, and small-cap. The resulting sample comprised 783 U.S.-domiciled funds for the 20 years ended December 31, 2009; 567 U.K.-domiciled funds for the 10 years ended December 31, 2009; and 225 Australia-domiciled funds for the 10 years ended December 31, 2009.

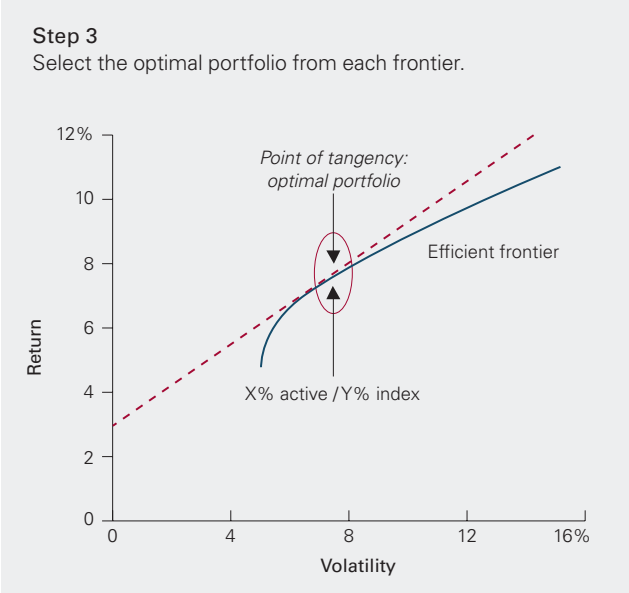
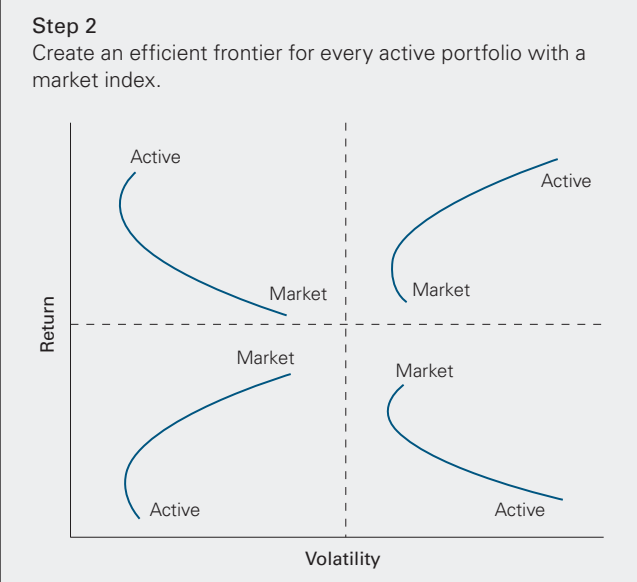
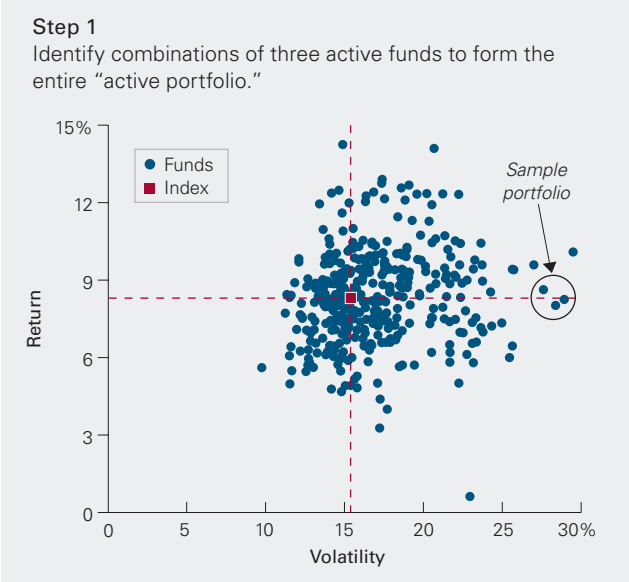
7 Each active portfolio was combined with index funds in 1% increments to form active/index portfolios. This led to the creation of 101 unique active/index combinations for each active portfolio. As an example, combining 79.7 million active fund portfolios with index funds would yield 8.05 billion portfolios (79.7 million x 101 = 8.05 billion).

Figure 4. Process map for quantitative exercise

Identifying investor skill level

| Neutral skill | Partial skill | Perfect skill | Perfect but unlucky skill |
|-------------------------|------------------------------------------------------|------------------------------------------------------|-----------------------------------------------------------------------------|
| Select funds at random. | Ability to select funds that survive for the period. | Ability to select funds that survive and outperform. | Ability to select funds that survive and outperform with higher volatility. |
| 100% of investors | Top 11% of investors | Top 5% of investors | About 3% of investors |

Optimization process for each skill level

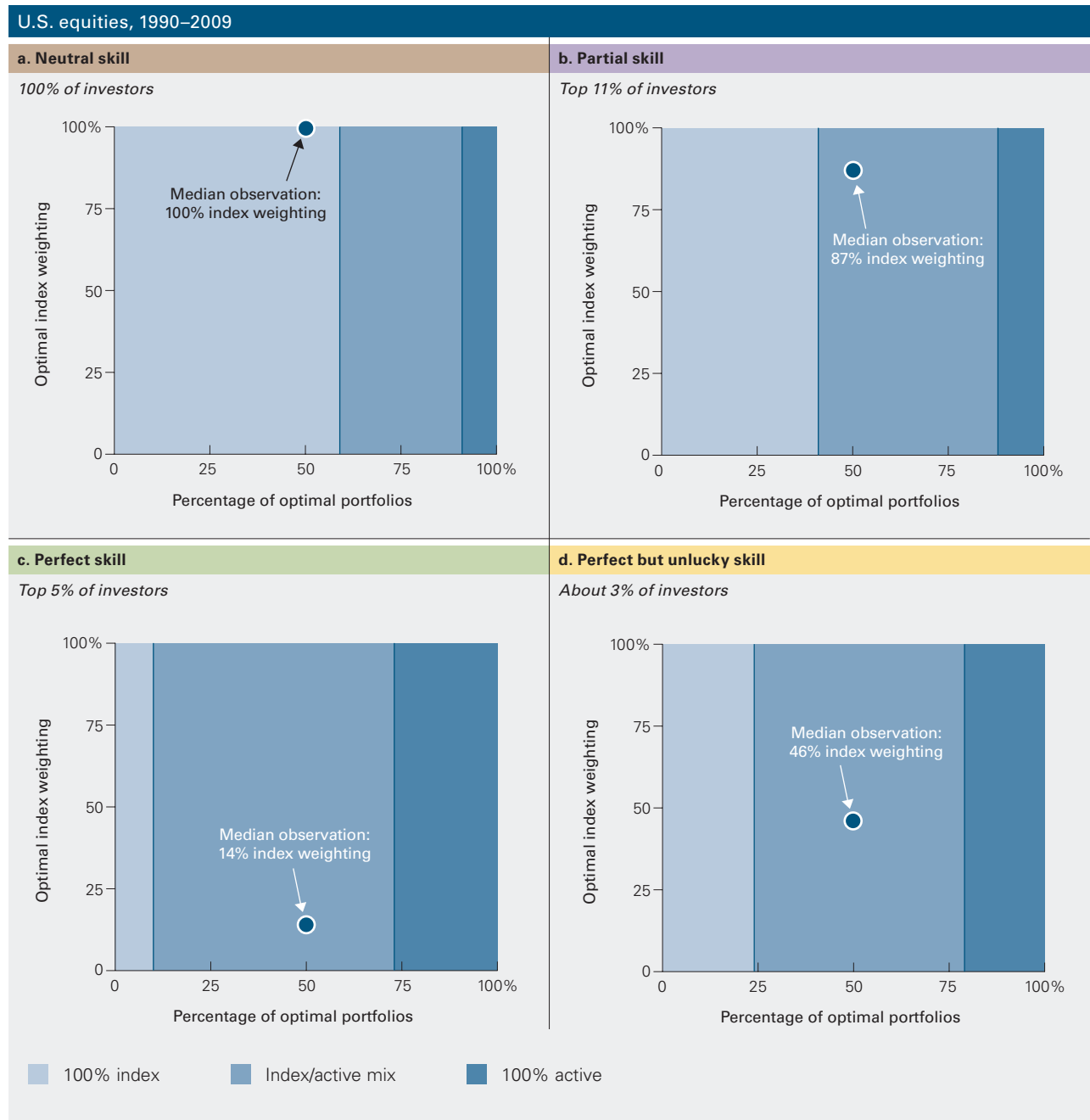


Step 4
Aggregate the results of all optimal portfolios. Shown below is the U.S. equity market.

| | Median portfolio index exposure | Percentage of optimal portfolios | | |
|---------------------------|---------------------------------|----------------------------------|------------------|-------------|
| | | 100% index | Index and active | 100% active |
| Neutral skill | 100% | 64% | 30% | 6% |
| Partial skill | 100 | 54 | 38 | 8 |
| Perfect skill | 19 | 9 | 69 | 22 |
| Perfect but unlucky skill | 57 | 29 | 57 | 14 |

Notes: Neutral skill level includes the entire investor population. All other skill levels are subsets of the total investor population. For the entire analysis, the U.S. equity market was represented by the Dow Jones Wilshire 5000 Index from December 31, 1989, through April 22, 2005, and the MSCI US Broad Market Index thereafter. Source: Vanguard.

Figure 5. Results of quantitative exercise: Optimal index weightings by skill level



Note: For the entire analysis, the U.S. equity market was represented by the Dow Jones Wilshire 5000 Index from December 31, 1989, through April 22, 2005, and the MSCI US Broad Market Index thereafter.

Source: Vanguard.

United States results

We began by looking at investors in the United States with the perfect ability to select managers, or the top 5% of all investors. Our analysis concluded that even investors with substantial foresight with respect to manager performance benefited from having indexing as part of their portfolio in the vast majority of cases. For the 20-year period (December 31, 1989, through December 31, 2009), it would have been optimal for these investors to hold only active funds 22% of the time; 69% of the time, these investors would be best served holding a mix of index and active funds; and 9% of the time they would be better off holding only index funds. In fact, the median index allocation for an investor with perfect skill for the time period was a surprising 19%. (See **Figure 5**.)

Not surprisingly, as we moved down the skill gradient, indexing played a larger role in the median portfolios. Overall, perfect but unlucky investors (about 3% of all investors) would have benefited from some index exposure in their portfolio 86% of the time. In fact, it would have made sense to hold only active funds 14% of the time; a mix of active and indexed funds 57% of the time; and purely index funds 29% of the time. Furthermore, the median index exposure was notably high, at 57%.

For investors with partial skill (the top 11% of investors) and investors with neutral skill (all investors), the results were even more dramatic, as the median portfolio for both investor groups was composed 100% of index funds. A majority of the time, those investors would have been better off avoiding active management entirely and using a completely indexed portfolio, as opposed to attempting to select successful active managers.

Global findings

Our findings for the United Kingdom and Australia were proportionately much the same as for the United States: The proper amount of active management in an investor's portfolio was driven by the skill he or she possessed in identifying manager talent at low cost. A greater ability to select talented managers warranted a greater allocation to active management. But in all cases for the ten-year period (December 31, 1999, through December 31, 2009), all of the investors benefited from using index funds for a significant portion of their portfolio. (See **Figure 6**.)⁸

Figure 6. Median active/index exposure by skill level

| Ability | Optimal index weighting (%) | | |
|---------------------------|-----------------------------|--------------------|-------------------------|
| | U.S. (20 years) | U.K. (10 years) | Australia (10 years) |
| Neutral skill | 100% | 100% | 100% |
| Partial skill | 100 | 87 | 84 |
| Perfect skill | 19 | 14 | 11 |
| Perfect but unlucky skill | 57 | 46 | 51 |

Notes: For the U.S. market, our analysis covered the period December 31, 1989, through December 31, 2009; for the U.K. and Australian markets, our analysis covered the period December 31, 1999, through December 31, 2009. We also conducted a similar analysis for the 5-, 10-, and 15-year periods ended 2009; the results yielded conclusions similar to those of the time periods shown in this figure across all three markets. The median active/index allocation was reflective of investors' ability to select outperforming managers.

Source: Vanguard.

It is important to note that these results reflect the outcomes of specific, and limited, time periods, and it would therefore be misleading to draw specific levels of precision from the figures. However, in general, we conclude that on a median basis, all investors would have benefited from having indexing as part of their portfolio, and that the 95% of investors with less than perfect skill would have benefited from having a majority of their portfolios in a market index.

⁸ For more detailed, quantitative results of our U.K. and Australia analyses, please refer to **Figures A-1 and A-2**, in the appendix, on page 11.

Conclusion

The basic tenets of the core-satellite methodology are that an investor must initially select a strategic asset allocation commensurate with his or her investment objectives using beta-based investments (i.e., index funds or exchange-traded funds [ETFs]), then selectively add actively managed funds as appropriate, in order to add positive alpha to the baseline portfolio. The results of our quantitative analysis reinforce three key findings for investors looking to employ a core-satellite approach in global portfolio construction.

- It is investor skill in selecting managers, not the ability to isolate particular segments of the market deemed inefficient, that drives the success of a core-satellite portfolio. An investor's ability to identify low-cost, successful managers should determine the portfolio's active weighting.
- Given the favorable risk–return characteristics of index funds, all investors benefit from having index funds in their portfolio. Unless an investor has perfect skill—the ability to select funds that survive and outperform—the investor is better off with a majority of his or her portfolio in index funds.
- When constructing a diversified portfolio, an investor should begin using a broad-market index fund and then consider substituting active funds for index funds to the extent the investor has conviction in particular managers.

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Appendix

Figure A-1. Quantitative results for U.K. market

| | Median portfolio index exposure | Percentage of optimal portfolios | | |
|---------------------------|---------------------------------|----------------------------------|------------------|-------------|
| | | 100% index | Index and active | 100% active |
| Neutral skill | 100% | 59% | 32% | 9% |
| Partial skill | 87 | 41 | 47 | 12 |
| Perfect skill | 14 | 10 | 63 | 27 |
| Perfect but unlucky skill | 46 | 24 | 55 | 21 |

Note: Analysis for the U.K. market covered the ten-year period ended December 31, 2009, as represented by the FTSE All-Share Index, and included 567 U.K.-domiciled funds.

Source: Vanguard.

Figure A-2. Quantitative results for Australian market

| | Median portfolio index exposure | Percentage of optimal portfolios | | |
|---------------------------|---------------------------------|----------------------------------|------------------|-------------|
| | | 100% index | Index and active | 100% active |
| Neutral skill | 100% | 55% | 39% | 6% |
| Partial skill | 84 | 47 | 44 | 9 |
| Perfect skill | 11 | 7 | 63 | 30 |
| Perfect but unlucky skill | 51 | 19 | 64 | 17 |

Note: Analysis for the Australian market covered the ten-year period ended December 31, 2009, as represented by the S&P/ASX 300 Index, and included 225 Australia-domiciled funds.

Source: Vanguard.



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