



The case for low-cost index-fund investing

Vanguard Research

April 2018

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- Due to governmental regulatory changes, the introduction of exchange-traded funds (ETFs), and a growing awareness of the benefits of low-cost investing, the growth of index investing has become a global trend over the last several years, with a large and growing investor base.
- This paper discusses why we expect index investing to continue to be successful over the long term—a rationale grounded in the zero-sum game, the effect of costs, and the challenge of obtaining persistent outperformance.
- We examine how indexing performs in a variety of circumstances, including diverse time periods and market cycles, and we provide investors with points to consider when evaluating different investment strategies.

Acknowledgments: The authors thank Garrett L. Harbron and Daren R. Roberts of Vanguard's Investment Strategy Group for their valuable contributions. This paper is a revision of Vanguard research first published in 2004 as *The Case for Indexing* by Nelson Wicas and Christopher B. Philips, updated in succeeding years by Mr. Philips and other co-authors. The current authors acknowledge and thank Mr. Philips and Francis M. Kinniry Jr. for their extensive contributions and original research on this topic.

Index investing¹ was first made broadly available to U.S. investors with the launch of the first index mutual fund in 1976. Since then, low-cost index investing has proven to be a successful investment strategy over the long term, outperforming the majority of active managers across markets and asset styles (S&P Dow Jones Indices, 2015). In part because of this long-term outperformance, index investing has seen exponential growth among investors, particularly in the United States, and especially since the global financial crisis of 2007–2009. In recent years, governmental regulatory changes, the introduction of indexed ETFs, and a growing awareness of the benefits of low-cost investing in multiple world markets have made index investing a global trend. This paper reviews the conceptual and theoretical underpinnings of index investing’s ascendancy (along with supporting quantitative data) and discusses why we expect index investing to continue to be successful and to increase in popularity in the foreseeable future.

A market-capitalization-weighted indexed investment strategy—via a mutual fund or an ETF, for example—seeks to track the returns of a market or market

segment with minimal expected deviations (and, by extension, no positive excess return) before costs, by assembling a portfolio that invests in the securities, or a sampling of the securities, that compose the market. In contrast, actively managed funds seek to achieve a return or risk level that differs from that of a market-cap-weighted benchmark. Any strategy, in fact, that aims to differentiate itself from a market-cap-weighted benchmark (e.g., “alternative indexing,” “smart beta” or “factor strategies”) is, in our view, active management and should be evaluated based on the success of the differentiation.²

This paper presents the case for low-cost index-fund investing by reviewing the main drivers of its efficacy. These include the zero-sum game theory, the effect of costs, and the difficulty of finding persistent outperformance among active managers. In addition, we review circumstances under which this case may appear less or more compelling than theory would suggest, and we provide suggestions for selecting an active manager for investors who still prefer active management or for whom no viable low-cost indexed option is available.

Notes on risk

Notes about risk and performance data: Investments are subject to market risk, including the possible loss of the money you invest. Past performance is no guarantee of future returns. Bond funds are subject to the risk that an issuer will fail to make payments on time, and that bond prices will decline because of rising interest rates or negative perceptions of an issuer’s ability to make payments. Investments in stocks issued by non-U.S. companies are subject to risks including country/regional risk, which is the chance that political upheaval, financial troubles, or natural disasters will adversely affect the value of securities issued by companies in foreign countries or regions; and currency risk, which is the chance that the value of a foreign investment, measured in U.S. dollars, will decrease because of unfavorable changes in currency exchange rates. Stocks of companies based in emerging markets are subject to national and regional political and economic risks and to the risk of currency fluctuations. These risks are especially high in emerging markets.

Funds that concentrate on a relatively narrow market sector face the risk of higher share-price volatility. Prices of mid- and small-cap stocks often fluctuate more than those of large-company stocks. U.S. government backing of Treasury or agency securities applies only to the underlying securities and does not prevent share-price fluctuations. Because high-yield bonds are considered speculative, investors should be prepared to assume a substantially greater level of credit risk than with other types of bonds. Diversification does not ensure a profit or protect against a loss in a declining market. Performance data shown represent past performance, which is not a guarantee of future results. Note that hypothetical illustrations are not exact representations of any particular investment, as you cannot invest directly in an index or fund-group average.

¹ Throughout this paper, we use the term *index investing* to refer to a passive, broadly diversified, market-capitalization-weighted strategy. Also for purposes of this discussion, we consider any strategy that is not market-cap-weighted to be an active strategy.

² See Pappas and Dickson (2015), for an introduction to factor strategies. Chow et al. (2011) explained how various alternatively weighted index strategies outperformed market-cap-weighted strategies largely on the basis of factors.

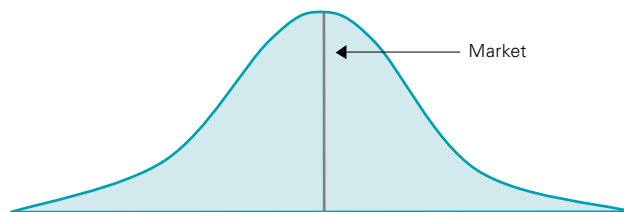
Zero-sum game theory

The central concept underlying the case for index-fund investing is that of the zero-sum game. This theory states that, at any given time, the market consists of the cumulative holdings of all investors, and that the aggregate market return is equal to the asset-weighted return of all market participants. Since the market return represents the average return of all investors, for each position that outperforms the market, there must be a position that underperforms the market by the same amount, such that, in aggregate, the excess return of all invested assets equals zero.³ Note that this concept does not depend on any degree of market efficiency; the zero-sum game applies to markets thought to be less efficient (such as small-cap and emerging market equities) as readily as to those widely regarded as efficient (Waring and Siegel, 2005).

Figure 1 illustrates the concept of the zero-sum game. The returns of the holdings in a market form a bell curve, with a distribution of returns around the mean, which is the market return.

It may seem counterintuitive that the zero-sum game would apply in inefficient markets, because, by definition, an inefficient market will have more price and informational inefficiencies and, therefore, more opportunities for outperformance. Although this may be true to a certain extent, it is important to remember that for every profitable trade an investor makes, (an)other investor(s) must take the opposite side of that trade and incur an equal loss. This holds true regardless of whether the security in question is mispriced or not. For the same reason, the zero-sum game must apply regardless of market direction, including bear markets, where active management is often thought to have an advantage. In a bear market, if a manager is selling out of an investment to position the portfolio

Figure 1. Market participants' asset-weighted returns form a bell curve around market's return



Source: Vanguard.

more defensively, another or others must take the other side of that trade, and the zero-sum game still applies. The same logic applies in any other market, as well.

Some investors may still find active management appealing, as it seemingly would provide an even-odds chance of successfully outperforming. As we discuss in the next section, though, the costs of investing make outperforming the market significantly more difficult than the gross-return distribution would imply.

Effect of costs

The zero-sum game discussed here describes a theoretical cost-free market. In reality, however, investors are subject to costs to participate in the market. These costs include management fees, bid-ask spreads, administrative costs, commissions, market impact, and, where applicable, taxes—all of which can be significant and reduce investors' net returns over time. The aggregate result of these costs shifts the return distribution to the left.

³ See Sharpe (1991) for a discussion of the zero-sum game.

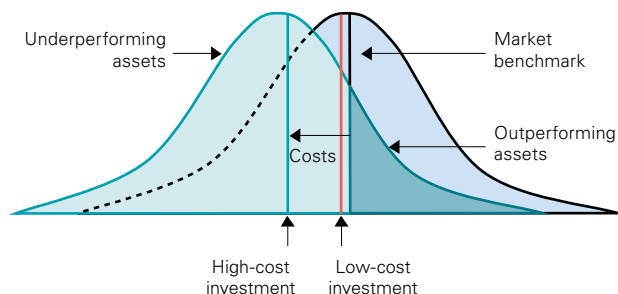
Figure 2 shows two different investments compared to the market. The first investment is an investment with low costs, represented by the red line. The second investment is a high-cost investment, represented by the blue line. As the figure shows, although both investments move the return curve to the left—meaning fewer assets outperform—the high-cost investment moves the return curve much farther to the left, making outperformance relative to both the market and the low-cost investment much less likely. In other words, after accounting for costs, the aggregate performance of investors is less than zero sum, and as costs increase, the performance deficit becomes larger.

This performance deficit also changes the risk–return calculus of those seeking to outperform the market. We previously noted that an investor may find active management attractive because it theoretically provides an even chance at outperforming the market. Once we account for costs, however, underperformance becomes more likely than outperformance. As costs increase, both the odds and magnitude of underperformance increase until significant underperformance becomes as likely as, or more likely than, even minor outperformance.

Figure 3 illustrates the zero-sum game on an after-cost basis by showing the distribution of excess returns of domestic equity funds (Figure 3a) and fixed income funds (Figure 3b), net of fees. Note that for both asset classes, a significant number of funds’ returns lie to the left of the prospectus benchmark, which represents zero excess returns. Once merged and liquidated funds are considered, a clear majority of funds fail to outperform their benchmarks, meaning that negative excess returns tend to be more common than positive excess returns.⁴ Thus, as predicted by the zero-sum game theory, outperformance tends to be less likely than underperformance, once costs are considered.

This raises the question of how investors can reduce the chances of underperforming their benchmark. Considerable evidence supports the view that the odds of outperforming a majority of similar investors increase if investors simply seek the lowest possible cost for a given strategy. For

Figure 2. Market participant returns after adjusting for costs



Source: Vanguard.

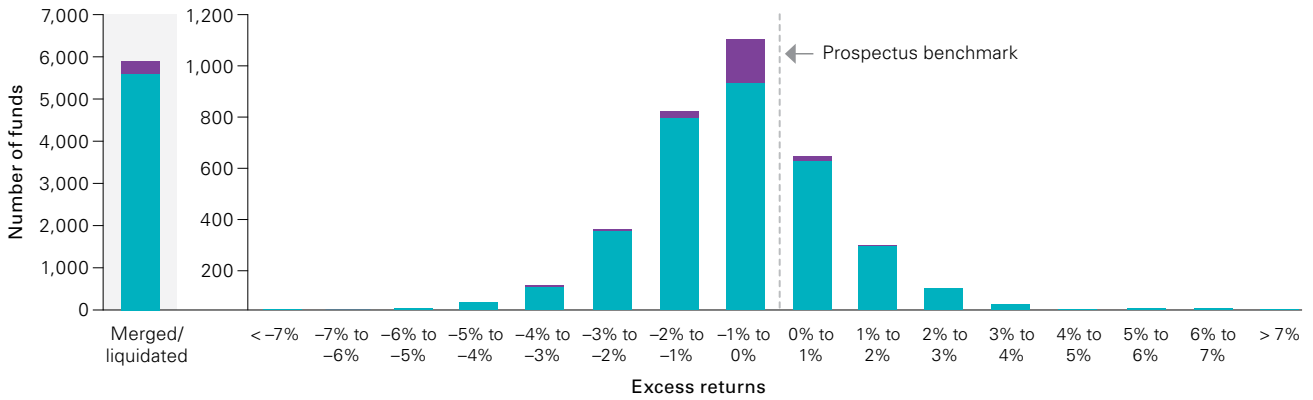
example, Financial Research Corporation (2002) evaluated the predictive value of different fund metrics, including a fund’s past performance, Morningstar rating, alpha, and beta. In the study, a fund’s expense ratio was the most reliable predictor of its future performance, with low-cost funds delivering above-average performance relative to the funds in their peer group in all of the periods examined. Likewise, Morningstar performed a similar analysis across its universe of funds and found that, regardless of fund type, low expense ratios were the best predictors of future relative outperformance (Kinnel, 2010).

This negative correlation between costs and excess return is not unique to active managers. Rowley and Kwon (2015) looked at several variables across index funds and ETFs, including expense ratio, turnover, tracking error, assets under management, weighting methodology, and active share, and found that expense ratio was the most dominant variable in explaining an index fund’s excess return.

⁴ Survivorship bias and the effect of merged and closed funds on performance are discussed in more detail later in this paper.

Figure 3. Distribution of equity and fixed income funds' excess return

a. Distribution of equity funds' excess return



b. Distribution of fixed income funds' excess return



Note: Past performance is no guarantee of future results. Charts a. and b. display distribution of funds' excess returns relative to their prospectus benchmarks, for the 15 years ended December 31, 2017. Our survivor bias calculation treats all dead funds as underperformers. It's possible, of course, that some of those funds outperformed the relevant index before they died. If we splice fund category average returns onto the records of dead funds, we see a modest decline in the percentage of funds that trail the index. The differences from our existing calculations are not material.

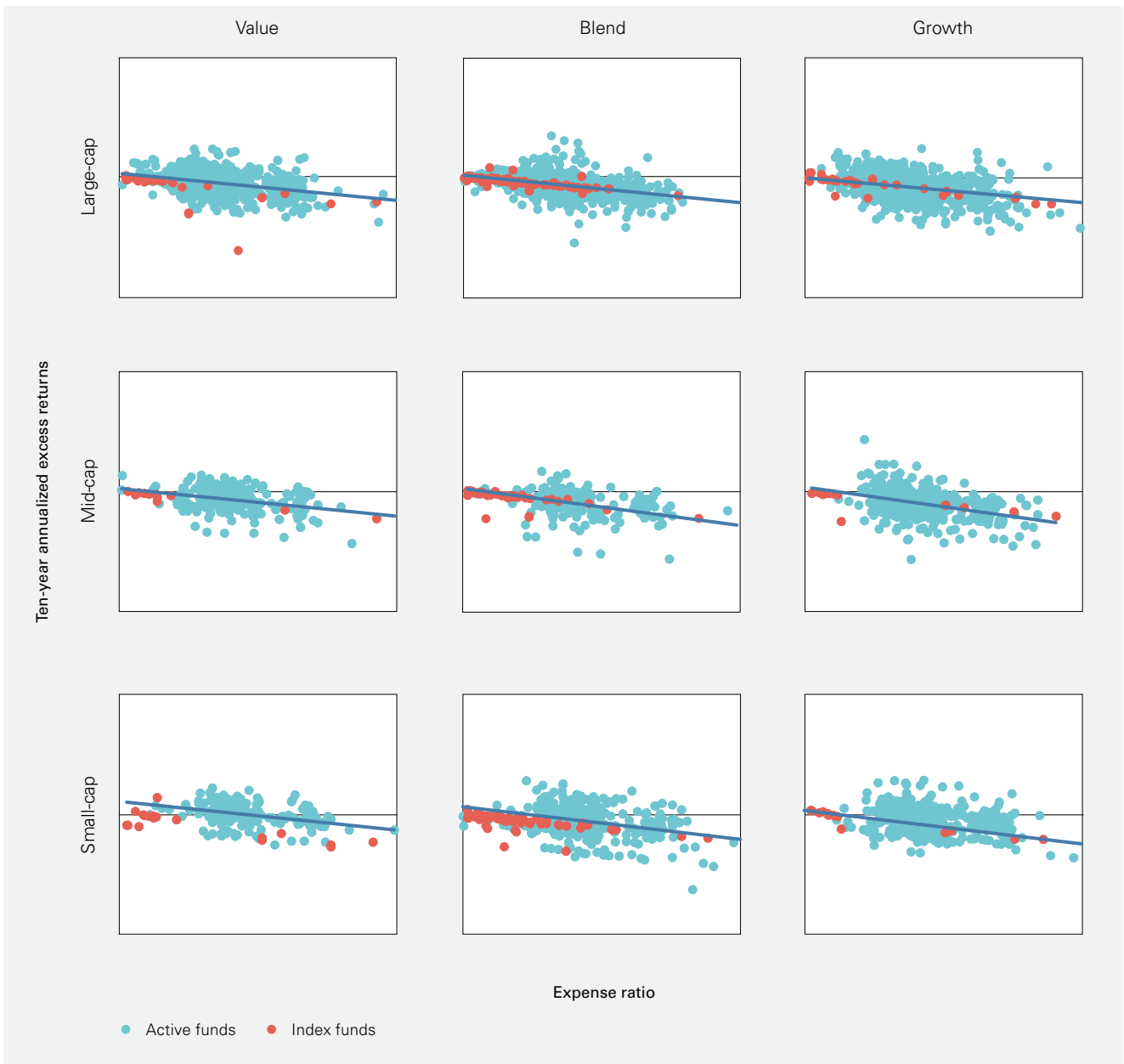
Sources: Vanguard calculations, using data from Morningstar, Inc.

To quantify the impact of costs on net returns, we charted managers' excess returns as a function of their expense ratios across various categories of funds over a ten-year period. **Figure 4** shows that higher expense ratios are generally associated with lower excess returns. The blue line in each category in the figure represents

the simple regression line and signifies the trend across all funds for each category. For investors, the clear implication is that by focusing on low-cost funds (both active and passive), the probability of outperforming higher-cost portfolios increases.

Figure 4. Higher expense ratios were associated with lower excess returns for U.S. funds:
As of December 31, 2017

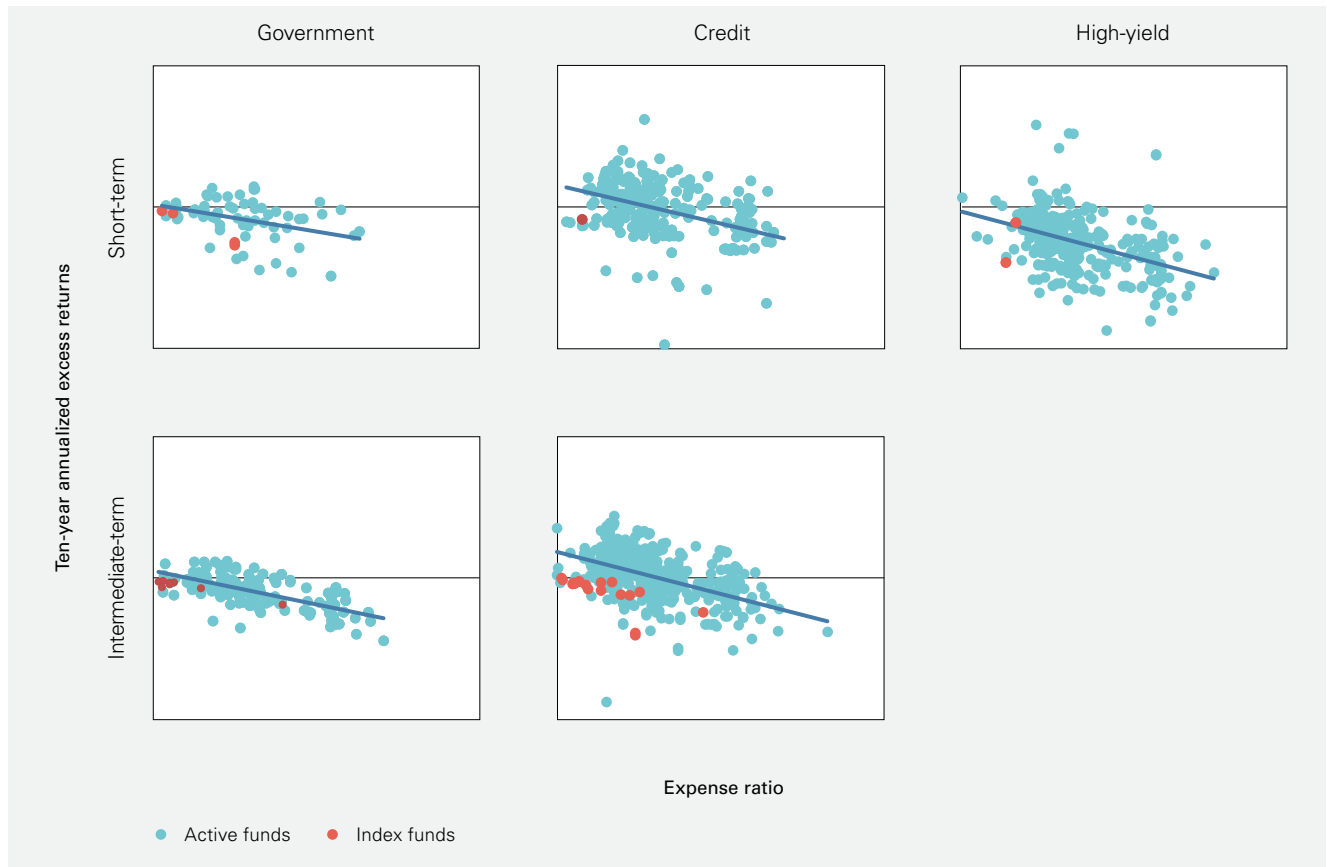
a. U.S. equity funds



(Continued on page 7)

Figure 4 (Continued). Higher expense ratios were associated with lower excess returns for U.S. funds:
As of December 31, 2017

b. U.S. bond funds



Notes: Index funds noted in red. Each plotted point represents a U.S. equity mutual fund within the specific size, style, and asset group. Each fund is plotted to represent the relationship of its expense ratio (x-axis) versus its ten-year annualized excess return relative to its stated benchmark (y-axis). The straight line represents the linear regression, or the best-fit trend line—that is, the general relationship of expenses to returns within each asset group. The scales are standardized to show the slopes' relationship to each other, with expenses ranging from 0% to 3% and returns ranging from -15% to 15% for equities and from -5% to 5% for fixed income. Some funds' expense ratios and returns go beyond the scales and are not shown.

Sources: Vanguard calculations, using data from Morningstar, Inc. All data as of December 31, 2017.

Costs play a crucial role in investor success. Whether invested in an actively managed fund or an index fund, each basis point an investor pays in costs is a basis point less an investor receives in returns. Since excess returns are a zero-sum game, as cost drag increases, the likelihood that the manager will be able to overcome this drag diminishes. As such, most investors' best chance at maximizing net returns over the long term lies in minimizing these costs. In most markets, low-cost index funds have a significant cost advantage over actively managed funds. Therefore, we believe that most investors are best served by investing in low-cost index funds over their higher-priced, actively managed counterparts.

Persistent outperformance is scarce

For those investors pursuing an actively managed strategy, the critical question becomes: Which fund will outperform? Most investors approach this question by selecting a winner from the past. Investors cannot profit from a manager's past success, however, so it is important to ask, Does a winning manager's past performance persist into the future? Academics have long studied whether past performance can accurately predict future performance. About 50 years ago, Sharpe (1966) and Jensen (1968) found limited to no persistence. Three decades later, Carhart (1997) reported no evidence of persistence in fund outperformance after adjusting for both the well-known Fama-French (1993) three-factor model as well as momentum. More recently, Fama and French (2010) reported results of a separate 22-year study suggesting that it is extremely difficult for an actively managed investment fund to outperform its benchmark regularly.

To test if active managers' performance has persisted, we looked at two separate, sequential, non-overlapping five-year periods. First, we ranked the funds by performance quintile in the first five-year period, with the top 20% of funds going into the first quintile, the second 20% into the second quintile, and so on. Second, we sorted those funds by performance quintile according to their performance in the second five-year period. To the second five-year period, however, we added a sixth category: funds that were either liquidated or merged during that period. We then compared the results. If managers were able to provide consistently high performance, we would expect to see the majority of first-quintile funds remaining in the first quintile. **Figure 5**, however, shows that a majority of managers failed to remain in the first quintile.⁵

It is interesting to note that, once we accounted for closed and merged funds, persistence was actually stronger among the underperforming managers than those that outperformed. These findings were consistent across all asset classes and all markets we studied globally. From this, we concluded that consistent outperformance is very difficult to achieve. This is not to say that there are not periods when active management outperforms, or that no active managers do so regularly. Only that, on average and over time, active managers as a group fail to outperform; and even though some individual managers may be able to generate consistent outperformance, those active managers are extremely rare.

⁵ We define consistently high performance persistence as maintaining top quintile excess return performance. It should, however, be noted that a manager may fall below the top quintile when measured against peers, but still generate positive outperformance versus a benchmark. Of course, it could also be the case that a manager remains in the top quintile but does not generate outperformance versus a benchmark.

Figure 5. Actively managed domestic funds failed to show persistent outperformance

Initial excess return quintile, five years ended December 31, 2012	Number of funds	Subsequent five-year excess return ranking, through December 31, 2017						Total
		Highest quintile	2nd quintile	3rd quintile	4th quintile	Lowest quintile	Merged/ liquidated	
1st quintile	1,108	19.8%	15.2%	12.6%	11.4%	18.1%	23.0%	100.0%
2nd quintile	1,118	16.8	14.0	17.5	12.2	11.9	27.5	100.0
3rd quintile	1,114	11.5	14.7	12.1	16.3	13.6	31.7	100.0
4th quintile	1,113	10.1	13.1	11.8	14.5	9.8	40.8	100.0
5th quintile	1,114	7.5	9.2	11.8	11.5	12.6	47.5	100.0

Notes: The far left column ranks all active U.S. equity funds within each of the 9-style Morningstar categories based on their excess returns relative to their stated benchmark during the five-year period as of the date listed. The remaining columns show how funds in each quintile performed over the next five years.

Sources: Vanguard and Morningstar.

When the case for low-cost index-fund investing can seem less or more compelling

For the reasons already discussed, we expect the case for low-cost index-fund investing to hold over the long term. Like any investment strategy, however, the real-world application of index investing can be more complex than the theory would suggest. This is especially true when attempting to measure indexing’s track record versus that of active management. Various circumstances, which we discuss next, can result in data that at times show active management outperforming indexing while, at other times, show indexing outperforming active management by more than would be expected. As a result, the case for low-cost index-fund investing can appear either less or more compelling than the theory would indicate. The subsections following address some of these circumstances.

Survivorship bias can skew results

Survivorship bias is introduced when funds are merged into other funds or liquidated, and so are not represented throughout the full time period examined. Because such funds tend to be underperformers (see the accompanying box titled “Merged and liquidated funds have tended to be underperformers” and Figure 6, on page 10), this skews the average results upward for the surviving funds, causing them to appear to perform better relative to a benchmark.⁶

⁶ For a more detailed discussion of the underperformance of closed funds, see Schlanger and Philips (2013).

Merged and liquidated funds have tended to be underperformers

To test the assumption that closed funds underperformed, we evaluated the performance of all domestic funds identified by Morningstar as either being liquidated or merged into another fund. Figure 6 shows that funds

tend to trail their benchmark before being closed. We found the assumption that merged and liquidated funds underperformed to be reasonable.

Figure 6. Dead funds showed underperformance versus style benchmark prior to closing date



Notes: Chart displays the cumulative annualized performance of those funds that were merged or liquidated within this study's sample, relative to a benchmark representative of that fund's Morningstar category. See Appendix for the list of benchmarks used. We measured each fund's performance from January 1, 2003, through the month-end prior to its merger or liquidation. Figure displays the middle-50% distribution of these funds' returns before their closure.

Sources: Vanguard calculations, based on data from Morningstar, Inc., Standard & Poor's, MSCI, CRSP, and Barclays.

However, the average experience of investors—some of whom invested in the underperforming fund before it was liquidated or merged—may be much different. **Figure 7** shows the impact of survivorship bias on the apparent relative performance of actively managed funds versus both their prospectus and style benchmarks.

In either case, a majority of active funds underperformed, and this underperformance became more pronounced as the time period lengthened and survivorship bias was accounted for. Thus, it is critical to adjust for survivorship bias when comparing the performance of active funds to their benchmarks, especially over longer time periods.

Figure 7. Percentage of actively managed mutual funds that underperformed versus their benchmarks: Periods ended December 31, 2017

a. Versus fund prospectus



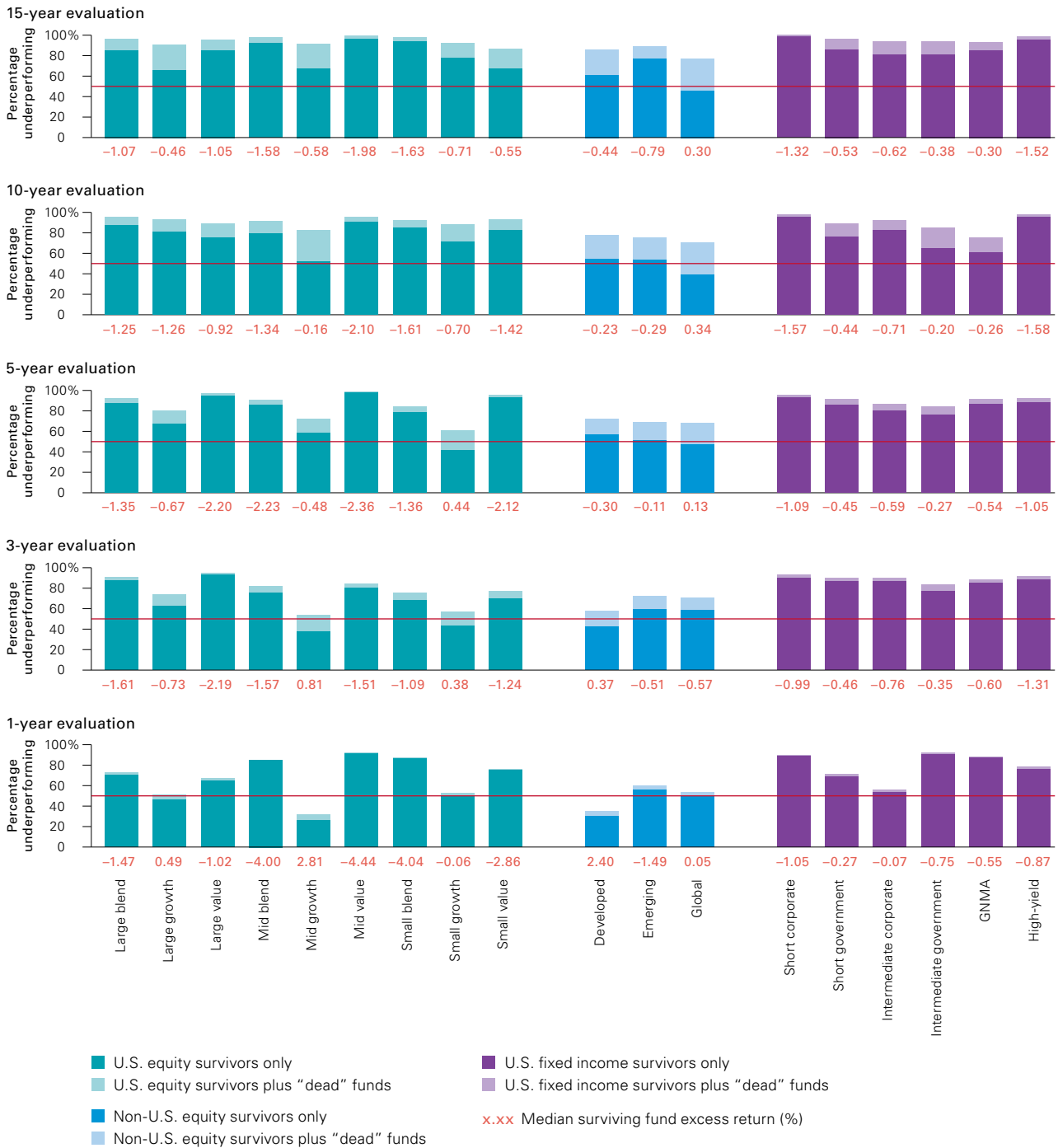
Note: Data reflect periods ended December 31, 2017. Fund classifications provided by Morningstar, benchmarks reflect those identified in each fund's prospectus. "Dead" funds are those that were merged or liquidated during the period.

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

(Continued on page 12)

Figure 7 (Continued). Percentage of actively managed mutual funds that underperformed versus their benchmarks: Periods ended December 31, 2017

b. Versus representative 'style benchmark'



Note: Data reflect periods ended December 31, 2017. Fund classifications provided by Morningstar. See appendix for list of benchmarks. "Dead" funds are those that were merged or liquidated during the period.

Sources: Vanguard calculations, using data from Morningstar, Inc., MSCI, CRSP, Standard & Poor's, and Barclays.

Mutual funds are not the entire market

Another factor that can complicate the analysis of real-world results is that mutual funds, which are used as a proxy for the market in most studies (including this one), do not represent the entire market and therefore do not capture the entire zero-sum game. Mutual funds are typically used in financial market research because their data tend to be readily available and because, in many markets, mutual fund assets represent a reasonable sampling of the overall market. It is important to note, however, that mutual funds are merely a market *sampling*. In cases where mutual funds constitute a relatively smaller portion of the market being examined, the sample size studied will be that much smaller, and the results more likely to be skewed. Depending on the direction of the skew, this could lead to either a less favorable or a more favorable result for active managers overall.

Portfolio exposures can make relative performance more difficult to measure

Differences in portfolio exposures versus a benchmark or broader market can also make relative performance difficult to measure. Benchmarks are selected by fund managers on an *ex ante* basis, and do not always reflect the style in which the portfolio is actually managed. For example, during a period in which small- and mid-cap equities are outperforming, a large-cap manager may hold some of these stocks in the portfolio to increase returns (Thatcher, 2009). Similarly, managers may maintain an over/underexposure to certain factors (e.g., size, style, etc.) for the same reason. These portfolio tilts can cause the portfolio to either outperform or underperform when measured against the fund's stated benchmark or the broad market, depending on whether the manager's tilts are in or out of favor during the period being examined. Over a full market or factor cycle, however, we would expect the performance effects of these tilts to cancel out and the zero-sum game to be restored.

Short time periods can understate the advantage of low-cost indexing

Time is an important factor in investing. Transient forces such as market cycles and simple luck can more significantly affect a fund's returns over shorter time periods. These short-term effects can mask the relative benefits of low-cost index funds versus active funds in two main respects: the performance advantage conferred on index funds over the longer term by their generally lower costs; and the lack of persistent outperformance among actively managed funds.

A short reporting period reduces low-cost index funds' performance advantage because the impact of their lower costs compounds over time. For example, a 50-basis-point difference in fees between a low-cost and a higher-cost fund may not greatly affect the funds' performance over the course of a single year; however, that same fee differential compounded over longer time periods can make a significant difference in the two funds' overall performance.

Time also has a significant impact on the application of the zero-sum game. In any given year, the zero-sum game states that there will be some population of funds that outperforms the market. As the time period examined becomes longer, however, the effects of luck and market cyclicity tend to cancel out, reducing the number of funds that outperform. Market cyclicity is an important factor in the lack of persistent outperformance as investment styles and market sectors go in and out of favor, as noted earlier.

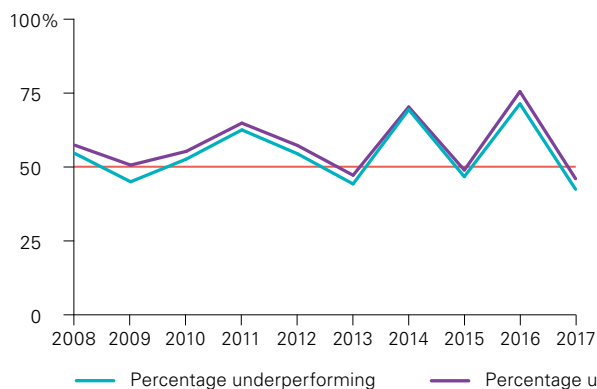
This concept is illustrated in **Figure 8**, which compares the performance of domestic funds over rolling one- and ten-year periods to that of their benchmarks. As the figure shows, active funds were much less likely to outperform over longer periods compared with shorter periods; this was especially true when merged and liquidated funds were included in the analysis. Thus, as the time period examined became longer, the population of funds that consistently outperformed tended to shrink, ultimately becoming very small.

Low-cost indexing—a simple solution

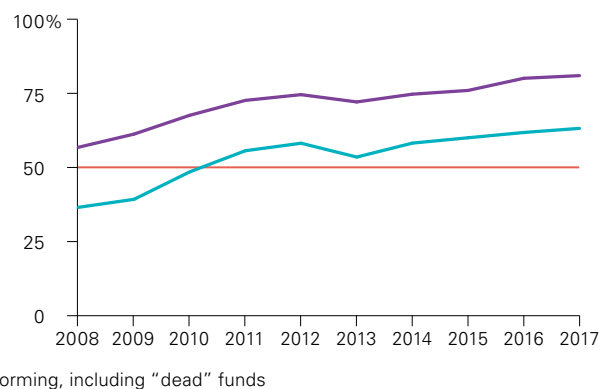
One of the simplest ways for investors to gain market exposure with minimal costs is through a low-cost index fund or ETF. Index funds seek to provide exposure to a broad market or a segment of the market through varying degrees of index replication ranging from full replication (in which every security in the index is held) to synthetic replication (in which index exposure is obtained through the use of derivatives). Regardless of the replication

Figure 8. Percentage of active U.S. equity funds underperforming over rolling periods versus prospectus benchmarks

a. One-year periods



b. Ten-year periods



Sources: Vanguard calculations using data from Morningstar, Inc. Performance is calculated relative to prospectus benchmark.

method used, all index funds seek to track the target market as closely as possible and, by extension, to provide market returns to investors. This is an important point and is why index funds, in general, are able to offer investors market exposure at minimal cost. Index funds do not attempt to outperform their market, as many active managers do. As such, index funds do not require the significant investment of resources necessary to find and capitalize on opportunities for outperformance (such as research, increased trading costs, etc.) and therefore do not need to pass those costs on to their investors.

By avoiding these costs, index funds are generally able to offer broad market exposure, with market returns at very low cost relative to the cost of most actively managed funds. Furthermore, because index funds do not seek to outperform the market, they also do not face the challenges of either persistent outperformance or of beating the zero-sum game. In short, by accepting market returns while keeping costs low, low-cost index funds lower the hurdles that make successful active management so difficult over the long term.

Although we believe that low-cost index funds offer most investors their best chance at maximizing fund returns over the long run, we acknowledge that some investors want or need to pursue an active strategy. For example, investors in some markets may have few low-cost, domestic index funds available to them. For those investors, or any investor choosing an active strategy, low-cost, broadly diversified actively managed funds can serve as a viable alternative to index funds, and in some cases may prove superior to higher-cost index funds; keep in mind that the performance advantage conferred by low-cost funds is quickly eroded as costs increase.

Conclusion

Since its inception, low-cost index investing has proven to be a successful investment strategy over the long term, and has become increasingly popular with investors globally. This paper has reviewed the conceptual and theoretical underpinnings of index investing and has discussed why we expect the strategy to continue to be successful, and to continue to gain in popularity, in the foreseeable future.

The zero-sum game, combined with the drag of costs on performance and the lack of persistent outperformance, creates a high hurdle for active managers in their attempts to outperform the market. This hurdle grows over time and can become insurmountable for the vast majority of active managers. However, as we have discussed, circumstances exist that may make the case for low-cost indexing seem less or more compelling in various situations.

This is not to say that a bright line necessarily exists between actively managed funds and index funds. For investors who wish to use active management, either because of a desire to outperform or because of a lack of low-cost index funds in their market, many of the benefits of low-cost indexing can be achieved by selecting low-cost, broadly diversified active managers. However, the difficult task of finding a manager who consistently outperforms, combined with the uncertainty that active management can introduce into the portfolio, means that, for most investors, we believe the best chance of successfully investing over the long term lies in low-cost, broadly diversified index funds.

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Additional selected Vanguard research on active and index investing

Low-cost: A key factor in improving probability of outperformance in active management. A rigorous qualitative manager-selection process is also crucial.

Wallick, Daniel W., Brian R. Wimmer, and James Balsamo, 2015. *Keys to Improving the Odds of Active Management Success*. Valley Forge, Pa.: The Vanguard Group.

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Appendix. Benchmarks represented in this analysis

Equity benchmarks are represented by the following indexes—Large blend: MSCI US Prime Market 750 Index through January 30, 2013, CRSP US Large Cap Index thereafter; Large growth: S&P 500/Barra Growth Index through May 16, 2003, MSCI US Prime Market Growth Index through April 16, 2013, CRSP US Large Cap Growth Index thereafter; Large value: S&P 500/Barra Value Index through May 16, 2003, MSCI US Prime Market Value Index through April 16, 2013, CRSP US Large Cap Value Index thereafter; Mid blend: S&P MidCap 400 Index through May 16, 2003, MSCI US Mid Cap 450 Index through January 30, 2013, CRSP US Mid Cap Index thereafter; Mid growth: MSCI US Mid Cap Growth Index through April 16, 2013, CRSP US Mid Cap Growth Index thereafter; Mid value: MSCI US Mid Cap Value Index through April 16, 2013, CRSP US Mid Cap Value Index thereafter; Small blend: Russell 2000 Index through May 16, 2003, MSCI US Small Cap 1750 Index through January 30, 2013, CRSP US Small Cap Index thereafter;

Small growth: S&P SmallCap 600/Barra Growth Index through May 16, 2003, MSCI US Small Cap Growth Index through April 16, 2013, CRSP US Small Cap Growth Index thereafter; Small value: S&P SmallCap 600/Barra Value Index through May 16, 2003, MSCI US Small Cap Value Index through April 16, 2013, CRSP US Small Cap Value Index thereafter. Bond benchmarks are represented by the following Bloomberg Barclays indexes: U.S. 1–5 Year Government Bond Index, U.S. 1–5 Year Corporate Bond Index, U.S. Intermediate Government Bond Index, U.S. Intermediate Corporate Bond Index, U.S. GNMA Bond Index, U.S. Corporate High Yield Bond Index. International and global benchmarks are represented by the following indexes: Global—Total International Composite Index through August 31, 2006, MSCI EAFE + Emerging Markets Index through December 15, 2010, MSCI ACWI ex USA IMI Index through June 2, 2013, FTSE Global All Cap ex US Index thereafter; Developed—MSCI World ex USA Index; Emerging markets—MSCI Emerging Markets Index.

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ISGIDX 042018