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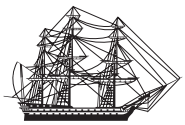

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In this issue:

Target date funds pursue an explicit, goal-based objective: helping investors achieve financial security in retirement. But how do we measure their progress toward this goal?

Our Investment Counseling & Research group has been exploring new benchmarking methodologies for these goal-based portfolios. We open our second issue of *Vanguard Investment Perspectives* with an overview of this work. We hope the results will prompt debate about the best way to evaluate these powerful retirement-saving vehicles.

This issue also includes some of the investment and investor analysis that we've shared with clients and researchers during the past six months:

- The challenges of trying to build portfolios on the market's theoretical efficient frontier.
- The similarities and differences between public and private real estate vehicles.
- The relationship between emotional intelligence and investor behavior.
- An analysis of the market's changing inflation dynamics.

The enthusiastic response to our first issue of *Vanguard Investment Perspectives* was enormously gratifying. We look forward to hearing your thoughts on our latest research.

Sincerely,

John J. Brennan
Chairman and Chief Executive Officer

Contents

Target date funds: Filling the information gap

Authors: John Ameriks, Ph.D., and Ellen Rinaldi, J.D., LL.M.

Target date funds provide a comprehensive solution to the retirement-saving challenge. But how do we know whether they're doing their job?

Unlike a conventional stock, bond, or balanced mutual fund, which seeks to meet a returns-based objective—outperforming the Standard & Poor's 500 Index, for example—target date funds pursue a goal-based objective: to help investors accumulate sufficient assets for retirement within a clearly defined time frame. The concept has proven popular. At the end of 2006, according to the Investment Company Institute, target date mutual fund assets totaled $114.3 billion, up from just $12.3 billion in 2001, a compound annual growth rate of 56%. Growth of these funds should remain strong, in part because of recent federal legislation on pensions and U.S. Department of Labor guidelines encouraging the use of target date funds in workplace retirement plans.

Target date funds provide a simple, yet comprehensive, solution for the millions of investors charged with selecting and managing their own retirement portfolios. The tools for analyzing the performance of these portfolios, by contrast, are limited. The problem is an absence of explicit information about the expectations and assumptions embedded in the funds' advice component. Without this context, basic questions about the use of these portfolios remain unanswered. For example, does a fund's advisory methodology assume a particular savings rate? How is retirement security defined? What does current performance tell an investor about the fund's progress toward its goal?

To address this information gap, we describe and analyze a complementary approach to benchmarking that reflects the unique objective of target date funds. This approach could potentially help investors obtain a clearer picture of the long-term returns a fund provider expects to deliver, a fund's track record relative to those expectations, and the relationship between fund returns and a "typical" investor's ability to finance retirement. The ideas outlined here may eventually lead to new forms of performance reporting and, ultimately, better outcomes for retirement investors.

Assets and advice in one package

Target date funds are combinations of securities and embedded, generic advice about the right way to select and allocate those securities.[1] An investor typically selects a target date fund with the maturity date that is closest to his or her expected retirement date. The fund manager assumes all investment responsibility, including fund selection, portfolio rebalancing, and the portfolio's transition toward an increasingly conservative asset allocation as the maturity date nears. Each provider's approach to asset allocation and security selection reflects its expectations about the returns available from a given strategy and its estimate of the long-term return required to help investors accumulate sufficient assets for retirement.

1 Conventional financial-planning advice is customized to an investor's preferences, wealth, taxes, and so on. What we call "generic" advice is targeted to the "typical" investor and therefore does not incorporate an individual investor's unique situation.

The issue: Conventional performance benchmarks provide little information about a target date fund's progress toward its goal.

The implication: Investors lack tools to evaluate these portfolios, which are assuming a larger role in workplace retirement plans.

Vanguard conclusion: New goal-based benchmarks are proposed to help investors make sense of these powerful retirement-savings vehicles.

Existing benchmarks: Incomplete picture, short-term focus

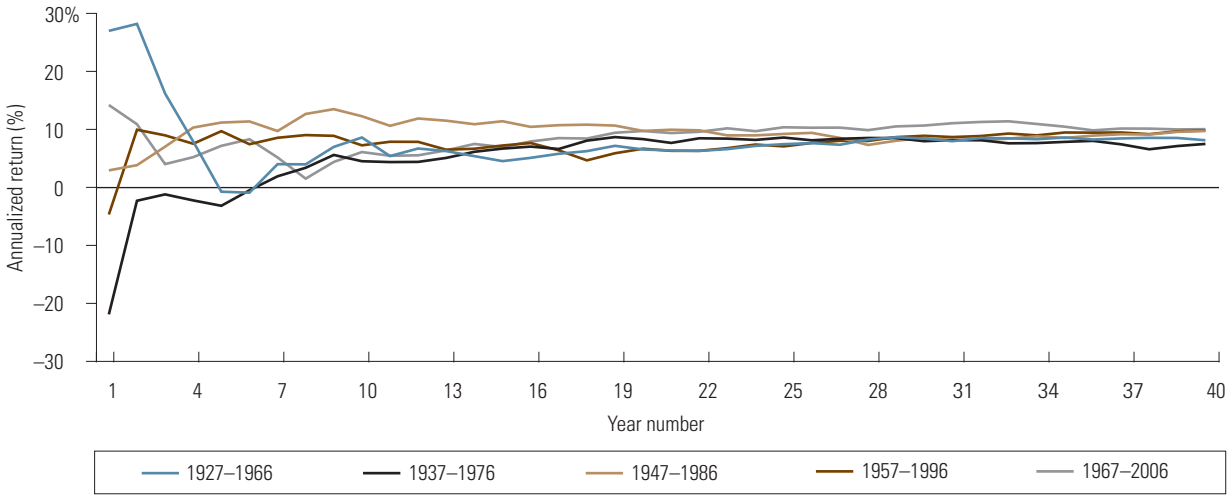
Conventional performance reporting provides no information about a target date fund's performance relative to these expectations. Instead, reporting tends to focus on a fund's short-term returns relative to peer groups or indexes—in effect, measures of short-term opportunity cost.[2]

Although these measures can provide important insight, their use with target retirement funds has several drawbacks. For example, because they're used to assess short-term performance, these benchmarks emphasize short-term volatility rather than long-term return—the more important measure over a time horizon that may be 10 to 40 years or more. Figure 1 shows the annualized cumulative performance of a balanced portfolio over four different 40-year periods. As the figure indicates, short-term returns have fallen within a broad range—potentially a source of alarm for less sophisticated investors; longer-term returns have converged to a similar number.[3]

In addition, the existing benchmarks do not help investors answer the most important questions about target date funds:

- What return does an investor need to earn to accumulate enough money for retirement?
- Does the investment provider expect its mix of embedded asset allocation advice and fund selections to meet this return threshold?
- Is the fund meeting these expectations?
- What risks are implied by these expectations?

Figure 1. Annualized cumulative nominal returns for balanced portfolio for selected 40-year periods (1927–2006)



Notes: Balanced portfolio of 65% equities/35% bonds. Equities represented by Standard & Poor's 500 Index (1926 through 1970) and Dow Jones Wilshire 5000 Composite Index (1971 through 2006). Bonds represented by S&P High Grade Corporate Index (1926 through 1968), Citigroup High Grade Index (1969 through 1972), Lehman Long-Term AA Corporate Index (1973 through 1975), and Lehman U.S. Aggregate Bond Index (1976 through 2006).

Source: Vanguard.

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.

2 One exception that we are aware of is Labovitz (2006), who simulated the expected wealth accumulation and risks for major target date fund providers. However, Labovitz did not compare the actual performance with the simulated performance.

3 We are not suggesting that risk is reduced with time. Sample mean return converges to the population mean return as the sample size increases (assuming no shift in the distribution). That said, small differences in annualized returns may result in large differences in wealth when accumulated over long periods of time. See Fisher and Statman (1999) for a review of the time-diversification debate.

New goal-based benchmarks

We propose two additional, complementary benchmarks that will help investors answer these critical questions about a target date fund's performance. The first benchmark identifies the return required by the typical investor to reach retirement sufficiency. The second benchmark presents fund performance relative to the investment manager's return expectations.

Benchmarking relative to savings target: A three-step analysis

Before we can evaluate the likelihood that a fund can help investors achieve retirement security, we need to define retirement security—a somewhat subjective concept that can differ dramatically from one person to the next. Because target date portfolios are designed to serve a broad range of savers, however, the most appropriate measure of total assets required for retirement security should reflect real-world data on the financial situation of a typical retiree.

Once we define a savings target for retirement security, we can estimate the rate of return required to accumulate this amount of assets. The answer depends on the amount and timing of an investor's regular contributions to the portfolio. We modeled the typical target date fund investor based on the average income earner and average contributor. The analysis had three steps:

1. We determined the savings target for a typical investor at retirement (age 65).
2. We calculated the rate of return necessary for the typical investor to reach this savings target over a 40-year period.
3. We conducted a robustness analysis—"stress tests"—to determine the return that would allow investors to reach the wealth target with a margin of safety for adverse contingencies such as health shocks or a decline in Social Security payouts.

Based on this analysis, we established the savings target as the amount of money that will allow investors, in 85% of the scenarios, to maintain their preretirement standard of living during retirement, without running out of money by age 95. We also determined that the rate of return required to help investors achieve retirement security, with a margin of safety for adverse contingencies, is a real (inflation-adjusted) return of 5%. Consider a household with annual income of $60,000. In our baseline case, shown in Table 1, the household would need to replace 75% of this income in each year of retirement, with an annual adjustment for inflation. Social Security would replace 43 percentage points of the 75% total; the remaining 32 percentage points would come from private savings.

Our simulations indicated that to sustain this spending level until age 95, with an 85% probability of success, a household would need to accumulate $411,000 by age 65 (see Table 1). Based on the typical investor's savings patterns, this goal could be achieved with a real return of just 1.9%.

Prudence suggested that we set the required rate of return above this bare minimum, however. What if Social Security payouts decline in response to projected deficits in the system? What if an investor wishes to have precautionary savings in anticipation of a possible adverse health shock? To accommodate these contingencies, we increased the replacement ratio from private sources to 60%, which raised the savings goal at retirement to $768,000. A household with annual income of $60,000 at age 65 would need to earn an average real return of 5% to get to this savings goal.

Table 1. Varying replacement assumptions for a given income level

Replacement assumptions	Age-65 income	Replacement ratio (%) Total	Social Security	Private sources	Savings goal ($) (x age-65 salary)	Required rate of return
Baseline	$60,000	75	43	32	$411,000 (6.9x)	Inflation + 1.9%
No employer medical benefit and two earners	$60,000	80	40	40	$513,000 (8.6x)	Inflation + 3%
Decline in Social Security replacement	$60,000	80	20	60	$768,000 (12.8x)	Inflation + 5%

Notes: Based on Vanguard Capital Markets Model™ simulations. Medium- and high-income life-cycle earnings pattern from SSA; annual contribution rates based on income and age from EBRI and ICI. Table data assume a savings period of 40 years and that savings are invested in Vanguard Target Retirement 2005 Fund from age 65 through age 95.

Sources: Aon Consulting/Georgia State University, SSA, EBRI, ICI, and Vanguard.

These hypothetical data do not represent the returns on any particular investment.

IMPORTANT: The projections or other information generated by Vanguard Capital Markets Model simulations regarding the likelihood of various investment outcomes are hypothetical in nature, do not reflect actual investment results, and are not guarantees of future results.

Benchmarking and return expectations

Our second benchmarking approach provides investors with two critical pieces of information. First, it specifies what return an investment manager expects to earn and, second, it reports actual returns relative to those expectations. This benchmark holds the provider accountable for the appropriateness of the return assumptions used in constructing the target date funds.

Of course, the financial markets' uncertainty makes setting return expectations a challenge. The median return expectation over the lifetime of a target date fund—an annualized return of 9.4%, for example—is one data point in a range of returns that might stretch from 5.9% to 12.5% with a 90% likelihood.[4] Although there is a very real economic difference between a 5.9% annualized return and a 12.5% annualized return, both results are well within the realm of expectation.

In other words, it is essential to communicate that the expected return is not a guaranteed return.

Over time, investors can assess the success of a fund in meeting these expectations. It is important to note that this benchmark takes no account of investors' saving behavior. Although the timing of investor cash flows affects the returns realized by the investor, this factor is beyond the investment manager's control.

4 This example is based on the hypothetical target date fund simulations discussed in the complete version of this research paper (Vanguard, 2007).

Two benchmarks, two new perspectives

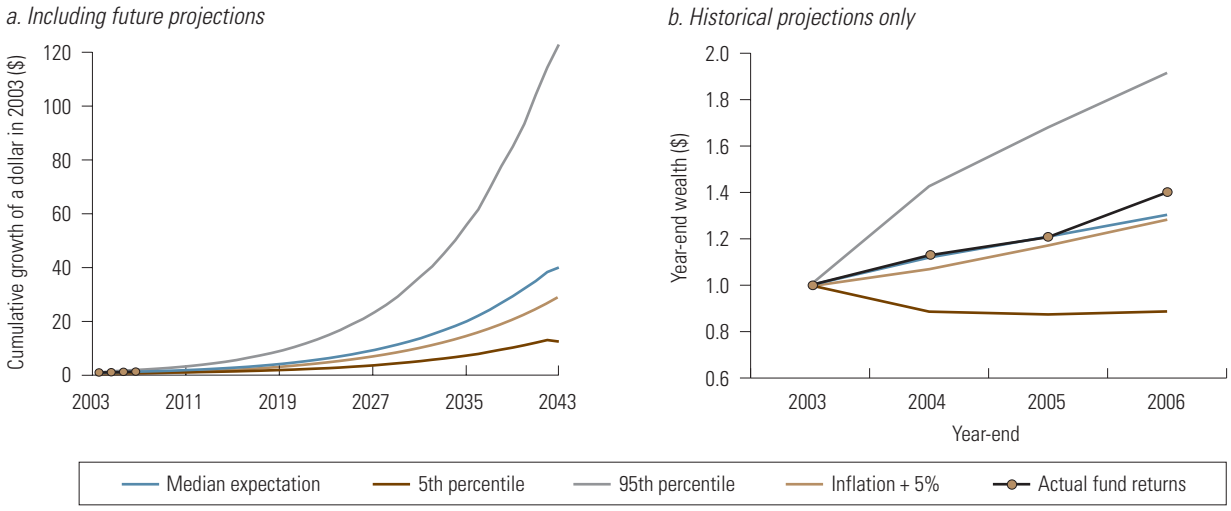
Figures 2a and 2b show how these two benchmarking methodologies can be integrated into simple charts to provide target date investors with critical information to gauge their funds' success in helping them achieve a secure retirement. Figure 2a displays the expectations for a hypothetical target date 2045 fund, from inception until its maturity date. We display the median expected return; bands at the 5th and 95th percentiles of expected returns; the "required rate of return" (inflation plus 5%); and the fund's actual return.

At a glance, an investor would be able to determine that the fund was thus far meeting its objectives: producing returns within the expected range and meeting the required rate-of-return threshold.[5] Figure 2b displays the same information, with the chart restricted to past performance.

Conclusion

The ideas and approaches that we have outlined here could lead to the development of new, complementary benchmarks that improve on currently available tools for evaluating a portfolio's success in achieving its goals. One measure would be helpful in assessing a fund's performance relative to the benchmark's stated long-term return expectations. A second, related measure would help investors better evaluate whether a fund's success in meeting these expectations would in turn help them achieve retirement security. These two new approaches have a variety of merits as benchmarking tools, potentially filling the information gap that has prevented investors from conducting a meaningful evaluation of these powerful retirement-savings vehicles.

Figure 2. Hypothetical target date 2045 fund versus its return-expectations benchmark and savings sufficiency benchmark



Notes: Projections using 10,000 simulations from Vanguard Capital Markets Model; 75 years of forward-looking simulations as of December 2002. Median nominal projected return of 2045 fund is 9.4% from 2004 through 2045. Median annualized average real return over the same period is projected to be 5.69%. For return-assumption details, see the full research paper (Vanguard, 2007). This chart assumes the fund started with $1 at the beginning of 2004.

Source: Vanguard.

This hypothetical illustration does not represent any particular investment.

This article is adapted from a Vanguard Investment Counseling & Research paper on *Target Date Funds and Goal-Based Benchmarks* (Vanguard, 2007). The paper is available on Vanguard.com.

References

Fisher, K.L., and M. Statman, 1999. A Behavioral Framework for Time Diversification. *Financial Analysts Journal* 55(3, May/June): 88–97.

Labovitz, M., 2006. *Targeting Target Date Funds*. Lipper Fund Industry Insight Report. http://www.lipperweb.com/research/fundIndustryOverview.asp.

Vanguard, 2007. *Target Date Funds and Goal-Based Benchmarks, 2007*. Valley Forge, Pa.: Vanguard Investment Counseling & Research, The Vanguard Group.

5 Note that there is a 75% chance that the hypothetical fund will beat the "inflation + 5%" threshold.

Chasing the efficient frontier: The opportunity, challenges, and risks

Author: Francis M. Kinniry Jr., CFA

As investors increasingly look to financial models to build portfolios optimally allocated across asset and sub-asset classes, they need to be wary of imputing permanence to historical risk and return characteristics that may not exist going forward.

At the end of 2006, the theoretically optimal portfolio included above-market weightings in real estate investment trusts (REITs), mid-capitalization value stocks, commodities, and emerging markets. Based on a mean-variance optimization of the past 18 years of returns, volatility, correlations, and cross-correlations, the efficient portfolio was expected to produce policy-portfolio-beating returns of 13% (versus 10.3%), at the expected policy-portfolio-level risk of 8.5%.[1]

Since then, value stocks have ceded market leadership to growth stocks. After a multiyear surge, REITs and commodities have cooled off. At the end of June 2007, this same "optimal" portfolio had produced a six-month return of 3.5%, trailing the market portfolio by 2 percentage points.

A six-month return may simply be noise, but this snapshot highlights the challenges of basing portfolio decisions solely on the efficient frontier. It also reveals the "winner's curse," the product of a misguided application of historical returns. History is a reliable guide to the risk and return relationships among different asset classes; financial theory suggests that, over time, volatile assets such as stocks should outperform low-risk assets such as cash, an expectation confirmed by the historical evidence. It's not clear, however, that historical returns are a reliable basis for forecasting returns within an asset class. That mid-cap value stocks have outperformed the broad stock market over the past 18 years, according to Russell indexes, does not necessarily imply that they will continue to produce superior risk-adjusted returns.

We examine the implications of using the historical returns of sub-asset classes such as size, style, and sector groups as a basis for expected returns. We start by analyzing the relationship between the returns and the relative valuations of the different sub-asset classes. We also explore the time-period dependency of the relative performance rankings among different sub-asset classes. We demonstrate that a modest change in the start or end dates of a return series can lead the same portfolio-construction model to produce dramatically different recommendations. Finally, we challenge the reader to place historical results in the appropriate context and to use caution in interpreting the recommendations of widely used portfolio-construction techniques.

The issue: Dividing asset classes into focused components can lead to "the winner's curse."

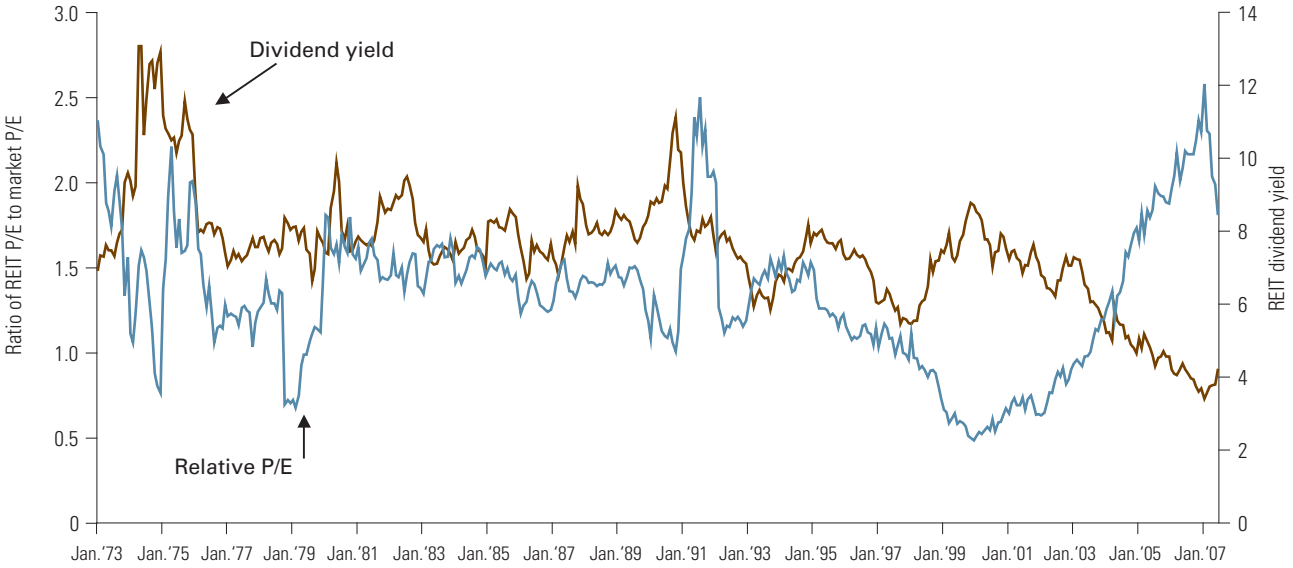
The implication: A narrow focus on past performance can produce portfolios with sub-optimal returns and unexpected risks.

Vanguard conclusion: Prudent portfolio construction demands an awareness of the assumptions built into asset-allocation methodologies and the information conveyed by historical relationships.

1 Our policy portfolio is a balanced portfolio of 60% stocks, 40% bonds. Of the stock portion, 80% is in U.S. equities and 20% in international equities, including emerging markets. Within the U.S. and international allocations, the sub-asset classes (including REITs) are weighted according to their historical market weights.

Figure 1. Valuations provide perspective regarding sustainability of historical experience

REIT dividend yield and relative P/E ratio



Source: Author's calculations using data from Thompson Datastream and the National Association of Real Estate Investment Trusts (NAREIT).

Can historical returns be reliable if valuations look very different?

Changes in valuation can have a big impact on asset returns. But the impact of valuation changes isn't visible in a return series. For example, the NAREIT Index returned an annualized rate of 14%, 2.5 percentage points more than the broad stock market, as measured by the Dow Jones Wilshire 5000 Index, from 1972 through 2006.

Is it reasonable to assume that this record of superior risk-adjusted return is an inherent characteristic of the sub-asset class? An analysis of REIT valuations raises doubts. Figure 1 displays historical REIT valuations relative to those of the broad stock market. Since 1973, the P/E ratio of the REIT index has generally been less than 1.5 times that of the broad stock market, as shown in the blue line. In addition, the red line shows that REITs have generally provided dividend yields averaging 8% or more. At the end of 2006, the REIT market's P/E ratio was about 2.5 times that of the broad market; its yield was below 4%.

The rise in valuations that helped REITs produce superior risk-adjusted returns in the past creates new hurdles for continued outperformance. If REITs generate earnings growth far above historical levels, or if valuations continue to increase dramatically, historical returns might prove to be a good approximation of future returns. That's possible, of course, but the questions about valuation make the case for over-weighting REITs seem less convincing than measures of risk-adjusted return such as historical Sharpe ratios would suggest. The same dynamics that produced excess returns in the past make future outperformance less likely.

Different time periods, different conclusions

The relationship between returns and changes in valuation suggests a larger caution about the use of historical data: time-period dependency. The addition of just a few years to the historical return series can produce a dramatic change in the composition of the efficient portfolio. At the beginning of 2000, REITs' trailing Sharpe ratio was modest. At the end of 2003, however, risk-adjusted returns suggested that REITs were among the market's most attractive investment opportunities.

As this example indicates, slight shifts in the starting and ending dates of a time series can produce dramatic reversals in the relative rankings of risk-adjusted performance. In Figure 2, we rank the stock market's sub-asset classes by three-year trailing Sharpe ratio on an annual basis. Changes in leadership can be quick, and the timing seemingly random. For example, from 1998 through 2000, large-cap growth had the highest Sharpe ratio among the six styles. However, a year later (and for the next five), this same market segment had the lowest. While some observers suggested that growth stocks were overvalued in the late 1990s, it wasn't until 2001 that the trailing Sharpe ratio had declined enough to reflect this view.

Figure 2. Ranking equity sub-asset classes according to risk-adjusted returns (Sharpe ratios)

Sharpe ratio rank:	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Highest	Small Value	Large Value	Large Growth	Mid Value	Large Growth	Large Growth	Large Growth	Mid Value	Small Value	Small Value	Small Value	Mid Value	Large Value
	Mid Value	Small Value	Large Value	Large Value	Large Value	Mid Growth	Large Value	Small Value	Mid Value	Mid Value	Mid Value	Small Value	Mid Value
	Large Value	Mid Value	Mid Value	Small Value	Mid Value	Large Value	Small Growth	Small Growth	Small Growth	Small Growth	Large Value	Mid Growth	Small Value
	Small Growth	Large Growth	Small Value	Large Growth	Small Value	Small Growth	Mid Growth	Mid Growth	Large Value	Large Value	Mid Growth	Large Value	Mid Growth
	Mid Growth	Small Growth	Mid Growth	Mid Growth	Mid Growth	Mid Value	Mid Value	Large Value	Mid Growth	Mid Growth	Small Growth	Small Growth	Small Growth
Lowest	Large Growth	Mid Growth	Small Growth	Small Growth	Small Growth	Small Value	Small Value	Large Growth	Large Growth	Large Growth	Large Growth	Large Growth	Large Growth

Notes: Large Growth is represented by the S&P 500/Citigroup Growth Index; Large Value by the S&P 500/Citigroup Value Index; Mid Growth by the S&P 400/Citigroup Growth Index; Mid Value by the S&P 400/Citigroup Value Index; Small Growth by the S&P 600/Citigroup Growth Index; and Small Value by the S&P 600/Citigroup Value Index. Ranking represents the trailing three-year Sharpe ratio. We used the Citigroup 3-Month U.S. Treasury Bill Index for the cash return.

Source: Vanguard Investment Counseling & Research.

The starting and ending valuations for a return series can highlight a market segment's vulnerability to the winner's curse. In Figure 3, we ranked the six styles by their price/earnings ratios relative to history. For example, at the end of 1999, large-cap growth and small-cap growth stocks had the highest relative historical P/E ratios—they were each in the 99th percentile of historical P/E ratios for their categories. Given these relative valuations, there was a significant headwind against the prospects for continued outperformance. In the years since, these sectors have produced relatively weak returns, succumbing to the winner's curse. Since 2003, mid-cap and small-cap value stocks have enjoyed the highest relative valuations as a result of many years of sustained outperformance. However, given that valuations in 2007 are substantially different from those in 1999 and 2000, should investors extrapolate recent performance forward? Or are such expectations doomed by the winner's curse?

Figure 3. U.S. equity styles ranked by P/E ratios relative to history

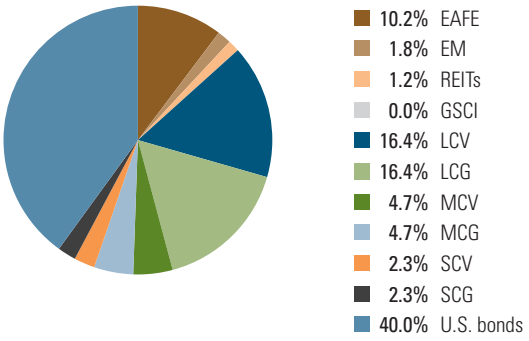
Percentile	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1 (Lowest)	Large Growth 0%	Large Value 7%	Large Value 22%	Small Growth 59%	Small Value 55%	Mid Value 20%	Small Value 21%	Small Value 58%	Mid Growth 13%	Small Growth 40%	Large Growth 40%	Small Growth 11%	Mid Growth 14%
2	Large Value 1%	Small Value 17%	Mid Value 36%	Mid Growth 65%	Large Growth 83%	Small Value 20%	Mid Value 46%	Large Value 76%	Small Growth 17%	Mid Growth 47%	Large Value 40%	Large Growth 22%	Large Growth 15%
3	Mid Value 1%	Mid Growth 20%	Large Growth 41%	Large Value 66%	Mid Value 85%	Large Value 92%	Large Value 74%	Mid Growth 77%	Mid Value 19%	Large Value 51%	Mid Growth 44%	Large Value 57%	Small Growth 19%
4	Mid Growth 2%	Mid Value 25%	Small Value 45%	Large Growth 68%	Mid Growth 92%	Mid Growth 96%	Small Growth 74%	Mid Value 78%	Small Value 25%	Large Growth 58%	Small Growth 54%	Mid Growth 60%	Large Value 59%
5	Small Growth 10%	Large Growth 26%	Small Growth 57%	Small Value 75%	Small Growth 92%	Large Growth 99%	Large Growth 89%	Large Growth 79%	Large Value 48%	Small Value 66%	Mid Value 66%	Small Value 80%	Mid Value 76%
6 (Highest)	Small Value 15%	Small Growth 58%	Mid Growth 61%	Mid Value 98%	Large Value 95%	Small Growth 99%	Mid Growth 90%	Small Growth 91%	Large Growth 48%	Mid Value 82%	Small Value 92%	Mid Value 83%	Small Value 85%

Notes: Benchmarks used are the same as in Figure 2. Price/earnings ratios are the weighted median P/Es of stocks in that style category. Percentile ranks depict the rank of year-end P/E ratios among previous monthly P/E observations in that style category.

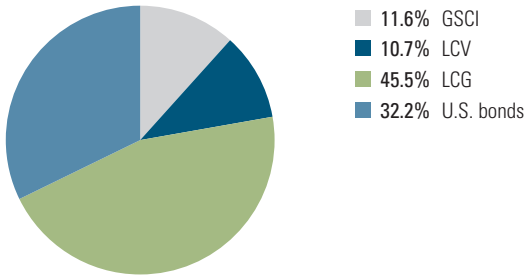
Sources: FactSet, Vanguard Investment Counseling & Research.

Figure 4. Mean-variance optimization case study: Policy portfolio and January 2000 portfolio

Policy portfolio



Mean variance optimized portfolio



Note: The policy portfolio is 60% stocks and 40% bonds. Of the stock portion, 80% is in U.S. equities and 20% in international equities, including emerging markets. Within the U.S. and international allocations, the sub-asset classes (including REITs) are weighted according to their historical market weights. U.S. bonds are represented by the Lehman U.S. Aggregate Bond Index. Developed-market international stocks (EAFE) are represented by the MSCI EAFE Index, and emerging-market stocks (EM) by the MSCI Emerging Markets Index. For U.S. stocks, large-cap growth (LCG), large-cap value (LCV), mid-cap growth (MCG), mid-cap value (MCV), small-cap growth (SCG), and small-cap value (SCV) are represented by, respectively, the Russell Top 200 Growth Index, the Russell Top 200 Value Index, the Russell Midcap Growth Index, the Russell Midcap Value Index, the Russell 2000 Growth Index, and the Russell 2000 Value Index for the period January 1988–May 1992, and by the MSCI US Large Cap 300 Growth Index, the MSCI US Large Cap 300 Value Index, the MSCI US Mid Cap 450 Growth Index, the MSCI US Mid Cap 450 Value Index, the MSCI US Small Cap 1750 Growth Index, and the MSCI US Small Cap 1750 Value Index for the period June 1992–December 2006. REITs are represented by the NAREIT Equity REIT Index. Commodities (GSCI) are represented by the S&P GSCI Commodities Total Return Index.

Sources: Vanguard Investment Counseling & Research, Zephyr Associates: AllocationADVISOR.

Mean-variance optimization: A case study

We explored questions about the limitations of historical returns in a case study of mean-variance optimization. We constructed five portfolios, each with different inception dates, based on return data from 1988 to each portfolio's start date.[2] The investment opportunity set included 11 asset and sub-asset classes. Each portfolio was then evaluated in real time to assess the relative success of the recommended allocation against the policy portfolio.[3]

We used an unconstrained mean-variance optimization process for our case study to amplify the instability of the efficient frontier. In practice, portfolio construction techniques may use constraints or upper and lower limits on sub-asset classes to limit such instability. Although these constraints tend to reduce the size and volatility of the factor loadings, they do not change which market segments get overweighted or underweighted.

Figure 4, which is based on the portfolio constructed as of January 1, 2000, highlights the differences observed between the policy portfolio on the left and the portfolio recommended by mean-variance optimization on the right. As the figure shows, the recommended portfolio includes fewer asset and sub-asset classes and significantly overweights large-cap growth stocks in comparison with the policy portfolio.

Table 1 shows that recommended over- and underweightings can change dramatically from period to period, an echo of our observation about the time-period dependency of returns. The top row specifies the weightings in the policy portfolio. The figures in the subsequent rows represent, for each of the five portfolios, the recommended deviations from the policy-portfolio weightings to reach the optimal allocation at the policy portfolio's volatility. For example, the portfolio constructed on January 1, 1997, held an emerging-markets stake that was 11 percentage points higher than that of the policy portfolio; it held a 25% weighting in commodities, compared with a 0% weighting for the policy portfolio; the efficient portfolio's bond weighting was 29.6 percentage points below that of the policy portfolio. When we add three more years of data, however, these significant tilts almost disappear or reverse direction, underscoring our observation about the time-period dependency of returns.

2 We started the analysis in 1988 to reflect the inception date for the MSCI Emerging Markets Index.

3 Again, our policy portfolio is defined as in footnote 1.

Table 1. Mean-variance optimization case study: Portfolio over- and underweightings

Portfolio construction date	EAFE	EM	REITs	GSCI	LCV	LCG	MCV	MCG	SCV	SCG	U.S. bonds
Policy-portfolio weightings	10.2%	1.8%	1.2%	0.0%	16.4%	16.4%	4.7%	4.7%	2.3%	2.3%	40.0%
1/1/1994	–10.2	33.3	–1.2	7.3	–16.4	–16.4	–4.7	–4.7	–2.3	–2.3	17.6
1/1/1997	–10.2	11.0	12.9	25.0	8.6	–3.7	–4.7	–4.7	–2.3	–2.3	–29.6
1/1/2000	–10.2	–1.8	–1.2	11.6	–5.7	29.1	–4.7	–4.7	–2.3	–2.3	–7.8
1/1/2003	–10.2	–1.8	–1.2	16.4	–16.4	–16.4	56.1	–4.7	–2.3	–2.3	–17.2
1/1/2006	–10.2	2.2	15.9	19.7	–16.4	–16.4	38.5	–4.7	–2.3	–2.3	–24.0

Note: See Figure 4 for benchmarks used.

Sources: Vanguard Investment Counseling & Research, Zephyr Associates: AllocationADVISOR.

Past performance, momentum bias, and unreliable performance

Table 2 shows the real-time performance of these mean-variance efficient portfolios. The portfolios formed in 1994, 1997, and 2000 trailed the returns of the policy portfolio; the portfolio formed in 2003 outperformed over the evaluation period, while the portfolio formed in 2006 has so far slightly underperformed the policy portfolio.

The patterns that emerge from Tables 1 and 2 are consistent with an embedded momentum bias. As is well known, mean-variance optimization (MVO) overweights asset and sub-asset classes that boast the best risk-adjusted returns—in effect, those that have recently outperformed. Approaches such as the Black-Litterman Model, or even more advanced regression-based models, can limit over- and under-weightings, but these techniques may change only the potential magnitude of tilts, not their direction. In a momentum cycle, past winners will be expected to continue to outperform. The cycle inevitably breaks down, however, and those investments with superior trailing performance produce below-market returns.

This pattern helps to explain the weak performance of the first three portfolios. The first portfolio, constructed in 1994, held a large overweight in emerging markets, one of the world's best-performing market segments from 1988 to 1994. Then, in early 1994, the Mexican peso imploded. The financial crisis reverberated through Latin America. Over the next two years, emerging markets were among the weakest performers, and the MVO portfolio trailed the market-weighted portfolio by –8.2% per year.

A similar dynamic explains the below-policy-portfolio return of the portfolio constructed in 2000. From 1988 to 2000, large-cap growth stocks surged ahead of their value-oriented counterparts, producing superior risk-adjusted returns. The MVO portfolio called for a 29% overweighting in large-cap growth stocks—just in time for their collapse. From 2000 to 2002, the MVO portfolio trailed the market portfolio by 3.8% per year.

The portfolio formed in 2003 outperformed during the subsequent evaluation period, as its overweighted segments continued to build on past performance. The portfolio formed in 2006 has recently started to come under pressure, as overweighted segments such as REITs have looked vulnerable. The remaining 18 months through 2008 will determine if the 2006 portfolio will be defined as successful.

Table 2. Mean-variance optimization case study: Subsequent performance of recommended portfolios

Portfolio construction date	Evaluation period	Policy-portfolio returns	MVO portfolio returns	Excess return	Large overweighting
1/1/1994	1994–1996	12.5%	4.3%	–8.2%	Emerging markets, commodities
1/1/1997	1997–1999	17.2	8.9	–8.3	Emerging markets, commodities, REITs
1/1/2000	2000–2002	–5.0	–8.8	–3.8	Large-cap growth
1/1/2003	2003–2005	10.7	19.6	8.9	Commodities, mid-cap value
1/1/2006	2006–6/2007	11.6	11.1	–0.5	Commodities, mid-cap value, REITs

Sources: Vanguard Investment Counseling & Research, Zephyr Associates: AllocationADVISOR.

This hypothetical example does not represent the return on any particular investment. Past performance is no guarantee of future returns.

More investment opportunities, a more volatile frontier

As asset classes are divided into smaller sub-asset classes and sectors, the momentum bias in mean-variance optimal portfolio construction techniques produces greater volatility in the composition of forward-looking portfolios. When the broad stock market is divided into style-based sub-asset classes, for example, one must necessarily come in first, and one last, in any given period. And, as our analysis of time-period dependency suggests, relative rankings change quickly. The result is instability in portfolios designed to load on investments that have outperformed over the observed historical time frame.

Instability isn't necessarily a problem, of course, if it leads to consistently superior performance. But the opportunities that a mean-variance optimization of sub-asset classes seeks to exploit are fleeting at best and perhaps even an illusion. Financial theory suggests that risk (more precisely, systematic risk) and return are related. We expect stocks to produce a higher long-term return than cash, because investors demand a higher expected return in exchange for assuming greater risk.

However, when one risk factor explains most of the performance of various sub-asset classes (market risk for stocks, interest rate risk for bonds), we would expect long-term risks and returns to be more similar than different. For example, all bonds, whether corporate or government-issued, share a similar structure and are subject to interest rate changes. As a result, over the long term we would expect investment-grade fixed income instruments to behave more similarly than differently. At the same time, stocks, whether small-cap value or large-cap growth, are beholden to systematic market risk. As a result, over the long term we would expect risks and returns to be more similar than different.

Think outside the black box

The decision to deviate from policy-portfolio weights is typically informed by a portfolio optimizer and the investment mandate's specific objectives. The two most commonly used approaches to portfolio optimization have been historical mean-variance and forward-looking expected frontiers. These approaches are relatively reliable when applied to broad asset classes—stocks, bonds, and cash. However, using historical relationships within broad asset classes to predict future relationships assumes permanence in those relationships—a permanence that may not exist. And because of the constantly changing dynamics of market interactions, there is no strong evidence that investors can consistently and accurately forecast returns, risk correlations, and cross correlations.

Investors should therefore use caution in modeling and allocating assets to strategies and/or asset classes for which index data are short in history or quality. Investors should also be cautious about large deviations from the market consensus portfolio. Such deviations may be consistent with an investor's objectives and unique circumstances, but it's important to be cognizant of the quality of inputs, how a model operates, and why a model is recommending a particular asset mix. The model's expectations can be compared with those embedded in the market portfolio.

Suppose an asset allocation model suggests that a portfolio should overweight small-cap value stocks. Does an analysis of valuations, expected earnings growth, and other fundamentals seem to provide support for this recommendation? Why does the consensus estimate of the appropriate yields, price/earnings ratios, and weighting for small-cap value stocks seem off-target? The evidence should meet a high threshold of proof. It's well-documented that the median active manager struggles to outperform the market (Philips and Ambrosio, 2007).

For the best chance of long-term success, investors should evaluate the model over different time periods, using various benchmarks and implementation schemes. Creating a range of expected future results, instead of single risk and return numbers, will decrease the likelihood for disappointment should the future not replicate the past.

References

Black, Fischer, and Robert Litterman, 1992. Global Portfolio Optimization. *Financial Analysts Journal* 48(5): 28–43.

Philips, Christopher B., and Frank J. Ambrosio, 2007. *The Case for Indexing*. Valley Forge, Pa.: Investment Counseling & Research, The Vanguard Group.

Are REITs an effective proxy for commercial real estate?

Author: Christopher B. Philips, CFA

Increasingly, institutional investors are expanding their targeted exposure to commercial real estate. Yet they continue to focus on private real estate vehicles, with doubts persisting as to whether REITs are an effective long-term proxy for an investment in commercial real estate.

Real estate is a unique and important asset class, and historically has provided competitive real returns and diversification opportunities for traditional portfolios. In the United States, the commercial real estate market may be as large as $5.3 trillion.[1] Unfortunately, most real estate is privately held and therefore difficult to document.

Investing in private real estate presents unique challenges. Direct ownership, for example, requires experience in property management and a considerable expenditure of time on the part of the owner; it may also entail hidden costs and presents a high degree of idiosyncratic risk. Rather than direct ownership, many institutional investors favor private investment vehicles to gain access to the commercial real estate market. The vehicles include open- or closed-ended commingled funds or private partnerships, with the underlying properties managed by a specialist. However, such holdings can be difficult to include in a diversified portfolio because of high costs, illiquidity, limited transparency, and large minimum investments.

As an alternative to private real estate investments, real estate investment trusts (REITs) provide two key comparative benefits: They are far easier for an investor to manage in a portfolio, and they carry lower costs. But are they real estate? Some research indicates that REITs perform more like small-capitalization value stocks than other real estate vehicles. Based on the qualitative and quantitative analysis described in this paper, we conclude that, although REITs have some stock market risk, particularly over short periods, REITs are an effective long-term proxy for the broad commercial real estate market. In addition, REITs are really the only way to capture the real estate market's systematic risk.[2]

The issue: In the past, some research has raised doubts about whether real estate investment trusts are an effective proxy for the broad commercial real estate market.

The implication: If REITs provide an effective proxy for an investment in commercial real estate, implementing an asset allocation recommendation is less complex.

Vanguard conclusion: There is no long-term substantive difference in real estate exposure between holding an interest in a private real estate partnership and holding shares in a REIT.

1 Source: Global Real Analytics. Other estimates include $2.4 trillion by UBS Global Asset Management Real Estate Research (2005) and $4.8 trillion by Institutional Real Estate, Inc.

2 This paper uses the National Association of Real Estate Investment Trusts (NAREIT) Index to represent REIT investments. For private investment holdings, we use a transactions-based index developed by the MIT Center for Real Estate (Fisher, Geltner, and Pollakowski, 2006), based on the National Council of Real Estate Investment Fiduciaries (NCREIF) Index. For more details, please refer to the full paper (Philips, 2007).

Do REITs truly represent an investment in real estate?

A REIT is an operating company that offers equity shares to the public and, as a result, trades on a stock exchange. REITs offer transparency and liquidity beyond that of most private real estate investments, and regional and property-type diversification are achieved more easily in public real estate than in private real estate. For example, a REIT index fund may hold more than 100 REITs, each representing many underlying properties.

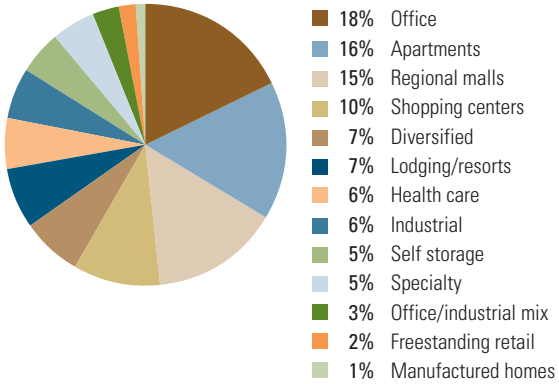
Still, some investors have expressed concern over whether REITs actually represent an investment in real estate. Their primary apprehension is the correlation of the equity market with the performance of REITs, particularly in the small-cap value sector. However, our findings indicate that, although higher historical correlations have existed between the performance of REITs and small-cap value stocks, a significant portion of REITs' returns remain uncorrelated, indicating substantial independence.

Although REITs constitute a small portion of the real estate market and have performed quite differently from other real estate vehicles in the short term, two fundamental similarities between REITs and the commercial real estate market have led us to conclude that REITs are representative of private real estate. Those factors are: core portfolio holdings and long-term performance.

Similar holdings, geographic diversity

REITs and private investments hold similar collateral: Both private and public investment pools derive their returns from holding portfolios of commercial real estate. As Figure 1 suggests, the REIT market is well-diversified across property types, including many property types likely to be included in a private investment pool. A REIT index is also geographically diversified, representing holdings from all areas of the country. Indeed, the range of property types and geographic regions suggests that a broad REIT index is more representative of the aggregate real estate market than any single REIT or private investment pool.

Figure 1. Sector composition of NAREIT Index: December 2006



Note: Numbers may not add up because of rounding.

Source: NAREIT.

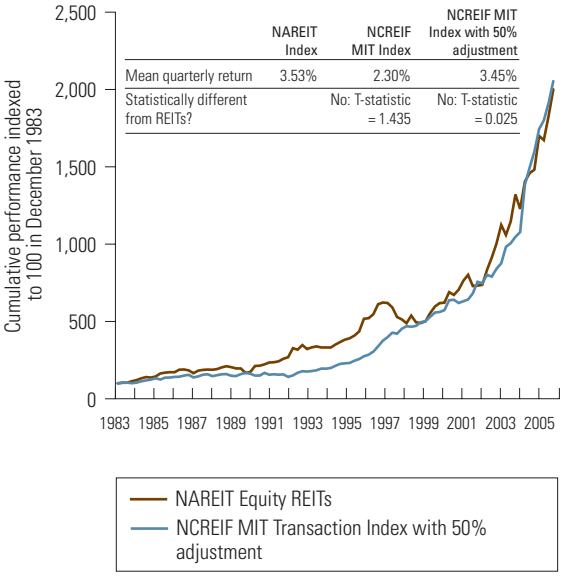
Similar long-term performance

It is also instructive to examine the performance of REITs relative to that of private holdings. Given that commercial real estate represents the underlying holding of both a public and a private investment vehicle, returns should be similar, particularly over the long term.

Figure 2 shows that since 1984 (the inception of the NCREIF MIT Index), the performance of public and private real estate has not differed meaningfully over longer periods—adjusting private real estate for the differences in how benchmark returns are reported (see details in notes below Figure 2). From this perspective, investors in broadly diversified public or private real estate vehicles would likely have ended up in essentially the same place over longer periods of time.

Figure 2. Long-term returns are similar across real estate investment options: December 1983–December 2006

NAREIT Equity REIT Index and Transactions-Based Private Real Estate Index: Comparison of long-term performance



Notes: We made two adjustments to the traditional NCREIF Index. First, we used the transactions-based index developed by the MIT Center for Real Estate and provided by NCREIF. This eliminated the smoothing resulting from appraisal pricing. Second, we adjusted the NCREIF returns to account for the discrepancy with which returns are reported. Because REIT returns are a function of capital structure, the return series accounts for any debt/equity ratio the firms employ. In contrast, private real estate returns assume that property investment is made without the use of debt financing. In fact, returns represent changes in property value only, not the returns realized by investors who may be partially financed with debt. Academic and industry analyses typically include adjustments to private real estate returns of anywhere from 30% to 70%. Our adjustment was an attempt to make the return series more comparable, with the acknowledgment that there are perhaps more complex and more accurate approaches. The analysis holds using alternate REIT benchmarks.

Sources: Author's calculations using data from NAREIT and NCREIF MIT. Analysis derived from methodology employed by researchers such as Joseph L. Pagliari Jr. (2003).

Past performance is no guarantee of future results.

Capturing systematic risk

Investment in a REIT index fund or exchange-traded fund (ETF) can provide the systematic returns of an investable real estate benchmark. With any asset class, for investors to obtain the risk and return characteristics of the market, an investable market index is required. In fact, outside of a REIT index fund or ETF, any investment in commercial real estate is idiosyncratic, and subsequently a bet on manager skill.

Here, the difference between idiosyncratic and systematic exposure is important, because investors typically model their asset allocation and expected portfolio risks and returns based on systematic exposure. Many assets can be replicated to capture the market beta, but many specialized investments such as privately held commercial real estate do not offer such an option. The derivatives markets may eventually help investors to track private real estate indexes, but opportunities are limited so far. As a result, manager selection results in a potentially wide distribution of return possibilities.

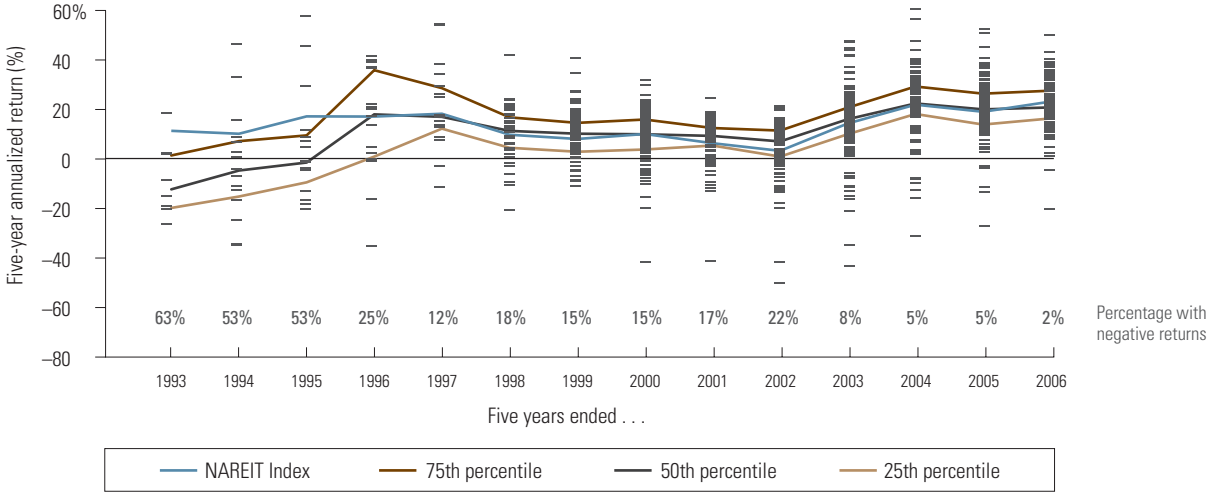
Figure 3, on page 16, which plots five-year annualized returns of individual REITs over time, demonstrates the relationship between idiosyncratic risk and systematic risk.[3] The dispersion of the 5-year returns simulates the idiosyncratic risk and distribution of alpha relative to the wider real estate market.

When evaluating the actual distributions, it is instructive to look at the spread between the 25th and 75th percentiles. In most years the five-year annualized spread was approximately 15%–20%. Such a spread sheds light on the challenges associated with implementing an asset allocation strategy with undiversified investment vehicles. Because investors in private partnerships cannot achieve a beta exposure, those investors likely believe that their managers can consistently deliver returns above the median return for all private partnerships and above the index return for public REITs.

3 We use REIT returns because REIT data are accurate and free of biases. Further, a REIT can be thought of as a publicly traded version of a private partnership or private investment pool. The investment managers invest in similar properties, with similar goals, objectives, and risks.

Figure 3. Idiosyncratic and systematic risks in real estate investments

Distribution of five-year annualized returns for individual REITs, 1988–2006



Source: Author's calculations using data from NAREIT and CRSP.

Conclusion

Although the vast majority of the commercial real estate market is closely held and unavailable to most investors, public real estate represents a reasonable proxy for investors interested in a systematic exposure to commercial real estate. A broad public real estate index provides investors with diversified exposure to real estate, eliminates idiosyncratic manager risk, and has delivered long-term returns similar to those of a broad-based private real estate benchmark. For most investors, public REITs represent a reasonable exposure to commercial real estate.

This article is adapted from a Vanguard Investment Counseling & Research paper on *Commercial Equity Real Estate: A Framework for Analysis* by Christopher B. Philips (2007). The paper is available on Vanguard.com.

References

Craft, T.M., 2001. The Role of Private and Public Real Estate in Pension Plan Portfolio Allocation Choices. *Journal of Real Estate Portfolio Management* 7(1):17–23.

Fisher, Jeff, David Geltner, and Henry Pollakowski, 2006. *A Quarterly Transactions-Based Index (TBI) of Institutional Real Estate Investment Performance and Movements in Supply and Demand.* MIT Center for Real Estate. http://web.mit.edu/cre/research/credl/tbi.html.

Pagliari, Joseph L., Jr., and James R. Webb, 1995. A Fundamental Examination of Securitized and Unsecuritized Real Estate. *Journal of Real Estate Research* 10(4): 381–426.

Pagliari, Joseph L., Jr., Kevin A. Scherer, and Richard T. Monopoli, 2003. Public Versus Private Real Estate Equities: A Risk-Return Comparison. *Journal of Portfolio Management, Special Edition*, pp. 101–111.

Philips, Christopher B., 2007. *Commercial Equity Real Estate: A Framework for Analysis.* Valley Forge, Pa.: Investment Counseling & Research, The Vanguard Group.

Seiler, Michael J., James R. Webb, and F.C. Neil Myer, 2001. Can Private Real Estate Portfolios Be Rebalanced/Diversified Using Equity REIT Shares? *Journal of Real Estate Portfolio Management* 7(1): 25–41.

Emotional intelligence and investment behavior

Authors: John Ameriks, Ph.D., Tanja Wranik, Ph.D.,
Peter Salovey, Ph.D., and Karin Peterson LaBarge, Ph.D.

In the past decade, psychologists have established emotional competence, or emotional intelligence (EI), as an important set of skills in the realm of decision-making and interpersonal relationships. Our research suggests a link between EI and investment behavior. Awareness and understanding of this link may be important in helping investors manage their assets effectively.

Some investors trade too much, others too little. Some prematurely sell their winners while hanging on to losers (Barber and Odean, 2001). Behavioral finance research has attributed these kinds of mistakes to cognitive biases. The idea that many investors make mistakes is widely accepted, but the source and nature of these biases remain poorly understood. In recent years, psychologists and economists have begun analyzing biometric data and conducting experiments and surveys to try to pinpoint psychological influences on investment behavior (Lo, Repin, and Steenberger, 2005).

In January 2007, we began to explore the relationship between investment decisions and emotional intelligence (EI), a well-defined capacity that measures a person's ability to perceive, understand, use, and manage emotions and emotional signals. Our preliminary findings suggest that an important relationship exists between people's capacity to manage their emotions and their resulting investment behavior.

What is emotional intelligence?

For our research purposes, we use the term *emotional intelligence* in a more specialized sense than the concept popularized by Daniel Goleman in his best-selling book *Emotional Intelligence*. In the popular conception, emotional intelligence includes a broad range of personality traits, social skills, and qualities such as "character." In our research, emotional intelligence is a more precisely defined and measured capacity similar to traditional aspects of intelligence. Traditional intelligence is a person's ability to use observed information or data (language, patterns, and spatial relationships) to think productively. Emotional intelligence is a person's ability to recognize and interpret emotions and to use and integrate them productively for optimal reasoning and problem-solving (Salovey and Mayer, 1990; Mayer and Salovey, 1997). In this way, EI is similar to traditional intelligence, but EI *uses moods or emotions* as "data" or information.[1]

The issue: Psychologists and economists have begun to quantify relationships between psychological characteristics and investment behavior.

The implication: Improved understanding of these relationships may lead to better portfolio design and advice-giving that can foster investor success.

Vanguard conclusion: Awareness and understanding of the link between EI and investment behavior are important in helping investors manage their wealth effectively.

Note: *John Ameriks, Principal, and Karin Peterson LaBarge, Senior Investment Analyst, are members of Vanguard's Investment Counseling & Research group. Tanja Wranik is an Assistant Professor in the Emotion Research Group at the University of Geneva, Switzerland. Peter Salovey is Dean of Yale College and the Chris Argyris Professor of Psychology at Yale University, New Haven, Connecticut.* *The authors gratefully acknowledge support from the Research Foundation of the CFA Institute. We also thank Multi-Health Systems, Inc., for its assistance in assembling the survey data and test scores used for this study.*

1 Emotional intelligence should be distinguished from emotionality. An emotional person may feel and/or act more intensively, while an emotionally intelligent person is one who is able to recognize and use emotions more productively.

Research in the last decade has shown that moods and emotions play important roles in reasoning, decision-making, and social relationships. Moreover, and contrary to popular beliefs, moods and emotions do not play the role of "culprit" in these processes (as though they should be eliminated); rather, they often contain valuable signals and clues that facilitate optimal personal choices and decisions. The trick is to know how to recognize and interpret these signals. Those who are high in EI are able to use and integrate their moods and emotions effectively. Those who are low in EI might ignore, misinterpret, or be overwhelmed by their moods and emotions and therefore not reap the potential benefits. Given the pervasiveness of moods and emotions in all spheres of life (including financial decision-making), this form of intelligence is gaining in acceptance, and the definitions, research, and measures are becoming ever more sophisticated.

Our research focused on Mayer and Salovey's specific model of emotional intelligence (1997) and on the emotional intelligence test based upon this model, which was developed by Mayer, Salovey, and Caruso (2002). The model comprises four distinct areas:

- Perceiving emotions—ability to recognize emotional signals in people's faces and via other communication channels.
- Using emotions—ability to use emotions to enhance thinking and problem-solving.
- Understanding emotions—ability to analyze emotions, predict how emotional states will change over time, and evaluate the influence of emotions on an outcome.
- Managing emotions—ability to understand and respond to emotional stimuli in the context of a particular goal or social situation.

Emotional intelligence can be measured both within each of these categories and as an overall composite measure of a person's relative ability in all areas. Our research focuses on investors' abilities within each of these separate areas and on the variety of influences that those abilities may have on investment behavior.

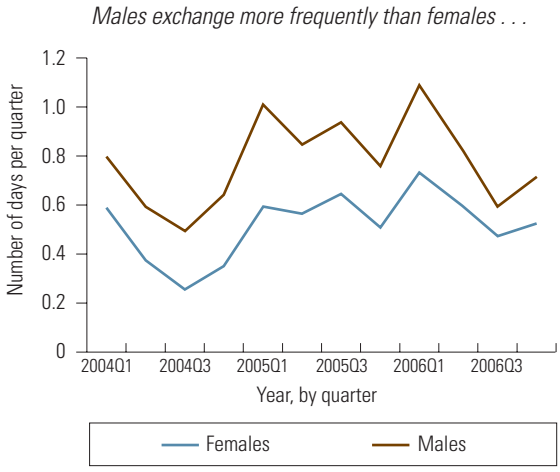
Survey sample and research goals

This article summarizes the results of a recent survey of 1,357 Vanguard investors, from whom we collected demographic information and administered a test of emotional intelligence.[2] The sample was not a random cross-section of Vanguard investors; rather, it was restricted to baby boomers (those born from 1946 through 1964) with at least $5,000 in two or more Vanguard retirement accounts at the end of 2005. We conducted the survey online in January and February 2007. In terms of demographics, 85% of respondents were between the ages of 45 and 55; the majority (69%) were male; and just over three-quarters (76%) were married. Just under three-quarters were still working full-time, whereas 11% were retired. Overall, the group was very highly educated, with correspondingly high incomes and wealth: 38% had a master's degree or higher, 58% had household income of over $100k, and 59% reported total household assets of $500k or more.

We emphasize that our research goal was *not* (and, owing to our survey's structure and small scale, *could not be*) to assess the EI of "investors" at large. To the extent that Vanguard investors (and the group we sampled within that class) may differ from other investors, our data do not allow us to generalize our conclusions to the overall universe of individual investors. Our goal was simply to determine whether, within a group of Vanguard investors, variation in the components of emotional intelligence had a significant relationship to observed investor behavior. Given our affirmative preliminary conclusions, an important avenue for future work will be to investigate whether these conclusions apply to a broader population.

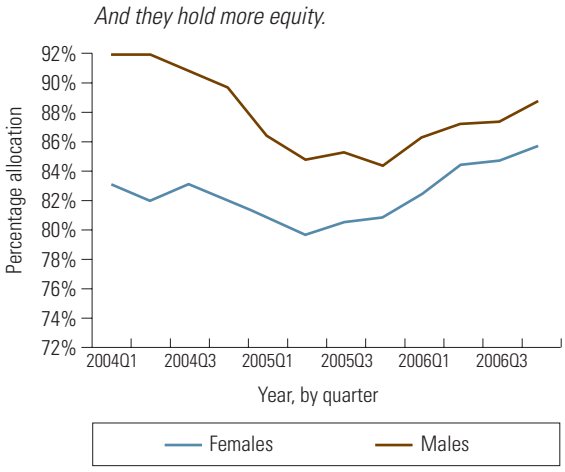
2 The survey sampled investors with individual retirement accounts at Vanguard. We have also surveyed more than 1,400 participants in Vanguard-administered employer-sponsored retirement plans; those results will be analyzed in later research.

Figure 1. Average number of days on which survey respondents made an exchange: 2004–2006



Source: Vanguard Investment Counseling & Research.

Figure 2. Survey respondents' average allocation to stocks in Vanguard® funds: 2004–2006



Source: Vanguard Investment Counseling & Research.

What drives investor behavior?

This article focuses on investor behavior in terms of the number of days investors (i.e., survey respondents) made an exchange during 2004–2006 and the investors' equity allocation at the end of 2006. Like Barber and Odean (2001), we found that within the group of respondents, men tended to trade more frequently than women. Men also tended to have a higher equity allocation. These differences, which were relatively modest in our study, are illustrated in Figures 1 and 2. Figure 1 shows that throughout 2004–2006,[3] the average number of days on which an exchange transaction occurred was uniformly higher for males than females (by roughly 30%), meaning men were significantly more likely to exchange assets from one fund to another than were women. Figure 2 plots the differences between male and female respondents in the overall allocation to equities; at the end of the first quarter of 2004, women held 8 percentage points, on average, less of their portfolios in stocks. By the end of 2006, the difference had narrowed to 3 percentage points.

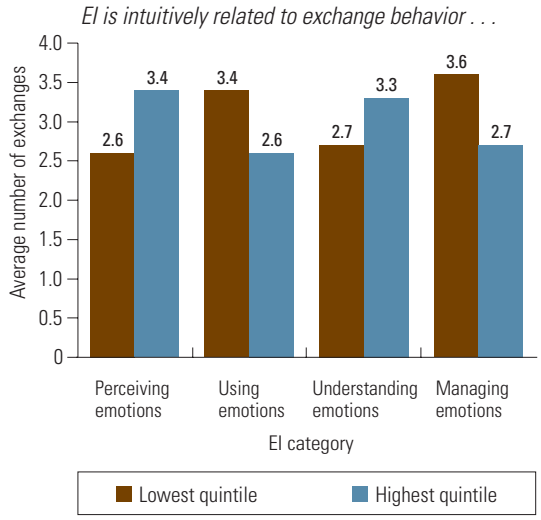
Differences in emotional intelligence have a relationship to investment behavior, particularly in terms of exchange activity. Figure 3, on page 20, presents exchange activity during 2006 for the lowest- and highest-scoring quintiles of respondents for each of the four components of emotional intelligence (perceiving, using, understanding, and managing emotions). Respondents scoring in the highest quintile for "perceiving emotions" tended to trade more frequently than those in the lowest quintile, while those in the highest quintile for "managing emotions" tended to trade less frequently than those in the lowest quintile.

The results paint a picture that can be considered somewhat consistent with (admittedly crude) profiles of various investor types. For example, an investor skilled at recognizing emotional signals—a spike in stock market volatility—would tend to trade more frequently, much like the proverbial "jittery" investor panicked by the stock market's occasional swoons. The stereotypical steely-nerved financier, by contrast, is skilled at using and managing emotional stimuli, subordinating signals of danger to a long-term strategy appropriate in the stock market context.

The relationship between differences in emotional intelligence scores and risk-taking was less clear. Investors in both the highest and lowest quintiles for each EI component held similar equity allocations at the end of 2006, as shown in Figure 4, on page 20.

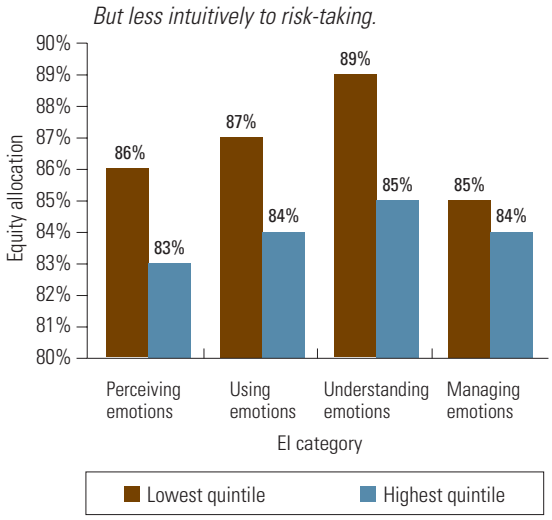
3 The use of the number of days, rather than the number of transactions, allowed us to count a single transactional event such as rebalancing, which might involve multiple exchanges in multiple funds, as one exchange.

Figure 3. Differences in survey respondents' average number of annual exchanges, by EI category: 2006



Source: Vanguard Investment Counseling & Research.

Figure 4. Differences in survey respondents' equity allocations, by EI category: As of December 31, 2006



Source: Vanguard Investment Counseling & Research.

Exchange activity: How important is EI?

As described, these high-level findings are consistent with intuitive guesses one might make about emotions and investment behavior. At the same time, we would expect investors who are especially sensitive to emotions or emotional cues and stimuli, or those who are especially skilled at managing their response to these cues and stimuli, to behave differently from the rest of the sample group.

Table 1. Poisson regression results: Influence of EI scores on exchange incidence

Emotional intelligence measure	Incidence-rate ratio	z-stat	p-value
Perceiving emotions " score	1.01	1.18	0.237
"Using emotions" score	0.99	–1.14	0.255
"Understanding emotions" score	1.01	0.85	0.395
"Managing emotions" score	0.98	–2.18	0.029

Note: See text for an explanation of incidence-rate ratio.

Source: Vanguard Investment Counseling & Research.

Without further analysis, however, we cannot determine whether the differences we found reflect *only* emotional intelligence or a combination of emotional abilities and other characteristics such as demographic variations. (For example, it has been established that, on average, women demonstrate greater emotional intelligence than men [Bernet, 1996]. The reason is that girls and women are allowed to explore various aspects of their emotional lives, which gives them greater breadth of knowledge, while boys and men tend to be restricted. More advanced parenting and educational practices, however, should help eliminate these differences for future generations.) To control for differences in these variables while assessing the importance of the four aspects of emotional intelligence in explaining differences in exchange activity, we used a mathematical model to predict the number of exchanges an investor would be expected to make based on his or her education, wealth, income, gender, and emotional intelligence.[4] The model allowed us to estimate the impact of each of these characteristics on the "incidence rate" (likelihood of occurrence) of an exchange transaction, independent of the other characteristics. The model allowed us to "control for" differences in education, wealth, income, and gender when estimating the relationship between EI and exchange activity. Table 1 shows the results of estimating the model parameters via a regression analysis. (For brevity, the table reports only the estimates for the EI scores.)

These statistical results show that, for the most part, the pattern observed in Figure 3 (that is, investors who scored higher on perceiving and understanding emotions made more exchanges relative to investors with low scores in these areas; and investors who

4 Formally, we estimated parameters in a Poisson model intended to capture variation in the incidence of exchange transactions across investors. This specification assumed that the likelihood of an exchange occurring is a constant probability through time that varies with the characteristics of the investor. An obvious extension of this work, which we will pursue in subsequent analysis, would be to implement a hazard model that would allow the probability of an event to potentially vary with the time since the last event as well as with investor characteristics.

scored higher on using and managing emotions made fewer exchanges relative to investors with lower scores in those areas) survives when variation in other demographic and economic characteristics is taken into account. The "incidence-rate ratio" numbers are the estimated impact of the test scores on the overall incidence of exchange transactions. An incidence rate coefficient of 1.01 means that the model's predicted incidence rate of an exchange is higher by a multiple of 1.01 (1%) for every unit of change in the underlying score. In other words, among two individuals with "perceiving emotion" scores that are ten points apart, the one with the higher score has a 10% higher likelihood of making an exchange transaction. For the numbers less than one, the impact is analogous: An incidence rate ratio of 0.98 implies that the overall incidence rate is lower by 0.98 (2%) for every unit of the underlying score. Thus, a ten-point difference in score on "managing emotions" leads to a 20% difference in the likelihood of an exchange transaction. Such a ten-point difference in emotional intelligence scores was quite common in the survey data; the standard deviation of the test scores measure was roughly ten points.

Although the overall direction of the effects of various aspects of emotional intelligence is preserved in this more detailed analysis, it is important to note that only the effect of "managing emotion" has strong statistical significance. More work is needed to determine whether these other categories of emotional intelligence truly are as powerful in explaining transactional behavior as these point estimates suggest.

New information can mean better portfolios

Our preliminary findings suggest that there is an important relationship between emotional intelligence and investment behavior. This relationship is hardly a shock. The power of emotion is a staple of market lore. Investors grapple with fear and greed. Markets climb a "wall of worry." The value of these findings and the growing body of similar research is that they underscore the importance of identifying the specific psychological mechanisms that guide investment decisions. Although these early results are suggestive, they are not the final word. We have shown that there is a link between EI and trading incidence; a clear next step is to extend the analysis to measures of risk-adjusted performance. We will also examine issues such as the choice between active and passive investment strategies.

As researchers work to pinpoint the source of investor biases, particularly those leading to investor mistakes, the investment industry can use this information to develop products and services that may help save investors from sabotaging their financial futures. Autopilot 401(k) plans and broadly diversified target maturity funds are a step in this direction. A more customized outcome of this research might be more tailored asset allocation advice, achieved after in-depth interaction between the investor and financial advisor. This advice would be based not only on an investor's financial goals and risk tolerance but also on the investor's psychological characteristics (including his or her emotional intelligence). New portfolio-construction methods combining the best of mathematical finance with rigorously quantified psychological metrics could be used to build better financial advice models and to create portfolios that enhance investors' likelihood of reaching their financial goals.

References

Barber, Brad, and Terry Odean, 2001. Boys Will Be Boys: Gender, Overconfidence, and Common Stock. *Quarterly Journal of Economics* 166 (1, February): 261–92.

Bernet, Michael, 1996. *Emotional Intelligence: Components and Correlates*. Toronto, Canada: American Psychological Association. (ERIC Document Reproduction Service No. ED 408 535). http://somats.com/ei1996.htm.

Lo, Andrew W., Dmitry V. Repin, and Brett N. Steenberger, 2005. *Fear and Greed in Financial Markets: A Clinical Study of Day-Traders*. Cambridge, Mass.: NBER Working Paper No. 11243 (March).

Mayer, John D., and Peter Salovey, 1997. "What Is Emotional Intelligence?" In *Emotional Development and Emotional Intelligence: Educational Implications*, edited by Peter Salovey and David Sluyter. New York: Basic Books, 3–31.

Mayer, John D., Peter Salovey, and David R. Caruso, 2002. *Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT) User's Manual*. Toronto, Canada: MHS Publishers.

Salovey, Peter, and John D. Mayer, 1990. Emotional Intelligence. *Imagination, Cognition, and Personality* 9: 185–211.

Evolving U.S. inflation dynamics

Author: Joseph H. Davis, Ph.D.

The dynamics of U.S. inflation have changed dramatically in recent decades, primarily because of more appropriate and transparent monetary policy. Will lower and more-stable trend inflation persist in the years ahead? What are the implications for future interest rates?

Inflation is a fundamental macroeconomic risk factor for a broad range of asset classes. Indeed, unexpected shocks to an economy's inflation process, or changes in inflation expectations, can significantly influence the level of interest rates and, by extension, the expected returns on stocks, bonds, and other financial assets. And, although stocks and bonds have proven to be an effective long-term inflation hedge, periods of unexpectedly high and volatile inflation—such as those observed in the mid-1970s and early 1980s—have historically been associated with periods of below-average or negative returns.

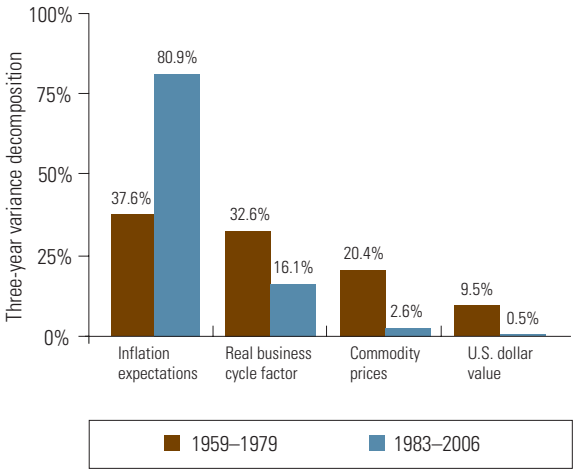
Since the 1980s, global inflation has generally trended lower and become less volatile. At the same time, inflation persistence has steadily declined, as inflation shocks (for example, the steep climb in energy prices) have led to smaller and more temporary increases in inflation.

This shift toward lower and more stable trend inflation is among the most significant global economic developments of the past several decades. In the years ahead, a critical question for investors is whether the trend can persist in the face of secular inflationary forces, including high food and energy prices, fiscal and trade imbalances, demographic dynamics, and the rapid industrial development of China, India, and other economies.

This article summarizes the primary findings of a more in-depth Vanguard paper (Davis, 2007) that investigates the evolving dynamics of the U.S. inflation process. We document that the profound changes in U.S. inflation persistence are the result of more effective and credible monetary policy, rather than of "globalization" or other structural changes in the economy. We then consider the potential implications for investors of these changes in inflation dynamics.

Figure 1. Drivers of U.S. inflation have changed markedly over time

Relative importance in explaining core CPI inflation



Notes: Figures reflect a Cholesky variance decomposition from 10,000 Monte Carlo bootstrapped simulations on a vector autoregression model's residual covariance matrix, measured over a three-year horizon. For details on the VAR model specification, see the full Vanguard paper (Davis, 2007).

Source: Vanguard Investment Counseling & Research.

The issue: Since the mid-1980s, inflation has trended lower and become less volatile. Will this trend persist in the years ahead?

The implication: More appropriate U.S. monetary policy has reduced the likelihood of a return to the high-inflation environment of the 1970s and early 1980s.

Vanguard conclusion: For investors, the anchoring of long-run inflation expectations should engender more stable long-term bond yields, albeit perhaps with higher real short-term interest rates.

A profound change in inflation dynamics

Our research shows that the relationship between U.S. inflation and those factors that influence the inflation process has changed markedly over the past several decades. To explore this relationship, we model the U.S. "core" inflation process (which excludes food and energy prices) as a function of five key variables: past inflation and expectations for future inflation, plus or minus the effects of broad economic "slack" (the gap between current output and potential full output) and two distinct supply-side shocks—commodity prices and foreign exchange rates.[1] From this model, we can evaluate the relative importance of each variable in explaining core inflation dynamics over two sample time periods.

Figure 1 documents the striking changes in U.S. inflation dynamics. In the 20 years prior to 1979—when Paul A. Volcker became chairman of the Federal Reserve Board—those factors deemed by conventional wisdom to drive the inflation process in fact did. The relative growth in real economic activity over the business cycle had a sizable impact on trend core inflation. Commodity-price shocks were another significant factor, accounting for about 20% of the volatility in core CPI inflation. The economically and statistically significant correlation between commodity-price shocks and future core inflation during that period implies that sharp increases in commodity prices eventually "bled over" and translated into sharp increases in core CPI inflation.

Since 1983, however, domestic core inflation has become less responsive to fluctuations in real economic activity and price-based shocks. Perhaps the most remarkable change is the pronounced weakening in the correlation between energy prices and future changes in core inflation. Although the two oil-price shocks of the 1970s were associated with large jumps in core inflation, recent surges in energy prices have not had a similar effect. Indeed, the "pass-through" from price movements for gasoline and other energy products to U.S. core inflation has declined considerably, even though the magnitude of oil-price fluctuations has not.[2]

As commodity prices, the business cycle, and other leading indicators of future inflation have weakened in their ability to predict core inflation over time, inflation expectations have become significantly more important in explaining both the level and volatility of core inflation. As Figure 1 illustrates, inflation expectations have accounted for about 81% of the variance in core inflation since the beginning of 1983, compared with only about 38% in the 1959–1979 period.

1 Specifically, Davis (2007) estimates a five-equation vector autoregression (VAR) macroeconomic model using quarterly data over two samples: 1959Q2–1979Q2 and 1983Q1–2006Q4. The VAR model includes the core Consumer Price Index (CPI) inflation rate, since we wished to isolate the "second-round effects" of commodity-based inflation pressures. We exclude the quarterly observations from 1979Q3 through 1982Q4, given the documented structural break in inflation volatility and monetary-policy regimes over this period. As is well known, Federal Reserve Chairman Paul Volcker formally announced a change in monetary policy in October 1979, targeting money supply to quell high and rising inflation. The Federal Reserve Board did not resume targeting the federal funds rate until after the October 1982 meeting of its Federal Open Market Committee.

2 Davis (2007) documents how core inflation's eventual response to a given percentage change in energy prices (that is, core inflation's "beta" in relation to energy-price inflation) has changed over time. Specifically, we show that rolling beta estimates of core CPI inflation in relation to the CPI energy inflation rate were roughly 0.2 during the 1970s, which meant that a doubling in oil prices led to an approximate 20% increase in core inflation over the following year. At the end of 2006, a doubling in oil prices would have been expected to increase core inflation less than 1%.

Monetary policy: A more effective firebreak for inflationary pressures

The conduct of U.S. monetary policy is the most cogent and logical explanation for the evolution in U.S. inflation dynamics since the early 1980s, since long-run inflation is ultimately under the control of an economy's central bank. More appropriate and credible monetary policy over the past two decades has resulted in better-anchored inflation expectations. The rising credibility of U.S. monetary policy in maintaining price stability has been cited by leading Federal Reserve officials (for example, Bernanke, 2007) as playing the most prominent role in the improved dynamics of U.S. inflation.[3]

The Fed has been instrumental in helping to alter U.S. inflation dynamics by setting short-term interest rates at a level more likely to neutralize inflation shocks. Indeed, macroeconomic theory predicts that the relationship between an economy's inflation rate and the other driving variables should change as inflation expectations adapt to changes in monetary policy.[4]

To better illustrate the changes in U.S. monetary policy, we estimated interest-rate policy rules. These so-called Taylor rules are simple monetary policy guidelines that prescribe how a central bank should systematically adjust interest rates in response to developments in inflation and macroeconomic activity in order to ensure both price stability and full employment. In equilibrium, a Taylor rule dictates that the federal funds rate is "neutral," with the U.S. economy growing at its potential and inflation at the Federal Reserve's desired level.

We investigated how the actual conduct of U.S. monetary policy has changed over time by estimating the equation discussed in the accompanying text box.[5] We estimated real-time forward-looking Taylor rules for two time periods: (1) the pre-Volcker "Great Inflation" regime from 1965Q1 to 1979Q2 and (2) the post-1982 "Great Disinflation" period. We analyzed three alternative real-time measures for the economy's output gap, or "slack." We measured inflation expectations based on the median year-ahead consensus survey inflation forecast from the Federal Reserve Bank of Philadelphia's *Survey of Professional Forecasters*. In our regressions, we controlled for the lag before data are released publicly.

The Taylor rules: Monetary policy guidelines

A popular family of Taylor rules states that "optimal" monetary policy should be both preemptive and forward-looking, responding to year-ahead inflation expectations rather than to past inflation levels. A forward-looking Taylor rule sets the federal funds rate ffr_t^{opt} at time t according to the formula:

$$ffr_t^{oppt} = r^* + E_t\pi_{t+4} + \gamma_\pi \cdot (E_t\pi_{t+4} - \pi^*) + \gamma_y \cdot (y_t^{gap} - ygap^*),$$

where r^* is the equilibrium real federal funds rate and π^* is the Federal Reserve Board's long-run inflation target. According to this Taylor rule, the Federal Reserve adjusts the fed funds target depending both on how far inflation expectations $E_t(\pi^e_{t+4})$ deviate from a long-run inflation target and on whether the U.S. economy is expanding above or below its potential $ygap^*$. In equilibrium, the inflation-expectations gap and output gap terms are zero, leaving the "neutral" fed funds rate as the sum of $r^* + \pi^*$.

How aggressively the Federal Reserve should respond to the gap in expected inflation and real output is a matter of debate. We can, however, estimate how the Fed has *actually* responded to such criteria in real time. By rearranging the above expression, we estimate the following equation:

$$ffr_t^{actual} = r^* + \gamma_y^{actual} \cdot (E_t\pi_{t+4} - \pi^*) + \gamma_y^{actual} \cdot (y_t^{gap}) + \varepsilon_t,$$

Macroeconomic theory and calibration suggest that the parameters necessary to achieve the Federal Reserve's long-run goals are $\gamma_y^{actual} = 1.5$ and $\gamma_y^{actual} = 0.5$. According to this rule, the Federal Reserve should respond to the gap between the public's inflation expectations and its own inflation target by raising the federal funds rate by a margin *greater than one*. That is, real short-term interest rates should be "restrictive" and thus should rise whenever public inflation expectations rise.

3 Other possible explanations for the changes in U.S. inflation dynamics include (1) globalization and (2) a more energy-efficient and less commodity-intensive U.S. economy. However, additional empirical analysis reveals that neither of these factors has been statistically meaningful. The variance decomposition of a "globalized" U.S. inflation model, for instance, is virtually indistinguishable from the results shown in Figure 1. For details, see Davis (2007).

4 This is formally known as the Lucas critique, after the seminal work of Robert E. Lucas Jr., winner of the Nobel Prize in economics.

5 We were careful to analyze historical interest rate decisions with the economic data available to the Federal Reserve at the time of its deliberations, since real-time Taylor rule policy recommendations differ considerably from those obtained with ex post revised data. For details, see Davis (2007).

Table 1. Real-time forward-looking Taylor rules under different regimes

Standard errors shown in parentheses below variable coefficients

	1965Q1–1979Q2 sample Real-time as-reported *ygap* variable			1983Q1–2006Q4 sample Real-time as-reported *ygap* variable		
Variable	Payroll gap	Real GDP gap	Stock-Watson gap	Payroll gap	Real GDP gap	Stock-Watson gap
Inflation expectations gap	0.421 (0.53)	0.402 (0.55)	0.395 (0.47)	**2.116*** (0.87)	**2.113*** (0.87)	**2.121*** (0.77)
Real output gap *(ygap)*	0.406 (0.66)	0.059 (0.39)	(0.115) (0.22)	**0.511*** (0.25)	0.305 (0.26)	**0.334*** (0.14)
Constant	**5.179*** (1.39)	**5.278*** (1.48)	**5.320*** (1.40)	**2.658*** (1.67)	**2.654*** (1.65)	**2.668*** (1.49)
Adjusted R-squared Standard error of equation	0.17 1.98	0.12 2.03	0.14 2.01	0.72 1.31	0.71 1.33	0.72 1.31

Notes: Variables significant at the 10% level are boldfaced and marked with an asterisk. We used a Generalized Method of Moments (GMM) estimator with prewhitening, Andrews bandwidth (appropriate AR(1) given potential IR smoothing), and a Bartlett kernel.

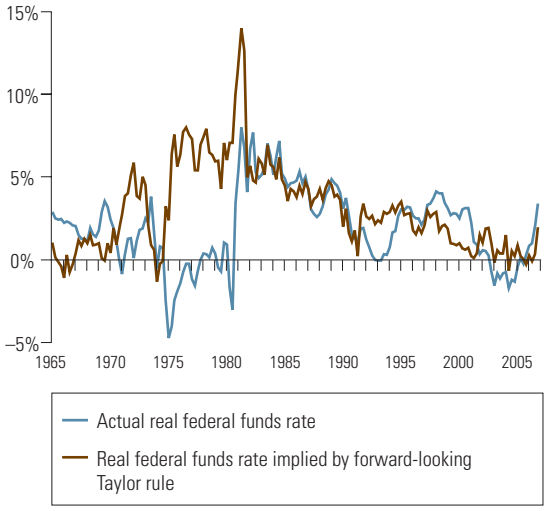
Source: Vanguard Investment Counseling & Research.

The regression results in Table 1 reveal a sharp difference in how monetary policy was conducted in the two periods. The forward-looking Taylor rule does not explain monetary policy very well in the pre-Volcker regime, with adjusted R^2 at or below 17%. Most notably, the coefficient on the inflation-expectations gap is well below 1.5; in fact, it is not statistically different from zero, regardless of how we quantify the real output gap. These results confirm that *during the 1960s and 1970s, the Federal Reserve maintained short-term interest rates that were too accommodative. The federal funds rate was simply too low to preserve low and stable inflation expectations.*[6]

Since the early 1980s, however, the Federal Reserve has demonstrated a stronger commitment to price stability, as shown in Table 1. Indeed, the estimated coefficients on the inflation expectations gap are above 2, revealing that real interest rates have risen notably when the public's expectations for inflation have deviated from the Federal Reserve's long-run inflation target. A forward-looking Taylor rule has more accurately characterized monetary policy since the early 1980s, with adjusted R^2 slightly higher than 70%.

Our empirical results demonstrate that, since the early 1980s, U.S. monetary policy has been more focused on low and stable inflation expectations than was the case earlier in the 1970s, a period characterized by some researchers as one of substantial "monetary policy mistakes." As an example, the estimated forward-looking Taylor rule illustrated in Figure 2 suggests that the average nominal federal funds rate should have been over 14% for the five years following the 1974 OPEC oil embargo, or approximately double the actual rate of 7%.

Figure 2. Monetary policy was too accommodative in the 1970s: Conventional versus Taylor estimates of inflation expectations



Notes: Actual real federal funds rate is defined as nominal federal funds rate minus year-over-year headline CPI inflation rate. Implied "optimal" real federal funds rate is derived from applying the equation results in Table 1 for the post-1982 period over the full 1965Q1–2006Q4 sample.

Source: Vanguard Investment Counseling & Research.

6 Explanations vary as to why the Fed was too accommodative during the 1970s. For an overview, see Davis (2007).

Implications for future short-term interest rates

More appropriate, credible, and transparent U.S. monetary policy over the past two decades has resulted in better-anchored inflation expectations and a more supportive environment for the economy and for equity and fixed income investors. If inflation expectations among investors and businesses remain well-anchored in the decades ahead, then future inflation shocks—whether they arise from oil prices, higher business demand, or a weaker U.S. dollar—should have relatively short-lived and muted effects on actual trend inflation. Indeed, the increasingly important role of inflation expectations in driving U.S. inflation dynamics has the potential to establish a virtuous self-reinforcing cycle of low and stable actual inflation.

However, we must stress that such a virtuous cycle is not assured, and in fact is conditional on appropriate monetary policy. Indeed, an obvious risk in the years ahead is that the stability of inflation could lead to complacency. Nobel Prize-winning economist Thomas Sargent (2000), for instance, expressed concern that the type of inflation seen in the 1970s could reoccur in the decades ahead if policymakers forget that *it was precisely restrictive monetary policy that has engendered a reversion of actual inflation toward its desired lower level.*

To preserve credibility, the Federal Reserve must continue to respond aggressively to shocks that have the potential to engender adverse effects on inflation dynamics. The practical difficulty of doing so, of course, is that the "neutral" federal funds rate is difficult to observe in real time. Although the Fed's long-run inflation target is widely believed to be around 2%, what is an appropriate value for the equilibrium real federal funds rate, r^*?

Many economists estimate that r^* is approximately 2%, basing that figure on the difference between the nominal federal funds rate and the year-over-year headline CPI inflation rate (see Figure 2). This estimate, when combined with a long-run inflation target of roughly 2.0%–2.5% for headline CPI, implies to some that the neutral long-run nominal federal funds rate is roughly centered in the 4.0%–4.5% range.[7]

However, an application of our estimated forward-looking Taylor rule suggests a higher expected long-run fed funds rate. Figure 3 indicates that a 2% estimate for r^* is biased downward. Certainly the 1970s and early 1980s were not characterized by a low-inflation equilibrium. For the future, the forward-looking rule suggests that a reasonable estimate for r^* is approximately 2.75%–3.5%. If accurate, then the neutral nominal fed funds rate lies approximately in the 4.75%–6.0% range over the long term.

Implications for future long-term interest rates

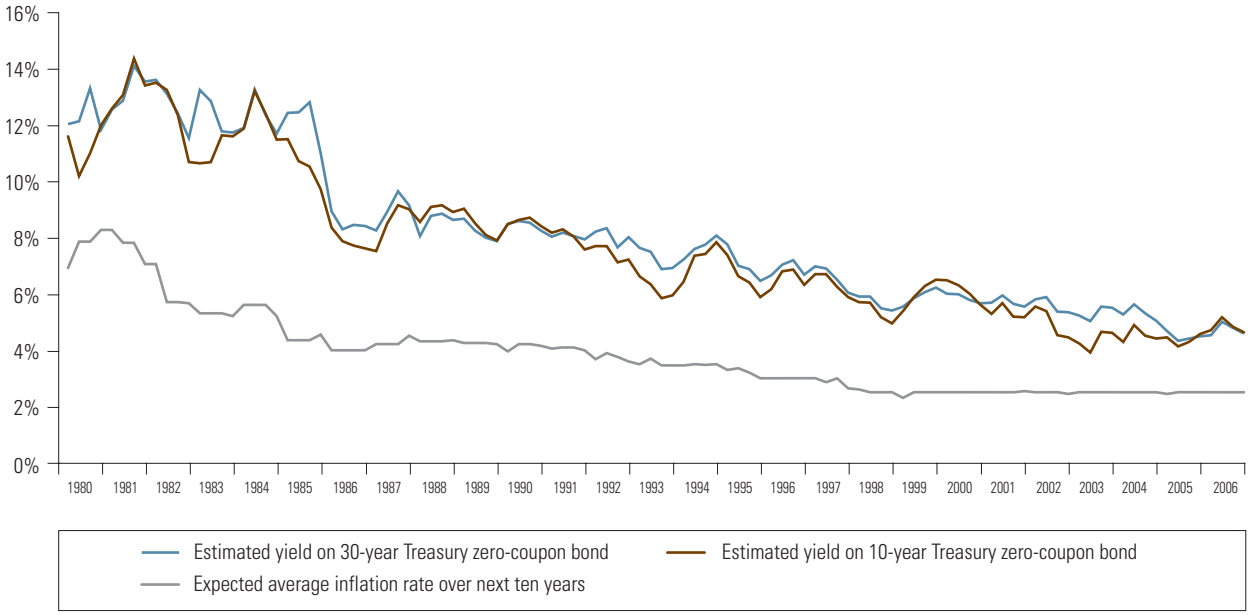
Over the past three decades, the average risk-adjusted return of long-term bonds, as represented by the Lehman Long U.S. Government/Credit Index, has been significantly lower than that of their intermediate-term counterparts. Between January 1973 and December 2006, intermediate-term bonds earned 90% of the return of long-term bonds with only 46% of the volatility. On average, bond investors who extended the duration of their portfolios have not been particularly well rewarded with higher risk-adjusted returns. Of course, the historical relative underperformance of long-duration bonds is due in part to the run-up in inflation expectations during the 1970s and early 1980s, given the high sensitivity of long-duration bonds to the level and uncertainty of long-term inflation expectations (see Figure 3).

The probability that the drastic underperformance of long-duration bonds will repeat in the future is now lower, precisely because the odds that a high-inflation regime will reoccur have fallen. With appropriate monetary policy, the better anchoring of long-run inflation expectations should engender more stable long-term interest rates and expected long-run bond returns than those observed over the past 30 or so years, all else equal.[8]

7 What exactly is a reasonable long-run expectation for U.S. inflation? Over the past decade, the consensus expected long-run CPI inflation rate has hovered near 2.5%. Interestingly, these long-run inflation expectations more closely mirror the average U.S. inflation rate recorded over the past two centuries than the average for the past several decades. According to data provided by the U.S. Bureau of Labor Statistics and Global Financial Data, the average annual U.S. CPI inflation rate over the period 1821–2006 has been 2.1%, versus average inflation rates of 3.9% since 1950 and 4.8% since 1970.

8 That said, all else equal will not hold at all times. Anchored long-run inflation expectations may not prevent long-term Treasury yields from periodically spiking, should other components of long-term interest rates—in particular, real yields and inflation risk premiums—spike in the future. As Fed Chairman Ben Bernanke (2007) and others have noted, it is unclear to what extent other forces—such as global liquidity, the increased interest in liability-driven investing and pension immunization strategies, or the activity of foreign central banks—have more recently distorted nominal yields of long-duration Treasury bonds. A more satisfying answer to what influences long-term interest rates requires a more rigorous framework. A macro-finance term structure model, for instance, can effectively decompose fluctuations in long-term bond risk premiums into various factors. This subject is beyond the scope of this article, and will be covered in a future Vanguard research publication.

Figure 3. Long-term interest rates and long-term inflation expectations



Notes: The expected average ten-year-ahead CPI inflation rate is taken from the Federal Reserve Bank of Philadelphia's *Survey of Professional Forecasters*. Zero-coupon yields were estimated using the Svensson method.

Source: Vanguard Investment Counseling & Research.

Implications for inflation-hedging instruments

The observed changes in U.S. inflation dynamics imply that the inflation-hedging properties of commodities and related asset classes may weaken further. As we have shown, the correlation between changes in commodity prices and actual core inflation has significantly deteriorated over time as the Federal Reserve became a more effective shield against commodity-based pressures.[9]

The inflation-hedging properties of Treasury Inflation-Protected Securities (TIPS), on the other hand, are invariant to changes in inflation dynamics. This is because the return of TIPS provides compensation for actual realized CPI inflation, regardless of the source of the CPI volatility. Of course, over longer investment horizons, stocks have proven to be the most effective inflation hedge by generating positive long-term returns well above the rate of inflation.

This paper is adapted from a Vanguard Investment Counseling & Research paper on *Evolving U.S. Inflation Dynamics: Explanations and Investment Implications* by Joseph H. Davis (2007). The paper is available on Vanguard.com.

References

Bernanke, Ben S., 2007. "Globalization and Monetary Policy." Speech delivered at the Fourth Economic Summit, Stanford Institute for Economic Policy Research, March 2, 2007, Stanford, Calif. http://www.federalreserve.gov/boarddocs/speeches/2007/20070302/default.htm.

Davis, Joseph H., 2007. *Evolving U.S. Inflation Dynamics: Explanations and Investment Implications*. Valley Forge, Pa.: Investment Counseling & Research, The Vanguard Group.

Sargent, Thomas J., 2000. *The Conquest of American Inflation*. Princeton, N.J.: Princeton University Press.

Stockton, Kimberly A., 2007. *Understanding Alternative Investments: The Role of Commodities in a Portfolio*. Valley Forge, Pa.: Investment Counseling & Research, The Vanguard Group.

9 For more details on commodities as an asset class, see Stockton (2007).

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