

Statistics and Suicide

Remarks to
The Institute of Quantitative Research in Finance

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May 6, 1984

It is an honor for a mere businessman to appear before this group of experts in the field of quantitative analysis of investments. In this businessman, you have a real believer in the ultimate application of theory to practice. I happen to believe that much of what is described in, for example, The Journal of Financial and Quantitative Analysis, will later turn up in the real world of investing--sometimes in pristine form (as in the concept of "duration" in a bond portfolio), other times rather mongrelized (as in the Capital Asset Pricing Model). So tonight perhaps speaker and audience have a good "fit" after all.

At least, I speak from the vantage of a businessman whose organization has in fact made important use of quantitative theory in its corporate strategy. For example:

- o We operate the world's first (and, so far, only) indexed mutual fund (Vanguard Index Trust). It began in 1976, presently has assets of \$250 million, and despite daily cash flows, transaction costs, and an expense ratio currently running at 0.28%, has consistently correlated at about .99* with the Standard & Poor's 500 Stock Index.

* A few of the terms used in this talk are a bit arcane. A layman's definition of each is included at the conclusion.

- o Our Trustees' Commingled Fund (for which Batterymarch Financial Management is adviser) surely is without peer in its reliance on the "efficient market hypothesis" for its portfolio selection and diversification.
- o The thesis that small companies may provide greater risk-adjusted returns than large ones is manifested in two Vanguard small company funds.
- o We also have two international portfolios, evidence of our belief--and yours--that expanding the investment universe to include the other half of the world (U.S. equities account for about 55% of the market capitalization of the world's stock markets) affords more diversification (and thus less risk) without necessary sacrifice in return.
- o Finally, our Municipal Bond Fund was formed in 1977 as a "series" of Portfolios--short-term, intermediate-term, long-term--with very strict maturity constraints, reflecting our endorsement of the quantitative work that suggests that "timing" interest rate moves is rarely productive. (Later, our corporate bond funds also adopted similar constraints.)

And this list of funds--comprising some \$2.5 billion of our \$8 billion of assets--really only begins to describe the impact of quantitative analysis on Vanguard, and ignores such things as the use of duration, Beta, and R^2 in our portfolio evaluation and performance measurement tasks.

I should note, importantly, that the uniqueness of The Vanguard Group of Investment Companies has greatly facilitated our work in the areas I have just described. The Vanguard Funds are not, as industry custom universally dictates, the captives (or "products") of their advisers. Rather, our Funds are free standing and independent--managing themselves on an "at cost" basis--and employing a diverse list of external investment advisers under contracts negotiated at arm's length. Thus, if an adviser has a particular style and skill, we can market them through a specific-strategy mutual fund. (Each of our 32 Fund Portfolios is designed with a specific strategy in mind.) And when we evaluate the adviser's performance, we are doubtless more rigorous and quantitative--and surely more objective--than those "captive" funds whose advisers are, in fact, evaluating themselves.

Having yet to find a single follower, Vanguard can hardly be said to be in "the vanguard" of structural change in the mutual fund industry. Nonetheless, this unique strategy has worked well for us, notably in allowing us the freedom to pursue innovative ideas for investment products, often, as I have noted earlier, based on developments in quantitative analysis. When our concept was implemented in 1974--the product of a "bifurcation" between the Funds and Wellington Management Company, then adviser to all the Funds--our assets were \$1.4 billion, down from \$2 billion a decade earlier. Today, a decade later, assets are at the \$8 billion mark. I mention this growth to you, not so much out of pride, but to point out that some application of quantitative theory to practice could hardly be said to have been disabling to our enterprise.

As much as I respect and appreciate quantitative theory, however, I cannot ascribe anything resembling certainty to it. It does not provide all of the "answers" in a field in which we are still learning new "questions." No matter how many programs are

processed, through how many now omnipresent computers, no matter how many billions of numbers are produced, no matter how many investment styles or market timing systems, tested over no matter how many varied market periods, I do not believe that, in the real world, there is a "secret" of optimal investing that awaits only our discovery. Thus, I view quantitative analysis as a tool--and a useful tool at that--to improve the judgments of intelligent, rational, experienced human beings. But they can work effectively together--they can interact--as I hope the following three examples will illustrate. The first relates to portfolio management, the second to the impact of cost, and the third to performance analysis.

I. Portfolio Management: A Tale of Two Mutual Funds

A classic case of the difference between quantitative analysis and human judgment happens to exist in two mutual funds in The Vanguard Group. One fund is run by one of the most knowledgeable and independent-minded portfolio managers in the world. The other fund is run by one of the most imaginative portfolio strategists in the world. One manager "picks stocks" after rigorous and thorough security analysis. The other sets strategy and lets his computer pick the stocks, using Value Line data in place of a research department. One executes portfolio transactions by constantly buying into weakness and selling into strength. The other sends transactions out to bid in a "black box" that enables brokers to compete for executions. One owns 80 securities, with 50% of assets in the ten largest holdings--clearly very concentrated. The other owns 250 securities, with 15% of assets in the top ten holdings--clearly very diversified.

The former are Vanguard's Windsor Fund and Wellington Management Company's John Neff; the latter are Vanguard's Trustees' Commingled Fund and Batterymarch's Dean

LeBaron. A greater dichotomy between "bottom up" and "top down" management would be difficult to find. Yet the quantitative data makes them look much like twins. Over the past four years (1980-1983 inclusive), a period in which the S&P 500 achieved an annual rate of return of +17%, Windsor's rate of return was +22%, and Trustees' an almost identical +21%, Windsor's R^2 is .75, Trustees' .76. Windsor's Beta is .76, Trustees' .86. For the fun of it, I regressed Windsor's returns against Trustees'; the R^2 was .93.

What accounts for this remarkable similarity? I would suggest that it lies in the basic investment philosophy of the two human beings. Both are "contrarians," looking for fundamental value, and both gravitate toward stocks with relatively low price-earnings ratios. One heads "east," as it were, by building his portfolio brick by brick; the other "west," by describing a series of strategies, from which the portfolio emerges via computer modeling. But, as a practical matter, one goes so far east and one so far west that "the twain shall meet," despite Kipling's view to the contrary--and meet in fact at about the same distance from the "market"--actually above it, in terms of performance. It will be fascinating to see the extent to which these two performance lines--one the judgmental model, the other the quantitative model--converge and diverge in the years ahead.

II. Costs: Reconciling Theory and Reality

In an article written in 1964, William Sharpe, working from the theory of portfolio selection and the Capital Asset Pricing Model, speculated that the essential difference between the risk-adjusted performance of individual mutual funds, and of the unmanaged Dow Jones Industrial Average, might be in the differences in expenses among the funds, and the fact that the Dow incurred none. In the conclusion to his paper, he pointed out

that selecting mutual funds in part on the basis of low expense ratio would have led to above-average returns in 1954-1963, but that "only time can tell" for the 1964-1973 period. As it happened, time told that it did not matter much. While the range of expense ratios was fairly large (from a low of 0.23% to a high of 1.05%), there was no significant net performance difference between the high cost and low cost funds on average. Nonetheless, this early study was a precursor of the attention that needs to be given to all kinds of investment costs today. Let me cite a few examples of the significance of costs.

First, it is a certainty that the costs of investing reduce the total returns garnered by all investors in the equity marketplace--probably by an amount of 1% to 1 1/2% annually--transaction costs, advisory and custody fees, etc. Thus, while theory might say that, in a market with a 10% gross return, the average investor would gain 10%, the reality is that the average investor gains only 8 1/2% to 9%. There is no way around this impasse for market participants in aggregate. Another certainty, I would argue, is that investors in "load funds" in the aggregate will inevitably earn, over the long run, lower returns than investors in "no load" funds, unless one wants to argue that the receipt of a commission by a salesman somehow endows a fund's adviser with superior management skills. Another certainty is that investors in high cost money market funds will earn less than investors in low cost money market funds, given the strict limits that exist on quality and maturity. Finally, it is a certainty that investors in high cost equity funds as a group will earn lower returns over time than investors in low cost funds, unless the high cost funds are able to use their revenues to hire superior portfolio managers or stock pickers. (Since the pay of portfolio managers and stock pickers is measured in dollars, and the impact of costs on performance is measured in percentages, the suggested link is obscure. It is the really large funds that have the dollars, and there is no sign whatever that they outperform smaller funds.)

It is, of course, difficult to translate these statistical "certainties" into performance realities. The variations in performance from one fund to another are inevitably large at the extremes. Risk adjustment, while necessary, can hardly be precise. Demonstrated superiority over, say, the past ten years may have become demonstrated inferiority over the past five years. So we must finally fall back on intelligent financial analysis, accompanied by a healthy measure of judgment. Nonetheless, investment costs are an important part of the process. And the cost structure is rising. Today, for example, new mutual funds often begin with far higher advisory fees than heretofore. New "distribution charges" are being piled on top of existing advisory fees. In sum, an expense ratio norm of perhaps 0.75% a decade ago is now over 1.0%, and many funds operate in the 1.5% to 2.0% range. (I recently saw a prospectus for a \$1 billion fund group whose portfolios had expense ratios of 1.9% to 2.3%. Imagine the impact of those costs on long-term gross returns of 10% or even 15%.) So perhaps a new quantitative study by Mr. Sharpe would give rise to more definitive conclusions. We hope so, for the Vanguard Funds are determined to keep costs at the minimum levels consistent with quality performance and service. Our expense ratios presently average about 0.55%, as we seek to be the industry's low cost producer.

A major concern about cost, in my view, relates to the enormous outpouring of new "beat-the-market" systems, based on frequent trading of stocks. They always look good, for they are retrospective in nature, and are tinkered with until they "work." But, when they use the Standard & Poor's Index, they ignore costs. And when they apply timing systems to mutual funds, while they are cost-free to the investor, the requisite transactions are hardly likely to be cost-free to the funds themselves. Many funds "favored" by these investors have portfolio turnover of 200% or more per year, and this

cost is being borne by somebody. With exchanges among funds (moving from a stock fund to a money market fund and vice versa is the typical transaction) running at the astonishing total of \$25 billion in 1983--on a stock fund asset base of \$60 billion--a major issue is before us. For if theory is cost free and reality expensive, the gap will have to be bridged.

III. Performance Analysis: Data, Beta and Judgment

As I noted at the outset, Vanguard stands in independent judgment on the performance achieved by the investment adviser for each of our Fund Portfolios. Despite our uniqueness in this regard, what we rely on in terms of performance data may strike you as somewhat basic. While the Funds' staff reviews performance each week, each month, and each quarter, it is basically the simple accumulation of annual data (total returns) over a period of years that is the key to our approach. What makes this approach effective, I believe, is the comparative standards to which it is applied. For each Fund, we have three standards:

- o A six-fund competitive group, carefully chosen in concert with the Fund's adviser, designed to replicate the characteristics and objectives of the Fund involved. (This "peer group" is rarely altered.)

- o The appropriate mutual fund industry group (for example, the Lipper Balanced Fund Average or Growth and Income Stock Fund Average), covering essentially all of the funds with similar objectives to ours. (This gives us a check on our six-fund group, hopefully affirming that it is an appropriate standard.)

o A market index, such as the Standard & Poor's 500 Stock Index for most of our stock funds, and a "split" S&P/Salomon Bond Index for our balanced funds. (The market index standard is probably the least relevant of the three standards.)

Each year, we rate each Fund as "above average," "average," or "below average," with "average" defined as performance within plus or minus 2/3 of the standard deviation of the mean return of the competitive group. (This system, on a random basis, would place half of our Funds in the "average" column, and a quarter in each of the other two). We might then modify our evaluation depending on our returns relative to the industry standard, or to the market index.

Key to this process is the selection and monitoring of the competitive group. The three principal statistics we use in our monitoring process are Beta (relative risk), R^2 (relative diversification), and yield (relative income). Each of these factors serves as an important qualifier for the competitive group, and significant deviations, over time, would provide the principal basis for change in the group.

I am a particular believer in Beta in this process, since over the years it has been a useful tool in measuring the risk exposure of investment portfolios. (I am speaking here of Betas based on ex-post portfolio performance, and not carried beyond one or two decimal points. I have found "cross-sectional" Betas far less useful, based as they are on individual stock characteristics that are erratic and unpredictable.) Beta has come a long way. I was almost shouted down when I discussed it in a speech at the Investment Company Institute General Membership Meeting in 1970, after which a critic wrote: "Now Jack Bogle may know what a Beta is, but I defy you to get an explanation from an independent director of the Wellington Fund." Well, all of our Directors do know what it is, and we do use it in our evaluation process.

As the following example may indicate, I wish that we had used it earlier: During the 1957-1966 decade, Wellington Fund's Beta held fairly steady in the .60 to .65 range. It crept steadily upward by about three basis points in each of the subsequent six years, reaching a high of .84 at the end of 1972. Had we only relied on it then, we would have seen a signal that we had taken on much more risk exposure (more stocks, of greater riskiness). After paying the price for this exposure in the 1973-1974 bear market, the Fund's policies were returned to their traditional conservative focus, and the Fund has performed consistently well since then. (My admiration for Beta as a useful general guideline, I should note, does not carry over to Alpha, which seems to me to suggest precision that is an illusion, and predictability that is non-existent.)

I want to underscore that no matter how many performance statistics we have, and no matter how they fit into a quantitative framework, we do not terminate nor retain advisers based solely on "the numbers." Past performance, however carefully quantified and evaluated, must be a range, not a point, a series of time frames, not merely one--and certainly over at least a three to five year period, barring some sort of calamity. (I cannot understand why many corporate pension plans today look at much shorter time frames, virtually putting their advisers in a revolving door.) And even if we could accurately characterize performance in the past, that says very little about performance in the future. Of course the data may prove the manager inadequate; but it can not prove that firing him will improve the situation.

Let me give this example of how hard it is to link past and future: we rank ordered the 87 common stock mutual funds that had twenty-year investment records, first for 1964-1973, and then for the 1974-1983 period.

- o Of the 22 top quartile funds in the base decade, six repeated, nine made the middle two quartiles and seven the bottom quartile.

- o Of the 22 bottom quartile funds in the base period, eight repeated, nine made the middle two quartiles, and five the top quartile.

If you see in these rankings a lack of consistency, you understand my point. Indeed, the coefficient of correlation of performance from the first period to the second was close to zero, about +0.1. This study suggests--and my own experience confirms--that random outcomes are the norm, and that when past performance success happens to be the precursor of success in the future, chance has played a major role.

My thesis is this: even if we could absolutely define past success, by accounting precisely for return, and risk, and cost, and all exogenous factors (adjustments that are well beyond our competence today), we would have failed to make the critical link to the future. Thus, we are left to rely on careful, if basic, quantitative analysis along with the exercise of the best possible business judgments. In the Vanguard structure, these tasks are the ongoing work of our officers and directors, when we retain existing advisers, or employ new advisers, or terminate advisory relationships. I believe that the records of our Funds over the past decade suggest that this combination of quantitative and qualitative elements--of statistics interacting with judgment--is proving effective.

Conclusion

In sum, my message to you tonight is that quantitative analysis has added a new and valuable dimension to the realm of investment management. It has spawned new types of investment strategies. It has emerged as a practical way to manage money. It has made us look in a new light at the costs of investing. And it has made it possible to establish more particular and acute standards of performance evaluation. All of this is to the good. But none of it should suggest that we abandon the exercise of our judgment, our common sense, or our experience. For excessive reliance on data at the expense of judgment can take us down a dangerous path, one suggested by this comment from Daniel Yankelovich, quoted by Adam Smith in "Super Money:"

The first step is to measure what can be easily measured. This is okay as far as it goes. The second step is to disregard that which can't be measured, or give it an arbitrary quantitative value. This is artificial and misleading. The third step is to presume that what can't be measured easily really isn't very important. This is blindness. The fourth step is to say that what can't be easily measured really doesn't exist. This is suicide.

With that final word, I have now closed the loop on my title—"Statistics and Suicide." Think about it.

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GLOSSARY

R²

Diversification of a portfolio, as indicated by the coefficient of determination, which measures the correlation between the market index and a portfolio. The R² indicates what percentage of the fluctuations in the portfolio are "explained" by the fluctuations in the market index (i.e., an R² of .90 would indicate that 90% of the portfolio's fluctuations would be explained by market fluctuations). Most common stock mutual funds range from .70 (special purpose) to .99 (Vanguard Index Trust).

BETA

Volatility of the portfolio relative to the market index. Betas higher or lower than 1.00 indicate that the portfolio is more or less volatile than the market index, respectively. (A Beta of 1.20 would indicate volatility 20 percent more than the market index, meaning that the portfolio should rise 24% in a 20% market rise. Most common stock mutual funds range from .70 (low risk) to 1.40 (high risk).

ALPHA

The total return of a portfolio, relative to the return available from a market portfolio with the same degree of risk (as measured by Beta). Positive and negative percentages are said to indicate the extent to which the portfolio manager has enhanced or decreased, respectively, the portfolio's risk-adjusted return vs. the market index. For example, a fund which had a risk-adjusted return of 12.5% per year when the market return was 11.0% would have a positive Alpha of 1.5%.

COEFFICIENT OF CORRELATION (R)

The square root of the coefficient of determination (R²). A measure of the degree of association between two variables, ranging in value from -1 to +1. A figure of R = +1 indicates a perfect positive linear relationship between values--for example, that each increase in one value was accompanied by an increase in the other. R = -1 indicates a perfect inverse or negative relationship, and R = 0 indicates no relationship.

DURATION

A measure of the weighted average maturity of a bond portfolio, and thus a measure of the portfolio's volatility. Specifically, duration measures the average time to each payment (of either principal or interest) on a bond, weighted by the present value of that payment.