

C A M B R I D G E   A S S O C I A T E S   L L C

# POLICY PORTFOLIOS, TACTICAL ASSET ALLOCATION AND OPPORTUNISTIC INVESTING

2003

Ian Kennedy

Copyright © 2003 by Cambridge Associates LLC. All rights reserved.

This report may not be displayed, reproduced, distributed, transmitted or used to create derivative works in any form, in whole or in portion, by any means, without written permission from Cambridge Associates LLC. Copying of this publication is a violation of federal copyright laws (17 U.S.C. 101 et seq.). Violators of this copyright may be subject to liability for substantial monetary damages. The information and material published in this report are confidential and non-transferable. This means that authorized members may not disclose any information or material derived from this report to third parties, or use information or material from this report, without the prior written authorization of Cambridge Associates LLC. An authorized member may disclose information or material from this report to its staff, trustees, or Investment Committee with the understanding that these individuals will treat it confidentially. Additionally, information from this report may be disclosed if disclosure is required by law or court order, but members are required to provide notice to Cambridge Associates LLC reasonably in advance of such disclosure. This report is provided for informational purposes only. It is not intended to constitute an offer of securities of any of the issuers that are described in the report. This report is provided only to persons that Cambridge Associates LLC believes to be "Accredited Investors" as that term is defined in Regulation D under the Securities Act of 1933. The recipient of this report may not provide it to any other person without the consent of Cambridge Associates LLC. Investors should completely review all Fund offering materials before considering an investment. No part of this report is intended as a recommendation of any firm or any security. Factual information contained herein about investment firms and their returns which has not been independently verified has generally been collected from the firms themselves through the mail. We can neither assure nor accept responsibility for accuracy, but substantial legal liability may apply to misrepresentations of results delivered through the mail. The CA Manager Medians are derived from Cambridge Associates LLC's proprietary database covering investment managers. Cambridge Associates LLC does not necessarily endorse or recommend the managers in this universe. Performance results are generally gross of investment management fees and do not include returns for discontinued managers.

## Introduction

The emergence of behavioral finance has reanimated the age-old question of the role of emotion in investors' decision making. Greed and fear still retain their pre-eminence, of course, but such secondary emotions as regret have now been added to the investment lexicon. Naturally, regret is most acutely in evidence during booms and busts—what investor has not thought, at some point in the past five years, "if only I had . . ."? Most recently, this has taken the form of: "if only I had sold equities in the first quarter of 2000" and a revulsion against the pedantic insistence of those who continue to preach the folly of market timing despite the irrefutable evidence of how much better off investors would be had they made such a tactical shift at that time.

Just when investors were seething with such regret and still writhing under the whip of the bear market, Peter Bernstein propounded his thesis that policy portfolios should be consigned to the scrapheap to be replaced by a more activist, tactical approach to portfolio management. Given the fertile ground in which this seed was planted, no wonder it quickly sprouted! Investment committees across the country debated the issue: the policy portfolio had seemingly failed; millions could have been saved from the equity wreck by a simple tactical shift; and, worst of all, prospective returns still looked dismal, requiring a more activist investment approach if one hoped to realize a return sufficient to sustain current spending.

In both the original thesis and the subsequent debate, however, policy portfolios have been misrepresented as inflexible, mechanistic constructs welded together by deterministic mean-variance optimization models, and incompatible with tactical or opportunistic investing. We don't know this Frankenstein; if it exists, we haven't met it, don't want to, and agree that it should be destroyed. Meanwhile, virtually every leading endowment continues to use the kind of policy portfolio we do know, which serves as the frame on which the portfolio is woven, the skeleton that supports the body. The policy portfolios we know are organic rather than mechanistic; that is, they grow and evolve over time, and nothing about them precludes various forms of tactical or opportunistic investing. This investment approach was summarized in our 2002 paper, *How Will You Earn What You Spend?*:

In the face of . . . uncertainty, our basic approach to investment planning combines the stability of a predominant allocation to equities, which we think should remain relatively constant, with the flexibility of a broad definition of equities and an advocacy of diversification among different types of equity assets. In implementing a portfolio built along these lines, the key question then becomes, *which assets should we buy and sell, and when?*

Such an approach is obviously activist to a greater or lesser extent, according both to changing conditions and to each investor's circumstances. It also corresponds with the actual practice of the more successful endowments and is likely to collapse into incoherence in the absence of a supporting framework provided by a policy portfolio.

So the discussion that follows aims to define and defend policy portfolios, as we see them, to elucidate their role in the investment management process, and to outline why and how we regard them as entirely compatible with tactical and opportunistic investing.

**SUMMARY**

## On Policy Portfolios

### What is a policy portfolio?

1. **A policy portfolio is simply an embodiment of a fund's long-term asset allocation policy.** Without a default allocation policy of this sort, there is no context in which to measure the success or failure of more tactical or opportunistic asset allocation decisions. The policy portfolio is the skeleton that supports the portfolio body.
2. **As such, it should incorporate the fund's objectives for risk and return.** For example, is maximizing spending (which can only be achieved by maximizing return) more or less important than ensuring that current spending can be sustained even under adverse investment conditions? In other words, an institution's long-term asset allocation policy should reflect an assessment of its tolerance for declines in spending versus its hunger for return and the importance assigned to maintaining the fund's real value.
3. **It should take the form of a portfolio with target allocations to those kinds of investment to which the institution thinks it should have a permanent, *long-term* commitment with a defined benchmark for each.** The use of "kinds of investment" instead of "asset classes" is deliberate. Many kinds of investment are, of course, asset classes; however, some are not, while others are misrepresented by traditional asset class labels. One could, of course, have a policy portfolio composed entirely of traditional equities, bonds, and cash. Increasingly, however, institutional portfolios also have allocations to other kinds of investment, some of which are best characterized by the role they are designed to play in the portfolio. Thus, for example, the Yale endowment has a substantial allocation to a variety of assets (e.g., real estate, oil and gas, timber) characterized in its policy portfolio simply as "Real Assets." Similarly, Yale also has a large allocation to a broad array of hedge fund strategies lumped together in the policy portfolio under the name "Absolute Return."

Other institutions have policy allocations identified by such labels as "Inflation-Hedging Assets," "Equity Hedging Assets," "Risk Reducing Assets"—even "Opportunistic Investments." The common denominator is the attempt to identify each investment's role in the total portfolio, which is a valuable exercise in itself since it quickly leads to a recognition of the virtues of diversification. Like a good sports team, a diversified policy portfolio complements strong offense with strong defense and the flexibility to perform well under varying conditions.

### What is a policy portfolio for?

1. **Because the asset allocation of the policy portfolio is designed to realize the institution's risk and return objectives over the long term, it establishes a normative allocation against which any short-term asset allocation decisions can be gauged.** In other words, it says, "Unless we have some compelling reason to act otherwise, *this* is how we should be invested." Lacking any such discipline, investors tend to pursue ad hoc allocations that generally result in their incurring too much or too little risk—both of which can lead to inferior returns.

- 2. The existence of a policy portfolio encourages the measurement of risk at the level of the total portfolio, as appropriate, rather than at the level of individual asset classes.** Since the purpose of the portfolio is to generate returns sufficient to meet some financial objective (e.g., pension fund liabilities, endowment spending), the appropriate measure of risk is the probability of falling short of this objective over some extended period of time. In the case of a defined benefit pension fund, the least risky portfolio is one that comes closest to defeasing the liabilities (i.e., zero shortfall); portfolio allocations that deviate from this are justifiable only if expected to generate additional returns well in excess of the additional shortfall risk they incur.

For endowment funds, however, the "liability" is not typically a predetermined dollar value, as it is for a defined benefit pension fund. It *could* be the case that an organization like a theater company or museum could define the dollar amount of budget support from endowment it needed to stay in business for the next 20 years, enabling one to calculate the present value of this liability and, on that basis, the policy allocation most likely to ensure that this level of annual spending were sustained without depleting the portfolio's real value. In reality, however, most endowment spending is *not* externally defined, but is derived from some combination of existing spending and expected return. That is, in response to the question, "How much do you want to spend from the endowment?" most college or foundation presidents, museum curators, theater directors, and so on will say, "How much can I have?" or "At least as much as we're spending now, adjusted for inflation," rather than thinking in terms of the present value of some future stream of payments.

Thus, for an endowment fund, a comprehensive shortfall risk assessment quantifies the joint probability of suffering a decline of x% from which one fails to recover within y years. How much shortfall risk is too much or too little varies greatly by endowed institution according to the budget's dependence on endowment spending, the reliability of other sources of revenue, budget elasticity (can one trim grants, shift funds temporarily from other areas, and resort to similar expedients to weather a storm?), debt service costs, and so on. (For a detailed discussion of endowment fund risk assessment, see our 2001 paper, *Portfolio Risk Measurement*.)

- 3. A policy portfolio also serves to focus the committee's attention on asset allocation (more than investment managers) as the first (and probably most important) investment management responsibility.** These two tasks—asset allocation and investment manager selection—are not as mutually exclusive as investment theory assumes. The existence of outstanding managers and the institution's confidence in its ability to identify and access such managers is an important consideration in determining how much can and/or should be allocated to asset classes like private equity and hedge funds, where the dispersion of manager returns is vastly greater than for traditional equities.

Nevertheless, although such implementation issues can influence asset allocation decisions, they should not change the sequence of decision-making and investment oversight: asset allocation first; manager selection and review second.

## How is a policy portfolio developed?

1. **First, the investment committee must decide which kinds of investment should and should not be considered for inclusion.** Only those investment categories the committee believes should have a permanent place in the portfolio should be included. In addition, a policy portfolio should not be sliced into too many parts. For example, an asset class like U.S. equities should not be subdivided into large and small or value and growth. The fundamental basis of return of each investment category should be sufficiently different from that of the others such that the correlation of returns between any two categories would not be expected to exceed 0.80 over time.
2. **Second, the policy portfolio should articulate and quantify the fund's tolerance for risk.** As discussed previously.
3. **Finally, different asset mixes should be reviewed to determine the ideal middle ground between the constraints imposed by risk aversion and the hunger for return.** When an institution ignores the relationship between risk and return, it usually ends up with a portfolio that is either more risky than appropriate, or earns less return than is possible, because the portfolio is badly diversified ("inefficient" in investment terms). The standard approach to evaluating the risk/return trade-off is efficient frontier analysis. However, note where we have introduced this type of analysis in the discussion—*after* the committee has already determined what level of risk (i.e., shortfall risk) is appropriate. In other words, we regard efficient frontier analysis (aka "mean variance optimization") as an excellent tool for comparing and evaluating different asset mixes, but not as a suitable foundation on which portfolios should be constructed. See the two appendices for further discussion of efficient frontier analysis.

## How often should a policy portfolio be reviewed and revised?

1. **Reviewed annually.** This answer surprises those who think of a policy portfolio as a sort of concrete straightjacket. However, since the primary investment management task is to ensure that the asset allocation is properly aligned with the institution's objectives, this should be checked once a year—a process that might take extensive advance preparation and several hours' discussion, if changes are contemplated, or as little as ten minutes.
2. **But revised much less often.** Using Yale again as a convenient example—and one that is reasonably representative (in this respect) of the larger university endowments in general—over the past 18 years (fiscal years ending June 30, 2003), Yale's policy asset allocation targets have shifted as follows:

	<b><u>Yale University Policy Asset Allocation (%)</u></b>				
	<b><u>1985</u></b>	<b><u>1990</u></b>	<b><u>1995</u></b>	<b><u>2000</u></b>	<b><u>2003</u></b>
U.S. Equity	65	45	25	15	15
Non-U.S. Equity	10	15	12.5	10	12.5
Private Equity	0	10	20	25	17.5
Real Assets	10	10	10	17.5	20
Absolute Return	0	0	20	22.5	25
U.S. Bonds	15	20	12.5	10	10

In fact, Yale's policy portfolio changes have tended, on the whole, to be more incremental than these five-year snapshots suggest. Major overhauls have been undertaken every three to four years, on average. It is perhaps important to note, however, that at any given point in time, the policy portfolio is *not* intended to be the best portfolio for the next three years. Rather, it is the best portfolio for the next 50 years, as seen from today.

Note how the increasing allocations to high risk/high return private equity investments during the 1990s are counterbalanced, in risk/return terms, by commensurate increases in the allocation to absolute return hedge fund strategies, whose equity risk exposure is relatively low, and by reduced allocations to public equity. Although many might regard Yale's portfolio as very "risky" because of the high allocations to unfamiliar categories like absolute return and real assets, the total exposure to equity risk has actually declined from 85% in 1985 to about 75% today (if we assume some equity risk exposure in the absolute return hedge funds). In its annual endowment fund report Yale asserts that "spending disruption risk" and "purchasing power impairment risk" (both versions of the shortfall risk described above) have been dramatically reduced since the 1980s.

Aspiring copycats should note that the relatively low systematic risk (i.e., market risk) of this portfolio is complemented by very high manager specific risk. Implicit in the decision to pursue such an approach is confidence that one has the resources, knowledge, and expertise necessary to select, access, monitor, and manage superior investment management in private markets, hedge funds, and public markets.

#### What would be the basis for such a revision?

1. **A change in the institution's investment objectives or risk tolerance.** Both are rare. Above all, endowment investment committee members should resist the natural temptation to allow the waxing and waning of instinctive risk tolerance/aversion to influence how they manage the portfolio. Risk exposure should be assessed in some disciplined, objective, dispassionate, methodical way.
2. **New information or new thinking about the asset classes in the portfolio.** For example, Dimson, Marsh, and Staunton's recent reconstruction of twentieth century equity market returns in 16 countries around the world has provided investors with significant new insights into both historical return data and the equity risk premium.<sup>1</sup>
3. **The introduction of new or newly investable asset classes.** TIPS is perhaps the best recent example of a new asset class, while hedge fund arbitrage strategies are an example of "newly investable."
4. **Growth in assets, which might either enable an institution to invest in new asset classes or preclude its doing so to the same extent as before.** Why have larger endowment funds consistently outperformed those with fewer assets? In a word, *scale*: with more assets larger endowments can afford to hire sufficient staff to push into new, unexplored, highly rewarding investment territory ahead of the pack (hence the title of David

---

<sup>1</sup> See *The Triumph of the Optimists: 101 Years of Global Investment Returns*, Elroy Dimson, Paul Marsh, and Mike Staunton, Princeton University Press, 2002.

Swensen's book, *Pioneering Portfolio Management*). Lacking scale, smaller institutions must generally rely more on outside help and are understandably reluctant to act as trailblazers since such expeditions require a high degree of both knowledge (which investment committee members may or may not have) *and* daily oversight (which they cannot possibly supply).

At the other end of the spectrum, some larger endowments have had to cut back their allocations to private equity simply because growth in assets prevents them from investing ever larger amounts of money without compromising the quality of their investments.

## On Tactical Asset Allocation

**What's the difference between revising the policy portfolio and making tactical allocation bets? Does the adoption of a policy portfolio preclude tactical or opportunistic investing?**

- 1. The policy portfolio reflects the investment committee's best thinking about the appropriate long-term asset allocation, based on currently available information, resources, objectives, and so on, *at that point in time*.** Although one's view of the long term should not change every day, it should evolve over time. A policy portfolio is like the equipment one assembles to undertake a journey through unknown territory, compiled on the basis of past experience of similar journeys,<sup>2</sup> plus a rough notion of what the climate and terrain may be like (ice caps or deserts, plains or mountains, hot and dry or cold and wet?). As one progresses, some pieces of equipment work better than expected, some worse—and yet one never knows what lies ahead, and so what is useless today may prove invaluable tomorrow if conditions change, which they most certainly will, perhaps when least expected. Given the chance to do so, one should obviously check the equipment periodically to see whether it is functioning as anticipated, while also looking constantly for new tools that might do the job better, or complement those one already owns.
- 2. A tactical allocation is a relatively short-term bet, which will either succeed or fail within a period of about three years.** Tactical bets may take several forms:
  - Deviations from target allocations. Policy portfolios may have no ranges around target allocations (this is increasingly common among larger endowments and foundations), or small ranges expressly for rebalancing purposes, or larger ranges to allow for tactical deviations from target. Most investors should not have such ranges since they are more likely to detract than to add value through tactical shifts.

Tactical ranges made more sense when most portfolios were limited to stocks, bonds, and cash, and so the only way to mitigate equity exposure was to shift some money from public equities to bonds or cash. However, in contemporary portfolios, equity risk is generally diversified through different forms of equity (or equity-like) investments, assiduous rebalancing among which should help maintain the level of risk

---

<sup>2</sup> "On the basis of past experience" does not equate to "in slavish and myopic devotion to what has worked in the past." As L.P. Hartley wrote in his memorable opening sentence of *The Go-Between*, "the past is a foreign country: they do things differently there."



deemed appropriate for the portfolio. Additional risk control can be exercised, if necessary, by shifts in implementation rather than through attempts to time the public equity markets. For example, an institution could lower the beta of its U.S. equity portfolio by shifting assets from a small-cap technology stock manager to a large-cap value manager without effecting any change in its total allocation to the asset class.

A second kind of tactical bet is the opportunistic allocation of assets to an investment not included in the policy portfolio on the basis of current valuations. High-yield bonds are perhaps the best example of this sort of investment. Few institutions include high-yield bonds in their policy portfolio and yet there are certainly times when this asset class seems to offer extremely attractive prospective returns.

The issue posed by this sort of allocation is: where will the money come from? The answer is usually public equities and the tactical allocation should not be made unless the investor believes the new investment will outperform the asset class from which the money is taken.

- Alternatively, a tactical allocation may be designed to counterbalance increased risk in some other part of the portfolio. In 2000, for example, institutions heavily invested in venture capital needed to sell down their public equities (since private equities are illiquid) and increase allocations to bonds or cash or absolute return hedge funds in order to offset the increased risk created by soaring venture capital values. Not to do so was to accede implicitly to the notion that the fund's risk tolerance was in fact much greater than it had been a few years earlier and that the higher allocation to risky assets was therefore appropriate (wrong answer!).
- Finally, tactical bets may be taken *within* asset classes without any impact on the policy portfolio. For example, a policy portfolio allocation to U.S. equities almost certainly assumes, both implicitly and as expressed in the benchmark, that the fund's actual U.S. equity portfolio will have the same characteristics as the asset class. Consequently, a significant overweight to small-cap or to value or growth stocks, relative to the benchmark index weight, represents a tactical bet within the asset class.

## On Opportunistic Investing

### Does the adoption of a policy portfolio preclude tactical or opportunistic investing?

Not at all—as the examples above illustrate. The notion that endowment (or pension) fund management consists largely of constructing a policy portfolio and then letting it run is purely fictional. The construction of a policy portfolio is the first step in a dynamic process. To revert to an earlier metaphor: the policy portfolio is the skeleton, but the skeleton lacks a body until the asset allocations are implemented, and the body subsequently needs constant feeding and exercising to remain healthy. The policy portfolio indicates how the fund should be deployed, but it says nothing about how the money should be *invested*.

The terms "tactical" and "opportunistic" are often used as if they were synonymous. However, "opportunistic investing" is simply one form of tactical investing. In the examples above, short-term deviations from policy allocations to equities, bonds, and cash are tactical asset allocation shifts (as distinct from "strategic" or longer-term asset allocation), but are not illustrative of opportunistic investing.

On the other hand, allocating money to high-yield bonds on the basis of unusually wide credit spreads and high levels of bond defaults is a good example of opportunistic investing.

Although not every example can be as neatly parsed, the broad distinction is that "tactical" simply means "relatively short term" while "tactical asset allocation" generally refers to short-term shifts among major asset classes. On the other hand, the essence of opportunistic investing is the attempt to exploit market dislocations, excesses, inefficiencies, mispricings—whatever results in a particular investment becoming unusually cheap. The "tactical" element in opportunistic investing is temporal—typically, the market corrects within a few years whatever anomaly has created the opportunity.

**APPENDICES**

## Appendix A

### THE USES AND LIMITATIONS OF EFFICIENT FRONTIER ANALYSIS

The basic assumptions on which efficient frontier analysis is based are at best intelligent "guesstimates" about an uncertain future, and are subject to estimation error that will affect the conclusions drawn by the model. In part, this is the consequence of our having very little historical data on some asset classes (e.g., venture capital) and unreliable data on others (e.g., real estate). However, even in the case of asset classes for which there exist reliable, long-term return series (e.g., large-cap U.S. stocks), this type of static, deterministic analysis fails to capture the changing nature of the asset class, the shifts in its relationships to other asset classes, and the problems of making predictions about its characteristics going forward. For example, although we have reliable data on U.S. stock returns over the past 75 years, many argue that the development of derivative securities, the advent of computerized trading, and the influx of capital into the stock market have changed the nature of the asset class in the past 20 years. For these reasons, investors should not construct their portfolios on the basis of efficient frontier analysis, but should use such analysis to test the efficiency of portfolios constructed by other means.

Efficient frontier analysis can also be used to test the efficiency of existing portfolios. It can help identify weaknesses in the current portfolio structure and suggest asset classes that should command a greater or lesser percentage of invested assets.

Implicit in the efficient frontier analysis is the assumption that the investor will rebalance among the asset classes eligible for inclusion in the portfolio. In practice, however, investors rarely rebalance their asset allocations with the frequency assumed by the model, and may find it difficult or impossible to affect rebalancing in a portfolio that includes significant allocations to illiquid asset classes.

Despite the limitations associated with efficient frontier analysis, it nevertheless provides compelling evidence of the benefits of diversifying a portfolio across a wide range of assets.

## Appendix B

### ENHANCED EFFICIENT FRONTIER ANALYSIS – EFFICIENT STATISTICAL EQUIVALENCE

#### Introduction

In the efficient frontier approach to asset allocation, the investor must make assumptions about the expected returns, variability of returns, and correlation of returns between the asset classes included in the analysis. These inputs provide the model with the data from which it constructs a series of "optimal" portfolios (i.e., portfolios whose asset allocations generate the lowest possible risk for different levels of return). These input assumptions are necessarily statistical estimates (partially based on historical data) and cannot be free of errors. It can be difficult to see how and to what extent the model's output, in particular the "optimal" portfolio weightings, will be affected by these estimation errors. The use of the enhanced frontier provides context about the effects of estimation error, contributing to the discussion of accuracy that commonly follows efficient frontier assumption decisions.

#### Efficient Statistical Equivalence Region

Mean-variance efficiency is a statistical concept, not a computational concept. (The ideas and procedures discussed here are borrowed from previous publications—see endnote.) The difference between a statistical concept and a computational one may be illustrated by an example.

Consider a set of known numbers. Calculate the average of this set. This is a computational average. Now consider a set of numbers that are unknown except for a "random" subset, or sample, of numbers that are known. The average of this whole set of numbers cannot be determined, but the average of the sample can be determined. The question then is how well this average represents the average of the whole set. This is a statistical average.

Now suppose another sample is taken from the set of unknown numbers. Suppose this sample is the same size and equally "random" as the first. The average of this new sample is also a statistical average and is neither better nor worse a representation of the whole set's average than the average of the first sample. The averages are said to be "statistically equivalent." Repeating this process produces a set of averages that are statistically equivalent.

Replacing the notion of computing an average with that of computing mean-variance efficient portfolios leads to the idea of an efficient region. Static mean-variance efficiency is computational, but by sampling various return environments that are *consistent* with the normative inputs, the mutable character of efficiency is introduced. The "efficient statistical equivalence region" consists of all portfolios that are statistically equivalent mean-variance efficient, because the randomly generated assumptions are a sample of a population that is derived from the static assumptions. This region spans an *area* in risk/return space not just a line. Any portfolio with return and risk characteristics lying inside that region is said to be consistent with mean-variance efficiency even though it may not be on the efficient frontier.

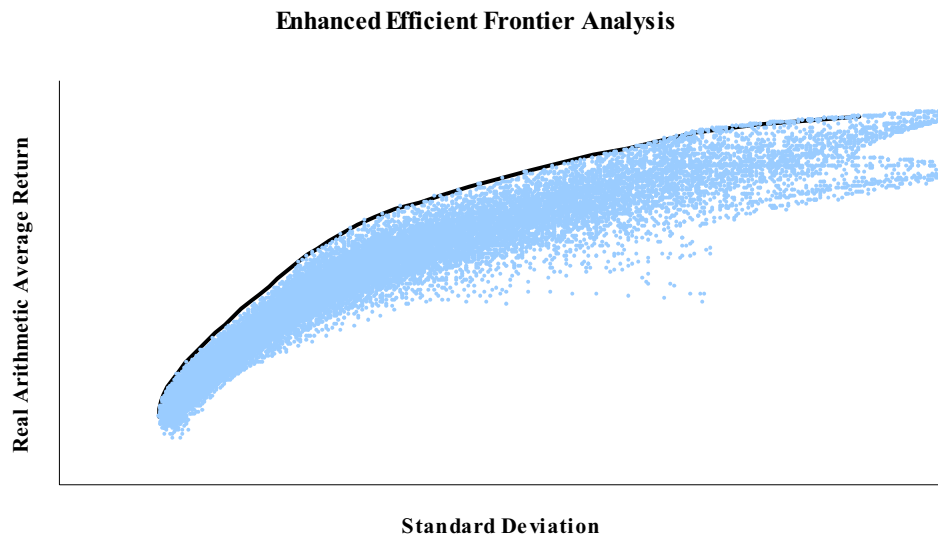
## Computation of Equivalence Region

The procedure for calculating efficient statistical equivalence regions is as follows:

1. Using base case inputs, simulate 25 years of annual returns for each asset class and derive new optimization input assumptions from the simulated return series.
2. Compute efficient frontier portfolios using the new assumptions and recalculate the return and risk of this frontier with the base case inputs.
3. After repeating the preceding steps (500 or more times), a lower curve excluding a chosen percent of the simulated frontiers is drawn (90% confidence interval excludes 10% of observed frontiers).
4. The Efficient Statistical Equivalence Region is observed between the simulated efficient frontier lower range and the base case efficient frontier.

The graph below was produced using this procedure. The standard input assumptions and no constraints were used, though they can be incorporated into this analysis.

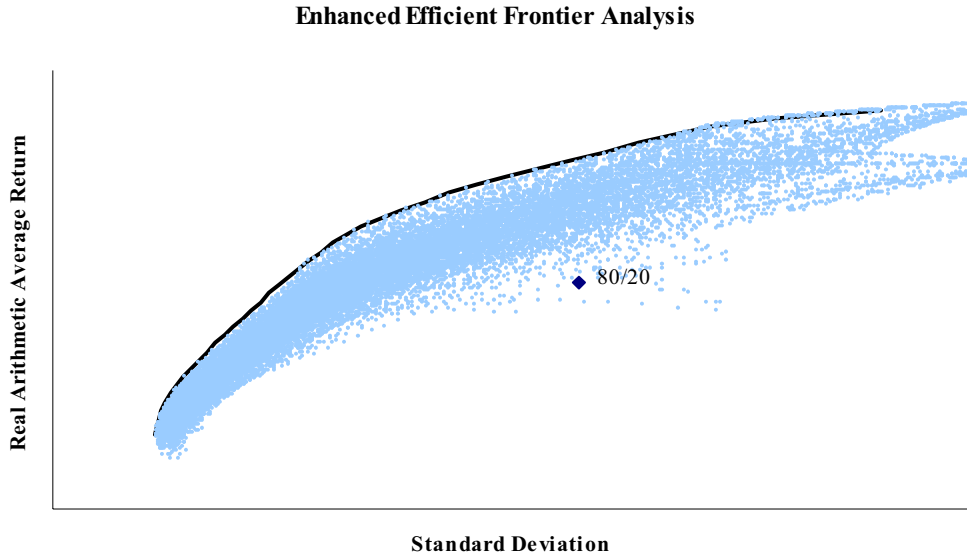
The bold line represents the base case efficient frontier and the dots represent 20,000 portfolios (500 iterations



with 40 portfolios per efficient frontier) that are statistically equivalent to that frontier. The "efficient statistical equivalence region" that the dots cover is quite wide. Indeed, given the range of return and risk characteristics this region covers, it is hard to imagine a portfolio that is not statistically equivalent to the efficient frontier.

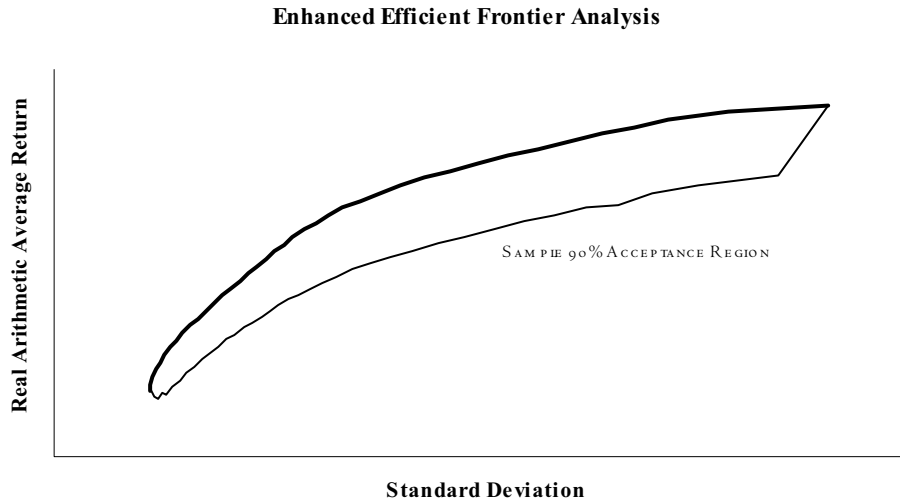
**Investment Implications**

In fact, a plain vanilla 80% stock and 20% fixed income portfolio is statistically equivalent to the efficient frontier (see graph below).

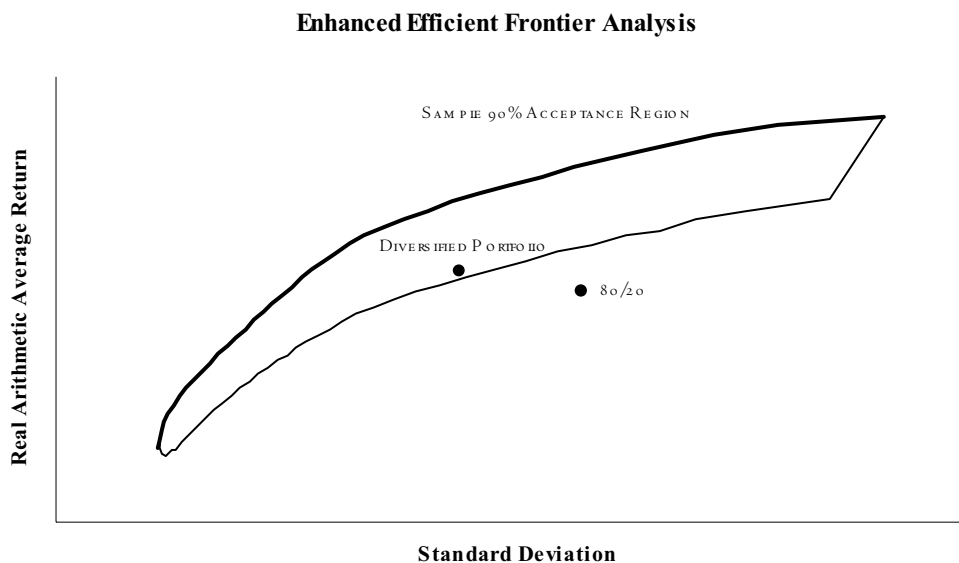


However, the location of the 80/20 portfolio in the equivalence region suggests that it may be an outlier and should not be accepted as statistically equivalent to the efficient frontier.

This idea can be formalized using procedures of statistical inference. In particular, the equivalence region is a sample acceptance region. The acceptance region represents 90% of the simulated efficient portfolios as they appear in the base case return environment. In the graph below, this region is outlined by the "true" efficient frontier and a lower bound acceptance band.



The next graph shows that the 80/20 portfolio falls outside this region, but a well-diversified portfolio of 40% U.S. stocks, 10% global ex U.S. stocks, 5% emerging markets, 10% absolute return, 5% venture capital, 5% private equity, 5% real estate, and 20% fixed income does not. The diversified portfolio is said to be consistent with *unconstrained* mean-variance efficiency for a type I error of 10%. Thus, a policy portfolio of this allocation could be accepted as just as efficient as the portfolios on the "true" efficient frontier. This analysis allows consultants to demonstrate to clients that policy portfolios constructed by bottom-up analysis (e.g., the hedging approach) and that are intuitively attractive are also consistent with mean-variance efficiency.



Endnote: a more detailed discussion of these concepts can be found in the following:

- J.D. Jobson and B. Korkie, "Putting Markowitz Theory to Work," *Journal of Portfolio Management*, Summer 1981.
- R.O. Michaud, "The Markowitz Optimization Enigma: Is 'Optimized' Optimal?" *Financial Analysts Journal*, January-February 1989.
- P. Jorion, "Portfolio Optimization in Practice," *Financial Analysts Journal*, January-February 1992.
- R.O. Michaud, "Efficient Asset Management: A Practical Guide to Stock Portfolio Optimization and Asset Allocation," Harvard Business School Press, Boston, June 1998.