The Portfolio Management Problem of Individual Investors: *A Quantitative Perspective*

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Over the past 30 to 40 years, a generally accepted approach has evolved for the management of institutional investment funds. Today we see an effort to adapt this approach to managing the funds of individual investors. The impetus behind this initiative is surely a laudable one—to improve the investment experience and outcomes of individuals by adapting the best practices validated in the institutional setting. However, there are difficulties, as the investment problems of institutions and individuals differ in some fundamental ways. Until institutional methods are suitably modified to account for these differences, the experience of individual investors is likely to remain less than it could be. This article identifies some of these key differences and suggests appropriate adaptations of institutional methods to suit individual investors.

THE INSTITUTIONAL APPROACH

Institutions vary greatly in terms of investor personality, from central banks through pension funds to charitable endowments. Broadly, however, they subscribe to the thesis that their investment objective is to maximize return within the constraint of a risk budget, while meeting some secondary requirements that reflect their investor personality, such as restricting investments to highly liquid assets or avoiding certain assets deemed to lack social respectability. In principle, they all have long-term investment horizons, but in analytic practice they treat that horizon not as one undivided period of time, but rather as a sequence of shorter horizon periods. Thus, risk budgets are typically stated in terms of the one-year-ahead risk, and return performance is monitored on a quarterly or monthly time scale.

In general, institutional portfolios are not managed as a unified whole. First an allocation of the portfolio to major asset classes (stocks, bonds, real estate, etc.) is made. Then for each asset category one, or typically more, managers are hired to manage a slice of the portfolio. These managers do not cooperate in managing the portfolio—in fact, they are implicit competitors. Each focuses narrowly on implementing the particular investment task for which they have been hired and their performance is assessed by comparison with a benchmark portfolio.

These institutional practices are not arbitrary, but rather reflect key aspects of the institutional setting. In framing the investment problem as a risk-return trade-off, institutions focus exclusively on investment assets. This focus reflects the fact that liabilities either do not enter into the problem or are exogenously fixed by other policies. Liabilities may need to be considered from the perspective of properly assessing risk, but the investment policy does not, for the most part, concern itself with managing liabilities. Thus, an exclusive focus on assets is justified. These assets are generally, with the possible exception of the real estate

component, highly marketable securities.

In theory at least, it would be feasible to liquidate the investments at the end of one investment period and start fresh from cash at the beginning of the next period. Since results in succeeding periods are not hostage to decisions taken in earlier periods, the analytic practice of treating a long investment horizon as divided into a number of shorter periods is well justified. Similarly, the decisions taken in managing a component of the total portfolio can be taken largely independently of what is happening in the rest of the portfolio. Thus, the division of the total portfolio into a number of independently managed subportfolios is a feasible approach which provides significant flexibility in selecting managers specialized in implementing specific investment strategies.

For an institutional investor, flexibility in building the management team is of paramount importance. Since all institutions have formulated the same investment problem—maximizing return within a risk budget over a short time horizon—they are explicit competitors of one another in the search for higher investment return.

Yet the search for higher return is necessarily a zero sum game, as a group of investors, before costs, must earn the average return. Once costs are considered, the game becomes a negative sum one; collectively, institutional investment management must produce below benchmark results. Faced with this unfavorable reality, institutional investors have a choice: either they can seek to minimize their costs and accept average returns (the passive approach) or they can aggressively seek to build the best possible investment management team in an effort to beat the field (the active approach). Most institutions employ both approaches to one degree or another. Success at both approaches, however, turns on the ability to select managers with specialized competencies, either in cost control or return generation. Thus, the whole formulation of the institutional investment problem is very compatible with and supportive of what turns out to be the key to success: manager selection.[1]

THE INDIVIDUAL INVESTOR

Terminologies vary, but for practical purposes we can consider the individual investor to be either affluent or high net worth. For the affluent investor, total economic resources are of roughly the same magnitude as the claims on those resources resulting from the investor's life choices. Those choices typically include a need for retirement income, the purchase of one or two houses, and the educational expenses of children. When the investor is young or middle aged, financial assets typically represent only the smaller portion of his total resources, with human capital and real estate assets representing the bulk of his resources. In late middle and old age, human capital is replaced by Social Security benefits and financial assets generally come to represent the greater part of the portfolio.

For the high net worth investor, resources are generally significantly greater than the claims on those assets arising from daily life. In general, financial assets represent the major part of the portfolio. By the numbers, affluent investors are, of course, the overwhelming majority of the investor population. Measured by assets, however, the high net worth and the affluent control comparable amounts of total wealth. Approximately 70% of the high net worth are either successful entrepreneurs or the highly compensated. Inherited wealth in the second generation represents most of the remainder. New fortunes tend to hold a portfolio concentrated in the business or industry which created the fortune. Thus, they are typically far from the well-diversified portfolio of the institutional investor. Further, these holdings may have control aspects or be wrapped up with entrepreneurial activities in such a way that their management reflects more of a business decision than a portfolio decision.

THE INVESTMENT POLICY OF INDIVIDUAL INVESTORS

Despite their varied personalities, institutions can subscribe to a simple formulation of an investment policy as maximizing return within a risk budget. Such a policy formulation, however, would be unnatural for individuals. One key difference is that individuals have the capacity and need to manage their liabilities as well as their assets. Consider the case of the affluent investor who seeks to buy a house, educate his children, and provide for his retirement. In purchasing the house, he has an explicit range of liability choices in the form of mortgage terms and amount. Additionally, both the timing and size of the purchase are subject to significant control. In educating the children, the timing of the expense is fixed but the investor can choose more or less expensive educational programs, and rely more or less on debt or assets to fund the expense. Finally, with regard to retirement income, there is usually some modest flexibility in timing, more substantial flexibility in choosing the lifestyle to be funded, but no ability to substitute debt for assets as a funding

source. A second key difference is the role of financial assets in the total wealth portfolio. While generating return is an important consideration, hedging considerations are also relevant. The importance of hedging considerations is most evident in the case of the high net worth investor with a concentrated position that cannot be traded. However, even the affluent investor may have significant nonmarketable positions in the form of human capital, real estate, and mortgage debt whose financial characteristics should shape the handling of the liquid assets.[2]

TAXES AND THE INDIVIDUAL'S INVESTMENT PORTFOLIO

Turning to a consideration of the individual investor's portfolio, we find that its properties are markedly different from those of an institutional investor. The reason is taxes, which have a number of profound effects on the portfolio. In the first place, taxes can create new assets in the portfolio. Consider for instance the case of tax loss carry forwards. These are assets in the sense that in certain circumstances positive benefit can be derived from them. At the same time they are nontransferable assets and hence nonmarketable assets. Thus, they cannot be valued by marking to market. At the same time, no benefit will be derived from these assets unless gains are generated from the marketable holdings. Thus, the portfolio must be managed by optimizing over both marketable and nonmarketable holdings.[3]

Similarly, by making growth investments instead of current income investments, the investor has the option to defer taxes. This tax option is of considerable value, but again this value cannot be evaluated by marking to market. If the investor chooses an investment policy which leads to tax deferral, then decisions made at a later period are strongly influenced by decisions made in an earlier period. As a result, it is no longer possible for the investor to accurately conceptualize a long investment horizon as a sequence of independent short horizon periods. Similarly, the decision to realize a gain in one asset may be influenced by the existence of a loss in another asset. Thus, there is some loss of efficiency which results from dividing the total portfolio into separately managed subportfolios.[4]

As we saw, the cornerstones of institutional portfolio management are mark-to-market performance measurement, division of a long horizon into subintervals, and division of a total portfolio into independently managed subportfolios. As a result of taxes, all three cornerstones are inapplicable to the individual portfolio. An individual must use appraisal performance measurement to capture the contribution of nonmarketable assets, generally cannot treat a long horizon as a succession of independent shorter periods, and must weigh the benefits of subdividing the portfolio against the efficiency loss that can result.[5]

Another effect of taxes is to create the asset location decision, which is an aspect of portfolio management absent from the consideration of institutional investors. For the affluent investor, the dominant tax consideration is income tax. Income tax law creates certain tax favored holding structures (e.g., IRAs, 401ks, annuities). The location problem is then how to distribute the assets among these structures versus taxable portfolios so as to maximize long-term return while preserving the necessary degree of intermediate financial flexibility. For the high net worth investor, these income-tax-sheltered structures are either not available or not materially significant. However, estate tax can be a more important consideration than income tax. Here a different form of the location problem arises, with the issue being the direct holding of assets versus the benefits of early transfer to trusts, foundations, and personal heirs. Again, a weighing of benefit versus a loss of flexibility is required, and in many cases the issues cannot be reduced to a purely financial question.[6]

Yet another aspect of taxes is to alter the definition of assets. Consider the case of a fixed-maturity semiannual-pay coupon bond with *de minimis* credit risk and no embedded options. From the perspective of an institutional investor, this is a very simple instrument. For the purposes of risk and return analysis, the investor will typically treat this instrument as if it were a portfolio of zero coupon bonds with one maturity at each cash flow point. For the individual investor, however, this instrument is far from simple. Tax law distinguishes at least 20 varieties of such an instrument, most of which cannot be adequately analyzed as if they were a portfolio of zero coupon bonds. Thus the basic analytic tools that an institutional investor takes for granted are flawed instruments in the hands of an individual investor. Indeed, some of the basic data that an individual investor requires to inform his decision making may not be readily available in databases, which are generally constructed to serve the needs of institutional investors.[7]

Finally, taxes change the basic asset return parameters. In general, taxes reduce expected returns, reduce asset variances, shift asset correlations, and may either increase or decrease asset Sharpe ratios. When one thinks of tax effects, it is often this shifting of these parameter values which first comes to mind. In fact, however, these parameter shifts are fairly easily accommodated within

the analytic structure employed by institutional investors and thus their effect, while of course important to final decisions, does not profoundly change the situation. It is the other tax effects noted above which render the whole investment framework of the institutional investor unsuitable to the individual investor and whose consequences are thus more profound.

STANDARD PRACTICE

Enough has been said about the fundamental differences between the institutional investment problem and that of the individual to see that a straightforward application of institutional methods to the individual's situation is going to be inadequate.

Common practice for individuals is to divide investment funds into a number of pockets, each dedicated to a specific financial goal. These pockets are then managed somewhat independently of one another, and though this results in some degree of portfolio inefficiency, the degree of that inefficiency is typically unmonitored and often unobservable. In the retirement account there is often a close emulation of institutional practice, with funds divided among a number of managers who follow either passive strategies or short-horizon active strategies. As the account is tax sheltered, this practice may in fact be an adequate solution. To the extent that this structure is carried over to the taxable account, a dramatic loss of portfolio efficiency will occur. However the portfolio is structured, there will generally be such a lack of transparency about the situation that it can be difficult to assess or adjust the portfolio in view of the investor's larger financial goals.

The reader is most likely a competent financial professional and also an affluent individual investor. As such, he can assess from his own experience the difficulties of getting an adequately deep financial analysis. For instance, here are two life situations the reader has probably personally encountered:

1. If one buys a house with a mortgage, there is generally a choice of financing options. A mortgage structure with a high monthly service requirement consumes a larger portion of the household budget, while a lower service requirement leaves some budget free for investment in alternate saving vehicles, such as a larger equity investment in a 401k fund. In addition, the mortgage usually contains a complex package of fixed income options, e.g., refinancing options and interest rate caps if it is an adjustable rate mortgage. Thus, the total portfolio choice involves going short the mortgage debt, long the embedded options, long the purchased real estate, and making a long range funding decision with respect to external investments. Although the complexity of this decision generally exceeds any decision made by an institutional portfolio manager, the decision is typically made based on the most superficial of financial analyses.
2. The reader may well be holding some combination of equity and corporate bond investments in a retirement vehicle. These investments carry significant exposure to the U.S. financial sector (20% of the S&P 500 and 10% of the Lehman aggregate). Presumably, the reader also has most of his human capital located in this sector, so there is clearly an issue of poor diversification. Yet determining the total financial sector exposure in the retirement portfolio alone is probably quite difficult, let alone understanding the inefficiency inherent in the total wealth portfolio.

In the abstract, these may be interesting but perhaps not deeply exciting issues. When one considers that the consequences of bad decision making may be, for instance, working five years longer at a job one dislikes, one realizes that these questions contain more emotional and financial import than initially meets the eye.

A BETTER APPROACH

Having identified some aspects of the problem facing an individual investor and the incentives for addressing those issues, let us briefly sketch a more adequate framework for addressing them. This framework is addressed most directly to the needs of the affluent investor, but with some adjustment it should also serve many of the needs of the high net worth investor.

The key to mastering the complexities of the individual investment problem is to construct it as a series of simpler problems. The first problem to be addressed is to determine the sources, scale, and timing of the individual's wealth and of claims on that wealth. Financial plans are generally worked out in terms of cash flow projections over the individual's life and are often close to incomprehensible. Greater clarity can be achieved if the plan is reduced to a balance sheet view (*see the Exhibit*). Such a perspective will help to illustrate three important observations:

Key Observations

1. In early middle age, financial assets represent only a small part of the total wealth portfolio and the risk taken here contributes very little to the total risk budget, which is dominated by career uncertainties. As such, aggressive investment policies may be adopted and are probably advisable from a diversification perspective. This stands in contrast to the mistaken view that because assets are small, risks cannot be taken or to the misunderstanding that because investment horizons are long, large risks can be taken.
2. In latter middle age, financial assets represent a larger part of the portfolio and now contribute significantly to the total risk budget. Thus, risk needs to be considered more carefully. Again, the misconception may be that because *financial* assets have grown, greater risk may be taken or, because age has advanced, the investment horizon has shortened and less risk may be taken. In fact, aging has reduced human capital and, most likely, total resources. However, claims also have been reduced, so financial security has probably been maintained or improved. With modern life expectancies, the investor's investment horizon probably has not yet been meaningfully curtailed.
3. In old age, actuarial risk may increase to a significant figure. This risk is completely diversifiable and yields no investment return. Standard portfolio theory, therefore, is that it should be eliminated through the purchase of life annuities. In general, however, annuities are often misunderstood as primarily a high cost tool for bond investment rather than as a risk control product and so they tend to be underutilized at present.

Net Resources and Margin of Safety

Throughout the investor's life cycle, useful analytic tools are *net resources*, defined as resources minus claims, and the *margin of safety*, defined as net resources as a percentage of total resources. The net resources show directly how large a loss can be absorbed before the financial plan becomes infeasible. The margin of safety shows how sensitive the financial plan is to effective resource management. Both numbers provide useful guidance as to how much risk can be taken in the investment portfolio.

For the high net worth investor, the handling of control stock positions and bequest objectives are often dominant considerations. These matters generally are business or life decisions, not portfolio decisions, and so they are addressed most naturally in the context of an overall financial plan.

A BETTER FINANCIAL PLAN

Stage 1: Project Cash Flows

To form the financial plan, some assumption is required as to what investment returns and funding costs will be, but in general the financial plan can be formulated without a detailed knowledge of the portfolio. Thus, the issues addressed in the financial plan can be successfully decoupled from the portfolio problems. The output of the financial planning process will be projected cash flows into and out of the investment portfolio over the investor's life as well as some risk guidance and minimum return requirements for the portfolio.

Stage 2: Portfolio Strategy

From this data, one can move on to addressing the second stage of the planning process, which is the formulation of a portfolio strategy. The strategy should decide how funds are distributed between regular and tax sheltered accounts, which asset classes are held, how those classes are distributed between the regular and sheltered accounts, and a policy for periodically rebalancing the overall portfolio. In this analysis, the nonmarketable positions, such as control blocks of stock or human capital, should be included as exogenous assumptions; thus their influence on the final results will be properly accounted for, while the portfolio strategy decisions will focus on control of the liquid assets. It is useful for the asset classes to be defined by type of asset held and management style, rather than just by type of asset. Thus, one would distinguish an actively managed equity class from a passively managed one, recognizing the different tax consequences that flow from distinct management styles and thus permitting the location effects to be accurately modeled.

Stage 3: Implementation

The third stage is implementation of the strategy. This involves selection of assets to fill out the allocations specified by the strategy, monitoring, and periodic rebalancing. In general this stage is not particularly different from implementation of an institutional portfolio strategy.

The primary difference is that one is using a multi-period risk budget and so one wants the implementation to reflect this difference. The natural approach is to repeat a Monte Carlo analysis (discussed below) with the portfolio now defined at the level of specific assets rather than asset classes. This tool has such analytic power that even the most complex portfolio decisions, such as different mortgage funding alternatives, can be accurately compared and assessed.

Stage 4: Performance Reporting and Analysis

Finally, one comes to performance reporting and analysis. The basic questions to be answered are:

1. Is the portfolio delivering the expected performance in the financial plan?
2. Are the deviations from plan financially significant?
3. Should adverse deviations be attributed to policy choices, poor portfolio strategy, poor portfolio implementation, adverse market conditions, or to changes in the financial plan?
4. Should either the portfolio or the plan be adjusted in view of the deviations?

Thus, the financial plan provides the fundamental benchmark against which portfolio performance is assessed. Comparison against market indices may still be interesting, particularly for assessing manager skill, but the key control issues revolve around executing on the financial plan and they should remain central to a performance discussion.

Monte Carlo Analysis: An Expanded View

Suppose for the moment that a portfolio strategy has been proposed. One can assess this strategy using the technique of Monte Carlo simulation. This technique inputs expected returns to different asset classes, applies standard models of asset dynamics, and develops a forecast of the probability distribution of portfolio value over a range of future years. In particular, this methodology can accurately model all the complexity that derives from the interaction of cash flows, taxes, variable asset returns, and rebalancing policies. As such, it gives an accurate presentation of the risks inherent in the strategy. In particular, one is interested in risk at three horizons:

1. *The near-term risk*. This is most naturally quantified by the *drawdown risk*, defined as:

   (expected return − 2 × the standard deviation of return) × starting portfolio value

   and interpreted as nominal value that could be lost in a typical bad year. Compared to the margin of safety in the financial plan, this measure shows whether adverse near-term performance could force immediate abandonment of the strategy.
2. *The medium-term risk*. This quantity measures the probability that, due to a succession of bad years, at some point in the next five years the cumulative drawdown will have so reduced the margin of safety in the overall financial plan as to force abandonment of the strategy.
3. *The ultimate shortfall risk*. This quantity measures the risk that in the long run claims on the portfolio grow faster than portfolio assets, resulting in ultimate failure of the financial plan. Whereas the near- and medium-term risks are primarily controlled by asset volatility, i.e., market risk, the ultimate shortfall risk is controlled more by the uncertainties in the asset expected returns, i.e., forecasting risk.

Obviously, one wants a portfolio strategy to be sustainable in the short and intermediate term and to ultimately achieve one's financial goals. Thus, these three measures of risk constitute the natural quantities to define the risk budget for a portfolio strategy. The strategy selection problem can then be framed as picking the strategy with the highest expected return within the constraints of the risk budget. In general, one will build a portfolio strategy using a combination of judgment supplemented by optimization tools to fine-tune various parameters (e.g., the rebalancing frequency in the taxable portion of the portfolio).

CONCLUSIONS

The investment problem of individuals is more complex than that of institutions. We have seen how multiple objectives, liability management, the presence of nonmarketable positions, the importance of multiple risk horizons and taxes all play a role in creating this complexity. We have sketched an analytic framework which is capable of bringing this complexity under control. This framework is surely not appropriate to every need, but in its salient features it clearly focuses on the key issues for a

EXHIBIT

A Balance Sheet View of the Life Cycle Finances of an Affluent Household

Age	35	45	55	65	75	85
Resources						
Human Capital	3,552	2,114	846	0		
Social Security		337	567	821	544	179
Net Real Estate		190	587	1,200	800	800
Tax Sheltered Savings		308	783	1,468	1,288	1,155
Regular Savings		42	325	276	764	515
Total	3,552	2,991	3,108	3,765	3,396	2,649
Claims						
Basic Living Expenses	1,737	1,418	1,057	686	426	207
Educational Expenses	414	465	523	0		
Discretionary Living Expenses	613	677	624	542	319	162
Total	2,764	2,560	2,204	1,228	745	369
Net Resources	788	431	904	2,537	2,651	2,280
Margin of Safety	22%	14%	29%	67%	78%	86%
Savings % Total Resources	0%	12%	36%	46%	60%	63%
Representative Risks						
Career Risk	710	210	0			
Financial Risk	0	35	170	155	235	200
Actuarial Risk				50	60	95

This table summarizes the financial life of a particular affluent household as derived from a financial model. The household consists of a husband working full time in a managerial capacity, a wife working part time in a professional capacity, and two children. Age represents the age of the parents. Resources and claims are in thousands of dollars of constant purchasing power. Nonmarketable items (human capital, social security, claims) are actuarial present values. Marketable items (real estate and savings) are market values.

Career risk refers to the uncertainty in salary progression. Financial risk is one-year drawdown risk. Actuarial risk reflects the impact of an uncertain date of death on post-retirement living expenses net of Social Security benefits. For this household annual gifts to children were commenced once the parents reached age 70. The cumulative lifetime transfer under this gifting program was 479. The combination of the estate, net of estate tax, and the gift program result in a total transfer of 2,060 to the children. Over the life cycle 72% of cash inflows were generated by salary and 28% by investment return. Of the cash outflows, 5% were financing costs. While these figures are derived in a highly specific case, they serve to indicate the overall importance of good financial management in attaining life goals.

wide swath of individual investors. As such it is manifestly superior to much of the unstructured decision making which occurs currently.

ENDNOTES

[1]Magnin and Tuttle [1983] is a standard reference for institutional practice.

[2]There has been considerable discussion of what should be considered the portfolio and how it should be measured. Practitioners tend to focus narrowly on financial assets valued at market values. Reichenstein [1998] argues strongly for both the inclusion of Social Security and private pension plans in the portfolio and for adjustment of nominal values to after-tax values. Fraser, Jennings, and King [2000] consider the appraisal and portfolio implications of the Old Age and Survivor Insurance in detail. Academic work (Merton [1992]; Campbell and Viceira [2002]; Roussanov [2003]) routinely considers human capital in the context of life cycle planning. Palacios-Huerta [2003] considers the return characteristics of human capital and Musumeci [1999] discusses human capital in a mean-variance framework. There is a diversity of approaches to residential real estate and its associated mortgages. Cauley, Pavlov, and Schwartz [2003] provide a recent analysis of the portfolio dimensions of real estate. In this article we adopt the most comprehensive view of the portfolio, but use the language of resources and claims rather than assets and liabilities to signal that not all items

are traditional assets or liabilities. Following other authors, we (silently) net Medicare benefits against health costs and do not discuss them in the portfolio context. This silence represents a concession to the complexity of the material rather than a judgment as to the adequacy of this approach.

[3]The importance of managing tax losses has been discussed at length by Stein and Narasimhan [1999] and by Arnott, Berkin, and Ye [2001]. Apelfeld, Granito, and Psarris [1996] present a multiperiod model for combined active stock selection and tax loss management.

[4]Brunel [2002] discusses the inefficiency in applying the institutional multi-manager structure to taxable assets. Shoven and Sialm [2003] discuss the question of locating financial assets among taxable and tax deferred accounts from a portfolio management perspective. The discussion of location issues by accounting and legal practitioners is extensive.

[5]AIMR's performance presentation standards address the problem of measuring and reporting performance for taxable accounts, primarily in the context of public communication. In private communication (the setting discussed in this article) analysis and reporting can be more adapted to the specific situation.

[6]See Brunel [2002] for a discussion of the location problem.

[7]See Leibowitz [1987] for a discussion of bond analysis in the presence of taxes. Garlock [2003] provides details on federal taxation of bonds.

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