

Thoughts on the Future: Theory and Practice in Investment Management

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I will try my hand at suggesting some fruitful directions for putting existing finance theory into investment management practice. I will take the perspective of the client, or customer, and explore a set of asset management issues for three groups—households, corporations (in particular, pension funds), and endowment funds. My intent is to build on and extend the existing intellectual foundation of our investment practice

These issues are inextricably connected to four horizons—the long run, the decision horizon, the planning horizon, and the planning subhorizons.

The long run is a series of short runs linked to the faraway objective. There are essentially three fundamental time horizons. The shortest is the trading horizon—the shortest length of time in which you can carry out or revise a transaction. Depending on the type of market, it could be virtually continuous (24 hours a day) or once a day. But the horizon is not chosen by the investor or the investor's agent; it is institutionally set.

The second-shortest horizon is the decision horizon—the length of time between deciding to revise a portfolio and executing the decision. It may be similar in length to the trading horizon or somewhat longer, such as a week or even a month. But realistically, it will not be, say, five years. No one is going to lock in a decision for five years without any way to revise it.

The longest time frame is the planning horizon—the length of time over which things matter to the decision maker. It can be quite long—60 years, 70 years, or in some cases, if the investor is interested in passing wealth to future generations, of indefinite duration.

And in addition, there are planning subhorizons—horizons that relate to targeted concerns. For example, within overall lifetime planning, investors may find it convenient to focus on the retirement component of the life cycle, and the length of

time until retirement is thus a planning subhorizon, as is the time spent in retirement.

Households

In the realm of households, one of the biggest trends that has arisen in the past 20–25 years is disintermediation—sometimes called disaggregation—of financial services. Householders are being called upon to make complex and important financial decisions that they did not have to make in the past. A prime instance in the investment management area is in providing for retirement.

In the past, people had defined-benefit pension plans provided by their employers. DB plans specify benefits as a fraction of final pay scale before retirement and require no management on the part of the householder. For some time, the trend has been to replace these plans with defined-contribution plans (or, somewhere in-between, cash-balance plans) in which the employee must decide on the mix of investments. In today's world, the householder confronts lots of opportunities and financial product choices. There are about 9,000 mutual funds and a great variety of financial insurance products. Although having choices is nice, it is also a quite daunting task to select among them. How do households get the necessary knowledge and expertise to execute effective plans? We have developed our models and made those available through advisory engines on the Internet. This disaggregated approach to saving and retirement planning simply hands out all the parts of the task to householders. They must make all the decisions and assemble the product parts.

Relying strictly on advice engines to provide guidance on assembling a retirement plan is not the direction in which our profession is headed. Instead, I see us going in the direction of more integrated financial products, products that are easy to understand, are tailored to individual profiles, and permit much more effective risk selection and control than we have had. Unlike current practice in the mutual fund and insurance industries, the integrated financial services business of the future is going to focus on the customer rather than the product as the primary unit of analysis or attention.

As an industry, investment management has been very successful—certainly as shown by the

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growth of mutual funds and pension funds. And the industry has made significant progress in developing and improving portfolio allocation and performance measurement. However, the central objective function used in even the most sophisticated advisory services is the basic mean–variance criteria of the 1950s, which is based on a static, one-period model of maximizing expected end-of-period wealth. And as central and useful as that approach has been, I think the time has come to extend the models by trying to capture the myriad of risk dimensions in a real-world lifetime financial plan.

Risk. The three main approaches to risk control or risk management are hedging, diversification, and insuring. Most of the advisory engines in current practice for households, however, focus only on diversification. Hedging, which is essentially getting rid of the risk by exchanging risky assets for a risk-free asset, is not considered. And I do not see any elements of insuring, which for financial risks is typically option-like instruments that, for a price, protect against losses on risky assets while retaining the upside benefits of those assets. So, we need to expand our toolkit to include all three methods of risk control.

■ *Risk in human capital.* Most of the advice we give to householders is explicitly geared to financial assets. It does not explicitly consider human capital—either in its value or risk characteristics. But human capital is, of course, the largest single asset most of us have throughout a good part of our lives, prior to retirement.

To incorporate human capital in total wealth as an extension of the model, we must be sure to capture its important individual risk characteristics. For example, a stockbroker, an automobile engineer, a baseball player, a surgeon, and a professor have very different risk profiles in their human capital. The easiest to analyze is the stockbroker's human capital, for which the risk is linked to what happens to the stock market. A stockbroker's human capital is probably more sensitive to the markets than, say, a professor's. If a stockbroker and a professor have the same total wealth (admittedly an unlikely hypothesis!) and similar risk tolerances, common sense would say that because the stockbroker has implicitly invested his human capital in the stock market, the allocation of his tangible wealth should be such that there is a lower percentage of wealth in the stock market for the broker than for the professor. To the general person in the street, this conclusion is perhaps at first counterintuitive. Many would say, "Well, the stockbroker is in the business, so the stockbroker should invest more in the market." As an oft-written dictum, "Invest only in what you know about" may have appeal, but from the point of view of efficient *risk bearing*, that concentrated allocation would rarely be appropri-

ate. In short, we need effective models of asset allocation that focus on more than expected levels of compensation. It is not enough to add human capital as a lump of wealth. We also have to take into account the volatility of that human capital and its correlation with other assets.

Another important element of human capital that warrants incorporation for purposes of decision making is flexibility. Together with the size of human capital, its volatility, and its correlation with other assets, we should also consider its flexibility. Returning to the retirement-planning issue: How long will you continue to work? Can you extend your work extra years if necessary? If you are a baseball player, the length of your work life is not flexible; baseball players cannot continue to be professional baseball players for much of their lives. Tenured professors, in contrast, can choose to continue to work for most of their lives.

■ *Risk in future reinvestment rates.* Which would you rather have—\$5 million or \$10 million? An easy question to answer, *if all else is held fixed*. But suppose instead that the question is framed as: Which would you rather have—\$5 million and a single investment with a 10 percent sure real rate available indefinitely into the future or \$10 million and a single investment at a 1 percent real rate for indefinitely into the future? That is—\$5 million with a 10 percent real rate versus \$10 million with a 1 percent real rate. Simplifying the problem into a perpetual annuity to make the point implies for the \$5 million at 10 percent, a real perpetual stream of \$500,000 a year indefinitely. For the \$10 million at 1 percent, the stream is \$100,000 a year in perpetuity. So, if I had asked the original question as "Which would you rather have—\$500,000 a year in perpetuity or \$100,000 a year in perpetuity?" the answer would have seemed easy also, although it contradicts choosing the option with the larger wealth. The precise answer, however, depends on how long you intend to be around. If you have fewer than 10 years, the larger wealth dominates and you stick with the \$10 million. If you have more than 10 years, the larger rate of return dominates and you go with the \$5 million and 10 percent real rate. The two annuity streams cross at 10 years.

The point is that, as powerful as the models we use are, end-of-period wealth, or wealth in general, is not a sufficient statistic for financial welfare. Wealth, or income, should be translated into an implied stream of sustainable consumption—unless, of course, we are in a one-period world in which the two match up. So, our advice should take into account, as a first-order matter, the issue of uncertainty about future reinvestment rates.

■ *Volatility of what?* Is risk better measured as volatility (riskiness) of wealth or as volatility (risk-

iness) of the flow of income and consumption? In the general case in which the future rates for both risk-free and risky assets are uncertain, for a household to maintain a consumption stream that is stable (which is one measure of risk if the household wants to have the same real level of consumption every year), what is needed is an asset that produces more wealth when interest rates go down (when the household needs more wealth) and generates less wealth when rates go up. That asset is bonds. And if we are dealing in terms of purchasing power or standard of living, then the bonds should be real and, typically, long dated, such as U.S. Treasury Inflation-Indexed Securities (known generally as TIPS). As an asset class, TIPS are not simply one of the assets that should be in a portfolio to reach the efficient frontier, but they (or something like them) serve the additional function of providing a hedge for the household. They reduce the risk to the household's standard of living, its future consumption stream, from changes in the investment opportunity set, at least with respect to changing interest rates.

We can extend this approach beyond the uncertainty about future interest rates to uncertainty about the risk-reward opportunities captured by, for example, the Sharpe ratio (portfolio excess return divided by the standard deviation of the return). If we are in the mean-variance world with its period-by-period snapshot as the core decision model, the opportunity set is affected by changes not only to interest rates but also to the slope of the risk-return opportunity. (Change in volatility of the market is beside the point in terms of the opportunity set.) We want to think about and model in our investment process how to hedge against unfavorable shifts in both interest rates and the Sharpe ratio.

In this connection, suppose that the rise in the U.S. stock market in the 1990s may have been fueled in part by Baby Boomers waking up to the need to save for retirement, which may have differentially driven equity prices higher and compressed the risk premium. In other words, all of the money coming in may have caused share prices to rise and the Sharpe slope to become flatter. If so, that development is important. The good news for householders is that during the 1990s, they could say, "Look how much wealth we have made in our 401(k)'s!" But if the Sharpe slope has flattened, the bad news is that households are going to need a lot more wealth to maintain the same consumption, or consumption stream, in retirement. So, households may be wealthier, but they may not be better off.

This issue is not academic. Considering its magnitude, it is an important factor in financial planning. Moreover, what might happen to stock

prices and the Sharpe slope when the Baby Boomers decide to go into retirement and draw down their annuities? Perhaps they will stay with equities, and perhaps they will not. What they do may significantly affect the equity risk premium.

In short, different measures are needed for the risk to household wealth in the long run and in the short run. Should the volatility of income, permanent income, perpetual flow, or wealth be used? Perhaps a simple version that picks up this effect could be introduced into the standard mean-variance model; namely, we should use an inflation-protected life annuity as *numeraire* for the investment portfolio. In other words, instead of using dollars in respect to the risk-reward frontier, an advisor would measure the frontier in terms of annuity units, so the riskless asset would be a life annuity with expected maturity equal to the lifespan of the particular person for whom the advisor was planning.

Targeted Expenditures. Another element advisors should include as part of an integrated plan for households is the notion of targeted expenditures. An example of such expenditures is college tuition, which is a common part of a financial plan at certain points in a client's life cycle. Consider the typical situation: A couple has a 2-year-old and decides, "We know for sure that we would like our child to go to college at 18 years old. Yes, that is what we are going to want to consume for sure." That consumption will occur 16 years from now, and typically, a good financial planner will attempt to build an investment program taking into account general inflation, looking at the various asset classes—growth stocks, mutual funds, bonds, and so forth—and their historical returns and correlations. If the advisor is very good, she will look specifically at the historical rates of tuition and room and board inflation, not simply general inflation, in order to target the right needs. Then, the advisor will say to the couple, "Well, if history repeats itself in terms of return patterns and in terms of inflation over the next 16 years, and if you save this amount for that purpose now, you will have enough to pay for your child to go to college." But suppose the client reasonably asks, "Oh, that is nice, but what if history does not repeat itself? What if the returns are not the same as in the past? What if tuition does not inflate at the rates of the past?" What the advisor usually says is, "Unfortunately, that risk is your problem. Perhaps what you should do is put in more than the projected investment as a cushion." She will talk about, for example, if the theoretical need is X dollars, maybe the client ought to put in $1.5X$ dollars. Now, suppose 16 years later, lo and behold, the couple has not only enough for the college target—the tuition and room and board—they have three times as much as they need

because she advised them to have a large cushion and things worked out well. Good outcome, on the one hand, but on the other hand, what if the couple is thinking, "You know, we could have used this extra money over the last 16 years to go traveling with the family or make life easier for us. We would have liked that." The problem is that, sure, now the clients can buy the kid a Corvette, but they cannot go back in time and consume what they would have preferred (such as traveling with their children when they were young). Thus, there is no "safe harbor" from this basis risk for the household. They can save too much as well as too little.

A sensible solution would be for the advisor to offer a product for that part of the plan that is targeted for college that is indexed to the cost of, say, a collection of universities. Then, the client makes a single payment and eliminates that risk altogether. Instead of it being "your problem," the advisor can say, "If you write a check for \$75,000 today, 16 years from now, we will deliver to you the amount needed to pay four years of tuition, room, and board." It is one important financial goal off the table. It makes sense to lock that in now because if they later become twice as wealthy, they will not expect to spend materially more on education and if they become half as wealthy, they are not likely to spend materially less on education. Target it, take it off the table. It is done. No uncertainties about growth asset rates and all the rest.

Of course, the downside to this solution is that the investment firm has to produce the promised amounts. That challenge is much harder for the firm than giving clients advice to invest in securities, because the firm, not its client, takes on the risk of the proposed investment strategy not working out. But it makes sense for the firm, rather than the individual, to bear this risk. It is doable to remove the basis risk from individuals. Imposing basis risk on individuals must be suboptimal to giving it to investment firms because the firms can spread that basis risk across some kind of institutional structure more effectively than the individual can. Imposing that kind of basis risk on households has nothing to do with selection bias and has nothing to do with moral hazard, which are the usual justifications for individuals needing to bear this type of risk.

One potential concern about feasibility may be, "Well, where are the clients going to get the \$75,000 needed to buy this contract?" The answer is that the firm will finance it, just the way a car or a house is financed. The difference is that the couple is not bearing the uncertainty about college costs. They make preset payments over time, but the risk is off the table.

As we see with the example of tuition costs, significant risks to households can be eliminated by contractual agreements with financial services

firms. However, to avoid one type of risk only to incur significant counterparty credit risk may not improve household welfare. This type of contractual solution is efficient only if the entities that provide the mechanism (the insurance) have sufficiently high credit—an AAA or AA+ credit—a credit rating that, for all practical purposes, makes bankruptcy remote. For that reason, providing that insurance, along with liquidity, is likely to become a large business. The large pools of pension funds may be very sensible bearers of this kind of core risk.

The same lost opportunities can happen to people in retirement who do not have real life annuities. They can become worried about outliving their wealth, so they end up living more frugally than would be necessary and leaving more money than they want to, perhaps leaving it to somebody they do not particularly care about. Saving in that manner for security is inefficient. So, a similar approach can be taken with core retirement funds. Along with the fear of outliving one's assets, another common concern of someone approaching retirement is that, having gotten used to a style of living, he would not like to see his standard of living go down. He would not mind it going up, but he surely does not want it to go down in his retirement years.

Although that goal need not apply to everybody, how a person likes to live is usually well established by retirement time, so materially reducing it is not acceptable. A core retirement plan based around an inflation-indexed annuity and ownership of one's principal residence (with perhaps a reverse mortgage to help produce more annuity flow) can ensure that both these concerns are addressed. This is true provided the contracts are essentially default free.

Formal utility theory models do exist in the literature to capture this kind of client behavior. They are called "habit-formation models." However, even if the advisor may not know exactly the person's utility function, the advisor can establish something like a defined-benefit plan that pays a significant fraction of final salary as a real life annuity, forming an early no-decision instrument proxy for what a DB plan was intended to do, without the flaws of nonportability and no inflation protection of actual DB plans in the United States.

Products. Some products of the future for householders will feature integrated risk management, condo value insurance, and customized risk management.

■ *Integrated risk management.* Examples of integrated risk management in the retirement part of the life cycle are long-term care and life annuities. The issue that raises the cost of these two products when purchased separately is selection bias. When I shop for life insurance, the insurance

company seems to set its premium schedule as if I were officially dead at 90 with 1.0 probability, but when I shop for an annuity, the same company seems to say, "In computing your annuity payments, we believe you may well live to be a very spry 107." I am not an actuary, but I believe that the fair basis for that difference in mortality assumptions is selection bias: People who know they are not well do not buy life annuities, and thus those who do buy them are expected to live longer than their age-cohort average. So, to possibly offset some of that bias, how about creating a product that bundles long-term care with a life annuity. The point is not simply that a client has the convenience of a financial supermarket where he or she can get a life annuity and long-term care in the same place. Bundling the products helps balance the selection-bias issues of actuarial characteristics. If someone turns out to need a lot of long-term care, the insurance company can know, after the fact, that this person will probably not live as long as expected beforehand. If the relationship is valid, then those who live much longer than expected are less likely to need long-term care. Thus, those who select this product have a way of signaling relatively less selection bias, which allows the company to provide them better terms.

■ *Condo value insurance.* Another product that would be valuable and could be created is an integrated product offering both traditional insurance and financial insurance—that is, a comprehensive "value insurance" policy—for a condo. Suppose you are a futures trader who moves to a condo in Chicago. If you are always going to live in Chicago, then whether the price of housing increases or decreases, ownership is a hedge to maintain the same standard of living in housing. But you recognize that you are at some risk of having to move to find work if the futures industry does poorly. If you and others like you have to move at the same time, housing prices are likely to be depressed when you have to make the sale. Ownership is no longer a hedge. Such risk might be better borne, rather than by you, by local institutions that are always going to be located in Chicago and thus have something of a hedge in the form of lower compensation to pay if the real estate market goes down. Perhaps, then, especially for people who are not going to be there permanently, the idea of some kind of floor or insurance of value, like a put option, on the condo might make sense. Such a product might also reduce the cost for local institutions of hiring people into the area. Whatever the exact product is, the idea is to marry the protection against the risk that the market value of

this asset will fall to all the protection traditional insurance provides for the usual property and casualty risks. Such pricing could be done efficiently and, to avoid moral hazard issues, by using local real estate price indexes to value the property.

■ *Customizing.* Advisory services should use the full toolkit of financial instruments and institutions to address client problems. They need to be prepared to look at not just standard securities but also contractual agreements and customized or special-purpose vehicles. In terms of hedging, I mean bring the risk-free rate back. And I do not mean a one-period risk-free rate; I mean the appropriate risk-free rate for the planning horizon.

Lots of important data can be incorporated into the models now because of the computational power available. I suspect that few financial planning services actually use the term structure of interest rates and the term structure of volatility as prospective inputs in advice models for their clients. Eventually, we will move to relatively seamless life-cycle financial solutions for risk management for individuals and households. We have the financial knowledge base to move forward significantly. For example, we know from option-pricing technology that we can find a replicating dynamic trading strategy for any derivative that will (at least approximately) replicate that derivative's payoffs. As Haugh and Lo (2001) and I (Merton 1989, 1992, 1995) have pointed out, we could turn that approach around to create, instead, derivative securities with payoffs that replicate dynamic trading strategies.

Suppose that an individual or her advisor comes up with an optimal dynamic portfolio strategy that is contingent on the evolving value of the portfolio and other variables, such as the investment opportunity set, income tax rates, and relative prices of consumption goods. Instead of the individual actually doing all the trading required to execute the plan, an institution could issue an instrument whose replicating strategy is that dynamic strategy. So, if you solve for an optimal trading strategy but you do not want to trade 24 hours a day as the optimal model with continuous trading opportunities would dictate, you can instead go to an investment firm and say, "Here is my strategy. You issue me a derivative instrument that replicates the payoffs to the strategy I would have followed if I were doing all this trading." This approach hands the execution of the strategy from a high-cost transactor to a low-cost transactor. Unlike the individual, institutions offering the derivative solution can both hedge its exposure at lower trading cost and also use the advantage of netting exposures among its clients to further reduce transaction costs.

This type of product will not be widely available tomorrow or three years from now, but I believe that this is the direction the industry will move.

Summary on Households. For investment services for households, we are headed toward integrated financial planning and the offering of comparatively seamless products to implement those plans. Therefore, those providing this service must consider a much wider set of asset classes and risks than in the analyses of the present. To the traditional analysis of risk–return trade-offs for tangible wealth including a riskless asset, we need to add explicit analyses of human capital, hedging of reinvestment rates, mortality and traditional insurance risk, and income and estate taxes.

Pension Funds

In the field of DB pension (or cash-balance) plans, analysts no longer focus simply on asset risk but, instead, focus on the risk of the pension surplus (difference between assets and liabilities). This approach recognizes that the pension assets are providing explicit collateral for the pension liabilities and that the fund can be used to immunize the risk of those liabilities—that is, to take the corporation’s responsibility for future payments to retirees off the balance sheet in the same way that the hypothetical couple could take future tuition payments for their children off their balance sheet by contracting with a financial institution to provide deferred annuities for members of the plan. But if the pension fund sponsor chooses to keep the pension fund and its associated liabilities on its balance sheet, the sponsoring company absolutely must look at the risks chosen for the pension fund from the perspective of the whole company. It cannot analyze optimal pension strategy without examining how the strategy would interact with the risks from all the assets and liabilities of the company.

Under ERISA rules, the corporation has a fiduciary duty to manage the pension assets solely in the interests of its plan members. But whether plan assets decline or rise in value, the amount of the company’s liability for pension benefits remains the same. Thus, like corporate real estate with a mortgage, the pension fund is an encumbered asset of the corporation. Hence, in terms of risk, corporate managers should view the plan as part of an integrated risk management program for the company. For example, suppose an outside money manager reallocates assets for a client pension fund from stocks to bonds for some reason. The manager has just reduced volatility in the company’s asset base. That is fine. But suppose before that reallocation, the company overall was operating at an optimal debt-to-equity ratio—trading off the risks of financial distress against tax benefits and lower agency costs that lower the cost of capital and so

forth. In that case, because the asset manager’s actions have decreased risk in the company’s asset base, maybe the optimal decision for the corporate capital structure would be to increase leverage in the company’s capital structure by issuing debt to retire company equity. In summary, the effect of a pension decision can change the company’s risk and may, therefore, have implications for optimal capital structure. Another way to think of the issue is as integrating risk management of the company—operations, hedging of targeted risk exposures, and capital structure.

For another example, consider a hypothetical aircraft engine manufacturer. This manufacturer typically books forward for engines to be delivered—the manufacturer builds them and has forward contracts from purchasers—and this exposure to future customer financial performance often continues even after the engines are delivered, because the purchases are often financed by the manufacturer. So, this manufacturer probably has substantial trade credit exposure concentrated in one industry—the airline industry. That trade credit exposure comes from an asset, and it has certain risk characteristics. In this case, perhaps the pension fund assets, everything else being the same, might be shaded away from investments in the airline industry because the company already has effective investment exposure there through the trade credit. This company has flexibility, however, as to where to carry that exposure, if at all. Suppose the company wants exposure to the airlines and, as described, is taking it in the form of trade credit; that is, in the absence of that trade credit, it would have held more airline stock. Should the company reduce its airline exposure in the pension fund? Perhaps not. Suppose for some reason the company prefers to take the airline exposure inside the pension fund. In that case, the company can use credit derivatives to take the risk arising from the trade credit off the operating balance sheet. The decision could go either way; the important corporate finance issue is the integration of risk management.

Pension fund assets and liabilities represent a huge piece of some companies’ market capitalization. At the beginning of 2001, the ratio of pension assets to market cap, not book cap, for the top quintile of companies with large pension plans was about 2 to 1. Combine that figure with a 50–70 percent equity mix in pension assets and the result is a bet on the equity market larger than the company’s entire equity capitalization. Furthermore, these companies are highly leveraged because pension liabilities are essentially debt.

You can imagine what must have happened to the pension surplus as a percentage of these companies’ market capitalization between 31 December 2000 and month-end September 2001. During

this period, the S&P 500 Index fell by more than 20 percent and the Nasdaq Index fell in excess of 40 percent. Because of the resulting “flight to quality” by investors after 11 September, combined with the downward trend in interest rates preceding it, the value of the long-duration fixed-payment pension liabilities went up. On a mark-to-market basis, a fully funded pension fund at year-end 2000 with 60 percent of its assets in the S&P 500 would now have a pension deficit of 12 percent of pension liabilities, without taking account of the increase in the value of liabilities from falling interest rates. Because the market capitalization of the average company’s own equity probably fell about 20 percent, the ratio of pension assets to market capitalization for the top quintile at the end of September probably rose to 220 percent. Thus, with the same percentage of equity assets in the fund, the relative size of the equity bet of those companies going forward was even larger than at the start of year.

Endowment Funds

In terms of total assets and liabilities, endowment-fund institutions are much like individuals or households. If the endowment is a university’s, the managers should look at its other assets—both tangible ones, such as buildings, and intangible ones, such as future tuition receipts. Gifts and bequests are particularly important for some universities. Research-oriented universities, such as the Massachusetts Institute of Technology, Harvard University, Stanford University, and similar institutions have substantial “shadow” investments in certain sectors because their graduates include many successful entrepreneurs in the science and technology areas who are likely to make gifts of their shares to their alma mater. Future public- and private-sector grants for research are also likely to be sensitive to success in the technology area, as are other university business assets, such as publishing. When considering the composition of the endowment, the institution needs to factor in all the assets, including the endowment as one asset but not the only one.

On the liability side of universities, some aspects that are important for surplus management in pension plans apply to endowments. The endowment needs to consider the cost of operations and other liabilities of the university when considering what risks to take. For example, a substantial liability for institutions such as Harvard University is faculty salaries. Harvard is in direct competition with comparable universities to attract top faculty and students. The cost of housing is probably the biggest single factor in the overall cost of living that differs among those university communities. Housing costs are very different in Harvard’s town of Cambridge (Massachusetts) from the costs in the hometowns of Yale (New Haven, Connecticut) or Stanford (Palo Alto, California) or the University of Chicago, and so on. This difference is likely to be the main source of differences in a typical professor’s pay package among those universities. So, if one of these institutions wants to attract people, it will typically have to pay more if it has a higher cost of housing than the others. Therefore, it is rational for the university to hold a much bigger component of local residential housing as a hedge in its portfolio than would ordinarily be held in a well-diversified market-weighted portfolio. And Harvard and Stanford do have such holdings.

Conclusion

It is, of course, not new to say that optimal investment policy should not be “one size fits all.” In current practice, however, there is much more uniformity in advice than is necessary with existing financial thinking and technology. That is, investment managers and advisors have a much richer set of tools available to them than they traditionally use for clients. My remarks here have tried to identify important directions for expansion of that advice. Executing these proposals efficiently is no small task. That said, I see this issue as a tough engineering problem, not one of new science. We know how to approach it in principle and what we need to model, but actually doing it is the challenge.

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