Strategic Asset Allocation:
Portfolio Choice for Long-Term Investors

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It's a great honor to be asked to give this lunch talk, and particularly to be introduced by Bob Shiller. I well remember when I first read a paper of Bob's – I was sitting in the New Haven train station during my third year as a Yale PhD student. Bob's paper on stock market volatility was so absorbing that I lost consciousness of my rather grimy surroundings and had to run frantically to catch my train. I remember thinking that this was the kind of work I would like to be able to do. By great good fortune, Bob later came to Yale and became my thesis adviser, coauthor, and the inspiration for much of my other research.

I'd like to talk today about my recent work on strategic asset allocation, the theory of portfolio choice for long-term investors. My book on this subject, written with Luis Viceira, has just been published by Oxford University Press who, I'm glad to see, are aggressively advertising it at this meeting.

Normative economics

In the book, Viceira and I make specific assumptions about investors' preferences and the financial market conditions they face. We solve for optimal portfolios under these assumptions, and present these portfolios as investment advice for long-term investors. We do not assume that investors have already chosen optimal portfolios, and thus we do not test our models by comparing our recommended portfolios with actual portfolios. The book is an exercise in normative economics rather than positive economics.

Normative economics has a somewhat precarious status in our profession. Most economists prefer to assume that individuals are already optimizing correctly, and that our job is merely to describe their choices. My colleague Robert Barro expressed this view with characteristic sharpness when he told me that "normative economics is what you call your model when it fails to fit the data".

On the other hand, there has always been a desire among economists to use our discipline to improve the world. This is only possible if some agents in the economy – private individuals, government bureaucrats, or politicians – are not already optimizing correctly. Keynes vividly expressed our desire to be useful in his essay "Economic Possibilities for our Grandchildren". He wrote: "If economists could manage to get themselves thought of as humble, competent people, on a level with dentists, that would be splendid!"

For most of the 20th Century, economists concentrated on improving the decisions of government policymakers. Keynes may have imagined Treasury and central bank officials as orthodontists, intervening with the painful but effective tools of fiscal and monetary policy. But today, dentists spend much of their time giving advice on oral hygiene. Rather than intervening themselves, they teach individuals to take care of their own mouths. Similarly, there may be a role for economists to offer advice to improve financial hygiene: the myriad economic and financial decisions that private individuals are asked to make.

Portfolio choice

Several factors make portfolio choice a particularly promising area for normative analysis. First, individuals are being asked to make increasingly complex portfolio decisions. During the last quarter century there has been a major shift away from defined-benefit pension plans, which offer people a defined income in retirement, towards defined-contribution plans, which offer people the chance to accumulate a portfolio of financial assets that will support their standard of living in retirement. DC plans have many advantages – notably, they accommodate job mobility and heterogeneous risk preferences – but they also require a higher level of investment expertise.

Second, there is evidence that people are not always making good choices. Recent work in behavioral finance has documented systematic patterns of individual behavior that are hard to reconcile with any rational model. The most egregious problem is the failure to diversify, particularly the tendency to invest heavily in the stock of one's employer. The dangers of this are luridly illustrated by the recent Enron collapse. Even when people try to diversify, Shlomo Benartzi and Dick Thaler have pointed out that they often do so naively by giving equal weight to each available option, even if some of the options are very similar while others are true diversifiers. Yet the benefits of diversification are easy to understand, and academic analysis of this subject has changed little for 50 years. If people fail to diversify properly, they may make even larger errors in more difficult aspects of portfolio construction such as asset allocation, which is the subject of my talk today.

Third, people appear to be hungry for portfolio advice. They seem to want to overcome the behavioral biases described by behavioral finance research. A large financial planning industry has sprung up to satisfy this hunger. The financial planning industry is highly sophisticated in some respects, notably in tax planning, but it tends to use rules of thumb to guide the tradeoff of risk and return. Here are two of the most familiar rules of thumb for asset allocation:

Aggressive investors should hold stocks, conservative investors should hold bonds.

Long-term investors can afford to take more stock market risk than short-term investors.

How can we assess these rules of thumb? What do you have to believe about the world to justify such rules? More generally, how can we set financial planning advice on a sound scientific foundation?

Academic portfolio choice theory

Of course, these are not new questions. Portfolio choice is a field with a great academic tradition. The pioneering work of Harry Markowitz in the early 1950's opened up the field to quantitative analysis and began the modern era in financial economics. In his 1952 *Journal of Finance* article "Portfolio Choice", Markowitz recognized that his mean-variance analysis could be used "both as a *hypothesis* to explain well-established investment behavior, and as a *maxim* to guide one's own action".

The normative use of utility theory was also emphasized by early decision theorists working in business schools, such as Howard Raiffa. In a 1961 article in the *Quarterly Journal of Economics*, Raiffa wrote: "The fact that most people can be shown to be inconsistent in their manifest choice behavior cuts two ways: First, it emphasizes the difficulties encountered in putting into practice a [rational] model…. Second, it clearly demonstrates how important it is to have a theory which can be used to aid in the making of decisions under uncertainty. If most people behaved in a manner roughly consistent with… theory then [it] would gain stature as a descriptive theory but would lose a good deal of its normative importance. We do not have to teach people what comes naturally. But as it is, we need to do a lot of teaching."

Markowitz's mean-variance analysis has indeed had great success as a maxim for portfolio choice. It has been programmed into optimizers that are used on a daily basis around the world. But despite its practical success, mean-variance analysis relies on the assumption that investors care only about the distribution of wealth one period ahead. This is highly unrealistic – most investors are interested in the standard of living that their wealth can support over the longer term. Also, a one-period horizon makes it impossible to evaluate the claim that long-term investors should take more stock market risk than short-term investors.

Financial economists recognized the need for a long-term portfolio choice theory several decades ago. Theoretical work on long-term portfolio choice began in the late 1960's with the pioneering research of Paul Samuelson and Robert Merton, and continued in the 1970's with important contributions from Mark Rubinstein, Joe Stiglitz, Doug Breeden, and others. For many years, however, academic research did not take the next step of making these models quantitative. Until the late 1990's they remained somewhat abstruse pieces of theory that were admired by academics but had only limited influence on practitioners.

In the last five years this situation has changed dramatically. Advances in theory and numerical methods have been applied to this area and have allowed us to find approximate analytical solutions and exact numerical solutions to complex long-term portfolio choice problems. Econometric methods have been used to estimate the asset

return processes that are the inputs to these problems. Portfolio choice has become one of the most active areas of empirical finance. It is now possible to pull together what we have learned from this recent research, and this is the purpose of my book with Viceira.

Risk, return, and the investment horizon

In the remainder of my talk, I will use this recent research to evaluate the two rules of thumb of financial planners:

Aggressive investors should hold stocks, conservative investors should hold bonds.

Long-term investors can afford to take more stock market risk than short-term investors.

Let us begin by considering the classic mean-standard deviation diagram for short-horizon investors. I will assume that three broad asset classes are available: stocks, bonds, and cash. Stocks have high risk and return, bonds have moderate risk and return, and cash is riskless. (In reality, cash is exposed to modest inflation risk but it is conventional to ignore this to simplify the analysis.) The blue curve shows the minimum-variance set of points that can be reached by combining stocks and bonds; the green line shows the minimum-variance set of points that can be reached by combining stocks and bonds with cash. Importantly, all these points are obtained by mixing cash with a single risky portfolio, the tangency portfolio of stocks and bonds. As James Tobin pointed out in the late 1950's, all investors are happy with a single mutual fund that offers this particular combination of stocks and bonds. The financial planners' first rule of thumb, advising conservative investors to increase their bond holdings, is simply wrong.

What if investors have long horizons? Paul Samuelson showed in the late 1960's that this need not make any difference. If investment opportunities are constant over time, then long-horizon expected returns and long-horizon risks compound in precisely the same way. Long-term investors perceive the same tradeoff of mean against variance as short-term investors do. Under plausible conditions on preferences, notably the condition of constant relative risk aversion, long-term investors should hold the same portfolios as short-term investors. This implies that the second rule of thumb, the one that tells long-term investors to increase their stock market exposure, is also wrong.

The key assumption of Samuelson's analysis is the constancy of investment opportunities. In the late 1960's this may have seemed a reasonable assumption, but since then we have accumulated evidence that investment opportunities change over time in various ways. First, short-term real interest rates move over time in a persistent fashion. They were unusually low during the 1970's, very high in the early 1980's, low again in the early 1990's, higher again in the late 1990's, and low again today. Second, expected excess returns on stocks and bonds show some predictable variation. The most important aspect of this is that over very long periods of time the stock market seems to mean-revert: bull markets tend to be followed by bear markets, and vice versa.

These phenomena mean that risks can appear different to long-term investors than to short-term investors. I illustrate this using a diagram with holding period on the horizontal axis, and annualized standard deviation on the vertical axis. Each colored line in the figure corresponds to a different asset class. The risks are estimated in annual US data over the period 1890 to 1998, using a vector autoregressive model that includes both asset returns and predictor variables such as bond yields and dividend-price ratios. Because the diagram is based on a VAR model, it can show extremely long holding periods out to 100 years, but holding periods out to 20 or 30 years are the most important ones in practice.

If investment opportunities were constant, the lines on the diagram would be horizontal, but in fact they have important slopes. The yellow line shows the annualized risk of a strategy of rolling over Treasury bills. The annualized standard deviation of this strategy is about 8% over a year, but it increases to 14% over 25 years. The green line shows the annualized risk of a strategy of rolling over 20-year nominal Treasury bonds: this risk is higher than the T-bill strategy at short horizons, but lower, at about 12%, over 25 years. The blue line shows the risk of a strategy of buying a nominal bond and holding it to the given maturity. This strategy is risky in real terms only because there is inflation; thus the blue line also gives the annualized standard deviation of inflation over the given horizon. Inflation risk is about 8% per year, increasing to 12% at long horizons. Finally, the red line shows the risk of holding the value-weighted index of US stocks. This risk is almost 18% for short-term investors, but considerably smaller at about 14% for 25-year investors. Overall, this diagram shows that stocks and bonds appear less risky, relative to Treasury bills, for long-term investors than for short-term investors. Jeremy Siegel has emphasized similar findings in his popular book *Stocks for the Long Run*.

Optimal portfolios for long-term investors

What do these numbers imply for long-term portfolio choice? It is tempting to plug long-term variances into a mean-variance optimizer, effectively shifting the cash point to the right and the stock and bond points to the left in the mean-standard deviation diagram. But this would be correct only for an investor who cares about the mean and variance of wealth at a single, distant future date and who is constrained to make a once-and-for-all decision today, with no opportunity to rebalance his portfolio over time. In the more realistic case where the investor cares about the stream of consumption that can be financed by wealth, and where the investor can rebalance the portfolio freely every period, the analysis becomes more difficult. One cannot use standard mean-variance analysis but must calculate intertemporal hedging demand for assets along the lines pioneered by Robert Merton.

The importance of hedging demand depends on the risk aversion of investors. Investors with relative risk aversion of one ignore long-term risks and hold a short-term mean-variance-efficient portfolio. That is, they invest myopically as if they had a short horizon. Investors with relative risk aversion greater than one, however, seek to hold assets that increase in value when investment opportunities deteriorate. Such assets provide insurance against the risk that the return on wealth will fall, reducing the standard

of living that the wealth can support. Assets with this insurance feature are precisely the assets that tend to have lower risks at long horizons. Thus Merton's portfolio choice theory, when combined with the VAR model for US asset returns in the 20th Century, implies that conservative long-term investors should tilt their portfolios towards stocks and long-term bonds.

These results are illustrated in a figure showing optimal asset allocation for long-term investors who believe that asset returns are generated by the 20th Century VAR model. The horizontal axis in each panel shows relative risk tolerance, the reciprocal of relative risk aversion. At the left side, risk tolerance is one while at the right, it is zero. Thus aggressive investors appear at the left, while conservative investors are shown at the right. The top panel shows the optimal allocation to stocks, while the bottom panel shows the optimal allocation to nominal bonds, assuming that these two assets and Treasury bills are the only ones available. The dashed line in each panel is the demand of a short-term investor, while the solid line is the demand of a long-term investor. Thus by moving from left to right we can see the effects of increasing conservatism, while by moving from the dashed to the solid line we can see the effect of increasing the investment horizon.

The figure supports both the rules of thumb used by financial planners. As one moves to the right, the demand for nominal bonds does not go to zero but instead approaches a dominant position in the portfolio. Long-term conservative investors should hold bonds to protect themselves against the risk that real interest rates will vary. Comparing the dashed and solid lines in the top panel of the figure, we see that long-term investors should hold more stocks than short-term investors.

Of course, these results depend on the VAR model that I estimated for asset returns since 1890. If I look at quarterly US data for the period since World War II, I get a somewhat different picture. In the last 50 years real interest rate risk has been much smaller relative to inflation risk at long horizons. The annualized standard deviation of a T-bill strategy is about 1.5% over a quarter and 3% over 25 years, while the annualized standard deviation of inflation rises to 5% over 25 years. Stock market mean-reversion remains strong in this period, with stock market risk measured at 16% for short-term investors and only 8% for 25-year investors. A VAR model estimated over this period implies that long-term nominal bonds are relatively unattractive to conservative long-term investors. They provide little protection against fluctuations in real interest rates, and they are exposed to significant long-term inflation risk. Here we see that scientific analysis can qualify, as well as validate, the established rules of thumb of financial planners.

At the danger of sounding like a bond salesman as well as a book salesman, I will conclude with an investment recommendation for conservative long-term investors who are concerned about inflation risk. These investors should hold long-term inflation-indexed Treasury bonds, or TIPS, which were first issued by the US Treasury at the suggestion of Larry Summers in 1997. Popular discussion of TIPS tends to emphasize predictions of their returns. Indeed, Larry himself told me that he was able to introduce TIPS with some confidence, because he knew that within a few years he would either be

able to claim that he had saved money for American taxpayers, or that he had introduced a great new investment for the American people. In my view, however, the important feature of TIPS is that they are the true riskless asset for long-term investors. Treasury bills are not riskless over the long term, because they must be rolled over at uncertain future real interest rates; but TIPS can support a riskless stream of consumption and should play a central role in conservative long-term portfolios.

The challenge of strategic asset allocation

The practical implementation of strategic asset allocation is certainly not easy. To form a long-term portfolio, investors must first think systematically about their preferences and about the constraints they face. In my talk today I have assumed the particularly simple constraint that financial wealth supports consumption, but many investors must also take into account labor income or fixed expenses. Second, investors must form beliefs about the future – not just about average asset returns and risks, but about the dynamic processes that determine interest rates and risk premia. These beliefs must be consistent with some reasonable view about the equilibrium of the economy. Third, investors must solve the intertemporal optimization problem that they have set up. Last but not least, they must carry out their strategic plan without succumbing to the psychological biases documented by behavioral finance economists. It is hardly realistic to expect individuals to do all this by themselves. One of the most interesting challenges of the 21st Century will be to develop systems, combining the scientific knowledge of financial economists with information technology and the human wisdom of financial planners, to help investors carry out the task of strategic asset allocation.

Strategic Asset Allocation

Portfolio Choice for Long-Term Investors

John Y. Campbell and Luis M. Viceira

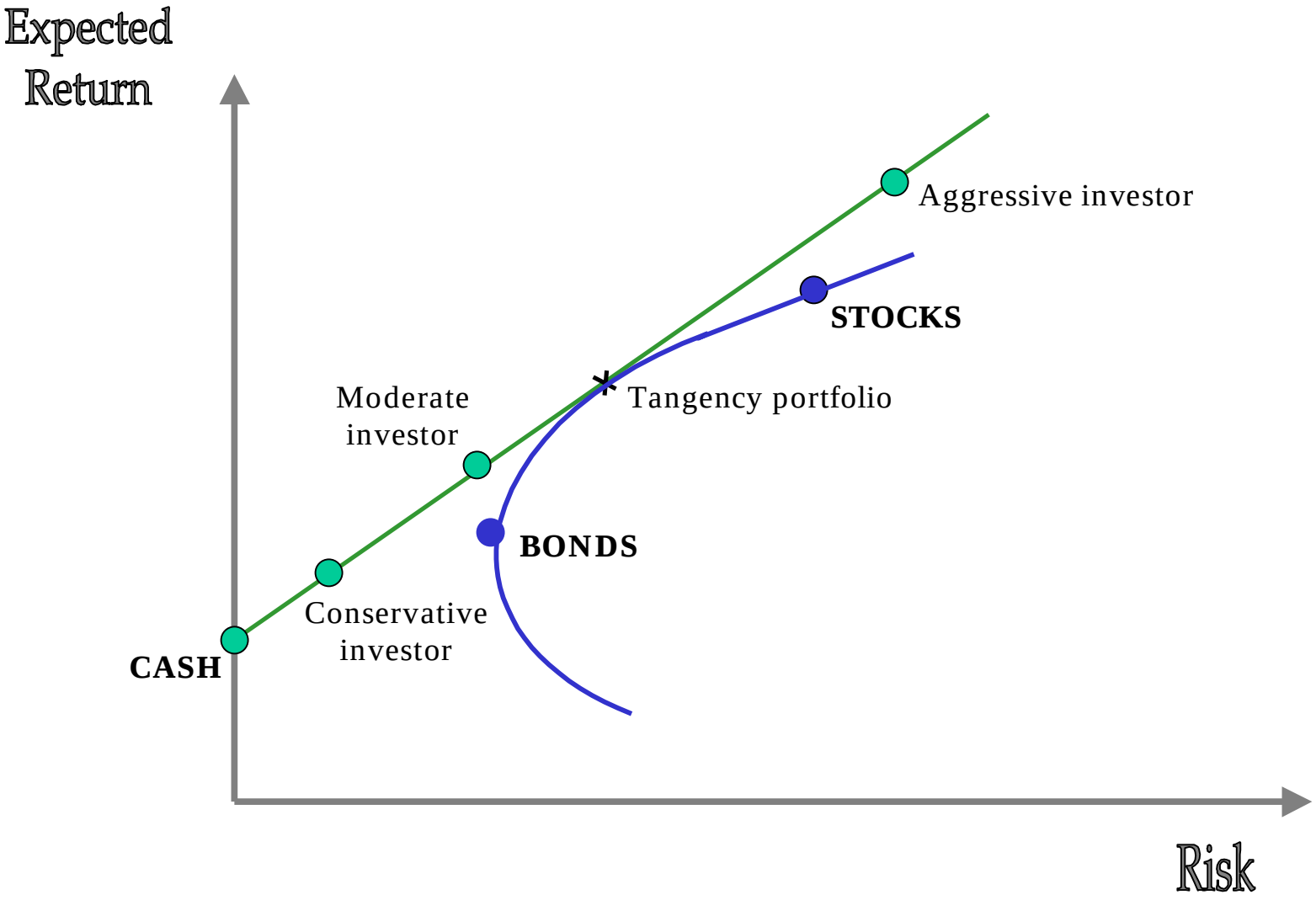
Oxford University Press, 2002

Financial planners' rules of thumb:

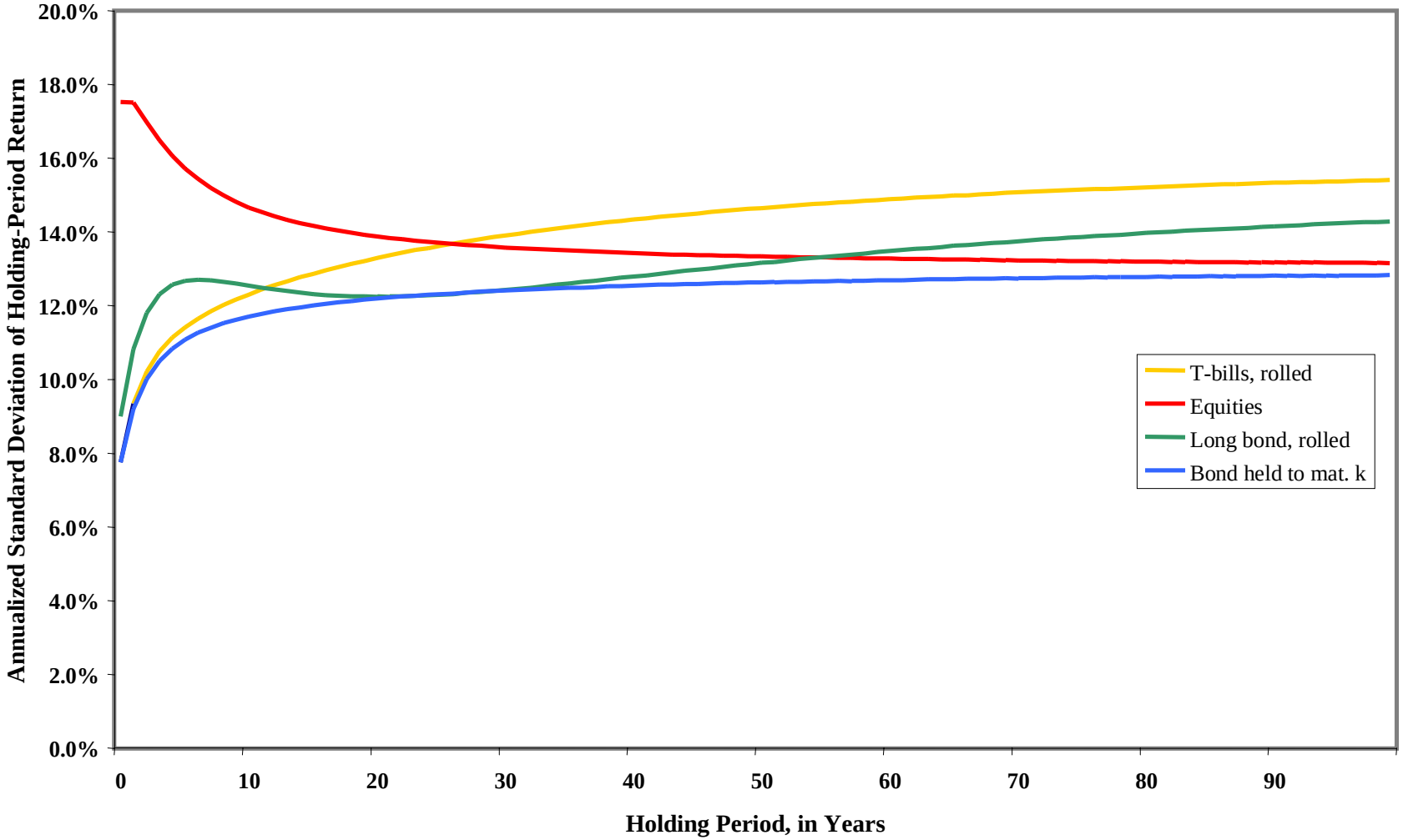
1. Aggressive investors should hold stocks, conservative investors should hold bonds.

2. Long-term investors can afford to take more stock market risk than short-term investors.

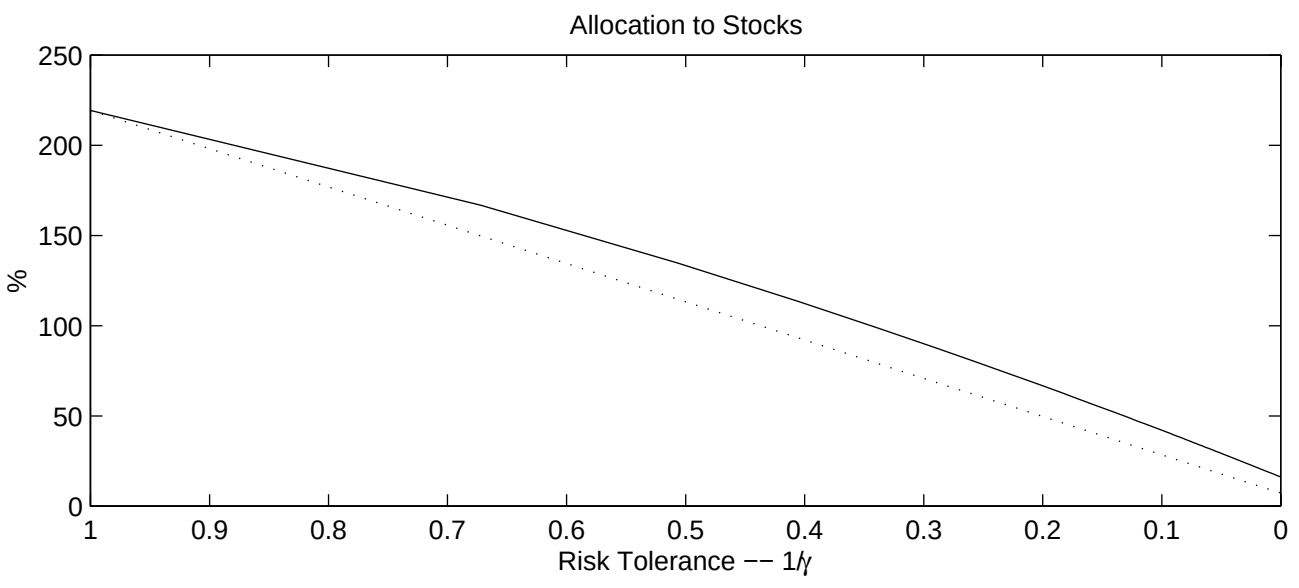
Short-term risk and return



Short- and Long-Term Volatility of Real Returns on Stocks, Bonds and Bills
Long-Term Annual Data (1890-1995)



Source: Campbell, J.Y., Y. L. Chan and L. M. Viceira (2000), "A Multivariate Model of Strategic Asset Allocation," manuscript, Harvard University.


Allocation to Stocks
250
200
150
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50
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%
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0.3
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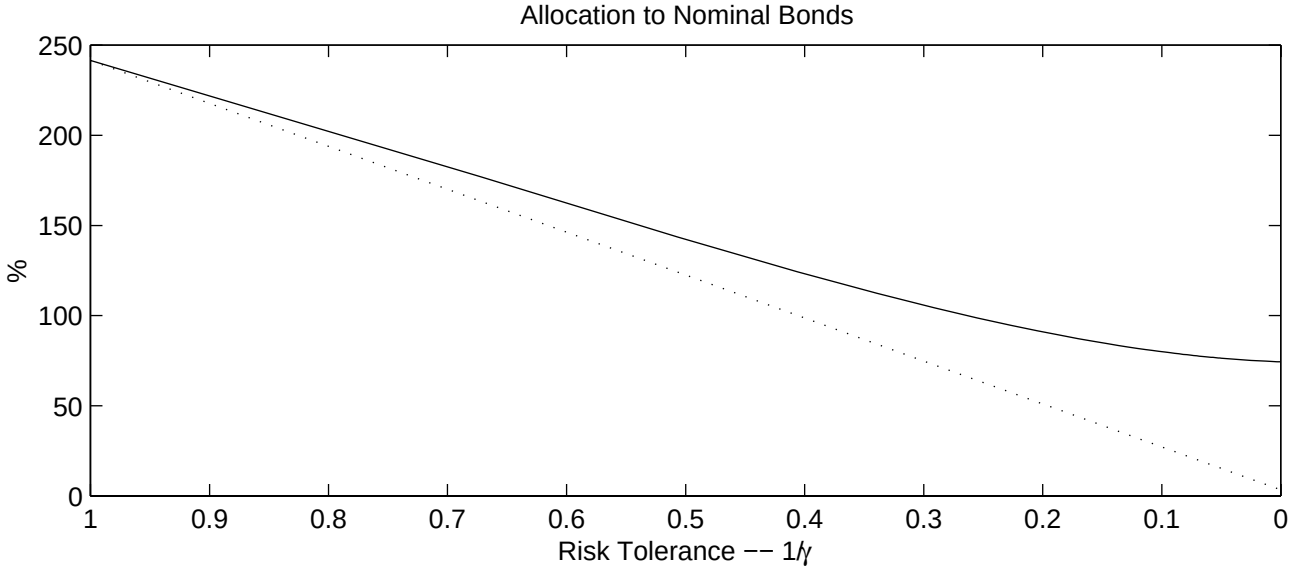
Risk Tolerance −− 1/γ


Allocation to Nominal Bonds
250
200
150
100
50
0
%
1
0.9
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0.7
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0.3
0.2
0.1
0
Risk Tolerance −− 1/γ