CHAPTER 5: Asset Allocation, Risk & Diversification: Some Topics Revisited

The asset allocation decision forms the foundation of portfolio design.[1] How should the investor make the asset allocation decision? What is an appropriate level of diversification?

Asset allocation usually refers to setting a portfolio's long-term systematic risk exposures by determining the weighting of various asset classes within the portfolio. The weighting scheme (asset allocation) can be very general – e.g., maintain a 60% weighting to stocks and a 40% weighting to bonds – or, it can stipulate the weights of U.S. and foreign securities and further subdivide according to specific stock and bond characteristics – e.g., value or growth.

Asset allocation usually refers to setting a portfolio's long-term systematic risk exposures by determining the weighting of various asset classes within the portfolio.

When is a Portfolio Under-Diversified?

It is difficult to assess the risk of under-diversified portfolios – portfolios owning only a few securities, or, a portfolio owning many securities concentrated in only a few asset classes or sectors.[2] An individual security's price change process often differs greatly from the price change process of its sector; and, furthermore, the price change process of a sector often differs greatly from the price change process of the larger asset class. For example, during 2001, the price of Enron exhibited behaviors that differed from energy sector stocks; while, contemporaneously, the energy sector exhibited behavior that differed from the S&P 500 Index of large

[1] See, for example, Farrell, James L., Portfolio Management: Theory and Application 2nd Edition (Irwin McGraw-Hill, 1997), p. 272: "Determining the asset mix that best suits the risk-return objective of the investor is the most important decision in meeting the longer-range goals of the investment plan." Whenever a portfolio must provide for cash flows to satisfy "liabilities" – e.g., the liability to provide safe, sustainable and substantial retirement income—the asset allocation decision becomes multidimensional. At a minimum, liabilities should be quantified so that the investor understands the portfolio's required return. As previously noted, a goal expressed in vague terms such as "growth," or "making a lot of money," or "beating the S&P 500," is not sufficient to allow for the construction of a portfolio that has a reasonable probability of prudently matching assets to liabilities. This is an important but complex extension of the topics in this introductory monograph. For further information, see Collins, Patrick J., Lam, Huy and Stampfli, Josh, "Monitoring and Managing a Retirement Income Portfolio, RIIA Between the Issues, Salem State University (December, 2015), pp. 4-34 and Howard, Ronald & Lax Yoel, "Strategic Asset Allocation in the Presence of Uncertain Liabilities," Modern Investment Management (John Wiley & Sons, 2003), pp. 110-135.

[2] The asset class of U.S. large company stocks is often represented by the S&P 500 stock index. The S&P 500, in turn, consists of a variety of sectors including Energy, Utilities, Financial, Consumer Staples, and so forth.

company U.S. stocks. The more granular the portfolio, the more difficult the task of quantifying its risk due to greater exposure to idiosyncratic events as opposed to the systematic risk factors discussed in the previous chapter.[3]

From time to time, one may hear that a portfolio of 15 to 30 stocks is well-diversified. This rule of thumb is so pervasive that it is worth taking a moment to examine it further. The source of this incorrect idea stems from a misreading of a 1970 research paper by Fisher and Lorie.[4] The study reported that a portfolio of 16 stocks achieves 90% of the diversification achieved by a portfolio owning all stocks on the New York Stock Exchange, while a portfolio of 32 stocks achieves 95% of that diversification. Other investigators writing in the 1970s and 1980s confirmed these conclusions.[5] Although independent studies reach slightly different conclusions based on analytical methodologies and the sample periods under investigation, most seem to demonstrate that a portfolio of relatively few stocks achieves substantial risk reduction benefits.

In 1975, however, Lorie cautioned investors against under-diversified portfolios. Failure to diversify completely (a failure to attain what Lorie called "the wisdom of extreme diversification") allows for the possibility of sizeable long-term underperformance relative to a comparable market-oriented benchmark such as the S&P 500 Index. The causes of investor confusion on this topic are:

1. The 1970 study assumes random sampling. However, most investors do not pick stocks at random. Rather, stocks are selected either under a bottom-up valuation approach or a top-down macroeconomic forecasting methodology. If either the valuation model(s) or macroeconomic predictions are wrong, a portfolio based on such a single-perspective opinion is subject to the risk of a substantial price decline.
2. Diversification benefits are achieved only "on average." Investors, however, must live with actual results, not with average expectations. The question becomes how far from the average return can a portfolio's return stray? The answer lies in a statistic known as 'tracking risk.' In the case of a 15 to 30 stock portfolio, the tracking risk is substantial.

Lorie states that merely picking "good" or "safe" stocks cannot reduce risk. Portfolio construction is not optimal when it merely bundles together stocks of blue chip companies (firms exhibiting strong current financial statements and favorable accounting ratios). Rather, portfolio risk reduction depends on combining securities with differing economic characteristics as measured by their volatility and tendency to move either in tandem or separately from each other. Investors who seek only to maximize returns (i.e., those who do not care about risk) will put all of their money in the single most promising security (or sector). Investors concerned about risk, however, will usually employ a strategy of broad diversification.

Testing Conventional Wisdom

The task of achieving effective diversification from a few individual securities is, according to an important

[3] In some cases it may be prudent to maintain an under-diversified portfolio. For example, if a portfolio tracks a contractual fixed income obligation that is measurable solely in terms of performance metrics appropriate to the U.S. bond market, it may not be prudent to hold stocks or real estate. In this case, the risk to be avoided is tracking risk—the failure of portfolio asset values to adjust to changes in the corresponding liability position. The next chapter discusses the prudence of under-diversified portfolio in terms of a portfolio manager's ability to forecast price changes accurately. For an in-depth discussion of diversification in the context of fiduciary law duties of prudence, see, Collins, Patrick J., "Diversification: Recent Legal and Academic Perspectives," California Trusts and Estates Quarterly, (Summer, 2003), pp. 35-42. This is available on the Schultz Collins website.

[4] Fisher, Lawrence and Lorie, James, "Some Studies of Variability of Returns on Investments in Common Stocks, Journal of Business (April, 1970), pp. 99-134.

[5] Bloomfield, T., Leftwich R. and Long, J. "Portfolio Strategies and Performance," Journal of Financial Economics, 1977, pp. 201-218.

study of stock returns, increasingly difficult.[6] The authors document, over the period 1962 through 1997, an increase in idiosyncratic volatility. This means that the number of randomly selected stocks needed to achieve effective diversification increased dramatically.[7] The study presents an in-depth decomposition of volatility into three components: market, industry and firm-specific volatility. Individual firm volatility increased substantially, and firm-specific volatility is by far the largest component of the total variability of the price of a stock. After adjusting for the effects of the 1987 crash, it concludes that the share of firm-specific volatility in contributing to total volatility in stock price increased from 65% to 76%.

Even if the conventional wisdom remains true, a well-diversified portfolio multiplied across multiple markets and nations may require ownership of several hundred securities.

With the above results in hand, the authors report: "[T]he increase in idiosyncratic risk has increased the number of stocks needed to reduce excess standard deviation to any given level. In the first two subsamples a portfolio of 20 stocks reduced annualized excess standard deviation to about five percent, but in the 1986 to 1997 subsample, this level of excess standard deviation required almost 50 stocks." Furthermore, as stated, these research findings assume a random selection process. Most asset managers do not form portfolios via a random selection process. Rather, they tend to overweight sectors that seem attractive and underweight those that they deem to be overvalued. This obviously reduces diversification that might have been achieved with a random sample.

Not only has the increase in idiosyncratic volatility made it more difficult to achieve effective diversification by holding only a few stocks, but a further examination of stock return volatility indicates that, during periods of recession, the number of securities in a portfolio must increase even further: "Because market volatility is substantially higher in recessions, even a well-diversified portfolio is exposed to more volatility when the economy turns down. The increase in volatility is stronger for an undiversified portfolio, because industry and firm-level volatility also increase in economic downturns. Thus diversification is more important, and requires more individual stock holdings, when the economy turns down." By 2002, Burton Malkiel of Princeton University concluded that "to get to where idiosyncratic risk asymptotically touches the systematic risk line … you need about 10 times as many stocks as before, or 200 stocks."[8] Of course, these conclusions focus on the U.S. stock market. Global diversification, however, entails ownership of securities throughout a variety of capital markets and geographic regions. Even if the conventional wisdom remains true, a well-diversified portfolio multiplied across multiple markets and nations may require ownership of several hundred securities.

Effective diversification enhances the ability to measure and control long-term portfolio risk. Strategic asset allocation depends on both of the investor's required return and the investor's tolerance for risk. Trivially, an allocation with an expected return below what is required to achieve financial goals is inappropriate. It is easy to see this type of mistake. Equally insidious, however, are allocations that produce more risk than necessary in light of the purposes, goals, distribution

[6] Campbell, John Y., Lettau, Martin, Malkiel, Burton G. and Xu, Yexiao, "Have Individual Stocks Become More Volatile? An Empirical Exploration of Idiosyncratic Risk," The Journal of Finance, (February 2001), pp. 1-43.

[7] Similar results for both U.S. and foreign equities are reported in Hill, Joanne M., "The Changing Role of the Intermediary," Best Execution and Portfolio Performance (Association for Investment Management and Research, 2001), pp. 26-28.

[8] Malkiel, Burton G., "How Much Diversification is Enough?" Equity Portfolio Construction (Association for Investment Management and Research, 2002), p. 26.

The greater the risk, the greater is the uncertainty of future results. Thus the goal is to design an asset allocation tailored to meet the investor's return objectives without generating a potentially dangerous 'risk gap,' where risk gap is defined as the voluntary election to assume risk greater than necessary.

requirements and economic circumstances of the portfolio. The greater the risk, the greater is the uncertainty of future results. Thus the goal is to design an asset allocation tailored to meet the investor's return objectives without generating a potentially dangerous 'risk gap,' where risk gap is defined as the voluntary election to assume risk greater than necessary.

More money is better than less; however, the blinkered pursuit of more money may be dangerous to your wealth. Effective portfolio management requires both measurement and management of risk.

CALIBRATING ASSET ALLOCATION WITH RISK PREFERENCES AND CONSTRAINTS

One way for an investor to find an asset allocation suitable to his risk tolerance is to track the behavior of a set of model portfolios. The investor may consider the historical returns achieved by various diversified portfolios, each of which differs according to its percentage allocation to fixed income (bonds) versus equities (stocks). A low variance portfolio owns a greater percentage of fixed income investments, while a high variance portfolio allocates more to stocks. Using this method, the investor can better understand the consequences of an asset allocation election along a continuum of risk/return choices.[9]

DISTRIBUTION OF MODEL PORTFOLIOS AMONG ASSET CLASSES

	Portfolio Equity/Fixed Income					
Asset Class	**0/100**	**20/80**	**40/60**	**60/40**	**80/20**	**100/0**
S&P 500 Stock Index	0.0%	4.0%	6.5%	10.0%	12.5%	17.5%
U.S. Large Cap Value Stocks	0.0%	4.0%	6.5%	10.0%	12.5%	16.5%
Decile 9-10 U.S. Small Cap Stocks	0.0%	4.0%	6.5%	10.0%	12.5%	16.5%
U.S. Small Cap Value Stocks	0.0%	4.0%	6.5%	10.0%	12.5%	16.5%
Int'l Large Cap Stock	0.0%	2.0%	7.0%	10.0%	15.0%	16.5%
Int'l Small Cap Stock	0.0%	2.0%	7.0%	10.0%	15.0%	16.5%
One Year Fixed Income	100%	60.0%	50.0%	30.0%	15.0%	0.0%
Five Year Fixed Income	0.0%	20.0%	10.0%	10.0%	5.0%	0.0%

FIGURE 5-2

[9] There are obvious difficulties with assuming that the future returns will mirror past results. More advanced methods for determining a prudent and suitable asset allocation may employ various types of risk modeling such as bootstrapping (reshuffled historical returns) Monte Carlo methods (parameterized simulations), and other risk modeling approaches. Interested readers can find additional information in: Collins, Patrick J., Fast, Steven M., and Schuyler, Laura, "Well-Performing Portfolios and Well-Disguised Insolvency," Representing Estate and Trust Beneficiaries and Fiduciaries (2014), pp. 499-534. This is available on the Schultz Collins website.

HISTORICAL PERFORMANCE OF MODEL PORTFOLIOS, 1973 - 2015

	Portfolio Equity/Fixed Income					
Asset Class	**0/100**	**20/80**	**40/60**	**60/40**	**80/20**	**100/0**
Annualized Return	5.52%	7.57%	8.89%	10.27%	11.36%	12.34%
Standard Deviation	3.78%	5.25%	8.42%	12.11%	15.92%	19.70%
Ending Value of $1,000	$10,093	$23,042	$38,947	$66,918	$102,349	$149,031

FIGURE 5-3

The Historical Risk/Return Continuum

The historical performance of several sample portfolios, based on quarterly returns series from 1973 through 2015[10], is shown in the figures that follow. **FIGURE 5-2** illustrates the distribution – i.e., weighting – of asset classes within each portfolio.[11] The portfolio labels reflect the ratio of equity to fixed income investments (that is, the 60/40 portfolio invests 60% of wealth in equities, and 40% in fixed income securities). The equity portion of the 60/40 portfolio invests 10% each in the S&P 500, U.S. Large Cap Value Stocks, U.S. Small Cap Stocks, U.S. Small Cap Value Stocks, International Large Cap Stocks, and International Small Cap Stocks. On the Fixed Income side, the portfolio invests 30% in One Year Fixed Income securities and 10% in Five Year Fixed Income securities. Taken together, the six model portfolios define a continuum of allocations from 100% fixed income to 100% equity.[12]

FIGURE 5-3 illustrates results realized over the forty-one year period. Annualized Return measures the mean annual compound rate of return. Standard Deviation measures the degree of investment risk realized by each portfolio. Ending Value of $1,000 describes the accumulation of $1,000 invested in each portfolio on January 1, 1973, as of December 31, 2015. The divergence of returns and cumulative results over the forty-one year period is dramatic.

The $149,031 earned by the 100% equity portfolio for each $1,000 invested on 1/1/73 is a relatively attractive number. However, investors should consider how disconcerting it would be to experience the worst annual losses that the all-equity portfolio generated over the period. During 1973 and 1974 the Arab Oil Embargo and the Watergate Presidential turmoil generated losses of -17.93% and -24.27%. In 2008 investors owning the 100% equity portfolio experienced a loss of -42.97%. Figure 5-4 details the year-by-year returns

[10] Data Sources:

Asset Class	Return Series
S&P 500 Index	Results as reported by Ibbotson Associates: Stocks, Bonds, Bills and Inflation.
One Year Fixed	One Year Constant Maturity U.S. T-Bills, as reported by Ibbotson Associates.
Intermediate Term	Barclays Capital Intermediate Term Govt/Credit, as reported by Ibbotson Associates.
International Small Cap Stocks	DFA International Small Company Index, as reported by Dimensional Fund Advisors.
U.S6-8 Index	Center for Research in Security Prices (CRSP) 6-8 Index, as reported by Ibbotson Associates.
U.S.Small Cap Value Stocks	Fama- French U.S. Small Cap Value Index, as reported by Ibbotson Associates.
U.S. Large Cap Value Stocks	Fama- French Large Cap Value Index, as reported by Ibbotson Associates.

[11] Returns are proxied by indexes; and, therefore, should not be construed as a track record of any actual portfolio. Indexed investments were not available to investors throughout the entire period. The annual return and standard deviation calculations are based on monthly returns for portfolios rebalanced quarterly during each one-year holding period.

[12] The asset allocation is illustrative only, and is not meant to constitute investment advice. Chapter Nine discusses interactive risk modeling.

for each asset allocation (See **FIGURE 5-4**).

To succeed, portfolios must often generate returns over and above the cost of living. Adjusting nominal annual returns for inflation provides a useful picture of portfolio results (See **FIGURE 5-5**).

The constant dollar adjustment shows that inflation is a threat to the portfolio that is both subtler and more persistent than sudden shocks to the domestic or global financial markets. Inflation strikes hardest at the 100% fixed income portfolio. This low variance portfolio traditionally appeals to the most risk-averse investors.[13] However, over the long-term, the "safest" portfolio is perhaps the most risky. For example, when portfolio returns are measured over five-year periods, the 100% fixed income portfolio experienced the greatest number of real losses (See **FIGURE 5-6**).

The salient point is that balanced portfolios often generated respectable long-term returns, in spite of difficult periods for the stock market. Poorly diversified portfolios, tilted strongly towards either 100% fixed income or 100% equity, however, did not.

Fear and Greed, Patience and Haste

The magnitude of the return generated by the all-stock portfolio acts as a powerful attractor towards tilting the allocation towards equity. Given a reasonably long planning horizon, it seems as if the opportunity cost of fixed income investments is extraordinarily high: $10,093 v. $149,031 at the extremes of the risk/return continuum. The long- run, however, is a series of short-runs; and, as the data also indicate, an investor may experience dramatic declines in wealth from allocations tilted heavily towards equity. The peak-to-trough decline in the S&P 500 Index during the five-month period from October 9, 2007 through March 9, 2008 was approximately 57%. Not surprisingly, a close examination of the historical track record often produces a fear/greed dynamic. It is impossible to keep emotional reactions out of the decision making process; and, as we will see in Chapter 7, doing so may be unwise, because the goal of a well-designed and prudently managed portfolio is to enhance the investor's "satisfaction" with wealth. Whenever subjective preferences are incorporated into the design process for private investors, there is a greater likelihood that investment policy accurately reflects personal economic goals.[14]

All-equity portfolios appeal to investors wishing to accumulate wealth quickly. Ironically, however, the return and variance properties of an all-equity portfolio require both great patience and extraordinary risk tolerance.[15] It is not surprising that the desire to grow wealth aggressively requires risk tolerance; however, patience is not often a trait commonly associated with the aggressive investor. Examination of the historical record clarifies the nature of this second, and most interesting, emotional dynamic.

FIGURE 5-7 depicts quarterly returns for the model portfolios over the 172 calendar quarters from 1973 through 2015.

The left axis depicts the magnitude of gains and losses. As the table proceeds to the right, the asset

[13] For a more detailed discussion of the combined effects on portfolios of inflation, trading costs and taxes, see TAXES, INFLATION AND TURNOVER below.

[14] For example, financial economists often incorporate a "subjective discount rate" into the design of retirement income portfolios. The rate reflects investor impatience – a wish to spend money early in retirement when good health motivates expenditures on travel, hobbies, entertainment, etc. A high subjective discount rate leads to forming a portfolio income distribution policy designed to provide for generous consumption early in retirement. Often, this is accomplished by assuming the risk of very low consumption later in life – investing is a prudent exchange of risk.

[15] One cannot conclude that the 100% equity portfolio, which generated the highest terminal wealth in the absence of cash flows, would also generate the greatest amount of ending wealth in the presence of periodic distributions. The presence of cash flow requirements alters the optimal asset allocation because each cash flow acts as a multiplier on downside returns and as a cap on upside returns. The 'Equity is better because it outperforms Bonds' argument is a potentially dangerous approach to wealth management in the presence of liquidity needs.

ANNUAL PORTFOLIO PERFORMANCE						
Annual Portfolio Performance: 43 Calendar Years 1/1/73 - 12/31/15						
YEAR	0/100	20/80	40/60	60/40	80/20	100/0
1973	7.31%	1.30%	**-3.15%**	**-8.25%**	**-12.90%**	**-17.93%**
1974	8.41%	1.41%	**-4.92%**	**-11.44%**	**-17.90%**	**-24.27%**
1975	6.90%	16.22%	24.21%	32.83%	40.95%	49.56%
1976	6.08%	13.55%	16.93%	22.41%	26.10%	32.17%
1977	6.08%	7.60%	12.22%	15.04%	19.52%	21.19%
1978	8.40%	9.41%	14.57%	17.59%	22.44%	24.59%
1979	10.81%	12.82%	14.55%	16.95%	18.44%	21.82%
1980	12.48%	14.14%	17.85%	20.80%	24.21%	27.41%
1981	15.22%	12.36%	10.45%	8.39%	6.25%	4.52%
1982	12.82%	17.63%	16.65%	18.21%	17.90%	19.60%
1983	9.71%	13.79%	18.14%	22.43%	26.73%	31.01%
1984	11.31%	11.16%	10.26%	9.55%	8.80%	7.85%
1985	8.67%	16.45%	23.21%	29.71%	36.95%	42.08%
1986	6.61%	11.73%	17.81%	22.60%	29.02%	32.04%
1987	6.76%	5.64%	7.59%	7.80%	9.59%	8.97%
1988	7.69%	10.97%	14.72%	18.25%	21.95%	25.38%
1989	8.76%	12.49%	14.82%	17.67%	20.20%	23.03%
1990	8.05%	3.49%	**-1.76%**	**-6.67%**	**-11.86%**	**-16.53%**
1991	6.05%	12.81%	15.33%	19.82%	22.78%	27.60%
1992	3.99%	6.52%	5.86%	7.01%	6.51%	8.48%
1993	3.49%	8.29%	12.35%	16.38%	20.71%	23.94%
1994	5.23%	3.10%	3.84%	3.38%	3.76%	3.32%
1995	6.13%	12.28%	14.07%	17.85%	20.10%	24.27%
1996	5.61%	7.36%	8.74%	10.52%	11.81%	14.15%
1997	5.70%	9.97%	11.25%	14.31%	15.70%	19.82%
1998	5.17%	6.87%	7.95%	9.12%	10.37%	11.39%
1999	5.07%	6.64%	10.45%	13.24%	16.81%	19.48%
2000	6.27%	4.66%	1.33%	**-1.24%**	**-4.37%**	**-6.91%**
2001	3.63%	4.83%	2.68%	2.23%	0.35%	0.29%
2002	2.02%	**-0.74%**	**-5.06%**	**-9.12%**	**-13.06%**	**-17.90%**
2003	1.25%	11.21%	20.37%	29.76%	39.09%	48.07%
2004	1.82%	5.86%	9.95%	13.88%	18.03%	21.61%
2005	3.59%	4.30%	6.30%	7.64%	9.54%	10.61%
2006	4.94%	7.90%	11.56%	14.84%	18.46%	21.53%
2007	4.61%	3.99%	3.36%	2.46%	1.97%	0.61%
2008	2.01%	**-6.30%**	**-15.72%**	**-24.71%**	**-33.97%**	**-42.97%**
2009	0.47%	10.09%	17.88%	26.41%	34.45%	42.75%
2010	0.31%	5.97%	9.31%	13.64%	17.27%	21.54%
2011	0.18%	0.00%	**-2.41%**	**-3.89%**	**-6.03%**	**-7.45%**
2012	0.17%	4.66%	7.92%	11.63%	15.08%	18.62%
2013	0.12%	7.03%	13.33%	20.13%	26.37%	33.62%
2014	0.12%	1.71%	1.65%	2.39%	2.48%	3.51%
2015	0.30%	**-0.56%**	**-1.10%**	**-1.93%**	**-2.42%**	**-3.49%**

FIGURE 5-4

ANNUAL CONSTANT DOLLAR PORTFOLIO PERFORMANCE						
Annual Portfolio Performance Adjusted for Inflation: 43 Calendar Years 1/1/73 - 12/31/15						
YEAR	0/100	20/80	40/60	60/40	80/20	100/0
1973	-1.36%	-6.89%	-10.98%	-15.67%	-19.95%	-24.56%
1974	-3.38%	-9.62%	-15.26%	-21.07%	-26.83%	-32.51%
1975	-0.11%	8.60%	16.07%	24.12%	31.71%	39.76%
1976	1.21%	8.34%	11.56%	16.79%	20.31%	26.10%
1977	-0.64%	0.77%	5.10%	7.75%	11.94%	13.51%
1978	-0.58%	0.35%	5.08%	7.86%	12.30%	14.27%
1979	-2.20%	-0.43%	1.10%	3.22%	4.53%	7.51%
1980	0.07%	1.55%	4.85%	7.48%	10.51%	13.36%
1981	5.76%	3.14%	1.39%	-0.51%	-2.47%	-4.06%
1982	8.61%	13.24%	12.30%	13.80%	13.50%	15.14%
1983	5.69%	9.63%	13.82%	17.95%	22.09%	26.22%
1984	7.07%	6.93%	6.06%	5.38%	4.66%	3.75%
1985	4.72%	12.22%	18.73%	25.00%	31.97%	36.92%
1986	5.42%	10.48%	16.50%	21.23%	27.57%	30.56%
1987	2.25%	1.18%	3.04%	3.25%	4.97%	4.37%
1988	3.13%	6.27%	9.86%	13.25%	16.79%	20.08%
1989	3.93%	7.49%	9.72%	12.45%	14.87%	17.57%
1990	1.83%	-2.47%	-7.42%	-12.04%	-16.93%	-21.33%
1991	2.90%	9.45%	11.90%	16.26%	19.13%	23.81%
1992	1.06%	3.51%	2.88%	3.99%	3.51%	5.42%
1993	0.73%	5.39%	9.35%	13.26%	17.48%	20.62%
1994	2.49%	0.41%	1.13%	0.69%	1.06%	0.63%
1995	3.50%	9.50%	11.25%	14.93%	17.13%	21.19%
1996	2.21%	3.91%	5.24%	6.97%	8.22%	10.47%
1997	3.93%	8.13%	9.39%	12.39%	13.76%	17.81%
1998	3.50%	5.17%	6.24%	7.39%	8.62%	9.62%
1999	2.33%	3.86%	7.57%	10.28%	13.76%	16.35%
2000	2.79%	1.23%	-1.99%	-4.47%	-7.51%	-9.96%
2001	2.05%	3.23%	1.11%	0.67%	-1.18%	-1.25%
2002	-0.35%	-3.04%	-7.27%	-11.23%	-15.08%	-19.80%
2003	-0.62%	9.15%	18.15%	27.37%	36.52%	45.34%
2004	-1.39%	2.52%	6.48%	10.29%	14.31%	17.77%
2005	0.17%	0.85%	2.79%	4.08%	5.92%	6.96%
2006	2.34%	5.22%	8.80%	11.99%	15.53%	18.52%
2007	0.51%	-0.09%	-0.69%	-1.56%	-2.02%	-3.33%
2008	1.91%	-6.39%	-15.80%	-24.78%	-34.03%	-43.02%
2009	-2.19%	7.17%	14.76%	23.07%	30.89%	38.97%
2010	-1.17%	4.41%	7.70%	11.97%	15.54%	19.74%
2011	-2.70%	-2.87%	-5.22%	-6.66%	-8.73%	-10.11%
2012	-1.54%	2.87%	6.07%	9.72%	13.11%	16.59%
2013	-1.37%	5.45%	11.64%	18.35%	24.50%	31.64%
2014	-0.63%	0.95%	0.89%	1.62%	1.71%	2.73%
2015	-0.43%	-1.28%	-1.81%	-2.64%	-3.13%	-4.19%

FIGURE 5-5

OVERLAPPING FIVE-YEAR PERIOD CONSTANT DOLLAR PORTFOLIO PERFORMANCE						
39 Overlapping Five Year Periods 1/1//73 - 12/31/15						
STARTING IN	0/100	20/80	40/60	60/40	80/20	100/0
1973	**-0.87%**	**-0.04%**	0.53%	0.78%	0.77%	0.37%
1974	**-0.71%**	1.47%	3.92%	5.86%	7.83%	9.06%
1975	**-0.47%**	3.45%	7.65%	11.70%	15.80%	19.70%
1976	**-0.43%**	2.07%	5.49%	8.53%	11.81%	14.79%
1977	0.45%	1.07%	3.49%	5.10%	7.21%	8.69%
1978	2.25%	3.46%	4.87%	6.26%	7.51%	9.00%
1979	3.51%	5.30%	6.56%	8.18%	9.32%	11.19%
1980	5.40%	6.81%	7.59%	8.63%	9.34%	10.40%
1981	6.36%	8.97%	10.29%	11.96%	13.30%	14.65%
1982	6.29%	10.48%	13.40%	16.47%	19.55%	21.93%
1983	5.02%	8.02%	11.47%	14.23%	17.69%	19.56%
1984	4.50%	7.35%	10.68%	13.30%	16.65%	18.37%
1985	3.88%	7.46%	11.43%	14.78%	18.84%	21.37%
1986	3.31%	4.49%	6.02%	6.99%	8.33%	8.64%
1987	2.81%	4.29%	5.17%	6.10%	6.86%	7.49%
1988	2.57%	4.77%	5.14%	6.25%	6.56%	7.71%
1989	2.08%	4.59%	5.04%	6.26%	6.69%	7.81%
1990	1.80%	3.18%	3.34%	3.93%	3.99%	4.50%
1991	2.13%	5.60%	7.21%	9.64%	11.39%	13.94%
1992	1.99%	4.50%	5.90%	7.83%	9.27%	11.37%
1993	2.57%	5.42%	7.21%	9.52%	11.35%	13.87%
1994	3.12%	5.38%	6.59%	8.36%	9.62%	11.71%
1995	3.09%	6.09%	7.92%	10.35%	12.25%	15.01%
1996	2.95%	4.44%	5.22%	6.34%	7.07%	8.37%
1997	2.92%	4.30%	4.38%	5.06%	5.14%	5.97%
1998	2.05%	2.05%	0.98%	0.22%	**-0.83%**	**-1.88%**
1999	1.23%	2.81%	3.15%	3.70%	3.81%	3.82%
2000	0.48%	2.54%	2.95%	3.70%	3.91%	4.07%
2001	**-0.04%**	2.47%	3.93%	5.49%	6.76%	7.71%
2002	0.02%	2.86%	5.46%	7.77%	10.15%	11.72%
2003	0.19%	3.48%	6.92%	10.02%	13.35%	15.97%
2004	0.70%	0.35%	**-0.09%**	**-0.98%**	**-2.00%**	**-3.84%**
2005	0.54%	1.24%	1.42%	1.22%	0.69%	**-0.60%**
2006	0.27%	1.95%	2.37%	2.70%	2.46%	1.67%
2007	**-0.74%**	0.33%	**-0.41%**	**-0.97%**	**-2.26%**	**-3.80%**
2008	**-1.15%**	0.91%	0.91%	1.20%	0.59%	**-0.13%**
2009	**-1.80%**	3.35%	6.77%	10.80%	14.21%	18.08%
2010	**-1.48%**	2.14%	4.12%	6.74%	8.73%	11.31%
2011	**-1.34%**	1.00%	2.21%	3.79%	4.97%	6.46%

FIGURE 5-6

MATRIX OF QUARTERLY PORTFOLIO RETURNS

(172 CALENDAR QUARTERS BETWEEN 1/1/73 AND 12/31/15)

QUARTERLY RETURN	100% FIXED RETURN	20/80	40/60	60/40	80/20	100% EQUITY
-28 to-26%						1
-26 to-24%						
-24 to-22%						
-22 to-20%						
-20 to-18%					1	5
-18 to-16%						1
-16 to-14%					5	1
-14 to-12%				1	1	2
-12 to-10%				5	3	3
-10 to-8%			1	3	3	4
-8 to-6%			6	4	4	6
-6 to-4%			6	5	10	8
-4 to-2%		7	6	11	4	4
-2 to 0%		22	16	17	18	15
Total Negative Quarters	0	29	35	46	49	50
0 to 2%	136	61	41	26	21	17
2 to 4%	36	59	48	33	24	21
4 to 6%		19	25	28	27	21
6 to 8%		3	13	17	15	16
8 to 10%		1	7	10	13	15
10 to 12%			1	3	8	8
12 to 14%				5	6	7
14 to 16%			1	2	2	6
16 to 18%				1	3	2
18 to 20%					2	3
20 to 22%						2
22 to 24%				1	1	1
24 to 26%						1
26 to 28%						
28 to 30%					1	

FIGURE 5-7

allocations move from 100% bonds to 100% stocks. Furthermore, the table portrays the frequency of both positive and negative quarters. Comparing the extreme left – 100% short-term government bonds portfolio – and extreme right – 100% stock portfolios, it is evident that in each quarter the all-short-term-Treasury portfolio always generates a positive return. There was no need for the investor to deal with the frustration of opening a quarterly statement only to discover a decrease in personal wealth over the period.[16] By contrast, both the frequency and magnitude of reversals of fortune are commonplace for stock-oriented investors. Approximately 30% of the time, the stock investor opened the quarterly performance statement only to find disappointing news. In one quarter, the investor opened the statement to discover that 25% of wealth evaporated in just a 90-day period.

As one moves deeper into equity risk exposure, the shocks to wealth may seem staggering. With some imprecision in vocabulary, it is important to realize that the asset allocation decision is "path dependent." By this we mean it is not sufficient to consider only the ending value of the wealth accumulation process [$10,093 v. $149,031 per $1,000 initial investment]. Rather, the investor should test his probable responses to the magnitude and frequency of the downside shocks to wealth that will inevitably occur.

As **FIGURE 5-8** illustrates, risk and return are tightly related (note that the y-axis is logarithmic in scale). Increasing portfolio exposure to equities increases the period-to-period amplitude of changes in portfolio value. The path of wealth accumulation for the 100% fixed income portfolio takes the shape of a relatively smooth curve. The path taken by the all equity portfolio exhibits rollercoaster returns. The $149,031 terminal value was not a free lunch.

> *Often, the investor most drawn to implement an allocation weighted towards stocks is temperamentally least suited to sustain it. This observation leads to another definition of investing: Investing is an initial forfeit of something of value in exchange for the expectation of receiving, at a later date, more than initially forfeited.*

[16] The 100% bond investor, however, may experience frustration because the slow growth of wealth may lag the rate of inflation.

Paradoxically, for some investors, the motivation for forfeiting things of value – i.e., current consumption – is the anticipation of the potentially large future payoffs that characterize stock-oriented portfolios. When, however, these investors experience the inevitable declines that come with such investments, they grow discouraged as the payoff goal recedes from view. They have not properly calibrated the portfolio allocation with their personal risk tolerance.

The study of behavioral finance provides some particularly helpful descriptions of investor reactions. One such descriptor is "Reference Dependence." When evaluating outcomes, the investor does not think probabilistically: "my portfolio is worth less today than it was yesterday, but the likelihood that I will reach my goal remains within acceptable risk bounds." Rather, the investor views stock price changes in terms of a reference level. For example, "my portfolio was worth $1 million last year but now, one year later, it is worth only $800,000." The investor defines financial success in terms of how far the portfolio is from the reference point. Often, the reference point is the maximum value attained by the portfolio to date rather than the stock of wealth required to fund future financial objectives. Any price change to the downside of the reference point is perceived as a "loss" as opposed to a realization of the expected volatility - i.e. variance-of the high-expected-return investment position.

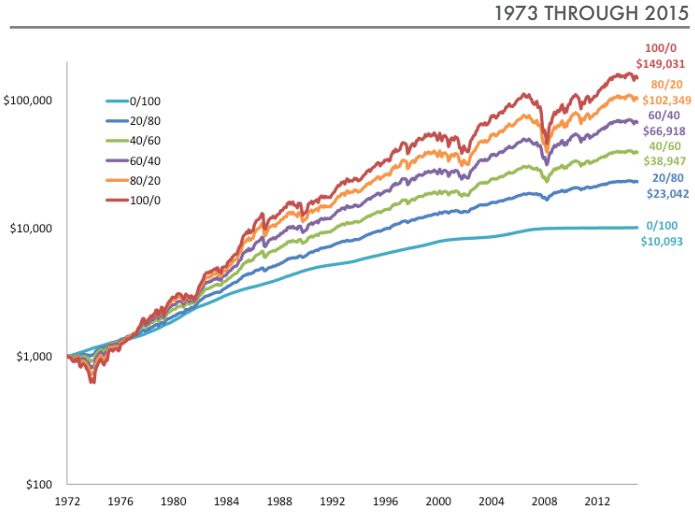

FIGURE 5-8

A challenge for investors tilting portfolio allocation towards equity is to move from a profit-and-loss mentality towards a probabalistic way of thinking.

A challenge for investors tilting portfolio allocation towards equity is to move from a profit-and-loss mentality towards a probabalistic way of thinking. Here's an example: an 86 year old investor is discouraged because, over the previous year, the portfolio value decreased by 7.5%. He complains that he cannot earn back the loss because he cannot return to the work force. Therefore, the loss represents a substantial decrement to his future consumption which, according to his frame of reference, must decrease by a corresponding 7.5%. Further investigation reveals that he can give himself a raise! This outcome is the result to the interaction of a variety of probabilities that include lifespan, investment realizations, and inflation paths. A profit-and-loss perspective was not as appropriate a risk metric as a shortfall probability risk metric – the likelihood he would outlive his nest egg.

FORMULATING INVESTMENT POLICY: BEYOND THE RISK/RETURN CONTINUUM

Unique Preferences and Constraints

The Risk/Return Continuum is useful as a heuristic either to gauge risk tolerance or to convey the cost in volatility that must be paid to achieve a required return. Once the investor determines the preferred

risk and return characteristics of the portfolio, the job of portfolio building and implementation begins.[17]

The first step is the selection of asset classes. Numerous asset classes are absent from the model portfolios, presented above, of the risk/return continuum. These include Real Estate, Emerging Markets, and International Bonds. Most investors will want to include one or more of these asset classes for the sake of diversification. As a general rule, expanding the opportunity set of investments enhances the ability to customize a portfolio that can produce a satisfactory future outcome.

Many investors have unique preferences or constraints that limit asset allocation policy. The investor may believe that U.S. investments are intrinsically superior to foreign investments; or that investing in foreign companies facilitates the transfer of domestic job opportunities to overseas competitors. Alternately, some investors are leery of certain U.S. large company stocks, and may wish to avoid investing in companies engaged in businesses or practices they consider morally reprehensible or environmentally destructive.

The asset allocation decision increases in complexity when an investor owns illiquid financial assets such as commercial real estate, closely-held business interests, annuities, long-term certificates of deposit, hedge funds/private equity interests or limited partnership units. Alternatively, even when financial assets are readily tradeable, the capital gains tax on sales of highly appreciated positions in stocks or mutual funds may make sales undesirable. All these factors affect which asset classes a portfolio should own and each asset's proportionate weighting within the portfolio.

Once the investor identifies and selects appropriate asset classes, he must determine suitable target weightings. Adoption of one of the naïve allocations used in the Continuum Model Portfolios may be inappropriate. At this point, the advantages of portfolio 'factor loading,' discussed in Chapter Four, come into play. By customizing exposures (value vs. growth, small vs. large, foreign vs. domestic, etc.), the investor can fine tune a portfolio to better support cash flows, wealth accumulation, or other objectives. Factor loading, if it is not to expose the portfolio to substantial unsystematic risk, should be both careful and sophisticated. Intelligent factor loading may enable investors selecting a fixed income percentage allocation to increase the expected return to the equity portion of their portfolios. As one commentator puts it:

> *Risks can be productive if they are expected to generate return, or unproductive when they are too large or unintended. Thus, knowing the level of risk in a portfolio is not enough. The investor must measure where the risk is coming from.*[18]

Finally, there is the "hedging" aspect of investment decision making. For example, a college professor or civil service employee may have steady, reliable labor income similar to bond interest, and so may prefer to hold equities. An entrepreneur, however, may have the sort of volatile income stream characteristic of equities, and may therefore strongly prefer to hold fixed income instruments.

What About Home Ownership?

Does home ownership influence the way you should invest? Investors usually allocate their portfolios without reference to the homes they own, yet home ownership is an important component of total wealth for many investors.[19] Shouldn't portfolio allocation decisions take account of home ownership and its peculiar risk/reward characteristics?

[17] Chapter Nine discusses other tools to help investors calibrate their risk/reward preferences.

[18] Litterman, Bob, "Risk Measurement," Modern Investment Management (John Wiley & Sons, 2003), pp.33-34.

[19] Business Week (February 14, 2013) estimates that for the richest 20 percent of U.S. households, the principal residence as a share of net worth is approximately 30 percent. For the next 60 percent housing is approximately 67 percent of total net worth.

A LIFE CYCLE MODEL OF INVESTING

In classical economics, total wealth is divided into two broad types:

- Human wealth: the present value of uncertain projected labor income; and,
- Financial wealth: the present value of uncertain future returns on stocks, bonds and other risky assets – including real estate.

In economic terms, human wealth is systematically converted to financial capital over the working career. Traditional financial planning doctrine encourages younger investors (who are generally wealthy in human capital but poor in financial capital) to own risky assets because:

- They have time to recover from investment losses either by adjusting consumption or generating additional labor income (by, e.g., getting a second job, working overtime, asking a spouse to work, etc.); and,
- The time remaining until their human wealth fully depreciates (i.e., at retirement age) is long enough that they can tolerate the risk required to capture the higher expected returns of stocks.

Similarly, workers approaching retirement age are encouraged to reduce portfolio risk because:

- They have less labor income flexibility; and,
- Their future consumption rests primarily on the value of their financial assets.

Home ownership complicates the situation, and financed home ownership (i.e., mortgage liability) complicates matters further. To economists, home ownership is a good example of a 'personal illiquid project.' Homes are illiquid relative to financial assets such as stocks and bonds, which can be easily sold without incurring onerous transaction costs. A home's ability to provide for consumption needs is difficult, because it is impossible to sell a fraction of the house, and borrowing against the house generates ongoing interest expense.

Additionally, homes are highly illiquid, and are generally purchased on a leveraged basis, sometimes with adjustable rate debt instruments. The deflation in home values during the 2007-2008 recession demonstrated the risk inherent in leveraged home ownership. Given home ownership under such conditions, what would be the demand to hold stocks? Given the risks inherent in financed home ownership, would it not make better sense to own bonds, or use financial assets to pay down the mortgage? Recall that the traditional doctrine of financial planning counsels that young adults should stretch to get into a home and buy stocks, while retirees should eliminate mortgage debt and buy income-producing bonds. Is that good advice?

THE HOME AS AN ILLIQUID PROJECT

Economists have investigated the portfolio impact of the personal illiquid project in several ways. One line of research focuses on differences in optimal portfolio choices made by investors constrained by personal illiquid projects, versus those not constrained. Faig and Shum[20] hypothesize that "individuals are more risk averse in their portfolio choice when financial assets are used to fund projects in which there is a substantial penalty for discontinuing or under-investing in their final stages." The intuition behind this statement is that home buyers will want to make sure that they can cover all multi-period costs of home ownership, including mortgage payments, taxes, repairs and other expenses. Failure to meet such expenses may result in personal bankruptcy or foreclosure proceedings that will impose severe economic costs. The increased

[20] Faig, Miquel & Shum, Pauline, "Portfolio Choice in the Presence of Personal Illiquid Projects," The Journal of Finance (February, 2002), pp. 303-328. See, also, Faig, Miquel & Shum, Pauline, "What explains household stock holdings?" Journal of Banking & Finance (September, 2006), pp. 2579-2597.

The increased risk of future financial ruin entailed by the stress of mortgage debt service should mean that risk-averse investors are less likely to assume financial risk; and, in turn, should reduce the demand to own stocks.

risk of future financial ruin entailed by the stress of mortgage debt service should mean that risk-averse investors are less likely to assume financial risk; and, in turn, should reduce the demand to own stocks.

The authors develop a sequence of mathematical models of a three-period economy in which the individual faces decisions in an uncertain investment environment. The goal is to maximize consumption in period three (i.e., retirement), assuming the house is liquidated at the end of period two in order to provide consumption funds in period three. This is tantamount to acquiring a reverse annuity mortgage, or selling the home and moving to a smaller residence or into an apartment or retirement community.[21]

In one of its iterations, the mathematical model provides insights into the relationship between the personal illiquid project and individual investor risk aversion. The authors note there are four regions of risk aversion, each with an attendant portfolio strategy:

> *"The first region is where the individual has such a small financial portfolio that there is no chance the project will be continued in the next period. In this case, the individual is risk neutral, as there is nothing he can do to avoid the penalty. The second region is where the individual has a relatively larger financial portfolio, but it is still insufficient to continue the project unless he invests all of it in stocks and hopes for abnormally high returns. In this case, the individual is risk loving … The third region is where the individual has a sufficiently large financial portfolio and the continuation of the project can be assured by investing mostly in cash. In this case, the individual is risk averse because the downside risk of stocks may jeopardize the chance of continuing the project…. The fourth region is where the individual has such a large financial portfolio that the continuation of the project is assured for any asset allocation. In this case, the individual is risk neutral."*

Thus, there are no 'rules of thumb' for optimal investing. The demand to hold cash or low-risk bonds is a function of many variables, including the amount of initial wealth, the expected return on stocks, the penalties for discontinuing the project, individual risk aversion, the projected future consumption that a successfully completed project will finance, and so forth. However, all else equal, "individuals engaged in personal illiquid projects are likely to have a high demand for safe assets… when they are penalized for either discontinuing their projects or continuing them at an inappropriate scale for lack of funding."

The authors find that, as expected, "in terms of the personal illiquid projects, a larger housing value, a bigger stake in investment real estate, and a greater business value all lead to a significantly safer financial portfolio. However, since real estate and private business are risky assets, there may be a diversification motive for holding safer financial assets, in addition to liquidity needs."[22]

[21] Although the authors do not specifically discuss specific investment portfolios, under their model the optimal retirement portfolio (absent bequest preferences) may consist of some combination of a reverse annuity mortgage and a 100% stock portfolio. Many seniors trade their home equity for retirement consumption offered through room/board/healthcare community memberships.

[22] The authors make a variety of interesting observations regarding risk, retirement and portfolio safety. They find that portfolios earmarked for retirement objectives are considerably more risky than portfolios of younger homeowners. In fact, in the sample that they analyze, age and risk aversion have a correlation coefficient of only +0.04.

Longstaff[23] also considers the need to own safe and marketable assets when undertaking illiquid projects, such as home ownership financed by a mortgage requiring many years of monthly payments. For Longstaff, portfolio liquidity is the safety net. When liquidity is constrained, however, the viability of the illiquid project is imperiled. One cannot readily increase the portfolio's exposure to a house by, say, quickly building a home addition, nor can one easily decrease exposure by selling the kitchen. In the case of home ownership, the worth of the asset (i.e., the equity in the home) can drop rapidly for several reasons – inability to meet mortgage payment obligations, deteriorating neighborhood, emergence of structural defects or pests, and so forth. If cash flow difficulties should arise, it might not be possible to sell mortgaged property quickly enough to avoid bankruptcy. When an adjustable rate mortgage is used to finance the home, increases in interest rates can quickly increase the burden of debt service and eviscerate the home's resale value. Longstaff's investment model indicates that the owner of an illiquid investment avoids both leverage and short sale positions even if the probability of financial ruin is small.

Not surprisingly, in the face of liquidity constraints, investors have a greater demand to hold safe assets. With fully liquid wealth, the investor can easily convert risky assets to cash before they fall below threshold values. Illiquid assets constrain this opportunity, so a source of cash must be present to service debt prior to the onset of adverse economic conditions. In many respects, the findings of Longstaff parallel those of Faig and Shum.

TURNING TRADITIONAL ADVICE ON ITS HEAD

A study by Waggle and Johnson also seeks to understand portfolio asset allocation decisions under conditions of home ownership.[24] They argue strongly that a mortgage should not be treated as a reduction in the commitment to the real estate position (so that the home is booked in the portfolio at the value of the homeowner's net equity), but as a negative position in a bond, booked as a separate asset. They point out that, "If an individual borrowed $1,000 to buy $1,000 in stock, no one would argue that the investor's net stock position was $0." Given this approach Waggle and Johnson are interested to discover the optimal portfolio allocation between stocks, bonds, and the personal residence.

Their model considers only a thirty-year fixed mortgage. The analysis assumes that the value of the home is fixed, and the homeowner determines the allocation among mortgage, stocks and bonds. Stock and bond weights are constrained to values of at least 0% (i.e., no short positions allowed). A final key variable is the percentage of net worth represented by the home. For example, when the home is 50% of net worth, a family could have a $300,000 house, a $300,000 mortgage and $600,000 in liquid assets. For younger homebuyers, the market value of the home often exceeds net worth; for older homeowners, who have accumulated stocks and bonds in retirement plans and personal accounts, this is not usually the case.

They first examine optimal allocations under the assumption of 100% financing, with optimality

[23] Francis A. Longstaff, "Optimal Portfolio Choice and the Valuation of Illiquid Securities," The Review of Financial Studies (Summer, 2001), pp. 407-431.

[24] Doug Waggle & Don Johnson, "The Impact of the Single-Family Home on Portfolio Decisions," Financial Services Review (Vol. 12, 2003), pp. 201-217. The asset allocation recommendations are based on returns and variance of stocks (S&P 500 Stock Index) and bonds (Lehman Brothers Long-Term Corporate Bond Index) from 1983 through 1998. Single Family Housing prices for the period are based on the Housing Price Index compiled by the Office of Federal Housing Enterprise Oversight. The annual return to stocks is 15.19%, to bonds is 12.22% and to single-family homes is 4.41% for the period under evaluation.

achieved by shifting the weights only of stocks and bonds. **FIGURE 5-9** summarizes the optimal allocation to stocks and bonds at different ratios of home value to investor net worth for an investor with average risk tolerance.

Note that the optimal allocation in the case of no house (Home Value = 0% of Net Worth) is close to the rule of thumb allocation for an investor with average risk tolerance given by traditional financial planning, which treats home ownership as a non-portfolio asset. When home ownership is considered, the traditional advice of financial planning is turned on its head: "... as the value of the home relative to investor net worth increases, the amount of stock that investors should hold in their portfolios decreases. This would have the biggest impact on younger investors where the home value as a percentage of net worth is likely to be the highest."

Home Value as % of Net Worth	% Allocation to Stocks	% Allocation to Bonds
0	64.10	35.90
25	57.58	42.42
50	51.07	48.93
75	44.56	55.44
100	38.04	61.96
150	25.02	74.98
200	11.99	88.01
250	0.00	100.00
300	0.00	100.00

FIGURE 5-9

Home Value as % of Net Worth	% Mortgage Financing	% Allocation to Stocks	% Allocation to Bonds
0	0.00	64.10	35.90
25	0.00	75.71	24.29
50	0.00	98.93	1.07
75	0.00	100.00	0.00
100	8.34	100.00	0.00
150	33.33	0.00	0.00
200	50.00	0.00	0.00
250	60.00	0.00	0.00
300	66.67	0.00	0.00

FIGURE 5-10

Their second model allows the allocation to mortgage loan financing to vary with the allocations to stocks and bonds. **FIGURE 5-10** displays optimal allocations for an investor of average risk tolerance.

These are startling results. Whenever the home value is less than 100% of net worth (a financial profile of older investors), the optimal allocation to mortgage financing is zero. Whenever home value exceeds 100% of net worth, the optimal portfolio holds no financial assets at all.[25] If we were to take this model as a guide, it suggests that younger homeowners should liquidate financial assets to reduce leverage, while investors whose home values do not exceed the value of their other assets should consider relatively high allocations to equities.

Should we take this model as a guide? Perhaps not. First, extreme concentration of portfolio assets in one or two asset classes is not an uncommon result of an unconstrained portfolio optimization calculation. The model's calculation method drives portfolios to overweight the asset classes that are least correlated and have the best risk adjusted return over the data sampling period. But in different sampling periods, different asset classes move to the head of the risk/return pack. In one period, small cap Japanese stocks may exhibit the best risk-adjusted return, while during the next, the S&P 500 may take a turn in the limelight. The optimization model gives the lion's share of portfolio allocation to those asset classes that happen to have the best risk-adjusted return over the sampling period. The result is thus dependent on the sampling period one selects.

Second, we ought also to include in the data set the returns series on several other asset classes that do not appear in Waggle and Johnson's study. As we

[25] Based on historical mortgage interest costs over the period 1983 through 1998.

noted earlier, a civil-service employee or tenured college professor has a future labor income stream that exhibits bond-like characteristics, which might incline him more to stock ownership. The present value of the career of an entrepreneur, a salesman or an attorney is more like an equity, and such people might be more inclined toward bonds.

We may offer a number of other important factors of economic wealth, which, in the best of all possible worlds, might take their rightful place in the process of overall portfolio allocation: the present value of future education, of expected inheritances, and bequest and gifting objectives. But perhaps the most important and salient economic asset, directly associated with home ownership, and yet overlooked by this study, is the present value of a lifetime's worth of monthly rent that homeowners no longer need pay to any landlord.[26] Rents avoided are effectively a discount on mortgage interest expense. If it is true, as Waggle and Johnson insist, that mortgages are properly treated as negative positions in bonds, then the present value of avoided future rent payments must be treated as a positive position in bonds. Including this built-in positive bond position among the present asset values of economic factors of home ownership would reduce the amount of overall wealth allocated to corporate, government or municipal bonds, or would reduce the portfolio effect of the negative mortgage bond. Either way, the allocation to stocks would tend to increase commensurately.

Whether we restrict our data set in time – i.e., as to sampling period – or in space – i.e., as to the limitations we place on the universe of available asset classes – ipso facto we make our decision on the basis of limited information. But this is a defect of all our decisions; and thus we acknowledge the general wisdom of the advice: "Don't put all your eggs in one basket."

[26] This is the heart of the reasoning behind the Jeffersonian ideal of the small landowner. It is also a reason foreclosure is so painful; foreclosure represents the loss of many dearly purchased years of avoided future rents.