

Saving for Retirement How Much Risk? Too Little or too Much?

With the conversion of more and more defined-benefit pension plans to defined-contribution plans, the challenge of managing retirement savings is being transferred from employers to employees. Employees must now direct the investment of their 401-k plans (or 403-b plans in the non-profit sector) to achieve retirement security. Gone are the days when an employee could count on retiring at some fixed percentage of his final earnings. Now an employee's retirement income will depend on the size of her 401-k at retirement. And the size of her 401-k will depend both on the level of annual contributions and on how it has been invested. But in fact, it will probably depend more on how it has been invested than on how much has been saved.

Consider the example of Tom, a 35 year old man currently earning \$40,000 per year and saving 6% of his earnings each year in a 401-k, between his and his employer's contribution. If Tom's income increases at an average of 4% per year – taking into account job changes and promotions – Tom will be making nearly \$130,000 per year by the time he is 65. If he continues to contribute 6% of his earnings every year, his 401-k balance at 65 could range anywhere between \$200,000 and \$900,000 depending on how he directs its investment during his working years and on investment returns. This range of outcomes translates to between \$1,320 and \$5,940 per month in retirement, figuring on a twenty-year post retirement payout and a 5% post-retirement return. Tom's 401-k would provide him between 12% and 55% of his age 65 earnings.

We don't have to imagine wild swings in investment returns to arrive at this range of outcomes. If Tom is a very conservative investor and keeps his 401-k invested in safe choices like bank CDs, money-market accounts, and Treasury-bills, he is likely to end up with a very modest 401-k balance when he retires and one that will buy him relatively little security in retirement. If Tom is a more aggressive investor and keeps his 401-k invested in a blend of domestic and international stocks, he is likely to have a much larger 401-k balance when he retires. Whether Tom ends up with \$200,000 or \$900,000 will largely depend on how he directs the investment of his 401-k. And how he directs the investment of his 401-k will largely depend on how risk averse he is.

What if Tom saves more? Even if Tom doubles his annual savings from 6% of his annual income to 12%, if he follows a conservative investment strategy he will still end up with about \$475,000 at retirement – just over half of what he might have saving half as much but investing it more aggressively. The more aggressive investment strategy has more risk and may be outside Tom's tolerance, but he needs to know what the trade-offs are between today and tomorrow, between his savings years and his retirement years.

Investors face a significant paradox in this trade-off between savings years and retirement years. Tom's situation is no different from anyone his age saving for retirement: the more risk averse he is, the more likely it is that his retirement savings will be too small to provide a comfortable retirement, that is unless he is saving a large portion of his annual income,

What can Tom do to insure he has the largest 401-k nest egg when he retires? Two things. First, he can maximize his contributions. Even if he invests conservatively, more savings today will translate into a larger retirement fund later on. Second, he can invest his 401-k in investments with higher returns. Instead of keeping his money in bank CDs or money market funds, Tom can invest it in the stock market or in real estate. But the stock market and real estate are much riskier than bank CDs or money market funds. Although they return more to the investor on average

over the long term, they are subject to considerable short-term fluctuations in value and returns—as has been all too evident recently. And there's the rub. Can Tom stomach watching his 401-k fluctuate in value as the stock market and real estate market rise and fall in value? Can he bear the risk of high return assets?

The issue is not quite so simple, for portfolio strategies exist that can reduce risk through diversification, through spreading a portfolio among several types of investments. Nevertheless, Tom's dilemma is one that every investor faces when planning, saving, and investing for retirement. How much risk can he tolerate? Is Tom's risk tolerance high enough to allow him to live with the sort of higher returning investments that will buy him a more secure retirement future?

All things being the same, every investor wants to minimize his or her risk exposure. But all things aren't the same. For reasons we explore elsewhere, if an investor wants to or needs to earn higher rates of return than she can get on guaranteed investments, she must accept risk. Low risk assets have low returns. There are no free lunches in investing. To get higher returns, one must accept higher risks. Rather than just avoiding risk, an investor may actually have to acquire it in order to have retirement security.

What a conundrum! If we keep our retirement savings invested in safe, low-risk investments, we may earn so little that we will be impoverished in retirement. On the other hand, if we invest our 401-k in riskier assets that produce higher returns over the long run, we may end up losing so much sleep watching our portfolio fluctuate before we retire that we die early of worry.

Three Questions about Risk

The moral of this example is that an investor planning for retirement faces more than one question about risk. In fact he or she must answer three questions about risk.

1. How much risk do I need?
2. Is the level of risk I need prudent?
3. How much risk can I tolerate?

The first question goes to the issue of the return required to achieve retirement security given reasonable assumptions about how much an investor will save. The second question asks whether the required risk is prudent given an investor's age and circumstances, leaving aside the question of personal risk tolerance. The third question addresses the personal risk tolerance of the investor.

Consider Tom's situation once more. At his savings rate, he needs more return and more risk. He is saving the equivalent of 6% of his annual earnings. At a highly conservative compound return rate of 4%, his 401-k will only amount to \$238,000 by the time he reaches 65 and will buy him a 20 year payout of only \$18,839 per year – a meager 15% of his pre-retirement income.

Assuming that Tom has decided he cannot afford to save any more than 6% of his earnings each year, he needs a higher average rate of return on his 401-k, if it is to provide him with a meaningful income in retirement. To get a higher rate of return, he must invest in riskier assets. Doubling his rate of return to 8% increases his payout in retirement to nearly \$35,000 per year – approximately 27% of his pre-retirement income. Increasing his average compound rate of return

to 12% increases his retirement payout to nearly \$70,000 per year or about 54% of his pre-retirement income.

What does a higher rate of return do to Tom’s risk exposure? To answer this question Tom, like any investor, is going to need some help or guidance from someone who knows the capital markets and the investment opportunities they offer. If Tom needs a 12% average compound rate of return, he may be able to achieve that rate of return by investing his 401-k in small company stocks – assuming that small company stocks produce the sort of returns in the future that they have produced in the past. But this would mean putting all of Tom’s retirement savings into one asset class – into the equivalent of one basket. It’s a better basket than having his retirement savings all in one company’s stock – as many employees do when they invest their 401-k exclusively in the stock of their employer. But nevertheless, his savings is not nearly as diversified as it might be.

Lessons in Risk and Return Measurement

Tom can do better by diversifying his 401-k more broadly. In fact, if he considers a wide range of asset categories and spreads his retirement savings over ten or more categories, he can achieve a required rate of return with less variability in returns than he could from any one category by itself or from any combination of two, three, or several asset categories. Measuring the return and risk opportunities of the range of investment options is the business of an investment professional, such as the *Asset Allocation Advisor*. Describing how these opportunities are measured is well beyond the scope of this article. But suffice it to say that through a study of historical returns, current market conditions, and economic and business prospects for the future, Tom would be presented with a range of expected portfolio return and risk choices, such as in the following table.

	Expected average annual investment return	Expected risk (variability of annual returns)
Minimum return/risk	4.0%	3.2%
	5.0%	3.7%
	6.0%	4.3%
	7.0%	5.0%
	8.0%	6.6%
	9.0%	8.7%
	10.0%	10.9%
	11.0%	13.3%
	12.0%	16.0%
	13.0%	19.0%
	14.0%	22.0%
Maximum return/risk	15.0%	29.2%

The choices in the table represent the best Tom might expect to do over the long term through diversifying his 401-k across a dozen or more broad asset categories. Note several things about the table. First, as the expected average annual return increases, so does the risk. This is the no free lunch principle at work—to get higher returns, an investor must be willing to accept higher variability and risk. Second, as the average annual return increases, the risk increases disproportionately. Doubling the expected rate of return more than doubles the expected risk. Third, for expected annual returns of 10.0% or more, the variability of annual returns exceeds the expected annual return, with the consequence of increasing probabilities of experiencing years with losses.

The variability of returns does two things. First it reduces the realized compound returns—the measure of return that really matters to Tom. Although an investor might think that return measurements are unambiguous, they are not. It’s the compound return that matters. A brief example will serve to illustrate.

Suppose Tom puts \$1,000 in an investment that produces a return of +20% in one year and -20% in another year. What’s Tom’s average rate of return? The simple average is 0%. But the simple average does not reflect what has actually happened to Tom’s portfolio. If he made 20% the first year, his investment would be worth \$1,200 at the end of that year (\$1,000 plus \$200). If he losses 20% the second year, his investment would be worth \$960 at the end of the second year (\$1,200 minus \$240). Conversely, if he lost 20% in the first year, his investment would be worth \$800 at the end of the first year (\$1,000 minus \$200). If he makes 20% in the second year, his investment would be worth \$960 at the end of the second year (\$800 plus \$160). Either way, he ends up with \$960 – a compound return rate of -2.02% per year.

Why do variable returns reduce the realized compound return? Because losses count more than gains. For Tom to make up a 20% loss, he has to have a 25% gain (\$1,000 to \$800 then back to \$1,000 requires a \$200 gain on \$800). But to lose a 20% gain he only has to lose 16.7% (\$1,000 to \$1,200 then back to \$1,000 requires a \$200 loss on \$1,200). Because of the variability of investment returns, the average compound return Tom will realize on any investment will be less than the simple average of the annual returns. The following table shows the impact.

	A Expected average annual investment return – simple average	B Expected average annual investment return – compound average	C Expected risk (variability of annual returns)
Minimum return/risk	4.0%	3.9%	3.2%
	5.0%	4.9%	3.7%
	6.0%	5.8%	4.3%
	7.0%	6.8%	5.0%
	8.0%	7.7%	6.6%
	9.0%	8.6%	8.7%
	10.0%	9.4%	10.9%
	11.0%	10.1%	13.3%
	12.0%	10.7%	16.0%
	13.0%	11.3%	19.0%
	14.0%	11.7%	22.0%
Maximum return/risk	15.0%	10.2%	29.2%

The picture doesn’t look as encouraging now for Tom. A diversified portfolio with an expected average annual return of 12.0% (in column A) brings with it so much variability (column C) that its compound return rate is less than 11% (column B). The most Tom can expect is a compound return rate of 11.7% from a portfolio with a simple annual average return of 14.0%, but this portfolio has an expected variability of 22.0% per year!

The second impact of variability is that it increases the probability of suffering a loss in any year. At the risk of oversimplification (and there are several technical issues to be considered here, which we will side step for simplicity’s sake), the risk of loss increases disproportionately as the

variability of returns increases. In other words, as variability increases, the risk of loss increases more than the increase in variability.

Consider three hypothetical portfolios all with an expected simple average annual return of 10% but with different expected variabilities.

	A Expected average annual investment return – simple average	B Expected risk (variability of annual returns)	C Expected average annual investment return – compound average	D Chance of loss in any year
Low variability	10.0%	5.0%	9.8%	2.3% or 1 in 43
Medium variability	10.0%	10.0%	9.5%	15.9% or about 1 in 6
High variability	10.0%	20.0%	8.1%	30.9% or about 1 in 3

Since returns on the low variability portfolio are tightly clustered around the average, the chance of experiencing a loss with this portfolio are low, only about once in every forty-three years. Returns on the medium variability portfolio are more broadly dispersed around the average; they are twice as variable as in the low variability portfolio. As a consequence, the chance of experiencing a loss with this portfolio is higher, and considerably higher – once in every six years compared to once in every forty-three years. Returns on the high variability portfolio are twice as variable as for the medium variability portfolio, and the risk of loss in any year is nearly once in every three years.

The low, medium, and high variability portfolios in the previous tables are entirely hypothetical, however, and could never exist. Why not? Because we cannot have three choices with the same expected return but with different variabilities. They would violate the no-free-lunch principle. Investors in the low variability portfolio get something for nothing compared to the medium and high variability portfolios – they would get a higher return with less risk. In reality, investors would much prefer the low variability portfolio and would prefer the medium variability portfolio to the high variability one. The greater demand for the low risk portfolios would drive up their prices and reduce their returns (less bang for the buck). The weak relative demand for the high risk portfolio would reduce its price and increase its return. In short order we would be left with a lower return on the low risk portfolio and a higher return on the high risk portfolio.

The real world choices would look more like this:

	A Expected average annual investment return – simple average	B Expected risk (variability of annual returns)	C Expected average annual investment return – compound average	D Chance of loss in any year
Low variability	7.0%	5.0%	6.8%	8.1% or about 1 in 12
Medium variability	9.6%	10.0%	9.1%	16.9% or about 1 in 6
High variability	13.3%	20.0%	11.4%	25.3% or about 1 in 4

The decrease in the expected return from the low variability portfolio has the effect of increasing the chances of experiencing a loss. The returns are still closely clustered around the average, but since the average is lower, more of the returns are likely to fall into the negative or loss range. A

mirror effect on the high variability portfolio decreases the chances of experiencing a loss – a higher average expected return means that fewer of the widely dispersed annual returns will fall into the negative or loss range. But even with a higher average expected return, the high variability portfolio still stands to realize a loss once in every four years.

In the final analysis, it is not the variability of returns that matters to investors but the risk of loss. Assets or portfolios with more variable returns have a higher likelihood of experiencing losses (and a higher likelihood of experiencing larger losses). An investor like Tom who needs more than a minimum return on his 401-k and, therefore, more than a minimum level of risk in his portfolio faces not just the prospect of seeing the return on his retirement portfolio vary from year to year, he also faces the prospect of seeing years in which his portfolio actually declines in value. And the more risk he takes on, the more often he will experience portfolio losses even though, on average over the long term, his return should be higher.

How Much Risk is Too Much?

At age 35, with thirty years to go before retirement, Tom needn't be overly concerned with losses his 401-k might experience in any year over the next ten or fifteen years. Losses are likely to be more than offset by gains in following years. Tom is in the advantageous position that his time horizon allows him to take on more risk than someone with a short-term time horizon. He can take on risk to achieve higher returns because he has thirty years to average out the losses he will inevitably experience along the way.

A portfolio with high variability, however, is not a prudent portfolio for someone nearing retirement and relying on that portfolio for his or her retirement income. Although such an investor may hope for a large increase in his 401-k just before he retires, by carrying a high risk level in his portfolio, he puts himself at risk of a loss in value just prior to retirement and the necessity of either working longer or accepting a reduced standard of living in retirement. Even if an investor enjoys taking risks, it is still imprudent and ill advised for her to have a retirement portfolio with a high expected variability if she plans on retiring in the near future and is dependent on her savings for her retirement income.

For this reason, as investors age and approach retirement, all other things being the same, they should adjust their 401-k to reduce portfolio risk to reduce the chances of a significant drop in portfolio value just before they plan on retiring. With reduced risk comes reduced return, but the short time horizon leaves investors with little choice.

How much risk is too much for a 401-k? We have seen that risk exposure should decrease as an investor approaches retirement, but at what level is an investor being imprudent?

Unfortunately, this is not a question that lends itself to a canned answer – the sort an investor can look up in a table and see if he or she meets the test. Other factors have to be taken into account: other assets, including a spouse's retirement savings; anticipated social security retirement income; the current and projected level of debt – if any; home ownership status; health and expected longevity; plans or willingness to work after retirement and the expected income; flexibility in lifestyle and expenditures; estate objectives; and more. Some of these factors may allow an investor to carry more risk nearer to retirement than would be prudent for others. Investors need guidance on assessing these factors and how they affect their prudent risk level.

Lessons about Risk

If there is no canned answer to the question, “How much risk is too much,” there are several lessons to be learned.

First, risk is largely unavoidable. Although one can eliminate the risk of a loss in principal by investing in bank CDs or Treasury bills, one cannot eliminate variability in returns. Retirees in the late 80’s and early 90’s learned this lesson as they saw the return on banks CDs fall from between 7% and 9% to less than 5%. Retirees living on their interest income saw it reduced by 50%.

Second, investors should know their 401-k portfolio’s risk exposure and expected return. An investor cannot make any judgment regarding risk if he does not know what it is. This author continues to be amazed by the number of investors who have no idea of the expected return on their portfolio or its expected risk. Investment advisors and money managers are mostly to blame for this. They target returns relative to some market benchmark. But investors need to know more than just the relative return, they need to know the absolute rate of return they can expect and the risk associated with that expected return. How can Tom know if his portfolio mix will achieve his retirement goal if he doesn’t know what compound return to expect?

The problem is not that advisors and managers are keeping the information to themselves, the problem is that most advisors and managers don’t know. They offer promises based on the historical performance of benchmarks rather than on the expected performance of the portfolio. Admittedly, this is a perilous exercise, because returns will almost never match expectations in the short term. But over the longer-term, returns must meet quantitative expectations or else investors will be left in hard times in retirement.

Third, investors need professional guidance, especially when it comes to understanding risk exposure. The approach taken by many advisors of asking how much risk a person can tolerate is not the best approach. Individuals need to know how much risk they need to assume to meet their objectives, and then they need to know whether that level of risk is prudent given their age and circumstances. These are not questions that can be answered with stock off-the-shelf answers, they require professional assistance. And employers are doing a poor job in providing this assistance. Simply giving employees the opportunity to meet once or twice a year with a sales representative from a major brokerage or fund management firm is not adequate.

The Third Question

We said earlier that investors have to answer three questions about risk. The first two questions were, “How much risk do I need to achieve my desired investment return?” and “Is this level of risk prudent?” The third question is “Can I live with this level of risk?” or “What’s my risk tolerance?”

This third and final question is not determinative: its answer should not set an individual’s investment strategy. An investor may have a risk tolerance that is too high, that allows him to assume more risk than is prudent. Conversely, an investor may have a tolerance that is too low, that prohibits him from assuming the prudent levels of risk he needs now to avoid an impoverished retirement. If an investor’s tolerance is too high, it is the duty of an advisor to

teach an investor about the consequences of taking on excessive risk. If an investor's tolerance is too low, it is an advisor's duty to educate the investor and to counsel methods for living with risk.

Determining your risk tolerance is far from easy. Our reaction to loss or variable returns is an emotional one, not a logical one. To ask a person how much loss they can live with is as useful as asking a person how much pain they can endure. No objective metric exists to measure pain, and no objective metric exists to measure our reaction to situations of risk. But the real problem is that we don't know what our tolerance is until we go through the experience, even if we had an objective measure at hand.

Dan Ariely (the James B. Duke professor of Behavioral Economics at Duke University) in his widely acclaimed study of forces that skew our so-called logical behavior, Predictably Irrational, states "to make informed decisions we need to somehow experience and understand the emotional state we will be in at the other side of the experience. Learning how to bridge this gap is essential to making some of the important decisions of our lives (p 104)." Ariely tells the story of advice his wife received prior to giving birth to their first child. If she could endure the pain of submerging her hands in a bucket of ice for two minutes, then she could endure the pain of childbirth without pain killers.

How about our loss tolerance? Six months ago, we would have had to ask: "What experience can proxy for a major loss in the value of our retirement nest egg or for widely fluctuating values?" Today, unfortunately, most investors do not need a proxy experience because they have suffered a real loss experience with their 401-k and other investment portfolios throughout 2008 and the start of 2009. Many of us now know the anxious feeling in the pit of our stomach as significant market value declines in our retirement savings change the prospects for our future. For younger investors, the anxiety may be less intense. For investors near to or past middle-age, the anxiety is real. Many of us know of people like my local dentist who had been planning on retiring within the next year or two but who has just been told by his accountant that he needs to work another ten years. Fortunately for this individual, he is young enough to work productively for another ten years and still retire at a reasonable age. For others, however, working ten more years may not be a realistic, much less a desirable option.

The question for many investors today is can they stomach staying invested in the risky assets they need to achieve the levels of return they need?

Leaving aside the question of whether allocations to risky assets make sense in the current economic environment, many advisers have urged their clients to stay invested in the stock market. This is not bad advice if it is intended to balance our natural risk avoidance after a painful loss experience. Our emotional decision making is immediate and visceral (hence the terms having the "stomach" or the "guts"). It is even seated in a different part of our brain from our rational thought processes. So, before we decide to sell all of our stocks and stuff the money in a mattress, we should sit back and try to balance the signals we are getting from our emotional instincts with those from our more reflective and rational decision-making thought processes. If we don't do this, we will always be buying high when markets are full of euphoria and selling low when markets are grim.

If we are to be prudent investors then, we have to find a way of counter balancing our gut instincts. This requires learning how to manage our emotional states. And it requires learning how to avoid the short-cut decision making that we are all prone to and that is ill suited to good investment decision making.

Managing our emotional states is at least partly a matter of not overloading ourselves with negative experiences. Nassim Nicholas Taleb, in his book *Fooled by Randomness* (a must-read for any investor, professional or otherwise), describes how neuro-science has discovered that losses impact us more than gains—about four times as much. Even if our portfolio is gaining ground two out of every three days, we still feel the losses more keenly than the gains despite the fact that they are outnumbered two to one. Taleb’s own personal way of managing his exposure to negative experiences is, paradoxically, to limit the amount of market tracking information he sees. He reads the *New Yorker* instead of the *Wall Street Journal*. He does not carry a device with streaming real-time market information. He does not monitor his positions continuously.

The moral for us is that frequent market and/or portfolio monitoring is just anxiety (or euphoria) inducing. It will only serve to damage our health and to impair our decision making by reinforcing our emotional reactions to market movements. We shouldn’t keep our television or computer screen tuned to the financial networks. We shouldn’t track our portfolios hour by hour, or even day by day. We should set up a regular schedule and look at our portfolios periodically as part of a larger information gathering exercise. We should avoid sharing war stories about how much we’ve lost (or made) in the market so we don’t relive the experience and the emotion. We should save our discussions about portfolio performance for an advisor who can both soothe our anxieties and temper our exuberances, and who takes a sober, rational approach to investing.

Hold That Decision

We also need to be aware of and to manage the cognitive biases and decision making short-cuts that are part of human nature. The fact is that our brains are not wired for complex analytical decision-making. We tend to make quick decisions based on sparse information and arrive at conclusions that fit in with some pre-established point of view or position and then believe that we are better-than-average decision makers and that our decisions are superior to those of others. We all believe we are above average! In the process, we tend to factor out information that does not support the view we are predisposed to take, and we exaggerate the significance of the information that supports our decision.

Although this view of our decision making is not a very flattering one, it is the unfortunate truth. We may like to think of our brains as computers capable of digesting large amounts of information, conducting careful analysis, and detecting deep patterns and complex relationships, but a brief reflection will tell us what the neuro-biologists know—such a brain would not have been of much use for survival in pre-modern times. Survival often required rapid decisions based on sparse information. Our brains adapted well to this purpose and embedded some critical decision making in non-reflective, emotional responses. We need to be very cautious not to use the same sort of decision making when it comes to investment decision making and portfolio management.

A large body of literature exists on the subject of behavioral finance and the cognitive biases and decision-making short cuts we are all prone to. A full review of our foibles is material for an article in itself. Suffice it for now to just list some of our shortcomings.

Besides making quick decisions on sparse information, we see patterns where none exist. We believe the future will be like the immediate past. We take comfort in holding the consensus view. We find making a judgment that diverges from the crowd to be very taxing. We are overly optimistic about the future and overconfident about our ability to make judgments about the

future. We gather information that supports our point of view and discount information that apparently discredits it. We become attached to things we have acquired and hold on to them past the point when it makes sense to do so. We refuse to acknowledge losses that have not been realized or think of them as less real.

Managing both our emotional responses and our decision-making processes by ourselves is a challenging task. One of the principal virtues of a good investment advisor is helping in this task. A good investment advisor does more than provide reliable information and analysis, he or she also serves as a counselor, easing anxieties, tempering enthusiasms, urging more deliberate and thorough analysis in decision making, and cautioning an investor about his biases and cognitive traps.

Conclusion

But what about Tom? What is he to do?

First, Tom needs to save more. No matter how difficult it may be for him to put more away, a 6% savings rate requires a reliance on an aggressive portfolio allocation and future investment returns. For someone his age and assuming he has no other resources, any savings rate less than 15% will require him to assume a high degree of investment risk in his 401-k and/or face an impoverished retirement. See the chart at the end of this article for more information.

Second, Tom needs to answer the three questions about risk: How much does he need? Is the risk he requires prudent? Can he live with the risk he requires? To answer these questions, Tom need to consult with a qualified investment advisor to determine what target rate of return he needs to achieve his retirement goals and what level of risk will be required to achieve that target. He needs to determine, with the assistance of his advisor, whether the level of risk is prudent given his age and circumstances. And he needs to discuss with his advisor how the level of portfolio risk compares with his risk tolerance, and steps he can take to live with his risk exposure.

Finally, Tom needs to consult with a qualified investment advisor to get the best and most thoughtful advice about how to diversify his portfolio to achieve maximum return with minimum risk. A qualified investment advisor is key here, someone with knowledge of global capital markets and demonstrated expertise in portfolio optimization. This knowledge and expertise is not found in your typical financial planner or run-of-the-mill investment advisor. Qualified advisors should perform independent portfolio optimizations using advanced optimization models. They should discuss assumptions regarding capital market returns with their clients, and they should provide quantitative estimates of portfolios returns and risk. Tom should know what to expect in terms of simple and compound rates of return from his portfolio over the long term.

In the final analysis, Tom needs to understand that risk is not something to be avoided unthinkingly. It is the source of higher returns, and when handled prudently and pragmatically, it can help insure a prosperous and worry-free retirement as secure as that provided by the defined-benefit pension plans of the good old days.

Required Annual Savings Rate
Sufficient to provide for 20 years of post-retirement payments starting at X% of final salary
and increasing by 3% each year.

Assuming a 7.5% annual pre-retirement return on investments,
a 5.0% post-retirement return on investments,
a 4% annual increase in compensation,
and starting with no other savings.

	% of final pre-retirement salary, inflation indexed at 3.0%								
Years to retirement	20%	30%	40%	50%	60%	70%	80%	90%	100%
10	28%	42%	56%	70%	85%	99%	113%	127%	141%
15	17%	26%	34%	43%	52%	60%	69%	78%	86%
20	12%	18%	24%	30%	35%	41%	47%	53%	59%
25	9%	13%	17%	22%	26%	30%	34%	39%	43%
30	7%	10%	13%	16%	20%	23%	26%	29%	33%
35	5%	8%	10%	13%	15%	18%	20%	23%	25%
40	4%	6%	8%	10%	12%	14%	16%	18%	20%
45	3%	5%	6%	8%	10%	11%	13%	15%	16%

How to read the table: Suppose I plan on retiring in twenty-five years, have no savings right now, and want to save enough to provide for twenty years of post-retirement payments that will start at 50% of my final salary and go up 3% each year. Reading across the 25 years to retirement line until I come to the 50% column, I find that I must save 22% of my salary each year. The total amount I will have to save will be less than 22% to the extent that matching contributions are made by my employer to my 401-k.

	% of final pre-retirement salary, inflation indexed at 3.0%								
Years to retirement	20%	30%	40%	50%	60%	70%	80%	90%	100%
10	28%	42%	56%	70%	85%	99%	113%	127%	141%
15	17%	26%	34%	43%	52%	60%	69%	78%	86%
20	12%	18%	24%	30%	35%	41%	47%	53%	59%
25	9%	13%	17%	22%	26%	30%	34%	39%	43%
30	7%	10%	13%	16%	20%	23%	26%	29%	33%
35	5%	8%	10%	13%	15%	18%	20%	23%	25%
40	4%	6%	8%	10%	12%	14%	16%	18%	20%
45	3%	5%	6%	8%	10%	11%	13%	15%	16%