Asset Allocation and the Transition to Income: The Importance of Product Allocation in the Retirement Risk Zone

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Abstract:

As Canadians transition from years of saving and wealth accumulation to generating cash-flow and income in retirement, they must voyage through a fragile period in which poor investment returns can devastate the sustainability of their portfolio. Anyone who retired in the early part of this decade -- and started withdrawing money from a deteriorating equity portfolio -- understands these risks first hand. Their finances might never recover.

In this report we focus analytic attention on this fragile period by quantifying the impact of poor investment returns in the retirement risk zone. We illustrate how an early bear market during retirement can double or even triple the ruin risk, compared to experiencing the same poor investment returns later on. The years just prior to retirement are equally important.

Furthermore, this risk cannot be avoided by attempting to time the market nor can it be mitigated by transitioning to a conservative (i.e. bond) asset allocation. Rather, our main argument is to advocate the role of new and innovative <u>FinSurance</u> products that create downside protection in the retirement risk zone. An additional benefit of insurance for a retirement portfolio is that it allows investors to comfortably and rationally take on more equity market exposure than they would have otherwise, in the absence of this guarantee.

In sum, although conventional wisdom dictates that <u>asset allocation</u> explains the greater part of investment performance in the accumulation phase, we believe that <u>product allocation</u> will determine success in the retirement income phase.

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Section #1: Introduction & Motivation

Canadians who are about to turn 60 years of age are at an especially sensitive point in their financial life-cycle. These individuals are less than 10 years away from the mandatory deadline to convert their registered retirement savings plan (RRSP) into a cash flow or income stream in the form of a life annuity or a registered retirement income fund (RRIF). As is shown in Exhibit #1.1, in mid-2006 this group consists of roughly 408,000 Canadians and is expected to represent an increasing fraction of the total population as the baby boomers move closer to retirement. This age-69 deadline is more than just an administrative wrinkle in the Canadian tax code. Indeed, age 60 is more than just a psychological milestone. The 5 to 10 years before and after the onset of cash-flow generation – a.k.a. retirement -- represent a very fragile period in the financial lifecycle. It is the <u>retirement risk zone</u> which is the focus of this report.

Exhibit #1.1: Number of 59 Year-old Canadians

First, some background on demographics, retirement and pensions. Canada's private pension system is part of a growing trend in developed countries, gradually transitioning from Defined Benefit (DB) to Defined Contribution (DC) pension plans. One of the main reasons for this is that a growing number of decision makers are finally realizing that DB plans are no longer suitable given the environment of a mobile workforce with increased life expectancies, lower interest rates and reduced equity market performance. Indeed, according to the human resource consultant Watson Wyatt, Canadian pension plans are on average only 85% funded. Thus, it is not surprising to see major corporations reducing the scale of their DB pension liability exposure. For example, in June of 2006 Nortel Networks announced that the company would begin offering DC plans – instead of DB plans -- to all new employees. Coincidently, on the exact same day as the Nortel announcement, which was widely covered by all major news and media in Canada, the Ontario Teachers'

Pension Plan announced a plan to increase its pension contribution rates to 11% of earnings from the current 8% by the year 2009 as a solution to its under-funded pension fund[2], mostly caused by poor market performance, lower interest rates and increased longevity. Retirement promises can be costly and risky to provide!

Exhibit #1.2 and exhibit #1.3 provide statistics that speak for themselves. Whereas in the year 1980 DB plan members accounted for 93.7 percent of all registered pension plan participants, this number fell to 81.2 percent by the year 2005.

Exhibit #1.2: Number of Participants in DB and DC Plans

Furthermore, according to the above-cited Watson Wyatt study, only one third of the remaining corporate DB pension plans offer automatic income indexing to protect retirees against inflation and the increased cost of living; 26% of these plans have irregular (a.k.a. arbitrary or sporadic) indexing, and 39% offer no inflation protection at all[3].

Exhibit #1.3: Is Your Registered Pension a DB Plan?

One of the many implications of this (albeit slow) transition from DB to a DC, is that current and future retirees may no longer be able to rely on a guaranteed retirement pension that provides lifetime income adjusted for inflation and independent of market performance, interest rates and the general economic environment. Individuals are being handed the responsibility and task of protecting and maximizing their nest egg.

Exhibit #1.4: Canadian Households: Median RRSP Assets

[2] Thorpe, Jacqueline. “Pension 'beast' continues to growl”. *National Post*. 06/28/06
[3] Powers, Gordon. “Time for a Pension Checkup.” *Sympatico / MSN Finance’s Retirement Centre*. 04/06/06

On the same note – and to get a magnitude of this phenomena -- a Statistics Canada survey conducted a few years ago found that RRSP assets alone were valued at more than $343 billion, representing 9.8% of all household assets. RRSPs are the quintessential DC plan. More precisely, households for whom the major income recipient was between the age of 55 and 65 held median RRSP assets of more than $50,000. For this same group, Exhibit #1.5 shows that total median private pension assets (including registered savings/payout accounts, employer pension benefits, annuities, etc.) were valued at about $160,000 and accounted for 40% of total assets. Managing these personal pensions is obviously a major responsibility.

Exhibit #1.5: Median Private Pension Assets

Yet, despite the relative importance of private pension assets on the balance sheets of Canadians, surveys suggest a general lack of preparedness for retirement. For instance, researchers at Statistics Canada examined the likelihood that households, where the major income recipient is between the ages of 45 and 64, will be able to generate an income stream that is equal to at least two thirds of their pre-retirement income including CPP/OAS, starting at age 65. The two thirds number is universally suggested to be the amount of money required to finance a standard of living similar to that of pre-retirement years. They estimated that 33% of this group may not attain this level of income or may even fall below the low income cutoff point. This percentage increases to 46% for unattached individuals compared to households. Finally, 29% of all Canadian households had no private pension assets and most alarmingly in 42% of these cases the major income recipient was of age 45 or greater.

In sum, the increased uncertainty associated with the retirement income environment will require a more focused risk-management approach in the income phase. We believe that in addition to continuing to stress the importance of savings and diversification, investment practices – and perhaps even theory itself -- will have to change to accommodate these realities.

Section #2: Review of Basic Portfolio Theory in the Accumulation Phase

In the late 1950s and early 1960s, the foundations of Modern Portfolio Theory (MPT) were developed by academic researchers at the University of Chicago, Harvard and MIT. Forty years later, Markowitz, Sharpe, Modigliani, Miller and Fama are household names, at least within the financial services sector. Although their collective contributions to the science of financial economics and investment theory are numerous – and have been described in humorous length by Peter Bernstein in his excellent book entitled *Capital Ideas: The Improbable Origins of Modern Wall Street* – one of the main insights from MPT is the concept of an efficient investment frontier that is measured by a portfolio's expected return and a portfolio's risk (a.k.a. volatility or standard deviation.) This contribution by Markowitz (1952) garnered him a Nobel Prize more than thirty years later.

Exhibit #2.1: The Markowitz Frontier

Exhibit #2.1 provides a graphical illustration of the idea. The intuition is quite simple. Imagine that a hypothetical investor is offered two investment choices; think of them as Investment A and Investment B. The first choice offers a forward-looking expected return of 8% per annum with volatility of 20% and the second choice offers a lower expected return of 7% but the same volatility or uncertainty of 20%. Roughly speaking what these numbers imply is that during the next year the actual return from these (random) investments will fall somewhere between 7% plus 20% (+27%) and 7% minus 20% (-13%) two thirds of the time.

Although this brief review of portfolio theory is not the time nor place to delve on the details behind how we actually know these statistical values going forward, one way to think about these two investment choices is to assume they both purchase identical securities, but one charges a management fee that is 100 basis points higher.

In the above scenario common sense would indicate that the higher 8% / 20% pairing in Investment A is superior to the 7% / 20% pairing offered by Investment B. After all, why expose yourself to the same (20%) level of risk when the expected return is 100 basis points better under Investment A? In the language of portfolio theory, the 8% / 20% investment choice stochastically dominates the 7% / 20% choice. Indeed, this rather trivial insight is taught to all aspiring security analysts, investment advisors and financial planners in their basic Finance 101 university courses.

The actionable insight from this chart is usually explained as follows. All that really matters when making portfolio and asset allocation decisions is (1) the expected investment return, and (2) the volatility of that investment return. Furthermore, the objective is to increase the former and reduce the latter. And, if you are not already sitting on the efficient frontier you are holding the wrong investment portfolio. The slogan is simple and catchy. Get on the frontier!

Indeed, all of this has become quite standard in the financial services industry and this is likely the best approach to managing money when accumulating wealth towards a distant retirement goal. Indeed if you invest $100, $1,000 or $10,000 in a mutual fund that is expected to earn 8% for 30 years, you will end up with over 32% more money at retirement, compared to investing in a fund earning 7% for 30 years.

However, one of the arguments we will make in this report is that when a given portfolio is experiencing withdrawals, i.e. in the de-cumulation, cash flow or income phase, the above mean and variance (or standard deviation) may not be the only things that matter. Furthermore, in some cases, one might be willing to settle for a lower expected return (i.e. 7% versus 8%) if there are long-term guarantees that are associated with those lower returns. In other words, when you are saving money, an expected 8% is always better than an expected 7%. But when you are dis-saving money the situation can be reversed. This might seem counter-intuitive at first, so let us start by reviewing the basic arithmetic of retirement income.

Section #3: How Long Does My Portfolio Have to Last In Retirement?

There are two often forgotten items to note about the arithmetic (or dare we say calculus) of retirement income. The first is related to human longevity and the second is related to price inflation and the cost of living. The impact of inflation over the very long and uncertain horizons during which retirees might be withdrawing funds from a portfolio, can be devastating. This is why good financial advisors and planners must educate their clients, consumers and retirees about longevity tables, as well as the difference between nominal and real investment returns.

Exhibit #3.1: Elderly Canadians

Exhibit #3.1 is a interesting reminder of the extent to which Canadians are experiencing longevity and thus spending more time in retirement. The exhibit displays the number and precise ages of Canadians receiving Canadian Pension Plan (CPP) benefits. Notice the increasing fraction of the beneficiaries in 1990 vs. 2001 (12.3% vs. 17.1%) who are above the age of 80.

Exhibit #3.2: Odds a 55, 65 and 75 Year-old Canadian Will Survive to Age…

Exhibit #3.2 tells a similar story. It displays the probabilities that a Canadian 55, 65 and 75 year-old (male, female, or at lease one member of a couple) will survive to various birthdays. While individual health status (and wealth status) has an impact on these numbers, it is important to understand that the length of one's retirement is random. You might require 30 years of income or it might be less than 10. This unique longevity risk – and its impact on portfolio allocation -- does not apply in the wealth accumulation stage of the life-cycle.

Exhibit #3.3: Range of Life Expectancies at Birth

Exhibit #3.3 should give the reader a sense of how longevity patterns and life expectancy have increased over the last century. In the year 1926, life expectancy (at birth) in Canada was somewhere between 55 and 65 years, depending on the province in question. By the year 2000 the gap between provinces has declined and life expectancy at birth is close to 80. This represents a remarkable advance of 20 to 25 years.

Exhibit #3.4: Forty Years of Canadian Inflation

Once we recognize that retirement might be much longer than in the past and we appreciate the inherent randomness of the retirement horizon, the next important step is to quantify the impact of (even small rates of) inflation over long time intervals. Exhibit #3.4 reminds us that although current inflation rates are well-under 4%, in the not-too-distant past annual inflation rates were in the double digits.

Exhibit #3.5: Inflation: What Does a $1,000 Payment, Really Buy You?

Exhibit #3.5 should convince the reader that even a mild 4% inflation rate can reduce the purchasing power of a nominal (pre-inflation) income stream by more than two thirds. If you are receiving a constant nominal $1,000 income payment that does not adjust or keep up with inflation, in 25 years from now it will only buy you $375 worth of goods under a 4% inflation rate. Your income must grow over time to keep pace with inflation. And, going forward there is never any assurance that the Bank of Canada will be successful in keeping inflation within its 1%-3% target range.

Now that we have discussed how long retirement might last as well as the importance of thinking in after-inflation values, the following exercise brings us closer to understanding the returns our portfolios must earn to achieve our income goals.

Exhibit #3.6 computes the required investment returns needed to support various spending rates over retirement horizons.

At this point in the report it is important for us to emphasize that we do not advocate or promote a particular retirement spending rate – either 4%, 5% or even 7% or 8% -- as being optimal or sub-optimal under any set of circumstances. Obviously, the lower the spending rate the higher the chance of sustaining this standard of living during retirement. But, at the same time, a lower spending rate means precisely that: less spending. Some retiree might accept a 10% to 20% chance of running out of money as a chance worth taking, in exchange for a higher initial spending rate. Others might want a lower 5% to 10% risk of ruin, but they will have to survive on lower levels of retirement income and withdrawals. This is clearly a personal risk tolerance issue.

Either way, the main takeaway is that the longer the horizon over which cash flow is desired, and/or the higher the desired spending rate, the higher is the required investment return. For example, if a retiree with a $100 initial nest egg desires $5 of real income (think of year 2006 values) to last for 35 years of retirement, they need to earn 3.56% percent per year.

Exhibit #3.6: How Much Do You Have to Earn Each Year to Fund Your Retirement?

Here lies one of the interesting impacts of the so-called *retirement risk zone*. If you want your initial portfolio (nest egg) of $100 to generate an income of $8 for exactly 25 years of retirement, you must earn a real return of 6.36% per annum. If you want to increase the horizon to 30 years of retirement, you must earn 7.02% instead of 6.36%, which is an additional 0.66% (a.k.a. 66 basis points) each and every year. However, if you want the portfolio to last yet another five years, which is 35 years instead of 30 years, you must earn 7.39% each year, which is a mere 37 basis points above the 7.02% needed for 30 years of income. Finally, if you want 40 years of income, all you need is 23 basis points above the required rate for 35 years of income. Why does five more years require less and less of an additional effort?

Mathematicians call this a non-linear relationship. To get from twenty five years to thirty years of retirement income, you need 66 additional basis points of return, but to get from thirty-five to forty years of retirement income requires only 23 incremental basis points. The answer will become crystal clear later on in the analysis, but here we offer a small hint. The big challenge in generating retirement income is getting the right -- and a high enough -- investment return early on, a.k.a. during the retirement risk zone. If you can make it through this period, the additional investment effort (return) will not be very onerous. More on this later.

Section #4: The Impact of the Sequence of Investment Returns

Once again and to recap, if a $100,000 portfolio is subjected to monthly withdrawals of $750 real dollars -- which is $9,000 annually -- and is earning an inflation adjusted rate of 7% per year (a.k.a. 0.5833% per month), this nest egg will be exhausted within month number 259. Start this doomed process at age 65 and you will get ruined half-way through age 86. Figure #4.1 illustrates the smooth and predictable path your portfolio will take on its way to zero.

Exhibit #4.1: Deterministic Path to Zero

For those who are interested in the algebra, we know this inevitable date with destiny with absolute certainty since the textbook equation $(1-(1+k)^{-n})/k$ teaches us that the present value of $750 for $n = 258.59$ periods under a periodic rate of $k = 0.005833$ is exactly $100,000. Ergo, the $100,000 will only last until age 86.5.

Of course, if you plan to withdraw a lower $625 per month -- which is $7,500 per year -- the money runs out by month 466 and the nest egg lasts well beyond the mythical age of 100 for the same 65 year-old retiree. The present value of $625 paid over 465.59 periods under a periodic rate of 0.5833% is also $100,000. We showed this numerically in Exhibit #3.6.

The issue we pursue in this section is as follows. Imagine you are a 65 year-old retiree who does not earn a constant 7% each and every year but instead you earn an arithmetic average 7% over your retirement? How variable is the final outcome – namely the age of ruin -- and what does it depend on?

Exhibit #4.2: The Hypothetical Investment Triangle

To put some structure on the problem – since there are so many ways to generate an average return of 7% -- imagine that the annual investment returns are generated in a cyclical and systematic manner. Exhibit #4.2 illustrates how this works. During the first year of retirement the portfolio earns 7%. In the second year of retirement it earns -13% and in the third year of retirement it earns 27%. By construction, the arithmetic average of these numbers is exactly 7%. Each month we plan on withdrawing the same $750 as in the earlier case. Then, in the fourth year we start the cycle again. First the portfolio earns 7%, then -13% and then 27%.

This cyclical process continues in three-year increments until the nest egg is exhausted and the money runs out. Do you think you will get ruined earlier or later than the prior case where returns were a smooth 7% each and every year? If you think the answer is earlier, you are right. Indeed, since you started retirement on the wrong foot – i.e. you had poor performance early in the retirement risk zone -- the date and time you hit zero occurs a full 3 years earlier, or at age 83. The positive 27% return in your third, sixth, ninth, etc., year of retirement isn't enough to offset the minus 13% returns in the second, fifth, eight, etc., year of retirement. This is akin to this year's 20% bull market failing to undo the damage of last year's 20% bear market. Remember that if you lose 50% this year, you need 100% to make it up next year.

Note that these answers can be obtained and computed with just as much accuracy as the previous case, although you can't use a simple formula for the present value.

Instead, you must do this manually or by hand. Exhibit #4.3 illustrates the result graphically.

Exhibit #4.3: Your Path to Zero Under Clockwise Returns

Here is how to do this calculation in a spreadsheet or manually. Start with $100,000 and have it earn 0.5833% in the first month. Then, withdraw $750 and have the remaining sum earn the same 0.5833% for the next month. Do this for 12 months in total and then repeat for 12 months under an investment return of -1.0833% per month, which is -13% per year. Finally, repeat for 12 months under an investment return of 2.2500% per month, which is 27% per year. Every 36 months the pattern repeats itself. Start with twelve 0.5833% numbers, then twelve -1.0833% numbers and finally twelve 2.2500% numbers. You should have a very long column of returns which mimics the picture in Exhibit #4.3, with the account ultimately reaching zero shortly after your 83rd birthday. In this case, an average return of 7% is <u>worse</u> than a return of 7% every year.

Now, here is the interesting part. What happens if you reverse the triangle of returns and instead start in the other direction? In other words, what happens if you earn 7%, then 27% and then -13% over and over again? Exhibit #4.4 displays the same triangle, but with the arrows going in the other direction. This might seem completely hypothetical, but essentially means that in your second year of retirement you experience a bull market instead of a bear market. The long behavior and performance of both triangles remain the same.

Exhibit #4.4: Reversing the Triangle

The arithmetic average investment return is the same 7% regardless of what side of the triangle you start retirement earnings and withdrawals. However, the interesting result is that this time around, the money runs out at age 89.5 as opposed to age 83.33 or 86.5. As you can see from Exhibit #4.5, in this particular case, an arithmetic average of 7% is better than 7% every year. Getting something on average is better than getting some for certain.

Exhibit #4.5: Counter Clockwise Investment Returns

In fact, the variance in outcomes (or the spread in retirement ruin dates) would have been even greater if we started with -13% or 27% as opposed to the same 7%. For example, if the sequence was -13%, 7% and then 27%, the age of ruin would be 81.

We see yet another implication of the retirement risk zone. This peculiar phenomenon is unique to the distribution phase of the lifecycle. In the accumulation phase – as money is being added to the account on an ongoing basis – it is impossible to exhaust the account no matter how poor the investment returns. Also, remember that one lump sum investment grows to the same value regardless of sequencing, since $(1.07)(1.27)(0.87) = (1.07)(0.87)(1.27)$.

Exhibit #4.6 summarizes the impact of the various sequences on the ruin age as well as the variation in months between the given sequence and the baseline case of 7% each and every year of retirement. Note that this sequencing gap can get quite large. There is a 14 year gap between repeating the sequence {-13%, 7%, 27%} versus {27%, 7%,-13%}.

Exhibit #4.6: Retirement Ruin Under Various Triplet Sequences

Exhibit #4.7 moves beyond the hypothetical and examines the same phenomenon using real world numbers. In this case we have gone back to the year 1985 and assumed that we invested $100,000 in two funds, fund A and Fund B. Both funds were subject to $9,000 annual withdrawals (ignoring inflation for the moment.) Although it might have been difficult to predict this at that time, both of these funds would end-up experiencing the same (arithmetic) average return and standard deviation (and thus the same geometric mean return) during the 21 years between

January 1985 and January 2006. Remember from the discussion in Section 2, both of these funds are on the same location on the efficient frontier. To Markowitz they are indistinguishable.

Exhibit #4.7: A Tale of Two Funds

Yet, the final outcome is quite different. The first portfolio, which is invested in Fund A, runs out of money right before the year 2000. The second portfolio, which is invested in Fund B, ends up with more wealth (in nominal terms) than they started with in January 1985. Why this enormous difference in outcomes, even though they were investing in identical -- at least from a Markowitz perspective -- funds? The answer and the blame lies in the poor markets during the retirement risk zone. Notice how Fund A experienced negative returns of -10.7% and -6.9% in years one and three, while Fund B earned very strong returns in the first three years. Of course, in the long-run they both earned an average of close to 8% per annum. And, even though Fund A earned an eye popping 38% in year four – to make up for the first three years -- while Fund B lost 14% in year four, it was too late. The damage was done.

Exhibit #4.8: How Much Longer Does He Have to Work?

Let us now look at the issue from the other side of retirement, namely the years just prior to the beginning of withdrawals. Very few people want to delay their retirement[4] as a result of bad performance in the market, but the scenario in Exhibit #4.8 tells us how much longer one might have to wait if investment returns turn-out worse than expected.

[4] Although, it is important to note that a number of researchers, including Jagannathan and Kocherlakota (1996) as well as Bodie, Merton and Samuelson (1992) have referenced the implicit option to delay retirement and work for a few more years as a possible justification for investing more aggressively (a.k.a. higher exposure to volatile equities) prior to retirement. Of course, very few people plan for this *ex ante*, but many will have to fall back on this plan *ex post*.

Some readers might erroneously conclude that lesson to be learned from these stories, is to avoid retiring at the start of a bear market. But, of course, this is absurd since one never knows with any degree of certainty whether next month's, year's or decade's return will be higher or lower than average. The true lesson that should be emerging is that retirees face a unique risk that has to be managed in a very different way.

Section #5: Quantifying the Fragile First Five to Fifteen Years

We are one step closer to understanding the need for new products to manage retirement income and cash flow distribution. Let us delve a bit deeper into the numbers. First, Exhibit #5.1 demonstrates the impact a particular spending rate and asset allocation will have on the probability of retirement ruin, for a given age of retirement. Notice that the probability of ruin tends to be minimized with an asset allocation that is balanced. Thus, neither a 100% equity portfolio nor a 100% bond portfolio is optimal in reducing the ruin probability. Diversification of asset classes is critical, even at advanced ages.

For example, if you decide to retire early at age 55 and start withdrawing $5 of annual inflation-adjusted income per $100 of initial value (or $50,000 of annual income per $1,000,000 nest egg), there is a 26% probability you will run out of money while you are still alive if you invest the entire portfolio in stocks. In fact, even if you diversify your asset allocation and invest half of the portfolio in fixed-income bonds the risk does not change substantially. Obviously, retiring at age 55 is not feasible if you only have 20 times your desired spending rate (i.e. you are planning to withdraw $5 of income per $100 of initial capital.)

Exhibit #5.1a,b,c: What is the Probability of Retirement Ruin?

In contrast, if this individual retires at the normal age of 65, the same $5 spending rate becomes mildly affordable (i.e. the probability of ruin is less than 20%) when the portfolio has a balance mix of stocks and bonds. At a $4 spending rate, the probabilities of retirement ruin drops to less than 10%. We have highlighted the safe regions (probabilities) in green and the elevated levels of risk in red.

The numbers in Exhibit #5.1 were generated using a mathematical procedure called analytic-function approximations. These algorithms are described in greater detail in the book *The Calculus of Retirement Income*, by Milevsky (2006). They can easily be recreated in a simple Excel spreadsheet.

One of the important takeaways from Exhibits #5.1 is the idea of an optimal asset allocation during retirement. Our analysis indicates that if a (typical 65 year old) retiree who is withdrawing between $4 and $5 inflation-adjusted dollars per year, diversifies his or her portfolio amongst stocks and bonds, the probability of retirement ruin is at its lowest. Indeed, a diversified portfolio is optimal. Notice that 100% allocation to fixed-income bonds leads to the highest (not lowest) probability of retirement ruin.

Next, we turn our attention to the retirement risk zone. Exhibit #5.2 provides yet another way to understand how important it is NOT to lose money in the so-called retirement risk zone. According to results of extensive computer simulations that we conducted at York University and the IFID Centre[5], we found that if a retiree "gets lucky" and earns an average annual growth rate (or geometric mean) of 10% on his investments during his first decade of retirement, the probability of retirement ruin drops from about 30% to about 7%. In other words, if we artificially force the portfolio to have an average annual growth rate of 10% (with a volatility of 20%) between ages 65 and 75, but then let the investment return vary randomly for the remainder of his life (with an average growth rate of 5%), the probability of retirement ruin is greatly reduced. This should come as no surprise. If investment returns are better

[5] The underlying simulation methodology we are using to generate these results has been described and used quite extensively by Ho, Milevsky and Robsinson (1994) as well as Bengen (2001) or Ameriks, Veres and Warshawsky (2001).

than anticipated, the odds will be better as well. But, if we force the expected investment return during the first decade of retirement to be 0%, the probability of retirement ruin increases from 30% to 75%. Once again, the qualitative aspects of this result should be expected.

What is interesting (and was surprising to us) is that when we alter the growth rate in the same manner in the second and third decade of retirement, the relative impact on the retirement ruin probability is substantially mitigated. Notice that if the compound annual return during the second decade was forced to be an expected 10% per annum, the ruin probability is reduced to 15%. And, if the compound annual return during the third decade was forced to be 10% on average, the probability drops to only 25%.

Exhibit #5.2: Returns over Three Decades of Retirement

Ergo, it is much better to earn the abnormally high return in the first decade of retirement, compared to the second or third decade of retirement. Of course, the opposite is true of poor or bad investment returns. If you earn a 0% average annual growth rate during your second decade of retirement -- from age 75 to 85 -- the retirement ruin probability is still high at 60%, which is not as high as if the same 0% was earned in the first decade of retirement. In that case the ruin probability would be close to 75%.

The main insight from Exhibit #5.2 and the underlying analysis is that the first decade of retirement is the most crucial one in determining whether your retirement plan will be successful. Intuitively, a poor performance from the financial market is more devastating, all else being equal, when you have a lot of wealth at stake.

Exhibit #5.3a: Conditional Probability of Ruin: 5 Years of Poor Returns (100% equity)

Exhibit #5.3b: Conditional Probability of Ruin: 5 Years of Poor Returns (60% equity)

Exhibit #5.3c: Conditional Probability of Ruin: 5 Years of Poor Returns (100% bonds)

Exhibits #5.3a, 5.3b and 5.3c narrow this down into five year periods as opposed to decades. The three tables display simulated results under various spending levels during a planned 30 years of retirement. In other words, we are examining the probability the funds will last the entire 30 years.

For example, in Exhibit #5.3a, under a $5-per-$100 strategy invested 100% in equity, the probability the portfolio will not last for 30 years is 35.3% This, once again, becomes the baseline case. Notice that if this portfolio drops in value by 5% per year for the first five years of the 30 year period, the conditional probability of ruin increases from 35.3% to over 72.2%. The culprit, of course, is the negative return in the risk zone. Notice that if this same investor loses 5% per year for the second five year period the conditional ruin numbers drop to 59.5% and then to 51.8% for the third five year period. And, at the very end the conditional ruin probabilities are virtually identical to the unconditional ruin probabilities. In plain English, poor returns towards end of the third decade will not change the odds. A similar patter is observed if we consider a more conservative portfolio – with an equity allocation of 60% - in Exhibit #5.3b and a bond allocation of 100% in Exhibit #5.3c

Exhibit #5.4: Fragile Fives: Spending $5

Exhibit #5.4 is a graphical representation of a subset of the numbers in Exhibit #5.3a. It displays the conditional ruin probabilities under a variety of bear market scenarios. The first column represents a bear market (defined as losing 5% per year for five years) in the first five years; the second column represents a bear market in the second five years, etc. The dashed line is the unconditional probability of ruin.

Exhibit #5.5: A Stochastic Sample Path

What all of this implies is that we must protect a retirement portfolio early on in the withdrawal process, a.k.a. in the retirement risk zone. Exhibit #5.5 displays the ideal risk management product. It would convert paths that lead to early ruin and extend their lifespan by mitigating the negative return in the first five to ten years. Of course, one does not know going forward which path nature (markets) will choose, but it is possible to go backwards and Exhibit #5.6 does this in a novel way.

Exhibit #5.6: Wealth Path Under a Reversed Historical Returns Sequence

Imagine that you had a time machine and could go back in time, sequentially. Suspend your disbelief for a moment and imagine that you retired on January 1, 2003 (just for the sake of example) and that your entire nest egg of $100 was invested in the S&P/TSX total return index. Thus, during the first month of retirement you would get December 2002 market returns, in the second month of retirement you would earn November 2002 returns, in the third month you would earn October 2002 returns. Each month you would withdraw a fraction of your initial portfolio, adjusted for inflation for that particular month. On what date would you run out of money and how would your wealth evolve over time?

Exhibit #5.7: You Retired on January 1, 2003 and Went Back in Time…

Exhibit #5.6 gives us the answer in graphical format while Exhibit #5.7 gives us the tabular results. If you went backwards in time while spending $9 per year, your portfolio would have barely made it to January 1990, or 13 years of retirement income. If you spent a lower $8 per year, you would have lasted slightly less than three more years to June 1987 and at a more reasonable $5 per year your portfolio would be exhausted at the start of the 60s. The evolution of the six wealth paths in Exhibit #5.6 illustrates that the outcomes of each of the spending strategies were largely shaped by the poor returns experienced in the initial, critical years.

Section #6: A Diversified Asset Allocation is Not Enough.

At first it might seem as if the problems or pitfalls within the retirement risk zone can not be avoided. On the one hand, if the new retiree invests entirely in short term fixed-income products that do not fluctuate and therefore do not expose the retiree to the quandary of the sequence of returns, the portfolio will show little growth over time and will be unlikely to keep-up with inflation and the cost of living. On the other hand, if the retirement portfolio is allocated to an equity asset class, there is a substantial probability that early negative returns will decimate the portfolio and force the retiree to reduce their desired spending level. It seems that you are "damned if you do and damned if you don't." Since it is impossible to predict the forward-looking sequence of returns, is there any alternative but to hope for the best and reduce spending in the event of a bear market?

Oddly enough, the answer to this question is yes. There is a better alternative and there is a way to have your cake and eat it as well, so to speak. Let us explain. The third alternative is to use derivative securities, namely put and call options to reduce the dispersion of portfolio returns -- both positive and negative -- and thus concentrate investment returns around a central value that, in most cases, this will improve the sustainability of the portfolio. That is the next step in the evolution of retirement income risk management.

For those new to the concept of financial options, there are derivative instruments whose value is based on or derived from the value of some underlying investment such as a stock or portfolio of stocks. Specifically, buying a call option provides an individual holder with the right, but not the obligation to purchase an underlying investment at a predetermined price, whereas buying a put option guarantees the holder the right to sell the underlying investment at a predetermined price. Purchasing put options on a portfolio's assets, therefore, guarantees a minimum return when the assets are finally sold. Combining puts and calls in a *retirement collar*, allows you to sell a call with a high strike price and, in turn, use the proceeds to purchase a put with a lower strike price. Thus, if the asset's market price falls below the lower strike price, loss is limited, since you have the right to sell your portfolio at this price. However, if the asset's value increases above the higher strike price you will have to sell the asset to the holder of the call, or give away your stock. But, at least you have downside protection even if this strategy limits the gains you could have earned on the portfolio.

So, imagine that at retirement you decide to allocate your $100 nest egg (which can arbitrarily be scaled up or down) and spend $4 per year from this nest egg. If all of the money is invested in equity-based products, the probability of retirement ruin, which is the probability the standard of living is not sustainable, is approximately 7.3% for a male and 8.4% for a female according to computer simulation calculations. But, if you purchase a 3-month put option that is 5% out-of-the-money, which means that the strike price is initially at $95, and you fund this purchase by selling a call option that is 6.6% out of the money, the put/call combination will reduce the dispersion of your portfolio and will reduce the probability of ruin to 1.5% for a male and 2.4% for a female. Note that these scenarios ignore transaction costs and assume the 3-month options are rolled over upon expiration. These examples are obviously hypothetical values that are meant to illustrate the impact of downside protection as opposed to providing targeted investment advice.

The intuition for why this works is that when "very bad" investment returns are removed or purged from future scenarios, any given initial nest egg has a much higher probability of sustaining the same standard of living. It is important to note that the retirement collar strategy of buying puts funded by selling calls within the retirement risk zone is not a free lunch. The strategy reduces the probability of retirement ruin by limiting the magnitude and frequency of (large) negative returns, but this comes at the expense of reducing the upside potential of the portfolio. This is yet another manifestation of the universal trade-off between financial risk and return.

Although the portfolio's income will last longer by "delaying its date" with zero, the portfolio will not grow or increase in value as rapidly as the un-collared or unprotected portfolio.

It might seem odd that using derivative securities such as puts and call option can have such an impact on the probability of retirement ruin. In fact, all of these quantitative results should resonate with the story we told in the previous section. By protecting your portfolio early in retirement, you reduce your exposure to a poor sequence of investment returns in the retirement risk zone.

Unfortunately, for many Canadian investors and retirees, engaging in this derivative/option hedging strategy might be unrealistic and expensive. First, these put and call options might not be available for the mutual funds and securities held by typical retirees. Second, this dynamic strategy would require constant monitoring and might involve substantial transaction costs (brokerage expenses, trading costs), especially for the small investor. The cost of buying put options, even if they are out-of-the-money and hence cheaper, and even if the premiums are partially funded by selling call options, can be quite high. As a ball-park figure, the cost of buying 3-6 month put options can range from 5% to 10% of the initial value portfolio, depending on the specific investments being hedged (or protected). It might be too complicated to bake your own product allocation at home.

But this is precisely where and why the new generation of retirement income products will increase in popularity and gain market share. A full suite of “FinSurance” products would certainly include fixed and variable life annuities that can hedge the retiree against longevity risk, inflation risk and perhaps even protect against unexpected and expensive health shocks. However, the new leading contender for retirement income product allocation is a concept called a guaranteed minimum withdrawal benefit (GMWB) which was introduced in the U.S. market over 5 years ago and has been extremely popular with soon-to-be retired baby boomers.

What a GMWB tries to achieve is to create an income stream that is protected from poor market performance early-on in retirement. Boiled down to its essence, a GWMB can be viewed as an umbrella that is placed on top of a portfolio of securities or funds. As long as you stay within the radius of the umbrella and make sure to hold it up at all times, it will protect you from the rain. More technically, the GMWB overlay guarantees that you will get *at least* your money back and perhaps much more, as long as you do not withdraw more than a specified amount from this underlying portfolio in any given year.

Indeed, in the last few years we have seen many different variations on the GMWB theme. Some promise to increase your payments over time, if the market performs well enough. Others add a bonus or extra return to your underlying investments if you do not withdraw any funds from your portfolio for a period of time.

Exhibit #6.1: What is the probability that a GMWB account value will reach zero within 30 years?

Exhibit #6.1 is a simulation illustration of one possible GMWB structure. It assumes that you invest $100 in a portfolio that is protected by a GMWB guarantee and is expected to earn a NOMINAL 8% (net of management fees) per annum, with volatility (a.k.a. standard deviation) of 15%. During the first ten years you do not withdraw any money and earn a "hypothetical" bonus of 5% each year. At the end of ten years you start withdrawing 5% of the portfolio value (plus any step-ups), which is at least 7.5% of the original amount. Every three years you then step-up your income withdrawals if market performance has been favorable. Notice that that the odds that your account value is completely depleted and the guarantee "kicks-in" to provide the remaining payments is 21.20%.

In sum, underlying mechanics or value proposition of this entire category of income products is that they manufacture the downside protection for any given investment portfolio within the retirement risk zone. Of course, the companies themselves manage this risk by hedging, either using the put and call options we described above, or at the very least by reinsuring the extreme risk. Therefore, if you don't want to manufacture these instruments yourself, you have the option of outsourcing the job to an insurance company.

Section #7: Ok, But Will GMWB's Keep-up With Inflation?

Of course, one of the concerns with GMWBs is that once the income flow starts, they are not designed to keep up with the consumer price index (CPI), and especially the cost of living for retirees. A secondary concern is that even with GMWBs, retirees still face *longevity risk* once the guarantees have been exhausted and all the promised money has been returned; one or both members of the couple might still outlive their retirement resources.

Indeed, inflation can be very different for a retiree compared to the general population. Although the equivalent does not yet exist in Canada, the U.S. Department of Labor has been tracking a unique inflation index for the elderly, called the CPI-E, which has consistently outpaced the regular U.S. CPI. This is due to components such as medical care, which is more heavily weighted in the CPI-E, and continues to rise in cost.

Thus, perhaps in response to the need for real versus nominal income, a number of companies have introduced GMWBs that step-up the guaranteed base upon which the withdrawal benefits are computed, on contract anniversaries ranging from quarterly to every 5 years. The hope and expectation is that if the underlying net account value increases over time, the withdrawal rates will be applied to a higher base and the income flow will trend upward over time. Some manufacturers even guarantee this stepped-up income flow for (a couple for) life, providing the additional benefit of longevity insurance.

To investigate how these products performed over time we conducted a series of Monte Carlo simulations that help shed light on the odds. We generated thousands of different scenarios for the value of the underlying sub-accounts based on hypothetical asset allocations. We started the process with a single premium deposit of $100,000, and in each of years #1, 2 and 3, $5,000 was withdrawn. Then, if *and only if* the hypothetical account value was above $100,000, the guaranteed base was stepped-up to this higher value and the new withdrawal amounts became 5% of the new base. This process continued in 3-year increments until the very end of the longevity curve.

Exhibit #6.2 illustrates the results of this analysis for a portfolio that consists of 80% equity-based and 20% bond-based investments. The table displays the algorithm's computed median withdrawal amount after every third year, as well as the 75th and 25th percentile which provide an inter-quartile range of the possible outcomes.

The numbers in Exhibit #6.2 can be benchmarked against the eroding power of an assumed 3% inflation rate. Notice that under this rate, the initial withdrawal or income flow of $5,000 must grow to $5,464 by year 3 of retirement to keep up with inflation and to $7,129 by the 12th year.

Exhibit #6.2: GMWB Withdrawals Over Time, 100% equity portfolio

So, does the GMWB living benefit keep up? In the 80% equity and 20% bonds case the answer is yes, but barely. Although the median income does grow and steps-up over time, it does not keep up with a 3% inflation rate. Note, however, that in one quarter of the scenarios the step-up performed even better than a 3% inflation rate. So it can be said that the GMWB has a *decent* chance of keeping up with a 3% retiree inflation rate.

To contrast the analysis under the moderately aggressive portfolio, we also generated scenarios and results for a 100% equity portfolio for which we now assume a more aggressive 8% net expected return with a volatility of 20%. These results are displayed in Exhibit #6.3 using the same tabular format.

Exhibit #6.3: GMWB Withdrawals Over Time, 80% equity portfolio

Once again, the same cyclical process from the previous simulation continues for the life of the policyholder, or at the very least until the entire guaranteed amount has been returned to the policyholder.

Notice that in Exhibit #6.3 under a 100% equity portfolio the median withdrawn amount does, in fact, keep up with a 3% retiree inflation rate. For example, in year 12, where the inflation-adjusted value of the $5,000 income is now $7,129, the median income flow is projected to be $7,190 per year. In fact, even in the worst 25% of scenarios income does start to increase by year number 12.

From a broader perspective, some important lessons emerge from this kind of analysis regardless of the exact parameter values. Although the retiree can certainly expect to receive a step-up and the median amount withdrawn does increase over time, there is at least a 25% chance that the policy holder will experience no step-ups during the first 10-12 years of the policy. And, if you are more skeptical about the equity premium, the probability of no step-up is even higher. Thus, for the step-up feature to actually keep up with retiree inflation, a substantial equity exposure within the underlying portfolio is critical. Notice how the middle column in Exhibit #6.2 lagged the 3% inflation rate, while the equivalent results in Exhibit #6.3 just managed to keep up with this benchmark.

Another important byproduct is the concept of an optimal asset allocation within a vehicle that offers a GMWB, which is something we are continuing to investigate. Preliminary research on our part -- which will be reported in the paper referenced as Huang, Milevsky and Salisbury (2006) – seems to indicate that when an investor is protected from prolonged negative returns during retirement in a GMWB structure, they can rationally accept more financial market risk for a given risk tolerance level. For example, if they are currently comfortable with a 50/50 equity/bond mix, having access to a GMWB might induce them to accept a 60/40 allocation. And, while the precise magnitude of this is dependent on the investor's risk tolerance as well as the level of insurance fees that are being charged, the qualitative results appear robust.

For example, in an idealized model – with low fees -- where exact calculations can be carried out, almost without fail, we find that optimal behavior is to select the maximum allocation to equity that is allowed by the terms of the GMWB. This is not hard to understand. In a portfolio without guaranteed withdrawals, a significant allocation to fixed income bonds acts to protect future income withdrawals from downturns in the equity market. But, within an investment with a GMWB umbrella, that role is now played by the guarantee itself. If the market declines, a rational and patient investor relies on the guarantee to support future consumption. Given the preferences of the individual we are considering, the role of the investment portfolio becomes solely to provide an opportunity for growth, and that is best done by maximizing one's exposure to equities. In plain English, you can eat (withdraw) more <u>and</u> sleep better at night (i.e. face less risk)!

Section #7: Final Words

Jorge Guinle was a colorful and eccentric Brazilian playboy who died on Friday March 5th, 2004 in Rio de Janeiro. Jorge was an interesting case study in personal financial mismanagement. He was born to one of the wealthiest families in Brazil, and spent a large part of his life dating Hollywood starlets such as Rita Hayworth, Lana Turner and Marilyn Monroe. This hobby was obviously quite expensive and he squandered most of his family's fortune well before he died at the age of 88. He got ruined, early on in his third decade of retirement. In fact, in an interview that took place one or two years before his death, Jorge said: "The secret of living well is to die without a cent in your pocket. But I miscalculated, and the money ran out too early" Indeed, he spent the last few years of his life trying to survive on a Brazilian state pension. According to his obituary that appeared in the prestigious *Financial Times* newspaper, he lost substantial sums of money on poorly executed real estate deals more than 20 years before he died.

Undoubtedly there are many others who have fared similarly in retirement, albeit perhaps with a less colorful lifestyle. Indeed, we do not know whether Mr. Guinle spent too much, invested too poorly or lived too long. Likely, all three factors likely contributed to his unfortunate situation. However, it should be quite clear from our analysis that the first decade of retirement is a sensitive and fragile period regardless of who you are and how much you are spending. Once again, poor market performance during the retirement risk zone can decimate an investment portfolio.

As Canadian baby boomers approach the retirement risk zone they must realize that asset allocation alone is not enough to generate a sustainable income stream for their retirement of unknown length. We believe that product allocation – namely buying instruments that can protect a portfolio against negative adverse returns early in retirement -- will become as important as asset allocation within the financial services industry over the next few years. Innovators will be rewarded.

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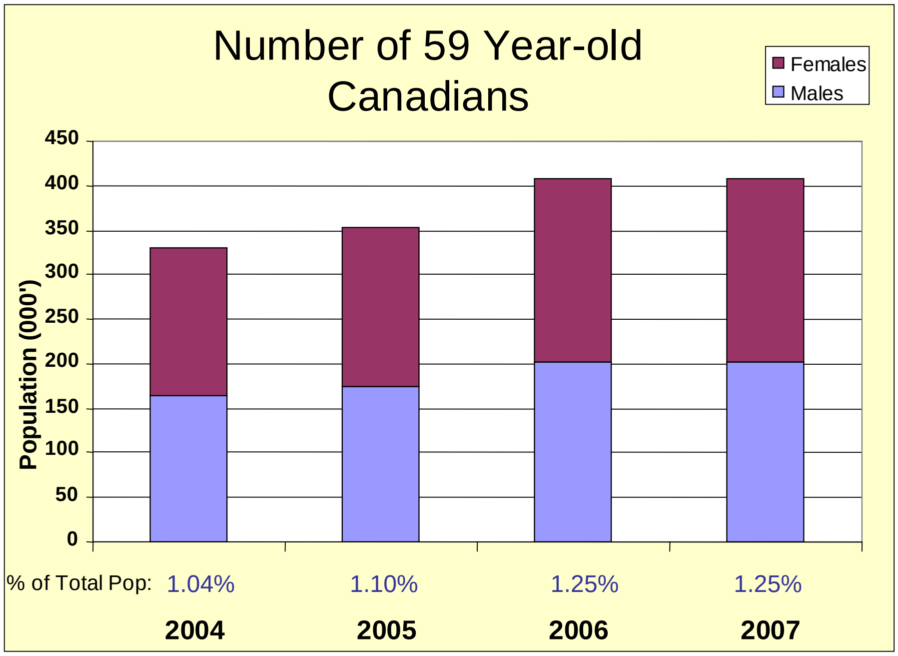
Exhibit #1.1



Source: CANSIM II, Statistics Canada Population Projections (July 2006), IFID Centre Calculations

Notes*: An increasing number of Canadians will be approaching the Retirement Risk Zone during the next few years.*

Exhibit #1.2

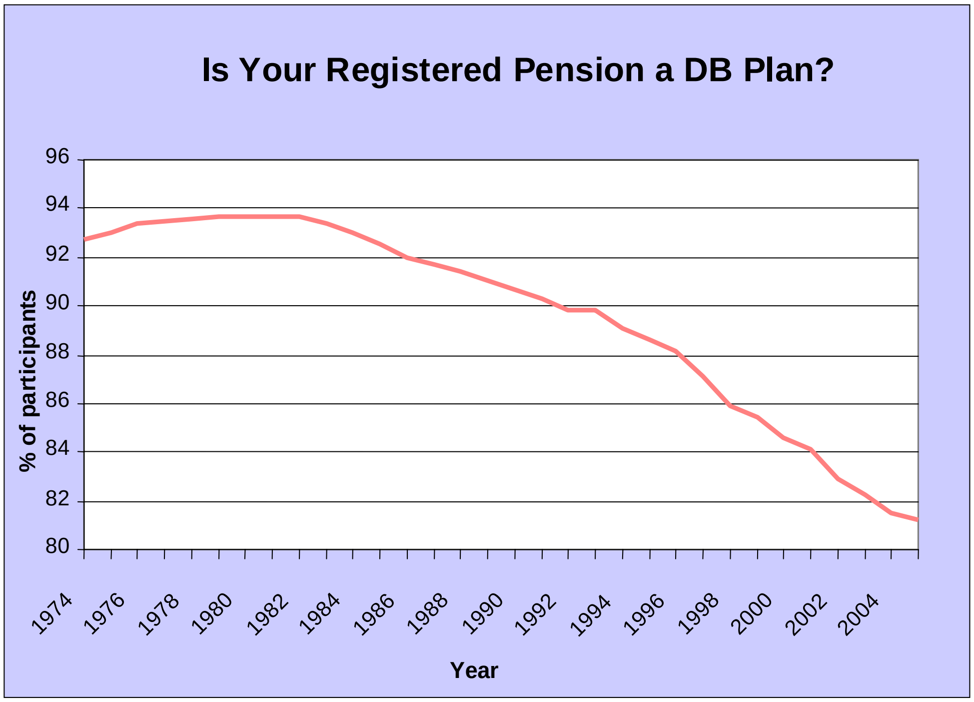
Number of Participants in DB and DC Plans

	1980		1990		2005	
Registered Pension Plan Type	**Number**	**% of Total**	**Number**	**% of Total**	**Number**	**% of Total**
Defined Benefit	4,194,283	93.7	4,633,587	90.7	4,604,775	81.2
Defined Contribution	231,275	5.2	430,561	8.4	885,840	15.6
All RPPs	4,475,429	100	5,109,363	100	5,669,858	100

Source: CANSIM II, Series: V31206517, V31206485, V31206477

Notes: *The overall percentage of defined benefit (DB) pension plans continues to decline in Canada. Whereas defined benefit plans comprised 55.1% of all registered pension plans in 1980, the percentage has gradually decreased to 49.3% in 2005 (not shown). As this table shows, the number of people in a defined contribution (DC) plan continues to increase as well. The percentages don't add-up to 100% because of a (rare) third type of pension plan, which is a hybrid DB/DC. Only a fraction of Canadian defined benefit plans provide income indexing to alleviate the impact of inflation.*

Exhibit #1.3



Source: CANSIM II

Notes: *Defined Benefit (DB) pension plans, with their implicit guarantees and market protection, peaked during the 1980's and are now on a declining trend*

Exhibit #1.4

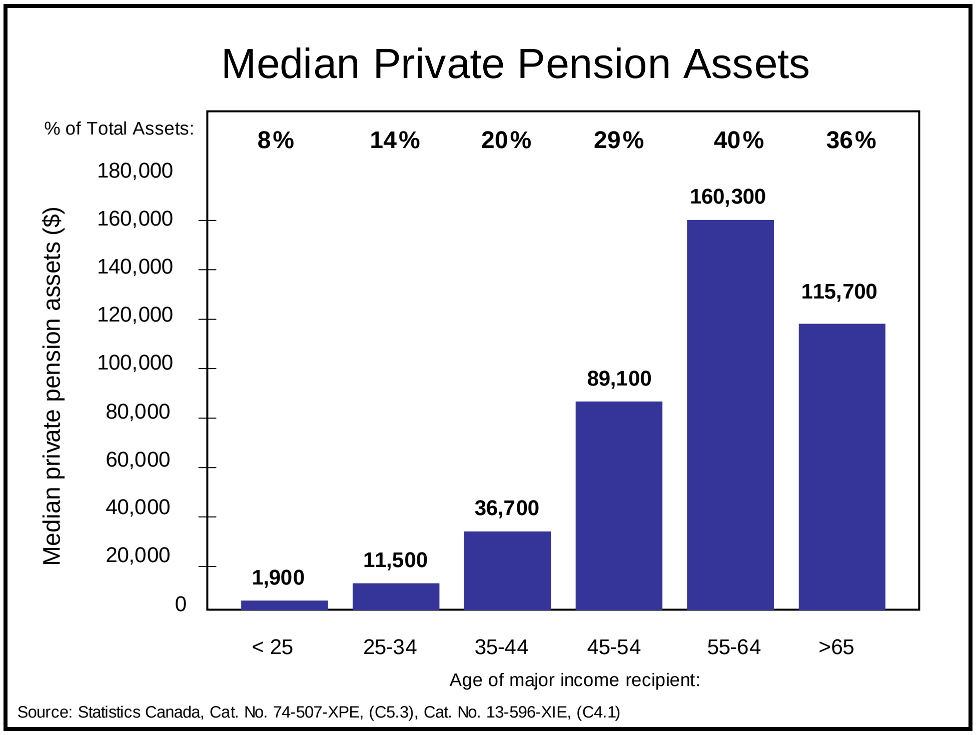
Canadian Households: Median RRSP Assets

Age of Major Income Recipient	% with RRSPs	Median RRSP Assets ($)[1]
<25	**24**	2,200
25-34	**59**	8,000
35-44	**66**	17,000
45-54	**71**	30,000
55-64	**69**	50,000
>65	**46**	46,000
Total	**60**	20,000

1 - For family units with this asset in 1999
Source: Statistics Canada, 2001 – Cat. No. 13-596 (T4.1), 2003 – Cat. No. 74-507 (T5.1)

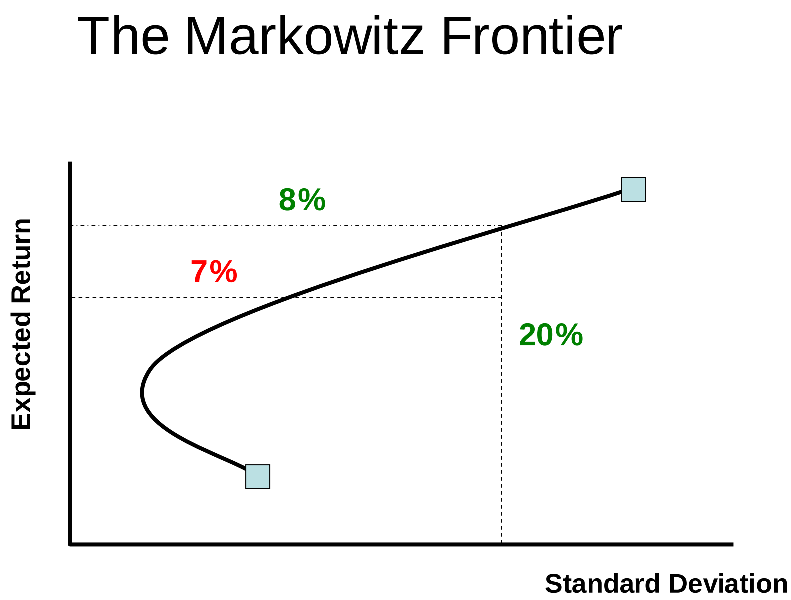
Notes: *Is the size of your RRSP above or below average? Will you have enough funds at retirement to finance your desired spending and income?*

Exhibit #1.5



Notes: *The median Canadian household aged 55-64 had $160,300 in pension assets at the beginning of the decade. Will this be enough?*

Exhibit #2.1



Notes: *In Markowitz' world on the efficient frontier, all that matters is the mean (expected return) and variance (risk) of the investment returns. All else being equal, the higher the expected return, the better.*

Exhibit # 3.1

Canada Pension Plan Retirement Beneficiaries

	1990		2001	
Age	**thousands**	**%**	**thousands**	**%**
60-64	231	13.7	416	15.1
65-69	567	33.5	748	27.2
70-74	407	24.1	635	23.1
75-79	281	16.6	479	17.4
80+	208	12.3	471	17.1

Source: Statistics Canada, Catalogue No. 74-507-XPE

Notes: *The aging of the Canadian population is already upon us. Note the percentage of CPP recipients above the age of 80 has increased from 12.3% in 1990 to 17.1% in the year 2001.*

Exhibit #3.2

The Probability a 55 year-old Canadian Will Live to Age…

Age	Male	Female	At Least One
60	94.87%	96.91%	99.84%
65	89.52%	93.81%	99.35%
70	79.79%	88.12%	97.60%
75	66.24%	79.64%	93.13%
80	49.02%	67.00%	83.18%
85	29.94%	49.35%	64.51%
90	13.56%	28.71%	38.37%
95	3.89%	11.29%	14.74%

The Probability a 65 year-old Canadian Will Live to Age…

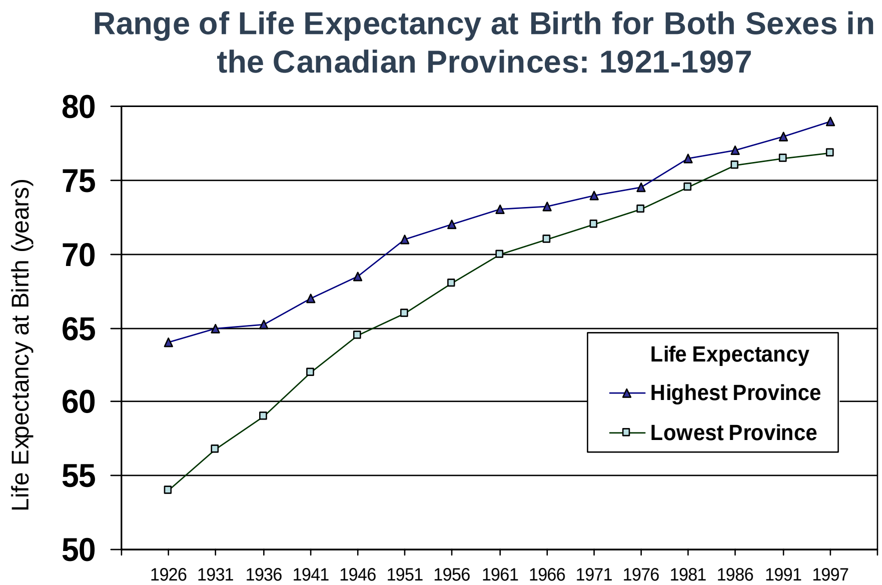
Age	Male	Female	At Least One
70	89.13%	93.94%	99.34%
75	73.99%	84.90%	96.07%
80	54.76%	71.42%	87.07%
85	33.44%	52.61%	68.46%
90	15.14%	30.60%	41.11%
95	4.34%	12.03%	15.85%

The Probability a 75 year-old Canadian Will Live to Age…

Age	Male	Female	At Least One
80	74.01%	84.12%	95.87%
85	45.20%	61.96%	79.15%
90	20.47%	36.05%	49.14%
95	5.87%	14.17%	19.21%

Notes: *These probabilities are based on Statistics Canada population mortality tables. These probabilities do not account for future improvements in longevity (i.e. there is no projection). If we do consider a projection, according to Statistics Canada, the survival probabilities change as follows. The 65 year-old male's probability of surviving to age 70, 75, 80, 85, 90 and 95 are: 89.2%, 75.1%, 57.6%, 38.2%, 20.1% and 7.5% respectively. The 65 year-old female's probability of survival to the same ages would be 94.0%, 85.5%, 73.4%, 56.6%, 35.9% and 18.6%, respectively.*

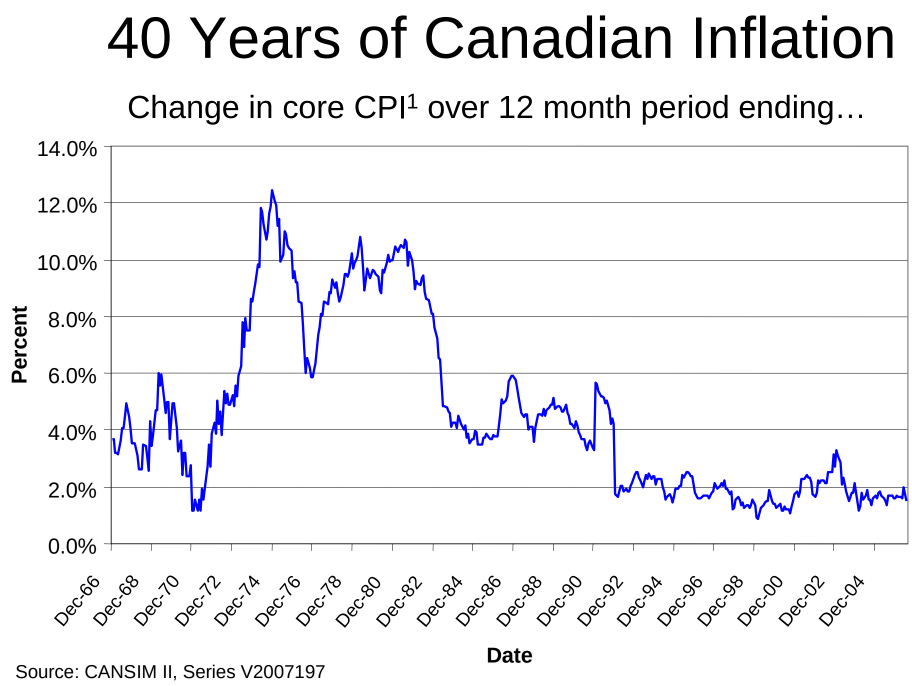
Exhibit # 3.3



Data Sources: Institute for Clinical Evaluative Sciences; Atlas Reports, The Health of Ontarians
Organization for Economic Cooperation and Development Health Data 1998

Notes: *Longevity has been increasing across Canada and the dispersion in life expectancy across the provinces has declined over time. What will this chart look like in 2017?*

Exhibit # 3.4



Notes: *Although current inflation rates are at a historical low and the Bank of Canada's mandate is to keep inflation within a target range, there is always a risk that it spikes. Note that core CPI, as defined by the Bank of Canada, excludes the 8 most volatile components (fruit, vegetables, gasoline, fuel oil, natural gas, mortgage interest, inter-city transportation and tobacco products).*

Exhibit # 3.5

Inflation: What Does a $1,000 Payment, Really Buy You?

Year #	0%	1%	2%	4%
1	$1,000	$990	$980	$962
5	$1,000	$952	$906	$822
10	$1,000	$905	$820	$676
15	$1,000	$861	$743	$555
20	$1,000	$820	$673	$456
25	$1,000	$780	$610	$375
30	$1,000	$742	$552	$308
35	$1,000	$706	$500	$253

Notes: *Even an inflation rate of 1% is deadly. A 4% annual inflation rate can erode two thirds of one's purchasing power after 25 years of retirement. Therefore, it is important that income increase over time to offset this erosion.*

Exhibit #3.6

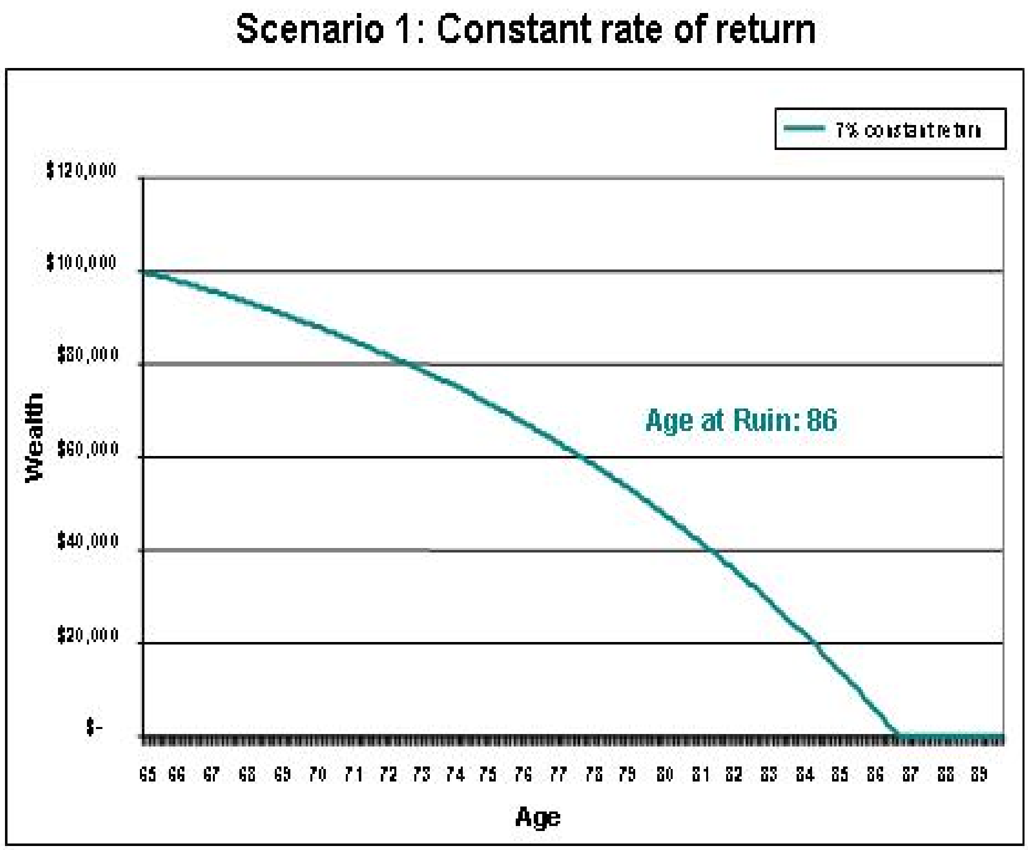
How Much Do You Have to Earn Each Year to Fund Your Retirement?

Annual Spending Rate	Number of Years in Retirement: 25	30	35	40
$4	0.00%	1.25%	2.04%	2.56%
$5	1.85%	2.91%	3.56%	3.98%
$6	3.49%	4.39%	4.93%	5.27%
$7	4.98%	5.75%	6.19%	6.47%
$8	6.36%	7.02%	7.39%	7.62%

***APR, compounded monthly**

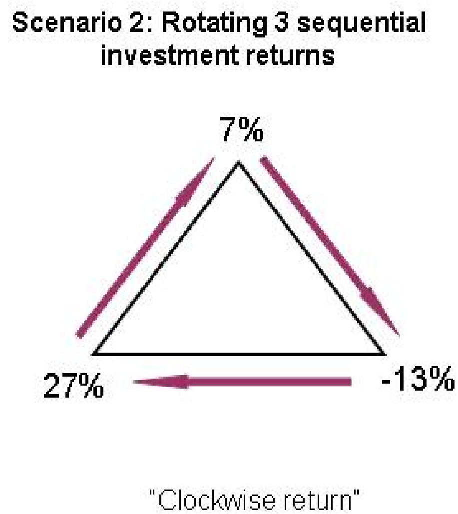
Notes: *Starting with a $100 nest egg, if you want to withdraw $8 each year in real (after inflation) units, your portfolio must earn 7.02% per year after inflation, if you want the money to last for 30 years.*

Exhibit #4.1



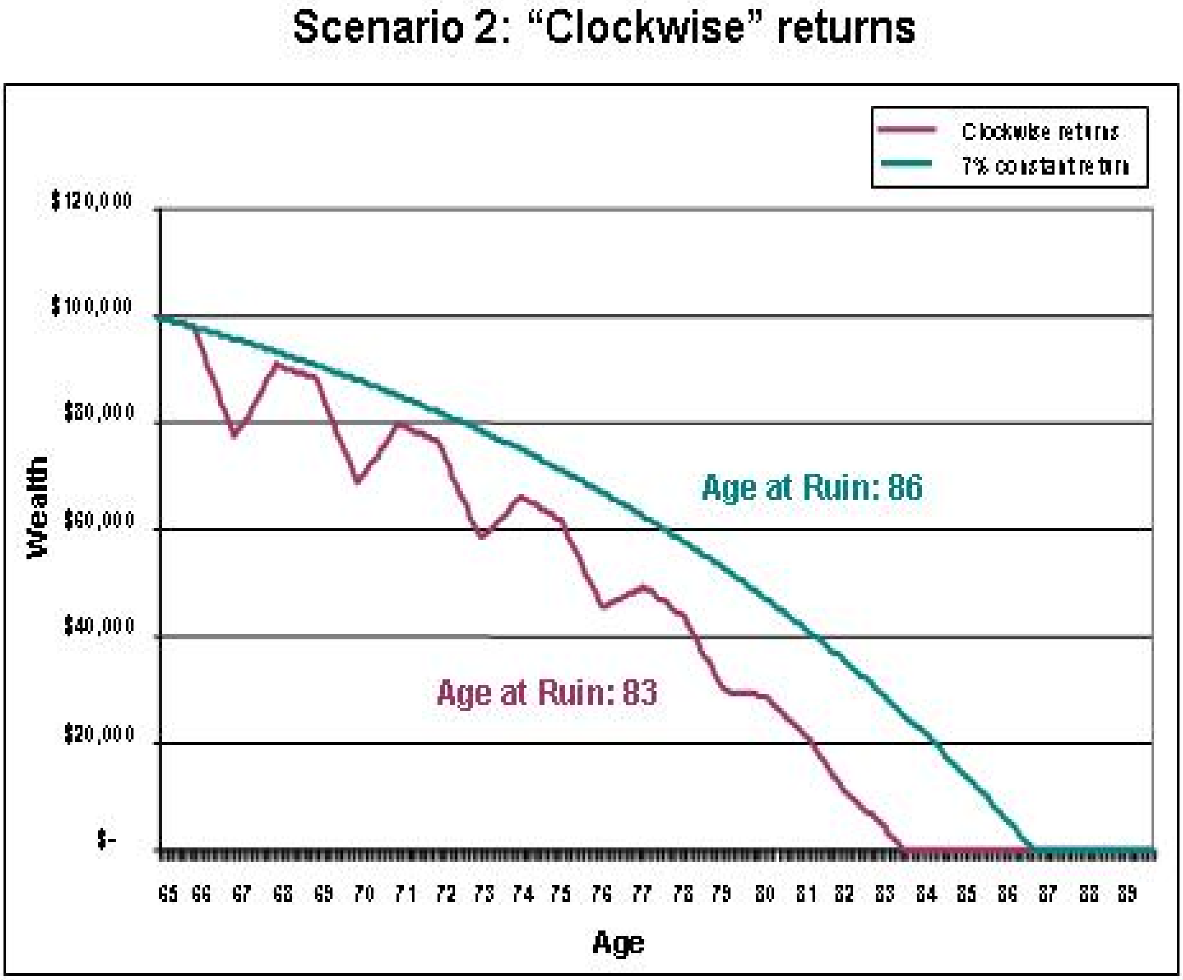
Notes: *In a deterministic world your date with destiny is perfectly predictable. If you spend $750 per month (or $9,000 per year) and earn 7% per year (or 0.58% per month), you get ruined at the start of your 3rd decade of retirement.*

Exhibit #4.2



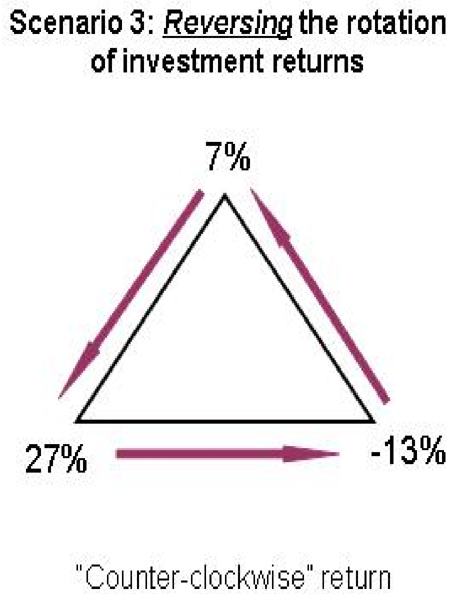
Notes: *As a hypothetical example, imagine a world in which you earn 7% in the first year or retirement, then -13% in the second year, then 27% in the third year. This process continues in three-year cycles, for ever. The arithmetic average return is 7%.*

Exhibit #4.3



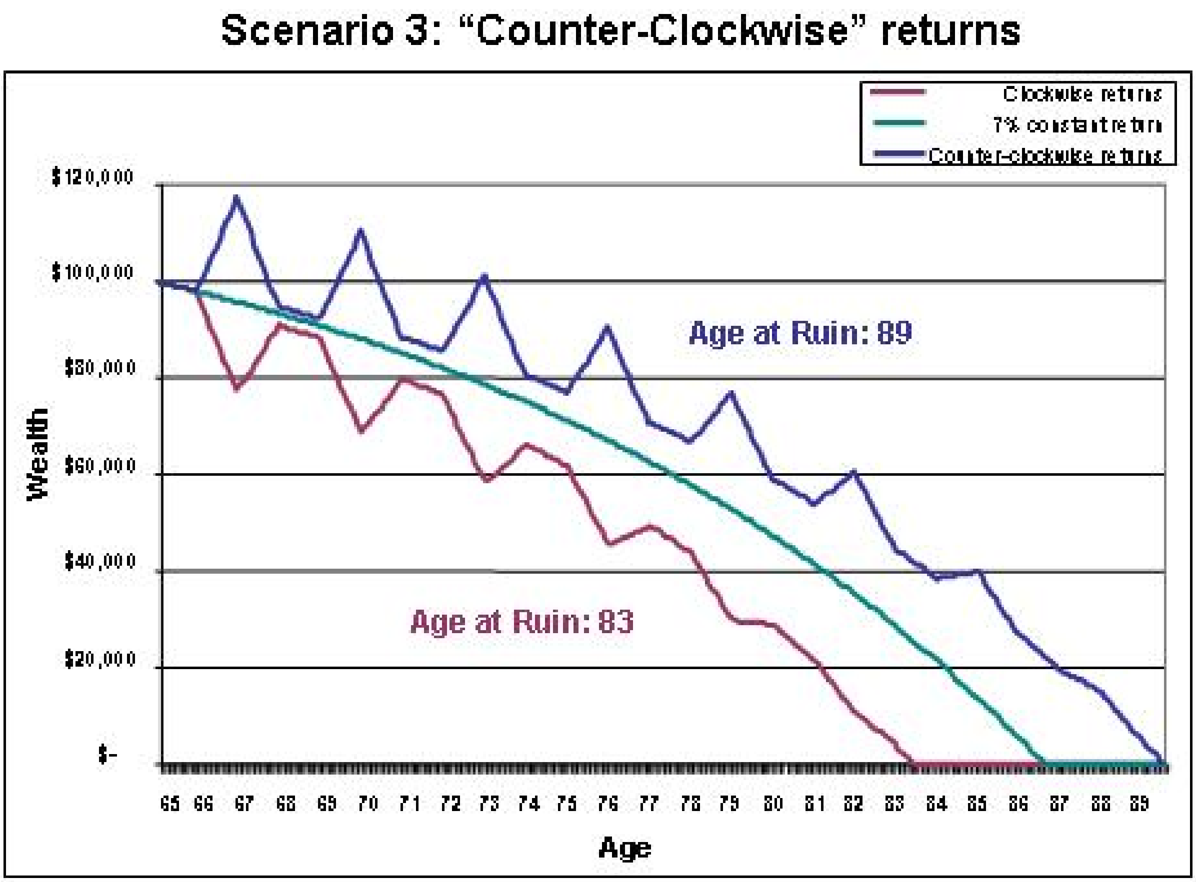
Notes: *Earning an average arithmetic return of 7% is much worse than exactly 7%, when you start your retirement in a bear market.*

Exhibit #4.4



Notes: Reversing the hypothetical example, in the second year of retirement, you go left (+27%) instead of right (-13%) Technically, this is the same asset class and leads to the same average investment return but the sequence is different. Is this scenario better or worse?

Exhibit #4.5



Notes: *Earning an arithmetic average return of 7% is better than exactly 7% each year, when the initial sequence is favorable. But, can you control the sequence?*

Exhibit #4.6

What stop did you get on the retirement merry-go-round?

Return Sequence	***Ruin Age***	***+/- Months***
+7%, +7%, +7%...	86.50	**0**
+7%, -13%, +27%...	83.33	**-38**
+7%, +27%, -13%...	89.50	**+36**
-13%, +7%, +27%...	81.08	**-65**
+27%, +7%, -13%...	94.92	**+101**

***Assumes $9,000 spending per year**.

Notes: *In all cases you earned a 7% average return during your retirement. If you retire directly into a "bear" market versus directly into a "bull" market, the gap in sustainability can be up to 14 years. Timing is everything.*

Exhibit #4.7

A Tale of Two Funds

	Fund A	Balance	Fund B	Balance
1985	-10.71%	$80,293	17.37%	$108,374
1986	0.79%	$71,924	11.63%	$111,973
1987	-6.90%	$57,964	37.35%	$147,719
1988	38.18%	$71,093	-14.41%	$117,436
1989	-5.97%	$57,849	10.15%	$120,352
1990	29.73%	$66,051	20.87%	$136,469
1991	13.87%	$66,209	-9.77%	$114,138
1992	-13.90%	$48,003	39.82%	$150,585
1993	34.87%	$55,740	32.50%	$190,523
1994	-1.52%	$45,894	-8.55%	$165,225
1995	-4.20%	$34,967	-5.62%	$146,932
1996	24.81%	$34,641	23.53%	$172,510
1997	-11.37%	$21,702	9.48%	$179,856
1998	34.08%	$12,754	4.20%	$178,407
1999	11.14%	$5,175	11.19%	$189,367
2000	14.30%	$0	-1.58%	$177,372
2001	-1.82%	$0	-11.06%	$148,760
2002	-9.26%	$0	-7.98%	$127,890
2003	14.75%	$0	10.38%	$132,163
2004	7.25%	$0	7.45%	$133,005
2005	5.96%	$0	-14.44%	$104,803
Arithmetic Mean:	7.81%		7.74%	
Standard Deviation:	16.60%		16.60%	

Notes: *Two funds. Same expected return (mean) and same risk (variance). Both portfolios experience the same annual withdrawals of $9,000. Fund A runs out of money in 2000, while Fund B ends-up better than it started. Why? Poor returns in the retirement risk zone.*

Exhibit #4.8

A 60 year-old wants to retire in 5 years and expects to earn 7% annually and save $1,125[1] per month, BUT faces a bear market in the last pre-retirement year

How Much Longer Does He Have to Work?

Start with: $228,000 Goal: $400,000		
Year Before Retirement: Investment Return	Extra Working Months Required to Meet Goal	Revised Retirement Age
-10%	20	67
-30%	46	69
-40%	60	70

1. This represents 1/12 of the current maximum allowable annual RRSP contribution

Notes: *The ability to meet one's financial retirement goals as the target retirement date approaches may be threatened by one year of poor returns.*

Exhibit #5.1a

Can You Afford Early Retirement at Age 55?

A Canadian Investor Starts Withdrawing (Retires) at Age 55.
What is the Probability of Retirement Ruin?

...Asset Allocation (Rebalanced Monthly...)	...Your Annual Inflation-adjusted Spending Rate, per $100 Initial Nest Egg $4.00	$4.50	$5.00	$5.50	$6.00	$ 6.50	$ 7.00
100% Equity + 0% Bonds	17.7%	22.0%	26.4%	30.8%	35.3%	39.7%	44.0%
80% Equity + 20% Bonds	15.0%	19.3%	23.9%	28.7%	33.5%	38.3%	43.1%
60% Equity + 40% Bonds	13.6%	18.1%	22.9%	28.1%	33.4%	38.7%	44.0%
50% Equity + 50% Bonds	13.5%	18.1%	23.2%	28.6%	34.2%	39.8%	45.3%
40% Equity + 60% Bonds	13.8%	18.7%	24.1%	29.9%	35.7%	41.6%	47.4%
20% Equity + 80% Bonds	16.6%	22.4%	28.5%	34.9%	41.4%	47.7%	53.8%
0% Equity + 100% Bonds	23.4%	30.2%	37.1%	44.1%	50.8%	57.1%	62.9%

Notes: Assumes 7% (3%) Arith. Mean and 20% (8%) standard deviation from Equities (Bonds), with 30% correlation.
Source: IFID Centre, Milevsky Robinson (FAJ, 2005) methodology applied to Canadian Mortality (MRL =27.5 yrs)

Exhibit 5.1b

Normal Retirement at Age 65?

A Canadian Investor Starts Withdrawing (Retires) at Age 65.
What is the Probability of Retirement Ruin?

...Asset Allocation (Rebalanced Monthly...)	...Your Annual Inflation-adjusted Spending Rate, per $100 Initial Nest Egg $4.00	$4.50	$ 5.00	$5.50	$6.00	$ 6.50	$ 7.00
100% Equity + 0% Bonds	12.0%	15.1%	18.5%	22.1%	25.7%	29.4%	33.1%
80% Equity + 20% Bonds	9.9%	12.9%	16.3%	19.9%	23.6%	27.5%	31.5%
60% Equity + 40% Bonds	8.7%	11.8%	15.2%	18.9%	22.9%	27.0%	31.3%
50% Equity + 50% Bonds	8.6%	11.7%	15.2%	19.0%	23.1%	27.4%	31.9%
40% Equity + 60% Bonds	8.7%	11.9%	15.6%	19.6%	23.9%	28.4%	33.0%
20% Equity + 80% Bonds	10.1%	13.8%	18.0%	22.5%	27.3%	32.2%	37.1%
0% Equity + 100% Bonds	13.9%	18.4%	23.2%	28.4%	33.6%	38.9%	44.1%

Notes: Assumes 7% (3%) Arith. Mean and 20% (8%) standard deviation from Equities (Bonds), with 30% correlation.
Source: IFID Centre, Milevsky Robinson (FAJ, 2005) methodology applied to Canadian Mortality (MRL =18.5 yrs)

Exhibit #5.1c:

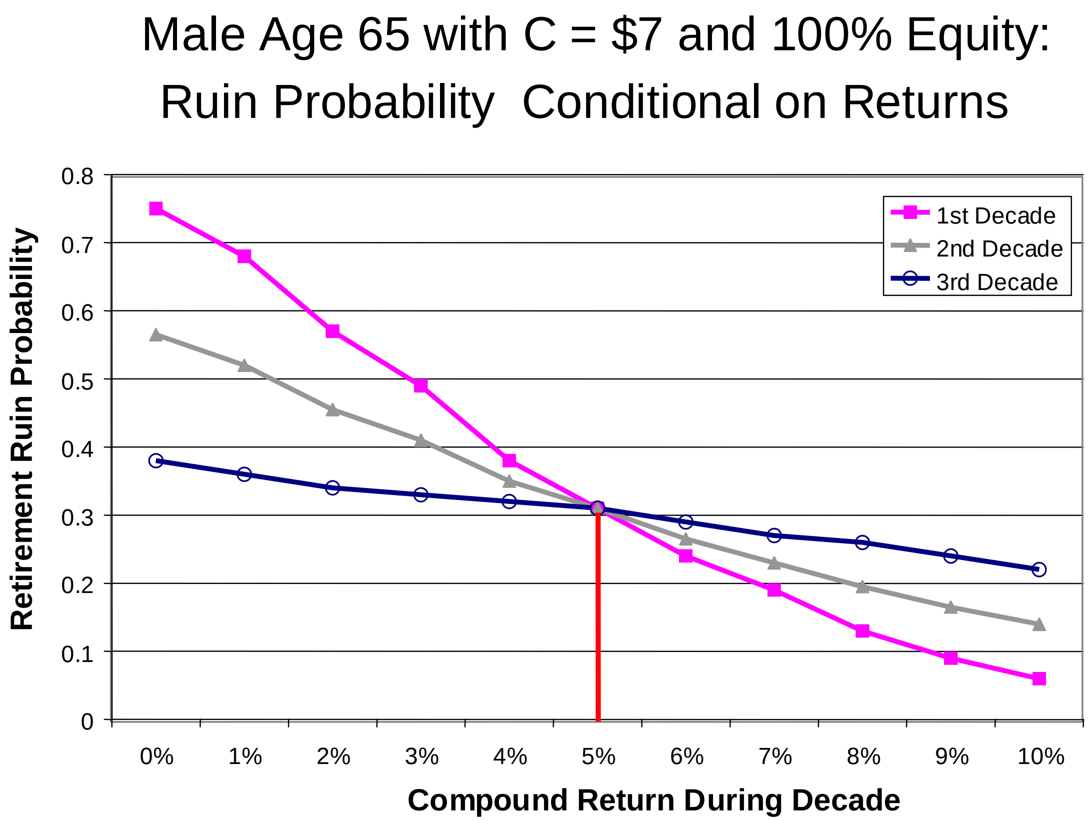
Late Retirement at Age 75?

A Canadian Investor Starts Withdrawing (Retires) at Age 75.
What is the Probability of Retirement Ruin?

...Asset Allocation (Rebalanced Monthly...)	…Your Annual Inflation-adjusted Spending Rate, per $100 Initial Nest Egg						
	$4.00	$4.50	$5.00	$5.50	$6.00	$ 6.50	$ 7.00
100% Equity + 0% Bonds	6.4%	8.3%	10.3%	12.6%	15.0%	17.6%	20.2%
80% Equity + 20% Bonds	5.1%	6.9%	8.8%	11.0%	13.4%	15.9%	18.5%
60% Equity + 40% Bonds	4.5%	6.1%	8.0%	10.2%	12.5%	15.1%	17.8%
50% Equity + 50% Bonds	4.3%	6.0%	7.9%	10.1%	12.5%	15.1%	17.9%
40% Equity + 60% Bonds	4.3%	6.0%	8.0%	10.2%	12.7%	15.4%	18.3%
20% Equity + 80% Bonds	4.9%	6.8%	9.0%	11.5%	14.2%	17.1%	20.3%
0% Equity + 100% Bonds	6.4%	8.7%	11.3%	14.2%	17.3%	20.6%	24.0%

Notes: Assumes 7% (3%) Arith. Mean and 20% (8%) standard deviation from Equities (Bonds), with 30% correlation.
Source: IFID Centre, Milevsky Robinson (FAJ, 2005) methodology applied to Canadian Mortality (MRL =11.5 yrs)

Exhibit: #5.2



Notes: *Earning a poor (lower than anticipated) average return during the first decade of retirement is much worse than earning the same return in the 2nd or 3rd decade. This is yet another manifestation of the retirement risk zone. Technically speaking we are computing the probability of ruin, which is dependent on the expected growth rate (geometric mean) during the 1st, 2nd and 3rd decade. Notice that all lines show the same ruin probability for the expected growth rate of 5%. This is the ruin probability when you expect growth of 5% during the entire three decades.*

Exhibit #5.3a

You Have Invested 100% of Your $100 Nest Egg in a Diversified Portfolio of Equities: Can Your Planned 30 Years of Retirement Income Survive Five Bad Years in the Market?

Inflation-adjusted Spending Rate per $100:	$4	$5	$6	$7
Investment Returns Earned as Planned:	22.08%	35.34%	47.64%	61.46%
First Five Years Earned -5% Returns:	48.48%	72.72%	88.16%	96.24%
Second Five Years Earned -5% Returns:	41.78%	59.50%	74.66%	84.10%
Third Five Years Earned -5% Returns:	35.70%	51.78%	65.76%	75.86%
Fourth Five Years Earned -5% Returns:	30.96%	45.74%	57.78%	69.60%
Fifth Five Years Earned -5% Returns:	26.64%	41.14%	53.98%	65.56%
Sixth Five Years Earned -5% Returns:	24.22%	37.36%	49.76%	62.74%

Notes: 100% equity portfolio earns an arithmetic mean of 7% (inflation-adjusted) with a volatility of 20%
Monte Carlo simulation assuming monthly withdrawals for exactly 30 years.

Notes: *The earlier in retirement one experiences negative (-5%) investment returns, the higher is the risk of retirement ruin. For example, a retiree that is withdrawing an inflation-adjusted $5 per year from a $100 initial retirement portfolio faces a 35.34% risk of retirement ruin. However, if this portfolio loses a compound -5% during the first five years of retirement, this risk increases to 72.72%.*

Exhibit #5.3b

You Invested 60% of Your $100 Nest Egg in Equities and 40% in Fixed-income Bonds. Can Your Planned 30 Years of Retirement Income Survive Five Bad Years in the Market?

Inflation-adjusted Spending Rate per $100:	$4	$5	$6	$7
Investment Returns Earned as Planned:	14.26%	31.40%	51.74%	68.50%
First Five Years Earned -5% Returns:	51.64%	83.68%	96.82%	99.66%
Second Five Years Earned -5% Returns:	40.66%	67.80%	84.92%	93.70%
Third Five Years Earned -5% Returns:	32.22%	55.98%	75.12%	86.16%
Fourth Five Years Earned -5% Returns:	24.90%	46.34%	66.08%	80.18%
Fifth Five Years Earned -5% Returns:	20.52%	40.04%	59.86%	75.24%
Sixth Five Years Earned -5% Returns:	15.42%	33.44%	54.46%	70.42%

Notes: 60/40 equity/bonds earns an arithmetic mean of 5.4% (inflation-adjusted) with a volatility of 13.3%
Monte Carlo simulation assuming monthly withdrawals for exactly 30 years.

Notes*: These results are similar to Exhibit #5.3a, but assuming the nest egg is invested in a portfolio of 60% equities and 40% bonds.*

Exhibit #5.3c

You Invested 100% of Your $100 Nest Egg in Bonds
Can Your Planned 30 Years of Retirement Income Survive Five Bad Years in the Market?

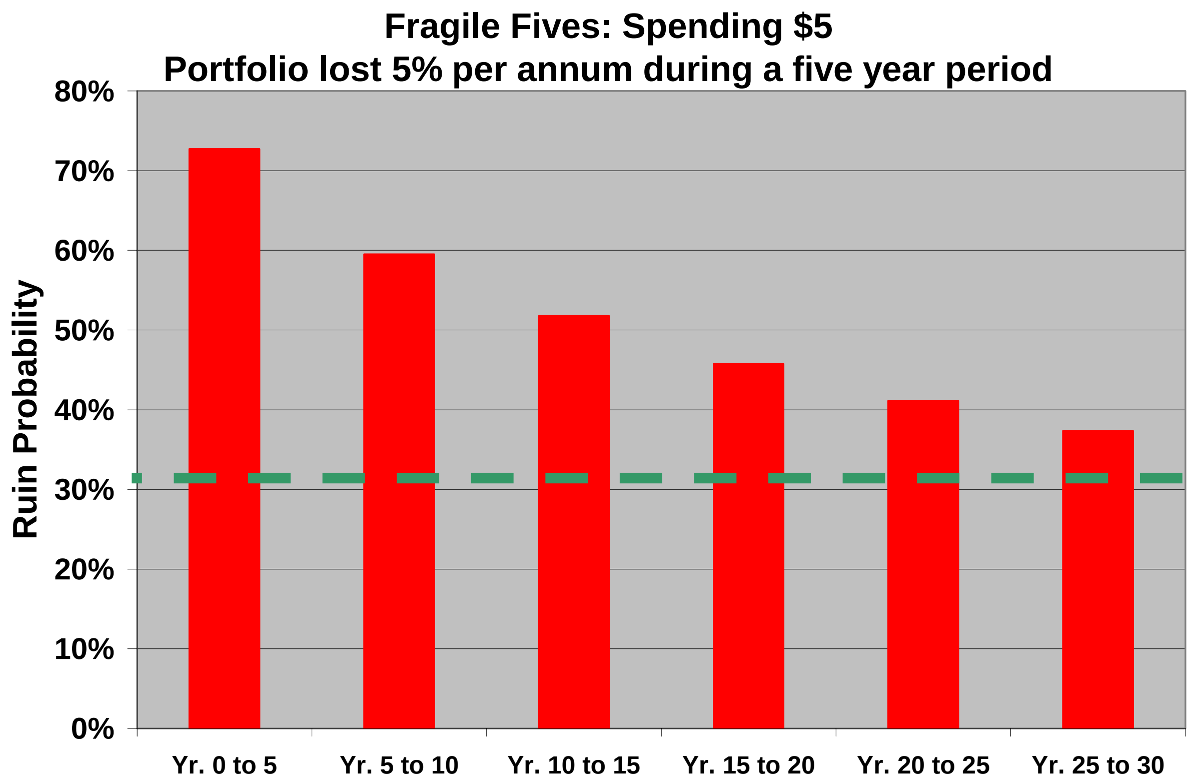
Inflation-adjusted Spending Rate per $100:

	$4	$5	$6	$7
Investment Returns Earned as Planned:	**21.68%**	**56.66%**	**84.84%**	**95.88%**
First Five Years Earned -5% Returns:	83.38%	99.24%	100.00%	100.00%
Second Five Years Earned -5% Returns:	66.56%	93.90%	99.20%	99.96%
Third Five Years Earned -5% Returns:	52.58%	86.76%	97.44%	99.60%
Fourth Five Years Earned -5% Returns:	42.08%	76.08%	94.26%	99.14%
Fifth Five Years Earned -5% Returns:	32.86%	68.86%	90.84%	97.68%
Sixth Five Years Earned -5% Returns:	24.12%	60.72%	85.26%	96.56%

Notes: 100% bond portfolio earns an arithmetic mean of 3% (inflation-adjusted) with a volatility of 8%
Monte Carlo simulation assuming monthly withdrawals for exactly 30 years.

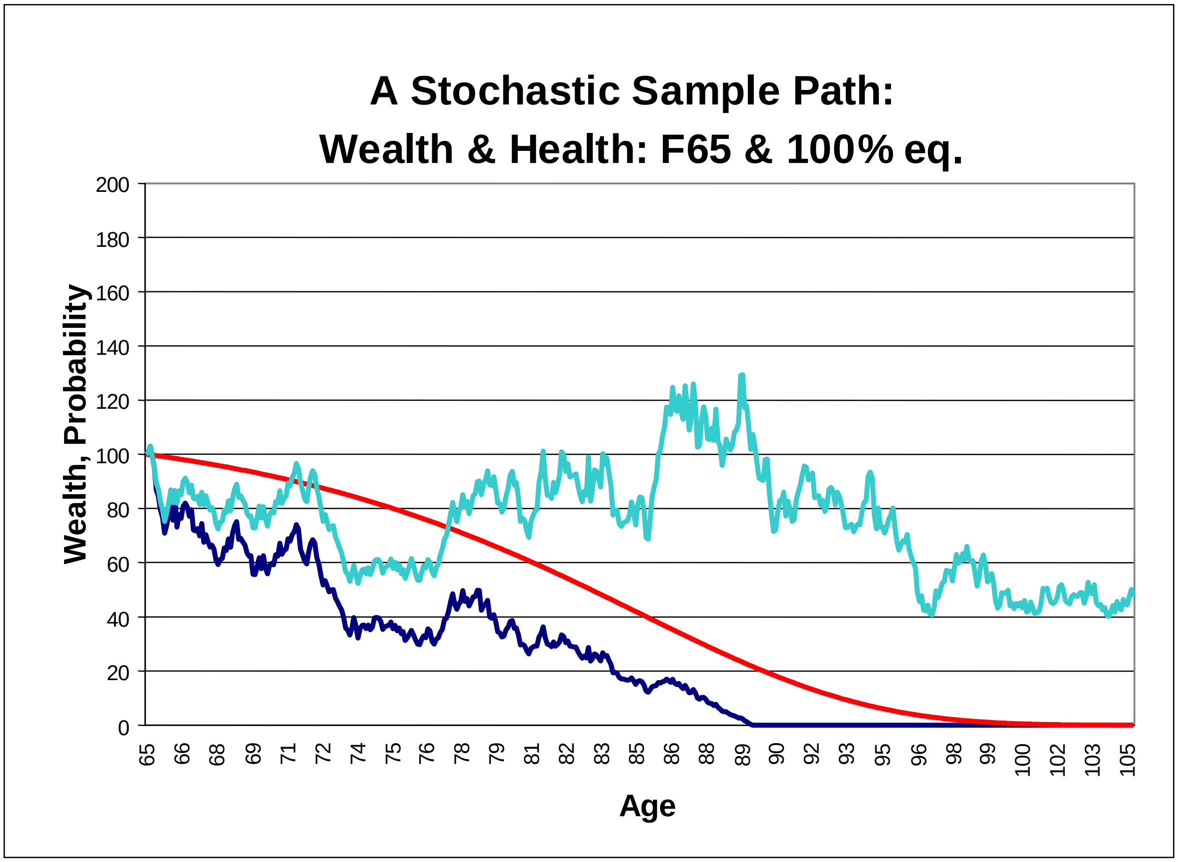
Notes*: These results show the same pattern that can be seen in Exhibits #5.3a and 5.3b, but in this case the nest egg is invested in a 100% bond portfolio.*

Exhibit #5.4



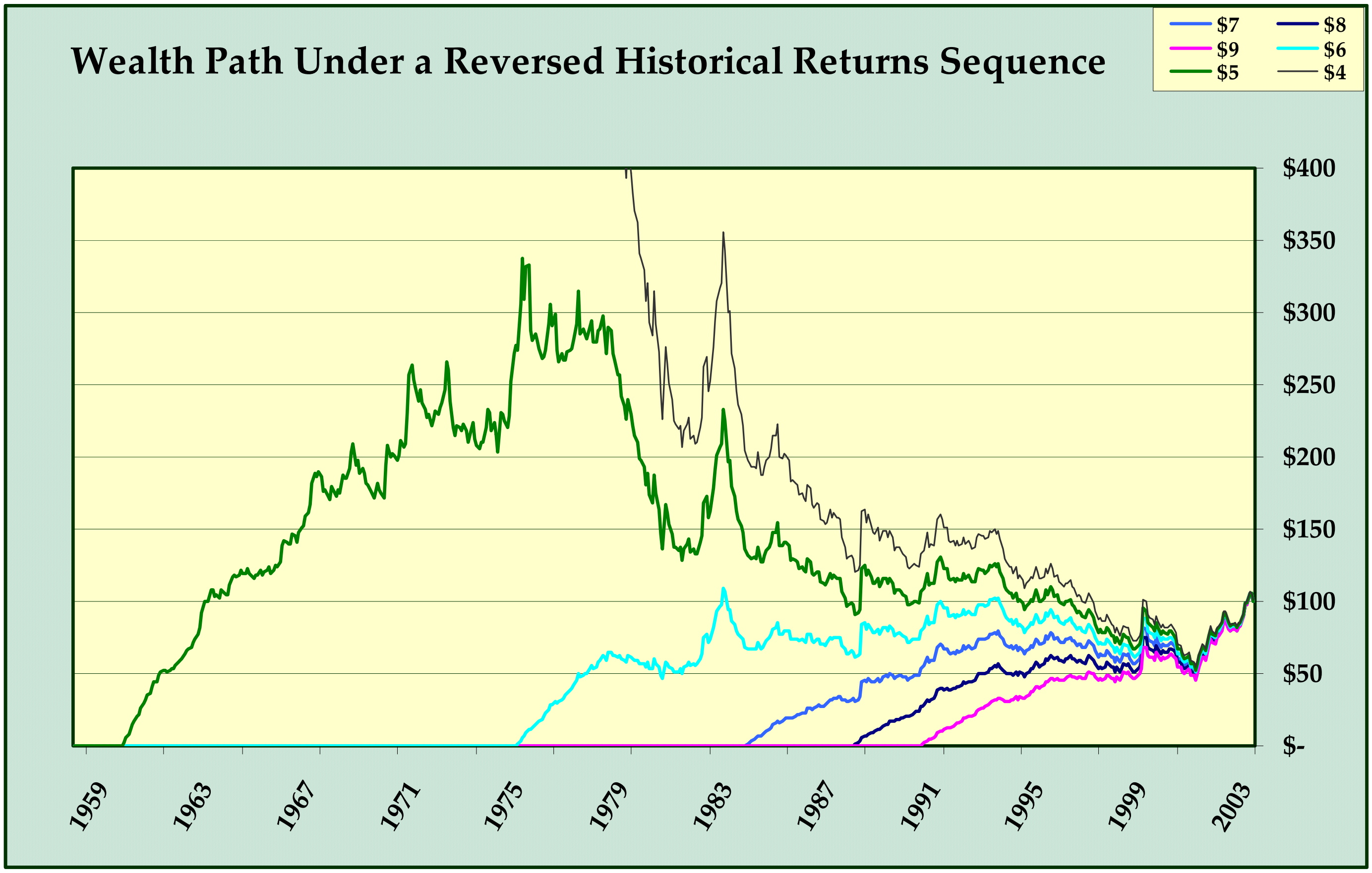
Notes: *As was demonstrated in Exhibit #5.3a, the probability of running out of money during a 30 year period of withdrawals is 35.34%. However, if the market drops five percent per annum during the first five years of withdrawals, the risk of ruin jumps to 72.72%.*

Exhibit #5.5



Note: *The role of product allocation is to take future paths and scenarios that might lead to early ruin, and make them last longer. By protecting the portfolio in the retirement risk zone with product allocation, there is a greater chance the funds will last longer.*

Exhibit #5.6



Notes: Reversal of the sequence. Imagine that you retired on January 1, 2003 and earned historical investment returns but in the reverse order or backward in time. You invested your $100 nest egg in the S&P/TSX composite total return index and you withdrew a fixed real fraction of your initial portfolio each year. How far back would your portfolio last?

Exhibit #5.7

You Retired on January 1, 2003 and Went Back in Time….

Spend	Year of Ruin
$4	Portfolio Lasts beyond 1956
$5	May, 1959
$6	July, 1974
$7	April, 1983
$8	June, 1987
$9	January, 1990

Note: Results based on S&P TSX total return index

Notes*: Although we certainly don't know when a nest egg will be exhausted going forward in time, we can imagine going backward in time. These results are based on a 100% allocation to the S&P TSX composite total return index, and the lousy results are largely blamed on Nortel's collapse.*

Exhibit #6.1

What is the probability that a GMWB account value will reach zero within 30 years?

		Expected Return (Net of MER)							
		4%	**5%**	**6%**	**7%**	**8%**	**9%**	**10%**	**11%**
Standard Deviation	**5%**	19.59%	3.50%	0.17%	0.00%	0.00%	0.00%	0.00%	0.00%
	8%	40.21%	19.34%	8.24%	2.41%	0.49%	0.05%	0.00%	0.00%
	10%	49.17%	30.99%	18.02%	8.15%	3.89%	0.96%	0.19%	0.10%
	12%	58.31%	42.37%	28.03%	17.04%	8.32%	4.31%	1.81%	0.77%
	15%	66.78%	55.56%	42.27%	31.50%	21.20%	13.26%	7.84%	4.39%
	20%	77.50%	69.83%	62.15%	53.91%	44.16%	34.71%	26.37%	20.13%

Notes: *You invest $100 into an account with a GMWB feature. The portfolio is expected to earn a NOMINAL 8% (net of management fees) per annum, with volatility (a.k.a. standard deviation) of 15%. During the first ten years you do not withdraw any money and earn a bonus of 5%. At the end of ten years you start withdrawing 5% of the portfolio value (plus any step-ups). The table illustrates that the odds that the account value reaches zero within 30 years (and that the guarantee provides the remaining payments) is 21.20% under this strategy.*

Exhibit #6.2

GMWB Withdrawal Over Time
Investment Portfolio: 80% Equity / 20% Bonds

Year	3% Inflation Adjusted	75%	50%	25%
		Chance of having more than…		
0	$5,000	$5,000	$5,000	$5,000
3	$5,464	$5,000	$5,130	$6,284
6	$5,970	$5,000	$5,769	$7,252
9	$6,524	$5,000	$6,188	$8,106
12	$7,129	$5,000	$6,515	$8,934
15	$7,790	$5,210	$6,803	$9,942
18	$8,512	$5,440	$7,336	$10,884
21	$9,301	$5,739	$7,870	$11,776
24	$10,164	$5,963	$8,501	$13,408

Notes: *This analysis assumes your portfolio is invested 80% equities and 20% bonds. It earns an average NOMINAL rate of 7%, after all investment fees and expenses, with a volatility (risk) of 16%.*

Exhibit #6.3

GMWB Withdrawal Over Time
Investment Portfolio: 100% Equity

Year	3% Inflation Adjusted	75%	50%	25%
		Chance of having more than…		
0	$5,000	$5,000	$5,000	$5,000
3	$5,464	$5,000	$5,159	$6,558
6	$5,970	$5,000	$5,899	$7,874
9	$6,524	$5,000	$6,489	$9,167
12	$7,129	$5,079	$7,190	$10,806
15	$7,790	$5,392	$7,751	$12,457
18	$8,512	$5,740	$8,577	$13,797
21	$9,301	$6,108	$9,706	$15,752
24	$10,164	$6,687	$10,897	$18,630

Notes: *The analysis in this case assumes your portfolio is invested 100% in equities. It earns an average NOMINAL rate of 8%, after all investment fees and expenses, with a volatility (risk) of 20%.*