# Financial Dynamics Improves Lifelong Planning

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## Introduction

Now at almost seventy-one years old, I reflect on the state-of-the-art for financial planning. My financial background is significantly different from almost all others as is my perspective of planning tools. My past has clearly influenced my thinking. Three degrees from M.I.T. gave me useful tools and exposure to Nobel Prize winners in economics. My years as an engineer working on some of the world's most sophisticated weapon systems gave me some practical experience with statistics and Monte Carlo analysis. A five year stint as president of Boeing's Aerospace Company and six years as Boeing's chief planner, reporting to the chairman, gave me a very broad perspective of economics, projecting the future, and risk.

Before retiring, I started to look at the tools for retirement planning and was astonished by their lack of sophistication and what I felt was naivety. So I decided to see if I could improve the tools people were using so that they offered better perspective. I've been at this for fifteen years now. I've enjoyed doing the research, writing programs to help professional planners and laymen, assisting financial journalists on national publications, maintaining a popular financial planning web site (www.analyzenow.com) and even writing a book on retirement planning at the request of John Wiley & Sons. The book, *J. K. Lasser's Your Winning Retirement Plan*, was given high marks by *The Wall Street Journal*, *Business Week*, and numerous other publications.

Since no one can predict the future, my main thesis is that the only honest forecasting has to show how a particular financial strategy would have performed in actual historical scenarios that include human reactions to changing economic situations. So that is the subject of this article. It begins with an elementary comparison of the kind of planning used by virtually all financial planners today with what I believe to be a more realistic representation of financial performance. Then the article goes on to show how feedback analysis can improve a retiree's future.

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### Dynamics vs. Statics

Do you know it is very likely that the retirement forecast provided by your professional financial planner was based on a budget assuming you will always buy the same amount of goods and services after you retire until you die? In other words, you would have the same inflation adjusted budget every year.

This probably seems perfectly rational to you if you are a long way from retirement, but think about the consequences if you are actually in retirement. Do you understand that the forecast assumes you will never increase that budget even if your investments do very much better than forecasted? Or worse, do you understand that the plan assumes you would never reduce your budget even after a bear market has virtually destroyed your remaining savings?

Well, that's where real human beings depart from the theoretical world of most financial planners. In real life, you may have to reduce your budget by 10%, 20% or even 30% in just a couple of years. Failure to do so would absolutely destroy that nest egg that was supposed to carry you far into your elderly years.

Before we begin, it's important that we share a common understanding of several of the terms we'll use frequently.

**Investment Balance.** This is the total before-tax value of the securities you have invested less some amount you decide to hold back to keep a reserve for unforeseen financial events not included in your retirement plan. The investments can include stocks, bonds, money markets and their equivalents in mutual funds as well as contracts, real estate, collectibles, etc. If you have an annuity that has already been annuitized, that is, already making regular payments, its principal is not included in Investment Balances although the payments themselves will be included in the analysis elsewhere.

**After-Tax Investment Balance.** Since any investments in deferred-tax accounts like an IRA or 401(k) still have taxes due on them, we sometimes refer to an after-tax investment balance. This would be the sum of taxable investments, tax-exempt investments and deferred-tax investments less the unpaid tax on deferred-tax investments or unrealized gains in taxable investments. This is often a better view of your actual wealth.

**Affordable Expenses.** This is the annual after-tax amount that you can afford to spend in retirement in a particular year. An alternative definition would be an after-tax retirement budget. Since it excludes the amount that you would pay for taxes, it is different from income. But it's also not equal to after-tax retirement income which can be more or less than affordable expenses. Usually affordable expenses will be less than after-tax income early in retirement and more than after-tax income late in retirement as people withdraw principal from taxable investments.

**Retire in 19__.** This refers to a scenario in which a person retires in a specific year. For example, Retire in 1956 would be a history of results for a person who retires on Jan. 1, 1956 and spends a calculated amount of money that year and in each subsequent year for up to thirty years or more that follow 1956. The returns and inflation are different in each year and correspond to those that actually occurred for the particular portfolio we describe including the reductions for investment costs.

**Returns.** These are the annual before-tax growth of investments expressed as before-tax percentages of investment balances including interest, dividends, and capital gains whether distributed or not. So, if you made no deposits or withdrawals and reinvested all of the interest, dividends, and capital gains distributions, and your investment balance was 10% higher than at the beginning of the year, you would have a 10% return.

**Life-Expectancy.** This is the age at which 50% of the population in a given age group will have died. When used in forecast equations, it is based on the difference between the age for death and your retirement age, or your current age if already retired. Let's say you were retire, 65 years old, and went to a web site like www.livingto100.com and found that the average person with your characteristics lives to age 85, you would have a life-expectancy of 20 years.

Now let's get to the heart of financial dynamics.

Long ago I found a fundamental weakness in financial planning. Financial planning was all based on what I call financial statics. That's not "statistics," it's "statics," a term I borrowed from elementary physics. Its opposite is financial dynamics. In physics, "statics" deal with constant forces on objects at rest. Dynamics deal with changing forces and things that move.

I like to think that Monte Carlo analyses are pseudo dynamics or partial dynamics at best. They start to get into dynamics when they vary the returns and perhaps inflation each period and see how investments react. But I don't think that is genuine dynamic analysis.

My view of dynamic analysis is two dimensional. Financial statics and pseudo dynamics are one dimensional. The only output of the statics and pseudo dynamics is investment balance. That's usually a time-wise plot of what may happen to your investments over a period of years. Dynamic analysis is two dimensional because there are two time-wise outputs. You get a plot of both investment balances and expenses versus time.

Non dynamic analyses assume that you specify a certain spending level that is usually adjusted for inflation each year. Expenses are an input, not a result. In non dynamic analysis you look for the point where the investment balance vanishes, that is, you run out of money in your investment portfolio. It's still static analysis if you flip the problem around to find how much you can spend before your money runs out at a specific age.

## Exhaustion Analysis

I characterize non dynamic analyses as exhaustion analyses because they exhaust your investments at some point. The goal is to find the point where you have spent all of your savings on the day you die, or, if married, the day when the surviving spouse dies. Although a number of planners use life-expectancy, it's better to use life-expectancy plus some extra years because you don't want to run out of money if you are in the 50% of the population that lives longer than life-expectancy. Still, that's one heck of a gamble, but it's implicit in exhaustion analyses as is the notion that you will continue spending at the same inflation adjusted rate. Monte Carlo analysts think they can give you some sort of a probability that you will run out of money on the day you or your spouse dies. It's still exhaustion analysis.

**Forecasting must account for human reactions.**

You see that statics, pseudo dynamics, and exhaustion models all fail to reflect that I'm going to reduce my spending when my investments go down appreciably or increase my spending when they go up magnificently (for a while). In such situations, if I take my advice from a professional financial planner each year, it is virtually inconceivable that the planner would recommend that I just increase last year's spending by whatever was last year's inflation.

Furthermore, the government will tempt me dearly to spend more if stocks go up or less if they go down if I have a 401(k), IRA, or the like and I am over 70 ½ years old. That's because the government specifies that I must withdraw at least as much as I would calculate by dividing last year's ending balance by this year's life expectancy. This amount is called the Required Minimum Distribution or RMD for short. Since investment balances can change much faster than life-expectancy, the RMD can change appreciably one year to the next. It's going to be very tempting to spend a large increase in RMD and cause me to go slow when my RMD goes down.

No one in their right mind would spend more (as the inflation adjustment would advise) when their investment portfolios take a very large hit. You might shed a tear for those poor momentum buyers of technical stocks that lost almost two thirds of their investments from 2000 to 2002 and had to continue spending because they couldn't get out of their expense commitments fast enough. I don't feel sorry for them myself though, because I don't feel that's a good way to select investments or to plan for the future.

If you don't believe that people spend more when their investments go up in value, you only have to look at the national consumption and savings statistics. These show that people not only spent more, they saved significantly less from their paychecks when their investments grew substantially without additional contributions. Corporations did the same thing. They effectively drained their retirement plan trusts to invest in alternative opportunities and give larger rewards to high level executives. Several financial journalists even said that the national savings statistics were in error because they did not include all of the capital growth from increased security values. After the recent severe market declines and loss of capital values, these same journalists suddenly became very quiet.

There is an unfortunate result from dynamic analyses. There is no cute way to determine the time when you will run out of money. In fact, with dynamic analyses, you will have at least some savings on the day you die. Now this will disappoint those who plan to live in public assisted housing and use Medicaid which effectively requires that your assets be close to zero to qualify. However, most of us who aspire to something different than living off welfare will need some money from savings even if we live well beyond what the 50/50 life-expectancy projection when we first retired.

## Running out of investments.

My wife and I provide some modest consolation to some widows who live on public assistance and depend on Medicaid. These are people in their eighties and older who have lived longer than the average person. They'd really like some money not only to support their essential needs, but also to be able to give something tangible to close friends and relatives on holidays or special occasions. These are people so far removed from spending an inflation adjusted retirement amount that they make such models look ridiculous. It doesn't mean that they are unhappy. It's just that their life style is far from what it was years ago, not necessarily because of reductions in physical capability, but certainly because they are broke.

Even in a pure theoretical world of perfectly constant returns and inflation, a dynamic analysis gives entirely different results than an exhaustion analysis. To understand this, you have to know that it is fundamental that retirement planning analyses make some kind of assumption about life expectancy. That's true whether you go to a planner only on the day you retire or if you go to a planner once every year. Fortunately, each year that we live, the age we are likely to die increases. The youngest age we would expect to die is the life expectancy we have when we are born. Each year that we live, our odds of living to a greater age improve. (Of course the exception that makes the rule is when we are told by our doctor that we have an incurable disease and death is immanent.) Per the IRS, about half of all 55 year olds will live to age 84. About half of all 70 year olds like myself will live to age 86. If you reach your 90$^{th}$ birthday, you have a 50/50 chance of living to 95, and so on.

In a sense, you can't outlive your life expectancy. Even a 100 year old has a life expectancy that's greater than 100. That's one thing to keep in mind. More important is that fact that life expectancy is a 50/50 number. Any plan worth its salt has to assume that you will be the part of the population that lives longer than the 50% point. Certainly you wouldn't want to plan on being in the lower 50% and spending all of your money before you even reached the 50/50 point. Dynamic planning fulfills this requirement. Exhaustion analyses does not unless it's based on Methuselah like age projections. It also requires an incredibly miserly person to stick with the plan when investments are booming and sheer stupidity to continue previous spending when investments collapse.

## Dynamic results are more realistic.

Let's compare exhaustion analysis with dynamic analysis in a simple example. Of course, it's not possible to find an example that would apply to everyone. People retire with vastly different resources, not only different net worth values but also with different assets. We're going to use a mix of retirement resources in order to demonstrate some points which we believe are generally applicable. We'll use a model that has Social Security, a modest fixed pension, and some stocks and bonds which could be held individually or in stock or bond mutual funds. Ether way, we'll call them stocks and bonds.

We'll first consider "John" who believes he has reached the point where he can easily retire since his investments have now reached the magic number for lots of people: $1,000,000.

Suppose that John finds a retirement computer program and decides to do his own analysis. He enters all of the requested information including his age of 65, a $15,000 annual Social Security benefit that increases with inflation plus a fixed pension of $10,000 a year. His $1,000,000 savings is in a deferred-tax account that has 65% stocks, 25% bonds, and 10% money markets funds. He has a 17% tax rate on Social Security and 20% tax on all other income. He decides to enter an inflation rate of 3.5% and a return on investment of 5.0%. Initially he enters age 86 life expectancy from an IRS table and finds he can spend almost $63,000 a year. After more careful consideration, he thinks that he may well live longer than the average person, so he adds 5 years to the IRS average. Now the computer tells him he can spend about $55,000 after-tax each year. Now look at Figure 1.

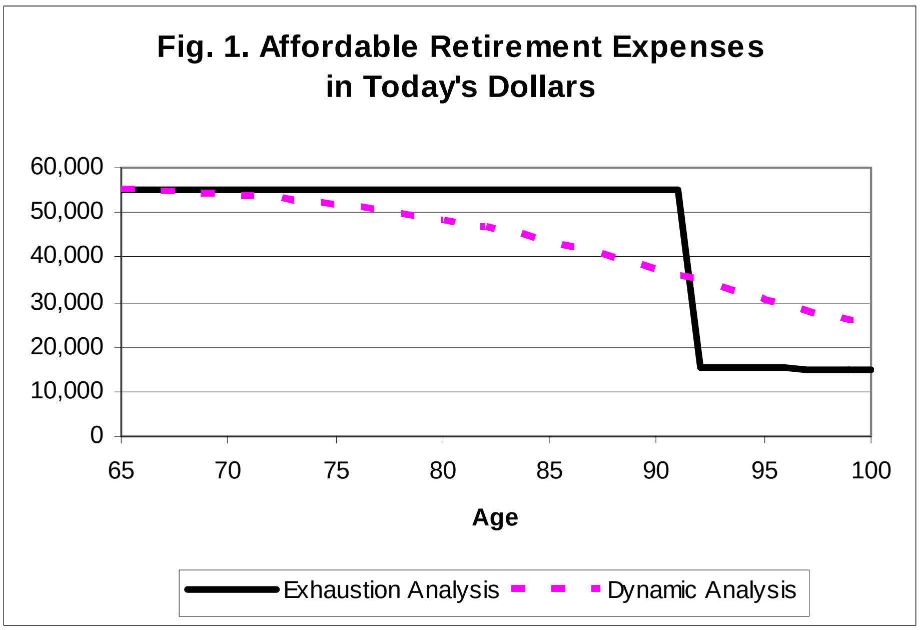


Figure1. This very simple case with constant returns and inflation shows that exhaustion analysis gives unrealistic results for those that live longer than the assumed age to die!

The vertical axis of Figure 1 represents the amount of money that John can afford to spend each year. It's important to note that these are inflation adjusted values, that is, they are all in values that represent constant purchasing power throughout John's life. The horizontal axis is John's age. John has just completed an exhaustion analysis which infers that his investments will be exhausted at age 92 and he will have to then live on Social Security and the horribly deflated value of his fixed pension. After 28 years of inflation, his pension is now worth only $3,000 of age 65 dollars, not the actual $8,000 after tax amount he is getting from his retirement checks.

John is a very conscientious fellow and every year gets out the same program and makes a new calculation as an alternative to last year's exhaustion analysis. He continues to add five years to the IRS life expectancy table when he does the calculation. The results of each year's calculation is illustrated by the Dynamic line on Figure 1. When John does a new analysis each year, he is doing what we call a dynamic analysis.

Note that John has to cut back on his spending appreciably as he gets older. That's because he has to stretch his remaining money over additional years. He'll never run out of money because he can never run out of life expectancy. When he reaches age 90, he knows that there is a good chance that he might live to over 100. If he didn't do the new calculations each year, he wouldn't have the funds to support such longevity, even though in a much more modest way than he envisioned when younger.

### Under and Over Estimating Future Returns

Of course it's not possible to forecast your future returns with any accuracy. You may estimate high either because you left out important things such as investment costs or, more likely, because you just happen to retire in a period that has poor market performance or one that is followed by high inflation. You may estimate low because the particular investments you selected went gangbusters and/or inflation was very low.

Figure 2 shows that estimates that miss the actual performance by only 2% have very large effects on retirement spending even in this highly simplified case with constant returns and constant inflation. When the actual returns are 2% less than used in the planning equations, the retiree is not hurt too badly until after about twenty years when the affordable expense drops more rapidly until at 100, there is virtually nothing left except his Social Security and deflated value of the fixed pension. Conversely, Figure 2 also illustrates how retirement budgets go up for a while as investments grow more than planned. The inevitable period of trying to survive significant budget reductions is pushed far to the right.

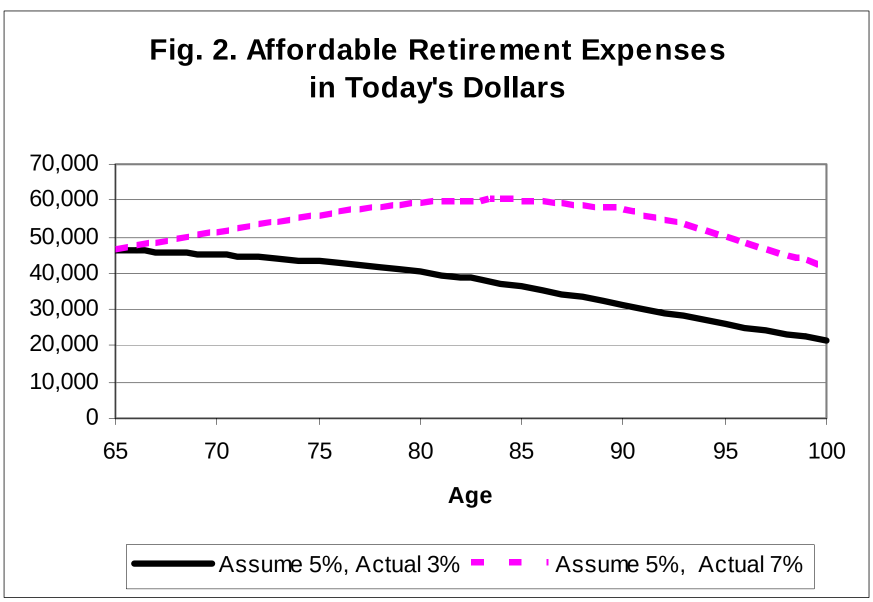


Figure 2. Even when we use constant returns, the effects from under or over estimating future returns by only 2% are very large.

What is the chance that a planner will be off by 2%? Of course no one knows the answer to this, but if history is any guide, returns over periods like 20 years are often more than 2% different from the long-term averages starting in 1926 that are often used by planners. In fact, they are so different that in the real histories we'll see shortly, there will be long stretches of both under and over estimating in each scenario. You'll gain an appreciation of this as we look at both very good and very bad actual scenarios in the material that follows.

## Retiring in a great year

Previously we reviewed extraordinarily simple cases with constant returns and inflation. That's not real life. In real life some very amazing things happen when people make a new retirement calculation each year. There are all kinds of scenarios we could illustrate, but we'll only illustrate a few hereafter: In the first case we'll follow the finances of John, a new retiree at age 65 in the year 1948. That was one of the very best years for retirement because the following years saw a tremendous burst in investment values.

We're going to assume that John has the same values for Social Security, pension and investments as in the previous simple cases even though no one even came close to getting $15,000 Social Security in those days and $1,000,000 would have represented a LOT of money at the time. We're going to keep these same numbers so that you can see what happens if you compare results for some real historical values of returns and inflation. We'll also base John's planning equations on the long-term average for his portfolio mix adjusted for costs and a small reduction for reverse dollar-cost-averaging.

The differences between exhaustion and dynamic analyses are huge in Figure 3. The exhaustion analysis succeeds in preserving John's assets well past his likely life. The dynamic analysis doesn't treat him so well if he lives into his late 90s, but instead of being able to spend $55,000 a year, John's calculations show that he can afford close to $110,000 a year in his early 80s. After that it's all downhill. If John would be able to cut his spending each year as shown he'd probably do pretty well. The problem, however, with most people is that they start to get used to the more luxurious life style and make commitments that are hard to modify or abandon. Some things are very difficult to get out of like vacation condominiums or time-shares and some things involve some embarrassment like having to give up memberships in organizations or significant home downsizing.

Figure 4 shows what happens to investment balances in the two different approaches. If John was able to stick to the exhaustion analysis spending levels, he'd be able to leave significant money to heirs. On the other hand, when he makes a new calculation each year to determine what he can afford in his new situation, he would spend down a lot of his investment balances and have relatively little at death even though most of his life he enjoyed good market growth and relatively low inflation.

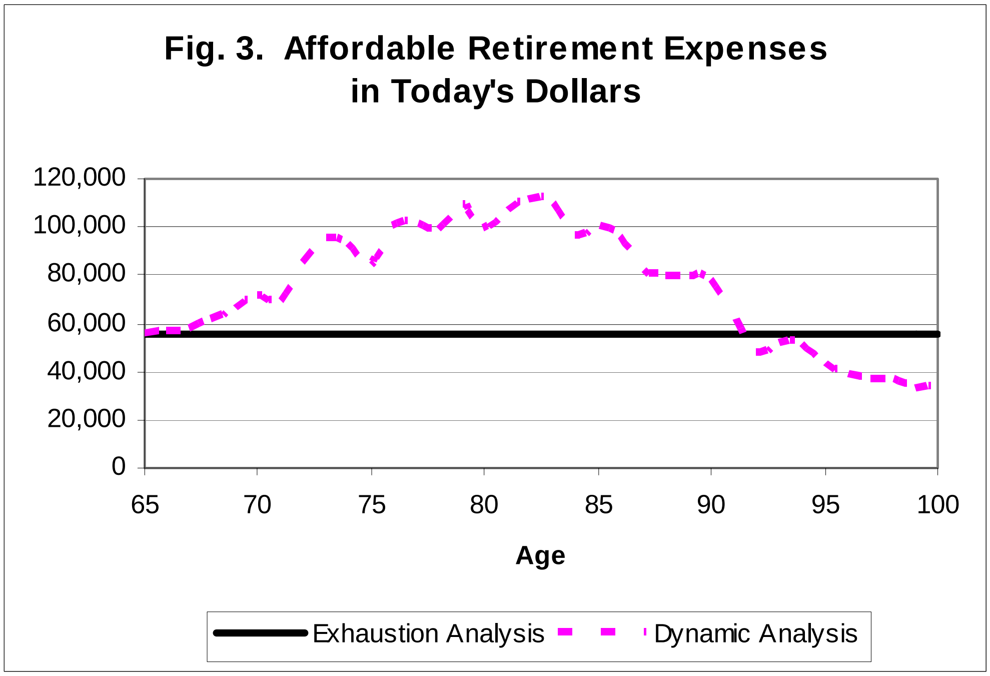


Figure 3. John retires in 1948 followed by some very good economic years.

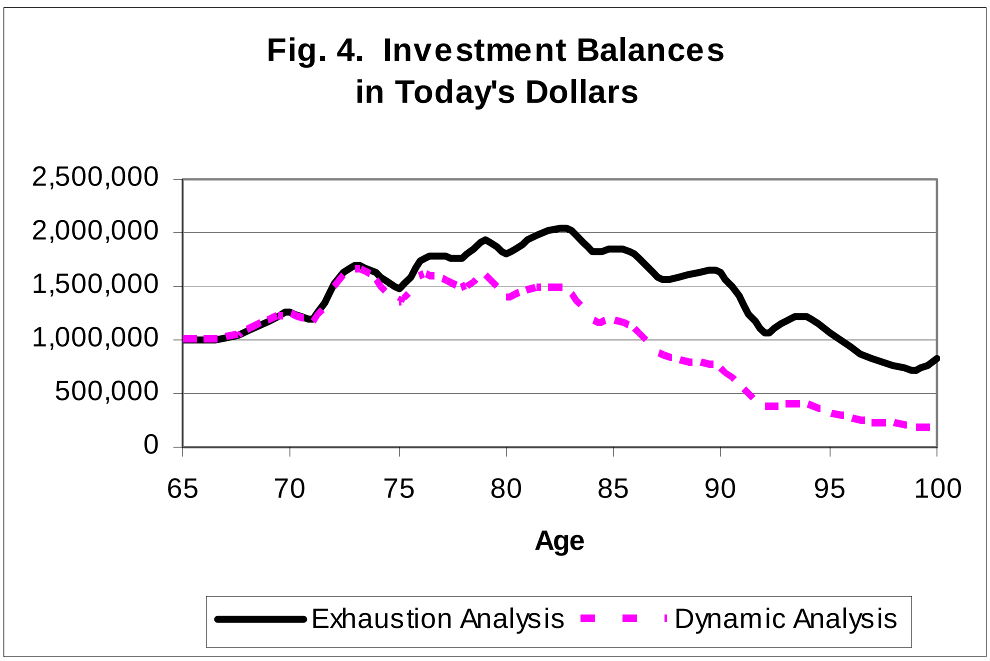


Figure 4. Exhaustion preserves investments for John's heirs in this scenario starting in 1948 but is an unlikely outcome.

## Retiring in a Bad Year

Now let's look at a completely different case. Let's see what would have happened to someone who retired at age 65 in 1965. That was one of the worst years to retire, and that's about when my father retired. My father's name was Henry, so we'll call this fictional fellow Henry. My father's actual retirement resources were different from Henry's, but his financial problems closely paralleled the same kind of financial distress my father experienced.

The year 1965 was the beginning of an unfortunate era for retirees. Investments behaved badly and inflation went wild. During the first twenty years of retirement, there were six years when stock returns were negative and another six years when inflation was near or above 10%. This represents the kind of situation that destroys the credibility of planners and planning programs. They have to continue to back off their forecasts and make excuses for the last projection. Disgruntled clients read and reread the protective fine print including proclamations that past performance is no guarantee of future results.

The two different approaches to retirement planning are illustrated in Figures 5 and 6 for the years that followed retirement in 1965. Figure 5 represents expense calculations and Figure 6 represents the corresponding investment values.

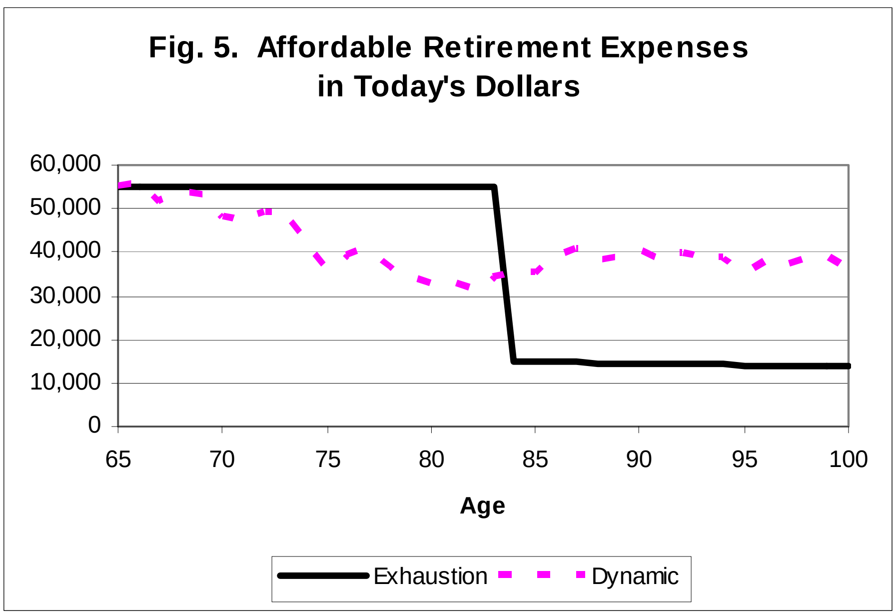


Figure 5. Henry retires in 1965, and a tough period follows.

Let's say Henry did an exhaustion analysis in 1965. Even though he expected that his money would last into his 90s, he would be in deep trouble at age 84. See Figure 5. On the other hand, if he did a new calculation each year his affordable budget would plunge to almost $33,000 by the time he reached 80. The market would subsequently improve so he'd have additional funds very late in life, but still far less than he probably initially imagined as the dynamic case in Figure 5 demonstrates.

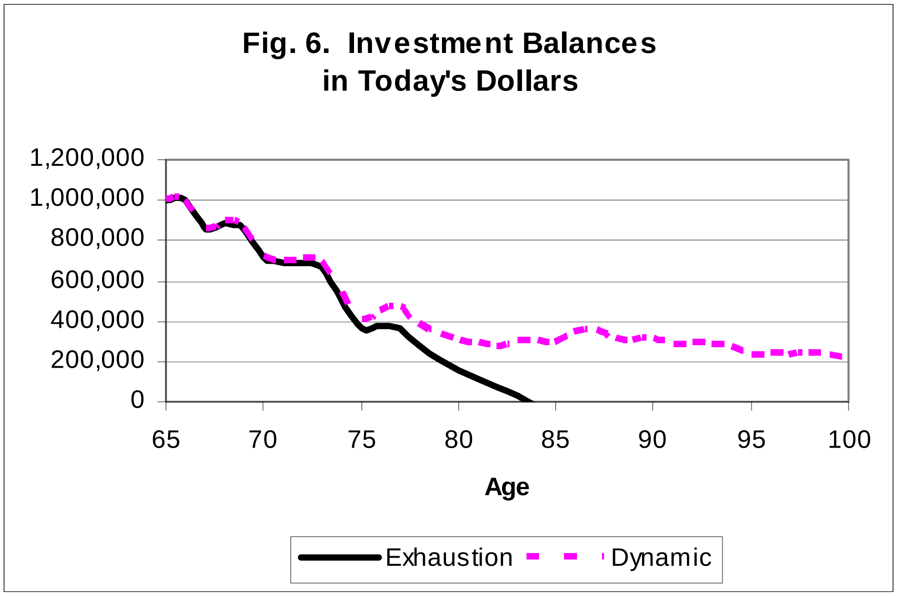


Figure 6. Exhaustion depletes Henry's investments early when retire in 1965.

Actually, my father didn't do either of these things. He was smart about finances and a very successful business person when he was working. However, financial calculators didn't exist in those days much less personal computers, so people did what I call Mom and Pop analyses. Mom and Pop sit down at the kitchen table and figure out how much income they can get each year from various sources. Then they try to figure out how they can cut expenses to live within that income. Like most people, my folks didn't have a good mechanism to calculate inflation effects, and they certainly would not have anticipated the wild inflation that was ahead of them, particularly since they lived through the depression and actual times of deflation.

To cope with the unfortunate market and inflation adversities, my father downsized the family home a number of times and then ultimately moved into a modest apartment. It wasn't until later in my parents' life that we were able to provide some financial assistance. When my father died at age 96, prices had increased five times over prices when he was 65. I can't represent what really happened with this simple computer program, but you can imagine the results if you used exhaustion analysis initially, then recognizing that you were in financial trouble after a few years, did a new exhaustion analysis, and repeated this process every few years. You end up overspending in each period so that retiree's actual investments disappeared at an alarming rate. Without our financial support and quite a bit of physical effort on the part of my sister, my father's later life would have been very difficult indeed.

**What if you draw a constant percentage of investments each year?**

There are a number of advisors that recommend that you just spend a constant percentage of your investments each year. The idea is to spend all of your interest and dividends and only a little of your principal. In turn the principal grows to help offset inflation and each year your fixed percentage means a little extra spending money.

We'll show how that theory works in a minute, but first consider what a constant percentage means when you have a mixture of deferred-tax and taxable accounts. Usually, the best strategy is to draw money from your taxable investments first and let the deferred-tax accounts compound as much as possible before you are forced at age 70 ½ to satisfy the IRS required minimum distributions, RMD. So if you had equal amounts in both kinds of accounts and you decided that you should withdraw 5% of your total investments as many recommend, then you'd have to withdraw 10% of your taxable investments in the first year.

On the other hand, after age 70 ½, the withdrawals from your deferred accounts are automatic and the equivalent percentage increases every year so that when you are in your nineties, your RMDs are about twice the fixed percentage, and you wouldn't draw anything out of taxable accounts.

So let's say you have all of your money in taxable accounts where you don't have this confusion, and let's take a look at what would happen in some real scenarios. Since we're simplifying this to the point where we have no deferred-tax accounts, we'll also just look at the taxable account without including the effects of Social Security and pension shortcomings which also tend to foul this theory. That's because a shortfall in Social Security inflation compensation and the inflation effects on fixed pensions demand that you draw more than your fixed percentage anyway just to keep even.

We'll show two different withdrawal rates in this simplified case: 5% and 3.5%. Initially, there will be $400,000 of taxable investments with a 10% tax rate on the return. The portfolio has 50% stocks, 25% long-term corporate bonds and 25% short term fixed income investments. The investment costs will be the same as we used before. However, we're going to eliminate Social Security and the pension which cloud these results.

Figure 7 shows what happens to the investments vs. time in both one of the best years to retire, 1948, as well as one of the worst years to retire, 1965. Note that the image of maintaining growth of principal disappears very shortly in the 1965 scenario and around age 80 in the 1948 scenario. Since this view of investment balances is in today's dollar values, it would be perfectly flat if the investment balances grew enough to offset inflation. It's certainly far from that in either case.

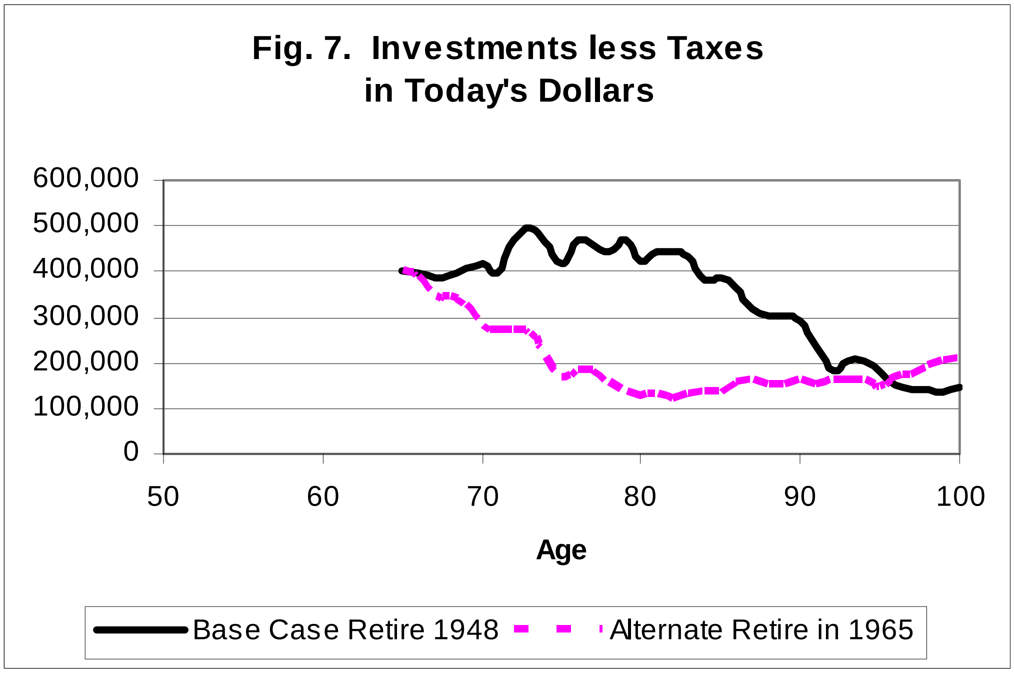


Figure 7. Investment balances in the scenarios that follow these two retirement years have profiles that don't do what is intended by taking out 5% of the investment balance each year.

It doesn't take a genius to guess what the resulting affordable expenses will look like when the investment profiles look like Figure 7. See Figure 8 for the disastrous effects in either case.

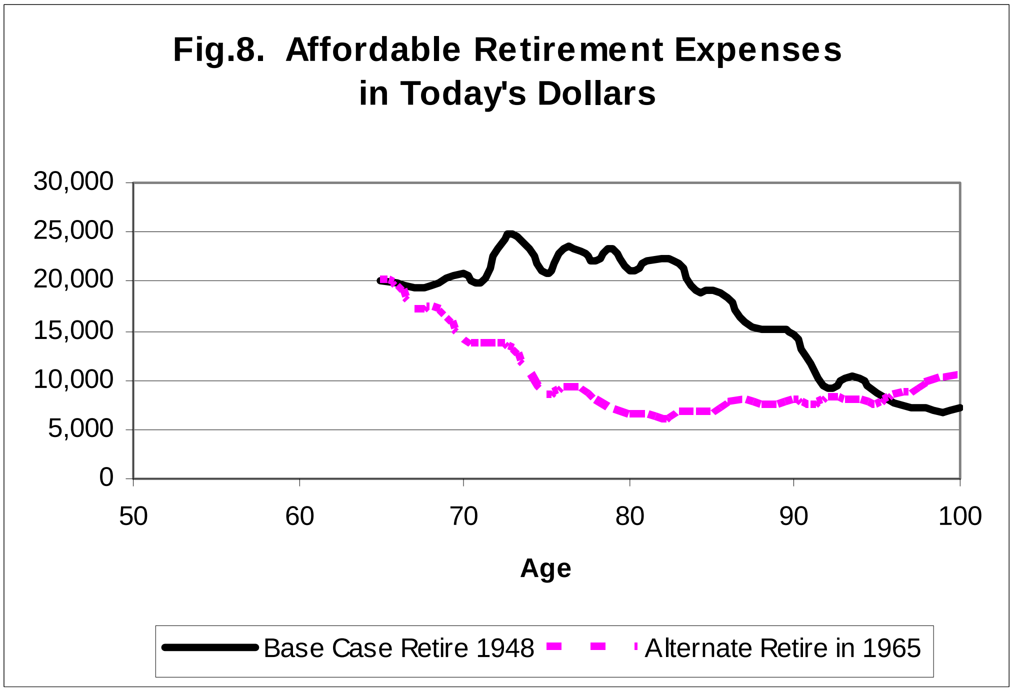


Figure 8. It would be very difficult to retire under either circumstance.

Well, then there are those who are advocates of the 3.5% withdrawal theory. Most often they mean 3.5% for the first year with an upward adjustment for inflation thereafter, but not always. The fact is that if you would go to the same planner who has this same theory, you'd get the 3.5% each year. So Figure 9 shows what happens at significantly lower withdrawal rates.

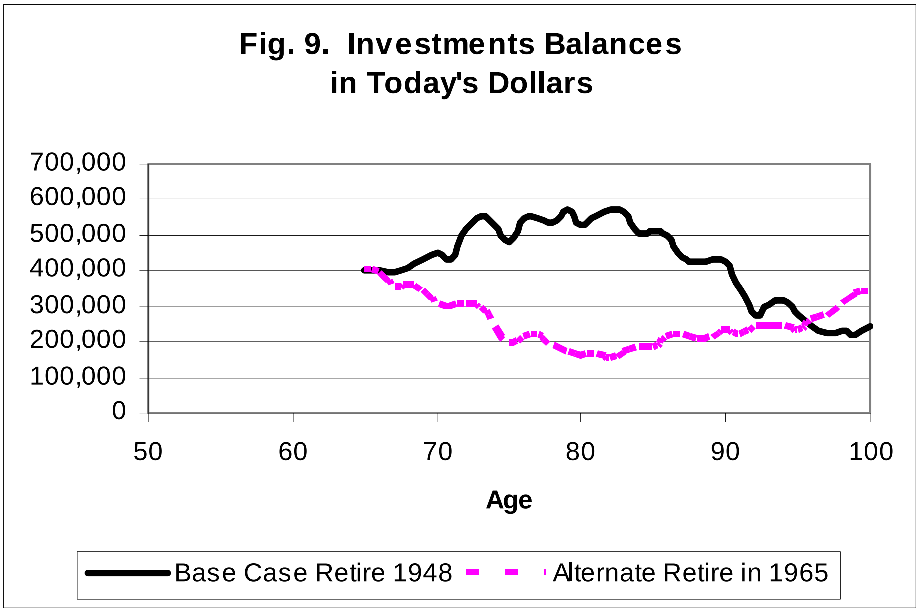


Figure 9. Reducing withdrawals to 3.5% still won't change the basic shape of the investment balance profiles.

Again it doesn't take a genius to see what happens to retirement budget even withdrawing only 3.5%. See Figure 10.

In the case of the 1965 scenario, the retiree starts with a little less than $15,000 budget and ends up with one-third of that for much of the rest of her life. On the other hand, the 1948 retiree gets to live fat on the hog for some years as the budget goes up by about one-third but then gets on a downward ski slope ending up with only about a third of the $20,000 that she had become accustomed to spend. That's real trouble as if retirees don't have enough to contend with.

So, saying you are going to use a constant percentage draw is not very meaningful unless you don't have a large amount of deferred-tax investments, and then it still gets mixed up if your Social Security is not fully compensated for inflation or if you have a fixed pension that you are trying to assist with additional draws to offset inflation. In the case of the wealthy individuals who have most investments in taxable accounts and Social Security and pensions are immaterial, a constant percentage draw still makes no sense when you look at the resulting investment and expense profiles.

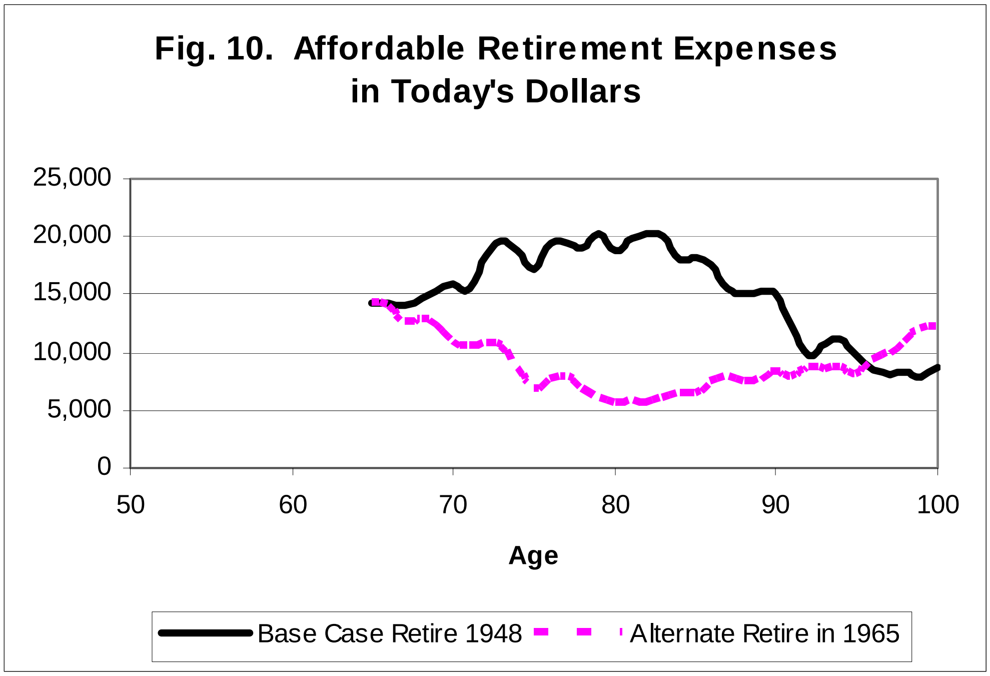


Figure 10. Spending a constant 3.5% of investments does not guarantee any spending stability or inflation protection as the scenarios starting in 1948 and 1965 demonstrate.

Next we'll see how planners can take advantage of some more modern methods of analysis using feedback concepts to improve both a retiree's perspective of the future as well as reactions to changes in returns and inflation.

## The Retirement Autopilot

Many readers won't remember when it often took two days to fly from Seattle to Washington, DC, but I do. The flight across just Montana felt the way it does today to do the whole trip. Not only was the flight slow, it almost always was bumpy. Every seat had a burp bag, and the airplane carried extras for those who needed more than one. Throwing up almost seemed contagious. When someone was heaving next to you, it was hard not to do the same.

The advent of the 707 made a big difference. It got some gust alleviation from its ability to fly higher as well as from the sweep of its wings. Nevertheless, one of the really effective things for smoothing out the flight was the modern airplane autopilot. Thinking about this one day on a flight to the east coast, I asked myself, "Why can't we do the same thing with retirement planning? Couldn't we use the same technology to reduce the wild annual changes in affordable expense projections?"

## Origin of the Retirement Autopilot

I had been doing some computer simulations and was well aware that the ups and downs of the security markets meant that retirees' calculated budgets fluctuated too much year-to-year. It really wouldn't be practical for retired people to change their budgets by large amounts each year--sometimes up, sometimes down.

So I decided to try applying the airplane autopilot concept to retirement planning. After all, even the stodgiest of automotive engineers were using similar principles as were engineers in a number of other industries. Modern automobiles incorporate feedback in automatic braking systems, transmissions, ride control, skid control, etc. It must work. The main difference between retirement and mechanical systems would be the time scale. Airplane and automobile systems have to work in fractions of a second. In contrast, the time scale for retirement planning is closer to a year than to a fraction of a second.

The similarity seemed close. An airplane is subject to gusts that make the ride rough. These gusts can be small or large. They can be up, down, forward, or even backward. Gusts can be large or small. A retirement model has to cope with changing markets, sometimes up, sometimes down, and no one knows in advance how large the changes will be.

The airplane autopilot can sense the airplane's position, attitude and yaw, and it knows the way the airframe will respond to gusts. Retirees know some similar things about their position and response to changes in investment balances, inflation, return and life-expectancy. Importantly, they also know how much their retirement planning system indicated they could spend last year and what to spend this year in line with their life expectancy under updated conditions.

## Feedback Solves the Problem

The notion I had was to feedback some of these things into the retirement equations. To understand this point, let's back up a little and look at some elementary control theory.

Most people's first encounter with the term feedback comes with the screech from a public address system when the gain is set too high. To solve the problem, someone turns the knob controlling the volume so that the microphone on the podium cannot hear the loudspeakers. With the volume (gain) set too high, the loudspeaker output reaches the microphone. The amplifiers in the system then increase the volume further thus increasing the speaker output even more. The louder sound reaches the microphone, is even further amplified until the loudspeaker's output finally reaches its maximum output. Then someone shouts, "Stop the feedback!"

In Figure 11 we show an Open Loop System and a Closed Loop System. We could use an airplane analogy here again, but let's use an automobile instead. Suppose the driver is handcuffed and can't turn the steering wheel. An automobile without anyone steering is an open loop system. The automobile will be uncontrolled and will soon run into a brick wall or something. If we take off the handcuffs, the driver can control the automobile. This then becomes a closed loop system. The driver and steering wheel provide the feedback to control the system to avoid obstacles. Of course this simplified example omits other feedback such as applied with the accelerator and brakes.

**Figure 11. Open and Closed Loop Systems**

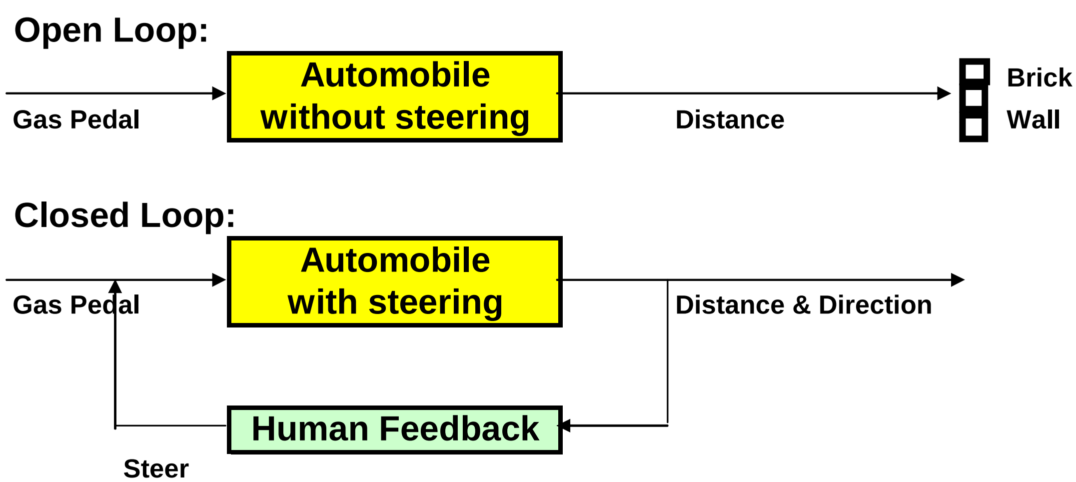


Figure 11. Feedback provides controlled response in a closed loop system.

Dr. Norbert Wiener wrote *Cybernetics*, one of the early books explaining feedback and closed loop systems. Cybernetics means the steersman, or person that controls the direction of a boat. I'm old enough to have attended Dr. Wiener's lectures at MIT. I even dated his niece. Dr. Wiener was one of the best mathematicians of his day, was incredibly difficult to follow in class because he went so fast, and was the perfect image of the forgetful professor. His niece told me that on a number of occasions he would rent a car for a trip and either forget where he parked it or that he had rented one in the first place. As a great mathematician, he saw clearly many practical applications of feedback principles. In fact, while I was still in college, the principles of feedback control were taught in classes on airplane control theory and were being applied in secret developments to improve bomb sights enabling the bombardier to ensure more accurate delivery of the weapons.

If you look at Figure 11 carefully, you'll see that the closed loop system has two outputs: distance and direction. The open loop system had only one output, namely, distance. Remember this point, because we're going to see something similar when we look at open and closed loop financial systems.

The diagram for financial control is no different that that for the automobile. See Figure 12. But this time let's take a little more time to look at the difference between open and closed loop systems.

**Figure 12. Open and Closed Loop Financial Systems**

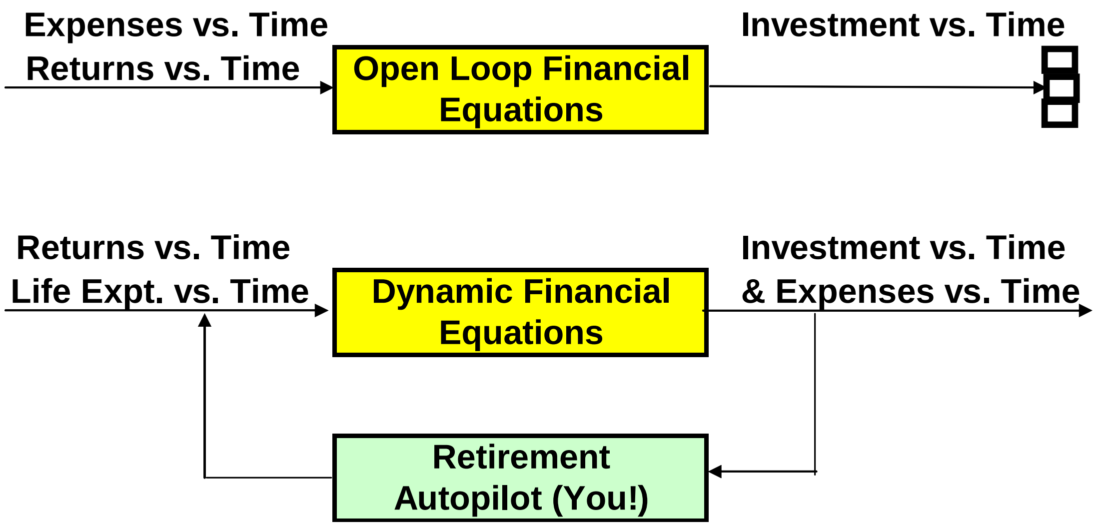


Figure 12. Closed loop financial systems have two outputs: Investments and Expenses.

In an open loop financial system, the major input is retirement expense which can be specified in any way, but it's most common to use an inflation adjusted expense that increases each year with inflation. Of course you also input the initial investment balance, inflation, return and life expectancy. You can specify returns and inflation so that they change with time. That's what happens in a Monte Carlo analysis. The output of the system is investment balance vs. time. There is no provision for human reactions and control.

The open loop financial analysis is what I call an uncontrolled exhaustion analysis. You spend money until there isn't any left. That is you look at a lifetime investment profile and find the point where the investment balance is zero. You exhaust your investments. This is analogous to the automobile in Figure 11, only the automobile eventually hits a brick wall instead of a financial disaster.

Perhaps you have noticed that there is some feedback in what I'm calling an open loop financial system. That's because what I am describing as an open loop system does feed back last year's investment balance when returns and inflation change each year. So I am defining an open-loop financial planning system as one lacking the outer control loop provided by the human. Just as in the case of the automobile, a human provides the feedback. The autopilot really is a human being making judgments based on incoming information and some form of logic. Ultimately, the autopilot is YOU using your own judgment.

The logic for the automobile autopilot feedback is based on visual information. The logic in a financial autopilot is based on financial numbers. The retirement autopilot not only feeds back the investment balance, it feeds back some other things it can measure, namely investment balances AND some form of expense calculation. We'll get to that in a moment. The main thing to understand right now is that there are TWO outputs for this human controlled closed loop system. Those outputs are:

(1) Investments vs. time (as with the open loop system), and
(2) Expenses vs. time where expenses are determined by logical reactions to financial numbers at the time.

The fact that there are two outputs is also analogous to the automobile example in Figure 11. The automobile outputs are distance and direction while the financial outputs are investment balances and expenses. Direction and expenses are not specified at the beginning as with an open loop system. They are both the outputs of human decisions.

The human has three obvious things to consider when making an intelligent decision about next year's spending:

(1) The amount the retiree spent last year adjusted upward for inflation. This is what the professional planner told him last year was the basis of his plan.

(2) A brand new calculation based on the last retirement balance and a new estimate of life expectancy, return, and inflation.

(3) A judgment as to how much to set aside from investments to make provisions for reserves for OSIFs (Oh shoot! I forgot.) and perhaps for perceived overpriced investment values.

My research has not developed the possibilities that are inherent in determining a reserve consistent with overpriced investment values. However, it does seem that one would want to have larger reserves when the price to earnings ratio of stocks are abnormally high as well as for possible other factors. I'm sure someone will try this kind of feedback in the future.

## Human Financial Logic

Extraordinary financial events force retirees to look at expenses, especially when something takes a big whack out of investments or radically increases their value. Even if retirees don't follow the desired approach of making an annual financial review, a dramatic change in investment level is likely to precipitate a change in their spending. I created a computer program called the Dynamic Financial Planning Pro to study these effects. It's currently available on www.analyzenow.com for anyone to try, or you can create your own program using the equations in the notes at the end of this article.

The program has equations intended to model human financial behavior or otherwise help with rules to govern budgeting actions for retirees. It does this with logic equations that the user can vary. Let's consider the most conservative logic option that the program provides. This kind of logic specifies that the user will take the most conservative conclusion between two alternatives, that is, the smaller of the two calculations below:

1. Last year's expenses increased by last year's inflation, or
2. A completely new calculation this year based on current values for the planning equations.

Basically, (2) is the after-tax sum of Social Security, pension and investment contributions where each year we make an entirely new estimate using a set of financial planning equations. In effect, (1) represents a person who doesn't do any replanning and (2) represents those who go to a planner for a new spending recommendation each year or make a new plan annually themselves.

### A Conservative Autopilot Example

Let's look at some examples to illustrate what can be done using an autopilot with1956 as the retirement year. There is no such thing as a typical retirement year, but 1956 is intermediate example between the two extremes from past history of retiring in 1948 (a very good year to retire) or 1965 (a very bad year to retire). Let's look at Figure 13 for a 1956 example.

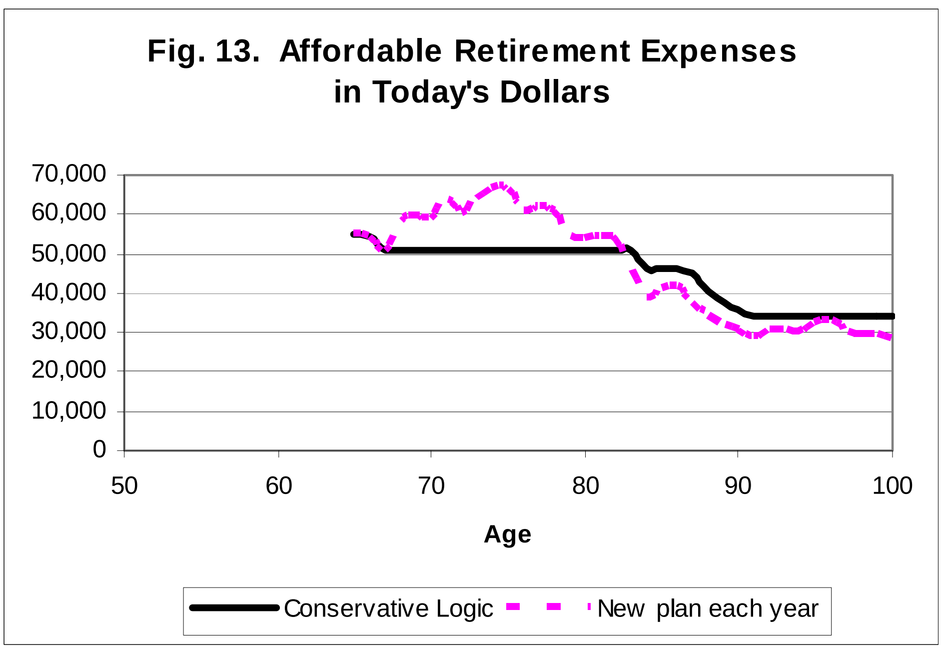


Figure 13. The conservative logic denies retirees early benefits but provides long-term resources in this scenario with retirement in 1956.

Figure 13 shows a comparison between a very conservative person who does not let expenses exceed either last year's computation adjusted for inflation or expenses based on a new calculation for the coming year. The retiree who lives longer than 83 years benefits greatly by restricting the upside growth in spending, thus making the investments last longer. Many people reaching their eighties are forced to spend less because they've run out of savings. Statisticians often note that older people spend less. Have the statisticians considered that many older people just do not have as much to spend?

The majority of older retirees with whom I have had contact would like to spend more if they had the money. A number of widows we know not only would like to spend more, they should spend more, but just can't come up with the money. Consequently, they must take steps that new retirees or people planning on retirement seldom consider. These include asking adult children for financial help, getting additional loans, going on Medicaid, living in subsidized housing, taking only a fraction of the drugs prescribed for their health, etc. Only the very wealthy can gracefully accommodate severe budget reductions late in life.

Picturing yourself in each of the two contrasting situations in Figure 13 helps to give meaning to the two lines on the chart. Sticking with the conservative logic might mean defying the advice of your financial planner. Alternatively, making a completely new plan each year has to be painful to implement. Consider that this retiree had to reduce spending from almost $70,000 to only about $30,000 a year during just 15 years of retirement. And this was not one of the worst years to retire! Remember too, that the situation would be worse for someone who didn't have the significant Social Security and pension as did the retiree in this example.

Even though financial conservatism is better it is difficult to stop spending more money when investments rise quickly in value-- particularly if the growth persists for several years or longer. Similarly, when investments fall, retirees cannot quickly adjust to the realities of a reduced investment base. Of course, there is always some hope that markets will spring back quickly. More importantly, changing commitments and life styles quickly is difficult. Divulging the need to spend less can be embarrassing, of course, but in any case t selling a home and finding less expensive accommodations and a new support base takes significant time.

In autopilot jargon, the very conservative logic in our example would correspond to a high-gain autopilot that is holding very close to a course except when forced into downward flight. Remember that the autopilot here is really a human adapting to change and not blindly setting the controls on the path of fixed real expenses that predictably exhaust investments.

## Introducing More Realism

Since individuals react somewhat differently, demonstrating all possible responses to changing market conditions is not feasible. However, planners can use the feedback technology we're describing to investigate different behaviors and to fit plans to the responses retirees indicate they would make to large market changes.

Later we'll talk about more sophisticated ways to represent human behavior, but for now let's consider equations that are easy to employ. If you compare results from the more complex analysis to the simple approach that follows, you'll find that there is not much difference for most people.

In this simple approach, we assume that the retiree will just use the average of the two outputs, that is, the sum of the following two numbers divided by two.

1. Last year's expenses increased by last year's inflation.
2. A completely new calculation for the current year based on updated values.

This is something of a compromise. If (2) above is very much larger than (1), the retiree increases her budget by only half of the difference. On the other hand, if (2) is very much less than (1), the retiree only goes half-way to (2) because she hopes the market will increase again and/or it's difficult to severely cut budgets in only one year.

In the example in Figure 14, we show the same case as in Figure 13, but instead of very conservative logic, i.e., a very conservative autopilot, the retiree uses this moderate compromise approach. Note that this strategy reduces much of the year-to-year changes but still largely tracks the results of a new plan each year with no autopilot.

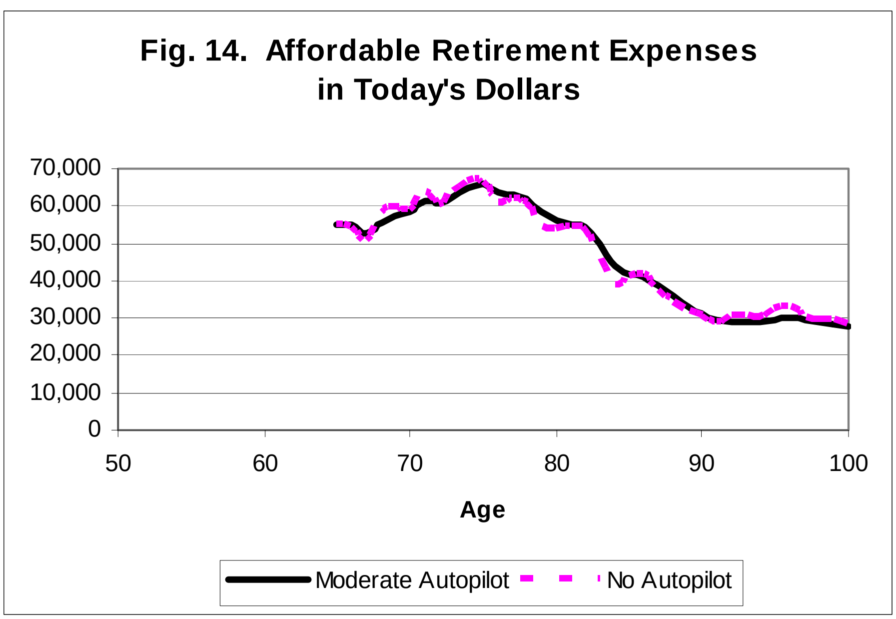


Figure 14. Moderate autopilot reduces expense changes in this 1956 example.

Planners don't yet think in terms of projections based on doing a new planning analysis each year (as in the No Autopilot line above), much less accounting for the real life reactions to new planning results (as in the Moderate Autopilot line above), but they should. Note that annual budgets without the autopilot often change by as much as 20% up or down from one year to the next. Almost any life style involves a degree of commitment that takes time to change. If downsizing a home is required, it can take very long indeed as the retiree first considers alternatives before putting the home on the market. Obviously, it takes time to sell, find a new location, purchase a new home, and relocate. In the case of my wife's and my parents, this process took several years, a lot of which was just getting emotionally tuned to what was coming and accepting the inevitable changes.

One thing you should notice about Figures 13 and 14 is the significant reduction in expenses late in life. The reason is that people anticipate longer life-expectancies as they age. We saw this even when returns and inflation were treated as constant as in the very simple example in Figure 1. In all of the past scenarios I've examined, there are only a small percentage of cases where this general reduction in spending capability does not occur. Most of the time reverse dollar-cost-averaging and increasing life expectancy combine to make financial survival of the elderly painful.

There is always the possibility that one spouse might die early and therefore the remaining spouse might be able to live on a lot less, but from what I've seen, living on a lot less is easier said than done. Often, the largest change is insurance costs because of reduced health insurance, long-term-care insurance, or life insurance. Similarly, some expenses like clothing are less, but this is usually a very small part of a retiree's expenses. Such reductions, however, are more than offset by the resulting loss of Social Security and pension benefits. Some cost categories can increase. For example, the survivor may eat out at restaurants more often.

After death of a spouse, elderly people living alone have to do some work that both spouses had shared. Surviving widows often have to hire handymen to do tasks such as yard work and repair jobs formerly performed by their husbands. Many widows or widowers may find transportation costs increase if taxis need to replace their own driving or to reduce difficulties of public transportation, particularly in inclement weather. And of course, costs start jumping appreciably as the elderly move from their own homes to independent living, then to assisted care, and finally to nursing homes. There is no way to look at the income statistics for the elderly and really visualize the changes that take place from significant income reductions. Those who say that, "The elderly need less as evidenced by their spending less" are making a big mistake. I know. Most of our friends are in their seventies and eighties. We also have a number of friends in their nineties. Moreover, some are very wealthy and some have little more than Social Security.

## Wide historical differences

Let's look at what can happen when the economy is extremely good to a retiree versus when it is extremely bad. If you look at actual historical scenarios, a person who retired in 1948 was able to enjoy a great financial life while someone who retired in 1965 really had a miserable financial future.

Those who retired in 1948 benefited from the post World War II boom. Those who retired in 1965 faced numerous market failures and a period of very high inflation rates. These two completely different scenarios are close to the extremes that have occurred since 1926, but there are other cases in both instances that have similar impacts. In fact, if retirees live long enough, they are likely to see a number of quite bad times.

You'll remember that retiring in 1956 would have been no picnic for a long-lived person. And that's only plus or minus eight or nine years from the worst and the best times to retire. So let's look at Figure 15 where we represent the two historical extremes.

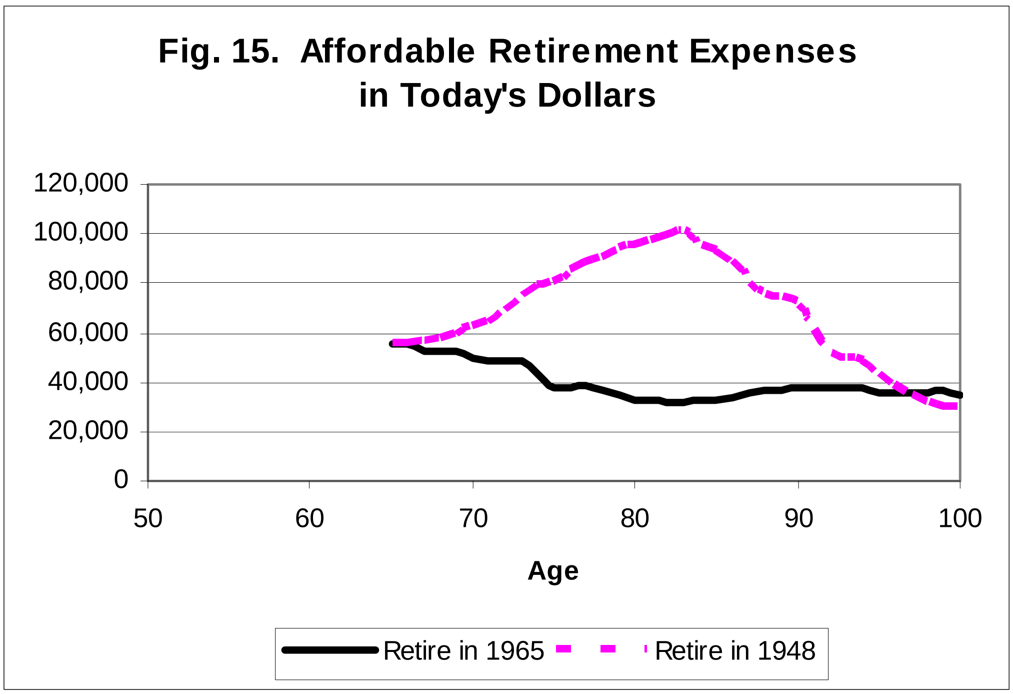


Figure 15. People who retired in 1948 had far different futures than those who retired in 1965.

The difference between the 1948 and 1965 retirement scenarios is incredibly large, with regard both to the high and low spending at different points in life as well as the severity of the annual changes. For example, at age 82, the person who retired in 1948 has an inflation adjusted budget of over $100,000 a year while the person who retired in 1965 has only a little over $30,000 annually.

It could be worse. Figure 15 reflects what I consider to be average human responses in such cases. (The particular autopilot rules used here represent a little more lag in the retiree's ability to react to market changes than the moderate autopilot showed earlier.) The autopilot has trimmed the higher frequency bumps that would otherwise appreciably aggravate the annual budget change accommodation. But let's get back to the physical world and try to imagine what is happening to human beings in these two different situations.

Although few people understood the concept of retirement planning in those days, I can remember conversations in the homes of relatives who were experiencing the market conditions during both of these scenarios. All of our relatives got together at major holidays. That was a crowd often reaching forty-four people sitting around in large circles where the men talked mostly about the economics of the day and times past while the women talked about family relationships and who was doing what. Most often the men blamed the politics of the day for their troubles and hoped and prayed for better times ahead. Those few who retired in 1948 and were in their eighties never would see the good-ole days again. Those who retired in 1965 were hit so hard early in their retirement that the improvements late in life did not do much good because they had so little left.

## Conclusions relating to the retirement autopilot

It's my contention that you can't protect yourself from long-term adverse economic effects such as represented by the 1965 retirement case in Figure 15, but you can reduce the degree of hurt by using the autopilot principles and a diversified investment portfolio.

If your investments appreciate far above normal in the first decade or so of your retirement, however, and if you abide by some very conservative budgeting logic, you could sustain future economic shocks pretty well. For example, in the 1948 case of Figure 15, if you did not let your expenses grow so dramatically, you would greatly reduce that downward spiral late in your retirement.

It is all rather abstract when a professional planner starts talking about the probabilities of outliving your investments. Until fairly recently, people did financial planning largely on a 50/50 basis. That is, there was a 50% chance of outliving your resources. The advent of Monte Carlo analyses has started to get planners to talk about more conservative plans, but most of the models have weak statistical inputs, don't account for human responses, and the probability concept is still abstract. I think it's much better to look at some historical scenarios that represent your likely reactions, not just blind spending until you run out of money. You could marry dynamic and Monte Carlo analyses, but the creators of Monte Carlo programs haven't advanced to that level much less adding autopilot feedback.

The retirement autopilot is very useful as a practical projection model representing how you expect to react to significant changes in the value of your investments.  It smoothes out what can easily be plus or minus 20% swings in your annual budgets.  Couple that with a dynamic analysis using multiple scenarios and you're likely to get a much better understanding of what might happen in the future as well as the things that you should do to be better prepared.

The retirement autopilot ultimately is YOU.  You are on autopilot if you moderate the growth of your budget even when your investments soar and your financial advisor says you can spend more.  A quite workable equation to help you is to restrain the upward growth of your budget by not letting it grow more than half-way between the larger number from your planner and last year's budget increased by inflation.  You can do the same thing on the downside when the market falls, but if you can reduce your budget even faster on the downside, you'll likely have a much better life in the long run.

So, unless you feel strongly that future returns, inflation, and personal economic events in your life will turn out to be benign straight and level paths, you'd better be prepared to cope with the kind of bumps in the road that existed in the past.

## Conclusions relating to dynamic analysis:

Future generations may well face much the same problem as those who retired in the 1960s.  In fact, it doesn't take much to paint a very bleak future for the baby boomers and Gen X who are loaded with debt and have saved little.  There is a real need to get people to understand that there is a definite relation between what you have saved when you retire and your life style after retiring.  People who aren't saving anything may be doing the current economy a great favor by increasing consumption, but they aren't helping themselves for that last quarter or third of their life when they'll be unemployed.

Optimistic planning methods like exhaustion analyses further add to the damage. Enter optimistic security performance, low inflation rates, forecasts using short life-expectancies, no reserves for unknowns, etc., and you further compound the troubles.  I can't help but think that the combination of an aging population and huge levels of private, commercial, and government debt have to enter this picture as well, not only with regard to future interest rates but also to inflation and future taxes.

As a former senior corporate planner, I was appalled by the primitive tools and poor perspective that permeates the retirement planning process.  Retirement planners I suppose have to be optimistic or they wouldn't have any clients, but that optimism does no favors for the people who are paying them for what they presume is good advice. Now I know that there are planners that are the exception and do the right thing, and I know that there are planners who just don't understand the shortcomings of the tools they are using.  But I also know that there is something wrong when multi-billion dollar financial firms who have the know-how persist in promoting self-serving materials that are misleading.

In a sense, retirement planning is like running a company. Before you embark on a project, you have to accumulate the resources to support it. That's the same as a pre-retirement plan where you have to save enough to retire. After you embark on a new company project, you have to stay within the budget supported by the amounts you've accumulated. That's true for retirement as well. If I didn't understand these basics, I would never have survived the Board of Director's reviews of Boeing's plans. As an individual, you have no Board of Directors to ask penetrating questions except possibly for a totally exasperated spouse long after the trouble is beyond repair. So ask your own questions about the assumptions behind a financial plan and the method used to project your future.

We showed how misleading exhaustion analysis can be when trying to get some perspective of your future. It's important to include how humans actually react when investment values jump up and down. This requires dynamic analysis. Dynamic analysis gives the perspective needed to make good judgments about the amount you should save before retiring and how much you can afford to spend after retiring. There is no great mystery to converting exhaustion analysis to dynamic analysis. You simply have to provide the equations to make a new plan every year. It just takes lots of equations. I estimate that the Dynamic Financial Planning program from www.analyzenow.com has well over 20,000 equations.

The same thing can be done with Monte Carlo analysis. If I was younger and had the energy, I'd do it myself. I believe the outcome is foreseeable, however. If almost every historical scenario from the Dynamic Financial Planner produces a more conservative plan than an exhaustion analysis, then the results from a Monte Carlo plan with dynamic analysis will also be more conservative. Of course, the interesting output will not be investment balances because those are unlikely to go to zero. The output worth viewing will be the probability of keeping affordable expenses of the elderly above some stated value given that the retirees will abide by some planning rules you choose for the retirement autopilot.

## Notes:

The source of all security returns used to develop the figures in this article is Global Financial Data.

**The Retirement Autopilot Equations:**

Sometimes it's hard to remember that the Retirement Autopilot is either the retiree or a professional planner who helps establish this coming year's budget for a retiree. It's a human being, not a piece of equipment or software. We're just trying to reflect real behavior, but to depict it in a financial model we have to talk in engineering terms. The following are the logic equations we use:

The letter n represents this year while n-1 represents last year and n-2 two years ago.

Pmt(n) is this year's computer calculation of affordable expenses.

Exp(n-1) x (1+Inflation) is the inflated value of last year's affordable expenses.

Exp(n) is this year's judgmental value of affordable expense determined from the following logic equations:

Logic:

> If Pmt(n) greater than Exp(n-1)x(1+Inflation),
> Then Exp(n) = Exp(n-1) x (1+Inflation) x UG + Pmt(n) x (1 – UG),
> Else Exp(n) = Exp(n-1) x (1+Inflation) x DG + Pmt(n) x (1 – DG).

Where:

> UG = Upside Gain
> DG = Downside Gain.

By adjusting the upside and downside gains, you can get remarkably different performance. The following are some extreme autopilot settings and their consequence:

> When UG = DG = 1, the equations above simulate exhaustion analysis, that is the inflation adjusted values of affordable expense are the same every year until the investment balances get to zero. This is the basis for over 99% of retirement plans. Nevertheless, in practice, few planners would have you substitute last year's plan (adjusted for inflation) for their most recent calculations as this case implies. When there is a new plan each year, the next case better represents what really happens.

> When UG = DG = 0, the equations then simulate the results of making a new affordable expense calculation each year by ignoring last year's computation. This represents the actual performance of most professional planners—an unfortunate choice in many instances.

> When UG = 1 and DG = 0, the equations above represent the most conservative of choices, that is, affordable expenses are the lesser ofPmt(n) or Exp(n-1) x (1+Inflation). This is my own personal control, but it does not represent the responses of most people nor professional planner's recommendations.

> When UG = 0 and DG = 1, you simulate the behavior of a desperate person that feels the need to justify whichever is the higher affordable expense calculation.

After experimenting with the Dynamic Financial Planning Pro by using many different settings of gains in all of the retirement scenarios on the program, it appears that the best representation of general human behavior is usually an upside gain of 0.75 and a downside gain of 0.25. Therefore, the "Factory Settings" on the Dynamic Financial

Planning program are those values, but the user is free to change them and experiment as well.

It turns out that there is not much difference between performance with the factory settings and the moderate case described earlier which simply uses the average of Pmt(n) and Exp(n-1) x (1+Inflation). You can represent this case in the more complex equations in the program by setting both UG and DG to 0.5. Unless you want to use the Dynamic Financial Planning Pro which allows you to select gains that may better represent your client's behavior, you can get quite satisfactory planning results by just averaging the results you get from last year's inflated affordable expense and the results of an entirely new calculation for this coming year.

Of course, if there are tremendous changes in many inputs to the plan, or you believe that last year's plan was a very poor representation of the future (Tongue-in-cheek examples: the client herself or another professional did the analysis.), you may not want to consider what last year's planned values were at all. Conversely, if you expect that this past year's exceptional growth will be wiped out with compensating market losses in future years, then you might just use last year's budget increased by last year's inflation.