Consistent Treatment Of Inflation For Retirement Planning

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Retirement planning requires care to distinguish between the promised nominal rate and the real interest rate: that is, the rate at which the real value of the investment grows. Nominal cash flows (measured in current dollars) should be discounted at nominal rates. Real cash flows (measured in constant dollars) should be discounted at real interest rates. Nominal and real rates of interest should not be mixed and matched. The consequences of a poor forecast are explored to demonstrate the importance of correctly estimating real interest rates.
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Introduction

Interest rates are usually quoted in nominal terms rather than real, inflation-adjusted terms, e.g., 3-month CD rates in the *Wall Street Journal* (Markets Diary, 2000, p. C1). A nominal interest rate is based on the actual number of dollars to be received without an offset for future inflation. It is important to distinguish between nominal cash flows (the actual number of dollars that will be paid or received) and real cash flows, which are adjusted for inflation when planning for retirement. When the inflation rate is low, the difference between real and nominal interest rates and rates of returns on investments may seem trivial, but the differences can be very large for a young worker saving for retirement, or for a retiree who may live another 30 years.

An investment may promise a high nominal interest rate, but if inflation is also high, the real rate of interest may be low or even negative. For example, if $1,000 is invested in a bank deposit offering an interest rte of 10%, the bank promises to pay $1,100 at the end of the year. However, the bank makes no promises about what the $1,100 will buy. What the $1,100 will buy depends on the rate of inflation over the year. If prices of goods and services increase by more than 10%, the depositor will lose ground in terms of goods and services that can be purchased.

The real rate of interest is approximately the difference between the nominal rate and the inflation rate. One should carefully consider nominal versus inflation-adjusted rates of interest when planning for retirement. The next section is a review of the relevant literature with respect to inflation. Then, an example correctly considering inflation is illustrated. The final section provides conclusions.

Literature Review

Nominal versus Real Rates of Interest

Most certificates of deposit (CDs) promise a fixed nominal rate of interest. The inflation-adjusted interest rate of course depends upon the inflation rate. Irving Fisher's great book, "The Theory of Interest: As Determined by impatience to Spend Income and Opportunity to Invest It," (1907, 1965) sums up what determines the real interest rate that investors demand. The real interest rate, according to Fisher, is the price that equates the supply and demand for capital. The supply depends on people's willingness to save, that is, to postpone consumption. The demand depends upon the opportunities for productive investment. Roll (1972) provides a commodity example explaining how a change in the expected inflation rate will cause the same change in the nominal interest rate, but it has no effect on the real, or inflation-adjusted, interest rate. Fama (1975) tested Fisher's theory and found it to be true 98% of the time for the period of 1953-1971.

Cissell, Cissel and Flaspohler (1990) provide an excellent description of the differences between nominal and real rates of interest. The nominal risk-free rate of interest is the rate of interest on a security that is free of all risk; it is proxied by the T-bill rate or the T-bond rate, and it includes an inflation premium. The real risk-free rate of interest is the rate of interest that would exist on default-free U.S. Treasury securities if no inflation existed. In general, the nominal (or stated) rate of a debt security is composed of a real risk-free rate of interest, plus several premiums that reflect inflation, the riskiness of the security, and the security's marketability (or liquidity).

While several indexes are used to track the general level of prices, one of the most widely used is the Consumer Price Index (CPI), which measures the average cost of the goods

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and services that are bought by the average U.S. consumer (Lipsey, Courant, Purvis & Stewiner, 1993). The change in the CPI from one year to the next measures the rate of inflation.

Real versus Nominal Cash Flows

Economists sometimes talk about current, or nominal, dollars versus constant, or real, dollars. For example, the nominal cash flow from the 1-year CD is $1,060. Lown (2000, p. 44) presents the formula for inflation-adjusted rates as:

$$r_{adjusted} = [r_{nominal} - r_{inflation}] / [1 + r_{inflation}] \quad (1)$$

For low levels of rates, this formula is close to $r_{nominal} - r_{inflation}$, so that for a nominal rate of 4% and an inflation rate of 3%, the simple subtraction formula gives a real (inflation-adjusted) rate of 1%. The exact formula provides a real rate of just over 0.97%. For higher rates, the simple subtraction formula becomes less accurate. For a nominal rate of 18% and an inflation rate of 5%, the simple subtraction formula gives a real (inflation-adjusted) rate of 13%. The exact formula provides a real rate just over 12.4%. The difference may seem small, although at 13%, in 40 years, $10,000 would grow into $1,327,816, while 12.4% would produce $1,073,130.

The general formula for converting nominal cash flows at a future period to real cash flows is found in many Finance textbooks, for example Brigham (1989):

$$\text{Real Cash Flow} = \text{Nominal Cash Flow} / (1 + \text{Inflation Rate})^t \quad (2)$$

For example, if an investor were to deposit $1,000 for 12 years at 6%, the future nominal payoff would be $\$1,000 \times 1.06^{12} = \$2,012.20$, but with an inflation rate of 4% a year, the real value of the payoff would be $\$2,012.20 / 1.04^{12} = \$1,256.81$. In other words, the investor will have roughly twice as many dollars as today, but the investor will be able to buy only 25% more goods and services.

When a bank quotes a 6% interest rate, it is quoting a nominal interest rate. However, if the inflation rate is 4%, one is only 1.92% better off at the end of the year than at the start. Thus, the bank is really offering an expected real rate of return of1.92%. A CD or other investment may promise a high nominal interest rate, but, if inflation is also high, the real interest rate may be low or even negative. Note that the nominal rate is certain but the real rate is only expected. The actual real rate cannot be calculated until the end of the year arrives and the inflation rate is known.

The 6% nominal rate of return with 4% inflation translates into a 1.92% real rate of return. Berne (1992) extends the consideration of inflation to financial condition, and the formula for calculating the real rate of return is:

$$1 + r_{nominal} = (1 + r_{real}) \times (1 + \text{inflation rate})$$
$$= 1 + r_{real} + \text{inflation rate} + (r_{real}) \times (\text{inflation rate}) \quad (3)$$

In this example,

$$1.06 = (1 + 0.0192) \times (1 + 0.04) \quad (4)$$

Rearranging equation 3 leads to the standard formula (Equation 1 above) shown in Lown (2000, p. 44).

Treat Inflation Consistently

Ibobotson and Sinquefield (1982) conducted a seminal study on rates of return in the U.S. financial markets; however, they did not adjust for inflation. Thus, their returns are nominal returns. Interest rates are usually quoted in nominal terms (Gitman & Joehnk, 1996; Rejda & Mcnamara, 1998). When planning for retirement, investors should take inflation into account when they decide what is a fair rate of interest. The formula linking the nominal interest rate and the real interest rate is:

$$1 + r_{nominal} = (1 + r_{real}) \times (1 + \text{inflation rate}) \quad (5)$$

$$\text{real rate of interest} = [(1 + \text{nominal rate}) / (1 + \text{real rate})] - 1 \quad (6)$$

If the interest rate is stated in nominal terms, then consistency requires that cash flows be estimated in nominal terms, taking into account trends in medical costs, housing costs, and other living expenses. Of course this calls for more than simply applying a single assumed inflation rate to all components of cash flows. Medical costs, for example, may increase at a faster rate than the CPI because of improvements in technology. On the other hand, certain food prices and gasoline prices may not have increased with inflation. The message of all this is quite simple: discount nominal interest rates at nominal discount rates, and discount interest rates explicitly considering inflation (real rates) with discount rates explicitly considering inflation (real rates). However, the application is not simple. Expectation rates of inflation are subject to change. Dimson and Marsh (1987) discuss the problems in recognizing and implementing real versus nominal discount rates. Anderson, Xiao and Garman (2000) provide an example of retirement planning explicitly considering inflation and taxes.

Sensitivity Analysis

Retirement planning concentrates on the most likely future outcome. However, retirement planning is not solely concerned with forecasting. Retirement plans need to be concerned with unlikely events as well as likely events. If a retirement plan considers what could go wrong, then the plans are less likely to ignore any danger signals and provide an ability to react more quickly in the event of trouble.

There are a number of ways of asking "what-if" questions about specific retirement plans and general financial plans. An excellent example of break-even analysis is provided by Reinhardt (1973). A sound retirement plan should consider the consequences of the plan under the most likely set of circumstances and then use sensitivity analysis to vary the assumptions one at a time. Hertz (1968) was one of the first to advocate simulation. Retirement plans using scenario analysis might look at the consequences of each plan under different plausible scenarios in which several assumptions are varied at once. Nichols (1994) discusses Monte Carlo simulation.

Illustrative Examples

Many financial professionals are asked to give advice to clients and others about future financial security. Providing for retirement is important, and the time value of money is essential in this analysis. These examples illustrate real versus nominal cash flows.

Assume your retired 72-year old uncle, a widower, asks your help in reviewing his retirement financial plan. You spend an afternoon talking through his financial situation and establish the following estimates:

Your uncle has sold his home and has accumulated retirement savings of $500,000, including pension benefits. He has conservatively invested in bank certificate of deposits yielding 5.0%. He has planned to draw these savings down over the rest of his life.

He wants to begin giving cash gifts to his family and to bequeath any remaining assets to his family at his death.

He receives $12,000 a year in Social Security, which is based on a combination of the number of years of contributions, age at retirement and income. To simplify the analysis the $12,000 will be treated as a single lump-sum payment versus the actual 12 payments of $1,000 each received throughout the year. This is indexed to the cost of living and should increase with inflation.

Your uncle's living expenses are now $21,000 per year, which includes his current apartment rent, food, entertainment, transportation, and medical expenses.

In addition, you use 3% inflation per year, and you use 13 years as the remaining life expectancy for your uncle: based on his health, family history, and general life expectancies for men of his age. Of course, you both recognize that this is only an estimate to be used for planning purposes. You also recommend a second "sensitivity" analysis reflecting a longer life, increased actual expenses, and a higher rate of inflation.

There is more to financial planning than grinding out calculations and estimating present and future values. If the major uncertainties can be identified, it may be worth undertaking additional preliminary research that will confirm whether the financial plan is worthwhile. And even if it has been decided that all has been done to resolve the uncertainties, sound financial planning still requires knowledge of the potential problems. The financial planner does not want to be caught by surprises if things go wrong: the financial planner wants to be ready to take corrective action.

Sensitivity analysis is a straight-forward method in which the financial planner considers in turn each of the determinants of a plan's success and estimates how far the plan would be altered by changing one variable, e.g., the rate of inflation, by taking a very optimistic view or a very pessimistic view.

Sensitivity analysis of this kind is straightforward, yet it is not always helpful. Variables seldom change one at a time. If expenses are higher than expected, it is a good bet that Social Security payments will be higher too. If the financial plan does not allow for the dependencies between the cash inflows and cash outflows, a false impression of the hazards of financial planning may result. Hertz (1968) was one of the first advocates of simulation.

How much can your uncle spend each year if he is willing to run down his savings? The 13-year ordinary annuity with present value equal to his savings is needed:

Present value = annual payment × 13-year annuity factor at 5% interest rate, consistent with your uncle's current long-term investment portfolio of CDs.

Using a Texas Instrument BA-35 financial calculator, the data-entry keystrokes are:

$500,000	=	PV
13	=	N
5	=	%I
CPT		PMT

The resulting ordinary annuity is $53,278. So, if your uncle is prepared to use up all of his savings, he can draw $53,278 a year from his investment account. With Social Security, his total income would be $53,278 + $12,000 = $65,278, compared with his current living expenses of $21,000 per year.

A more challenging problem relates to inflation over the next 13 years. The Social security payments are tied to the consumer price index and therefore reflect inflation, so the current $12,000 pension from Social Security will likely increase to $17,622 [$12,000 × 1.03^{13}]. However, the annuity of $53,278 a year from your uncle's savings is fixed in *nominal* terms and therefore will remain constant, and its purchasing power will steadily decline. Your uncle's expenses will likely increase to $30,839 [$21,000 × 1.03^{13}]. Table 1 represents your uncle's current and forecasted cash flows in thirteen years.

Table 1
Example 1: Current and Forecasted Cash Flows

Source	**Forecasted Cash Flows**	**Current Cash Flows**
Cash Inflows		
Social Security (indexed to CPI; fixed in real terms at $12,000)	$17,622	$12,000
Savings (fixed nominal annuity)	$53,278	$53,278
Total Cash Inflows	$70,900	$65,278
Cash Outflows		
Expenses (indexed to CPI; fixed in real terms at $21,000)	$30,839	$21,000
Net Cash Flow	$40,061	$44,278

Once inflation is recognized, it is shown that the excess cash flow will decline. If actual expenses increase at a rate greater than inflation and/or if your uncle lives more than 13 years, the net cash flow will be reduced even more. The second example extends your uncles life to 18 more years, an immediate additional medical expense of $4,000 per year is included (increasing current total expenses to $25,000 per year), and inflation is forecasted to be 6% rather than 3%. These changes in assumptions are reflected next.

The 13-year ordinary annuity is extended another 5 years to become 18 years, with present value equal to his savings is needed:
Present value =
annual payment × 18-year annuity factor at 5% interest rate.

Using a Texas Instrument BA-35 financial calculator, the data-entry keystrokes are:

$500,000	=	PV
18	=	N
5	=	%I
CPT		PMT

The resulting ordinary annuity is reduced to $42,773. So, if your uncle is prepared to use up all of his savings, he can now only draw $42,773 a year from his investment account. With Social Security, his total income would be only $42,773 + $12,000 = $54,773, compared with his revised current living expenses of $25,000 per year.

The Social Security payments are still tied to the CPI and therefore reflect inflation; the current $12,000 annualized annuity in Social Security will likely increase to $34,252 [$12,000 × 1.06^{18}]. However, the annuity of $42,773 a year from your uncle's savings is fixed in *nominal* terms and therefore will remain constant, and its purchasing power will steadily decline. Your uncle's expenses will likely increase to $59,941 [$21,000 × 1.06^{18}]. Table 2 represents your uncle's revised current and forecasted cash flows in eighteen years.

Table 2
Example 2: Current and Forecasted Cash Flows

Source	**Forecasted Cash Flows**	**Current Cash Flows**
Cash Inflows		

Social Security (indexed to CPI; fixed in real terms at $12,000)	$34,252	$12,000
Savings (fixed nominal annuity)	$42,773	$42,773
Total Cash Inflows	$77,025	$54,773
Cash Outflows		
Expenses (indexed to CPI; fixed in real terms at $21,000)	$59,941	$25,000
Net Cash Flow	$17,084	$29,773

Conclusions

Rates of interest are often cited in nominal terms versus inflation-adjusted terms. Retirement financial planning can be enhanced by explicitly considering inflation. It is important to distinguish between nominal cash flows (the actual number of dollars that will be paid or received) and real cash flows, which are adjusted for inflation when planning for retirement. And inflation should be treated consistently. Nominal interest rates should be discounted at nominal rates and real interest rates should be discounted at real rates.

The examples illustrated the importance of recognizing how inflation adjusted interest rates and nominal rates differ and the related implications for retirement planning. In addition, different assumptions can result in vastly different outcomes. A person's risk tolerance should be considered given uncertain outcomes. In theory, three possible attitudes towards risk can be identified: aversion to risk, indifference to risk, and preference for risk. Risk aversion characterizes individuals who prefer to avoid or minimize risk. Both logic and observation suggest that investors are predominantly risk averters, especially when substantial dollar amounts are involved.

Why should risk aversion generally hold? Given two alternatives, each with the same expected dollar returns, why do most decision makers prefer the less risky one? While several explanations have been proposed, perhaps the most satisfying one involves utility theory (Fiegenbaum & Thomas, 1988).

At the heart of risk aversion is the notion of a diminishing marginal utility for money. If an individual with no money receives $1,000, it can satisfy his or her most immediate needs. If the person then receives a second $1,000, it will obviously be useful, but the second $1,000 is not quite so necessary as the first $1,000. Thus, the value, or utility, of the second, or marginal, $1,000 is less than the utility of the first $1,000, and so on for additional increments of money. It is therefore concluded that the marginal utility of money income or wealth diminishes. Because individuals with a diminishing marginal utility for money will suffer more pain from a dollar lost than they will derive pleasure from a dollar gained, they will strongly avoid risk. Thus, they will require a very high return on any investment that is subject to much risk.

There is more to retirement planning than grinding out calculations. If major uncertainties can be identified, it may be worth undertaking additional research that will confirm whether the plan is worthwhile. And even if all that can be done to resolve uncertainties, there is a value in being aware of the problems. One does not want to be caught by surprise if things go wrong: one desires to be ready to take corrective action.

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