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Comment

Discounting in Forensic Economics

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I. Introduction

In projecting future earnings the forensic economist has to make explicit or implicit assumptions about inflation, productivity growth, and interest rates.

To be precise, let I represent the expected future inflation rate, P the expected future productivity growth rate, and R the nominal interest rate. Assume for simplicity that inflation and productivity are going to be constant in the future, and that the term structure of interest rates is flat, so R is the same whatever the future horizon. Assume further that a disabled plaintiff will lose earnings equivalent to E dollars per year in current year dollars, on account of her disability. Finally assume that E would not rise in future years due to individual specific factors like promotions, but would rise due to economy wide factors like inflation and productivity growth.

Now in real, constant dollar terms lost earnings in the t^{th} future year are:

$$\text{(1)} \qquad \text{Real Earnings, Year} \quad t = (1 + P)^t E$$

In nominal, then-current dollar terms lost earnings in the t^{th} year are:

$$\text{(2)} \qquad \text{Nominal Earnings, Year} \quad t = (1 + P)^t (1 + I)^t E$$

The present value (at time $t = 0$) of lost earnings in the t^{th} year are:

$$\text{(3)} \qquad \text{PV of Earnings, Year} \quad t = \left[\frac{(1 + P)\,(1 + I)}{(1 + R)}\right]^t E$$

Clearly the adjustment factor $\frac{(1 + P)(1 + I)}{(1 + R)}$ is crucial. For instance, if $t = 30$, then the present value of year t earnings equals 1.00E if the adjustment factor is 1, .40E if the adjustment factor is .97, and 2.43E if the adjustment factor is 1.03.

The purpose of this note, therefore, is to focus on the adjustment factor. There are three ways to approach it. Two make sense and really ought to be viewed as equivalent. The third is ad hoc and a blessing for plaintiffs' attorneys. The three approaches have been summarized by the United States Supreme Court in Jones and Laughlin Steel Corp. v. Pfeifer (462 United States 523 ,1983). See also Feldman (1988).

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Table 1

Average Annual Rates of Inflation and Real Hourly Compensation Growth (Productivity)

Period	Number of Years	Inflation (percent)	Productivity (percent)	(1 + I)(1 + P)
1948–1988	40	4.02	2.05	1.068
1958–1988	30	4.75	1.53	1.064
1968–1988	20	6.22	0.76	1.070
1978–1988	10	5.96	0.13	1.061
1981–1988	7	3.59	0.93	1.046

Source: U.S. Department of Labor, *Handbook of Labor Statistics,* 1989, Tables 98 and 113.

II. First Approach: Market Interest Rate

The "market interest rate" approach, also called "inflate-discount", allows the economist to make an explicit assumption about I and P, and then to combine these with an actual observable interest rate, such as the yield on long-term U.S. Treasury bonds. For projections 30 years in the future or less, interest can be locked in now, and there is no need to speculate as to what future interest rates might be. This is important; it means that one term of the three, namely R, is concrete and observable; the economist must make an informed judgment about only two: future inflation I and future productivity growth P.

Such a judgment might depend on past levels of I and P. Table 1 shows past average inflation and productivity growth rates, based on Department of Labor Consumer Price Index and real hourly compensation statistics.

On the basis of numbers like those in Table 1, and assuming that what's past is prologue, an economist might assume that I is somewhere between 4 and 6 percent, that P is somewhere between 1 and 2 percent, and that $(1+I)(1+P)$ is somewhere between 1.05 and 1.07.

Alternatively, the economist might seek other opinions about factors like expected future inflation. The investment firm Drexel Burnham Lambert conducts a monthly poll of over one hundred and seventy institutional investment managers about, among other things, their current projections of future inflation 10 years into the future (see Drexel Burnham Lambert, "Decision Makers Poll, " Various issues). What matters, of course, is what experts currently believe future inflation will be, not what they might have believed some time in the past. Based on DBL's latest poll (in November of 1989), the average long-term inflation expectation is 4.26 percent. (See Table 2.)

Having made an informed judgment about I and P, the economist can look up R in a newspaper. Note that whether or not the term structure is flat, it is not necessary to consider future rollovers provided t is less than or equal to 30 years. With stripped Treasury securities readily available, it is easy to purchase a bond today to pay a nominal $(1+P)^t(1+I)^t E$ t years hence. Courts have generally held that the appropriate security is a default- risk-free Treasury, so the economist need not consider higher yielding but riskier alternative securities, like corporate bonds or stocks.

Table 2

Drexel Burnham Lambert Decision Makers Real Yields

Survey Month	(1) 10-Year Gov't Bond Yields	(2) 10-Year Inflation Expectations	(3) Expected Real Yields
September 1981	15.90	7.62	8.28
September 1982	12.34	6.73	5.61
October 1983	11.49	6.65	4.84
October 1984	12.16	5.79	6.37
November 1985	9.78	5.84	3.94
November 1986	7.25	5.24	2.01
November 1987	8.85	5.14	3.71
November 1988	8.96	4.65	4.31
November 1989	7.87	4.26	3.61

Excerpted from Drexel Burnham Lambert (1989), p. 8.

As I write this (December 15, 1989), the average yield on long-term U.S. Treasury bonds is around 8.0 percent. (Which is not far from that reported by Riley (1989), who finds that forensic economists use an average discount factor of 8.91% for determining present value.)

All things considered, then, the inflate-discount approach to the adjustment factor suggests that, at the present time, a plausible factor would be:

$$\text{(4)} \qquad \text{Adjustment Factor} = \frac{(1 + P)(1 + I)}{(1 + R)} = \frac{(1.015)(1.045)}{1.08} = .982$$

Looking at earnings 30 years in the future gives

$$\text{PV of Earnings, Year 30} = (.982)^{30}E = .58E$$

III. Second Approach: Real Interest Rate

The real interest rate R^* is defined by the equation

$$\text{(5)} \qquad 1 + R = (1 + R^*)(1 + I)$$

(Note that for R and I reasonably small fractions, this equation is almost equivalent to $R = R^* + I$. Also note that in a continuous discounting model, where PV of earnings at time t is

$$\text{(6)} \qquad e^{(R-P-I)t}E,$$

the real interest rate is defined exactly by $R = R^* + I$.) R^* is the expected real rate of return to investors, after allowing for inflation.

Substituting in the adjustment factor gives

$$\text{(7)} \qquad \text{Adjustment Factor} = \frac{(1 + P)(1 + I)}{(1 + R^*)(1 + I)} = \frac{1 + P}{1 + R^{*\prime}}$$

and the I term disappears.

The disappearance of the I term is a relief to many courts, and some economists, because it saves the economist from having to make a judgment about I, and it saves the court from having to listen to such a judgment.

But the rub is that R^* is not observable; it is not in the newspaper. (Indexed U.S. Treasury bonds do not exist, although in some places [e.g. Israel] at some times short-term indexed C.D.'s and notes have been available.) Therefore, under the real interest rate approach, the economist must make an informed judgment about R^*, that is neither better nor worse than an informed judgment about I. How could it be otherwise? These variables are connected by one equation $(1+R) = (1+R^*)(1+I)$. One variable R is observable and concrete. The other two are judgmental. But if you make an assumption about R^*, you must simultaneously be assuming a specific value for I, and vice versa. In particular, if you observe that $R = 8$ percent and you assume that $I = 4.5$ percent, then you must be assuming $R^* = 3.35$ percent. On the other hand, if you assume $R^* = 3.35$ percent when $R = 8$ percent, then you are also assuming $I = 4.5$ percent, even if you don't say so!

Some courts and economists (e.g., Mead (1984)) hold that the real interest rate approach is superior because R^* is constant. (If this were true, any change in R would reflect purely and simply a change in expected inflation I.) For if R^* is constant (more or less) and can be readily computed from past data, the only judgmental term remaining in the adjustment factor is P. Alas, it just isn't so. Studies of past ex post realized real interest rates show they vary wildly. For instance, the ex post real interest rate on three- year Treasury notes, over the period 1953–1988, varied between a low of -4.10 percent and a high of $+9.91$ percent (Feldman [1988]). For ex ante real interest rates, which are the ones that concern us here, it's useful to examine the Drexel Burnham Lambert numbers in column (3) of Table 2. This table shows that average expected real yields (based on 10 year bonds and 10 year inflation expectations) ranged from a low of around 2 percent to a high of 8 percent in the 1980's. Note that the November 1989 Drexel Burnham Lambert expected real yield is 3.61 percent.

If the economist abandons the discredited hypothesis of a constant real interest rate, he can make his own judgment about the future real interest rate (remembering that $1+R = (1+R^*)(1+I)$ must be true, or, as an approximation, $R = R^* + I$). Or alternatively, he might use other expert judgments, like those summarized by Drexel Burnham Lambert.

All things considered, then, the real interest rate approach to the adjustment factor suggests that at the present time a plausible factor would be

$$\text{(8)} \qquad \text{Adjustment Factor} = \frac{1 + P}{1 + R^*} = \frac{1.015}{1.0335} = .982$$

(This, of course, is based on my R^*. Based on Drexel Burnham Lambert's November 1989 R^*, the adjustment factor is .980.)

IV. Third Approach: Total Offset

In the case of Beaulieu v. Elliot (434 P 2d 665, Alaska, 1967) the Alaska Supreme Court evidently decided that the numerator of the adjustment factor just equals the denominator, and therefore the two terms offset each other. Consequently, the Alaska adjustment factor equals 1.0. A simple adjustment factor makes present value calculations simple. which suggests a reduced cost of litigation. This is seen by some as a virtue of the total offset method (see, e.g., Palaez, 1989).

In case of Kaczkowski v. Bolubusz (491 Pa 561, 421 A 2d 1027, 1980) the Pennsylvania Supreme Court decided "as a matter of law that future inflation shall be presumed equal to future interest rates with those factors offsetting." That is, $R^* = 0$. Therefore, the Pennsylvania adjustment factor is

$$\text{Adjustment Factor} = 1 + P \tag{9}$$

Looking at earnings 30 years out in Pennsylvania, and assuming P = 1.5 percent, gives

$$\text{PV of Earnings, Year 30} = (1.015)^{30}\ E = 1.56\ E \tag{10}$$

This is almost three times what the other approaches indicate!

It must be said that when the Alaska and Pennsylvania decisions were made, the offsetting assumptions were not implausible. Moreover, the Kaczkowski v. Bolubusz decision replaced a worse economic mistake of an earlier case, Havens v. Tonner (243 Pa Super 371, 365 A 2nd 1271, 1976). (In Havens v. Tonner a court had held I and P to be speculative and inadmissable, and so forced an adjustment factor of $\frac{1}{1 + R}$.)

But we know better now than to assume that R = I. We have had unusually high (although not constant) real interest rates since around 1981. The financial decision makers polled by Drexel Burnham Lambert project a real yield of $R^* = 3.61$. To make the ad hoc assumption that $R^* = 0$, as Pennsylvania total offset does, is delightful for plaintiffs and plaintiffs' attorneys but contrary to the evidence.

V. Conclusions and Suggestions

Consider the adjustment factor again, and define Q^* implicitly as follows:

$$\text{Adjustment Factor} = \frac{(1+ P)(1 + I)}{1 + R} = \frac{1 + P}{1 + R^*} = \frac{1}{1 + Q^*} \tag{11}$$

As an approximation (and exactly, in a continuous time discounting framework) we have:

$$\begin{aligned} Q^* &= R^* - P = R - I - P \\ &= \text{market interest rate} - \text{earnings rate growth} \end{aligned} \tag{12}$$

Q^* may be viewed as the real interest rate *after adjustment for productivity growth*.

Based on the Drexel Burnham Lambert real interest rate of 3.61 percent, a currently plausible estimate for Q^* is 3 to 4 percent minus P. In light of evidence like Table 1 it's difficult to see how P could be estimated at more than around 1.5 percent. These observations suggest a current Q^* of around 2 percent.

Where then do forensic economists stand on this crucial number (or the underlying R, I and P)? Reading through the short essays on selecting a discount rate in the April 1989 issue of the *Journal of Forensic Economics* reveals the following:

Francis J. Colella: $Q^* = 0$ to 1. 0 preferred.
Bryan C. Conley: $R^* = 2$ to 3.
$P = 1$ to 2.
$Q^* = 1$.
Thomas O. Depperschmidt: Avoid the whole issue by using a structured settlement.
Frank Falero: Use a current R. Use long-term treasuries for long projections.
Pauline Fox: Use an R based on a weighted average of returns on securities of different maturities.
Ralph Frasca: Use an R based on the Pension Benefit Guaranty Corporation.
Thomas Ireland: Use an R based on AAA corporate bonds.
William P. Jennings and Penelope Mercurio: Use an R, but adjust it downward to compensate for risk associated with variable future costs.
Robert T. Patton: $Q^* = 0$.
G. Michael Phillips: Use an R based on AAA corporate bonds.
Clarence C. Ray: Use an R based on the 20 year average yield on 3 month Treasury bills.
Reuben E. Slesinger: $R^* = 2$ to 3.

In short, forensic economists are all over the board. At one extreme, there is a cluster at $Q^* = 0$ percent. (And more extreme, there is a well-known economist at a Boston, Massachusetts university who currently uses $Q^* = -2$ percent, and consequently gets extremely impressive present values.) At the other extreme, there are forensic economists who use an R based on AAA corporate bonds, which currently yield around 9 percent. Since $Q^* = R - I - P$, it's difficult to imagine that these economists use a Q^* much lower than $+2$ to $+3$ percent.

I would like to make some suggestions that might narrow our disagreements. Perhaps most economists could agree on the following propositions, at least for projections 30 or fewer years into the future:

(1) In theory at least, the adjustment factor is $\frac{1}{1 + Q^*}$, where $Q^* = R^* - P = R - I - P$ (approximately in a discrete model, and exactly in a continuous model).
(2) Since future interest may be locked in when $t < 30$, R is observable and concrete.
(3) Since I and P represent our estimates of *future* inflation and productivity growth, I and P are uncertain, unobservable, and matters of professional judgment. This is in contrast to R, which can be found in the newspaper (once we agree on U.S. Treasuries and the appropriate maturity).
(4) Since $R^* = R - I$ and R is concrete, R^* is exactly as uncertain, unobservable and judgmental as I.
(5) Since $Q^* = R - I - P$ and R is concrete, Q^* is exactly as uncertain, unobservable and judgmental as I plus P.

(6) Since $R - I - P = R^* - P$, the inflate-discount and the real interest rate methods are mathematically equivalent. The only difference is that the real interest rate method is not explicit about the assumed inflation rate, which must in fact equal $R - R^*$.
(7) The variants of the total offset method are qualitatively different from inflate-discount and real interest because they make particular economic assumptions, namely that $Q^* = 0$ (Alaska) or $R^* = 0$ (Pennsylvania). Both of these assumptions are arguable on the basis of economic evidence, especially the Pennsylvania assumption.

References

Feldman, Allan M., "Real Instant Rates and Total Offset in Computations of Damages in Death and Disability Cases, "*Connecticut Bar Journal*, v. 62, pp. 212–230, 1988.
Hoey, Richard B., David Rolley, and Hellen Hotchkiss, "Decision-Makers Poll," *Drexel Burnham Lambert Research Publication*, November 29, 1989.
Mead, Arthur, "Calculating Present Value," *Trial*, v. 20, pp. 16–20, 1984.
Pelaez, Rolando F., "The Total Offset Method," *Journal of Forensic Economics*, v. II, No. 2, pp. 45–60, 1989.
Riley, Stephen T., "The Economic Consultant in Forensic Economics," *Journal of Forensic Economics*, v. II, No. 3, pp. 1–18, 1989.
U.S. Department of Labor, *Handbook of Labor Statistics*, BLS Bulletin Number 2340, 1989.