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I. Introduction

Many forensic economists assert that a "risk-free" discount rate should be used to discount future lost earnings to present value in personal injury cases. By this they usually mean that the discount rate should be based on the yields that are available on securities with no risk of default. Sometimes they also mean that the securities should be as free as possible of inflation risk, the risk that unanticipated inflation will diminish the purchasing power of the lump sum award. The case for using a risk-free discount rate appears to rest primarily on the case law rather than on any underlying economic or financial theory. And there has been a flow of recent articles arguing on economic grounds that a "risk-adjusted" discount rate should be used instead.

The purposes of this paper are twofold. First, the paper surveys the legal and economic issues relating to the consideration of risk in discounting future lost earnings to present value. Second, it develops and presents empirical evidence on the effect on present values of incorporating several alternative levels of risk into the discount rate. Data on investment returns on securities of varying degrees of risk are combined with data on the growth of labor compensation to calculate a number of alternative net discount rates for historical periods of various lengths, and these net discount rates are used to compute present values for future periods of various lengths. This makes it possible to examine the impact of potential risk adjustments on present value under varying circumstances.

The rest of this paper is laid out as follows. Sections II and III briefly review the legal and economic arguments, respectively, surrounding use of a risk-free discount rate. Section IV discusses the methods and data used to generate the empirical results, which are then briefly described in Sections V and VI. Finally, Section VII offers some concluding comments.

II. Legal Background

A number of court decisions can be cited in support of the use of a risk-free discount rate. Gilbert has argued forcefully for what he calls the "risk free criterion," quoting the U.S. Court of Appeals in *Brown & Root, Inc. v. Desautel* (1977): "...the discount rate should be based on the yield paid by investments in the safest securities, without expecting the beneficiary to exercise financial expertise or skill." (Gilbert, 1991, p. 42) Gilbert stated that this requires a dis-

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count rate free of default risk, but he went on to say: "*Ceteris paribus*, the *risk free criterion* also appears to require that the risk due to unanticipated inflation be minimized...." (Gilbert, 1991, p. 42) It is generally the case that all U.S. Treasury securities are considered to be free of default risk, but until recently, only very short-term Treasury securities (Treasury bills) were also considered to minimize inflation risk. Since 1997, Treasury Inflation-Protected Securities (TIPS) have provided an alternative to Treasury bills as a means of minimizing inflation risk.

Probably the most frequently cited opinion relating to use of the risk-free discount rate comes from the U.S. Supreme Court in *Jones & Laughlin Steel Corp. v. Pfeifer* (1983), which in turn drew liberally upon its earlier decision in *Chesapeake & Ohio Railway Co. v. Kelly* (1916). According to the *Pfeifer* court:

> The discount rate should be based on the rate of interest that would be earned on 'the best and safest investments.' Once it is assumed that the injured worker would definitely have worked for a specific term of years, he is entitled to a risk-free stream of future income to replace his lost wages; therefore, the discount rate should not reflect the market's premium for investors who are willing to accept some risk of default. (*Jones and Laughlin*, 1983, p. 537)

Yandell (1991) has interpreted *Pfeifer* to mean that the discount rate should be *both* default risk free and inflation risk free. Others have apparently come to the same conclusion (see Romans and Floss, 1992; Albrecht and Wood, 1997). Ireland also has cited *Pfeifer* as the primary support for his view that the discount rate should not carry a premium for default risk (Ireland, 1999, p. 157). He has noted elsewhere, however, that while *Pfeifer* mandates a discount rate free of default risk, it does *not* mandate a discount rate free of what he calls "inflation uncertainty."[1] (Ireland, 1997, p. 28) Thus, all intermediate or long term Treasury securities, not just short-term Treasuries or TIPS, could presumably satisfy the legal mandate of *Pfeifer*.

The *Pfeifer* opinion arose out of a federal court proceeding dealing with federal statutory law (the Longshoremen's and Harbor Workers' Compensation Act), and it "sets a standard that is applied in many legal venues, both state and federal" (Ireland, 1999, p. 157). This probably explains why, according to a recent survey, only U.S. government securities were used for discounting by 82% of the members of the National Association of Forensic Economics (Brookshire and Slesnick, 1993, pp. 36-37). Still, this standard is certainly not universally applied. Forensic economists can and do testify in personal injury cases in many legal venues using discount rates based on the investment returns available on securities that carry default risk, including municipal bonds, corporate bonds, annuities and corporate stocks.[2]

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[1]Ireland distinguishes between inflation "risk," which relates to the expected rate of inflation that is already embodied in the nominal interest rate, and inflation "uncertainty," which relates to the unexpected variance in the expected rate of inflation. (Ireland, 1997, pp. 24-25) Others have used the term "inflation risk" to mean the same thing as Ireland's "inflation uncertainty."

[2]A colleague of the author has testified on corporate stock returns in at least 10 different states.

It should also be noted that the *Pfeifer* opinion contains enough confusion that it seems unlikely to be the final word (see Breeden, 2002, p. 24). Judicial opinions can change in the face of persuasive economic arguments as well as changing economic circumstances, such as the increasing financial sophistication of the general public. For example, approximately half of all U.S. households now own mutual funds (Investment Company Institute, 2003, p. 41), and 90% of these households hold *equity* funds that represent 65% of their mutual fund portfolios (Investment Company Institute, 2003, p. 44). With so much financial information and advice now freely available in the mainstream news media and over the Internet, it might someday be concluded that investment in mutual funds does not necessarily require a high degree of "financial expertise or skill."

It is often argued that there should be no connection between the determination of an appropriate discount rate and an appropriate investment allocation of a damage award. (See, for example, Romans and Floss, 1992; Ireland, 1998) As Ireland has put it:

> No investment advisor would advise an award recipient to place a lump sum in a riskless investment of any sort....A reasonable investment allocation for most workers would include a significant fraction of common stocks. The fact that the discount rate...should be riskless does not imply that the award should be invested in a riskless fashion. (Ireland, 1998, p. 269)

Clearly, one possible basis for this view would be the case law from *Pfeifer* and similar rulings. However, the *economic* basis for this view is that the appropriate discount rate, rather than reflecting the prospective investment allocation of the award, should instead reflect the degree of risk associated with the future earnings stream that is to be discounted. This is discussed in detail in the following section.

III. Economic Arguments

Setting legal considerations aside, there has been an ongoing economic debate about the use of a risk-free discount rate. Jennings and Phillips (1989) have discussed the risk associated with deviations of *actual* future labor income from *expected* future labor income. To the extent that such deviations may occur, this would "call for the stream of expected labor earnings to be discounted by a higher, risk-adjusted rate." (Jennings and Phillips 1989, p. 123) Their survey of the literature indicates that labor is not a risk-free asset, and that investment in human capital is, in fact, subject to considerable risk. They quote other scholars to the effect that human capital is "probably more risky than physical capital."(Levhari and Weiss, 1974, p. 950)

Phillips (1989) has categorized the risks associated with labor income into non-systematic and systematic risks. Non-systematic risks are inherent in the individual employee and individual employer, while systematic risks are inherent in the overall economy. Examples of non-systematic risk offered by Phillips include skill obsolescence in the face of advancing technology or foreign competition, family emergencies, and even a possibility that a particular industry might exit from a region entirely. A further elaboration of non-systematic risk might include unanticipated health problems, changes in family structure due to childbirth, divorce, or the death of a spouse, and the relocation of offices, plants or production lines, all of which could adversely affect an individual's earnings. The one example of systematic risk offered by Phillips is the possibility of cyclical unemployment, but to this could be added variations over time in economy-wide productivity growth. Phillips has argued that the risks of labor income call for a discount rate somewhere in-between a risk-free rate (short-term Treasuries) and the total return on a diversified stock portfolio (e.g., the S & P 500), and he suggests as a first approximation the use of the AAA corporate bond rate. (Phillips, 1989, pp. 93-94)

Of course, some of the risks of labor income often are accounted for by adjusting the future earnings stream itself, and when this is done it would be "double-counting" to also adjust the discount rate for these same risks. Thus, the "LPE" method adjusts the earnings stream downward for the probabilities of death, non-participation in the labor force, and unemployment to obtain the *expected* earnings stream. But even so, Margulis (1992) has applied generally accepted principles of finance to reach the same general conclusion as Jennings and Phillips. Margulis emphasizes that "parity in risk" should be maintained between projected earnings and the discount rate. Only *actual* future earnings are risk-free, and they are not knowable. *Expected* future earnings are not risk-free. According to Margulis:

> To compute a lump-sum award for damages by discounting uncertain, albeit expected, future losses to present value by a risk-free interest rate may yield an award which is excessive and which unjustly enriches the plaintiff. The correct discount rate to apply is one which is risk-adjusted to counterbalance the forecast uncertainties associated with estimating future losses. (Margulis, 1992, p. 41)

This position has been challenged by Albrecht (1993, 1997), who has attempted to show, using simple algebra, that a risk-free rate should be used to discount expected earnings. Albrecht first assumes that the expected future loss has been calculated and is known. He then defines the problem as one of calculating a present amount such that the expected future value of this present amount equals the expected future loss. He then proceeds to demonstrate that this result can be obtained only through use of a risk-free rate.

Albrecht has been challenged, and Margulis supported, by Biederman and Baesemann (1996), who have argued that a risk-free discount rate should be used only in two very special cases: (1) when discounting *certainty equivalents*, or (2) when the decision-maker is indifferent to risk. A certainty equivalent could, in principle, be calculated as the expected future loss less an adjustment factor, with the latter set at the level such that the certainty equivalent would yield the same level of utility as would be obtained from the uncertain but expected income. If the future earnings stream being discounted does not consist of certainty equivalents, then the use of a risk-free discount rate would be justified only if the decision maker is indifferent to risk, i.e., risk-neutral. (Biederman and Baesemann, 1996, p. 46-47)

Henderson and Seward (1998) have also entered the fray on the side of Margulis. Albrecht explicitly assumed risk-neutrality, and Henderson and Seward demonstrate quite clearly that Albrecht's results do not hold if individuals are risk-averse. Since risk-aversion is the normal state of affairs, use of a risk-free discount rate will typically result in overcompensation of the plaintiff.

A similar, more recent discussion has occurred among Bell and Taub (1999), Ireland (1999) and Breeden (2002). Bell and Taub have taken Ireland to task for stating that, once the earnings stream has been adjusted for non-survival, non-participation in the labor force and unemployment, the use of a discount rate that includes a premium for default risk is incorrect in that it involves double counting of the risk that the worker would not earn the projected income. Bell and Taub have asserted that (1) there is no necessary equivalence between the risk of not earning the projected income and the risk of default on bonds, so reducing the projected earnings using the LPE method is not equivalent to raising the discount rate to incorporate the probability of default, (2) even if there were such equivalence, the LPE method does not cover *all* of the risks of the future earnings, e.g., variance in productivity growth, and (3) even if the LPE method *did* cover all of the risks of the future earnings, a risk-free rate should be used only for certainty equivalents.

In his response, Ireland has stated that his insistence on the use of a risk-free discount rate was primarily based on legal rather than economic grounds. Any adjustments to be made for the risk of labor income should be made to the earnings stream, not the discount rate, in order to comply with the law. (Ireland, 1999) In any case, it does seem clear that the LPE method does not adjust for all of the risks of future earnings. In addition to the uncertainty of future productivity growth that has been highlighted by Bell and Taub, there are a number of non-systematic risks that are not accounted for with this method. Even if an individual does not die, drop out of the labor force or become unemployed, he/she may experience an unanticipated reduction in earnings in the future for a variety of possible reasons. These might include developing health problems of the individual or family members, a change in family responsibilities due to a change in the family structure, skill obsolescence due to advancing technology or foreign competition, and relocation decisions of the employer.

While commenting on the dispute between Bell and Taub and Ireland, Breeden (2002) carries the discussion one step further by focusing on what he calls the "income-variance" risk factor. Two individuals might have identical expected future earnings streams, but the expected variance of the two earnings streams could be quite different. He offers the example of two brothers, one a free-lance financial advisor with a widely-fluctuating income and the other a university administrator with a much more stable income. He suggests that the two cases should not be treated the same, and that use of a risk-adjusted discount rate may be appropriate where the expected variance is high.

While clearly there are differences of opinion, the literature just surveyed does convey considerable support, on economic grounds, for incorporating risk into the discount rate due to the inherent riskiness of labor income. To date there has been little consideration of how risk might be incorporated into the discount rate or of what effect this might have in practice. The remainder of this paper seeks to fill this empirical void by showing the effect of basing the discount rate, in whole or in part, on returns available on "risky" investments of varying degrees of risk.

IV. Method and Data

Published surveys of forensic economics practice as well as an examination of the forensic economics literature indicate that the most common method used by forensic economists to estimate the present value of a future earnings loss involves the use of long-term historical averages of discount rates and earnings growth rates (see Brookshire and Slesnick, 1993, 1999). These average discount rates and earnings growth rates are used, either separately or after first being combined into a *net* discount rate, to calculate the present value of the future losses.

In this paper, this historical averages method is employed to generate net discount rates based on historical periods of various lengths (30, 20, 10 years) and based on the investment returns on securities of various degrees of risk (Treasury bills, intermediate-term government securities, long-term corporate bonds, large company stocks, a mixed portfolio). These net discount rates are then used to estimate the present value of a future earnings loss for future periods of 30, 20 and 10 years, respectively. The net discount rate is defined as

$$[(1 + R)/(1 + G)] - 1$$

where R is the average compound annual rate of return on investments over the historical period and G is the average compound annual compensation growth rate over the same historical period. In calculating the present value awards, it is assumed that investment returns are received and wages paid out at the end of each year and that the initial annual loss is $1,000, as measured in the year just prior to the first year of the future loss period.

The investment return data used in this study are the annual returns on Treasury bills, intermediate-term government bonds (constant five-year maturity), long-term (high-grade) corporate bonds and large company stocks covering the period 1972-2001 from Ibbotson's. (Ibbotson Associates, 2002) These returns are the *total* returns, including capital gains and losses as well as interest and dividends. Each of these four investment vehicles is considered separately and, in addition, a mixed portfolio is utilized consisting of 50% large company stocks, 30% intermediate-term government bonds, and 20% Treasury bills. This portfolio obviously represents just one of an infinite number of alternative asset allocations that might be considered. However, it was chosen to incorporate a significant component of "risky" securities while still representing a relatively conservative portfolio for a long-term investor with a moderate tolerance for risk.[3]

The labor earnings series used in this study to calculate earnings growth rates is the U.S. Bureau of Labor Statistics index of compensation per hour in the U.S. non-farm business sector. (See Jacobs, 2001 and *Economic Report of the President*, 2003.) Given the increasing importance of fringe benefits in the post-World War II period, a labor earnings series that includes fringe benefits seems clearly preferable to a wage-only series for calculating net discount rates.[4]

V. Risk, Net Discount Rates and Present Values

The main results of this study are summarized in Tables 1 and 2, each of which is comprised of three parts. Table 1-a shows, for the 30-year historical period, 1972-2001, the average compound annual rates of return on the various investments,[5] the average compound annual rate of growth in employee compensation,[6] and the corresponding net discount rates. These net discount rates are used to compute the present values shown for 30-year, 20-year and 10-year future loss periods. The net discount rates range from 0.73% when the "risk-free" Treasury bills are used to 6.01% when the riskiest alternative, large company stocks, are used. Of course, such a wide range of net discount rates produces a wide range of present values. In the case of the 30-year future loss, for example, the present value ranges from $26,855 with Treasury bills to just $13,750 with large company stocks.

Table 1-b shows the net discount rates and present values when the 20-year historical period, 1982-2001, is used to derive the net discount rates. Over this period the average return on Treasury bills was actually lower than for the 30-year historical period, although the average returns on government bonds, corporate bonds and stocks were significantly higher. When these various returns are coupled with the lower average compensation growth rate (4.35% vs. 5.88%), we find the net discount rates were markedly higher across the board, but much less so for Treasury bills compared to the other investments. As a result, in comparison to the case with the 30-year historical period, the present values derived from use of the various alternative investments are all much lower relative to the Treasury bill present values.

Table 1-c displays the outcomes when the 10-year historical period, 1992-2001, is used for the historical averages underlying the net discount rates.

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[3]Linke (1997, p. 248) recently reported data showing that corporate defined benefit pension plans held 56% of their assets in equities. A similar allocation is often recommended to individuals of moderate risk tolerance who are approaching retirement.

[4]Fringe benefits were minimal prior to World War II, but began to grow rapidly during the war and thereafter, so they now constitute a significant fraction of total employee compensation. See Kaufman and Hotchkiss, 2003, pp. 408-409.

[5]The compound average annual returns for the 30-year historical period reported in Table 1 were calculated from the annual return data in Ibbotson Associates, 2002, Table 2-5. The returns for the 10-year and 20-year historical periods are from Tables 2-9 and 2-11, respectively.

[6]The compound average annual growth rates in compensation for the various historical periods reported in Table 1 were calculated from the data in Jacobs, 2001 and Economic Report of the President, 2003.

During this period, the average compensation growth rate was lower than for the 20-year historical period (3.98% compared to 4.35%), but average returns were also lower on all investments, and net discount rates were lower across the board.

Table 1
Historical Net Discount Rates and Present Values
(Base Loss = $1,000)

1-a. Historical Period: 1972-2001						
				Length of Future Loss Period		
			1972-2001	30 Years	20 Years	10 Years
Investment Type	Ave. Return*	Comp. Growth**	Net Discount	Present Value	Present Value	Present Value
T-Bills	6.65	5.88	0.73	$26,855	$18,546	$9,610
Intermed. Gov't	8.50	5.88	2.47	$21,014	$15,633	$8,766
Corp. Bonds	8.99	5.88	2.94	$19,753	$14,960	$8,556
Large Stocks	12.24	5.88	6.01	$13,750	$11,461	$7,357
Portfolio	10.00	5.88	3.89	$17,525	$13,724	$8,155

1-b. Historical Period: 1982-2001						
				Length of Future Loss Period		
			1982-2001	30 Years	20 Years	10 Years
Investment Type	Ave. Return*	Comp. Growth**	Net Discount	Present Value	Present Value	Present Value
T-Bills	6.09	4.35	1.67	$23,447	$16,884	$9,140
Intermed. Gov't	9.88	4.35	5.30	$14,860	$12,151	$7,610
Corp. Bonds	12.12	4.35	7.45	$11,868	$10,233	$6,880
Large Stocks	15.24	4.35	10.44	$9,092	$8,264	$6,030
Portfolio	11.80	4.35	7.14	$12,237	$10,480	$6,978

1-c. Historical Period: 1992-2001						
				Length of Future Loss Period		
			1992-2001	30 Years	20 Years	10 Years
Investment Type	Ave. Return*	Comp. Growth**	Net Discount	Present Value	Present Value	Present Value
T-Bills	4.56	3.98	0.56	$27,545	$18,871	$9,699
Intermed. Gov't	6.73	3.98	2.64	$20,545	$15,385	$8,689
Corp. Bonds	8.09	3.98	3.95	$17,397	$13,651	$8,131
Large Stocks	12.93	3.98	8.61	$10,640	$9,388	$6,529
Portfolio	9.40	3.98	5.21	$15,011	$12,243	$7,644

*Based on data from Ibbotson Associates (2002).
**Based on data from *Economic Report of the President* (2003) and Jacobs (2001).

Table 2
Potential Overcompensation from Using Risk-Free Discount Rate

2-a. Basis for Discounting: Government Bonds			
Historical Period	Length of Future Loss Period		
Used For Discounting	30 Years	20 Years	10 Years
1972-2001	28%	19%	10%
1982-2001	58%	39%	20%
1992-2001	34%	23%	12%

2-b. Basis for Discounting: Corporate Bonds			
Historical Period	Length of Future Loss Period		
Used For Discounting	30 Years	20 Years	10 Years
1972-2001	36%	24%	12%
1982-2001	97%	65%	33%
1992-2001	58%	38%	19%

2-c. Basis for Discounting: Portfolio			
Historical Period	Length of Future Loss Period		
Used For Discounting	30 Years	20 Years	10 Years
1972-2001	53%	35%	18%
1982-2001	92%	61%	31%
1992-2001	83%	54%	27%

Before proceeding, another aspect of the data shown in Table 1 should be noted. Given the length of the future loss period, and given the investment vehicle, the estimated present value of the future loss varies considerably depending on the length of the historical period used as the basis for discounting. This suggests that any forensic economist who uses the historical averages method should select the historical period very carefully.[7]

VI. Potential Overcompensation

The data in Table 1 illustrate just how much difference it makes when a net discount rate based on a risk-free security (Treasury bills) is used instead of one of the risky alternatives. If use of a risk-adjusted discount rate is considered appropriate, then discounting with Treasury bills will result in overcompensation of the plaintiff. The present value figures in Table 1 have been used to derive the figures relating to potential overcompensation that appear in Table 2.

Suppose first that, based on legal considerations, it is considered inappropriate to expose the lump sum recipient to default risk but appropriate to expose him to moderate inflation risk. It might then be reasonable to base the discount rate on the returns on intermediate-term government bonds. Table 2-a illustrates the potential overcompensation from basing the discount rate on Treasury bills instead. For a 30-year future loss, we would over-compensate

[7]Others have found problems with the accuracy of the historical averages method. For two of the best studies, see Schilling (1985) and Haydon and Webb (1992).

the plaintiff by 28% if we use the 30-year historical averages to derive the net discount rate. The extent of overcompensation would be 58% if we use the 20-year historical averages, and 34% if we use the 10-year historical averages. For a 20-year future loss, the use of Treasury bills instead of intermediate-term government bonds would result in overcompensation ranging from 19% using the 30-year historical period to 39% using the 20-year historical period. For a 10-year future loss, the overcompensation would range from 10% to 20%.

Suppose next that it is considered appropriate, based on economic grounds, for the lump sum recipient to be exposed to a relatively low level of default risk as well as some inflation risk. The returns on high-grade corporate bonds might then be a reasonable basis for the net discount rate. (The default risk could be minimized through investment in an appropriate mutual fund.) Under these circumstances, if Treasury bills are used instead of corporate bonds as the basis for discounting, the extent of overcompensation will generally be even greater than in the previous case, as illustrated in Table 2-b. For a 30-year future loss it would range from 36% to as high as 97% , depending on the historical period used to derive the net discount rate. For a 20-year future loss, the overcompensation would range from 24% to 65% , and for a 10-year future loss, the overcompensation would range from 12% to 33% .

Finally, suppose that the appropriate level of risk for discounting purposes can be represented by the portfolio described earlier, consisting of 50% large company stocks, 30% intermediate government bonds and 20% Treasury bills. Table 2-c shows the potential overcompensation if Treasury bills are used instead of the portfolio as the basis for discounting. For a 30-year future loss the overcompensation would range from 53% to 92% depending on the historical period used to derive the net discount rate; for a 20-year future loss the overcompensation would range from 35% to 61%; for a 10-year future loss the overcompensation would range from 18% to 31%.

Other things being equal, the use of a risk-free discount rate maximizes the present value. If the use of a risk-free discount rate is inappropriate, then its use would result in overcompensation for the plaintiff. As these results show, the potential overcompensation in many cases could be very substantial.

VII. Concluding Comments

Where the use of a risk-free discount rate is clearly mandated by law, forensic economists must use a risk-free discount rate. This makes the determination of the appropriate discount rate a somewhat easier task. But forensic economists are retained as economic, not legal, experts, and should not presume anything about the law. And where the use of a risk-free discount rate is not clearly mandated by law, it is the responsibility of the economic expert to apply his/her expertise to a more thorough analysis of the appropriate discount rate. This would include consideration of the economic arguments for incorporating risk. By considering how returns on alternative investments of varying degrees of risk differ from the returns on Treasury bills, this paper has demonstrated that incorporating risk in a reasonable way into the discount rate can make a significant difference in the estimate of the present value of a lost future earnings stream. The results indicate that, under many circumstances, the failure to incorporate risk will result in substantial overcompensation for the plaintiff.

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