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Abstract

Valuing damage awards for personal injury or wrongful death requires the application of finance theory to achieve a practical result. Methods for discounting future earnings losses fall into two major categories: Current market rates, which offer greater objectivity, and historical rates, which theoretically offer greater stability of results by averaging away the effect of often volatile "current" market conditions.

The purpose of this paper is to provide a unique ex post comparison of damage awards using distinctive current and historical rates methods that highlight the inherent differences between the two major discounting alternatives. Current market rates methods are represented by a Treasury bond ladder with no instrument rollover, using initial market rates for both discounting and investing damage awards. Historical rates methods are represented by intermediate term government bonds; historical average five-year Treasury yields are used for discounting the damage award, with annual bond rollover required afterwards to maintain the award investment in comparable instruments, creating realized total returns from investing. These alternative methods are compared, ex ante in terms of the present value of the awards, and also ex post, in terms of how well each method's award, based on the same projected lost earnings, is able to support paydowns based on actual lost earnings.

Key findings include: (a) both methods result in widely varying lump sum awards; (b) the idea that historical rates offer greater stability of results over time is empirically unsupportable; (c) that a good measure of methodological accuracy is the relative variance in award present values observed by first discounting and then subsequently investing under each method using the same instruments; (d) that different economic conditions greatly affect the relative ex post accuracy of each method; and (e) that neither method is very accurate in projecting present value of earnings losses upon ex post analysis.

I. Introduction

The subject of how best to discount future economic losses in damage award cases has been analyzed by forensic economists for many years. Alt-

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hough many variations of discount rate methods exist, the most common methods employed by practitioners fall into two main groupings: current market interest rates and historical rate averages. Trends among the different methods have been tracked over many years via surveys of forensic economists. In the most recent survey on this question, historical average methods were the choice of 42.9% of the respondents vs. 32.2% of respondents choosing current interest rate methods, with the balance choosing some other method (Brookshire, Luthy and Slesnick, 2009, p. 18). Since these surveys began in 1990, the trend has been toward greater convergence in usage between these two most popular methods.

In this paper, the two main discounting approaches are represented as follows: (1) A Treasury bond ladder with no instrument rollover, using recent market rates for discounting and investing, and the present value of all earnings forecast-to-actual variances, vs. (2) intermediate term government bonds, using historical period average rates for discounting, and then rolling over comparable bonds each year to obtain realized total returns on investment and then computing the present value of earnings forecast-to-actual variances. The inherent tradeoff between these two approaches is the relative *objectivity* of using a ladder of current interest rates (with only a possible update of current rates at time of award settlement if they have materially changed), and the presumed greater *stability* of using historical rates. The market alone determines the impact of using a current interest rate ladder on the present value of an award, whereas a fair degree of subjectivity impacts the historical rate method, since the present value of an award depends greatly on the selection of which past period of historical observations to use for discounting, as well as on the specific instrument maturity selected.

The goal of this paper is to provide a unique way to compare the results from using these two alternative methods, *ex ante* in terms of the present value of the awards, and especially *ex post*, in terms of relative accuracy under different market conditions and forecast-to-actual earnings variances. This requires seeing how well lump sum awards based on the same projected lost earnings but discounted differently would be able to support paydowns based on actual lost earnings if the awards were invested in the same or similar instruments as used for discounting. The intermediate term bond approach in theory is more stable than current interest rates; if actually used to invest a damage award, it offers the potential benefit of interest rate risk reduction in times of rising interest rates due to higher than expected inflation. By contrast, investing a damage award in a current interest rate ladder allows less flexibility in responding to rising inflation and interest rates; but in exchange, it offers future interest income certainty from the initial investment, and if inflation and interest rates subsequently fall, a plaintiff reaps the benefit of having locked in above-market rates. This paper explores these tradeoffs in terms of the relative magnitudes of the awards before the fact, as well as their after-the fact relative accuracy under very different economic conditions. These tradeoffs are measured over three different 20-year "forecast" periods (1970-1989; 1980-1999; and 1990-2009), and using two different lookback periods for historical returns (10 and 20 years). This range of "forecast" and lookback periods comprises six very distinct scenarios, in contrast with a number of other studies that use numerous rolling time periods with overlapping years that may provide more robust conclusions, albeit with different methodologies for comparison.

Comparing results from these two distinct discounting methods over very different non-overlapping time periods of economic conditions, we will answer three specific questions:

How large are the differences in the ex-ante lump sum awards between the two methods?

Which method appears to be more accurate?

How and why does forecast accuracy between the two methods appear to change under different economic conditions?

II. Related Studies

Many forensic economists (FEs) use a single-maturity current interest rate for discounting, and a separate earnings growth rate for projecting future lost earnings. Other FEs combine the two measures into a single net discount rate (NDR)[1] for simplicity of analysis. Although many observers would agree that there is some linkage between interest rates and earnings growth rates, the existence of a yield curve with a changing slope over time implies that earnings growth cannot be adequately linked solely to changes in the rate of a single maturity instrument. Nonetheless, many studies have tried to address the relative accuracy of using current vs. historical interest rates, and these often compare results against a single number as the "observed" or "actual" NDR.

In two papers, Cushing and Rosenbaum performed among the most comprehensive analyses to answer this important question: Which method is able to forecast NDR with the most accuracy? (Cushing and Rosenbaum, 2006, pp. 139-159; Cushing and Rosenbaum, 2010, pp. 147-171, hereafter referred to as C&R). To do this, they compared not only current vs. historical interest rates but also their own proposed estimators. In their first study, using annual data they forecasted the five-year ahead average NDR, defined as $= r_t - g_t$, where r_t is the one-year U.S. Treasury bill rate and g_t is the annual growth rate of average hourly earnings in manufacturing (C&R, 2006, p. 149). The main question being tested in their paper was whether the NDR is stationary, which means that shocks are transitory and the series reverts to a long-term mean value, and thus estimates based on historical values are reasonable; if not "… then past observations have questionable predictive value and the best predictor of the next period's discount rate depends mainly on the current discount rate." (C&R, 2006, p. 139)

Numerous related earlier studies were referenced by C&R. A detailed review of these studies is beyond the scope of this paper, other than to summarize C&R's observation that the literature on the stationarity of net discount

[1]The net discount rate or NDR may be defined as $[(1+r)/(1+g)]-1$, where r is the interest rate used for discounting and g is the earnings growth rate assumed in deriving future period lost earnings. Sometimes this is approximated by r-g.

rates has very mixed conclusions.[2] In order to help resolve this question, in their 2006 study, C&R derived an optimal estimator of future NDRs that depends upon the forecast horizon and the time-series properties of the net discount rate process. After testing U.S. data from 1960-2000, C&R's found that both their compromise estimator based on equal weights to current and long term average NDRs, and their optimal but more cumbersome estimator, outperformed either the current value or long-term average NDRs for prediction purposes.

In their 2010 study, C&R built upon their earlier work and addressed two separate questions: (1) Whether the optimal and compromise estimators developed in their 2006 study outperformed professional forecasts of NDR, and (2) whether multivariate estimators that account for the potentially different time series behaviors that underlie changes in earnings and interest rates improve upon their earlier methods. C&R found that their compromise estimator once again performed best, in this case based on U.S. data over the period 1978-2003. Regarding the use of multivariate forecasts, C&R found that over the entire sample period, using the separate histories of interest rates and earnings growth did not materially improve forecasts of NDR, although it did do so for the most recent of the periods that were analyzed, 1990-2003 (C&R, 2010, pp. 163-169).

In 2008, Clark, et al. provided a review of research addressing the time series properties of the net discount ratio or NDR*[3] (Clark, et al., 2008, Table 1, p. 234), while proposing their own method of modeling the NDR* as a fractionally integrated process. They observed that economy-wide and sector NDR* are "long memory processes that are mean-reverting," i.e., that "[I]f shocked away from its historical average, a mean-reverting but non-stationary NDR* will eventually revisit this level (Clark, et al., 2008, p. 242). The studies cited in their literature review were mixed on NDR/NDR* stationarity, with structural breaks in NDR over time sometimes used to explain a return to stationarity. One study cited, Braun, et al., was the least convinced on this point, in which NDR was found to be "…nonstationary even after accounting for two structural breaks" (Braun, et al., 2005, cited in Clark, et al., 2008, p. 234).

Brian Brush has conducted three studies highly relevant to this topic (2003, 2004, and 2011). In each of Brush's studies, rather than directly testing the stationarity and mean reversion of NDR, he tried to determine relative accuracy among methods to estimate lost future earnings.

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[2]See Gamber and Sorenson, 1993 and 1994 for changes in their conclusions on NDR stationarity, and Horvath and Sattler, 1997, and Payne, et al., 1999, for studies that suggested regime changes or structural breaks over time in the NDR. Payne, et al., provided a cautionary note worth quoting from their study. After recognizing a mean reverting tendency for NDRs toward their "long-run mean level," they suggested that FE's need to

> …be aware of structural breaks in the data and use caution when applying averages of historical net discount rates….[and] If the structure of the economy has changed, then an average over the entire period (both pre- and post-periods), would be misleading as an indicator of the future course of the economy. (Payne, et al., p.222)

[3]Net discount ratio or NDR* is defined as 1/(1+NDR) where NDR is the net discount rate (Clark, et al., 2008, p. 232).

In the earliest of his three studies (2003), Brush used a method similar to Schilling (1985) in the latter's comprehensive historical period study (based on data dating back to 1871), but resolving what Brush considered to be certain data and methodological deficiencies. Brush developed 518 distinct cases involving various combinations of past and future time periods using ex ante and ex post historical averages for compound investment returns (Ibbotson, 2002)[4] and wage growth rates based on data from 1926-2001 and using two different instrument types (30-day T-bills and intermediate term government bonds). In each case he used a specified period's historical averages for both the compound investment returns on these instruments and earnings growth rates to estimate the present values of earnings loss as *foresight awards*, assuming that past behavior will be replicated in the future. Based on *actual* investment returns and wage growth rates over the relevant future period, he then calculated the lump sums required to replace wages as *hindsight awards*. Brush observed that for 30-year and 20-year future loss periods, investment returns and wage growth rates for various-length past periods "…would have resulted in large absolute forecast errors and an overwhelming bias in favor of plaintiffs." (Brush, 2003, p. 82) Brush cites a general upward movement in NDRs over time (implying non-stationarity) with the direction being a primary reason for overcompensation in hindsight, including biases resulting from Federal Reserve policy affecting interest rates (especially T-bills), and the use of a wage-only series rather than one which includes benefits that clearly rose more rapidly after WWII (Brush, 2003, pp. 99-102).

In his next study (2004), Brush compared the accuracy of various alternative methods to estimate the present value of lost earnings, not limited to historical averages methods. He updated an earlier study by Dulaney (1987, pp. 37-48) that tested different methods of forecasting lost earnings "compensation growth" (including fringe benefits) over 15 separate 20-year rolling forecast periods (the first from 1953-1972 and the last from 1967-1986). In Dulaney's study, four methods were compared in terms of estimated vs. actual present value of lost compensation, including: (1) a single base year method for compensation growth and interest rates (i.e., using the base year of loss period makes this closest to a "current rates" method); (2) a three-year base period average method for both of these measures; (3) the total offset method (compensation growth rate will equal future interest rates; and (4) historical averages method in which long-period (i.e., rolling 20-year) averages are assigned to both measures. Brush made one overriding observation: All four methods were substantially less accurate during the more recent set of 15 20-year periods (beginning from 1968-1987) than they were during the earlier set of 15 20-year periods from Dulaney's study (beginning from 1953-1967). The mean deviations were at least double in the later set of periods in Brush's study for all methods and more than quadruple for the three-year base method which Dulaney found to be the most accurate. Brush concluded that no single method

[4]This is the same data series used by the authors in this paper, updated through 2009.

could be claimed superior in terms of having higher degree of accuracy over long periods of time (Brush, 2004, p. 12).[5]

In his most recent study (2011), Brush used historical simulation to compare the accuracy of nine alternative methods of estimating the present value of future lost earnings, using the annual returns on 30-day T-bills and U.S. manufacturing wages from 1926-2008.[6] Without enumerating each method, they include essentially the same four methods as in his 2004 study, plus a second historical average method based on the entire 83-year data series, plus four combinations of the other methods. Brush observed that the historical averages method relying on the immediately prior period (HA-1 in his study), was the least accurate among methods, with the same overcompensation bias as he observed in his previous two studies. Brush concludes that his results "… provide some support for the use of an estimation method that combines historical averages with current or recent rates as suggested by the work of Cushing and Rosenbaum (2006, 2010), and Haydon and Webb (1992)." (Brush, 2011, p. 17)

There clearly are good reasons why no consensus exists in the FE community as to the preferred method of discounting damage awards. As many of the above studies indicate, it does not seem that there is a strong empirical basis supporting the supposed robustness of historical rate methods. Perhaps the main tradeoff between the methods remains the relative objectivity of current rate methods, especially a ladder of current rates, an issue addressed by Rosenberg (2010), vs. the supposedly greater robustness over time of historical rate methods, or perhaps a combination of methods.

III. Theoretical and Practical Issues in Comparing Methods

As shown in the above studies, there are many ways that the relative accuracy of historical vs. current interest rate methods can be compared. A key consideration in making comparisons is selection of the time period over which to observe current and historical interest rates as well as earnings growth rates. Based on the many studies cited above that recognize "breaks" in the relationship between earnings growth and interest rates, utilizing a single NDR for discounting, however convenient and widely utilized, remains theoretically questionable. Moreover, the requirement to incorporate a single maturity in-

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[5]Brush also noted that while the total offset method still had defenders, recent research studies have led to a near consensus against the use of the total offset method (see Brush, 2004, p. 11 for a list of defenders and opponents of this method).

[6]Brush notes that intermediate-term government bonds offer an alternative investment return series in lieu of T-bills, but says this is not suitable for either the current rates or base period methods due to their high volatility from capital gains and losses. (Brush, 2011, p. 9) The authors would add that historical period total returns on intermediate-term bonds would not be suitable for discounting damage awards under *any* method, due to the much higher volatility of total returns as compared with yields, as well as to the non-investability to earn total returns *ex ante* on a bond (i.e., one can lock in stated yields on a bond at time of investment, but one cannot lock in total returns). Instead, using historical average *yields* on such bonds is appropriate for estimating a damage award, *ex ante*; then utilizing total returns, *ex post*, is entirely appropriate to assess the relative accuracy of this method, as is presented later in this paper.

strument within an NDR imposes a subjective choice as to which instrument maturity is appropriate for inclusion.

Figure 1 shows 45 years of estimated NDR's based on the BLS series on earnings growth[7] applied separately to the average one-, three-, five-, and seven-year Constant Maturity Treasury (CMT) yields during each of those years.[8] With the benefit of hindsight it is relatively easy to see some of the historical breaks in NDR data series. It is also easy to see that the choice of maturity instrument, while important, is less critical to the results than the period over which the NDR is calculated, as the NDRs among the various maturity bonds tend to cluster closely over discrete time periods. The obvious question is whether using a longer term historical period for earnings growth and interest rate data will afford misleading comfort about NDR stability by virtue of the greater likelihood that the data series will span one or more break points. And although all four Treasury series exhibit similar patterns over time, the reality is that subjectivity cannot be avoided in selecting any one remaining maturity period for historical data.

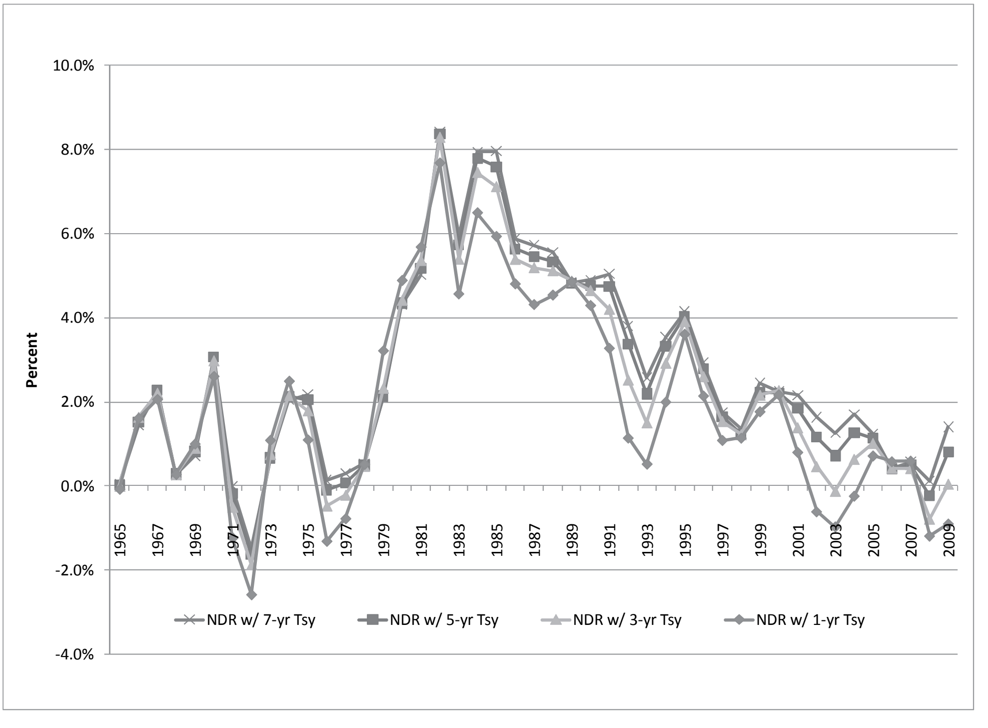

Figure 1. Net Discount Rates Based on Different Treasury Maturities

[7]See Economic Report of the President, Table B–47 (February 2010).

[8]See Board of Governors of the Federal Reserve System, Economic Research-Federal Reserve Bank of St. Louis, Treasury Constant Maturity series.

While the volatility exhibited above undermines the use of historical rates as being predictably mean-reverting toward a relatively stationary NDR, a separate issue undermines using a single NDR to represent current rate methods as well. Since each future cash flow should be discounted at the rate appropriate to its future time horizon, it is more theoretically correct to fully utilize the current yield curve and apply a series of interest rates with different remaining maturities equal to the individual future cash flows in order to properly discount projected lost earnings. If discounting is supposed to be based exclusively on *current* interest rates, this can only be achieved by using a ladder of current rates observed at time zero, with the mix of bonds maturities left outstanding at each future year based on the paydowns of each future period's lost earnings cash flow. This is one of the approaches taken in this paper, explained fully in the next section.

One practical consideration in comparing current vs. historical rates methods is how to test their relative accuracy in replacing a plaintiff's future lost earnings. It is widely recognized that how an award is later invested is in no way constrained by the discount method used to derive that award (Ireland, 1998). However, linkage between the discount rate(s) chosen to value an award, and the expected return on those same instruments over time is implicit; this is why courts have referenced the appropriateness of using rates for discounting from instruments that afford protection to the plaintiff from various risks such as default (*Jones & Laughlin Steel Corp. v. Pfeifer*, 462 U.S. 523, 1983). This paper suggests a practical way to link the results of discounting and investing based on the same instruments to shed light on relative accuracy between methods.

IV. Methodology

The central purpose of this paper is to offer a unique way of comparing, ex post, the relative accuracy of both methods based on actually investing lump sum awards derived, ex ante, in the same instruments used for discounting. To do this, two alternatives representing the current and historical rates methods, both using U.S. Treasuries, were employed: (a) a dedicated portfolio based on current interest rates observed prior to the analysis period, in which no instrument rollover is assumed for projection purposes; and (b) a portfolio based on average historical interest rates over some lookback period, in which yearly balance rollover is inherent. This allows us to compare the two methods ex ante, in terms of the relative size of their lump sum awards applicable to different historical periods of time, and ex post, in terms of how well each method would have been able to support paydowns based on actual lost earnings as the only fully objective point of reference.

1. Treasury Ladder without Rollover (T-Ladder)

The Treasury ladder (T-Ladder) approach used in this paper is one of several variations of the current market rate discounting method. A case was made in the prior section that creating a dedicated portfolio via a ladder of

Treasury notes and bonds is more theoretically representative of current rates applied to a time series of future cash flows instead of using a single net discount rate. More broadly, using a bond ladder at current rates (i.e., current yields) is the preferred representative of the current interest rate method. This is because:

Using a single maturity current market yield is inherently subjective in choosing that maturity.

A Treasury "ladder" of notes and bonds, all invested at time zero to match the cash flow maturities of the projected lost earnings, more accurately embeds the current term premia for different maturity Treasuries, as compared to a single maturity Treasury.

By definition, all yields in such a bond ladder are truly "current" market yields. Hence instrument rollover of remaining award balances at non-current market yields is not required to derive a lump sum award based on projected lost earnings (except for lost future earnings that would occur more than 30 years in the future).

Typically with this method, a series of recent market-observed yields are applied prospectively such that each period's projected earnings loss is discounted at its own objectively-obtained discount rate. The objectivity of using actual current market-observed yields is one of this method's primary virtues. In particular, the forensic economist avoids having to arbitrarily (or deliberately) select a specific historical period's average yield when discounting future economic losses.

For Treasury notes and bonds, market yields were observed mainly via the constant maturity treasury (CMT) series maintained by the Fed (Federal Reserve Bank of St. Louis, website).[9] Figure 2 shows a sample of CMT yields from 1969 through 2009, along with inflation as measured by the CPI-U, December to December. The linkage between inflation and Treasury yields over time is important to understanding how this method affects the present value of damage awards. Since inflation affects both earnings growth and the bond yields used for discounting, differences between inflation expectations and "actuals" for both earnings and bond yields will together influence the accuracy of awards for each method. As Figure 2 shows, while the linkage between inflation and bond yields is obvious, the timing can be variable; in particular, the precipitous decline in inflation beginning in the early 1980s was followed by a more gradual and uneven decline in bond yields over the decade.

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[9]The official Federal Reserve data series does not have any yield data for the 20-year CMT from January 1987-September 1993, and sporadically for other maturities. To obtain the average 20-year CMT yield for December 1989, an alternative Federal Reserve data source from its Divisions of Research and Statistics, although not an official Federal Reserve statistical release, was used (Gurkaynak, et al., 2006, see references for website). In this source, daily par coupon yields have been estimated since 1961 for most maturities up to 30 years from the prevailing Treasury yield curve, and like the CMT data are also available via a Federal Reserve website. Upon investigation of this source during other years when 20-year CMT yields were available, this alternative source of par yields was found to be much closer to those yields observed for the 20-year CMT than could have been obtained via interpolation between the 10-year and 30-year CMT.

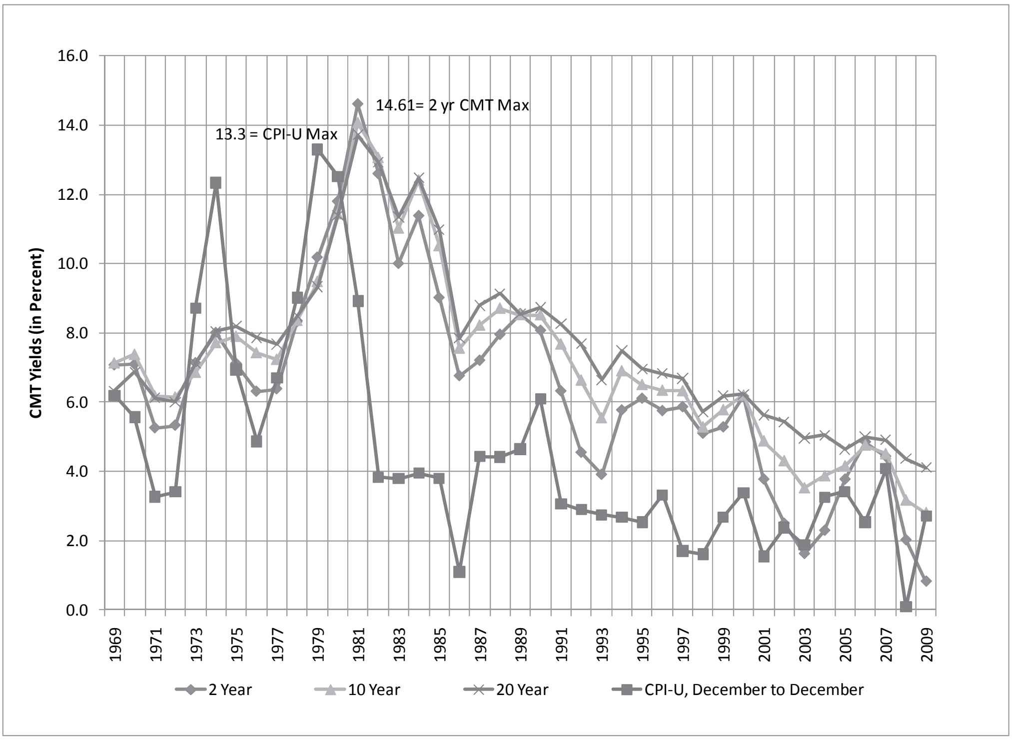

Figure 2. Constant Maturity Treasury Yields

For the year-specific discount rates employed with the T-Ladder method, we used the average yields for each maturity Treasury observed during the month of December immediately prior to each 20-year period for which we "forecast" lost earnings. After interpolation to obtain unobserved maturities, this series of discount rates was used with lost earnings projections based on the reference lookback periods in order to solve for the present value of a damage award. For example, if an FE were to derive the present value of an award on December 31, 1989 based on the FE's "forecast" of lost earnings over the period 1990-2009, the FE might use the current T-bond yields on that one last day of 1989. In order to minimize the chances of possible year-end noise in these data, in this paper we used the average T-bond yields during the month of December prior to the analysis period for discounting each of the next 20 years' lost earnings, in this case yields from December 1989. When applying this method in a real world case, one might prefer to use market yields observed on a single day, but using prior month market yields here should avoid any possible last day of the year market yield distortions.

The formula for deriving the present value of damage awards using the T-Ladder method is as follows:

$$\text{PV of T-Ladder Award} = \sum_{i=1}^{n} \frac{\text{Projected Earnings Loss}_{i,LBPeriod\,j,Scen.K}}{(1+\text{Weighted T-Bond Yield}_{0,i})^{i}}$$

where:

i = year of projected earnings loss, from 1 to 20
n = 20 (since all projections in this paper assume a 20-year loss period)
Projected Earnings Loss $_{i,LBPeriod\,j,Scen.K}$ = Loss projected in each year i, based on Lookback Period j in Scenario K = 1. The analysis period is 1970-1989, the Lookback Period is 10 years, the earnings loss each year i over the next 20 years is projected to grow from the base year (1969) Bureau of Labor Statistics (BLS) earnings amount at the compound annual growth rate over the prior 10 years, i.e., 1960-1969
Weighted T-bond Yield $_{0,i}$ = Weighted Average Yield on T-bonds observed at time zero (i.e., in December prior to first year), still outstanding during each year i

To assess how lump sum award results might change under various earnings growth and capital market conditions, we used three different 20-year forecast periods of damage award analyses (1970-1989, 1980-1999, and 1990-2009), and two different lookback periods (10 and 20 years) for key data and assumptions, explicit and implicit, such as historical earnings growth, inflation and Treasury yields. These are shown in Table 1.

In order to have a comparable 20-year lookback time period for earnings growth as for historical interest rates, it was necessary to extend the BLS mean earnings data for private, non-agricultural, non-supervisory workers, which was available only from 1964 onward. Census Bureau median wage and salary earnings data were used to extend the BLS series back to 1950.[10]

For each scenario, the precise mix of the T-Ladder bond maturities to be invested in was determined as follows. Each year's remaining award balance was calculated from the prior year's balance by incrementing it with the projected interest income on all outstanding T-bonds (with bond interest assumed to be paid annually, for simplicity), and then decrementing it at year end based on the paydown of each year's projected earnings loss from the applicable lookback period. Using the EXCEL Solver function, the solution for each scenario was derived such that the lump sum remaining after each year's increment and decrement resulted in a zero remaining award balance in exactly 20 years.[11]

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[10]Census Bureau median wage and salary earning data are available back to 1947 in its Income Data series, Table P-53. "Wage or Salary Workers (All) by Median Wage and Salary Income and Sex: 1947 to 2009," see references for website. Based on the fact that the BLS mean and Census Bureau median earnings growth rate exhibited a very stable relationship (i.e., BLS growth rates were 86.9% of Census growth rates from 1964-1980, and 86.6% from 1980-2009) the BLS earnings series was extended backward to 1950, assuming 87% growth rate from 1950-1964.
[11]Note that there is usually more than one solution that will satisfy these conditions, although the differences among them tend to be minimal. In any event, in order to minimize solution "noise," the initial weights entered for each bond maturity before invoking EXCEL Solver are set equal to 5%, which is 1/20 of the number forecast years and corresponding bond maturities.

Table 1
Key Scenario Data, Lookback Period vs. Forecast Period

			Earnings Growth			Inflation			Five-Year Treasury Note Yield		
Scenario	Scenario Lookback Period for Earnings Growth, Inflation, and Historical Rates	Scenario Forecast Period	Earnings Growth Rate, from Lookback Period (used in all forecasts)	Actual Earnings Growth Rate During Forecast Period	Actual less Lookback Period Earnings Growth Rate	Annualized Inflation Rates, from Lookback Period (impacting all forecasts)	Actual Annualized Inflation Rate During Forecast Period	Actual less Lookback Period Annualized Inflation Rate	Historical Average 5-Yr T-Note Yield, from Lookback Period	Actual Average 5-Yr T-Note Yield During Forecast Period	Actual less Lookback Period Average 5-Yr T-Note Yield
	10-Yr Lookback										
1	1960-1969	1970-1989	4.02%	5.28%	1.26%	2.52%	6.22%	3.71%	4.65%	8.89%	4.24%
2	1970-1979	1980-1999	6.45%	3.66%	-2.80%	7.36%	4.01%	-3.35%	7.38%	8.37%	0.99%
3	1980-1989	1990-2009	4.12%	3.05%	-1.08%	5.10%	2.73%	-2.37%	10.41%	5.12%	-5.29%
	20-Yr Lookback										
4	1950-1969	1970-1989	3.84%	5.28%	1.45%	2.37%	6.22%	3.85%	4.01%	8.89%	4.88%
5	1960-1979	1980-1999	5.23%	3.66%	-1.57%	4.91%	4.01%	-0.90%	6.02%	8.37%	2.35%
6	1970-1989	1990-2009	5.28%	3.05%	-2.23%	6.22%	2.73%	-3.50%	8.89%	5.12%	-3.78%

Although the award balance would become zero after 20 years based on paydowns of forecasted future earnings losses, if actual future earnings losses are different, there will be either a balance shortfall or surplus each year. These yearly balance shortfalls/surpluses from actual earnings are converted to 2009 dollars using the ratio of each year's CPI-U to the index value for 2009. The total of all inflation-adjusted shortfalls/surpluses by scenario, expressed as a percent difference of the award settlement balance, is a measure of forecast accuracy applied to the T-Ladder method,[12] as well as used for comparison with the historical interest rates method, described below.[13]

2. Intermediate Term Government Bonds with Rollover (IntGov)

The second discounting and investing method analyzed in this paper is that of Intermediate Term Government Bonds with rollover (IntGov). It is one of many historically-based discounting methods in which some average of multiple-year, historical period data are used instead of current market data. Here, unlike with a fixed ladder of bonds, the concept of rollover is central to the comparison being sought.[14] For discounting purposes, the historical yields on five-year CMTs are used to represent intermediate term government bonds,

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[12]The T-Ladder method would require many speculative assumptions if one were to instead assign additional borrowing costs to cover higher actual than projected earnings losses, or to account for re-investment of surplus interest if actual earnings losses were lower. In any event, such alternative treatment of earnings shortfalls/surpluses relative to forecast would undermine the point of comparing T-Ladder as one type of current rate method, for which method accuracy for discounting and investing requires funding projected earnings losses based on current interest rates only, without the need to rollover any bonds.

[13]Interest rates, inflation, and earnings trends may be drawn from very different economic conditions, which make any explicit linkage among them problematic. Forecasts of earnings growth rates in nominal dollars often reflect recent inflation, perhaps more than they reflect historical earnings growth rates and inflation over lengthy lookback periods. However, earnings growth rates observed after the fact are not necessarily more correlated with the inflation expectations embedded in current market yields than they are with historical average inflation. In this paper, we assume that future earnings growth rates should be informed by what they have been in the past; therefore, holding lookback periods constant within each scenario allowed us to generate a common set of projected future earnings growth rates, which in turn enables an ex post comparison of relative forecast accuracy between the current and historical rates discounting methods. This is why we tested results for both discount methods in each of three historical periods using both 10-year and 20-year lookback periods.

[14]Whether an FE chooses to discount a damage award using some historical period average yield of intermediate term government bonds as compared to some current yield method is a matter of professional choice. Regardless of how one derives the damage award, subsequently investing that award in intermediate term government bonds and maintaining the outstanding award balance each year in similar securities can benefit a plaintiff in two practical ways, especially if done via mutual funds:

- Ease of managing award: Due to the high liquidity of mutual funds, a plaintiff's uncertain future cash flows are more easily met by fund redemptions as needed, rather than by a predetermined schedule of Treasury redemptions.
- Less interest rate risk: Because an intermediate term bond fund rebalances constantly, it may incur lower interest rate risk than a predetermined ladder of securities, even if the average maturity of bond durations are relatively comparable to a bond ladder at time zero. Such a bond fund may not perform any better over a given future period than a current yield ladder, but the worst case circumstance might be mitigated, i.e., having locked in all rates via a ladder of bonds invested at time zero followed by sharply rising inflation that diminishes the purchasing power of future income generated at those time zero yields.

with the lookback periods for historical yields as discount rates being the same as those assumed for earnings growth in each of the six scenarios.

The formula used for deriving the present value of a damage award using the IntGov method is as follows:

$$\text{PV of IntGov Award} = \sum_{i=1}^{n} \frac{\text{Projected Earnings Loss}_{i,LBPeriod\,j,Scen.K}}{(1+\text{5-Year T-Note Yield}_{avg,LBPeriod\,j,Scen.K})^{i}}$$

where:

i = year of projected earnings loss
n = 20 (since all projections in this paper assume a 20-year loss period)
Projected Earnings Loss $_{i,LBPeriod\,j,Scen.K}$ = Same as in T-Ladder formula
5 Year T-Note Yield $_{avg,LBPeriod\,j,Scen.K}$ = Average yield observed (or derived by interpolation where needed) for five-year CMT notes during lookback period$_j$ for Scenario K. For example, in Scenario K = 1, the analysis is 1970-1989, and the Lookback Period is 10 years. Therefore, the average 5-Year CMT yield during 1960-1969 would be the discount rate used for all year in Scenario 1

To test the ex post accuracy of this method, consistent with the idea of being able to invest in the same instrument type as used for discounting, there is a need to observe actual total returns over the award lifetime (interest income plus price changes over the same year, resulting in capital gains or losses). The Ibbotson (2010) index series for Intermediate Term Government Bonds, which dates to 1926, does exactly that.[15] This series, while directly comparable to the five-year maturity Treasuries utilized for the historical method ex ante analyses, represents a slightly shorter average remaining maturity (and hence bond duration) as compared with present-day intermediate term government bond mutual funds which typically have average remaining maturities of between five and 10 years. Nonetheless the average total returns and correlation of the Ibbotson series with comparable intermediate term government bond mutual funds were similar.[16]

[15]Ibbotson's series is calculated as one-year holding period total returns, derived from single T-bond selected as the shortest non-callable bond with a maturity not less than five years.

[16]For the years 2000-2009, the Ibbotson data were compared with the average annual total returns of four mutual funds most theoretically comparable with it, and that had at least 10 years of performance data. Vetting of these funds for appropriateness was performed by reviewing the holdings and strategies as explained in their prospectuses. The annual returns of the four funds (VFIUX, DFIGX, DRGIX, and TRUSX) together had an average correlation with Ibbotson data of 99.0%, with the least correlated of these funds being 94.0%. The difference in annualized total return between the geometric average of these four funds and the Ibbotson index over the 10-year period of overlap was 17 basis points.

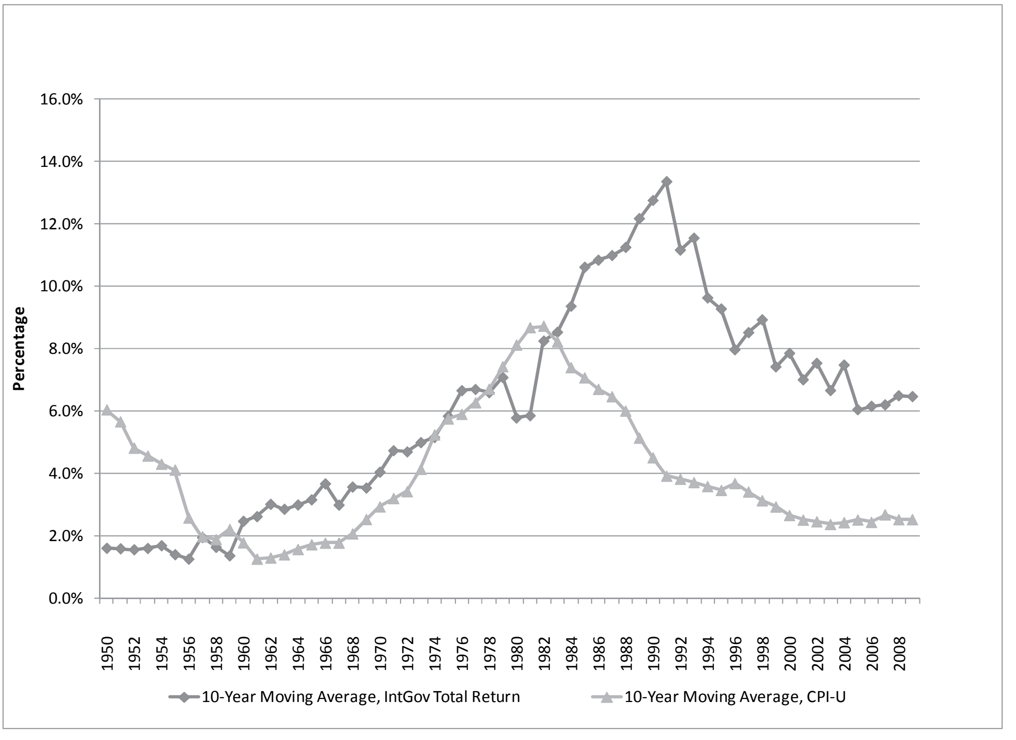

Figure 3. 10-Year Moving Averages: Total Returns on Intermediate Term Government Bonds and Inflation (CPI-U, December to December)

Since coupon rates are locked in at time zero on a ladder of current yielding bonds, subsequent inflation clearly affects the realized return after the fact. Therefore, it is worth assessing how much subsequent inflation correlates with the total returns on a portfolio of intermediate term government bonds. The correlation between annual IntGov total return and concurrent inflation (CPI-U, December to December) since 1950 is a negligible .015. However, to better sort out the year-to-year noise, 10-year moving averages of the total returns on the InvGov series and inflation are shown in Figure 3. This clearly shows the correlation of IntGov total returns with inflation. This correlation is .38 from the period beginning in 1950, and rises to .51 if we begin the correlation period in 1957, after the post-war inflationary effect of the end of rationing is eliminated from the 10-year moving average on bond yields and hence, total return. Thus, while a ladder of current yield Treasuries clearly is exposed to inflation risk, so is a portfolio of IntGov bonds that maintains close to a five-year remaining maturity.

Unexpected inflation is a leading risk to plaintiffs by affecting the purchasing power of cash flows generated from investing damage awards in order to replace lost future earnings. How much bond rollover mitigates inflation risk, which is a close corollary to interest rate risk, is central to this paper's ex post comparison between discounting methods. Inherent in the IntGov method is that bonds must be rolled over each year to maintain the same basic intermediate term characteristics, hence reducing the interest rate risk of having bond duration becoming too short or too long. However, because the two methods result in different lump sum award amounts, the question is whether bond rollover has a greater or lesser impact on the accuracy of the lump sum award in terms of not over- or under-compensating the plaintiff in light of actual earnings losses.

To analyze this, we solve for the PV of award adjustments expressed in 2009 dollars between the two methods by substituting actual earnings losses for projected earnings losses, and in the case of the IntGov method, also factoring in annual total returns via bond rollover to maintain equivalent maturity bonds as were used for discounting. Unlike the T-Ladder method, the rollover inherent in the IntGov method creates new total return results each year that incorporate buying and selling to maintain intermediate term government bond characteristics throughout the 20-year projected loss horizon. Observed total returns were applied to the projected remaining award balance each year and then decremented by each year's "actual" earnings loss. This enables calculation of an annual shortfall or surplus relative to projection that is comparable to those derived with the T-Ladder method.

V. Results

Table 2 summarizes the primary comparative results of this paper.[17] Columns A-D contain scenario and actual-less-projected earnings data common to both methods being compared; Columns E-I contain T-Ladder-specific results; Columns J-O contain IntGov-specific results; and Columns P-Q contain direct comparisons between the two methods. These results are discussed by way of answering the three specific questions raised in Section I.

1. How large are the differences in the ex-ante lump sum awards between the two methods?

Comparing Columns G and L, the PV of award settlements, all converted into 2009 dollars, the IntGov method exhibited a somewhat wider range than T-Ladder, with the lowest value of $324,473 (Scenario 3) being less than half of the highest value of $669,406 (Scenario 4). Column P shows the percentage difference in the PV of awards, with IntGov ranging from 29% to 47% higher than T-Ladder in the two earlier forecast periods, and ranging from -7% to -17% lower than T-Ladder in the most recent forecast period. Perhaps unsurprisingly, having a longer lookback period (Scenarios 4, 5 & 6) does not appear to mitigate the magnitude of difference between methods in PV of lump sum awards.

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[17]A set of detailed results for Scenario 1 covering both methods is presented in Appendix Tables A-1a and A-1b. Comparable results as shown in these tables were obtained for the other five scenarios. They are not included in this paper but are available on line at *JFE* as Supplemental Material to this paper.

Table 2
Comparative Damage Award Results: Treasury Ladder with No Rollover vs. Intermediate Term Government Bonds with Rollover

Key Assumptions:	Treasury Ladder, no rollover ("T-Ladder")	Intermediate Term Govt Bonds w/ rollover ("IntGov")
Earnings Growth	Apply lookback period infl. (CPI-U) to "forecast" earnings	Same as for T-Ladder
Discounting (to Obtain PV of Award)	Apply CMT Tsy yields from December of prior year for each lookback period	Apply average historical yield of 5-year T-note for each lookback period
Investing	Invest PV of award at prior December average yields; maturity mix derived by paying down award to zero. PV of earnings shortfalls/surpluses vs actual are computed yearly with CPI-U to get end-balance adjustments	Invest PV of award at historical average yields for same lookback period as assumed for discounting, with projected award paydown to zero. PV of shortfalls/surpluses from actual earnings *and* IntGov total returns are computed yearly with CPI-U to get end-balance adjustments

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Scenarios			Earnings	Treasury Ladder (no rollover) †					Intermediate Term Govt Bonds w/ rollover ††						Comparisons	
#	Lookback period for inflation and Total Return on Int. Term Bonds w/ rollover	Period over which Future Earnings Losses are Projected	Actual less Projected Earnings Growth Rate	Discount Rate Implied from Projected Earnings Growth & T-Ladder Yields	PV of Award w/ T-Ladder, in Beg. Year's dollars	PV of Award in 2009$: Col F x CPI Ratio (2009/beg yr $)	PV of Award Adjustments due to Actual vs. Projected Earnings, 2009$	Award Adjustments as % of Award	Discount Rate, Average Historical Rate on 5-Year Treasury During Lookback Period	PV of Award w/ InGov, in Beg. Year's $	PV of Award in 2009 $: Col K x CPI Ratio (2009/beg yr $)	Actual Average Total Return During 20-yr "forecast" periods	PV of Award Adjustments due to Actual vs. Projected Earnings, & Actual Total Returns vs. Projected Yields, 2009 $	Award Adjustments as % of Award	% Diff. in PV of Award, IntGov over T-Ladder: (Col. L / Col. G) - 1	Absolute Value Difference in % Total PV of Adjustments, IntGov less T-Ladder: Abs(Col. O) - Abs(Col. I)
	10 Years															
1	1960-1969	1970-1989	1.26%	7.38%	91,474	496,322	(111,517)	-22%	4.65%	117,910	639,760	9.42%	123,084	19%	29%	-3%
2	1970-1979	1980-1999	-2.80%	10.35%	164,441	411,481	174,813	42%	7.38%	214,636	537,084	9.53%	416,391	78%	31%	35%
3	1980-1989	1990-2009	-1.08%	8.09%	242,991	392,179	69,623	18%	10.41%	201,040	324,473	6.77%	(60,425)	-19%	-17%	1%
	20 Years															
4	1950-1969	1970-1989	1.45%	7.38%	89,939	487,997	(120,832)	-25%	4.01%	123,373	669,406	9.42%	156,954	23%	37%	-1%
5	1960-1979	1980-1999	-1.57%	10.36%	147,856	369,981	79,288	21%	6.02%	217,304	543,761	9.53%	395,167	73%	47%	51%
6	1970-1989	1990-2009	-2.23%	8.11%	269,445	434,875	159,517	37%	8.89%	251,451	405,834	6.77%	80,204	20%	-7%	-17%

† In T-Ladder method, projected earnings losses are discounted to present value (Col. F) using current market yields for remaining maturity Treasury bonds observed on average during each December prior to the first projection year. The maturity mix of Treasury bonds was solved to fully pay out projected earnings over time. A single implied discount rate (Col. E) is solved for based on the award present value. No assumptions about bond rollover are made so that *only* current yields are used for both discounting and investing, thus avoiding the subjectivity of satisfying, ex post, each period's earnings shortfalls or surpluses (relative to projected earnings) by choosing some mix of new bond maturities that must be borrowed at or invested in. Instead, each year's earnings shortfalls/surpluses relative to "actuals" result from actual vs. projected earnings, and are present-valued at the appropriate CPI-U to obtain results in 2009 dollars (Col. H).

†† In the IntGov method, projected earnings losses are discounted to present value (Col. K) using average historical 5-year T-note yields based on lookback period (Col. J). Annual bond rollover is required to maintain roughly the same average bond maturity for the remaining award balance. Since a plaintiff must re-invest yearly at prevailing rates, each year's total return (interest income plus capital gains/losses) was obtained by bond rollover and applied as yearly investment income to the projected remaining award balance. Annual shortfalls/surpluses result from two factors: (a) actual vs. projected earnings and (b) total returns vs. the historical average yields used for discounting. Present value of shortfalls/surpluses are computed in 2009 dollars (Col. N).

2. Which method appears to be more accurate?

This question can be answered in at least two different ways:

(a) Which method is more accurate in terms of having lower annual adjustments as percentages of lump sum award amounts, after paying down actual rather than projected earnings?

Columns H and N contain the present value of award adjustments in 2009 dollars. These adjustments are due to actual rather than projected earnings losses for both the T-Ladder and IntGov methods. For the IntGov method only, these adjustments also include the added impact of rollover via the actual total return of intermediate term government bonds rather than the historical average yield on five year Treasury bonds used for discounting.Columns I and O present these award adjustments as percentages of each scenario's projected award. In Column I, award adjustments using the T-Ladder method ranged from −25% to +42%, while in Column O, these adjustments using the IntGov method ranged from −19% to +78%. In terms of magnitude of percentage award adjustments, the IntGov method had by far the two largest, +78%, and +73% (shown in Column O), both for the middle analysis period of 1980-1999. Columns I and O are combined as a single measure in Column Q, showing the difference in absolute value of percentage award adjustments, IntGov minus T-Ladder. In Scenarios 1, 4, and 6, the T-Ladder absolute value of percentage award adjustments were larger, and in Scenarios 2, 3, and 5, the IntGov percentage award adjustments were larger.

Based on the relative magnitudes of difference, the T-Ladder method appears to be somewhat more accurate, although these results only represent a limited number of scenarios. One should not overstate the certainty of this conclusion, just as other analysts of the same issue have recommended. Since the reasons for these results are complex, it is useful to explore the circumstances under which forecast accuracy seems to change, and the reasons why, which are addressed in answering Question 3. However, before doing so, a second measure of accuracy based on the Dulaney-Brush approach is considered in the part (b) variation on Question 2.

(b) Which method provides a more accurate net discount rate and lump sum award relative to some "objective" measure?

It is worth a reminder that there is no perfectly objective "actual" present value or net discount rate to observe after the fact. Nonetheless, it is instructive following the approach which Dulaney originated and Brush replicated in his comparison of discount methods (explained in Brush, 2004, pp. 13-14). Although the Dulaney-Brush approach does not measure forecast accuracy in terms of seeing how well each method is able to support paydowns based on actual earnings losses, it posits a quasi-objective "actual" present value for each forecast period, and similarly, a quasi-objective NDR for each of the three time periods of analysis. However, the Dulaney-Brush method derives these quasi-objective values only from actual earnings and actual ex-post Treasury yields.[18] This excludes the full bond rollover impact on method accuracy resulting from annual *total returns*, which is highly relevant to any method that explicitly requires bond rollover. Instead, the Dulaney-Brush method only reflects the interest income effect on the award balance by substituting each year's actual average Treasury yield for the historical average Treasury yield used for discounting. It does not reflect the capital gains or losses from bond rollover that would occur if, during each year, actual outstanding bonds were sold and replacement bonds purchased in order to realize each year's actual yields from investing the award in the same remaining maturity instrument.[19] That is because a real bond portfolio that maintains the same approximate maturity over time requires annual bond sales and repurchases to obtain annual interest income at each year's prevailing yield for roughly the same maturity bonds. This is why only total return provides a complete measure of ex post bond portfolio performance, since it is comprised of annual interest income plus capital gains or losses from bond rollover.

Despite its limitations, a slightly modified version of the Dulaney-Brush approach was used in this paper to generate "actual" NDRs and present values of lost earnings as "accuracy" benchmarks for comparison with the T-Ladder and IntGov methods, shown in Table 3. For the first analysis period 1970-1989, the "actual" present value of lost earnings was estimated to be $102,257 in current dollars at the beginning of the forecast period. Table A-2 in the Appendix shows how this was calculated (applicable for both Scenarios 1 and 3, since lookback period is irrelevant for actual earnings and yields). The same procedure was applied to the other two analysis periods. As shown in the last two columns of Table 3, the T-Ladder method was more accurate than the IntGov method when compared via the Dulaney-Brush analytical approach, since it exhibited lower absolute values of variances in both NDR and in PV of award for all scenarios, based on the actuals for these measures calculated as described.

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[18]Another element of quasi objectivity enters via the selection of what instrument maturity yields or "interest returns" are assumed for actuals. In his 2004 study, Brush used the actual average yields on three-year Treasury notes, but in his 2011 study, Brush used what he calls the "interest return" on 30-day T-bills (Brush, 2011, p. 20), which actually is the Ibbotson total return series on 30-day T-bills, albeit almost the same as interest returns, given the short maturity of the instrument. The point is that instrument selection for "actuals" remains arbitrary.

[19]Omission of capital gains/losses in fact can seriously affect the ex post accuracy of investing in an intermediate term bond portfolio. Using the Ibbotson series data to decompose the yearly total returns from rolling over the outstanding T-bond with at least five-years remaining maturity, the average total capital appreciation returns in the absolute value were large at 3.64%, 5.75%, and 5.30% during the three decades of 1970-1979, 1980-1989, and 1990-1999, respectively. Moreover, these capital appreciation returns were significant relative to the income returns on those bonds, representing 52%, 65% and 85% in those three decades. While Brush's later approach in his 2011 study did use total returns instead of yields, the fact that he chose 30-day T-bills as the instrument to represent ex post "actuals" means that the capital gains/losses component would be negligible. Brush calls these "interest returns" (2011, p. 16), but Ibbotson only publishes "total returns" for its T-bill series, unlike intermediate term bonds which have separate income and capital appreciation returns. In any case, whether total returns, interest returns, or current yields were used would have little effect on measuring "accuracy" if the arbitrary selection of the instrument for measuring accuracy was 30-day T-bills, unlike the selection of intermediate term bonds.

Table 3
Net Discount Rate and Award PV "Actuals" (latter as ratio) vs. Projections (1)

Common Assumptions to Both Methods in Deriving "Actuals"									T-Ladder/Current Rate Method ††				IntGov/Historical Rate Method				Comparison of Methods	
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Scenario	Lookback period for Earnings Growth	Period of Projected Earnings Loss	Projected Earnings Growth Rate, from Lookback Period	Actual Earnings Growth Rate	Projected less Actual Earnings Growth Rate †††	Derived "Actual" "Discount Rate, from Actual Earnings & Each Yr's 5-Yr T-Note Rate	Derived "Actual" Net Discount Rate *	Derived "Actual" Present Value of Earnings Losses	Discount Rate Implied from Projected Earnings Growth & T-Ladder Yields	T-Ladder "Projected" Net Discount Rate (Implied from yield curve)	T-Ladder Projected (implied) less "Actual" Net Discount Rates	Ratio of Award PVs, Projected /"Actual"	Discount Rate from Projected Earnings Growth & Historical 5-yr T-Note Yield	IntGov Projected Net Discount Rate	IntGov Projected less "Actual" Net Discount Rates	Ratio of Award PVs, Projected /"Actual"	Absolute Value of Variance from "Actual" NDR, IntGov less T-Ladder **	Absolute Value of Variance in PV Ratio to Actual, IntGov less T-Ladder ***
	10-Yr Lookback																	
1	1960-1969	1970-1989	4.02%	5.28%	-1.26%	8.17%	2.74%	102,257	7.38%	3.23%	0.49%	0.89	4.65%	0.61%	-2.13%	1.15	1.64%	0.05
2	1970-1979	1980-1999	6.45%	3.66%	2.80%	9.98%	6.09%	140,385	10.35%	3.66%	-2.44%	1.17	7.38%	0.87%	-5.23%	1.53	2.79%	0.36
3	1980-1989	1990-2009	4.12%	3.05%	1.08%	5.93%	2.79%	267,669	8.09%	3.81%	1.02%	0.91	10.41%	6.04%	3.24%	0.75	2.23%	0.16
	20-Yr Lookback																	
4	1950-1969	1970-1989	3.84%	5.28%	-1.45%	8.17%	2.74%	102,257	7.38%	3.41%	0.68%	0.88	4.01%	0.17%	-2.57%	1.21	1.89%	0.09
5	1960-1979	1980-1999	5.23%	3.66%	1.57%	9.98%	6.09%	140,385	10.36%	4.87%	-1.22%	1.05	6.02%	0.75%	-5.35%	1.55	4.13%	0.49
6	1970-1989	1990-2009	5.28%	3.05%	2.23%	5.93%	2.79%	267,669	8.11%	2.68%	-0.11%	1.01	8.89%	3.43%	0.64%	0.94	0.52%	0.05

† This table is based on extending the same methodology used by Dulaney-Brush (Brush, 2004, pp. 13-14). In this approach, "actual present value" (i.e., a purportedly objective lump sum award derived after the fact) was solved over the relevant time period by adding interest earned each year at the actual three-year Treasury rate on the outstanding award balance minus each year's actual compensation, such that the award balance would pay down exactly to zero in the last year of the award life. This was used in a ratio of estimated (or projected) vs. "actual" PV in order to compare relative accuracy among methods. Only two minor methodology changes were made here compared with Dulaney-Brush: (1) Instead of using each year's average 3-year Treasury rate, we use average 5-year Treasury rates in order to be more consistent with intermediate term government bonds contained in the Ibbotson series; and (2) instead of actual total compensation we used actual earnings.

†† For the T-Ladder method, in order to compare NDR's, a single discount rate is solved for in lieu of the ladder of actual time zero Treasury rates, both of which pay the same lump sum down to zero.

††† Note that the values in Column F are the same as those in Column D in Table 2, except for having the opposite sign . This is done here to be consistent with Brush's approach, in which he expresses all differences or ratios in terms of "Estimated" (i.e., projected) minus or divided by "Actual" values.

* Actual" net discount rate is calculated as [(1+r)/(1+g)]-1, where r= actual interest rate for discounting the award to PV, from Column G, and g = actual earnings growth rate, from Column E.

** Calculated as absolute value of Column P less the absolute vaue of Column L.

*** Calculated as the absolute value (Column Q - 1) less the absolute value of (Column M - 1).

Since NDR is a derived value that is used to obtain the PV of an award, we consider the variances in PV of the award vs. the "actual" PV of the award to be the more important measure of the two, shown in the last column (Column S) of Table 3. It shows that the two methods are relatively close in absolute value of PV of award variances in Scenarios 1 and 6; however, the IntGov method appears to be much less accurate in the other scenarios, especially Scenarios 2 and 5, the same middle analysis period, 1980-1999, for which it also appears the least accurate as measured in Part (a) of this subsection.

It must be noted that in a separate analysis (not shown here) there was little difference in the Table 3 results if one used the three-year remaining maturity Treasury bond as Brush did in his 2004 study, instead of the five-year remaining Treasury bond that was ultimately applied in Table 3. This is not surprising; as Figure 1 showed previously, although net discount rates are variable over time, they are similar across many bond maturities (e.g., the three-, five-, and seven-year Treasuries) at any point in time.

Whether or not the Dulaney-Brush method of deriving an "actual" ex post PV of an award is the preferred means of assessing methodological accuracy is a separate issue entirely. As noted above, substituting actual Treasury bond yields each year to earn interest on remaining award balances clearly captures the *interest income effect* of "actual" rates; it does not capture the "actual" *capital gains and losses effect* from switching between investment instruments each year, which is necessary to obtain new instruments with the same characteristics that generate "actual" yearly interest income. An argument can be made that perhaps there is no single "actual" present value of a damage award that should apply ex post in all cases, since how one might invest a damage award, consistent with the discounting instruments chosen, will result in different levels of interest rate risk incurred. Moreover, it is well established in finance that identical compensation should not be expected for incurring different levels of risk. Since the levels of interest rate risk are not equal between a ladder of bonds with all yields locked in at time zero vs. a bond portfolio that rolls over every year, it is problematic to compare their results against a single "objective" award present value. A better comparison might be to see which method that both discounts and invests in the same instruments serves to produce, ex post, yearly income amounts closest to actual earning losses with lower cumulative shortfalls or surpluses. This is the analytical approach employed previously in Table 2, and it is the focus for answering the remaining question.

3. How and why does forecast accuracy between the two methods appear to change under different economic conditions?

To answer this question, it is important to understand the different reasons why adjustments to awards become necessary under the two discount rate methods. Both methods have in common the difference between forecasted and actual earnings growth rates. However, if only for analytical purposes, consistency within each method requires *discounting and investing* with the same instruments appropriate to each method. Therefore, using an historical interest rate method requires initially investing the award at a market rate and then rolling over unused balances each year to maintain similar funding characteristics over time, even if actual and forecasted earnings were identical. By contrast, current rate methods such as the T-Ladder are intended to lock in current interest rates in the interest of objectivity and the certainty of obtaining nominal cash flows based on forecasted lost future earnings. Some rollover of award balances would likely occur if either method were used to invest a lump sum damage award. However, such rollover would be far greater with the IntGov method, because the intention is to annually rebalance remaining funds to have the same intermediate bond maturity over time.

As explained in the methodology section, each period's different economic conditions are reflected through actual earnings and interest rate changes after inception via the cumulative annual earnings shortfalls or surpluses relative to forecasts, all converted to 2009 dollars. How and why forecast accuracy differs between the methods based on the first definition of accuracy (Question 2, Part A, with results shown in Table 2) is best seen by focusing separately on each distinct time period of analysis, as follows:

1970-1989, Scenarios 1 and 4: Relative accuracy is close between the methods for this period but with opposite signs. Higher actual earnings growth than projected (Table 2, Column D) in both scenarios (+1.26% and +1.45%, respectively), other things being equal would create balance shortfalls for both the T-Ladder and IntGov methods. However, the actual total return (geometric mean) on intermediate term government bonds during this 20-year period was relatively high at 9.42% (Column M), more than double the historical average five-year T-note rates used for discounting in both scenarios (Column J). This extremely positive rollover effect in both scenarios relative to the low historical rates used for discounting creates surplus income (coupon interest plus capital gains) in most years for the IntGov method. This rollover effect more than offsets the negative earnings growth effect and provides very large positive PV of award adjustments. Taking earnings growth and rollover together, these result in a net of surplus adjustments for IntGov vs. only shortfall adjustments for the T-Ladder method due to higher earnings growth alone. (For IntGov and T-Ladder, respectively, these adjustments were +19% vs. −22% in Scenario 1, and +23% vs. –25% in Scenario 4, shown in Columns O and I). Column Q merely expresses these differences in absolute value as an indication of relative forecast accuracy, in which the two methods are roughly comparable, albeit with opposite sign award adjustments.

It must be emphasized that there is no comparable rollover effect with the T-Ladder method. The fact that the T-Ladder's 7.38% implied discount rate[20] in Scenarios 1 and 4 (Column E) exceeded the average historical rates on five-

[20]A single implied discount rate is solved for using the same PV of award already derived from all individual T-Ladder bond maturities and yields. Note that these implied discount rates shown in Column E are similar but not the same for each pair of scenarios with the same analysis period due to the different scenario lookback periods for earnings growth. Different earnings growth rates result in different mixes of the same T-Ladder bond maturities and yields, from which the different PV of awards arise.

year T-notes in both scenarios (Column J) served mainly to generate lower ex ante PV of awards for the T-Ladder method than IntGov (Column P).

1980-1999, Scenarios 2 and 5: Relative accuracy is most discrepant between the methods for this period, with IntGov being by far the less accurate in these scenarios. Here, lower actual than forecasted earnings growth in both scenarios (−2.80% and −1.57%, Column D) had the opposite effect from the prior analysis period, and created surpluses rather than shortfalls for both the T-Ladder and IntGov methods from 1980-1999. The actual total return on IntGov bonds during this period was highest at 9.53% (Column M), and again exceeded the historical average five-year T-note rates used for discounting in both scenarios (Column J). Since inflation fell dramatically especially in the early years of this period, it is not surprising that lower actual than projected earnings growth rates were accompanied by lower actual than projected interest rates. The effects of substantially lower actual earnings growth and very high annualized bond rollover returns were both highly positive in creating surplus adjustments to the award PV for the IntGov method, i.e., +73% to +78% of the award PV in both scenarios (Column O). The T-Ladder method also had positive earnings growth effects, but no rollover impact, other than having the present value of earnings "surpluses" relative to projections in 2009 dollars, effectively earning each year's compound rate of inflation. The T-Ladder method experienced +42% and +21% in PV of award adjustments in the two scenarios (Column I).

The absolute value differences in PV of award adjustments between IntGov and T-Ladder are the largest among the six scenarios for this middle analysis period, shown in Column Q (+35% and +51%). These magnitudes are largely the result of IntGov having *complementary impacts* (i.e., positive income variances from both earnings growth and rollover), as compared with T-Ladder which is impacted mainly through variances in earnings growth. (This contrasts with the earlier analysis period of 1970-1989, in which the earnings growth and total return impacts were offsetting for the IntGov method.)

Even though the geometric mean total returns for IntGov bonds were similar for the two analysis periods (9.42% during 1970-1989, and 9.53% during 1980-1989), the extent of award adjustment in the latter period was also impacted by the timing of inflation changes affecting earnings growth and interest rate changes. As shown earlier in Figure 2, from 1970-1989, inflation and interest rates first rose before declining, whereas from 1980-1999, inflation and interest rates both declined precipitously after peaking around 1980. The fact that both inflation and interest rates peaked in the early 1980s and began sharp descents thereafter meant that a damage award invested in 1980, based on higher lookback period projections of earnings growth as compared with 1970 would experience a much larger windfall from investing starting around 1980.

It is important to note that the benefit from locking in high initial rates, with or without rollover, is obtained by a plaintiff only if such rates are used for subsequent investing and not just for discounting lost future earnings. The implied discount rates from December 1979 current yields on T-Ladder bonds

(Column E, 10.35%, 10.36% in Scenario 2 and 4, respectively) substantially exceeded the average historical yields on five-year T-notes in both scenarios (Column J), just as had occurred in Scenarios 1 and 2. This fact alone resulted in lower PV of awards for the T-Ladder vs. the IntGov method during (Column P). Only if the plaintiff were to invest surplus funds (e.g., from needing less future earnings due to lower inflation) in longer term assets that earned returns above inflation, would the plaintiff have benefited by more than indicated via the T-Ladder method. In that sense, the T-Ladder method employed here without any funds rollover may be conservative in not making subjective assumptions about how a plaintiff might invest such "surplus" earnings. However, we should not infer with benefit of hindsight that in the early 1980s a prudent investor would always have taken advantage of declining rates to lock them in by investing all "surpluses" for lengthy future periods.[21]

1990-2009, Scenarios 3 and 6: Relative accuracy between the methods is mixed; close for the shorter lookback period (Scenario 3) but with opposite signs, and not so close for the longer lookback period (Scenario 6), both resulting in overcompensation. Here, in terms of forecast vs. actual results we have the mirror image of the earliest analysis period, 1970-1989. From 1990-2009, we instead observe *lower* actual than forecasted earnings growth (Column D), which resulted in surplus adjustments due to earnings alone for both discount methods in both scenarios. However, actual total returns on IntGov bonds averaging 6.77% (Column M) fell below the historical average five-year T-note rates used for discounting in both scenarios for the first time (Column J). Other things being equal, lower total returns as compared with the discount rate assumed results in earnings shortfalls for the IntGov method. Taken together, the lower total return rollover effect offsets the lower actual earnings effect, creating a mixed net effect on PV of award adjustments for the IntGov method. These offsetting effects result in a net of negative (income shortfall) award adjustments in Scenario 3 and a net of positive (income surplus) award adjustments in Scenario 6 (-19% and +20%, respectively, in Column O).

For the T-Ladder method, positive PV of award adjustments due to lower actual earnings growth were observed for both Scenarios 3 and 6 (+18% and +37%, respectively, in Column I). As shown in Column Q, the choice of lookback period made a large difference in relative accuracy. Again, longer lookback periods for earnings growth assumptions does not necessarily make for a more accurate forecast. In Scenario 3, with a 10-year lookback period, the two methods showed little absolute value difference in PV of award adjustments, +1% (based on opposite sign adjustments for each method). By contrast, in

[21]Plaintiffs would have reason to be highly uncertain about earnings shortfalls or surpluses relative to projections lasting over a lifetime. While in reality a plaintiff facing a funding shortfall might sell off bonds that locked in beginning period rates, there is no certainty that a plaintiff would do so rather than forego consumption, and even if he/she did so, it would be speculative to assume which bonds might best be sold. Similarly, if a plaintiff faced a funding surplus, it would be speculative to assume which maturity additional bonds would be purchased for re-investment, whereas a plaintiff could instead just increase consumption. Thus, to avoid such speculation for both methods, each annual shortfall/surplus was simply converted to 2009 dollars via the appropriate CPI-U adjustment.

Scenario 6, with a 20-year lookback period, the T-Ladder method absolute value adjustments exceeded those of the IntGov method by 17%.

For the T-Ladder method, the 8.09%/8.11%[22] implied discount rates (Column E, based on 1989 "current" rates in both scenarios), were for the first time lower than the average historical rates on five-year T-notes in both scenarios (Column J). These lower discount rates generated higher PV of awards for the T-Ladder method vs. the IntGov method, also for the first time, as shown in Column P.

VI. Summary and Conclusions

This paper attempts to identify and analyze many of the theoretical and practical issues surrounding the choice of discount rate methods to valuing damage awards, in particular, the usage of current interest rates vs. historical interest rates. It is argued that the absolute accuracy of any discount rate method is difficult to measure due to many subjective factors, including the selection of what type and maturity instrument(s) are used to derive the projected and "actual" present values after the fact. In terms of relative accuracy, one also cannot avoid the need to define what exactly is meant by "current interest rates," and whether that definition should include or exclude some rule-based method for handling variances of actual from forecasted earnings. It is argued here that there is a strong implied linkage between discounting and investing that, although not explicitly required by courts, has been made in language used in rulings at least since the Supreme Court's 1983 *Jones & Laughlin Steel Corp. v. Pfeifer* decision. We believe that this linkage is equally valid here to assess the relative accuracy of lump sum awards used to support actual vs. projected earnings paydowns under different market conditions.

Toward that end, the T-Ladder method and the IntGov methods were compared for their relative award sizes, ex ante, and their relative accuracy, ex post, in terms of PV of award adjustments needed to keep a plaintiff whole. The results found in this study were broadly consistent with those found by Brush and others, i.e., that neither the current or historical interest rate methods have proven to be very accurate, nor does either method show a dispositive forecast superiority. Although emulating Brush's analytical approach showed some forecast superiority of the T-Ladder as one type of current rate method, we believe that in measuring accuracy, his approach only captures the income effect of substituting actual for historical average rates each year, without the capital gains and losses if one actually had invested in bonds with those actual yields. If one accepts that accuracy should include the consistency of investing and discounting with the same instruments, then capital gains/losses also need to be part of the equation in evaluating ex post accuracy. We also believe that while actual earnings losses may be observed, ex post, there is no universally acceptable present value of earnings losses that may be similarly observed; in fact, having different levels of interest rate risk protection under different dis-

[22]The 2 basis points difference in implied discount rate for the T-Ladder method between Scenarios 4 and 6 was due to slightly different bond weightings applied to the same yields, based on the different lookback periods' earnings growth rates.

counting and investing methods means that having a single agreed upon measure of present value of lost earnings is unrealistic. Also, it is unclear whether some conceptually optimal approach, such as the one offered by Cushing and Rosenbaum (i.e., that splits the difference between current interest rates and historical interest rates) will generally provide more robust results than either method.

These conclusions of necessity are limited in scope. Interest rate risk is mitigated via an investment strategy that allows for rolling over damage award balances to meet changing economic conditions, especially to address the impact of inflation on the purchasing power of lost earnings replacement. Investing in intermediate term government bonds via mutual funds is one way to offer this type of protection along with ease of award management over time. Although the results presented in this paper suggest that the IntGov method per se is somewhat less accurate than a Treasury ladder invested at current interest rates, this may be simply the result of the limited set of market conditions and lookback period combinations analyzed. It is not hard to imagine more scenarios like this in which the IntGov method's relative forecast accuracy improves. For now, FEs should consider the theoretical and practical tradeoffs of each approach and use their best judgment in selecting a method. In the meantime, to echo Brush's conclusion (Brush, 2004, p. 12), better methods for estimating the present value of future lost earnings should remain a priority for forensic economists.

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Appendix

Tables A-1a and A-1b present the detailed results for Scenario 1 applied to each of the two discounting and investing methods. Due to space limitations, the other 10 tables for Scenarios 2-6 are not included here, but are available on line at *JFE* under Supplemental Material for this paper.

Table A-2 presents the calculation of an "Actual" present value of earnings losses for Scenario 1 using essentially the same method as Brush did (Brush, 2004, p. 14), except that he used the actual average yield on the three-year Treasury note for each year, whereas in this paper we used the average yield on the five-year Treasury note. As noted in the text, the results in terms of relative accuracy by scenario are similar had we used the three-year Treasury instead of the five-year Treasury. Also noted in the text, in answering Question 2 Part B, Brush himself switched in his 2011 study to using 30-day T-bill "interest returns" to obtain "actual" present value. For reasons discussed in greater detail by Rosenberg, (2010, pp. 181-182), using 30-day T-bills violates the finance principal "Parity of Risk," as this instrument is essentially devoid of either default risk or inflation risk and thus is inappropriate for discounting uncertain future lost earnings to obtain a damage award. For that reason, we consider Brush's method of deriving a quasi-objective "actual" present value of lost earnings to be better represented by using a longer term instrument, hence the five-year Treasury.

Table A-1a, Scenario 1
T-Ladder Method Used in Damage Award for Period 1970-1989, 10-Year Lookback for Earnings Growth Assumption

										Decrement Award Balance based on Interest Income - Projected Earnings			Adjustments to Award Balance based on Interest Income - Actual Earnings		
Year count	Year	Weekly earnings: 1969 in *Current$*; annual change at 10 year prior earnings growth rate of 4.021%	*Projected* Total Annual Earnings, Current$	Ladder of Tsy Yields by Maturity, from December 1969	Discount Factor from Tsy Ladder	PV of *Projected* Annual Earnings Loss in *1970$*, Tsy Ladder	Actual Weekly Earnings, Current$	*Actual* Total Annual Earnings, Current $	Weighted Yield from Tsy Ladder, by Yr of Forecast	Award Balance at Beginning of Year based on *Projected* 10-Year Prior Earnings Growth Rate	Interest Assumed to be Earned on Balance During Year	Award Balance at End of Year After Adding Interest Income & Subtracting *Projected* Earnings	Shortfall / Surplus due to *Projected - Actual* Earnings, by Year, Current$	CPI Adjustment Factors to convert to 2009$	PV of Award Adjustments due to Actual vs. Projected Earnings, 2009$
	1969	120.75													
1	1970	125.61	6,531	8.17%	0.9245	6,038	125.80	6,542	7.58%	91,474	6,932	91,875	(10)	5.426	(55)
2	1971	130.66	6,794	8.13%	0.8552	5,810	133.58	6,946	7.55%	91,875	6,933	92,014	(152)	5.254	(799)
3	1972	135.91	7,067	8.10%	0.7916	5,595	143.91	7,483	7.51%	92,014	6,912	91,859	(416)	5.081	(2,114)
4	1973	141.37	7,351	8.03%	0.7342	5,398	152.77	7,944	7.47%	91,859	6,866	91,373	(593)	4.674	(2,770)
5	1974	147.06	7,647	7.96%	0.6818	5,214	161.25	8,385	7.44%	91,373	6,794	90,520	(738)	4.161	(3,071)
6	1975	152.97	7,954	7.73%	0.6396	5,088	170.28	8,855	7.40%	90,520	6,695	89,261	(900)	3.891	(3,502)
7	1976	159.12	8,274	7.51%	0.6024	4,984	182.67	9,499	7.37%	89,261	6,576	87,562	(1,225)	3.710	(4,544)
8	1977	165.52	8,607	7.56%	0.5584	4,806	195.30	10,156	7.35%	87,562	6,439	85,394	(1,549)	3.477	(5,385)
9	1978	172.17	8,953	7.60%	0.5171	4,630	210.50	10,946	7.33%	85,394	6,262	82,703	(1,993)	3.190	(6,357)
10	1979	179.10	9,313	7.65%	0.4785	4,456	225.70	11,736	7.30%	82,703	6,039	79,429	(2,423)	2.816	(6,823)
11	1980	186.30	9,687	7.57%	0.4480	4,340	241.12	12,538	7.26%	79,429	5,768	75,510	(2,851)	2.502	(7,134)
12	1981	193.79	10,077	7.50%	0.4200	4,233	261.89	13,618	7.22%	75,510	5,452	70,885	(3,541)	2.297	(8,136)
13	1982	201.58	10,482	7.42%	0.3944	4,134	273.09	14,201	7.18%	70,885	5,090	65,492	(3,719)	2.213	(8,228)
14	1983	209.68	10,904	7.34%	0.3707	4,042	286.18	14,881	7.14%	65,492	4,676	59,265	(3,978)	2.132	(8,480)
15	1984	218.12	11,342	7.27%	0.3490	3,958	298.00	15,496	7.10%	59,265	4,208	52,130	(4,154)	2.051	(8,519)
16	1985	226.89	11,798	7.20%	0.3289	3,881	305.03	15,862	7.06%	52,130	3,681	44,013	(4,064)	1.976	(8,028)
17	1986	236.01	12,272	7.12%	0.3104	3,809	309.87	16,113	7.02%	44,013	3,091	34,831	(3,841)	1.954	(7,506)
18	1987	245.50	12,766	7.05%	0.2933	3,744	317.16	16,492	6.98%	34,831	2,433	24,498	(3,726)	1.871	(6,973)
19	1988	255.37	13,279	6.98%	0.2775	3,684	326.62	16,984	6.95%	24,498	1,702	12,920	(3,705)	1.792	(6,640)
20	1989	265.64	13,813	6.91%	0.2628	3,630	338.10	17,581	6.91%	12,920	893	(0)	(3,768)	1.713	(6,453)
Sum						91,474		242,259							(111,517)

Table A-1b, Scenario 1
IntGov Method Used in Damage Award for Period 1970-1989, 10-Year Lookback Period both for Earnings Growth Assumption and for five-year T-Note Rate Used for Discounting Projected Earnings
(Total Return on IntGov Bonds Used for Generating Income on Each Years' Projected Remaining Award Balance)

										Decrement Award Balance based on *Projected* Earnings & Interest Income			Adjustments to Award Balance based on *Actuals* (Earnings & Total Returns) vs. *Projections* (Earnings and Historical Average Yield)			
Year count	Year	Weekly earnings: 1969 in *Current$*; annual change at 10 year prior earnings growth rate of 4.021%	Projected Total Annual Earnings, Current$	10-Year Lookback, Average Historical 5-Year T-Note Yield Used For Discounting Forecasted Earnings Losses	Discount Factors from Historical Average 5-yr T-Note Yield	PV of *Projected* Earnings Loss in *1970$*, Average Historical 5 -yr T-Note Yield	Actual Weekly Earnings, Current$	Actual Total Annual Earnings, Current $	*Actual* Yearly Total Return on Interm. Term Govt Bonds	Award Balance at Beginning of Year based on *Projected* 10-Year Prior Earnings Growth Rate	Interest Assumed to be Earned on Balance During Year from Average Historcial 5-year T-Note Yield	Award Balance at End of Year After Adding Interest Income & Subtracting *Projected* Earnings	IntGov Total Return less Historical 5 Yr T-Note Yield	Shortfall / Surplus due to *Actual* Earnings & Total Returns vs. *Projected* Earnings & Interest Inc. at Historical Avg. Yield, Current$	CPI Adjustment Factors to convert to 2009$	PV of Award Adjustments by Year due to Actual vs. Projected Earnings, & Actual Total Returns Vs. Projected Yield, 2009$
	1969	120.75	-													
1	1970	125.61	6,531	4.65%	0.9555	6,241	125.80	6,542	16.86%	117,910	5,486	116,865	12.21%	14,385	5.426	78,052
2	1971	130.66	6,794	4.65%	0.9131	6,203	133.58	6,946	8.72%	116,865	5,438	115,508	4.07%	4,606	5.254	24,200
3	1972	135.91	7,067	4.65%	0.8725	6,166	143.91	7,483	5.16%	115,508	5,375	113,816	0.50%	167	5.081	847
4	1973	141.37	7,351	4.65%	0.8337	6,129	152.77	7,944	4.61%	113,816	5,296	111,760	-0.04%	(640)	4.674	(2,993)
5	1974	147.06	7,647	4.65%	0.7966	6,092	161.25	8,385	5.69%	111,760	5,200	109,314	1.04%	424	4.161	1,762
6	1975	152.97	7,954	4.65%	0.7612	6,055	170.28	8,855	7.82%	109,314	5,086	106,446	3.17%	2,565	3.891	9,982
7	1976	159.12	8,274	4.65%	0.7273	6,018	182.67	9,499	12.87%	106,446	4,953	103,124	8.22%	7,522	3.710	27,910
8	1977	165.52	8,607	4.65%	0.6950	5,982	195.30	10,156	1.41%	103,124	4,798	99,316	-3.24%	(4,893)	3.477	(17,015)
9	1978	172.17	8,953	4.65%	0.6641	5,946	210.50	10,946	3.49%	99,316	4,621	94,984	-1.16%	(3,147)	3.190	(10,038)
10	1979	179.10	9,313	4.65%	0.6346	5,910	225.70	11,736	4.10%	94,984	4,420	90,091	-0.56%	(2,951)	2.816	(8,308)
11	1980	186.30	9,687	4.65%	0.6064	5,874	241.12	12,538	3.91%	90,091	4,192	84,595	-0.74%	(3,517)	2.502	(8,800)
12	1981	193.79	10,077	4.65%	0.5794	5,839	261.89	13,618	9.45%	84,595	3,936	78,454	4.80%	518	2.297	1,191
13	1982	201.58	10,482	4.65%	0.5536	5,803	273.09	14,201	29.09%	78,454	3,651	71,623	24.44%	15,453	2.213	34,191
14	1983	209.68	10,904	4.65%	0.5290	5,768	286.18	14,881	7.41%	71,623	3,333	64,052	2.76%	(2,002)	2.132	(4,267)
15	1984	218.12	11,342	4.65%	0.5055	5,733	298.00	15,496	14.01%	64,052	2,980	55,690	9.36%	1,841	2.051	3,775
16	1985	226.89	11,798	4.65%	0.4830	5,699	305.03	15,862	20.33%	55,690	2,591	46,484	15.68%	4,668	1.976	9,223
17	1986	236.01	12,272	4.65%	0.4615	5,664	309.87	16,113	15.14%	46,484	2,163	36,374	10.48%	1,032	1.954	2,017
18	1987	245.50	12,766	4.65%	0.4410	5,630	317.16	16,492	2.91%	36,374	1,693	25,301	-1.75%	(4,362)	1.871	(8,162)
19	1988	255.37	13,279	4.65%	0.4214	5,596	326.62	16,984	6.10%	25,301	1,177	13,199	1.45%	(3,339)	1.792	(5,983)
20	1989	265.64	13,813	4.65%	0.4027	5,562	338.10	17,581	13.29%	13,199	614	(0)	8.64%	(2,628)	1.713	(4,500)
Sum						117,910		242,259								123,084

Table A-2
Calculation of "Actual" Present Value of Earnings Losses Based on Scenario 1 Assumptions, Assuming the Actual five-year T-Note Rate

Year count	Year	Actual Earnings Growth Rate	Actual Average Annual CMT 5-Yr T-Note Yield	Beginning Balance	Plus Interest	Minus Actual Earnings	Ending Balance
	1969						
1	1970	4.18%	7.38%	**102,257**	7,542	(6,542)	103,258
2	1971	6.18%	5.99%	103,258	6,183	(6,946)	102,494
3	1972	7.73%	5.98%	102,494	6,131	(7,483)	101,142
4	1973	6.16%	6.87%	101,142	6,945	(7,944)	100,143
5	1974	5.55%	7.80%	100,143	7,813	(8,385)	99,571
6	1975	5.60%	7.77%	99,571	7,732	(8,855)	98,449
7	1976	7.28%	7.18%	98,449	7,068	(9,499)	96,018
8	1977	6.91%	6.99%	96,018	6,712	(10,156)	92,574
9	1978	7.78%	8.32%	92,574	7,700	(10,946)	89,327
10	1979	7.22%	9.52%	89,327	8,502	(11,736)	86,094
11	1980	6.83%	11.48%	86,094	9,882	(12,538)	83,437
12	1981	8.61%	14.24%	83,437	11,878	(13,618)	81,697
13	1982	4.28%	13.01%	81,697	10,625	(14,201)	78,122
14	1983	4.79%	10.80%	78,122	8,434	(14,881)	71,674
15	1984	4.13%	12.24%	71,674	8,774	(15,496)	64,952
16	1985	2.36%	10.13%	64,952	6,579	(15,862)	55,669
17	1986	1.59%	7.31%	55,669	4,070	(16,113)	43,626
18	1987	2.35%	7.94%	43,626	3,462	(16,492)	30,596
19	1988	2.98%	8.47%	30,596	2,592	(16,984)	16,203
20	1989	3.51%	8.50%	16,203	1,378	(17,581)	**0**