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Using TIPS to Discount to Present Value

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Abstract

The practice of forensic economics has a long history of trying to identify the correct interest rate to use when valuing economic losses in personal injury and wrongful death cases. We trace the legal history as it relates to the appropriate interest rates and adjustments for inflation. We then discuss the use of Treasury Inflation Protected Securities, TIPS, and an analysis of the combined effect of realized inflation and taxes on the effective return. We come to the unexpected conclusion that the use of TIPS does not lend itself to a simple adjustment to the rate for taxes nor eliminate the need to consider expected inflation.

I. Introduction

Forensic economic practitioners serve two masters: law and economics. As economists, we are bound to apply the best economic principles and practices that our limited understanding avails. As experts testifying in court, we are constrained to follow practices and procedures that are approved by and, in some cases, directed by law. The practice of forensic economics has a long history of trying to satisfy both masters in an effort to identify the correct interest rate to use when valuing economic losses in personal injury and wrongful death cases.

In the first half of this paper, we trace the legal history in the U.S. Federal courts and our sister common law nations that deal with the choice of a discount rate. Particular attention is given to laws and decisions which have implications concerning the use of interest rates on TIPS. In 1916 the U.S. Supreme Court in *Kelly v. Chesapeake & Ohio* established the legal principals "that when future payments or other pecuniary benefits are to be anticipated, the verdict should be made on the basis of their present value only" (p. 491) and that the interest to be used should be based on "the best and safest" investment. After a long silence, the Supreme Court returned to this topic in the 1983 *Jones & Laughlin v. Pfeifer* decision. There, the Court discussed the issues relating to the impact of inflation on both estimated future losses and the discount rate and expressed a preference; although it did not mandate a

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particular approach. In this section we also review cases in the Federal courts that comment on the use of a real rate versus a market rate of interest and the concomitant implications for adjusting the losses for inflation.

The second section of the paper analyzes the economic aspects of using U.S. Treasury inflation protected securities (TIPS), first issued in 1997. These bonds provide an observable market real rate of interest that would seem to eliminate the need for forecasting inflation or relying on a historical real interest rate. We model real returns on TIPS under differing scenarios for inflation and taxation. Without consideration of taxes, TIPS perform as intended and protect the investor from unanticipated inflation.

The taxation of TIPS complicates their use. Some practitioners have recommended resolving this with a simple adjustment; however, our modeling shows that the after-tax real return is a function of both the tax rate and the rate of inflation. The combined effect of inflation and taxation is that there is no simple adjustment that can be applied to convert a pre-tax TIPS rate to an after-tax discount rate. Double digit inflation can even reduce the after-tax return to zero.

Finally, we make modest suggestions for using TIPS to determine the discount rate in personal injury and wrongful death cases.

II. Laws and Legal Decisions with Implications for the Use of TIPS

A. Legal interpretation of “risk-free” interest rate: *Kelly* and *Pfeifer*

Over the past decade or so, there has been some debate in the forensic economic community concerning the suggestion that the discount rate used in personal injury and wrongful death cases should contain a premium for some risk of default. Advocates have proposed that rates on corporate bonds or even common stocks should be used to determine the appropriate discount rate (Breeden and Brush, 2008; Albrecht, 2012). However, in the legal community, there has been no such debate that has risen to the level of an appellate court. The U.S. Supreme Court has ruled, and forensic economists generally agree, that the interest rate used to discount future values to present value should be a "risk-free" interest rate. The seminal decision by the U.S. Supreme Court dealing with the choice of an appropriate discount rate used to value future losses is *Kelly v. Chesapeake & Ohio Railway Co*. (1916).

The Court clearly stated that the primary intention of the decision was to establish the legal principal “that when future payments or other pecuniary benefits are to be anticipated, the verdict should be made up on the basis of their present value only” (p. 491). While the Court did not specify that the discount rate should be based on any particular financial asset, it did hold that the discount rate should be based on safe and secure assets. The Court’s requirement of the “best and safest investment” is the foundation for the Court’s later advocacy of a risk-free discount rate. It has been quoted in hundreds of subsequent decisions.

Currently, U.S. Government securities are considered free from risk of default and are therefore consistent with “best and safest” for determining the discount rate to be used to calculate present values. However, risk of default is only one aspect of risk when investing in financial assets. A second component of risk is inflation and a decline in the purchasing power of money during the period of time that the security is held. Inflation may be anticipated or unanticipated. Presumably, market interest rates contain a premium for anticipated inflation. If this expectation is realized using market interest rates to discount future losses will fairly compensate the plaintiff for his losses. Thus, correctly anticipated inflation is not a matter of concern.

Unanticipated inflation is the difference between what was forecast on a given date and the actual inflation that subsequently occurs. If the forecast is too low, unanticipated inflation will be positive and the plaintiff will be under-compensated. If the forecast is too high, the defendant will be over-penalized.[1] Thus, unanticipated inflation is an important concern in the selection of a fair and proper discount rate.[2]

Problems imposed by inflation are the primary theme in a landmark 1983 U.S. Supreme Court decision concerning the proper choice of a discount rate in personal injury and wrongful death awards (*Jones & Laughlin v. Pfeifer*, 1983). *Pfeifer* was a personal injury action brought in a Pennsylvania Federal Court under the Longshoremen's and Harbor Workers Compensation Act (LHWCA). The District Court found in favor of plaintiff's injury claim and calculation of the award, which applied Pennsylvania's "total offset approach." The Third Circuit affirmed, but the Supreme Court reversed, finding error solely on the ground that an injury claim under LHWC should be governed by federal maritime rather than state law. But the Court went beyond that narrow holding to lay out what it considered a proper framework for discounting lump sum lost earnings awards in an inflationary environment. In doing so, it reviewed the various methods taken by the Federal Courts and other common law countries to account for inflation and reach a fair discount rate.

Pfeifer relies on the principles of *Kelly*, that the award should be discounted and that the discount rate should be based on the interest rate of "the best and safest investment" (*Kelly v. Chesapeake & Ohio Railway Co.*, 1916, p. 491). The Court begins its analysis by reviewing the way in which damages should be measured in an inflation-free economy:

> 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 & Laughlin v. Pfeifer*, 1983, p. 537)

To emphasize the point, the Court adds the calculation of present value should be based on two elements: (1) projected income that the worker would

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[1]The frequency distribution of unanticipated inflation is an empirical matter about which little is known. Presently, with very low real and nominal interest rates, it seems that the distribution must be highly skewed in the direction of underestimating future inflation.

[2]Currently, the discussion in Wikipedia identifies 19 categories of financial risk. None of the remaining categories is considered relevant in the choice of the best and safest asset for determining the discount rate.

have earned and (2) "the appropriate discount rate, reflecting the safest available investment" (*Jones & Laughlin v. Pfeifer*, 1983, pp. 537-538).

The Court then considered inflation and observed that inflation has been a permanent feature of our economy for decades and must be properly addressed in calculating an equitable award. The Court explicitly noted that market interest rates include an allowance for anticipated inflation:

> The second stage of the calculation requires the selection of an appropriate discount rate. Price inflation—or more precisely, anticipated price inflation—certainly affects market rates of return. If a lender knows that his loan is to be repaid a year later with dollars that are less valuable than those he has advanced, he will charge an interest rate that is high enough both to compensate him for the temporary use of the loan proceeds and also to make up for their shrinkage in value. (*Jones & Laughlin v. Pfeifer*, 1983, pp. 538-539)

Prior to the *Pfeifer* decision most courts in the U.S. had permitted use of market interest rates (which include a premium for anticipated inflation) to discount to present value. However, the Court refused to permit plaintiffs to include inflation in projected wages on the theory that forecasting wage inflation is speculative. Following the double-digit inflation of the 1970's, this inequity was too great to be ignored, and the Court stated:

> Unfortunately for triers of fact, ours is not an inflation-free economy. Inflation has been a permanent fixture in our economy for many decades, and there can be no doubt that it ideally should affect both stages of the calculation described in the previous section. (*Jones & Laughlin v. Pfeifer*, 1983, p. 538)

The Court did not take the next logical step and discuss unanticipated inflation. However, it did express concern about the lack of accuracy of inflation forecasts, which can result in significant levels of unanticipated inflation. This is evident in its statement that:

> Sustained price inflation can make the award substantially less precise. Inflation's current magnitude and unpredictability create a substantial risk that the damages award will prove to have little relation to the lost wages it purports to replace. (*Jones & Laughlin v. Pfeifer*, 1983, pp. 546-547)

In its final conclusion, the *Pfeifer* Court refused to mandate a single approach to deal with inflation and determine a fair discount rate. Instead, it approved use of three separate methodologies: the nominal (or market) interest rate, the real interest rate (or below market rate), and the total offset methods. The Court again expressed its concern with inflation forecasts and the implications for the determination of an award for damages and discouraged use of the Market Rate approach, which includes an inflation forecast in both projected wages and the discount rate:

> Since specific forecasts of future price inflation remain too unreliable to be useful in many cases, it will normally be a costly and ultimately unproductive waste of longshoremen's resources to make such forecasts the centerpiece of litigation . . . both plaintiffs and trial courts should be discouraged from pursuing that approach. (*Jones & Laughlin v. Pfeifer*, 1983, p. 548)

The total offset approach was carefully reviewed, and the Court noted that it "has the virtue of simplicity and may even be economically precise," but the Court was "not prepared to impose it on unwilling litigants." (*Jones & Laughlin v. Pfeifer*, 1983, p. 550-551)

Concerning the real interest rate method, the Court first noted in a lengthy footnote (#30) that the real interest rate is obviously not perfectly stable and perhaps not even relatively stable.[3] Nevertheless, it concluded: "We do not believe a trial court adopting such an approach . . . should be reversed if it adopts a rate between 1 and 3% and explains its choice." (*Jones & Laughlin v. Pfeifer*, 1983, p. 548-549)

B. Federal Court Decisions and Legal Comment after *Pfeifer*

Pfeifer has proven to be a Rosetta stone for the Federal Courts to use as precedent in future lost income decisions. Recently Westlaw showed over 3,300 citations to the decision, many for the general proposition that lump sum awards must be discounted, but many cases also cite *Pfeifer* because it authorizes the litigants and trial courts to choose any of three methods of accounting for inflation and discount rate so long as it fairly compensates the plaintiff and the court explains its reasoning.

Six years later, the Second Court reaffirmed their decision in *Doca v. Marina Mercante Nicaraguense,* 1980, that trial judges may use a real interest rate of 2% if there is no evidence to the contrary or if the evidence is unconvincing (*McCrann v. United States Lines, Inc*., 1986), and in 2003 it again reaffirmed this ruling (*Ammar v. United States,* 2003).

Shortly following the Supreme Court's decision in *Pfeifer*, the Fifth Circuit Court met *en banc* and issued a ruling which limits the options for selecting a method to determine an appropriate discount rate in all Federal courts in the 5th and 11th Circuits (*Culver v. Slater Boat Co.,* 1983). While the Supreme Court had approved three acceptable methods, the Fifth Circuit Court observed that:

> No one can accurately predict the course of future inflation. A survey of the general literature for the past several years illustrates a sorry tale of repeated confusion, contradiction and uncertainty in economic forecasts. (*Culver v. Slater Boat Co.,* 1983, pp. 119-120)

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[3]When *Pfeifer* was decided, the real interest rate was measured by subtracting an inflation rate from an interest rate using historical data and assuming that the average was stable and would remain reasonably constant over the projected period. With the advent of TIPS we have an observable market determined real interest rate for maturities to 30 years. The Court's concern expressed in footnote #30 is no longer relevant.

The Court ruled that:

> We, therefore, withdraw the opinion in *Culver I . . . ,* and hold that, in the absence of a stipulation by the parties concerning the method to be used, fact-finders shall determine and apply an appropriate below-market discount rate to adjust loss-of-future-earnings awards to present value to account for the effect of inflation. (*Culver v. Slater Boat Co.,* 1983, p. 117)

In a series of three decisions, the Ninth Circuit Court endorsed the three approaches to discounting approved in *Pfeifer* (*Shaw v. U.S.,* 1984; *Trevino v. U.S.,* 1986; and *McCarthy v. U.S.,* 1989). It explicitly approved the real interest rate method and, at a time that preceded the development of the TIPS market in the U.S., it approved the use of historical data to determine an appropriate real discount rate. However, it warned that the period used must be representative of what is to be expected in the future.

Prior to the *Pfeifer* decision, the Tenth Circuit Court addressed the issue of dealing with inflation when calculating damages in *Steckler v. U.S.* (1977). It noted that legal opinion was in a state of flux and reviewed reported opinions from circuit courts around the country. Subsequently, the Tenth Circuit Court cited both *Steckler* and *Pfeifer* and, without explicitly opposing *Pfeifer,* it reaffirmed its objection to a mechanical application of the total offset method (*Hull by Hull v. U.S.,* 1992, p. 1511). And without reversing its decision in *Steckler,* it approved the use of either the real rate or market rate methods for discounting with the qualification that:

> Whether a net discount rate is used or actual investment interest and inflation figures are used, the basis of the computation must be explained and supported by competent evidence. (*Hull by Hull v. U.S.,* 1992, p. 1511)

While Federal circuit courts have shown a distinct preference for the real rate method, the market rate method is not without support—especially at the district court level. This is illustrated in a series of cases in Washington, D.C. and nearby district courts in the Fourth Circuit (*Muenstermann v. U.S.*, 1992; *Calva-Cerqueira v. U.S.*, 2003; *Lawson v. U.S.,* 2006; and *Dugar and Gillespie v. Washington Metropolitan Area Transit Authority*, 2008).

A Louisiana Federal district court decision in 2007 demonstrates that accepting the principle that the discount rate should be a below market real rate does not determine how that rate is to be determined. In *Theodile v. Delmar Systems Inc.,* 2007, Plaintiff's economist utilized a 1.36% below market or real discount rate based on short-term U.S. Treasury notes rather than using U.S. Treasury Inflation Indexed Bonds. The defendant's expert testified that based on U.S. Treasury Inflation Indexed Bonds, 2.13% was the lowest present value discount available utilizing the "below market discount rate" mandated by *Culver II.*

The judge rejected the argument that *Culver II* mandated use of TIPS, but permitted both experts to testify. This case is particularly important because it is the only reported case that we have been able to find in which the court considered the use of Treasury Inflation Protected Securities as an appropriate measure of the real interest rate to be used to discount future losses to present value.

Since the advent of TIPS and the availability of inflation adjusted securities, some legal commentators have also called for their use in setting the discount rate in injury cases:

> Now we have a developing market for longer term U.S. Government securities indexed to inflation. Thus at a minimum appellate courts and, where appropriate, the district courts (Federal Tort Claim Act cases, for example) should take judicial notice of this market in rendering opinions on the economic evidence employed in determining present value. . . . *Doca* and a few other cases cited were commendable efforts to deal with the real rate approach when there were no such instruments outstanding. These cases should be reviewed in light of this new market. (Curran, 1998, p. 405)

Use of inflation adjusted U.S. Treasuries has also been advocated for use in injury cases in Hong Kong. Chan and Chan's (2003) recommendation states:

> In Hong Kong the claimant in personal injury litigation should be assumed to invest the lump sum award in low-risk investment vehicles. Under the linked exchange rate system we believe the average real rate of return from U.S. Treasury inflation-indexed securities is an appropriate yardstick for the determination of the discount rate in Hong Kong. (p. 22)

C. Consideration of TIPS in Our Sister Common Law Countries

As the Court noted in *Pfeifer*, the common law countries shared the same concerns of under compensation and speculation which the introduction of inflation to award calculations can cause. The real rate approach was generally established then and continues today in the United Kingdom and Canada, and to a slightly lesser degree in Australia.

In 1981 the UK first issued Index Linked Government Securities (ILGS), which are comparable to U.S. TIPS. In 1994 the UK Law Commission recommended that legislation be passed to require the courts to take account of the interest rate on ILGS when determining a discount rate. The Damage Act of 1996 authorized the Lord Chancellor to issue an order prescribing the appropriate discount rate to be used by UK courts nationwide to discount damage awards. Thereafter, the House of Lords issued a decision in the case of *Wells v. Wells* (1999) holding that the discount rate should be assessed on the assumption that the claimant will invest in ILGS. Therefore a discount rate of 3% was appropriate in the case at that time. Two years later, on June 25, 2001, the Lord Chancellor issued an order setting UK's discount rate at 2.5%. In doing so he confirmed that a single rate, generally based on ILGS's, was to cover all cases and the rate should remain for the foreseeable future and that it was undesirable to make frequent changes (Lewis, 2012). While some critics asserted the rate was excessive and not based solely on ILGS's and some litigants sought a lower rate in their particular case under the "exceptional circumstance" section of the Damage Act, they have not succeeded. With the exception of a court decision in the Bailiwick of Guernsey, where the Damage Act does not apply, the 2.5% discount rate continues in the UK (Tarren, 2010).

Canadians follow the British lead and generally favor use of the real rate method for determining the discount rate. They differ in that the rules are determined by and for each province and territory individually. Seven of the provinces (Ontario, British Columbia, Nova Scotia, Saskatchewan, Manitoba, New Brunswick, and Prince Edward Island) have prescribed specific rates to be used for discounting pecuniary losses. In six of the provinces the discount rate is between 2.5% and 3.5% (Rich Rotstein LLP, 2013).

In 2000 Ontario adopted a two-tier approach, which sets one rate for the first 15-year period following the date of trial and a different rate for all later years (Dionne, 2011). The discount rate for the first 15 years is equal to the average interest rate on long-term Government of Canada Real Return Bonds over the prior year minus 1% and rounded to the nearest .25% (Ontario Rules of Civil Procedure 53.09, 2013). In 2000 the rate was 3.00%. It has generally declined since then and is -0.50% in 2013 (Ontario Ministry of the Attorney General, 2013). Losses for periods beyond 15 years are discounted at the fixed rate of 2.5%.

Advocates of the rule have noted the benefits that a prescribed discount rate can have in preventing the drawbacks of complex uncertain calculations, inconsistent results, and extended trials (Henein, 2011). These were the same concerns noted in *Pfeifer* quoting Judge Newman of the Second Circuit in *Doca v. Marina Mercante* who warned that "The average accident trial should not be converted into a graduate seminar on economic forecasting" (*Jones & Laughlin v. Pfeifer,* 1983, p. 548).

When Pfeifer was decided, Australia's High Court had set the country's discount rate at 2% on the theory that it represented long term real rates (*Jones & Laughlin v. Pfeifer,* 1983, p. 541). The rate was raised by that Court to 3% in *Todorovic v. Waller* (1981). However, beginning in 1984, the legislature in each Australian state and territory raised the applicable discount rates for their courts from 5% to 6%, some varying by type of action, such as medical malpractice. Because the cash interest rate at the time of the *Todorovic* decision was 12.5%, subsequent increases in the discount rate in times when rates are markedly lower have been criticized for affording a windfall for insurers and under compensation for plaintiffs (Davies, 2009). Australian discount rates by state and territory are shown on the Cumpston Sarjeant website (Cumpston Sarjeant, 2008).

III. Prior Discussions in the Forensic Literature

TIPS were initially issued in the U.S. in 1997, but remarkably little has been written in the forensic literature about the use of TIPS to discount future losses to present value. For example, *Determining Economic Damages* (2010) reproduces two papers by Jayne and Ireland published in 1998. The discussion in *Expert Economic Testimony: Reference Guides for Judges and Attorneys* was written in 1998 and has not been updated since then. In a 2001 paper in the *Journal of Forensic Economics*, Weckstein identifies four characteristics of TIPS that distinguish them from standard Government securities: interest rate risk, liquidity risk, tax treatment, and purchasing power risk. This paper builds on Weckstein, quantifies the tax effects on TIPS, and concludes that there is no simple adjustment to convert the rate on TIPS to a discount rate.

IV. TIPS with Unanticipated Inflation or Deflation

Inflation-Protection Bonds, which are intended to protect the investor from inflation, have been issued in Canada, Great Britain and other countries for many years. There were even contracts in ancient Mesopotamia that were essentially IPBs (Brynjolfsson and Faillace, 1997, p. 1).

The United States Treasury began issuing Treasury Inflation Protected Securities (TIPS) in January 1997. They are designed to offset the depreciation in the value of the currency due to inflation. Like other government securities, payment of principal and interest is guaranteed by the full faith and credit of the United States. They are therefore free of default risk and are appropriate for use in discounting future payments to present value in personal injury and wrongful death cases. There is a wealth of detailed information regarding TIPS on Treasury Direct, the U.S. Treasury's website that lets individuals buy and redeem securities directly from the U.S. Department of the Treasury.

The difference between TIPS and the more familiar, conventional U.S. Treasury bonds is that the principal and semi-annual interest payments are adjusted by the rate of inflation as measured by the unadjusted percentage change in the Consumer Price Index for Urban Consumers (CPI-U). Each month (with a two-month lag) the maturity value of the bond increases by the percentage of inflation from the date of issue to the date of payment. The semi-annual interest payment is based on this new face value. Therefore, TIPS pay a real rate of return to the holder—not simply a nominal rate, as is the case with conventional government securities.

In the past, economists who choose the real cash flow approach to valuing a loss had to rely on a historical average, or a forecast of future real rates, or an authority (such as the Budget Office). The advent of TIPS added a new option. TIPS provide a market-based real rate of return for their calculations. Instead of estimating future inflation to adjust cash flows, they can project real cash flows and use current market rates on TIPS to discount future real losses. Using TIPS seems to eliminate the uncertainty intrinsic in estimating future inflation.

In this section, we present an Excel model to describe and explain how interest and principle payments adjust in both nominal and real terms in response to inflation and to unanticipated changes in inflation over the life of the security. In the following section we add the effect of taxes to the analysis.

For illustration, consider a 5-year, $1,000 face value TIPS with annual (rather than semi-annual) interest payments. The coupon rate on the bond, which is used to calculate the interest payments, is a real rate set at the initial auction of the security. Periodic interest payments and payment of face value at maturity will depend on inflation over the life of the security. To begin, assume a real interest rate of 2.0% and zero taxes. The cash flow and rate of return on the bond (IRR) are shown in Table 1. The security is issued at the end of year zero. Values of the variables are shown for the end of the following five years. Columns 2 and 3 show the inflation rate for the year and the CPI at the end of the year. Columns 4 and 5 show the face value at the end of the year and the change for that year. Payments and receipts for principal and interest (P & I) are shown in column 6. To show the effect of unanticipated inflation the table assumes annual inflation rates of 0%, 5%, 0%, 1%, and 2%. With the release of the CPI each month, the face value of the bond is adjusted by the percentage increase since the date of original issue. In practice, there is a two-month lag between inflation and adjustment in the face value.

Table 1
TIPS with Unanticipated Inflation but No Taxes

Values in bold font can be changed.	
Initial face value	**$1,000**
Real interest rate	**2%**
Inflation rate	**variable**
Tax rate on interest	**0%**
Tax rate on increase in face value	**0%**

End of Year	Actual Inflation Rate	CPI	Face Value	Annual Change	Cash Flow: P & I	Cash Flow: Taxes	Cash Flow: Net Cash Flow	Real Net Cash Flow
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0		100.0	1000.00		−1000.00		−1000.00	−1000.00
1	**0.0%**	100.0	1000.00	0.00	20.00	0.00	20.00	20.00
2	**5.0%**	105.0	1050.00	50.00	21.00	0.00	21.00	20.00
3	**0.0%**	105.0	1050.00	0.00	21.00	0.00	21.00	20.00
4	**1.0%**	106.1	1060.50	10.50	21.21	0.00	21.21	20.00
5	**2.0%**	108.2	1081.71	21.21	1103.34	0.00	1103.34	1020.00
					IRR =		3.61%	2.00%

With no inflation in the first year, the face value is unchanged, and the interest payment is 2% of $1,000. In year 2, 5% inflation increases the face value by $50 and the interest payment to $21. In year 3 the price level is constant, so the face value and interest payment are the same as the previous year. In years 4 and 5 inflation picks up, and the face value and interest payment increase as well. At the end of year 5, the CPI is up by 8.2%, and the bond is redeemed at $1,081.71. The final column shows that the annual interest payment has been a constant $20.00 in real terms and the bond is redeemed at its initial purchasing power. The nominal rate of return over the life of the bond is

3.61%, and the real rate of return is 2%, as promised. Actual inflation has no effect on the real return, even if inflation is unanticipated.[4]

In the event that net deflation occurs over the life of the bond, the adjusted face value will be less than the original face value, but the bond will be redeemed at its original face value. For example, Table 2 shows the results with some inflation but net deflation over the life of the bond. At maturity, the CPI is $95.05, and the face value of the bond is $950.50. Interest each year, including year 5, is calculated on the current face value, but the bond is redeemed at its original value of $1,000. In year 5 the cash flow is $1,000 principal and $19.01 interest. The final column of the table shows that the annual interest payments are $20 in real terms, as they should be. However, the redemption value of $1,000 is worth $1,052.08 in base year prices. Thus, the average real rate of return over the entire life of the bond is 2.98%—not 2%. With net deflation over the life of a TIPS bond, the real rate of return is greater than the coupon rate. The actual rate of deflation does affect the real return.

Table 2
TIPS with Deflation and No Taxes

		Values in bold font can be changed.						
		Initial face value				**$1,000**		
		Real interest rate				**2%**		
		Inflation rate				**variable**		
		Tax rate on interest				**0%**		
		Tax rate on increase in face value				**0%**		
End of Year	Actual Inflation Rate	CPI	Face Value	Annual Change	Cash Flow: P & I	Cash Flow: Taxes	Cash Flow: Net Cash Flow	Real Net Cash Flow
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0		100.0	1000.00		−1000.00		−1000.00	−1000.00
1	**1.0%**	101.0	1010.00	10.00	20.20	0.00	20.20	20.00
2	**0.0%**	101.0	1010.00	0.00	20.20	0.00	20.20	20.00
3	**−1.0%**	100.0	999.90	−10.10	20.00	0.00	20.00	20.00
4	**−2.0%**	98.0	979.90	−20.00	19.60	0.00	19.60	20.00
5	**−3.0%**	95.05	950.50	−29.40	1019.01	0.00	1019.01	1072.07
					IRR =		1.98%	2.98%

V. Taxation of TIPS

The introduction of income taxes into the analysis complicates the relationships among the coupon real interest rate, inflation, and the internal rate of return. Taxing of interest income on TIPS is comprised of two components. The

[4]By contrast, T-Bills will adjust to inflation and yield a predetermined real rate of return only if (1) inflation is accurately predicted, (2) market rates adjust instantly, and (3) market forces maintain a constant after-tax real rate.

first is a tax on the annual cash interest received. As expected, income taxes on the periodic interest payments reduce the real rate of return. The standard expression to adjust for taxes is $r = i(1- t)$, in which r denotes the real after-tax rate of return if the security is held to maturity, i denotes the coupon (real) interest rate used to calculate interest payments, and t denotes the marginal tax rate on interest income.

For example, consider TIPS paying real interest rate of 2%, an annual inflation rate of 3%, and a marginal tax rate of 15% on only the cash interest received. Each year the face value and interest payment increase by 3%, but so too do the tax payments. The real cash flow remains $17.00 per year, and the yield to maturity is 1.70% [i.e., 0.85 (2%)].

However, investors in TIPS are also subject to income tax on the annual inflation adjustment accrual. Each year the increase in the face value is reported on Form 1040 OID and must be included as ordinary income on Form 1040. When TIPS were first introduced, it was thought that this tax effect could be corrected by subtracting 25 basis points from the rate on the TIPS (Ireland, 1997-1998, p. 27). Actually, however, the relationship is considerably more complicated than that. When the income tax on accrued interest due to the inflation adjustment is included, it reduces the IRR in this example below 1.70%. The question then is, "Is there a simple adjustment which can be applied to calculate the after-tax rate of return?" We believe that there is not.

Table 3 shows results for a marginal tax rate of 15%.[5] The interest payments each year (in column 6) increase, but so too do income taxes. The real interest payment is constant at $12.63 and the IRR on the bond if held to maturity is 1.26%—not 2% as promised at the time of issue and not 1.70% as it would be if only cash payments of interest were taxed.

It is interesting to note that if inflation is stable the term to maturity does not matter. If the analysis in Table 3 is extended to 20 years, the interest payments and taxes increase each year, but the real net cash flow remains constant at $12.63. Therefore, the real rate of return is 1.26% regardless of the term to maturity.

These results also show that as the inflation rate increases, the nominal rate of return increases, but the real rate of return declines. Even inflation in low double digits can reduce the after tax real return to zero. Table 4 shows the results for a 2% TIPS with 15% tax rate and inflation of 12.78%. Each year the interest payment is just enough to pay the income taxes, and the net cash flow each year is zero. At maturity, the bondholder gets back a lot of money, but it will only buy what his original $1,000 would have bought. The net rate of return on the 2% TIPS is zero.

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[5]In 2014 the marginal tax rate for couples filing jointly is 15% for taxable income between $17,850 and $72,500. This range should include a large proportion of awards in PI and WD cases.

Table 3
TIPS with Inflation and Taxes on Annual Interest Payments and Increase in Face Value

		Values in bold font can be changed.						
		Initial face value				**$1,000**		
		Real interest rate				**2.0%**		
		Inflation rate				**3.0%**		
		Tax rate on interest				**15%**		
		Tax rate on increase in face value				**15%**		
					Cash Flow			Real
End of Year	Stable Inflation Rate	CPI	Face Value	Annual Change	P & I	Taxes	Net Cash Flow	Net Cash Flow
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0		100.00	1000.00		−1000.00		−1000.00	−1000.00
1	3.0%	103.00	1030.00	30.00	20.60	−7.59	13.01	12.63
2	3.0%	106.09	1060.90	30.90	21.22	−7.82	13.40	12.63
3	3.0%	109.27	1092.73	31.83	21.85	−8.05	13.80	12.63
4	3.0%	112.55	1125.51	32.78	22.51	−8.29	14.22	12.63
5	3.0%	115.93	1159.27	33.77	1182.46	−8.54	1173.92	1012.63
					IRR =		4.30%	1.26%

Table 4
TIPS with Double Digit Inflation

		Values in bold font can be changed.						
		Initial face value				**$1,000**		
		Real interest rate				**2.0%**		
		Inflation rate				**12.78%**		
		Tax rate on interest				**15%**		
		Tax rate on increase in face value				**15%**		
					Cash Flow			Real
End of Year	Stable Inflation Rate	CPI	Face Value	Annual Change	P & I	Taxes	Net Cash Flow	Net Cash Flow
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0		100.00	1000.00		−1000.00		−1000.00	−1000.00
1	12.8%	112.78	1127.80	127.80	22.56	−22.55	0.00	0.00
2	12.8%	127.19	1271.93	144.13	25.44	−25.44	0.00	0.00
3	12.8%	143.45	1434.49	162.55	28.69	−28.69	0.00	0.00
4	12.8%	161.78	1617.81	183.33	32.36	−32.35	0.00	0.00
5	12.8%	182.46	1824.57	206.76	1861.06	−36.49	1824.57	1000.00
					IRR =		12.78%	0.00%

If inflation is stable for the life of the security, the inflation rate which makes the rate of return equal to zero depends on the real pre-tax interest rate on the bond and the tax rate according to the formula

$$p = \frac{r(t-1)}{r - tr - t} \tag{1}$$

in which p denotes the inflation rate, r denotes the pre-tax real interest rate, and t denotes the marginal tax rate on interest and increase in principal. For example, to approximate current economic conditions, set r = .5% and t = 15%. Then,

$$p = \frac{.005(.15-1)}{.005 - .005(.15) - .15} \approx 0.292$$

Thus, if the real interest rate on TIPS is .5%, stable inflation of 2.92% reduces the real rate of return to zero regardless of the term to maturity.

VI. Implications for Selection of a Discount Rate in Tort Cases

The market for TIPS has matured, deepened, and widened since their introduction in 1997. TIPS are now available in a wide range of maturities. They can be easily purchased through intermediaries or directly from the Treasury by unsophisticated investors and with low transaction costs. Most importantly, they are backed by the full faith and credit of the United States for payment of both principal and interest in real terms. The interest rate on TIPS provides a market determined measure of the real interest rate on a risk-free security.

In legal jurisdictions which define loss of income or earning capacity without consideration of income taxes, the interest rate used to discount future values to the present should be a before-tax rate. Thus, it seems clear that the market rate on TIPS is appropriate for discounting future losses in personal injury and wrongful death tort cases.

It should be noted, however, that this conclusion does not answer the current debate concerning use of current versus historical interest rates for discounting. Our sister common law nations generally use a historical average rate on inflation adjusted securities to set a discount rate to be used in most tort cases. Courts in the U.S. have declined to follow this path and dictate a specific discount rate which must be used. They have even refused to select a single method for determining the discount rate. Thus, forensic experts who choose to use current market rates are free to do so, and the market rate on TIPS is one interest rate that satisfies the risk-free standard.

Table 5
Adjustments Required to Convert the Pre-tax Rate on
TIPS to a Discount Rate for Forensic Analysis

After-tax rate of return		
Inflation Rate	Pre-tax Real Rate	
	2%	4%
0%	1.70%	3.40%
4%	1.12%	2.82%
10%	0.34%	2.40%
Adjustment to determine the discount rate		
Inflation Rate	Pre-tax Real Rate	
	2%	4%
0%	−0.30%	−0.60%
4%	−0.88%	−1.18%
10%	−1.66%	−1.60%

In addition, TIPS protect the investor from unanticipated inflation, which enhances their status as a risk-free security. Others have suggested that T-Bills also provide protection from unanticipated inflation because market rates will adjust to incorporate inflation. We have argued that T-Bills will only provide this protection if short-term inflation forecasts are accurate and if market prices adjust instantaneously. These conditions are seldom found outside of economic theory.

In jurisdictions that require deduction of income taxes, the use of TIPS becomes more complicated. The market rate on TIPS must be adjusted to an after-tax rate to discount losses that likewise have been reduced for pre-injury taxes. This adjustment depends on the plaintiff's post-injury income tax rate, the real interest rate on TIPS, and the inflation rate over the life of the bond.

Table 5 illustrates the combined effect of taxation and inflation on the rate of return. The top portion of the table shows the after-tax rate of return when held to maturity for two real pre-tax rates and three stable inflation rates, with a 15% income tax rate. With zero inflation a pre-tax rate of 2% yields 1.70% [i.e., 2% (1- 0.15)]. As the inflation rate increases the after-tax rate of return declines. Four percent inflation reduces the yield to 1.12%, and 10% inflation reduces it to 0.34%.

As a result, the adjustment required to convert the real pre-tax TIPS rate to an after-tax discount rate increases with the rate of inflation. The bottom portion of the table shows the adjustment required. For example, with zero inflation a 2% TIPS rate must be reduced by 0.30%. Higher inflation increases the adjustment. Four percent inflation increases the adjustment to −0.88%, and with 10% inflation the adjustment is −1.66%. Not only is the required adjustment not a constant, as was previously thought, but the mathematical relationship between the rate of inflation and the adjustment is distinctly non-linear.[6]

Furthermore, the after-tax rate of return and required adjustment also depend on the tax rate on the interest income. With a marginal tax rate of 25%, 10% inflation reduces the real rate of return on the 2% bond to −0.77%. There is no simple adjustment to convert a pre-tax TIPS interest rate to an after-tax discount rate.

The significance of this conclusion is mitigated when we consider the fact that many awards for lost income will be subject to minimal income taxation. Specifics will depend on facts of the individual case, but consider a totally disabled worker with no post-injury earnings filing jointly with a spouse. The annual interest payment and the increase in face value of the TIPS are reported on page 1 of Form 1040 and become part of adjusted gross income. Deductions and personal exemptions are subtracted from AGI to get taxable income. In 2014 the standard deduction for a couple filing jointly is $12,200 and the personal exemption is $3,900. Both of these are adjusted annually by the increase in the CPI. With two personal exemptions, income from the award would have to be over $20,000 to incur any income tax. Assuming 2% real interest rate and 3% inflation, the award would have to be over $400,000 to incur any income tax whatsoever. For higher awards the marginal tax rate is only 10% for the first $17,850 of taxable interest. In subsequent year's interest income, taxes, and the tax rate would steadily decline. Thus, in the case of a totally disabled worker with no additional income and an award of less than $750,000 a plaintiff's economic expert may reasonably ignore the tax, use the pre-tax TIPS rate, and not to attempt to reduce the real interest rate on TIPS for income taxes.

VII. Summary and Conclusion

In 1916 the Supreme Court of the United States insisted that future economic losses must be discounted to present value if the award is to be made as a lump sum payment. The Court ruled that the discount rate should be based on the return that could be earned on the safest and best investments. These two words were clearly redundant. There was no dual meaning intended by using two words. The Court also refused to identify any single financial asset which met that standard, and specifically mentioned several that might qualify.

Sixty-seven years later, the Court affirmed the 1916 decision and issued a lengthy decision which focused on problems in calculating an equitable award in an inflationary environment. It recognized that economic losses in personal injury and wrongful death cases are losses of real purchasing power—not merely nominal monetary losses. Inflation significantly complicates the process of evaluating future losses and reducing those to present value. As the earlier Court had done, it refused to ordain one procedure as dogma and all others as false doctrine. Instead, it set forth general guidelines while insisting that future losses and the discount rate should be treated equally. Inflation must ei-

[6]As shown by Equation (1).

ther be included in both or excluded from both. Either way, it is real wage growth and real interest rates that determine an equitable award.

The Court did not explicitly discuss the problem of unanticipated inflation and the devastating effect that it can have on the purchasing power of an award or the overcompensation that can result from an unexpected decline in inflation. However, by clearly recognizing that inflation poses a serious problem in calculating an equitable award, it is reasonable to expect that if the issue comes before the Court, it will recognize that unanticipated inflation is a significant problem that must be addressed in the calculation of present value.

Since the *Pfeifer* decision, four U.S. circuit courts (2^{nd}, 5^{th}, 9^{th}, and 10^{th}) have rendered opinions concerning the selection of a proper discount rate. All acknowledge that the Pfeifer decision is the ruling law in Federal courts, and quote the three methods approved in that decision. In general, they have shown a preference for the real rate method, but only the Fifth Circuit has required that it must be used in Federal cases. In all of these decisions, the courts have approved the use of historical rates to determine the real interest rate. There has been no discussion concerning the use of current market-determined real rates at the appellate court level. As a matter of fact, we have found only one instance in which a district court considered the issue of nominal rates on standard government securities versus real rates on TIPS. Even that dispute was more about the level of the discount rate than about the proper methodology. In short, U.S. Federal courts have not considered the appropriate use of TIPS to determine the discount rate.

It is quite a different story in our sister common law countries. The United Kingdom, Canada, and Australia have all shown a distinct preference for the use of real interest rates and real wage growth rates, and all have approved the use of real rates on inflation protected securities to determine the discount rate. By and large, they have also chosen to prescribe a discount that must be used in most cases. Except for Ontario, these prescribed rates are based on a historical average, or normal rate. Since 2000, Ontario prescribes the rate to be used each year based on the rate on Canadian real rates in the past year.

All debt instruments presumably include a premium for anticipated inflation and for uncertainty in expected inflation. TIPS go one step further. TIPS are the only United States Government securities which are adjusted for all inflation—unanticipated as well as anticipated. Therefore, they better meet the standard as the “safest and best” security to determine the appropriate discount rate for forensic purposes.

The interest rate on TIPS provides the forensic economist with a market-determined measure of the real interest rate which protects the investor from both anticipated and unanticipated inflation. In jurisdictions which require that taxes be ignored in calculation of losses, we believe that this is the best available measure of the discount rate that should be used to reduce future losses to present value.

Other jurisdictions, including Federal courts, require that after-tax income must be used to calculate future losses. The discount rate in these courts should be an after-tax rate. If there were no taxation of the annual accrued increase in face value, after-tax rates on TIPS could easily and accurately be calculated from reported market rates with the formula $r = i\ (1 - t)$. But in the United States, income taxes must be paid each year on the accrued increase in face value. We have shown that the adjustment to convert market rates to after-tax rates is not a constant. It is an increasing and non-linear function of the ex-post rate of inflation over the life of the security. This leads to the disturbing conclusion that, using the market rate on TIPS to estimate the after-tax discount rate requires the analyst to predict the rate of inflation that will occur over the life of the security, which is what we had hoped to avoid.

However, many awards will be subject to little or no federal income tax. For an award of less than $750,000 a plaintiff's economic expert may reasonably use the market rate on TIPS and not attempt to reduce it for income taxes on the interest income.

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