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Economic Theory and the Present Value of Future Lost Earnings: An Integration, Unification, and Simplification of Court Adopted Methodologies

GARY A. ANDERSON* and DAVID L. ROBERTS**

I. INTRODUCTION

In the last few years courts have accepted several methods of assessing the present value of future lost earnings. These include the market (or nominal) interest rate approach,[1] the *Penrod* rule,[2] the Alaska rule (or total offset approach),[3] the *Feldman* approach,[4]

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1. In the market-interest rate approach, future lost earnings are forecasted using a market (or nominal) growth in earnings rate and then discounted to present value using a market (or nominal) interest rate. This method has been used in many court cases. For a discussion of the market interest rate, see *infra* note 49 and accompanying text.

2. Under the *Penrod* rule future lost earnings were either forecasted using a 0% growth in earnings rate or a below-market (or real) growth in earnings rate. Future lost earnings were then discounted to present value using a market (or nominal) interest rate. This approach was adopted in Johnson v. Penrod Drilling Co., and used exclusively in the Fifth Circuit from 1975-1982. 510 F.2d 234 (5th Cir. 1975). The *Penrod* rule was overruled in Culver v. Slater Boat Co., 688 F.2d 280 (5th Cir. 1982).

3. The Alaska rule (or total offset approach) is based on the assumption that the growth rate in lost earnings is equal to the interest rate. Thus the effect on the award of lost

the offset (or net discount or modified *Feldman*) approach,[5] the below-market (or real) interest rate approach,[6] and the average annual damage approach.[7] Although many of these methods are mathematically similar,[8] the potential for confusion and inequitable awards is enormous.[9] In some cases the courts have mandated methods which are grossly biased in favor of either the plaintiff or the defendant.[10] In other cases the courts have allowed methodolo-

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earnings growing over time is exactly offset by the effect on the award of the interest income that the plaintiff will earn by investing the award. Under this assumption the award would simply be the product of earnings in the year prior to injury and the expected number of years of lost earnings. The Supreme Court of Alaska first introduced this approach in Beaulier v. Elliott, 434 P.2d 665 (Alaska 1967). The Third Circuit adopted this approach in Jones & Laughlin Steel Corp. v. Pfeifer, 678 F.2d 453 (3d Cir. 1982), *vacated*, 462 U.S. 523 (1983). The Alaska Supreme Court first introduced this approach in Beaulier v. Elliot, 434 P.2d 665 (Alaska 1967).

4. In the original *Feldman* approach future lost earnings are forecasted using a 0% growth in earnings rate and then discounted to present value using a below-market (or real) interest rate. Feldman v. Allegheny Airlines, Inc., 524 F.2d 384 (2d Cir. 1975).

5. In the offset approach, future lost earnings are forecasted using a 0% growth in earnings rate and then discounted to present value using a net (or differential) discount rate based on the relative difference between the expected interest rate and growth in earnings rate. For an explanation of this method, see *infra* Section III(C).

6. In the below-market interest rate approach, future lost earnings are forecasted using a below-market (or real) growth in earnings rate and then discounted to present value using a below-market (or real) interest rate. This approach has been utilized in many court cases; *see, e.g., infra* note 51. For an explanation of this method, see *infra* Section III.

7. In the average annual damage approach, future lost earnings are forecasted using a market (or nominal) growth in earnings rate — then summed and divided by the number of years of lost earnings — to determine the average annual damage. The average damage is assumed to exist in each year of losses and then discounted to present value using a market (or nominal) interest rate. This approach is one of several found acceptable by the Fifth Circuit Court of Appeals in Culver v. Slater Boat Co., 688 F.2d 280 (5th Cir. 1982) (*Culver* I). The decision to allow several methods was later withdrawn in Culver v. Slater Boat Co. and the below-market (or real) interest rate approach was adopted. 722 F.2d 114 (5th Cir. 1983) (*Culver* II).

8. The market, below-market, and offset approaches are mathematically equivalent under certain conditions; *see infra* Section III.

9. For a discussion of these alternative approaches and their potential for producing inequitable awards, see Landsea & Roberts, *Inflation and the Present Value of Future Economic Damages*, 37 U. MIAMI L. REV. 93 (1984). *See also, infra* Section VI, Table II p.___ and accompanying text.

10. *See, e.g.*, Johnson v. Penrod Drilling Co., 510 F.2d 234 (5th Cir. 1975). In this case the Fifth Circuit Court of Appeals adopted an approach (the *Penrod* rule) that is grossly biased in favor of defendants. The Fifth Circuit eventually overruled *Penrod* in Culver v. Slater Boat Co., 688 F.2d 280 (5th Cir. 1982) (*Culver* I). The court recommended several alternative methods of assessing the present value of future lost earnings. One recommended method was the average annual damage approach, which is grossly biased in favor of plaintiffs. This method was criticized in Culver v. Slater Boat Co., 722 F.2d 114 (5th Cir. 1983) (*Culver* II), where the court adopted the below-market interest rate as the standard in the Fifth Circuit.

For an explanation of the biases associated with the *Penrod* rule and the average angies which incorporate incorrect definitions of economic parameters[11] and violate certain well-known economic relationships.[12] Use of these methods has resulted in large variations in damage awards among cases with similar fact patterns.[13]

The variations among these methodologies and the potential for inequitable awards have not gone unnoticed. Recently the courts have indicated a desire to adopt a single methodology that would simplify and standardize the process of damage assessment, and reduce the variation among awards in similar cases. In *Doca v. Marina Mercante Nicaraguense, S.A.*, the Second Circuit Court of Appeals warned that "[t]he average accident trial should not be converted into a graduate seminar on economic forecasting."[14] In *Johnson v. Penrod Drilling Co.*,[15] the Fifth Circuit adopted the *Penrod* rule. The court finally overruled this method, extremely biased in favor of defendants,[16] in *Culver v. Slater Boat Co.*,[17] where the Fifth Circuit enumerated several alternative approaches that would be acceptable.[18] Ironically, the average annual damage approach served as one such alternative, one that is extremely biased in favor of plaintiffs.[19] The Fifth Circuit later reversed its decision in *Culver I* with *Culver v. Slater Boat Co.*,[20] (*Culver II*), and adopted the below-market interest rate approach. The Third Circuit adopted the Alaska (or total offset) rule in *Jones & Laughlin*

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nual damage approach, and for an assessment of the percentage errors in present value awards resulting from the use of these two approaches, see Landsea & Roberts, *supra* note 9, at 106, 117. In many cases these two approaches may result in errors in awards in excess of 50%.

11. *See, e.g., infra* notes 51, 55; *see also* Anderson & Roberts, *Rejoinder and Clarification of Zocco-Ledford's* "Penrod *Overruled: Implications and Shortcomings in* Culver," 30 Loy. L. Rev. 87 (1985); Landsea & Roberts, *supra* note 9, at 93.

12. For a discussion of these economic relationships and how they have often been neglected in assessing damage awards, see *infra* Sections V and VI.

13. Offset (or differential discount) rates of 0% and 7% respectively were used to assess awards in Beaulier v. Elliott, 434 P.2d 665 (Alaska 1967), and Arnold v. Teno, 83 D.L.R.2d 609 (Can. 1978). All other things being equal, a change in this rate from 7% to 0% would effect twenty and forty years of lost future earnings from a change of approximately 89% and 200%.

14. 634 F.2d 30, 39 (2d Cir. 1980).

15. Johnson v. Penrod Drilling Co., 510 F.2d 234 (5th Cir. 1975). For an explanation of the *Penrod* rule, see *supra* note 2.

16. *See supra* note 10.

17. 688 F.2d 280 (5th Cir. 1982).

18. The alternatives include: the market interest rate approach, the below-market interest rate approach, the offset approach, and the average annual damage approach.

19. *See supra* note 10.

20. 722 F.2d 114 (5th Cir. 1983).

Steel Corp. v. Pfeifer,[21] but the Supreme Court of the United States later vacated this decision on appeal.[22]

The decision in *Jones*[23] is particularly interesting in light of the Supreme Court's selection of a limited range of methods for the assessment of damage awards in personal injury litigation. The Court identified three basic, acceptable methodologies: the market interest rate approach,[24] the below-market interest rate approach,[25] and the offset approach.[26] After examining each of these methods, the Supreme Court stated:

> The litigants and the amici in this case urge us to select one of the many roles that have been proposed and establish it for all time as the exclusive method in all federal trials for calculating an award for lost earnings in an inflationary economy. We are not persuaded, however, that such an approach is warranted. . . . For our review of the foregoing cases leads us to draw three conclusions. First, by its very nature the calculation of an award for lost earnings must be a rough approximation. Because the lost stream can never be predicted with complete confidence, any lump sum represents only a "rough and ready" effort to put the plaintiff in the position he would have been in had he not been injured. Second, sustained price inflation can make the award substantially less precise. Inflation's current magnitude and unpredictability create a substantial risk that the damage award will prove to have little relation to the lost wages it purports to replace. Third, the question of lost earnings can arise in many different contexts. In some sectors of the economy, it is far easier to assemble evidence of an individual's most likely career path than in others.[27]

The Court refused to adopt a single methodology on the grounds that any attempt to assess a damage award for future lost earnings would be highly speculative. This opinion will not reduce the number of inequitable awards, and may cause a court to fail to allocate the time that it needs in order to properly evaluate the other methodologies that are available.

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21. 678 F.2d 453 (3d Cir. 1982).

22. Jones & Laughlin Steel Corp. v. Pfeifer, 462 U.S. 523 (1983). The Supreme Court refused to make the total offset approach mandatory in the federal courts. *Id.* at 550. The Court claimed that the legislative branch of the federal government is better equipped to make that kind of decision. *Id.*

23. *Id.*

24. *Id.*

25. *Id.*

26. *Id.*

27. *Id.* at 546-47.

This decision does not provide guidance to lower courts that are struggling with the question of how to assess damages in personal injury cases. The Fifth Circuit exemplifies the effect of this lack of guidance; after reviewing the Supreme Court's decision, the court elected to adopt the below-market interest rate approach.[28] Unfortunately, the Fifth Circuit defines the below-market interest rate and other economic variables incorrectly[29] by allowing a variation in these variables (and thus in awards) that is inconsistent with historical experience[30] and accepted economic theories.[31] It also advocates forecasting techniques that violate sound economic principles.

The courts' failure to establish a single unbiased method of assessment emanates from the legal community's lack of understanding of certain economic concepts and relationships that are fundamental to the assessment of awards for lost earnings. The purpose of this article is to explain these basic economic principles and to show their relevance in the determination of equitable awards.[32]

Understanding these principles is of paramount significance in establishing the basis for a simple and unbiased criteria that could reduce the number of inequitable future lost earnings damage awards. First, the three acceptable methods identified by the Supreme Court for determining awards are mathematically equivalent,[33] provided that the court correctly defines[34] and consistently estimates[35] the parameters to the present value calculation. In contrast to the Supreme Court's assertion, all three approaches yield exactly the same present value award.[36] If courts understand the correct definitions of the economic parameters used in these alternative models, the natural relationship between the models should prevent courts and litigants from using incorrect methods of assessment, such as the grossly biased *Penrod* rule.[37]

Second, awards for future lost earnings are more predictable

28. Culver v. Slater Boat Co., 722 F.2d 114 (5th Cir. 1983).

29. *See infra* note 51.

30. *See infra* note 87-88 and accompanying text.

31. For an example of an accepted economic theory, see *infra* note 93 and accompanying text.

32. *See infra* note 87-89 and accompanying text.

33. *See infra* Section III.

34. *See infra* Section III.

35. *See infra* Section VI.

36. *See* Jones & Laughlin Steel Corp. v. Pfeifer, 462 U.S. 523, 521-43 (1983).

37. *See, e.g., supra* note 10.

than the Supreme Court suggests. It is true that future earnings and price inflation rates are difficult to forecast, and that future earnings depend on the career or occupation of the injured party. These factors, however, do not necessarily imply that awards for lost earnings are highly speculative. Economic theory and historical evidence suggest that stable and predictable relationships exist among the various parameters used in the three alternative models.[38] These relationships imply that awards are relatively predictable,[39] and that specific forecasts of future lost earnings[40] and price inflation rates[41] are not relevant in determining how large the award should be in order to replicate future lost earnings.

Third, the economic relationships explained in this article should help resolve the important issue of whether there is a preferred methodology. Although the three models that the Supreme Court found acceptable are mathematically equivalent, they are not equally desirable. The Court should adopt a methodology that is conceptually and mathematically valid, and that minimizes any potential biases that could arise if the court improperly forecasts economic variables that it uses to determine the damage award. It should be as simple as possible for litigants to determine whether the values of the economic variables used to calculate the award are consistent with accepted economic theories and historical experience. As we shall see, these criteria suggest that the offset methodology offers the most reliability.[42]

Section II explains the relationships between market (or nominal) and below-market (or real) interest rates and growth in earnings rates. Understanding how economists define nominal and real rates of change in relation to each other is an essential prerequisite to understanding the three basic methodologies that the Supreme Court accepted.[43] Section III presents these three alternative models and illustrates their mathematical equivalency. These models are important because they provide the basis for understanding the relevance of the various economic concepts and relationships that are explained and documented in Section IV. In Section V and VI these economic principles are used to explain why awards for lost earnings are much less speculative than the Supreme Court

38. *See infra* Section IV.
39. For a discussion of the predictability of awards, see *infra* Section V.
40. *See infra* note 77 and accompanying text.
41. *See infra* note 79 and accompanying text.
42. *See infra* Section VI.
43. *See, e.g., supra* notes 1, 5, & 6.

suggested, and why the offset approach to determining awards is preferred. Section VII contains concluding remarks.

II. The Relationships Between Nominal and Real Rate of Change

The relationships between nominal (or market) and real (or below-market) interest rates and growth in earnings rates[44] are defined and explained in this section. These relationships, which the courts have often defined incorrectly,[45] provide the basis for comparing the alternative approaches to assessing damage awards for lost earnings.

A. *Nominal and Real Interest Rates*

The real (or below-market) rate of interest is equal to the interest rate that would exist in a noninflationary economy. For example, suppose that an individual invests $10,000 for one year at an interest rate of 2% and that price inflation is 0%. At the end of the year the investor will receive a $10,000 principal payment plus a $200 interest payment for a total of $10,200. Because prices have remained constant, the individual may purchase 2% more consumer goods and services with $10,200 than with the previous year's principal of $10,000. The investor has therefore realized a "real" return on the investment of 2%.

The nominal (or market) rate of interest is the interest rate which lenders state in financial contracts and use to compute interest payments. This rate is "nominal" in the sense that its real value depends on the rate of price inflation. Economists may consider a 7% nominal interest rate good when price inflation is 4%, but bad when price inflation is 10%. Lenders and borrowers are aware of the effects of price inflation on the value of principal and interest payments. Accordingly, the interest rates stated in financial contracts reflect the expectations of price inflation over the contract period. When lenders expect future price inflation, they demand higher returns to protect the purchasing power of their investments. Borrowers are willing to pay these higher returns because they expect to make their principal and interest payments

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44. Irving Fisher introduced this relationship in I. FISHER, THE THEORY OF INTEREST 399-451 (1930). The relationship between nominal and real rates of change is widely employed in economics and finance, and most modern textbooks offer a treatment of this subject. *See, e.g.*, J. VAN HORNE, FINANCIAL MANAGEMENT AND POLICY 132 (5th ed. 1980).

45. *See infra* notes 51, 55.

with dollars that have reduced purchasing power.

It follows that the nominal interest rate is equal to the real interest rate plus a premium for expected future price inflation. The following formula expresses this relationship:

(1) $k = k_r + i + i(k_r)$

where k is the nominal rate of interest, k_r is the real rate of interest, and i is the expected rate of price inflation. The premium for expected price inflation ($i + i(k_r)$) results from the fact that inflation erodes the purchasing power of both the principal sum invested and the interest income investors earn. The first term (i) protects the purchasing power of the principal and the second term ($i(k_r)$ protects the purchasing power of the interest income.

For example, assume that lenders and borrowers would agree on a 2% interest rate if they expected price inflation to be 0%, but that they actually expected price inflation to be 5%. Equation (1) indicates that lenders and borrowers should therefore agree on a 7.10% interest rate ($k = .02 + .05 + .05(.02) = .0710$). Thus, if an individual invests $10,000 for one year at an interest rate of 7.10%, the interest payment at the end of the year will be $710. Of this $710, $200 represents real interest, $500 maintains the purchasing power of the $10,000 principal, $10,000(.05) = $500, and $10 maintains the purchasing power of the $200 real interest payment, ($200(.05) = $10).

Equation (2), a revision of equation (1), expresses the real rate of interest:

(2) $k_r = \dfrac{k - i}{1 + i}$

Thus, if the nominal or market rate of interest is 7.10% and the rate of price inflation is 5%, equation (2) indicates that the real rate of interest is 2% ($k_r = (.071 - .05)/(1 + .05) = .02$).

Returning to our example, assume that an individual invests $10,000 for one year at an interest rate of 7.10% and that price inflation is 5%. At the end of the year the investor will receive a $10,000 principal payment plus a $710 interest payment for a total of $10,710. This does not represent a 7.10% increase in the investor's ability to purchase consumer goods and services, because prices have increased by 5%. A 5% price increase implies that the investor will need $10,500 to purchase the same quantity of goods and services that the $10,000 principal would have purchased the previous year, and that he will require $210 to purchase the same quantity of goods and services that $200 would have purchased the previous year. After adjusting for price inflation, the investor may purchase only $200 more at the end of the year than he could have at the beginning of the year. The investor has realized a 2% increase in the ability to purchase goods and services and a 2% real return on the investment.

B. *Nominal and Real Growth in Earnings Rates*

The distinction between nominal and real growth in earnings rates is the same as the distinction between nominal and real interest rates. Nominal rates are the rates of change in actual year to year wages (or investment principals) and real rates are the rates of change in the wage earner's (or investor's) ability to purchase consumer goods and services. The following formula expresses the relationship between the nominal and real growth in earnings rates:

(3) $g = g_r + i + i(g_r)$

or, solving equation (3) for g_r,

(4) $g_r = \dfrac{g - i}{1 + i}$

where g and g_r are the nominal and real growth rates in earnings and i is the price inflation rate.

For example, assume that an employee earned $10,000 last year. Further assume that if the employee and employer expected price inflation of 0% they would agree on a 3% or $300 wage increase based on productivity gains of the employee. This would represent a real growth rate in earnings of 3% because the employee, given 0% price inflation, could purchase 3% more goods and services with $10,300 than with the previous year's earnings of $10,000. Suppose, however, that the employee and employer both expected price inflation of 5%. Equation (3) indicates that they should agree on a wage increase of 8.15% ($g = .03 + .05 + .05(.03) = .0815$). This increase of 8.15% or $815 will protect the employee's real earnings from price inflation. A price inflation rate of 5% implies that the employee will need $10,500 to purchase the same quantity of goods and services that $10,000 would purchase the previous year, and that he will need $315 to purchase the same quantity of goods and services that $300 would purchase the previous year. Thus, when price inflation is 5%, a consumer requires $10,815 to purchase the same quantity of goods and services as $10,300 will purchase when price inflation is 0%. It follows, as equation (4) indicates, that an 8.15% wage increase when price inflation is 5% provides the employee with a real wage increase of only 3% ($g_r = (.0815 - .05)/(1 + .05) = .03$).

III. Three Alternative Models

The purpose of this section is to explain the three acceptable alternative models identified by the Supreme Court for assessing the present value of future lost earnings, and to illustrate that if the courts correctly define and estimate the parameters to these three models, all three will yield exactly the same present value award.

The current practice in personal injury litigation is to award the plaintiff a present sum of money as compensation for future lost earnings. The purpose of the award is to allow the plaintiff, through investment in relatively safe government securities, to replicate over time the lost income stream.[46] In order to assess the present value of future lost earnings, the court must predict the amount of future lost earnings and then discount them to present value. Discounting reduces the lost future income stream to present value by removing the interest income that the plaintiff could earn through investment. The idea is that the award plus the interest earned on the award should equal the future lost earnings that the plaintiff would have received had he or she not been injured.

Most methods of assessing present value awards involve forecasting the average annual rate of growth in lost earnings and the average annual rate of interest for the period of loss.[47] The courts use the average growth in earnings rate to calculate future lost earnings, and they use the average interest rate to discount these future lost earnings to present value.[48] Most approaches may be categorized according to whether future lost earnings are forecasted and then discounted to present value using nominal (or market) growth in earnings and interest rates, real (or below-market) growth in earnings and interest rates, or a differential (or offset) discount rate based on the difference between the nominal and real growth in earnings and interest rates.

A. *The Nominal Growth in Earnings and Interest Rate Model*

This approach utilizes forecasts of the average annual growth

46. *E.g.*, Jones & Laughlin Steel Corp. v. Pfeifer,462 U.S. 523, 534-37 (1983).

47. Average rates are normally used because in the past growth in earnings and interest rates have varied widely from year to year, making forecasts of individual annual rates impractical. *See infra* Figures 1(a), 2(a) p. 742.

48. Most modern finance textbooks offer a discussion of calculating future values and discounting future values to present values. *See, e.g.*, J. Weston & E. Brigham, Essentials of Managerial Finance 291 (7th ed. 1985).

in earnings and interest (or discount) rates in nominal or market terms.[49] The courts use the nominal growth in earnings rate to forecast future lost earnings and then they use the nominal interest rate to discount these future lost earnings to present value.[50] This method is illustrated in Part A of Table I, which is based on the assumptions that an individual earned $10,000 in the year prior to injury, that the court expects the individual to lose three years of earnings, that the court expects earnings in the individual's occupation to grow at an annual, nominal rate of 8.15% over the period of losses, and that the annual, nominal interest rate will be 7.10% over the period of losses.

As Table I indicates, the court expects first year's lost earnings to be $10,815, an 8.15% increase over the previous year's earnings of $10,000 (that is, $10,000(1 + .0815) = $10,815). The present value of the first year's lost earnings is $10,098 (that is, $10,815/(1 + .0710) = $10,098). An immediate award of $10,098 invested at 7.10% would grow to $10,815 by the end of the first year, the exact amount of lost earnings expected at that time (that is, $10,098(1 + .0710) = $10,815). For the second year, the court expects lost earnings to be $11,696. Note that this represents an 8.15% increase

49. The nominal growth in earnings and interest rate approach has been applied in numerous court cases. *See, e.g.*, Taenzler v. Burlington N., 608 F.2d 796, 801 (8th Cir. 1979); Steckler v. United States, 549 F.2d 1372 (10th Cir. 1977); Huddell v. Levin, 537 F.2d 726 (3d Cir. 1976); Bach v. Penn Cent. Trans. Co., 502 F.2d 1117, 1122 (6th Cir. 1974); Turcotte v. Ford Motor Co., 494 F.2d 173, 186-87 (1st Cir. 1974); Magill v. Westinghouse Elec. Corp., 464 F.2d 294, 301 (3d Cir. 1972); District of Columbia v. Barriteau, 399 A.2d 563, 566-69 (D.C. Cir. 1979); Schmitt v. Jenkins Truck Lines, Inc., 170 N.W.2d 632 (Iowa 1969); Ott v. Frank, 202 Neb. 820, 277 N.W.2d 251 (1979); Resner v. Northern Pac. R.R., 161 Mont. 177, 505 P.2d 86 (1973).

50. The nominal growth in earnings and interest rate model may be expressed in mathematical notation as follows:

$$PV = Y_0 \left[\sum_{t+1}^{N} \frac{(1+g)^t}{(1+k)^t} \right] = \frac{Y_0(1+g)}{(1+k)} + \frac{Y_0(1+g)^2}{(1+k)^2} + \cdots + \frac{Y_0(1+g)^N}{(1+k)^N}$$

where *PV* is the present money value of expected future lost earnings; Y_0 the money value of lost earnings in the year injured; *N* is the number of lost years of earnings expected to be incurred; *g* is the average, annual, nominal growth rate expected in lost earnings over the *N* years; *k* is the average, nominal interest (or discount) rate expected over the *N* years, and *t* is a variable which takes on the values of 1 through *N*. The numerator of the fraction in this equation, $Y_0(1+g)t$, is the forecast of lost earnings for year *t*. Dividing this value by the denominator $(1+k)t$ discounts this forecast to present value. The equation indicates that the present value of expected lost earnings should be calculated for each of the *N* years that lost earnings are expected, and then summed. For an example, see the calculations in Part A of Table I *infra* p. 730.

TABLE I

A COMPARATIVE EXAMPLE OF THE THREE MODELS*

A. Nominal Growth in Earnings and Interest Rate Model:

Year	Lost Earnings	Present Value of Lost Earnings
1	$10,000(1+.0815) =$10,815	$10,815/(1+.0710) =$10,098
2	$10,000(1+.0815)^2 =$11,696	$11,696/(1+.0710)^2 =$10,197
3	$10,000(1+.0815)^3 =$12,650	$12,650/(1+.0710)^3 =$10,297
		$30,592

B. Real Growth in Earnings and Interest Rate Model:

Year	Lost Earnings	Present Value of Lost Earnings
1	$10,000(1+.03) =$10,300	$10,300/(1+.02) =$10,098
2	$10,000(1+.03)^2 =$10,609	$10,609/(1+.02)^2 =$10,197
3	$10,000(1+.03)^3 =$10,927	$10,927/(1+.02)^3 =$10,297
		$30,592

C. Differential Discount Rate Model:

Year	Lost Earnings	Present Value of Lost Earnings
1	$10,000	$10,000/(1−.0097) =$10,098
2	$10,000	$10,000/(1−.0097)^2 =$10,197
3	$10,000	$10,000/(1−.0097)^3 =$10,297
		$30,592

*Assumptions: base year earnings = $10,000, years of lost earnings = 3, nominal growth in earnings rate = 8.15%, nominal discount (interest) rate = 7.10%, and price inflation rate = 5%. These assumptions imply: real growth in earnings rate = 3%, real discount (interest) rate = 2%, and differential discount rate = −0.97%. The best year earnings, years of lost earnings, the nominal growth in earnings and interest rates, and the price inflation rate were arbitrarily selected. The real growth in earnings and interest rates and the differential discount rate were calculated using equations (4), (2), and (5), respectively.

over the previous year's lost earnings of $10,815 (that is, $10,815(1 + .0815) = $11,696). The present value of the second year's lost earnings is $10,197. An immediate award of this amount invested at 7.10% per annum for two years would grow to $11,696, the exact amount of the lost earnings expected after two years. Finally, the present value of the third year's lost earnings is $10,297. This amount, invested at 7.10% per annum, would grow to $12,650 in three years, the exact amount of lost earnings forecasted for year three. Summing the present values of each year's lost earnings yields a total percent value award of $30,592.

B. *The Real Growth in Earnings and Interest Rate Model*

This approach requires a forecast of the average annual growth in earnings and interest rates in real or below-market terms.[51] The real growth and interest rates are equal to the nominal growth and interest rates adjusted for expected price inflation.[52] The court then uses the real growth in earnings rate to forecast future lost earnings in real terms, and uses the real interest rate to discount these future lost earnings to present value.[53] Part B of Table I illustrates this method and utilizes the same assumptions as the nominal growth in earnings and interest rate approach used in Part A of this table. In addition, the example assumes that the court expects the price inflation rate to be 5% per year over the period of losses. This implies that the real growth in earnings and interest rates are 3% and 2%, respectively.[54]

As Table I indicates, the court expects the first year's lost earnings in real terms to be $10,300, a 3% real, after-inflation increase over the previous year's earnings of $10,000. The present value of the first year's real lost earnings is $10,098. In other

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51. The expected future real interest rate has been widely employed in Canada to discount expected lost earnings. In three cases, however, the court incorrectly imposed a 0% growth rate for lost earnings rather than allowing lost earnings to be forecast by using a real growth in earnings rate based on expected productivity increases. *See, e.g.*, Andrews v. Grand & Toy Alberta Ltd., 83 D.L.R.3d 452 (Can. 1978); Arnold v. Teno, 83 D.L.R. 609 (Can. 1978); Thornton v. Board of School Trustees, 83 D.L.R.3d 480 (Can. 1978).

In the United States, the real interest rate was used in Feldman v. Allegheny Airlines, Inc., 524 F.2d 384, 388 (2d Cir. 1975) and Doca v. Marina Mercantc Nicaraguense, S.A., 634 F.2d 30, 39 (2d Cir. 1980). In Jones & Laughlin Steel Corp. v. Pfeifer, the Supreme Court of the United States found discounting with the "below-market" (real) interest rate to be acceptable, provided that lost earnings are forecasted using the below-market (real) growth rate. 462 U.S. 523, 541-43 (1983). The real growth in earnings and interest rate approach was adopted as the standard in the Fifth Circuit Court of Appeals in Culver v. Slater Boat Co., 722 F.2d 114, 115 (5th Cir. 1983). In all of these cases, however, the courts have incorrectly defined the real interest and growth in earnings rates as the nominal rates less the expected inflation rates (i.e., $k_r = k - i$). This leads to small errors in the award, usually less than 4%. For a discussion of this problem, see Landsea and Roberts, *supra* note 9, at 117 & n.82.

52. *See supra* equations (2) & (4) p. 730-31 and accompanying text.

53. The real growth in earnings and interest rate model may be expressed as follows:

$$PV = Y_0 \left[\sum_{t=1}^{N} \frac{(1+g_r)^t}{(1+k_r)^t} \right] = \frac{Y_0(1+g_r)}{(1+k_r)} + \frac{Y_0(1+g_r)^2}{(1+k_r)^2} + \cdots + \frac{Y_0(1+g_r)^N}{(1+k_r)^N}$$

where g_r is the average, annual, real growth rate expected in lost earnings, and k_r is the expected average, real interest rate, and the other variables are as defined. *See supra* note 50. In this equation the numerator of the fraction $Y_0(1+g_r)^t$ is the forecast in real terms of lost earnings in year t. This value is discounted to present value by dividing it into the denominator $(1+k_r)^t$. This equation indicates that the present value of each year's expected lost earnings should be calculated and then summed to determine the award. For an example, see the calculations in Part B of Table I *supra* p. 734.

54. Given the nominal growth in earnings, interest, and the price inflation rates, the real growth in earnings and interest rates may be calculated by using equations (4) and (2) respectively, *supra* p. 730-31.

words, an immediate award of this amount invested at 2% per annum would grow to $10,300 by the end of the first year, the amount of real lost earnings expected at that time. Similarly, the court may calculate the present value of expected future lost earnings for the second and third years by using the expected real growth in earnings and interest rates as illustrated in Table I, Part B. The sum of the present values for each of the three years of losses yields a total present value award of $30,592.

It is important to note that in this example, the nominal and real growth in earnings and interest rate approaches are equivalent. In computing these illustrations, they yield the same present value award: $30,592. This equivalency results because one must reduce both the nominal growth in earnings and interest rates in order to obtain the real growth in earnings and interest rates. A reduction in the growth rate decreases the award, because it reduces the forecast of future lost earnings; while a reduction in the interest rate increases the award, because it reduces the expected interest income earned via investment of the award. If one computes the real growth and interest rates using equations (2) and (4), the increase in the present value award resulting from the reduction of the nominal interest rate to its real value will offset exactly the decrease in the present value award caused by reducing the nominal growth rate to its real value.

C. *The Differential Discount Rate Model*

Economists define the differential discount rate in terms of the difference between the interest rate used to discount future lost earnings to present value and the growth rate used to forecast future lost earnings.[55] The following formula expresses the differ-

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55. The basic idea underlying the differential discount or offset approach has been utilized in many cases. Courts have generally been too restrictive in determining the magnitude of the differential discount rate. For example, in Beaulieu v. Elliott, the court adopted a 0% differential discount rate (i.e., $k = g$ and/or $k_r = g_r$). 434 P.2d 665 (Alaska 1967). This approach is often referred to as the Alaska rule or offset approach, and was adopted as the standard in the Third Circuit in Jones & Laughlin Steel Corp. v. Pfeifer, 678 F.2d 453 (3d Cir. 1982), *vacated*, 462 U.S. 523, 541-43 (1983).

For examples of cases in which the differential discount rate has not been assumed to be 0%, see Pierce v. New York Cent. R.R. Co., 304 F. Supp. 44 (W.D. Mich. 1969); Gowdy v. United States, 271 F. Supp. 733 (W.D. Mich. 1967); State v. Guinn, 555 P.2d 530 (Alaska 1976); Jesselon v. Waters, 3 W.W.R. 715 (B.C. 1981); Malat v. Bjornson, 114 D.L.R.3d 612 (B.C. Ct. App. 1980). In the latter five cases, however, the courts have incorrectly defined the differential discount rate as the difference between the nominal rate of interest and the nominal rate of growth in earnings ($k-g_r$), or the difference between the real rate of interest and the real rate of growth in earnings. These incorrect definitions of the differential

ential discount rate algebraically as follows:

$$(5)\ d = \frac{k - g}{1 + g} = \frac{k_r - g_r}{1 + g_r}$$

where d is the differential discount rate, k is the nominal interest rate, k_r is the real average annual interest rate forecasted for the period of losses, g is the nominal interest rate, and g_r is the real average annual growth rate in lost earnings forecasted for the period of losses. Equation (5) indicates that the court may define the differential discount rate in terms of the difference between the nominal (or market) interest and growth in earnings rates $((k - g)/(1 + g))$ or the real (or below-market) interest and growth in earnings rates $((k_r - g_r)/(1 + g_r))$. Both definitions will produce the same differential discount rate if the court correctly defines the nominal and real interest rates, and the nominal and real growth rates, in relation to each other.[56]

The differential discount rate approach is based on the fact that the amount of the award ultimately depends on the difference between the interest rate used to discount future lost earnings to present value and the growth rate used to forecast lost earnings. This occurs because increases or decreases in both the interest and growth in earnings rates have offsetting effects on the magnitude of the award. For example, an increase in the interest rate (other factors remaining constant) will decrease the award because it increases the interest income earned per dollar of award, but an increase in the growth in earnings rate (other factors remaining constant) will increase the award because it increases the forecast of future lost earnings. If both the interest and growth rates increase,

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discount rate lead to relatively small errors in present value awards, usually less than 3%. For a discussion of this problem and the errors it produces, see Landsea & Roberts, *supra* note 9 at 114-17 (note that this approach has sometimes been referred to as the modified *Feldman* approach).

The small errors produced in awards by incorrectly defining the differential discount rate have led some analysts to contend that this approach is inconsistent with the market interest rate approach. *See, e.g.*, Note, *Future Inflation, Prospective Damages, and the Circuit Courts*, 63 VA. L. REV. 105, 111 (1977).

56. *E.g.*, assume that the nominal interest and growth in earnings rates are 7.10% and 8.15% respectively and that the price inflation rate is 5%. Equations (2) and (4) indicate that the corresponding real interest and growth in earnings rates are 2% $((k - i)/(1 + i) = (0.071 - 0.05)/(1 + 0.05) = 0.02$ or 2%) and 3% $((g - i/(1 - i = (0.0815 - 0.05)/(1 + 0.05) = 0.03$ or 3%), respectively. The differential discount rate is therefore −0.97%, regardless of whether it is calculated by using the nominal interest and growth in earnings rates $((k-g)/(1 + g) = (0.710 - 0.0815)/(1 + 0.0815) = -0.0097$ or −0.97%) or the real interest and growth in earning rates $((k_r - g_r)/(1 + g_r) = (0.02 - 0.03)/(1 + 0.03) = 0.0097$ or −0.97%).

there will be no effect on the differential discount rate, because the effects on the award of increasing the interest rate and the growth in earnings rate will offset each other exactly.[57]

Part C of Table I illustrates the differential discount rate approach and utilizes the same assumptions used in Parts A and B.[58] As equation (5) indicates, the differential discount rate is −0.97%: (d = (.0710 − .0815)/(1 + .0815) = (.02 − .03)/(1 + .03) = −.0097). Thus, the court may reduce the nominal growth in earnings rate from 8.15% to 0% provided it reduces the nominal interest rate from 7.10% to −0.97%. The court may reduce the real growth in earnings rate from 3% to 0% provided it reduces the real interest rate from 2% to −0.97%. In Table I, Part C, therefore, each year's lost earnings equal the $10,000 earned in the year of injury, that is, growth in lost earnings = 0%, and the court discounts the lost earnings to present value by using the differential discount rate of −0.97%.[59]

Note that the present values of each year's lost earnings are the same for this approach as they are for the nominal and real growth in earnings and interest rate approaches illustrated in Parts A and B of Table I. Thus, all three approaches yield the same present value award provided that one correctly defines the parameters in making the necessary calculations, as in equations (1) through (5). It is also important that these parameters be consistent in the sense that they all reflect the same future economic scenario. This consistency requirement is discussed in Section IV.

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57. *E.g.*, if the interest and growth in earnings rates are reduced from 7.10% and 8.15% to 2% and 3%, the differential discount rate remains constant at −0.97%. As Part C of Table I indicates, *supra* p. 734 , a differential discount rate of −0.97% yields the same award amount, whether it is based on interest and growth in earnings rates of 7.10% and 8.15%, as in Part A of Table I, *supra* p. 734, or on interest and growth in earnings rates of 2% and 3%, as in Part B of Table I, *supra* p. 734.

58. The differential discount rate approach may be expressed as follows:

$$PV = Y_0 \left[\sum_{t=1}^{N} \frac{1}{(1+d)^t} \right] = \frac{Y_0}{(1+d)} + \frac{Y_0}{(1+d)^2} + \cdots + \frac{Y_0}{(1+d)^N}$$

where *d* is the differential discount rate and the other variables are as defined. *See supra* note 50. This equation indicates that the award may be determined by assuming that each year's lost earnings will equal earnings in the year of injury, provided that each year's lost earnings are discounted to the present value by using the differential discount rate. For an example, see the calculations in Part C of Table I, *supra* p. 734.

59. The differential discount rate method offers computational simplicity because present value tables of multipliers have been computed for use when the future earnings (cash flows) are all equal and the discount rate (differential rate) is constant over the period. These tables are known as present value interest factor tables for annuities and may be found in most corporate or investment finance textbooks. *See, e.g.*, J. WESTON & E. BRIGHAM, ESSENTIALS OF BUSINESS FINANCE 754-55 (7th ed. 1985).

IV. Economic Theory and Empirical Evidence

Various economic and financial theories suggest that stable and predictable relationships exist among the various parameters in the calculation of present value. This section explains these theories and presents empirical observations in support of them. The empirical evidence is based on historical data from the period 1952 through 1982. It includes the annual wages of the average workers in several industries,[60] the annual interest rates on one-year Treasury notes,[61] the annual rates of inflation in the consumer price index for urban workers and clerical employees,[62] and the annual levels of gross national product for the United States economy.[63]

A. *The Long-Term Relationship Between Nominal Interest and Growth Rates*

As we saw in Section II, we may view the nominal interest and growth in earnings rates as equal to the real interest and growth in earnings rates, plus a premium for expected future price inflation.[64] This premium emanates from the fact that price inflation

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60. The annual wage information used in this section was taken from the National Bureau of Economic Research (NBER) computer data tape maintained and distributed by the City Bank of New York. This tape contains millions of observations of different economic variables collected by the NBER. The University of Miami purchased a copy of this tape from the City Bank of New York. The tape is stored at the University's computer center and is available to faculty members who wish to use the data for research purposes. The tape contains annual studies of wages for the average worker in manufacturing, mining, and construction; and for the average worker in each of nineteen manufacturing industries. Wage information of this sort was used to compute the annual growth in earnings rates and other wage related information plotted in Figures 1, 2, 3, and 4. *See infra* p. 741, 744, 748, 749 and accompanying notes.

61. This information was taken from the NBER computer data tape, and consists of the interest rates on one-year United States Treasury notes for January 1 of each year from 1952 through 1982. These interest rates are plotted in Figure 1(a), and were used to compute the other interest rate related variables plotted in Figures 1(b), 2, 3, and 4. *See infra* p. 741, 744, 748, 749.

62. This information was obtained from the NBER computer data tape, and was used to calculate the annual rates of price inflation plotted in Figure 1(b), *see infra* p. 741, as well as the real interest, growth in earnings, and growth in GNP rates plotted in Figure 2 *infra* p. 744.

63. The gross national product (GNP) is a measure of the total money value of goods and services produced in the economy during a given time period—usually one year. For an explanation of how GNP is measured, see Samuelson & Nordhaus, Economics 102-121 (12 Ed. 1985). Annual observations of GNP were taken from the NBER computer data tape, *see supra* note 60, and were used to compute the growth rates in GNP plotted in Figure 2, *see infra* p. 744. Note that one may measure the growth rate in GNP in either nominal or real terms, just as one may measure growth rates in investment principals or earnings in nominal or real terms.

64. *See supra* equations (1) & (3) p. 730, 731 and accompanying text.

erodes the purchasing power of invested funds and employee incomes. Thus, when lenders expect future price inflation, they demand higher returns in order to protect the purchasing power of their investments. Borrowers are willing to pay these higher returns, because they expect to make their principal and interest payments with dollars that have reduced purchasing power. Likewise, employees demand higher incomes, and employers agree to these demands, because the employers will pay the employees with dollars that have reduced purchasing power, and the employers will pass on these increased costs to consumers through increased prices for consumer goods.

These arguments imply that nominal interest rates and growth rates in earnings are positively related. An increase or decrease in the expected rate of future price inflation should cause increases or decreases in both nominal interest rates and growth rates in earnings. Such changes protect the real purchasing power of investments and earnings from price inflation.

This positive relationship between nominal interest and growth in earnings rates is not evident when one examines the historical annual observations of these variables. This fact is illustrated in graph (a) of Figure 1, where the annual nominal interest rates on one-year Treasury notes (k), the annual nominal growth rates for the earnings of the average worker in manufacturing, mining, and construction (g), and the annual rates of inflation in the consumer price index (i) are plotted for the period 1952 through 1982. Although there are many years in which the nominal interest, growth in earnings, and price inflation rates changed in the same direction, there are several years in which they varied in opposite directions.

The lack of a strong positive relationship between annual interest and growth rates is not surprising. Although both rates may depend on the anticipated rate of price inflation, they may also depend on a number of other economic factors; such as, wage contracts, the relative bargaining strength of employers and employees, the demand and supply of loanable funds, the rate of growth in economic activity, and the federal government's monetary and fiscal policies.[65] These factors, combined with the difficulty of forecasting future inflation rates, explain why the annual interest and growth rates do not follow the actual annual inflation rates more closely.

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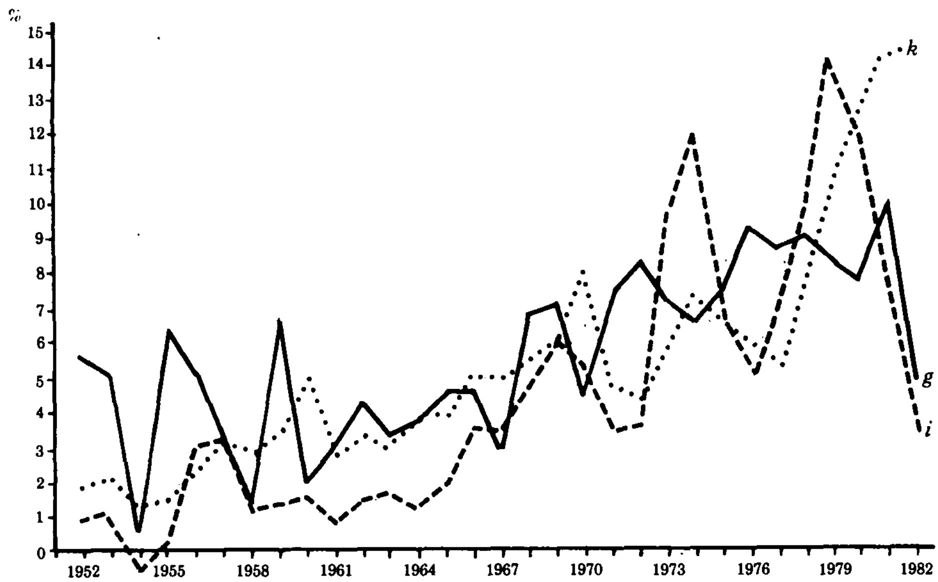
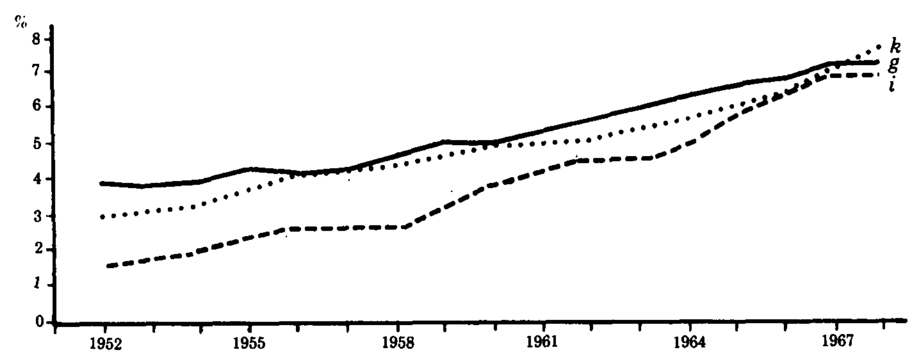
65. *See generally*, SAMUELSON & NORDHAUS, *supra* note 63.



(a) Annual Nominal Interest (*k*), Growth in Earnings (*g*), and Price Inflation (*i*) Rates.



(b) Average Nominal Interest (*k*), Growth in Earnings (*g*), and Price Inflation (*i*) Rates for Successive Fifteen Year Periods.

FIGURE 1: Relationships Between Nominal Interest Rates, Nominal Growth in Earnings Rates and Price Inflation Rates.

*The information used to compute the observations plotted in this figure was obtained from the NBER data tape. *See supra* notes 60-63.

The absence of a strong pattern in the year-to-year variations in nominal interest and growth in earnings rates may explain why some critics believe that awards for lost earnings are not predictable. Personal injury litigation, however, often involves extended periods of lost earnings, and the short run factors that prevent nominal interest and growth rates from adjusting to changes in the expected rate of inflation— such as wage contracts, government economic policies, and incorrect expectations— do not prevent nominal interest and growth rates from adjusting over longer periods of time.[66] Thus, year-to-year variations in annual nominal interest and growth rates are much less significant in determining the magnitude of the award than are the average of the annual interest rates and the average of the annual growth rates in earnings over the period of losses.

In graph (b) of Figure 1 the average nominal interest, growth in earnings, and price inflation rates are plotted for each successive fifteen year period between 1952 and 1983. For example, suppose that the average worker incurred lost earnings for the fifteen year period from 1952 through 1966. The averages of the annual interest, growth, and inflation rates for this fifteen year period are plotted in graph (b) for 1952, the first year of lost earnings. Similarly, if the period of lost earnings is 1953 through 1967, the averages of the annual interest, growth, and inflation rates for this period are plotted for 1953. Thus, the average rates for any fifteen year period of losses between 1952 and 1983 are plotted in graph (b) corresponding to the first year of losses.

An inspection of graph (b) indicates a strong positive relationship among the fifteen year averages of the nominal interest, growth, and inflation rates. Higher or lower average price inflation rates are related to higher or lower average interest and growth in earnings rates. Thus, the average rates over longer periods of time support the positive relationships between these variables, as sug-

66. *See supra* note 65 and accompanying text. For example, suppose that a labor union expects 4% price inflation over the next three years and, based on this expectation, agrees to a three-year wage contract which specifies annual raises of 5%. If actual price inflation during the first year of the wage contract turns out to be 8%, the union members will receive a smaller than expected real income (in terms of purchasing power). Although the union would like to negotiate a larger raise in income, the wage contract prohibits this for an additional two years. Therefore, wage contracts may prevent the growth in earnings rates from immediately adjusting to changes in the rate of inflation. Other factors also prevent the growth in earnings and interest rates from adjusting to changes in inflation during short periods of time. These temporary constraints on the adjustments of growth in earnings and interest rates, however, do not prevent these rates from adjusting to changes in price inflation over longer periods of time.

gested by economic theory. This result is very important, because it implies that the expected rate of future price inflation is not really necessary to determine the correct present value award for future lost earnings. For example, if the actual average rate of inflation over the period of losses is larger than the court expected, the actual average interest and growth in earnings rates will also be larger than expected. Increases in the average interest and growth rates have offsetting effects on the correct award, because both the actual interest income earned on the award and the actual lost earnings incurred are greater than the court expected.[67] Therefore, the award required to replicate actual lost earnings will be relatively stable regardless of the rates of anticipated and/or realized price inflation over the period of losses.[68]

B. *The Long-Term Relationship Between Real Interest and Growth Rates*

The real interest and growth in earnings rates depend on the rate of growth in real gross national product (GNP).[69] During periods in which the output of the economy is expanding rapidly (the growth rate in GNP is high), the demands for investment funds are relatively high. During these periods, lenders are able to negotiate relatively high interest rates and employees are able to bargain for relatively large wage increases; thus, the real interest rate and the real growth rate in earnings are relatively high. Conversely, during periods in which the economy is expanding slowly, or in fact decreasing (the growth rate in real GNP is low or negative), the demands for investment funds and wage increases are relatively low. During these periods lenders and employees each have relatively less bargaining power. As a result, they negotiate relatively small

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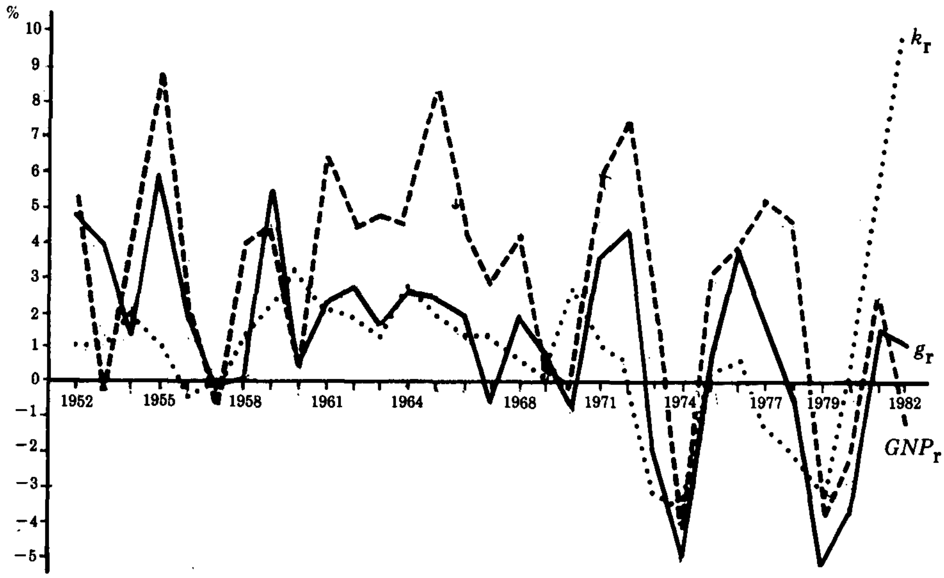
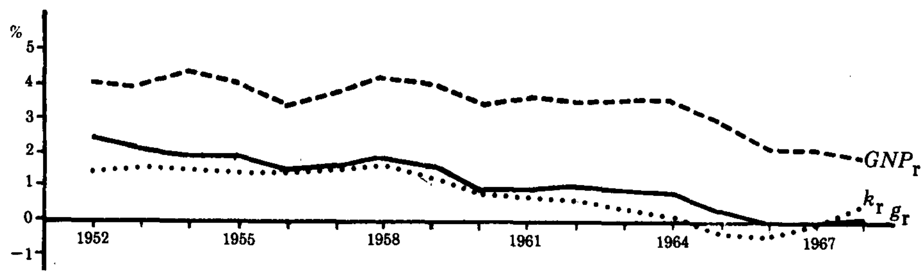
67. *See generally supra* note 58 and accompanying text.

68. This result occurs only if the award is invested in relatively short-term securities, such as one-year Treasury notes. In this case the balance of the award is reinvested each year in new Treasury notes at the new prevailing interest rate. Thus, the interest rate earned on the award can vary with the growth rate in earnings. If the award is invested in long-term government securities, the interest rate earned is then fixed for the life of the investment, and therefore cannot vary with the growth rate. In this case differences between expected and realized inflation may be very important. For example, suppose that the actual inflation rate over the period of losses is greater than expected. This causes the growth rate in earnings to be greater than expected, and the interest rate that can be earned on new investments to be greater than expected. The interest rate earned on the award does not increase, however, because it has been previously fixed by the investment in long-term securities. The greater than expected lost earnings are not offset by the greater than expected interest income. Moreover, the injured party is unable to replicate actual lost earnings.

69. *See generally supra* note 63.



(a) Annual Real Interest (k_r), Growth in Earnings (g_r), and Growth in GNP (GNP_r) Rates.



(b) Average Real Interest (k_r), Growth in Earnings (g_r), and Growth in GNP (GNP_r) Rates For Successive Fifteen Year Periods.

FIGURE 2: Relationships Between Real Interest Rates, Real Growth in Earnings Rates, and Real Growth in GNP Rates.

*The information used to compute the observations plotted in this figure was obtained from the NBER data tape. *See supra* notes 60-63.

interest rates and wage increases; thus, both the real interest rate and the real growth rate in earnings are relatively low.

These arguments imply that real interest rates and real growth in earnings rates are positively related. An increase or decrease in the growth rate of real GNP should cause increases or decreases, respectively, in both real interest rates and real growth in earnings rates.

The historical relationships between real interest rates (k_r), real growth in earnings rates (g_r), and real growth in GNP rates (GNP_r), are illustrated in Figure 2. The annual real rates for the period 1952 through 1982 are plotted in graph (a), and the averages of the annual real rates for each successive fifteen year period during this time are plotted in graph (b). For example, the averages of the real annual rates for the fifteen year period 1964 through 1978 are plotted in graph (b) corresponding to 1964.

Inspection of the real annual rates presented in graph (a) indicates a weak positive relationship. Although there are years in which the real rates increase or decrease together, there are several years in which they change in opposite directions. This occurs because specific annual real interest and growth in earnings rates depend on other factors in addition to the real growth rate in GNP. These other factors, such as wage contracts and government policies, often prevent the real interest and growth in earnings rates from adjusting to short-term changes in the real GNP growth rate.[70] The year-to-year variations in the annual real rates are less significant in determining the award required to replicate lost earnings than the averages of the annual rates over the period of losses. An inspection of graph (b) indicates a strong positive relationship among the fifteen year averages of the annual real rates. Thus, the factors that prevent, in the short-term, the real interest and growth in earnings rates, from adjusting to changes in the growth rate in real GNP do not prevent such adjustments over longer time periods.

The strong positive relationship among the fifteen year averages of the real interest and growth in earnings rates is important because it implies that the level of economic activity over the period of loss is not necessary to determine the initial award required to replicate lost earnings. Thus, forecasts of future levels of real GNP are generally not necessary to determine awards. If the actual level of real GNP is greater or less than the court expected, both

70. *See supra* notes 65-66.

the average real interest and growth in earnings rates will be greater or less than expected. An increase or decrease in both of these rates will have offsetting effects on the value of the required award.[71] If both the average real interest and growth in earnings rates are greater or less than the court expected, then both the real interest income earned by investing the award and the real lost earnings of the injured party will be respectively greater or less than expected.[72]

C. *The Long-Term Relationship Between Growth Rates for Different Occupations*

In the long-term, the average growth in earnings rate should not vary substantially across different occupations. This is true because large differences in the growth rates for alternative occupations would, over time, cause dramatic changes in wage differentials. For example, suppose that the average annual growth rates in earnings for two different occupations are 10% and 6%, respectively. If the earnings in both occupations are $10,000 this year, in fifteen years the annual earnings will be $41,772 and $23,966, respectively. Such wage differentials will induce workers to relocate from a low to a high growth in earnings occupation. Over time, this reallocation of labor will tend to equalize growth in earnings rates. The increased supply of labor in the high growth in earnings occupation will tend to reduce its growth in earnings rate, while the decreased supply of labor in a low growth in earnings occupation will tend to increase its growth in earnings rate. Thus, any differences in average growth in earnings rates for various occupations should be relatively small when confronting longer periods of lost earnings.

This phenomenon is illustrated in Figure 3, where the average growth in earnings rates for average workers in manufacturing ($g(M)$), mining ($g(I)$), and construction ($g(C)$) are plotted for each successive fifteen year period between 1952 and 1983. The average growth rates for any fifteen year period during this time are plotted corresponding to the first year included in the average. The differences in the average growth rates for each of the fifteen year time periods are relatively small. Moreover, one may explain the

71. *See generally supra* note 58 and accompanying text.

72. *See supra* note 68. This result is valid only if the award is invested in relatively short-term securities so that the real interest rate can vary with the real growth in earnings rate over the period of losses.

differences that do exist by the fact that the industry is expanding or contracting. For example, the recent increases in the growth rate for mining may be related in part to increased investment in this industry as a result of the energy crisis. Similarly, the recent declines in the growth rates for construction may be related in part to decreased investment in this industry resulting from large increases in mortgage rates.

These observations have very important implications for the assessment of awards for lost earnings. As we have seen, the magnitude of the award depends upon the earnings received in the year of injury, the number of years of losses, and the average growth in earnings and interest rates over the period of losses. For a relatively long period of loss, the average growth in earnings rates across occupations should be relatively stable and the court should use the same average interest rate to determine all awards. It follows, therefore, that any substantial differences in awards for individuals with different occupations should depend primarily upon differences in earnings in the year of injury. For example, assume that two individuals in different occupations are injured on the same day, that the court expects both individuals to incur lost earnings for the next thirty years, and that both individuals were well established in their occupations and did not expect to make any dramatic changes in their productivity; for example, become unemployed or through education secure a position with a higher annual income. If one individual earned one and one-half times the income of the other individual in the year prior to injury, then this individual should receive an award that is approximately one and one-half times the award that the other individual will receive. Any deviation from this result would have to be explained in terms of assumed different average growth in earnings rates for the thirty years of losses. But, as we have seen, substantial differences in the average growth in earnings rates for different occupations are unlikely to exist over long periods of time.

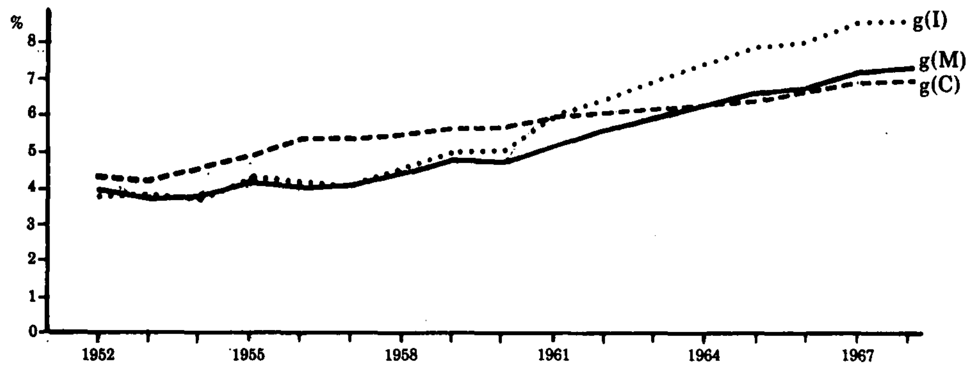


FIGURE 3: Average Real Growth Rates for the Average Workers in Manufacturing (g(M)), Mining (g(I)), and Construction (g(C)) for Successive Fifteen Year Periods.

*The information used to calculate the observations plotted in this figure was obtained from the NBER data tape. *See supra* notes 60-63.

V. The Predictability of Awards

This section explains why awards for future lost earnings are more predictable than the Supreme Court has concluded. The courts may calculate correct present value awards for future lost earnings by using a differential discount rate.[73] They may base the differential discount rate on the relative difference between the average nominal interest and growth in earnings rates, or the average real interest and growth in earnings rates expected over the period of losses.[74] Assuming that earnings in the year of injury and the number of years of losses are known, the courts require only the differential discount rate to determine the correct award.[75]

Both the average nominal interest and growth in earnings rates and the average real interest and growth in earnings rates increase and decrease together over time.[76] This indicates that the relative differences between these two rates are stable over time. The differential discount rate, which depends on these relative differences, is therefore stable over time. In addition, the average growth in earnings rates for different occupations do not vary

73. *See generally supra* note 59 and accompanying text.
74. *See supra* equation (5) p. 737.
75. *See supra* Table I(c) p. 734 and accompanying text.
76. *See supra* text accompanying notes 64, 67, 69, & 71.

greatly over long periods of time.[77] This implies that the differential discount rate is stable when viewed across different occupations.[78]

The stability of the differential discount rate is illustrated in Figure 4, where the average differential discount rates for the average workers in manufacturing (*d*(*M*)), mining (*d*(*I*)), and construction (*d*(*C*)) are plotted for each successive fifteen year period from 1952 through 1982. The average differential discount rates are remarkably stable both over time and across the three industries.

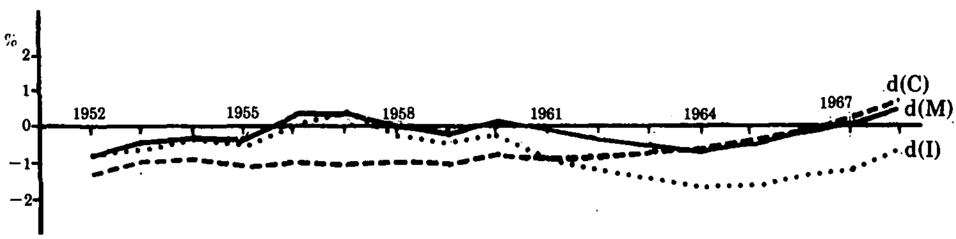


FIGURE 4: Average Differential Discount Rates for the Average Workers in Manufacturing (d(M)), Mining (d(I)), and Construction (d(C)) for Successive Fifteen Year Periods.

*The information used to compute the observations plotted in this figure was obtained from the NBER data tape. *See supra* notes 60-63.

These results are extremely important because they indicate that awards for lost earnings are predictable. Changing economic conditions, such as changes in the rates of price inflation and growth in real GNP, cause changes in the same direction in the average nominal interest and growth rates and in the average *real* interest and growth rates. These changes have little effect on the differential discount rate.[79] Because the correct award may be determined only by using earnings in the year of injury, the number of years of lost earnings, and the differential discount rate, changing economic conditions then will have little effect on the amount of the correct award.

77. *See supra* Section IV(C) .

78. *See supra* Section IV(C) .

79. *See, e.g., supra* note 56 and accompanying text. Assume that the average interest and growth rates for the period of losses are either 17.30% and 18.45%, 7.10% and 8.15%, 2% and 3%, or −3.10% and −2.15%. Each of these combinations of interest and growth rates, regardless of whether they are nominal or real, yield exactly the same differential discount rate of −0.97%. This may be established by substituting each pair of interest and growth rates into equation (5).

VI. Evaluation of Alternative Models

The three alternative models presented in Section III are equivalent because they yield the same present value when the nominal and real interest and growth in earnings rates, and the differential discount rate are correctly defined in relation to each other.[80] The models differ, however, in that they require the forecast of different economic variables for the period of losses. In this section, the three models are evaluated with respect to biases that may be introduced into the present value calculation through forecasting of the average interest, growth in earnings, and differential discount rates.

The differential discount rate is more stable over time than the nominal and real interest and growth in earnings rates.[81] This is an important observation, because forecasts of the future values of economic variables are likely to be more accurate when the variables are less volatile over time. Because the court may determine the correct award by using the differential discount rate, and this rate has remained remarkably stable in the face of dramatically changed economic conditions over the past thirty years,[82] it is unnecessary to forecast future nominal or real interest and growth rates which may vary significantly with the growth rate in real GNP and the price inflation rate.

In addition, over long periods of losses, the real interest and growth in earnings rates are positively related, because they both vary with the real growth rate in GNP.[83] Therefore, if the real growth and interest rate approach is to be consistent with accepted economic theory and historical experience,[84] the forecasts of the real interest and growth in earnings rates must reflect the same rate of growth in real GNP. Likewise, the nominal interest and growth in earnings rates are also positively related over long time periods, because they depend on the real interest and growth in earnings rates, and on the rate of price inflation.[85] Thus, if the nominal growth and interest rate approach is to be consistent with accepted economic theory and historical experience,[86] the estimates of the nominal interest and growth in earnings rates must

80. *See supra* Table I p. 734 and accompanying text.
81. *See supra* Figures 1(b), 2(b), & 4 p. 741, 744, 749.
82. *See supra* Table I(C) p. 734 and accompanying text.
83. *See supra* note 58, equations (1), (3), and accompanying text.
84. *See supra* Section IV(B).
85. *See supra* notes 69, 71, and accompanying text.
86. *See supra* Section IV(A).

reflect the same rate of growth in real GNP and the same rate of price inflation.

In practice, courts often neglect these consistency requirements when they employ the nominal and real interest and growth rate models.[87] For example, the Fifth Circuit Court of Appeals endorsed the nominal interest and growth rate model, and suggested using the average annual rate of change in the plaintiff's salary in the years prior to injury as the nominal growth rate and the current rate of return on relatively safe investments, such as government bonds, as the nominal interest rate.[88] The difficulty with this recommendation is that the historical growth rate in salary reflects past rates of price inflation and past rates of growth in real GNP,[89] while the current rate of return on investments reflects the expectation of future rates of price inflation and the future rates of growth in real GNP.[90]

The fifth circuit court later withdrew its endorsement of the nominal interest and growth rate model and adopted the real interest and growth rate model as the relevant standard.[91] The court did not, however, withdraw the method of forecasting that it endorsed in its earlier decision.[92] Presumably, this method would be acceptable to the court if applied to the forecasting of real, as opposed to nominal, interest and growth in earnings rates. In addition, the court indicated that the real interest rate could range from 3% to −1.5% according to expected future economic conditions, without requiring that the real growth in earnings rate be varied to reflect the same economic forecast.[93] For a given real growth in earnings rate, a change in the real interest rate of 4.5%, that is, from 3% to −1.5%, would cause a change in the differential discount rate of approximately 4.5%.[94] The court is apparently willing to allow variations in the differential discount rate which are inconsistent with accepted economic theories and historical evidence.[95]

87. *See infra* note 88 and accompanying text.

88. Culver v. Slater Boat Co., 688 F.2d 280, 309 (5th Cir. 1982).

89. *See supra* Figure 1(a) p. 741 and accompanying text.

90. *See supra* text accompanying note 64.

91. Culver v. Slater Boat Co., 722 F.2d 114 (5th Cir. 1983).

92. *See id.*

93. *Id.* at 122. The Court discussed a 3% to −1.5% range in interest rate, but the Court did not discuss any range for the growth in earnings rate.

94. This may be established by assuming a constant real growth in earnings rate and calculating the differential discount rate (using equation (5)) for real interest rates of 3% and −1.5%. *See supra* p. 737.

95. Economic theory indicates that the differential discount rate should be very stable

Another problem arises when the economic expert employs a nominal growth in earnings rate based on his or her individual forecast of future price inflation, and a nominal interest rate based on the "market" determined yield on government securities.[96] The difficulty with this approach is that the yields on government securities reflect the expectations of future price inflation of investors in the government securities market.[97] Unfortunately, there is no way to determine whether the inflation rate forecast by the individual is in any way equal to the market inflation rate as reflected in the returns on long-term securities.[98]

The magnitude of the errors in present value awards associated with independent forecasts of the nominal interest and growth in earnings rates and the real interest and growth in earnings rates may be substantial. A hypothetical example will illustrate the potential magnitude of such errors. Assume that over the future period of loss the correct nominal growth in earnings and interest rates are 8.15% and 7.10%, respectively. The price inflation rate is 5%, the real growth in earnings and interest rates are 3% and 2%, respectively, and the differential discount rate is −0.97%. In addition, assume a plus or minus 20% range for forecasting errors in the calculations of the nominal interest and growth rate model, the real interest and growth rate model, and the differential discount rate model.[99] Table II presents the percentage errors in present value awards for both fifteen and thirty years of lost earnings. Forecasting errors of plus 20% would result in nominal growth and interest rates of 9.78% and 8.52%, respectively; real growth and interest rates of 3.60% and 2.40%, respectively; and a differential discount rate of 1.16%. Forecasting errors of minus 20% would produce nominal growth and interest rates of 6.52% and 5.68%, respectively; real growth and interest rates of 2.40% and 1.60%, respectively; and a differential discount rate of −0.78%. Suppose, for example, that an individual earned $10,000 in the year prior to injury, and the court expects thirty years of

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both over time and across occupations. *See supra* note 76 and accompanying text. The differential discount rate has historically been very stable. *See supra* Figure 4 p. ___ and accompanying text.

96. *See, e.g., supra* text accompanying note 88.

97. *See supra* note 44 and accompanying text.

98. *See supra* equation (1) p. 730 and accompanying text. There is no way to determine what portion of the observed nominal yield on government securities reflects the real rate of interest, and what portion reflects the premium for expected future price inflation.

99. Twenty percent forecasting errors are likely given the historical volatility of interest and growth in earnings rates. *See supra* Figures (1), (2), & (4) p. 741, 744, 749.

lost earnings. All three models yield an award of $350,171, provided that the court uses the correct parameters in the calculations. In Table II, therefore, the percentage errors in the award corresponding to the nominal growth and interest rates of 8.15% and 7.10%, the real growth and interest rates of 3% and 2%, and the differential discount rate of -0.97% are all 0%. A nominal growth rate of 6.52% (minus 20% error) combined with a nominal interest rate of 8.52% (plus 20% error), however, yields an award of $227,781, for an underestimate of 34.95%. Similarly, a real growth rate of 3.60% (plus 20% error) combined with a real interest rate of 1.60% (minus 20% error) yields an award of $411,632, for an overestimate of 17.55%.

TABLE II

PERCENTAGE MISSTATEMENTS IN PRESENT VALUES DUE TO TWENTY PERCENT FORECASTING ERRORS

A. Nominal Interest and Growth Rate Model (correct k = 7.10%, correct g = 8.15%)

	Fifteen Years of Lost Earnings			Thirty Years of Lost Earnings		
	g=8.15%	g+.2g =9.78%	g−.2g =6.52%	g=8.15%	g+.2g =9.78%	g−.2g =6.52%
k=7.10%	0%	13.26%	−11.49%	0%	28.56%	−21.16%
k+.2k=8.52%	−10.06%	1.48%	−20.10%	−18.71%	2.97%	−34.95%
k−.2k=5.68%	11.73%	27.01%	−1.48%	25.03%	63.07%	−2.91%

B. Real Interest and Growth Rate Model (correct k_r = 2.00%, correct g_r = 3.00%)

	Fifteen Years of Lost Earnings			Thirty Years of Lost Earnings		
	g_r=3.00%	$g_r+.2g_r$ =3.60%	$g_r-.2g_r$ =2.40%	g_r=3.00%	$g_r+.2g_r$ =3.60%	$g_r-2.g_r$ =2.40%
k_r=2.00%	0%	4.91%	−4.63%	0%	10.04%	−8.92%
$k_r+.2k_r$=2.40%	−3.13%	1.57%	−7.58%	−6.09%	3.15%	−14.33%
$k_r-.2k_r$=1.60%	3.29%	8.40%	−1.54%	6.66%	17.55%	−3.03%

C. Differential Discount Rate Model (correct d = −0.97%)

	Fifteen Years of Lost Earnings	Thirty Years of Lost Earnings
d=−0.97%	0%	0%
d+.2d=−1.16%	1.59%	3.18%
d−.2d=−0.78%	−1.55%	−3.05%

Inspection of Table II indicates that 20% errors in the differential discount rate produce misstatements in awards of approximately 1.5% when earnings are lost for fifteen years, and misstatements of approximately 3% when earnings are lost for thirty years. The nominal and real interest and growth rate models produce comparable misstatements provided that the interest and growth rates consistently reflect the same rates of expected inflation and real GNP growth. Comparable misstatements are produced because errors in the forecasted values of the inflation and GNP growth rates cause errors in the same direction in the forecasted values of both the interest and growth in earnings rates.[100] For example, a 20% forecasting error in the anticipated inflation rate should lead to errors in the same direction of approximately 20% in both the nominal and real interest and growth rates. When the court overstates or understates the nominal interest and growth rates and/or the real interest and growth rates by 20%, the misstatements in awards are then approximately 1.5% for fifteen years of losses, and approximately 3% for thirty years of losses.

If the court independently forecasts the interest and growth rates employed in the nominal and real interest and growth rate models, however, the court may violate the consistency requirement that when either the interest or growth in earnings rate increases or decreases the other rate should change comparably. In this case, the percentage misstatements in present values may be much larger. For example, suppose that an individual earned $10,000 in the year prior to injury and that the court expects lost earnings for thirty years. A plus 20% error in the nominal growth rate ($g = 9.78\%$) combined with a minus 20% error in the nominal interest rate ($k = 5.68\%$) yields an award of $571,032 (an overstatement of 64.07%), while a minus 20% error in the nominal growth rate ($g = 6.52\%$) combined with a plus 20% error in the nominal interest rate ($k = 8.52\%$) produces an award of $227,781 (an understatement of 34.95%). This example illustrates how two experts may arrive at dramatically different award recommendations in the same personal injury case.

Courts may avoid large errors caused by using inconsistent growth and interest rates by adopting the differential discount rate approach. In the above example the correct growth and interest rates are assumed to be 8.15% and 7.10%, respectively, which implies that the correct differential discount rate is -0.97%.[101] The nominal model using 20% forecasting errors in the nominal growth in earnings and interest rates produced award estimates of $571,032 and $227,781, respectively. In order to achieve the same award estimates, the differential discount rate model would have to use differential discount rates of -3.37% and 1.88%, respec-

100. *See supra* Table II p. 753.
101. *See supra* equation (5) p. 737.

tively. To produce those discount rates, it would require forecasting errors of as much as 284.54% and −293.81%, respectively. Given the historical stability of the differential discount rate model,[102] forecasting errors of this magnitude for the differential discount rate are highly unlikely. The differential discount rate model is more reliable and predictable than either the nominal rate model or the real discount rate model.

VII. Conclusions

Most of the methods for determining the present value of future lost earnings that courts have adopted or endorsed require forecasts of either the nominal interest and growth in earnings rates, the real interest and growth in earnings rates, or the differential discount rate. Over long periods of time, average *real* interest and growth in earnings rates are positively related. Both vary positively with the average real growth rate in GNP.[103] Average *nominal* interest and growth in earnings rates over long periods of time are also positively related because they depend on the average real interest and growth in earnings rates, and because both vary positively with the average rate of price inflation.[104] In addition, differences in the average growth in earnings rates for different occupations should be relatively small over long periods of losses.[105]

These relationships have two important implications for the assessment of awards in future lost earnings cases. First, because nominal interest and growth in earnings rates and real interest and growth in earnings rates tend to increase and decrease together over time, courts should prefer the differential discount rate, which is based on the difference between the nominal or real interest and growth in earnings rates and is relatively stable over time .[106]

Moreover, while differences in growth in earnings rates for different occupations tend to be small, the differential discount rate is relatively stable across different occupations.[107] The stability of the differential discount rate over time and across occupations suggests that awards for lost earnings, based on the differential discount rate, are relatively more predictable than many critics believe.

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102. *See supra* Figure (4) p. 749.
103. *See supra* Figure 1(b) p. 741 and accompanying text.
104. *See supra* Figure 2(b) p. 744 and accompanying text.
105. *See supra* Figure 3 p. 748 and accompanying text.
106. *See supra* Section V .
107. *See supra* Figure 4 p. 749 and accompanying text.

Second, if courts use the nominal or real interest and growth rate models to assess awards, the interest and growth in earnings rates should be consistent. The *real* interest and growth rates should reflect the same expected rate of growth in real GNP, and the *nominal* interest and growth rates should reflect the same expected rate of growth in real GNP and the same anticipated rate of price inflation. One method of enforcing these consistency requirements is to use the nominal or real interest and growth rates employed in these alternative approaches to compute the corresponding differential discount rate.[108] The result could then be compared to historical values of this variable. Courts could then reject combinations of the *nominal* interest and growth rates or the *real* interest and growth rates that yield differential discount rates inconsistent with historical experience . Given the historical stability of the differential discount rate, it should provide a useful benchmark for evaluating the consistency of various combinations of nominal and/or real interest and growth rates. It is simple to understand and employ.

Finally, the significance of the results presented in this article and the potential that it may have to reduce the bias in personal injury litigation awards and settlements indicates that a more extensive historical investigation into the magnitude and stability of the differential discount rate over time and across occupations is desirable. The results of such an investigation will be presented in a forthcoming paper.[109]

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108. *See supra* equation (5) p. 737.

109. Anderson & Roberts, *Stability in the Present Value Determination of Future Lost Earnings: A Historical Perspective With Implications for Predictability*, 39:5 U. MIAMI L. REV. (1985).