The Unintended Consequences of Tort Reform:

Rent Seeking in New York State's Structured Settlements Statutes

By

Lawrence M. Spizman*
Professor of Economics
Mahar Hall
State University of New York At Oswego
Oswego, New York 13126
315.341.3479 Fax 315.343.8006 spizman@oswego.edu

and

Elizabeth Dunne Schmitt
Assistant Professor of Economics
Mahar Hall
State University of New York At Oswego
Oswego, New York 13126
315.341.3488 edunne@oswego.edu

Abstract

The Unintended Consequences of Tort Reform: Rent Seeking in New York States Structured Settlements Statute

The tort reform movement of the 1980's has resulted in 90 percent of all states passing some type of tort reform. New York State, attempting to reduce litigation costs under the spirit of tort reform, revised its structured settlement procedures for large jury verdicts by proscribing a specific discounting procedure. This procedure differs from traditional discounting methods used by forensic economists. While tort reform is intended to reduce the amount of litigation there may be unintended consequences resulting in an increase in tort litigation. This paper shows that New York's tort reform, CPLR Articles 50-A and 50-B, has an overall pro-plaintiff bias that creates economic rent. This bias, and the confusion surrounding it, is consistent with the increase in tort filings in New York State between 1988 and 1996.

The Unintended Consequences of Tort Reform: Rent Seeking in New York States

Structured Settlements Statutes

I.   Introduction

Discounting future economic losses was one of several legal issues addressed by the state tort reform movement of the 1980s and 1990s and is also an important research topic among Forensic Economists[1]. During this period, almost 90 percent of the states enacted some type of tort reform legislation (Schmit et al 1997). These reforms include laws affecting the assignment of liability, the size of potential damage awards, and allowable methods for discounting future economic and non-economic losses. Most tort reforms were in response to increasing liability insurance costs and therefore designed to reduce the amount of litigation (Viscusi et al 1993). However, some tort reform laws may have had the opposite effect. States mandating specific discounting procedures may distort settlement negotiations and actually increase the incentive to go to trial.

New York State's provisions for structured judgements, while passed as tort reform in the 1980s in the hope of reducing litigation costs, actually overcompensate the plaintiff, resulting in awards up to three times higher than the present value of the jury award (Wolkoff and Hanushek 1995, Lambrinos and Harmon 1995). [2] The purpose of this paper is to examine the unintended

---

[1] The three main forensic journals; Journal of Forensic Economics, Litigation Economics Digest, and Journal of Legal Economics, devote approximately 16% (from their first issues through 1999) of their publication titles to determining the proper discount rate.

[2] Both studies make the comparison between 50-B and actual present value losses using selective but general examples.   Lambrinos and Harmon present the economic loss for nine cases focusing on base year earnings and

consequences of New York State's Articles 50-A and 50-B tort reform by demonstrating how the post-verdict discounting requirements result in a pro-plaintiff bias and how this bias impacts settlement negotiations. We argue that New York State ("NYS") tort reform, rather than reducing tort litigation, may have contributed to an increase in litigation and litigation costs.

Inflationary pressures of the late 1970's and early 1980's precipitated dramatic increases in the cost of liability insurance, which led to the tort reform movement of the 1980's (Viscusi, Zeckhauser, Born, and Blackman 1993). Viscusi et al, point out that general liability premiums rose from $3.1 billion in 1975 to 19.1 billion in 1988. State legislatures, including those in New York, responded to intense lobbying by the insurance and medical industry by passing tort reforms intended to reduce insurance costs.[3]

An injured party's decision to bring a legal claim depends on the costs and benefits associated with that claim (Cotter and Rubinfeld 1989); tort reforms change the political and economic calculus of whether cases are pursued and/or resolved prior to trial.

Several authors have examined the empirical link between tort reform and the decision to file. Schmit, Browne, and Lee (1997) find a negative relationship between per capita claim filings and certain types of tort reforms. Browne and Puetz (1998) conclude that accident victims will not seek a legal remedy as often as they did prior to state tort reforms. Neither of these papers specifically address structured settlements.

---

remaining work-life expectancy of the plaintiff and wage inflation and the discount rate. Wolkoff and Hanushek use three representative cases to illustrate the overvaluations of 50-B. While it is possible to develop certain facts that might alter the overall outcome of these two studies, nevertheless their generality appears to be correct, as we will prove in this paper.

[3] Viscusi et al (1993) discuss this issue on a national level.   Siegel 1985, 1986 discusses the political process involved in passage of the new law in New York State. His commentaries state that the new structured judgments were enacted primarily as a benefit to insurance companies. The court in *Bermeo et al v Atakent and New York City Health and Hospitals Corporation*, *241 A.D. 2d 235; 671 N.Y.S. 2d 727; 1998 N.Y.* also state that this was the primary reason for structuring settlements**.**

State tort reforms may have unintended consequences, in particular, overcompensating plaintiffs relative to the true present value of future damages. Such reforms may result in an increase, rather than a decrease in litigation. Rolando Pelaez (1995) examines the error rate of the Pennsylvania offset rule, which requires a zero real interest rate in discounting all damages. Pelaez claims that the simplicity of this rule comes at the price of overcompensating the plaintiff between 30% and 100%, depending on growth rates and work-life expectancies. The size of settlement offers and the decision to file in Pennsylvania is affected by the overcompensation.

NYS law has a unique feature in that the court, not the jury, reduces future damages to present value.[4] Consequently, economists in personal injury and wrongful death cases are permitted to testify only to the nominal value of the future loss stream (including an inflation factor), not its present value. All damage awards in excess of $250,000 must be structured by the judge under the guidelines of Civil Practice Law & Rules (CPLR) Articles 50(a) (CPLR 5031-5039) in 1985[5] and 50(b) (CPLR 5041-5049) in 1986.[6] Since articles 50-A and 50-B are identical in language, we will refer to them as 50-B for the remainder of this paper

Like the Pennsylvania offset rule, NYS Article 50-B discounts future damages in such a way that it produces an overall pro-plaintiff bias.[7] Pennsylvania's failure to account for the time value of money is somewhat offset by the rule's simplicity because both the plaintiff and defendant can easily recognize the bias and adjust their settlement strategies accordingly. Thus, settlement offers may change, but the incentive to proceed to trial will not. The simplicity of Pennsylvania's offset rule is not mirrored in NYS. Chief Judge Kaye of the Court of Appeals of

---

[4] As of July 30, 1986 the jury awards the full amount without reducing it to present value (CPLR 4111[f]). Also see NYPJI supplement PJI2: 320.3, p 499 for a discussion on the evolution of present value in New York State.

[5] Called "Periodic Payment of Judgments in Medical and Dental Malpractice Actions."
[6] In 1986 the legislature expanded article 50-A (which dealt with Medical Malpractice) to include all personal injury and wrongful death actions. It was identical to 50-A and is called Article 50-B ("Periodic Payment of Judgments in Personal Injury, Injury to Property and Wrongful Death Actions").

New York summarized four different case descriptions of 50-B by saying "The structured judgment provisions have deservedly been labeled ' circuitous', 'vexing', 'as every Judge's nightmare', 'and at best *** ambiguous' which can lead to inexplicable results.'"[8]   Article 50-B increases the likelihood that the plaintiff and the defendant base their settlement decisions on different assessments of potential damages. This asymmetry may alter the incentives to accept a settlement or proceed to trial.

Since the passage of Article 50-B, NYS experienced the second largest increase in the country of tort cases per 100,000 population between 1988 and 1996.[9]   In 1996 the number of reported torts per 100,000 was 462.61, up from 295.99 in 1988, an increase of over 56%. California, on the other hand, experienced a 45% reduction in torts during the same period. Why did NYS experience such a dramatic increase? We suggest this increase is consistent with legislation that is both flawed and misunderstood. While the general purpose of tort reform is to reduce litigation costs, we contend that NYS's 50-B requirements increase the complexity and therefore costs of litigation by requiring cumbersome post-verdict negotiations. Until the legislature rewrites the law[10] a better understanding of the 50-B bias by the plaintiffs and defendants may result in more efficient settlement negotiations, which will reduce filings over the long run.[11] The rest of this paper is organized as follows: section II briefly describes the structuring of judgements under 50-B, section III documents the pro-plaintiff bias inherent in 50-

---

[7] There are also several potential defense bias that may exist under 50-B which we discuss in section II A.
[8] *Bryant v New York City Health and Hospital Corporation , Depradine et. al. v New York City Health & Hospital Corporation,* No. 124, No. 137, decided July 1, 1999
[9] Court Statistics Project 1997.
[10] Lambrinos & Harmon (1995) and McKenna (1995) have made their own recommendations of what can be done.
[11] NYS Senate Bill No. 2277, sponsored by Senator Dale Volker (R-Buffalo) and Assemblyman Joe Morelle (D-Rochester) seeks to place further limits on tort awards. It among other things seeks to cap non-economic damages at $250,000 while limiting lawyers' contingency fees. See Bowden (1999) for a more complete discussion of the Volker-Morelle bill.

B, section IV discusses the impact of 50-B on the decision to file and on post-verdict negotiations, and section V concludes.

II. Structured Settlements under NYS 50-B

A. An Overview of 50-B

Under 50-B past damages are paid as a lump sum. One-third of this amount is paid to the attorney with the plaintiff receiving two-thirds. The jury award of nominal future damages is bifurcated under 50-B. The first $250,000 of future damages are paid as a lump sum payment. Two thirds of this lump sum payment goes to the plaintiff and one third goes to the plaintiff's attorney.

The methodology for determining the attorney's fee on the structured portion of the remaining verdict is as follows. The first $250,000 lump sum payment is subtracted from the total nominal future loss in proportion to the damage losses in each category (earnings, household services, medical costs, pain and suffering etc.) as awarded by the jury.[12] After subtracting each categories proportion of the $250,000 the remaining future loss associated with each category of loss (earnings, household services, medical, pain and suffering etc) is then divided by the number of years specified by the jury to get the annual average loss. The statute requires that the nominal amount of future pain and suffering must be paid out within a maximum of 10 years. These annual average payments are increased by 4% per year for the entire loss period. The augmented average annual payments are discounted to the present. One-

---

[12] For example, if earning losses are 60% of the total award then 60% of $250,000 or $150,000 would be deducted from the award for future lost earnings. If lost household production is 10% of the verdict award then 10% of the $250,000 or $25,000 is deducted from the future award for household production etc.

third of this amount is paid to the attorney as a lump sum payment.[13]   The remaining 2/3 of this amount (for each category of loss) is then divided by the number of years the plaintiff is to receive the award.   An annuity with the corresponding payment and time structure is then purchased for the plaintiff.

While the structure of 50-B contains several pro-plaintiff provisions, there are provisions of 50-B that benefit the defendant as well. [14]   Riccardi (1996) discusses how terminating the payment for non-economic losses upon the death of creditor reduces the value of the structured judgment to the plaintiff. Additionally, 50-B further restricts the collateral source rule and permits offsets against future plaintiff recoveries.   Wolkoff and Hanushek (1995A) discuss why the impact of these provisions is likely to be small. First, if non-economic losses are zero or minimal then termination does not make a difference. Second, the 10-year maximum on pain and suffering limits the probability of the plaintiff dying prior to receiving all non-economic damages. Furthermore, as the plaintiff approaches 10 years of post-verdict survival, the remaining damages are worth increasingly less in real terms. This is also true for other non-economic losses. However, if the plaintiff should die suddenly then this part of the statute can be a significant offset to the pro-plaintiff biases especially if there are large non-economic damages awarded by the jury.

Additionally, the *Rohring* methodology has a bias in favor of the defendant because it provides for double discounting. This occurs because the final annuity payments are based on values already discounted under 50-B guidelines, not the nominal future losses. While it is

---

[13] The final step of the structured payment has proved to be controversial with evolving interpretations of the statute by the courts. *Rohring v City of Niagara Falls*, 84 N.Y. 2d 60; 638 N.E. 2d 62 1994 methodology appears to have withstood several challenges on appeal and is the de-facto methodology for calculating the attorneys fees and structuring the balance of future losses.
[14] The latest case on this issue is *Bryant* (1999) where Chief Judge Kaye discusses how defendants benefit by "paying a judgment in periodic installments..." She also discusses how stopping certain payments upon death of the plaintiff may also benefit the defendant.

possible, it is highly unlikely that the pro-defense bias will be significant enough to offset the pro-plaintiff bias. This is so because the pro-plaintiff bias exists in every situation while the defense offsets may or may not ever come into play. The conflicting pro-plaintiff and pro-defendant aspect of 50-B further adds to uncertainty over damage awards, which affect post-trial settlement negotiations.

B. Imposing the 50-B structure After the Verdict

Part of the 50-B structuring process involves intense post verdict negotiations by both sides, often through their economists or an annuity company representative.[15] The jury's verdict sets the nominal value of the award, which must then be structured by the judge under 50-B and related case law.   However, prior to the judge setting the structure, the two parties to the dispute may reach an agreement on their own, which may consist of a lump-sum payment, an alternative settlement structure or a combination of both.   If the parties agree to settle then there is no need for the court to structure the settlement under article 50-B.[16]

The negotiations revolve around determining an appropriate discount rate and the structure of the annuity. The negotiations become particularly acrimonious when trying to determine the final structure of the award. The acrimony occurs because the plaintiff, while interested in the actual structure and its final dollar value prior to discounting, is also interested in the cost to the carrier of purchasing the annuity. The defendant, on the other hand, is interested mostly in its cost of purchasing the annuity contract.

---

[15] These post-verdict negotiations occur after a verdict for the plaintiff. Clearly if the case reached a jury verdict the pre-trial negotiations, no matter how intense, did not result in a settlement. This paper is only concerned with the post-verdict negotiations that occur between the plaintiff and defendant under the watchful eye of the judge.
[16] See *Bermeo v. New York city Health and Hospital Corporation*.

The plaintiff's attorneys will always tell their clients the actual non-discounted value of the award, since clients will be pleased with the larger numbers. The defendant's main concern is its cost of purchasing the annuity. The plaintiff's attorney should also recognize the cost aspect because that in essence is what the damages are to the tortfeasor. Any cost savings realized by the defendant in the annuity market[17] are not shared with the plaintiff, so the plaintiff wants these savings put back into purchasing a larger annuity. The defendant would be willing to have a structure that pays more to the plaintiff if the cost is lower. The plaintiff's attorney wants to make sure that the structure is favorable to the client while costing the defendant the maximum amount. Thus, while the structure is important to the injured client, the costs associated with purchasing the annuity are also important.

Because of the complexity of 50-B, the disputants often have different annuity structures and consequently different cost estimates. The disputants (even under the watchful eye of the judge) find it difficult to reconcile their numbers due to different interpretations of the statute and uncertainty about the timing of damages, hence the post-verdict bargaining.[18] Negotiating the proper discount rate was simplified under the first New York case dealing with the new legislation, *Ursini v Sussman*[19]. Judge Gammerman in *Ursini* chose the discount rate based on the past recommendations of other economists.[20] This ruling set a precedent, making it easier for

---

[17] See Romans and Floss (1999) for a full discussion of the interest rate switch between the annuity rate of return and the discount rate and how that may increase or decrease what the plaintiff will receive.

[18] Courts since *Bryant* (1999) still find 50-B to be a "daunting task". *Coyne v Etra eta al.* Supreme Court of New York, Nassau County 703 N.Y.S.sd 869; 1999 December 9. In addition to determining the discount rate the *Coyne* case had to determine what constituted future damages.

[19] *Ursini v. Sussman* 541 N.Y.S2d 916 (Sup.1989)

[20] Gammerman polled 9 economist on the discount rates they have used previously. He then chose 7.5%, which was the upper range of the 6 to 8% reported by the surveyed economists. Judge Peter Tom in writing the opinion of the Appellate division in *Bermeo et al v Atakent and New York City Health and Hospitals Corporation* said the following: "the better part of caution would be for a court to elicit the parties' respective positions as to what rate would be appropriate, after which the court could make its own determination."

parties in future cases to reach an agreement on the proper discount rate, but it did not solve any of the problems of agreeing to a structure.

C. How Does 50-B Work?

To understand why both plaintiffs and defendants may derive different post- verdict values for the 50-B structured payment, it is necessary to understand how 50-B affects the size of a jury's award. The mandated structure of awards under 50-B results in a present value calculation that systematically differs from the true economic value of the losses. A plaintiff enters litigation with the expectation of recovering damages, but the 50-B structure inflates these damages over and above the true present value of the jury award. Resources used to satisfy the jury award have opportunity costs. 50-B is a legislated structure, which results in a present value calculation that is greater than the actual present value of the jury award. The difference between the opportunity cost and the 50-B award can be considered economic rent. Rent seeking behavior by both the plaintiff and defendant occurs during the post verdict negotiations required by 50-B and is discussed in Section IV of this paper.

To demonstrate why a pro-plaintiff bias exists under 50-B, let us consider a personal injury award consisting of lost wages, lost household services, and pain and suffering. A present value calculation is used to convert the future loss stream to an equivalent value in today's dollars.[21] Define the following variables:

W_0 = base year salary

g   = salary growth rate

H_0 = base year cost of providing lost household services

h   = growth rate of household service costs

P_0 = base year pain and suffering losses[22]

π = annual inflation rate

N   = expected work-life

T   = life expectancy

r   = discount rate

As previously stated, economists in New York can testify only to nominal losses and not to present value. However, they are allowed to present evidence on inflation adjustments to the jury. A jury determines pain and suffering awards. Normally, present value calculations for lost wages would be discounted over the expected work-life of the injured party, while lost household services and pain and suffering awards are discounted over the plaintiff's life-expectancy. The present value of the future loss stream is given by

(1)
$$\sum_{n=0}^{N-1} \frac{W_0(1+g)^n}{(1+r)^n} \quad + \quad \sum_{t=0}^{T-1} \frac{H_0(1+h)^t}{(1+r)^t} \quad + \quad \sum_{t=0}^{T-1} \frac{P_0(1+\pi)^t}{(1+r)^t}$$

Correctly estimating the present value depends on an accurate estimate of future losses, choosing the proper discount rate, and discounting over the appropriate time period.

Once a jury reaches a verdict in New York, the judge structures the settlement to comply with 50-B, which mandates that the present value of future losses be calculated in a manner

---

[21] Past damages, those incurred between the date of injury and the date of the award, are paid out as a lump sum, so that the 50-B structures apply only to future damages.

[22] There are alternative views as to how pain and suffering losses are calculated. The view used here is that pain and suffering losses are measured annually and increase at the rate of inflation. Another view is that pain and suffering losses are a lump sum award, or are awarded over a time period shorter than the life expectancy of the plaintiff.

significantly different from equation (1). [23]   Under 50-B the first $250,000 of the jury's verdict

for future losses is paid out as a lump sum. The remaining nominal economic damages are

divided by the expected work-life for an average annual loss, which is augmented by an annual

growth rate of 4%:

Total nominal economic damages, X, are given by

(2) $$X = \sum_{n=0}^{N-1} W_0(1+g)^n \quad + \quad \sum_{t=0}^{T-1} H_0(1+h)^t .[24]$$

Under 50-B, the present value of equation (2) is calculated as[25]

(3) $$250,000 \quad + \quad \sum_{n=1}^{N-1} \left\{ \frac{\left[\dfrac{(X-250,000)}{N} \right]}{(1+r)^n} \right\} (1.04)^n .$$

Nominal pain and suffering losses are averaged over a maximum of ten years.[26] The pain and

suffering award made by the jury is:

(4) $$P = \sum_{t=0}^{T-1} P_0(1+\pi)^t$$

Under 50-B the present value of the pain and suffering award is calculated as[27]

---

[23] We assume that the jury verdict is based on the testimony of the economist and includes an inflation factor.

[24] Other components of losses such as medical care, life care etc. can be added to this equation as required by the jury verdict.

[25] We assume that nominal economic damages exceed $250,000. For simplicity, we also assume that N=T, which actually understates the pro-plaintiff bias.

[26] The jury may have a verdict for pain and suffering less than 10 years but the statute requires a maximum of 10 years or the number of years set by the jury, which ever is lower. We assume that the life expectancy of the plaintiff exceeds ten years.

[27] If the plaintiff dies prior to paying out the future pain and suffering award then the defendant does not have to pay that portion of the award. This is a defense bias that only occurs upon death of the plaintiff within ten years. If there is information to suggest that the plaintiff may not live to 10 years then their attorney will certainly factor that into their post-verdict negotiations strategy. This may also occur during the actual trial trying to get the sympathy of the jury so that they front load most of the pain and suffering either under past pain or suffering or for less than 10 years. Unless there is information that would be brought out at trial that the plaintiffs life will be significantly shortened this defense bias would be purely random. For this to offset totally the plaintiff bias the jury award would have to be skewed almost entirely to future pain and suffering, something a plaintiff attorney (knowing that a shorten life span has occurred) will take extra care at trial to explain to the jury.

$$(5) \qquad \sum_{t=1}^{10} \frac{\left(P\!\!\Big/\!10\right)(1.04)^t}{(1+r)^t}$$

Combining (3) and (5), the present value of the total future loss stream under 50-B is calculated as

$$(6) \qquad 250{,}000 \;+\; \sum_{n=1}^{N-1}\left\{\frac{\left[\dfrac{(X-250{,}000)}{N}\right]}{(1+r)^n}\right\}(1.04)^n \;+\; \sum_{t=1}^{10} \frac{\left(P\!\!\Big/\!10\right)(1.04)^t}{(1+r)^t}\,.$$

Equation (6) is always larger than equation (1), resulting in a pro-plaintiff bias.[28] There is a positive relationship between the size of the bias and the size of the award, X and P, the length of the discounting periods, N and T, and the discount rate, r.

The complexity of equation (6) can lead to the plaintiff, defendant and judge calculating different values for the present value of the loss.[29] Because of these different values, it is not clear how much of the bias the judge will allocate to the plaintiff. This uncertainty provides the motivation for post-verdict negotiations, where both sides are encouraged to agree to a discount rate and then to agree to an actual structured payment. Even if the verdict is reduced upon appeal, the 50-B structuring must be completed.[30]   During the 50-B negotiations, the plaintiff seeks to maximize its share of the bias, while the defendant seeks to minimize the rent it will pay. In essence, the 50-B structure establishes an upper range for the damage award while traditional present value calculations establish a lower range. Knowing that the 50-B bias exists

---

[28] We will prove this in section IV.

[29] It is very possible that none of the disputants know how to make the 50-B calculations or for that matter have any experience at all in large verdict awards.

[30] The trial court in *Bermeo v Atakent et al and New York City Health and Hospital Corporation* reduced a jury verdict of $45 million in damages and the Appellate Court increased the trial courts reduction , but still required it to be structured under 50-B.

and understanding why it occurs becomes crucial in negotiating the size of the rent the plaintiff will receive.

III. Reasons for the Article 50-B Pro-Plaintiff Bias

The source of the 50-B bias is not necessarily an incorrect discount rate, but an incorrect discounting procedure. There are four major reasons why 50-B overestimates the loss: (1) The $250,000 lump sum payment, (2) smoothing the future loss stream over the expected work-life, (3) double adjustment for inflation, and (4) averaging the pain and suffering award over a ten-year period.

A. Lump Sum Payment

Article 50-B requires that the first $250,000 of future losses be paid as a lump sum. Normally, in calculating present value, discounting starts after the first period and continues to the work-life expectancy or life expectancy of the plaintiff, with each period's losses multiplied by a smaller discount factor. Under 50-B, the first $250,000 is not discounted. The remaining future losses are then discounted. Any provisions for a lump sum payment that exceeds first period losses will always result in an upward bias in the present value calculation. Consider a stream of payments over N periods:

$$X_0, X_1, X_2, \ldots, X_N, \text{ where } X_i > 0 \text{ and } X_i < X_{i+1}$$

The present value of this payment stream is given by

(7)
$$\sum_{n=0}^{N} \frac{X_n}{(1+r)^n}.$$

Now suppose some of the payments are paid out as a lump sum (L) in the first period, with the remaining payments discounted as in equation (6). The present value of this lump sum payment stream is given by

(8) $\qquad L + \sum_{n=k+1}^{N} \frac{X_n}{(1+r)^n},\quad$ where $\quad L = \sum_{n=0}^{k} X_n \quad$ and $\quad 1 \le k < N$.

Equation (7) is always less than equation (8) for any positive discount rate.[31]

The bias due to the lump sum payment depends on the amount of damages, the work-life expectancy, and the discount rate, but can typically account for 5 to 10 % of the total 50-B bias (Wolkoff and Hanushek 1995).

B. Smoothing the Future Loss Stream

The second source of pro-plaintiff bias is due to the smoothing of future losses over the work-life expectancy. Article 50-B mandates that after deducting the lump sum payment, the remaining future losses are divided by the number of years recommended by the jury (usually the economist's estimate of work-life expectancy) to calculate the average loss per year. Consequently, this smoothes the time path of future losses. However, the actual loss stream

---

[31] This is true because for any $i > 0$, $X_i > \dfrac{X_i}{(1+r)^i}$, and therefore $L = \sum_{n=0}^{k} X_n > \sum_{n=0}^{k} \frac{X_n}{(1+r)^n}$. Thus

$$L + \sum_{n=k+1}^{N} \frac{X_n}{(1+r)^n} > \sum_{n=0}^{k} \frac{X_n}{(1+r)^n} + \sum_{n=k+1}^{N} \frac{X_n}{(1+r)^n} = \sum_{n=0}^{N} \frac{X_n}{(1+r)^n}.$$

increases over time, so replacing it with the smoothed loss stream overestimates the present value of the actual losses. It can be shown that the present value for any multi-period, increasing loss stream will be less than the present value of the smoothed loss stream:

(9) $$\sum_{n=0}^{N}\frac{X_n}{(1+r)^n} < \sum_{n=0}^{N}\frac{\overline{X}}{(1+r)^n} \quad where \quad \overline{X} = \sum_{i=0}^{N}\frac{X_i}{N+1}.^{32}$$

The inequality in equation 9 occurs because the actual loss stream (the numerator in the left-hand side of equation 9) increases over time, starting with a base year loss and rising according to some growth rate, as in equation (2). Thus, prior to discounting, losses incurred in the later periods are actually greater than the average annual loss, and losses incurred in the earlier periods are smaller than the average annual loss. Also, discounting future losses puts more weight on earlier losses and less weight on later losses. Therefore, if the actual loss stream is replaced with a loss stream equal to the average annual loss (the numerator in the right hand side of equation 9), more weight is given to annual losses that are too high (relative to the actual loss in those periods) and less weight is given to annual losses that are too low. The result is an overestimation of the present value of the actual loss stream.

Smoothing future losses accounts for 20-26% of the total overestimation (Wolkoff and Hanushek 1995). If the jury specifies a time period less than the actual work-life expectancy then the overestimation would be even larger.

C. Double Adjustment for Inflation

---

[32] See the appendix A for the proof of this statement.

The third source of the pro-plaintiff bias occurs when the smoothed loss stream is augmented by the mandated 4% growth rate after the jury verdict. Since the economist testified at trial to nominal future losses and included an inflation factor for both lost wages and household services (See equation 2), including another 4% increase as mandated by the statute results in a double adjustment for inflation. Presumably, the jury also makes the necessary adjustments based on the inflation testimony while deliberating the pain and suffering award (see equation 4). Thus the present value of the economic damage award becomes:

(10)
$$\sum_{n=0}^{N} \frac{\overline{X}}{(1+r)^n}(1.04)^n \quad where \quad \overline{X} = \sum_{n=0}^{N} \frac{X_n}{N+1}$$

Given the inequality in equation (9), it can further be shown that equation (10) increases the post-verdict plaintiff bias.[33] Wolkhoff and Hanushek (1995) attribute 46 to 51% of the total bias to the double inflation adjustment.

The legislature's motivation for including a 4% post verdict adjustment is unclear. However, this adjustment may have been perceived as an advantage by insurance companies, given the high level of inflation during the late 1970s and early 1980s.[34] It appears that lobbyists and lawmakers did not understand that 4% would be *in addition* to the economist's inflation testimony of economic damages at trial.

Legal challengers to adjusting the structured settlement by 4% continue to arise. Most recently, in *Schultz v. Harrison Radiator,* 90 NY2d 311 (1997) the defendant tried to disallow

---

[33] For all n=1,2,3, …,N, $\frac{\overline{X}}{(1+r)^n}(1.04)^n > \frac{\overline{X}}{(1+r)^n}$.

Therefore $\sum_{n=0}^{N} \frac{\overline{X}}{(1+r)^n}(1.04)^n > \sum_{n=0}^{N} \frac{\overline{X}}{(1+r)^n} > \sum_{n=0}^{N} \frac{X_n}{(1+r)^n}$.

the plaintiff's testimony about inflation, arguing that a 4% post verdict inflationary adjustment would double compensate the plaintiff. The Court of Appeals (the highest court in NYS), citing past precedent, ruled that economic testimony about inflation is allowed, as is the post verdict 4% mandated adjustment. The *Schultz* court refused to change the common law and left the 4% issue to be resolved by the legislature. The same court in *Bryant* (1999) again upheld the 4% adjustment. The court correctly discussed how the 4% adjustment protects the plaintiff from a rise in prices over time. However, the court did not appear to recognize that expert testimony about inflation during the trial (on which the jury bases its verdict) provided the same protection. Thus the double adjustment for inflation remains. In both *Schultz* and *Bryant,* the court's attempt to justify the 4% adjustment on economic grounds demonstrated a misunderstanding of the true issue. [35]

D. Pain and Suffering

A fourth source for the pro-plaintiff bias occurs when the time period for damages due to pain and suffering is truncated to a maximum of ten years. Juries typically make an award based on their belief that pain and suffering will remain for the life expectancy of the plaintiff. If not, they set the time frame for which pain and suffering will be compensated. However, under 50-B, the entire award for pain and suffering is paid out over a maximum of ten years (or less, if the jury so instructs). Reducing the number of years over which the future loss is discounted

---

[34] It has been suggested, partly in Romans and Floss 1999, that the 4% adjustment is actually a risk premium to compensate the plaintiff for locking in a structure for future payments, something that would not occur in the absence of injury. However the *Schultz* and *Bryant* courts clearly view the 4% as an inflation adjustment.
[35]   The *Schultz court* said the 4% adjustment "does not provide additional compensation for a plaintiff above and beyond damages awarded; rather, it ensures that the passage of time will not devalue the award because of a general

overestimates the present value of the loss.   The following equations show that the smoothed

and truncated loss stream will always result in a larger present value. Equation (9) allows us to

state that

(11) $$\sum_{t=0}^{T-1}\frac{P_0(1+\pi)^t}{(1+r)^t} \quad < \quad \sum_{t=0}^{T-1}\frac{P/T}{(1+r)^t} \quad \text{where} \quad P = \sum_{t=0}^{T-1}P_0(1+\pi)^t.$$

It is also true that

(12) $$\sum_{t=0}^{T-1}\frac{P/T}{(1+r)^t} \quad < \quad \sum_{t=0}^{9}\frac{P/10}{(1+r)^t} \quad \text{where} \quad T > 10.\ [36]$$

The size of this overestimation depends on the life expectancy and the size of the award

for pain and suffering. Wolkhoff and Hanushek (1995) attribute 16 to 24% of the total bias to

the ten-year limitation for pain and suffering losses.

IV. The Effect of 50-B on Settlement Negotiations

Section III establishes that the 50-B structure always results in a pro-plaintiff bias relative

to the actual present value of the future loss stream of the structured settlement.[37] The pro-

plaintiff bias alone increases the potential benefits of litigation for the plaintiff, thus increasing

total litigation (which includes cases settled prior to being filed and cases filed).[38] Therefore

even if the proportion of cases going to trial stays the same, there is still an increase in the

number of filings due to the total increase in litigation. In addition, 50-B may increase not only

---

rise in prices for goods and services..." The court did not recognize that the economist already testified to inflation
at trial.

[36] See appendix B for the proof of this statement.

[37] While this may be offset by the defense biases discussed in section II, the pro-plaintiff bias will always exist in
the 50-B structure.

[38] Lee, Browne and Schmit (1994) document the positive relationship between the expected return of a tort filing
and the number of tort filings.

the total amount of litigation in NYS, but also the proportion of litigation proceeding to trial by

altering both the information structures among the disputants and plaintiff attitudes towards risk.

A. 50-B and the Perception of Bias

 If both parties understand the economic consequences of 50-B, the disputant's pre-trial

settlement offers will rise thus facilitating settlement,[39] while the decision to go to trial remains

unaffected.[40] However, if the disputants do not equally understand the economic implications of

50-B, the probability of a trial increases.

The key issue is not the actual size of the 50-B bias, but the perception by each side of

whether a bias exists at all (Schmit et al 1997). Given the complexity and misunderstanding

surrounding 50-B, it is not surprising that each side has different perceptions of the size of the

bias. We contend that plaintiffs were better informed about the 50-B bias in the years

immediately following the legislation. With different perceptions about the implications of 50-

B, plaintiffs' expected damage awards increase, making them more willing to go to trial than the

defendants, who may not expect any change in expected losses due to 50-B.[41] Since both parties

have different damage values associated with the tort, pretrial agreement is less likely, resulting

in more cases being filed for trial. This is also consistent with what has happened in NYS

between 1988 and 1996.

There are several reasons why defendants, who are often insurance companies, have been

less likely to understand the economic consequences, or existence, of the pro-plaintiff bias in the

---

[39] Both parties, having full information, know the size of the plaintiff bias associated with 50-B thus they make the necessary upward adjustments in their settlement negotiations.

[40] Spier (1994) states that symmetrically informed parties will settle their dispute rather than go to court.

years immediately following the enactment of 50-B. Since the 50-B reform was a direct result of

lobbying by the insurance industry that industry erroneously thought it would be beneficial to

them.[42] Given the termination of certain payments upon death and the offset allowed under the

collateral source rule the defendants may have assumed at first that 50-B is always favorable to

them.   This lobbying effort was due to a 200% rise in general liability premiums between 1984

and 1986.[43] This period accounted for most of the growth in liability premiums since 1975.

Large jury awards during this time period were partly to blame for this increase. Severe

insurance rationing followed, resulting in many firms finding it difficult to acquire liability

insurance at any price. This growth of insurance costs concentrated in a two-year period along

with high rates of inflation led to a general panic demanding tort reform. In response to this and

under pressure from the insurance industry, New York State passed Articles 50-A /50-B without

understanding their economic consequences. [44]

Another reason why the insurance industry did not bother to examine in more detail the

economic consequences of 50-B was due to the sudden increase in profitability in 1988. It is

likely that insurance companies attributed this return to profitability partly to state tort reforms,

including NYS 50-B. The insurance industry experienced huge operating losses in 1985 due to

claim losses exceeding premiums. (Viscusi et al 1993) Profitability was restored in 1988 as loss

---

[41] Lee, Browne and Schmit (1994) discuss the positive relationship between the expected return of a tort filing and the number of tort filings.

[42] The insurance industry certainly would not lobby for a law that would be costly for them.

[43] Viscusi et al (1993) also document a 56% increase in medical malpractice insurance from 1984-1985 and another 26% from 1985 to 1986. Even automobile premiums, which historically do not rise much, increased by 25.6% from 1985 to 1986.

[44] Viscusi et al speak to the general lack of understanding by state legislators in the following statement "State responded with reform legislation, despite a general lack of understanding about how the existing liability rules affected insurance markets or how specific reforms might change their performance." p. 166.

ratios dropped by 40 percentage points or more (Viscussi et al 1993).[45] The insurance industry

likely attributed its increasing profitability to its successful lobbying for tort reform.

Why didn't economists inform insurance companies about the pro-plaintiff bias inherent

in the 50-B structure? Defendants (insurance companies) historically have been reluctant to hire

economists, since their testimony about damages establishes a lower bound for the financial

award and may be seen as an admission of liability (Spizman 1995). Since defendants

traditionally do not use economic experts[46] they are not as well informed about the consequences

of 50-B. Plaintiffs do routinely use economists to estimate economic damages and analyze

structured settlements, and are thus more likely to be informed about the pro-plaintiff bias of 50-

B. Economic experts would not only make the normal present value calculation but they would

also try to make the 50-B calculations.   If defendants do not retain an economist during the

actual pretrial negotiations they may not be informed about the size or even the existence of the

50-B bias. Also, the lack of depositions in NYS tort litigation perpetuates the misinformation.

All of the above results in defendants not recognizing the 50-B plaintiff bias, thus making lower

settlement offers, while rent-seeking plaintiffs, recognizing that the bias exists, reject defendant

offers because of a greater expected post-verdict return. Therefore fewer pretrial settlement

offers will be accepted, and the rate of filings, as NYS data suggest, increases. It is likely that

this misinformation declined as court rulings clarified the application and consequences of 50-B

structuring.

---

[45] Loss ratios of less than one indicate profitability while a loss ratio greater than one indicates losses. Viscusi et all
(1993) show that, with respect to medical malpractice, insurers went from paying $1.15 for every $1 in premiums to
paying 58.4 cents in claims for every $1 in premiums. General liability showed a loss ratio of 1.017 in 1985 drop to
.569 in 1988.
[46] This appears to be changing as more and more defendants use economists (even if not disclosed as experts) to
analyze the economics of the lawsuit.

B. The Role of 50-B in Altering the Attitudes of the Plaintiff Towards Risk

The expectation of post-trial damage awards exceeding the actual present value of future losses may induce a lottery mentality among rent-seeking plaintiffs. Thus, they may be more willing to risk a trial even if the defendants increase their settlement offers (Schmit et al 1997). If a plaintiff is normally risk averse; i.e., willing to accept an offer below the expected damage award in order to avoid the uncertainty of a trial, then the lottery mentality makes the plaintiff less risk averse, effectively increasing the minimum settlement a plaintiff will accept. Thus, even if the defendant recognizes the 50-B bias and makes a larger pre-trial offer, the plaintiff may reject the offer because 50-B alters not only the expected size of the award, but the plaintiff's attitude towards risk.

C. 50-B and Post-verdict Negotiation

One of the more interesting aspects of NYS law is the post-verdict bargaining process. Post-verdict negotiations often lead to "horse trading" at a level beyond pre-trial negotiations. Since the jury verdict is not discounted (economists cannot testify to discounted values) but instead requires post verdict structuring under 50-B, the two sides must agree to the discount rate (the easy part of the negotiations) and the structure of the annuity to be purchased. If the two sides cannot agree to a structure, the law requires the judge to structure the settlement under 50-B. Both sides involved in the 50-B negotiations seek to maximize their benefits or minimize their costs subject to the jury's verdict. Negotiating the structure, under the watchful eyes of the

judge, often leads to both sides reaching an agreement without the judge imposing a 50-B structure.

The very existence of the post-verdict negotiations, however, is a testament to the uncertainty about the proper application of a 50-B structure. If the law were clear about how to establish the structure, then the incentive to negotiate would be greatly reduced. The defendant has an interest in negotiating a post-verdict settlement that minimizes the pro-plaintiff bias in a 50-B structured settlement while maximizing any pro-defendant biases. If the defendants do not actually know the size of the bias, what may be perceived as intransigence in negotiations may in fact just be economic ignorance. The plaintiff's incentive is to maximize the rent, where the rent is the higher present value that comes from an imposed structure, rather than actual damages. The negotiations occur under the uncertainty of the judge's ability to correctly structure the settlement if the disputants fail to agree.[47] If plaintiffs "hold out" for a 50-B award, they may receive substantially less due to judicial error. The uncertainty of how the judge, in the absence of agreement, will distribute the 50-B bias leaves room for negotiations. By requiring substantial post-verdict negotiation, 50-B increases the complexity and therefore the costs of litigation.

Post-verdict negotiations result in a further expenditure of resources on litigation and are yet another source of inefficiency. Usually, when a jury verdict is reached (unless the verdict is appealed), the case is closed quickly. However, under 50-B the case can be drawn out longer by adding the post-verdict process. It is not in the best interest of the defendant to stall on this matter however, because the statute also has a 9% interest penalty that is added on the damage award after a jury verdict is given. Nor is it advantageous for a seriously injured plaintiff who

---

[47]   While it is true that the statutes and case law provides the judge with a method of calculating the damages under 50-B, as recently as 1999 the courts have had to resolve issues about the correct application of the statute. (See *Bryant*)

cannot work. This efficiency loss is another unintended consequence of 50-B. The post-verdict process under 50-B appears to usurp the basic intent of tort reform.

D. The Role of the Judge

The role of the judge in a 50-B hearing is unique because, in the absence of the disputants agreeing to a structure, the judge must make the final economic calculations. If judges know the bias of 50-B, why don't they set new precedents and rule in such a manner that the bias is reduced? The most obvious reason is that they believe the legislative branch and not the judicial branch should change the law.[48] Tabarrok and Helland (1999) suggest another reason why a judge will not want to alter the bias of 50-B.   Since trial judges are elected in New York and trial lawyers are big contributors for their reelection, judges have an incentive to redistribute wealth from the defendant, which is usually an out of state company, to the plaintiff, who is a potential voter and contributor. Tabarrok and Helland call this constituency service the "local voter" effect.[49] With this in mind, there is no incentive for a judge to make new law by trying to overturn the legislated 50-B bias. However there is still an incentive for the judge to get both sides to agree to a post-verdict settlement and avoiding making the calculations on her own.

The judge can expedite agreement in the negotiating process, because often both sides have appeared before the same judge and may do so again in the future. Thus, both sides recognize the external cost of intransigence in front of the judge in their 50-B negotiations.

---

[48] Judges may, however, inadvertently reduce the bias if the judge incorrectly calculates the losses and the disputants do not know the correct calculations.

[49] Their hypothesis is that this effect causes awards to be larger in states where the judiciary is elected rather than appointed.

Understanding this court room calculus, while also trying to avoid making the 50-B calculations herself, the judge uses moral suasion to facilitate an agreement to the structure.

V. Conclusion

This paper discusses the unintended consequences of the 50-B as one element of tort reform in New York State. State tort reforms of the 1980s were passed with the intention of reducing the cost of litigation and the number of filings. NYS tort reform has had unintended consequences which have increased the expected return of filing a claim for the plaintiff while adding to the length and complexity of post-verdict negotiations for both parties. This is consistent with dramatic increase in the rate of filing in the years following the passage of 50-B

Provisions for a structured settlement under 50-B result in a pro-plaintiff bias to damage awards, creating a disincentive for plaintiffs to settle for actual damages. The complexity of the statutes suggest that these implications are not well understood by the disputants, resulting in differing assessments of expected damage awards that discourage pre-trial settlements and lengthen post-verdict negotiations.

Empirical research on the affect of 50-B or tort filings will clarify whether these reforms have actually increased the cost of litigation. However, such research would require data on pre- and post-trial settlements. Much of that data is proprietary and thus unavailable, and any subset of available data may not be representative.

While some may believe that the courts have resolved all the major issues of structuring under 50-B, the *Bryant* court itself does not agree:

> As a concluding observation, we note that as CPLR articles 50-A and 50-B
> reach their 15th anniversary, having generated a good deal of frustration and
> litigation, it would perhaps be an opportune time for the Legislature to review
> these enactment's to assure that, in actual operation, they are meeting their

objectives and not--as submissions before us urge- egregiously overcompensation or undercompensating anyone.[50]

Until the legislature rewrites the law[51], a better understanding of the 50-B bias among plaintiffs, defendants, and judges may result in more efficient settlement negotiations and possibly reduce the filing rate in New York.

References

Argentine, Stephanie L. 1992. "From Verdict to Judgment: The Evolution, Confusion and Reformation of CPLR Articles 50-A and 50-B." *Buffalo Law Review* 40: 917-961.

Bowden, Michael M. 1999. "New York is the Latest Battleground Over Tort Reform." *Lawyers Weekly USA, May 3, 99 LWUSA 428.*

Browne, Mark J., and Puelz, Robert. 1998. "The Effect of Legal Rules on the Value of Economic and Non-Economic Damages and the Decision to File." Working Paper, University of Wisconsin-Madison.

---

[50] *Bryant v. New York City Health and Hospitals Corp.*
[51] See Bowden (1999).

Cotter, Robert, and Rubinfeld, D. 1989. "Economic Analysis of Legal Disputes." *Journal of Economic Literature* 27: 1067-97.

Court Statistics Project, 1997. *State Court Caseload Statistics, 1996*, National Center for State Courts.

Lambrinos, James, and Harmon, Oskar R. 1995. "Plaintiff Bias in the CPLR 50-A/50-B Statues." *Albany Law Review* 59: 693-707.

Lee Han-Duck, Browne Mark J. and Schmit Joan T, 1994, "How Does Joint and Several Tort Reform Affect the Rate of Tort Filings? Evidence from the State Courts", *The Journal of Risk and Insurance*, vol. 61. No 2, 295-316.

McKenna Patrick J., 1995   "A Four Percdent Solution to the "Judge's Nightmare*," New York State Bar Journal*, Jan. at 44.

Riccardi, Anthony H, 1996, "A Reply to Professors Wolkoff & Hanushek on The Economics of Structured Judgments Under CPLR Article 50-B," *Buffalo Law Review* Fall, Vol. 44-3: 991-1006.

Rolando, Pelaez. 1995. "Pennsylvania's Offset Rule: Fantasy Masquerading as Economics." *Journal of Legal Economics* 5(3): 1-16.

Romans Thomas, Floss Frederick, 1999 "Structured Settlements and the Interest Rate Switch" *Journal of Forensic Economics* 12(1), 57-64.

Schmit, Joan T.; Browne, Mark J.; Lee, Han Duck. 1997. "The Effect of State Tort Reforms on Claim Filings." *Risk Management and Insurance Review* 1: 1-17.

Siegel, David D. 1985. "Practice Commentaries The 1985 Amendment Creating the Structured Payment" , McKinney's Cons Laws of NY, CPLR article 50-A, §5031, 715.

Siegel, David D. 1986. "The 1986 Amendment Extending the Structured Judgment to Tort Actions Generally" , McKinney's Cons Laws of NY, CPLR article 50-B, §5041, 726.

Spier, K. 1994. "Pretrial Bargaining and the Design of Fee-Shifting Rules." *Rand Journal of Economics* 25:197-214.

Spizman, Lawrence M. 1995. "The Defense Economist's Role in Litigation Settlement Negotiations." *Journal of Legal Economics* 5(2): 57-65.

Tabarrok Alexander and Helland Eric, 1999. "Court Politics: The Political Economy of Tort Awards", *The Journal of Law and Economics*, Vol. XLII (1) (Pt.1) April,   157-188.

Viscusi, W. Kip; Zeckhauser, Richard J.; Born, Patricia; Blackmon, Glenn. 1993. "The Effect of
        1980s Tort Reform Legislation on General Liability and Medical Malpractice Insurance."
        Journal of Risk and Uncertainty 6: 165-186.

Wolkoff, Michael, and Hanushek, Eric. 1995. "The Economics of Structured Judgments Under
        CPLR Article 50-B." *Buffalo Law Review* 43: 563-582.

Wolkoff, Michael, and Hanushek, Eric. 1995A. "Rush to Judgment: The (Dis)Incentive to Settle
        Personal Injury Cases" *New York State Bar Journal* March/April 52-56.

Bermeo et al v Atakent and New York City Health and Hospitals Corporation, *241 A.D. 2d 235;
671 N.Y.S. 2d 727; 1998 N.Y. App.Div. Lexis 4431.*

Bryant v New York City Health and Hospital Corporation , Depradine et. al. v New York City
Health & Hospital Corporation, No. 124. No. 137, 93 N.Y.2d 592;716 N.E. 2d 1084; Lexis 1432;
695 N.Y.S.2d 39 decided July 1, 1999, Court of Appeals of New York.

Civil Practice Law & Rules (CPLR) Articles 50(a) (CPLR 5031-5039) in 1985 and 50(b) (CPLR
5041-5049) in 1986

Coyne v Etra et al. Index No. 29346/94 Supreme Court of New York, Nassau County 703
N.Y.S.2d 869; 1999 N.Y. Misc. Lexis 615.

Rohring v City of Niagara Falls, No 117 Court of Appeals of New York, 84 N.Y. 2d 60; 638
N.E. 2d 62 1994, Lexis 1427; 614 N.Y.S.2d 714

Schultz v. Harrison Radiator, 90 NY2d 311 (1997)

Ursini v. Sussman 541 N.Y.S2d 916 (Sup.1989)

Appendix A

Prove

(A1)
$$\sum_{n=0}^{N} \frac{X_n}{(1+r)^n} \quad < \quad \sum_{n=0}^{N} \frac{\overline{X}_N}{(1+r)^n}$$

where

(A2) $\quad N \geq 1, \quad r > 0, \quad X_i > 0, \quad X_i > X_{i+1} \quad \text{and} \quad \overline{X}_N = \sum_{i=0}^{N} \frac{X_i}{N+1}$

Proof by mathematical induction

step 1: Show that (A1) is true for $N = 1$

$$X_0 + \frac{X_1}{(1+r)} \quad < \quad \frac{X_0 + X_1}{2} + \frac{\dfrac{X_0 + X_1}{2}}{(1+r)} \quad \text{is true}$$

$\Leftrightarrow$

$$2(1+r)X_0 + 2X_1 \quad < \quad (1+r)X_0 + (1+r)X_1 + X_0 + X_1$$

$\Leftrightarrow$

$$rX_0 < rX_1$$

$\Leftrightarrow$

$X_0 < X_1 \quad$ which is assumed in (A2)

Thus, (A1) is true for $N = 1$.

step 2: Assume that (A1) is true for $N = k$

(A3)
$$\sum_{n=0}^{k} \frac{X_n}{(1+r)^n} \quad < \quad \sum_{n=0}^{k} \frac{\overline{X}_k}{(1+r)^n}$$

Multiplying through by $(1+k)(1+r)^k$, (A3) becomes

(A3a) $\quad (k+1)\sum_{n=0}^{k}(1+r)^{k-n}X_n \quad < \quad \sum_{n=0}^{k}(1+r)^{k-n}\left(\sum_{i=0}^{k}X_i\right)$

step 3: Show that (A1) is true for $N = k+1$

$$\sum_{n=0}^{k+1}\frac{X_n}{(1+r)^n} \quad < \quad \sum_{n=0}^{k+1}\frac{\overline{X}_{k+1}}{(1+r)^n} \quad \text{is true}$$

$$\Leftrightarrow$$

$$\sum_{n=0}^{k}\frac{X_n}{(1+r)^n}+\frac{X_{k+1}}{(1+r)^{k+1}} \quad < \quad \sum_{n=0}^{k}\frac{\overline{X}_{k+1}}{(1+r)^n}+\frac{\overline{X}_{k+1}}{(1+r)^{k+1}}$$

$$\Leftrightarrow$$

(A4) $\quad (k+2)\sum_{n=0}^{k}(1+r)^{k-n}X_n +(k+2)\frac{X_{k+1}}{(1+r)} \quad < \quad \sum_{n=0}^{k}(1+r)^{k-n}\left(\sum_{i=0}^{k+1}X_i\right)+\frac{\left(\sum_{i=0}^{k+1}X_i\right)}{(1+r)}$

The first terms on each side of (A4) may be rewritten as follows:

(i) $\quad (k+2)\sum_{n=0}^{k}(1+r)^{k-n}X_n = (k+1)\sum_{n=0}^{k}(1+r)^{k-n}X_n +\sum_{n=0}^{k}(1+r)^{k-n}X_n$

and

(ii) $\quad \sum_{n=0}^{k}(1+r)^{k-n}\left(\sum_{i=0}^{k+1}X_i\right)=\sum_{n=0}^{k}(1+r)^{k-n}\left(\sum_{i=0}^{k}X_i\right)+\sum_{n=0}^{k}(1+r)^{k-n}X_{k+1}$

Substituting (i) and (ii) into (A4),

$$(k+1)\sum_{n=0}^{k}(1+r)^{k-n}X_n +\sum_{n=0}^{k}(1+r)^{k-n}X_n +(k+2)\frac{X_{k+1}}{(1+r)}$$

(A5) $\qquad\qquad <$

$$\sum_{n=0}^{k}(1+r)^{k-n}\left(\sum_{i=0}^{k}X_i\right)+\sum_{n=0}^{k}(1+r)^{k-n}X_{k+1}+\frac{\left(\sum_{i=0}^{k+1}X_i\right)}{(1+r)}$$

(A1) is true if and only if (A5) is true. Since (A3) is assumed to be true, this implies that

the first term on the LHS of (A5) is less than the first term on the RHS of (A5). Thus

(A1) is true if the remaining inequality holds, or

(A6) $\displaystyle\sum_{n=0}^{k}(1+r)^{k-n}X_n + (k+2)\frac{X_{k+1}}{(1+r)} \quad < \quad \sum_{n=0}^{k}(1+r)^{k-n}X_{k+1} + \frac{\left(\displaystyle\sum_{i=0}^{k+1}X_i\right)}{(1+r)}.$

(A6) is true if and only if

(A7) $\displaystyle\sum_{n=0}^{k+1}(X_{k+1}-X_n) \quad < \quad \sum_{n=0}^{k}(1+r)^{k+1-n}(X_{k+1}-X_n)$

note that the LHS of (A7) = 0 when n = k+1, so (A7) is equivalent to

$$\sum_{n=0}^{k}(X_{k+1}-X_n) \quad < \quad \sum_{n=0}^{k}(1+r)^{k+1-n}(X_{k+1}-X_n)$$

Under the assumptions in (A2),

$$X_{k+1}-X_n \quad < \quad (1+r)^{k+1-n}(X_{k+1}-X_n) \qquad \text{for all} \quad 0 \le n \le k .$$

Thus, the inequality in (A7) holds and (A1) is true.

Appendix B

Prove

(B1) $\displaystyle\sum_{t=0}^{T-1}\frac{P/T}{(1+r)^t} \quad < \quad \sum_{t=0}^{9}\frac{P/10}{(1+r)^t}$

where

(B2) $\quad r > 0, T > 10 \quad \text{and} \quad P = \displaystyle\sum_{t=0}^{T-1}P_0(1+\pi)^t$

Proof by mathematical induction

step 1: Show that (B1) is true for T = 11.

$$\sum_{t=0}^{10}\frac{P/11}{(1+r)^t} \quad < \quad \sum_{t=0}^{9}\frac{P/10}{(1+r)^t} \qquad \text{is true}$$

$$\Leftrightarrow$$

$$\sum_{t=0}^{10}\frac{10}{(1+r)^t} \quad < \quad \sum_{t=0}^{9}\frac{11}{(1+r)^t}$$

$$\Leftrightarrow$$

$$\frac{10}{(1+r)^{10}} \quad < \quad \sum_{t=0}^{9} \frac{1}{(1+r)^t}$$

$$\Leftrightarrow$$

(B3) $\quad \displaystyle\sum_{t=0}^{9} \frac{1}{(1+r)^{10}} \quad < \quad \sum_{t=0}^{9} \frac{1}{(1+r)^t}$

Under (B2), $\dfrac{1}{(1+r)^{10}} < \dfrac{1}{(1+r)^t}$ for all $t = 0,1,2,...9$.

Thus, (B3) is true and therefore (B1) is true for $T = 11$.

step 2: Assume the (B1) is true for $T = k$.

(B4) $\quad \displaystyle\sum_{t=0}^{k-1} \frac{P/k}{(1+r)^t} \quad < \quad \sum_{t=0}^{9} \frac{P/10}{(1+r)^t}$

step 3: Show that (B1) is true for $T = k+1$.

(B5) $\quad \displaystyle\sum_{t=0}^{k} \frac{P/(k+1)}{(1+r)^t} \quad < \quad \sum_{t=0}^{9} \frac{P/10}{(1+r)^t} \quad$ is true

$$\Leftrightarrow$$

$$\sum_{t=0}^{k} \frac{10}{(1+r)^t} \quad < \quad \sum_{t=0}^{9} \frac{k+1}{(1+r)^t}$$

from (B4) we assume that

$$\sum_{t=0}^{k-1} \frac{10}{(1+r)^t} \quad < \quad \sum_{t=0}^{9} \frac{k}{(1+r)^t}$$

so (B5) is true if

(B6) $\quad \dfrac{10}{(1+r)^k} \quad < \quad \displaystyle\sum_{t=0}^{9} \frac{1}{(1+r)^t} \qquad$ or $\qquad \displaystyle\sum_{t=0}^{9} \frac{1}{(1+r)^k} \quad < \quad \sum_{t=0}^{9} \frac{1}{(1+r)^t}$

Under (B2), $\dfrac{1}{(1+r)^k} < \dfrac{1}{(1+r)^t}$ for all $t = 0,1,2,...9$.

Thus, (B6) is true, (B5) is true for $T = k+1$, and (B1) is true.