A Primer on Prejudgment Interest

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If justice were immediate, there would never be an award of prejudgment interest.\textsuperscript{1} The injured party would receive an enforceable judgment immediately, with no loss in value from the time value of money. Because justice often takes many years to achieve, interest is added to the original judgment to ensure that compensation is complete.\textsuperscript{2} These calculations are ubiquitous, since the laws of most U.S. jurisdictions provide for interest on legal judgments from the time the claim arose until the date of judgment.\textsuperscript{3} Such interest is called prejudgment interest.\textsuperscript{4}

When the injury occurred long before the judgment, prejudgment interest can equal or even exceed the principal. For example, in 1992 the Seventh Circuit awarded French plaintiffs $65 million in damages and $148 million in prejudgment interest in a suit arising out of the grounding of the

\begin{itemize}
\item \textsuperscript{1} Interest is defined as "payment for the use or forbearance of money, or as damages for its detention." Brown v. Hiatts, 82 U.S. 177, 185 (1872).
\item \textsuperscript{2} See Proctor & Gamble Distrib. Co. v. Sherman, 2 F.2d 165 (S.D.N.Y. 1924). In his opinion, Learned Hand wrote:
  
  Whatever may have been our archaic notions about interest, in modern financial communities a dollar to-day is worth more than a dollar next year, and to ignore the interval as immaterial is to contradict well-settled beliefs about value. The present use of my money is itself a thing of value, and, if I get no compensation for its loss, my remedy does not altogether right my wrong.

  Id. at 166.
\item \textsuperscript{3} See James D. Wilson et al., \textit{Prejudgment Interest in Personal Injury, Wrongful Death and Other Actions}, 30 TRIAL LAW. GUIDE 105, 114-17, 136-94 (1986) (surveying the law on prejudgment interest and noting that at least 32 states permitted or required payment of prejudgment interest on personal injury or wrongful death actions in 1986, while most states that did not allow prejudgment interest on such claims nonetheless allowed it for pecuniary losses).
\item \textsuperscript{4} See 1 DAN B. DOBBS, DOBBS LAW OF REMEDIES: DAMAGES, EQUITY, RESTITUTION § 3.6(1), at 335 (2d ed. 1993).
\end{itemize}
supertanker, *Amoco Cadiz*, off the coast of Brittany in 1978. Even when the legal resolution occurs quickly, the interest can be large when the judgment is large, especially when interest rates are high. Moreover, because of the effect of compounding, even small differences in interest rates can have large effects on the final award. For example, in *Amoco Cadiz*, a one percent difference in the interest rate (100 basis points) would have changed the final award by $20 million. For these reasons, the methods courts use to calculate prejudgment interest are of much practical significance.

The calculation of prejudgment interest is also of theoretical importance. Prejudgment interest plays an important role in promoting fairness and efficiency. Fairness generally requires that the successful plaintiff be fully compensated for its losses and that the defendant pay this amount.

5. *See In re Oil Spill by the Amoco Cadiz off the Coast of France on Mar. 16, 1978, 954 F.2d 1279, 1335 (7th Cir. 1992) (per curiam) [hereinafter *Amoco Cadiz*]. The supertanker *Amoco Cadiz* broke apart off the coast of Brittany, spilling most of its load of 220,000 tons of oil into the sea. The wreck, one of the largest oil spills in history and more than six times the size of the Exxon Valdez spill, damaged nearly 200 miles of coast and took more than six months and 340 million French francs to clean up. *Id.* at 1285; *see* Charles McCoy, *Alaska Spill Found Less Damaging Than Was Feared*, WALL ST. J., May 12, 1989, at A4 (stating that the *Exxon Valdez* spilled 11 million gallons of oil); *Amoco Corp.*, WALL ST. J., Jan. 27, 1992, at B4 (stating that the *Amoco Cadiz* spilled 68 million gallons of oil). Using the exchange rate on January 4, 1992 (0.18988), the date the Seventh Circuit issued its opinion, an award of 340 million francs is worth $64.593 million. *See Exchange Rates: Friday, January 3, 1992, WALL ST. J., Jan. 6, 1992, at C12; Amoco Cadiz, 954 F.2d at 1330.* The conversion of that award from francs into dollars is discussed in subpart VI(F), infra. An additional $20 million plus interest was awarded to the owner of the cargo. *Amoco Cadiz, 954 F.2d at 1330.* The award for the lost cargo and the prejudgment interest on it are not discussed further in this Article.

6. Throughout this Article, I will assume an original judgment of $65 million, *see supra* text accompanying note 5; a prejudgment period of 10.6 years, *see infra* note 66 and accompanying text, and an interest rate of 11.85%, *see infra* note 61 and accompanying text. The multiplier (which represents the interest rate compounded for 10.6 years), total award, and interest component, assuming interest rates of 10.85%, 11.85%, and 12.85%, are given in the following table:

<table>
<thead>
<tr>
<th>Interest Rate (%)</th>
<th>Multiplier</th>
<th>Total Award ($ millions)</th>
<th>Interest Component ($ millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.85</td>
<td>2.9799</td>
<td>193.692</td>
<td>128.692</td>
</tr>
<tr>
<td>11.85</td>
<td>3.2775</td>
<td>213.037</td>
<td>148.037</td>
</tr>
<tr>
<td>12.85</td>
<td>3.6018</td>
<td>234.115</td>
<td>169.115</td>
</tr>
</tbody>
</table>

As the above table indicates, a 1% reduction in the interest rate would have reduced the interest component of the award by $19 million, whereas a 1% increase would have raised it by $21 million. These very large differences, around 14% of the interest component, stem from interest compounding, which is discussed in subpart II(A), infra.

Because excess funds can be lent at interest and funds can be borrowed only by paying interest, unless interest is assessed on the original judgment the successful plaintiff is not fully compensated and the losing defendant is unjustly enriched. The payment of prejudgment interest, therefore, ensures that the plaintiff receives full compensation for its losses and that the defendant pays the full penalty, thereby putting both parties in the same position that they would have been in if the judgment had been paid immediately.

Prejudgment interest also has an efficiency rationale, promoting efficiency in two ways. First, because prejudgment interest is an element of full compensation, it plays a role in ensuring that prospective parties have the appropriate incentives to take precautions when engaging in the same activity that produced the judgment. Efficiency generally requires that victims receive full compensatory damages and that injurers pay this amount. Accordingly, because compensation is incomplete without prejudgment interest, prospective defendants will be underdeterred and will take too few precautions, whereas prospective plaintiffs will be over-deterred and will take excessive precautions. Thus, prejudgment interest helps ensure that prospective parties undertake the efficient levels of precautions.

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8. See General Motors Corp. v. Devex Corp., 461 U.S. 648, 655-56 (1983) (stating that prejudgment interest is necessary to place the patent owner in its rightful position); Funkhouser v. J.B. Preston Co., 290 U.S. 163, 168 (1933) (stating that the plaintiff is "not fully compensated if he is confined to the amount found to be recoverable as of the time of breach," with nothing added for delay); Procter & Gamble Distrib. Co. v. Sherman, 2 F.2d 165, 166 (S.D.N.Y. 1924) (L. Hand, J.) ("The present use of my money is itself a thing of value, and, if I get no compensation for its loss, my remedy does not altogether right my wrong.").

9. See Amoco Cadiz, 954 F.2d at 1332 ("An injurer allowed to keep the return on [the money owed to the plaintiff] has profited by the wrong."); Federal Deposit Ins. Corp. v. British-American Corp., 755 F. Supp. 1314, 1328 (E.D.N.C. 1991) ("Awarding prejudgment interest in this case does not penalize defendants, but rather puts each party in the same position it would now be in had the fraudulent transfer never occurred.").

10. See In re Pago Pago Aircrash of Jan. 30, 1974, 525 F. Supp. 1007 (C.D. Cal. 1981). The court provided the following justification for awarding prejudgment interest: An individual who must litigate to recover damages should be placed in the same position, when he recovers, as the individual who recovered the day he suffered an injury. Otherwise, the tortfeasor benefits from denying liability and continuing to litigate, while he reaps the use of money to which the plaintiff is entitled, and the plaintiff is deprived of the benefit he should have derived from an immediate recovery. Id. at 1014.


Second, if there were no provision for prejudgment interest, defendants would have a powerful incentive to stretch out litigation.\textsuperscript{13} Delays in judgment would effectively provide the defendant with an interest free loan from the plaintiff until the judgment is rendered. Because the defendant could not otherwise borrow money without paying interest, the defendant would benefit at the plaintiff's expense by stretching out litigation.\textsuperscript{14} With interest at a market rate, neither party would benefit from nor be injured by delay in this respect.\textsuperscript{15} Thus, awarding prejudgment interest reduces the defendant's incentive to delay judgment.\textsuperscript{16}

Nonetheless, the requirement that a losing defendant pay prejudgment interest to a successful plaintiff remains far from universal.\textsuperscript{17} Although a growing number of jurisdictions recognize a successful plaintiff's entitlement to prejudgment interest,\textsuperscript{18} other jurisdictions expressly bar recovery.\textsuperscript{19} Still other courts and statutes leave it to the discretion of the court whether to provide prejudgment interest.\textsuperscript{20} Frequently, within a jurisdiction, the availability of prejudgment interest depends on the source of the claim and the nature of the injury. For example, in California a successful plaintiff whose claim is for a certain amount (liquidated) or an amount capable of being made certain by calculation (clearly ascertainable) is entitled to prejudgment interest.\textsuperscript{21} In addition, a plaintiff whose damages are neither liquidated nor clearly ascertainable may be awarded

\textsuperscript{13} See Wilson et al., supra note 3, at 110 ("The longer the delay, the longer defendants or their [insurance] carriers are allowed to hold monies long due plaintiffs and compound the interest earned on those monies."); Recent Developments—Prejudgment Interest as Damages: New Application of an Old Theory, 15 STAN. L. REV. 107, 111 (1962) [hereinafter Recent Developments] (arguing in favor of prejudgment interest awards to "discourage defendant's use of 'the law's delay' as an instrument of coercion").

\textsuperscript{14} See Henderson, supra note 12, at 775-76 (contending that the failure to require prejudgment interest discourages settlement offers).

\textsuperscript{15} There are other incentives not to stretch out litigation, most notably the legal costs that are incurred.


\textsuperscript{17} See Wilson et al., supra note 3, at 136-94 (surveying state and federal law on prejudgment interest).


\textsuperscript{19} See id. at 199-200 (stating that a good example of "the traditional approach" is Illinois, where the courts provide prejudgment interest only when expressly provided by contract or in one of the few situations expressly enumerated by statute).

\textsuperscript{20} See id. at 204. This tripartite division in the treatment of prejudgment interest—allowed as a matter of right, left to the discretion of the court, or denied absolutely—has long existed. See Note, Developments in the Law: Damages—1945-47, 61 HARV. L. REV. 113, 136 (1947).

\textsuperscript{21} See CAL. CIV. CODE § 3287(a) (West 1996) ("Every person who is entitled to recover damages certain, or capable of being made certain by calculation, and the right to recover which is vested in him upon a particular day, is entitled also to recover interest thereon from that day . . . .").
Similarly, under federal law the availability of prejudgment interest appears to depend not only on the relevant statute, but also often on the court in which the claim is filed.

Commentators trace the lingering reluctance of legislatures and courts to provide prevailing plaintiffs with prejudgment interest to an ancient hostility towards interest. Interest was long seen as a means of punishing an egregious defendant rather than compensating a successful plaintiff. That view led to the common-law rule that prejudgment interest was allowed for liquidated claims, but not for unliquidated ones. The logic was that only defendants who could determine exactly what they owed could improperly withhold payment. That distinction between liquidated and unliquidated damages has been widely rejected; prejudgment interest is now widely considered necessary to provide prevailing plaintiffs with prejudgment interest to an ancient and medieval prejudices against the charging of interest. Similarly, under federal law the availability of prejudgment interest generally depends on both the federal statute and the forum; as between cases of liquidated and unliquidated damages, is not a sound one.

The logic was that only defendants who could determine exactly what they owed could improperly withhold payment. That distinction between liquidated and unliquidated damages has been widely rejected; prejudgment interest is now widely considered necessary to ensure full compensation to the plaintiff and to prevent unjust enrichment of the defendant.

22. See id. § 3287(b) ("Every person who is entitled under any judgment to receive damages based upon a cause of action in contract where the claim was unliquidated, may also recover interest . . . ."); id. § 3288 ("In an action for the breach of an obligation not arising from contract, and in every case of oppression, fraud or malice, interest may be given in the discretion of the jury."). The distinction between ascertainable and unascertainable damages has been rejected in many jurisdictions. See Funkhouser v. J.B. Preston Co., 290 U.S. 163, 168 (1933) ("[A] distinction, in this respect, simply as between cases of liquidated and unliquidated damages, is not a sound one."); 1 Dobbs, supra note 4, § 3.6(2), at 341 (pointing to courts' and legislators' "liberalization" of the "ascertainable" standard as an implicit rejection of the limitation).

23. See Michael K. Brown, The Availability of Prejudgment Interest in Personal Injury and Wrongful Death Cases, 16 U.S.P. L. REV. 325, 337 (1982) ("The availability of prejudgment interest in personal injury or wrongful death actions brought under a federal statute depends upon the statute involved as well as upon the forum . . . ."); J.A. Bock, Annotation, Recovery of Prejudgment Interest on Wrongful Death Damages, 96 A.L.R.2d 1104, 1107 (1964) (stating that the allowance of prejudgment interest generally depends on both the federal statute and the forum); see also Alan R. Gilbert, Annotation, Award of Prejudgment Interest in Admiralty Suits, 34 A.L.R. Fed. 126, 228-43 (1977) (surveying the disagreement among courts as to the propriety of awarding prejudgment interest under various federal statutes for wrongful death and personal injury causes of action in admiralty).

24. See Martin Oyos, Note, Prejudgment Interest in South Dakota, 33 S.D. L. REV. 484, 485-88 (1988) (providing a historical overview of prejudgment interest in South Dakota from ancient times to the present); see also John C. Kair & Robin C. Kair, Opportunity Cost: A Measure of Prejudgment Interest, 39 BUS. LAW. 129, 131 (1983) (stating that the "ancient and medieval prejudices against the charging of interest" affect the current treatment of prejudgment interest). However, the recognition that prejudgment interest is a necessary part of restitution is ancient, even in cultures that otherwise prohibited interest. For example, primitive versions of prejudgment interest were awarded when fruit or seeds were taken to be planted; the successful claimant received a share of the resulting increase. See 1 Fritz M. Heichelheim, An Ancient Economic History 104 (Joyce Stevens trans., 1958).

25. See Rothschild, supra note 18, at 196.

26. See Oyos, supra note 24, at 487; Rothschild, supra note 18, at 196.


28. See Recent Developments, supra note 13, at 107-10; H. Deane Wigg, Comment, Prejudgment Interest: Too Little, Too Much, or Both?, 10 UCLA-ALASKA L. REV. 219, 221-23 (1981) (declaring that one rationale for awarding prejudgment interest "is [to compensate] the plaintiff's loss of the use
Accordingly, the trend is towards awarding prejudgment interest on all monetary awards.\textsuperscript{29} Nonetheless, there has been little movement to improve how prejudgment interest is calculated.\textsuperscript{30} Fairness and efficiency do not merely require that prejudgment interest be assessed;\textsuperscript{31} they require that it be assessed correctly.\textsuperscript{32} Correctly calculating prejudgment interest requires the proper use of financial principles.

In many jurisdictions, however, the correct calculation of prejudgment interest is prevented by a statute that requires the selection of an improper interest rate or the use of a conceptually wrong computational method.\textsuperscript{33} Even when a statute does not require an incorrect calculation, courts often do a poor job of calculating prejudgment interest, thereby undercutting the goals of fairness and efficiency. For example, some jurisdictions have adopted by common law the statutory, fixed postjudgment interest rate as the prejudgment interest rate\textsuperscript{34} or award simple interest.\textsuperscript{35}

In still other jurisdictions, trial court judges have wide discretion in setting an interest rate and calculating prejudgment interest. Under federal law, for example, courts have significant discretion in determining how


\textsuperscript{30} See \textit{infra} note 47.

\textsuperscript{31} A rule that prohibits the award of prejudgment interest, such as the common law rule that prejudgment interest is not recoverable on amounts that are neither liquidated nor ascertained by fixed standards, is both unfair and inefficient. \textit{See infra} subpart VI(A).

\textsuperscript{32} As the Seventh Circuit asked rhetorically in \textit{Amoco Cadiz}, "[W]hat is the point of computing the principal amount of damages in intricate detail if the judge may turn around and increase (or reduce) the value of that award by a factor of three on the basis of vague equitable concerns?" \textit{Amoco Cadiz}, 954 F.2d 1279, 1334 (7th Cir. 1992).

\textsuperscript{33} \textit{See infra} subpart VI(G).

\textsuperscript{34} Hawaii and Texas have each adopted their statutory, fixed, postjudgment rate as the prejudgment rate. \textit{See} Wong, supra note 28, at 226 n.38 (citing Lucas v. Liggett & Myers Tobacco Co., 461 P.2d 140, 144 (Haw. 1969)); Sergesketter, supra note 27, at 250-53 (discussing Cavnar v. Quality Control Parking, Inc., 696 S.W.2d 549, 554 (Tex. 1985)). Texas, however, has recently adopted a modified version of the Treasury bill rate by statute. \textit{Tex. Rev. Civ. Stat. Ann.} art. 5069-1.05, \S 2, \S 6(g) (Vernon Supp. 1997).

\textsuperscript{35} \textit{See} Big Bear Properties, Inc. v. Sherman, 157 Cal. Rptr. 443, 446-47 (Cal. Ct. App. 1979); State v. Day, 173 P.2d 399, 410 (Cal. Ct. App. 1946) (noting the general rule that interest may not be compounded unless statutory provisions provide otherwise or the parties have stipulated to an amount of compound interest that does not violate any statutory provision); \textit{see also} Landals v. George A. Rolfea Co., 454 N.W.2d 891, 896 (Iowa 1990); Shaefter v. Kelton, 619 P.2d 1226, 1231 (N.M. 1980); Papadopoulos v. Oregon State Bd. of Higher Educ., 617 P.2d 931, 934 (Or. Ct. App. 1980); Spang & Co. v. USX Corp., 599 A.2d 978, 984 (Pa. Super. Ct. 1991); Tri-State Ref. & Inv. Co. v. Apaloosa Co., 431 N.W.2d 311, 316-17 (S.D. 1988) (all interpreting statutes as requiring that the accumulation of prejudgment interest be calculated as simple interest). The most common incorrect computational method required by statute or adopted by courts is to grant simple interest. \textit{See infra} subpart II(A).
prejudgment interest is calculated. That discretion has been broadly exercised, seriously undercutting the law’s goals of compensating victims and deterring wrongdoers.\textsuperscript{36}

A good example of this phenomenon occurs in successful patent infringement suits. Thanks to a strong statement by the U.S. Supreme Court, awarding prejudgment interest is the rule in patent infringement suits.\textsuperscript{37} However, the courts have provided much less guidance on how that interest should be calculated. A recent commentator on the patent decisions of the Federal Circuit, in describing the methods used to calculate prejudgment interest, observed that “the recent cases indicate appellate approval of almost unfettered discretion in the district courts. No reported cases have reversed district judges in their decisions on these points.”\textsuperscript{38} The range of methodologies approved in patent cases is especially troubling\textsuperscript{39} because the rationale for unifying patent appeals within the Federal Circuit was to harmonize their treatment.\textsuperscript{40}

This wide range of discretion, common with equitable remedies, is unusual with money judgments at law.\textsuperscript{41} The usual explanation for the persistence of so much discretion is that courts and legislatures have yet to formulate the proper rules for calculating prejudgment interest.\textsuperscript{42} They have not been helped by commentators.\textsuperscript{43} In spite of the important role that prejudgment interest plays in the administration of justice, the

\textsuperscript{36} Cf. Christopher P. Bowers, Comment, \textit{Courts, Contracts, and the Appropriate Discount Rate: A Quick Fix for the Legal Lottery}, 63 U. Chi. L. Rev. 1099 (1996) (describing the case law setting the appropriate rate to discount future damages as inconsistent and in disarray and proposing that courts adopt a uniform market peg).

\textsuperscript{37} See General Motors Corp. v. Devex Corp., 461 U.S. 648, 655 (1983) (“[P]rejudgment interest should ordinarily be awarded.”). The patent statute authorizes the award of interest, even though it is not very clear. 35 U.S.C. § 284 (1994) (“[T]he court shall award the claimant damages adequate to compensate for the infringement, but in no event less than a reasonable royalty for the use made of the invention by the infringer, together with interest and costs as fixed by the court.”).


\textsuperscript{39} For an example of the approval of inconsistent methodologies by the Federal Circuit, see infra note 80.


\textsuperscript{41} See 1 DOBBS, supra note 4, § 3.6(5), at 360-61.

\textsuperscript{42} See id.; CHARLES T. MCCORMICK, HANDBOOK ON THE LAW OF DAMAGES § 51, at 210-11 (1935); 1 THEODORE SEDGWICK, A TREATISE ON THE MEASURE OF DAMAGES § 297, at 567-68 (9th ed. 1912); see also Brown, supra note 23, at 331 (criticizing the broad language of California Civil Code § 3288, which fails to provide guidelines governing a jury’s discretionary award of prejudgment interest under that statute).

\textsuperscript{43} See Lony N. Hoffman, \textit{Recovery and Calculation of Prejudgment Interest Under Texas Law}, 35 S. Tex. L. Rev. 439, 440 (1994) (“Blame for the systematic deficiencies [regarding the calculation of prejudgment interest] can be shared equally by courts and commentators alike, who have devoted only scant attention to the subject.”).
scholarly literature is limited. What literature there is mostly addresses the implications for litigation and settlement of a rule that awards prejudgment interest compared to one that does not. Discussion of the various methods that could be used to calculate prejudgment interest in the legal literature is nearly absent; that literature consists primarily of contradictory court opinions. Yet most opinions give the issue of prejudgment interest little attention. As the Court of Federal Claims recently stated, "A generally-agreed, standard, objective method of fixing delay damages [prejudgment interest] . . . is sorely needed." Accordingly, this Article seeks to fill that gap by providing more guidance than is currently available for the calculation of prejudgment interest.

This Article describes how prejudgment interest should be calculated, and if its advice is followed, it will curtail, but not eliminate, discretion. One of the themes that emerges is that there is not likely to be an

44. See, e.g., Porrier, supra note 11, at 558-59 (arguing that prejudgment interest discourages settlement by increasing the stake); Hans Zemel et al., Delay in the Court 133-36 (1959) (arguing that prejudgment interest does not discourage settlement); Ronald J. Gilson & Robert H. Mnookin, Disputing Through Agents: Cooperation and Conflict Between Lawyers in Litigation, 94 Colum. L. Rev. 509, 535-36 (1994) (arguing that as the difference between the market interest rate and the prejudgment interest rate increases, the parties are less likely to act cooperatively); Miller, supra note 16, at 567 (proposing that prejudgment interest both discourages settlement by increasing the stakes and encourages settlement by reducing defendant's incentive to delay); George L. Priest, Private Litigants and the Court Congestion Problem, 69 B.U. L. Rev. 527, 539 (1989) (proposing that prejudgment interest discourages settlement by significantly increasing the cost of settlement).

45. I could find only five such articles—Franklin M. Fisher & R. Craig Romaine, Janis Joplin's Yearbook and the Theory of Damages, 51 Acct. Auditing & Fin. 145 (1990); Keir & Keir, supra note 24; R.F. Lanziolotti & A.K. Esquivel, Measuring Damages in Commercial Litigation: Present Value of Lost Opportunities, 5 J. Acct. Auditing & Fin. 125 (1990); James M. Patell et al., Accumulating Damages in Litigation: The Roles of Uncertainty and Interest Rates, 11 J. Legal Stud. 341 (1982); and Wong, supra note 28. In addition to these articles and the articles cited in footnote 44, the scholarly literature consists mostly of notes arguing that prejudgment interest should be more widely available in the author's home state or in a particular substantive area of the law. See, e.g., Hoffman, supra note 43, at 454-55 (1994) (proposing a statute to expand the availability of prejudgment interest to more instances than are currently available in Texas).

46. See Hoffman, supra note 43, at 440 ("[E]very lawyer who has struggled with calculating the correct measure of interest recovery . . . laments the labyrinthine pathways of the rules."); see also 1 Doebb, supra note 4, § 3.6, at 333-64 (reviewing the case law relating to the calculation of prejudgment interest).

47. See Keir & Keir, supra note 24, at 131-32 (stating that most courts ignore prejudgment interest or treat it perfunctorily). As the Supreme Court of Wisconsin wrote, nearly 100 years ago:

Laycock v. Parker, 79 N.W. 327, 332 (Wis. 1899). Those words could have been written today. See Nelson v. Travelers Ins. Co., 306 N.W.2d 71, 75 (Wis. 1981) ("With some exceptions, these observations could be made with equal pertinence today . . . .").

observable market interest rate that can be identified in each case as the absolutely correct rate to use. The law will have to be content with proxies and with adjustments that are only approximations. Even so, these proxies and adjustments are constrained by financial principles. Setting out these limits will, I hope, assist not only judges in assessing prejudgment interest but, in addition, should aid lawyers in framing their arguments and legislators in writing the statutes that provide for interest on judgments.50

I. The Problem

Prejudgment interest is assessed in order to place the parties in the same position they would have been in had the defendant paid the plaintiff an amount equal to the original judgment when the injury occurred.51 Thus, in order to compensate the plaintiff and prevent the defendant from profiting from the delay, the law requires that the injurer pay interest on the original judgment as would be required in a voluntary transaction.52 A clear statement of the rationale for awarding prejudgment interest was recently made by the Seventh Circuit using as an example the costs incurred by French plaintiffs to clean up the Brittany coast following the Amoco Cadiz oil spill:

[C]onsider what would have happened if the French parties had borrowed $60 million to finance the cleanup in April 1978, and Amoco had put that sum in trust to fund an award of damages . . . . The victims would have had to pay the market rate of interest . . . . If they arranged to repay the debt in a single balloon payment at the end (when they recouped from Amoco), and if the rate of interest averaged 12%, then by April 1991 the victims would owe their creditors $262 million. Meanwhile the trust fund, lending out its assets at the market rate of 12%, would have grown to $262 million. Scores would be fully settled if Amoco tendered its interest in the

49. These calculations are sometimes made by special masters, see, e.g., Amoco Cadiz, 954 F.2d 1279, 1330 (7th Cir. 1992), and by juries, see, e.g., CAL. CIV. CODE § 3288 (West 1996) (“In an action for the breach of an obligation not arising from contract . . . interest may be given, in the discretion of the jury.”).
50. Statutory reforms are discussed briefly infra subpart VI(G).
51. See supra text accompanying notes 7-10.
52. General Motors Corp. v. Devex Corp., 461 U.S. 648, 657 (1983) (holding that prejudgment interest should be awarded absent justification for withholding such an award). As the Supreme Court stated in that case, a patent infringement suit:
In the typical case an award of prejudgment interest is necessary to ensure that the patent owner is placed in as good a position as he would have been in had the infringer entered into a reasonable royalty agreement. An award of interest from the time that the royalty payments would have been received merely serves to make the patent owner whole, since his damages consist not only of the value of the royalty payments but also of the foregone use of the money between the time of infringement and the date of the judgment.
Id. at 655-56.
fund: it would thus "pay" $60 million as of 1978, and the victims would receive $60 million as of 1978; the lenders who financed the cleanup would receive full payment for the use of their money. (We use these dates and rate only as illustrations; the periods and rates actually used in this case differ. We also disregard taxes.)

Victims who finance their own cleanup lend to themselves; forced to devote money to a project not of their own choosing (money they otherwise could have lent out at the market rate of interest), they are entitled to compensation for the "hire" of this capital. Tortfeasors who choose to reinvest their money in their business (as Amoco has done) rather than create a trust fund . . . are in no position to complain when called on to pay prejudgment interest. An injurer allowed to keep the return on this money has profited by the wrong.53

As described by the Seventh Circuit, the court's role is to assess a final judgment that places the parties in the same position they would now be in had the original judgment been paid immediately. Financial economists call that amount the future value of the original judgment, the amount the original judgment would have grown into over the interim. Accordingly, the final judgment must equal this future value. The general formula for the future value of the original judgment, $FV$, is

$$FV = J(1+\frac{r_1}{n})(1+\frac{r_2}{n}) \cdots (1+\frac{r_i}{n}) \cdots (1+\frac{r_n}{n}) \cdots (1+\frac{r_T}{n}),$$

(1)

where $J$ is the original judgment, $r_i$ is the (annual) interest rate for period $i$, $n$ is the number of compounding periods in a year, and $T$ is the time in years between the injury and the issuance of an enforceable judgment.54 The full amount the court should award is $FV$, with prejudgment interest, $I$, equal to the difference between $FV$ and $J$. Each of the individual terms of the form $(1+r_i/n)$ is called a forward factor. The ith forward factor is the amount that $1$ at the beginning of period $i$ will grow to by the end of period $i$.

Courts rarely calculate the final award using equation (1) directly. Instead, the final award is most often assessed by first calculating a multiplier (denoted by $m$), which when applied to the original judgment produces the final judgment:

$$FV = J \times m.$$

(2)

53. *Amoco Cadiz*, 954 F.2d at 1331-32 (citations omitted).

54. Thus, $nT$ is the number of compounding periods between the injury and the judgment. The reason for separating $n$ and $T$ is that the choice of compounding period is conceptually distinct from the length of the prejudgment period. See infra subparts IV(A) and VI(A).
Thus, once it has determined liability and assessed the original judgment, the court's role in assessing prejudgment interest can be reduced to setting the multiplier, \( m \).

To correctly set the multiplier, the court must either use or estimate the proper forward factors over the prejudgment period.\(^{55}\) This is most commonly done by finding an interest-rate index to use as a proxy for the true rate and then selecting a single interest rate, \( r_m \), that is an appropriately calculated mean of that rate over the prejudgment period.\(^{56}\) Thus, the multiplier is commonly calculated as follows:

\[
m = (1 + \frac{r_m}{n})^T.
\]

Setting the multiplier entails three tasks.\(^ {57}\) First, the court, as its most difficult task, sets the interest rate for the prejudgment period, \( r_m \).\(^ {58}\) Second, the court determines the length of the prejudgment period, \( T \).\(^ {59}\) Third, the court calculates the number of compounding periods in a year, \( n \). Although this last task might seem trivial, surprisingly, it is often performed incorrectly, resulting in substantial miscalculations of interest.\(^ {60}\)

The final award to the French plaintiffs in \textit{Amoco Cadiz} was calculated in this way, using equations (2) and (3). The court accepted the plaintiff's claim that it should set \( r_m \) equal to the average prime rate over the 1980s\(^ {61}\) and implicitly set \( n \) equal to one.\(^ {62}\) The court next calculated the length of the prejudgment period in years. The prejudgment period did not begin when the spill occurred,\(^ {63}\) but instead began on January 1, 1980.\(^ {64}\) It ended July 24, 1990, when the district court adopted the special master's

\(^{55}\) The formula for the prejudgment interest, \( I \), is

\[
I = J \times (m - 1).
\]

\(^{56}\) Alternative methods of calculating the mean interest rate are discussed \textit{infra} subpart VI(C).

\(^{57}\) Equations (2) and (3) together imply that the full award calculated at this constant rate over the prejudgment period is given by

\[
FV = J \times (1 + \frac{r_m}{n})^T.
\]

\(^{58}\) The interest rate is discussed \textit{infra} subparts II(B), II(C), IV(B), IV(D), VI(D), VI(F) and Parts III, V.

\(^{59}\) The prejudgment period is discussed \textit{infra} subpart VI(B).

\(^{60}\) The compounding period is discussed \textit{infra} subpart IV(A).

\(^{61}\) The arithmetic mean prime rate over the 1980s calculated to four decimal places is 11.85%.

The court adopted the plaintiff's proposed rate of 11.9%, the arithmetic mean calculated to three decimal places. \textit{See infra} note 339.

\(^{62}\) \textit{Id.}

\(^{63}\) The spill occurred on March 16, 1978. \textit{Amoco Cadiz}, 954 F.2d at 1331.

\(^{64}\) \textit{Id.} at 1337.
recommendations and issued its final report.\textsuperscript{65} Expressed in years, the prejudgment period is 10.5616 years, which I will round to 10.6 years.\textsuperscript{66} Setting $r_m=11.85\%$, $n=1$, and $T=10.6$, the multiplier, using equation (3), is $3.2775$.\textsuperscript{67} The final award, which is calculated using equation (2), is the product of the original judgment and the multiplier. Valuing the original judgment at $65$ million implies a final award of $213.037$ million.

In the pages that follow, I use the calculation of the multiplier in \textit{Amoco Cadiz} to illustrate the proper calculation of prejudgment interest. On the whole, the Seventh Circuit did a good job with prejudgment interest, and its opinion in \textit{Amoco Cadiz} is among the most sophisticated opinions on that subject written by any court. Yet, there are alternative values for $r_m$, $n$, and $T$ that produce final awards that are more consistent with the law's goals of compensating the French plaintiffs and preventing Amoco from being unjustly enriched but are not excessive.

The rest of this Article is divided into six Parts. Part II discusses the basic requirements that an award of prejudgment interest should meet. Part III describes how to set the interest rate consistent with those requirements. Part IV describes various adjustments to the multiplier. Part V addresses the choice of interest rate when there are special circumstances, and Part VI discusses issues regarding the calculation of prejudgment interest not addressed elsewhere. Part VII presents the conclusion, which is followed by an appendix that calculates the alternative \textit{Amoco Cadiz} awards presented throughout this Article.

\section*{II. Basic Principles of Prejudgment Interest}

This Part describes the basic principles that should be used to calculate prejudgment interest, leaving the more technical issues for later. The paradigm employed in this Article is a suit between two publicly traded corporations with ready access to the capital markets.\textsuperscript{68} These corporations can raise funds, if necessary, to compensate for the funds denied to them by delay.\textsuperscript{69} The stockholders are assumed to hold diversified investment portfolios, so little of their wealth is tied up in the litigating corporations.\textsuperscript{70} The specific problems raised when individuals and close

\begin{footnotesize}
\begin{itemize}
\item 65. \textit{Id.} at 1290.
\item 66. July 24 is the 205th day of the year (for a nonleap-year). Thus, 56.16\% of 1990 took place through July 24. Hence, the prejudgment period is 10.5616 years.
\item 67. This multiplier is less than 2\% smaller than the multiplier set by the court—3.3162. \textit{Amoco Cadiz}, 954 F.2d at 1335. I was unable to produce the court's multiplier using the interest rate, dates, and methods described by the court.
\item 68. The same logic applies to government entities that can easily access the capital markets.
\item 69. The corporations can also invest any excess funds. That, however, can be done by any investor.
\item 70. The stockholders are not assumed to own equal portions of each corporation, which would mean whatever they lost on one holding they would gain on the other. However, even if that were the
\end{itemize}
\end{footnotesize}
corporations are parties are addressed later. The principal conclusions reached in this Part are that prejudgment interest should be compounded, that the interest rate should correspond to the interest rate the defendant pays, or can pay, for unsecured debt, and that prejudgment interest should be assessed at a floating rate.

A. Simple Versus Compound Interest

One of the most frequently contested issues involving prejudgment interest is whether the court should award simple or compound interest. With simple interest, the interest is calculated each period on the original base amount. Thus, ten percent simple interest on $1 million will produce $100,000 every year. With compound interest, the interest is calculated each period by adding to the last period's ending base the interest calculated over that period. Thus, in the first year, ten percent compound interest on a $1 million base will produce $100,000 interest, which is added to the base (reinvested), giving a base at the beginning of the second year of $1.1 million. In the second year, there is $110,000 interest, ten percent of $1.1 million, and in the third year $121,000 interest, ten percent of $1.21 million. As long as interest accrues, annual interest will increase by ten percent each year. As this example illustrates, the difference between compound and simple interest is that with the former, interest earned in the past generates current interest, whereas with the latter, past interest never generates current interest. Obviously, compound interest will produce a larger award than simple interest at the same rate.

The traditional, common-law rule is that prejudgment interest is not compounded. Even some state statutes that have otherwise liberalized the traditional rules on prejudgment interest still insist on simple

71. See infra subpart V(B).
72. See Rothschild, supra note 18, at 217 ("The most frequently litigated interest issues in breach of trust cases are whether to award simple or compound interest and at what rate interest should apply.").
74. See id.
75. There are two technical exceptions of no practical importance. First, simple and compound interest will produce the same award when the interest rate is always zero, because there is no interest. Second, simple interest can exceed compound interest when interest rates are negative. Stated interest rates, however, are never negative because one cannot earn zero interest by holding cash. In practice, nominal rates are greater than zero, so these two exceptions are irrelevant.
76. See RESTATEMENT (SECOND) OF CONTRACTS § 354 cmt. a (1981); 1 DOBBS, supra note 4, § 3.6(4), at 353 & n.7. It is also the rule in the United Kingdom. See La Pintada Compania Navegacion S.A. v. President of India, [1984] 2 Lloyd's Rep. 9, 17.
interest. When there is no specific statutory provision, courts are divided on whether interest should be compounded. California, for example, awards simple interest. That appears to be the majority rule. Under federal law, the decision whether to award simple or compound interest is left to the discretion of the court.

Conceptually, the proper way to calculate prejudgment interest is to use the compound interest formulation. Compound interest is required because prejudgment interest is not paid to the plaintiff as it accrues, but is retained by the defendant until the judgment is enforced. Thus, each period the defendant's obligation to the plaintiff increases. Compound interest accounts for this effect, as can be seen in equation (1).

The award of compound interest is also consistent with commercial practices. Although some commercial contracts call for simple interest, these are almost exclusively short-term contracts of known duration.

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77. See MINN. STAT. § 549.09(1)(c) (1996); TEX. REV. CIV. STAT. ANN. art. 5069-1.05 § 6(g) (Vernon Supp. 1996); N.J. R. Ct. 4:42-11(b); 1 DOBBS, supra note 4, § 3.6(4), at 353.

78. See BigBear Properties, Inc. v. Gherman, 157 Cal. Rptr. 443, 446-47 (Cal. Ct. App. 1979); State v. Day, 173 P.2d 399, 410 (Cal. Ct. App. 1946) (noting the general rule that interest may not be compounded unless statutory provisions provide otherwise or the parties have stipulated to an amount of compound interest that does not violate any statutory provision).

79. See 1 DOBBS, supra note 4, § 3.6(4), at 354.

80. See Bio-Rad Lab., Inc. v. Nicolet Instrumental Corp., 807 F.2d 964, 969 (Fed. Cir. 1986) (stating that whether prejudgment interest should be simple or compound is left to the discretion of the district court).

81. If prejudgment interest were paid to the plaintiff as it accrued, the plaintiff would still get the benefit of compounding because the interest received could be reinvested elsewhere, generating compound interest. See Rothschild, supra note 18, at 218; Patrick J. McDivitt, Comment, Pre-Judgment Interest as an Element of Damages: Proposed Solutions for a Colorado Problem, 49 U. COLO. L. REV. 335, 342-43 (1978). Conceptually, the proper treatment would be to compound interest and to reduce the base by any payment from the debtor to the creditor. This would be equivalent to simple interest only when all interest was paid as it accrued.

82. The corresponding version of equation (1) with simple interest would be

\[ FV = J\left(1 + \frac{r_1}{n} + \frac{r_2}{n} + ... + \frac{r_n}{n}\right) \]

Thus, the multiplier with simple interest, \( m_n \), would be

\[ m_n = 1 + \frac{r_n}{n} \]

which is smaller than the multiplier with compound interest, as given in equation (3), when \( r_n \) is positive.

83. See Sergeaketter, supra note 27, at 255-59; Wong, supra note 28, at 231-32 (both noting that financial institutions commonly compound interest). The recognition of this principle is the foundation upon which the tax treatment of explicit and implicit interest is based. See generally Peter C. Canellos & Edward D. Kleinbard, The Miracle of Compound Interest: Interest Deferral and Discount After 1982, 38 TAX L. REV. 565 (1983); Lawrence Lokken, The Time Value of Money Rules, 42 TAX L. REV. 1 (1986).

84. When a contract is of known duration, there is a unique effective interest rate that when compounded is equivalent to the stated simple interest rate.
Simple interest is almost never provided when there is no requirement to pay interest as it accrues and the loan is for an indefinite duration. Finally, fairness and efficiency require that interest be compounded. Simple interest unfairly favors the defendant. With simple interest, the plaintiff is not fully compensated and the defendant does not fully pay for the harm caused. As a result, simple interest underdeters the defendant and overdeters the plaintiff from engaging in the activity that produced the harm. In addition, simple interest encourages the defendant to drag on legal proceedings. Of all of the suggestions made in this Article, this one—that prejudgment interest be compounded—is likely to be, if not the most significant, at least one of the most significant, in terms of dollars. Returning to *Amoco Cadiz*, the total award would have been reduced by over $66 million had the court awarded simple as opposed to compound interest.

B. What Interest Rate? Defendant's Borrowing Cost

The conclusion that emerges from this subpart is that prejudgment interest should be calculated using the defendant's cost of borrowing. That a single rate can be used might seem counterintuitive: the prejudgment interest award is intended to both compensate the plaintiff for delay and to prevent the defendant from being unjustly enriched, yet the plaintiff and the defendant might have very different interest rates.

Because the fairness and efficiency goals of prejudgment interest concern both the plaintiff and the defendant, the most basic question in the

85. See Keir & Keir, supra note 24, at 145.

86. The multiplier, total award, and interest component of the award with both simple and compound interest, under the same assumptions as in note 6, are set out in the following table:

<table>
<thead>
<tr>
<th>Method of Calculating Interest</th>
<th>Multiplier</th>
<th>Total Award ($ millions)</th>
<th>Interest Component ($ millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple</td>
<td>2.2561</td>
<td>146.647</td>
<td>81.647</td>
</tr>
<tr>
<td>Compound</td>
<td>3.2775</td>
<td>213.037</td>
<td>148.037</td>
</tr>
</tbody>
</table>

As the above table indicates, the interest component of the award with compound interest is $66 million larger. Accordingly, if the court had accepted defendant's argument and assessed only simple interest, the interest award would have been cut by 45%.

I am indebted to Professor Bernard Black for this example. His excerpt from Judge Easterbrook’s per curiam opinion in *Amoco Cadiz* and the accompanying questions on prejudgment interest in his corporate finance materials, the latter of which I use several times, inspired me to write this Article.

87. The argument that prejudgment interest should be assessed using the defendant’s borrowing rate was first made by James M. Patell, Roman L. Weil, and Mark Wolfson. See Patell et al., supra note 45, at 342-46 (arguing that assessing prejudgment interest at defendant’s borrowing rate compensates the plaintiff for the risk of default by the defendant).

88. See Wong, supra note 28, at 222-23.
calculation of prejudgment interest is whose interest rate to use. Should the court look to the plaintiff or to the defendant? The answer to that question has the potential to affect the outcome substantially when the litigation involves parties with very different economic resources. A large, safe corporation with little debt and many tangible resources can borrow very cheaply in the capital markets. In contrast, a smaller, riskier corporation with a large amount of debt in its capital structure might not be able to borrow at all or only at a very high interest rate.

The solution is reasonably straightforward, and the key is determining what the judgment is intended to accomplish. If the judgment is intended to compensate the plaintiff or to prevent similarly situated parties from taking excessive precautions, then the court should look to the plaintiff. If, however, the judgment is intended to punish the defendant,\textsuperscript{89} to force the defendant to disgorge any profits it might have realized,\textsuperscript{90} or to encourage parties in circumstances similar to the defendant's to take proper precautions, then the court should look to the defendant.\textsuperscript{91} In some cases, this guidance will lead the court to arrive at an unambiguous decision to look either to the plaintiff or to the defendant. However, in other cases, the court will not be able to make a clear choice because the judgment might reasonably be both to compensate the plaintiff and to deter the defendant. Thus, there might not be a single correct interest rate to use.\textsuperscript{92} Fortunately, when the parties are both publicly traded corporations, the ambiguity disappears because the same interest rate should be used for both parties. Why this is so is described next. However, when one of the parties is an individual, it is unlikely that there will be a single correct interest rate to use.\textsuperscript{93}

\textsuperscript{89} In most jurisdictions and in most substantive areas of the law, prejudgment interest is not assessed on punitive damages. See 1 Dobbs, supra note 4, § 3.6(4), at 356.

\textsuperscript{90} "Restitution . . . is an award made to remedy unjust enrichment of the defendant . . . ." Id. § 3.6(2), at 343.

\textsuperscript{91} On the plaintiff's side, the purpose of the original award is to compensate the plaintiff and to prevent similarly situated parties from taking excessive or inefficient precautions. The purpose of prejudgment interest on that award is to ensure that the present value of the award is not reduced by delay so that the purpose behind the award is achieved. On the defendant's side, the purposes of the award might be to punish the defendant, to encourage similarly situated parties to take appropriate precautions, or to prevent the defendant's unjust enrichment. Similarly, the purpose of the award of prejudgment interest is to ensure that the present value of the award is not reduced so that the purpose of the original judgment is achieved. This Article uses the language of both purposes on the plaintiff's side and of all three purposes on the defendant's side for the original award. However, for the purpose of calculating prejudgment interest, nothing turns on which, if any, purpose the original award serves for either the plaintiff or the defendant.

\textsuperscript{92} In that event, if the party that is to receive payment has a lower discount rate than the party that is to pay, then either the payor will pay too much or the recipient will receive too little. The interest award will not be exactly right for both parties unless the government steps in and either makes up or collects the difference.

\textsuperscript{93} See infra subpart V(B).
That recognition—that if the judgment is to compensate the plaintiff, the court should calculate interest from the plaintiff’s perspective, whereas if the judgment is to prevent the defendant’s unjust enrichment, the court should look at it from the defendant’s perspective—is only the first step in the analysis. It does not answer the question of what interest rate to use. That question is easiest to answer when the judgment is to prevent the defendant’s unjust enrichment. As the excerpt from *Amoco Cadiz* suggests, the defendant’s decision not to pay the plaintiff earlier implies that it elected to borrow from the plaintiff. The defendant could have borrowed that money from outside sources at the time of the cleanup, paid the plaintiff then, and repaid the loan presently. Had it done so, it would have been in the same financial position in which it will find itself when it pays the plaintiff upon judgment. Thus, the loan from the plaintiff effectively replaces a loan from outside creditors. If the defendant knew what the ultimate judgment would be, such financing through the plaintiff would be attractive if prejudgment interest were calculated at a lower rate than its borrowing costs and unattractive if calculated at a higher rate. The defendant would be indifferent between the two alternatives only if the rates were identical. Hence, when the award prevents the defendant from being unjustly enriched by its actions, the defendant’s borrowing rate is the proper rate to use.

When the judgment is intended to compensate the plaintiff, which interest rate the court should use might seem more complicated. The plaintiff has unlimited investment opportunities. It could have invested the proceeds of immediate restitution in its own business, made investments in other businesses by purchasing stock or debt, or even made nonbusiness investments, such as purchasing U.S. Treasury securities or shares of common stock. Alternatively, the corporation could have distributed the proceeds to its shareholders, each one of whom would have invested or consumed the proceeds in a different way. There is no way to know what returns would have been realized.

Although we cannot possibly know how the plaintiff would have invested the proceeds had the plaintiff received them earlier, we do know how they actually were invested. They were advanced to the defendant corporation. We also know that in an efficient market, expected return

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94. See supra text accompanying notes 52-53.
95. See Keir & Keir, supra note 24, at 146-47; see also Oyos, supra note 24, at 509 (calling for prejudgment interest at the rate of return generally available to investors without describing how to set that rate).
96. After all, the defendant does not distribute any funds during the prejudgment period; instead, any funds that would be awarded to the plaintiff are held by defendant during this period—for the plaintiff if the plaintiff ultimately prevails.
is a function of risk. The more risk an investor undertakes, the higher the expected return. Thus, the appropriate choice of interest rate should reflect the risk that the plaintiff bears by virtue of its investment in the defendant. Since the plaintiff bears the risk of an investor in the defendant corporation, the interest rate that the defendant pays to borrow money is again the correct rate to use.

C. Accounting for Position in Capital Structure

The analysis has so far concluded that courts should use an interest rate that reflects the rate at which the defendant is borrowing or can borrow money to assess prejudgment interest. The question that next arises is which interest rate? A modern corporation can have many sources of debt capital. Should the court look at the company's senior debt or its subordinated debt, or should it look at the rate the company paid on trade credit or on a credit line that the company has that is collateralized by its receivables? For that matter, why talk only about debt? The corporation also has equity, so why not use the return on equity?

The above questions can be answered by recognizing that rates of return differ across investments in a single company because the investments have different risks. The rate of return increases as one moves up

97. For a discussion of how to adjust the calculation if the market is believed to be inefficient, see infra subpart V(C).

98. The interest rate should not compensate the plaintiff for the risk of losing the case because doing so would overcompensate plaintiffs relative to a system in which justice was immediate. To see this, assume that a plaintiff has a claim for $1000, but the state of legal precedent or the reliability of the evidence is such that the plaintiff has only a 50% chance of winning at trial. Assume further that the claim will take two years to litigate and that defendant's unsecured borrowing cost is 10%. In this case, the plaintiff, if successful, should receive $210 in prejudgment interest in addition to a $1000 judgment. The expected present value of such a judgment is $500, which equals what the expected present value would be if the case were decided immediately and the judgment would be for $1000 if the plaintiff won. Adjusting the interest rate to compensate for the risk of the plaintiff losing the case would require doubling the award to $2420, which implies an annual interest rate of 56%. The present value of such an award, discounted at 10%, is $2000. Because the plaintiff's chance of winning is 50%, such an award would have an expected present value of $1000. This is twice the value of the case to the plaintiff with an immediate decision. Moreover, if the plaintiff's chance of winning were smaller, say 25%, the award would have to be quadrupled to $4840. In effect, adjusting the interest rate for the risk that the plaintiff will lose is equivalent to eliminating the plaintiff's ex ante risk of losing at trial.

Neither should the interest rate be calculated on the expected value of the judgment. Such a rule would undercompensate plaintiffs. In the above example, the expected judgment is $500. Two years of interest at 10% on this amount is $105, which produces a final judgment, if the plaintiff wins, of $1105. This has a present value of $913.22, and an expected present value of $456.61, which is less than $500. Ex ante full compensation would then require that an unsuccessful plaintiff receive the other $105 in interest from its defendant. (This has a present value of $86.78 and an expected present value of $43.39.) Such a system is impractical because it would require the court to assess the ex ante probability of winning or losing in each case.
the capital structure because the chance of not getting paid, the risk of default, increases. Since return increases with risk, the rate at which prejudgment interest is calculated should reflect the risk that the judgment will not be paid. Thus, prejudgment interest should be assessed at a rate equal to the interest rate on corporate debt with the same default risk as the judgment. That is to say, prejudgment interest should be calculated at the interest rate that the corporation would pay to voluntary creditors that took the same position in the capital structure.

The logic is the same when the award is intended to prevent the defendant's unjust enrichment. To prevent the defendant from being unjustly enriched by the delay, the defendant should pay interest at the same rate that it would pay a voluntary creditor that took the same position in the capital structure and had the same rights as the plaintiff.

Because the plaintiff is paid in full unless the defendant goes bankrupt, the plaintiff's risk of receiving less than full payment depends on its risk of loss in the event of the defendant's bankruptcy. Thus, the rate at which prejudgment interest should be assessed depends on the priority in bankruptcy of claims arising out of lawsuits.

In bankruptcy, legal claims are treated in a manner similar to that of unsecured debt. When a corporation becomes bankrupt, its secured creditors have prior claim to the corporation's pledged assets. If the corporation is liquidated, the pledged assets are first used to pay secured claims. If there is any cash left over, it goes to pay unsecured claims. If the realized value of the assets is insufficient to pay secured creditors, the unsatisfied claims of secured creditors are lumped together with the claims of unsecured creditors. Thus, because secured debt is more likely to be paid in bankruptcy than unsecured debt, secured debt pays a lower interest rate than unsecured debt. Since legal judgments are treated on par with unsecured debt, the proper interest rate to use is the rate for unsecured debt.

Unsecured debt can be senior or subordinated. In bankruptcy, senior debt is paid in full before subordinated debt is paid at all. Accordingly, senior debt pays a lower interest rate than subordinated debt.

100. See id. at 79.
101. See id. at 10.
102. See id. at 79.
103. See Gorenstein Enters., Inc. v. Quality Care—USA, Inc., 874 F.2d 431, 436 (7th Cir. 1989) (Posner, J.) ("The plaintiff is an unsecured, uninsured creditor, and the risk of default must be considered in deciding what a compensatory rate of interest would be.").
105. Subordinated debt is said to be junior to the senior debt. Id. at 318.
Legal judgments are not treated as senior or subordinated, but are treated on par with the two together. Thus, prejudgment interest should be assessed at the rate for unsecured debt that is neither senior nor subordinated.

In some highly leveraged companies, the debt can have many levels of seniority paying different interest rates. If leverage is low and risk is low, it is not very important which debt the court uses to calculate interest because the interest rates will be clustered together. If there is a great deal of leverage and many different classes of debt, however, then it is important that the court select the right place in the capital structure because interest rates will likely vary substantially.

Litigants frequently argue that courts should assess prejudgment interest at a rate other than the defendant's cost of unsecured borrowing. In the rest of this Part, I will discuss some of these proposed standards and show why they would be inappropriate to use.

One argument that a plaintiff sometimes makes is that prejudgment interest should be assessed at the average return on the plaintiff's equity. The proffered rationale for such an award is that had the plaintiff had the

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105. See David W. Leebron, Limited Liability, Tort Victims, and Creditors, 91 COLUM. L. REV. 1565, 1637 (1991) ("Unsecured creditors share pro rata with tort victims."). David Leebron has proposed that tort creditors be given priority in bankruptcy. Id. at 1643-46. If Professor Leebron's suggestion is adopted, it would no longer be appropriate to calculate prejudgment interest using the defendant's overall cost of unsecured borrowing. Instead, a lower rate that reflects the senior status of the claim would be appropriate.

Alternatively, if the judgment were treated in bankruptcy on par with all capital voluntarily extended to the firm, it would be appropriate to award prejudgment interest at the defendant's average cost of capital.

106. Prejudgment interest should be assessed using the stated return, not the expected return, on the defendant's unsecured debt. Voluntary creditors are compensated through a higher stated interest rate for the risk that the defendant will become bankrupt and thus will be unable to pay the judgment in full. In effect, when there is a positive probability that the loan will not be repaid in full, the stated interest rate on the loan exceeds the expected return from making the loan. Because the plaintiff also has to face this risk, the court should assess prejudgment interest using the defendant's stated interest rate, not its expected rate of return. That conclusion greatly simplifies the calculation. To calculate the expected return would require some pretty fancy calculations using the capital asset pricing model (CAPM). Fortunately, those calculations can be avoided because the court should not use the expected rate of return and instead should use the stated return to compensate for the possibility that the judgment might not be paid in full.

Although the stated interest rate is used to calculate what the defendant owes the plaintiff, what the plaintiff recovers depends on the actual return on the unsecured debt. On debt instruments, the actual return is the promised return, unless the obligor defaults, in which case it might be less. Thus, the proposed rule ultimately pays plaintiffs as a class the actual return, not the stated return, from investing in defendants as a class. In an efficient market, the expected return is an unbiased estimate of the actual return.

107. See, e.g., Hughes Aircraft Co. v. United States, 31 Fed. Cl. 481, 492 (1994) ("Plaintiff ... urges use of its own return on equity as the measure of delay compensation . . . ."); aff'd, 86 F.3d 1566 (Fed. Cir. 1996). This method is endorsed by the Keirs, who propose that prejudgment interest be awarded at the plaintiff's average historical return. Keir & Keir, supra note 24, at 148.
money it would have invested it in its own business; therefore, the return that the business has produced over that period is the best estimate of what the plaintiff lost through delay.\textsuperscript{108} There are two problems with this argument. First, the return on the plaintiff’s equity reflects the risk of the average investment in the plaintiff. That, however, is not the investment the plaintiff has made (albeit involuntarily) with the funds. Instead, the plaintiff has invested them in the defendant’s debt and should receive a corresponding risk-adjusted return. Giving the plaintiff a higher return, based on its overall risk, would overcompensate the plaintiff for the risk it bore through its forced investment in the defendant. Second, it might be argued that the plaintiff should receive the presumably higher return on its equity because the defendant’s refusal to immediately pay prevented it from investing the money in its own business. Thus, the plaintiff’s lawyer might rhetorically ask, “Why should the plaintiff lose out when its investments are profitable because the defendant did not pay the plaintiff sooner?” The simplest response to this argument is that the defendant’s refusal to pay earlier does not prevent the plaintiff from investing in its business. Because the plaintiff is assumed to have easy access to the capital markets, it can borrow at a risk-adjusted interest rate to fund prospective projects.\textsuperscript{109} Accordingly, because the plaintiff can borrow to fund available projects, the defendant’s retention of money that is later judicially determined to be owed to the plaintiff does not prevent the plaintiff from undertaking particular projects.

This suggests a second argument—that prejudgment interest should be awarded at the plaintiff’s cost of borrowing.\textsuperscript{110} This argument can be made either by the plaintiff, when its borrowing cost is high, or by the defendant, when the plaintiff’s borrowing cost is low or at least lower than the defendant’s. The logic is that because the plaintiff was denied access over the prejudgment period to the amount ultimately awarded, it had to make up for it by borrowing.\textsuperscript{111} Accordingly, to put the plaintiff in the same position today as it would be in had it been paid immediately, the defendant should pay interest at the plaintiff’s cost of borrowing. Why this approach is wrong is easiest to see when the plaintiff’s cost of borrowing is lower than the defendant’s. Assume, for example, that the plaintiff can

\textsuperscript{108} See Hughes Aircraft, 31 Fed. Cl. at 492; Keir & Keir, supra note 24, at 146-49.

\textsuperscript{109} Recall that the choice of interest rate is predicated on the assumption that the plaintiff can readily raise funds through the capital markets. The calculation of prejudgment interest when the plaintiff is an individual or a close corporation without such access is discussed infra subpart V(B).

\textsuperscript{110} See, e.g., Amoco Cadiz, 954 F.2d 1279, 1332 (7th Cir. 1992) (holding that the defendant should pay the market rate for prejudgment interest because “[that is what the victim must pay . . . if it borrows money”]. The Keirs are also sympathetic to this argument, endorsing the use of the plaintiff’s cost of capital as another method to set prejudgment interest. Keir & Keir, supra note 24, at 147.

\textsuperscript{111} Equivalently, the plaintiff could have reduced its borrowings had the defendant immediately paid the plaintiff the amount ultimately awarded.
borrow without giving security at the riskless rate but that the defendant's unsecured borrowing rate is much higher. In this case, providing the plaintiff with prejudgment interest at the riskless rate will not compensate the plaintiff for the risk it bears of a default by the defendant. Because some defendants will default, plaintiffs as a class will be undercompensated if prejudgment interest is assessed at their borrowing rate. It would also be wrong to use the plaintiff's cost of borrowing if it exceeded the defendant's cost of unsecured debt. The plaintiff's borrowing rate on the withheld funds would not exceed the defendant's if the hypothetical lender to the plaintiff were assured of payment in the event that the defendant pays the plaintiff. The hypothetical lender, however, is not so assured, conditional upon the judgment being paid, because other claimholders in the plaintiff also have a right to share in the award. Hence, they too will benefit from the award because they might receive a larger payment than otherwise. Thus, awarding prejudgment interest at the plaintiff's cost of borrowing will overcompensate the plaintiff. Therefore, prejudgment interest should not be awarded at the plaintiff's cost of borrowing but at the defendant's.

Another argument that is sometimes made is that prejudgment interest should be awarded at the Treasury bill rate, which is the interest rate that the federal government pays when it borrows. Because the federal government's obligations are backed by the full faith and credit of the United States, the taxing power, and the power to print money, they are widely considered to have no risk of default. Although some large and mature businesses with little debt in their capital structure pay interest at the same rate as the federal government, most companies do not. Because their debt has some risk of default, these companies pay higher interest rates to compensate for that risk. Accordingly, it is generally correct to use the defendant's stated borrowing rate to calculate prejudgment interest. When the federal government is the defendant, however, the Treasury bill rate would be appropriate to use.

112. This benefit will equal the difference between the plaintiff's and the defendant's cost of unsecured borrowing. This is an implication of the well-known Theorem I of Franco Modigliani and Merton Miller, which states that a firm's cost of capital is not affected by how its ownership is divided among different classes of securities. See ROSS ET AL., supra note 73, at 418-21.

113. See Fisher & Romaine, supra note 45, at 146-48 (arguing that prejudgment interest should be awarded at a risk-free rate). By statute, Minnesota assesses prejudgment interest at the Treasury bill rate. MINN. STAT. § 549.09(1)(c) (1996).

114. See ROSS ET AL., supra note 73, at 256.

115. See id. at 256-57.

116. See id.

117. Thus, the court in Amoco Cadiz was correct in rejecting the district court's use of the interest rate on Treasury securities. See Amoco Cadiz, 954 F.2d 1279, 1332 (7th Cir. 1992) (concluding that the prime rate would be the best measure of the defendant's cost of borrowing).

118. In Hughes Aircraft Co. v. United States, 31 Fed. Cl. 481 (1994), aff'd, 86 F.3d 1566 (Fed. Cir. 1996), Hughes alleged that the federal government infringed one of its patents for positioning...
More generally, any fixed prejudgment interest rate will usually be wrong. Unfortunately, some state courts assess prejudgment interest in this way, using the same fixed interest rate that they are required by statute to use to calculate postjudgment interest.\(^{119}\) The obvious advantage of using a fixed rate is that the prejudgment interest calculation is easier because the task of setting an interest rate is eliminated. The cost of such a rule, however, is a loss of accuracy: sometimes too much interest and sometimes too little interest will be awarded. When interest rates are high, there will be a tendency to award too little,\(^{120}\) and when they are low to award too much. Thus, once again, we are driven back to the conclusion that prejudgment interest should be calculated at the defendant's cost of unsecured borrowing.

That the proper interest rate is the defendant's cost of unsecured borrowing might help to explain the law's failure to develop rules for the calculation of prejudgment interest. That rule does not yield a specific interest rate or even refer to a specific index. Instead, the correct rate depends on characteristics of the defendant. Such variations may have made it difficult for courts to formulate and put forth a general rule. Such a rule does exist, however, and how it might be implemented will be discussed in Part III.\(^{121}\) Before describing how prejudgment interest should be calculated in practice, however, there is one more principle to discuss—whether prejudgment interest should be calculated at a fixed or floating interest rate.

\(^{119}\) See supra note 34.

\(^{120}\) Moreover, if the defendant is not charged prejudgment interest at a rate that reflects its own default risk, then it will have an incentive to increase that risk. See Roman L. Weil, Compensation for the Passage of Time, in LITIGATION SERVICES HANDBOOK 37.1, 37.4 (Roman L. Weil et al. eds., 2d ed. 1995).

\(^{121}\) There is an analogy to the underlying award because the amounts differ across cases even though there are general rules for calculating the award.
D. Fixed or Floating Interest Rate?

Interest rates usually vary with the duration of an investment. This phenomenon is called the term structure of interest rates. Typically, short-term rates are less than long-term rates, producing an upward sloping term structure.

The term structure of interest rates would seem to complicate the task of calculating prejudgment interest. If a plaintiff suffers an injury on January 1, 1986, and does not receive payment until January 1, 1996, then the plaintiff had a claim against the defendant for the intervening ten years. Since the claim arose in 1986 but was not paid until 1996, the ten-year interest rate in 1986 would appear to be the appropriate interest rate to use because that was the interest rate that the defendant would have had to pay to borrow for ten years. There is, however, a good reason for not calculating prejudgment interest using fixed interest rates but instead preferring floating-rate measures whenever possible.

As described previously, prejudgment interest is provided for both fairness and efficiency reasons. Providing prejudgment interest at the long-term rate does not compromise fairness. Ex ante the shareholders of neither plaintiff nor defendant corporations would be advantaged or disadvantaged by using a long-term rate. Although ex post there will be losers and winners from changing interest rates, they are as likely to be investors in defendants (debtors) as in plaintiffs (creditors). Providing prejudgment interest at the long-term rate does not compromise the first efficiency rationale, deterrence, either. Because ex ante plaintiffs and defendants receive full compensation and pay the full cost when interest is assessed at the long-term rate, they have the right incentives to avoid harm.

122. Duration is a concept that measures the wait for the cash flows from a debt instrument. Duration is defined as the mean wait for the bond’s promised cash flows. It is the weighted average of the time until each cash flow, where the weights are the proportion that the present value of each payment bears to the total value of the bond. Duration differs from maturity, which is the date on which the last payment on the bond is due. See Zvi Bodie et al., Investments 441 (1989). The principal reason why duration is important in finance is because the sensitivity of the value of a debt instrument to changes in interest rates is a function of duration. The higher the duration of a bond, the greater the sensitivity. See id. at 440 (explaining that as payments become more distant the effect of discounting exerts greater influence on the price of bonds).

123. See Joseph Bankman & William A. Klein, Accurate Taxation of Long-Term Debt: Taking into Account the Term Structure of Interest, 44 Tax Rev. 335, 335 (1989) (“The phrase ‘term structure of interest rates’ is used by economists to describe the relationship between short-term and long-term interest rates.”).

124. Occasionally, long-term rates are below short-term rates. When this happens, the term structure is said to be inverted.

125. This assumes that there is a blanket rule of using the long-term rate. If the long-term rate is sometimes used and the short-term rate is used in other cases, then whichever party gets to choose will benefit at the expense of the other party.
Providing prejudgment interest at the long-term rate does, however, compromise the second efficiency rationale for prejudgment interest; using a long-term interest rate will interfere with the parties' incentives to settle. If interest rates rise, defendants will be borrowing at below market interest rates, which will give them an incentive to prolong litigation. Of course, the plaintiff will have the opposite incentive; but it is easier for one party unilaterally to delay litigation than it is to expedite it. The incentives are reversed when interest rates fall: plaintiffs will have an incentive to delay, since they are receiving above market interest rates.

The conclusion that using a long-term interest rate satisfies only two of the three reasons for granting prejudgment interest does not imply that it would be appropriate to use a short-term rate. Before one can understand why it is desirable to calculate prejudgment interest using short-term interest rates, an understanding of what drives the interest-rate term structure is necessary.

Two theories have been offered to account for the term structure of interest rates. The first theory, the expectations theory, hypothesizes that the term structure is driven by expectations about interest rates in the future over different horizons. Thus, an upward sloping term structure would indicate a market consensus that interest rates will rise continuously in the future.126

The second theory, the liquidity preference theory, hypothesizes that investors are risk averse and generally have a shorter investment horizon than do most issuers. Accordingly, to induce these investors to hold long-term bonds they have to receive a premium in the early years. The premium compensates for the risk that they will sell the bonds when interest rates are high, in which case bond prices are low,127 and suffer a larger loss than they would receive from holding short-term bonds.128 The available evidence strongly supports the liquidity preference hypothesis.129

Perhaps the most compelling evidence in support of the liquidity preference hypothesis is the persistent upward slope of the yield curve. If brought about by the expectations hypothesis, the persistence of that upward slope would imply a systematic tendency by the market to overestimate future interest rates.130

126. See Ross et al., supra note 73, at 152.
127. There is an inverse relation between bond prices and interest rates. See id. at 119-20.
128. See Theodore S. Sims, Long-Term Debt, the Term Structure of Interest and the Case for Accrual Taxation, 47 TAX L. REV. 313, 331 (1992) (observing that the yield curve's positive slope is due to the risks of holding long-term debt).
129. See Ross et al., supra note 73, at 153-54; Sims, supra note 128, at 330-31 (explaining that investors prefer the safety of short-term investments and must be induced to hold riskier long-term debt with the promise of a premium return).
130. See Ross et al., supra note 73, at 154.
The liquidity preference hypothesis implies that the term structure reflects the interest rate risk from locking in an interest rate ex ante.\textsuperscript{131} Because prejudgment interest is calculated ex post, there is no risk that interest rates will later change.\textsuperscript{132} Accordingly, prejudgment interest should be calculated using a very short-term rate, which does not contain a premium for interest rate risk. Using a short-term interest rate implies that prejudgment interest is effectively calculated on a floating-, variable-, or an adjustable-rate basis, not on a fixed-rate basis.

Calculating interest on a floating-rate basis is consistent with the fairness justification for prejudgment interest, even though it will produce smaller interest awards. The lower awards are not unfair to plaintiffs because it is unnecessary to compensate them for the risk that interest rates will rise—that risk was eliminated by using floating interest rates. Moreover, because the plaintiff is fully compensated for delay and the defendant does not benefit from it, the first efficiency criterion, that the parties have the correct incentives to avoid activities that might produce harms and to take precautions to reduce those harms, is also met.

As described above, using a fixed interest rate that reflects the cost to the defendant of unsecured borrowing when the claim arose also has the same two advantages. The problem with using a fixed interest rate is that it interferes with the incentive to settle. When interest rates rise, the defendant, who is borrowing from the plaintiff at below market rates, has an incentive to delay. Similarly, when rates fall, the plaintiff, who is receiving an above-market rate from the defendant, has an incentive to delay. In contrast, when prejudgment interest is calculated using a floating-rate measure, neither party has an incentive to delay.\textsuperscript{133} Because the plaintiff is receiving the proper risk-adjusted market rate of return and the defendant is paying that rate, neither party is benefitted (or harmed) by delay. Therefore, when prejudgment interest is calculated using a fixed rate of interest, the fairness justification for prejudgment interest and only one of the two efficiency justifications are satisfied. However, when a floating rate of interest is used, the fairness justification and the two efficiency justifications are satisfied.

\textsuperscript{131} This does not suggest that expectations do not affect the yield curve, but only that expectations do not explain its persistent upward slope.

\textsuperscript{132} Because interest is awarded at the end of the process when the path of interest rates is known, there is no reason to guess what interest rates were.

\textsuperscript{133} When a floating-rate debt instrument, instead of a fixed-rate instrument, is used as the basis for calculating prejudgment interest, the present value of the award is invariant to interest rate movements.
E. Summary

Three simple rules emerge from this Part. First, courts should award compound interest, never simple interest, because the defendant retains and has the use of the plaintiff's money until the judgment is finally paid.134

Second, prejudgment interest should be assessed at a rate that reflects the defendant's cost of unsecured borrowing. This rule both charges the defendant exactly what it saved by not extinguishing the obligation earlier and provides the plaintiff with the risk-adjusted return on the investment that it was forced to make in the defendant.135

Third, prejudgment interest should be assessed at a floating interest rate. This rule ensures that neither party has an incentive to delay in order to take advantage of a favorable interest rate.136

III. Setting the Prejudgment Interest Rate

The previous Part discussed the most basic issues in the calculation of prejudgment interest. This Part describes how to set the interest rate. It endorses the use of the prime rate as a default, and describes several ways to go beyond it to produce a more accurate result.

The previous Part set out the standard that the interest rate should meet. To ensure that the plaintiff is fully compensated and that the defendant is not unjustly enriched, prejudgment interest should be assessed at the rate that the defendant would pay on an equivalent voluntary transaction. That Part concluded that interest should be assessed at a floating rate that reflects the defendant's cost of unsecured borrowing.

Setting the precise, theoretically correct interest rate imposes additional constraints—the interest rate must reflect the precise risk of default and any terms and conditions that would influence that rate. One determinant of default risk is when a bond is to be repaid. In general, the more quickly a bond is repaid, the greater the likelihood of full repayment. This is because uncertainty tends to increase with the horizon.137 Interest rates are affected not only by duration; they are also affected by the terms and conditions contained in the bond indenture.138 Bonds are commonly is-

134. This rule applies whenever prejudgment interest is awarded. It is not limited to litigation between two publicly traded companies.

135. This rule applies to cases between publicly traded corporations. It does not always apply when the plaintiff is an individual or does not have easy access to the capital markets. See infra subpart V(B).

136. This rule should also be applied whenever prejudgment interest is awarded; it is not limited to suits between public companies.


138. For example, corporate debt can be callable by the issuing corporation or convertible by the holder into the issuer's stock. Callable debt will pay higher interest than noncallable debt because the
sued containing many features that affect the interest rate. In contrast, the judgment is without these additional features. Accordingly, in theory, prejudgment interest should be assessed at the rate that the defendant would pay to borrow the amount of the original judgment with a simple, floating-rate bond that was payable in full on the judgment date with no payments made prior to that date. Most defendants, however, are unlikely to have such zero-coupon bonds outstanding.\textsuperscript{139} Thus, courts cannot turn to precisely comparable debt instruments to assess prejudgment interest.\textsuperscript{140}

Issuer will call the debt only when it is to its advantage (and therefore to the holder's disadvantage) to do so. Debt is frequently callable by the issuing corporation at a small premium to par. This makes it attractive to the corporation to call its debt when it can issue new debt at a sufficiently lower interest rate than the rate on its outstanding debt to cover the cost of the refinancing. \textit{See} RO\textsc{ss} \textsc{et} \textsc{al.}, \textit{supra} note 73, at 594-98. Conversely, convertible debt will pay lower interest than straight debt because the convertibility feature is valuable to the holder. The holder will convert the debt to equity only when doing so is to its advantage. \textit{See id.} at 662. For a discussion of the law and economics of call provisions, see \textsc{William} \textsc{A. Klein et al.}, \textit{The Call Provision of Corporate Bonds: A Standard Form in Need of Change}, 18 \textsc{J. Corp. L.} 653 (1993). For a discussion of the law and economics of convertible debt, see \textsc{William} \textsc{W. Bratton, Jr.}, \textit{The Economics and Jurisprudence of Convertible Bonds}, 1984 Wis. \textsc{L. Rev.} 667 and \textsc{William} \textsc{A. Klein}, \textit{The Convertible Bond: A Peculiar Package}, 123 \textsc{U. Pa. L. Rev.} 547 (1975). Unlike corporate bonds, which are issued pursuant to a trust indenture, legal claims are not protected by covenants and warranties, which restrict the issuer's activities by triggering a default when violated. Common warranties include maintenance of a sinking fund, minimum capital requirements, and restrictions on further borrowing. In contrast to the many features that investment bankers add to debt issues, the legal claim is without these bells and whistles. Accordingly, the reference rate should be based on an instrument that incorporates none of these features. Although there are techniques for making some of these adjustments using option pricing theory, that discussion is beyond the scope of this Article. For some of these adjustments, such as the value of the bondholders' right to declare a default, there are no techniques currently available.

\textsuperscript{139} A zero-coupon bond is a bond that makes a single payment of interest and principal at maturity and makes no prior payments. The final judgment is similar to a zero-coupon bond with principal equal to the original judgment.

\textsuperscript{140} Even if such bonds were outstanding, they still would not provide the precise, theoretically correct interest rate that would place the successful plaintiff in the same position that it would be in had it been paid the amount of the eventual judgment immediately and invested the proceeds in the defendant on the same terms as the legal judgment. This is true because the correct interest rate will reflect the size of the judgment ultimately rendered by the court, which is rarely known in advance. Of course, the potential liability is unlikely to escape the notice of the corporation's creditors. To the extent that the potential litigation liability reduces other creditors' expected recoveries, they will require higher interest rates and so existing claims will fall in value. Thus, in an efficient market, the cost of funds to the defendant, after knowledge of the potential liability becomes public, will accurately reflect the attendant risks. Accordingly, once the claim is public, the defendant's borrowing cost should reflect the expected judgment. It will also evolve over time as the defendant's prospects in the litigation change.

I have two observations to offer about using an interest rate that reflects this risk. First, any figure derived from the market is based on the market's estimate of the final judgment. That estimate will evolve over time and can be wrong. A perfectly accurate calculation of interest should reflect what the judgment ultimately is, not what the market expected it to be. This is because the risk to the plaintiff of receiving less than full payment is a function of the size of the judgment ultimately rendered, not of creditors' expectations of what it would be. Thus, unless the court can assess what the market expected it to do, it cannot calculate what the interest rate on its unsecured debt would have been had the market known the outcome of the case.
that prejudgment interest be awarded at a floating rate that reflects the defendant's cost of unsecured borrowing. Loans at prime are generally unsecured, and many corporations borrow regularly at the prime rate, which changes frequently. Moreover, using the prime rate has two additional advantages. First, the rate is widely published, easing the task of calculating prejudgment interest. Second, the prime rate is a market-determined rate that varies, often substantially, over time as interest rates change. The problem with using the prime rate is that in any given case the prime rate might be too high or too low. That is, it might not reflect the defendant's cost of unsecured borrowing.

The prime rate will be too low when the defendant's unsecured debt has a relatively high probability of default. This is likely to occur when the defendant's business is volatile or its leverage is high. The prime rate will be too high when that default probability is relatively low. This is most likely to occur for well-established companies with little leverage. What the prime rate does not do is it does not reflect the risk of an unsecured investment in a particular defendant. Thus, to obtain a more accurate calculation of prejudgment interest, some effort must be made to reflect the risk of the defendant's unsecured debt.

There are at least two methods of estimating that interest rate. These methods are both approximations. Although neither will yield a precise, theoretically correct answer, they will produce credible results when done with some care. Both are also relatively simple to implement. Accordingly, they are likely to be worth pursuing in most cases, and certainly will be worth the effort when the original judgment is large, the prejudgment period is long, or when the defendant's cost of unsecured borrowing is substantially above or below the prime rate.

The most obvious method for the court to use is to look at a floating- or short-term interest rate at which the defendant can or is borrowing unsecured. For example, throughout the prejudgment period, Amoco had access to and borrowed through the commercial paper market. Com-

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144. See Gorenstein, 874 F.2d at 436 (noting that the prime rate is a "readily ascertainable figure").

145. The prime rate rose 6% from 1979 to 1981; it then fell 8% from 1981 to 1983. See infra Appendix.

146. See BLOCK & HIRT, supra note 142, at 212 tbl.8-1 (demonstrating that the interest rate on commercial paper, available to large, prestigious companies, was lower than the prime rate for every year between 1971 and 1989).

mmercial paper, which is considered a substitute for bank loans, are short-term, unsecured promissory notes. Because the commercial paper market is more restrictive than the market for bank loans at prime, the interest rate on commercial paper is regularly two to three percent below the prime rate. As a result, only the most creditworthy borrowers, such as Amoco, can issue commercial paper.

I have recalculated the final award in Amoco Cadiz, using the commercial paper rate instead of the prime rate to calculate prejudgment interest. The mean interest rate for commercial paper, calculated in the same manner as the Amoco Cadiz court used to calculate the mean prime rate, is 9.57%. Using the same assumptions and methods to calculate the final award produces a final award of about $171 million, a $42 million reduction from the Seventh Circuit's figure. For a corporate defendant that issues commercial paper, the calculation of prejudgment interest using the average commercial paper rate will produce a more accurate award than one calculated using the prime rate because it uses more specific information.

The problem with using a short-term rate, such as the commercial paper rate, is that no allowance is made for duration. If there is very little risk that the firm will default on its obligations in the short term, but default is much more likely in the long term, then the issuer will not be able to borrow long term at a floating rate close to the commercial paper rate. This would not have been a problem for Amoco, in spite of the long prejudgment period, because it could and did borrow long term at low interest rates. However, when it is a problem, which is likely to occur when the defendant's future is uncertain and the prejudgment period is long, there are two ways to alleviate it. The first is to make use of mathematical techniques to estimate the increase in risk as maturity in-

148. See Block & Hirt, supra note 142, at 210.
149. See Economic Report of the President 358 tbl.B-72 (1995) (reporting that in 1994 the rate for commercial paper was 4.93% per annum while the prime rate was 7.15% per annum); infra Appendix Tables 1, 2.
150. See infra Appendix Table 2.
151. This is calculated using equation (3) and assuming an original judgment of $65 million and a prejudgment period of 10.6 years.
152. This is a 28% reduction in the interest component of the award.
153. This calculation could also be made using the actual interest rate paid by Amoco on its commercial paper. Such a calculation would be even more accurate because it uses even more specific information.
154. See supra note 137 and accompanying text.
155. In 1974, Amoco issued $150 million of floating rate notes, due in 1989, a fifteen-year debt. Moody's Investors Service, Moody's Industrial Manual 973 n.8 (1986). The interest rate on the debt was 1% above the "Treasury Bill Rate." Id. As can be seen by comparing the interest rates listed in Table 1 of the Appendix, 1% above Treasury bill rates would still have been significantly lower than the prime rate over the prejudgment period. See infra Appendix.
creases and to adjust interest rates for that risk. The second is to use the following method to estimate the appropriate interest rate.

The second method for setting the prejudgment interest rate is for the court to estimate the spread of the rate at which the defendant could have borrowed over some short-term interest rate index for a term that is roughly comparable to the prejudgment period. A simple way to do this is to start with the rating of the corporation's unsecured long-term debt, and then, using information from the bond rating services on the risk premiums for various risk classes, calculate what interest rate the defendant would have paid on similarly rated short-term or floating-rate debt. The difference between the rate that the defendant would have paid and the index is then added to the index's average over the prejudgment period to produce the prejudgment interest rate.

As applied to the facts of Amoco Cadiz, this calculation is straightforward. Throughout the prejudgment period, the unsecured long-term debt of Amoco was rated AAA by Standard and Poor's and Aaa by Moody's Investor Services, both agencies' highest ratings. Such debt is considered to be of the highest quality, with a very low probability of default. Accordingly, such debt pays very low interest rates, just slightly above the rate on U.S. Treasury securities. Based on data collected over the period from 1973 through 1987, which overlaps somewhat with the prejudgment period in Amoco Cadiz, the spread over Treasury bills for triple-A-rated debt averaged forty-seven basis points. Over the period used by the Amoco Cadiz court to calculate its average interest rate, the short-term Treasury bill rate averaged 8.85%. Adding forty-seven basis points to this rate, the constant interest rate used to calculate prejudgment interest is 9.32%. The corresponding final judgment is

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156. These techniques are described by Merton, supra note 137, at 455-60. Such an exercise is beyond the scope of this Article.

157. If the corporation does not have a single class of unsecured debt outstanding, but several classes of senior and subordinated debt, the court could take a weighted average of the ratings, in which the weights are the outstanding balances, to estimate the rating that would be appropriate for the claim. The spread can also be estimated from the difference between the yield on the corporation's unsecured debt and Treasury securities with the same duration.


159. The prejudgment period runs from January 1, 1980 through July 24, 1990, the date the district court adopted the report of the special master. Amoco Cadiz, 954 F.2d 1279, 1290, 1337 (7th Cir. 1992).

160. Edward I. Altman, Measuring Corporate Bond Mortality and Performance, 44 J. Fin. 909, 917 (1989). A basis point is one-hundredth of a percentage point, so 47 basis points is a difference in interest rates of slightly less than 0.5%.

161. See infra Appendix.

162. This is 2.58% (258 basis points) below the interest rate the Amoco Cadiz court used to assess prejudgment interest. See Amoco Cadiz, 954 F.2d at 1335, 1337 (awarding the French plaintiffs prejudgment interest at the rate of 11.9% per annum).
about $167 million,\textsuperscript{163} which is $46 million less than the award made by the court using the prime rate.\textsuperscript{164}

The virtue of the above method is that it takes into account the risk of a long-term investment in the defendant corporation.\textsuperscript{165} Such calculations, however, are only approximations. The principal reason is that debt instruments with the same bond rating do not all pay the same interest rate; ratings are an imprecise measure and they exclude much information that affects interest rates.\textsuperscript{166} Accordingly, within a given rating, it is common to have a spread of rates and overlaps between ratings. The above method averages these features, but it does not eliminate them, which can be expected to affect the interest calculation.

The two methods of setting the prejudgment interest rate that I have outlined above are simple to implement and either one, if accepted by the Amoco Cadiz court, would have reduced the interest component of the final judgment by about $40 million.\textsuperscript{167} In addition, either argument was a likely winner for Amoco in view of Seventh Circuit precedent, which calls for using the prime rate only if neither side presents evidence of the cost

\textsuperscript{163}. This is also calculated using the assumptions in supra note 151.

\textsuperscript{164}. See supra text accompanying notes 67, 143. This represents a 31% reduction in the interest component of the award.

\textsuperscript{165}. A court could also use the yield on Amoco's debt to estimate the spread over Treasury securities. This estimate can then be used to calculate the multiplier, as in the text.

\textsuperscript{166}. Ratings only measure the risk of default; they exclude other factors that affect interest rates. See supra note 138.

\textsuperscript{167}. There is a third method for setting the prejudgment interest rate. That method calculates what interest rate a debt instrument that had the same terms as the judgment would pay. Financial economists have developed several models to estimate the market interest rate on a bond. These models commonly work by estimating a risk premium over Treasury securities as a function of several variables. Typically, the most important variables include leverage (which is frequently measured using financial ratios), volatility, and duration.

Another factor that these regressions find affects interest rates is marketability. The easier it is for a debtholder to sell a bond when the investor wants to turn it into cash, the lower the interest rate. See Lawrence Fisher, Determinants of Risk Premiums on Corporate Bonds, 67 J. Pol. Econ. 217, 221 (1959) (explaining that "yields on almost all securities include" risk premiums, which depend in part "on the ease of turning the securities into cash"). The legal claim, however, cannot easily be sold, because direct sales of such claims are prohibited. Whether an adjustment should be made for the lesser marketability of the legal claim than a debt offering of the defendant is an interesting policy question. These regressions also often find that the bond ratings are significant. The ratings are a method of capturing information not contained in the other variables. For example, nonfinancial information, such as the legal restrictions and protections in the bond indenture, is difficult to incorporate into a regression equation but is closely examined by the rating agencies.

One difficulty with such models is that the regression equation might have to be estimated at different points in time. It is not sufficient to estimate one equation and then to use the resulting coefficients to estimate the interest rate over the prejudgment period because the coefficients are not necessarily stable. If they are not stable, separate equations must be estimated for different times, and each equation must be used to calculate interest rates only for the time it was estimated. Accordingly, because of the complexity of the task, I have not used it to calculate prejudgment interest in Amoco Cadiz.
of the defendant's unsecured borrowing. Yet Amoco presented no such evidence, arguing only that prejudgment interest should not be awarded, but if it were awarded, then it should be assessed at the Treasury bill rate. Both arguments were inconsistent with precedent. As a result, Amoco probably paid $40 million more than necessary.

To summarize the results of this Part, a court will rarely be able to observe a market transaction that is an exact equivalent of the coerced loan to the plaintiff. Accordingly, to set the prejudgment interest rate the court is going to have to use proxies and possibly make some adjustments. The Seventh Circuit has developed a rule of using the prime rate unless either party provides a more accurate estimate of the defendant's cost of unsecured borrowing. That is a good rule because the prime rate is readily ascertainable and reflects changing market conditions. This Part has also described how to move beyond the prime rate by using a short-term rate at which the defendant borrows or by estimating the spread over Treasury securities on the defendant's long-term unsecured debt. Either method is a simple way for parties to address the question of what interest rate to use to assess prejudgment interest.

IV. Adjustments to the Multiplier

The previous Part described how to set the prejudgment interest rate, focusing on the selection of an interest rate index. This Part discusses possible refinements to the calculation of the multiplier once the index has been selected. Four such refinements are described: the choice of the compounding period, the calculation of the mean interest rate, fractional compounding periods, and income taxes. The two most important refinements are for the compounding period and income taxes.

168. See Gorenstein Enters., Inc. v. Quality Care—USA, Inc., 874 F.2d 431, 437 (7th Cir. 1989) (Posner, J.) (choosing "the prime rate for convenience" but noting that "the interest rate paid by the defendant for unsecured loans" would be "a more precise estimate").

169. Amoco Cadiz, 954 F.2d 1279, 1333 (7th Cir. 1992).

170. Id. (explaining Amoco's position that the French plaintiffs were "not entitled to an increase" in the Treasury bill rate "[b]ecause the district court could (and in Amoco's view should) have declined to award any prejudgment interest").

171. See Gorenstein, 874 F.2d at 436-37 (announcing "that prejudgment interest should be presumptively available to victims of federal law violations," rejecting the use of the Treasury bill rate to calculate prejudgment interest "because there is no default risk with treasury bills," and choosing the prime rate for convenience but noting that a better estimate would be the interest rate paid by the defendant for unsecured loans).

172. However, neither method will produce the precise, theoretically correct interest rate. The first method does not take account of duration, and the second method does not adjust for the many features included in corporate debt that influence interest rates. Although there are methods to adjust for these effects, neither method eliminates the problem of the market's evolving estimate of the final judgment, which cannot be completely fixed. See supra note 140.
A. Choice of Compounding Period

A frequently overlooked aspect of the litigation of prejudgment interest is the compounding period. All interest rates, either explicitly or implicitly, assume a compounding period. The compounding period refers to the frequency with which interest is calculated, and the number of compounding periods in a year is denoted by \( n \). Yearly compounding means that interest is calculated just once a year (so \( n = 1 \)); monthly compounding means that it is calculated once a month (so \( n = 12 \)). The compounding period is important when calculating compound interest, which is how prejudgment interest should be calculated, as opposed to simple interest.\(^{173}\) Because compound interest calculates interest on interest, the more frequent the compounding, the greater the amount of interest.

For example, assume that a court has decided to calculate interest on a judgment by reference to a 10% interest rate that reflects the rate paid on bonds issued by the defendant. If the judgment is for $1 million and interest is to be calculated for one year, then the judgment including interest would be for $1.1 million, with $100,000 interest. However, corporate bonds usually pay, and thus compound, interest every six months.\(^{174}\) Thus, the bond probably pays 10%, compounded semiannually, which means that the interest rate is 5% over each six-month period. Hence, over the first six months, $50,000 interest will accrue. After six months, the outstanding balance is $1,050,000. On this amount, interest will accrue at the rate of 5% over the next six months, producing an additional $52,500 interest. Therefore, the total interest on the judgment will be $102,500. The $2,500 interest accrual in the second six-month period exceeds the interest accrued during the first period because of compounding. It is the 5% interest on the $50,000 interest generated in the first period. It is a general principle that for a given stated interest rate, more interest accrues the shorter the compounding period.

Moreover, the impact of the choice of compounding period on the award can be substantial. For example, the Amoco Cadiz court awarded interest at the prime rate compounded yearly.\(^{175}\) The court did not take into account the practice that prime rate loans typically call for quarterly interest compounding.\(^{176}\) Adjusting the interest rate calculation for the

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173. See supra subpart II(A).
175. Amoco Cadiz, 954 F.2d at 1332.
176. Other courts have. For example, in a patent suit brought by Mobil against Amoco, Mobil was awarded prejudgment interest at the prime rate, compounded quarterly. See Mobil Awarded $91 Million Against Amoco, REUTERS LTD., Oct. 3, 1994, available in LEXIS, News Library, ARCNWS file (awarding "prejudgment interest compounded quarterly based on the prime rate"). That opinion was later withdrawn without explanation. See Patent, Opinion Recalled, 49 Pat. Trademark & Copyright J. (BNA) No. 1207, at 138 (Dec. 8, 1994).
more frequent compounding that the quoted rate presumes would have increased the interest component of the award by about $11 million.\textsuperscript{177}

The above discussion implies that the calculation of interest on a judgment should use the same compounding period that is used with the reference interest rate. If that compounding period is not used, the court is using not the reference interest rate but a different rate to calculate interest.\textsuperscript{178}

B. Of Means, Arithmetic and Geometric

The usual method of setting an interest rate with which to calculate prejudgment interest is to take an average (mean) of interest rates from the injury until the judgment.\textsuperscript{179} The mean rate is commonly calculated by taking a sample of rates over the prejudgment period, adding these rates together, and dividing by the number of observations to produce a mean rate of interest. That mean interest rate, called the arithmetic mean, is then used to determine the multiplier by plugging that value into equation (3).

\textsuperscript{177} A loan that pays interest of 11.85%, compounded quarterly, actually pays interest at 2.9625% each quarter. Over 10.6 years, there are 42 full quarterly compounding periods and 40% of a 43d. Thus, the multiplier can be calculated as follows:

\begin{equation}
(1 + \frac{.1185}{4})^{43} - (1.029625)^{42} - 3.4482.
\end{equation}

Accordingly, the total award can be calculated as follows:

\begin{equation}
$65 million \times 3.4482 = $224.133 million.
\end{equation}

That is an increase of $11.1 million from the final award arrived at by the Amoco Cadiz court. Thus, by correctly compounding interest quarterly, the interest component of the award would have been increased by about 7.5%.

\textsuperscript{178} See Hughes Aircraft Co. v. United States, 31 Fed. Cl. 481, 493 (1994) ("[W]e are mindful that rate of interest and compounding period are inextricably related."). aff'd, 86 F.3d 1566 (Fed. Cir. 1996). Another way to give effect to this prescription is to calculate the effective interest rate from the stated interest rate and then calculate interest using annual compounding. The formula for the effective interest rate, \( r_e \), is

\begin{equation}
r_e = (1 + \frac{r}{n})^n - 1,
\end{equation}

where \( r \) is the stated interest rate and \( n \) is the number of compounding periods in a year. Thus, if interest is compounded quarterly, \( n = 4 \), and if it is compounded monthly, \( n = 12 \). See ROSS ET AL., supra note 73, at 91. An interest rate of 11.85%, compounded quarterly, is equivalent to an effective interest rate of 12.39%, which is calculated as follows:

\begin{equation}
.1239 = (1 + \frac{.1185}{4})^4 - 1.
\end{equation}

\textsuperscript{179} The term "mean" is used instead of "average" because average is ambiguous. Average can imply the mean value as described above, or the median value (the value for which half the observations are below and half above) or the mode (the value that occurs most frequently). See DARRELL HUFF, HOW TO LIE WITH STATISTICS 28 (1954).
This method, although it has the virtue of simplicity, is wrong and biased against the defendant because it systematically overestimates the correct amount of interest.

In order to calculate the interest that accrues on the original judgment, a court should calculate the geometric mean of the forward factors. The motivation for this result comes from the principle of compounding. Because the accumulated value of an investment will grow by the forward factor over each compounding period, the compound average rate of growth (i.e., the constant rate of growth that will produce the same ending value) is the geometric mean. The rationale for using the geometric mean is easier to understand through an example.

Suppose that in each of two successive years an asset will either double in value ($r=100\%$) or halve in value ($r=-50\%$), both with probability 50%. Accordingly, a $1$ investment will either be worth $2$ or $0.50$ at the end of the first year. Suppose that the asset's performance over the two-year period results in the asset doubling in one year and halving in the other, so that the asset's price ends up exactly where it started. This implies that a constant annual return of zero over the two years would replicate the total return on the asset. Consequently, the geometric mean rate of return is zero.

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180. The geometric mean, $\mu_g$, of $z$ observations $-O_1, O_2, \ldots, O_t, \ldots, O_z-$ is the $z$th root of their product:

$$\mu_g = (O_1O_2\ldots O_z)^{1/z}.$$  

In contrast, the arithmetic mean, $\mu_a$, is their sum divided by $z$:

$$\mu_a = \frac{O_1 + O_2 + \ldots + O_z}{z}.$$  

181. See BODH ET AL., supra note 122, at 721.

182. The example comes from id. at 722-23.

183. Assuming that the asset first doubles in value, it will be worth $2$ at the end of the first year. Since it is assumed to lose half of its value during the second year, it will be worth $1$ at the end of that year. This can be written as

$$FV = $1(1 + 1)(1 - .5) = $1.$$

184. The formula for the geometric mean rate of return, $r_g$, over two periods is given by

$$r_g = \frac{(1 + r_1)(1 + r_2)^{1/2} - 1.}$$

Because of the commutative property of multiplication, the order in which the returns are realized does not affect the ending value. Substituting in the realized returns, the equation for the geometric mean can be written

$$r_g = \frac{(1 + 1)(1 - .5)^{1/2} - 1 - 0,}$$

which implies that the geometric mean return is zero, $r_g = 0.$
However, the arithmetic mean rate of return over the two years is not zero, but 25%. Of course, an investment yielding 25% a year over two years will not replicate the total return earned on the asset, which is zero, but will greatly exceed it. The result, that the arithmetic mean exceeds the geometric mean, is not coincidental. Geometric means will never exceed arithmetic means, and as long as there is any variability in the periodic return, the arithmetic mean will exceed the geometric. Moreover, the difference between the two becomes greater as the volatility of returns increases.

The principal result that emerges from this subpart is straightforward and simple. Courts incorrectly calculate prejudgment interest when they calculate the arithmetic mean of the relevant interest rates and then use that rate to calculate the total award. Instead, the theoretically correct method is to calculate the geometric mean of the forward factors and then use that rate to calculate the total award on a constant interest basis. The formula for the periodic geometric mean rate of return for a T-year investment, $r_A/n$, is given by

185. The arithmetic mean rate of return, $r_A$, is the sum of the two periodic returns divided by 2:

$$ r_A = \frac{r_1 + r_2}{2}. $$

Thus, the arithmetic mean is

$$ r_A = \frac{100\% + -50\%}{2} = 25\%. $$

186. With a compounded annual return of 25%, $1 will grow to $1.5625 at the end of two years.

187. See BODIE ET AL., supra note 122, at 721.

188. See id. (noting that in a 60-year period of tracking various investments, the greatest difference between means occurs with stocks of small firms, which have the greatest standard deviation in their annual returns).

189. The general formula for the periodic arithmetic mean, $r_A/n$, is as follows:

$$ r_A/n = \frac{r_1 + r_2 + \ldots + r_T}{n}. $$

190. The periodic interest rate is $r_A/n$, and there are $n$ compounding periods in a year. The annual interest rate, which is the way interest rates are usually expressed, is $r_A$, compounded $n$ times in a year. Throughout this Article, I follow the usual convention of expressing interest rates as annual rates.

191. The equation for the geometric mean can easily be expanded to take into account more observations than compounding periods. Suppose, for example, that a court decides to use the one-year Treasury rate to calculate prejudgment interest over a five-year period from January 1, 1991, through December 31, 1995. The court could use the rate on January 1 of each year, which would give it five observations. However, there is no particular reason to favor the rates on January 1 over any other day of the year. In particular, if there is an upward trend in interest rates over the five years, looking at interest rates at the beginning of each year would underestimate accrued interest. Similarly, choosing a date at the end of the year would overestimate accrued interest. A more accurate measure of interest rates over the five-year period would take samples more frequently, perhaps quarterly or even daily depending on the amount involved. When the geometric average return is calculated in this manner, $nT$ in equation (4) is the number of observations instead of the number of compounding periods.
\[
\frac{r_n}{n} = \left[\left(1 + \frac{r_1}{n}\right)\left(1 + \frac{r_2}{n}\right)\ldots\left(1 + \frac{r_i}{n}\right)\ldots\left(1 + \frac{r_n}{n}\right)\right]^{1/n} - 1, \quad (4)
\]

where \(r/n\) is the return in each period.192

Using the computer databases, my research assistants and I examined the cases in which prejudgment interest has been awarded. We were unable to find any discussion of the proper method of averaging interest rates for the purpose of calculating prejudgment interest. Undoubtedly, some courts have used the geometric mean because lawyers, and, more frequently, the experts they have hired, have calculated prejudgment interest that way and the courts have accepted their calculations. However, because the arithmetic mean is far more familiar to most people, especially anyone who has ever calculated a grade point average, I suspect that most calculations use it and are, therefore, theoretically flawed.

Although it is theoretically incorrect to use the arithmetic mean to calculate interest, the error that results from using it instead of the geometric mean is probably small. For example, the plaintiffs in \textit{Amoco Cadiz} would have been awarded about $1 million less had the court used the geometric mean instead of the arithmetic.193 Although $1 million is

There is one cautionary note when the number of observations exceeds the number of compounding periods. The resulting calculation for the full value of the award will no longer replicate the performance that an investor could have obtained by investing the original judgment in Treasury securities at the date the injury occurred. However, this should not be a concern because the court's task is not to calculate what the plaintiff could have received by investing in one-year Treasury securities and rolling over the investment at the end of each year.

192. To see that the geometric mean is the theoretically correct mean to use, substitute equation (3) into equation (2), which yields

\[
FV = J \times \left(1 + \frac{r_m}{n}\right)^T.
\]

Setting this last equation equal to equation (1), which expresses \(FV\) as a function of \(J\) and the forward factors, and dividing both sides by \(J\), yields

\[
\left(1 + \frac{r_m}{n}\right)^T = \left(1 + \frac{r_1}{n}\right)\left(1 + \frac{r_2}{n}\right)\ldots\left(1 + \frac{r_i}{n}\right)\ldots\left(1 + \frac{r_n}{n}\right).
\]

Taking the \(n\)th root of each side and subtracting one yields the formula for the correctly calculated periodic mean interest rate:

\[
\frac{r_m}{n} = \left[\left(1 + \frac{r_1}{n}\right)\left(1 + \frac{r_2}{n}\right)\ldots\left(1 + \frac{r_i}{n}\right)\ldots\left(1 + \frac{r_n}{n}\right)\right]^{1/n} - 1.
\]

Because the above formula for \(r_m/n\) is also the formula for \(r_j/n\), equation (4), the geometric mean is the correct mean to use.

193. The plaintiffs in \textit{Amoco Cadiz} claimed that the average prime rate over the 1980s was 11.9%. \textit{Amoco Cadiz}, 954 F.2d 1279, 1335 (7th Cir. 1992). Using data published by the federal government, the arithmetic mean of the prime rate over the 1980s was 11.85% (rounded to four decimal places). \textit{See} \textit{Economic Report of the President, supra} note 149, at 358 tbl.B-72 (listing the bond yields and interest rates from 1929-1994); \textit{infra} Appendix Table 2. The corresponding geometric mean was
not an amount that most lawyers or their clients would ignore, it is less than one percent of the interest component of the award. Thus, the practical significance of calculating the mean interest rate in the proper way is likely to be small in most cases.194 Given the additional complexity of calculating the geometric mean and the relatively small amounts involved,195 I am not surprised that we could find no discussion of it.196

<table>
<thead>
<tr>
<th>Method of Calculating Mean</th>
<th>Mean</th>
<th>Multiplier</th>
<th>Total Award ($ millions)</th>
<th>Interest Component ($ millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arithmetic</td>
<td>11.85</td>
<td>3.2775</td>
<td>213.037</td>
<td>148.037</td>
</tr>
<tr>
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<td>11.80</td>
<td>3.2620</td>
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194. Given the volatility of interest rates over the prejudgment period in Amoco Cadiz, unless interest rates become much more volatile, it is unlikely that the method of calculating the mean interest rate will have a large effect in many cases.

195. In addition, the time and effort that would have to be devoted to explain the proper averaging method to the decision-maker might not be worth the effort. See Michael Brookshire & Frank Sleanick, 1993 Survey of NAFE Members: A Follow-Up Survey of Economic Methodology, 7 J. FORENSIC ECON. 25, 31-32 (1993) (asserting that a simple and less accurate method is appropriate for estimating trend values).

196. There is a second lesson that emerges from this subpart and that lesson, unfortunately, is neither straightforward nor simple to follow. The arithmetic mean had the desirable property that it allowed adjustments that were either a simple increase or decrease of a fixed number of percentage points or a multiple of the rate to be made after the calculation of the mean. Making such adjustments after calculating the arithmetic mean was equivalent to calculating the mean of the adjusted values. In contrast, the geometric mean does not have this desirable property. With the geometric mean, neither adjustments that are a fixed multiple of the rate nor fixed increases or decreases can be made after the calculation of the mean without changing the result. Such adjustments must be applied to each entry before calculating the mean if the resulting value is to be the geometric mean of such adjusted values.

To see that adjusting the geometric mean is not equivalent to calculating the geometric mean of the adjusted entries, return to the example above. Assume that the plaintiff's marginal tax rate is 50%, and assume that the tax treatment of prejudgment interest changes so that it is not includable by the plaintiff. Since prejudgment interest is assumed not to be includable in income, the appropriate rates of return would be cut in half. Thus, the first year's return would be 50% and the second year's return -25%. The resulting product of the future value factors (1.125%) implies a compound annual interest rate of 6.07%. (Recall that the periodic returns were 100% and then -50%. With a 50% tax rate, the after-tax returns, assuming the losses are fully deductible, are 50% and -25%. Thus, the forward factors are (1 + .5) and (1 - .25), and their product is 1.125, the square root of which is 1.0607, which implies a constant annual rate of return of 6.07%.) This is not equal to the before-tax compound annual interest rate (0%) reduced by the tax rate (still 0%). Thus, since the compound adjusted interest rate is correct only if each entry is adjusted before calculating the mean value, proper interest calculation requires such a process. The difference, however, is probably small in most cases.
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C. Fractional Periods

One problem that is likely to arise frequently in the calculation of prejudgment interest is what to do with fractional periods. Rarely will the prejudgment period coincide precisely with a whole number of the reference rate's compounding periods. Thus, to calculate interest for the prejudgment period, the court will likely have to calculate interest for fractional periods, either at the beginning or end of the prejudgment period.197

There are two ways to calculate interest for a fractional period. The first is to assume that simple interest is paid within each compounding period.198 For example, if the compounding period were 180 days \((n=2)\) and 45 of the 180 days were to be included at the end of the prejudgment period, then the interest for the fractional period would be one-fourth of the interest that would be due if the entire compounding period were included. If the prejudgment period were 3 years and 45 days \((T=3.125)\) and the interest rate were 10\%, compounded semiannually, the multiplier would be 1.3568, which is the multiplier for 6 periods \((1.3401)\) plus one-fourth of the difference between the multipliers for 7 \((1.4071)\) and 6 periods.199 The second method is to calculate compound interest over the partial last period by putting the fraction into the exponent.200 Thus, the exponent would be 6.25 and the multiplier would be 1.3565.201 Because simple interest accelerates the accrual of interest within a compounding period, the first method would produce a slightly higher result than the second.202 In the above example, the difference would be less than thirty cents on each $1000 of the original judgment.203

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197. For an amusing discussion of how many days there are in a year for the purpose of calculating prejudgment interest, see Amoco Cadiz, 789 F. Supp. 268, 270-71 (N.D. Ill. 1992), aff'd mem., 4 F.3d 997 (7th Cir. 1993).

198. This is equivalent to paying interest on a pro-rata basis within a compounding period.

199. When simple interest is provided over a fractional period, the multiplier given in equation (3) becomes:

\[
m = (1+r)^{nT'} + f((1+r)^{nT'} - (1+r)^{nT}),
\]

where \(nT'\) is the number of completed compounding periods and \(f\) is the completed portion of the last period.

200. This is equivalent to assuming continuous compounding within a compounding period.

201. The exponent (6.25), the number of compounding periods, is the product of \(n\) (2) and \(T\) (3.125).

202. See Financial Compound Interest and Annuity Tables 2051-52 (Charles H. Gushee ed., 6th ed. 1980). Compound interest generates more interest than simple interest across two or more complete compounding periods. Id. at 2051. However, simple interest generates interest more rapidly within a single period. Id.

203. This is less than one-thirtieth of 1\% of the final award and less than one-tenth of 1\% of the interest component of that award.
Returning to *Amoco Cadiz*, the prejudgment period is 10.6 years. Compounding interest yearly, there are ten complete compounding periods and 60% of an eleventh. Thus, using the first method (simple interest) to calculate interest over the fractional period, the multiplier would be 3.2824, which is the multiplier for 10 years (3.0645) plus 60% of the difference between the multiplier for 11 years (3.4276) and the multiplier for 10 years. The second method (continuously compounded interest) produces a multiplier of 3.2775.²⁰⁴ Hence, the total award with the first method is $213.355 million, which is $318,000 more than the award with the second method.²⁰⁵

The theoretically correct method to calculate prejudgment interest is the same method that the parties to the referenced financial transaction would use in calculating fractional period interest if the occasion arose. This will usually be the first method, the simple interest calculation for fractional periods, because this is the standard bond convention.²⁰⁶ If, however, the reference rate called for the second method, continuously compounded interest, then that method would be the one to use. In practice, however, the difference is unlikely to be large enough to warrant much attention.

D. Adjusting the Multiplier for Taxes

Much has been written on the tax treatment of legal recoveries, which includes prejudgment interest. That literature takes the judgment as given and seeks to examine from the perspective of tax law what the proper tax treatment should be. That literature does not ask whether courts correctly assess judgments and therefore does not propose to adjust their tax treatment to offset any systematic errors in calculation. Instead, the literature assumes that judgments, on average, are correctly calculated, or if there are systematic errors in calculation, these errors fall within the purview of others to correct, and it seeks to assess the proper tax treatment according

²⁰⁴. See supra text accompanying note 67.
²⁰⁵. This is a difference of about one-fifth of 1% of the interest component. The difference is much smaller with quarterly compounding. There are 42 complete compounding periods and 40% of a forty-third. The first computational method produces a multiplier of 3.4486, which is the multiplier for 42 periods (3.4082) plus 40% of the difference between the multiplier for 43 periods (3.5091) and the multiplier for 42 periods. The second computational method produces a multiplier of 3.4482. The difference in the award is about $23,000, less than one-fiftieth of 1% of the interest component. In general, the shorter the compounding period, the smaller the difference from choosing one or the other computational method for fractional periods.
²⁰⁶. See FRANK J. FABOZZI, FIXED INCOME MATHEMATICS 73-74 (rev. ed. 1993) (stating that accrued interest on a bond between coupon payments is calculated pro-rata); FINANCIAL COMPOUND INTEREST AND ANNUITY TABLES, supra note 202, at 2053 ("[I]n the case of bonds it is customary to compute simple accrued interest from the last coupon date.").
to tax principles. In this Article, I adopt the opposite approach. Because this is not a tax article, I do not consider whether the current tax treatment of prejudgment interest is correct. I only consider how interest should be calculated in light of the tax treatment the law provides. Thus, if the tax treatment of prejudgment interest is changed, the calculations will have to be modified.

This Article has so far described how prejudgment interest should be calculated without taking taxes into account. When the calculation takes taxes into account, the multiplier has to be modified because the tax treatment of prejudgment interest does not precisely mirror the tax treatment of corporate bond interest generally. The principal result that emerges is that taxes will reduce the multiplier because both the original award and prejudgment interest on that award are deferred for tax purposes.

There are two ways in which the tax treatment of prejudgment interest might differ from that of interest generally—characterization and timing. Starting with characterization, prejudgment interest is treated as interest for tax purposes and does not take its character from the underlying judgment. Thus, prejudgment interest is deductible by the payor and includable by the recipient, which means that prejudgment interest is characterized in the same manner as interest generally. Accordingly, because prejudgment interest is taxable, prejudgment interest should be awarded at a before-tax rate.


208. Brabson v. United States, 73 F.3d 1040 (10th Cir. 1996) (holding that prejudgment interest is taxable to the plaintiff because it is compensation for the lost time value of money in obtaining a judgment and lacks the necessary immediate link between the award and the injury to qualify for the statutory exclusion of damages received on account of personal injuries or sickness under I.R.C. § 104(a)(2) (1994)), rev'd 859 F. Supp. 1360, 1361 (D. Colo. 1994) (holding that mandatory prejudgment interest paid to personal injury victims is not taxed because under Colorado law it is characterized as damages), *petition for cert. filed*, 64 U.S.L.W. 3709 (U.S. Apr. 10, 1996) (No. 95-1641); Commissioner v. Raphael, 133 F.2d 442, 444-47 (9th Cir. 1943) (holding that prejudgment interest is taxable to the plaintiff even when the underlying judgment is tax exempt); Koves v. Commissioner, 100 T.C. 124, 131 (1993) (stating that statutorily imposed prejudgment interest is not excluded from income as damage on personal injury and is therefore taxable), *aff'd mem.*, 25 F.3d 1048, cert. denied, 115 S. Ct. 424 (1994); Michael Asimow, *The Interest Deduction*, 24 UCLA L. REV. 749, 770-72 (1977) (asserting that the line of authority that stands for the proposition that prejudgment interest should be taxed like the underlying damage award has been discredited); Feinberg, * supra* note 207, at 376-77 (noting that prejudgment interest is taxed to the recipient as interest regardless of how the underlying claim is taxed).
If both the characterization and timing of prejudgment interest were identical to those of interest generally, it would be appropriate to award prejudgment interest as described above, when taxes are ignored. Awarding prejudgment interest at the stated interest rate would place the successful plaintiff in the same position that it would have been in, both before and after paying taxes, had the defendant paid its liability immediately and had the plaintiff loaned the proceeds to the defendant in exchange for an unsecured promise by the defendant to later repay the loan with interest.209

However, the timing of the creditor's interest inclusions and the debtor's deductions are not the same with prejudgment interest as they would be on a debt instrument with the same terms. Prejudgment interest is taxed when it is paid,210 whereas interest generally (including bond interest) is taxed as it accrues, even if it is not paid until much later.211 Thus, compared with interest on a bond, the inclusions and deductions with prejudgment interest are tax deferred.

The deferral of tax on prejudgment interest together with interest compounding imply that on an after-tax basis the plaintiff would be overcompensated and the defendant would overpay if the final judgment were calculated using the multiplier in equation (3) without an adjustment for taxes. Because of compounding, the plaintiff earns interest on money that it would have paid in taxes (on interest previously earned) were the liability paid immediately and the proceeds invested in the defendant's debt. Accordingly, the present value of the plaintiff's tax liability on the prejudgment interest award is less than what its corresponding liability would be on bond interest if the damages were paid immediately and the proceeds invested at the same interest rate in the defendant's unsecured debt. Therefore, because the plaintiff's tax liability from prejudgment interest is less than its liability from the interest on a bond with the same terms, the multiplier and the award should be reduced to account for taxes.

Similarly, the defendant overpays unless the multiplier is modified to reflect the deferral of tax on prejudgment interest. If the defendant paid

209. This assumes that the settlement and the loan would be treated as separate transactions for tax purposes and would not be combined into a deferred settlement. See Treas. Reg. § 1.461-4(g)(1)(ii)(A) (as amended in 1995) (specifying that payment of a liability arising under a tort, breach of contract, or violation of law as outlined by Treas. Reg. § 1.461-4(g)(1)(ii) (as amended in 1995) "does not include the furnishing of a note or other evidence of indebtedness of the taxpayer").

210. It cannot be taxed as it "accrues" because the obligation is not fixed until the award is final and because the taxpayer must file a return shortly after the end of each year for the previous year. The taxpayer cannot delay filing until all transactions that began during the year are completed. See 26 U.S.C. § 441(a) (1994); Temp. Treas. Reg. § 1.441-1T(b)(1)(ii)(B) (as amended in 1987) (stipulating that unless otherwise provided a "taxable year may not cover a period of more than 12 calendar months").

211. This is the result of the original issue discount (OID) rules. The OID rules are codified at 26 U.S.C. §§ 1271-1275.
the plaintiff immediately and the plaintiff invested the proceeds in unse­
cured, zero-coupon debt issued by the defendant, the defendant would not
have to wait until the bond matured and the interest was paid to deduct its
interest expense. Instead, each year the defendant would deduct the in­
terest that accrued during that year. Thus, once again, the multiplier
should be reduced, but now it is because the defendant’s tax benefit from
interest paid on a bond is greater than its benefit from an equivalent award
of prejudgment interest.

In order to adjust the award for the deferred tax on prejudgment in­
terest, the court should recognize that had the defendant paid the plaintiff
immediately and had the plaintiff invested the proceeds, the plaintiff would
have paid taxes all along on the accrued interest. Accordingly, the plaintiff
would have earned interest after paying taxes not at the stated (before-tax)
interest rate but at the after-tax rate. Thus, because the plaintiff will be
taxed on prejudgment interest only when it is received, prejudgment
interest should be awarded at the after-tax interest rate and then grossed up
for taxes when it is received. This will leave the plaintiff, after paying
taxes, with the same after-tax award. It will also leave the defendant in the
same position as it would be if it borrowed the money to pay the
plaintiff because it would have received interest deductions all along.
Therefore, when the tax treatment of prejudgment interest is taken into
account, the multiplier, denoted by $m_{AT}$, becomes:212

$$m_{AT} = \frac{(1 + \frac{r_{mAT}}{n})^{nT} - 1}{1 - \tau_T} + 1,$$

where $\tau_T$ is the tax rate in year $T$ and $r_{mAT}$ is the mean after-tax interest
rate, with $r_{mAT} = r_1(1-\tau_T).$213

There are two complications with calculating a multiplier using equa­
tion (5) that are not present when using equation (3). First, a quick look
at equation (5) reveals that the court needs more information to calculate
the multiplier with equation (5) than with equation (3). Equation (3) is a
function only of the stated interest rate and time; it is not a function of
corporate tax rates. In contrast, equation (5) is a function not only of the

212. The intuition behind equation (5) is as follows: the numerator is the after-tax interest
component of the multiplier and the denominator is the gross-up. One is added to the multiplier
because the original award is not grossed-up, which is also why one is subtracted in the numerator.

213. If prejudgment interest were not taxable, but bond interest still were, it would not be
appropriate to gross up the payment. Accordingly, the multiplier would become

$$m_{AT} = \frac{(1 + \frac{r_{mAT}}{n})^{nT}}{1 - \tau_T}.$$
stated interest rate and time, but also of corporate tax rates over the prejudgment period. The additional burden of making this more complicated calculation, however, is small. The defendant's past tax rates can be readily determined from the defendant, and the calculation is easy to do with a spreadsheet.

The second complication from calculating the multiplier using equation (5) is that the plaintiff and the defendant might require different multipliers. Only if the plaintiff and the defendant are both subject to tax at the same rate will they have the same multiplier. If, however, the parties are subject to tax at different rates, they will have different multipliers because each party's multiplier is a function of its history of marginal corporate tax rates. In this event, any multiplier set by the court will at most be right for only one side, and hence, the court must decide upon which party to focus attention because the final judgment will either be too large or too small for the other party.214

Adjusting the multiplier for the tax treatment of prejudgment interest is not the only modification that tax considerations might require. In order to satisfy the goals of fairness and efficiency, the multiplier might also have to be adjusted to reflect the tax treatment of the original judgment. Equation (5) implicitly assumes that there would be no tax consequences to either party from paying the award immediately. That is to say, if the defendant paid the plaintiff immediately, the plaintiff would not be taxed and so could turn around and invest the entire payment. If, however, an immediate payment would be taxable to the plaintiff, then the plaintiff could not invest the entire award but only the after-tax award.215 (Similarly, if the defendant could have deducted its payment to the plaintiff, that would have reduced its after-tax payment and hence the amount it must borrow to pay the plaintiff.) On this amount, the plaintiff will earn interest and pay taxes each year, as described above. Compounding interest at the after-tax rate yields what the plaintiff would have accumulated after taxes, assuming that it had been paid immediately.

Once again, to calculate the final judgment, the after-tax award must be grossed up, so that the plaintiff will be left, after paying taxes, with the after-tax award. Accordingly, when the original award is taxable, the multiplier, now denoted by $m_{cr}$, may be written as216

214. This problem is especially likely to occur when the defendant is a municipality because the interest paid on the judgment is taxable to the plaintiff, whereas interest paid on municipal bonds usually is not. Thus, if the award is to compensate the plaintiff, then the defendant's cost of unsecured (tax exempt) borrowing must be increased to reflect the tax paid by the plaintiff on the interest. Alternatively, if the award is to deter the defendant, then it would not be necessary to increase the interest rate to ensure that the defendant does not benefit from the delay.

215. The effect is the same if the immediate payment of the award would cause the plaintiff to lose a deduction or exclusion that it otherwise would have had.

216. The intuition behind equation (6) is that the numerator is the after-tax component of the multiplier and the denominator is the gross-up. One is neither subtracted from the numerator nor added to
(6)

\[ m_{at} = \frac{(1 - \tau_o)(1 + \frac{r_m^{AT}}{n})^{nT}}{1 - \tau_T} \]

where \( \tau_T \) and \( r_m^{AT} \) are as defined in equation (5) and \( \tau_o \) is the tax rate at the time of injury.\(^{217}\) Multipliers calculated using equation (6) will usually be smaller than those calculated using equation (5) because with the latter there is no interest on that portion of the original award that the plaintiff would have paid in taxes (and that the defendant would have saved in taxes).\(^{218}\)

Which multiplier a court should use depends on the tax situations of the parties and the nature of the award. The court must first decide whether to focus on the plaintiff or the defendant, or a weighted average of the two. Then it should inquire into whether the award, if paid immediately, would be taxed to the plaintiff or deductible by the defendant, as relevant. If it would be taxed, use equation (6); if not, use equation (5). In all cases, use the relevant party’s tax rates. Equations (5) and (6) both reduce to equation (3) when all tax rates are zero.

In *Amoco Cadiz*, for instance, the court properly compensated the French plaintiffs, which were tax-exempt government entities, by using equation (3) because their recovery and interest earnings were not reduced by taxes.\(^{219}\) If, however, the primary purpose behind the award had been to prevent Amoco’s unjust enrichment or to deter future spills, then an adjustment would have been necessary and the court should have used equation (6).

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\(^{217}\) If prejudgment interest were not taxable, but the award were, then the multiplier would become:

\[ m_{at} = (1 - \tau_o)((1 + \frac{r_m^{AT}}{n})^{nT} - 1) + \frac{1 - \tau_o}{1 - \tau_T} \]

\(^{218}\) It is possible for the result to be reversed if tax rates have increased sharply. This is most likely to occur when interest rates are low and the prejudgment period is short. The intuition is that a larger award is necessary to compensate the plaintiff for the higher tax rate that is in effect when the judgment is paid versus the tax rate that would have applied had there been an immediate payment. If interest rates are low and the prejudgment period is short, then the additional interest that is a result of the higher tax rate prevailing at the end of the prejudgment period with equation (6) will exceed the interest earned on that portion of the original award that would have been taxed had it been paid immediately.

\(^{219}\) The Seventh Circuit suggested that such an adjustment should have been made, but it made no attempt to do so. See *Amoco Cadiz*, 954 F.2d 1279, 1331 (7th Cir. 1992). Yet if the purpose of the award is to compensate the plaintiffs, as the court suggested, *see id.*, then no adjustment is necessary.
In general, equation (6) will give the correct multiplier when the purpose of the award is to prevent the defendant's unjust enrichment because the defendant would have been entitled to a deduction as soon as it had paid the plaintiff but no sooner. When the purpose of the award is to compensate the plaintiff, the analysis is more complicated. If the award is taxable when it is received, then equation (6) gives the correct multiplier. On the other hand, if the award is not taxable at that time, then equation (5) gives the correct multiplier.

220. The Treasury regulations provide that a deduction for a liability arising out of a legal dispute can only be taken when the liability is paid. See Treas. Reg. § 1.461-4(g)(2) (as amended in 1994). However, if the payment is a fine or penalty paid to the government, it is not deductible. See 26 U.S.C. § 162(f) (1994). In that case, because accelerating the payment would not accelerate a deduction, the court should use equation (5).

221. Thus, the court should also use equation (5) when the award compensates the plaintiff, the plaintiff is an individual, and the award is for personal injury, wrongful death, or a violation of civil rights because such awards are exempt from taxes. See MARVIN A. CHIRELSTEIN, FEDERAL INCOME TAXATION: A GUIDE TO THE LEADING CASES AND CONCEPTS 40-42 (7th ed. 1994) (describing the limits of the tax exemption for damage award recovery).

222. The Treasury regulations provide that the taxpayer cannot claim a loss when "there exists a claim for reimbursement with respect to which there is a reasonable prospect of recovery." Treas. Reg. § 1.165-1(d)(2)(i) (as amended in 1977). In such a case, the loss is held in abeyance until it can be ascertained whether reimbursement will be received. Id. Consequently, since the loss is deferred, it is offset by the reimbursement.

223. I ignore state income taxes, which should also be included. If the state tax rate is τ_s and the federal rate is τ_f, then because state income taxes are deductible for federal income tax purposes, the combined total tax rate, τ_C, is given by:

\[ τ_c = τ_s + τ_f(1 - τ_s). \]

The combined total income tax rate should be used in the multiplier.

prime rate in the same manner as the *Amoco Cadiz* court, but adjusting for the tax treatment of prejudgment interest only (using equation (5)), the final award would have been $162.166 million.\(^{225}\) Of course, this calculation does not take into account the deferral of tax on the original judgment. Because an immediate payment would have been deductible, the award necessary to prevent Amoco's unjust enrichment (using equation (6)) would have been even less—-$105.661 million.\(^{226}\)

In *Hughes Aircraft Co. v. United States*,\(^{227}\) the government, which had infringed a Hughes patent for positioning satellites in orbit, resulting in a large damage award in favor of Hughes, argued that the final award should be adjusted for taxes in a manner similar to that proposed in this section.\(^{228}\) The Court of Federal Claims, however, rejected that argument and calculated the award as described above without regard to taxes. Among other reasons, the court said that the method proposed by the government would inappropriately discriminate among successful plaintiffs whose tax rates vary.\(^{229}\) Such a modification, however, is not inappropriate; rather, it is necessary to compensate for plaintiffs' different tax situations. It is the failure to make these adjustments that introduces discrimination on an after-tax basis among plaintiffs; the adjustments are necessary to eliminate that discrimination. Moreover, the failure to adjust for taxes will systematically favor plaintiffs and disfavor defendants by awarding too much interest.\(^{230}\) Thus, such a rule would compromise the fairness and efficiency goals of prejudgment interest which require that the judgment be neither devalued nor increased by the passage of time. Awarding the correct amount of interest requires adjusting for the deferral of interest and the taxability of the judgment.

**E. Summary**

This Part has described four refinements to the calculation of prejudgment interest that affect the multiplier once the interest index has been selected. Two of them—assessing compound interest at a constant rate

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\(^{225}\) This is a 34\% reduction in the interest component of the award.

\(^{226}\) The latter award is as small as it is because of the large drop in the top marginal corporate tax rate that occurred in the middle of the prejudgment period. *See supra text accompanying notes 223-24.* Had the top rate remained at 46\%, the final award would have been about 20\% larger.


\(^{228}\) *Id.* at 494. *Note that in Hughes*, the governmental party was the defendant, not the plaintiff as in *Amoco Cadiz*, and so to compensate the private plaintiff for its loss would require using a tax-adjusted multiplier.

\(^{229}\) *Id.* at 495.

\(^{230}\) It will also favor high-bracket plaintiffs more than low-bracket ones.
equal to the geometric (not the arithmetic) mean interest rate over the prejudgment period and adjusting for fractional periods using the method of calculating such interest that would be used in the referenced transaction—although theoretically correct are unlikely to have a large impact on the final award. The other two refinements—adjusting for the compounding period and for income taxes—are not only theoretically necessary, but can also have a large impact on the final award. Consequently, prejudgment interest should be calculated with explicit reference to the compounding period, by setting $n$ equal to the number of compounding periods in one year on the referenced loan. Prejudgment interest should also be calculated after adjusting for the effect of income taxes on both the original award and on prejudgment interest. This requires not merely adjusting the numbers put into the multiplier, but modifying the multiplier itself.

V. Special Problems in the Choice of an Interest Rate

This Part returns to the selection of the rate at which prejudgment interest is assessed. It considers special situations that arguably might lead a court away from using the defendant's cost of unsecured borrowing. Specifically, this Part first considers whether a court should adjust the interest rate when the judgment forces the defendant into bankruptcy. This Part then looks at how a court might adjust the interest rate when one or more of the parties is not a publicly traded corporation but a close corporation or an individual. Finally, this Part looks at how a court should respond when the parties argue that a different interest rate should be used because the securities market is not efficient.

A. Judgments That Would Bankrupt the Defendant

Special problems arise in setting an appropriate interest rate when the judgment would have bankrupted the defendant had it been paid immediately. Bankruptcy is most likely to occur with mass torts in which the liabilities can be staggering. 231

For the purpose of calculating prejudgment interest, it is important to distinguish between immediate payments that would bankrupt the defendant and judgments that will bankrupt the defendant when they are later issued. This produces three new cases: (1) judgments that bankrupt the defendant when issued but would not have immediately bankrupted the defendant had they been paid when the injury occurred; (2) judgments that bankrupt the defendant when issued and would have bankrupted the defendant had they

231. Of course, with mass torts, most plaintiffs are individuals, and this fact raises additional problems. The calculation of interest when an individual is a party is discussed infra subpart V(B).
been paid when the injury occurred; and (3) judgments that would have bankrupted the defendant had they been paid when the injury occurred but will not do so when issued. The fourth category, judgments that would not have bankrupted the defendant and will not do so, has been the topic of discussion throughout this Article.

For judgments that would not have bankrupted the defendant had they been paid at the time of injury but will do so when they are issued, it is not appropriate to adjust the interest rate. The reason is that plaintiffs as a class are compensated for the possibility of less than full payment by a stated interest rate above the riskless rate: interest is awarded at a rate above the riskless rate because some plaintiffs are not paid their full judgment. Thus, when the loss occurs it should not be shifted to other creditors by raising the prejudgment interest rate.

The other two cases are more difficult to evaluate. Arguably, if the defendant would have been bankrupted had it immediately paid the plaintiff but will not now be bankrupted, the shareholders of the defendant will receive a windfall. Thus, it can be argued that the prejudgment interest rate should be increased to give the entire value of the equity to the plaintiffs. On the other hand, the risk that the value of the corporation will fall below the face value of the debt and later rise above it is one of the risks borne by debt. Even so, no one would pay more than the excess of the corporation's market value over its secured claims for an unsecured note payable only by the corporation, whatever the interest rate. This implies that there might be no interest rate at which the plaintiff would have preferred to be a creditor of the defendant rather than paid in full immediately. As a result, it is not clear what interest rate a court should select.

The last case is when the judgment both would have bankrupted the defendant if granted immediately and will do so now. With such judgments, there is again no interest rate high enough that creditors would voluntarily extend their obligation to the defendant. Thus, the problems are similar to those in the previous case.

Perhaps it is best to say that the analysis in this Article deals with the case in which the judgment would not have thrown the corporation into

232. See Ross s al., supra note 73, at 456-57. That risk increases with duration. 233. Moreover, when the judgment bankrupts the defendant, then there is an additional consideration that does not arise when an immediate judgment would have bankrupted the defendant but the judgment when issued does not. In this case, a larger recovery is at the expense of other creditors and a smaller one is to their benefit. The benefits and losses are not at the equityholders' expense, as is usually the case. Arguably, a court should preserve the plaintiff's fractional claim in the assets of the corporation. However, creditors other than tort creditors are better able to monitor and influence the corporation than are tort creditors. In addition, they might be thought to be more morally culpable. Thus, it might be appropriate that they should lose out to the plaintiffs. This would imply that a higher interest rate should be used.
bankruptcy had it been paid immediately. When an immediate judgment would have bankrupted the defendant, there are difficult policy questions that must be answered before proper financial principles can be applied to calculate prejudgment interest.

B. Individuals and Closely Held Corporations

Thus far, this Article has explicitly considered the calculation of interest for publicly traded corporations. The advantage of limiting the discussion to such companies is that it eliminates any difference between the interest rate that the plaintiff would require to lend to the defendant and the rate at which the defendant can obtain debt capital. However, when the plaintiff is an individual or a closely held corporation, there can be a substantial deviation between these rates. Accordingly, granting interest at the defendant's cost of borrowing might not fully compensate the plaintiff for the delay.

For the purpose of calculating prejudgment interest, it is important to distinguish two possibilities: when the defendant is an individual or a close corporation and when the plaintiff is an individual or a close corporation. When the defendant is an individual or a close corporation, the defendant's cost of unsecured borrowing will both compensate the plaintiff for the risk it must bear by virtue of its involuntary loan to the defendant and prevent the defendant's unjust enrichment.234 Thus, when the defendant is an individual or a close corporation, but the plaintiff is a public corporation, the calculation of prejudgment interest is unchanged. When the plaintiff is an individual or a close corporation, however, granting prejudgment interest at the defendant's cost of unsecured borrowing will often provide the plaintiff with less than full compensation for the risk it is forced to endure.

To illustrate that result, assume that the plaintiff is an individual, that the defendant is a publicly traded corporation, and that a suit results in a $5 million judgment in favor of the plaintiff. Unless the plaintiff is very wealthy, she will have had most of her wealth involuntarily tied up in the defendant corporation from the time of the injury until the enforcement of the final judgment. Had she had the $5 million immediately, however, she probably would not have invested all of it in any single corporation.235 Finance theory teaches that risk averse investors should diversify their

234. In addition, when the defendant is an individual, any judgment will usually be paid by an insurance company. In that case, it is not the ability of the individual defendant to pay the ultimate judgment but the insurance company's ability that determines the proper interest rate. Insurance is taken up in more detail in the discussion of multiple defendants. See infra subpart VI(D).

235. Thus, it is not the nature of the legal entity but the inability of the plaintiff to diversify away the risk of defendant's default that drives the result.
portfolios to reduce unique risk.\footnote{236} The incentive to diversify is strong because unique risk, also called unsystematic risk, is not compensated for in the market.\footnote{237} Thus, because the plaintiff cannot eliminate the unsystematic risk that is imposed on her by the defendant’s wrongful act,\footnote{238} granting prejudgment interest at the defendant’s cost of unsecured borrowing will not fully compensate her for the delay.\footnote{239}

A second reason that such a plaintiff will not be fully compensated for the delay is that delay reduces a plaintiff’s control over the timing of her consumption. Assume that the plaintiff described above was sixty years old with a small income and a grown family when the injury occurred. Assume further that it took ten years to adjudicate the case during which time neither her income nor her family relations changed. However much pleasure she would get from sharing her award with her family, friends, and favorite causes, such a plaintiff would probably be interested in her own consumption as well. Had she received $5 million when the injury occurred, she could have increased her consumption over the rest of her life. At seventy, she can still increase her future consumption, but she cannot increase her past ten years’ consumption. Although calculating prejudgment interest at the defendant’s cost of borrowing compensates the plaintiff for the interest she could have earned, it does not compensate the plaintiff for how she would have valued the additional consumption in the interim.\footnote{240}

\footnote{236} See \textit{Ross et al.}, \textit{supra} note 73, at 295.\
\footnote{237} See \textit{Burton G. Malkiel, A Random Walk Down Wall Street} 244 (5th ed. 1996). The total risk of an asset can be divided into two parts: systematic risk and unsystematic risk. Unsystematic risk is that portion that can be diversified away by combining the asset into a portfolio with other assets. The risk that cannot be diversified away is called systematic risk. The market compensates investors for the systematic risk they endure through higher expected returns. Investors, however, are not compensated for unsystematic risk, because that risk can be eliminated at very little cost by holding a diversified portfolio. \textit{Id.} at 200-03.\
\footnote{238} If the defendant’s unsecured debt is riskless, this problem is eliminated.\footnote{239} See \textit{Patell et al.}, \textit{supra} note 45, at 354-62 (modeling the interest necessary to compensate a plaintiff with a nontransferable claim). To compensate the plaintiff fully for the delay, the plaintiff should receive interest that reflects the interest rate she would require to induce her to invest so much money in such a risky venture. This latter amount is going to be difficult, if not impossible, to determine because it depends on the plaintiff’s level of risk aversion. However, an approximate method of compensating the plaintiff for such risk is to estimate the default risk the defendant has involuntarily imposed upon the plaintiff, and to compensate the plaintiff according to how much the market would pay the plaintiff for enduring this much systematic risk. Such a calculation would be only a floor because the plaintiff, if strongly risk averse, might require a very large interest rate to accept so much risk. Unfortunately, the real measure here depends on the plaintiff’s psychology, which might lead one to conclude that no adjustment should be made. Nonetheless, despite the obvious possibilities of self-serving claims, paying the plaintiff the market rate of interest might severely undercompensate highly risk averse plaintiffs. Thus, compensating an individual plaintiff for unsystematic risk at the market rate for systematic risk appears to be a reasonable compromise. A proposal that would compensate the plaintiff without imposing additional interest on the defendant is introduced \textit{infra} subpart VI(F).\footnote{240} See \textit{Patell et al.}, \textit{supra} note 45, at 354-62 (modeling the impact of a nontransferable claim on an intertemporal pattern of consumption).
Of course, if a court concludes that the judgment is solely directed at the defendant, then these complications are irrelevant, and the defendant's cost of unsecured borrowing should be used to calculate prejudgment interest. If, however, the judgment in whole or part is directed at the plaintiff, then these complications must be addressed.241

A related problem that arises when the plaintiff is an individual or a close corporation is that the interest rate that compensates the plaintiff will no longer equal the rate required to prevent the unjust enrichment of the defendant. A higher rate will usually be required to compensate the plaintiff than is required to prevent the unjust enrichment of the defendant.242 If the court uses the appropriate interest rate for the defendant, the plaintiff will be insufficiently compensated. If the court uses the correct rate to compensate the plaintiff, then the defendant will pay too much. Accordingly, based on the substantive law and the relevant public policies, the court will have to choose whether to use the appropriate interest rate for the plaintiff or for the defendant, or something in the middle.

C. Inefficient Financial Markets

The calculation of prejudgment interest in this Article has been premised on the assumption that the securities market is efficient. An efficient market is one in which no investment strategy can consistently outperform the market.243 An inefficient market implies that there are some investment strategies that can outperform the market.244 In spite of the enormous literature on market efficiency,245 there is still no consensus on the efficiency of the securities market.246 Although numerous studies support the efficiency hypothesis,247 there are also some persistent anomalies that

241. Although commentators emphasize the dual nature of judgments, courts frequently elevate the compensatory function of monetary awards and prejudgment interest over deterrence, punishment, and preventing unjust enrichment. See, e.g., Wong, supra note 28, at 221-23 (reviewing cases and concluding that the principal rationale for prejudgment interest has shifted from punishment to compensation).

242. A lower rate than the defendant's cost of unsecured borrowing would never be appropriate to compensate the plaintiff because the plaintiff can always receive the market rate on its investment.

243. In other words, no investment strategy of buying and selling individual securities can consistently generate higher returns than holding a well-diversified portfolio of securities over the same period. See Ross ET AL., supra note 73, at 370.

244. See id. at 359.

245. For a recent and thorough survey of the literature, see Eugene F. Fama, Efficient Capital Markets: II, 46 J. FIN. 1515 (1991). For a more accessible but less thorough treatment of the efficient capital market hypotheses, see Malkiel, supra note 237, at 157-224.

246. See Malkiel, supra note 237, at 191-93 (summarizing the opposing viewpoints and proposing a middle position).

247. See Ross ET AL., supra note 73, at 373-78. Two classic studies supporting the efficiency of the bond market are Mark I. Weinstein, The Systematic Risk of Corporate Bonds, 16 J. FIN. & QUANTITATIVE ANALYSIS 257 (1981) (concluding that bond ratings reflect default risk but lag behind, and therefore only marginally affect, the market's evaluations of changes in risk) and Mark I.
no one has been able to account for in a manner consistent with the hypothesis. This subpart considers how relaxing the assumption of market efficiency would change the calculation of prejudgment interest. The conclusion reached is that any impact is likely to be small. Moreover, because there is no practical way for courts to adjust their calculations for an inefficient market, they should not attempt to do so.

One obvious argument for a prevailing plaintiff to make, especially one whose business has been successful over the period of the lawsuit, is that it would have invested the funds in its business and so the investment would have produced a return about equal to what the plaintiff made on its invested capital over that period. For example, if the company made 30% on its invested capital over the prejudgment period, then the plaintiff would argue that the defendant should have to pay prejudgment interest at 30%. This is essentially the argument that lawyers for Hughes Aircraft recently made in a patent infringement case brought against the federal government. Hughes's lawyers argued that the federal government should pay interest on patent royalties it never paid at a rate equal to Hughes's average annual return on equity because that is how Hughes would have invested the royalties.

Under the assumption that the stock market is efficient, this argument is easy to shoot down. First, it is not the average return of the company but its marginal return that is relevant. The managers of a corporation whose capital is rationed will begin with the projects with the highest net present value per dollar of investment and will work down to less attractive projects. Thus, any additional capital would be spent not on the average project but on the next best project, which ex ante should be worse than any of the previous projects. In addition, if capital is not rationed, the marginal product should have an expected return equal to the firm's cost of financing that project. Otherwise, the managers are not maximizing the value of the firm. Thus, at the margin, there is no ex ante excess return from increased investment. Moreover, at the margin, there is no excess return or loss to the plaintiff from investing in the defendant's securities, including its debt, which is the investment that the plaintiff was forced to

Weinstein, The Effect of a Rating Change Announcement on Bond Price, 5 J. FIN. ECON. 329, 345 (1977) (finding that bond rating changes reflect changes in risk but do not affect perceived market risk and concluding that this lack of effect supports the semistrong form of the efficient capital market hypothesis).

248. The most enigmatic of such anomalies concerns seasonalities. See ROSS ET AL., supra note 73, at 378-79 (noting studies showing variance in stock returns depending on the month or the day of the week).


250. See Vartabedian, supra note 118, at D1.

251. See ROSS ET AL., supra note 73, at 176-78.
make by the defendant’s wrongdoing. It follows that the plaintiff would be overcompensated if it received the return on defendant’s equity because the risk that any judgment would not be paid is less than the risk of the plaintiff’s equity. Accordingly, if the market is efficient, the plaintiff is fully compensated for the risk it bears because there are no foregone profit-making opportunities when it receives interest at the defendant’s cost of unsecured borrowing.\footnote{252}

If the market is assumed not to be efficient, the plaintiff can argue that the respective cost of capital to it and to the defendant do not fully reflect the risk of investments in either of them. Specifically, the plaintiff can argue that the market overestimates its risk and underestimates the defendant’s risk, so that the return it has to offer to raise capital is higher than what is appropriate for its risk, whereas the return the defendant pays does not adequately compensate for its risk. This argument, assuming it is true, only gets the plaintiff so far. Even if the market is assumed to be inefficient, the firm can still raise capital to undertake new projects. Thus, the upper limit on the increased interest cost to the plaintiff, because of market inefficiency, is the sum of (1) the amount by which the interest rate on the defendant’s debt is insufficient to compensate for the risk the plaintiff is forced to bear and (2) the excess of the amount the plaintiff must pay investors to fund the projects it could not fund through retained earnings because of the defendant’s wrong over the rate that would compensate investors for their risk.

Furthermore, recognition that the market is inefficient does not necessarily require an interest rate adjustment in the plaintiff’s favor. Rejection of the efficiency hypothesis does not imply that the return on the plaintiff’s securities is too high or that the return on the defendant’s debt is too low. The market might be inefficient because the securities of other firms are mispriced or because the entire stock market moves in certain predictable ways, without the plaintiff’s securities being underpriced relative to the defendant’s securities. In addition, the plaintiff’s arguments work in both directions. The defendant can argue that the risk of its securities was overestimated by the market, which would provide the plaintiff with a windfall if the defendant were required to pay interest at its borrowing cost. The defendant can also argue that the risk of the plaintiff’s securities was underestimated, so that any additional funds reinvested in the plaintiff would have been poorly invested.

Finally, because proving the required facts and quantifying the additional interest owed as a result of the inefficiency will be so difficult, I strongly caution against making any attempt to adjust for claimed market inefficiencies. Self-serving claims would abound, and any result could be

\footnote{252. \textit{See supra} text accompanying notes 107-09.}
explained as an adjustment for inefficiency.\textsuperscript{253} When an adjustment is made for inefficiency, the judge is rejecting verifiable market data in favor of a claim by one of the parties' lawyers about the underlying value of securities that cannot be substantiated.

\textbf{D. Summary}

This Part examined three situations in which it arguably might not be appropriate to assess prejudgment interest at the defendant's cost of unsecured borrowing. These situations are the bankruptcy of the defendant, when the plaintiff is an individual or a close corporation, and if the securities market is inefficient.

If the judgment would not have bankrupted the defendant had it been issued immediately, then the court should assess prejudgment interest using the defendant's cost of unsecured borrowing, even if the final judgment bankrupts the defendant. Using the defendant's cost of unsecured borrowing is appropriate in these circumstances, because the excess over the risk-free rate compensates the plaintiff for the risk that the defendant will default. On the other hand, if the original judgment would have forced the defendant into bankruptcy had it been issued immediately, then it might be appropriate to assess interest at a rate other than the defendant's cost of unsecured borrowing.

The second situation arises when the plaintiff is an individual or a close corporation. In that case, assessing prejudgment interest at the defendant's cost of unsecured borrowing will probably not compensate the plaintiff for the risk of the defendant defaulting, because the plaintiff is unlikely to be able to diversify away that risk. Thus, to compensate the plaintiff for the risk she is forced to bear, the court will often have to assess prejudgment interest at a rate higher than the defendant's cost of unsecured borrowing.

The final situation examined in this Part arises when the securities markets in which the plaintiff and defendant raise capital is considered inefficient. In that case, the court should not adjust the interest rate at which prejudgment interest is assessed for any perceived inefficiency because of the lack of hard data on which it can rely to make an adjustment.

\textbf{VI. Other Issues in the Calculation of Prejudgment Interest}

This Part discusses several diverse but important issues in the calculation of prejudgment interest that have not already been addressed. These

\textsuperscript{253} If securities markets were inefficient and a corporation's managers could consistently make money in these markets, they would probably be portfolio managers or investors, not corporate managers.
issues are what awards generate prejudgment interest, when to begin the prejudgment period, the equitable grounds for denying prejudgment interest, multiple defendants, postjudgment interest, and the relationship between prejudgment interest and currency conversion. This Part concludes with a brief discussion of possible statutory reforms.

A. Awards that Generate Prejudgment Interest

As the law is currently enforced, not all awards generate prejudgment interest. The most glaring exception is the common law rule that interest is not recoverable on claims that are neither liquidated to a dollar amount nor ascertainable by fixed means. Although most states have liberalized the common law rule against awarding prejudgment interest on unliquidated claims, that proposition still has some validity. The traditional example of an unliquidated claim is a personal injury, although many other claims can also be unliquidated. The usual justification for not awarding prejudgment interest on such amounts is that it is unfair to the defendant, who does not know how large the award will be. This argument, however, proves too much, as it is no more unfair to hold the defendant liable for the underlying sum, which is an uncertain amount, than it is to hold the defendant liable for the interest thereon. Thus, because prejudgment interest prevents the value of an award from being reduced by delay, prejudgment interest should be awarded on both liquidated and unliquidated damages, as most courts and commentators recognize.

Another common-law restriction on prejudgment interest is that prejudgment interest is not awarded on nonpecuniary losses, such as pain and suffering. However, it is not clear why prejudgment interest should

254. See 1 Dobbs, supra note 4, § 3.6(1), at 336.
255. Liberalization has sometimes occurred judicially, such as by treating interest as lost rental value or by taking a broad interpretation of what is ascertainable, see id. § 3.6(2), at 339-46, and sometimes through statute, see id. § 3.6(2), at 346-48.
256. See id. § 3.6(1)-(3), at 336-52 (describing the common-law rule as the most significant limitation on the recovery of prejudgment interest).
257. Damages for nuisance, destruction of property, and back pay, as well as attorney’s fees, have all been held unliquidated and unascertainable at some time. See id. § 3.6(1), at 336.
258. See id. § 3.6(3), at 351; Recent Developments, supra note 13, at 107-08.
259. See 1 Dobbs, supra note 4, § 3.6(3), at 351-52 (reasoning that although the eventual amount payable by the defendant is unknown, it is still within the defendant’s possession and could be invested).
260. See, e.g., Funkhouser v. J.B. Preston Co., 290 U.S. 163, 168 (1933); Oyos, supra note 24, at 509-10 (proposing the elimination of the liquidated-unliquidated distinction and stating that this will give plaintiffs full compensation); Sargesketter, supra note 27, at 269 (stating that damages of all types should bear prejudgment interest in order to give full compensation).
261. See 1 Dobbs, supra note 4, § 3.6(4), at 356 (pointing out that pain and suffering damages are nonascertainable and therefore ineligible for interest under the common-law rule).
be denied for nonpecuniary losses because both pecuniary and nonpecuniary losses are compensated for with monetary awards. The effect of this prohibition is to undercompensate the plaintiffs who have suffered nonpecuniary losses and to unjustly enrich the defendants who have imposed them. Moreover, the magnitude of this effect varies directly with what the multiplier otherwise would be. The magnitude of both the plaintiff’s recovery for nonpecuniary losses and the defendant’s payment will fall with delay and with market interest rates, considerations unrelated to the magnitude of the injury or the merits of the claim. It might be suggested that the award of nonpecuniary damages implicitly takes these considerations into account, and there is some evidence that awards are adjusted for delay. It would, however, seem desirable to make such adjustments explicitly, so they can be reviewed by the appellate courts, rather than implicitly, which escapes appellate review.

Nonpecuniary awards do, however, present a problem that does not occur with pecuniary awards. Pecuniary awards are based on actually incurred costs, which are easily measured using prices from the time of injury. Interest is then assessed upon these awards in the usual manner. With nonpecuniary awards, the danger is that a court looking at an injury that occurred years earlier, and without a precise guide, is likely to draw upon current values. When this occurs and prejudgment interest is also awarded, there is a double recovery. Because the interest rate includes a premium for inflation, such a plaintiff would recover the inflation portion of the prejudgment interest award twice. The solution, however, is not to deny prejudgment interest, which would deny successful plaintiffs compensation for the rest of the risk-adjusted return. Instead, the solution is either to be careful to use values appropriate for the time of injury, or if using current values, to reduce them for inflation before adding interest.

A related question that often arises with prejudgment interest is how to deal with future damages. Commentators recognize that plaintiffs would receive a double recovery if future damages were reduced to a present value as of the judgment date and then prejudgment interest were awarded.

262. See Stephen J. Carroll, RAND CORP., JURY AWARDS AND PREJUDGMENT INTEREST IN TORT CASES 11 (1983) (reporting that juries are implicitly awarding interest at an annual rate of 3.7% between injury and trial).

263. See Rothschild, supra note 18, at 216. For example, prejudgment interest is not awarded on the punitive portion of a treble damage antitrust award and is discretionary on the untrebled portion. See Robert H. Lande, Are Antitrust "Treble" Damages Really Single Damages?, 54 OHIO ST. L.J. 115, 130 & n.57 (1993). In part, the logic is that the trebling is intended to compensate for the delay. However, a more accurate final award would increase the original award by a smaller amount and provide interest. Cf. Brown, supra note 23, at 346-47 (stating that "unsupervised" delay-based additions to awards by juries are an "arbitrary" way to compensate plaintiffs for delay). This is likely to result in a large inaccuracy in antitrust cases because these cases take longer to resolve than most other cases. Cf. Lande, supra, at 133 (estimating that antitrust cases average 4.5 years from filing to judgment).
264. See McDivitt, supra note 81, at 338-41; see also Wong, supra note 28, at 240 (stating that prejudgment interest on future damages does not overcompensate the plaintiff provided that the damages are discounted to the date of injury).

265. Discounting is the process of calculating the present value of a future cash flow; it is the opposite of compounding, which is used to calculate the final judgment from the original judgment. See 1 Dobbs, supra note 4, § 3.6(3), at 351 (stating that the reduction to present value "is essentially the application of interest in reverse"). When discounting, it is common to call the interest rate the discount rate. See Ross, supra note 73, at 86.

266. See McDivitt, supra note 81, at 340.

267. For an argument not to use hindsight in measuring damages that occur after the date of injury but to use the best estimate of the stream of violations as of the date of injury, see Fisher & Romaine, supra note 45, at 153-56 (using hindsight does not take into account that the plaintiff was relieved not only of the stream of returns but also of the associated risk).

268. For example, if the patent on which the plaintiff has built its business, a risky start-up venture, is infringed by a strong company, then a discount rate that is appropriate for the venture (a high rate) should be used to calculate the present value of the project. Prejudgment interest should then be awarded on this amount using the defendant's cost of unsecured borrowing (a low rate). Alternatively, if a risky company embarks on a low-risk project that is lost because it (the defendant) breaches a contract with the plaintiff, then a low discount rate that is appropriate for the project should be used to discount the project's cash flows and prejudgment interest should be awarded on this amount at the defendant's cost of unsecured borrowing. In this latter example, the plaintiff's overall risk is irrelevant because the success of the project or the payment of the judgment does not depend on the plaintiff's overall risk.

269. Compare N.Y. C.P.L.R. 5001(b) (McKinney Supp. 1996) (stating that interest is to run from the "earliest ascertainable date the cause of action existed, except that interest upon damages incurred thereafter shall be computed from the date incurred"), with Nev. Rev. Stat. § 17.130(2) (1995) ("[T]he judgment draws interest from the time of service of the summons and complaint....").
claim is filed are that it is unfair to penalize the defendant by assessing
interest until the plaintiff's claim is filed and that such a rule encourages
earlier filings. The first argument is not persuasive because it is based
on the repudiated theory that prejudgment interest is punishment. The
second argument has some merit in that waiting for the claim to be filed
to start to accrue interest will discourage plaintiffs from delaying filing.
Such a rule will also encourage injured plaintiffs to file immediately
without trying to negotiate a settlement first and it will encourage injurers
to try to discourage victims from filing quickly. Neither effect would
seem desirable. Accordingly, the recognition that prejudgment interest
compenses for the defendant's possession of money that rightfully belongs
to the plaintiff implies that a better rule would be to start accruing interest
as soon as the claim arose. This will place plaintiffs and defendants in the
same position as if the defendants had immediately paid the plaintiffs,
which is the purpose behind prejudgment interest.

In Amoco Cadiz, although the injury occurred in 1978, the court began
the prejudgment period on January 1, 1980, when the cleanup costs were
incurred. Assuming, as an approximation, that the entire $65 million
expenditure was made on March 16, 1978, the day the Amoco Cadiz ran
aground, the prejudgment period would be 12.4 years (rounded to the
nearest tenth of a year). Calculating the multiplier in the same manner as
before, but setting $T=12.4, not 10.6, would result in a final award of
$260.615 million, a 22% increase.

270. See Brown, supra note 23, at 349-50 (arguing that it is unfair to penalize the defendant by
assessing interest before the claim is filed); Don W. Cloud, Jr., Note, Cavnar v. Quality Control
Parking, Inc.: Prejudgment Interest is Now Recoverable in Personal Injury, Wrongful Death and
Survival Action Cases, 38 BAYLOR L. REV. 385, 409 (1986) (contending that assessing prejudgment
interest from the date of filing is needed to discourage plaintiffs from delaying filing); Wilson et al.,
supra note 3, at 116 (arguing that assessing interest from the date of injury denies the defendant the
opportunity to set aside sufficient reserves in some cases).

271. See supra text accompanying notes 24-29.

272. See Thomas F. Londrigan & Lawrence R. Smith, Prejudgment Interest: Is There Profit in
Court Delay?, JUDGES' J., Fall 1984, at 12, 15 (arguing that assessing prejudgment interest from the
date of filing will result in unnecessary filings by plaintiffs who have not yet assessed the merits of their
case but who do not want to delay the accrual of interest); Gyos, supra note 24, at 508 (contending that
assessing prejudgment interest from the date of filing will encourage hastily filed and poorly crafted
pleadings).

273. See supra text accompanying notes 7-10.

274. Amoco Cadiz, 954 F.2d 1279, 1337 (7th Cir. 1992). The Seventh Circuit gives no explana-
tion for this delay, noting only that the district court delayed the start of the accrual of prejudgment
interest and that on appeal the French plaintiffs have not contested this delay. Id. at 1335.

275. The assumptions on which this calculation rests are set out in note 6. The percentage
increase in the award is larger than that in the length of the prejudgment period (17%) because of
compounding.
C. EQUITABLE GROUNDS FOR DENYING INTEREST

Courts sometimes deny interest to plaintiffs who have unduly delayed taking legal action under the doctrine of laches.\(^\text{276}\) Although at first glance this would seem to be a suitable penalty, it is not. A simple way of seeing why it is inappropriate to deny interest as a penalty for laches is because the penalty would vary directly with the interest rate. If the interest rate were high, the penalty would be large; if it were low, the penalty would be small. No reason has been offered, and I can think of none, why the penalty should depend on the interest rate, which is most sensitive to the expected rate of inflation.\(^\text{277}\)

Arguably, a better penalty would have the plaintiff forfeit only the real interest rate for delay. The real interest rate is roughly the difference between the nominal interest rate and the inflation rate.\(^\text{278}\) However, differences in real interest rates are largely due to differences in risk.\(^\text{279}\) It is not clear why it would be appropriate to charge plaintiffs that endure more risk, because an unsecured investment in the defendant is riskier, a larger penalty for delay. This suggests using the risk-free real interest rate. However, it is frequently close to zero,\(^\text{280}\) which means that it is effectively no penalty at all.

\(^{276}\) See, e.g., West Virginia v. United States, 479 U.S. 305, 311 n.3 (1987) (stating that “an equitable consideration such as laches” could justify a denial of interest).

\(^{277}\) In order to understand this point, consider an original judgment for $1 million and a two-year prejudgment period. Assume that the defendant’s debt is riskless, and that the risk-free interest rate is alternatively 2% or 10%, compounded annually, over the two-year period. If the prejudgment interest rate is 2%, the final award will be $1,040,400, whereas if it is 10%, the award will be $1,210,000. In both cases, the plaintiff would be in the same position as it would be had it received $1 million immediately and deposited it in the bank. (This example ignores taxes.)

Now consider what will happen if the court decides to deny prejudgment interest for one of the two years. The plaintiff will receive $1,020,000 when the interest rate is 2% and $1,100,000 when the interest rate is 10%. Although the nominal amount of the award is larger when the interest rate is 10%, the real value of the award is smaller when the interest rate is larger. When the interest rate is 2%, it would take $980,392 to grow into $1,020,000 in two years. In contrast, when the interest rate is 10%, it would take $909,091 to grow into $1,100,000 in two years. Thus, when the interest rate is 2%, the effect of the one year interest denial is equivalent to a reduction in the original award of $19,608, but when the interest rate is 10%, the effective reduction is four and a half times larger, $90,909.

\(^{278}\) Denoting the inflation rate by \(\pi\) and the nominal interest rate by \(r\), the formula for the real interest rate, \(i\), is:

\[
i = \frac{1 + r}{1 + \pi} - 1 = \frac{r - \pi}{1 + \pi} = r - \pi.
\]

Unless the inflation rate is very large, the real interest rate is roughly the difference between the nominal interest rate and the inflation rate. See ROSS ET AL., supra note 73, at 195.

\(^{279}\) See David P. Hariton, The Taxation of Complex Financial Instruments, 43 TAX L. REV. 731, 742 (1988) (stating that the excess of the interest rate paid by any borrower over that paid by the federal government is solely attributable to the risk of the borrower defaulting).

\(^{280}\) See ROGER G. IBBOTSON & REX A. SINQUEFIELD, STOCKS, BONDS, BILLS, AND INFLATION: HISTORICAL RETURNS (1926-1987) 8 (1989) (stating the real rate of return on Treasury bills was close to zero over the entire 1926-87 period).
Although the above reasons caution against penalizing the plaintiff with lost interest, the most important argument supporting this position is that interest is not an independent exaction from the defendant or an award to the plaintiff. Rather, it is only compensation for the inevitable delay between the occurrence of the event that triggers the liability and a final judgment.\footnote{281}{See supra text accompanying notes 7-10.} Only if the delay is caused by the plaintiff and is prejudicial to the defendant would it be appropriate to penalize the plaintiff. However, even here, the penalty should be assessed up front as a reduction in the judgment and not as a loss of interest.\footnote{282}{See Keir & Keir, supra note 24, at 137 ("A rule that would be more consistent with the law of damages would allow interest, as in the case of any other compensation, on the basis of the wrong done, not the course of litigation.")}. There is one exception to the proposed rule against denying or reducing interest on equitable grounds. It would be appropriate to reduce the interest award when awarding interest at the defendant’s cost of unsecured borrowing does not fully compensate the plaintiff. Thus, when the judgment is to compensate the plaintiff, rather than to deter or penalize the defendant, and that requires a higher interest rate than the defendant’s cost of unsecured borrowing,\footnote{283}{The appropriate prejudgment interest rate is likely to be higher than the defendant’s cost of unsecured borrowing when the plaintiff is an individual and the award is for a large amount relative to the plaintiff’s wealth. In this case, the plaintiff will have been exposed to excessive nondiversifiable risk and the delay will influence the plaintiff’s spending pattern. See supra subpart V(B). The appropriate prejudgment interest rate will not be higher when the plaintiff is a publicly traded corporation (unless the plaintiff’s and defendant’s tax rates differ) because then the defendant’s cost of unsecured borrowing is the appropriate rate for both parties. See supra subparts II(B-C).} it would be appropriate to deny the plaintiff the difference because of any unreasonable delay.

Assuming that some portion of the standard interest award is denied as a penalty for delay, the obvious question is for what time should the penalty be assessed? If there is an unreasonable delay of one year in bringing suit, which year’s interest should be denied or reduced? Is it the first year, the year that the delay in filing was unreasonable, or the final year? Arguably, the final year is correct because interest for every other year would still have been paid had the suit been timely filed and had the legal process continued at the same pace.

D. Multiple Defendants

The discussion so far has assumed that there is one plaintiff and one defendant. Because interest should be awarded at the defendant’s cost of

\footnote{281}{See supra text accompanying notes 7-10.}
\footnote{282}{See Keir & Keir, supra note 24, at 137 ("A rule that would be more consistent with the law of damages would allow interest, as in the case of any other compensation, on the basis of the wrong done, not the course of litigation.")}. Courts probably find the denial or reduction of interest for laches an attractive remedy because it seems precise. Having no other guidance regarding how much to reduce an award because of plaintiff’s laches, they adopt a mathematical method that produces a precise, numerical answer. In this context, however, the precision is deceptive because the interest disallowed is a function of several factors unrelated to the inequitable behavior.

\footnote{283}{The appropriate prejudgment interest rate is likely to be higher than the defendant’s cost of unsecured borrowing when the plaintiff is an individual and the award is for a large amount relative to the plaintiff’s wealth. In this case, the plaintiff will have been exposed to excessive nondiversifiable risk and the delay will influence the plaintiff’s spending pattern. See supra subpart V(B). The appropriate prejudgment interest rate will not be higher when the plaintiff is a publicly traded corporation (unless the plaintiff’s and defendant’s tax rates differ) because then the defendant’s cost of unsecured borrowing is the appropriate rate for both parties. See supra subparts II(B-C).}
unsecured borrowing, the calculation of prejudgment interest is not affected by multiple plaintiffs. The calculation does, however, have to be adjusted when the plaintiff can recover from more than one party. There are at least three situations in which the plaintiff can look to more than one party to recover: (1) when there are multiple defendants who are jointly and severally liable; (2) when the defendant is part of a group of affiliated corporations; and (3) when the defendant has insurance that would pay its liability. In each case, the simple rule that prejudgment interest should be charged at the defendant’s cost of unsecured borrowing has to be interpreted in light of the possibility of recovering from multiple sources.

When the defendants are jointly and severally liable, a successful plaintiff will fail to collect the full judgment only if all defendants are insolvent. Because the plaintiff will collect the entire judgment if any defendant is solvent, the plaintiff should be awarded prejudgment interest at the market interest rate for an unsecured loan made to (or guaranteed by) all of the defendants. Of course, the interest rate for such a loan will be at least as low as the rate paid by the most creditworthy defendant on its unsecured debt because the hypothesized loan cannot be riskier than a loan to that party. 284

Although the above rule provides the plaintiff with the proper amount of interest, it does not charge each defendant the proper amount. Joint and several liability means that each defendant is in effect guaranteeing the other defendants’ obligations. Thus, each defendant is in effect making a loan to the other defendants in the amount of their liability to the plaintiff. As with other loans, interest should be paid between defendants, especially if unsecured borrowing rates differed. 285 Although I know of no court that has been so meticulous as to adjust one defendant’s prejudgment interest rate to account for the risk of nonpayment by another, such an adjustment would be necessary to meet the goals of fairness and efficiency.

284. The loan will be less risky than a loan to the most creditworthy borrower as long as there is any chance that one of the other defendants will be solvent when the most creditworthy one is insolvent.

285. This is perhaps easier to understand through an example. Assume that there are two defendants, Big and Small, with unsecured annual borrowing rates of 6% and 10% respectively over the two-year prejudgment period. Big and Small are jointly and severally liable for $1 million and each owes half. Because the plaintiff is at least as well off as it would be if it could look only to Big to recover, the plaintiff should receive interest at a rate no higher than 6%. If, however, Small goes bankrupt, Big will have to pay the entire judgment; and if Big goes bankrupt, Small will have to pay. Thus, Big has a $500,000 claim against Small for contribution, and Small has a similar claim against Big. Although the principal amounts are cancelled when the judgment is paid, the interest components are not. Because Big’s claim against Small is riskier than Small’s claim against Big, Big should receive a higher interest rate from Small than Small should pay Big. Thus, Small should pay Big interest at 4%, the difference between the two companies’ borrowing rates, on $500,000 for two years. As a result, Small in effect pays interest at 10% on $500,000, which prevents it from being unjustly enriched.
Therefore, because the right of contribution is grounded in equity,\textsuperscript{286} such an apportionment should not be an abuse of discretion.\textsuperscript{287}

When the defendant is part of an affiliated group of companies, there is often a dispute regarding how far up the corporate structure liability extends. For example, the supertanker \textit{Amoco Cadiz} was operated by a wholly owned subsidiary of the parent.\textsuperscript{288} Thus, if the subsidiary were liable but the parent were not, the plaintiffs could look only to the subsidiary's assets to satisfy a judgment. Although the plaintiffs would ex ante be less likely to collect their judgment, they would be compensated for this additional risk through a higher prejudgment interest rate. Accordingly, the interest rate should reflect where in the capital structure liability rests.\textsuperscript{289}

The last scenario to consider is when there is insurance. The analysis is different depending upon whether the plaintiff or the defendant is the insured. When the plaintiff is the insured, the plaintiff recovers from its insurer and the insurer is subrogated to the plaintiff in the suit against the defendant. In this case, the defendant's unsecured borrowing rate is again the correct interest rate to use. When the defendant is the insured, the plaintiff can look both to the defendant and to its insurance company for recovery. Thus, from the plaintiff's perspective, the situation is similar to that of joint and several liability. Since the plaintiff is paid if either party is solvent, prejudgment interest should be assessed at a rate not above the lesser of the defendant's and its insurance carrier's rate for unsecured borrowing.

\textsuperscript{286} See Embrey v. Borough of West Mifflin, 390 A.2d 765, 774 (Pa. 1978) (emphasizing that the contribution is intended to approximate an equitable division of responsibility between defendants who are jointly liable to a plaintiff).


\textsuperscript{288} Standard Oil, later Amoco, was the parent of Amoco International Oil Company (AIOC) and Amoco Transport. \textit{Amoco Cadiz}, 954 F.2d 1279, 1287 (7th Cir. 1992). Amoco Transport owned the \textit{Amoco Cadiz} and AIOC operated the vessel. \textit{Id}.

\textsuperscript{289} Parent-subsidiary liability also creates a strategic issue. Although the plaintiff is subsidized for the risk it bears, liability is assessed only after the parties know whether the subsidiary has survived. Accordingly, if the subsidiary has survived, the successful plaintiff has an incentive to claim that the subsidiary is liable but the parent is not and collect the higher interest rate that reflects the ex ante risk of the subsidiary's bankruptcy. Conversely, the defendant has an incentive to concede the parent's liability and pay the lower rate that reflects its ex ante risk.
E. Postjudgment Interest

The time from the injury until the trial court issues its judgment is the prejudgment period. The time from the trial court's original judgment until the judgment is paid, including the time during which appeals are pending, is the postjudgment period.

To compensate for delay during this period, successful plaintiffs receive postjudgment interest. In contrast to prejudgment interest, post-judgment interest is exclusively a statutory creation, and many jurisdictions have a set statutory rate for calculating postjudgment interest. In California, for example, the postjudgment interest rate is 10%. The arguments made throughout this Article with respect to prejudgment interest also apply to postjudgment interest. In any given case, a fixed rate is likely to benefit one party at the other's expense because it will only be a coincidence if the defendant's cost of unsecured borrowing matches the statutory rate. Accordingly, the benefitted party will be encouraged to file excessive motions and appeals and drag out the procedure. That party will also have a reduced incentive to take precautions.

Federal law provides for postjudgment interest at the fifty-two week Treasury bill rate. This is appropriate when the federal government is the defendant. In general, however, that rate is too low because many defendants cannot borrow unsecured at that rate. It will, therefore, encourage defendants to file excessive appeals and weaken the deterrent effect of awards.

A fairer and more efficient result would be for courts to calculate postjudgment interest using the same techniques that have been described for prejudgment interest. This task should not be too difficult as long as prejudgment interest has been calculated because a court could use the same reference rate for the postjudgment period as for the prejudgment period. A court would only have to incorporate later interest rate observations into the calculation to assess postjudgment interest. Such a change, however, would require amending the existing postjudgment statutes.

290. There is a split among the courts as to which prejudgment interest starts to accrue. Some courts start the prejudgment period when the cause of action accrues, and other courts only start the clock once a claim has been filed. See supra text accompanying notes 269-73.

291. For a discussion of the possibility of a hiatus in the accrual of interest under federal law because prejudgment interest runs until the date of the verdict, whereas postjudgment interest starts to accrue when the judgment is issued, which might be after the verdict, see 1 DOBBS, supra note 4, § 3.6(6), at 362.

292. See 1 Id. § 3.6(1), (6), at 335, 361-62.

293. See CAL. CIV. PROC. CODE § 685.010 (West 1993).

294. See supra text accompanying note 13.


296. Statutory reforms are taken up infra subpart VI(F).
F. Currency Conversion

Throughout this Article, I have assumed that the original judgment was for $65 million. However, the costs incurred by the French plaintiffs to clean up the Brittany Coast were not in U.S. dollars but in French francs (FF). As calculated by the federal courts, the compensable cleanup costs totalled approximately 340 million FF. Thus, as illustrated by Figure 1, the court’s task is to go from an original award of 340 million FF as of January 1, 1980, to a final award in dollars of unknown amount as of July 24, 1990. This requires two steps: converting the award into dollars and assessing prejudgment interest.

As Figure 1 further illustrates, there are two principal methods a court can use to calculate the final award. First, it can convert the original award to dollars using the exchange rate at the time of the injury (“breach date” rule) and then calculate interest using an interest rate for dollar-denominated loans. (This method is indicated by the arrows labelled a.) Alternatively, a court can calculate prejudgment interest using an interest rate for franc-denominated loans and then convert the award to dollars using the exchange rate at the end of the prejudgment period (“judgment date” rule). (This method is indicated by the arrows labelled b.)

![Diagram](image)

**Figure 1—Relation Between Currency Conversion and Prejudgment Interest**

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297. *Amoco Cadiz*, 954 F.2d 1279, 1330 (7th Cir. 1992). I valued this award at $65 million using the exchange rate at the time of appeal, approximately 5.5 to 1. *See supra* note 5. It was on top of this amount that prejudgment interest was assessed to arrive at a value for the final award of about $213 million.

298. This is the date the prejudgment period began, not when the injury occurred. *See supra* note 274 and accompanying text.

299. This is the end of the prejudgment period. *Amoco Cadiz*, 954 F.2d at 1290. Thereafter, postjudgment interest is assessed as provided by statute. *See supra* subpart VI(E).

300. These are only the two most obvious of a continuum of possibilities. The award could be converted at any moment from the start to the end of the prejudgment period; it could also be converted in pieces over the period.
Figure 1, thus, makes clear that the selection of a currency conversion rule determines the choice of currency for the purpose of calculating prejudgment interest and vice versa. This connection between the currency conversion rule and the calculation of prejudgment interest has apparently not been recognized either by the courts or by previous commentators. Yet a connection exists, and the failure to account for it has led the calculation of many awards astray, including the award in *Amoco Cadiz*.

Awards that do not properly take into account that connection are flawed because interest rates (with the same borrower) are not equal for loans in different currencies. They do, however, have a specific relationship. A large, multinational company such as Amoco can easily borrow in dollars or francs. As long as the market anticipates the franc-dollar exchange rate in the future to be either above or below the current (spot) exchange rate, the interest rate Amoco pays on dollar-denominated loans will not equal the interest rate it pays on franc-denominated loans. For example, if the franc-dollar spot rate at the start of the prejudgment period exceeds the forward rate at that time for the end of the period, then the interest rate it pays on dollar-denominated loans will be below that on franc-denominated loans. The reason is arbitrage. If interest rates were equal, then a profit could be made with no investment by borrowing in francs, lending an equivalent amount (at current exchange rates) in dollars, and locking in a profit by entering into a forward contract to convert less than all of the dollar proceeds of the loan extended into enough francs to pay the entire loan received. Arbitrage will be prevented only if the difference in interest rates equals the difference between forward and spot rates. This relationship is called interest-rate parity. It is, thus, because interest rates in dollar-denominated and franc-denominated loans are generally not equal (for the same borrower) that the currency translation and prejudgment interest issues are related.

301. When courts discuss both issues, they invariably discuss them separately and without any apparent connection. A good example of this is the Seventh Circuit's opinion in *Amoco Cadiz*. Compare *Amoco Cadiz*, 954 F.2d at 1327-30 (discussing currency conversion), with *Amoco Cadiz*, 954 F.2d at 1330-37 (discussing prejudgment interest). Even the court in the one case that I am aware of that got the relationship between currency conversion and prejudgment interest right does not seem to have been aware of the connection. In *Ingersoll Milling Machine Co. v. Granger*, 833 F.2d 680 (7th Cir. 1987), the Seventh Circuit awarded prejudgment interest based on a Belgian interest rate and used the judgment day rule to convert Belgian francs into U.S. dollars.

302. The forward rate, or the rate at which parties can lock in an exchange of two currencies at a given future date, is the best indicator of the market's expectation of the future spot rate. See *Bridley & Myers*, supra note 103, at 834.

303. The dollars left over are the profit from arbitrage.

304. See id. at 860-65. Denoting the spot rate by $s$, the current forward rate by $f$, and the multipliers along paths $a$ and $b$ by $m_a$ and $m_b$, interest-rate parity implies that

$$s \times m_a \times f \times m_b$$
A common mistake for a court to make is to calculate prejudgment interest using an interest rate for dollar-denominated loans and to convert the award into dollars using the exchange rate at the end of the prejudgment period. This is illustrated by the bold arrows in Figure 1. As is clear from the diagram, this method is flawed because it does not properly account for the relationship between the currency conversion rule and the choice of currency for the calculation of prejudgment interest. In effect, the court is using the interest rate at which the defendant can borrow in dollars to calculate the interest it must pay on a debt in foreign currency.305

The Seventh Circuit made essentially the same mistake in *Amoco Cadiz*, even though it never converted the award to dollars. The Seventh Circuit ordered an award in francs, leaving it to the district court to convert the award, if needed.306 The Seventh Circuit’s decision to leave the award in the currency of the injured parties was an unusual decision for a U.S. court, where monetary awards are almost always in dollars.307 It was also inconsistent with the use of an interest rate for dollar-denominated loans, the U.S. prime rate, to calculate prejudgment interest.308 In effect, the Seventh Circuit stated its intention to move along the horizontal portion of path b and to stop there, but what it actually did was to move along the horizontal portion of path a. That is to say, the court assessed interest using a rate for dollar-denominated loans when the award of prejudgment interest should have been based on a rate for franc-denominated loans.

305. For example, in *Black Sea & Baltic General Insurance Co. v. S.S. Hellenic Destiny*, 575 F. Supp. 685 (S.D.N.Y. 1983), the court calculated prejudgment interest using the interest rate on short-term, risk-free federal paper, but it converted the damages from Saudi Arabian riyals to U.S. dollars using the judgment date rule. Id. at 693-95. That is, the court used a dollar-denominated interest rate to calculate prejudgment interest, but converted the award from riyals to dollars on the date judgment was entered.

306. *Amoco Cadiz*, 954 F.2d at 1337.

307. See id. at 1328 ("Foreign currency awards are rare . . . in the United States—this may be the first . . . ").

308. There is an additional problem with the Seventh Circuit’s decision to keep the award in francs. The problem is that the postjudgment interest rate is fixed by statute. This rate is set by a political process that has often explicitly, and has probably always at least implicitly, assumed that the rate is for dollar-denominated judgments. Postjudgment interest in this case was governed by federal law, which provides for interest at the U.S. Treasury bill rate. See 28 U.S.C. § 1961 (1994). Accordingly, if the award is not converted to dollars by the end of the prejudgment period, then the award of postjudgment interest, measured in dollars, might be ex ante much higher or lower than the statutory rate. (When the award is in the currency of a country experiencing high inflation, so that its currency would be expected to depreciate substantially relative to the dollar, the dollar value of the award is likely to fall sharply over the postjudgment period. In the extreme case, where the foreign currency is being hyperinflated, the award could be practically wiped out.) Thus, as long as postjudgment interest is calculated using an interest rate for dollar-denominated loans, the award should be converted to dollars by the end of the prejudgment period.
The Seventh Circuit's failure to account for the connection between currency conversion and prejudgment interest had a large impact on the final award. I have recalculated the final award in *Amoco Cadiz*, focusing on the connection between the calculation of prejudgment interest and the conversion of the award from francs into dollars. The final award is the product of the original award in francs (340 million FF), the interest multiplier, and the currency conversion rate. The awards are calculated using the prime interest rate, 11.85%, for dollar-denominated loans. For franc-denominated loans, they assume an interest rate of 14.11%. The resulting awards are calculated as follows:

<table>
<thead>
<tr>
<th>path</th>
<th>Interest Rate (%)</th>
<th>Interest Multiplier</th>
<th>Currency Conversion Rate</th>
<th>Final Award ($ millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>11.85</td>
<td>3.2775</td>
<td>.2491</td>
<td>277.585</td>
</tr>
<tr>
<td>b</td>
<td>14.11</td>
<td>4.0501</td>
<td>.18416</td>
<td>253.599</td>
</tr>
<tr>
<td>bold</td>
<td>11.85</td>
<td>3.2775</td>
<td>.18416</td>
<td>205.218</td>
</tr>
<tr>
<td>Seventh Circuit</td>
<td>11.85</td>
<td>3.2775</td>
<td>.18988312</td>
<td>211.592</td>
</tr>
</tbody>
</table>

As is clear from the above table, there is a substantial difference between the awards calculated along paths a and b compared with those calculated using either the bold path or the Seventh Circuit's method. The

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309. The interest multipliers in the table are all calculated using equation (3), with a prejudgment period of 10.6 years.
310. The currency conversion rate is the price of the franc in dollars on the date of conversion. Exchange rate data come from the *Wall Street Journal*.
311. This is not the French prime rate, the *Taux de base bancaire*, for which data is published by the Banque de France. Using that data, the arithmetic mean of the French prime rate over the 1980s was only 11.59%. Prime rates, however, are often not directly comparable across countries because lending practices differ substantially. Thus, I did not use the French prime rate to calculate prejudgment interest. Instead, I used the interest-rate parity formula in footnote 304 to calculate the U.S. prime rate in francs over the 1980s, which is the figure in the text. I used the spot and 90-day forward rates (for the dollar price of the French franc) at the beginning of each quarter from 1980 through 1989 and the yearly U.S. prime rate over the 1980s, as given in the Appendix, *infra*. I calculated the product of the ratio of the 40-spot and 90-day forward rates (1.2358), which is an estimate of the anticipated increase in the relative value of the dollar over the 1980s. I then multiplied the interest multiplier for a loan at prime (3.2775) by 1.2358 to calculate the interest multiplier for an equivalent loan in francs. The resulting multiplier (4.0501) implies a constant interest rate of 14.11%. (The accuracy of the estimate would increase by using more observations for the ratio of spot and forward rates.)
312. The currency conversion rate is for the date of the Seventh Circuit's opinion, January 24, 1992. The final award differs slightly from that used elsewhere in this paper because the dollar value of the original award is slightly less than $65 million.
awards calculated using the conceptually correct methods (paths \(a\) and \(b\)) are about 25% larger than those calculated using the two incorrect methods. Thus, the Seventh Circuit's failure to properly account for the currency conversion issue cost the plaintiff more than $40 million.\(^{313}\)

As can also be seen from the table, the four final awards differ substantially in amount. No two awards are equal, not even those along paths \(a\) and \(b\).\(^{314}\) Obviously, the court can grant only one award. Moreover, it is important to establish in advance a general rule regarding which one of the two conceptually correct paths will be used. If the choice were left to one or the other side, it would choose whichever path produced a more favorable result. To some extent, this advantage can be reduced by requiring the party with the choice to make an early and binding selection. The advantage, however, cannot be eliminated unless a binding decision must be made when the injury occurs because currency movements will make one or the other choice preferable.\(^{315}\) In addition, requiring that the selection be made early during a lawsuit will interfere with the parties' incentives to settle because the value of the option increases with the deferral of the decision. For example, if the plaintiff must select a path when it files suit, the plaintiff gains and the defendant loses by deferring filing. Accordingly, to eliminate the option element, the law should provide for a unique path in advance.

There is an extensive jurisprudence on the conversion of awards in foreign currencies into dollars. It is beyond the scope of this Article to survey and evaluate that area of law.\(^{316}\) Its implication for the calculation

\(^{313}\) The above calculations assess prejudgment interest at the U.S. prime rate. I have argued elsewhere in this Article regarding *Amoco Cadiz* that the prime rate is too high and that a better rate would be either the commercial paper rate or the Treasury bill rate plus 47 basis points. See supra Part III. Interest-rate parity implies that the ratio between the multiplier in dollars and francs is independent of the dollar interest rate index used. Accordingly, if the commercial paper rate is used, the multiplier for an award in francs is \(2.6347\), which is the product for the multiplier for an award in dollars and the adjusted ratio of spot and forward rates (1.2358). The corresponding award is $211.638 million. This is very close to what the Seventh Circuit awarded the French plaintiffs in *Amoco Cadiz*. In effect, the court's choice of an overly generous interest rate offset its use of a conceptually incorrect and (in this case) parsimonious currency conversion rule. It was, however, just chance that the two mistakes offset one another so closely. In another case, the conceptual errors might reinforce each other. Of course, in a purely domestic context, there is no currency conversion, so the improper calculation of prejudgment interest will produce the wrong final award.

\(^{314}\) The awards along paths \(a\) and \(b\) are not equal because the conversion of currency with path \(b\) uses the spot rate on July 24, 1990, not the forward rate for that date on January 1, 1980. The award along path \(a\) exceeds that along path \(b\) because the forward price of the franc in dollars tended to over-estimate subsequent spot prices over the very volatile 1980s.

\(^{315}\) Interest-rate parity implies that, looking into the future, neither path \(a\) nor \(b\) will be better ex ante. However, with floating exchange rates, realized spot rates rarely equal the rates predicted by prior forward rates, so one or the other path would be better ex post. Thus, if the selection of a path is made in midstream, a party should choose the one on which they are currently ahead.

\(^{316}\) The prevailing approach is to look to the jurisdiction in which the plaintiff's cause of action arose to determine what rule is applicable. The "judgment date" rule is applied only when the obli-
of prejudgment interest is, however, clear. If the currency conversion rule takes precedence, then the currency used to calculate prejudgment interest must follow.

G. Statutory Reforms

Although this Article is primarily concerned with how courts should go about calculating prejudgment interest, it also has implications for both the drafting of statutes that award prejudgment interest and their interpretation. Throughout this Article, I have argued that prejudgment interest should be awarded from the time the claim arose, at a rate that reflects the defendant’s cost of unsecured borrowing, and that such interest should be compounded. Because such an award is necessary both to compensate the plaintiff and to prevent the defendant’s unjust enrichment, statutes should be written to require that courts award successful plaintiffs prejudgment interest on these terms. Unless prejudgment interest is awarded on this basis, the fairness and efficiency goals of the legal system will not be met.

As currently drafted, not all statutes permit courts to award interest as recommended. For example, several state statutes preclude the court from awarding prejudgment interest at the market rate either by setting a statutorily fixed interest rate or by requiring the court use an index that is not related to the risk of the defendant. Another problem with various state statutes is that they require simple interest. Although both types of

gation arises entirely under foreign law. If, however, at the time of breach the plaintiff has a cause of action arising under U.S. law, the “breach date” rule is applied. See Zimmermann v. Sutherland, 274 U.S. 253, 256 (1927); In re Good Hope Chem. Corp., 747 F.2d 806, 811-12 (1st Cir. 1984); Jamaica Nutrition Holdings v. United States Shipping Co., 643 F.2d 376, 380-81 (5th Cir. Unit A Apr. 1981); Conte v. Flota Mercante Del Estado, 277 F.2d 664, 670-71 (2d Cir. 1960); Oathercrest Ltd. v. First Am. Bank & Trust, 649 F. Supp. 106, 120-21 (M.D. Fl a. 1985), aff’d, 805 F.2d 995 (11th Cir. 1986) (all applying the “breach date” rule which employs the rate of exchange in effect on the date of the breach). Some courts, however, view conversion of damages as a substantive rather than a procedural issue and have applied state law in diversity cases. See, e.g., Competex, S.A. v. LaBow, 783 F.2d 333, 334 (2d Cir. 1986); Nikimiha Sec. Ltd. v. Trend Group Ltd., 646 F. Supp. 1211, 1228 (E.D. Pa. 1986) (both applying state law after finding the conversion of damages to be a substantive issue). The Seventh Circuit in Amoco Cadiz endorsed a third approach—to award the final judgment in the currency the parties chose for the transaction that gave rise to the dispute. Amoco Cadiz, 954 F.2d 1279, 1327-28 (7th Cir. 1992).


318. See, e.g., MINN. STAT. § 549.09(1)(c) (1996) (assessing prejudgment interest at “the secondary market yield of one year United States treasury bills, calculated on a bank discount basis”); OKLA. STAT. tit. 23, § 6 (West 1994) (assessing prejudgment interest at the Treasury bill rate plus 4%, but not more than 10%); TEX. REV. CIV. STAT. ANN. art. 5069-1.05 §§ 2, 6(g) (Vernon Supp. 1997) (assessing prejudgment interest at the 52-week Treasury bill rate but not less than 10% nor more than 20%).

319. See, e.g., MINN. STAT. § 549.09(1)(c) (1996); TEX. REV. CIV. STAT. ANN. art. 5069-1.05, § 6(g) (Vernon Supp. 1997) (both providing for a simple interest calculation).
of statutes simplify the calculation of interest, they do so by sacrificing fairness and efficiency. Because improved calculations can be made without great difficulty, the law should require courts to award prejudgment interest at the risk-adjusted market rate and to compound interest.

There is another group of statutes that warrant comment. These statutes seek to encourage settlements by linking the award of prejudgment interest to the defendant’s settlement offer. These statutes relieve defendants of an increasing portion of their interest obligations as their offers more closely approximate the final award. There is a large literature on how various legal rules encourage parties to settle legal disputes, with many active disagreements. Although it is not settled, it might be desirable to reward parties for making reasonable settlement offers through additional awards or reductions ancillary to the judgment. However, even if such adjustments are desirable, they should not be made by increasing or decreasing the interest multiplier. The reason why is that the magnitude of the effect would depend on factors that are unrelated to the activity being encouraged such as capital structures, which vary across firms, and market interest rates, which vary over time. Interest, which is compensation for the use of money, is always appropriate. Perhaps the judgment, or fees and costs, should be adjusted in light of the parties’ behavior, but once the award is set, interest upon it should be calculated in the manner described in this Article.

Finally, the law should permit a defendant to satisfy a judgment by placing money in an irrevocable trust. On this money, only the return

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320. For example, Texas forgives interest to the extent of the defendant’s settlement offer. TEX. REV. CIV. STAT. ANN. art. 5069-1.05, § 6(b) (Vernon Supp. 1997). Pennsylvania has a similar statute that tolls interest if the defendant makes a written settlement offer and the plaintiff does not recover more than 125% of that offer. See 1 DORBBS, supra note 4, § 3.6(2), at 347 n.36. Minnesota provides that if the losing defendant’s settlement offer was closer to the judgment than the prevailing plaintiff’s, then the plaintiff shall receive prejudgment interest on the lesser of the judgment or the defendant’s offer, but only from the time the action was commenced until the offer was made. See MINN. STAT. § 549.09(1)(b) (1996). Interestingly, these statutes are all asymmetric. They do not increase the plaintiff’s interest recovery if the plaintiff has made a reasonable settlement offer, but the defendant has not. They only reduce the plaintiff’s recovery if the defendant has been reasonable. Why such an asymmetric incentive system is appropriate is not clear.


322. See supra subpart VI(C) (discussing reasons not to deny interest on equitable grounds).

323. Unless the trust is irrevocable, the plaintiff is still in the position of an unsecured creditor. Only if the trust is irrevocable will the plaintiff be ensured that the funds will be available to pay a judgment in its favor.
earned by investing it would be allowed as prejudgment interest.\textsuperscript{324} This would fully compensate the plaintiff and fully charge the defendant for delay. It would, in effect, place the parties in the position they would have occupied had compensation been paid immediately.\textsuperscript{325} Moreover, as long as the trustee is required to maintain a diversified portfolio, thereby eliminating the unsystematic component of risk, the trust will compensate the plaintiff for the risk it endures even when the plaintiff is an individual.\textsuperscript{326}

\textbf{H. Summary}

The topics covered in this Part are more diverse than those covered in previous Parts. Even so, the principal results can be summarized in a few brief paragraphs.

First, prejudgment interest should be the rule. Courts should award prejudgment interest on liquidated and unliquidated damages and on pecuniary and nonpecuniary losses. It is also better to make the award of prejudgment interest explicit, so that it can be reviewed, rather than to compensate successful plaintiffs for delay by increasing the judgment by an unspecified amount.

Second, prejudgment interest should be awarded from the time of the injury until the date of judgment. Courts should also be reluctant to deny or reduce interest on equitable grounds.

Third, there are two situations that require special attention: multiple defendants and losses incurred in a foreign currency. When there are multiple defendants, the successful plaintiff should receive interest at a rate that reflects its probability of recovering from any defendant. Such a rate cannot exceed, but might well be much lower than, the rate that would reflect the probability of recovering from a particular defendant. When the loss occurs in a foreign currency, the currency conversion rule should be consistent with the currency on which the calculation of prejudgment interest is based.

Fourth, the fairness and efficiency of damage awards would be improved if statutes awarding postjudgment interest did not set a fixed interest

\textsuperscript{324} The court should use a first-in, first-out method of accounting, and it should award interest at a rate equal to the return earned by the trust while the money is in trust. Before the money was in trust, prejudgment interest should be assessed in the usual way.

\textsuperscript{325} \textit{See Amoco Cadiz}, 954 F.2d 1279, 1332 (7th Cir. 1992) (considering a hypothetical trust fund established by the defendants in order to justify an award of prejudgment interest).

\textsuperscript{326} When the plaintiff is a public corporation, the compensation would be complete. When the plaintiff is an individual, the trust would eliminate any difference in interest rates which arises because the plaintiff cannot diversify away the defendant's unique risk, but not the problem of the plaintiff's deferred consumption. \textit{See supra} subpart \textit{V(B)}. The elimination of the interest-rate discrepancy would encourage tortfeasors facing suits from individuals to establish such trusts. To encourage this activity plaintiffs should be prohibited from introducing evidence on the size of these trusts during the liability phase of trial and during the damages phase until the issue of prejudgment interest is addressed.
rate but required that postjudgment interest be calculated in the same manner as that proposed for prejudgment interest. Moreover, to the extent that existing law prevents the proper calculation of prejudgment interest, it should be revised to permit such calculations.

VII. Conclusion

This Article has filled a gap in the literature by providing guidance for courts to use in calculating prejudgment interest. The most basic principles are that prejudgment interest should be compounded and calculated at a floating rate that reflects the defendant's cost of unsecured borrowing. Because a court will rarely observe a market transaction that is an exact equivalent of the coerced loan to the plaintiff, the court is going to have to use proxies and possibly make some adjustments to set the prejudgment interest rate. Moreover, because in many cases the additional interest paid or received would not justify the effort and expense of such an exercise, a good rule would be the one adopted by the Seventh Circuit—to use the prime rate of interest as a default. Either party could move the court beyond this rate by introducing evidence of the defendant's cost of unsecured borrowing or by estimating the cost of such borrowing as the spread over an index, as described in Part III.

The proper calculation of prejudgment interest entails additional steps. The most significant of these include the following: prejudgment interest should be calculated with explicit reference to the compounding period and the multiplier should be adjusted for taxes, which are deferred. If the injury is in a foreign currency, the currency conversion rule should be consistent with the currency in which prejudgment interest is calculated. Finally, prejudgment interest should be awarded from when the injury occurs until the date of judgment.

By following the guidance described in this Article and by forcing parties seeking variances from that guidance to follow the lines of argument outlined, prejudgment interest can be calculated more consistently and accurately than is now being done. Such a result would significantly improve the fairness and efficiency of dispute resolution by compensating for the inevitable delay while the judicial machinery moves to a conclusion.

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327. It is also unlikely that the precise, theoretically correct measure can be calculated.
328. See supra subparts IV(A), VI(E).
329. See supra subpart VI(F).
330. See supra subpart VI(A).
VIII. Appendix: Alternative Calculations of the Final Award

This Appendix describes alternative ways of calculating the final judgment in Amoco Cadiz. The calculations all assume an original award of $65 million and a prejudgment period of 10.6 years. The calculations are made for the prime rate, the commercial paper rate, and the Treasury bill rate using various computational methods. The award is calculated using both geometric and arithmetic mean interest rates over the 1980s. The calculations are first done assuming yearly compounding and then using the compounding period that each interest rate assumes. Finally, the award is calculated assuming a spread of 47 basis points over the Treasury bill rate.

The prime rate, the commercial paper rate, and the Treasury bill rate either were or could have been proposed to calculate the final award in Amoco Cadiz. The prime rate was proposed by the plaintiffs and accepted by the court;331 the Treasury bill rate was proposed by the defendant;332 the commercial paper rate would have had a good chance of being accepted had it been proposed by the defendant.333 The reason for providing such a variety of calculations is to illustrate the effect of different assumptions on the final award.334

Table 1 sets out the different interest rates that prevailed each year from 1978, when the Amoco Cadiz ran aground, through 1992, when the Seventh Circuit issued its opinion.

<table>
<thead>
<tr>
<th>Year</th>
<th>Prime Rate</th>
<th>6-month Commercial Paper Rate</th>
<th>3-month Treasury Bill Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978</td>
<td>9.06</td>
<td>7.99</td>
<td>7.22</td>
</tr>
<tr>
<td>1979</td>
<td>12.67</td>
<td>10.91</td>
<td>10.04</td>
</tr>
<tr>
<td>1980</td>
<td>15.27</td>
<td>12.29</td>
<td>11.51</td>
</tr>
<tr>
<td>1981</td>
<td>18.87</td>
<td>14.76</td>
<td>14.03</td>
</tr>
</tbody>
</table>

331. Amoco Cadiz, 954 F.2d 1279, 1335 (7th Cir. 1992).
332. Id. at 1333.
333. See supra notes 167-71 and accompanying text.
334. The calculations are for the final award required to compensate the plaintiffs for delay; they are not for the final award that would prevent the defendant's unjust enrichment by delaying payment. The latter award would be calculated using equation (6) as the multiplier, and would be much smaller than those here. See supra subpart IV(D).
<table>
<thead>
<tr>
<th>Year</th>
<th>Prime Rate</th>
<th>6-month Commercial Paper Rate</th>
<th>3-month Treasury Bill Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>14.86</td>
<td>11.89</td>
<td>10.69</td>
</tr>
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<td>1983</td>
<td>10.79</td>
<td>8.89</td>
<td>8.63</td>
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<td>1984</td>
<td>12.04</td>
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<td>9.93</td>
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<td>1986</td>
<td>8.33</td>
<td>6.39</td>
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<tr>
<td>1987</td>
<td>8.21</td>
<td>6.85</td>
<td>5.82</td>
</tr>
<tr>
<td>1988</td>
<td>9.32</td>
<td>7.68</td>
<td>6.69</td>
</tr>
<tr>
<td>1989</td>
<td>10.87</td>
<td>8.80</td>
<td>8.12</td>
</tr>
<tr>
<td>1990</td>
<td>10.01</td>
<td>7.95</td>
<td>7.51</td>
</tr>
<tr>
<td>1991</td>
<td>8.46</td>
<td>5.85</td>
<td>5.42</td>
</tr>
<tr>
<td>1992</td>
<td>6.25</td>
<td>3.80</td>
<td>3.45</td>
</tr>
</tbody>
</table>


As the above table illustrates, interest rates varied markedly between 1978 and 1992.

Using the data in Table 1, Table 2 calculates mean interest rates. Both arithmetic and geometric mean interest rates are calculated for the 1980s, the period the Amoco Cadiz court used to calculate a mean interest rate. This roughly corresponds with the period for which the court awarded prejudgment interest, which ran from January 1, 1980 through July 24, 1990, when the district court issued its final judgment. The geometric mean is calculated using equation (4); the arithmetic mean is calculated using the formula in note 189.

335. Amoco Cadiz, 954 F.2d at 1337.
336. Id. at 1290.
337. In both calculations, n is set equal to 1 and T is set equal to 10.
Table 2: Average Interest Rates, 1980-89

<table>
<thead>
<tr>
<th>Method of Calculating Mean</th>
<th>Prime Rate</th>
<th>C/P Rate</th>
<th>T/B Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arithmetic</td>
<td>11.85</td>
<td>9.57</td>
<td>8.85</td>
</tr>
<tr>
<td>Geometric</td>
<td>11.80</td>
<td>9.54</td>
<td>8.82</td>
</tr>
</tbody>
</table>

The above table shows that over the 1980s the prime rate was the highest of the three mean rates. On average, the prime rate was 3% higher than the Treasury bill rate. The commercial paper rate was in the middle, with a mean 72 basis points above the Treasury bill rate.

The various multipliers are calculated using the mean interest rates in Table 3. The multipliers are first calculated assuming yearly interest compounding \((n=1)\), as the court did in *Amoco Cadiz*. The entries in the following table are calculated using equation (3), with \(T=10.6\).

Table 3: Multipliers, Annual Compounding

<table>
<thead>
<tr>
<th>Method of Calculating Mean</th>
<th>Prime Rate</th>
<th>C/P Rate</th>
<th>T/B Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arithmetic</td>
<td>3.2775</td>
<td>2.6347</td>
<td>2.4569</td>
</tr>
<tr>
<td>Geometric</td>
<td>3.2620</td>
<td>2.6271</td>
<td>2.4497</td>
</tr>
</tbody>
</table>

The corresponding final awards are given in Table 4. The final awards, which are calculated using equation (2), are the product of the original judgment, $65 million, and the multipliers, as calculated in Table 3.

Table 4: Final Awards, Annual Compounding

<table>
<thead>
<tr>
<th>Method of Calculating Mean</th>
<th>Prime Rate</th>
<th>C/P Rate</th>
<th>T/B Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arithmetic</td>
<td>213.037</td>
<td>171.256</td>
<td>159.696</td>
</tr>
<tr>
<td>Geometric</td>
<td>212.030</td>
<td>170.759</td>
<td>159.230</td>
</tr>
</tbody>
</table>

338. The multipliers are all calculated after rounding the relevant interest rate to four decimal places (e.g., 11.85%).
The above table presents various calculations for the final judgment in *Amoco Cadiz*, assuming annual interest compounding. The method used by the court produces an award of $213.037 million. Had the court accepted the defendant's suggestion and used the Treasury bill rate, but otherwise used the same computational method, the award would have been $50 million less—$159.696 million. Alternatively, had the court used the commercial paper rate, the best of the three estimates, the final award would have been $171.256 million, or $42 million less than the final award using the prime rate.

The final award can also be calculated taking into account the compounding period implicit in the various interest rates. Interest is compounded semiannually with the six-month commercial paper rate and quarterly with the other two rates. Thus, the multiplier for the commercial paper rate is calculated using equation (3) with \( n=2 \) and the other two multipliers are calculated using the same formula with \( n=4 \). As can be seen in Table 5, the resulting multipliers are larger than those in Table 3 because more frequent compounding increases the interest component of the award.

### Table 5: Multipliers, Implicit Compounding

<table>
<thead>
<tr>
<th>Method of Calculating</th>
<th>Prime Rate</th>
<th>C/P Rate</th>
<th>T/B Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arithmetic</td>
<td>3.4482</td>
<td>2.6937</td>
<td>2.5291</td>
</tr>
<tr>
<td>Geometric</td>
<td>3.4305</td>
<td>2.6855</td>
<td>2.5213</td>
</tr>
</tbody>
</table>

The corresponding awards, assuming that interest is compounded as implicit in the reference rate, are calculated using equation (2) and are shown in Table 6.

---

339. That value was calculated by taking the arithmetic mean of the prime interest rate over the 1980s, which was 11.85%. The French plaintiffs claimed (and the Seventh Circuit accepted) that the average prime rate was 11.9%, *Amoco Cadiz*, 954 F.2d at 1335, the above value rounded to the nearest tenth of a percent. Rounding to the nearest tenth of a percent, instead of the nearest hundredth, increases the award to $214.049 million, which is an increase of slightly more than $1 million, or about seven-tenths of one percent of the interest component.

340. This represents a 36% decrease in the interest component of the award.

341. See *supra* Part III.

342. Using the commercial paper rate reduces the interest component of the award by 28%. This is much closer to the award using the Treasury bill rate than to the award with the prime rate. The award of prejudgment interest using the commercial paper rate is 3.6 times closer to the award with the Treasury bill rate than with the prime rate.

343. This was recommended *supra* subpart IV(A).
Table 6: Final Awards, Implicit Compounding

<table>
<thead>
<tr>
<th>Method of Calculating Mean</th>
<th>Prime Rate</th>
<th>C/P Rate</th>
<th>T/B Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arithmetic</td>
<td>224.133</td>
<td>175.087</td>
<td>164.393</td>
</tr>
<tr>
<td>Geometric</td>
<td>222.982</td>
<td>174.557</td>
<td>163.882</td>
</tr>
</tbody>
</table>

In Part III, I calculated the final award assuming that Amoco's cost of unsecured borrowing was 47 basis points over the Treasury bill rate. The corresponding arithmetic and geometric mean prejudgment interest rates are 12.32% and 12.29%. Using these interest rates, the multipliers and final awards are given in Table 7.

Table 7: Multipliers and Final Awards, Spread over Treasury bills

<table>
<thead>
<tr>
<th>Compounding Period</th>
<th>Yearly</th>
<th>Quarterly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method of Calculating Mean</td>
<td>Multiplier</td>
<td>Award</td>
</tr>
<tr>
<td>Arithmetic</td>
<td>2.5717</td>
<td>167.159</td>
</tr>
<tr>
<td>Geometric</td>
<td>2.5794</td>
<td>166.673</td>
</tr>
</tbody>
</table>

Among the final awards calculated using the prime, commercial paper, and Treasury bill interest rates, the awards in Table 7 are closest to those calculated using the commercial paper rate. Using a spread of 47 basis points over the Treasury bill rate produces final awards slightly lower than those using the commercial paper rate.

As described above, the conceptually correct way to calculate prejudgment interest is to use the geometric mean, and to compound interest using the implicit compounding period. Therefore, the best estimate of the final award is probably from the last table, using the geometric mean and adjusting for quarterly compounding—$172.064 million.

344. These mean interest rates were calculated by adding 47 basis points to the arithmetic and geometric mean Treasury bill rates in Table 2.
345. See supra subparts IV(A-B).
346. This is probably the best estimate of those given here because it uses the most specific information—Amoco's triple-A bond rating.
347. As described in note 196, the theoretically correct way to calculate the geometric mean with an adjustment is not to make the adjustment after calculating the mean, but to adjust each observation
The next best estimate is probably the one using the six-month commercial paper rate, calculated in the same way except for semiannual compounding instead of quarterly compounding—$174.557 million.348

before calculating the mean. The impact, however, of such a theoretically correct adjustment is very small. The interest component of the award is about $2000 larger, or two-hundredths of one percent of the interest awarded, when the adjustment is made before calculating the mean. (This assumes that the interest rate is not rounded before calculating the multiplier. If the interest rate is first rounded, even this small difference disappears.)

348. The calculations assume an original award of $65 million, which is based on converting the award to dollars using an exchange rate at the end of the prejudgment period. Converting the award at the beginning of the prejudgment period or using an interest rate for a franc-denominated loan (either would have been appropriate) increases the final award by about 20%. See supra subpart VI(F).

Calculating prejudgment interest from the date of injury, as proposed supra subpart VI(A), implies a prejudgment period of 12.4 years. Accordingly, the award calculated using the commercial paper rate or a spread of 47 basis points over the Treasury bill rate will be about 15% larger.

Together these two modifications increase the final award between 35 and 40%. Thus, the final award should have been around $230 to $240 million. Such an award, about 10 to 15% larger than the actual award in *Amoco Cadiz*, would have fully compensated the French plaintiffs over the prejudgment period.