Economic Issues in Damage Estimation

Ted C. Schroeder  
Iowa State University

Marvin L. Hayenga  
Iowa State University

Follow this and additional works at: http://lib.dr.iastate.edu/econ_las_staffpapers

Part of the Business Administration, Management, and Operations Commons, Economic History Commons, Economic Theory Commons, and the Finance and Financial Management Commons

Recommended Citation
http://lib.dr.iastate.edu/econ_las_staffpapers/27

This Report is brought to you for free and open access by the Economics at Iowa State University Digital Repository. It has been accepted for inclusion in Economic Staff Paper Series by an authorized administrator of Iowa State University Digital Repository. For more information, please contact digirep@iastate.edu.
Economic Issues in Damage Estimation

Abstract
The size of damage awards in court cases has become a major concern of the insurance industry, of many persons, corporations, and local governments unable to insure themselves economically, and state and federal legislative bodies. The accuracy and equity of estimated damages and corresponding awards have the greatest impact on the plaintiffs and defendants involved in business liability or personal injury cases, but can also play a role in prolonging litigation when estimates of damages differ greatly, even though liability is clearly established. After liability is established in the courts for losses sustained due to the actions of another party, there must be determination of the appropriate compensation. Often these losses can be substantial as well as complex to estimate. In this paper, we offer some approaches to estimating damages that may lead to more accurate and equitable damage awards.

Disciplines
Business Administration, Management, and Operations | Economic History | Economic Theory | Finance and Financial Management

This report is available at Iowa State University Digital Repository: http://lib.dr.iastate.edu/econ_las_staffpapers/27
Economic Issues in Damage Estimation

by
Ted C. Schroeder
and
Marvin L. Hayenga*

No. 157

May, 1986

*Graduate Research Assistant and Professor, respectively, Department of Economics, Iowa State University. Helpful comments and suggestions were offered by Neil Harl. Any errors are the responsibility of the authors.
Economic Issues in Damage Estimation

INTRODUCTION

The size of damage awards in court cases has become a major concern of the insurance industry, of many persons, corporations, and local governments unable to insure themselves economically, and state and federal legislative bodies. The accuracy and equity of estimated damages and corresponding awards have the greatest impact on the plaintiffs and defendants involved in business liability or personal injury cases, but can also play a role in prolonging litigation when estimates of damages differ greatly, even though liability is clearly established. After liability is established in the courts for losses sustained due to the actions of another party, there must be determination of the appropriate compensation. Often these losses can be substantial as well as complex to estimate. In this paper, we offer some approaches to estimating damages that may lead to more accurate and equitable damage awards.

When a business suffers losses, many issues arise in determining the monetary value of the damages. To estimate losses, the relevant revenues and costs must be determined, along with the duration of losses and appropriate discount rates to be applied. In cases involving significant losses, with limited data, or entailing particular complexities, it is likely that an expert may be necessary to estimate damages. However, it is important that the court understand and be able to challenge the conceptual basis, if not all of the complexities of the techniques being utilized by the expert. If an expert is not called upon for consultation, the burden of damage estimation rests even more heavily on the court.
The estimation of damages can be a complex task and, as a result, frequent errors have been made by the courts in the estimation process. Relatively minute changes in assumptions (such as changing the discount rate) or the inclusion (or exclusion) of a relevant cost or revenue can result in erroneous damage estimates. Therefore, the courts need to become more familiar with both the conceptual ideas and the intricacies involved in assigning a monetary lump-sum value to damages, which can significantly affect the final damage estimate.

A limited volume of literature has dealt specifically with the issue of compensatory damage estimation. This paper considers the various types of damages most often litigated, the need for expert testimony, and focuses on the procedures and economic issues involved in damage estimation. A brief survey of particular complexities in the estimation of damages is discussed. The emphasis is on issues involved in estimating damages in an economically justifiable manner. Case illustrations of appropriate and inappropriate damage estimation procedures are cited to exemplify certain damage estimation techniques.

**ROLE OF THE EXPERT**

The use of expert testimony in modern lawsuits has become a significant tool in the litigation process. The expert witness due to his/her specialization is uniquely qualified to bring forth knowledge about technical or scientific issues or facts of a lawsuit. Parties attempting to prove or disprove a significant fact in a trial have recognized the importance of an expert's testimony. "Today's juries are not just swayed by scientific and objective evidence, they demand it ..." (Perdue 1973). Where once the issue of many appellates' opinions was the question of admissi-
bility of expert testimony, current courts see the expert testimony as a necessity in establishing certain facts (Perdue 1973). The expert is legally allowed to express a personal opinion in certain areas of testimony (which is usually not the case for a general witness).

A diverse variety of experts may testify in establishing certain aspects of a case; they include veterinarians, engineers, physicians and surgeons, economists, accountants, statisticians, geologists, or others. In cases involving significant monetary losses, the use of an economist's testimony becomes invaluable. O'Connor and Miller (1972) state that "... when there is substantial future economic loss, the use of the economist-statistician becomes almost mandatory." The economist is particularly qualified to deal with the financial impacts of economic loss on a firm (or individual) such as levels of inflation, interest rates, product and input prices, firm efficiency, market competition, and associated profitability. The adept economic expert can be a key witness in the estimation of economic losses and damages.

With the ever increasing demand for the use of economist-statistician experts in damage estimation, it becomes progressively more important that these experts be able to convey details of their damage calculations in an understandable and convincing manner to the court, including judges, attorneys, and jurors. Possibly one of the greatest challenges the expert may face is explaining a statistical or economic principle to a person not trained in this area. For example, relatively simple statistical techniques and tests such as multiple regressions or t-tests, or simple economic concepts such as marginal versus incremental revenues or discounting of future revenues will likely be completely unfamiliar to those not trained in these areas. The challenge for the expert is to use the simple or
sophisticated techniques necessary to most accurately estimate damages while presenting the procedures and results in the most credible and understandable fashion to individuals varying greatly in educational and scientific background. It is the duty of the attorneys trying the case to make certain that the procedures used are tested and explained as fully as is possible through their examinations and cross-examinations of the expert witness.

DAMAGES

Broadly stated, damages can be categorized as either compensatory or punitive. As the term implies, compensatory damages are intended to compensate the victim of a wrong doing. On the other hand, punitive damage acts as a punishment to the wrongdoer to both deter such future actions by that party and to set an example for others. Given the present legal structure, of these two, only compensatory damages have evolved to where the courts now frequently rely on direct scientific estimation procedures. This is not to imply that expert witnesses are not used for helping to legally delineate the recklessness of the defendant's actions; they are used for this purpose. However, opinions on the amount of punitive damages that would deter such action in the future is generally not part of the testimony.

Punitive Damages

Punitive damages are awarded to parties who are the victims of a malicious act. Punitive damages are designed as a punishment to deter such future actions by the wrongdoer or any other party. In theory, the sole purpose of punitive damages is deterrence, not compensation. The role of punitive damages is to set an example and to punish the guilty party.
The amount of punitive damages awarded does not necessarily bear any relation to other damages awarded. Punitive damage award levels are at the discretion of the jury. The jury typically is instructed to base the damage amount on 1) the nature and extent of the plaintiff's injury, 2) the degree of reprehensibility of and risk created by the defendant's misconduct, and 3) the defendant's wealth position (Owen 1982). There is much jury discretion on the level of punishment to be directed toward the wrongdoer. As a result, punitive damages tend to be grossly inconsistent and at times excessive, prompting the reexamination of current law in many legislative forums in the mid-1980's. Where both compensatory and punitive awards appear appropriate, the jury-determined punitive damages frequently tend to be biased upward. Wheeler (1983) provides the following analysis by Justice Powell:

"In most jurisdictions jury discretion over the amounts awarded is limited only by the gentle rule that they not be excessive. Consequently, juries assess punitive damages in wholly unpredictable amounts bearing no necessary relation to the actual harm caused. And they remain free to use their discretion selectively to punish expressions of unpopular views."

A frequently cited example of the excessive punitive damage awards declared by a jury occurred in Grimshaw v. Ford Motor Company (1981). The jury awarded $125 million in punitive damages to a victim of an accident in which Ford was found negligent. A trial court later reduced this amount to $3.5 million. In addition to the monetary cost, punitive damages by their nature create a badge of disgrace for the defendant. The imposition of punitive damages implies that the defendant was found to have acted maliciously and in wanton and reckless regard for the rights of others. Thus, public opinion of the accused may be severely damaged by the imposition of punitive damages. As a result the financial impact of
punitive damages on the defendant is frequently more profound than the actual cash amount awarded.

A number of methods of dealing with the problems of punitive damage determination have surfaced, ranging from bifurcation (litigating punitive damages in a separate trial from other damages) to insurance. See Wheeler (1983) and Owen (1982) for recent examples of proposed punitive damage-award estimation techniques. One argument, which has not arisen in this area, is the use of economic concepts in the determination of punitive awards. Punitive damages are after all, a means of deterrence. Given this fact, the legal goal is to reduce the economic well-being or status of the wrongdoer sufficiently to deter such future actions. Simply setting bounds on punitive damages as some multiple of other damages awarded (as some courts have advocated) is arbitrary. Given the defendant's wealth position and the malevolence of his act, an economist may be more suited to estimate (or at least recommend guidelines for) fair and necessary (but not excessive) punitive damages than those procedures presently being used or proposed. For example, the economist can assist in determining the business's net worth, its liquid assets, its debt to asset ratio, and how much they could change without threatening the firm's viability. Economists can assist in estimating the value of subsidiaries that could be sold without devastating the firm's main line of business. Depending upon the severity of the defendant's actions, the jury would then have some guidelines to use in determining whether a certain level of punitive damages would be, in effect, a relative "slap on the wrist" or a "knockout blow." The economist's testimony in this area may help juries become less biased by public opinion about the defendant and imposed punitive damages more consistent with the person's or firm's economic situation. The goal is to settle upon punitive
Compensatory Damages

Compensatory damages are awarded for recovery of financial losses incurred by the plaintiff. That is, compensatory damages serve the purpose of bringing the damaged party to the financial position where they would be had the damage not occurred.

Compensatory damages deal with issues of damage ranging from personal injuries and deaths to property damage and other pure economic losses. Compensatory awards are a matter of economics as well as law. Economic experts are frequently consulted to aid in the estimation and substantiation of the claimant's compensatory damages. In cases of substantial economic loss, the use of an economic expert is imperative. From this point forward, the discussion of damages refers only to compensatory damages unless otherwise specified.

LOST PROFITS V. PERSONAL INJURY DAMAGES

Pure economic losses primarily involve, among others, lost profits and personal injury losses. Whereas the damages are similar in some regards (both legal and economic), they are vastly different in others. The cause (or fault) of the loss is a question of law, though economists can sometimes help cast light on the cause-effect relationships in a business situation that might assist the court in determining liability for a loss. The estimation and quantification of losses is especially amenable to economic analysis. In this section, we discuss the estimation of lost profits and examine alternative techniques used in the determination of personal injury losses and lost profits.
There is a vast literature on various issues of the estimation of damages in personal injury litigation. These many articles are the result of the large number of issues that arise in the estimation of personal injury loss. Primary problems that arise include discounting, allowing for inflation, future earnings estimation, expected growth in wages and productivity, fringe benefit allowances, decreased consumption as a result of a death, life expectancy estimations, valuing loss of consortium, valuing lives of children and housewives, and many others.

Lost profit damage estimation, on the other hand, has not developed a similar large volume of literature. This may be due to a number of factors including 1) the number of personal injury suits may have outnumbered lost profits suits; 2) the stigma of personal injuries is stronger than that of lost profits, thus directing more attention toward it; 3) valuing of life and limb may be outwardly less concrete than estimating lost profits and may deserve more scrutiny in the literature. Whatever the reasons, personal injury loss estimation has had more attention in the legal literature than lost-earnings estimation, and economists have paid relatively little attention to the issues involved in damage estimation in the literature.

Lost earnings damages are frequently related to some form of contract breach (either implied or actual). Recent articles dealing with aspects of pure economic damages include Barton (1972), who discusses potential problems that frequently arise in modern-day contracting; Geotz and Scott (1979), who contrast the different levels of compensation that should be allowed under differing underlying market structures and competition levels; Leonard (1970), who discusses various issues involved in the general estimation of damages, focusing in particular on applying the theory of market price to damages; Perloff (1981) who discusses the foreseeability
doctrinal and its application in lost earnings estimation; Posner (1977), who outlines the purpose and legal aspects of contracts; Rea (1982), who develops a theory of optimal insurance for setting guidelines for damage estimation in property loss situations; Shavell (1980), who includes a discussion of damage estimation being a substitute for complete contingent contracts; Faber (1983), who outlines the estimation and proof of damages in agricultural chemical litigation; and Kuhlman and Johnson (1984), who develop methods to monitor the competitiveness of bids and estimate the damages from bid-rigging in public construction projects. Though the literature on lost earnings damage estimation is not as lengthy as that for personal injuries, many of the issues covered in the personal injury literature apply also to lost profits.

In general, damages for breach of contract are a substitute for complete contingent contracts (Shavell 1980). That is, the damage measure is meant to reduce the need for specification of complete contingencies in contracts between parties. In this manner, contracts need not specify detailed liquidated damage clauses, which would make contracting more expensive and time consuming, thus defeating many of the advantages of contracting. In addition, in cases of negligence on behalf of the defendant, the goal of lost earning damages is to put the injured party in the position he/she would have enjoyed if the defendant had not acted negligently.

A number of issues become relevant in delineating the damages that are recoverable. From a legal standpoint, the Foreseeability Doctrine plays an important role in assigning damages. The test of reasonable foreseeability refers to the situation under which, legally, a party cannot recover damages due to a breach in instances where the potential for damage was reasonably
known by only the plaintiff. The types of damages that fall under this
d Doctrine are determined by the courts and are typically not a part of the
economic expert's concern (unless requested to help determine the extent to
which both parties involved should have had an idea of the potential damages
to the other party under breach). Rather, the expert attempts to estimate
the damages incurred and does not deal with whether or not these damages
were reasonably foreseeable by the defendants.

DAMAGE ESTIMATION

Estimating the amount of economic damages that have been incurred by
one party as a result of another party's actions can be a complex task,
especially when losses are substantial. In determining the loss amount, one
must consider the classes of damages incurred, the relevant items to be
included in the award that are attributable to the other party's actions,
any deductions that should be made from the gross damages for revenues still
realized or costs not incurred, the discounting procedure to be used, and
the manner in which the unique characteristics of the case being considered
will affect damages.

Classes of Losses

The first step in estimating damages is to define the types of losses
that were incurred and are suspected to be in the future as a result of the
defendant's negligence. One should actually list in broad categories the
various classes of actual or potential losses. For example, do the damages
include reduced sales volume or sales prices, increased costs of performing
normal business activities, physical losses of property or reduced property
values. The delineation of these classes of damages and any classes of
gains from the other party's actions that might offset some of those losses
is the first step in the process of damage estimation. After determining what the general economic impacts are arising from the actions under litigation, the expert can evaluate the data available from the individuals or businesses involved, determine the amount of relevant "outside" information from similar businesses that might provide useful insights into the performance changes that resulted from the negligence, and proceed with estimating the amount of damages.

Duration of Damages

In the estimation of damages, one of the key issues is the duration of the loss. The loss may be all incurred in a single period. For example, this may be the result when a farmer breaches a contract for the delivery of corn at a specified price on a given day to the local grain elevator. The elevator could, under normal conditions, easily replace the contracted corn by buying someone else's corn on the cash market. To the extent that a ready market exists for corn, the elevator has only a single-period loss, that being the difference between the contract price and spot price of corn on the contracted day of delivery. If, however, the failure to deliver a product caused a processing plant to shut down for a day, the net income consequences of that would also be a component of the total loss.

Conversely, the damage may result in a much longer period of loss. If an orchard of fruit trees is destroyed by a fire, the fruit grower will realize lost earnings from subsequent harvest for a number of years in the future (depending on the age of the trees in the orchard). The same concept might apply when product safety or integrity is hurt by negligence of suppliers and the value of a consumer brand franchise is reduced for a long time. Single-period losses typically are simpler to deal with than
multiple-period losses, which require projections of the damage in subsequent years along with determining the appropriate discount rate to convert the losses into present value.

In estimating lost future earnings, one must determine how long into the future these losses will occur. In personal injury, wrongful death cases, one can simply use insurance mortality tables to estimate the number of years that the individual was actually expected to live. The damages would be the net discounted value of the individual's total earnings, less living expenses for the remainder of his expected lifetime. However, in cases of lost earnings by a business concern, the question becomes more complex. In this case, one must determine if the losses will increase, decrease, or be a constant amount each year and how long into the future the damage will affect profits. The correct time structure will depend on the case at hand.

Figure 1 illustrates three distinct possible loss scenarios (Leonard 1970). A single-year loss could occur where losses would involve area ABC. The loss could involve multiple periods but decrease in significance linearly each year; the nominal loss would be area ABD. One could observe a longer-term effect where, for instance, a firm's market share is severely damaged, which would result in losses over a much longer period. In the case of "permanent" damages, Leonard (1970) suggests capitalizing the difference between normal earnings and postdamage earnings. In this case, the loss amount is area ABC plus the annual difference in projected earnings before and after the damage (the area between lines BE and CD) divided by the net discount rate. Damages would continue accruing up to the point where the difference between the expected nondamage revenue and the
Figure 1: Three Possible Durations of Economic Damages

Net Revenue

Expected Nondamage Revenue

Point of Damage

Year
postdamage revenue (line BE) divided by the net discount rate is no longer significant.

Relevant Inclusions and Necessary Deductions in Damage Estimation

A frequent misconception in damage awards for lost earnings is that, even in cases where the damaged business would have had a net operating loss, damages still may be significant. For example, consider a farmer who raises market hogs and, through some negligent act of another party (e.g., the introduction of a disease), the producer experiences abnormal death losses of the hogs being raised. Further, suppose average returns per pig were negative for hog producers during the period when this producer experienced the abnormal death losses. The defendant's lawyer argues that since the hog producer would have lost money on each pig produced, the abnormal death loss actually improved the financial position of the producer; thus, the defendant did the plaintiff a "favor" by increasing death losses for the producer. Statements such as this may sound intuitively plausible to the lay jury member—if one is losing money on each unit of sales, increased unit sales will increase losses. However, in most cases of economic damage estimation, this could not be further from the truth. The key issue at hand is the net cash revenues foregone due to the damages; i.e., how much better off the plaintiff would have been without the problems caused by the defendant?

Profits (and losses) are cash revenues less variable expenses and fixed expenses. The fixed expenses are incurred by the firm regardless of the level of production. For example, the hog producer has fixed expenses of building and equipment depreciation, which will be incurred (or charged as costs) by the firm regardless of the volume of sales. If one allocates
these fixed costs over a 10-pig litter, the cost allocated to each pig will be half of that allocated to each pig in a 5-pig litter. However, this is not the key issue here. The crux or the issue is that these fixed costs are not paid each year by the producer. The fixed costs are irrelevant in determining the lost earnings per pig that died. How much better off would the producer be if he had been able to raise and sell the additional pigs? He would have been better off by the amount of additional income that their sale would have generated, after subtracting the incremental costs incurred in raising them. Therefore, another significant cost that is irrelevant in the damage estimation is the cost of getting the pigs that died to the weight they were when they died. If the pigs died a month before the date that they would have been marketed, then the costs to get them to that age are not relevant in determining the damages. These costs (including breeding herd maintenance, labor, feed costs, energy costs, and interest) are sunk costs after they are incurred, and deducting them from gross revenues would not be appropriate when calculating the actual damages. The relevant damages are the incremental net revenues that would have been incurred (but were not) for the final month of raising the hogs. Clearly, standard accounting measures of profit levels for hog producers, even during the same time period, are not necessarily an appropriate index of the losses incurred in this situation.

This process is referred to as determining incremental profits. Frequently, economists talk in terms of marginal net revenue, which is the addition to total net revenue by increasing production by one unit; i.e., added revenue per unit less added costs (both variable and fixed) incurred in generating additional production. However, in figuring economic damages, the incremental revenue is what is relevant. That is, damage is the total
foregone cash revenue less the cash costs that would have normally been
required to finish producing the final good less any revenue which was
salvaged through attempted mitigation. Fixed costs and sunk variable costs
are not considered in calculating incremental net revenues. Damages would
be grossly understated if one simply multiplied typical accounting measures
of profit per unit times decreased units to determine losses because partial
production up to the point of damage has involved costs that were paid by
the damaged party, and these costs ought to be repaid. For example, if a
manufactured good or good in the process of being manufactured) is des-
troyed, then the loss to the manufacturer is the gross sales revenue which
the good would have generated less only those manufacturing and sales costs
(to complete production and sale) allocated to that good that were not yet
incurred.

The estimation of economic loss involves calculating the expected gross
revenue that the firm should have realized had the damage not been incurred
and deducting from that the cash expenses that would have been required to
be paid (but were not because of decreased operating level). The costs not
incurred (as a result of the damages) to be deducted from gross revenues to
determine damages should include only those costs that would have been paid
had the damage not occurred. For example, in the case of a self-employed
farmer, one should not deduct charges for the farmer's own labor because
this is not a cash cost. However, if the farmer would have had to hire
labor to operate the portion of the business that was damaged or if he was
able to forego hiring labor due only to his having more time to spend on the
remainder of the business (as a result of the damages), then the costs of
hired labor should be deducted from revenues when estimating monetary
damages.
Compensation for damages may be reduced if the damaged party has not mitigated damages to the extent that this is possible; plaintiffs neglecting to do so should not be placed in the same position as they would have been had the damage not occurred. Consider a corn producer whose crop is destroyed early in the season by the application of defective herbicides. To the extent that the producer could replant corn or another suitable crop yet that growing season, the producer has the obligation to do so and reduce overall damages to the cost of replanting plus the reduced net revenue received for the replanted (lower yielding) crop versus what would have been expected in the absence of the defective chemical. In such situations, the economic expert must estimate the damages that would have been realized with "reasonable" mitigation efforts (possibly more than one scenario) along with total damages, to assist the court in determining the damages consistent with the responsibilities of both parties to the dispute.

DATA

In the process of damage estimation, the analyst relies on data supplied by the attorneys of the parties involved in the dispute. The analyst must be supplied detailed records of the firm to estimate and substantiate or refute the alleged economic damages. This usually includes the economic data relevant to the issue for several production periods before and after the incurred damage. The data may include sales volumes and receipts, production records, financial statements, invoices for costs associated with the damages, labor records, inventories, and income tax returns, as well as intended production and sales levels, expansion plans, etc. The more complete and detailed the data supplied, the more accurately the analyst will be able to estimate damages.
However, complete data and records are frequently not available, particularly in cases involving "small" businesses where extensive records may not be kept. In these cases, one must rely on data that would apply to the "typical" business of this type. For example, in estimating damages to a farm business, the analyst may need to rely on private or university enterprise record services which can provide information collected from farms involved in the same type of business in the same general location for the same time period. The analyst may utilize estimates on the breakdown of net revenues for similar operations based upon actual market prices and "typical" production size and efficiency characteristics for the period in question. These "typical" business estimates should be adjusted to reflect any differences between the typical business and the firm in question. For example, if the typical corn producer is assumed to raise corn yielding 130 bushels/acre and the firm in question can document a 140 bushels/acre yield average, then the cost and profit estimates obtained for the typical farm should be adjusted to reflect this increased productivity.

In calculating damages for the period beyond which data are available, one must forecast the damages. In forecasting the damages the analyst must determine the difference between the expected earnings had the damage not occurred and the earnings expected to be realized after the damages occurred. In forecasting these future earnings, a number of techniques can be used. For example, future sales that have followed a historical linear trend can be projected based on a simple regression model incorporating a time trend variable. One may consider letting the past sales (or earnings) figures serve as a basis for future sales (earnings) and estimate either a time series model or a distributed lag regression model based on historical market relationships and use it to forecast. The analyst may find some
leading indicators that historically have been related to the earnings of the firm, which can then be used in a multiple regression model to forecast damages. The point is that the analyst will need to forecast the damages that will occur in the future, and these forecasts will be based on data available up to the time of the trial and prior market interrelationships that might be reasonably expected to persist into the future. Indeed, the analyst may want to estimate future damages by more than one technique and compare those or use a composite of various techniques.

It is not always necessary or preferrable to estimate expected earnings both with and in the absence of the damages and then calculate the economic loss as the difference between the two. Frequently, the defendant's attorneys question the economic expert as to what the net income of the plaintiff would have been (or is forecasted to be) in the absence of the damages. However, this is not the issue; rather, only the estimated damages is what matters. Consider a farmer whose crop is destroyed by the negligence of a crop sprayer. The key damages are the lost net change in sales revenues adjusted by the changes in crop-related costs paid by the farmer. The income the farm is generating from livestock production, other parts of the business, or the farmer's part-time job are irrelevant and generally need not be considered in the damage estimation. The damages are enterprise specific, and the analyst may not need to be concerned with the overall economic performance of all facets of the firm. In cases involving bankruptcy or inability of the firm to expand due to the defendant's actions, the analyst may need to evaluate the entire economic viability of the firm. However, damages that may be enterprise specific frequently can be estimated without the increased complexity of having to evaluate the
entire firm's expected nondamage and postdamage earnings, thus reducing the cost of the analysis required.

DISCOUNTING

In 1916, the Supreme Court of the United States in Chesapeake and Ohio Railway Co., v. Kelly, 241 U.S. 485 (1916) ruled that lump-sum awards must be discounted to their present value. In most damage litigation today the issue of the time value of money is an important factor in the final estimation process. Because of the slow judicial process, economic damage incurred by the plaintiff will be judged and awarded long after the "act". In these instances, it is generally agreed by both economists and the courts that the damage amount be adjusted for interest foregone up to the time period when the case is ruled upon. A dollar today is worth less than a dollar in the past because one could have invested less than a dollar in the past and drawn interest to end up with a dollar today. Awards for damages that extend into the future likewise must be adjusted for interest which can be earned on a lump-sum award today. That is, a dollar today is worth more than a dollar in the future inasmuch as it could be invested and result in more than a dollar a year from now. The basic need for adjusting awards for the time value of money is clear; however, a number of practical problems arise in determining the proper discount rate that should be applied in adjusting past or future damages to their present value.

The discount rate is used to adjust damages that have already occurred or are expected to be incurred in the future to their present value. The discount rate reflects the opportunity cost of the damages; i.e., the economic "cost" to the injured parties as a result of not having the funds they should have had were it not for the damages. The discount rate should
be chosen so as to adjust the award to a value that would approximately replace the revenue lost as a result of the damage. The appropriate discount rate is related to the market rate of interest at which the injured party would have invested the lost revenues (i.e., the opportunity cost). Therefore, the discount rate, for a particular case, ought to be the market rate of interest paid for borrowed funds or received from savings or investments by the injured party, whatever would have been the best use of the money in the absence of the damages. Thus, the appropriate discount rate for different individual situations will likewise differ.

Discounting Damages Incurred Before the Trial

In adjusting losses (for the time value of money) that have occurred before the trial, one can use the prevailing interest rate during the time of damage to adjust the award. The analyst can simply collect historical data on interest rates for the period in question and use this information to adjust the damage. But what interest rate(s) should the analyst use to adjust the awards (i.e., the prime rate, T-bill rates, mortgage rates, etc.)? The choice of the particular interest rate depends on the facts of the particular case. If the cash losses incurred would have been used to pay off outstanding loans, then the interest rate used to adjust the damages should be the rate charged on borrowed funds over the period. Had the damage not been incurred, the plaintiff would have had the additional cash to make payments on an outstanding loan. By delaying this payoff, the total interest due has grown at a compound rate on the amount of cash damages incurred. For example, if the interest rate on borrowed funds was a constant 14 percent over the historical period, then the cash losses should be increased based upon that compound rate. However, this applies only to
cash that would have otherwise (had the damage not been incurred) been available to the plaintiff.

Losses to less liquid assets and cash losses not committed to loans should be adjusted by an alternative method. These losses should be adjusted by the net return on investment that the firm would have been realizing had the damage not occurred. The firm (or individual) would have been realizing a rate of return on its invested funds that it was not able to realize due to the damages. In determining the appropriate rate of return on investment that the firm should have been enjoying, the analyst must estimate the appropriate rate of return that would have been expected for the firm in the absence of the damage. In estimating the rates of return, one could look at historical rates of return on invested funds for the firm in question before the damages and compare this with another set of firms in the industry with similar characteristics. One should then observe what return on investment the other firms were realizing during the period of damages and adjust this rate to reflect how the firm in question had historically performed relative to the others analyzed. This rate should then be adjusted for inflation to determine a net real rate of return. For example, suppose that the damaged firm typically realized rates of return at a rate of 95 percent of the competing (or similar) firms analyzed, and that the competing or similar firms realized real rates of return of 10 percent annually during the duration of the damages to the firm. Then the relevant real rate of return for the plaintiff is 9.5 percent. The analyst would then increase the nominal damages for each year by 9.5 percent compounded annual interest rate for the period of damage duration to estimate the present value of damages at the trial date. This, however, would be useful
only for adjusting historical damages, for which historical data are available.

In cases where the damages prevented repayment of loans, the funds not repaid due to the cash losses caused via the negligence of the defendant by the trial date would include all the cash damages that would have been applied to the loan plus all accrued (compounded) interest. However, in cases where cash losses in excess of loan payments were incurred and/or noncash damage was realized, one needs to consider rates of return that would have been realized without the damages and increase the damages by the real rate of return that the firm would have been expected to realize.

Discounting Future Damages

In cases involving future damages, the issue of discounting becomes more complex. In these instances, one must rely on forecasts of the damage amount and forecasts of the discount rate. The problems involved in forecasting the discount rate are numerous.

In cases involving punitive damages for future pain and suffering, the courts have not generally required (or allowed) discounting of the damages. In Metz v. United Technologies Corp., 754 F.2d 63(1985), the court stated that it would be erroneous to instruct the jury to reduce an award for future pain and suffering to its present worth because it is not measured with any mathematical precision and that reduction to present worth would be "arbitrary as well as artificial." However, in cases involving losses of future earnings, the discounting of losses to present value is a necessity to arrive at the most "correct" estimate of damages to be paid.

Recent court decisions have recognized the necessity of discounting future rewards to present worth. In Metz v. United Technologies Corp.,
(previously cited), the court stated that present value calculations are a necessary element of all awards involving future earning capacity. Metz was injured in a helicopter that crashed, and United Technologies Corporation, the manufacturer of the helicopter, admitted responsibility. Metz was awarded monetary benefits for loss of future earning capacity, and the courts ruled that the award should be made upon the basis of its present value only. Past and current courts alike recognize the need for discounting of losses to get them to present value.

However, there has not been a consistent application of this discounting of awards by the trial courts. Westbrook v. General Tire and Rubber Co., 754 F.2d 1233(1985), is a prime example of the trial court's failure to properly discount future earnings. Westbrook was driving a cement truck on a Texas highway when the front tire of the truck blew out, causing the truck to swerve into the ditch and overturn. Westbrook suffered numerous physical injuries, including a fractured vertebra. Westbrook was earning $15,000 per year at the time of the accident, and he had 38 years of expected diminished earning capacity due to the accident. The jury awarded the plaintiff $597,000 for pain and suffering and $328,000 (the expected difference between future minimum wage and a truck driver's salary for 38 years) for lost earning capacity. Failure to reduce this amount of foregone earning capacity to present worth resulted in grossly overstated damages. Recent litigation has not consistently recognized the appropriateness of discounting.

Even where courts have recognized the necessity for reducing awards to present worth, at times the methods used to discount have been incorrect. A prime example of erroneous discounting methods occurred in Shaw v. United States, 741 F.2d 1202(1984). When Karen Shaw gave birth to Richard Shaw,
the baby suffered brain damage, which the court found was caused by the negligence of the hospital medical staff. The district court awarded damages of $11,732,345.43. Of this amount $4,780,147 was for future medical expenses and lost earnings. The court then stated that the (future) damages shall be reduced to present value by using a discount rate of 1 percent (9 percent interest less 8 percent inflation = 1 percent). No explanation was given by the court for the determination of the interest rate and inflation rate, which makes it highly questionable. (In the last 20-30 years, a 2-3% real rate of return is fairly typical). The court then applied the 1 percent discount rate to deduct $47,801.47 (1 percent of the damages) from the pecuniary damages and claimed this resulting amount to be the net discounted present value of the damage that should be awarded. This is a completely erroneous method of calculating the present value of the award because it would be appropriate only if all the future damages would be incurred in the following year. Even if one were willing to accept the seemingly arbitrary 1 percent as the appropriate discount rate, the amount that should be deducted from the award to reduce it to present worth would be $2,151,066 (assuming a 60-year remaining life span). Payment should have been $2,629,081 at the time of settlement, far below the almost $5 million originally ruled. Clearly, especially in cases involving large settlements for long-term injuries, discounting to present worth can involve an adjustment of a substantial sum of money. Emphasis needs to be placed on the necessity for discounting and using the correct technical process to transform future damages into current dollars. This is one area where the use of an economist/financial expert can add significantly to the accuracy of calculating the present worth of a stream of damages because the process is relatively simple for those trained in this area.
Determination of the appropriate discount rate is a very important part of the discounting procedure. The discount rate reflects the rate of return on investment into the future and the rate of inflation. If the expected rate of return on investments is exactly equal to the expected rate of inflation, the net discount rate is zero, and $1,000 damages estimated for next year would require a $1,000 award this year. Any return on investment is essentially offset by the decreasing purchasing power of the funds due to inflation, implying a discount rate of zero. Otherwise, a positive discount rate would result in a damage award less than $1,000 this year. Though the cases cited have dealt with personal injuries, the same ideas transfer to evaluating the discount rate in cases involving pecuniary damages to firms. The key difference is that one must project the rate of business earnings into the future as opposed to individuals' salaries in personal injury litigation.

Additional Issues in Discounting

In capital budgeting (finance) literature, the discount rate is stated to reflect 1) the after-tax rate of return required to cover the opportunity cost of equity capital (i.e., the "cost" or foregone return of not using equity capital to finance the next best, equal-risk level alternative), 2) the inflation rate, and 3) risk premiums added to reflect the uncertainties of earnings, prices, costs, production and sales, etc. (Penson and Lins, 1980). The real discount rate typically increases as the rate of return, or the riskiness of the project, increases and decreases as the inflation rate increases. The higher the discount rate, the lower will be the present worth of damages because the plaintiff can invest the award at a higher rate or return.
In cases involving personal injury and loss of earning capacity, the discount rate should reflect the low-risk rate of interest that the individual could earn from investments, and this rate is then adjusted downward to account for inflation. For instance, with a market interest rate of 10 percent and an inflation rate of 8 percent, the low-risk discount rate would be 2 percent. If one invested $100 today at 10 percent interest with an 8 percent inflation rate, the cash balance in one year would be $110, but the equivalent purchasing power next year would be $102.

Recent literature discussing discount rates that should be used in personal injury, lost earning capacity awards has led toward a general theme of offsetting the interest rate with the inflation rate in calculating the discount rate. Brody advocates a total offset method of discounting in personal injury instances, where the rate of interest is presumed equal to the inflation rate, the discount rate becomes zero, implying that the lump-sum award need not be adjusted to reduce it to present worth. Brody assumes a scenario of a hypothetical accident victim with a given wage and assumed 20-year loss in earning capacity. He then simulates the financial situation that would result for the individual over the 20-year period (1960-79), comparing four methods of discounting: 1) setting the discount rate equal to the interest rate and assuming that the constant current wage rate would persist over the 20 years; 2) inflating wages over time but using a discount rate equal to the interest rate; 3) using a fixed discount rate of 2 percent, which was the average real rate of return from risk-free investments during the period; and 4) the total offset method of a discount rate of zero, with a constant wage assumed. The total offset method resulted in the most consistent damage award of the methods employed in terms of not substantially over- or under-compensating the victim. The first three
methods ended up under-compensating the victim substantially. That is, the balance of the fund, reduced annually for the expected earnings, which would have been realized each year, fell to zero before the end of the 20-year earning expectancy. The total offset method came the closest to netting a balance of the gross award of zero (allowing for the annual withdrawals from the fund at a level equal to what the individual was expected to have earned) at the end of the 20-year simulation period. The fund was exhausted based on the annual withdrawals from the fund given the actual annual interest and inflation rates that occurred during these years.

Winer echoed the results of Brody, although he argued that the total offset method and the fixed adjusted discount rate method may both be useful, depending on the particular case. For example, if the individual's wage rate would have been expected to increase at a slower rate than the inflation rate, a partial offset may be preferred to the total offset method. At any rate, Winer concluded that both methods provide for a more consistent and predictable treatment of discounting than a case-by-case forecasting of future interest and inflation rates.

The inability of experts to agree on forecasts of the actual interest and inflation rates makes these forecasts questionable, but the difference between these two series (or the discount rate) has been fairly stable for long periods of time, though more sporadic in recent years. While some courts have considered forecasts of inflation rates as speculative and highly error prone (Winer), the generally positive real rate of return on investments does appear to be forecastable with reasonable precision. Also, the courts ought to distinguish between the appropriate discount rates to use in cases where damages are applied to loans or investments, with appropriate compounding effects, and those where lump-sum payments are going
to be periodically withdrawn for consumption purposes. The latter situation would involve substantially lower discount rates in estimating appropriate lump-sum damages.

These recent studies have shed some light on the appropriate discount rate to use in personal injury cases. However, they have both ignored an integral part of the discount rate as it is outlined in the finance field. These studies have ignored integrating the level of risk associated with potential high variability and uncertainty of the estimated lost earnings. In general, the higher the degree of risk of the enterprise, the higher the discount rate should be. In capital budgeting methods of comparing investment alternatives, the discount rate is adjusted based upon the investor's risk attitudes and the riskiness of the investment. The more risk averse the decision maker, the higher the discount rate will be on the more risky prospects. Put another way, the risk-averse investor would require a risk premium to entice him into investing in a risky prospect. However, in determining the discount rate to be used in estimating damages, it is not the risk attitude of the plaintiff that matters as much as the riskiness of the enterprise. If the firm is involved in a low-risk business that can consistently compete within its industry and realize a uniform profit in the future (had the damage not occurred), there is no strong basis to increase the discount rate to reflect riskiness. However, if the firm is involved in a business with high financial risks in which earnings can be highly variable and/or entry and exit of firms in the industry is high, the discount rate should be increased to reflect this increased risk.

In determining the risk adjustment to be added to the discount rate, historical data on the firm in question and other firms should be considered. For example, in evaluating the risk-adjusted discount rate for
a manufacturing firm, one could compare typical rates of return by this firm relative to an index of returns for a set of similar firms during the period of damages. The more (less) volatile the returns for the firm in question relative to the average firm, the larger (smaller) the discount rate should be in adjusting damages to present value.

Where data on historical returns for the damaged business relative to the average firm are not available, one may have no basis to adjust the discount rate for risk. This is frequently the problem that arises in adjusting damages for farms where very limited, useful historical data on specific enterprises for the individual farm exist. In these cases, one cannot justify a risk-adjusted discount rate and should rely on the risk-free discount rate to reduce lump-sum damage awards to present value. If however, the farmer could document that his production has been less variable than the average farm in the region, then one may be justified in reducing the discount rate accordingly.

CASE EXAMPLES

Agriculture

In calculating damages, one should reduce the total expected revenue (had it not been for the damages) by the amount of revenue actually received. This idea was properly applied in Holm v. Hansen, 248 N.W.2d 503(1976). Holm recovered damages for bred cattle purchased from Hansen, which were infected with brucellosis. The court computed damages based on the total number of calves the plaintiff should normally have been able to raise and deducted from this total the income from the sale of the calves that were raised. The court stated that "... (the) defendant is correct in his contention that the trial court must consider income received by
plaintiff from sale of the (43) calves of the purchased herd ...." In this case, the procedure used was internally consistent; the damages for lost calves included only the income foregone for the number of calves raised below the normal number expected. To prevent a double payment, one must deduct actual income to determine the net damage figure.

Interpretations of this decision have been confused. In a similar case in Iowa in 1982 (which was eventually settled out of court and thus is not referenced here for anonymity), the court incorrectly interpreted the decision from Holm v. Hansen. The trial judge agreed with the defendant's attorney that damages for lost calves should be calculated as the expected number of calves that should have been raised, were it not for the disease, less those calves that actually were raised multiplied by the expected net revenue per head. This would have been correct (assuming that the relevant costs and revenues were included). However, from this amount, the revenue received from the calves actually raised was deducted. This amounted to double counting of the plaintiff's revenue from the calves raised and undercompensated the plaintiff. Attorneys and judges alike must be careful to interpret details of damage estimation and not blindly rely on partial statements made by previous courts.

Industrial

The estimation of damages for two recent cases in Iowa illuminates some of the issues discussed. They also serve as prime examples of how specific issues of a particular case influence the damage estimation procedure. Kemin Industries brought suit against two suppliers in 1983 to recover damages for defective goods supplied to Kemin by the two companies over a 4-year period.
Kemin manufactures and sells chemical hay preservatives and preservative applicators. Each supplier manufactured pumps for the applicators that were installed and sold by Kemin. The pumps supplied by both companies developed serious problems as a result of flaws in the manufacturing. As a result of the defective pumps, Kemin's sales of both applicators and preservatives declined drastically. The cumulative effect of selling defective pumps for consecutive years had a very damaging effect on Kemin's sales.

The damages were the lost profits due to past and future declines in sales, of which portions of the damages were attributable to each defendant separately. The process used by the economic expert to estimate the damages was as follows: 1) Estimate the applicator sales, which historically had exhibited a linear trend, with a linear regression equation with a time trend as the regressor. This equation was used to forecast pump sales in the absence of the defects. 2) A regression equation was estimated for chemical sales as a function of applicator sales and previous year's chemical sales. 3) The forecasted applicator sales based on the trend equation could then be substituted into the chemical sales equation to obtain a forecast of the future chemical sales. The difference between expected and actual pump and chemical sales was calculated for 5 years, the time the damage first appeared up until the trial date. 4) Based on the estimated statistical relationships in 2), a 70 percent annual customer chemical repurchase rate was found to exist historically; the lost chemical sales were reduced by this amount each year into the future until the amount became insignificant. 5) Incremental net profits per unit sales were then estimated based on recent history for Kemin, and the sales figures were multiplied by the incremental profit per unit to obtain the damages due to
decreased chemical sales. 6) The damages were allocated to the two defendants based upon the dates of sale of the applicators containing the respective firms' pumps and percentage of defective applicators manufactured by each firm in Kemin's records. 7) The allocated damages were discounted to present value by using an average historical rate of return for Kemin.

The Kemin example, though condensed, illustrates the complexities that can be involved in the estimation of damages (many details of the case and the estimation process were ignored to conserve space in this discussion). The case exemplifies some of the econometric models that can be used sometimes to forecast potential sales and damages and one procedure to allocate damages among more than one party.

SUMMARY AND CONCLUSION

The need for and use of economic experts in estimating damages in litigation has increased in recent years. The increased complexities and monetary amounts involved have made expert testimony (or consultation) almost a necessity in determining damages. Concepts that are relatively straightforward to an economist may be completely unfamiliar to the court. The estimation of damages requires the use of scientific approaches for which the expert is trained. Frequently, when the courts have estimated damages, the awards have been incorrect, and inconsistencies in amounts awarded and estimation techniques used have been appealed to higher courts while others remain uncontested; as a result many plaintiffs have been left either significantly over- or under-compensated.

Some frequent problems involved in estimating damages are
1) forecasting future losses, 2) determining incremental net revenues lost, 3) estimating losses where limited data are available, 4) determining
additional costs incurred due to the damages and which should be reimbursed, and 5) determining the appropriate discount rate to be applied in converting the awards to present worth. The courts need to be familiar with and understand the concepts involved in damage estimation to more equitably and accurately make determinations of appropriate damages in litigation.
FOOTNOTES

1 Perdue (1973), who examines the role and importance of expert testimony in court; O'Connor and Miller (1972), who discuss estimation of lost earning power by an injured individual; Brody (1982), who advocates the offset method of discounting future earnings for an individual (where the real discount rate is zero; i.e., the inflation rate offsets the nominal discount rate); Levmore (1982), who develops a self assessment valuation of loss theory for personal injury cases; Winer (1982), who discusses the effects of inflation on future earnings of an individual; Bale (1983), who develops a discussion similar to that of Brody in discounting losses to present worth; Komesar (1975), who develops a general utility theory of personal injury loss; Mishan (1971), who discusses the applicability of cost-benefit analysis in determination of personal injury and death losses; Owen (1982), who advocates bifurcation of monetary award determinations in cases involving both personal injury and punitive damages; and Speiser (1970), who discusses the determination of lost income for a deceased individual. In addition to this list, guides to legal periodicals contain lists of many more articles dealing with some issue on the estimation of losses in personal injury cases.
REFERENCES:


