The Resolution of Medical Malpractice Claims

Modeling the Bargaining Process

Patricia Munch Danzon, Lee A. Lillard

Research Design and Methods
This research is supported by The Institute for Civil Justice.

The Rand Publications Series: The Report is the principal publication documenting and transmitting the Institute's major research findings and final research results. The Note reports other outputs of Institute research for general distribution. Publications of The Rand Corporation do not necessarily reflect the opinions or policies of Rand's and the Institute's research sponsors.

Published by The Rand Corporation
The Resolution of Medical Malpractice Claims

Modeling the Bargaining Process

Patricia Munch Danzon, Lee A. Lillard

1982

Research Design and Methods
The Institute for Civil Justice

The Institute for Civil Justice, established within The Rand Corporation in 1979, performs independent, objective policy analysis and research on the American civil justice system. The Institute's principal purpose is to help make the civil justice system more efficient and more equitable by supplying policymakers with the results of empirically based, analytic research.

Rand is a private, non-profit institution, incorporated in 1948, which engages in nonpartisan research and analysis on problems of national security and the public welfare.

The Institute examines the policies that shape the civil justice system, the behavior of the people who participate in it, the operation of its institutions, and its effects on the nation's social and economic systems. Its work describes and assesses the current civil justice system; analyzes how this system has changed over time and may change in the future; evaluates recent and pending reforms in it; and carries out experiments and demonstrations. The Institute builds on a long tradition of Rand research characterized by an interdisciplinary, empirical approach to public policy issues and rigorous standards of quality, objectivity, and independence.

The Institute disseminates the results of its work widely to state and federal officials, legislators, and judges, to the business, consumer affairs, labor, legal, and research communities, and to the general public.
Board of Overseers

CHAUNCEY J. MEDBERRY, III, Chairman of the Executive Committee, Bank of America; Chairman of the Board of Overseers, The Institute for Civil Justice

KENNETH J. ARROW, The Joan Kemmy Professor of Economics and Professor of Operations Research, Stanford University

WILLIAM O. BAILEY, President, Aetna Life and Casualty Company

ARCHE R. BOE, President, Sears Roebuck & Company

GUIDO CALABRESI, Sterling Professor of Law, Yale Law School

RICHARD P. COOLEY, Chairman and Chief Executive Officer, Wells Fargo Bank and Wells Fargo & Company

THOMAS R. DONAHUE, Secretary-Treasurer, AFL-CIO

W. RICHARD GOODWIN, President and Chief Executive Officer, Highmark Capital Corporation

SHIRLEY M. HUPSTEDLER, Attorney, Hupstedler, Miller, Carlson & Brandeston, former U.S. Circuit Judge, former Secretary, U.S. Department of Education

JOHN A. LOVE, Chairman, President and Chief Executive Officer, Ideal Basic Industries and former Governor of Colorado

LAURENCE E. LYNN, JR., Professor of Public Policy, John F. Kennedy School of Government, Harvard University

ROBERT H. MALOTT, Chairman and Chief Executive Officer, PMC Corporation

EDWARD J. NOHA, Chairman and Chief Executive Officer, CHA Insurance

WILLIAM B. SCHWARTZ, Vannevar Bush University Professor and Professor of Medicine, Tufts University

ELEANOR R. SHELDON, former President, Social Science Research Council

GUSTAVE H. SHUBERT, Senior Vice President, The Bond Corporation, Director, The Institute for Civil Justice

JUSTIN A. STANLEY, Partner, Mayer, Brown & Platt; former President, American Bar Association

PUTTER STEWART, Associate Justice, United States Supreme Court; retired (Will join the Board of Overseers, March 1986)

WARD WAGNER, JR., Partner, Cohn, Ober, Wagner, Wagner, Johnson, Hazen & Ricks; former President, The Association of Trial Lawyers of America

ROBERT B. WILCOX, President, Property-Casualty Insurance Council

SANDRA L. WILLET, Executive Vice President, National Consumers League

MARGARET BUSH WILSON, Partner, Wilson, Smith and McCutie; Chairman of the NAACP National Board of Directors

PAUL S. WISE, President, Alliance of American Insurers

LEONARD WOODCOCK, Adjunct Professor of Political Science, University of Michigan; President Emeritus, United Auto Workers; former U.S. Ambassador to the People's Republic of China

HONORARY MEMBERS

IRVING A. BLUESTONE, Professor of Labor Studies, Wayne State University; former Vice President, United Auto Workers

EDWARD H. LEVI, Clark A. Lloyd Distinguished Service Professor of Law, University of Chicago, former Attorney General of the United States

SAMUEL R. PIERCE, JR., Secretary, U.S. Department of Housing and Urban Development

DONALD H. RUMSFELD, President and Chief Executive Officer, G.D. Searle & Company

CHARLES J. ZWICK, President and Chief Executive Officer, Southeast Banking Corporation; former Director of the U.S. Bureau of the Budget
Foreword

Observers of the civil justice system recognize two dominant groundswells of legislated (as opposed to judge-made) change in American personal injury law during the past few decades. The first was the movement of many states toward no-fault auto liability systems. The second was the legislature reaction to a nationwide upsurge in medical malpractice insurance premiums during the early 1970s.

Rand's Institute for Civil Justice has been conducting a study of the resolution of medical malpractice claims. The study applies sophisticated behavioral and mathematical modelling techniques to two rich lodes of data, collected by major insurance carriers, covering the vast majority of all claims of this type that were closed in 1974 and 1976—years that bracket the heart of the period of generally perceived crisis.

The objectives of the work are ambitious. They can be summarized as an attempt to build an analytic tool capable of providing at least preliminary answers to most of the questions that practitioners, scholars, and policymakers have not been afraid to ask, but to which they have heretofore received no empirically documented answers. To wit: Do the parties to medical malpractice disputes act rationally, on the average? What determines whether voluntary settlement occurs, and if so, what dollar level? What would the verdict have been if a settled claim had been carried through to trial? What differences do principles of law and justice make in the upwards of 90 percent of cases that are settled instead of being tried to verdict? Is the compensation achieved through settlement or verdict fairly distributed across the broad spectrum of people who file malpractice claims? Which of the legal changes legislated during the crisis period seem to have had an immediate effect—and was that effect in the direction intended by the enacting legislature?

To be sure, the answers provided by the study are neither definitive nor entirely comprehensive. The analytic model employed does not try to reproduce all of the nonrational behavior that leavens the human condition. Rather, it seeks to establish the degree to which actual
behavior, as expressed in thousands of closed claims, fits the patterns predicted by the model on the simplistic assumption that all parties are merely trying to maximize their financial advantage. The closer the fit, the more useful the model and its assumptions should be for anticipating the likely effects of proposed changes in public policy. At the same time, we begin to develop a research instrument that is not only capable of analyzing the behavior of parties to medical malpractice claims, but also is applicable to any bargaining situation involving opposing parties in a dispute that can and will be adjudicated by a third party if the disputants cannot settle it themselves.

The publication of these results is therefore doubly important for the Institute for Civil Justice. In themselves, they constitute a unique contribution to a policy issue of great significance across the country. Perhaps even more important, they introduce a research method that may prove useful in a much wider research arena.

The results of our research appear in two reports. The present report is a detailed, technical description of the data base, the model, and the statistical analysis performed with the model; it is the second in the Institute's series on Research Design and Methods. Readers desiring a nontechnical discussion of our findings are referred to the companion-piece to this report, R-2793-ICJ, *The Resolution of Medical Malpractice Claims: Research Results and Policy Implications*, by Patricia Munch Danzon and Lee A. Lillard.

This kind of combination of substantive and methodological contribution is what the Institute was founded to generate. This study is a worthy addition to the evidence that such contributions are possible, as a technical matter, and that their insights can be communicated in plain English. It should reward the time invested by every reader with a serious interest in civil justice practice and policy.

Gustave H. Shubert
Director, The Institute for Civil Justice
Summary

The early 1970s witnessed a rapid increase in the frequency of claims and the size of awards in all lines of tort law. The surge was most extreme in medical malpractice claims, with the result that malpractice insurance premiums rose steeply—as much as 300 percent in some states. In response, legislatures in most states enacted changes in the law that were intended to curb the perceived causes of the eruption in premiums. These tort reforms were enacted with scant empirical evidence on how the malpractice system operates or the likely effects of proposed changes. Previous academic studies of the settlement process, which resolves over 90 percent of claims, have been largely theoretical. Prior empirical studies of closed-claim data have lacked the methodology necessary to analyze the settlement process and its relation to outcomes in court.

This study makes two contributions. First, it develops a methodology that permits estimation of a model of the process of dispute resolution, including the settlement process and its relation to outcomes in court. Second, it applies the model to data on over 5800 claims closed in 1974 and 1976, to obtain estimates of the determinants of outcomes at verdict and in settlement, including preliminary estimates of the effects of statutory changes enacted in response to the crisis.

The theoretical model of the disposition process builds on that developed by others. Each claim has a potential outcome at verdict—the so-called "shadow verdict"—that depends on the facts of the case and the law defining liability and compensable damages. Because litigation is costly, both parties have incentives to settle. The actual outcome of the claim—whether it is dropped without payment, settled for a positive sum, or litigated to verdict, and the size of any positive settlement—depends on the defendant's maximum offer (expected award at verdict gross of litigation cost) relative to the

plaintiff's minimum ask (expected award at verdict net of litigation costs). The model implies that the sample of claims observed to close at each stage of disposition will be a nonrandom sample, "self-selected" on the basis of those characteristics whose effects on probability and size of payment we wish to measure. Estimation using standard econometric techniques that do not correct for this selection bias therefore will yield biased estimates of population parameters.

An important feature of this study is the development of maximum likelihood estimation procedures which, together with some simplifying theoretical and empirical assumptions, enable us to obtain unbiased estimates of population parameters and of the unobserved latent variables—potential award at verdict, potential settlement, ask and offer—for all claims, regardless of their actual stage of disposition. The estimates of these latent variables provide evidence on how well the settlement process reflects the shadow verdict, and of the influence of the ask and offer on the settlement. The estimation procedure builds on switching regression models and techniques for correcting for selection bias. This methodology and issues of parameter identification are described in detail in the text.

The model is estimated using data from two national samples of malpractice claims closed in 1974 and 1976. These data contain information on the injury, the plaintiff and the defendant, the stage of disposition, and the size of payment if any. Information on the legal environment in the state in which each claim was closed, including laws passed between 1974 and 1976, was added to the claim files.

At the most general level, the major finding is that claim disposition is far from the random process often charged by critics of the tort system. The outcome, either in court or settlement, appears to adhere to the legal standard of negligence and damages to some extent; and when it diverges from that standard it does so in ways that are consistent with rational behavior of the litigants in the face of high costs of litigation. More specifically, the estimates imply that court awards are strongly influenced by the plaintiff's economic loss and the law of compensable damages. A verdict in favor of the plaintiff is more likely in a claim involving death or severe injury, but this does not necessarily imply that the court is relaxing the negligence standard. Out-of-court settlements are strongly influenced by the shadow verdict. On average, cases settle for 75 percent of that verdict; the discrepancy is larger (smaller), the greater the litigation costs of the plaintiff (defendant). Claims that are more likely to win at verdict are more likely to receive payment in out-of-court settlement.

Litigation costs influence claim disposition. Claims with small shadow verdicts are more likely to be dropped without payment and are less likely to go to verdict, presumably because of relatively high
litigation costs. The evidence clearly refutes the popular belief that insurance companies stand ready to pay out money freely to be rid of small claims, including unfounded “nuisance” claims. The limited evidence concerning the determinants of the decision on whether to go to verdict shows that the probability is higher if (1) the stakes are large, which suggests large fixed costs of going to court and greater uncertainty about awards for serious injuries, and (2) the plaintiff’s probability of winning is low.

The huge discrepancy between the mean award at verdict ($102,000) and out-of-court settlement ($26,000) is due mainly to the fact that cases taken to trial consist disproportionately of cases whose shadow verdicts are large because of large economic loss. Similarly, the extremely uneven distribution of dollars among claimants—50 percent of dollars are paid to 3 percent of claims (or 5 percent of all claims receiving some payment)—largely reflects the uneven distribution of injury severity and measurable economic damage.

Although these data cannot reveal the full long-run impact of the 1974-76 tort reforms, they suggest that ceilings on awards, permission to pay awards in periodic installments, and elimination of specific dollar requests by plaintiffs (i.e., by barring the ad damnum clause) significantly reduce awards and reduce the probability and size of payment in out-of-court settlements. Limits on contingent fees charged by plaintiffs’ attorneys decrease settlement size, increase the likelihood that a case is dropped, and decrease the likelihood of litigation to verdict. This is interpreted as evidence that unconstrained contingent fees do not convey rents at the margin. If so, fee constraints will limit expenditure of litigation at the cost of reduced compensation to plaintiffs.
Acknowledgments

The authors are indebted to staff of the American Insurance Association who kindly provided the data for this study. Rand colleagues Michael Ward and Dennis Smallwood provided many helpful comments. We wish to thank Karl Schutz, who wrote the statistical routines to perform calculations, and Christine Peterson, who prepared the data for analysis. This research has benefitted to some extent from support provided by the Health Care Financing Administration under contract 600-76-0150, and by The Hoover Institution.
## Contents

FOREWORD ................................................................. iii  
SUMMARY ................................................................. v  
ACKNOWLEDGMENTS .................................................. ix  
FIGURES AND TABLES ................................................... xiii  

Section

I. INTRODUCTION ..................................................... 1  

II. THE MODEL OF DISPUTE RESOLUTION ....................... 4  
   The Courts .......................................................... 5  
   Predictions of the Model ........................................ 8  

III. ECONOMETRIC MODEL: ESTIMATION AND  
    IDENTIFICATION .................................................. 11  
   The Econometric Model .......................................... 11  
   Estimation and Identification .................................. 13  
   Likelihood Function for FIML Estimation .................... 21  

IV. DATA AND PARAMETER ESTIMATES 24  
   Data ............................................................... 24  
   Parameter Estimates ............................................. 25  
   Quasi-Analysis-of-Variance ...................................... 31  

V. STRUCTURAL PARAMETERS AND THEIR  
   INTERPRETATION .................................................. 35  
   Potential Award at Verdict (V) ................................. 35  
   Plaintiff's Probability of Winning (W) ....................... 39  
   Why Cases Are Dropped (The Plaintiff's Minimum  
   Ask (A)) ........................................................... 40  
   The Defendant's Maximum Offer (M) ............................ 42  
   Size of Settlement (S) ............................................ 43  
   Propensity to Go to Verdict ..................................... 43
VI. FURTHER IMPLICATIONS OF PARAMETER ESTIMATES ............................................. 47
   The Probability of Winning in Court for Cases Settled or Dropped .................................. 47
   Accounting for the Distribution of Dollars ................................................................. 49
   Simulated Effects of Tort Reforms: Limits on Awards .................................................. 52

VII. CONCLUSIONS ................................................................. 55

REFERENCES ................................................................. 57
Figures

1. Disposition of Medical Malpractice Claims .......... 4
2. Dispositions and Potential Settlements ............ 22

Tables

1. Variable Description and Means .................. 26
2. Selected Statistics on Dollar Payments ............ 28
3. FIML Regression Coefficient Parameter Estimates ... 29
4. Covariance Parameter Estimates .................. 31
5. Reduced-Form Quasi-Analysis-of-Variance .......... 32
6. Full Sample Mean and Range of Relevant Predicted Values .................. 33
8. Effect of Severity of Injury ..................... 37
9. Predicted Mean Values Based on Observed Characteristics (X), by Stage of Disposition ...... 45
10. Effect of Number of Defendants .................. 46
11. Plaintiff's Probability of Winning (P) for Cases Dropped and Settled .................. 48
12. Accounting for Difference Between Mean Verdict and Mean Settlement .................. 49
13. Accounting for the Dispersion of Dollar Payout .... 51
15. Effects of Hypothetical 30 Percent Reduction in Litigation Costs .................. 54
I. INTRODUCTION

This report makes two contributions to the area of legal studies. First, we develop a methodology that permits estimation of a model of the process of dispute resolution, including outcomes in court and in out-of-court settlements. This methodology, including issues of statistical estimation and identification, is carefully detailed. Second, we apply the model to data on medical malpractice claims. The resulting estimates concerning determinants of which claims get paid, and how much, add to our understanding of how the tort system operates, and provide evidence relevant to the policy debate over tort reform.

It is well known that the great majority of civil and criminal cases are settled out of court. Landes (1971), Gould (1973), Posner (1973), and others have developed theoretical models of the disposition process, in which the decision to settle and the size of settlement depend on the defendant's maximum offer (expected award at verdict, gross of litigation costs) relative to the plaintiff's minimum ask (expected award at verdict minus litigation costs). Variants of this model have been applied in several contexts, but so far it has not been estimated empirically with data on individual claims. Two obstacles stand in the way of estimation using standard econometric techniques. First, the hypothesized determinants of the outcome, the potential verdict, ask, offer, and litigation costs are all unobserved. Second, analysis of the determinants of the probability and size of payment to the plaintiff, whether in or out of court, cannot be generalized to the universe of claims as a whole; the reason is that, if the theory is correct, claims closed at each stage of disposition are not random samples but are "self-selected" on the basis of those case characteristics whose effect we wish to measure. Parameter estimates are valid conditional estimates for claims closed at each stage of disposition, but are potentially biased estimates of population parameters. In particular, we cannot use information from claims closed at verdict to infer the potential verdict—the so-called "shadow verdict"—for claims that were settled out of court.

In this study we develop maximum likelihood estimation procedures which, together with some simplifying theoretical and empirical assumptions, enable us to obtain unbiased estimates of population

1Landes uses statewide data on criminal cases to analyze trial frequency. Munch (1976) uses data on payments in eminent domain cases to estimate determinants of size of payment. Baxter (1980) discusses settlement of antitrust cases.
parameters and of the unobserved latent variables—potential award at verdict, potential settlement, ask, and offer—for all claims, regardless of their stage of disposition. The data are drawn from two surveys of insurance company claim files closed in 1974 and 1976. Among the more interesting findings, we estimate that, on average, cases settle for 74% of their potential verdict and that settlement size is much closer to the defendant’s offer than to the plaintiff’s ask. Since the estimates are constrained by the assumptions of the model, we cannot test it directly; but the plausibility of the estimates supports the plausibility of the model.

A second purpose of this study is to provide evidence relevant to the policy debate over tort reform. The early 1970s witnessed a rapid increase in the frequency and size of claims in many lines of tort law: personal, product, professional, municipal, and automobile liability. The subsequent increases in liability insurance premiums led many states to enact changes in liability law, especially for medical malpractice and product liability. These tort "reforms" were intended to reduce the size of awards, limit the scope of liability, and reduce the cost of litigation. More fundamental changes, such as replacing the negligence system with a no-fault system for malpractice, were shelved pending the outcome of these tort reforms.

Major criticisms of the system have been that awards are either random or excessive; that the legal standard of negligence has little bearing on the outcome of the roughly 90% of cases that settle out of court; that the costs of operating the system are exorbitant; that these costs impel many plaintiffs with small but valid claims to drop them—and many other plaintiffs to pursue large "nuisance" claims because insurance companies supposedly will pay out money to avoid costly litigation. These allegations are apparently lent some credence by the observed outcomes of the disposition process. For example, less than 10 percent of the medical malpractice claims closed in 1974 and 1976 were tried to verdict; the remainder were settled out of court. In cases tried to verdict the plaintiff won 28% of the time, but received payment in 51% of out-of-court settlements. The average award at verdict was $102,000, compared with $26,000 at settlement. Roughly 50% of the total dollar payout was concentrated on less than 3% of the total number of claims (or 5% of all claims that involved some payment).

Our estimates show that the most extreme criticisms of the system are unfounded. Legal standards appear to influence court verdicts

---

2These measures include caps on awards; permission to make periodic payments of future damages; modification of the collateral source rule; limits on contingent fees of plaintiffs' attorneys; use of arbitration and pretrial screening panels; shorter statutes of limitations, etc. A listing of the changes, by state, is given in Danzon (1982).
directly and settlements indirectly. Lower plaintiff win rates but larger awards at verdict than at settlement are largely attributable to nonrandom selection of cases, by stage of disposition. When outcomes systematically depart from the legal standard, they do so in ways predicted by the economic model of claim disposition. Tort reforms designed to limit awards and limit contingent fees have had significant effects.

The model is also used to simulate the effects of hypothetical changes in litigation costs, such as might result from the introduction of arbitration or pretrial screening panels. We estimate that, under plausible assumptions, a 30% cost reduction for both plaintiff and defendant per case of going to verdict would reduce total litigation costs by only 3%, because more cases would be taken to verdict and fewer would be dropped without payment.

The model of dispute resolution is presented in Sec. II. Section III discusses statistical issues of estimation, parameter identification, and prediction. Section IV describes the malpractice data for 1974 and 1976 and briefly presents parameter estimates. The parameter estimates and their interpretation are discussed in detail in Sec. V. Section VI presents further implications of the estimates for tort reform, accounting for the distribution of dollar payments and the probability of winning in court. Concluding remarks appear in Sec. VII.
II. THE MODEL OF DISPUTE RESOLUTION

If a patient is injured as a result of medical treatment, the physician (or hospital) is liable for the damages suffered if there was a departure from the “due” standard of care.\footnote{Under the strict locality rule, due care is the customary practice of physicians in the same specialty and locality. Since the 1960s, this strict version has been expanded by many courts to include similar localities for general practitioners and a nationwide standard for specialists.} In our sample, about 43\% of claims are dropped without payment, 51\% are settled out of court by payment to the plaintiff, and 7\% are litigated to verdict, of which the plaintiff wins roughly one in four. Figure 1 illustrates the sequential nature of the disposition process, a very simple model of

\begin{center}
\includegraphics[width=0.5\textwidth]{diagram.png}
\end{center}

Fig. 1—Disposition of medical malpractice claims
the underlying decision process. It is derived from a more complete model (Danzon, 1980) in which the litigants select utility-maximizing expenditure on litigation, subject to an expected payoff function in terms of influence over the outcome, and the cost of litigation inputs. Because of the limited data available for this empirical study, we ignore endogeneity of litigation inputs and their influence on outcomes; bluff and gaming; the modification of bargaining positions over time; and delay as either an input or an outcome.

Throughout we use the log transformation of dollar values. Except where explicitly stated otherwise, the notation and discussion refer to log values.

THE COURTS

For each claim, there is a probability that the plaintiff will win and a potential award should the case go to verdict.

Potential Verdict (V)

The potential award at verdict (V), conditional on winning, depends on characteristics of the case, such as the severity of the injury and the law defining compensable damages:

\[ V = \zeta X + v, \]

where X is a vector of observed case and state characteristics and v is a residual reflecting all unobserved factors.

In general, the basic rules of damages for personal injury apply in medical malpractice cases. Compensable damage has two components: "economic" loss (wage loss; medical and other out-of-pocket expenses) and "pain and suffering," which is a catch-all for all nonpecuniary damages. Under the collateral source rule, awards are not reduced by compensation available to the plaintiff from other sources, such as medical or unemployment insurance. Typically, the award is paid in a

---

2The log transform is appropriate for estimation if laws and other measured binary variables, and all unmeasured factors included in the residual, have proportional rather than additive effects on awards. With our data, major unmeasured factors are the plaintiff's probability of winning and litigation costs, both of which plausibly have roughly proportional effects.
lump sum that includes damages incurred to date (without interest) and the present discounted value of expected future damages. Since 1975 many states have enacted statutory changes in the basic tort damage rules for cases of medical malpractice. These changes include dollar caps on either the total award or some component; admissibility of evidence of compensation from collateral sources; periodic rather than lump-sum payment of future compensation; and abolition of the *ad damnum* clause (whereby plaintiff requested specific dollar payments).

### Plaintiff's Probability of Winning (P)

Under the negligence standard, the plaintiff must prove that his injury was causally linked to negligence—substandard medical care. This is a threshold problem. Define IW as an index of the propensity for the court to favor the plaintiff.\(^3\) If IW exceeds some threshold value, arbitrarily set to zero, the defendant is judged negligent and the plaintiff wins award \(V\). If IW falls short of the threshold, the plaintiff loses and receives no payment. The propensity to favor the plaintiff depends on the facts of the case, the quality of the evidence, and the law defining liability and burden of proof. The propensity index equation is specified as

\[
IW = \theta'X + w + \tau.
\]

Factors available in our data are represented by \(X\), factors observable by the plaintiff and defendant (assumed the same) are represented by \(w\). These factors together influence litigant behavior out of court and are given the notation

\[
W = \theta'X + w.
\]

Other important factors unknown to litigants or determined only at verdict are represented by the term \(\tau\). Litigant expectations are assumed unbiased so that \(\tau\) has mean zero. The effect of the "unknowable" factors is assumed to be uncorrelated with \(w\) or any other residual term in the model. No such restriction need be placed on \(w\).

The distinction between \(w\) and \(\tau\) is nontrivial. The probability that the plaintiff will win if the claim goes to verdict is monotonically related to \(W = \theta'X + w\). From the litigants' point of view, the proba-

---

\(^3\)The direction of \(IW\) is arbitrary and has no substantive content. Greater \(IW\) could index the propensity for the court to favor the defendant, in which case \(IW > 0\) would indicate that plaintiff loses and vice versa.
bility is \( P(IW > 0) = P(\tau > \theta'X + w) \), where \( X \) and \( w \) are known to the litigants. The term \( w \) appears because the researchers observe only \( X \). If the variance in \( \tau \) is zero, then litigants know with certainty the outcome in court. If the variance in \( w \) is zero, then the researchers observe everything litigants do. From the view of the researchers, the probability that the plaintiff will win if the claim goes to verdict is \( P(IW > 0) = P(w + \tau > \theta'X) \). The main implication is that \( w \) affects the decision to drop, settle, or litigate, while \( \tau \) does not.

Resolution Prior to Verdict: The Decision to Drop, Settle, or Litigate

Because litigation is costly, both parties have an incentive to settle prior to adjudication. We assume that the minimum the plaintiff will settle for, the "minimum ask" (\( A \)), depends on the expected benefits of pursuing the claim to verdict (probability and size of potential verdict) relative to the cost of litigation:

\[
A = \gamma_1 W + \gamma_2 V + \alpha'X + u_1 .
\]

The term \(-\alpha'X\) reflects the plaintiff's litigation costs, and \( u_1 \) is a residual representing plaintiff prediction errors and other unobserved factors. If the minimum ask is positive (expected benefit exceeds litigation cost), the plaintiff pursues the claim. If the minimum ask is negative (\( A < 0 \)), the claim is dropped without payment. The plaintiff's decision (as well as the defendant's) depends on the observable part of the propensity index \( W \) rather than directly on the probability of winning. The two are monotonically positively related.

\[\text{4} \text{Negative because lower litigation costs increase the plaintiff's ask.} \]

\[\text{5} \text{A major difference between this model and similar models is the addition of the condition for a case to be dropped. Previous models posit that the offer is equal to the defendant's expected payoff plus litigation costs. If litigation costs are always positive, the offer is always positive. This assumption cannot explain why many cases (42 percent in our sample) are dropped with zero payment. In discussing "nuisance" suits, Posner abandons the normal model and hints at notions of bluff, strategic behavior, and plaintiff error. He concludes: "One is led to predict ... that pure nuisance claims are infrequent, that when made they are usually turned down, and that when turned down the plaintiff does not pursue the matter in court. This is not to say that there are never fraudulent claims having a sufficiently large expected value to support a credible threat to litigate if the defendant refuses to settle; or claims that, while unlikely to prevail, are not so weak that they would not justify a nongaming claimant in expending some money on a lawsuit." Although not stated explicitly, this suggests a prediction that cases closed with zero payment have low probability of winning but large stakes. We adopt the simple hypothesis that cases are dropped if the (log) ask becomes nonpositive. Assuming proportional costs implies that the dollar ask, \( W^{\gamma_1 V^{\gamma_2}} \exp(-\alpha'X + u_1) \) is never negative, but a dollar ask below one dollar implies a benefit cost ratio below one.} \]

\[\text{6} \text{This approach has both advantages and disadvantages. The overriding advantage is that it leads to an estimable model. The difference between \( W \) and the observable} \]

If the plaintiff decides not to drop the claim, the next issue is whether the claim can be settled out of court or will be pursued to verdict. The defendant’s maximum offer is the expected payout if the claim were to go to verdict plus the litigation costs of doing so. Define the defendant’s maximum offer equation as

$$M = \gamma_2 W + \gamma_4 V + \beta X + u_2.$$  

Again, the propensity index $W$ is used to indicate the defendant’s assessment of the probability that plaintiff would win at verdict. The term $\beta X$ reflects the defendant’s litigation costs, and the residual, $u_2$, includes prediction errors and other unmeasured factors.

The minimum ask and maximum offer (shortened here to “ask” and “offer”) are not the ask and offer actually made in pretrial negotiations. They are unobserved latent values that implicitly define the potential bargaining range and hence determine the disposition of claims.\(^7\) When the plaintiff’s ask exceeds the defendant’s offer (and is positive), there is no possibility for settlement out of court and the claim goes to verdict. That is, claims go to verdict if and only if $A > \max (0, M)$.

When the plaintiff’s minimum ask is positive but less than the defendant’s offer, i.e., $0 < A < M$, the claim is settled out of court for a positive payment. The settlement amount lies within the bargaining range defined by the difference between the offer and the ask. We posit a very simple settlement relationship in which the plaintiff and defendant “split the difference” between the ask and offer\(^8\) at some ratio $g$:

$$S = (1 - g)A + gM = A + g(M - A).$$

Each claim has a “potential” settlement regardless of its actual disposition.

**PREDICTIONS OF THE MODEL**

This model implies that the disposition of all claims, including those settled out of court, is influenced by the legal standard of pay-

---

\(^7\)The simple trichotomy of three stages of disposition—drop, settle, or litigate to verdict—ignores the time dimension of dispute resolution. In fact, settlement may occur at any point after filing the claim. The ask and offer presumably adapt during negotiations and incorporate the expected payoff in settlement as well as the expected payoff at verdict. With the data available, identification of such a model empirically is not possible. We include closure/pursuit as a control variable in the settlement equations.

\(^8\)Since $A$ and $M$ are log values, the settlement is a weighted geometric mean of the dollar ask and offer.
ment equal to damages if and only if negligence occurred. However, certain systematic departures from this standard are also predicted. Specifically:

1. Settlements discount the potential verdict by the probability of a plaintiff verdict.

2. The discrepancy between settlement and potential verdict is larger (smaller), the larger are plaintiff's (defendant's) litigation costs.

3. The probability that a claim is dropped without payment to the plaintiff depends not only on the probability of proving liability in court, but also on the size of the potential award (negatively) and plaintiff's litigation costs (positively).

4. Cases closed at each stage of disposition are not a random sample of all claims, but are "selected" on the basis of case characteristics that determine the expected payoff and prediction errors relative to the cost of litigation. Specifically, the sample of cases going to verdict will be a small atypical group of cases in which the plaintiff's overestimate or the defendant's underestimate of the payoff at verdict is large relative to the costs of litigation.

5. An interesting variant of this general model is the following (where \( \gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = 1 \), and \( p \) identical with \( \ln P \)):\(^9\)

\[
A = p + V + \alpha'(X) + u_1,
\]

\[
M = p + V + \beta'(X) + u_2, \text{ and}
\]

\[
S = p + V + g\beta'(X) + (1 - g\alpha'(X)) + gu_1 + (1 - g)u_2.
\]

This model yields the following additional predictions:

5a. If expectations are unbiased on average (\( E(u_1) = E(u_2) = 0 \)) and bargaining power and costs are equal (\( g = 0.5 \) and \( \alpha = \beta \)), then settlement is for the expected court award: in dollar terms, \( S = PV \).

5b. A necessary condition for going to verdict is:

\[
u_1 - u_2 > \beta'(X) - \alpha'(X) \rightarrow \text{litigate to verdict}.
\]

Thus, if prediction errors are proportional to \( V \), whereas costs are less than proportional, then cases involving large

---

\(^9\)Risk neutrality and unbiased expectations are necessary conditions.
stakes are more likely to be litigated. Similarly, if prediction errors fall relative to costs as W increases, claims where the plaintiff's case is strong are less likely to be litigated.

---

10Posner (1973) shows that the probability of litigation increases with the stakes, under the restrictive assumptions that (1) the parties disagree only on the probability of winning, and (2) the costs of litigation are fixed and do not affect the outcome. Danzon (1980) shows that prediction 5b holds even allowing that costs are endogenous and influence the outcome.
III. ECONOMETRIC MODEL: ESTIMATION AND IDENTIFICATION

This section is concerned with econometric issues. The econometric model is written in reduced form to display its discrete-continuous character and to facilitate the discussion of parameter identification and estimation. Identifying restrictions and estimability of parameters are motivated by considering a multistage instrumental variable procedure.

The first stages may be represented as a three-level sequential probit problem with nonindependent levels.¹ Next, the continuous regression equation for the observable settlement amount for cases settled and the observable award amount for cases won by plaintiff at verdict, as well as the settlement bargaining parameter, are introduced in such a way as to show that all reduced-form parameters are estimable given certain zero-order restrictions. Structural parameters may be recovered with an additional covariance restriction. The likelihood functions for FIML (full maximum likelihood) estimates used to obtain the estimates are also presented.

THE ECONOMETRIC MODEL

The model's structural equations are:

\[ V = \xi'X + \nu \]
\[ W = \theta'X + w \]
\[ IW = W + \tau \]
\[ A = \gamma_1 W + \gamma_2 V + \alpha'X + u_1 \]
\[ M = \gamma_3 W + \gamma_4 V + \beta'X + u_2 \]

These equations are assumed identified if \( V, W, IW, A, \) and \( M \) are observable. In particular, we will speak of zero-order restrictions on \( \alpha \) and \( \beta \). The system of equations is obviously triangular. The residual

¹This is the sequential probit model discussed in Amemiya (1981), except that the levels of decision are not independent. In this case, additional identifying restrictions are needed.
terms \( v, w, u_i, u_s \) are assumed to be multivariate normal with zero mean and covariance \( \Sigma \). We denote \( \sigma_i \) by \( \sigma_i \). The residual term \( \tau \) is assumed normal with zero mean and variance \( \sigma_s \), and is assumed independent of all other residual terms. Since IW determines only a discrete outcome, some normalization is required for the probit calculation. We assume \( \sigma_{uw} + \sigma_{us} = 1 \).

It is expositionally convenient to introduce new notation for reduced-form equations:

\[
A = \alpha^* X + \epsilon_1 \\
M = \beta^* X + \epsilon_2 \\
S = \alpha_s X + \epsilon_s
\]

where \( \alpha^* = \gamma_1 \theta' + \gamma_2 \gamma_3' + \alpha' \), \( \beta^* = \gamma_3 \theta' + \gamma_4 \gamma_5' + \beta' \), \( \alpha_s = \alpha^* + g(\beta^* - \alpha^*) \), \( \epsilon_1 = \gamma_1 w + \gamma_2 v + u_1 \), \( \epsilon_2 = \gamma_3 w + \gamma_4 v + u_2 \), \( \epsilon_s = \epsilon_1 + g(\epsilon_2 - \epsilon_1) \).

The full model may be written in reduced form in the switching regression format. There are four mutually exclusive and exhaustive observable regimes. In two of those regimes there is a continuous observable dependent variable (log dollar payment to the plaintiff).

**Regime 1**: Plaintiff drops the claim if and only if
\[
\epsilon_1 \leq -\alpha^* X.
\]

**Regime 2**: The claim is settled out of court for the amount \( S = \alpha_s X + \epsilon_s \) if and only if \( \epsilon_1 > -\alpha^* X \) and \( \epsilon_2 - \epsilon_1 > - (\beta^* - \alpha^*) X \).

**Regime 3**: The claim reaches verdict and plaintiff loses if and only if
\[
\epsilon_1 > -\alpha^* X \\
\epsilon_2 - \epsilon_1 \leq - (\beta^* - \alpha^*) X \quad \text{and} \quad w + \tau \leq - \theta' X.
\]

---

2Throughout, all residual terms are independent of \( X \).
Regime 4: The claim reaches verdict and plaintiff wins the award amount $V = \xi'X + v$ if and only if

$$\epsilon_1 > -\alpha^*X$$

$$\epsilon_2 - \epsilon_1 \leq - (\beta^* - \alpha^*)X \quad \text{and}$$

$$w + \tau > -\theta'X.$$ 

The model clearly satisfies the coherency conditions in Gourieroux, Laffont, and Monfort (1980), since the underlying system in V, W, A, and M is triangular and only linear transformations are used.

**ESTIMATION AND IDENTIFICATION**

Identifying restrictions and parameter estimability are motivated by the use of a multistage instrumental variable procedure. The sequence of stages of estimation is chosen to best reveal the nature of the model. Other sequences and, indeed, other sets of identifying restrictions, are not explored here. We have chosen to first consider only the discrete information on the disposition of the claim. Certain functions of parameters are estimable from that information alone. Then the information of the award or settlement amount is introduced to recover additional parameter values. Regression and covariance parameters can be recovered subject to certain identifying restrictions. The likelihood function for FIIML estimation is also reported and is used to obtain the estimates reported later.\(^3\) For expositional convenience, the likelihood function is specified for each claim conditional on its observed values including stage of disposition. Log likelihood is the sum of individual claim log likelihood values, but is not written explicitly in each case.

**Three Sequential Choices, Four Regimes**

The discrete outcomes clearly occur sequentially. First, plaintiff decides whether or not to pursue the claim. If the claim is dropped, as it is 42 percent of the time in our data, the story ends there. If the claim is pursued by plaintiff, then plaintiff and defendant together determine whether the claim can be settled out of court. If so, a payment is made and the story ends there. If not, the claim goes to verdict, where

\(^3\)The Berndt et al. (1974) procedure is used for search. Analytic first derivatives may be obtained from the authors.
the court decides whether the defendant is negligent and, if so, the size of award to the plaintiff. The model is sequential probit. Unlike the sequential probit model discussed in Amemiya (1981), the residual terms for each stage are not independent.

(1) Claims Dropped or Not: Stage 1

Each claim either is or is not dropped. This information alone allows consistent estimation of the normalized reduced-form regression coefficients relative to residual standard deviation, i.e., $\alpha^* / \sigma_{\epsilon_1}$. Given the assumed normality of $u$, $v$, and $w$, and thus $\epsilon_1$, a simple probit model is appropriate. Define

$$l_i = \begin{cases} 1 & \text{iff } A = 0, \text{ the claim is dropped} \\ -1 & \text{otherwise.} \end{cases}$$

The likelihood value for each observation $i$ is then given by

$$L(l_i|X_i) = \Phi[-l_i(\alpha^*/\sigma_{\epsilon_1})X_i].$$

These estimates may be used to construct an instrument, say $A^*(X) = (\alpha^*/\sigma_{\epsilon_1})X$, which can be used at subsequent stages of estimation.

(2) Claims Not Dropped Are Settled or Litigated to Verdict: Stage 2

A claim not dropped is either settled or pursued to verdict. The model is sequential probit and additional functions of reduced-form parameters, i.e., $(\beta^* - \alpha^*)/\sigma_{\epsilon_{2-4}}$ and $\rho_{1,2-4}$ are estimable if a zero-order restriction is introduced.\(^4\)

The parameters are not identified without at least one restriction. The stage 1 probit uses a single proportion, conditional on $X$, to identify the regression coefficients $\alpha^*/\sigma_{\epsilon_1}$. Adding information on whether claims not dropped were settled or litigated adds only one additional empirical moment (the three outcome probabilities sum to one), but introduces two additional functions of parameters. Zero correlation between $\epsilon_1$ and $\epsilon_2 - \epsilon_1$ is not likely to be acceptable. It is sufficient to introduce a nontrivial zero-order restriction\(^5\) of the form

\(^4\)The symbol $\sigma_{\epsilon_{2-4}}$ denotes the standard deviation of the linear combination of variates $\epsilon_2 - \epsilon_1$. Similar notation is used for the correlation.

\(^5\)For simplicity, zero-order restrictions will be used. Any linear combination will do. Since to our knowledge the identification of nonindependent sequential probit models is a new issue, consider a simple example. With no explanatory variables $X$, the two means and correlation are underidentified, since only two independent proportions are
\[ \beta^*_j - \alpha^*_j = 0 \quad \text{while} \quad \alpha^*_j \text{ not equal to } 0. \]

There should be at least one variable that is omitted from the difference \( M - A \) but appears in \( A \). Conditional on the \( X \) vector appearing in \( M - A \), independent variation in the instrument \( A^*(X) \) allows estimation of both additional functions of parameters.

Either two-stage maximum likelihood (2SML) or full maximum likelihood (FIML) methods may be used, depending on whether the instrument from stage 1 is used or not. The stage 1 branch corresponding to a claim dropped, \( A > 0 \), is further subdivided into two branches, those settled out of court and those reaching verdict. Define

\[
I_2 = \begin{cases} 
1 & \text{iff } A > \max (0, M), \text{ claim goes to verdict} \\
-1 & \text{iff } 0 < A \leq M, \text{ claim is settled.}
\end{cases}
\]

The likelihood function for claims reaching this branch, \( A > 0 \), is given by

\[
L(I_1, I_2|X) = -1, I_2|X_i) = \Phi((\alpha^*/\sigma_v)X_i, -I_2((\beta^* - \alpha^*)/\sigma_{x_2-x_1})X_i - I_2p_{x_1,x_2-x_1}).
\]

Given these parameter estimates, it is possible to construct an instrument for the normalized difference between the offer and ask. Define

\[
MA^*(X) = ((\beta^* - \alpha^*)/\sigma_{x_2-x_1})X.
\]

(3) Plaintiff Wins or Loses at Verdict: Stage 3

Whether or not the plaintiff wins an award at verdict is the third discrete event in a three-level sequence of discrete events. This addi-
tional information for claims reaching verdict adds one additional independent empirical moment (the four outcome probabilities sum to one) but introduces three additional functions of parameters $\theta^*, \rho_y x_{y-1},$ and $\rho_d x_{d-1}.^{6}$ It is sufficient to introduce two nontrivial zero-order coefficient restrictions of the following type:\textsuperscript{7}

$$\theta_n = 0 \quad \text{while} \quad \alpha_n^* \text{ not equal to 0}$$

and

$$\theta_m = 0 \quad \text{while} \quad \beta_m^* - \alpha_m^* \text{ not equal to 0}.$$ 

There must be at least one variable omitted from the $W$ equation that appears in the $A$ equation, and at least one variable omitted from the $W$ equation that appears in the difference equation. Conditional on the $X$ vector appearing in $W$, independent variation in the instruments $A^*(X)$ and $MA^*(X)$ allows estimation of all three functions of parameters.

Either three-stage or FIML may be used, depending on whether the instruments from stages 1 and 2 are used or not. The stage 2 branch corresponding to a claim reaching verdict, $A > \max(0, M)$, is further subdivided into two branches. Define

$$I_3 = \begin{cases} 
1 \text{ iff } IW \leq 0, \text{ plaintiff would lose} \\
-1 \text{ iff } IW > 0, \text{ plaintiff would win}
\end{cases}$$

The likelihood function for claims reaching verdict is given by

$$L(I_1, I_2, I_3 | X_i) = \Phi[\frac{\alpha^* / \sigma_{\epsilon}}{X_i}, -\frac{(\beta^* - \alpha^*) / \sigma_{\epsilon-1}}{X_i},$$

$$-I_3 \theta'X_i - \rho_{x_{d-1}, X_i},$$

$$-I_3 \theta'X_i - \rho_{x_{d-1}, X_i} - I_3 \rho_{x_{y}, X_i} - I_3 \rho_{x_{d-1}, X_i}].$$

Given these parameter estimates, it is possible to construct an instrument for the propensity for the plaintiff to win, say $W^*(X) = \theta'X_i$.

**Observing Settlement and Award Amounts**

Observing settlement and award amounts, along with some additional zero-order restrictions, allows identification of structural and

---

\textsuperscript{6}Note that $\rho_{x_{y}, X_i} = \sigma_{x_{y}/\sigma_{\epsilon}}$ and $\rho_{x_{d-1}, X_i} = \sigma_{x_{d-1}/\sigma_{\epsilon}}$, since it is assumed that $\sigma_{y} + \sigma_{\epsilon} = 1$, and that $\tau$ is uncorrelated with the other residuals.\textsuperscript{7}Clearly, $m$ cannot equal $j$ and $m$ cannot equal $n$. \
reduced-form regression coefficients and residual covariance parameters, subject to $\sigma_w = 1$. For convenience, we first introduce the award amount at verdict and then the settlement amount.

**Observation of Award Amount for Claims Won at Verdict.** The equation relating awards to claims characteristics is $V = \zeta'X + v$. For several reasons, the event of reaching verdict and plaintiff winning an award may not be independent of the "potential" award amount even conditional on relevant claims characteristics $X$. First, the potential award is hypothesized to affect litigant behavior directly, i.e., $\gamma_2$ and $\gamma_4$ may be nonzero. Second, unobserved variables may introduce nonzero covariation between $u_1$, $u_2$, $w$, and $v$. For these reasons,

$$E(V|X, I_1 = -1, I_2 = 1, I_3 = -1)$$

$$= \zeta'X + E(\nu|\nu_1 > -\alpha^*X, \varepsilon_2 - \varepsilon_1 < -(\beta^* - \alpha)X, w + \tau > \theta'X)$$

$$= \zeta'X + \sigma_y\Omega_{ii}\Omega_{11}^{-1}[\lambda_1(X), \lambda_2(X), \lambda_3(X)]'$$

The term $\Omega_{ii}$ is the $3 \times 3$ correlation matrix for $(\varepsilon_1, \varepsilon_2 - \varepsilon_1, w + \tau)$ for which an estimate is available from earlier stages, and $\Omega_{11}$ is the vector of the correlations between these and $v$. The conditional expectation of $v$ is nonzero, and a function of $X$, when any of the above parameters are nonzero. Ignoring the sample selectivity will lead to biased estimates of the parameters.

The terms $\lambda_j(X)$ are the expectations of the $j$-th standardized normal variate given appropriate truncation in three dimensions. That is,

$$\lambda_j(X) = E(Z_2|Z_1 > -(\alpha^*/\sigma_{11})X, Z_2 < -(\beta^* - \alpha)X/\sigma_{2-1}X, Z_2 > -\theta'X\Omega_{11})$$

where $Z$ denotes a standardized normal variate. These expectations are a generalization of the univariate inverse mills ratio method introduced in Heckman (1979) and Lee (1979) and the bivariate version introduced in Tunali, Behrman, and Wolfe (1980). Given estimates of the parameters of the sequential probit model it is possible to construct instruments for these conditional expectations.\(^8\)

Given instruments for $\lambda_j(X)$, OLS may be used to estimate the following regression equation for the N4 claims receiving an award at verdict, for which $V$ is observed:

$$V_i = \zeta'X_i + C_1\lambda_1(X_i) + C_2\lambda_2(X_i) + C_3\lambda_3(X_i) + \eta_{1i}.$$

\(^8\)Simple computational formulas for these expectations are available from the authors.
The equations \((C_1, C_2, C_3) = \sigma_v \Omega_{v1} \Omega_{11}^{-1}\) represent three equations in four unknowns since an estimate of \(\Omega_{11}\) is available. Given an estimate of \(\sigma_v\), we may estimate \(\Omega_{v1}\) as

\[
\Omega_{v1} = (C_1, C_2, C_3)\Omega_{11}/\sigma_v .
\]

The residual \(\eta_i\) has zero expectation but is heteroscedastic. An estimate of \(\sigma_v\) may be obtained from the sum of squared residuals. The asymptotic expected value of the squared residual from this equation is given for each claim by

\[
\sigma_v[1 - \Omega_{v1} \Omega_{11}^{-1}(\Omega_{11} - \Sigma^{**})\Omega_{11}^{-1}\Omega_{1v}].
\]

Therefore, \(\sigma_v\) may be estimated by computing

\[
\sigma_v = \sum_{i=1}^{N_4} \eta_i^2/N4 + (C_1, C_2, C_3)(\Omega_{11} - \sum_{i=1}^{N_4} \Sigma^{**} (C_1, C_2, C_3)') .
\]

The \(\Sigma^{**}\) is the \(3 \times 3\) variance-covariance matrix of the standardized variates \((\epsilon_i/\sigma_{e1}, (\epsilon_i - \epsilon_i)/\sigma_{e2-e1}, w + \tau)\) conditional on the degree of truncation in these variates implied by the claim disposition of winning at verdict. That is,

\[
\Sigma^{**} = E(Z'Z|Z_i > - (\alpha*/\sigma_{e1})X, Z_2 < -((\beta* - \alpha)X/\sigma_{e2-e1})X, Z_3 > -\theta X|\Omega_{11} )
\]

The elements of \(\Sigma^{**}\) may be computed based on available parameter estimates.

**Observation of Settlement Amount for Claims Settled Out of Court.** The equation relating the settlement amount to claims characteristics is \(S = A + g(M - A)\) and in reduced form is \(S = \alpha_s X + \epsilon_s\). In reduced form the expected settlement amount, given that settlement occurred \((0 < A < M)\), is given by

\[
E(S|X, I_1 = -1, I_2 = -1) = (\alpha + g(\beta* - \alpha*))X + \sigma_{e1}\lambda_4(X) + g\sigma_{e2-e1}\lambda_5(X).
\]

The terms \(\lambda_4\) and \(\lambda_5\) are expectations of standardized normal variates appropriately truncated in two dimensions. That is,

\[
\lambda_4(X) = E(Z_1 > -(\alpha*/\sigma_{e1})X, Z_2 > -((\beta* - \alpha)X/\sigma_{e2-e1})X|\Omega_{22}),
\]

\[
\lambda_5(X) = E(Z_1 > -(\alpha*/\sigma_{e1})X, Z_2 > -((\beta* - \alpha)X/\sigma_{e2-e1})X|\Omega_{22}).
\]
where $Z$ denotes a standardized normal variate. The term $\Omega_{z}$ is the 2 \times 2 correlation matrix for $(\varepsilon_1, \varepsilon_2 - \varepsilon_1)$, for which an estimate is available from earlier stages.

Given instruments for $\lambda_4(X)$ and $\lambda_5(X)$, OLS may be used to estimate the following regression equation for the $N_s$ claims settled out of court, for which $S$ is observed:

$$S_i = C_4'X_i + C_5\lambda_4(X) + C_6\lambda_5(X) + \eta_{i2}.$$  

The residual $\eta_{i2}$ has zero expectation. The coefficient $C_5$ estimates $\sigma_{4}^{-1}$, the coefficient $C_6$ estimates $g\sigma_{2^{-1}4}$, and the vector of coefficients $C_4$, estimates $(\alpha^* + g(\beta^* - \alpha^*))$. The estimate of $\sigma_{4}^{-1}$ implies an estimate for $\alpha^*/\sigma_{4}^{-1}$, which in turn implies an estimate of $g(\beta^* - \alpha^*)$ from $C_4$.

At this point it is necessary to introduce at least one additional restriction to fully unravel the remaining parameters. The three functions of parameters $g\sigma_{2^{-1}4}$, $(\beta^* - \alpha^*)/\sigma_{2^{-1}4}$, and $g(\beta^* - \alpha^*)$ must be solved. A known value of $g$ is one alternative. If $g$ is to be estimated, a sufficient zero-order restriction is one of the form

$$\beta^* = 0 \quad \text{while} \quad \alpha^*_k \text{ not equal to 0 for some } k.$$  

Since an estimate of $\alpha^*$ is available, this restriction implies an estimate of $g$ from $g(\beta^*_k - \alpha^*_k) = g\sigma^*_k$, which in turn implies an estimate for $\sigma_{2^{-1}4}$, from $g\sigma_{2^{-1}4}$, and an estimate for all $(\beta^* - \alpha^*)$. In addition, the estimates $\sigma_{4}$, $\sigma_{2^{-1}4}$, $\sigma_v$, and $\sigma_{w-r} = 1$ imply estimates of the covariances between $(\varepsilon_1, \varepsilon_2 - \varepsilon_1, w, v)$ from the corresponding correlations.

**Obtaining Structural from Reduced-Form Parameters and Summary of Identifying Restrictions**

To this point we have shown zero-order conditions under which reduced-form parameters are estimable. As it stands, certain structural covariance parameters are underidentified. The problem arises from the distinction between the "knowable" part of the propensity of plaintiff to win at verdict, which affects litigant behavior (W), and the "unknowable" part (r) which does not.

Before addressing this issue, let us review the restrictions introduced so far. First, the structural equations are assumed identified if A, M, W, W*, and V were observed. For simplicity, only zero-order restrictions are considered. Since the system is block triangular, this implies restrictions of the form
\( \alpha_0 = 0 \quad \text{while} \quad \theta_q \text{ not equal to } 0, \)
\( \alpha_{r} = 0 \quad \text{while} \quad \zeta_r \text{ not equal to } 0, r \text{ not equal to } q. \)
\( \beta_{i} = 0 \quad \text{while} \quad \theta_i \text{ not equal to } 0, \text{ and} \)
\( \beta_{p} = 0 \quad \text{while} \quad \zeta_p \text{ not equal to } 0, p \text{ not equal to } t. \)

Estimability of the reduced-form coefficients from the combination of qualitative and continuous observable outcomes relies on additional restrictions. The nonindependent sequential probit nature of the discrete disposition information requires zero-order restrictions of the form

\[
\begin{align*}
\beta^*_j - \alpha^*_j &= 0 \quad \text{while} \quad \alpha^*_j \text{ not equal to } 0 \\
\theta_n &= 0 \quad \text{while} \quad \alpha^*_n \text{ not equal to } 0 \\
\theta_m &= 0 \quad \text{while} \quad \beta^*_m - \alpha^*_m \text{ not equal to } 0.
\end{align*}
\]

Identification of the settlement bargaining parameter \( g \) requires a zero-order restriction of the form

\[ \beta^*_k = 0 \quad \text{while} \quad \alpha^*_k \text{ not equal to } 0. \]

Given these restrictions, reduced-form coefficients and covariance terms are estimable. For the four reduced-form equations for \( A, M, W, \) and \( V \) there are nine covariance terms instead of ten because of the normalization \( \sigma_{ww} + \sigma_{r} = 1 \) (\( r \) is uncorrelated with \( u_1, u_2, w, \) and \( v \)). There are eleven structural covariance parameters, however, because of the distinction between \( \sigma_{ww} \) and \( \sigma_{rr} \), and only the one restriction (the sum equals one). Since \( \gamma_1, \gamma_2, \gamma_3, \) and \( \gamma_4 \) are estimable, the structural covariance terms \( \sigma_{vv}, \sigma_{wr}, \sigma_{uw}, \) and \( \sigma_{u2,v} \) are estimable from reduced-form parameters.

Remaining parameters are underidentified because the remaining equations relating structural and reduced-form covariance terms involve \( \sigma_{ww} \) and we know only that \( \sigma_{ww} + \sigma_{rr} = 1. \) One identifying restriction would be \( \sigma_{ww} = 0. \) This implies that the researchers observe all variables relevant to the litigant's assessment of the probability that plaintiff would win. This is unlikely to be acceptable. An attractive alternative is to assume that the covariance between unobserved elements of \( W \) and unobserved elements of \( A \) is the same as the covariance with unobserved elements of \( M, \) i.e., \( \sigma_{u1,w} = \sigma_{u2,w} \). Alternatively, one may assume \( \sigma_{u1,w} = 0 \) and/or \( \sigma_{u2,w} = 0. \)

\(^9\)The restrictions \( \sigma_{u1,v} = 0, \sigma_{u2,v} = 0, \) and \( \sigma_{w,v} = 0 \) will not do.
LIKELIHOOD FUNCTION FOR FIML ESTIMATION

We use the convention of defining the likelihood function for each potential claim disposition and set of observables, i.e., branch of the likelihood function.

Regime 1: Plaintiff drops the claim

\[ L(I_1 = 1|X) = \Phi(-\alpha^*X/\sigma_{e1}). \]

Regime 2: Claim is settled out of court for amount \( S \)

\[
L(S, I_1 = -1, I_2 = -1|X) = \int_{-\infty}^{S-\alpha^*X}(\sigma_{e1}\sigma_{e2-1})^{-1}\phi(\epsilon_1/\sigma_{e1},
\quad S - \alpha_sX - \epsilon_1/g\sigma_{e2-1}))d\epsilon_1 
= \Phi((S - \alpha_sX)/\sigma_{e1})(Q1 - Q2)/\sigma_{e3}
\]

where \( Q1 = \Phi(((S - \alpha^*X)/\sigma_{e1} - \rho_{e1,e3}(S - \alpha_s)/\sigma_{e3})/(1 - \rho_{e1,e3}^2))^{1/2} \)
and \( Q2 = \Phi(((\alpha^*X)/\sigma_{e1} - \rho_{e1,e3}(S - \alpha_s)/\sigma_{e3})/(1 - \rho_{e1,e3}^2))^{1/2} \)

Regime 3: Plaintiff loses claim at verdict

\[
L(I_{1i} = -1, I_{2i} = 1, I_{3i} = 1|X_i) 
= \Phi((\alpha^*/\sigma_{e1})X_i, (\beta^* - \alpha^*)/(\sigma_{e2-1})X_i, -\theta^*X_i| - \rho_{e1,e3}, -\rho_{e1,w+r}, \rho_{e2-e3,w+r}) .
\]

Regime 4: Plaintiff wins amount \( V \) at verdict

\[
L(V, I_{1i} = -1, I_{2i} = 1, I_{3i} = -1|X_i) 
= \int_{-\alpha^*X}^{\infty} \int_{-\infty}^{-(\beta^* - \alpha^*)X} \int_{-\infty}^{\infty} \phi((V - \zeta^*X)/\sigma_{e1}, \epsilon_1/\sigma_{e1}, (\epsilon_2 - \epsilon_1)/(\sigma_{e2-1}, (w + \tau))d(w + \tau)d(\epsilon_2 - \epsilon_1)d\epsilon_1 
= \sigma_{e1}\phi((V - \zeta^*X)/\sigma_{e1})\Phi(-u_{e1,w+r}, u_{e2-\epsilon1,w+r}, -u_{w+r}) 
- \rho_{e1,w+\tau}, \rho_{e2-\epsilon1,w+\tau} - \rho_{e1,e3,w+\tau} .
\]
where \( u_{s1} = (-\alpha^*X/\sigma_{\epsilon 1} - \rho_{s1,v}(V - \zeta'X/\sigma_v))/(1 - \rho_{s1,v}^2)^{1/2} \)

\[ u_{s2-\epsilon 1} = (-\beta^* - \alpha^*)X/\sigma_{\epsilon 2-\epsilon 1} - \rho_{s2-\epsilon 1,v}(V - \zeta'X/\sigma_v))/(1 - \rho_{s2-\epsilon 1,v}^2)^{1/2} \]

\[ u_{\omega+f} = (-\theta'X - \rho_{\omega+f,v}(V - \zeta'X/\sigma_v))/(1 - \rho_{\omega+f,v}^2)^{1/2} \]

and

\[ \Omega_{s1,s2-\epsilon 1,\omega+f} = D^{-1/2}(\Omega_{11} - \Omega_{14}\Omega_{44})D^{-1/2} \]

\[ D = \text{diag}[(1 - \rho_{1,v}^2), (1 - \rho_{42-\epsilon 1,v}^2), (1 - \rho_{\omega+f,v}^2)] . \]

The likelihood function for claims in Regime 2 deserves further explanation. Figure 2 depicts the situation. Figure 2a corresponds to the first integral (transformed to \( \epsilon 1 \) and \( \epsilon 2 \)) form of the likelihood function. Settlement out of court occurs if and only if \( 0 < A < M \), which corresponds to the wedge-shaped area above \( A = M \) in the positive quadrant. A particular potential settlement amount corresponds to points on the line \( S = (1 - g)A + gM \). However, only those points on the line within the settlement wedge correspond to observed settlement amounts. It is computationally more convenient to transform

![Fig. 2—Dispositions and potential settlements](image-url)
the integral from $(\epsilon_1, \epsilon_2)$ to $(\epsilon_1, \epsilon_1 + g(\epsilon_2 - \epsilon_1))$. The second form of the likelihood function uses these new variates and corresponds to Fig. 2b (in terms of A and S). The computationally convenient form is to factor out the marginal density of $(\epsilon_1 + g(\epsilon_2 - \epsilon_1))$ and evaluate the integral of the conditional distribution, which is a readily available two-limit probit calculation.
IV. DATA AND PARAMETER ESTIMATES

This section describes the data on which our parameter estimates are based, presents the parameter estimates based on the full information maximum procedure, and discusses the zero-order identifying restrictions and other empirical restrictions.

DATA

The data are drawn from two surveys of insurance company claim files closed in 1974 and 1976, both of them broadly representative but not strictly randomized samples of claims against physicians and hospitals.\(^1\) The surveys report information on the injury (a severity index, the insurance company's estimate of economic loss), the plaintiff (age, sex, income, employment status), the defendant(s) (physician or hospital), and the outcome of the claim (stage of disposition and amount of payment, if any).\(^2\)

Information on the evidence of negligence is unfortunately sparse and not uniform in the two surveys. The 1974 survey reports specific allegations by the plaintiff—\textit{res ipsa loquitur}, misdiagnosis, lack of informed consent.\(^3\) The 1976 survey reports extensive information on the nature of the injury. We define broad categories of injuries that are likely to influence the ease of proving negligence: (1) an obvious error, such as treatment of the wrong part of the body; (2) an injury induced by treatment; (3) lack of preventive care. Type 1 cases are categorized with 1974 \textit{res ipsa} cases. Binary variables indicate if any

---

\(^1\)The 1974 survey instrument and data are described in AIA (1976), and those for 1976 in Westat (1979).

\(^2\)Response rates tend to be low on items not routinely collected by insurers, such as plaintiff's income. Income was dropped from the analysis after preliminary estimates showed no significant effects. Claims were excluded from the analysis if data on key variables were missing or inconsistent. Claims involving severe injuries or payment to the plaintiff are more likely to have good data and hence are overrepresented in the analysis samples.

\(^3\)In the case of an injury that would not normally occur in the absence of negligence, the plaintiff may invoke the doctrine of \textit{res ipsa loquitur}—"the thing speaks for itself." This alleges \textit{prima facie} evidence of negligence and shifts the burden of proof from the plaintiff to the defendant. It has also been invoked in situations where the plaintiff was not in a position to recognize that he was being injured or by whom because, for example, he was under anesthesia. \textit{Res ipsa} was invoked in only 4\% of cases in the 1976 sample, but in 20\% of those in the 1974 sample.
one of these (not mutually exclusive) injury categories was mentioned at least once in the files relating to the incident.

The litigants' expected costs of going to court are also not reported, and therefore must be represented by proxy variables, which are discussed below.

Data from other sources on characteristics of the legal environment of the state in which a claim occurred were merged with the basic claim files. Table 1 gives definitions, sources and means by stage of disposition for all variables.

Some additional statistics are reported in Table 2 to illustrate the skewed distribution of dollar payments. Of claims closed pre-verdict, 54% received a positive payment, while 28% of claims litigated to verdict received a positive payment. Claims settled with positive payment account for 87.5% of dollars paid, with the remaining 12.5% paid at verdict. Pre-verdict payments, then, clearly outweigh payments at verdict in number and total amount, but the average award at verdict is much larger: $102,174 versus $26,174 for claims settled out of court.

PARAMETER ESTIMATES

Tables 3 and 4 present estimates of the model parameters. These estimates are subject to several restrictions, some of them to achieve identification as discussed in Sec. III, others necessitated by computational difficulty.

The computational problem is that a computer routine is not yet available to compute the trivariate cumulative normal probabilities accurately and at reasonable cost. The fraction of claims for which the plaintiff goes to verdict and wins is 0.0185 (108 of 5832). Estimated probabilities range from 0.0007 to 0.0640. With probabilities this small, the trivariate routine must be very accurate; but routines of such accuracy are prohibitively expensive for use with iterative maximum likelihood methods. The only feasible option, chosen here, is to restrict parameter values so that the trivariate probability is the product of bivariate and univariate probabilities. We assume that v and w are uncorrelated with u1 and u2, and that γ1 and γ3 are zero. Essentially, the residuals from the litigant behavior equations are uncorrelated with the residuals from the verdict and propensity to win equations, and the propensity to win does not directly affect the ask and offer. These assumptions, especially the latter, are not very
Table 1

**Variable Description and Means**
(Standard errors in parentheses)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Full Sample N=5832</th>
<th>Pre-verdict</th>
<th>Verdict</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Drop N=3492</td>
<td>Settle N=2950</td>
<td>Loss N=282</td>
</tr>
<tr>
<td><strong>California</strong></td>
<td>0.2227</td>
<td>0.2194</td>
<td>0.2678</td>
</tr>
<tr>
<td><strong>Permanent Partial Disability</strong></td>
<td>0.2270</td>
<td>0.1766</td>
<td>0.2580</td>
</tr>
<tr>
<td><strong>Permanent Total Disability</strong></td>
<td>0.0432</td>
<td>0.0321</td>
<td>0.0488</td>
</tr>
<tr>
<td><strong>Death</strong></td>
<td>0.1445</td>
<td>0.1364</td>
<td>0.1437</td>
</tr>
<tr>
<td><strong>Defendants Log</strong></td>
<td>0.3226</td>
<td>0.2439</td>
<td>0.3745</td>
</tr>
<tr>
<td><strong>Induced by Treatment</strong></td>
<td>0.2348</td>
<td>0.2725</td>
<td>0.2973</td>
</tr>
<tr>
<td><strong>Lack Prevention</strong></td>
<td>0.0830</td>
<td>0.0807</td>
<td>0.0905</td>
</tr>
<tr>
<td><strong>Resipsa</strong></td>
<td>0.0660</td>
<td>0.0241</td>
<td>0.0953</td>
</tr>
<tr>
<td><strong>Loss Log</strong></td>
<td>5.7303</td>
<td>4.5780</td>
<td>6.4858</td>
</tr>
<tr>
<td><strong>Loss ($1000)</strong></td>
<td>0.2852</td>
<td>0.3953</td>
<td>0.2098</td>
</tr>
<tr>
<td><strong>Life</strong></td>
<td>29.5711</td>
<td>29.2632</td>
<td>29.9692</td>
</tr>
<tr>
<td><strong>PPD x Life</strong></td>
<td>6.3950</td>
<td>4.5744</td>
<td>7.6281</td>
</tr>
<tr>
<td><strong>PTS x Life</strong></td>
<td>1.2734</td>
<td>0.9927</td>
<td>1.3930</td>
</tr>
<tr>
<td><strong>Death x Life</strong></td>
<td>4.1354</td>
<td>3.6999</td>
<td>4.2758</td>
</tr>
<tr>
<td>-------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>LID</td>
<td>.5568</td>
<td>.7877</td>
<td>.5515</td>
</tr>
<tr>
<td></td>
<td>0 if claim closed in 1976 (January-July); 1 if claim closed in 1974</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>.9515</td>
<td>.8824</td>
<td>1.0268</td>
</tr>
<tr>
<td></td>
<td>AD + RECLIM + PERPD</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>AD = 1 if law eliminates r; = 0 otherwise</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>RECLIM = 1 if law limits recovery; = 0 otherwise</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PERPD = 1 if law permits periodic payments and injury is permanent; = 0 otherwise</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LID X 76</td>
<td>.6657</td>
<td>.5257</td>
<td>.4336</td>
</tr>
<tr>
<td></td>
<td>10 x 1976</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLLATERAL SOURCE &amp;</td>
<td>.4244</td>
<td>.3700</td>
<td>.4858</td>
</tr>
<tr>
<td></td>
<td>1 if collateral source rule modified; = 0 otherwise</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLA X 76</td>
<td>.2462</td>
<td>.2548</td>
<td>.2102</td>
</tr>
<tr>
<td></td>
<td>Collateral source x 1976</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATTORNEY</td>
<td>.6539</td>
<td>.6137</td>
<td>.4898</td>
</tr>
<tr>
<td></td>
<td>1 if attorney represented plaintiff; = 0 otherwise</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FEEL X 76</td>
<td>.4078</td>
<td>.3680</td>
<td>.4610</td>
</tr>
<tr>
<td></td>
<td>1 if law limits contingent fee; = 0 otherwise</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LAG IN REPORTING</td>
<td>1.905</td>
<td>1.8296</td>
<td>2.0340</td>
</tr>
<tr>
<td></td>
<td>In (months between injury and filing claim)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COURT DELAY</td>
<td>2.7902</td>
<td>2.8040</td>
<td>2.7727</td>
</tr>
<tr>
<td></td>
<td>In (average number of months of court delay in state)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>In (number claims closed in state in 1976)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PREJUIT</td>
<td>.4208</td>
<td>.6505</td>
<td>.2824</td>
</tr>
<tr>
<td></td>
<td>1 if claim closed prior to filing legal suit; = 0 otherwise</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHYSICIAN</td>
<td>.6835</td>
<td>.6861</td>
<td>.6837</td>
</tr>
<tr>
<td></td>
<td>1 if at least one physician defendant; = 0 otherwise</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>Known for 1976 claims only.

<sup>b</sup>Includes states passing law between January 1975 and July 1976.

Table 2

**Selected Statistics on Dollar Payments**

<table>
<thead>
<tr>
<th>Payment Amount ($)</th>
<th>Dropped or Settled</th>
<th>Taken to Verdict</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2492</td>
<td>282</td>
</tr>
<tr>
<td>1-10,000</td>
<td>1875</td>
<td>24</td>
</tr>
<tr>
<td>10,000-50,000</td>
<td>725</td>
<td>32</td>
</tr>
<tr>
<td>Over 50,000</td>
<td>350</td>
<td>52</td>
</tr>
<tr>
<td>Total</td>
<td>5442</td>
<td>390</td>
</tr>
<tr>
<td>Share of payment dollars</td>
<td>87.5%</td>
<td>12.5%</td>
</tr>
</tbody>
</table>

Average payment (for positive payments)

| Log     | 8.7   | 10.5   |
| Dollars | $26,176 | $102,174 |

attractive and may introduce substantial bias into our estimates.\(^4\) We have tried to point out potential effects of these restrictions in subsequent sections. We believe that even these restrictive estimates are a substantial improvement over prior estimates (based on OLS and simple logit). A partial test lies in the plausibility of our estimates.

The last two columns of Table 3 deserve some comment. As discussed in Sec. III, it is computationally convenient to estimate normalized probit coefficients corresponding to A and \(M - A\) (\(W\) is already normalized) and the standard deviations and a monotonic transformation of correlations. Constraints among parameters are then formulated accordingly. This procedure minimizes the required movement of parameters during the iterative search process. We use the transformation \(\rho = 2\tan^{-1}(\text{ROD})/\pi\) to keep the correlation within the range \((-1,1)\) during the search process. ROD is then the directly estimated parameter. Conveniently, \(\rho = 0\) when ROD = 0.

---

\(^4\)Another potentially restrictive assumption made here is the joint log-normality of the residuals. If false, this assumption may lead to systematic bias. For a discussion of this issue in simpler models, see Goldberger (1980), Lee (1981), and Lillard, Smith, and Welch (1981). The solution to this problem is outside the scope of this report.
Table 3

FIML Regression Coefficient Parameter Estimates

<table>
<thead>
<tr>
<th>Variable</th>
<th>Equation</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>W</td>
<td>V</td>
<td>A</td>
<td>M-A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$\theta$</td>
<td>$\zeta$</td>
<td>$a/\eta$</td>
<td>$(\beta-\alpha)/\sigma_{e2-e1}$</td>
</tr>
<tr>
<td>CONSTANT</td>
<td>-.9948</td>
<td>4.6026</td>
<td>-1.5942</td>
<td>2.2933</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.1584)</td>
<td>(.4409)</td>
<td>(.2168)</td>
<td>(.1123)</td>
<td></td>
</tr>
<tr>
<td>CALIFORNIA</td>
<td>.1865</td>
<td>-.2044</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.1984)</td>
<td>(.1550)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PERMANENT PARTIAL DISABILITY</td>
<td>.3447</td>
<td>.4650</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.1789)</td>
<td>(.1440)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PERMANENT TOTAL DISABILITY</td>
<td>.3250</td>
<td>.6042</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.3105)</td>
<td>(.2617)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEATH</td>
<td>.6440</td>
<td>.6821</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.2128)</td>
<td>(.1799)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEFENDANTS (log)</td>
<td>.4477</td>
<td></td>
<td></td>
<td></td>
<td>.0007</td>
</tr>
<tr>
<td></td>
<td>(.1418)</td>
<td></td>
<td></td>
<td></td>
<td>(.0116)</td>
</tr>
<tr>
<td>INDUCED BY TREATMENT</td>
<td>.3565</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.2341)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LACK OF PREVENTION</td>
<td>-.0958</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.5015)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RESIPSA</td>
<td>-.0478</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.2363)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOSS (log)</td>
<td>.4406</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.0305)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOSS (&lt;$100)</td>
<td>2.0481</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.2866)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LIFE</td>
<td>-.0062</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.0025)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PFD x LIFE</td>
<td>.0191</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.0044)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTD x LIFE</td>
<td>.0293</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.0068)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variable</td>
<td>$\theta$</td>
<td>$\zeta$</td>
<td>$\alpha/\sigma_1$</td>
<td>$(R-\alpha)/(\sigma_2-\sigma_1)$</td>
<td></td>
</tr>
<tr>
<td>--------------------------------</td>
<td>----------</td>
<td>---------</td>
<td>-------------------</td>
<td>-----------------------------------</td>
<td></td>
</tr>
<tr>
<td>DEATH X LIFE</td>
<td>.0129</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.0046)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1976</td>
<td>.6401</td>
<td>.6233</td>
<td>-.3632</td>
<td>.3557</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.2524)</td>
<td>(.2720)</td>
<td>(.0927)</td>
<td>(.0707)</td>
<td></td>
</tr>
<tr>
<td>LID</td>
<td>.0098</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.0807)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LID X 1976</td>
<td>-.3547</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.0959)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLLATERAL SOURCE (COLR)</td>
<td>.3969</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.1696)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLR X 1976</td>
<td>-.1654</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.1886)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATTORNEY</td>
<td>.4155</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.0632)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FEE LIMIT</td>
<td>.1545</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.0580)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FEE LIMIT X 1976</td>
<td>-.1502</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.0772)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LAG IN REPORTING</td>
<td>.0070</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.0136)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COURT DELAY (log)</td>
<td>-.0321</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.0157)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLAIM FREQUENCY (log)</td>
<td>-.0131</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.0079)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRESUIT</td>
<td>-.2621</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.0147)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHYSICIAN</td>
<td>.0716</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.0132)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POTENTIAL AWARD (V)</td>
<td>1.1449</td>
<td>-.4357</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.1222)</td>
<td>(.0666)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** Standard errors in parentheses.
Table 4

| Parameter | Estimate (Std dev) | $|t|$ |
|-----------|--------------------|-----|
| $\sigma_v = \sigma_{\text{VV}}^{1/2}$ | 1.3697 (.1264) | 10.8 |
| $\sigma_{u_1} = \sigma_{u_1u_1}^{1/2}$ | 4.4141 (.1612) | 27.6 |
| $\sigma_{u_2} = \sigma_{u_2u_2}^{1/2}$ | 1.0726 (.1674) | 6.4 |
| ROD | $-0.6010 (.4149)$ | 1.4 |

NOTE: A ROD is defined such that

$$\rho_{u_1u_2} = 2 \tan^{-1}(\text{ROD})/\pi.$$ 

This procedure maintains $0 < \rho < 1$ during the search procedure.

Blank entries in Table 3 correspond to zero-order coefficient restriction. These restrictions are sufficient to identify the model (even in the absence of the computational problem). A number of variables affect the award (V) and win-propensity (W) equations, but do not directly affect A and M.

One set of restrictions is not obvious from Table 3. The variables Court Delay, Claim Frequency, and Presuit are restricted to have equal coefficients in the A and M equations ($\alpha = \beta$ while $\alpha$ not equal to 0), and thus have zero coefficients in column (4). The variables Attorney, Fee Limit, Fee Limit X 1976, and Lag in Reporting affect A only so that $\beta = 0$ while $\alpha$ not equal to 0 (and corresponding values are used in computation but are simply omitted from column (4)). Again it is evident which variables affect A and $(M - A)$ but not W.

**QUASI-ANALYSIS-OF-VARIANCE**

Before we discuss the parameter estimates in detail, consider the explanatory power of the measured variables in determining the la-
tent endogenous variables V, S, A, M, and IW. While variables such as V and S are observed only for subsets of claims, we use full sample variances. For example, while V is observed directly for only 1.85% of claims, there is information about its potential value for all dispositions through its endogenous effect. Variation "due to X" is computed as $\zeta S_{xx}\zeta$ and total variation is $\zeta S_{xx}\zeta + \sigma_w$. Other computations are similar.

This quasi-analysis-of-variance is reported in Table 5. The explanatory power of observed characteristics is fairly high for V (43%), S (52%), and M (37%). Explanatory power is much lower (16%) in A, due to both larger explained and residual variance. The large variance of A relative to M suggests but cannot prove that plaintiffs are less predictable than defendants. Contributing to the large variance of A is its role in the behavioral model, together with the empirical facts. Recall that 42.7% of claims are dropped. For these claims, by assumption, the ask is negative. Only 6.7% of claims are litigated to verdict. For these claims, by assumption, the ask exceeds the offer. Consequently, the assumptions that constrain the estimates force A to exhibit large variance and a low mean.\(^5\) Explanatory power of observed characteristics is also low in the IW equation (17%), partly because relevant data are lacking and because IW parameters are implicitly

<table>
<thead>
<tr>
<th>Source</th>
<th>V</th>
<th>IW</th>
<th>S</th>
<th>A</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Due to X</td>
<td>1.56</td>
<td>.21</td>
<td>2.04</td>
<td>4.05</td>
<td>1.83</td>
</tr>
<tr>
<td>Residual</td>
<td>2.08</td>
<td>1.00</td>
<td>1.85</td>
<td>20.83</td>
<td>3.12</td>
</tr>
<tr>
<td>Total</td>
<td>3.64</td>
<td>1.21</td>
<td>3.89</td>
<td>24.88</td>
<td>4.95</td>
</tr>
<tr>
<td>&quot;R^2&quot;</td>
<td>.43</td>
<td>.17</td>
<td>.52</td>
<td>.16</td>
<td>.37</td>
</tr>
</tbody>
</table>

\(^5\)These perhaps implausible results for A may cast doubt on the assumption that a negative ask is a necessary and sufficient condition for a case to be dropped. However, any alternative assumption that involves the offer (e.g., that a case is dropped if the potential settlement is nonpositive) would result in implausibly low predicted values of the offer. Another possible explanation of the poor performance of the ask equation is that our assumption of log normality is incorrect. Lillard, Smith, and Welch (1981) show the importance of distributional assumptions in the context of estimating unreported census incomes.
estimated from the small subsample of cases actually going to verdict. Therefore, low explanatory power in IW relative to V suggests but cannot prove that courts are less predictable on the issue of liability than they are on damages.

The correlation between reduced-form predicted values of the ask A and the offer M due solely to measured variables, A(X) and M(X), is a very high +.94. The correlation in reduced-form residuals is near zero, −.07. The negative correlation in structural residuals, −.49, is offset by the positive effect of v on each through γ_vσ_v and γ_vσ_v.

Another potentially interesting set of statistics is the full sample means (geometric for log values) and the range of predicted values. These are presented in Table 6. The range of predicted values is quite large. The predicted probability that a claim will be dropped ranges from 0.048 to 0.799, with the mean of 0.421. The predicted probability

<table>
<thead>
<tr>
<th>Table 6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FULL SAMPLE MEAN AND RANGE OF RELEVANT PREDICTED VALUES</strong></td>
</tr>
<tr>
<td>Item</td>
</tr>
<tr>
<td>Probability of drop, $\Phi(-\hat{A}(x)/\sigma_{\epsilon_1})$</td>
</tr>
<tr>
<td>Probability of settle, $\Phi(\hat{A}(x)/\sigma_{\epsilon_1}, (\hat{M}(x) - \hat{A}(x))/\sigma_{\epsilon_2-\epsilon_1})$</td>
</tr>
<tr>
<td>Potential settlement amount</td>
</tr>
<tr>
<td>Log</td>
</tr>
<tr>
<td>$\exp(\hat{S}(x) + \sigma_{SS}/2)$</td>
</tr>
<tr>
<td>Probability go to verdict</td>
</tr>
<tr>
<td>Probability go to verdict and win</td>
</tr>
<tr>
<td>Potential award amount</td>
</tr>
<tr>
<td>Log</td>
</tr>
<tr>
<td>$\exp(\hat{V}(x) + \sigma_{VV}/2)$</td>
</tr>
</tbody>
</table>
of settlement out of court ranges from 0.185 to 0.865, while the potential settlement dollar amount (full sample variance corrected) ranges from $405 to $1,609,496 with a mean of $18,122. The predicted probability of going to verdict and winning ranges from 0.0007 to 0.064, while the potential award dollar amount (full sample variance corrected) ranges from $1,334 to $2,262,321 with a mean of $27,415.
V. STRUCTURAL PARAMETERS AND THEIR INTERPRETATION

This section discusses the interpretation of estimated structural parameters, presented in Table 7. We begin with the structural equation for the potential award at verdict and proceed to the plaintiff's probability of winning, the plaintiff's minimum-ask equation, defendant's maximum-offer equation, and potential settlement equation. We assess the effects of characteristics of the claim, the plaintiff, the defendant, and certain aspects of the legal environment in which claims are litigated.

POTENTIAL AWARD AT VERDICT (V)

The evidence is strong that courts are influenced by the basic law of compensable damages and recent modifications.

Compensable Damages

The law of compensable damages provides for compensation of economic loss and pain and suffering. We have data only on the insurer's estimate of economic loss. If courts awarded a uniform markup over economic loss for pain and suffering, the elasticity of $V$ with respect to loss would be unity. In fact, the estimated elasticity of $V$ with respect to loss is 0.44. Unfortunately, this coefficient is biased toward zero by measurement error in loss. Therefore, this result cannot be used to infer that the markup for pain and suffering is a decreasing proportion of loss, or to support or refute the common conclusion that the tort system tends to overcompensate small cases and undercompensate large cases.

Table 8 shows how severity of injury affects the outcome. The potential verdict for cases of permanent total disability is more than twice as large as for cases of death. This is consistent with the law of com-

---

1 The error in loss is of two types: (1) missing or erroneous data, which are imperfectly controlled for by including the dummy variable, DLOSS; (2) the loss reported in insurance company files, which is usually not discounted and therefore overestimates the present discounted value used by the courts. Using bivariate regressions, Danson (1980) shows that the hypothesis cannot be rejected, that the apparent regressivity is due solely to error in reported loss.

2 For example, see AIA (1974).
Table 7

PARAMETER ESTIMATES OF STRUCTURAL MODEL

<table>
<thead>
<tr>
<th>Variable</th>
<th>Equation</th>
<th>Verdict (V)</th>
<th>Win (W)</th>
<th>Ask (A)</th>
<th>Offer (M)</th>
<th>Settlement (S)</th>
<th>gS + (1-g)a</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONSTANT</td>
<td></td>
<td>4.603</td>
<td>-.995</td>
<td>-7.28</td>
<td>3.93</td>
<td>2.45</td>
<td></td>
</tr>
<tr>
<td>CALIFORNIA</td>
<td></td>
<td>-.204</td>
<td>.187</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PERMANENT PARTIAL DISABILITY</td>
<td></td>
<td>.465</td>
<td>.345</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PERMANENT TOTAL DISABILITY</td>
<td></td>
<td>.604</td>
<td>.325</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEATH</td>
<td></td>
<td>.682</td>
<td>.644</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEFENDANTS ($\log_e$)</td>
<td></td>
<td>.448</td>
<td>.44</td>
<td>.38</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INDUCED BY TREATMENT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.357</td>
</tr>
<tr>
<td>LACK OF PREVENTION</td>
<td></td>
<td>-.096</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RESIPSA</td>
<td></td>
<td>-.048</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOSS ($\log_e$)</td>
<td></td>
<td>.441</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DLOSS ($&lt;$100)</td>
<td></td>
<td>2.048</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LIFE</td>
<td></td>
<td>-.006</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPD x LIFE</td>
<td></td>
<td>.019</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTD x LIFE</td>
<td></td>
<td>.029</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEATH x LIFE</td>
<td></td>
<td>.013</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1976</td>
<td></td>
<td>.623</td>
<td>-.640</td>
<td>-1.66</td>
<td>.08</td>
<td>-.15</td>
<td></td>
</tr>
<tr>
<td>LID</td>
<td></td>
<td>.010</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LID x 76</td>
<td></td>
<td>-.355</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLLATERAL SOURCE</td>
<td></td>
<td>.397</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLR x 76</td>
<td></td>
<td>-.165</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATTORNEY</td>
<td></td>
<td>1.90</td>
<td></td>
<td>.25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FEE LIMIT</td>
<td></td>
<td>.71</td>
<td></td>
<td>.09</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FEELIM x 76</td>
<td></td>
<td>-.69</td>
<td></td>
<td>-.09</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LAG IN REPORTING</td>
<td></td>
<td>.03</td>
<td></td>
<td>.004</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COURT DELAY</td>
<td></td>
<td>-.15</td>
<td>-.15</td>
<td>-.15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLAIM FREQUENCY</td>
<td></td>
<td>-.06</td>
<td>-.06</td>
<td>-.06</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRESUIT</td>
<td></td>
<td>-1.20</td>
<td>-1.20</td>
<td>-1.20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHYSICIAN</td>
<td></td>
<td>.35</td>
<td></td>
<td>.30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POTENTIAL VERDICT (V)</td>
<td></td>
<td>1.14</td>
<td>.70</td>
<td>.77</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 8  
Effect of Severity of Injury

<table>
<thead>
<tr>
<th>Effect on Outcome</th>
<th>Permanent</th>
<th>Permanent</th>
<th>Permanent</th>
<th>Permanent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability of drop, A&lt;0</td>
<td>0.500</td>
<td>0.317</td>
<td>0.248</td>
<td>0.317</td>
</tr>
<tr>
<td>Probability of settle, 0&lt;A&lt;N</td>
<td>0.451</td>
<td>0.617</td>
<td>0.677</td>
<td>0.619</td>
</tr>
<tr>
<td>Settlement, S(X), log $</td>
<td>7.13</td>
<td>8.75</td>
<td>9.53</td>
<td>8.85</td>
</tr>
<tr>
<td>Probability go to verdict, A&gt;M</td>
<td>0.049</td>
<td>0.066</td>
<td>0.075</td>
<td>0.064</td>
</tr>
<tr>
<td>Probability win, W&gt;0</td>
<td>0.143</td>
<td>0.261</td>
<td>0.285</td>
<td>0.368</td>
</tr>
<tr>
<td>Award, V(X), log $</td>
<td>7.53</td>
<td>9.13</td>
<td>10.03</td>
<td>9.23</td>
</tr>
</tbody>
</table>

Compensable damages, which provides no compensation for a decedent’s pain and suffering and for medical and living expenses had he lived. Table 8 clearly shows that potential verdict affects size of settlement and stage of disposition. We return to this later.

For permanent injuries, V increases roughly 2 percent per year of additional life expectancy of the plaintiff. Estimates using a quadratic rather than a linear function of life expectancy show that awards for permanent injuries are greatest for very young plaintiffs, whereas for temporary injuries awards peak in the late thirties or forties, which is roughly consistent with age-earning profiles.\(^3\)

Tort Reforms

We include two indicators of tort reforms: modification of the collateral source rule to admit evidence of collateral compensation; and LID, which indicates passage of a law to limit awards, institute peri-

\(^3\)Danzon (1980). The interactions between the severity indicators and life expectancy were introduced to control for potential discounting bias. If reported loss is undiscounted but awards reflect a discounted present value, the coefficient of the undiscounted loss variable would be downward biased. The coefficients of the interaction variables should be negative, and their introduction should raise the coefficient of loss. In fact, the interaction coefficients are positive and the coefficient of loss is essentially unaffected. We interpret this as further evidence of reporting error in loss, due to factors other than discounting.
odic payments, or limit the plaintiff's *ad damnum*. To distinguish the net impact of these statutes from the fact that they were more likely to be enacted in states where awards were relatively high in 1974, we include an indicator for states in which a law was ever passed (for example, LID) and an interaction between the indicator and the 1976 dummy (LID × 76). The coefficient of a law variable alone indicates the difference in 1974 between states that did and states that did not subsequently pass the law. The sum of this coefficient and the coefficient of the interaction measures this differential in 1976. Thus the coefficient of the interaction measures the net effect of changing the law.

The estimates imply that in states that subsequently modified the collateral source rule, awards were 49 percent \(e^{.97} - 1\) higher in 1974, confirming that tort reform was a response to the "crisis." Modification of the collateral source rule reduced this differential by 15\% \(e^{-1.65} - 1\) by 1976 but the significance level is low. Measures to reduce awards by limiting the plaintiff's *ad damnum*, limiting the award, or instituting periodic payments (LID) are estimated to have reduced awards by 30 percent \(e^{-3.56} - 1\). The feedback of laws limiting awards on the outcome at earlier stages of disposition is discussed later.

### State and Year Effects

We include a dummy variable for California, because of the allegation that California courts are atypically pro-plaintiff and one-third of the claims in our sample occur in California. We find no California effect, but this simply implies that California is no different from the frequency-weighted mean for other states. The few litigious states that dominate this mean may be no different from California, although the majority of states may differ.

The estimates imply that, compared with 1974, verdicts were 86\% \(e^{.62} - 1\) higher in 1976 in states that passed no laws to constrain

---

4LID measures the average effect of these three laws. By July 1976, 6 states limited recoveries, 5 allowed periodic payments, and 16 limited the *ad damnum*. Since the number of states passing a law is the number of degrees of freedom available to estimate its effects, accurate estimation of the effects of each law separately is not possible. The indicator for a law permitting periodic payment is included (by interaction) only for claims involving permanent injury, since temporary injuries should not be affected.

5Periodic payments will reduce awards if the insurer can establish a trust fund yielding a higher rate of discount than a jury would have used to discount future payments to a present value. The *Los Angeles Times*, February 5, 1981, reports a growth of firms specializing in establishing structured settlements, and cites statements by attorneys that by using structured settlements they are able to settle for less than if the defendant were required to pay a lump sum.
awards, and 30 percent \((e^{0.35} - 1)\) higher in states that did pass such laws. It is beyond the scope of this study to explain this trend in malpractice awards in excess of that predicted by changes in the rate of inflation.\(^6\) These estimates are consistent with evidence that tort recoveries for other liability lines outpaced the general rate of inflation during the early seventies.\(^7\) However, we caution that our estimates of trends may be affected by the nonreporting of certain other variables in one of the two years.\(^8\) Bias in the estimate of year-effects could bias the estimates of effects of tort reforms, which are essentially year-effects in states that changed a law.

**PLAINTIFF'S PROBABILITY OF WINNING (W)**

The estimates of the determinants of the plaintiff's probability of winning are severely limited by lack of data. Because technical difficulties force us to (implicitly) estimate \(W\) from cases going to verdict only, the estimates are conditional estimates for cases actually going to verdict but may be biased estimates of population parameters.

**Evidence of Negligence**

The estimates imply that the plaintiff's probability of winning is higher in cases of severe injury, particularly death. This does not necessarily imply that courts relax the negligence standard in favor of no-fault compensation in cases of severe injuries, as is commonly alleged. Obviously, the more severe the injury, the easier it is to show damages. Further, if good care is less likely to result in severe injury than bad care, then it is a reasonable inference that the more severe the injury, the higher the probability that negligence instead of bad luck was involved.

Recall that the 1974 data indicate allegations made by the plaintiff, whereas the 1976 data give information on the injury. Although these estimates based on pooled 1974 and 1976 data show no significant effect of type of injury or allegation, these coefficients are biased toward zero because of nonuniformity of the data, which effectively

---

\(^6\)Between 1974 and 1976, the Consumer Price Index increased 15.4% and the medical care component increased 22.7%; the overall rate of inflation fell from 11.0 percent to 5.8%; and the yield on 3-year bonds fell from 7.9% to 5.3%.

\(^7\)Trends in claim frequency and severity are analyzed in Danzon (1982).

\(^8\)Of the variables with data for one year only, attorney representation is the most significant. Although it is included only in the ask, it could affect coefficients in other equations because all equations are estimated simultaneously.
introduces measurement error. Estimates in Danzon (1980) show that cases alleging *res ipso* typically settle and have a 50% higher probability of payment to the plaintiff. Cases involving obvious treatment error show similar effects. Cases alleging lack of informed consent or misdiagnosis have, respectively, a 34% and 21% lower probability of winning at verdict. Cases of injury induced by treatment are more likely to win in settlement, suggesting a higher probability of winning in court. Thus there is some evidence that the malpractice system tends to penalize obvious errors disproportionately.

**Number of Defendants**

The estimated elasticity of \( W \) with respect to number of defendants is 0.46. The mean predicted probability of winning is almost twice as high in cases involving multiple defendants (0.30) as in single-defendant cases (0.16). These estimates are almost certainly too low, because they apply only to cases tried to verdict, but the relative magnitude is interesting. It tends to confirm the hypothesis that the incentive facing multiple defendants to shift liability to each other effectively aids the plaintiff.\(^9\)

**WHY CASES ARE DROPPED (THE PLAINTIFF'S MINIMUM ASK (A))**

By assumption, a claim is dropped if the ask becomes negative, which depends on the plaintiff's expected litigation costs relative to his expected payoff. Although the coefficient of determination is low (\( R^2 = 0.16 \)), the observed characteristics are statistically significant with expected signs, and have some explanatory power. The mean predicted probability of being dropped is 0.45 for cases actually dropped, compared with 0.37 for cases receiving some payment.

**Potential Verdict (V)**

The elasticity of \( A \) with respect to \( V \) is 1.12. Thus cases with small stakes are more likely to be dropped. For example, for minor injuries the probability of being dropped is 0.5, compared with 0.25 for perma-

\(^9\)The effect of multiple defendants is expected to be less under a rule of pro rata contribution, since the payoff to shifting blame falls to zero for all defendants expecting to be found negligent. Danzon (1980) finds no significant difference in awards in states adopting comparative negligence, a proxy for contribution in proportion to fault.
nent total disability (see Table 8). This suggests that fixed costs of litigation are a significant obstacle to prosecution of minor claims.

Plaintiff Litigation Costs

Since the plaintiff bears the burden of proving negligence, delay that results in decay of evidence and reduces compensation because of interest forgone is costly to the plaintiff. We use two measures of delay: the lag in reporting the claim and court congestion. Court congestion has the expected negative effect (elasticity = −0.5), which is consistent with Landes' finding that the settlement rate in criminal cases is positively related to court delay. Lag in reporting has no significant effect. Cases with attorney representation are much less likely to be dropped.\(^{10}\)

Limits of Contingent Fees

Limits on contingent fees tended to be passed in states with a relatively high litigation rate (34% of cases dropped, compared with 45% in other states) in 1974. The estimates imply that fee ceilings increased the percent dropped by 5 percentage points; decreased settlement size by 9%; and reduced the proportion of cases litigating to verdict by 1.5 percentage points. These estimates tend to refute the common argument that contingent fees yield windfall returns that are higher than competitive rates. Consequently, it is argued, fees could be reduced with no weakening of the attorney's effort, and hence with no reduction in the plaintiff's probability of winning and gross recovery, and with an increase in recovery net of fee. On the contrary, however, the evidence is more consistent with contingent fees yielding only competitive returns at the margin.\(^{11}\)

Other Variables

Filing and then dropping a case represents error by the plaintiff. We hypothesized that errors should occur less frequently (higher A) in states where the frequency of claims is high, implying a large stock of information and possibly more specialized litigants. The weak nega-

\(^{10}\)Of cases closed presuit, attorneys represented 50% of those dropped without payment, 63% of those settled with payment. Virtually all cases proceeding to suit had representation.

\(^{11}\)A theoretical analysis of contingent fees and the effects of fee constraints is given in Danzon (1981).
tive effect of claim frequency is inconsistent with this prediction. The indicator that a claim closed prior to suit (PRESUIT) is included to control for unmeasured case characteristics. The significant negative coefficient does not imply that filing suit per se increases the probability of receiving payment.

THE DEFENDANT'S MAXIMUM OFFER (M)

Potential Verdict (V)

The elasticity of the offer with respect to V (0.71) is significantly less than the ask elasticity (1.12). These elasticities may reflect three factors: risk aversion; correlation between V and the omitted probability of winning P; and correlation between V and omitted litigation costs. Assuming that any correlation between V and P affects ask and offer equally, and that plaintiffs are at least as risk-averse as defendants, the finding that the ask increases relative to the offer as V increases suggests that the defendant's litigation expenditure increases less than in proportion to the plaintiff's as V increases.\(^\text{12}\)

Defense Litigation Costs

We hypothesize that defense costs are higher in cases with multiple defendants, because of incentives to shift blame, and in cases involving physician defendants, because physicians incur higher time and embarrassment costs of going to court than do institutional defendants. The significant elasticity of the offer with respect to number of defendants (0.44) is consistent with multiple defendants tending to raise costs for the defense. However, this may be an upward-biased measure of the cost effect, to the extent that the omitted probability of winning is positively correlated with number of defendants for reasons other than cost. The offer is 42% higher if there is at least one physician defendant.

Court delay and closure prior to suit reduce the offer; claim frequency in the state has a weak negative effect. For reasons of identification, court delay, closure presuit, and claim frequency are constrained to have equal effects on the ask and offer. This is plausible for any variable that affects the stakes equally for both parties (closure presuit) or shifts costs from one to the other (court delay). The constraint

\(^{12}\)For additional evidence on this, see Danzon (1981).
was imposed on claim frequency in the absence of any strong a priori reason to expect different effects. Also for reasons of identification, the proxies for plaintiff and defense litigation costs (court delay, lag in reporting, physician defendant, limits on contingent fees) are omitted from the V and W equations. This is plausible if these factors affect the cost of going to verdict but not the input of effort to influence outcome, conditional on going to verdict.

**SIZE OF SETTLEMENT (S)**

By assumption, settlement is a weighted average of the ask and the offer. The estimates imply that the offer dominates, with a weight (g) of 0.87 compared with 0.13 for the ask.\(^{13}\) The estimated parameters of the S equation are simply these weights applied to the estimated parameters of the A and M equations.

The estimated elasticity of S with respect to V of 0.77 implies that the proportional discrepancy between settlement and potential verdict increases with the stakes. On average, cases settle for 74 percent of their potential verdict. Settlement size is higher in cases with multiple defendants or a physician defendant (defense litigation costs); lower (elasticity = −0.15) in states with court congestion (plaintiff litigation costs); and 9 percent lower subsequent to limiting contingent fees. Our estimate of the marginal product of attorney representation (28%) is probably a lower bound because of measurement error in this variable due to nonreporting in 1974.\(^{14}\)

**PROPENSITY TO GO TO VERDICT**

In our sample, 50% of cases are settled prior to filing a legal suit, 40% after filing suit but before verdict (including during trial), and less than 10% are tried to verdict. Although cases tried to verdict represent a small fraction of the total, they are important because they determine the precedents that guide future settlements, and expenditure on litigation is substantially higher.\(^{15}\)

---

\(^{13}\)The dominance of the offer may be influenced by the large unexplained variance of the ask which, as noted above, may be sensitive to behavioral and distributional assumptions.

\(^{14}\)Using single-year estimates for cases closed presuit, the effect of attorney representation is 150% (Danzon, 1980).

\(^{15}\)The plaintiff attorney’s contingent fee percentage is typically 40% if the case goes to trial, compared with 33% if it is settled pretrial (Dietz, Baur, and Berul, 1973). For the defense, NAIC 1980 reports that expenditure on cases tried to verdict averages twice that on cases settled.
Recall that by assumption, necessary and sufficient conditions for litigation to verdict are $A > 0$ and $A > M$. Under certain conditions, this implies that the plaintiff’s expected court award exceeds the defendant’s expectation by more than the sum of their litigation costs. The propensity to litigate is expected to be higher, the greater the variance of prediction errors, relative to the costs of going to court. Since the propensity to go to verdict depends on the difference between the ask and the offer, the coefficients are simply the difference between the A and M coefficients.

Potential Verdict ($V$)

The propensity to litigate increases with $V$ (elasticity = 0.4). Since it seems unlikely that prediction errors increase more than in proportion to $V$, this evidence suggests that costs increase less than in proportion to $V$. Thus the stage of disposition appears to be significantly influenced by substantial fixed costs of going to court. Table 9 reports simulated mean values of $V$, $S$, etc., by stage of disposition. The mean $V$ for cases actually litigated to verdict and won, is roughly twice as large as the mean $V$ for cases settled out of court, which in turn is roughly twice that for cases dropped. We return to this below.

Other Variables

Evidence of other factors contributing to the propensity to litigate is sparse. Attorney representation is virtually essential to filing suit and, a fortiori, to going to verdict. We estimate that limits on contingent fees reduce the probability of going to verdict from 0.061 to 0.046—a trivial absolute change but a substantial percentage change. Although multiple defendant cases have 90 percent larger $V$ than

---

16 Since plaintiff costs are subtracted in $A$ and defense costs are added in $M$, a less than proportional increase in costs with $V$ implies an elasticity of the difference $(A - M)$ with respect to $V$ greater than zero, as observed.

17 In Table 9, predicted means $S(X)$ and $V(X)$ are means of the log values. To provide some measure of central tendency in dollar values, estimates of the median and the mean are reported, but both are approximations because of selectivity. For the full sample, dollar values are log normally distributed. Then $\exp(V(X))$ estimates the median and $\exp(V(X)) + \sigma_x/2$ estimates the mean conditional on $X$. For specific dispositions, systematic selection on the basis of $V(X)$ implies that for the subsample observed at each disposition, $V(X)$ is not normally distributed. Then $\exp(V(X))$ and $\exp(V(X) + \sigma_x/2)$ are not precise measures of median and mean for claims closing at that stage of disposition.

18 Measured characteristics have little explanatory power in the $M - A$ equation ($R = 0.03$).
Table 9

PREDICTED MEAN VALUES BASED ON OBSERVED CHARACTERISTICS (X), BY STAGE OF DISPOSITION

<table>
<thead>
<tr>
<th>Item</th>
<th>Dropped</th>
<th>Settled</th>
<th>Won</th>
<th>Lost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability of drop, A&lt;0</td>
<td>.491</td>
<td>.377</td>
<td>.285</td>
<td>.326</td>
</tr>
<tr>
<td>Probability of settle, 0&lt; A&lt; M</td>
<td>.460</td>
<td>.563</td>
<td>.650</td>
<td>.613</td>
</tr>
<tr>
<td>Settlement:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( S(X), \log s^a )</td>
<td>7.23</td>
<td>8.23</td>
<td>9.22</td>
<td>8.80</td>
</tr>
<tr>
<td>( \exp (S(X))^b )</td>
<td>3,437.0</td>
<td>9,473.0</td>
<td>18,945.0</td>
<td>11,701.0</td>
</tr>
<tr>
<td>( \exp (S(X) + \hat{G}_{s}^2/2)^c )</td>
<td>8,678.0</td>
<td>23,920.0</td>
<td>47,833.0</td>
<td>29,545.0</td>
</tr>
<tr>
<td>Probability go to verdict, A&gt;M</td>
<td>.050</td>
<td>.060</td>
<td>.065</td>
<td>.061</td>
</tr>
<tr>
<td>Verdict and win, A&gt;M and W&gt;0</td>
<td>.010</td>
<td>.014</td>
<td>.021</td>
<td>.014</td>
</tr>
<tr>
<td>Award:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( V(X), \log s^a )</td>
<td>7.86</td>
<td>8.49</td>
<td>9.20</td>
<td>8.73</td>
</tr>
<tr>
<td>( \exp (V(X))^b )</td>
<td>5,821.0</td>
<td>12,052.0</td>
<td>23,046.0</td>
<td>14,176.0</td>
</tr>
<tr>
<td>( \exp (V(X)) + \hat{G}_v^2/2)^c )</td>
<td>16,460.0</td>
<td>34,077.0</td>
<td>65,163.0</td>
<td>40,820.0</td>
</tr>
<tr>
<td>Probability win, W&gt;0</td>
<td>.184</td>
<td>.224</td>
<td>.317</td>
<td>.230</td>
</tr>
</tbody>
</table>

\( ^a \) Mean of log dollar values.
\( ^b \) Mean of exponentiated log dollar values = approximate median.
\( ^c \) Mean of exponentiated log dollar values = approximate mean conditional on X. (See footnote 17.)

Single defendant cases, a higher probability of winning at verdict (0.30 vs. 0.16), and a lower probability of being dropped (0.35 vs. 0.46), they are marginally less likely to go to verdict (0.055 vs. 0.056). (See Table 10.) Thus, although multiple defendants tend to be associated with large V and, presumably, with uncertainty as to liability of individual defendants, both of which tend to increase the probability of going to verdict, this is apparently offset by higher defense litigation costs and higher P.

Evidence from Danzon (1980) suggests that the probability of going
Table 10

Effect of Number of Defendants

<table>
<thead>
<tr>
<th>Effect on Outcome</th>
<th>Single Defendant</th>
<th>Net Change</th>
<th>Multiple Defendants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability of drop</td>
<td>.455</td>
<td>-.103</td>
<td>.352</td>
</tr>
<tr>
<td>Probability of settle</td>
<td>.488</td>
<td>.105</td>
<td>.593</td>
</tr>
<tr>
<td>Settlement (log $)</td>
<td>7.41</td>
<td>1.33</td>
<td>8.74</td>
</tr>
<tr>
<td>Probability go to verdict</td>
<td>.056</td>
<td>-.001</td>
<td>.55</td>
</tr>
<tr>
<td>Award (log$)</td>
<td>8.03</td>
<td>.65</td>
<td>8.68</td>
</tr>
<tr>
<td>Probability win</td>
<td>.164</td>
<td>.134</td>
<td>.298</td>
</tr>
</tbody>
</table>

to verdict is inversely related to $P$. Few cases alleging *res ipsa* go to verdict. Cases alleging misdiagnosis or lack of informed consent have a relatively high probability of going to verdict but a low probability of winning.\(^{19}\) Evidence from a 1970 survey, which reports the insurer’s evaluation of the merit of the case, shows that the insurer’s evaluation that there was negligence greatly reduces the probability of going to verdict.

\(^{19}\)This might be construed as investment in establishing more efficient legal rules, assuming that the existing system provides insufficient deterrence to errors of diagnosis or advice. However, the necessary condition for the efficient evolution of common law, that individual litigants internalize all social costs and benefits, is surely not realized in medical malpractice. See Rubin (1977), Priest (1977), Landes and Posner (1979).
VI. FURTHER IMPLICATIONS OF PARAMETER ESTIMATES

This section explores some further implications of the model and parameter estimates. First, we take a second look at the probability of winning in court for cases settled or dropped. Second, we present a partial accounting for the skewed distribution of dollar payments and the disparity between mean payment at settlement and verdict. Finally, we simulate the effects of actual and hypothetical tort reforms.

THE PROBABILITY OF WINNING IN COURT FOR CASES SETTLED OR DROPPED

In theory, the ask, offer, and size of settlement discount the expected verdict by the expectation of the plaintiff's probability of winning in court, \( P = \Phi(W) \). Empirically, we were unable to incorporate \( W \) directly into the estimates of \( A, M, \) and \( S \) and hence obtain unbiased estimates of \( P \) for cases settled or dropped. However, \( P \) can be estimated indirectly from the settlement equation, given estimates of \( S, V, g, \alpha, \) and \( \beta, \) and assuming unbiased expectations and risk neutrality. By Eq. (6.1) (in logs):

\[
S = p + V + g\beta'(X) - (1 - g)\alpha'(X) .
\]  

(6.1)

\( S, V, \) and \( g \) are estimated from the data, but \( \alpha \) and \( \beta \) are unknown. If we further assume that costs are a uniform percentage of potential award, the same for plaintiff and defense (i.e., \( \alpha = \beta \)), then we have:

\[
p = S - V - \alpha(2g - 1) .
\]  

(6.2)

Equation (6.2) is used to estimate \( P \) under two assumptions about costs: (1) \( \alpha = \beta = 0.1 \), and (2) \( \alpha = \beta = 0.3 \), and three assumptions about \( g \): (1) \( g = 0.87 \), as estimated, (2) \( g = 0.5 \), and (3) \( g = 1 \). We report the estimates based on measured characteristics only, since the results including information implied by the stage of disposition are essentially identical.

Table 11 reports estimates of \( P \) under these alternative assumptions. The bounds on \( P \) for cases settled with payment range from 0.57 to 0.77, whereas for cases dropped without payment, the estimates range from 0.39 to 0.53. Regardless of the assumed parameter values, the estimates of \( P \) are higher for cases paid than for cases dropped.
This suggests that the settlement process is not random with respect to which cases are paid: Cases more likely to win in court are more likely to win out of court. Note that these estimates of \( P \) are downward biased if plaintiff litigation costs exceed defense litigation costs and if plaintiffs are typically more risk-averse than defendants. Table 11 also gives values of \( P \) computed using the estimated coefficients of the \( W \) equation. These direct estimates are implausibly low (0.18 and 0.22). For the wealth-maximizing defendant, it is rational to settle if \( S < M = PVe^u \) (in dollars). Thus, if \( P \) is only 0.22, it does not pay the defense to settle, even if costs of going to verdict are as much as one-third of the potential verdict, unless it can settle for less than one-third of the potential verdict.\(^1\) In fact, cases that actually settle

\[ \text{Table 11} \]

**Plaintiff's Probability of Winning (P) for Cases Dropped and Settled**

<table>
<thead>
<tr>
<th>Estimates</th>
<th>Probability of Winning</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dropped Cases</td>
</tr>
<tr>
<td>indirect estimates</td>
<td></td>
</tr>
<tr>
<td>( \ln P = S - V - \alpha(2g - 1) )</td>
<td></td>
</tr>
<tr>
<td>( g = .87 )</td>
<td></td>
</tr>
<tr>
<td>( \alpha = .1 )</td>
<td>.49</td>
</tr>
<tr>
<td>( \alpha = .3 )</td>
<td>.43</td>
</tr>
<tr>
<td>( g = .5 )</td>
<td></td>
</tr>
<tr>
<td>( \alpha = .1 )</td>
<td>.53</td>
</tr>
<tr>
<td>( \alpha = .3 )</td>
<td>.53</td>
</tr>
<tr>
<td>( g = 1.0 )</td>
<td></td>
</tr>
<tr>
<td>( \alpha = .1 )</td>
<td>.48</td>
</tr>
<tr>
<td>( \alpha = .3 )</td>
<td>.39</td>
</tr>
<tr>
<td>Direct estimate</td>
<td></td>
</tr>
<tr>
<td>( P = \Phi(W)^2 )</td>
<td>.18</td>
</tr>
</tbody>
</table>

\(^2\)Probably downward biased because of estimation of \( W \) from cases going to verdict only.

\(^1\)\( S/V = P e^u = (0.22) \times (1.35) = 0.30 \).
receive 77 percent of their potential verdict. If costs are one-third, this is rational settlement behavior for the defense only if \( P > 0.57 \). If litigation costs are lower, one-tenth, the observed settlement behavior is rational only if \( P > 0.7 \).

Thus the discrepancy between plaintiff win rates at verdict (28%) and settlement (51%), often cited as evidence that the settlement process is capricious, in fact partly reflects selection bias: Cases litigated to verdict are disproportionately those for which the plaintiff has a low probability of winning.

ACCOUNTING FOR THE DISTRIBUTION OF DOLLARS

The Difference Between Mean Verdict and Mean Settlement

Recall that the actual mean verdict in our sample is $102,000, compared with a mean settlement of $26,000. Table 12 presents a rough accounting for the discrepancy between mean potential verdict and

<table>
<thead>
<tr>
<th>Item</th>
<th>Percent Log $ Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_v )</td>
<td>Mean potential verdict (cases won at verdict)</td>
</tr>
<tr>
<td>( V_s )</td>
<td>Mean potential verdict (cases paid at settlement)</td>
</tr>
<tr>
<td>( V_y - V_s )</td>
<td>Difference due to observed measures of compensable damages</td>
</tr>
<tr>
<td>( S_s )</td>
<td>Mean potential settlement</td>
</tr>
<tr>
<td>( V_s - S_s )</td>
<td>Difference due to settlement process</td>
</tr>
</tbody>
</table>

NOTE: Reported estimates are based on measured characteristics only. Estimates based on measured and unmeasured characteristics are very similar.
mean potential settlement in terms of two factors: (1) the propensity
of claims involving large compensable damages to go to verdict; and
(2) the fact that out-of-court settlements discount potential verdicts
for the probability of winning, litigation costs, etc. As a measure of
compensable damages we use the mean predicted V for claims closed
at each stage of disposition, since the main predictors in the V equa-
tion are the observed measures of compensable damages: severity,
loss, and life expectancy. Subscripts v and s denote cases closed (with
payment) at verdict and settlement, respectively.

The estimates imply that \( V_v \) exceeds \( V_s \) by 103%. By contrast, for
cases settled out of court, the difference between their potential ver-
dict and their potential settlement, \( V_v - S_v \), which reflects discount-
ing for \( P, \beta - \alpha, \) and \( g, \) is only 30%. Thus the fact that cases going to
verdict typically involve much larger stakes accounts for over three
times as much of the explained discrepancy between mean verdict and
mean settlement as the tendency for cases to settle for less than their
potential verdict.

Distribution of Total Payment

A frequent criticism of the tort system in general and medical mal-
practice in particular is the highly skewed distribution of the total
dollar payout. The lower 50% of cases accounts for four percent of the
total dollars paid. The upper 5% accounts for 49% of total dollars paid.

This uneven distribution may be decomposed into three factors: (1)
the skewed distribution of compensable damages (59% of cases in-
volves minor injury, 23% involve permanent partial disability, 4% in-
volves permanent total disability, and 14% involve death); (2) the
tendency to settle for less than the potential verdict; and (3) the in-
teraction of \( V \) and stage of disposition.

Table 13 shows the contribution of these factors to the skewness of
dollar payout. Panel A includes claims closed with and without pay-
ment. Fully 74 percent actually receive under $6,500, while 2.6% re-
ceive over $140,000. To indicate the contribution of compensable
damages, line 2 shows the hypothetical distribution if all cases re-
ceived their potential verdict. The percent receiving less than $6,500 falls (from 74% to 62%), but there is little increase in the over $140-
000 class (2.6% to 3.5%). Line 3, which assigns all cases their poten-
tial settlement, shifts the distribution to the right only marginally,
and still underpredicts in the under $6,500 class, because of the large
fraction closing with zero payment although their potential verdicts
and settlements are positive.
Table 13

ACCOUNTING FOR THE DISPERSION OF DOLLAR PAYOUT

<table>
<thead>
<tr>
<th>Cases</th>
<th>Percent of Cases</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&gt;$6,500</td>
<td>&gt;$30,000</td>
<td>&gt;$140,000</td>
</tr>
<tr>
<td>A. All cases (5832)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actual</td>
<td>26.2</td>
<td>9.8</td>
<td>2.6</td>
</tr>
<tr>
<td>V</td>
<td>37.9</td>
<td>14.2</td>
<td>3.5</td>
</tr>
<tr>
<td>S</td>
<td>32.0</td>
<td>11.0</td>
<td>2.2</td>
</tr>
<tr>
<td>B. Paid cases (3058)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actual</td>
<td>50</td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>V</td>
<td>43.5</td>
<td>17.6</td>
<td>4.5</td>
</tr>
<tr>
<td>Random V or S</td>
<td>32.1</td>
<td>11.1</td>
<td>2.3</td>
</tr>
<tr>
<td>V or S</td>
<td>39.8</td>
<td>14.8</td>
<td>3.3</td>
</tr>
<tr>
<td>C. Cases won at verdict (108)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actual</td>
<td>82.4</td>
<td>55.6</td>
<td>21.3</td>
</tr>
<tr>
<td>V</td>
<td>57.8</td>
<td>28.7</td>
<td>9.2</td>
</tr>
<tr>
<td>D. Cases paid in settlement (2950)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actual</td>
<td>48.8</td>
<td>17.3</td>
<td>4.3</td>
</tr>
<tr>
<td>S</td>
<td>39.1</td>
<td>14.3</td>
<td>3.1</td>
</tr>
</tbody>
</table>

Panel B, using paid cases only, tells a similar story: 50% of actual payments, compared with 56% of potential verdicts, are under $6,500. At the other extreme, 5% of actual payments, compared with 4.5% of potential verdicts, exceed $140,000. Thus the skewed distribution of dollar payout is largely accounted for by the skewed distribution of compensable damages.

The interaction of severity and stage of disposition can be shown in several ways. A comparison of potential verdicts (line 2) in panels A and B shows that cases dropped are drawn disproportionately from the lower range of V: If the propensity to drop were random, the distribution of paid claims would mirror the distribution of all claims. Alternatively, line 3 in Panel B shows the effect of randomly selecting from the full sample, a subsample of cases equal in size to the paid sample and assigning them randomly V or S in the proportions of actual verdicts and settlements. Line 4 assigns V or S correctly, i.e., as a case that either went to verdict or settled. In all size-classes except the lowest, the proportion of claims in line 4, using correctly
assigned V or S, exceeds what would be expected if stage of disposition were random (line 3).

Panels C and D compare the actual and predicted distributions of verdicts and settlements. They show that while our predictions of settlements are quite accurate, we rather severely underpredict verdicts for the sample of cases actually litigated to verdict and won (21.3% of actual verdicts exceed $140,000, compared with 9.2% predicted). This suggests that the log-normal assumption is not completely accurate.

SIMULATED EFFECTS OF TORT REFORMS: LIMITS ON AWARDS

To illustrate how tort reforms intended to influence one dimension of claim disposition influence others indirectly, Table 14 simulates the ramifications of laws designed to limit awards (dollar caps, periodic payments, and elimination of ad damnum). The table distinguishes states that enacted at least one of the three laws from states that enacted none. The first two columns show mean predicted values in 1974 and 1976, respectively, based on the law actually in effect. The third column shows counterfactual calculations, i.e., predicted values had the law not changed, for states that in fact made a change, and predicted values had the law been changed, for states that in fact made no change.

The counterfactual calculations imply that laws limiting awards reduced potential verdicts by 42% ($e^{-0.54} - 1$). This feeds into a 34% reduction in settlement size, and a 5 percentage point increase in the number of cases going to verdict. States that passed laws limiting awards had higher awards in 1974 than states that passed no such laws. This ranking was reversed by 1976, largely because of the change in law.

The model can also be used to simulate partial effects of changes in the cost of litigating, such as the pro-plaintiff trends in rules of procedure and evidence in the 1960s, or the introduction of arbitration and pretrial screening panels by many states since 1975.\footnote{Table 9 shows the effect of passing the average number of laws (1.5), whereas Table 1 shows the average effect of each law: $(1.5) \times (-.36) = -.54$.}

\footnote{Since the 1960s, common law changes, such as admitting textbooks as evidence of the standard of care, expanding the locality rule, and more liberal interpretation of res ipsa, have effectively reduced the plaintiff's cost of proving liability. Danson (forthcoming) estimates the effect of such changes on the frequency and severity of the claims. Arbitration and panels affect the payoff as well as the cost of litigation inputs. Use of alternative forums was not sufficiently widespread by 1976 to estimate their effect directly from the data.}
Table 14

**Effects of State Laws Limiting Awards: Dollar Caps, Periodic Payments, Eliminating Ad Damnum**

### A. States Passing at Least One Law

<table>
<thead>
<tr>
<th>Disposition</th>
<th>(1) 1974 (Before)</th>
<th>(2) 1976 (After)</th>
<th>(3) 1976 (Counterfactual)</th>
<th>Effect of Law (2)-(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability of drop</td>
<td>.371</td>
<td>.484</td>
<td>.435</td>
<td>.049</td>
</tr>
<tr>
<td>Probability of settle</td>
<td>.561</td>
<td>.470</td>
<td>.514</td>
<td>-.044</td>
</tr>
<tr>
<td>Settlement, S(X), log $</td>
<td>8.03</td>
<td>7.48</td>
<td>7.90</td>
<td>-.42</td>
</tr>
<tr>
<td>Probability go to verdict</td>
<td>.062</td>
<td>.046</td>
<td>.051</td>
<td>-.005</td>
</tr>
<tr>
<td>Award, V(X), log $</td>
<td>8.41</td>
<td>7.88</td>
<td>8.42</td>
<td>-.54</td>
</tr>
</tbody>
</table>

### B. States Passing No Law

<table>
<thead>
<tr>
<th>Disposition</th>
<th>(1) 1974 (Before)</th>
<th>(2) 1976 (After)</th>
<th>(3) 1976 (Counterfactual)</th>
<th>Effect of Law (2)-(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability of drop</td>
<td>.436</td>
<td>.397</td>
<td>.444</td>
<td>.049</td>
</tr>
<tr>
<td>Probability of settle</td>
<td>.509</td>
<td>.550</td>
<td>.506</td>
<td>-.044</td>
</tr>
<tr>
<td>Settlement, S(X), log $</td>
<td>7.66</td>
<td>8.21</td>
<td>7.79</td>
<td>-.42</td>
</tr>
<tr>
<td>Probability go to verdict</td>
<td>.054</td>
<td>.055</td>
<td>.050</td>
<td>-.005</td>
</tr>
<tr>
<td>Award, V(X), log $</td>
<td>8.20</td>
<td>8.53</td>
<td>7.99</td>
<td>-.54</td>
</tr>
</tbody>
</table>

The precise effects of specific measures is beyond the scope of this study. Instead we simulate the effects of hypothetical cost-reducing measures which result in (1) a 30% reduction in plaintiff costs (increase in A); (2) a 30% reduction in defense costs (decrease in M); and (3) a simultaneous 30% reduction in both A and M. This latter might approximate a uniform switch to arbitration. The results are shown in Table 15.

The 30% reduction in plaintiff costs has a minimal effect: 2 percentage point reduction in cases dropped, 0.6 percentage point increase in costs.

---

4For (1), we add in 1.3 to the constant in the ask equation. For (2) we subtract in 1.3 from the constant in the offer. For (3) we combine (1) and (2). This method of simulating changes in costs is obviously only approximate.
Table 15

Effects of Hypothetical 30 Percent Reduction in Litigation Costs

<table>
<thead>
<tr>
<th>Disposition</th>
<th>Actual</th>
<th>Plaintiff</th>
<th>Defendant</th>
<th>Both</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability of drop</td>
<td>.421</td>
<td>.401</td>
<td>.421</td>
<td>.401</td>
</tr>
<tr>
<td>Probability of settle</td>
<td>.523</td>
<td>.537</td>
<td>.517</td>
<td>.530</td>
</tr>
<tr>
<td>Settlement, $S(X), \log S$</td>
<td>7.85</td>
<td>7.89</td>
<td>7.62</td>
<td>7.66</td>
</tr>
<tr>
<td>Probability go to verdict</td>
<td>.056</td>
<td>.062</td>
<td>.062</td>
<td>.069</td>
</tr>
<tr>
<td>Probability go to verdict and win</td>
<td>.013</td>
<td>.014</td>
<td>.014</td>
<td>.015</td>
</tr>
<tr>
<td>Mean verdict, $V(X), \log S$</td>
<td>8.25</td>
<td>8.25</td>
<td>8.25</td>
<td>8.25</td>
</tr>
</tbody>
</table>

NOTE: A 30 percent cost-reduction for the plaintiff implies that the ask increases 30 percent; for the defendant, that the offer decreases 30 percent.

cases going to verdict, and a 4 percentage point increase in settlement size. The comparable reduction in defense costs has the same effect on percentage of cases going to verdict, but induces a 20% reduction in S, because of the dominant weight of the offer ($g = 0.87$). The simultaneous reduction in plaintiff and defense costs increases the percentage going to verdict from 5.6 to 6.9. This small absolute increase represents a 23% increase. Fewer cases are dropped, but settlement size for those paid is reduced 22%.

These simulations show that measures that reduce costs per case may not reduce total expenditure on litigation. To illustrate, assume first that the litigation costs of settlement are zero and that the costs of going to verdict are 30% of the verdict, initially, 20% after the change. With these assumptions, total expenditure on litigation falls by 18%, since the increase in percentage of cases going to verdict only partially offsets the reduction in cost per case. If costs of settling are 10% of the potential verdict, before and after the change, then total litigation savings are reduced to 3%, as fewer cases are dropped and more incur settlement costs.

Obviously, this analysis is insufficient to evaluate the efficiency of procedural reform because it ignores the influence of litigation expenditure on the accuracy of the outcome, on incentives to file claims, and ultimately on the frequency of injury through deterrence of negligence. It simply illustrates that procedural reform intended to reduce total expenditure on litigation may be counterproductive.
VII. CONCLUSIONS

Although, with the data available, one cannot directly test the economic model of claim disposition, the plausibility of our estimates, which are constrained by the assumptions of the model, lends credence to the model.

Taken at face value, the estimates imply that the outcome of the malpractice system is far from random. Court awards are strongly related to economic loss. Because of error in reported economic loss, we cannot measure the markup for pain and suffering, but our data do not support the conclusion reached by others that small cases are systematically overcompensated and large cases undercompensated (relative to economic loss). Data deficiencies also limit tests of the extent to which courts adhere to the standard of liability only in cases of negligence. We find that a plaintiff verdict is more likely in the case of death or severe injury, but this does not necessarily imply relaxation of the negligence standard.

Out-of-court settlements are strongly influenced by the shadow verdict. On average, cases settle for 74% of their potential verdict. This discrepancy is larger (smaller) the greater the litigation costs of the plaintiff (defendant). For technical reasons, we were unable to estimate directly the probability of winning in court for cases actually closed out of court; however, indirect estimates suggest that for cases paid, this probability is in the range of 0.6 to 0.8, whereas for cases dropped it is 0.4 to 0.5. Thus, whatever standard that the courts apply does feed back to the outcome at settlement.

Costs appear to influence disposition in the predicted manner. The evidence overwhelmingly refutes the allegation that insurance companies stand ready to pay out on any case, no matter how trivial, in order to avoid litigation costs. Claims with small potential verdict are less likely to receive payment, presumably because of relatively high litigation costs.

Although these data cannot reveal the full long-run impact of the 1974-76 tort reforms, they suggest that ceilings on awards, periodic payments, and elimination of the plaintiff's ad damnum significantly reduce awards, and reduce the probability and size of payment in settlement out of court. Limits on contingent fees decrease settlement size, increase the likelihood that a case is dropped, and decrease the likelihood of litigation to verdict. This is interpreted as evidence that unconstrained contingent fees do not convey rents at the margin. If so,
fee constraints will reduce litigation costs at the cost of reduced compensation to plaintiffs.

The limited evidence on the determinants of the decision to go to verdict shows that the probability is higher if (1) the stakes are large, which suggest large fixed costs of going to court, and (2) the plaintiff’s probability of winning is low. The interaction between severity and stage of disposition contributes to the observed skewness of the distribution of payout and to the wide gap between the mean verdict and mean settlement. However, the skewed distribution of dollars among claimants, which is widely criticized, appears to be attributable primarily to the extremely skewed distribution of compensable damages.
REFERENCES


National Center for Health Services Research, Legislative Index, Rockville, Maryland, December 1976.
Other ICJ Publications

R-2716-ICJ
The Law and Economics of Workers’ Compensation
Policy Issues and Research Needs
L. Darling-Hammond and T. J. Knausner
1980

R-2717-ICJ
Models of Legal Decisionmaking
Research Designs and Methods
D. A. Waterman and M. A. Peterson
1981

R-2732-ICJ
Court Efforts to Reduce Pretrial Delay
A National Inventory
P. Ebner, with the assistance of J. Adler, M. Selvin, and M. Yesley
1981

R-2733-ICJ
Judicial Arbitration in California
The First Year
D. Hensler, A. Lipson, and E. Ralph
1981

R-2763-ICJ
The Resolution of Medical Malpractice Claims
Research Results and Policy Implications
P. M. Danzon and L. A. Lillard
1982

R-2881-ICJ
The Civil Jury
Trends in Trials and Verdicts, Cook County, Illinois, 1960-1979
M. A. Peterson and G. L. Priest
1982

R-2882-ICJ
Cost-Benefit Analysis and Voluntary Standards for Consumer Products
L. L. Johnson
1982

R-2922-ICJ
The Pace of Litigation
Conference Proceedings
J. W. Adler, W. F. Feistner, D. R. Hensler, and M. A. Peterson
1982

A special bibliography (SB 1064) provides a list of other Rand publications in the civil justice area. To request the bibliography or to obtain more information about The Institute for Civil Justice, please write or telephone: The Institute for Civil Justice, The Rand Corporation, 1700 Main Street, Santa Monica, California 90406, (213) 393-0411.