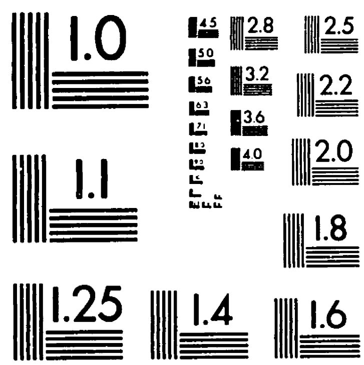

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# ESSAYS ON THE EMPIRICAL ANALYSIS OF ACCIDENT LAW

by

**DANIEL PHILIP KESSLER**

J.D., Stanford University (1993),
B.A., Harvard University (1988)

Submitted to the Department of Economics
in Partial Fulfillment of the Requirements
for the Degree of

DOCTOR OF PHILOSOPHY
in Economics

at the

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**ABSTRACT**

A large law-and-economics literature has been concerned with two topics: the effect of tort laws on individuals' accident avoidance behavior, and the effect of laws on individuals' dispute resolution behavior after an accident has occurred. Most of this work has been theoretical in nature. The purpose of this dissertation is to investigate these two topics empirically, and, in doing so, to build on the theoretical literature and improve our understanding of the ways in which the tort system succeeds or fails in providing people with the incentive to organize economic activity in a socially optimal fashion.

The first and second chapters examine the influence of tort law on precautionary behavior. Chapter 1, entitled "Fault, Settlement and Negligence Law," considers the relationships between fault and settlement amount under two different rules for damage assessment, contributory and comparative negligence. Using data on insurance settlements arising out of auto accidents, Chapter 1 compares (1) the observed relationships between actual settlement amount and a single-valued appraisal of the defendant's fault, calculated by the defendant's insurer at the time of settlement ("appraised fault") to (2) the relationships predicted by models of parties' beliefs about fault-at-trial given their appraisal of fault, assuming each regime were actually to be implemented in the way it is articulated. I present two major findings. First, settlements under comparative negligence exceed those under contributory negligence, which is consistent with what the model predicts. Second, the relationship between appraised fault and settlement is significantly weaker than either of the articulated negligence doctrines suggest, under a wide range of assumptions about the manner in which parties appraise fault at the time of settlement. This suggests that black letter law, at least in the case of contributory and comparative negligence, may be less important in shaping

individuals' accident avoidance behavior than law and economics scholars previously have supposed.

Chapter 2, written jointly with Mark McClellan of Harvard University, looks at the role of medical malpractice tort law in shaping physicians' precautionary behavior. In "Do Doctors Practice Defensive Medicine?" we investigate whether the fear of liability drives physicians and hospitals to administer treatments that have minimal medical benefit -- that is, to engage in "defensive medicine." We provide empirical support for the hypothesis that doctors do practice defensive medicine using a unique longitudinal data set that matches inpatient records collected on elderly Medicare recipients treated for a heart attack in 1989 with information on state tort laws. We find that patients from states with relatively lower levels of medical malpractice tort liability receive less in the way of intensive treatment but suffer no worse health outcomes, holding their demographic characteristics constant.

The third chapter examines the influence of tort law on dispute resolution behavior. The purpose of "The Causes of Delay in the Settlement of Legal Disputes" is to investigate empirically the causes of delay using data on insurance settlements arising out of auto accidents, and, in doing so, to investigate the relative importance of strategic bargaining and learning to the settlement process. Based on the results from a semiparametric hazards model, I present two major findings. First, delays in trial courts "trickle down" to the settlement process, resulting in delays in settlement, conditional on settlement occurring. This is consistent with both models of strategic bargaining and models of learning. Second, increases in the size of legal disputes are associated with greater delays in settlement. This is predicted by the learning model but not by the strategic bargaining models.

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The research and writing of this dissertation has occupied me for most of the last four years, in law school and graduate school. Without question, it was the defining experience of my six-plus years of post-graduate education. The process of thanking those who helped and supported me in the preparation of this work, then, is as much about my reflections on my education as a whole as it is about this work or research at all.

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**ESSAYS ON THE EMPIRICAL ANALYSIS OF ACCIDENT LAW**

**Table of Contents**

## Introduction

People often harm one another accidentally. A driver collides with a pedestrian; a doctor carelessly prescribes a medication that makes a patient sicker; a manufacturer builds a lawn mower with a design flaw that explodes in the course of regular use. In none of these instances did anyone violate a explicit contract; and yet, in each case, it seems that the injurer should be held legally responsible.

The body of law that has developed to deal with the allocation of the costs of accidental injuries is called "tort" law. Tort law specifies the extent to which an injurer is responsible to an injured party for the injured party's losses. Tort law has two objectives: compensating victims adequately and giving injurers the incentive to act in a socially appropriate way.[1]

It is undeniable that the tort system results in some compensation to victims as a class: in 1990, American drivers paid about $45 billion to insure against tort liability solely arising out of bodily injuries caused in car accidents.[2] However, there is disagreement over whether particular victims are compensated adequately. The Harvard Medical Practice Study (1990), for example, found that sixteen times as many patients suffered an injury from

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[1]See, e.g., Priest (1987) and Rabin (1988).

[2]Carroll et al. (1991).

negligent medical care as received compensation in New York State in 1984.[3]

From an economic perspective, however, the effect of tort law on individuals' behavior is more important than the distribution of compensation. Tort law may provide individuals with the incentive to waste profound amounts of resources. First, accident law may give people the incentive to take either insufficient precautions to avoid accidents, which would result in social losses due to injuries, or excessive precautions, which would result in wasted resources on the precautions themselves. In the provision of health care, for example, fear of medical malpractice tort liability may result in the administration of substantial amounts of medical treatment that have minimal health benefits.[4] Second, tort law may give individuals the incentive to resolve legal disputes after an accident has occurred in a socially costly way, by, for example, delaying settlement or requiring the intervention of the judiciary.

For this reason, a large law-and-economics literature has been concerned with two topics: the effect of tort laws on individuals' <u>ex ante</u> accident avoidance behavior, and the effect of laws on individuals' <u>ex post</u> dispute resolution behavior. Most of this work has been

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[3]Harvard Medical Practice Study (1990), p. 6.

[4]Reynolds et al. (1987).

theoretical in nature. The purpose of this dissertation is to investigate these two topics empirically, and, in doing so, to build on the theoretical literature and improve our understanding of the ways in which the tort system succeeds or fails in providing people with the incentive to organize economic activity in a socially optimal fashion.

This introduction has three sections. For background purposes, Section I outlines the process by which a typical tort claim is resolved, including the elements of a successful tort claim. Section II summarizes the results presented in the three chapters of this dissertation. Finally, Section III discusses the implications of the results for the theoretical law-and-economics literature and for our understanding of the tort system.

## I. The Resolution of a Tort Claim

Most tort claims are settled, not litigated. More than 99 percent of tort claims alleging a bodily injury arising out of an auto accident are settled,[5] as are about 95 percent of paid medical malpractice tort claims.[6] Still, since these claims are resolved "in the shadow of the law," a basic understanding of the legal system is central to understanding how tort law affects individuals' behavior.

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[5]In the United States in 1987. Insurance Research Council (1988).

[6]Holoweiko (1992).

Tort claims generally are resolved under state law, using the courts and laws of the state in which the accident occurred.[7] Tort claims are subject to a statute of limitations, which requires that lawsuits to resolve a claim be filed within two to five years of the date of the injury (or, in some cases, the date on which the injury was discovered), depending on the state and the type of injury. A successful claim is comprised of proof of liability and a showing of damages. In most states, proof of liability involves showing (1) the defendant owed a duty of care to the injured party; (2) the defendant breached that duty by behaving negligently; and (3) that the negligent behavior of the defendant caused the injury. The assessment of damages varies across states to a greater degree; it provides the basis for the empirical analysis in this dissertation and is discussed in Section II. However, since the three elements necessary to establish liability are common across states, I discuss each of them here in turn.

The general rule regarding duty is that each person owes everyone else a duty not to injure by "commission," but does not owe a duty not to injure by "omission." The most important exception to this rule applies to people in "special relationships"; in such cases, the potential defendant owes a duty not to injure by omission as well. States differ slightly in the special

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[7] See Weintraub (1980), p. 266 et seq.

relationships that they recognize, but most create a special relationship in situations in which the parties are otherwise contractually related. For example, a doctor has an absolute duty to her patients, and a landlord has an absolute duty to anyone lawfully on her property.

This duty is breached by negligent behavior. Negligent behavior is defined as less than the level of precaution that a reasonable person would take, given the circumstances surrounding the accident. The definition of negligence is specified more precisely in certain situations. Negligent behavior by a physician, for instance, is generally defined as less care than that which is customarily practiced by the average member of profession in good standing, given the circumstances of the doctor and the patient.[8]

Proving that the negligent behavior caused the injury involves proving both "cause-in-fact" and "proximate cause." Cause-in-fact is established if the injured party would not have suffered damage, but for the conduct of the defendant. Notable exceptions to this rule exist for medical injuries, in which causation may be established based on only a change in the probability of an adverse outcome, and for injuries caused by more than one party, in which causation may be established if the defendant's conduct was a "substantial factor" in causing the injury.

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[8]Keeton et al. (1984).

Proximate cause imposes the additional requirement that the chain of causation-in-fact between the defendant's negligence and the injury is relatively short and foreseeable. For example, a waiter's rude treatment of a restaurant patron may be the cause-in-fact but not the proximate cause of that patron's subsequent car accident.

## II. Tort Law and Individual Behavior

Once liability is established, the plaintiff's damages are assessed. The rules for the assessment of damages vary across states and over time. This dissertation makes use of this variation to investigate empirically the effect of laws on individuals' ex ante accident avoidance behavior, and the effect of laws on individuals' ex post dispute resolution behavior.

The first and second chapters examine the influence of tort law on precautionary behavior. Chapter 1, entitled "Fault, Settlement and Negligence Law," considers the relationships between fault and settlement amount under two different rules for damage assessment. The traditional rule, contributory negligence, ostensibly bars injured plaintiffs from recovery if they are at all at fault in an accident. The newer regime, comparative negligence, apportions damages between the plaintiff and defendant according to the parties' relative fault. Several law-and-economics scholars have evaluated these two compensation rules theoretically, according to the extent to which each could be expected to elicit optimal levels of precautionary behavior.

But the theoretical analyses have been based on the assumption that the regimes operate as the simple statements of the laws suggest, which is unlikely to be true. Using data on insurance settlements arising out of auto accidents, Chapter 1 compares (1) the observed relationships between actual settlement amount and a single-valued appraisal of the defendant's fault, calculated by the defendant's insurer at the time of settlement ("appraised fault") to (2) the relationships predicted by models of parties' beliefs about fault-at-trial given their appraisal of fault, assuming each regime were actually to be implemented in the way it is articulated. I present two major findings. First, settlements under comparative negligence exceed those under contributory negligence, which is consistent with what the model predicts. Second, the relationship between appraised fault and settlement is significantly weaker than either of the articulated negligence doctrines suggest, under a wide range of assumptions about the manner in which parties appraise fault at the time of settlement. This suggests that black letter law, at least in the case of contributory and comparative negligence, may be less important in shaping individuals' accident avoidance behavior than law and economics scholars previously have supposed.

Chapter 2, written jointly with Mark McClellan, looks at the role of medical malpractice tort law in shaping physicians' precautionary behavior. In "Do Doctors Practice Defensive Medicine?" we investigate whether the fear of liability drives physicians and hospitals to administer treatments that have minimal medical benefit -- that is, to engage in "defensive medicine." We use a longitudinal data set of inpatient records collected on all elderly Medicare recipients treated for a heart attack in 1989, matched with information on state tort laws, based on the state in which the patient was treated. We model the effect of tort laws on a key dimension of treatment intensity: whether the patient received cardiac catheterization ("intensive" treatment) in the 90 days after the heart attack, or less costly noninvasive monitoring. We also model the effect of state tort law on an important patient outcome: mortality one year after admission to the hospital.

The basic proposition in this chapter on which the test for defensive medicine is based is as follows. If reductions in medical malpractice tort liability are associated with decreases in the probability of intensive treatment but not with increases in adverse patient health outcomes, <u>ceteris paribus</u>, then doctors and hospitals practice defensive medicine -- that is, they supply a socially excessive level of care due to malpractice tort liability. If providers practice defensive medicine, then changes in tort laws that reduce liability -- "tort reforms" -- reduce inefficiency in the medical care delivery system.

The results indicate that doctors do practice defensive medicine. Patients admitted to a hospital with a heart attack in 1989 in states with relatively lower levels of legal liability are less likely to receive catheterization for their heart attacks but do not have significantly higher levels of mortality, conditional on their demographic characteristics. This result is insensitive to the specification or estimation method used. This suggests that liability-reducing "tort reforms" can induce doctors to choose a more efficient level of precautionary behavior.

The third chapter examines the influence of tort law on ex post dispute resolution behavior. The purpose of "The Causes of Delay in the Settlement of Legal Disputes" is to investigate empirically the causes of delay using data on insurance settlements arising out of auto accidents, and, in doing so, to investigate the relative importance of strategic bargaining and learning to the settlement process.

The two classes of models have both common and distinguishing responses to various aspects of the legal system. To typify the similarities and differences of the models, I derive a learning model, and present the results of Spier's (1992) model of "deadline effects," in which disputes have a propensity to settle immediately before litigation for strategic reasons.

The paper presents two testable propositions. First, if either the learning model or the deadline effects model is correct, increasing the wait for a trial should lead to fewer early settlements and more late settlements, conditional on settlement occurring. Second, if the learning model is correct, then mandatory prejudgment interest laws, which increase the value of all claims but do not otherwise change the terms of disputes, should increase delay, conditional on settlement. On the other hand, if the deadline effects model in particular -- or the strategic bargaining models in general -- explain delay, then prejudgment interest should have no effect on the timing of settlement, because those models generate delay that is invariant to dispute size.

The results demonstrate that strategic bargaining models in general, and the deadline effects model in particular, are consistent with some properties of observed delays in bargaining, but fail to explain others. Regarding the first proposition, the probability that a claim from a state with relatively greater growth in the queue of cases waiting for trial would settle rapidly is decreasing over the period 1977-1987, conditional on settlement occurring, even as the probability that a claim from a state with relatively lesser growth in the trial queue would settle rapidly is increasing, holding constant the characteristics of the claim and other aspects of the legal environment in the shadow of which the claim was resolved. This suggests that delays in the court system decrease the rapidity of settlement.

Regarding the second proposition, estimates show that prejudgment interest results in the backloading of settlements. This finding is consistent with the learning model, but not indicated by the strategic bargaining models in general, or the deadline effects model in particular.

III. Implications of the Results

The empirical results presented in this dissertation have implications for our understanding of law-and-economics, and for our understanding of the practical operation the tort system. On a epistemological level, Chapters 1 and 3 show that the highly structured theoretical models that have become increasingly common in the field of law-and-economics may depend on assumptions that do not reflect the operation of the legal system. In Chapter 1, I show that the relationship between fault and compensation is weaker than the simple statements of the contributory and comparative negligence statutes suggest. Since that relationship is a principal way in which tort law influences precautionary behavior, the empirical results imply that tort law may have less of an effect on accident avoidance behavior than law-and-economics scholars have previously supposed. In Chapter 3, I show that strategic bargaining models fail to explain an important property of settlement behavior: increases in the size of disputes are associated with increases in time-to-settlement. Claims from states with mandatory prejudgment interest laws, which increase the value of all claims but do not otherwise change the terms of dispute, take longer to settle, conditional on settlement occurring, than claims from states without prejudgment interest.

On the other hand, this dissertation shows that the basic principle behind law and economics -- that the legal system provides incentives that affect individual behavior and efficiency in fundamental ways -- is sound. Chapter 1 shows that settlements under comparative negligence exceed those under contributory negligence, which is consistent with what the simple statements of the laws suggest. Chapter 2 shows that doctors' treatment behavior responds to tort laws: patients from states with high levels of medical malpractice liability receive high levels of treatment intensity. Chapter 3 derives a simple learning model based on individual utility-maximizing behavior that is consistent with the observed timing of settlement behavior.

The results also have implications for our practical understanding of the tort system. By implication, Chapter 1 suggests that bars to recovery throughout tort law may not have the incentive effects that some have supposed. Results from Chapter 2 indicate that the tort system induces doctors to administer treatments with minimal medical benefit, to avoid legal liability. Chapter 3 shows that changes in laws that increase the value of legal disputes or increase trial-court queues will tend to increase delays in settlement.

Taken together, these observations indicate that further empirical law-and-economics research is warranted, on the tort system and otherwise. Chapters 2 and 3 investigate <u>whether</u> aspects of the tort system change behavior; <u>how</u> the tort system changes behavior is not addressed. Particularly in the context of medical malpractice, understanding the mechanism by which the tort system induces doctors to administer excessive treatments is valuable, because it would enable us to choose the most effective way to modify the legal system to improve efficiency. If malpractice laws change doctors behavior simply by affecting the level of monetary transfers from doctors to patients, conditional on liability, then caps on damages may be most effective. However, because doctors are fully insured for financial liability in tort, this may not be the case. Rather, if the threat of trial -- with its attendant damage to reputation, and uninsurable nonpecuniary costs of being publicly scrutinized -- is the primary cause of defensive medicine, then legal reforms that discourage lawsuits may be the best way to reduce "defensive medicine."

Empirical law-and-economics research in fields of law that have been less studied by economists may be even more productive. For example, empirical analysis may be able to illuminate the current debate on the reform of the criminal justice system.

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# Chapter 1

# Fault, Settlement and Negligence Law

Over the past 40 years, most states have altered the tort laws that govern the apportionment of damages from accidental injury. In 1950, the doctrine of contributory negligence, which bars injured plaintiffs who are at fault from recovery, was law in all but five American jurisdictions. By 1990, all but six states and the District of Columbia had adopted comparative negligence, which apportions damages between an injured plaintiff and the injuring defendant according to their relative fault.[9]

The legal community at large has favored this major change in liability law on two independent grounds. Some have faulted contributory negligence for its seeming unfairness in foreclosing even minimally faulty plaintiffs from recovery.[10] Others maintained that the bar to recovery under contributory negligence should be abolished because, in operation, it is either mitigated or totally disregarded by the legal system. Keeton (1962), for example, argued that the discrepancy between the laws as written and as implemented led to unpredictability of outcomes and a "duplicity [that] extends its corroding influence into attitudes about laws and legal institutions."[11]

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[9]See appendix B.

[10]See Cooter and Ulen (1986); Fleming (1976); and G. Schwartz (1978).

[11]Keeton (1962), p. 506. See also Fleming (1976).

Most law and economics scholars have evaluated the two regimes theoretically, according to the extent to which each could be expected to elicit optimal levels of accident avoidance behavior. Some early research[12] found that the all-or-nothing nature of contributory negligence would lead to efficient precautionary conduct. More recently, some economists have argued that the theoretical results are either indeterminate,[13] or that comparative negligence is more efficient than contributory negligence.[14]

Both lawyers and economists have assumed, however, that the negligence regimes operate in practice as the simple statements of the laws suggest. But that assumption seems unlikely to be valid. Anecdotal evidence suggests, for example, that contributory negligence does not bar all faulty plaintiffs from recovery. There is widespread agreement that juries allow negligent plaintiffs to recover in contributory-negligence regimes by administering a rough

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[12]See, e.g., Brown (1973) and Calabresi (1970).

[13]See, e.g., Diamond (1974) and White (1989).

[14]For example, Rubinfeld (1987) shows that comparative negligence can improve efficiency if injurers differ in their cost of taking care and the standard of care is uniform across injurers, because apportionment of damages according to fault can lead to smaller divergences from the optimal level of care across individuals than an all-or-nothing liability rule. Cooter and Ulen (1987) and Haddock and Curran (1985) find that comparative negligence can improve welfare if liability is assigned with error, particularly if individuals are risk-averse, due to the risk-bearing costs and socially excessive precaution associated with contributory negligence.

form of comparative negligence.[15] Similarly, courts have developed various doctrines that mitigate the all-or-nothing effect of contributory negligence. For example, courts sometimes define defendant negligence more broadly than plaintiff negligence,[16] or refuse to bar a plaintiff from recovering on the ground that the victim was vicariously liable for the negligent behavior of another, even if they would hold a defendant liable in a similar situation.[17]

By the same token, comparative negligence often has been adopted with exceptions that make it more favorable to defendants than it would be were it applied rigidly, with damages apportioned strictly according to fault. Some states do use "pure" comparative negligence, with damages so apportioned, but many states use a "modified" comparative negligence rule, which retains plaintiff negligence as a complete bar to recovery if the plaintiff's fault is greater than some preset level.[18]

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[15]See Matthew Bender (1991), § 1.20(2); G. Schwartz (1978), p. 726; Keeton (1962), p. 506; and Ross (1970), p. 141.

[16]Cooter and Ulen (1986), p. 1073. See also V. Schwartz (1986), p. 6, for discussion, or Rossman v. La Grega, 28 N.Y.2d 300 (1971) for an example.

[17]See V. Schwartz (1986), p. 251.

[18]There are three types of modified comparative negligence. The first type of modified comparative negligence, the "slight/gross" type, bars any recovery by plaintiff unless her negligence is slight and the defendant's negligence is gross. The second type, the "49 percent" rule, bars plaintiffs from recovery unless they are 49 percent at fault or less. The third type, the "50 percent" rule, bars plaintiffs from recovery unless they are 50 percent at fault or less. For simplicity, I analyze all three

Beyond all this, legal scholars have found that the tort system compensates plaintiffs whether or not they are at fault.[19] Indeed, compensation of victims for its own sake is a judicially acknowledged objective of accident law.[20] In the extreme, this would imply that defendants are held responsible for damages due to accidental injury regardless of plaintiff fault, under both contributory and comparative negligence.

For these reasons, empirical investigation of the actual relationship between compensation and fault is important. If it differs from what the simple statements of the laws suggest, then the existing fairness and efficiency arguments for the various liability regimes would be premised on inaccurate assumptions. If the relationship were similar in all of the regimes, then the arguments about the fairness and efficiency consequences of the choice of liability regime would not be relevant. Assuming that the relationship were roughly proportional to fault, the only major rationale for the change from contributory to

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types together in this paper, assuming that they all follow the 50 percent rule. Furthermore, modified comparative negligence is sometimes implemented in such a way as to make comparative negligence even more favorable to defendants: in the case of multiple defendants, for example, some jurisdictions require that plaintiff's fault exceed the fault of each defendant before plaintiff is allowed to recover at all.

[19] See, e.g., Priest (1985, 1987a, 1987b) and Rabin (1988).

[20] See, e.g., Escola v. Coca Cola Bottling Co. of Fresno, 24 Cal. 2d 453, 462 (1944).

comparative negligence would be to bring the articulated law into line with what actually occurs.

The relationship between compensation and fault also may have broader implications for the study of tort law. If the bar to recovery were not enforced in contributory or modified comparative negligence, it might likewise be that bars to recovery in other areas of tort law are not enforced. For example, plaintiff negligence can be a complete defense to (strict) products liability, even in jurisdictions that have adopted comparative negligence.[21]

More generally, understanding the relationship between compensation and fault can shed light on the role of tort law in the economy. A finding that fault and compensation are not strongly related would be consistent with the hypothesis that defendants in tort act as insurers against accidental injury. This has broad implications for a wide variety of economic activity, from the price and availability of liability insurance[22] to the rate of innovation,[23] because allocating all accident costs to defendants, even when plaintiffs are at fault, can lead to inefficiently low levels of both plaintiff precaution and accident-generating activities.

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[21]See, e.g., Cousins v. Instrument Flyers, Inc., 397 N.Y.S.2d 498 (1977), aff'd, 405 N.Y.S.2d 441 (1978).

[22]See, e.g., Priest (1987a, 1987b).

[23]See, e.g., Viscusi and Moore (1993).

Using data on insurance settlements arising out of auto accidents, I compare (1) the observed relationships in the three negligence regimes between actual settlement amount and a single-valued appraisal of the defendant's fault, calculated by the defendant's insurer at the time of settlement ("appraised fault") to (2) the relationships predicted by models of parties' beliefs about fault-at-trial given their appraisal of fault, assuming each regime were actually to be implemented in the way it is articulated. This comparison allows us to investigate the extent to which compensation behavior conforms to, or the way in which it may depart from, the prescriptions of different liability regimes. Section I presents the models relating parties' expectations about fault-at-trial to settlement amount. Section IA presents the models of appraised fault and settlement used in estimation; section IB develops a theoretical model of the relationships between appraised fault, fault-at-trial, and settlement, against which the estimates are compared. Section II describes the automobile insurance claim data and estimation methods used, and suggests the ways in which this paper offers an advance over previous empirical work. Section III presents the empirical findings about the actual influence of appraised fault and negligence regime on settlements, and the fourth and final section concludes with the implications of the results.

## I. Models of Fault and Settlement

The data for this study involve automobile accidents. So, consider an accident between two individuals, both of whom could engage in precautionary behavior. Assume that each party suffers injury. Consider a jury trial of one party's claim, claim i, against the other.[24] At the conclusion of the trial, the jury determines the defendant's fault, $F_i$, $F_i \in [0,1]$ (which is sufficient to describe both parties' fault, since their fault adds to 1).[25] In addition, the jury determines the plaintiff's damages in the accident, $D_i$.

The jury reports $F_i$ and $D_i$ to the judge who applies the liability rule and arrives at an award, $C_i$. The different liability rules in the three negligence regimes can be written as special cases of a "generalized liability rule" that specifies award to be proportional to fault-at-trial ($F_i$) if $F_i \geq \tau$, $0 \leq \tau \leq 1$, and zero otherwise:

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[24]The parties' claims can be considered individually because there is, in this situation, generally no reduction of a claim by the amount awarded to a counterclaim (set-off): under the Uniform Comparative Fault Act, and under the comparative negligence law of Rhode Island, Arizona and California, set-off is not allowed. Furthermore, there is a general presumption against set-off in cases in which the parties have liability insurance, based on the argument that allowing set-off in these cases would negate the risk-spreading effects of the insurance. See V. Schwartz (1986), chap. 19, and Heft and Heft (1991), § 4A.220-4A.250.

[25]With no loss in generality, assume that juries explicitly apportion fault between plaintiff and defendant in all legal regimes.

$$C_i = \begin{cases} F_i D_i & \text{if } F_i \geq \tau \\ 0 & \text{otherwise} \end{cases}.$$

Contributory negligence has $\tau = 1$; modified comparative negligence has $\tau = 0.5$;[26] and pure comparative negligence has $\tau = 0$.

Data on fault-, damages- and award-at-trial, however, are not sufficient to test whether the negligence regimes operate as the black letter law suggests. By construction, award-at-trial will depend on fault and damages according to the simple statements of the laws. The problem is that juries have the ability to alter the level of damages reported to the judge, conditional on the assessment of fault and the level of actual damages, so as to accomplish extralegal aims.[27]

Thus, evaluation of the negligence regimes requires a measure of damages that depends only on the characteristics of cases, and not on fault. Given a model that relates characteristics to damages, detailed information on the characteristics of several cases, assessments of fault and award sizes, we could test whether the empirical mapping of fault and damages into award resembles what the law suggests.

Creating a data set from the court records of

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[26]Assuming a 50 percent rule. See note 10.

[27]For example, damages for pain and suffering are largely at the jury's discretion.

several states operating under different negligence regimes that includes a detailed, standardized set of case characteristics would be extremely costly, and the result would be potentially unreliable, because of variation in the quality of court records. Thus, I analyze data from insurance settlements arising out of automobile accidents. These data both enable me to estimate the relationship between fault and award, holding constant a measure of damages that does not depend on fault, and allow me to investigate the settlement process, which is important in its own right: more than 99 percent of automobile accident injury claims are litigated to a verdict.[28]

Consider the parties' behavior at the settlement stage, when neither $F_i$ nor $D_i$ has actually been observed. Assume that, in nonlitigated claims, both parties are risk-neutral, face equal litigation costs, have symmetric access to information, and split gains from settlement equally. Also, assume $F_i$ and $D_i$ are appraised independently. Then the value of settlement, $c_i$, can be shown to be equal to expected award at trial under the generalized liability rule above, assuming that the laws operate as they are written:

$$c_i = E(C_i) = E(D_i) * [Pr(F_i=1) + E(F_i|\tau \le F_i<1)*Pr(\tau \le F_i<1)]. \qquad (1)$$

Subsection A presents the approximations to (1) used in estimation, which specify settlement as a function of a

[28]See Insurance Research Council (1988).

single-valued appraisal of fault-at-trial. Subsection B provides a theoretical example of what the exact relationship between settlement and a single-valued appraisal of fault-at-trial might be, under different assumptions about parties' beliefs about fault-at-trial given appraised fault.

A. Models Used In Estimation

With information on the distribution of either party's beliefs about what a jury's assessment of fault would be, if the claim were tried to a verdict, claim characteristics and settlement amount, we could test whether the observed relationship between settlement and beliefs about fault resembles what the different liability regimes predict. By implication, we could test whether $\tau$ in each regime corresponds to what the laws suggest, and whether award-at-trial is proportional to fault-at-trial, for $F_i \geq \tau$.

Unfortunately, the data contain only a single-valued appraisal of fault-at-trial, calculated at the settlement stage -- I refer to this as "appraised fault," denoted by $f_i$, where $f_i$ is the response of the defendant's insurance company to the question "What was the degree of fault of the defendant in the accident?" Thus, I estimate three models, which specify settlement as a function of appraised fault, meant to be approximations to equation (1): a linear model, a spline model and a series approximation to a fully nonparametric model.

Define the characteristics of claim i, that influence both the appraisal of fault and damages, as $X_i$; characteristics that influence only the appraisal of fault as $R_i$; variables containing information on state laws as $L_i$, where $L_{0i}$ is a dummy variable that equals one if the claim was adjudicated under contributory negligence, and zero otherwise, $L_{1i}$ is a dummy variable that equals one if the claim was adjudicated under modified comparative negligence, and $L_{2i}$ is a dummy variable that equals one if the claim was adjudicated under pure comparative negligence. $L_{3i}$ is a dummy variable that equals one if the state law pertaining to the claim requires defendants to pay plaintiffs interest on the principal amount of a damage award from the time of injury or filing of a lawsuit to the time of judgment (mandatory "prejudgment interest").[29] As above, $c_i$ denotes settlement amount and $f_i$ denotes the defendant's insurer's appraisal of the defendant's fault.

The excluded instruments ($R_i$) that influence only the appraisal of fault include three variables from the data base on whether the defendant/insured was cited by the police for violating any traffic laws in conjunction with

[29]Mandatory prejudgment interest laws would be expected to increase compensation to claimants, whether or not their claims were litigated. See Carroll (1983) for a discussion.

the accident.[30] This information can be used to construct valid instruments for appraised fault, under the assumption that the instruments are correlated with appraised fault but otherwise uncorrelated with settlement. Violation of traffic statutes provides either rebuttable or unrebuttable evidence of civil negligence in vehicle tort cases in most states,[31] but should not otherwise influence the probability of winning or the value of a settlement, holding $X_i$ constant. The characteristics $X_i$ include information about the location of the accident, the claimant's injuries and resulting disabilities and the claimant's role in the accident.

The defendant's appraised fault depends on characteristics $X_i$, laws $L_i$, and the instruments $R_i$. I specify the determination of appraised fault as an exponential function of these variables and a parameter vector $\Gamma$ in all three models:

$$f_i = e^{Z\Gamma}, \tag{2}$$

or

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[30]The data base contains information on 9 specific violations for which the defendant might have been cited, and information on whether the defendant was cited for any other violations. From this, I construct three instruments: whether the defendant was cited for one of the nine specific violations, whether the defendant was cited for an unlisted violation and whether the defendant was cited for multiple violations.

[31]See Dooley and Lindahl (1990), § 3.33.

$$\ln(f_i) = Z_i\Gamma, \tag{3}$$

where Z contains X, L and R, $Z_i = (X_i | L_i | R_i)$.

In each model, I specify expected damages ($E(D_i)$) to be equal to $\exp(X_iB)$, where B is a parameter vector. I define settlement amount to be proportional to appraised fault and damages in a way that varies with the prevailing law. In the linear model, settlement and appraised fault are related by:

$$c_i = f_i^{\alpha} e^{L_i\Delta} e^{X_iB}, \tag{4}$$

or

$$\ln(c_i) = \alpha\ln(f_i) + L_i\Delta + X_iB, \tag{5}$$

where $\alpha = \alpha_0 L_{0i} + \alpha_1 L_{1i} + \alpha_2 L_{2i}$: the responsiveness of settlement to appraised fault is allowed to vary by negligence regime.

As a practical matter, however, researchers are unable to observe all of the characteristics of each claim and all of the aspects of each state's law that the parties do. Let $X_i = (x_i | \tilde{x}_i)$, $L_i = (l_i | \tilde{l}_i)$ and $R_i = (r_i | \tilde{r}_i)$, where $x_i$, $l_i$ and $r_i$ are observed and $\tilde{x}_i$, $\tilde{l}_i$ and $\tilde{r}_i$ are not observed by the researcher. Assume that the unobserved characteristics are uncorrelated with the observed characteristics.[32] Note that $l_i$ contains only the dummy variables $L_{0i}$-$L_{3i}$, and $r_i$ contains only variables regarding the defendant's traffic violations. Then, considering the linear case, equations (3) and (5) can be rewritten as:

$$\ln(c_i) = \alpha\ln(f_i) + x_i\beta + l_i\delta + \epsilon_{1i} \tag{6}$$

and

$$\ln(f_i) = z_i\gamma + \epsilon_{2i}, \tag{7}$$

where $B = (\beta|\tilde{\beta})$, $\Gamma = (\gamma|\tilde{\gamma})$, $\Delta = (\delta|\tilde{\delta})$, $\epsilon_{1i} = \tilde{x}_i\tilde{\beta} + \tilde{l}_i\tilde{\delta}$, $\epsilon_{2i} = \tilde{z}_i\tilde{\gamma}$, $z_i = (x_i|l_i|r_i)$, and $\tilde{z}_i = (\tilde{x}_i|\tilde{l}_i|\tilde{r}_i)$. By construction, $E(\epsilon_{1i}|z_i) = E(\epsilon_{2i}|z_i) = 0$.

Equations (6) and (7) comprise the basic model used in estimation. It is important to notice that OLS estimates of equation (6) will be inconsistent because there are unobserved common determinants of appraised fault and settlement, $\tilde{x}$ and $\tilde{l}$, such that $E(\epsilon_1|\ln(f)) \neq 0$. For example, certain characteristics of a claim that are unobserved by the researcher may indicate that both damages and the defendant's fault are high. This endogeneity problem, however, can be addressed in estimation, because there are instruments for appraised fault.

[32]The validity of this assumption is investigated in section II, especially note 29.

In addition to the linear model (equation (6)), I estimate the influence of appraised fault on settlement in two less restrictive ways. First, I estimate a spline approximation to $\alpha$:

$$\ln(c_i) = \alpha_a\, f0\_49_i + \alpha_b\, f50_i + \alpha_c\, f51\_99_i + x_i\beta + l_i\delta + e_{1i}, \tag{8}$$

where

$$f0\_49_i = \begin{cases} 1 \text{ if } 0 \leq f_i \leq 0.49 \Leftrightarrow \ln(f_i) \leq -0.71 \\ 0 \text{ otherwise} \end{cases},$$

and the other dummy variables are defined similarly. The parameters $\alpha_a$, $\alpha_b$ and $\alpha_c$ vary by negligence regime just as $\alpha$ does in the linear model. Second, I estimate the relationship between appraised fault and settlement nonparametrically, where settlement is proportional to a function of appraised fault that is allowed to vary by negligence regime, expected damages and negligence law:

$$\ln(c_i) = g(\ln(f_i)) + x_i\beta + l_i\gamma + e_{1i}. \tag{9}$$

B. Theoretical Models

The data specify only a single-valued appraisal of fault-at-trial, not the distribution of beliefs about fault-at-trial. This is important because negligence law would predict different relationships between the single-valued appraisal and settlement, depending on what a given appraisal implies about parties' beliefs. Thus, assumptions about the distribution of fault-at-trial around appraised fault are necessary in order to test whether the observed influence of appraised fault on settlement resembles what the laws predict.

I allow for two very different models of the relationship between appraised fault and fault-at-trial: the "low-scope" and the "high-scope" model of appraisals. The low-scope model assumes that an appraisal of claim i reflects only a judgment about the relative probabilities of two outcomes, were the claim tried to a verdict: $F_i=0$ (no liability) or $F_i=1$ (full liability). I term this the low-scope model because the scope of possible outcomes of fault-at-trial considered in the appraisal process is narrow. For example, under contributory negligence, parties might make low-scope appraisals of fault, because (at least in theory) contributory negligence allows for either no-liability or full-liability outcomes at trial only. Even under comparative negligence, parties might make low-scope appraisals, if making more comprehensive appraisals that consider a wider range of outcomes at trial is costly or impossible.

The high-scope model assumes that appraisals reflect the probabilities of $F_i=0$, $F_i=1$, and every possible apportionment of fault-at-trial ($0<F_i<1$). I term this the high-scope model because the range of possible outcomes of fault-at-trial considered in the appraisal process is wide.

Under comparative negligence, parties might make high-scope appraisals of fault, because comparative negligence allows for all possible apportionments of fault-at-trial.

I present two versions of the low-scope model. The unbiased low-scope model of the appraisal process assumes that parties at the settlement stage view fault-at-trial in claim i, if the claim were tried to a verdict, ($F_i$) as a Bernoulli random variable, where

$$F_i = \begin{cases} 1 \text{ with probability } f_i \\ 0 \text{ with probability } (1-f_i) \end{cases}.$$

I term this the unbiased low-scope model of appraisals because appraised fault for claim i $f_i = E(F_i)$. Under the unbiased low-scope model, then, the value of settlement would be independent of negligence regime (all three regimes impose equal liability on defendants who are either wholly or not at all at fault):

$$c(f_i, E(D_i)) = E(D_i) * f_i. \tag{10}$$

However, the unbiased low-scope model contains a strong assumption about the variance of outcomes at trial around the parties' appraisal at the settlement stage, namely that $var(F_i) = f_i(1-f_i)$. This may be unrealistic in that $f_i=1$ implies $var(F_i) = 0$: indeed, 85 percent of the settlements analyzed in this paper have $f_i=1$, which (under the unbiased model) would imply that appraisers were certain about liability in 85 percent of all claims. In addition, the unbiased low-scope model cannot be easily expanded to allow for high-scope appraisals.

Thus, I present a more general model of the appraisal process, which allows for both low- and high-scope appraisals:

$$F_i = \begin{cases} 1 \textit{ with probability } \pi_1(f_i) = \Phi\left(\frac{\eta + f_i - 1}{\sigma_2}\right) \\ f_i^* \in (0,1) \textit{ with probability } 1 - \pi_1(f_i) - \pi_0(f_i) , \\ 0 \textit{ with probability } \pi_0(f_i) = \Phi\left(\frac{\eta - f_i}{\sigma_2}\right) \end{cases}$$

where $f_i^*$ is distributed as a truncated normal random variable, the untruncated version of which has mean $f_i$ and variance $\sigma_1^2$, and $\Phi$ denotes the cumulative standard normal distribution function. This model assumes that appraised fault ($f_i$) is approximately unbiased for fault-at-trial ($F_i$) if $f_i$ is in the interior of (0,1), and that $f_i$ is the mode of $F_i$ if $f_i$ is either 0 or 1. As such, I term this the approximately unbiased model.

The approximately unbiased model of the relationship between $f_i$ and $F_i$ has three parameters. The parameter $\eta$ ($\eta \in \{0,0.5\}$) describes the "scope" of the appraisal of fault. As discussed above, $\eta$ indicates the extent to which parties consider the possibility of apportionment of damages at the settlement stage. If the appraisal is low-scope, which corresponds to $\eta = 0.5$, parties do not consider the possibility of apportionment at the settlement stage: appraisals reflect only a judgment about the probabilities of a verdict of no liability or full liability. Given the functional forms employed in the model, $\eta = 0.5$ implies that $\pi_0 + \pi_1 = 1$ and $Pr(0<F_i<1) = 0$. If the appraisal process is high-scope, which corresponds to $\eta = 0$, $\pi_0 + \pi_1 \leq 0.51$ and $Pr(0<F_i<1) \geq 0.49$ for values of $\sigma_2 \leq 0.4$: parties do consider the possibility of apportionment when settling claims.

The parameter $\sigma_1$ ($\sigma_1 \in (0,\infty)$) captures the variance of $F_i$ around $f_i$, conditional on $F_i$ being in the interior of (0,1). The parameter $\sigma_2$ ($\sigma_2 \in (0,\infty)$) denotes the extent to which changes in $f_i$ represent changes in the probability that $F_i$ will lie in various parts of the interval [0,1]. For example, very large values of $\sigma_2$ imply that there is a 50 percent chance that the defendant would be held fully liable and a 50 percent chance that the defendant would be exonerated, with no possibility of apportionment, independent of $f_i$.

Two limiting cases deserve attention. As $\sigma_1, \sigma_2 \to 0$ and $\eta = 0$, then $F_i = f_i$. As the variance of a high-scope appraisal process becomes arbitrarily small, appraised fault equals fault-at-trial. On the other hand, as $\sigma_1, \sigma_2 \to \infty$, then $Pr(F_i=0) = Pr(F_i=1) = 0.5$. As the variance of the appraisal process becomes arbitrarily large, appraised fault contains no information: parties believe that defendants have a 50 percent chance of being fully liable and a 50 percent chance of being exonerated, independent of the appraisal $f_i$.

Under the approximately unbiased model, then, the amount of the settlement of claim i under particular negligence regimes, as they are typically articulated, can be written as a function of the regime, parameterized by $\tau$, appraised fault, expected damages, and the scope and precision of the appraisal process ($\eta$, $\sigma_1$ and $\sigma_2$):

$$c(f_i,E(D_i);\tau,\eta,\sigma_1,\sigma_2) = E(D_i) * \{\pi_1+(1-\pi_1-\pi_0)*[f_i+\sigma_1\frac{\phi\left(\frac{f_i-\tau}{\sigma_1}\right)-\phi\left(\frac{f_i-1}{\sigma_1}\right)}{\Phi\left(\frac{f_i-\tau}{\sigma_1}\right)-\Phi\left(\frac{f_i-1}{\sigma_1}\right)}]*[\frac{\Phi\left(\frac{f_i-\tau}{\sigma_1}\right)-\Phi\left(\frac{f_i-1}{\sigma_1}\right)}{\Phi\left(\frac{f_i}{\sigma_1}\right)-\Phi\left(\frac{f_i-1}{\sigma_1}\right)}]\}, \tag{11}$$

where $\phi$ is the standard normal density function.

Tables 1 through 3 and figure 1 show the relationship between appraised fault $f_i$, fault-at-trial $F_i$ and settlement $c_i$ predicted by the three models (unbiased low-scope, approximately unbiased low-scope and high-scope) for $\sigma_1 = 0.15$ and $\sigma_2 = 0.4$. Table 1 compares the probability distribution of $F_i$ given $f_i$ generated by the three models. If parties make approximately unbiased low-scope appraisals, $f_i = 0$ implies $\Pr(F_i=0) = 0.894$ and $\Pr(F_i=1) = 0.106$; $f_i = 1$ implies $\Pr(F_i=1) = 0.894$ and $\Pr(F_i=0) = 0.106$; $f_i = 0.75$ implies $\Pr(F_i=1) = 0.734$ and $\Pr(F_i=0) = 0.266$; and $f_i = 0.5$ implies $\Pr(F_i=0) = \Pr(F_i=1) = 0.5$. In the high-scope case, $f_i$

= 0.5 implies $\Pr(F_i=0) = 0.106$, $\Pr(0<F_i<1) = 0.789$, and $\Pr(F_i=1) = 0.106$.

Under the assumption that $E(D_i) = \$1$, adopted for convenience, figure 1 plots the relationship between appraised fault $f_i$ and $\ln(c_i)$ that would be predicted by each of the three negligence regimes under each of the three models. Figure 1 indicates that settlement should be invariant to the choice of liability rule under the assumption that the parties make low-scope appraisals: the solid and the long-dashed lines are the same in all three panels of the figure. This accords with intuition: even if the laws are operating as they are written, settlement would be invariant to liability rule if individuals made judgments only about the presence or absence of liability; all three regimes impose equal liability on defendants who are either wholly or not at all at fault. In the high-scope case, figure 1 again shows that appraised fault and settlement are related as intuition would suggest. Settlement is related to appraised fault more strongly under contributory and modified comparative negligence than under pure comparative negligence. In particular, figure 1 shows that the relationship between fault and settlement is strongest for plaintiffs whose appraised fault is near the level $\tau$ at which recovery is barred.

Tables 2 and 3 tabulate the information contained in figure 1. Table 2 gives log-differences in the predicted value of settlements across appraised fault levels by negligence regime; table 3 gives log-differences across negligence regime by appraised fault level. If parties make approximately unbiased low-scope appraisals, the next-to-last row of the second panel of table 2 shows that a defendant appraised to be wholly at fault would settle for exp(0.581) = 1.8 times more than a defendant appraised to be half at fault, regardless of negligence regime. If parties make high-scope appraisals, the next-to-last row of the final panel of table 2 shows that a defendant appraised to be wholly at fault would settle for exp(1.555) = 4.7 times more than a defendant appraised to be half at fault under contributory negligence, exp(0.982) = 2.7 times more under modified comparative negligence and exp(0.625) = 1.9 times more under pure comparative negligence.

Table 3 depicts only high-scope appraisals, because settlement is invariant to regime for low-scope appraisals. If the parties make high-scope appraisals, table 3 shows that settlements under pure comparative negligence are greater than those under modified comparative negligence, and that settlements under modified comparative negligence are greater than those under contributory negligence. For example, a defendant appraised to be not at fault would settle for exp(2.353) = 10.5 times more under pure comparative than under contributory negligence; a defendant appraised to be wholly at fault would settle for exp(0.626) = 1.9 times more.

## II. Data and Estimation

### A. Data

To estimate equations (6)-(9), I use a 1987 cross-section of 7,385 automobile insurance bodily injury claims, collected by the Insurance Research Council. Thirty-four insurers, comprising nearly 60 percent of the American passenger automobile insurance market, participated in the data collection project. (Participating insurers are listed in appendix A.) A claim was included in the sample if one of the participating insurers settled with a claimant during a two-week period in the summer of 1987.[33] Each record contains information on $c_i$, $f_i$, $x_i$, $r_i$, and the state in which the accident occurred. (A list of the specific variables used in analysis can be found in table 4.)

Each claim in the database was matched with a set of the main state laws that governed its disposition. In identifying the state law that controls the disposition of a claim, I apply the law in effect at the location of the accident, which is the traditional conflict of law rule used in tort cases.[34] I include four dummy variables, $L_0$-$L_3$, to

[33]Litigated claims are excluded from the analysis. However, there are only 32 claims in the sample that were litigated to a verdict, and including them in the analysis would not have altered the results.

[34]See Weintraub (1980), p. 266 et seq.

control for state law in the equations. Appendix B summarizes the negligence regimes in effect -- pure comparative, modified comparative or contributory -- in the United States, from the early 1900's to the present date.

Since other tort and non-tort laws may be correlated with either settlement or negligence regime, I restrict the sample to claims from states in which tort law was the only relevant provision of law governing the payment of automobile insurance claims; I exclude, for example, claims from states that allow no-fault or add-on automobile insurance. Considering only two-party accidents further reduces any omitted variable bias, by eliminating the influence of other elements of state law, such as joint and several liability laws. Finally, I exclude claims from Illinois, which altered its regime shortly before the claims data were collected.[35] The 25 states from which data are used are denoted with a "+" in appendix B.

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[35]Including claims from Illinois in the sample could distort the estimated effects of negligence regime by selecting claims into negligence regime in a manner that is correlated with compensation. The average modified comparative negligence claim in the sample from Illinois, for example, took less time to resolve than the average pure comparative negligence claim from Illinois, by virtue of the fact that claims are collected at a point in time in 1987. Since time-to-resolution is likely to be correlated with compensation, including claims from Illinois in the sample could bias estimated effects of negligence regime, but excluding claims from Illinois should not.

B. Econometric Issues

Estimation of equations (6) and (7), (8) and (7), or (9) and (7) is complicated by three properties of the data. First, the fact that there are common unobserved determinants of both fault and the value of settlement, $\tilde{x}$ and $\tilde{l}$, means that OLS estimates of equation (6) or (8), or nonparametric estimates of equation (9) will be inconsistent, because in general $E(\epsilon_1 | \ln(f)) = E(\epsilon_1 | \epsilon_2) \neq 0$. In other words, appraised fault is endogenous in a model of the influence of appraised fault on settlement. Second, the fact that claimants may drop claims means that the observed sample of settlements is truncated. I assume that nonlitigated claims are resolved in one of two ways: either they are settled by the insurer for at least $1, or they are dropped. This implies that the sample of settlements is truncated at $\ln(c) = 0$; thus, instrumental variables estimates of any of the models will be inconsistent.[36] Third, since $\ln(f)$ is undefined at $f = 0$ and for $f > 1$ (since $0 \leq f \leq 1$), the conventional assumption of normality may not be appropriate for $\epsilon_2$.

I employ a variety of techniques to investigate the relative importance of these three properties of the settlement data to the estimation process. I estimate the linear model of settlement (equation (6)) by OLS, which

[36] See, e.g., Greene (1990), chap. 21.

accounts for none of the three complications and full-information maximum likelihood (FIML), which accounts for all three properties of the data. I estimate the spline model (equation (8)) by OLS and FIML; and the formulation of the nonparametric IV estimator (equation (9)) accounts for endogeneity and the nonnormality of $\epsilon_2$ but not the truncation of the sample. In all of the estimation routines, I assume that legal regime is exogenous.[37]

The FIML and nonparametric IV models correct for the endogeneity of appraised fault and the nonnormality of $\epsilon_2$ by assuming a censored tobit model for the determination of fault. These models assume that f is a censored version of an underlying variable $f^*$:

$$\ln(f_i) = \begin{cases} 0 \ \textit{if} \ \ln(f_i^*) \geq 0 \rightarrow f_i^* \geq 1 \\ -4.61 \ \textit{if} \ \ln(f_i^*) \leq -4.61 \rightarrow f_i^* \leq 0.01 \end{cases}$$

and

$$\ln(f_i^*) = z_i\gamma + e_{2i}^*, \qquad (12)$$

where $\epsilon_2^*$ is normally distributed.

[37]To investigate the validity of the assumption that legal regime is uncorrelated with the error terms in the models, I reestimated the models with state-level characteristics that might influence states' laws, including but not limited to choice of negligence regime (see, e.g., Danzon (1985)). Including controls for the number of attorneys per capita in 1988 and the percentage of the state living in urban areas in 1980 did not change the fundamental results presented in the following section.

The FIML models jointly estimate the settlement (equation (6) or (8)) and fault (equation (12)) equations. The FIML estimates of the linear and spline models, under the assumption that $\epsilon_1$ and $\epsilon_2^*$ are bivariate normally distributed, are found by maximizing the bivariate tobit likelihood functions found in appendix C. The nonparametric IV estimates, under the assumption that $\epsilon_2^*$ is normally distributed and that z is independent of $\epsilon_1$ and $\epsilon_2^*$, are obtained according to the method outlined in appendix C.

This represents an advance over previous work that has attempted to measure the relationship between fault and liability in general[38] and work that has attempted to assess the importance of the shift from contributory to comparative negligence on the relationship between fault and liability.[39] The majority of the studies account for neither the jointly determined nature of fault and damages nor plaintiffs' drop decision in estimating the relationship between fault and settlement level or award at trial. Farber and White (1991) and White (1989) do account for plaintiffs' drop decision, but not for endogeneity. As indicated above, if there are unobserved determinants of compensation that are correlated with fault, estimates of

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[38]See, e.g., Farber and White (1991).

[39]See Hammitt (1985); Low and Smith (1992); Rolph, Hammitt and Houchens (1985); Ross (1970); Shanley (1985); White (1989); and Wittman (1986).

the relationship between fault and settlement that do not account for this fact will be inconsistent.

## III. Empirical Results

Table 4 presents the variables used in analysis and some descriptive statistics. The first and second rows of the table show that the level of settlements is both higher and more variable under comparative negligence than under contributory negligence. This is consistent with conventional wisdom about comparative negligence: it compensates a wider variety of claimants, and it compensates them more generously than contributory negligence. The third through seventh rows of table 4 detail the distribution of appraised fault in the data. The most striking property of that distribution is how faulty the average defendant is appraised to be: approximately 95 percent at fault. Depending on negligence regime, between 82 and 92 percent of defendants are appraised to be wholly at fault. In addition, the table shows that the characteristics of accidents ($x_i$ and $r_i$) vary across negligence regimes. This could be due to the fact that different types of accidents occur in different geographic regions: in the sample, contributory negligence is the law mainly in the southeast, pure comparative negligence is a predominantly western phenomenon, and modified comparative negligence is most frequently employed in the midwest.

Alternatively, sample differences in accident characteristics might be due to the differential truncation of the samples across regimes.

In particular, differences in appraised fault across negligence regimes do not appear to be due to reporting bias or any other regime-dependent factor. Based on FIML estimates of the basic model (equations (6) and (12)), reported in appendix D, hypothesis tests fail to reject that negligence regime has no statistically significant influence on the appraisal process. The influence of negligence regime on appraised fault is economically insignificant as well. Point estimates indicate that average appraised fault in pure-comparative-negligence (modified-comparative-negligence) jurisdictions is only 1.8 percent lower (1.4 percent higher) than in contributory negligence jurisdictions, other claim characteristics held constant.

A. The Relationship Between Fault and Settlement

Table 5 sets out the estimated effects of appraised fault on settlement, holding other claim characteristics constant, in each of the three negligence regimes. The first panel of that table contains estimates from the linear model, equation (6); the second panel of the table contains estimates from the spline model, equation (8). In the first panel, the OLS estimates indicate that the responsiveness of settlement to appraised fault ($\alpha$)

under contributory negligence is not statistically distinguishable from zero. The FIML estimates lead to a different conclusion: the responsiveness of settlement to appraised fault is statistically different from zero under all three regimes at a 10 percent level of significance. Additionally, in the linear model, we reject the null hypothesis of no endogeneity: the correlation between $\epsilon_1$ and $\epsilon_2^*$ is statistically different from zero at the 10 percent level of significance (from appendix D, $\rho$ = -0.077, standard error = 0.040). This suggests that there may be common determinants of appraised fault and settlement amount not observed by the researcher.

The spline estimates (contained in the second panel of table 5) show that appraised fault and settlement are not as strongly related as the theoretical model of section IB predicts. Assume that the difference in settlements between $f \in [0,.49]$ and $f = 1$ ($f \in [.51,.99]$ and $f = 1$) is approximated by the difference in settlements between $f = 0.25$ and $f = 1$ ($f = 0.75$ and $f = 1$). Comparing the FIML estimates from the spline model to the values that the theoretical model predicts (which can be found in table 2) shows that the responsiveness of settlement to appraised fault is weaker than predicted, whether parties make low-scope or high-scope appraisals, in each of the different negligence regimes. For example, a defendant appraised to be wholly at fault would actually settle for exp(0.954) =

2.6 times more than one appraised to be between 0 and 49 percent at fault, ceteris paribus, under contributory negligence; but theory predicts that a defendant appraised to be wholly at fault would settle for at least exp(2.800) = 16.5 times more than one appraised to be 25 percent at fault, if the parties make high-scope appraisals, or exp(1.386) = 4 times (exp(1.212) = 3.4 times) more, if the parties make (approximately) unbiased low-scope appraisals.

In general, the difference between the empirical results and the theoretical predictions is statistically significant. Under pure comparative negligence, Wald tests reject the null hypothesis that the three spline estimates from table 5 are equal to the three predicted values in table 2, at a 1 percent level of significance, whether parties make unbiased or approximately unbiased low-scope appraisals ($\chi_{(3)}^2$ = 22.0 or 13.5, respectively) or high-scope ($\chi_{(3)}^2$ = 21.1) appraisals. Under modified comparative negligence, Wald tests reject the analogous null hypothesis, whether parties make unbiased or approximately unbiased low-scope ($\chi_{(3)}^2$ = 24.5 or 15.9) or high-scope ($\chi_{(3)}^2$ = 112.2) appraisals. Under contributory negligence, however, Wald tests reject the analogous null hypothesis only if parties make high-scope appraisals ($\chi_{(3)}^2$ = 30.1). If parties make low-scope appraisals in contributory negligence regimes -- which would be consistent with the all-or-nothing nature of contributory negligence -- we fail to reject that the effect of appraised fault on settlement differs from the effect predicted by the doctrine of contributory negligence as it is generally articulated ($\chi_{(3)}^2$ = 3.3 or 1.7).

Figure 2, which compares the nonparametric-IV estimated effect of appraised fault on settlement to the theoretically predicted effect, both clarifies and supports these conclusions.[40] The first panel of figure 2 suggests that contributory negligence does not bar all faulty plaintiffs from recovery. The first panel contains three lines: the estimated relationship between settlement and appraised fault, the predicted relationship if parties make approximately unbiased low-scope appraisals, and the predicted relationship if parties make high-scope/low-variance appraisals in a negligence regime that bars recovery to plaintiffs who are more than 70 percent at fault ($\eta = 0$, $\sigma_1 = 0.05$, $\sigma_2 = 0.2$, $\tau = 0.3$). The estimated effect of appraised fault on settlement suggests that parties make high-scope appraisals, and that contributory negligence bars only very faulty plaintiffs from recovery. The second and third panels of figure 2 confirm what the FIML results disclosed: under both forms of comparative negligence, settlement is less responsive to appraised fault than the statements of the laws predict, whether parties make low- or

[40]Figure 2 does not provide estimates of the effect of fault on settlement at the extremes of the fault distribution because the nonparametric IV estimator is inconsistent at f = 0 and f = 1.

high-scope appraisals of fault-at-trial.

The general result in this subsection -- that appraised fault and settlement are very weakly related -- is also consistent with the hypothesis that the single-valued appraisal of fault used in the paper contains little information. In terms of the model in section IB, the world might be characterized by the limiting case $\sigma_1$, $\sigma_2 \rightarrow \infty$. Estimates of equation (12) indicate that this is not the case. If appraised fault ($f_i$) contained no information about fault-at-trial, then $f_i$ should be uncorrelated with the instruments ($r_i$) which are determinative of fault-at-trial under the law. But the instruments are individually and jointly significant predictors of appraised fault, in both a statistical and an economic sense. Based on FIML estimates of equation (12) from appendix D, citation for a single traffic violation in connection with an accident results in an estimated increase in appraised fault of between 15 and 89 percent (exp(0.143) = 1.15, exp(0.636) = 1.89), depending on the violation. Citation for multiple violations results in an estimated increase in appraised fault of 107 percent (exp(0.727) = 2.07). All of these effects are significantly different from zero at least at a five percent level of significance. This means that the commission of traffic violations is an important factor in the determination of appraised fault, which is inconsistent with the claim that appraised fault contains little information about fault-at-trial.

B. The Relationship Between Negligence Regime and Settlement

Table 6 shows that settlements under pure comparative negligence are greater than those under modified comparative negligence, and that settlements under modified comparative negligence are greater than those under contributory negligence, across the entire spectrum of appraised fault. This ordering of the magnitude of settlements across negligence regimes is consistent with what the black letter law predicts, under the assumption that parties make high-scope appraisals (table 3). The differences in settlement schedules across negligence regimes are statistically significant. Based on the FIML estimates of the spline model, Wald tests reject the null hypothesis that settlement amount under pure comparative negligence is equal to settlement under modified comparative negligence, for claimants with similar characteristics and levels of appraised fault, at a 1 percent level of significance ($\chi_{(4)}^2$ = 61.0). Wald tests also reject the null hypotheses that settlements under modified comparative are equal to those under contributory negligence ($\chi_{(4)}^2$ = 16.5) and that settlement under pure comparative is equal to settlement under contributory negligence ($\chi_{(4)}^2$ = 90.1), both at a 1 percent level of significance.

## IV. Conclusion

The empirical results both answer specific questions about the influence of contributory and comparative negligence and have broader implications for the economic analysis of accident law.

In a broad sense, one set of findings from this study is consistent with prior expectations about the effect on damages of a jurisdiction's choice of negligence regime. Settlements under pure comparative negligence exceed those under modified comparative negligence, and settlements under modified comparative negligence exceed those under contributory negligence, everything else being equal. This finding has two implications. First, it indicates that the contours of tort law do influence settlement behavior, and in the fashion that theory would predict. Second, it suggests by implication that parties at the settlement stage appraise the extent to which each of the participants is at fault, not merely the presence or absence of fault. If the appraisal process involved judgments only about the presence or absence of liability, then settlement would be invariant to the choice of negligence regime.

A more technical, but nevertheless significant finding, is that appraised fault is an endogenous variable in a model of the influence of appraised fault on settlement amount. That is, determinants of appraised fault not observed by the researcher are correlated with unobserved determinants of settlement. Tests reject the hypothesis that residual appraised fault is uncorrelated with residual settlement; and estimates of the effect of appraised fault on settlement using models that account for endogeneity differ from those using models that do not. This finding suggests that estimates of the influence of fault on settlement from prior studies that fail to account for that endogeneity may be incorrect.

The most significant finding in this study, however, is that the relationship between appraised fault and settlement is not nearly as strong as the articulated negligence doctrines suggest, and this is so under a wide range of assumptions about the manner in which parties appraise fault at the time of settlement. Because factors that determine fault-at-trial -- whether the defendant was cited by the police for committing traffic violations in connection with the accident -- have a significant influence on appraised fault, this finding indicates that the relationship between fault and award at trial is likely to be less strong in practice than in theory. Statistical tests reject the hypothesis that the actual relationship between appraised fault and settlement resembles what the doctrines of pure and modified comparative negligence predict. In fact, tests reject, at high conventional levels of significance, the hypothesis that the actual effect of appraised fault on settlement under modified comparative negligence is even as great as the predicted effect of appraised fault on settlement under _pure_ comparative negligence, the regime in which compensation presumably is least responsive to determinations of fault. Under some assumptions we do, on the other hand, fail to reject the hypothesis that contributory negligence bars all faulty plaintiffs from recovery. But, even here, nonparametric estimates of the relationship between appraised fault and settlement suggest that contributory negligence bars only severely negligent claimants, specifically those who are 70 percent or more at fault.

These findings suggest that prior theoretical and empirical evaluations of the shift from contributory to comparative negligence may have been premised on incorrect assumptions. Theoretical comparisons of negligence regimes have uniformly assumed that they operate in practice as they do in theory; empirical comparisons have assumed that fault is exogenously determined. The findings reported here more generally point to the possibility that the relationship between fault and compensation in the tort system may be weaker than the laws, as written, would suggest. In particular, bars to recovery in other areas of tort law, such as products liability law, might likewise not have significant effects on the magnitude of awards. By implication, black letter law may be less important in shaping individuals' accident avoidance behavior than law and economics scholars previously have supposed.

Thus, continued empirical investigation is important both in its own right and for the light that it can shed on theoretical models in law and economics. This paper does not address the particular behavioral or efficiency implications of the results; that question remains to be addressed by future research.

Table 1: Probability Distribution of Fault-At-Trial F Given Appraised Fault f

| | | low-scope unbiased | low-scope approx. unbiased | high-scope |
|---|---|---|---|---|
| f=0 | Pr(0<F≤0.5) | 0.000 | 0.000 | 0.494 |
| | Pr(0.5≤F<1) | 0.000 | 0.000 | 0.000 |
| | Pr(F=1) | 0.000 | 0.106 | 0.006 |
| f=.25 | Pr(0<F≤0.5) | 0.000 | 0.000 | 0.668 |
| | Pr(0.5≤F<1) | 0.000 | 0.000 | 0.035 |
| | Pr(F=1) | 0.250 | 0.266 | 0.030 |
| f=.5 | Pr(0<F≤0.5) | 0.000 | 0.000 | 0.394 |
| | Pr(0.5≤F<1) | 0.000 | 0.000 | 0.394 |
| | Pr(F=1) | 0.500 | 0.500 | 0.106 |
| f=.75 | Pr(0<F≤0.5) | 0.000 | 0.000 | 0.035 |
| | Pr(0.5≤F<1) | 0.000 | 0.000 | 0.668 |
| | Pr(F=1) | 0.750 | 0.734 | 0.266 |
| f=1 | Pr(0<F≤0.5) | 0.000 | 0.000 | 0.000 |
| | Pr(0.5≤F<1) | 0.000 | 0.000 | 0.494 |
| | Pr(F=1) | 1.000 | 0.894 | 0.500 |

Table 2: Predicted Log-Differences in Settlements Across Appraised Fault Levels By Regime

| | contributory | modified compar. | pure compar. |
|---|---|---|---|
| unbiased low-scope | | | |
| f=0 to f=1 | ∞ | ∞ | ∞ |
| f=0.25 to f=1 | 1.386 | 1.386 | 1.386 |
| f=0.5 to f=1 | 0.693 | 0.693 | 0.693 |
| f=0.75 to f=1 | 0.288 | 0.288 | 0.288 |
| approx. unbiased low-scope | | | |
| f=0 to f=1 | 2.136 | 2.136 | 2.136 |
| f=0.25 to f=1 | 1.212 | 1.212 | 1.212 |
| f=0.5 to f=1 | 0.581 | 0.581 | 0.581 |
| f=0.75 to f=1 | 0.198 | 0.198 | 0.198 |
| high-scope | | | |
| f=0 to f=1 | 4.389 | 4.978 | 2.661 |
| f=0.25 to f=1 | 2.800 | 2.923 | 1.458 |
| f=0.5 to f=1 | 1.555 | 0.982 | 0.625 |
| f=0.75 to f=1 | 0.631 | 0.197 | 0.177 |

Table 3: Predicted Log-Differences in Settlements Across Regimes By Level of Appraised Fault, High-Scope Appraisals

| | pure-contributory | modified-contributory | pure-modified |
|---|---|---|---|
| f=0 | 2.353 | 0.036 | 2.317 |
| f=0.25 | 1.967 | 0.503 | 1.464 |
| f=0.5 | 1.554 | 1.197 | 0.357 |
| f=0.75 | 1.079 | 1.059 | 0.020 |
| f=1 | 0.626 | 0.625 | 0.001 |

## Table 4: Average Values of Variables By Regime

| | Full Sample | Contrib-utory | Modified Compar. | Pure Compar. |
|---|---|---|---|---|
| settlement amount ($) | 5209.163 | 2906.052 | 4818.347 | 5990.158 |
| std deviation | 11347 | 6869 | 10990 | 12312 |
| appraised defendant fault | 0.949 | 0.981 | 0.949 | 0.941 |
| 0≤defendant fault≤.49 | 0.021 | 0.007 | 0.017 | 0.027 |
| defendant fault=.5 | 0.033 | 0.008 | 0.020 | 0.045 |
| .51≤defendant fault≤.99 | 0.094 | 0.069 | 0.144 | 0.077 |
| defendant fault=1 | 0.852 | 0.916 | 0.819 | 0.851 |
| location of accident (1=yes) | | | | |
| western region | 0.484 | 0 | 0.200 | 0.747 |
| northeastern region | 0.032 | 0 | 0.083 | 0.016 |
| southeastern region | 0.245 | 1 | 0.051 | 0.146 |
| midwestern region | 0.239 | 0 | 0.667 | 0.091 |
| city w/pop>100K | 0.358 | 0.297 | 0.299 | 0.402 |
| suburb of city w/pop>10K | 0.189 | 0.089 | 0.127 | 0.245 |
| city w/10K≤pop≤100K | 0.278 | 0.327 | 0.325 | 0.244 |
| city w/pop<10K | 0.097 | 0.170 | 0.131 | 0.062 |
| rural | 0.077 | 0.117 | 0.118 | 0.047 |
| claimant injuries (1=yes) | | | | |
| none | 0.010 | 0.006 | 0.006 | 0.013 |
| lacerations | 0.263 | 0.371 | 0.293 | 0.220 |
| fractures | 0.053 | 0.046 | 0.060 | 0.051 |
| disfigurement | 0.029 | 0.030 | 0.036 | 0.024 |
| neck strain | 0.578 | 0.464 | 0.519 | 0.636 |
| back strain | 0.444 | 0.365 | 0.382 | 0.494 |
| other strain | 0.114 | 0.072 | 0.113 | 0.125 |
| concussion | 0.038 | 0.025 | 0.055 | 0.034 |
| other injuries | 0.133 | 0.118 | 0.130 | 0.138 |
| claimant disability (1=yes, base group is no disability) | | | | |
| temporary | 0.401 | 0.437 | 0.432 | 0.377 |
| permanent partial | 0.039 | 0.045 | 0.052 | 0.032 |
| permanent total | 0.003 | 0.003 | 0.002 | 0.003 |
| fatality | 0.005 | 0.001 | 0.007 | 0.004 |
| claimant rehab. (1=yes, base group is no rehab.) | | | | |
| hospitalized≤7 but>0 days | 0.044 | 0.038 | 0.060 | 0.038 |
| hospitalized>7 days | 0.020 | 0.028 | 0.026 | 0.016 |
| need rehab. services | 0.511 | 0.585 | 0.553 | 0.472 |
| weeks lost from work | 2.136 | 1.516 | 2.195 | 2.267 |
| claimant role in accident (1=yes, base group is other) | | | | |
| auto driver | 0.582 | 0.566 | 0.566 | 0.594 |
| passenger in auto | 0.329 | 0.377 | 0.346 | 0.309 |
| motorcycle driver | 0.024 | 0.019 | 0.022 | 0.027 |
| passenger on motorcycle | 0.004 | 0.003 | 0.006 | 0.003 |
| pedestrian | 0.050 | 0.025 | 0.052 | 0.056 |
| defendant traffic violation (1=yes, see footnote 22 for explanation) | | | | |
| listed violation | 0.214 | 0.226 | 0.282 | 0.177 |
| unlisted violation | 0.091 | 0.166 | 0.146 | 0.046 |
| >1 violation | 0.026 | 0.032 | 0.031 | 0.022 |
| legal regime | | | | |
| contributory | 0.147 | 1 | 0 | 0 |
| pure comparative | 0.573 | 0 | 0 | 1 |
| modified comparative | 0.280 | 0 | 1 | 0 |
| prejudgment interest | 0.658 | 0.501 | 0.501 | 0.774 |
| N | 7385 | 1084 | 2069 | 4232 |

## Table 5: Estimated Effects of Appraised Fault on ln(Settlement) By Regime

(standard errors in parentheses)

| | contributory | modified compar. | pure compar. |
|---|---|---|---|
| **Linear Model: Equation (6)** | | | |
| OLS estimates | | | |
| slope ($\alpha$) | 0.131 | 0.145 | 0.257 |
| | (0.108) | (0.079) | (0.044) |
| intercept ($\delta$) | 5.336 | 5.562 | 5.874 |
| | (0.161) | (0.147) | (0.151) |
| FIML estimates | | | |
| slope ($\alpha$) | 0.239 | 0.242 | 0.357 |
| | (0.123) | (0.096) | (0.063) |
| intercept ($\delta$) | 5.304 | 5.530 | 5.841 |
| | (0.165) | (0.152) | (0.155) |
| **Spline Model: Equation (8)** | | | |
| OLS estimates | | | |
| $f\epsilon[0,.49]$ to $f=1$ ($-\alpha_a$) | 0.859 | 0.387 | 0.667 |
| | (0.440) | (0.199) | (0.112) |
| $f=0.5$ to $f=1$ ($-\alpha_b$) | 0.046 | 0.384 | 0.241 |
| | (0.390) | (0.184) | (0.086) |
| $f\epsilon[.51,.99]$ to $f=1$ ($-\alpha_c$) | 0.068 | -0.135 | -0.185 |
| | (0.139) | (0.074) | (0.067) |
| FIML estimates | | | |
| $f\epsilon[0,.49]$ to $f=1$ ($-\alpha_a$) | 0.954 | 0.403 | 0.686 |
| | (0.417) | (0.459) | (0.112) |
| $f=0.5$ to $f=1$ ($-\alpha_b$) | 0.068 | 0.394 | 0.257 |
| | (0.436) | (0.471) | (0.443) |
| $f\epsilon[.51,.99]$ to $f=1$ ($-\alpha_c$) | 0.085 | -0.126 | -0.174 |
| | (0.166) | (0.173) | (0.175) |

| Equation # | Equation |
|---|---|
| (6) | $\log(c_i) = \alpha\log(f_i) + x_i\beta + 1_i\delta + \epsilon_{1i}$ |
| (8) | $\log(c_i) = \alpha_a f0\_49_i + \alpha_b f50_i + \alpha_c f51\_99_i + x_i\beta + 1_i\delta + \epsilon_{1i}$ |

Table 6: Estimated Effects of Negligence Regime on ln(Settlement)
(standard errors in parentheses)

| | pure-contributory | modified-contributory | pure-modified |
|---|---|---|---|
| **Linear Model: Equation (6)** | | | |
| OLS estimates | | | |
| slope ($\alpha$) | 0.126 | 0.013 | 0.112 |
| | (0.117) | (0.134) | (0.089) |
| intercept ($\delta$) | 0.537 | 0.225 | 0.312 |
| | (0.057) | (0.068) | (0.043) |
| FIML estimates | | | |
| slope ($\alpha$) | 0.118 | 0.002 | 0.116 |
| | (0.115) | (0.135) | (0.090) |
| intercept ($\delta$) | 0.537 | 0.225 | 0.312 |
| | (0.060) | (0.067) | (0.041) |
| **Spline Model: Equation (8)** | | | |
| OLS Estimates | | | |
| $f\epsilon[0,.49]$ ($\alpha_a+\delta$) | 0.718 | 0.688 | 0.030 |
| | (0.454) | (0.484) | (0.212) |
| $f=0.5$ ($\alpha_b+\delta$) | 0.331 | -0.120 | 0.452 |
| | (0.398) | (0.424) | (0.201) |
| $f\epsilon[.51,.99]$ ($\alpha_c+\delta$) | 0.780 | 0.419 | 0.360 |
| | (0.155) | (0.161) | (0.099) |
| $f=1$ ($\delta$) | 0.526 | 0.216 | 0.310 |
| | (0.059) | (0.069) | (0.043) |
| FIML Estimates | | | |
| $f\epsilon[0,.49]$ ($\alpha_a+\delta$) | 0.794 | 0.769 | 0.027 |
| | (0.402) | (0.437) | (0.230) |
| $f=0.5$ ($\alpha_b+\delta$) | 0.336 | -0.111 | 0.447 |
| | (0.427) | (0.459) | (0.214) |
| $f\epsilon[.51,.99]$ ($\alpha_c+\delta$) | 0.784 | 0.426 | 0.358 |
| | (0.145) | (0.150) | (0.105) |
| $f=1$ ($\delta$) | 0.526 | 0.213 | 0.310 |
| | (0.062) | (0.071) | (0.042) |

| Equation # | Equation |
|---|---|
| (6) | $\log(c_i) = \alpha\log(f_i) + x_i\beta + 1_i\delta + \epsilon_{1i}$ |
| (8) | $\log(c_i) = \alpha_a f0\_49_i + \alpha_b f50_i + \alpha_c f51\_99_i + x_i\beta + 1_i\delta + \epsilon_{1i}$ |

Figure 1

Predicted Effect of Appraised Fault on ln(Settlement)

Contributory Negligence

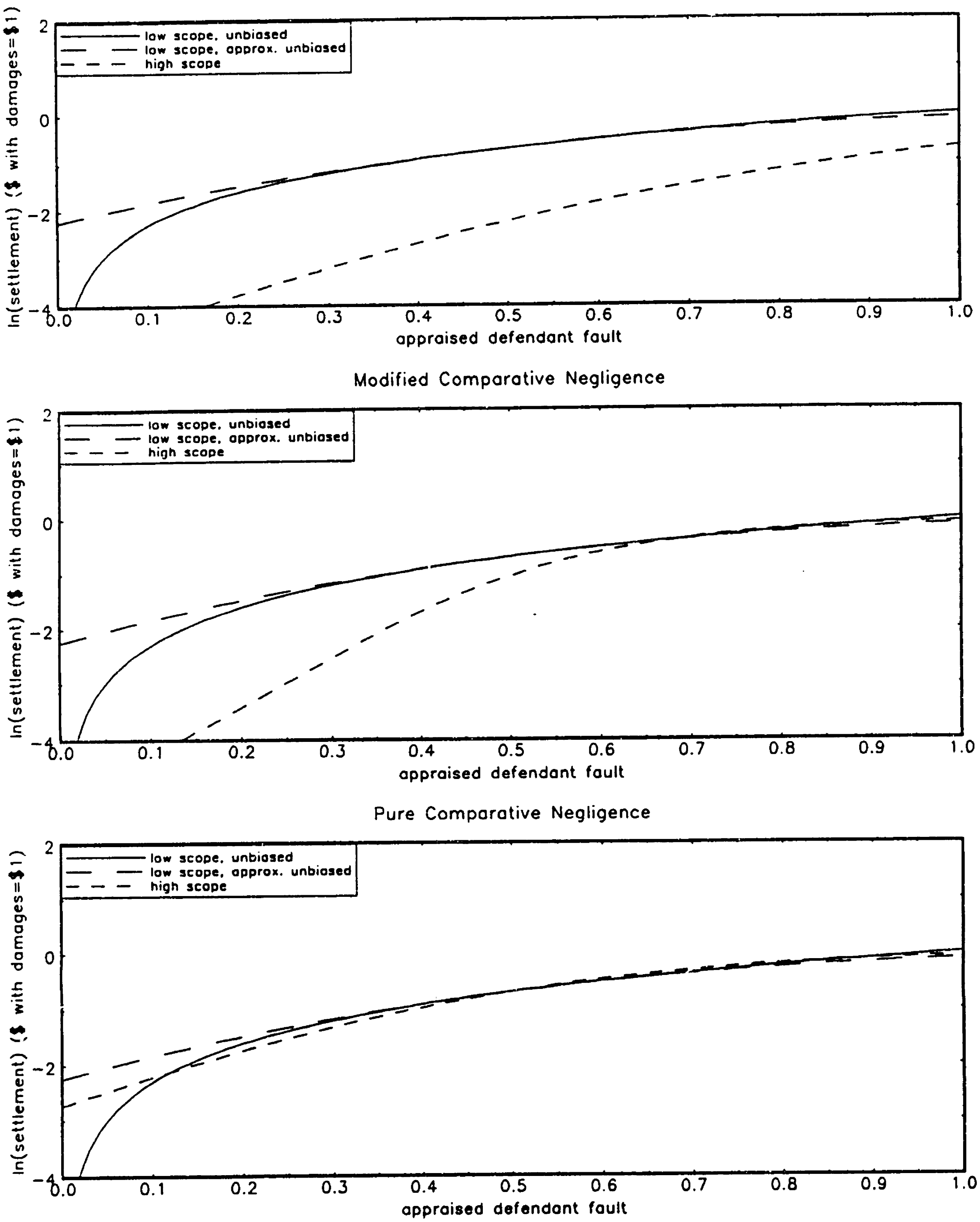
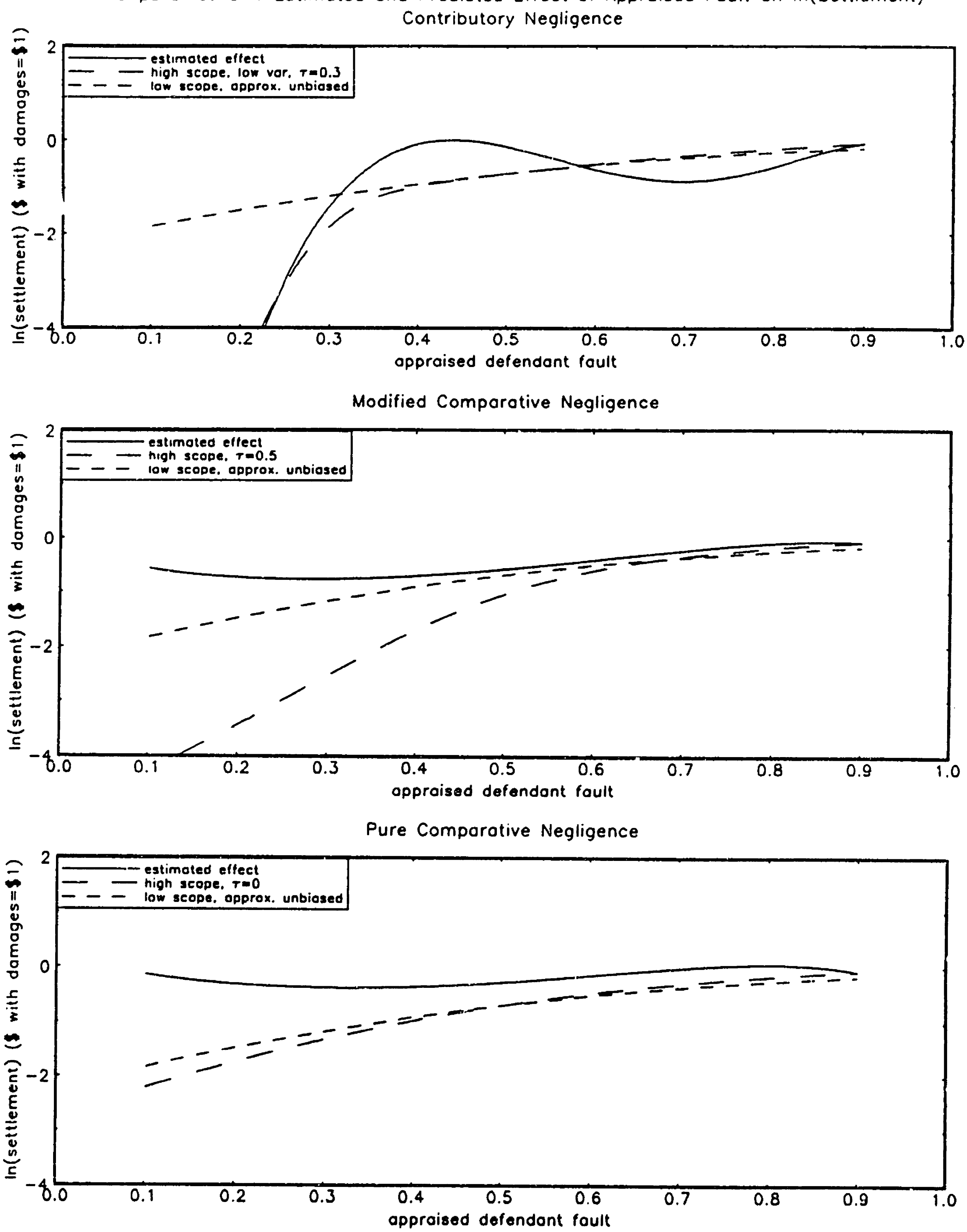


Figure 2
Nonparametric IV Estimated and Predicted Effect of Appraised Fault on ln(Settlement)



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# Chapter 2

## Do Doctors Practice Defensive Medicine?[41]

[41]Joint with Mark McClellan, Harvard University.

In theory, the medical professional liability system may either promote or inhibit efficiency in the supply of health care. If the malpractice system induces health care providers to take precautionary measures that improve patient health outcomes, it may improve efficiency. However, if the fear of liability drives physicians and hospitals to administer treatments that have minimal medical benefit -- that is, to engage in "defensive medicine" -- the tort system may have profound social costs.

The influence of liability rules on providers' treatment behavior and patient health outcomes is both difficult to measure and potentially large. Estimates of the impact of malpractice liability on the cost of physicians' services, for example, are as large as $13.7 billion in 1984, or approximately 15 percent of the total expenditure on physicians' services.[42]

For this reason, empirical evidence on the existence of defensive medicine is important in evaluating the current medical professional liability system. In this paper, we test for the incidence of defensive medicine with an examination of the link between medical malpractice tort law, doctors' treatment behavior and patient outcomes. We use a longitudinal data set of inpatient records collected on all elderly Medicare recipients treated for a heart

[42]Reynolds et al. (1987).

attack in 1989, matched with information on state tort laws, based on the state in which the patient was treated. We model the effect of tort laws on a key dimension of treatment intensity: whether the patient received cardiac catheterization ("intensive" treatment) in the 90 days after the heart attack, or less costly noninvasive monitoring. We also model the effect of state tort law on an important patient outcome: mortality one year after admission to the hospital.

The basic proposition in this paper on which the test for defensive medicine is based is as follows. If reductions in medical malpractice tort liability are associated with decreases in the probability of intensive treatment but not witn increases in adverse patient health outcomes, _ceteris paribus_, then doctors and hospitals practice defensive medicine -- that is, they supply a socially excessive level of care due to malpractice tort liability. If providers practice defensive medicine, then changes in tort laws that reduce liability -- "tort reforms" -- reduce inefficiency in the medical care delivery system.

The first section of the paper discusses the theoretical ambiguity of the influence of the current liability system on efficiency in health care, and reviews the existing empirical literature on the subject. The second section presents econometric models of treatment decisions and patient outcomes, and formally presents the test for defensive medicine used in the paper. The third section discusses the tort law and Medicare data in detail. It also outlines our future research agenda, which includes extending the analysis herein on repeated cross-sections of Medicare data to identify the effects of changes in tort laws, testing for defensive medicine in the context of other illnesses, and using a broader range of measures of treatment and outcomes. Section four presents the empirical results, and the last section concludes with policy simulations and recommendations for the tort system.

## I. Malpractice Liability and Efficient Precaution In Health Care

Malpractice claims are adjudicated in state courts, and liability for malpractice is borne primarily by individual physicians, not by hospitals.[43] Although there is a large amount of variation across states in liability rules, as discussed in Section III below, there are three elements required for a successful malpractice claim in most states. First, the claimant must show that the patient actually suffered injury. Second, a successful malpractice claimant must establish that the provider caused the patient's injury (or death) -- that is, the claimant must attribute the injury to the action or inaction of the provider, as opposed to nature. Third, a successful

[43]Sloan, Bovbjerg, and Githens, (1991), p. 27.

claimant must show that the provider was negligent. Stated simply, this entails showing that the provider took less care than that which is customarily practiced by the average member of profession in good standing, given the circumstances of the doctor and the patient.[44]

One of the roles of the liability system is to induce doctors to take the optimal level of precaution against patient injury; but in theory, the basic "negligence rule" may lead to socially too little, optimal, or too much care, even assuming that damages are assessed accurately on average and the standard of care is set at the socially optimal level. Of course, if parties are fully informed about risks and there are no costs to contracting, then doctors will supply the optimal level of precaution, independent of the liability system.[45]

However, the conditions that the Coase theorem requires for efficient precaution in health care may not be met. Thus, even if damages are assessed accurately and the standard of care is set at the optimum, the current liability system may lead to a level of precaution at which the social marginal cost of care is not equal to the social marginal benefit. To begin with, the malpractice system may give providers the incentive to take too little care. If liability costs are fully insurable and precaution is

[44]Keeton et al. (1984).

[45]Coase (1960).

costly to physicians, then the malpractice system may not deter physicians from negligent behavior at all. A similar outcome would occur if obtaining compensation for negligent injury is costly for patients: the Harvard Medical Practice Study (1990), for example, found that sixteen times as many patients suffered an injury from negligent medical care as received compensation in New York State in 1984.[46]

On the other hand, the liability system may induce doctors to provide too much care -- that is, to practice defensive medicine. For example, the fact that health care providers' precautionary behavior may be ex post difficult to verify may give them the incentive to take too much care. Assume that providers bear all of the costs of precaution and choose the level of precaution that they will take. If courts assign liability with error, Cooter and Ulen (1986) and Craswell and Calfee (1986) show that injurers may take too many precautions, because of the all-or-nothing nature of the liability decision: small increases in precaution above the optimal level may result in large decreases in expected liability. Thus, evidentiary uncertainty in medical malpractice cases may lead to defensive medicine.

Even if courts operate without mistakes, the threat of litigation may drive providers to take excessive care, as long as malpractice litigation is costly. Suppose that patients who suffer an adverse medical outcome have

[46]Harvard Medical Practice Study (1990), p. 6.

imperfect information as to the level of care taken by the provider, so that some fraction of these patients who received nonnegligent medical care sue. Assume that these suits impose costs on providers not covered by liability insurance -- such as reputation costs and the value of the provider's time spent defending the suit[47] -- and that the probability of an adverse outcome is decreasing in the level of care. Providers, then, may have the incentive to engage in defensive medicine, due to the expected savings in litigation costs that would accrue from the decreased number of nonnegligent adverse events associated with socially excessive precaution. The incentive to overprovide care is intensified by the fact that neither patients nor providers bear the costs of precaution in any particular case, because most health care is financed through health insurance.

The previous empirical literature is consistent with the hypothesis that providers practice defensive medicine, although the results from the literature are subject to some caveats. Two of the studies find a positive correlation between malpractice liability and treatment intensity[48] in data collected by the Harvard Medical

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[47]Evidence suggests that doctors find the prospect of being sue "singularly unpleasant, disruptive, and depressing." OTA (1993), p. 7.

[48]Harvard Medical Practice Study (1990) and Localio et al. (1993). The Harvard Medical Practice Study also found no significant relationship between liability risk and adverse health outcomes, although they could not reject that there was a negative relationship.

Practice Study (1990), which examined the relationship between variation in the rate of medical malpractice claims filed against hospitals in New York in 1984 and variations in costs and the rate of intensive treatment or injury. As the authors of that study explain, though, estimating the impact of liability rules on behavior with the correlation between claims rates and variations in costs or injury rates may be problematic. For instance, if some unobserved factor -- such as the health status of the patients on admission or the ability of the doctors -- causes hospitals to have both high claims rates and high rates of injury or high costs, then claims rates, costs, and injury rates may be related, even if malpractice liability has no effect on behavior.

Reynolds et al. (1987) use AMA survey data to assess the extent of practice changes implemented in response to liability risk. They conclude that approximately 15 percent of the total expenditure on physicians' services are attributable to malpractice law, based both on self-reported information about practice changes and on correlations between fees for or utilization rates of various procedures and liability insurance premiums. However, the Harvard Medical Practice Study (1990) found that doctors' self-reported medical malpractice risk is systematically greater than actual risk[49]; and

[49]According to the Harvard Medical Practice Study (p. 9), physician surveys conducted in New York in 1984 revealed that the overall perceived risk of being sued for malpractice in a given

insurance premiums are not an exogenous measure of malpractice liability. If wealthier individuals demand both more insurance against malpractice and more of other medical services, then doctors who serve a wealthy clientele will pay high malpractice premiums, charge high prices, and carry out a greater number of procedures, even in the absence of any effect of malpractice liability on outcomes.

Another group of studies estimates the effect of tort laws on either state-average levels of malpractice premiums or on the level of compensation paid to closed malpractice claims.[50] These studies generally find a negative correlation between decreases in tort liability and insurance premiums; in other words, this work finds that tort reforms effectively reduce medical malpractice liability, which is necessary if tort reforms are to reduce defensive medicine.

But neither a negative correlation between tort reforms and malpractice liability nor a positive correlation between measures of liability risk and treatment intensity is sufficient to show defensive medicine. If providers practice defensive medicine, then tort reforms must (1) reduce malpractice liability; (2) induce a change in treatment behavior as a result; and (3) not increase the

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year was 20 percent, approximately three times the actual risk. See also Lawthers et al. (1992).

[50]See, e.g., Danzon (1985, 1986); Sloan, Mergenhagen and Bovbjerg (1989); and Zuckerman, Bovbjerg and Sloan (1990).

incidence of adverse health outcomes attributable to the law-induced change in treatment.

## II. Econometric Models

We model two types of processes: physician treatment decisions and patient outcomes. Physician treatment decisions are represented by a vector of dichotomous variables; patient outcomes are represented by a scalar dichotomous variable. Each treatment decision or outcome is modeled as a nonparametric function of patient demographic characteristics, state laws, and state- and time-fixed-effects. The coefficients of interest to us are the estimated average impact of state laws: finding that liability reductions reduce treatment intensity but do not worse outcomes, on average, is evidence of defensive medicine.

Consider a general model. In state s = 1...S during year t = 1...T, individual $i=1...N_{st}$ may receive one or more treatments k = 1...K. The individual has background characteristics $X_{ist}$ that influence both treatment decisions and outcomes.

Let the baseline level of tort law be the most pro-plaintiff that applied in any state over the time period t=1...T. State tort systems deviate from the baseline legal regime at a point in time by having one or more of M characteristics. Define $L_{st}$ as an M-vector of dummy variables, where $L_{st,m} = 1$ if the legal regime of state s at time t imposes less than the baseline level of liability by having the mth. characteristic, m=1...M. Also, define

$$R^k_{ist} = \begin{cases} 1 & \text{if } i \text{ in } s \text{ at } t \text{ receives treatment } k \\ 0 & \text{otherwise} \end{cases}$$

and

$$O_{ist} = \begin{cases} 1 & \text{if } i \text{ in } s \text{ at } t \text{ suffers an adverse health outcome} \\ 0 & \text{otherwise} \end{cases} ,$$

$\theta^j_t$ as a time-fixed-effect, $\alpha^j_s$ as a state-fixed-effect, and $v_{ist}{}^k$ as a mean-zero error term, $E(v_{ist}{}^k \mid X_{ist}, L_{st}) = 0$, $var(v_{ist}{}^k \mid X_{ist}, L_{st}) = \sigma^2$.

The model assumes that malpractice law affects providers' treatment decisions, through its effect on malpractice pressure, but does not otherwise affect patient outcomes. Doctors make treatment decisions based on the state of medical technology in use in the year and state in which the patient is hospitalized, the patient's background, and state tort law:

$$R^k_{ist} = \theta^k_t + \alpha^k_s + X_{ist}\beta^k + L_{st}\phi^k + v^k_{ist} ,$$

and patient's health outcomes depend on time, location, background characteristics, and the K treatment decisions of the patient's health care providers:

$$
\begin{aligned}
O_{ist} &= \theta_t^0 + \alpha_s^0 + X_{ist}\beta^0 + \sum_{k=1}^{K} R_{ist}^k \gamma_k + v_{ist}^0 \\
&= T_t + A_s + X_{ist}B + L_{st}\Phi + V_{ist} ,
\end{aligned}
$$

where

$$
\begin{aligned}
T_t &= \theta_t^0 + \sum_{k=1}^{K} \gamma_k \theta_t^k & A_s &= \alpha_s^0 + \sum_{k=1}^{K} \gamma_k \alpha_s^k \\
\Phi &= \sum_{k=1}^{K} \gamma_k \phi^k & B &= \beta^0 + \sum_{k=1}^{K} \gamma_k \beta^k \\
V_{ist} &= v_{ist}^0 + \sum_{k=1}^{K} \gamma_k v_{ist}^k
\end{aligned}
$$

In this framework, $\phi^k$ ($\Phi$) is an estimate of the effect of tort law on treatment behavior (patient outcomes). Under the model, proposition 1 sets out the sufficient conditions to show that doctors practice defensive medicine:

> Proposition 1: For some liability reduction m, finding $\phi_m^k \leq 0\ \forall$ k with $\phi_m^k < 0$ for some k and $\Phi_m = \Sigma_k\ \gamma_k\phi_m^k \leq 0$ is evidence of defensive medicine.

In other words, a negative effect of liability reductions on treatment intensity and a negative or insignificant effect liability reductions on adverse health outcome is evidence of defensive medicine. Equivalently, liability reduction m improves efficiency, because it reduces costly treatment intensity without an adverse effect on patient outcomes.

A convenient empirical test can be developed based on proposition 1. Suppose that only one treatment decision, k*, is observed by the researcher. Assume that liability reductions never induce doctors to intensify treatment:

(A1) $\phi_m^k \leq 0 \; \forall \; k,m$. Then proposition 2 suggests an hypothesis test for defensive medicine:

> Proposition 2: Assume (A1). For some liability reduction m and treatment k*,
> (1) rejecting $h_{0a}$: $\phi_m^{k*} = 0$ in favor of $h_{1a}$: $\phi_m^{k*} < 0$; and
> (2) failing to reject $h_{0b}$: $\Phi_m = 0$ or rejecting $h_{0b}$ in favor of $h_{1b}$: $\Phi_m < 0$
> is evidence of defensive medicine.

Proposition 2 highlights the fact that estimates of $\gamma_k$ are not necessary to test for defensive medicine -- only the reduced-form estimates of the effect of laws on treatments and outcomes are needed. It also highlights the fact that only one dimension of treatment intensity needs to be observed, if liability reductions reduce that dimension of treatment.

We estimate the effect of laws on one key dimension of treatment and one important health outcome. First, we estimate the effect of tort laws on the probability that an elderly Medicare beneficiary receives intensive rather than nonintensive treatment within 90 days of his or her heart attack, holding demographic factors constant. Second, we estimate the reduced-form effect of the change in medical practice patterns induced by malpractice law on one-year mortality. Because mortality is not a complete measure of adverse health outcome, these data do not provide definitive proof of defensive medicine; treatment intensity may fail to reduce mortality but may reduce adverse health outcomes more generally. However, since mortality is an easily identifiable, objective measure of outcome, and other adverse outcomes are likely to be correlated with mortality, it provides a convenient start.

## III. Data

The data used in analysis come from two sources. The first source of data, on variation in states' liability laws, appears in Appendix B.[51] The baseline legal regime is defined as the regime hypothesized to impose the highest level of liability on providers: the "negligence rule," as it is typically implemented, in a regime in which prejudgment interest is imposed. Prejudgment interest increases malpractice liability relative to the simple negligence rule. Typically, defendants are not liable for interest on damages until the date of judgment; some states now require defendants to pay prejudgment interest, starting at the date of injury or the date of filing, to plaintiffs. The five classes of liability-reducing divergences from the baseline legal regime are summarized in table 1A, starting with "No Prejudgment Interest."

The other four classes of liability reductions are known as "tort reforms." The first class establishes caps on the percentage that contingency-fee attorneys can charge. These laws have been implemented with the purpose of making it more difficult for plaintiffs with low-expected-value or

[51] See Campbell, Kessler and Shepherd (19?4).

risky claims to obtain representation. Fee caps restrict plaintiffs ability to sue because contingency-fee attorneys who must bear fixed costs of representation would require a greater percentage in weaker cases, all else held constant, and if the attorneys were risk-averse, a greater percentage in riskier cases as well. By restricting plaintiffs ability to contract for legal services, these laws may reduce the expected liability of defendants.

Second, the repeal of the collateral source rule has reduced defendants' liability directly. In 1854, the Supreme Court first announced what has evolved into the collateral source rule,[52] which states that the defendant must bear the full cost of the injury suffered by the plaintiff, even if the plaintiff were compensated for all or part of the cost by an independent or "collateral" source. This means that defendants liable for medical malpractice always bear the cost of treating a patient for medical injuries resulting from the malpractice, even if the treatment was financed by the patient's own health insurance. Either the plaintiff enjoys double recovery (the plaintiff recovers from the defendant and his own health insurance for medical expenses attributable to the injury) or the defendant reimburses the plaintiff's health insurer, depending on the plaintiff's insurance contract and state or

[52]The Propeller Monticello v. Mollison, 58 U.S. (17 How.) 152 (1854).

federal law.[53]

States have enacted two types of reforms to the collateral source rule. The first type of reform generally allows defendants to introduce evidence of plaintiff's first-party collateral source recoveries to the jury. The second type of reform generally requires judges to reduce tort recoveries by the amount of collateral source reimbursement. In any event, these reforms may reduce the liability of providers.

Third, caps on damage awards also may reduce defendants' liability directly. Caps on damages generally fall into one of two categories: caps on total damages, or caps on noneconomic damages only, such as pain and suffering.

Fourth, mandatory periodic payments of future damages are hypothesized to reduce the scope of liability. In general, damages for future losses are payable in a lump sum at the time of judgment, and are calculated by the jury without instruction or expert assistance. It has been argued that juries do not discount future losses at all; rather, they multiply the estimated loss per year by the expected number of years that the loss would be in effect, which overstates the true value of the plaintiff's loss.

In response to this phenomenon, states enacted

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[53]For example, the Federal Government now requires that medical expenses paid by Medicaid and Medicare be reimbursed from tort awards. See 42 U.S.C. § 2651 (1992).

reforms to the lump-sum payment rule, which generally require the jury to specify plaintiff's losses on an annual basis and the defendant to purchase an annuity that produces annual income equal to plaintiff's losses.

Based on the five classes of divergences in Table 1A, ten characteristics posited to affect the incidence of defensive medicine were derived, and are listed in table 1B. Characteristics 1 and 2 concern caps on attorneys' fees. Characteristics 3 through 6 concern reforms to the collateral source rule. Reforms that mandate offset for collateral source payments are allowed to affect behavior differently than reforms that merely allow evidence of collateral source payments to be admitted in court; reforms that exempt Federally-funded or medical insurance collateral source benefits from the reform to the rule are allowed to affect behavior differently from those that do not. Caps on noneconomic and total damages represent characteristics 7 and 8, and mandatory periodic payment of future damages represents characteristic 9. The states that impose mandatory prejudgment interest have characteristic 10.

Characteristic 11 controls for the existence of patient compensation fund (PCF) in a state. PCFs provide government-administered excess malpractice liability insurance, generally financed through a tax on insurance premiums. Providers in states with PCFs may have substantially different incentives than those in baseline states that use a simple negligence-rule-based tort system alone. If PCFs monitor or experience-rate doctors less than private insurers, thereby weakening the link between deterrence and compensation, PCFs would weaken doctors' incentives to engage in accident avoidance behavior. On the other hand, if patients are more likely to file malpractice claims against doctors than they would be in the absence of a PCF, because the probability of receiving compensation from the fund is greater than the probability of receiving compensation from a private insurer, and the incentive for doctors to engage in accident avoidance behavior is primarily nonpecuniary in nature, PCFs might induce doctors to take greater precautions. Even if the existence of a PCF weakens the monetary incentives to engage in accident avoidance behavior that doctors face -- leading to theoretically less precaution -- the monetary incentives might be so weak already that the increase in the probability of claiming attributable to the PCF, which strengthens doctors incentives to engage in accident avoidance behavior -- leading to theoretically more precaution -- could dominate.

Other "tort reforms" hypothesized to reduce medical malpractice risk were also enacted in the 1980s. Failing to control for these is unlikely to bias the results presented below. States shortened statutes of limitations; raised standards of care; tightened evidentiary standards;

and required arbitration of malpractice claims. Results from the closed-claim studies discussed above suggest that different standards of care, different evidentiary standards, and different arbitration regulations have an insignificant effect on behavior.[54] Statutes of limitations, which are relevant in situations involving latent injuries, are not particularly important in the empirical exercise below, which involves an injury the adverse consequences of which tend to appear before any statute of limitations would exclude a injured patient. Some states also enacted reforms that required losers to pay winners' legal costs, which were intended to be pro-defendant, but could in theory either reduce or increase malpractice risk. These reforms are likely to be only marginally important because they either excluded attorneys' fees from the provision[55] or relieved indigent parties, often defined broadly, of the obligation to pay.[56]

The second source of data, on Medicare treatment records, contains longitudinal information on each of the 230,824 elderly Medicare beneficiaries who were admitted to a hospital with the primary diagnosis of a heart attack in 1989. These data on treatments and demographic

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[54]See Office of Technology Assessment (1993), Table 3-3, for a summary.

[55]See, e.g., Cal. Code of Civ. Proc. R. 998 (1991).

[56]See, e.g., Fla. Stat. 768.56(1) (1983).

characteristics were obtained from the Health Care Financing Administration (HCFA); death dates of the patients were obtained from HCFA's Health Insurance Skeletonized Writeoff File, based on death reports validated by the Social Security Administration.

Each of the 230,824 observations in the Medicare data set was matched with a set of eleven tort law variables. Each of the tort variables was set to one if the characteristic of the law in question had become effective in the state in which the patient was treated, as of the date of the patient's initial admission to the hospital with a heart attack. Otherwise, the variable in question was set to zero.

The data impose various limitations on this paper that we will address in future research. First, the cross-sectional nature of the data does not enable us to estimate all of the parameters of the model outlined in Section 2. Identification of that model requires repeated cross-sections of treatment and outcomes data such that some claims are observed in states before and after a change in legal regime. The next stage of this project will make use of repeated cross-sections to control for fixed state- and time-effects; however, the estimates below are based on a restricted model that sets $\{\theta_t\} = 0$ and controls for region-fixed-effects only, with s=1...9 (U.S. census) regions. Second, data limitations allow us to examine only one health outcome: death. This strategy may result in a false finding of defensive medicine, if intensive treatment of heart attacks improves the quality of patients' lives without prolonging them. The next stage of this project will use an expanded set of outcome measures that better capture the influence of treatment on patient health such as subsequent admission rates with chest pain, congestive heart failure, and other complications of heart attacks leading to diminished quality of life. Third, the data only provide us with information on treatments and outcomes in one illness, albeit common and serious. Further research will explore the incidence of defensive medicine in connection with other illnesses, involving treatment decisions such as the aggressiveness of imaging and biopsy workup for patients with breast lumps or abnormal lung exam findings, the frequency of biopsy of swollen lymph nodes, and the use of advanced brain imaging techniques (CT and MRI) in the workup of headaches.

## IV. Empirical Results

Descriptive statistics based on the merged Medicare treatment record-tort law data set appear in table 2. Of all elderly people covered by Medicare who were admitted to the hospital in 1989 with a heart attack, 28.5 percent received the intensive treatment, catheterization. Within one year of their admission, 37.9 percent of the original sample had died. Liability-reducing tort reforms applied widely to this population: for example, 39 percent of all heart attack patients were treated in states that capped noneconomic damages in medical malpractice tort actions. In addition, 49.8 percent of the sample was treated in states that did not impose mandatory prejudgment interest on medical malpractice tort awards. Table 2 also indicates that neither the raw probability of treatment, nor the raw probability of adverse health outcome, nor patient demographic characteristics (except region of residence) differ substantially by legal regime. However, the descriptive statistics alone do not indicate whether any particular change in tort law, conditional on patient demographics and region, influences either treatment decisions or health outcomes.

Ordinary least-squares regression results that show the effect of laws on treatments and outcomes, conditional on patient demographics, appear in Table 3.[57] According to the hypothesis test formulated in Proposition 2, the results suggest that doctors do practice defensive

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[57]The results in Table 3 are insensitive to the mode of estimation. The regressions in Table 3 wer reestimated (1) with heteroscedasticity-consistent standard errors; (2) with a seemingly-unrelated-regressions method that allows for correlation between the error terms in the two equations $v_{ist}^{k*}$ and $V_{ist}$; and (3) in a two-equation probit framework. Regardless of method, the results both suggest that doctors practice defensive medicine according to Proposition 2, and show that the same legal reforms improve efficiency.

medicine. Results from the first part of the procedure are found in the first two columns of the table. The (more restrictive) specification (1) in the first column constrains the influence of different types of attorney fee caps to be equal and constrains the influence of different types of collateral source rule reforms to be equal. Some liability reductions reduce the probability of intensive treatment. This finding is consistent with the standard economic model of accident avoidance behavior, which would predict that reductions in physician liability bring reductions in precautionary behavior. Caps on damages, for example, reduce doctors' propensity to employ intensive treatment. Individuals treated in states that cap noneconomic damages arising out of a medical malpractice tort are 1.254 or 0.854 percentage points less likely to be treated intensively than individuals treated in states without caps on damages, depending on specification; individuals treated in states that cap total damages arising out of a medical malpractice tort are 0.995 or 1.093 percentage points less likely to be treated intensively. Patients from states without prejudgment interest also receive less in the way of intensive treatment: the presence of prejudgment interest in a state is associated with approximately an increase of 1.4 percentage points in the probability of catheterization. However, some ostensibly liability-reducing tort reforms, such as reforms to the collateral source rule, have no significant effect on treatment patterns.

The existence of a PCF, which has a theoretically ambiguous effect on liability, significantly increases the probability of intensive treatment, by 4.052 percentage points. This would be consistent with a model in which PCFs increase nonpecuniary medical malpractice liability costs by inducing patients to file and pursue a greater number of claims. Laws that require future damages to be paid periodically increase the risk of intensive treatment by approximately 2 percentage points. This is surprising because mandatory periodic payments laws are intended to be liability-reducing, not liability-increasing: juries, it is assumed, discount future damages at less than the interest rate or not at all, whereas mandatory periodic payment laws require future damages to be discounted at market interest rates.[58]

The columns (3) and (4) of Table 3 present results from the second part of the estimation procedure, and show that doctors do practice defensive medicine. In general, reductions in liability from the baseline do not result in a statistically significant increase in mortality through their influence on treatment intensity. Caps on damages and no prejudgment interest, for example, are associated with a decreased probability of intensive treatment but not with an

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[58]Hughes (1989).

increased risk of mortality. Conversely, legal regimes associated with increases in treatment intensity, such as those with a PCF, are not necessarily associated with decreases in mortality. One exception to this pattern is mandatory periodic payment statutes, which are associated with a significant increased probability of intensive treatment and a significant decreased risk of mortality (columns (2) and (4)).

The fact that mandatory periodic payment statutes are associated with more intensive treatment and lower mortality does not refute the hypothesis that doctors practice defensive medicine. A finding of defensive medicine requires neither that all legal reforms work in the way in which they are intended, nor that every legal reform that influences treatment intensity has no reduced-form effect on adverse outcomes. For example, showing that a legal system that imposed no liability for medical malpractice at all reduced treatment intensity but increased the incidence of adverse outcomes, relative to a high-liability baseline system, would not imply that any reduction in liability from the high-liability baseline that reduced treatment intensity would also reduce patient well-being. In the language of Proposition 2, doctors practice defensive medicine if there exists some legal reform that reduces treatment intensity without increasing the incidence of adverse outcomes.

The finding of defensive medicine in this paper is strengthened by the fact that legal reforms, taken together, influence treatment behavior more strongly than they influence health outcomes through their effect on treatment decisions. At a one percent level of significance, F-tests reject the null hypothesis that laws have no effect on treatment behavior in both of the specifications in Table 3 ($F(7,\infty) = 33.14$ in column (1); $F(11,\infty) = 22.18$ in column (2)). However, F-tests fail to reject the null hypothesis that laws have no effect on health outcomes at a five percent level of significance in column (3) ($F(7,\infty) = 1.23$), and fail to reject the hypothesis that laws have no effect on outcomes at a one percent level of significance in column (4) ($F(11,\infty) = 1.85$).

## V. Conclusion

The practice of "defensive medicine" may be a potentially serious social problem: if the fear of liability drives health care providers to administer treatments that have minimal medical benefit, then the liability system may have profound social costs arising out of the excessive precautionary behavior that it fosters. This paper provides empirical support for the hypothesis that doctors do practice defensive medicine using a unique longitudinal data set that matches inpatient records collected on elderly Medicare recipients treated for a heart attack in 1989 with information on state tort laws.

The basic proposition in this paper on which the test for defensive medicine is based is as follows. If decreases in medical malpractice tort liability are associated with decreases in the probability of intensive treatment but not with increases in adverse patient health outcomes, *ceteris paribus*, then doctors and hospitals practice defensive medicine -- that is, they supply a socially excessive level of care due to malpractice tort liability. If providers practice defensive medicine, then changes in tort laws that reduce liability -- "tort reforms" -- reduce inefficiency in the medical care delivery system.

The results suggest that doctors do practice defensive medicine. Patients admitted to a hospital with a heart attack in 1989 in states with relatively lower levels of legal liability are less likely to receive catheterization for their heart attacks but do not have significantly higher levels of mortality, conditional on their demographic characteristics. This result is insensitive to the specification or estimation method used.

The results also suggest that certain types of liability reforms would improve efficiency in the health care delivery system: if a particular liability reduction (increase) is associated with a decrease (increase) in treatment intensity but not with an increase (decrease) in adverse outcomes, then enacting (abolishing) that aspect of tort law would reduce wasteful precautionary behavior by providers. With respect to treatment for heart attacks, we find that caps on noneconomic and total damages improve efficiency by reducing treatment but not increasing mortality. Conversely, we find that mandatory prejudgment interest and patient compensation funds decrease efficiency by increasing treatment intensity but not reducing mortality.

Again, with respect to treatment for heart attacks, the estimates can be used to calculate the potential savings from particular liability reforms. Based on Table 3, abolishing mandatory prejudgment interest reduces the probability of catheterization, the intensive treatment analyzed in the paper, by approximately 1.4 percentage points without significantly increasing mortality, which implies that at least 4.9 percent of catheterizations are medically unnecessary. Since a conservative estimate of the total cost of catheterization is $4500,[59] and Medicare reimbursed providers for 115,972 treatments for heart attacks, abolishing mandatory prejudgment interest would have saved Medicare 115,972 x 0.014 x 4500 = $7.3 million on catheterizations alone in 1989.

Significant further research questions on this

[59]In 1987. See McClellan (1993, 1994) for calculations to this effect.

topic can be addressed with the same basic methodology set out in this paper. As outlined in Section III, the cross-sectional nature of the data, the limited scope of observable health outcomes, and the limited number of illnesses in connection with which we explore the incidence of defensive medicine will be addressed in future versions. In addition, the link between liability law and malpractice "pressure" should be investigated with data on malpractice awards across states and over time, because it is key to understanding the influence of liability law on physicians' behavior.

Table 1A: Liability-Reducing Divergences from the Baseline Legal Regime

1. No mandatory prejudgment interest: In states with mandatory prejudgment interest, courts add interest on damages to all judgments for plaintiff, accruing from the date of injury or filing of the suit. Thus, the absence of mandatory prejudgment interest, which is the common-law or default rule, may impose less than the baseline level of liability on defendants.

2. Caps on percentages that contingency fee attorneys can charge: this change to tort law may reduce liability by restricting plaintiffs ability to sue, because contingency-fee attorneys bear fixed costs of representation.

3. Reforms to the collateral source rule: The collateral source rule, an old common-law tort doctrine, states that the defendant must bear the full cost of the injury suffered by the plaintiff, even if the plaintiff were compensated for all or part of the cost by an independent or "collateral" source. This means that defendants liable for medical malpractice always bear the cost of treating a patient for medical injuries resulting from the malpractice, even if the treatment was financed by the patient's own health insurance. Either the plaintiff enjoys double recovery (the plaintiff recovers from the defendant and his own health insurance for medical expenses attributable to the injury) or the defendant reimburses the plaintiff's health insurer, depending on the plaintiff's insurance contract and state or federal law. Reforms to the collateral source rule may reduce the extent of defendants' liability for plaintiffs' injuries in either case by reducing the defendant's responsibility to finance damages arising out of an insured injury.

4. Caps on damages

5. Mandatory periodic payments: In general, damages for future losses are payable in a lump sum at the time of judgment, and are calculated by the jury without instruction or expert assistance. It has been argued that juries do not discount future losses; thus, requiring that future damages be paid periodically may reduce liability.

Table 1B: Characteristics of Tort Laws Coded and Used in Analysis

| Characteristic | Description |
|---|---|
| 1 | Attorney Fee Caps I: Are fees on awards > $200,000. capped at 20% or less? |
| 2 | Attorney Fee Caps II: Are fees on awards subject to any nondiscretionary cap at all? |
| 3 | Collateral Source Rule Reform I: Is evidence of collateral source payments admissible? |
| 4 | Collateral Source Rule Reform II: Is collateral source offset mandatory? |
| 5 | Collateral Source Rule Reform III: Does reform to the rule, if it exists, exclude medical insurance benefits? |
| 6 | Collateral Source Rule Reform IV: Does the reform to the rule, if it exists, exclude Federally funded benefits? |
| 7 | Caps on Damages I: Is there a cap on noneconomic damages? |
| 8 | Caps on Damages II: Is there a cap on total damages? |
| 9 | Periodic Payments: Is periodic payment of any future damages mandatory? |
| 10 | Prejudgment Interest: Is payment of prejudgment interest mandatory? |
| 11 | Patient Compensation Fund: Does the state have an operating patient compensation fund? |

Table 2: Average Values of Variables By Legal Regime

| | | --------Legal Regime-------- | |
|---|---|---|---|
| | Full Smpl | Baseline | Liability < Baseline |
| **Dependent Variables** | | | |
| catheterization within 90 days (Intensive Treatment) | 0.2849 | 0.2842 | 0.2850 |
| dead Within 1 year of Admission to Hospital (Adverse Outcome) | 0.3790 | 0.3777 | 0.3793 |
| **Patient Demographics** | | | |
| resident of rural area | 0.2901 | 0.3096 | 0.2857 |
| black | 0.0567 | 0.0626 | 0.0556 |
| female | 0.5038 | 0.5063 | 0.5035 |
| 70 ≤ age ≤ 74 | 0.2296 | 0.2318 | 0.2291 |
| 75 ≤ age ≤ 79 | 0.2218 | 0.2262 | 0.2208 |
| 80 ≤ age ≤ 84 | 0.1760 | 0.1717 | 0.1770 |
| 85 ≤ age ≤ 89 | 0.1051 | 0.0983 | 0.1065 |
| 90 ≤ age | 0.0366 | 0.0325 | 0.0375 |
| New England | 0.0706 | 0.0000 | 0.0861 |
| Middle Atlantic | 0.1885 | 0.4038 | 0.1410 |
| South Atlantic | 0.1747 | 0.1745 | 0.1748 |
| East North Central | 0.1792 | 0.0000 | 0.2187 |
| East South Central | 0.0729 | 0.0000 | 0.0889 |
| West North Central | 0.0815 | 0.0000 | 0.0995 |
| West South Central | 0.1028 | 0.4065 | 0.0359 |
| Mountain | 0.0369 | 0.0150 | 0.0418 |
| **Tort Law Variables** | | | |
| attorney fee caps I (strong caps) | 0.0341 | 0.0000 | 0.0416 |
| attorney fee caps II (weak caps) | 0.4129 | 0.0000 | 0.5039 |
| any attorney fee caps | 0.4471 | 0.0000 | 0.5456 |
| collateral source I (evidentiary reform) | 0.2171 | 0.0000 | 0.2649 |
| collateral source II (direct offsets) | 0.4223 | 0.0000 | 0.5153 |
| collateral source III (medical ben excl) | 0.1169 | 0.0000 | 0.1426 |
| collateral source IV (federal ben excl) | 0.0430 | 0.0000 | 0.0525 |
| any collateral source | 0.6394 | 0.0000 | 0.7803 |
| damage caps I (noneconomic damages) | 0.3896 | 0.0000 | 0.4755 |
| damage caps II (total damages) | 0.0855 | 0.0000 | 0.1043 |
| mandatory periodic pmts | 0.4250 | 0.0000 | 0.5186 |
| no mandatory prejudgment interest | 0.4976 | 0.0000 | 0.6072 |
| patient compensation fund | 0.1709 | 0.4038 | 0.1196 |
| N | 230824 | 41667 | 189157 |

Interactions between age, gender, and race also included in analysis.

Table 3: Estimates of the Effect of Tort Laws on the Probability of Catheterization Within 90 Days and Probability of Death Within 1 Year of Heart Attack (*100, Standard Errors In Parentheses)

| Variable | Dependent Variable | | | |
|---|---|---|---|---|
| | 90d cath (1) | 90d cath (2) | 1yr dead (3) | 1yr dead (4) |
| attorney fee caps I (strong caps) | | -1.188 (0.683) | | 0.782 (0.791) |
| attorney fee caps II (weak caps) | | 0.293 (0.293) | | 0.349 (0.328) |
| some attorney fee caps | 0.128 (0.252) | | 0.019 (0.283) | |
| collateral source I (evidentiary reforms) | | 0.639 (0.397) | | 0.872 (0.448) |
| collateral source II (direct offsets) | | -0.553 (0.353) | | 0.425 (0.394) |
| collateral source III (medical benefits excl) | | 0.936 (0.417) | | -0.813 (0.467) |
| collateral source IV (federal benefits excl) | | 0.332 (0.702) | | -2.029 (0.800) |
| some collateral source rule reforms | 0.055 (0.283) | | 0.445 (0.319) | |
| damage caps I (noneconomic damages) | -1.245 (0.257) | -0.854 (0.293) | -0.098 (0.289) | -0.414 (0.329) |
| damage caps II (total damages) | -0.995 (0.388) | -1.093 (0.416) | -0.053 (0.437) | 0.353 (0.460) |
| mandatory periodic payments | 1.803 (0.292) | 1.953 (0.301) | -0.484 (0.328) | -0.761 (0.338) |
| no mandatory prejudgment interest | -1.435 (0.232) | -1.399 (0.248) | -0.265 (0.261) | 0.123 (0.257) |
| patient compensation fund | 4.157 (0.341) | 4.052 (0.357) | -0.410 (0.384) | -0.501 (0.396) |
| $R^2$ | 0.143 | 0.143 | 0.059 | 0.059 |
| N | 230824 | 230824 | 230824 | 230824 |

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# Chapter 3

# The Causes of Delay in the Settlement of Legal Disputes

> Delay haunts the administration of justice. It postpones the rectification of wrong and the vindication of the unjustly accused...[60]

Delay in the resolution of legal disputes has attracted significant attention because of the nature and magnitude of the costs it creates. Delays in litigation due to queues in the courts, for instance, are substantial. Not one of the twenty-six urban trial courts studied by the National Center for State Courts in 1987 met American Bar Association standards for delay in either civil or criminal cases.[61] Such delays impose serious social costs. In criminal cases, delay can result in the imprisonment of innocent parties; in civil cases, delay prevents the prompt compensation of the injured party, contravening one of main goals of the tort system (Restatement of Torts, 2d, Sec. 901(a)). The social cost of delay in litigated disputes is one reason that an extensive theoretical literature has attempted to understand the decision to settle or litigate.[62]

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[60]Southern Pacific Transportation Co. v. Stoot, 530 S.W.2d 930 (1975), cited in Goerdt (1989).

[61]In Pittsburgh, PA, 86 percent of all pending civil cases were more than one year old; in Newark, NJ, 41 percent of all pending felony criminal cases were more than one year old (Goerdt (1989)).

[62]Most of this literature has modeled the decision in a static framework. The first models that sought to explain the parties' decision to litigate (for example, Landes (1971), Gould (1973), Posner (1973), and Baxter (1980)) assumed that the decision to litigate was nonstrategic, and based on what has been come to be known as "divergent expectations." Divergent expectations models have been used to explain failures to agree in the labor-management

But almost all legal disputes are settled, not litigated. For example, more than 99 percent of tort claims alleging a bodily injury arising out of an auto accident are settled[63]; more than 95 percent of all serious criminal cases are resolved with a plea bargain.[64] And, just as delay in litigated disputes imposes social costs, so might delay in the resolution of ultimately settled disputes. Ultimately settled disputes do not settle immediately. Settled auto bodily injury claims take, on average, 216 days to be resolved, and fully half of all claims remain unresolved after 115 days.[65] Delays in settlement also involve significant amounts of lawyers' time: 41 percent of bodily injury tort claimants who ultimately settle are

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relations context as well (Hicks (1963); Farber and Katz (1979); Bazerman and Neale (1982); Farber and Bazerman (1989)). Newer models of the decision to litigate explicitly address the effects of private information on decisionmaking (For example, P'ng (1983), Bebchuk (1984), Reiganum and Wilde (1986), Nalebuff (1987), and Schweizer (1989). For a review of these models, see Cooter and Rubinfeld (1989).) These models avoid some of the difficulties of divergent expectations models (See Kennan and Wilson (1993), Sec. 7.5, for elaboration), but they still view the settlement process itself in a static way. Very recently, some lawyers and economists have investigated the decision to litigate empirically (See, e.g., Eisenberg (1989, 1990), Perloff and Rubinfeld (1988), and Salop and White (1988)).

[63]In the United States in 1987. Insurance Research Council (1988).

[64]In California, from 1981 to 1990. Based on a San Jose Mercury News analysis of California Bureau of Criminal Statistics and Board of Prison Terms Data. See Schmitt (1991).

[65]In 1987. Based on the author's calculations using the data employed for this paper.

represented by an attorney.[66] Thus, because the number of settled disputes is so much greater than the number of litigated disputes, the aggregate social costs of delay in settlement may be even larger than those associated with the decision to settle or litigate.

The purpose of this paper is to investigate empirically the causes of delay in the settlement of ultimately settled legal disputes using data on insurance settlements arising out of auto accidents, and, in doing so, to investigate the relative importance of strategic bargaining and learning to the settlement process. Section I reviews some strategic bargaining models of delay in bargaining, develops a simple model of learning in the presence of private information applicable to legal disputes, and presents some (opposing) testable implications of the models. Section II describes the auto insurance claim data and estimation methods used. Section III gives the empirical results and their implications for the models of delay in Section I; based on these findings, the fourth and final section concludes with some prescriptions for legal reform to reduce delay in the settlement process.

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[66] Id.

I. Models of Delay

The purpose of this section is to investigate the assumptions central to and the implications of various models of delays in bargaining, as applied to the settlement of a legal dispute in which the parties have symmetric perfect information about any costs of delay but asymmetric information about the plaintiff's damages. To facilitate discussion, I first set up the problem and present the notation used throughout this section. Second, I show that strategic bargaining models that explain delay in this context fall into one of two categories: either they require assumptions that conflict with the structure of the problem, or they generate delays in settlement that are invariant to the size of the dispute. Third, I develop a nonstrategic model of learning that generates delay as an increasing function of dispute size.

This difference between the strategic and the learning models leads to an empirical test of the ability of the strategic bargaining models to explain delay in the settlement of legal disputes: if delay in settlement increases with the size of disputes, then the learning model explains delay that the strategic models cannot. The section concludes with a formalization of this test and some other empirical diagnostics of the models.

A. Setup and Notation

Consider an accident between two parties in which one side suffers a bodily injury. Liability is publicly known, but the plaintiff's damages are privately known to either the plaintiff or the defendant.[67] Conditional on observable characteristics, the uninformed party knows that plaintiffs' damages $\beta$ are uniformly distributed on $[\underline{\beta},\overline{\beta}]$; in other words, if the claim were to be tried to a verdict, plaintiff would receive an award of $\beta$. There is a queue for trials that is T+1 periods long; assume that either the plaintiff or the defendant can force a claim to be tried to a verdict. The common discount rate is r per period, and the court imposes prejudgment interest -- interest on plaintiffs' damages, running from the date of the accident to the date of the trial -- at rate R.

Delay imposes costs of d at the beginning of each period on the uninformed party, which are publicly known.[68] Litigation imposes costs of L at time T+1 on both the plaintiff and the defendant, exclusive of all costs of delay. Throughout the section, I disregard the possibility

[67]The most familiar case, of course, would be that the plaintiff has private information about his damages. However, if the defendant has specialized knowledge about the circumstances surrounding the injury, such as a physician in a medical malpractice claim, she may have superior information about damages.

[68]For notational convenience, I follow Spier (1992) and assume that the informed party's delay costs are zero. See Spier (1989) for further details.

any plaintiff would want to drop her claim.[69] For simplicity, assume that the parties are risk-neutral and only the uninformed party makes offers, at a rate of one per period.

B. Strategic Bargaining Models

The theoretical literature on delay in bargaining consists of four types of strategic models: wars of attrition, screening models, signalling models, and models of "deadline effects" (the propensity for disputes to settle immediately before a discontinuous change in the economic structure). In the context presented in subsection A above, these models fall into one of two categories: either they require assumptions that are implausible or conflict with the setup of the problem, or they generate delays that are invariant to the size of the dispute. I discuss each of the four types of models in turn.

Wars of attrition generally assume that one party to the dispute is uncertain about the other's cost of delay.[70] Because it is collectively costly, delay resembles a battle to ascertain the stronger (lower-cost-of-delay)

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[69]A sufficient condition for this is

$$\frac{\beta(1+R)^T-L}{(1+r)^T} > \frac{d(1+r)}{r}\left(1-\left(\frac{1}{1+r}\right)^T\right),$$

assuming that plaintiffs are uninformed. This assumption is investigated in section III.

[70]See, e.g., Kennan and Wilson (1989, 1990).

party, who then claims all of the gains from trade for herself. These models of wars of attrition are not applicable to the problem here by construction: delay costs are public. Other work has shown that wars of attrition can generate delays in mixed-strategy equilibria without uncertainty about delay costs (Ordover and Rubenstein (1986)). However, in this model, the dispute is explicitly assumed to be "all-or-nothing," as in a child custody dispute or criminal charge, and therefore of arbitrary "size"; in other words, delay is invariant to the size of the dispute.

Screening and signalling models, on the other hand, require that the delay costs of the informed party be correlated with informed party's type. If the parties share a common discount rate, then discounting alone will not produce a delay cost,[71] and since d is constant across types,[72] the necessary relationship between delay cost and type is absent.

More generally, generating screening or signalling

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[71]The fact that discounting does not generate a delay cost in models of pretrial bargaining is explained by Spier (1992). She contrasts pretrial bargaining with the canonical examples of delay by a durable goods monopolist (see, for example, Gul, Sonnenschein, and Wilson (1986)) or by workers in a strike (Hart (1989)). In both of those cases, delay results in the destruction of resources, either the interest on consumers' surplus or forgone profits of the firm. Thus, the uninformed party can use time to distinguish among types. In the pretrial bargaining model, in contrast, the pie is not shrinking: what one side loses from delay, the other gains.

[72]This would be true even if plaintiffs had different costs of delay than defendants.

in the context of legal disputes requires potentially counterintuitive assumptions. Suppose that plaintiffs are liquidity constrained, e.g. have a higher discount rate than defendants, say $r_p > r_d$. If defendants are uninformed about damages, then plaintiffs bear a cost of delay that is correlated with type: higher-$\beta$ plaintiffs have higher costs of delay. The positive correlation between type $\beta$ and delay cost could also be achieved by allowing delay in high-damages cases to be more costly in some other way.

But for screening and signalling models to work, higher-$\beta$ plaintiffs need to have <u>lower</u> costs of delay. In other words, plaintiffs with high damages have to be more patient than plaintiffs with low damages. If this were true, defendants could employ a "skimming" strategy in screening models by making a low offer early and progressively increasing the size of the offer over time.[73] In signalling models, higher-$\beta$ plaintiffs could indicate their type by waiting. If low-$\beta$ plaintiffs are more patient than high-$\beta$ plaintiffs, the uninformed defendant would be unable to screen low- from high-types and the well-informed plaintiffs would be unable to signal their types with time. This is analogous to the requirement in the durable goods

[73]Notwithstanding the problem of the Coase conjecture: as the interval between offers shrinks to zero, the maximum delay shrinks to zero, and the defendant's offers rise to that which would be offered to the highest type. See, for example, Kennan and Wilson (1989).

monopolist models that the high-valuation buyer is willing to pay more to consume sooner and the requirement in the strike duration models that the high-profit firm suffers a greater loss from the continuation of the strike.

On the other hand, if plaintiffs are uninformed about damages, then defendants need to be liquidity constrained, e.g. $r_d > r_p$, in order for screening or signalling to take place. If this were true, then higher-$\beta$ defendants would have higher costs of delay, and plaintiffs could screen by starting with a high settlement offer that declined over time. But this is counterintuitive, insofar as defendants as a group are generally wealthier than plaintiffs.[74]

Delay costs that enable time to be used as a screen or signal are difficult to impose in other ways as well. Another common way of imposing delay costs in models of sequential bargaining is to create a positive probability that each period of bargaining will be the last (see, for example, Roth et al. (1988) for discussion of these models). One analogue in a legal dispute with, for example, an uninformed defendant would be for the defendant to induce a positive probability of litigation in each period through a refusal to bargain with some fraction of all types then

[74]A similar argument holds if defendants have liability insurance. However, this necessary condition for screening and signalling would be satisfied if higher-$\beta$ cases have higher delay costs due to some other factor.

remaining. This would enable uninformed defendants to use a skimming strategy (because low types would be willing to settle for low amounts early whereas high types would not) in a form of a screening equilibrium. Such a model, however, suffers from a more serious flaw than the Coase property that afflicts screening models generally, because the screening in the model has nothing to do with time at all. Indeed, in situations in which this model generated a separating equilibrium, the equilibrium could be reached almost immediately, with the uninformed defendant randomly refusing to bargain with some plaintiffs and then offering to settle with those who remain for some amount greater than the previous offer.

Models of deadline effects require less in the way of counterintuitive assumptions to achieve delay in bargaining, but do have the property that delay is invariant to dispute size. Spier (1992) derives the unique perfect Bayesian equilibrium of the model discussed in part A, in which there are deadline effects when the plaintiff is uninformed. In her model, if delay costs d were equal to zero, then all settlement would occur in the last period; if d > 0, then a U-shaped pattern of settlement emerges. The range of dispute sizes $\overline{\beta}-\underline{\beta}$ is relevant for the decision to settle or litigate in her model -- as the range of dispute sizes rises, the probability of litigation rises -- although the average dispute size $(\overline{\beta}-\underline{\beta})/2$ is not. However, neither the range of dispute sizes nor the average dispute size is relevant to the timing of settlement, conditional on settlement occurring. In other words, delay in the settlement process is invariant to the size of the dispute.[75]

C. A Learning Model

Alternatively, consider a model of learning in the presence of private information.[76] Suppose that one uninformed defendant faces many plaintiffs, as is the case in the auto insurance claims data used in this paper. Assume the parties split gains from settlement equally. I focus on the timing of settlement by assuming that a constant small fraction of cases are litigated, and that the composition of litigated cases is the same as the composition of settled cases.

The defendant learns about plaintiffs' types according to the following technology: with k periods of learning, the defendant is able to divide plaintiffs into k equal-sized groups. After the jth period, the defendant knows which plaintiffs have type $\beta < \hat{\beta} = j(\bar{\beta} - \underline{\beta}) / k$. In periods subsequent to j, then, the defendant learns no more about plaintiffs with types $\hat{\beta} < \beta$. The defendant can

[75]A similar result is obtained by Ma and Manove (1993), who generate a deadline effect due to stochastically imposed delay in offer transmission with an arbitrarily-sized dispute.

[76]If we rule out mixed strategies, for example, then the deadline-effects or war-of-attrition equilibrium no longer holds.

credibly communicate the fact that she knows this information to plaintiffs. Thus, if we assume that delay is costly even if no learning is done, then after each period j, the defendant settles with all remaining plaintiffs who have type $\beta < \hat{\beta}$, because neither side can profit from waiting.

The jth period of delay from learning costs the defendant i(j), payable at the start of the period, where $i(j) \;/\; (1+r)^{t-1} = d - cT$, both for convenience and to reflect the fact that the average cost of learning per period rises as the uninformed party attempts to distinguish among more similar types (because of the increasing marginal cost of information on types) and falls as time-to-trial rises (because longer time-to-trial loosens a constraint on the learning process).

Within each of the k groups, the defendant pools among types of plaintiffs, paying all plaintiffs in the group (who constitute 1/k of all plaintiffs) the present value of the damages that would be awarded at trial for the highest type in the group. Under the assumption of symmetric litigation costs and equally split gains from settlement, then, the payment to each plaintiff in the jth group equals

$$j\left(\left(\frac{\bar{\beta}-\underline{\beta}}{k}\right)+\underline{\beta}\right)\left(\frac{1+R}{1+r}\right)^{T}.$$

So defendants choose the level of learning k by minimizing the total costs of the settlement process:

$$\min_{k} \left(\sum_{j=1}^{k} j\left(\frac{\overline{\beta}-\underline{\beta}}{k}\right)+\underline{\beta}\right)\left(\frac{1+R}{1+r}\right)^{T}\left(\frac{1}{k}\right) + (d-cT)k,$$

subject to the constraint that $k \leq T$.

The first-order conditions of the defendant's problem imply a choice of k:

$$k = \min\left(T, \sqrt{\left(\frac{1+R}{1+r}\right)^{T}\left(\frac{\overline{\beta}+\underline{\beta}}{2(d-cT)}\right)}\right),$$

which implies a probability of settlement, conditional on settlement occurring ($f_t$):

$$f_t = \begin{cases} \max\left(\sqrt{\dfrac{2(d-cT)(1+r)^{T}}{(\overline{\beta}+\underline{\beta})(1+R)^{T}}}\ ,\ \dfrac{1}{T}\right) & \text{if } t \leq \min(k,T) \\ 0 & \text{otherwise} \end{cases}.$$

D. Testing Between Strategic and Learning Models

In this subsection, I present three comparative statics results of the model of deadline effects formulated by Spier (1992) and the learning model developed above, to typify some similarities and differences between strategic and learning models regarding delay in settlement, conditional on settlement occurring. (Appendix F contains the main theoretical result from Spier (1992) on which the comparative statics for that model are based.) The two classes of models have some common properties. First, in both models, increases in the time between accident and trial T lead to the backloading of settlements for reasonable parameter values, in the absence of prejudgment interest. In the deadline effects model, increases in T decrease the conditional probability of settlement occurring for all t up to the old deadline, and allow for some settlements between the old deadline and the new deadline where none occurred before, as long as $L < d(1+r)/r$. In the learning model, increases in T increase the equilibrium amount of learning, which moves settlements back in time, as long as $c > (d - cT)\ln(1+r)$. Thus the comparative statics on T allow us to check the validity of the two models as indicated in Proposition 1:

> Proposition 1: If either the learning model or the deadline effects model is correct, increasing time-to-trial should lead to fewer early settlements and more late settlements, conditional on settlement occurring, in the absence of prejudgment interest.

Comparative statics also highlight differences between the two models. In particular, the timing of settlement in the deadline effects model is invariant to the distribution of types, whereas settlements in the learning model become more backloaded in time as the value of the average type increases, assuming an interior solution. It might seem, then, that showing that observable characteristics of claims associated with higher average settlements were also associated with longer times-to-settlement would be evidence for the learning model over the deadline effects model. Unfortunately, characteristics correlated with higher average settlements might also be correlated with higher litigation costs, and increases in litigation costs lead to the backloading of settlements in the deadline effects model. Thus, although observable claim heterogeneity does not provide a parsimonious test between learning and deadline effects, it leads to an additional check on the two models:

> Proposition 2: If either the learning model or the deadline effects model is correct, then claim heterogeneity associated with higher average settlements and higher litigation costs should lead to the backloading of settlements.

However, claims from states with prejudgment interest $R \neq 0$ would be on average more valuable but should not be associated with different litigation or delay costs per se: prejudgment interest increases the value of all claims by $(1+R)^T$ but does not affect any other aspects of the case. Thus, in the deadline effects model, the imposition of prejudgment interest should not affect the timing of settlement, conditional on settlement occurring (although it does decrease the unconditional probability of settlement at all t). This is a special case of the more general proposition discussed above that delay is invariant to dispute size in the strategic bargaining models.

In the learning model, on the other hand, prejudgment interest increases the value of the claim of the average type, which increases the equilibrium level of learning, and leads to the backloading of settlements. Both of these models conflict with the model of settlement behavior implicit in much of the legal literature, which suggests that prejudgment interest decreases delay. This finding is difficult to derive formally: if one party could impose delay and obtain a gain due to the presence or absence of prejudgment interest, and the other party knew this, the party with the potential gain should not need to actually delay settlement to collect the present value of the gain from delay. Nonetheless, this model can be found in both judicial decisions[77] and law review articles:

> Mandatory prejudgment interest not only allows for the achievement of compensatory goals, but also eliminates the economic incentive for defendants to postpone settlement negotiations and thereby prolong litigation.[78]

This leads to proposition 3.

> Proposition 3: If the learning model is correct, then prejudgment interest should increase delay, conditional on settlement; if the "legal" model is correct, then prejudgment interest should reduce delay. On the other hand, if the strategic bargaining models completely explain delay, then prejudgment interest should have no effect on the timing of settlement.[79]

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[77] State v. Phillips, 470 P.2d 266 (Alaska 1970).

[78] Rothschild (1982), p. 192.

[79] Even if delay costs are increasing in the value of claims, because (for example) of liquidity constraints, prejudgment interest still allows us to distinguish between the learning model and the deadline effects model, as long as litigation costs are not increasing in the value of claims. This is because higher delay costs which may be due to prejudgment interest would decrease delay in settlement, conditional on settlement occurring, in the deadline effects model.

Figure 1 illustrates this graphically, showing the distribution of settlement times, conditional on settlement, for the deadline effects model and the learning model, with and without prejudgment interest.

## II. Estimation and Data

### A. Estimation

To investigate propositions 1-3, I estimate two empirical models, one to capture the influence of claim characteristics and the legal environment on the timing of settlement, and one to capture the influence of claim characteristics and the legal environment on settlement amount, conditional on settlement occurring. To analyze the timing of settlements, I specify and estimate a semiparametric proportional hazards model, along the lines of Han and Hausman (1990) and Meyer (1990). The model is semiparametric in that the baseline hazard is nonparametric and the influence of observable heterogeneity takes a particular functional form.

I follow the standard proportional hazards specification. Suppose that we observe the settlement of claims over discrete periods, which may or may not be of the same length. In particular, either we observe that claim i settles by the end of period $t_i$, $t_i = 1, 2, \ldots, \bar{t}-1$, $\bar{t} \leq$ time-to-trial T; or we observe that claim i has not settled by the end of $\bar{t} - 1$. I divide time into eleven periods.

Periods 1-10 include claims settled by 30, 60, 120, 180, 240, 300, 360, 540, 720, and 900 days after the accident. Period eleven includes all claims not settled after 900 days.

In addition, claim i has a set of observable characteristics $x_i$ and is resolved under a legal regime with characteristics $l_i$. Then the hazard function for claim i, which is the probability of settlement at time $\tau$ conditional upon the survival of the claim up to $\tau$, can be written:

$$\lim_{h \to 0^+} \frac{prob(\tau < t_i < \tau + h \mid t_i > \tau)}{h} = \lambda_i = \lambda_0(\tau, l_i)\exp(x_i\beta + l_i\delta),$$

where the baseline hazard $\lambda_0(\tau, l_i)$, $\beta$, and $\delta$ are parameters to be estimated.

Estimating the baseline hazard as a nonparametric function of time and legal regime is an important innovation in the evaluation of strategic bargaining models. Previous empirical work that investigates the importance of various models in explaining the timing of the settlement of legal disputes (such as Fournier and Zuehlke (1991)) uses a parametric baseline hazard such as the Weibull. Assessing the models with empirical results obtained with a parametric baseline hazard may be difficult because the parameterization may conflict with some of the properties of the timing of settlements that the models predict. For example, if the deadline effects model explains the timing of settlement, the baseline settlement hazard may have a U-shaped distribution, which implies that the baseline hazard may exhibit decreasing, then increasing duration dependence. But this is ruled out by the functional form assumptions of the Weibull, which requires either increasing or decreasing duration dependence, but not both, and the log-logistic, which allows for increasing then decreasing duration dependence, but not decreasing then increasing duration dependence. Since a parametric proportional hazards model may be misspecified, hypothesis tests based on the estimates may be difficult to interpret.

The likelihood of an observation in the semiparametric hazards model is defined as follows. If $F_i(\tau)$ is the cumulative distribution function, then the log of the survivor function, $\log(1-F_i(\tau))$, can be written as the integral of the hazard:

$$\log(1-F_i(\tau)) = \int_0^{\tau} \lambda_i(u)\,du ,$$

which implies that probability of claim i settling by the end of period $\tau$ is

$$F_i(\tau) = 1 - \exp(-\sum_{j=1}^{\tau} \exp(x_i\beta + l_i\delta + \gamma_j^A + l_i\gamma_j^B)),$$

where

$$\gamma_j = \log(\int_{j-1}^{j} \lambda_0(u)du).$$

Thus the likelihood of claim i in the basic hazard model is:

$$\mathcal{L}(\beta,\delta,\gamma) = (F_i(t_i) - F_i(t_i - 1))^{1-I_i} \, (1 - F_i(\bar{t} - 1))^{I_i},$$

where $I_i = 1$ if the claim has not settled by the end of period $\bar{t} - 1$. Based on this, conventional maximum-likelihood methods can be used to obtain estimates of $\beta$, $\delta$, and $\gamma$.

I estimate two versions of the hazard model. First, I constrain $\gamma_j^B = 0 \ \forall \ j$: I term this the basic model. Second, in the "augmented" model, I allow for interaction between the baseline hazard parameters and the legal environment variables $l_i$. In the augmented model, I constrain $\gamma_j^B = 0$ for $j < 7$ (settlements reached in 10 months or less) and constrain $\gamma_j^B = \gamma_{j'}^B \ \forall \ j,j' \geq 7$ (settlements reached in 11 months or more).

To accomplish the second goal -- the assessment of the influence of claim characteristics on settlement amount, conditional on settlement occurring -- I use a standard ordinary least squares model of the effect of characteristics and legal regime on the logarithm of settlement amount:

$$\log(\textit{settlement amount}_i) = x_i B + l_i \Delta + \varepsilon_i,$$

where $\epsilon_i \sim N(0, \sigma^2)$.

B. Data

To estimate the hazard and settlement amount equations, I use two cross-sections of 17,588 settled automobile insurance bodily injury claims, collected by the Insurance Research Council. Thirty-four insurers, comprising nearly 60 percent of the American passenger automobile insurance market, participated in the data collection project. (Participating insurers are listed in appendix A.) A claim was included in the master sample if one of the participating insurers settled with a claimant during a two-week period in the fall of 1977 or the summer of 1987. Each record contains information on $x_i$, the number of days between accident and settlement, settlement amount, and the state in which the accident occurred. (A list of the specific variables used in analysis can be found in table 1.)

Each claim in the database was matched with a set of variables describing the legal environment governing its disposition. In identifying the legal environment that controls the disposition of a claim, I apply the law in effect at the location of the accident, which is the traditional conflict of law rule used in tort cases.[80] I include three dummy variables, $l_1$-$l_3$, to control for legal environment in the equations. The first variable, $l_1$, is equal to one if the claim were resolved in a state that employed comparative negligence. The second variable, $l_2$, is equal to one if the claim were resolved in a state that had mandatory prejudgment interest.

The third variable, $l_3$, captures whether the state had long backlogs in its trial courts -- that is, whether time-to-trial T was large. Unfortunately, this information is not available on a state-by-state basis. However, information on filings and dispositions in state trial courts are available on a state-by-state basis for selected years from 1978 to 1987.[81] Under the assumption that trial queues for claims from states with disposition rates (dispositions/filings) less (greater) than one are increasing (decreasing), information on filings and dispositions from 1978-1987 indicate whether time-to-trial is increasing or decreasing over the period. So even though we cannot classify claims on the basis of time-to-trial, we can classify claims being resolved in regimes with relatively larger or smaller growth rates in T.

Define a variable in $x_i$, $d87_i$, $d87_i = 1$ if claim i

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[80]See Weintraub (1980), p. 266 et seq.

[81]See Appendix B. National Center for State Courts (1978-1987).

came from the 1987 cross-section. Then the estimated coefficient on $d_i$ from the hazard model measures the growth rate in delay in settlement over the time period spanned by the two cross-sections, conditional on other characteristics of the claim and legal environment. Also define $l_{3i} = d87_i * I(\Sigma DISP_{s,t} / \Sigma FILE_{s,t})$, where $I(.) = 1$ if the sum of dispositions over filings from 1978-1987 in state s (where claim i is based on an accident in state s) is less than 0.95.[82] Then the estimated coefficient on $l_3$ measures the additional growth rate in delay in settlements experienced by claims from high-time-to-trial-growth states, relative to claims from low-time-to-trial states.

Since other tort and non-tort laws may be correlated with either settlement probability or legal regime, I restrict the sample to claims from states in which tort law was the only relevant provision of law governing the payment of automobile insurance claims; I exclude, for example, claims from states that allow no-fault or add-on automobile insurance. Considering only two-party accidents further reduces any omitted variable bias, by eliminating the influence of other elements of state law, such as joint

[82]I choose a 95 percent rather than a 100 percent disposition rate as a breakpoint because 19 of 20 of the states analyzed in the paper have disposition rates less than 100 percent.

There is one caveat to my calculation of disposition rates. Data on filings and dispositions are unavailable for 1982 and 1983, and for certain other years for some states. I assume that trial queues are static in years in which data are unavailable. See Appendix B.

and several liability laws. Finally, I exclude claims from Illinois, which altered its legal regime shortly before the 1987 claims data were collected,[83] and from states for which data on filings and dispositions were unavailable. This limits the sample to 12,228 claims from 20 states. Tables detailing the comparative negligence and prejudgment interest laws for all states are found in Appendix B; filings and dispositions for 1978-1987 for the 20 states analyzed in this paper are found in Appendix E. The 20 states analyzed in this paper are marked with a "/" in the tables of laws.

## III. Empirical Results

Table 1 presents the variables used in analysis and some descriptive statistics. As discussed in the introduction, the average time between accident and settlement is approximately 216 days, with a standard deviation of approximately 286 days. This suggests that delays in settlement, conditional on settlement occurring, are considerable. The average amount paid to resolve a bodily injury claim was approximately $2,649 in 1977 dollars; in the 1977 cross section, the average amount paid was $2,381 (standard deviation $6,580), and in the 1987

[83]Including claims from Illinois in the sample would be problematic because it would induce a correlation between the (independent) legal environment variables and the (dependent) variable, time-to-settlement.

cross section, the average settlement was $2,913 (standard deviation $6,234). This indicates that tort settlements have risen in real terms over time, although the variance of settlement amounts has fallen. The independent variables $x_i$ include controls for the claimant's demographic characteristics, injuries, and disabilities, as well as for the location of the accident (including state dummies) and the legal environment under which the claim was resolved.

Table 2 offers more detailed descriptive statistics regarding the distribution of settlement times in the data month-by-month, measured from the date of each accident. Defining the risk set in month m, $R_m$, as the number of claims not settled by the start of month m, and the number of settlements in month m as $S_m$, the Kaplan-Meier empirical hazard is defined as $S_m/R_m$ (with a standard error of $(S_m(R_m-S_m)/R_m^3)$. The Kaplan-Meier hazard and the distribution of settlement times for months 1-30 are also presented graphically in Figure 2. Table 2 indicates that the hazard rate is gently declining over the first 30 months of settlement, and by 30 months, 96 percent of all claims have settled. Table 2 also shows that the median settlement time is approximately 4 months, but that after 12 months, 18 percent of all ultimately settled claims are still unresolved.

Table 3 gives maximum-likelihood estimates of selected parameters from the semiparametric hazard model.

The first panel of Table 3 contains estimates of the period-by-period integrated baseline hazard:

$$\int_{j-1}^{j} \lambda_0(u)du = e^{\gamma_j},$$

along with the standard error, calculated by the delta method, for both the basic model, and the augmented model, which includes interactions between the baseline hazard and the legal environment. The estimated baseline hazard for the augmented model is graphed in Figure 3, under the assumption that the hazard rate is constant within an interval defined by any $\gamma_j$. The top panel shows the baseline hazard for settlements in a regime without mandatory prejudgment interest; the bottom panel shows the baseline hazard for settlements in a regime with prejudgment interest. In both panels, the solid line depicts the estimated baseline hazard, and the dashed lines give 95 percent confidence intervals.

Figure 3 indicates that the flexibility of the nonparametric baseline hazard may be important for evaluating the different theories. As the top panel of Figure 3 shows, the baseline hazard in regimes without prejudgment interest exhibits both decreasing and increasing duration dependence. In regimes with prejudgment interest, this effect is more pronounced, as the bottom panel of the figure makes clear. Thus, a parameterization such as the

Weibull or the log-logistic that constrains duration dependence to a particular form may be misspecified.

The remainder of Table 3 shows the estimated coefficients on selected explanatory variables $x_i$ in the models. Demographic characteristics are relevant in the determination of time-to-settlement. Claims involving women take longer to settle than claims involving men, holding other characteristics of the claim and claimant constant. We also see that the process of claim disposition has become more rapid over time: claims from the 1987 cross-section settle more quickly than claims from the 1977 cross-section.[84] In results not presented in Table 3, claimant age increases the hazard rate for young claimants but decreases the hazard rate for older claimants. For claimants less than 62 years of age, age has a positive, significant effect on the hazard; for claimants greater than 62 years of age, age has a negative effect on the hazard.

The coefficients also indicate that more serious claims take longer to settle. Claims based on an injury that resulted in a disability or fatality take significantly longer to settle than those that are not; and claims arising

[84]This effect disappears if the responsiveness of the hazard to claim characteristics is allowed to vary over time; and in fact, likelihood-ratio tests reject the restriction that the responsiveness of the hazard to claim characteristics is equal in the two cross-sections ($\chi_{(23)}^2 = 74.0$). However, none of the other results presented in this section change if year/characteristic interaction terms are included in the analysis.

out of some tangible personal injury take longer to settle than claims that do not. In both the basic and the augmented models, for example, the hazard rate of settlement of claims involving fatalities is approximately exp(-0.9) = 0.4 times as great as that for claims not involving a fatality. The coefficient on the "no injury" category is greater than zero, which implies that claims based on no apparent injury settle quickly, whereas the coefficients on injuries such as "disfigurement" and the various strain categories are consistently and significantly less than zero.

The location of the accident and the legal environment influence the settlement hazard as well. Claims arising out of accidents in large cities take longer to settle than claims from rural areas (the base group); and we reject the null hypothesis that the state fixed effects are zero ($\chi_{(19)}^2 = 395.6$). The influence of legal regime on the hazard rate is summarized in the basic model. Prejudgment interest and comparative negligence both, on average, decrease the hazard rate -- that is, those changes in legal regime are associated with longer time-to-settlement, conditional on settlement occurring. Also, Table 3 shows that increased court backlog "trickles down" to the settlement process. These observations are discussed more completely in the text accompanying Table 5.

Table 4 directly addresses Proposition 2. Table 4 indicates that claim heterogeneity associated with higher settlement amounts and/or greater litigation costs is also associated with longer times-to-settlement, consistent with both the deadline effects model and learning model. The first two columns of table 4 replicate the estimates from the basic hazard model in the first two columns of table 3; the second two columns of table 4 present OLS estimates of the influence of claim characteristics and the legal environment on the logarithm of settlement amount.[85] Injuries and disabilities associated with higher average settlements are also associated with the largest decreases in the hazard rate. Fatality, permanent total disability, permanent partial disability, hospitalization for more than a week, and disfigurement are the five most costly injury characteristics, and also the five characteristics

[85]Throughout the analysis, I have assumed that plaintiffs never drop their claims. This assumption is verified by the data. The sample of claims includes only claims settled for some nonzero amount; thus dropped claims are excluded from the sample, consistent with the assumption. One way to investigate the validity of the no-drop assumption is to compare estimates of the importance of characteristics and legal environment in the claim resolution process obtained under the no-drop assumption to estimates that allow for dropped claims to exist in the population: if the estimates obtained under the two assumptions differ, then dropped claims may be important.

I reestimated the response of settlement amount to characteristics with a truncated Tobit model, which allows for (dropped) claims valued at less than $1 to exist in the population, although not in the sample. In comparison, OLS estimates are only correct if there are no dropped claims in the population, e.g. if the sample is not truncated. The Tobit estimates are very similar to the OLS estimates, except that the influence of comparative negligence on settlement amount is larger in the Tobit specification.

associated with the greatest delay. However, there is not a monotonic relationship between average settlement amount and delay, as the simple learning model or a model of deadline effects that assumed a monotonic relationship between litigation costs and average type would predict. Neck and back strains, for example, are less costly to defendants than fractures, but take longer to settle. This might be consistent with either a learning model or a model of deadline effects. Neck and back strains are injuries that are notoriously difficult to disprove -- in the language of Section I, the range of types $[\underline{\beta},\overline{\beta}]$, conditional on a neck or back strain, is relatively larger. So, the observation that strains take disproportionately longer to settle would be consistent with a more complex learning model, in which the amount of learning depended positively on the range of types, or with a model of deadline effects, in which litigation costs depended positively on the range of types.

Table 5 investigates Propositions 1 and 3, and provides support for the learning model over the model of deadline effects and the "legal" model of delay. The top panel of Table 5 shows that claims from states with relatively greater growth in time-to-trial T from the end of 1977 to 1987 (as measured by trial queue growth) have relatively greater declines in the baseline level of early settlements and relatively greater increases in the baseline level of late settlements, conditional on settlement occurring. These differences are statistically significant at conventional levels. Column (1) of the top panel of Table 5 shows that, from 1977 to 1987, the settlement of auto bodily injury claims became more rapid in states with case disposition rates of over 95 percent in their trial courts during that period. The baseline fraction of claims settling within one month rose by slightly more than 5 percent, while the baseline fraction of claims that took between 7 and 30 months to settle fell by approximately 3.8 percent. In contrast, column (2) shows that the settlement of claims slowed in states with disposition rates of less than 95 percent: the baseline fraction of claims settling within one month fell by approximately 3.3 percent. This is consistent with both a model of deadline effects and a model of learning (Proposition 1).

The bottom panel of the table shows that prejudgment interest results in the backloading of settlements -- that is, greater delay -- which is consistent with the learning model, but inconsistent with the "legal" model, and not indicated by the strategic bargaining models (Proposition 3). In the learning model, increasing the value of the average type's claim increases delay in settlement, but in the deadline effects model, the timing of settlement, conditional on settlement occurring, is invariant to the distribution of types. The baseline settlement rate in the first month after an accident, in the absence of mandatory prejudgment interest, is 38.5 percent; but the baseline first-month settlement rate in the presence of prejudgment interest is only 32.8 percent. Furthermore, the baseline settlement rate in the eleventh through thirtieth months is 4 percent in the absence of prejudgment interest, but 7.3 percent in the presence of prejudgment interest. The month-by-month difference in settlement rates due to prejudgment interest is generally statistically significant.

## IV. Conclusion

Delay in the settlement of ultimately settled legal disputes can impose large social costs. Almost all criminal and civil disputes are ultimately settled, and settled disputes do not settle immediately. Delay in this context can result in socially undesirable outcomes ranging from the failure to reimburse a liquidity-constrained injured party for her tort losses in a timely way to the unjust imprisonment of a criminal defendant while her case is being plea-bargained.

Thus, it is important to understand why there are delays in settlement. Although most bargaining models are theoretically ill-suited to understanding bargaining over the value of a tort claim in the presence of private information about damages, some are not. Using two cross-sections of settled auto bodily injury claims, one from 1977 and one from 1987, and a semiparametric hazards model, this paper presents estimates from that shed light on the empirical causes of delay in settlement. In doing so, the paper shows that strategic bargaining models in general, and a model of deadline effects in particular, are consistent with some properties of observed delays in bargaining, but fail to explain others.

First, the probability that a claim from a state with relatively greater growth in the queue of cases waiting for trial would settle rapidly is decreasing over the period 1977-1987, conditional on settlement occurring, even as the probability that a claim from a state with relatively lesser growth in the trial queue would settle rapidly is increasing, holding constant the characteristics of the claim and other aspects of the legal environment in the shadow of which the claim was resolved. This suggests that delays in the court system decrease the rapidity of settlement. This empirical finding is statistically significant at conventional levels, and is consistent with both a model of learning and a (strategic) model of deadline effects.

Second, claims arising out of injuries that result in higher average settlement amounts take longer, on average, to settle. Death, serious disability, disfigurement, and long-term hospitalization are the five most costly injury characteristics, and are also the five characteristics of claims associated with the greatest delays in settlement. The observed positive relationship between average settlement amount and delay is consistent with the learning model, but not necessarily with the deadline effects model, which predicts that the timing of settlement, conditional on settlement occurring, is invariant to changes in the distribution of the value of claims. However, the observed relationship may be consistent with the deadline effects model, because claim heterogeneity that is correlated with higher average settlement amount may also be correlated with higher litigation costs, which would induce the backloading of settlements in a model of deadline effects.

The data can be used to distinguish between the two theories, however. Some states enacted mandatory prejudgment interest statutes over the period 1977-1987. Mandatory prejudgment interest provides a "natural experiment" to test between the theories because it increases the value of claims without changing costs of litigation or delay. Thus, if the learning model is correct, mandatory prejudgment interest should increase delay, conditional on settlement; if the "legal" model of prejudgment interest is correct, prejudgment interest should decrease delay; and the strategic bargaining models, which generate delays in settlement that are invariant to dispute size, would predict that prejudgment interest has no effect on delay.

Hazard estimates show that prejudgment interest results in the backloading of settlements. This finding is consistent with the learning model, inconsistent with the legal model, and not indicated by the strategic bargaining models in general, or the deadline effects model in particular. The baseline settlement rate in the first month after an accident, in the absence of mandatory prejudgment interest, is 38.5 percent; but the first-month baseline settlement rate in the presence of prejudgment interest is only 32.8 percent. Furthermore, the baseline settlement rate in the eleventh through thirtieth months is 4 percent in the absence of prejudgment interest, but 7.3 percent in the presence of prejudgment interest. The difference in settlement rates due to prejudgment interest is generally statistically significant.

In addition, the empirical results suggest ways that the social costs of delay in the settlement process can be reduced. To begin with, reducing delays in trial courts will not only reduce delays for ultimately litigated cases, but also reduce delays for ultimately settled cases. Second, the results suggest that legal reforms that increase (decrease) the value of claims will increase (decrease) delays in the settlement process, conditional on settlement occurring. In the course of evaluating legal reforms, then, the potential effect of the reform on delay may be important to consider.

Further research on this topic remains to be done. Most significantly, this paper does not reject strategic bargaining: it only shows that strategic bargaining models fail to explain an important aspect of settlement behavior that can be explained by a simple learning model. Future work should investigate whether an expanded version of the strategic models that included a process such as learning is supported by the data. Also, the data indicate that the simple learning model presented may be incomplete. The model predicts that delay is an increasing function of the mean value of claims, but the data show that delay is an increasing function of both the mean and the variance of claims, conditional on observed claim heterogeneity.

## Table 1: Descriptive Statistics

| | |
|---|---|
| **continuous variables** | |
| settlement amount ($) | 3931.627 |
| std. deviation | 9622.680 |
| days between accident and settlement | 216.148 |
| std. deviation | 285.882 |
| claimant age | 31.014 |
| std. deviation | 16.705 |
| weeks lost from work | 2.140 |
| std. deviation | 16.380 |
| **claimant demographics (1=yes)** | |
| female | 0.525 |
| 1987 cross-section | 0.503 |
| **claimant injuries (1=yes)** | |
| none | 0.006 |
| lacerations | 0.183 |
| fractures | 0.069 |
| disfigurement | 0.021 |
| neck strain | 0.417 |
| back strain | 0.301 |
| other strain | 0.153 |
| concussion | 0.033 |
| other injuries | 0.258 |
| **claimant disability (1=yes)** | |
| temporary | 0.447 |
| permanent partial | 0.043 |
| permanent total | 0.002 |
| fatality | 0.007 |
| **claimant rehabilitation (1=yes)** | |
| hospitalized≤7 but>0 days | 0.055 |
| hospitalized>7 days | 0.039 |
| need rehab. services | 0.268 |
| **claimant role in accident (1=yes)** | |
| passenger | 0.353 |
| pedestrian or other | 0.061 |
| **legal environment (1=yes)** | |
| prejudgment interest | 0.348 |
| 1987 * incr. ct. backlog | 0.321 |
| comparative negligence | 0.664 |
| N | 12228 |

| | |
|---|---|
| **location of accident** | |
| city w/pop>100K | 0.359 |
| suburb of city w/pop>100K | 0.170 |
| city w/10K≤pop≤100K | 0.250 |
| city w/pop<10K | 0.122 |
| Alabama | 0.033 |
| Arizona | 0.053 |
| Idaho | 0.006 |
| Maine | 0.010 |
| North Carolina | 0.077 |
| Tennessee | 0.051 |
| Vermont | 0.005 |
| Alaska | 0.003 |
| California | 0.368 |
| Indiana | 0.039 |
| Iowa | 0.018 |
| Missouri | 0.063 |
| New Mexico | 0.014 |
| Nebraska | 0.009 |
| Ohio | 0.114 |
| Oklahoma | 0.032 |
| Rhode Island | 0.011 |
| West Virginia | 0.019 |
| Wisconsin | 0.053 |
| Wyoming | 0.003 |

Table 2: Kaplan-Meier Empirical Hazard of Settlements

| Month | Risk Set | Settlements | Hazard Rate | Standard Error |
|---|---|---|---|---|
| 1 | 12228 | 2777 | 0.2271 | 0.0037 |
| 2 | 9451 | 1592 | 0.1684 | 0.0038 |
| 3 | 7859 | 1071 | 0.1363 | 0.0038 |
| 4 | 6788 | 818 | 0.1205 | 0.0039 |
| 5 | 5970 | 735 | 0.1231 | 0.0042 |
| 6 | 5235 | 648 | 0.1238 | 0.0045 |
| 7 | 4587 | 544 | 0.1186 | 0.0047 |
| 8 | 4043 | 464 | 0.1148 | 0.0050 |
| 9 | 3579 | 432 | 0.1207 | 0.0054 |
| 10 | 3147 | 326 | 0.1036 | 0.0054 |
| 11 | 2821 | 299 | 0.1060 | 0.0057 |
| 12 | 2522 | 340 | 0.1348 | 0.0068 |
| 13 | 2182 | 227 | 0.1040 | 0.0065 |
| 14 | 1955 | 163 | 0.0833 | 0.0062 |
| 15 | 1792 | 146 | 0.0814 | 0.0064 |
| 16 | 1646 | 142 | 0.0862 | 0.0069 |
| 17 | 1504 | 126 | 0.0837 | 0.0071 |
| 18 | 1378 | 112 | 0.0812 | 0.0073 |
| 19 | 1266 | 111 | 0.0876 | 0.0079 |
| 20 | 1155 | 72 | 0.0623 | 0.0071 |
| 21 | 1083 | 88 | 0.0812 | 0.0083 |
| 22 | 995 | 78 | 0.0783 | 0.0085 |
| 23 | 917 | 80 | 0.0872 | 0.0093 |
| 24 | 837 | 92 | 0.1099 | 0.0108 |
| 25 | 745 | 64 | 0.0859 | 0.0102 |
| 26 | 681 | 50 | 0.0734 | 0.0099 |
| 27 | 631 | 45 | 0.0713 | 0.0102 |
| 28 | 586 | 43 | 0.0733 | 0.0107 |
| 29 | 543 | 49 | 0.0902 | 0.0123 |
| 30 | 494 | 33 | 0.0668 | 0.0112 |
| 30+ | 461 | | | |

Table 3: Hazard Model Estimates

| | Specification: basic Param | basic StdErr | augmented Param | augmented StdErr |
|---|---|---|---|---|
| integrated baseline hazard | | | | |
| <1 month | 0.4535 | 0.0361 | 0.4867 | 0.0398 |
| 1-2 months | 0.3447 | 0.0281 | 0.3716 | 0.0311 |
| 2-4 months | 0.5433 | 0.0441 | 0.5880 | 0.0490 |
| 4-6 months | 0.5487 | 0.0453 | 0.5952 | 0.0504 |
| 6-8 months | 0.5350 | 0.0449 | 0.5801 | 0.0499 |
| 8-10 months | 0.5252 | 0.0450 | 0.5682 | 0.0498 |
| 10-12 months | 0.5765 | 0.0501 | 0.3970 | 0.0367 |
| 12-18 months | 1.2635 | 0.1074 | 0.9170 | 0.0825 |
| 18-24 months | 1.2895 | 0.1141 | 1.0353 | 0.0951 |
| 24-30 months | 1.2105 | 0.1167 | 1.1674 | 0.1190 |
| >10 months*prej.interest | | | 1.8054 | 0.1247 |
| >10 months*incr.ct.backlog | | | 1.9431 | 0.1358 |
| claimant demographics | | | | |
| female | -0.0627 | 0.0184 | -0.0664 | 0.0186 |
| 1987 cross-section | 0.1258 | 0.0506 | 0.1622 | 0.0514 |
| claimant injuries | | | | |
| none | 0.0317 | 0.1158 | 0.0464 | 0.1140 |
| lacerations | 0.0046 | 0.0269 | 0.0003 | 0.0270 |
| fractures | -0.1088 | 0.0439 | -0.1340 | 0.0442 |
| disfigurement | -0.4363 | 0.0667 | -0.4338 | 0.0693 |
| neck strain | -0.2022 | 0.0241 | -0.2086 | 0.0243 |
| back strain | -0.2824 | 0.0245 | -0.2915 | 0.0243 |
| other strain | -0.2334 | 0.0293 | -0.2478 | 0.0295 |
| concussion | -0.0734 | 0.0520 | -0.0852 | 0.0531 |
| other injuries | -0.0173 | 0.0233 | -0.0240 | 0.0238 |
| claimant disability | | | | |
| temporary | -0.3108 | 0.0210 | -0.3049 | 0.0215 |
| permanent partial | -0.6526 | 0.0544 | -0.6204 | 0.0571 |
| permanent total | -0.6938 | 0.2319 | -0.6586 | 0.2584 |
| fatality | -0.9035 | 0.1247 | -0.8923 | 0.1307 |
| claimant rehabilitation | | | | |
| hospitalized≤7 but>0 days | -0.4114 | 0.0448 | -0.3918 | 0.0465 |
| hospitalized>7 days | -0.6726 | 0.0615 | -0.6313 | 0.0647 |
| need rehab. services | 0.0118 | 0.0287 | -0.0116 | 0.0277 |
| claimant role in accident | | | | |
| passenger | -0.1050 | 0.0223 | -0.1023 | 0.0226 |
| pedestrian or other | -0.0789 | 0.0398 | -0.0784 | 0.0404 |
| location of accident | | | | |
| city w/pop>100K | -0.1372 | 0.0340 | -0.1292 | 0.0347 |
| suburb of city w/pop>100K | -0.0210 | 0.0384 | -0.0142 | 0.0391 |
| city w/10K≤pop≤100K | 0.0329 | 0.0339 | 0.0348 | 0.0347 |
| city w/pop<10K | 0.0538 | 0.0369 | 0.0560 | 0.0379 |
| state fixed effects | yes | | yes | |
| legal environment | | | | |
| prejudgment interest | -0.0887 | 0.0423 | -0.2026 | 0.0429 |
| 1987 * incr. ct. backlog | -0.1553 | 0.0375 | -0.2748 | 0.0396 |
| comparative negligence | -0.0967 | 0.0447 | -0.0935 | 0.0459 |
| Log-likelihood | -25965.4 | | -25713.4 | |
| N | 12228 | | 12228 | |

Table 4: Effects of Claim Characteristics on Ln($ Settlement) and the Settlement Hazard

| | Dependent Variable | | | |
|---|---|---|---|---|
| | Settlement Hzd | | ln($settlement) | |
| | Param | StdErr | Param | StdErr |
| **claimant injuries** | | | | |
| none | 0.0317 | 0.1158 | -0.3251 | 0.1386 |
| lacerations | 0.0046 | 0.0269 | 0.1926 | 0.0322 |
| fractures | -0.1088 | 0.0439 | 0.8084 | 0.0515 |
| disfigurement | -0.4363 | 0.0667 | 1.2249 | 0.0786 |
| neck strain | -0.2022 | 0.0241 | 0.5440 | 0.0280 |
| back strain | -0.2824 | 0.0245 | 0.7207 | 0.0275 |
| other strain | -0.2334 | 0.0293 | 0.5649 | 0.0326 |
| concussion | -0.0734 | 0.0520 | 0.3762 | 0.0612 |
| other injuries | -0.0173 | 0.0233 | 0.1443 | 0.0284 |
| **claimant disability** | | | | |
| temporary | -0.3108 | 0.0210 | 0.9224 | 0.0256 |
| permanent partial | -0.6526 | 0.0544 | 1.8552 | 0.0622 |
| permanent total | -0.6938 | 0.2319 | 2.2337 | 0.2238 |
| fatality | -0.9035 | 0.1247 | 4.0970 | 0.1337 |
| **claimant rehabilitation** | | | | |
| hospitalized≤7 but>0 days | -0.4114 | 0.0448 | 1.1242 | 0.0517 |
| hospitalized>7 days | -0.6726 | 0.0615 | 1.7576 | 0.0659 |
| need rehab. services | 0.0118 | 0.0287 | 0.2222 | 0.0338 |
| **claimant role in accident** | | | | |
| passenger | -0.1050 | 0.0223 | -0.0025 | 0.0258 |
| pedestrian or other | -0.0789 | 0.0398 | -0.0141 | 0.0488 |
| **location of accident** | | | | |
| city w/pop>100K | -0.1372 | 0.0340 | 0.1873 | 0.0414 |
| suburb of city w/pop>100K | -0.0210 | 0.0384 | 0.0387 | 0.0461 |
| city w/10K≤pop≤100K | 0.0329 | 0.0339 | -0.0270 | 0.0424 |
| city w/pop<10K | 0.0538 | 0.0369 | -0.0471 | 0.0472 |
| state fixed effects | yes | | yes | |
| **legal environment** | | | | |
| prejudgment interest | -0.0887 | 0.0423 | 0.0800 | 0.0542 |
| 1987 * incr. ct. backlog | -0.1553 | 0.0375 | 0.1252 | 0.0468 |
| comparative negligence | -0.0967 | 0.0447 | 0.0691 | 0.0584 |
| estimation method | semiparametric ML | | OLS | |
| Log-likelihood/$R^2$ | -25965.4 | | 0.5451 | |
| N | 12228 | | 12228 | |

Table 5: Comparative Statics, Augmented Specification
Baseline Distribution of Settlement Times

Effect of Court Delays:

| baseline distribution of settlement times | (1) 1977-1987 growth in small-queue-growth states param | serr | (2) 1977-1987 growth in large-queue-growth states param | serr | (2) - (1) ---Difference--- param | serr |
|---|---|---|---|---|---|---|
| <1 month | 0.0505 | 0.0169 | -0.0327 | 0.0123 | -0.0832 | 0.0125 |
| 1-2 months | 0.0090 | 0.0027 | -0.0078 | 0.0036 | -0.0168 | 0.0038 |
| 2-4 months | -0.0065 | 0.0043 | 0.0013 | 0.0017 | 0.0078 | 0.0056 |
| 4-6 months | -0.0137 | 0.0051 | 0.0077 | 0.0027 | 0.0214 | 0.0044 |
| 6-8 months | -0.0123 | 0.0040 | 0.0081 | 0.0030 | 0.0204 | 0.0030 |
| 8-10 months | -0.0092 | 0.0027 | 0.0067 | 0.0027 | 0.0159 | 0.0024 |
| 10-12 months | -0.0047 | 0.0014 | 0.0153 | 0.0044 | 0.0200 | 0.0043 |
| 12-18 months | -0.0069 | 0.0020 | 0.0065 | 0.0040 | 0.0134 | 0.0042 |
| 18-24 months | -0.0036 | 0.0012 | -0.0022 | 0.0011 | 0.0014 | 0.0011 |
| 24-30 months | -0.0016 | 0.0006 | -0.0018 | 0.0007 | -0.0002 | 0.0003 |

Effect of Prejudgment Interest:

| baseline distribution of settlement times | (1) --W/o prejint-- param | serr | (2) ---W/prejint--- param | serr | (2) - (1) --Difference--- param | serr |
|---|---|---|---|---|---|---|
| <1 month | 0.3854 | 0.0244 | 0.3280 | 0.0218 | -0.0574 | 0.0124 |
| 1-2 months | 0.1908 | 0.0067 | 0.1759 | 0.0075 | -0.0148 | 0.0033 |
| 2-4 months | 0.1884 | 0.0044 | 0.1892 | 0.0041 | 0.0007 | 0.0029 |
| 4-6 months | 0.1056 | 0.0066 | 0.1182 | 0.0048 | 0.0125 | 0.0034 |
| 6-8 months | 0.0571 | 0.0062 | 0.0712 | 0.0055 | 0.0140 | 0.0031 |
| 8-10 months | 0.0315 | 0.0049 | 0.0436 | 0.0050 | 0.0121 | 0.0025 |
| 10-12 months | 0.0134 | 0.0026 | 0.0327 | 0.0053 | 0.0192 | 0.0036 |
| 12-18 months | 0.0166 | 0.0040 | 0.0305 | 0.0066 | 0.0139 | 0.0038 |
| 18-24 months | 0.0071 | 0.0022 | 0.0083 | 0.0028 | 0.0012 | 0.0015 |
| 24-30 months | 0.0027 | 0.0011 | 0.0019 | 0.0009 | -0.0008 | 0.0006 |

Figure 1: Predicted Distribution of Settlements Over Time

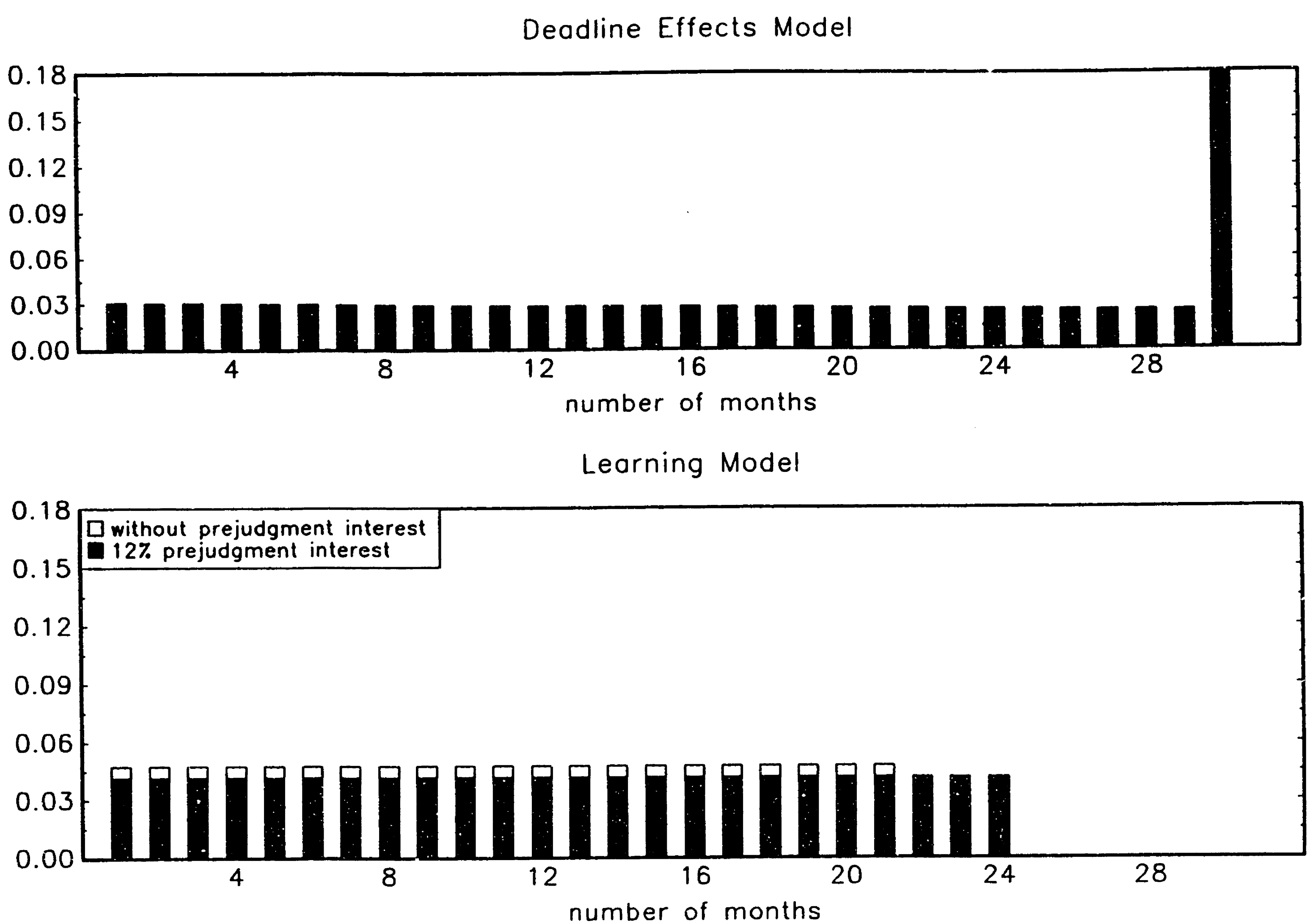
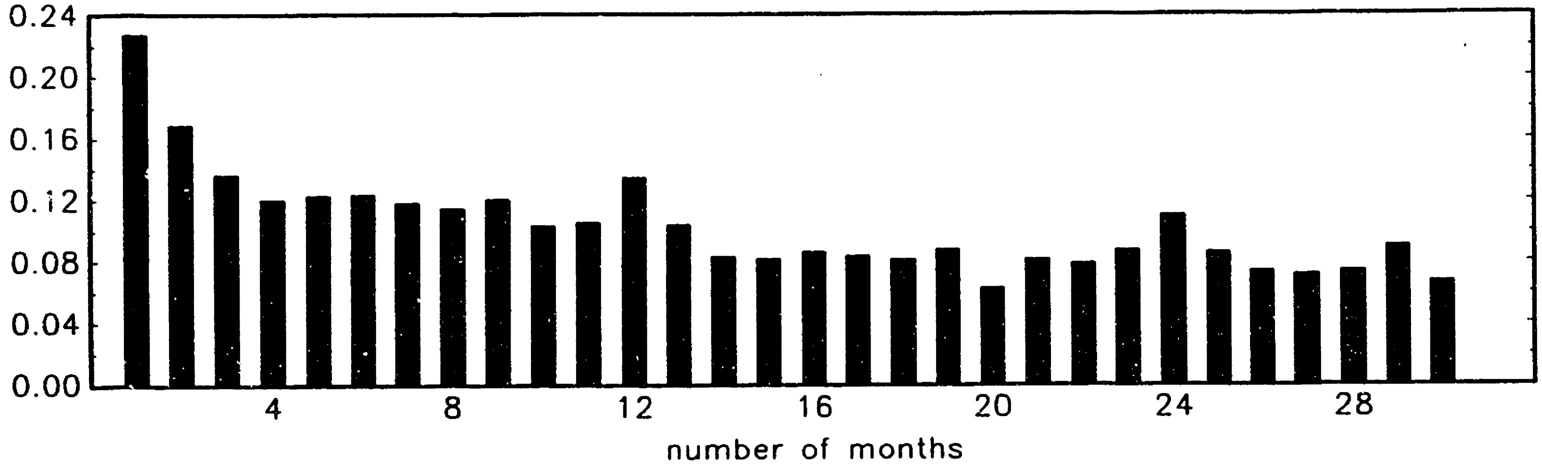


Figure 2

Kaplan–Meier Empirical Hazard




Distribution of Settlement Times

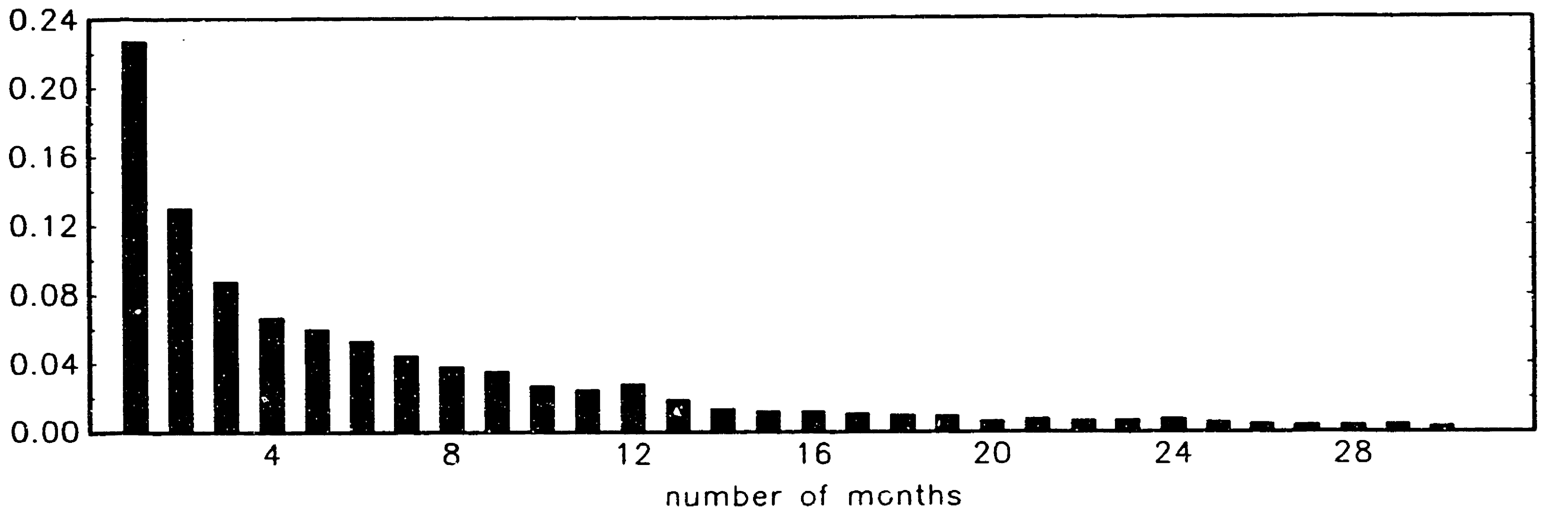
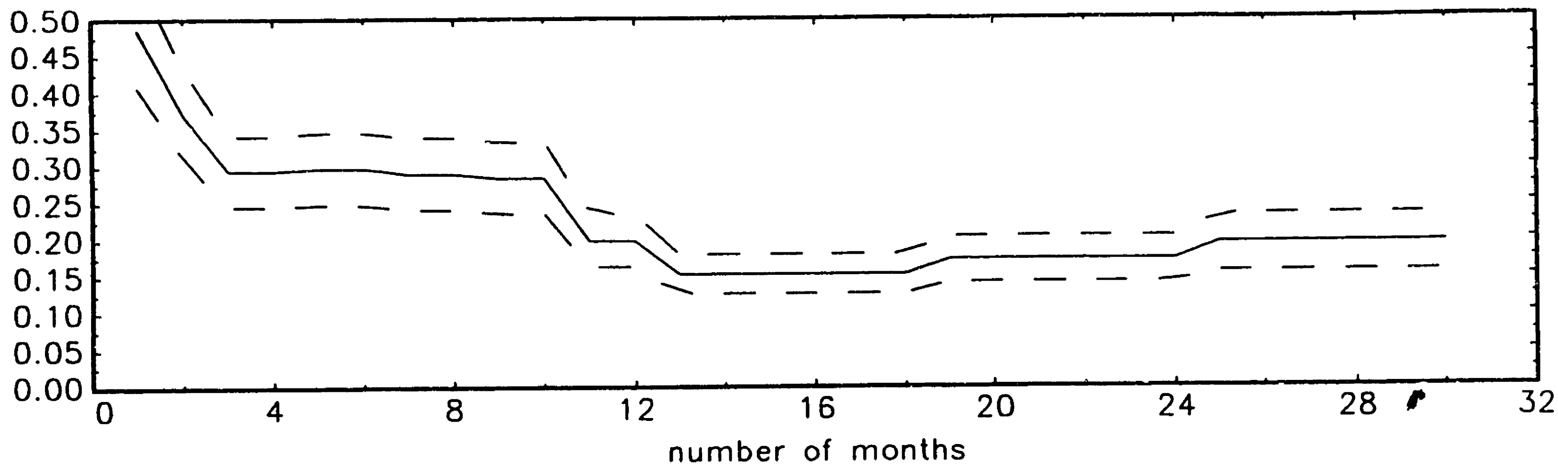
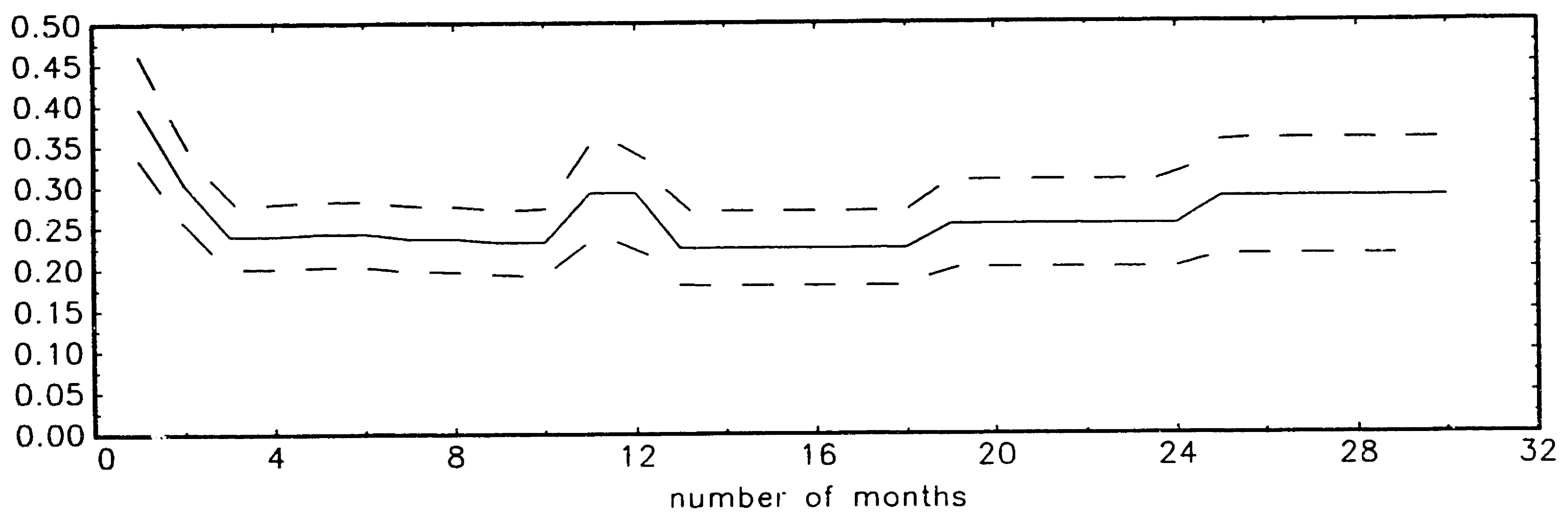


Figure 3

Baseline Hazard, No Prejudgment Interest




Baseline Hazard, Prejudgment Interest



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Appendix A: Participating Insurers, Chapters 1 and 2

Aetna Life and Casualty
Alfa Mutual Insurance Company
Allied Group (1987 only)
Allstate Insurance Company
American Family Mutual Insurance Company
American General Group (1987 only)
Auto Club of Michigan (1987 only)
Auto Club of Southern California
California State Automobile Association (1987 only)
CIGNA (1987 only)
Concord Group (1987 only)
Continental Insurance Group
Country Mutual Insurance Company (1987 only)
Detroit Automobile Inter-Insurance Exchange (1977 only)
Erie Insurance Group (1987 only)
Farm Bureau Mutual of Kansas (1987 only)
Farm Bureau Mutual of Kentucky (1977 only)
Farm Bureau Mutual of Iowa (1987 only)
Farmers Mutual of Nebraska (1987 only)
Farmers Insurance Group (1977 only)
Fireman's Fund Insurance Companies (1977 only)
GEICO
Hartford Insurance Group (1977 only)
Insurance Company of North America (1977 only)
Island Insurance Company (1987 only)
Kemper Insurance Companies (1977 only)
Liberty Mutual Insurance Company
Maryland Casualty Company (1977 only)
MFA Mutual Insurance Company (1977 only)
Mountain West Farm Bureau (1987 only)
National Farmers Union Insurance Company
Nationwide Mutual Insurance Company
New Jersey Manufacturers Insurance Company
PEMCO Insurance (1987 only)
Prudential Property and Casualty Insurance Company
SAFECO Insurance Company
Selected Risks Insurance Company (1977 only)
Sentry Mutual Insurance Company (1977 only)
Shelter Insurance Company (1987 only)
Southern Farm Bureau Casualty
State Farm Mutual Automobile Insurance Company
Tennessee Farmers (1987 only)
Travelers Insurance Company
United Farm Bureau of Indiana (1987 only)
USAA (1987 only)
USF&G Company (1977 only)

**Appendix B**

**Tort Laws Used in Analysis**[86]

[86]See Campbell, Kessler and Shepherd (1994), cited in Chapter 3.

Caps on Attorneys' Fees**

| State | Med Mal or General | Code Section | Eff. dates apply to | Effective Dates From | Effective Dates To* | Fee Schedule Percentage | Fee Schedule Applies to ($ '000) | Comments |
|---|---|---|---|---|---|---|---|---|
| AL | | | | | | | | |
| AK | | | | | | | | |
| AZ | MM | 12-568 | | 2/27/76 | | | | a |
| AR | | | | | | | | |
| CA | MM | Bus. & Prof. 6146 | contract | 12/12/75 | 12/31/87 | 40 | 0-50 | |
| | | | | | | 33.3 | 50-100 | |
| | | | | | | 25 | 100-200 | |
| | | | | | | 10 | 200+ | |
| | | | | 1/1/88 | | 40 | 0-50 | |
| | | | | | | 33.3 | 50-100 | |
| | | | | | | 25 | 100-600 | |
| | | | | | | 15 | 600+ | |
| CO | | | | | | | | |
| CT | G | 52-251c | injury | 10/1/86 | | 33.3 | 0-300 | |
| | | | | | | 25 | 300-600 | |
| | | | | | | 20 | 600-900 | |
| | | | | | | 15 | 900-1200 | |
| | | | | | | 10 | 1200+ | |
| DE | MM | Tit. 18, 6865 | | 1976 | | 35 | 0-100 | |
| | | | | | | 25 | 100-200 | |
| | | | | | | 10 | 200+ | |
| DC | | | | | | | | |
| FL | MM | 768.56 | injury | 7/1/80 | 6/30/86 | | | b |
| | G | Bar Rule 4-1.5 | injury | 7/1/86 | | 40 | 0-1000*** | c |
| | | | | | | 30 | 1000-2000 | |
| | | | | | | 20 | 2000+ | |
| GA | | | | | | | | |
| HI | G | 607-15.5 | | 8/1/86 | | | | a |
| ID | MM | 39-4213 | | 1975 | 6/1/81 | 40 | | |
| IL | MM | Ch. 100, 2-1114 | filing | 8/15/85 | | 33.3 | 0-150 | |
| | | | | | | 25 | 150-1000 | |
| | | | | | | 20 | 1000+ | |
| IN | MM | 16-9.5-5-1 | | 1975 | | 15 | 100+ | d |
| IA | MM | 147.138 | | 1975 | | | | a |
| KS | MM | 7-121b | | 1976 | | | | a |
| KY | | | | | | | | |
| LA | | | | | | | | |
| ME | MM | Tit. 24, 2961 | contract | 8/1/88 | | 33.3 | 0-100 | |
| | | | | | | 25 | 100-200 | |
| | | | | | | 20 | 200+ | |
| MD | MM | 3-2A-07 | | 1976 | | | | a |
| MA | MM | Ch. 231, 60I | injury | 11/1/86 | | 40 | 0-150 | |
| | | | | | | 33.3 | 150-300 | |
| | | | | | | 30 | 300-500 | |
| | | | | | | 25 | 500+ | |

* Reforms declared unconstitutional do not apply to claims pending as of the date of the ruling.

**Laws found in General Statutes, Civil Practice, Civil Procedure, or Revised Code unless otherwise indicated. Caps apply per injury unless otherwise specified.

***See comments section for further explanation.

Caps on Attorneys' Fees (cont'd.)**

| State | Med Mal or General | Code Section | Eff. dates apply to | Effective Dates From | To* | Fee Schedule Percentage | Applies to ($ '000) | Comments |
|---|---|---|---|---|---|---|---|---|
| MI | G | Ct. Rules 8.121(b) | contract | 7/9/81 | | 33.3 | | |
| MN | | | | | | | | |
| MS | | | | | | | | |
| MO | | | | | | | | |
| MT | | | | | | | | |
| NE | MM | 44-2834 | | 1976 | | | | a |
| NV | | | | | | | | |
| NH | G | 508:4-d | injury | 7/1/86 | | | 200+ | a |
| NJ | G | Ct. Rules 1.21-7 | contract | 11/1/76 | | 33.3 | 0-250 | |
| | | | | | | 25 | 250-500 | |
| | | | | | | 20 | 500-1000 | |
| | | | | | | *** | 1000+ | a |
| NM | | | | | | | | |
| NY | G | Ct. Rules 603.7 | | 1/1/70 | | 50 | 0-1*** | e |
| | | | | | | 40 | 1-3 | |
| | | | | | | 35 | 4-25 | |
| | | | | | | 25 | 25+ | |
| | MM | Jud. Law 474a | contract | 7/1/85 | | 30 | 0-250 | |
| | | | | | | 25 | 250-500 | |
| | | | | | | 20 | 500-1000 | |
| | | | | | | 15 | 1000-125 | |
| | | | | | | 10 | 1250+ | |
| NC | | | | | | | | |
| ND | | | | | | | | |
| OH | | | | | | | | |
| OK | G | Tit. 5, 7 | | 1953 | | 50 | | |
| OR | MM | 752.150 | contract | 9/29/75 | 9/29/87 | 33.3 | | |
| PA | MM | Tit. 40, 1301.604 | | 1/15/76 | 9/22/80 | 30 | 0-100 | f |
| | | | | | | 25 | 100-200 | |
| | | | | | | 20 | 200+ | |
| RI | | | | | | | | |
| SC | | | | | | | | |
| SD | | | | | | | | |
| TN | MM | 29-26-120 | | 1975 | | 33.3 | | |
| TX | | | | | | | | |
| UT | MM | 78-14-7.5 | injury | 4/29/85 | | 33.3 | | |
| VT | | | | | | | | |
| VA | | | | | | | | |
| WA | MM | 7.70.070 | | 1976 | | | | a |
| WV | | | | | | | | |
| WI | MM | 655.013 | contract | 7/24/75 | 6/13/86 | | | a |
| | | | | 6/14/86 | | 33.3 | 0-1000*** | g |
| | | | | | | 20 | 1000+ | |
| WY | G | Ct. Rule 6 | | 1977 | | | | a |

* Reforms declared unconstitutional do not apply to claims pending as of the date of the ruling.
**Laws found in General Statutes, Civil Practice, Civil Procedure, or Revised Code unless otherwise indicate
Caps apply per injury unless otherwise specified.
***See comments section for further explanation.

## Caps on Damage Awards**

| State | Med Mal or General | Code Section | Eff. dates apply to | Effective Dates From | Effective Dates To* | Cap 1/Cap 2 Damages to which Stat. applies | Cap ($ '000) | Comments |
|---|---|---|---|---|---|---|---|---|
| AL | MM | 6-5-544; 6-5-54 | injury | 6/11/87 | | A/B | 400/1000 | |
| AK | G | 09.17.010 | injury | 6/11/86 | | A,C | 500 | |
| AZ | | | | | | | | |
| AR | | | | | | | | |
| CA | MM | Civ. Code 3333.2 | | 12/12/75 | | A | 250 | b |
| CO | G<br>MM | 13-21-102.5<br>13-64-102 | filing<br>injury | 7/1/86<br>1/1/89 | | A,C<br>A/D | 500<br>250/1000 | c<br>d |
| CT | | | | | | | | |
| DE | | | | | | | | |
| DC | | | | | | | | |
| FL | G<br>MM | 768.80<br>766.207, 766.209 | injury<br>injury | 7/1/86<br>7/5/88 | 4/23/87 | A<br>A | 450<br>250*** | o<br>p |
| GA | | | | | | | | |
| HI | G*** | 663-8.7 | injury | 8/1/86 | 10/1/93 | E | 375 | a |
| ID | G | 6-1603 | injury | 7/1/87 | | A | 400 | e |
| IL | | | | | | | | |
| IN | MM | 16-9.5-2.2 | | 1975<br>1/1/90 | 12/31/89 | D<br>D | 500<br>750 | |
| IA | | | | | | | | |
| KS | G***<br>G | 60-19a01-02<br>60-1903 | injury | 7/1/87<br>1970<br>7/1/75<br>7/1/84 | <br>6/30/75<br>6/30/84 | A<br>B,D<br>A,B<br>A,B | 250<br>50<br>25<br>100 | g |
| KY | | | | | | | | |
| LA | MM | 40:1299.42 | | 1975 | | D,F | 500 | |
| ME | | | | | | | | |
| MD | G | 11-108 | injury | 7/1/86 | | A | 350 | |
| MA | MM | Ch. 231, 60H | injury | 11/1/86 | | A,C | 500 | i |
| MI | MM | 600.1483 | injury | 10/1/86 | | A | 225 | j |
| MN | G | 549.23 | filing | 8/1/86 | 5/4/90 | G | 400 | k |
| MS | | | | | | | | |
| MO | MM | 538.210 | injury | 2/3/86 | | A | 350 | l |
| MT | | | | | | | | |
| NE | MM | 44-2825 | injury | 1976<br>1/1/85<br>1/1/93 | 12/31/84<br>12/31/92 | D<br>D<br>D | 500<br>1000<br>1250 | |
| NV | | | | | | | | |
| NH | G | 508:4-d | injury | 7/1/86 | 3/13/91 | A | 875 | n |
| NJ | | | | | | | | |
| NM | MM | 41-5-6-41-5-7 | | 1/1/76 | | D,H | 500 | |
| NY | | | | | | | | |
| NC | | | | | | | | |

* Reforms declared unconstitutional do not apply to claims pending as of the date of the ruling.

**Laws found in General Statutes, Civil Practice, Civil Procedure, or Revised Code unless otherwise indicated. Caps apply per injury unless otherwise specified.

***See comments section for further explanation.

Caps on Damage Awards (cont'd.) **

| State | Med Mal or General | Code Section | Eff. dates applies to | Effective Dates From | Effective Dates To* | Cap 1/Cap 2 Damages to which Stat. applies | Cap ($ '000) | Comments |
|---|---|---|---|---|---|---|---|---|
| ND | | | | | | | | |
| OH | MM | 2307.43 | injury | 7/28/75 | | A | 200 | q |
| OK | | | | | | | | |
| OR | G | 18.550 | filing | 9/28/87 | | A | 500 | |
| PA | | | | | | | | |
| RI | | | | | | | | |
| SC | | | | | | | | |
| SD | MM | 21-3-11 | injury | 7/1/76<br>7/1/86 | 6/30/86 | D<br>D | 500<br>1000 | |
| TN | | | | | | | | |
| TX | MM | Art. 4590i, 11.02-04 | injury | 8/29/77 | 5/11/88 | D | 500 | r |
| UT | MM | 78-14-7.1 | injury | 4/28/86 | | A | 250 | |
| VT | | | | | | | | |
| VA | MM | 8.01-581.15 | injury | 10/1/76<br>10/1/83 | 9/30/83 | D<br>D | 750<br>1000 | |
| WA | G | 4.56.250 | filing | 6/11/86 | 4/27/89 | A | *** | s |
| WV | MM | 55-7B-8 | injury | 6/6/86 | | A | 1000 | |
| WI | MM | 893.55 | filing | 6/14/86 | 12/31/90 | A | 1000 | t |
| WY | | | | | | | | |

* Reforms declared unconstitutional do not apply to claims pending as of the date of the ruling.
**Laws found in General Statutes, Civil Practice, Civil Procedure, or Revised Code unless otherwise indicate
Caps apply per injury unless otherwise specified.
***See comments section for further explanation.

Reforms to the Collateral Source Rule***

| State | Med Mal or General | Code Section | Eff. dates apply to | Effective Dates From | Effective Dates To* | Evidentiar or Direct** | Collateral Sources Excluded | Comments |
|---|---|---|---|---|---|---|---|---|
| AL | MM | 6-5-545 | injury | 6/11/87 | | E | I | a |
| AK | MM | 09.55.548 | injury | 1976 | | D | A | |
| | G | 09.17.070 | injury | 6/11/86 | | D | A | |
| AZ | MM | 12-565 | | 2/27/76 | | E | | a,b,c |
| AR | | | | | | | | |
| CA | MM | Civ. Code 3333.1 | | 12/12/75 | | E | | a,d,e |
| CO | G | 13-21-111.6 | filing | 7/1/86 | | D | B | |
| CT | MM | 52-225a | filing | 10/1/85 | | D | C | a |
| | G | 52-225a | injury | 10/1/86 | | D | C | a |
| DE | MM | Tit. 18 Sec. 6862 | | 1976 | | E | B | |
| DC | | | | | | | | |
| FL | MM | 768.50 | | 1975 | | D | C | f,g |
| | G | 768.76 | injury | 7/1/86 | | D | C | f |
| GA | G | 51-12-1 | injury | 7/1/87 | 3/15/91 | E | | a,h |
| HI | | | | | | | | |
| ID | MM | 39-4210 | | 1975 | 6/1/81 | D | | |
| | G | 6-1606 | injury | 7/1/90 | | D | C,D,E | f |
| IL | MM | Ch. 110, 2-1205 | | 1976 | | D | C | i |
| | G | Ch. 110, 2-1205 | injury | 11/25/86 | | D | C,F | f,i,j |
| IN | G | 34-4-36-2 | injury | 9/1/86 | | E | D,E,G,H | a,b |
| IA | MM | 147.136 | | 1975 | 6/30/87 | D | | k |
| | G | 668.14 | injury | 7/1/87 | | E | E,H | a |
| KS | MM | 60-3403 | | 7/1/85 | 7/17/87 | E | D | a,b,l |
| | G | 60-3805 | injury | 7/1/88 | | D | C | a,m |
| KY | G | 411.188 | filing | 7/15/88 | | E | D | a,b |
| LA | | | | | | | | |
| ME | MM | Tit. 24 Sec. 2906 | filing | 9/19/89 | | D | C | a,n |
| MD | | | | | | | | |
| MA | MM | Ch. 231, 60G | judgment | 11/1/86 | | D | C | f |
| MI | G | 600.6303 | filing | 10/1/86 | | D | C,D | f |
| MN | G | 548.36 | filing | 8/1/86 | | D | D | f |
| MS | | | | | | | | |
| MO | | | | | | | | o |
| MT | G | 27-1-308 | injury | 10/1/87 | | D | C,D | p |
| NE | MM | 44-2819 | | 1976 | | E | I | f,q,r |
| NV | | | | | | | | |
| NH | | | | | | | | |
| NJ | G | 2A:15-97 | injury | 12/18/87 | | D | D,J | f,t |
| NM | | | | | | | | |
| NY | MM | Civ. Prac. 4545 | injury | 7/1/81 | | D | C | f |
| | G | Civ. Prac. 4545 | filing | 7/28/86 | | D | C | f |
| NC | | | | | | | | |
| ND | G | 32-3.2-6 | injury | 7/8/87 | | D | C,D,H | |

* Reforms declared unconstitutional do not apply to claims pending as of the date of the ruling.

**Evidentiary reforms generally mean that evidence of collateral source payment is admissible to fact finder; direct reforms generally mean that the judge must reduce award by amount of collateral source benefits.

***Laws found in General Statutes, Civil Practice, Civil Procedure, or Revised Code unless otherwise indicate

Reforms to the Collateral Source Rule (cont'd.) ***

| State | Med Mal or General | Code Section | Eff. dates applies to | Effective Dates From | To* | Evidentiar or Direct** | Collateral Sources Excluded | Comments |
|---|---|---|---|---|---|---|---|---|
| OH | MM<br>G | 2305.27<br>2317.45 | <br>injury | 1975<br>1/5/88 | | D<br>D | K | e,u<br>f |
| OK | | | | | | | | |
| OR | G | 18.580 | filing | 9/29/87 | | E | D,G,L | q |
| PA | MM | Tit. 40, 1301.602 | | 1975 | 9/22/80 | D | B | v |
| RI | MM | 9-19-34.1 | | 1976 | | D | | e,f |
| SC | | | | | | | | |
| SD | MM | 21-3-12 | | 7/1/77 | | E | C,E,G,H | |
| TN | MM | 29-26-119 | filing | 7/1/75 | | D | M | |
| TX | | | | | | | | |
| UT | MM | 78-14-4.5 | injury | 4/29/85 | | D | C | f |
| VT | | | | | | | | |
| VA | | | | | | | | |
| WA | MM | 7.70.080 | | 1976 | | E | | |
| WV | | | | | | | | |
| WI | | | | | | | | |
| WY | | | | | | | | |

* Reforms declared unconstitutional do not apply to claims pending as of the date of the ruling.

**Evidentiary reforms generally mean that evidence of collateral source payment is admissible to fact finde direct reforms generally mean that the judge must reduce award by amount of collateral source benefits.

***Laws found in General Statutes, Civil Practice, Civil Procedure, or Revised Code unless otherwise indic

Changes from Contributory to Comparative Negligence***

| State | Type of Compar. Negligence | Case Cite or Code Section | Eff. dates apply to | Effective Dates From | To** | Comments |
|---|---|---|---|---|---|---|
| AL+/ | | | | | | |
| AK+/ | P | 540 P.2d 1037 | judgment | 9/17/75 | | a |
| AZ+/ | P | 12-2501 - 12-2509 | filing | 8/31/84 | | |
| AR | M | 27-1763 - 27-1765 | | 1955 | | |
| CA+/ | P | 532 P.2d 1226 | judgment* | 3/31/75 | | |
| CO | M | 13-21-111 | injury | 7/1/71 | | |
| CT | M | 52-572h | | 10/1/73 | | |
| DE | M | Tit. 10, 8132 | injury | 7/17/84 | | |
| DC | | | | | | |
| FL | P | 280 So.2d 431 | judgment* | 7/10/73 | | b |
| GA | M | 46-8-291, 51-11-7 | | c. 1900 | | c |
| HI | M | 663-31 | injury | 1969 | | |
| ID+/ | M | 6-801-6-806 | | 7/1/71 | | |
| IL | P<br>M | 421 N.E.2d 886<br>2-1107.1, 2-1116 | judgment*<br>injury | 4/17/81<br>11/25/86 | 11/25/86 | d |
| IN+/ | M | 34-4-33-1 et seq. | injury | 1/1/85 | | |
| IA+/ | P<br>M | 327 N.W.2d 742<br>668.3 | judgment<br>filing | 12/22/82<br>7/1/84 | 6/30/84 | |
| KS | M | 60-258a, 60-258b | injury | 7/1/74 | | |
| KY | P | 673 S.W.2d 713 | judgment | 7/5/84 | | |
| LA+ | P | 2323 | injury | 8/1/80 | | |
| ME+/ | M | Tit. 14, 156 | | 1965 | | |
| MD | | | | | | |
| MA | M | Ch. 231, 85 | injury | 1969 | | |
| MI | P | 275 N.W.2d 511 | judgment | 2/8/79 | | |
| MN | M | 604.01, 604.02 | filing | 7/1/69 | | |
| MS+ | P | 11-7-15 | | 1910 | | |
| MO+/ | P | 661 S.W.2d 11 | judgment* | 1/31/84 | | |
| MT+ | M | 27-1-702 et seq. | | 10/1/75 | | |
| NE+/ | M | 25-1151 | | 1913 | | |
| NV+ | M | 41.141 | | 7/1/73 | | |
| NH+ | M | 507:7a | injury | 1969 | | |
| NJ | M | 2A:15-5.1 et seq. | injury | 8/24/73 | | |
| NM+/ | P | 634 P.2d 1234 | judgment | 2/12/81 | | |
| NY | P | Civ. Prac. 1411 | injury | 9/1/75 | | |
| NC+/ | | | | | | |
| ND | M | 9-10-7 | | 7/1/73 | | |
| OH+/ | M | 2315.19 | judgment* | 6/20/80 | | |
| OK+/ | M | Tit. 23, 12 -14 | injury | 8/16/73 | | |
| OR | M | 18.470-18.510 | judgment | 9/29/71 | | |
| PA | M | Tit. 42, 7102 | injury | 9/7/76 | | |
| RI+/ | P | 9-20-4, 9-20-4.1 | judgment | 7/1/71 | | |
| SC | | | | | | |
| SD | M | 20-9-2 | | 1941 | | |

* Applicable to all trials not yet started.

** Reforms declared unconstitutional do not apply to claims pending as of the date of the ruling.

***Laws are found in General Statutes, Civil Practice, Civil Procedure, or Revised Code unless case citation or other indication is given.

P=pure comparative, M=modified comparative, blank=contributory

Changes from Contributory to Comparative Negligence (cont'd.) ***

| State | Type of Compar. Negligence | Case Cite or Code Section | Eff. dates apply to | Effective Dates From | To** | Comments |
|---|---|---|---|---|---|---|
| TN+/ | | | | | | |
| TX | M | Rev. Civ. Stat. 2212a | injury | 8/27/73 | | e |
| UT | M | 78-27-37 - 78-27-43 | | 4/28/73 | | |
| VT+/ | M | Tit. 12, 1036 | injury | 7/1/70 | | |
| VA | | | | | | |
| WA | P | 4.22.005-4.22.020 | judgment | 4/1/74 | | |
| WV+/ | M | 256 S.E.2d 879 | judgment | 7/10/79 | | |
| WI+/ | M | 895.045 | | 1931 | | |
| WY+/ | M | 1-1-109 - 1-1-113 | | 5/24/73 | | |

* Applicable to all trials not yet started.
** Reforms declared unconstitutional do not apply to claims pending as of the date of the rulin
*** Laws are found in General Statutes, Civil Practice, Civil Procedure, or Revised Code unles case citation or other indication is given.
P=pure comparative, M=modified comparative, blank=contributory

Reforms Requiring Periodic Payments**

| State | Med Mal or General | Code Section | Eff. dates apply to | Effective Dates From | Effective Dates To* | Damages to which Stat. applies | $ floor ('000) | Comments |
|---|---|---|---|---|---|---|---|---|
| AL | G | 6-11-3 | injury | 6/11/87 | | A | 150 | a |
| AK | | | | | | | | b |
| AZ | MM | 12-581-12-594 | filing | 9/15/89 | | B | | |
| AR | | | | | | | | c |
| CA | MM | Civ. Pro. 667.7 | | 12/12/75 | | A | 50 | d |
| CO | MM | 13-64-203 | injury | 7/1/88 | | A | 150 | |
| CT | G | 52-225d | judgment | 10/1/86 | 10/1/87 | B | 200 | e |
| DE | | | | | | | | f |
| DC | | | | | | | | |
| FL | G | 768.78 | injury | 7/1/86 | | A | 250*** | g |
| GA | | | | | | | | |
| HI | | | | | | | | |
| ID | G | 6-1602 | injury | 7/1/87 | 6/30/92 | A | 100 | |
| IL | MM | Ch. 110, 2-1705-18 | filing | 8/15/85 | | A | 250 | h |
| IN | | | | | | | | |
| IA | | | | | | | | i |
| KS | | | | | | | | j |
| KY | | | | | | | | |
| LA | | | | | | | | |
| ME | MM | Tit. 24, 2951 | filing | 9/19/85 | | A | 250 | |
| MD | | | | | | | | k |
| MA | | | | | | | | |
| MI | G | 600.6307 | filing | 10/1/86 | | B,C*** | 250 | l |
| MN | | | | | | | | |
| MS | | | | | | | | |
| MO | MM | 538.220 | injury | 2/3/86 | | A | 100 | |
| MT | | | | | | | | |
| NE | | | | | | | | |
| NV | | | | | | | | |
| NH | | | | | | | | |
| NJ | | | | | | | | |
| NM | MM | 41-5-7 | | 1976 | | D | 100 | |
| NY | MM<br>G | Civ. Prac. 5031<br>Civ. Prac. 5041 | filing<br>filing | 7/1/85<br>7/30/86 | | A<br>A | 250<br>250 | |
| NC | | | | | | | | |
| ND | | | | | | | | n |
| OH | MM | 2323.57 | injury | 10/20/87 | | A | 200 | o |
| OK | | | | | | | | |
| OR | | | | | | | | |
| PA | | | | | | | | |
| RI | | | | | | | | |
| SC | | | | | | | | p |
| SD | MM | 21-3A-1 - 21-3A-13 | injury | 7/1/88 | | A | 200 | |
| TN | | | | | | | | |
| TX | | | | | | | | |

* Reforms declared unconstitutional do not apply to claims pending as of the date of the ruling.
**Laws are found in General Statutes, Civil Practice, Civil Procedure, or Revised Code unless otherwise indicat
***See comments secton for further explanation.

Reforms Requiring Periodic Payments (cont'd.) **

| State | Med Mal or General | Code Section | Eff. dates apply to | Effective Dates From | Effective Dates To* | Damages to which Stat. applies | $ floor ('000) | Comments |
|---|---|---|---|---|---|---|---|---|
| UT | MM | 78-14-9.5 | injury | 4/28/86 | | A | 100 | |
| VT | | | | | | | | |
| VA | | | | | | | | |
| WA | G | 4.56.260 | filing | 6/11/86 | | B | 100 | q |
| WV | | | | | | | | |
| WI | MM | 655.015 | injury | 1975 | 6/14/86 | D | 25 | |
| WY | | | | | | | | |

* Reforms declared unconstitutional do not apply to claims pending as of the date of the ruling.

**Laws are found in General Statutes, Civil Practice, Civil Procedure, or Revised Code unless otherwise indi

***See comments secton for further explanation.

Statutes Mandating Payment of Prejudgment Interest in Personal Injury Cases**

| State | Actions to Which Statu Applies | Code Section | Eff. dates apply to | Effective Dates From | To | Interest Accrues As Of | Interest Rate (%)**** | Comments |
|---|---|---|---|---|---|---|---|---|
| AL/ | | | | | | | | |
| AK/ | tort* | 09.030.065 et seq; 45.45.010 | injury | 1965 | | injury | 10.5*** | a |
| AZ/ | | | | | | | | |
| AR | | | | | | | | |
| CA/ | pers. injury* | 3291 | judgment | 1/1/82 | | *** | 10 | b,c |
| CO | pers. injury | 13-21-101 | filing<br>filing | 1935<br>1/1/83 | 12/31/82 | filing***<br>injury | 9<br>9*** | d<br>e |
| CT | all civil | 52-192a | injury | 10/1/76<br>10/1/79 | 9/30/79 | filing<br>filing*** | 6<br>12 | f<br>f |
| DE | | | | | | | | |
| DC | | | | | | | | |
| FL | | | | | | | | |
| GA | tort | 51-12-14 | | 1968 | | plaintiff offer | 12 | g |
| HI | | | | | | | | h |
| ID/ | | | | | | | | |
| IL | | | | | | | | |
| IN/ | | | | | | | | |
| IA/ | all civil | 535.2 et seq | judgment | 1/1/81 | | filing | 10 | i |
| KS | | | | | | | | |
| KY | | | | | | | | |
| LA | tort | 13:4303; LA Civil Code art 2924 | filing | 1970<br>9/12/80<br>9/12/81<br>1/2/88 | 9/11/80<br>9/11/81<br>1/1/88 | filing<br>filing<br>filing<br>filing | 7<br>10<br>12<br>*** | j |
| ME/ | all civil | Tit. 14, 1602 | filing<br>filing<br>injury | 1969<br>7/1/80<br>8/1/88 | 6/30/80<br>7/31/88 | filing<br>filing<br>filing | 6<br>8<br>8*** | k<br>k<br>k,l |
| MD | | | | | | | | hh |
| MA | pers./ prop. inj. | Chap. 231, 6B | judgment<br>judgment<br>judgment<br>judgment | 1946<br>8/14/74<br>9/19/80<br>7/1/82 | 8/13/74<br>9/18/80<br>6/30/82 | filing<br>filing<br>filing<br>filing | 6<br>8<br>10<br>12 | m<br>m<br>m<br>m |
| MI | all civil | MSA 27A.6013; Comp. L. 600.6013 | judgment<br>judgment<br>judgment | 7/21/65<br>6/1/80<br>1/1/87 | 5/31/80<br>12/31/86 | filing<br>filing<br>filing | 6<br>12<br>*** | n<br>n<br>n,o |
| MN | all civil | 549.09 and admin. comments | judgment<br>judgment<br>injury | 7/1/84<br>1/1/86<br>8/1/86 | 12/31/85<br>7/31/86 | filing<br>filing<br>min(filing, plaintiff offer | 9<br>8<br>*** | p<br>p<br>p,q |
| MS | | | | | | | | |
| MO/ | | | | | | | | |

* Except cases in which state government is defendant.

**Laws found in General Statutes, Civil Practice, Civil Procedure, or Revised Code unless otherwise indicated. In regimes in which laws are effective as to judgment date, the rate at which prejudgment interest accrues varies with the rate in effect unless otherwise indicated.

***See comments section for further explanation.

****Rates are compounded annually unless otherwise indicated.

Statutes Mandating Payment of Prejudgment Interest in Personal Injury Cases (cont'd.) **

| State | Actions to Which Statu Applies | Code Section | Eff. dates apply to | Effective Dates From | To | Interest Accrues As Of | Interest Rate (%)**** | Comments |
|---|---|---|---|---|---|---|---|---|
| MT | torts | 27-1-210 et seq | filing | 10/1/85 | | filing+30 d | 10 | p |
| NE/ | | | | | | | | |
| NV | all civil | 17.115, 17.130 | injury<br>injury | 7/1/79<br>7/1/87 | 6/30/87 | filing<br>filing | 12<br>*** | r<br>r,s |
| NH | all civil | 524:1-b | judgment<br>judgment | 1957<br>8/16/81 | 8/15/81 | filing<br>filing | 6<br>10 | |
| NJ | tort* | Ct. Rule 4:42-11(b) | judgment<br>judgment<br>judgment<br>judgment | 1/31/72<br>4/1/75<br>9/14/81<br>1/1/88 | 3/31/75<br>9/13/81<br>12/31/87 | max(filing, inj.+6 mo) | 6<br>8<br>12<br>6*** | <br><br><br>t |
| NM/ | | | | | | | | u |
| NY | wrongful death | Estate & Trust 5-4.3 | judgment<br>judgment | 1967<br>6/26/81 | 6/25/81 | injury<br>injury | 6<br>9 | |
| NC/ | insured civil | 24-1, 24-5 | filing | 5/5/81 | | filing | 8 | |
| ND | | | | | | | | v |
| OH/ | | | | | | | | w |
| OK/ | pers. injury | Tit. 12, 727(2) | judgment | 9/10/71<br>10/1/79<br>4/1/82<br>11/1/86 | 9/30/79<br>3/31/82<br>10/31/86 | filing | 6<br>10/6<br>15/1<br>*** | <br>x<br>x<br>y |
| OR | | | | | | | | |
| PA | pers./ prop. inj. | R. Civil Proc. 238 | filing<br>judgment | 4/15/79<br>11/7/88 | 11/6/88 | max(filing, inj.+1 yr)<br>inj.+1 yr | 10<br>*** | z<br>aa |
| RI/ | all civil | 9.21-10 | judgment<br>judgment<br>judgment | 9/1/58<br>9/1/70<br>5/8/81 | 8/31/70<br>5/7/81 | filing<br>filing***<br>injury | 6<br>8<br>12 | <br>bb |
| SC | | | | | | | | |
| SD | | | | | | | | cc |
| TN/ | | | | | | | | dd |
| TX | tort | 696 S.W. 2d 549 | judgment | 6/5/85 | | min(death, inj.+ 6 mo) | *** | m, ee |
| UT | pers. injury | 78-27-44 | judgment<br>judgment | 5/13/75<br>4/28/91 | 4/28/91 | injury<br>injury | 8<br>10 | p<br>p,ff |
| VT/ | | | | | | | | |
| VA | | | | | | | | gg |
| WA | | | | | | | | |
| WV/ | all civil | 56-6-31 | judgment | 7/5/81 | | injury | 10 | p |
| WI/ | all civil | 807.01 | filing | 5/11/80 | | plaintiff offe | 12 | b |
| WY/ | | | | | | | | |

* Except cases in which state government is defendant.

**Laws found in General Statutes, Civil Practice, Civil Procedure, or Revised Code unless case citation or other indication is given.

In regimes in which laws are effective as to judgment date, the rate at which prejudgment interest accrues varies with the rate in effect unless otherwise indicated.

***See comments section for further explanation.

****Rates are compounded annually unless otherwise indicated.

Comments to Appendix B
Comments to Caps on Attorneys' Fees

a
Attorneys' fees are subject to court scrutiny.

b
Attorneys' fees are subject to court scrutiny according to statutory guidelines.

c
Unless settlement occurs before defendant files an answer or the demand for an arbitrator is made, in which case contingency fees must not exceed 33.3 percent of the first $1,000,000. of recovery. In addition, if defendants admit liability at the time of filing of answers and request a trial only on damages, then contingency fees must not exceed 33.3 percent of the first $1,000,000. of recovery, 20 percent of any recovery between $1,000,000. and $2,000,000., and 15 percent of any recovery over $2,000,000. Finally, contingency fees may be 5 percent higher if appeals are filed or action is required for recovery on the judgment.

d
Cap applies to awards paid by state PCF.

e
Fees are capped at the listed fee schedule or 33.3 percent, whichever is larger.

f
Declared unconstitutional, Heller v. Frankston, 475 A.2d 1291 (1984).

g
Fees are capped at 25 percent of the first $1,000,000. recovered if liability is stipulated within 180 days after filing of complaint and not later than 60 days before the first day of trial.

Damages to Which Caps on Damage Awards Apply

A
Noneconomic damages

B
Damages for wrongful death

C
Except damages for disfigurement or severe physical impairment

D
Total damages

E
Damages for actual pain and suffering only, not mental anguish, disfigurement, loss of enjoyment of life, or loss of consortium

F
Except interest, costs and future medical care

G
Damages for embarrassment, emotional distress and loss of consortium only, not pain, disability or disfigurement

H
Except punitive damages and medical care

Comments to Caps on Damage Awards

a
Cap applies generally but not to automobile torts, among other types of cases. Cap does apply to medical malpractice.

b
Constitutionality upheld, Fein v. Permanente Medical Group, 695 P.2d 665 (1985).

c
Awards limited to $250,000. unless court finds clear justification to exceed.

d
Court can allow circumvention of cap under certain circumstances.

e
Cap does not apply if injury was caused by willful or reckless misconduct, or circumstances that would constitute a felony. Cap is adjusted annually for inflation based on the state's average wage.

g
Cap applies to pain and suffering only, and not to medical malpractice claims, from 7/1/87-7/1/88.

i
Jury can allow circumvention of cap under certain circumstances.

j
Cap does not apply in cases involving a wrongful death, an intentional tort, a foreign object wrongfully left in the body, an injury to the reproductive system, a fradulent concealment of injury by defendant, a wrongfully removed limb or organ, or the loss of vital bodily function. Cap is adjusted annually for inflation based on the CPI.

k
Effective as to actions arising before but filed after 5/4/90.

l
Cap applies per defendant. Cap is adjusted annually for inflation.

n
Declared unconstitutional, Brannigan v. Usitalo, 587 A.2d 1232 (1991).

o
Declared unconstitutional, Smith v. Department of Insurance, 507 So.2d 1080 (1987).

p
If parties agree to binding arbitration. If parties agree to arbitration, or plaintiff refuses to arbitrate, economic damages limited to 80 percent of plaintiff's wage loss and earning capacity. If parties agree to arbitration, nonecnomic damages are limited to $250,000. * reduction in capacity to enjoy life, where reduction in capacity is defined as a number between zero and one. If plaintiff refuses to arbitrate, noneconomic damages limited to $350,000. per incident. If defendant refuses to arbitrate, no limits apply.

q
Limit may be inoperative because lower courts in Ohio are divided as to the constitutionality of 2307.43. See, e.g., Duren v. Suburban Community Hospital, 495 N.E.2d 51,55 (1985).

r
Declared unconstitutional by the TX Supreme Court as of 5/11/88, Lucas v. U.S., 757 S.W.2d 687 (1988), but may have been inoperative before 5/11/88 because lower courts were divided as to the constitutionality of 11.02-11.04. See, e.g., Baptist Hospital of Southwest Texas v. Baber, 672 S.W.2d 296 (1984).

s
Noneconomic damages may not exceed 0.43*the average annual wage in WA*min(15 years, the life expectancy of the injured party). Declared unconstitutional, Sofie v. Fibreboard Corp., 771 P.2d 711 (1989).

t
Cap is adjusted annually for inflation.

Collateral Sources Excluded from Reforms to the Collateral Source Rule

A
Federal program sources which by law seek subrogation from life insurance

B
All reimbursement from privately obtained collateral sources

C
Reimbursement from collateral sources that have subrogation rights

D
Life Insurance

E
All federal benefits

F
Reimbursement for medical or hospital expenses directly attributable to the medical injury at issue

G
Reimbursement from collateral sources financed directly by plaintiff or his family

H
All state benefits

I
All nonmedical collateral source benefits

J
Workers' compensation

K
Reimbursement from collateral sources financed by plaintiff or his employer

L
Retirement, disability and pension benefits

M
Reimbursement from collateral sources financed privately and individually

Comments to Reforms to the Collateral Source Rule

a
Plaintiff may present evidence of costs of obtaining collateral source benefits.

b
Plaintiff may present evidence of subrogation rights of collateral sources.

c
Constitutionality upheld, Eastin v. Broomfield, 570 P.2d 744 (1977).

d
Constitutionality upheld, Fein v. Permanente Medical Group, 695 P.2d 665 (1985).

e
No collateral source may obtain subrogation.

f
Plaintiff's award is increased by amounts paid for collateral source benefits.

g
Constitutionality upheld, Pinillos v. Cedars of Lebanon Hospital Corp., 403 So. 2d 365 (1981).

h
Declared unconstitional, 402 S.E.2d 269 (1991). May have been inoperative before 3/15/91 because 51-12-1 was not applied by some lower courts.

i
Award shall be reduced by 50 percent of lost-income collateral source benefits and 100 percent of health insurance benefits, not to exceed 50 percent of the total award.

j
First $25,000. of award not subject to abrogation of collateral source rule.

k
Constitutionality upheld, Rudolph v. Iowa Methodist Medical Center, 293 N.W.2d 550 (1980).

l
Declared unconstitutional, Farley v. Engelken, 740 P.2d 1058 (1987). May have been inoperative before 7/17/87 because 60-3403 was not applied by some lower courts.

m
First $150,000. of award not subject to abrogation of collateral source rule.

n
Award may be increased by the plaintiff's litigation costs.

o
Evidence of special damages paid by defendant prior to trial may be introduced, but not evidence of collateral source benefits generally. See MO Stat. 490.715.

p
Applies only to awards exceeding $50,000.

q
Evidence on plaintiff's collateral source benefits is introduced only to the judge, not the jury.

r
Constitutionality upheld, Prendergast v. Nelson, 256 N.W.2d 657 (1977).

s
New Hampshire enacted a reform to the collateral source rule (507-C:7) in 1977 which was declared unconstitutional shortly thereafter (Carson v. Maurer, 424 A.2d 825 (1980)).

t
As of 7/1/72, the collateral source rule ceased to apply in cases involving public defendants in New Jersey. See NJ Rev. Stat. 59:9-2(e)

u
May be inoperative due to the fact that some courts have refused to apply 2305.27. See, e.g., Griffey v. Rajan, 514 N.E.2d 1122 (1987).

v
Declared unconstitutional; see Heller v. Frankston, 475 A.2d 1291 (1984) for a discussion. Also note that as of 12/5/80, the collateral source rule ceased to apply in cases involving public defendants in Pennsylvania. See PA Stat. Ann. Tit. 47, 8553(d).

## Comments to Reforms to the Contributory Negligence Rule

a
Codified in AK Stat. 09.17.060, 09.17.080, 09.17.900.

b
Codified in FL Stat. 768.81.

c
Original statute was passed in 1863; however, statute was not extended to injury cases generally and clarified so as to make it apparent that the 49 percent rule was to be applied until the early 1900s.

d
Pure comparative negligence applies to all injuries incurred before 11/25/86; 50-percent modified comparative negligence applies to all injuries incurred after 11/25/86.

e
See also TX Civ. Prac. & Rem. Code 33.001 et seq.

## Damages to Which Reforms to Periodic Payments Apply

A
Future damages

B
Future economic damages

C
Except health care costs and collateral source benefits

D
Future health care costs

Comments to Reforms Requiring Periodic Payments

a
AL Code 6-5-543 applies the periodic payments rule to medical malpractice cases specifically, also effective 6/11/87. Periodic payment in medical malpractice cases was within the judge's discretion as of 1975. See AL Code 6-5-486.

b
Periodic payment in medical malpractice cases was within the judge's discretion as of 1976. See AK Stat. 09.55.548.

c
Periodic payment in medical malpractice cases was within the judge's discretion as of 4/2/79. See AR Stat. 16-114-208.

d
Constitutionality upheld, American Bank and Trust Co. v. Community Hospital of Los Gatos-Saratoga Inc., 683 P.2d 670 (1984).

e
Statute applies to all cases closed 10/1/86-10/1/87.

f
Periodic payment in medical malpractice cases was within the judge's discretion as of 1976. See DE Code Ann. tit. 18, 6864.

g
Statute applies to any case in which economic damages exceed $250,000, except in medical malpractice cases, to which statute always applies.

h
Constitutionality upheld, Bernier v. Burris, 497 N.E.2d 763 (1986).

i
Periodic payment in medical malpractice cases was within the judge's discretion as of 1984. See IA Code 668.3.

j
Declared unconstitutional, upholding lower court's opinion, Kansas Malpractice Victims Coalition v. Bell, 757 P.2d 251 (1988).

k
Periodic payment of future economic damages was within the judge's discretion as of 7/1/86. See MD Ct. & Jud. Pro. 11-109.

l
Statute does not apply to plaintiffs more than 60 years of age. MI Comp. Laws 600.6309.

m
New Hampshire allowed either party to force payments to be periodic (507-C:7) in 1977 which was declared unconstitutional shortly thereafter (Carson v. Maurer, 424 A.2d 825 (1980)).

n
Periodic payment of future economic damages for institutional or custodial care was within the judge's discretion as of 7/8/87. ND Cent. Code 32-03.2-09.

o
Periodic payment of future damages was within the judge's discretion as of 1/5/88. OH Rev. Code 2323.56.

p
Periodic payment of damages from South Carolina's PCF was within the judge's discretion in cases in which damages exceed $100,000. as of 1976. SC Code Ann. 38-79-480.

q
All or part of the damages may be required to be paid periodically.

r
In cases subject to 655.27(5)(d), the PCF shall not pay more than $500,000. per year. Before 6/14/86, the applicable limit was $25,000. in future medical expenses. WI Stat. 655.015.

Comments to Statutes Mandating Payment of Prejudgmnet Interest In Personal Injury Cases

a
For injuries on or after 6/12/80 but before 6/11/86, interest rate increases 2 percentage points if award is greater than defendant's last offer, and interest rate decreases 2 percentage points if award is less than plaintiff's last offer. For injuries on or after 6/11/86, interest rate increases 5 percentage points if award is greater than defendant's last offer, and interest rate decreases 5 percentage points if award is less than plaintiff's last offer. Also, for injuries on or after 6/11/86, interest accrues as of filing date.

b
If plaintiff makes a prejudgment offer, award must be greater than plaintiff's offer for plaintiff to collect prejudgment interest. Date from which interest accrues is within the discretion of the jury unless plaintiff makes a prejudgment offer, in which case interest accrues from the date of the offer.

c
For judgments in wrongful death actions entered before 1/1/82, prejudgment interest was within the discretion of the jury. See Canavin v. Pacific Southwest Airlines, 148 Cal. App. 3d 512 (1983).

d
For injuries on or after 7/1/79, interest accrues as of injury.

e
Interest rate equals discount rate on 1/1 of year of judgment plus 2 percentage point for appealed cases.

f
If plaintiff makes a prejudgment offer, award must be greater than or equal to plaintiff's offer for plaintiff to collect prejudgment interest. For actions filed on or after 10/1/81, interest accrues as of filing date unless plaintiff makes an offer more than 18 months after filing, in which case interest accrues as of the date of the offer.

g
Plaintiff must make one and only one offer for prejudgment interest purposes, and that offer must be less than or equal to the final award, in order to recover prejudgment interest.

h
Prejudgment interest was within the judge's discretion as of 5/18/79. See HI Rev. Stat. 636-16.

i
Prejudgment interest on future damages prohibited for injuries occurring on or after 7/1/87.

j
Interest rate equals prime rate plus 1 percentage point but between 7 and 14 percent.

k
If prevailing party receives a continuance of greater than 30 days, interest is suspended for that time.

l
Interest Rate equals 8 percent if award is less than $30,000.; otherwise, interest rate equals one-year T-bill rate at time of filing plus 1 percentage point.

m
Interest compounded daily.

n
If either side makes an offer revealed to be substantially less favorable to the other side than the judgment, then the judge may suspend the accrual of interest as of the date of the offer. Prejudgment interest on future damages prohibited for filings on or after 10/1/86.

o
Interest rate equals five-year T-bill rate plus 1 percentage point.

p
Interest accrues on special damages only.

q
If defendant makes an offer which is closer to the final judgment than plaintiff's offer, whether or not plaintiff makes any offer, then plaintiff receives prejudgment interest on min(defendant's offer, final judgment) and prejudgment interest only accrues until the date of defendant's offer. Subsequent offers and counteroffers supercede prior offers and counteroffers. For prejudgment interest accruing in 1986, 1987, 1988, 1989, 1990, 1991, and 1992 interest rates are 8, 8, 8, 8, 7, 7, and 5 percent, respectively.

r
If defendant makes an offer which plaintiff does not accept, and plaintiff does not obtain a judgment more favorable than the offer, then plaintiff loses all prejudgment interest.

s
On injuries on or after 7/1/87, interest rate equals prime rate in NV plus 2 percentage points, adjust 1/1 and 7/1 of each year that the prejudgment interest accrues.

t
For prejudgment interest accruing in 1988, 1989, 1990, 1991, 1992, and 1993, interest rates are 6, 7, 8, 8.5, 7.5, and 5.5 percent respectively.

u
Prejudgment interest was within the judge's discretion as of 1963. NM Stat. Ann. 56-8-4.

v
Prejudgment interest was within the jury's discretion as of 1877. ND Cent. Code Ann. 32-03-05.

w
Prejudgment interest was within the judge's discretion, in cases in which the defendant failed to make a good faith effort to settle, for cases filed after 7/5/82. OH Rev. Code 1343.03.

x
First listed rate applies to actions against private parties; second listed rate applies to actions against state or local governments.

y
Interest rate equals T-bill rate plus 4 percentage points for actions against private parties; interest rate equals max(10, T-bill rate plus 4 percentage points) for actions against state or local governments.

z
If defendant makes an offer, prejudgment interest accrues only to the date of the offer, unless award is greater than 125 percent of the offer.

aa
Interest rate equals prime rate plus 1 percentage point. The applicable prime rates for prejudgment interest accruing in 1988, 1989, 1990, 1991, and 1992 are 8.75, 10.5, 10.5, 9.75, and 6.5 percent, respectively.

bb
For judgment entered on or after 3/21/77, interest accrues as of date of injury.

cc
Prejudgment interest was within the jury's discretion as of . SD Cod. Laws Ann. 21-1-11; 21-1-13.

dd
Prejudgment interest was within the discretion of the court or jury as of 1922. TN Code Ann. 47-14-123.

ee
Interest rate equals 1 year T-bill rate, but not less than 10 percent, and not more than 20 percent. Interest accrues at the rate in effect at the time of judgment, but not on future damages. Prejudgment interest in contract cases is governed by 5069-1.01.

ff
Prejudgment interest for future damages prohibited for judgments entered on or after 4/29/91.

gg
Prejudgment interest was within the discretion of the court of jury as of 1940. Code of VA Civ. Rem. & Proc., 8.01-382.

hh
Prejudgment interest was within the judge's discretion, in cases of unnecessary delay by defendant, as of 1957. MD Cts. & Jud. Proc. 11-301.

The likelihood function for the linear model is based on the work of Hausman and Wise (1977, 1979):

$$\ln(\mathcal{L})=\sum_{i|f=1}\{\ln[\frac{1}{\sigma_1}\phi\left(\frac{\ln(c)-x\beta-l\delta}{\sigma_1}\right)\Phi\left(\frac{\frac{z\gamma}{\sigma_2}-\frac{\rho}{\sigma_1}(\ln(c)-x\beta-l\delta)}{(1-\rho^2)^{1/2}}\right)]-\ln[\Phi\left(\frac{x\beta+l\delta}{\sigma_1}\right)]\}\ +$$

$$\sum_{i|1<f<0}\{\ln[\phi_b(\ln(c)-\mu_c,\ln(f)-\mu_f,\sigma_c,\sigma_f;\rho_{cf})]\ -\ \ln[\Phi\left(\frac{\mu_c}{\sigma_c}\right)]\}\ +$$

$$\sum_{i|f=0}\{\ln[\frac{1}{\sigma_1}\phi\left(\frac{\ln(c)+4.61\alpha-x\beta-l\delta}{\sigma_1}\right)\Phi\left(\frac{\frac{-4.61-z\gamma}{\sigma_2}-\frac{\rho}{\sigma_1}(\ln(c)+4.61\alpha-x\beta-l\delta)}{(1-\rho^2)^{1/2}}\right)]$$

$$-\ln[\Phi\left(\frac{-4.61\alpha+x\beta+l\delta}{\sigma_1}\right)]\},$$

where $\phi_b$ is the bivariate normal density function; $\Phi$ is the univariate cumulative normal distribution function; $\phi$ is the univariate normal density function; $\sigma_c=(\sigma_1^2+2\sigma_1\sigma_2\rho\alpha+\sigma_2^2\alpha^2)^{1/2}$; $\rho=\mathrm{cor}(\epsilon_1,\epsilon_2)$; $\sigma_1=\mathrm{var}(\epsilon_1)$; $\sigma_2=\sigma_f=\mathrm{var}(\epsilon_2)$; $\rho_{cf}=(\sigma_1\rho+\sigma_2\alpha)/\sigma_c$; $\mu_c=x\beta+1\delta+\alpha z\gamma$; and $\mu_f=z\gamma$.

The likelihood function for the spline model is based on Hausman and Wise (1979):

$$\ln(\mathcal{L})=\sum_{i|f0\_49=1}\{\ln[\frac{1}{\sigma_1}\phi\left(\frac{\ln(c)-\mu_1-\alpha_a}{\sigma_1}\right)\Phi\left(\frac{-.713-z\gamma-\frac{\rho}{\sigma_1}(\ln(c)-\mu_1-\alpha_a)}{(1-\rho^2)^{1/2}}\right)]$$

$$-\ \ln[\Phi\left(\frac{\mu_1+\alpha_a}{\sigma_1}\right)]\}\ +$$

$$\sum_{i|f50=1}\{\ln[\frac{1}{\sigma_1}\phi\left(\frac{\ln(c)-\mu_1-\alpha_b}{\sigma_1}\right)[\Phi\left(\frac{-.673-z\gamma-\frac{\rho}{\sigma_1}(\ln(c)-\mu_1-\alpha_b)}{(1-\rho^2)^{1/2}}\right)-\Phi\left(\frac{-.713-z\gamma-\frac{\rho}{\sigma_1}(\ln(c)-\mu_1-\alpha_b)}{(1-\rho^2)^{1/2}}\right)]\ ]$$

$$-\ \ln[\Phi\left(\frac{\mu_1+\alpha_b}{\sigma_1}\right)]\}\ +$$

$$\sum_{i|f51\_99=1}\{\ln[\frac{1}{\sigma_1}\phi\left(\frac{\ln(c)-\mu_1-\alpha_c}{\sigma_1}\right)[\Phi\left(\frac{(-.01-z\gamma-\frac{\rho}{\sigma_1}(\ln(c)-\mu_1-\alpha_c)}{(1-\rho^2)^{1/2}}\right)-\Phi\left(\frac{(-.672-z\gamma-\frac{\rho}{\sigma_1}(\ln(c)-\mu_1-\alpha_c)}{(1-\rho^2)^{1/2}}\right)]\ ]$$

$$-\ln[\Phi\left(\frac{\mu_1+\alpha_c}{\sigma_1}\right)]\}\ +$$

$$\sum_{i|f=1}\{\ln[\frac{1}{\sigma_1}\phi\left(\frac{\ln(c)-\mu_1}{\sigma_1}\right)\Phi\left(\frac{-z\gamma-\frac{\rho}{\sigma_1}(\ln(c)-\mu_1)}{(1-\rho^2)^{1/2}}\right)]\ -\ \ln[\Phi\left(\frac{\mu_1}{\sigma_1}\right)]\},$$

where $\mu_1=x\beta+1\delta$.

The nonparametric IV estimates are obtained according to the following routine, based on Newey and Powell (1989). First, estimate $\gamma$ from equation (12) with an upper (at 0) and lower (at -4.61=ln(.01)) censored tobit model. Second, calculate $\hat{\epsilon}_2^*$ for all uncensored observations. Third, estimate a series approximation to the following equation for the uncensored observations by OLS:

$$\ln(c) = g(\ln(f)) + \lambda(\hat{e}_2^*) + x\beta + l\gamma + e_3,$$

where g(.) is approximated by $\sum_{j=1}^{4} \eta_j [\frac{\ln(f)}{1+|\ln(f)|}]^j$, $\lambda(.)$ is

approximated by $\sum_{j=1}^{4} \xi_j [\frac{\hat{e}_2}{1+|\hat{e}_2|}]^j$, $\eta_j = \eta_{0j} L_0 + \eta_{1j} L_1 + \eta_{2j} L_2$, and $\xi$ is

defined similarly. This method provides a consistent estimate of g(ln(f)) for each regime, up to a constant term, for uncensored values of ln(f). For the censored observations, $\hat{\epsilon}_2^*$ is not independent of z, which violates a necessary condition for consistency.

## Appendix D: FIML estimates of Equations (6) and (12), Chapter 1

| | Eqn (12): ln(f) | | Eqn (6): ln(c) | |
|---|---|---|---|---|
| | Coef | StdErr | Coef | StdErr |
| constant | 1.086 | 0.313 | 5.304 | 0.165 |
| location of accident | | | | |
| western region | 0.313 | 0.080 | 0.282 | 0.049 |
| northeastern region | 0.460 | 0.144 | -0.039 | 0.079 |
| southeastern region | 0.592 | 0.108 | 0.109 | 0.064 |
| midwestern region (omitted) | | | | |
| city w/pop>100K | 0.190 | 0.092 | 0.188 | 0.054 |
| suburb of city w/pop>10K | 0.337 | 0.103 | 0.083 | 0.058 |
| city w/10K≤pop≤100K | 0.278 | 0.094 | 0.009 | 0.054 |
| city w/pop<10K | 0.337 | 0.116 | -0.062 | 0.063 |
| rural (omitted) | | | | |
| claimant injuries | | | | |
| none | 0.753 | 0.336 | -0.612 | 0.158 |
| lacerations | -0.141 | 0.064 | 0.053 | 0.036 |
| fractures | -0.074 | 0.131 | 0.913 | 0.076 |
| disfigurement | -0.266 | 0.144 | 1.094 | 0.088 |
| neck strain | 0.099 | 0.056 | 0.582 | 0.032 |
| back strain | -0.073 | 0.055 | 0.793 | 0.030 |
| other strain | -0.186 | 0.074 | 0.397 | 0.046 |
| concussion | -0.239 | 0.109 | 0.461 | 0.078 |
| other injuries | 0.000 | 0.075 | 0.307 | 0.040 |
| claimant disability | | | | |
| temporary | 0.020 | 0.064 | 0.683 | 0.036 |
| permanent partial | 0.207 | 0.159 | 1.723 | 0.088 |
| permanent total | -0.497 | 0.393 | 1.999 | 0.267 |
| fatality | -0.926 | 0.267 | 4.324 | 0.244 |
| claimant rehab. | | | | |
| hospitalized≤7 but>0 days | -0.016 | 0.134 | 0.971 | 0.081 |
| hospitalized>7 days | -0.076 | 0.221 | 1.395 | 0.130 |
| need rehab. services | 0.047 | 0.062 | 0.445 | 0.035 |
| weeks lost from work | 0.000 | 0.001 | 0.003 | 0.000 |
| claimant role in accident | | | | |
| auto driver | 0.031 | 0.271 | -0.194 | 0.140 |
| passenger in auto | 0.009 | 0.074 | -0.294 | 0.020 |
| motorcycle driver | -0.290 | 0.093 | -0.122 | 0.027 |
| passenger on motorcycle | -0.676 | 0.217 | -0.017 | 0.052 |
| pedestrian | -1.127 | 0.278 | -0.083 | 0.155 |
| legal regime | | | | |
| contributory (omitted) | | | | |
| pure comparative | -0.018 | 0.111 | 0.537 | 0.060 |
| modified comparative | 0.014 | 0.129 | 0.225 | 0.068 |
| prejudgment interest | -0.306 | 0.059 | 0.176 | 0.035 |
| ln(appraised fault) | | | 0.239 | 0.123 |
| ln(appraised fault)*modified | | | 0.002 | 0.135 |
| ln(appraised fault)*pure | | | 0.118 | 0.115 |
| defendant traffic violation | | | | |
| listed violation | 0.143 | 0.066 | | |
| unlisted violation | 0.636 | 0.114 | | |
| >1 violation | 0.727 | 0.199 | | |
| $\sigma_1$ | 1.158 | 0.010 | | |
| $\sigma_2$ | 1.290 | 0.018 | | |
| $\rho$ | -0.077 | 0.040 | | |

Appendix E: Filings and Dispositions in State Courts, Selected Years, 1978-1987

| State | 1987 filings | 1987 dispositions | 1986 filings | 1986 dispositions | 1985 filings | 1985 dispositions | 1984 filings | 1984 dispositions |
|---|---|---|---|---|---|---|---|---|
| AL | 715313 | 670412 | 669490 | 631303 | 610016 | 593516 | 595551 | 590747 |
| AK * | 19605 | 18505 | 21071 | 18706 | 21626 | 18561 | 20460 | 15948 |
| AZ | 1800047 | 1658042 | 1827007 | 1744512 | 1496963 | 1514224 | 571243 | 543918 |
| CA | 18782143 | 15156647 | 18983972 | 15484189 | 18771701 | 16206032 | 18333359 | 16255372 |
| ID | 344973 | 344083 | 333558 | 340164 | 325134 | 324905 | 315803 | 312200 |
| IN | 1248539 | 1221189 | 1212962 | 1156547 | 1156947 | 1103553 | 1079552 | 999092 |
| IA | 922729 | 899097 | 888940 | 880443 | 860506 | 849063 | 0 | 0 |
| ME | 312121 | 295351 | 282262 | 271175 | 262875 | 248712 | 232905 | 226714 |
| MO | 835039 | 794848 | 800342 | 761341 | 777685 | 733818 | 0 | 0 |
| MT | 31517 | 27790 | 32740 | 27910 | 32057 | 27082 | 30421 | 26117 |
| NE | 429519 | 431465 | 444255 | 448075 | 378833 | 385393 | 305760 | 297986 |
| NM ** | 68656 | 65518 | 70900 | 65063 | 67449 | 66321 | 65474 | 61764 |
| NC | 2030961 | 1948102 | 1837843 | 1782638 | 1702491 | 1620830 | 1596860 | 1584993 |
| OH | 3186859 | 3175153 | 3041253 | 3004382 | 2801137 | 2785425 | 2693913 | 2673720 |
| OK | 506265 | 458069 | 514840 | 479313 | 508864 | 470430 | 492157 | 468667 |
| RI ** | 68862 | 63211 | 75342 | 64055 | 74161 | 61487 | 69076 | 58211 |
| TN | 162008 | 143199 | 154466 | 139479 | 145014 | 132473 | 141504 | 132620 |
| VT | 174090 | 176007 | 169638 | 161131 | 160482 | 158969 | 147682 | 148154 |
| WV | 348028 | 342096 | 347045 | 340974 | 350252 | 333431 | 341984 | 330814 |
| WI | 1086587 | 1074813 | 569668 | 555050 | 574616 | 571407 | 536203 | 537598 |
| WY | 179981 | 180263 | 152342 | 152584 | 12311 | 12448 | 114138 | 110957 |

| State | 1981 filings | 1981 dispositions | 1980 filings | 1980 dispositions | 1979 filings | 1979 dispositions | 1978 filings | 1978 dispositions | total filings/ dispositions |
|---|---|---|---|---|---|---|---|---|---|
| AL | 670949 | 655281 | 651444 | 624717 | 599964 | 596145 | 536451 | 509537 | 0.9666221 |
| AK * | 14316 | 13619 | 146573 | 143907 | 138174 | 119270 | 132007 | 126524 | 0.9127637 |
| AZ | 114808 | 112981 | 1433356 | 1216656 | 1059610 | 1055393 | 938108 | 897788 | 0.9449228 |
| CA | 18179778 | 15477265 | 18804434 | 14604390 | 18179660 | 14968656 | 17290024 | 14908249 | 0.8317162 |
| ID | 296350 | 310638 | 321947 | 317334 | 312080 | 304421 | 298664 | 291578 | 1.0017335 |
| IN | 1055848 | 1019768 | 1036771 | 953004 | 879660 | 815211 | 811214 | 741595 | 0.947601 |
| IA | 0 | 0 | 528250 | 530299 | 503882 | 505163 | 517706 | 481615 | 0.9891364 |
| ME | 243175 | 239877 | 249575 | 239362 | 205091 | 200295 | 231657 | 126022 | 0.9627976 |
| MO | 716962 | 663695 | 603771 | 553458 | 518454 | 474539 | 613586 | 533527 | 0.936374 |
| MT | 35553 | 27688 | 31345 | 26850 | 30553 | 24526 | 29278 | 23472 | 0.8384131 |
| NE | 320651 | 312981 | 318150 | 321162 | 318180 | 318293 | 448249 | 303924 | 0.9999909 |
| NM ** | 54187 | 53983 | 55216 | 54309 | 53517 | 48839 | 0 | 0 | 0.9549792 |
| NC | 1664421 | 1636602 | 1618867 | 1571301 | 1582624 | 1549578 | 0 | 0 | 0.971745 |
| OH | 2828377 | 2841371 | 2866158 | 2839058 | 2589694 | 2563550 | 0 | 0 | 0.9937657 |
| OK | 0 | 0 | 496305 | 470093 | 496303 | 470093 | 0 | 0 | 0.9342997 |
| RI ** | 72480 | 65666 | 31104 | 26034 | 31586 | 24294 | 0 | 0 | 0.8588466 |
| TN | 131844 | 121019 | 128056 | 113771 | 89894 | 83524 | 0 | 0 | 0.9090027 |
| VT | 131857 | 131340 | 123554 | 118949 | 123807 | 122387 | 0 | 0 | 0.9862546 |
| WV | 368317 | 374750 | 372297 | 334758 | 356447 | 328888 | 0 | 0 | 0.9602881 |
| WI | 553162 | 556264 | 392334 | 358579 | 335310 | 299325 | 0 | 0 | 0.9765695 |
| WY | 13246 | 14043 | 0 | 0 | 0 | 0 | 0 | 0 | 0.9963497 |

*: Superior Court only. **: District Court only. Trial queues assumed to be static in years in which data are missing.

Appendix F

Under the assumptions set forth in Section IA, Spier (1992) shows that the Perfect Bayesian Equilibrium series of settlement offers is unique as long as

$$\underline{\beta}\left(\frac{1+R}{1+r}\right)^{T} < \frac{\overline{\beta}(1+R)^{T}-L}{(1+r)^{T}} - \frac{d}{r}\left(1-\left(\frac{1}{1+r}\right)^{T-1}\right),$$

and that the distribution of types remaining at the beginning of period t is uniform on $[\underline{\beta},\beta_t]$ where

$$\beta_t = \begin{cases} \overline{\beta} & \text{if } t = 1 \\ \frac{d(1+r)}{r}\left(1-\left(\frac{1}{1+r}\right)^{t-1}\right) & \text{if } 1 < t \leq T \\ \beta_T - L & \text{if } t = T+1 \end{cases}.$$

This implies that the probability of settlement at time t, conditional on settlement occurring ($f_t$) is equal to

$$f_t = \begin{cases} \dfrac{d(1+r)^{(T-t)}}{\frac{d}{r}(1+r)^{T}(1-(1+r)^{(1-T)})+L} & \text{if } t < T \\ \dfrac{L}{\frac{d}{r}(1+r)^{T}(1-(1+r)^{(1-T)})+L} & \text{if } t = T \end{cases}.$$