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Contracting with Costly State Falsification: Theory and Empirical Results From automobile Insurance

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Contracting with Costly State Falsification: Theory and Empirical Results from Automobile Insurance*

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I. Introduction

The design of optimal contracts has been a source of considerable attention amongst economists for over a decade. While a complete description of this now-voluminous theoretical literature is well beyond the scope of this brief review, there are two lines of inquiry worthy of particular note. The first is the examination of the agency relationship, which began with the work of Ross (1972) on financial intermediaries and was extended by Holmstrom (1979, 1982) and Shavell (1979) to the "sharecropper" problem. This area has been one of continuing interest, and is nicely summarized by Hart and Holmstrom (1987). The second major line of theoretical research on contract design, and the one of particular interest in this paper, concerns environments where agents possess private information. This is sometimes referred to as the "adverse selection" problem because of the initial applications in the context of labor and insurance markets considered by Spence (1972) and Rothschild and Stiglitz (1976). This hidden information framework has been used to examine, *inter alia*, the efficiency of contracts which utilized categorical discrimination in insurance (Crocker and Snow, 1986; Bond and Crocker, 1991), the design of optimal regulatory schemes (Baron and Myerson, 1982; Baron, 1989), and efficient contracts with costly state verification (Townsend, 1979). Most noteworthy from the perspective of this paper, however, is the recent work by Lacker and Weinberg (1989) on optimal contracting with costly state falsification, a point to which we shall return below.

As the theory of contracts has evolved, there has been a contemporaneous, and burgeoning, literature on empirical models of long-term contracting.[1] This line of research has, however, been

[1] These articles have examined the issues of contract duration (Joskow, 1987; Crocker and Masten, 1988), pricing provisions (Joskow, 1988, 1990; Crocker and Masten, 1991; Leffler and Rucker, 1991), quantity options (Goldberg and Erickson, 1987); Masten and Crocker, 1985), nondiscrimination guarantees (Hubbard and Weiner, 1991; Crocker and Lyon, 1994) and contractual incompleteness (Crocker and Reynolds, 1993). While this literature has been notably successful in explaining a wide range of contractual design issues, all of these articles rely on the application of a transaction-cost approach of the type initially suggested by Klein, Crawford and Alchian (1978) and Williamson (1979). Even the recent empirical work on the design of sharecropping contracts (Allen and Lueck, 1992, 1993) is motivated from a transaction-cost perspective rather than being an application of the more formal agency framework discussed.

characterized by a transaction cost emphasis, and the extensive and well-developed literature on incentive contracting has had surprisingly little impact on empirical studies of contract design. The only exceptions to this general observation are the examination of shirking in crop share arrangements by Shaban (1987), and the more recent empirical investigations of moral hazard in franchising (Lafontaine, 1992), of signaling by deductibles in insurance (Puelz and Snow, 1994), and Vistnes' (1993) use of the costly state verification framework to model Medicaid payments to hospitals. Overall, the empirical applications of incentive contracting models are most notable by their paucity.

This paper develops a theoretical model of optimal insurance contracting with costly state falsification that generates formal empirical implications which are tested using data on automobile insurance settlements. The theoretical approach applies the basic falsification approach first considered by Lacker and Weinberg (1989) to an insurance environment in which claimants have private information about their actual losses, and who can engage in privately costly falsification designed to misrepresent the actual loss state to insurers. We demonstrate that the design of an efficient contract in a setting with falsification faces an inherent tension between the goal of smoothing income by making the insurance payments contingent on the size of the loss, on the one hand, and the incentives that such contingent payments engender for claims inflation through costly state falsification, on the other. As we indicate in the formal analysis of the next section, the presence of falsification leads to insurance payments which are relatively generous for small losses coupled with more miserly compensation for severe accidents. Moreover, we show that the extent to which the optimal contract penalizes large claims is directly proportional to the ease of falsification. As a result, the theoretical model provides clear, and testable, implications about the design of optimal contracts, and ones that are consistent with our analysis of claims payments in automobile insurance.

The results of our paper fill, at least partially, the existing gap between the theory of incentives and empirical contract design, and also have important implications for fraud management in insurance. There has been a great deal of attention devoted recently to the problem of fraudulent insurance claiming. Concerns about fraud have prompted insurance industry studies of individual claims in several states (Florida Insurance Research Center, 1991; Automobile Insurers Bureau of Massachusetts, 1990; Weisberg and Derrig, 1991). These studies have utilized insurance claims professionals to evaluate the validity of each claim, in order to measure the extent of fraud and to characterize the features of claims which appear to be indicative of fraud. There is also a growing body of more formal empirical work on the subject. These studies also aim primarily at documenting the existence of fraudulent or exaggerated claims in selected insurance markets (Dionne and St-Michel, 1991; Dionne, St-Michel and Vanasse, 1993; Cummins and Tennyson, 1996).

What is lacking in this empirical literature is consideration of contractual mechanisms by which insurers might manage the problem of fraud. This is also true to some extent of the theoretical literature on insurance fraud management, which tends to focus on characterizing optimal auditing schemes to deter the filing of fraudulent claims (Dionne, St-Michel and Vanasse, 1993; Picard, 1994; Bond and Crocker, 1996) rather than contractual arrangements to deter fraud. The application of the costly state falsification framework to the insurance claiming environment is perhaps more natural, especially in view of the fact that penalties for fraudulent claiming are virtually nonexistent,[2] and hence audits can at best result in claim denial. Thus, to the extent that efficient policies entail the crafting of *ex ante* incentives, as well as *ex post* sanctions, to deter claims exaggeration, this research provides insights into a heretofore ignored aspect of effective fraud management.

[2] For example, McKenzie (1993) reports that only .5 percent of all suspected fraud cases reported to the California insurance fraud bureau are actually prosecuted; claims adjustors in the Massachusetts claims study estimated that under 3 percent of apparently fraudulent claims contained sufficient evidence to be referred to law enforcement agencies (Weisberg and Derrig, 1991).

The empirical analysis employs a large data set of liability insurance claims for bodily injuries experienced in automobile accidents, which provides a particularly appropriate venue for examining the implications of the theory. Falsification in automobile liability claims is an area where fraud is legendary,[3] so that it is likely that insurance companies would utilize all of the tools at their disposal--including *ex ante* contract design--to mitigate the costs of misrepresentation. Moreover, the data provide a great deal of information for each accident, including the economic damages claimed and the insurance payments actually awarded, and information on the characteristics of each claim which permit the construction of proxies to control for the ease of falsification. The detail contained in the data also permits the use of firm- and state- specific fixed effects models to correct for unobserved heterogeneity at both levels. These features make these data uniquely suited to the task of identifying contractual responses to the problem of claims exaggeration.

The paper proceeds as follows. The next section provides a theoretical model of claims falsification in a liability insurance market, and derives testable theoretical implications regarding the structure of efficient insurance contracts in such an environment with costly state falsification. Section III contains a description of the data on automobile insurance claims settlements that we use to test the theory. We then present the empirical results, and conclude with a discussion of the implications of our findings.

II. A Model of Costly State Falsification

Since our data consist of bodily injury liability claims filed against the drivers of automobiles involved in accidents, we examine a model of *third party* insurance in which the purchaser of insurance and the injured party are different individuals. Hence, the insurance contract that we model is the (implicit)

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[3]Consumers rank automobile insurance as the area of insurance in which fraud is most common (see Mooney and Salvatore, 1990). Previous analyses of automobile liability insurance claims have estimated that 10 to 30 percent of claims are suspicious or exaggerated (Weisberg and Derrig, 1991; Rand Corporation, 1995).

contract between the insurance provider and the injured party, rather than that between the insurance provider and the purchaser of insurance.[4] To that end, we consider a continuum of risk-averse injured parties, each of whom has the von Neumann-Morganstern utility function $U(W_i)$, where W_i is the wealth in the high-loss (I=H) or low-loss (I=L) state. An injured party's expected utility given the contingent wealth $W \equiv (W_L, W_H)$, where λ is the probability of the low-loss state, is written as

$$V(W_L,W_H) \equiv \lambda U(W_L) + (1-\lambda)U(W_H). \tag{1}$$

The injured parties are assumed to experience the loss θ_H (θ_L) in the high-loss (low-loss) states, where $\theta_H > \theta_L$. A liability insurance settlement contract $C \equiv (I_H, I_L)$ consists of a payment to the injured party of I_i in the loss states, where $I \in \{H,L\}$. The cost to the insurer of providing contract C is written as

$$\Pi(I_H,I_L) = \lambda I_L + (1-\lambda)I_H. \tag{2}$$

A. <u>A First-Best Benchmark</u>

Before proceeding, it will be useful to characterize, as a benchmark for future comparison, the efficient contracts which result when θ is public information and the injured parties have no ability to falsify the magnitude of their losses. Letting $\bar{W}$ denote the initial wealth of each injured party, a first-best insurance contract, denoted $C^* \equiv (I_L^*, I_H^*)$, is a solution to the problem that minimizes the cost to the insurer (2) of providing coverage subject to a constraint on the expected utilities of the injured individuals

$$V(W_L, W_H) \geq \bar{V} \tag{3}$$

where

[4]The theoretical predictions from a model of first-party insurance under costly state falsification are similar, as demonstrated by Crocker and Morgan (1995).

$$W_i = \bar{W} - \theta_i + I_i \;\; for \; i \in \{H, L\}. \tag{4}$$

It is straightforward to show that a solution equalizes the wealth of the injured parties across the loss states. Letting D* denote that portion of the loss which is not covered by the insurer, the following lemma characterizes a solution to the first-best problem.

Lemma: The first-best insurance contract, C^*, solves

(i) $I_i^* = \theta_i - D^*$ for $I \in \{H, L\}$, and

(ii) $U(\bar{W} - D^*) = \bar{V}$.

We now turn to the case in which the injured parties may engage in claims falsification.

B. Loss Falsification

Our approach represents both a simplification and an extension of the work on costly state falsification by Lacker and Weinberg (1989). On the one hand, the simplification is that we consider an environment where insureds can suffer only two discrete sizes of loss, while Lacker and Weinberg are concerned with a continuum of loss types.[5] On the other hand, the extension arises from the fact that, unlike Lacker and Weinberg, we are able to characterize closed-form solutions for the optimal contracts, which form the basis for the testable implications considered in the empirical work.[6]

We will assume that the insurer may be prevented by the injured party from observing the magnitude of the loss suffered. Specifically, given an actual loss of "θ", the injured party can misrepresent

[5] Results for the case of a continuum of losses and for more general falsification cost functions are similar, and are provided in the model of first-party insurance examined by Crocker and Morgan (1995).

[6] Lacker and Weinberg begin by examining optimal contracts under the constraint that agents not wish to engage in falsification. After characterizing such "no-falsification" contracts, they turn to the case of optimal contracts with falsification and derive some technical conditions under which solutions to the two problems coincide. Note that, in the environment with discrete types considered below, the optimal contract will always entail some falsification so long as falsification is not too costly.

the loss to be "y" at a monetary cost of $c(\theta,y)$. In the interests of simplicity, we shall assume that the cost of falsification is a quadratic in the amount of falsification, θ-y, so that $c(\theta,y) \equiv \xi(\theta-y)^2$, where ξ is an exogenous parameter. The problem facing the insurer is to design insurance contracts in an environment where the injured parties may falsify the magnitudes of their losses.

The incentives to falsify can be seen most clearly by reference to Figure 1, where the first-best benchmarks correspond to truthful reporting of losses ($y_i = \theta_i$) and are depicted as $L^* \equiv (\theta_L, I_L^*)$ and $H^* \equiv (\theta_H, I_H^*)$, respectively. Given the potential for falsification, an individual of type θ who reports a loss of y and receives an insurance payment of I obtains a utility of

$$U(\bar{W} - \theta + I - \xi(\theta - y)^2) \tag{5}$$

which defines a preference ordering over y and I. Specifically, an indifference curve for a θ- type agent has slope $-2(\theta-y)\xi$, so that θ_L-type indifference curves $(\bar{U}_L)$ always exhibit the single-crossing property with respect to those of θ_H-types $(\bar{U}_H)$, as depicted in the figure.[7]

For sufficiently costly falsification (a high value of ξ), the θ_L-type agent may find falsification unattractive, so that the first-best insurance contract C^* is obtainable. Alternatively, if falsification is less costly (a low value of ξ), then the θ_L-type individual would prefer to falsify and report a loss of θ_H, and obtain the higher insurance payment I_H^*. It is straightforward to demonstrate that C^* is attainable if and only if $\xi > 1/(\theta_H - \theta_L)$, which is the condition under which $\bar{U}_L$ lies to the left of H^* in Figure 1. For lower values of the falsification cost parameter ξ, the contract C^* is not attainable, and the optimal contract will necessarily be second-best.

[7]See, for example, Cooper (1984).

The design of an optimal settlement contract when individuals are able to falsify their losses will involve a tradeoff between the insurance benefits of conditioning payouts on loss magnitudes, on the one hand, and the incentives that such differential payments engender for falsification, on the other. The insurer could, of course, eliminate all incentives to falsify by paying the same amount regardless of the reported loss. But such a strategy would severely limit the ability of insurance to smooth income, with deleterious effect. Alternatively, contracts which attempted to smooth income by making the insurance payout rise with the reported loss encourage falsification. Thus, an optimal contract must balance the conflicting goals of providing insurance and the mitigation of falsification.

There are two ways to approach the problem of determining the optimal contract. The first is to characterize the optimal insurance payment, I, as a function of observed loss, y, while recognizing that y is, in fact, endogenously chosen by the injured party given the stipulated insurance payment. This would entail the characterization of an optimal contract by use of the *indirect mechanism* I(y). This paper will, however, adopt a different solution technique, and use the *direct mechanism* approach developed by Myerson (1979) and Harris and Townsend (1981). Under this formulation, an injured party who announces his type to be θ_i receives the contingent allocation $A^i \equiv \{I_i, y_i\}$. To be attainable, an allocation must satisfy the self-selection conditions

$$U(\bar{W}-\theta_i+I_i-\xi(\theta_i-y_i)^2) \geq U(\bar{W}-\theta_i+I_j-\xi(\theta_i-y_j)^2) \ for\ i,j\in\{H,L\}. \tag{6}$$

It is straightforward to demonstrate that, for any allocation that is implementable by a direct mechanism in which the agent announces her type (θ), there exists an indirect mechanism where the agent chooses a decision (y) that implements the same allocation[8]. Put differently, while we expect to observe in practice

[8] See, for example, Fudenberg and Tirole (1991), p. 257 for a discussion of the relationship between direct and indirect mechanisms.

an indirect mechanism of the form I(y) where the insurance payout is determined by the observed (post-falsification) loss, it is easier to use the direct mechanism equivalent to characterize a solution.

An efficient contract is a solution to the welfare problem that minimizes the expected costs of insurers

$$\underset{A^H, A^L}{Minimize} \quad \Pi(W_L, W_H) \tag{7}$$

Subject to the expected utility constraint (3) and the truth-telling constraints (6), where $W_i \equiv \bar{W} - \theta_i + I_i - \xi(\theta_i - y_i)^2$ for I$\in$ {H,L}. The following theorem characterizes a solution.

Theorem: If $\xi < 1/(\theta_H - \theta_L)$, then an efficient insurance contract is second-best, and satisfies the following conditions:

(i) For θ^L-types: $y_L = \theta_L$ and $W_L > \bar{W} - D^*$;

(ii) For θ^H-types: $y_H > \theta_H$ and $W_H < \bar{W} - D^*$; and

(iii) $U(W_L) = U(\bar{W} - \theta_L + I_H - \xi(\theta_L - y_H)^2)$.

Proof: The Lagrangean expression associated with problem (7) may be written as

$$\begin{aligned} L = \Pi(W_L, W_H) - \beta_L[U(W_L) - U(\bar{W} - \theta_L + I_H - (\theta_L - y_H)^2] \\ - \beta_H[U(W_H) - U(\bar{W} - \theta_H + I_L - (\theta_H - y_L)^2] - \alpha[V(W_L, W_H) - \bar{V}] \end{aligned} \tag{8}$$

where β_L, β_H and α are undetermined multipliers. The first-order conditions for an interior maximum are

$$\frac{\partial L}{\partial I_L} = \lambda - U'(W_L)(\alpha\lambda + \beta_L) + \beta_H U'(\bar{W} - \theta_H + I_L - \xi(\theta_H - y_L)^2) = 0; \tag{9}$$

$$\frac{\partial L}{\partial I_H} = (1-\lambda) - U'(W_H)(\alpha(1-\lambda)+\beta_H) + \beta_L U'(\bar{W}-\theta_L+I_H-\xi(\theta_L-y_H)^2) = 0; \tag{10}$$

$$\frac{\partial L}{\partial y_L} = U'(W_L)(\theta_L-y_L)(\alpha\lambda+\beta_L) - \beta_H U'(\bar{W}-\theta_H+I_L-\xi(\theta_H-y_L)^2)(\theta_H-y_L) = 0; \tag{11}$$

and

$$\frac{\partial L}{\partial y_H} = U'(W_H)(\theta_H-y_H)(\alpha(1-\lambda)+\beta_H) - \beta_L U'(\bar{W}-\theta_L+I_H-\xi(\theta_L-y_H)^2)(\theta_L-y_H) = 0. \tag{12}$$

It is easy to show that the first-best allocation C^* is attainable only if neither self-selection constraint binds ($\beta_H = \beta_L = 0$), which requires that $\xi > 1/(\theta_H - \theta_L)$, violating the condition stipulated in the statement of the theorem. With lower falsification costs, C^* is not attainable and a solution is given by $\beta_L > 0$ and $\beta_H = 0$. Then, solving (9) for α and substituting the result into (10) , yields the result that $W_L > W_H$. Since $\beta_H = 0$ and (10) imply that $\alpha > 0$, the associated (binding) expected utility constraint, and part (ii) of the lemma, require that $W_L > \bar{W} - D^* > W_H$.

From (11) we obtain

$$U'(W_L)(\theta_L-y_L)(\gamma\lambda+\beta_L) = 0$$

which implies $y_L = \theta_L$, so that θ_L-types do not falsify. Finally, since $\theta_H > \theta_L$, it follows from (12) that $y_H > \theta_H$, so θ_H-types falsify.

Q.E.D.

An optimal contract is depicted as {H,L} in Figure 1, where θ_H-types (θ_L-types) receive the H (L) contracts. By part (iii) of the Theorem, θ_L-types are indifferent between the two contractual offerings and, by part (i), do not falsify the loss state. Moreover, θ_H-types do engage in falsification to inflate their loss severities. Finally, since $W_L > W_H$, the ability of insureds to falsify their loss severities results in settlements where those suffering the low loss (θ_L) are more generously compensated than those suffering higher losses (θ_H). From an empirical perspective, the problem with implementing a test of this prediction is that it would require the observation of the θ_H-types' falsification costs. Specifically, this disparity in compensation ($W_H < W_L$) involves the post-falsification wealth position of the θ_H-types (since $W_H \equiv \bar{W} - \theta_H + I_H + \xi(\theta_H - y_H)^2$), and therefore requires an observation of the costs to insureds of falsification ($\xi(\theta_H - y_H)^2$). Clearly, one of the problems involved in dealing with falsification is that it is not observable, which would make a direct empirical test of this prediction somewhat difficult.

Alternatively, if one could couch the result of the Theorem (that smaller claims should be compensated more generously than the larger ones) in terms of observable variables, a direct empirical test would become plausible. Letting $C^* \equiv (I_H^*, I_L^*)$ denote a first-best contract as characterized by the lemma, and $C \equiv (I_H, I_L)$ be a solution to the second-best problem (7), the following Corollary demonstrates the effects of claims falsification on the insurer's optimal settlement strategy. In essence, the optimal contract is able (partially) to mitigate falsification by flattening out the I(y) profile, thereby reducing the incentives to falsify.

Corollary: If $\xi < 1/(\theta_H - \theta_L)$, an optimal contract satisfies

$$\frac{I_H^* - I_L^*}{\theta_H - \theta_L} = 1 > \frac{I_H - I_L}{y_H - y_L}.$$

Proof: The equality follows directly from part (i) of the lemma.

We prove the inequality in two steps. First, note that part (i) of the Theorem implies that $I_L > y_L - D^*$, where D^* is defined in part (ii) of the lemma. To complete the proof, it is sufficient to show that $I_H <$

y_H - D^*. Note that the $\bar{U}_H$ indifference curve through H^* depicted in Figure 1 is the locus of allocations under which $U(W - \theta_H + I - \xi(\theta_H - y)^2) = U(W - D^*)$, and is characterized by the equation

$$I = \theta_H - D^* + \xi(\theta_H - y)^2. \tag{13}$$

We know from part (ii) of the Theorem that $\bar{W} - D^* > W_H$, so it follows that the allocation H must lie below the $\bar{U}_H$ indifference curve.

Similarly, the $\bar{U}_L$ indifference curve in Figure 1 is the locus of allocations where $U(W - \theta_L + I - \xi(\theta_H - y)^2) = U(\bar{W} - D^*)$, and is characterized by

$$I = \theta_L - D^* + \xi(\theta_L - y)^2. \tag{14}$$

Part (i) of this Corollary, in conjunction with the parts (iii) (the binding self-selection constraint) and (ii) (falsification by θ_H-types) of the Theorem imply that $\{I_{H,} y_H\}$ must be in the region BH^*A of the Figure. To finish the proof, it is sufficient to show that the locus H^*A lies entirely below the 45-degree line depicted.

To demonstrate this result, we will show that, given θ_H, there does not exist a value of θ_L for which A lies above the 45-degree line and for which $y_H > \theta_H$. Letting $A \equiv (I_A, y_A)$, point A is characterized by a solution to (13) and (14), which is easily shown to be

$$y_A = \frac{\theta_H + \theta_L + 1/\xi}{2}$$

$$I_A = \frac{2\theta_H + 2\theta_L - 4D^* + \xi\theta_H^2 - 2\theta_H\theta_L\xi + \theta_L^2\xi + 1/\xi}{4}$$

from which it follows immediately that

$$(y_A - D^*) - I_A = \frac{(1/\xi) - \xi(\theta_H - \theta_L)^2}{4}. \tag{15}$$

Equation (15) is the vertical distance between point A and the 45-degree line. For $\theta_L = \theta_H$, this distance is $1/4\xi$, and as θ_L declines the distance declines until it equals zero at $\hat{\theta}_L \equiv \theta_H - 1/\xi$. But this is exactly the value of θ_L at which falsification ceases, and the first-best contract C^* is attainable.

Thus, whenever the optimal contract is second-best ($\hat{\theta}_L < \theta_L < \theta_H$), the region BH^*A lies entirely below the 45-degree line, so that $y_H - D^* > I_H$. This concludes the proof of the corollary. **Q.E.D.**

The left-hand-side of the expression in the corollary is the slope of the insurance settlement profile in the absence of falsification, $I^*(y)$, while the right-hand-side is the slope of the second-best profile, $I(y)$, when insurers anticipate that injured parties may engage in claims falsification. This provides the following testable implication of the theory.

Hypothesis 1: In an environment with costly state falsification, the marginal increase in insurance payments as a function of the claimed amount is less than one.

The implication of Hypothesis 1 is that the I(y) schedule should have a slope of less than unity, so that an increase in the loss claimed should result in a less-than-proportional increase in the insurance payout.

In addition, the extent to which the optimal insurance policy departs from full insurance depends on the falsification costs. As ξ decreases, the optimal insurance schedule I(y) flattens out, and becomes completely horizontal when $\xi = 0$. The problem, of course, is that with costless falsification, the insurer is unable to make differential insurance payments contingent on θ. Alternatively, as falsification costs increase (larger values of ξ), the insurance schedule become progressively steeper. If falsification is sufficiently costly, the first-best full insurance contract is attainable. This leads to our second prediction:

Hypothesis 2: For accidents where falsification is more (less) costly, the insurance payment schedule should be steeper (flatter).

We now turn to a discussion of the data and empirical tests of these hypotheses.

III. The Data

The data on individual insurance claims for automobile-related injuries are obtained from the Insurance Research Council (IRC), an insurance industry research and advisory group, and result from a nationwide study of automobile injury claims undertaken from May through September of 1987. In this study, over 50 automobile insurance companies completed extensive reports on each automobile injury claim closed within a two week period during the May-September time horizon.[9] The data include insurance claims from accidents in all 50 states and the District of Columbia.

The data include detailed information regarding both the amount claimed and the amount paid to the claimant by the insurer: These amounts are reported by each category of loss, including medical

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[9]Each company was allowed to choose the two week period for which they reported, to maximize participation in the study.

expenses, wage loss and rehabilitation expenses, and general damages where relevant. The survey also reports the insurance policy coverage limits. Details are also given regarding the circumstances of each accident: the location (by state and size of city), the number of vehicles involved, and whether the accident involved any traffic offenses and/or citations. The accident details also contain information regarding the nature and severity of the injuries incurred by the claimant, and the extent of trauma and/or disability suffered. Also included is information on the personal characteristics of the claimant, including age, sex, and employment status.

The extensive information reported on the value of each claim and its settlement permits direct tests of the predictions of our theoretical framework regarding the relationship between claims amounts paid and claims amounts filed. The wealth of detail regarding claim characteristics other than claimed amounts and paid amounts is also essential to the empirical testing, as it permits the construction of proxies to measure claims falsification costs, and also provides useful control variables for the analysis.

In keeping with the theoretical model, our empirical analysis utilizes the survey claims reported under bodily injury liability (BIL) coverage. Bodily injury liability claims are filed by individuals injured in an accident which is the fault of another driver. The claims are filed against the BIL insurance coverage of the at-fault driver, which pays the injury costs for which the insured driver is legally liable. Under BIL coverage, claimants are eligible for compensation of all financial losses due to injury (including medical bills, lost wages and rehabilitation expenses), and for general damages. General damages awards are intended to compensate the victim for other costs associated with the injury which are by their nature not documentable (e.g., "pain and suffering").

BIL claims are ideally suited for testing hypotheses regarding the relationship between claimed amounts and paid amounts for claims of varying sizes and characteristics: there are a large number of these claims in the data, the size of claimed amounts varies a great deal, and the maximum coverage limits of the insurance policies are generally very high.[10] A further advantage of these claims for our analysis is the varied nature of the losses which are compensable under this coverage, which range from medical expenses to wage losses to general damages. Given the institutional setting for claims reporting and claims payments by insurance companies, it seems unlikely that a significant fraction of claimants would receive stated compensation for documented medical bills which is different from the claimed amount. The amount of wage loss or general damages paid by the insurer, which will be the result of negotiations between the insurer and the claimant, seem to be more likely areas in which the insurer might utilize discretion in the claim payment. General damages payments and full compensation for wage losses are only available in liability insurance.

In testing hypotheses regarding claim payment patterns, it is desirable to use a sample of claims of diverse size and characteristics which are nevertheless filed and settled under a homogeneous insurance and legal environment. To preserve homogeneity of the claiming and settlement environment, we first eliminate claims filed under residual market insurance policies. These insurance policies are made available in all states to high-risk drivers unable to obtain insurance in the private market and, in many states, the premiums for these policies are subsidized by drivers insured in the voluntary sector of the market (Harrington, 1991). Moreover, in all states any profits or losses incurred by insurers of residual market policies are shared across all automobile insurers in the state, which implies that the handling and

[10]The data set also contains claims filed under personal injury protection (PIP) coverage, medical payments claims and uninsured motorists claims. The PIP claims are not ideal for our purposes because they are filed under no-fault compensation regimes, in which the incentives to exaggerate small claims may be influenced by the specific features of the state compensation regime. In addition, in some states payment offsets for amounts the claimant received from health insurance (for medical expenses) or workers compensation (for wage losses) complicate determination of amounts paid to the claimant, and most state laws include limits on the amounts of wage loss which can be compensated under this coverage. Medical payments claims are not ideal because the payment is often censored due to the relatively low policy limits; moreover, these claims are most often accompanied by a BIL claim with another insurer, making analysis of insurer payment strategies difficult. There are relatively small numbers of uninsured motorists claims in the data, and over 25 percent of these claims are filed for general damages only; in these cases we have no data on the claimed amount.

payment of claims under these policies may differ substantially from those filed under voluntary market policies (Blackmon and Zeckhauser, 1991).

BIL claims which are subject to tort thresholds, such as those filed in jurisdictions with no-fault insurance laws,[11] are also eliminated from the sample because the incentives for falsification are different for these claims. No-fault insurance laws impose restrictions on the ability of those injured in automobile accidents to file claims for general damages under bodily injury liability coverage. Only those claims which exceed a threshold level of severity, specified in state laws either in descriptive terms or as a dollar amount of medical expenses, are eligible for such awards. The existence of this threshold thus creates additional incentives for the exaggeration of small claims, which do not exist in states which utilize the traditional tort system for compensating injuries.

We also omit all observations for which claims were filed with more than one insurer. From the data available it is unclear in these cases the extent to which the payment strategies of the various insurers involved are coordinated. The survey coders were also encouraged to estimate the amount paid under those policies if it was unknown. Hence, using these claims when attempting to shed light on the determinants of the claim payment relative to the amount claimed is potentially problematic. We do not eliminate observations for which claims were filed under multiple coverages with the same insurer, because these payments are more easily thought of as part of a coordinated strategy.

In addition, we eliminate claims involving fatality or permanent total disability, since the claim and payment amounts for these claims may exhibit different characteristics than those for other injuries.[12] For fatalities, the reported economic loss amounts may be artificially low relative to the severity of the injury, because medical expenses and rehabilitation costs will tend to be low for these claims. In addition, for

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[11]Each claim in the survey was coded with respect to whether a tort threshold was relevant for the claim. This coding was the basis for the elimination of claims.

[12]Previous studies of BIL claims payments also eliminate these claims categories due to similar concerns (Weisberg and Derrig, 1991; Hammit, 1985).

these claims and for permanent total disability claims the proportion of wage losses claimed under economic damages will be much larger than for other claims. These claims are also much more likely than other claims to report losses which exceed the insurance policy limits. Moreover, very few fatal and permanent total disability claims remained in the sample after eliminating claims based on the criteria discussed in the previous paragraphs (a total of only 88 claims). The disproportionately large amounts of losses claimed for these observations, and the distinct patterns of claiming, led us to be concerned about the potential for these claims to bias our findings.

Finally, we omit from the analysis claims for which the data are not usable or which contain obvious coding errors. Included in this category are claims for which no loss amount is reported, or for which the reported loss amount is zero, since we cannot analyze the claims payment relative to the claimed amount in these cases. This eliminates claims which are primarily settled under other insurance coverages, and for which a BIL claim is filed only to receive general damages. Since we are interested in knowing whether the payment amount is artificially lowered because the claim exceeds the policy coverage limit, we also eliminate claims for which the policy limit is missing or recorded as zero, as well as those demonstrating inconsistencies with respect to the existence of claims with other insurers. Making these adjustments to the data leaves a sample of 12,870 observations.

IV. Econometric Analysis of Data

This section reports the results of the empirical analysis of the BIL claims sample. Before proceeding, recall that the testable empirical implications derived from the theoretical section are that the size of the insurance payment, I, should depend on the amount of claimed loss, y, as well as on the cost of falsification, c. Thus, we may write the basic empirical relationship as

$$I_i = \beta_0 + \beta_1 y_i + \beta_2 c_i y_i + \eta' X_i + \epsilon_i \tag{18}$$

where X_i denotes a vector of control variables and ϵ_i is an independent and identically distributed error term. The theory predicts that the insurance payment is increasing in the size of the claimed loss, but less than proportionately, so that $0 < \beta_1 < 1$, and that increases in falsification costs result in a steeper I(y) schedule, so $\beta_2 > 0$.

The data set contains several variables reported for each insurance claim which serve as useful controls in the estimation. These controls include both characteristics of the claim and of the claimant. The claim controls consist of a dummy variable indicating if the insurer paid a larger amount under the claim due to joint and several liability, and another indicator variable equal to one if there was no traffic citation issued in the accident leading to the claim. The former variable is included to account for differences in claim amounts paid due to legal requirements associated with the claim, while the latter is a proxy for the degree of insured fault in the accident, and is included because a lesser degree of fault reduces the liability of the injurer in many states.[13]

The claimant controls consist of the age and sex of the claimant, and an indicator variable for whether the claimant was in the labor force. We have no expectations regarding either the signs or the significance of these variables, but include them to allow for possible differences in claims payments based on individual differences. Notice, however, that in terms of the theoretical model, statistically significant differences in claims payments across individuals of differing characteristics would imply that D^* varied with these characteristics. Summary statistics and descriptions of the variables included in the models are reported in Table 1.

[13]The degree of fault of the insured was reported directly in the survey, but since this is not an objective feature of the claim but rather a judgment of the insurer, we were concerned about its potential endogeneity. Nonetheless, the estimation results are extremely similar when this variable is included in the model.

The empirical analysis also recognizes the potential for systematic differences in claims payment patterns across insurance firms and across accident locations. Claims payment strategies may vary based on firm size, management efficiency, ownership structure or other characteristics which are unobservable in these data. Similarly, there may be differences in claims payment patterns across states, and across locations within states, which arise due to unobservable heterogeneity in the regulatory, legal or competitive environments. We do not know the identity or characteristics of any firms in the data set, but the data do include firm identifier codes. In addition, the location of each accident by state is also given, as is information regarding the size of the city in which the accident occurred. Hence, to the extent that unobserved heterogeneity leads to systematic differences in the payment practices across insurers, states, or accident locations within states, these can be controlled through a simple fixed-effects model to produce accurate inferences in the estimation.

Claims payment patterns in the sample may also vary along the time dimension. Since the data are obtained from claim files which were closed in 1987, they result from accidents occurring over a number of years. The vast majority of the accidents in our sample (95.3 percent) occurred in years 1985 through 1987, with 85.7 percent occurring in either 1986 or 1987, and hence the extent of time variation in the sample is not great. Nonetheless, accidents reported in the data set span the time period 1975 through 1987. Due to unobservable differences in the handling of claims remaining open for longer periods of time, payments for claims closed during 1987 may vary systematically with the date of the automobile accident which produced the claim. We control for this possibility by including accident-year dummy variables in the fixed-effects versions of our estimated models.[14]

[14]One concern, of course, is to what extent the reported data reflect nominal versus real values of payments. Insurers in this data set appear to pay claims in nominal amount only (or the claimed amounts are themselves adjusted for inflation), since preliminary analysis of the data revealed no systematic underpayment or overpayment of claims with earlier accident dates. A major problem in making our own adjustments to the reported values is that we have very limited data on the timing of claim expenses and claim payments: we only know the date of the accident, the date the claim was filed, and the dates of the first and last payments made by the insurer. Hence, we use the dollar amounts as reported in the data set, and control for potential time variation via the fixed-effects.

A. Claim Payment Patterns

The data provide a number of possible measures of the amount paid (I) relative to the amount claimed (y). The most comprehensive measure of the amount paid to the claimant is the sum of payments for economic damages (compensation for documented losses) and general damages paid. If general damages awards are thought to represent compensation for lost utility, then these amounts are rightfully included in the total compensation for losses. An important shortcoming of this measure for our analysis is that we have no information regarding the amount of general damages sought by the claimant. Hence, we cannot effectively use the total compensation amount to assess payments relative to claimed amounts.

The basic measure of the compensation of a claimant, therefore, is the economic loss amount paid. Our calculation of this amount includes both the economic damages paid under BIL coverage ("special damages") and the amounts paid under other automobile insurance coverages by the same insurer. The economic loss amount claimed is the total of the documented losses of the claimant, which is the sum of medical expenses, wage losses, rehabilitation, replacement and other service expenses.

Hypothesis 1 derived from the theoretical framework predicts that the slope of the payment function should be less than one, so that the proportion of the claimed losses paid by the insurer should be lower at higher levels of reported economic loss. This hypothesis is tested by estimating several simple linear regression models of the economic losses paid versus the claimed amount of loss. The first model includes only the claimed amount of economic loss as an explanatory variable, while the second adds the control variables representing characteristics of the claim and of the claimant. The final model specification includes state, firm, accident location and accident year fixed-effects in addition to the control variables.

Two estimation methodologies are employed: ordinary least squares regression and censored normal regression. The censoring technique is utilized because some of the observations in the sample have insurance payments which are censored by the insurance policy coverage limits. The censored regression model takes into account the fact that the value of the claim payment for these observations is artificially restricted to be the value of the policy coverage limit. To avoid erroneously treating claims for which only general damages payments were censored, we define a claim to be censored if the amount of economic loss claimed exceeds the value of the BIL policy limit plus any payments made under other auto insurance coverages, and the value of total economic losses paid equals that limit value. Under this censoring definition, 22 claims in the sample have payments censored by the policy coverage limit.[15]

The estimation results for all models under both estimation methodologies are reported in Table 2.[16] The results indicate that claims for economic damages are paid, on average, at a rate of about 80 cents on the dollar. These results are strongly significant in all models estimated, and the estimated slope coefficient is largely invariant to the model specification and the estimation methodology. The findings are thus highly supportive of Hypothesis 1.

B. Falsification Costs

In this section we report the results of estimations using the data on injury characteristics to construct proxies for the costs of falsification (c). Previous empirical analyses of moral hazard and fraud in insurance claiming suggests one method for segregating claims by level of falsification costs. In their study of workers' compensation claims, Dionne and St-Michel (1991) cite medical experts who maintain that injuries can be classified according to the degree of diagnostic difficulty. Perhaps not surprisingly, injuries involving spinal disorders or lower back pain are categorized as very difficult to diagnose, while injuries such as contusions, amputations, fractures and burns are the easiest. Dionne and St-Michel

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[15]The 22 censored observations are dropped in the OLS regressions to avoid bias in the estimation from censoring.

[16]Similar analyses were also undertaken using only the BIL component of economic loss payments. We have also estimated linear models of payment amounts versus claimed amounts for the medical and wage components of claims separately. Each of these alternative specifications yield qualitatively similar results to those reported in the paper.

hypothesize that difficult-to-diagnose injuries should be more prone to falsification and, consistent with this hypothesis, their empirical analysis found that worker injuries involving lower back pain exhibited greater increases in recovery time in response to increases in the generosity of compensation benefits.

These findings are also in agreement with the perceptions of insurance claims specialists. In a study of automobile insurance fraud in Massachusetts, Weisberg and Derrig (1991) asked such professionals to evaluate the validity of individual claims for bodily injury. The largest single indicator of suspicion cited by the claims adjustors was the reporting of a soft tissue injury such as a sprain or a strain. Using their subjective assessments of claims validity, these analysts concluded that 50 percent of claims involving only strain or sprain injuries were suspicious or fraudulent, compared with under 10 percent of those involving easy-to-diagnose injuries such as contusions, lacerations and fractures. Nonetheless, the adjustors also concluded that less than three percent of suspicious claims contained enough evidence of fraud to be denied or prosecuted. These findings further suggest that soft tissue injuries are easy to falsify relative to other types of injuries.

Based on the findings of these studies, we partition the sample of BIL claims into two injury categories: those involving sprain injuries, and those involving no sprains. We hypothesize that injuries involving sprains are less costly to falsify than those not involving these soft tissue injuries. Interpreting Hypothesis 2 from the theoretical model in terms of the claims payment measures investigated here, the implication is that the slope of the payment schedule should be flatter for claims involving sprains than for other claims.

The results of this analysis, using the estimation methodologies and the same model specifications reported for the basic linear models above, are reported in Table 3. These models include separate intercepts and slopes for each injury category to facilitate the test of the hypothesis that the payment schedule differs for the two categories of claims. Since "Nosprain" is the omitted dummy variable, these results indicate that the payment profile for injuries involving sprains has a larger intercept, and a flatter slope, than does that associated with nonsprain injuries. Nonsprain claims are paid at a rate of approximately 90 cents on the dollar, while those involving some sprain receive about 76 cents. An F-test indicates that the differences in these slope estimates are statistically significant. These results are established at extremely high levels of significance independently of the control variables included and the estimation methodology employed, and are consistent with the hypothesis that claims payment schedules are adjusted to reflect the relative potential for falsification across different types of injuries.

We also investigate an alternative way of measuring falsification costs, using the data available on the categories of economic losses claimed. Claimed amounts are separated into medical expenses and wage losses, and the latter are separated into actual lost wages and estimates of future lost wages. We hypothesize that wage losses are more easily falsified than medical expenses, since falsifying medical expenses requires documentation for services received from a licensed practitioner. Fictitious wage losses are much less difficult to acquire, given that the extent of true wage losses may be exaggerated by simply neglecting to report earnings opportunities in the casual labor market, and that documentable wage losses may be exaggerated by malingering in anticipation of compensation from insurance sources. It should be particularly easy to exaggerate future wage losses, which must in any case be only estimates of the likely future earnings possibilities.

We hypothesize, therefore, that falsification costs are lower for wage claims than for medical claims, and lowest of all for claims involving future wage losses. To examine this relationship, we define three categories of claims: those involving only loss amounts for medical treatments, those involving claims for medical losses and past wages ("Past wage"), and those claims which include some amount of future wage losses ("Future wage"). Hypothesis 2 implies that the slope of the payment schedule should be flatter if past wage losses are claimed than if only medical losses are claimed, and flatter still if future wage losses are also claimed.

The results of estimating the models using this alternative falsification cost specification are reported in Table 4. Consistent with Hypothesis 2 from the theory, the estimated payment profiles for claims which include past wage losses have a flatter slope than claims dealing with medical losses alone and, when claims include amounts for future wage losses, the payment profile becomes even flatter. Specifically, claims seeking compensation for medical losses only are compensated at a rate of about 91 cents on the dollar, while claims involving medical losses plus past wage losses are compensated at about 80 cents on the dollar, and those seeking compensation for future wage losses receive only about 67 cents on the dollar. The coefficient estimates are statistically significant in all of the models estimated and, as the reported F-statistics demonstrate, the slope coefficients are significantly different from each other at conventional levels of confidence. These results are consistent with the hypothesis that insurers adopt settlement strategies to mitigate the increased potential for falsification when claims involve past or future wage losses.

C. Endogenous Claimed Amount

Our theoretical model of the design of insurance settlement contracts predicts that insurers will devise payment schedules for claims which anticipate the potential for falsification by claimants. Under the strictest interpretation of this theoretical framework, in which the payment schedules for all claims are designed by the insurer in advance of any claim, the claim payment and the claimed amount are not simultaneously determined. Institutional realities differ somewhat from this theoretical ideal, however, in that the settlement for any given claim is determined at the time of its filing, and is likely to be influenced by the interactions between the claimant and the insurer's claims adjustor. In addition, we do not know the extent to which the data reported in the claims survey forms represent initial claimed amounts or claimed amounts which reflect the outcome of some settlement process itself. These factors complicate the situation and imply that the claimed amount and the payment amount may in fact be jointly determined.

Accordingly, this section of the paper reports the results of estimating the payment schedules under the assumption that the amount of damages claimed is endogenous. The two-stage-least-squares results are reported in Table 5.[17] We report the estimates for the basic payment schedule (i.e., imposing an identical slope for all claims), the payment schedule which assumes that sprain claims are less costly to falsify than nonsprain claims, and the payment schedule which assumes that wage claims are less costly to falsify than medical claims. For each payment schedule we report two estimates of the model: one without any control variables, and then one which incorporates both the control variables and state, firm, location and accident-year fixed effects.

The estimation results in Table 5 are consistent with those of the previous tables and, hence, with the predictions of the theoretical model. All of the slope coefficient estimates are statistically significant, and the coefficients are significantly different across the sample partitions in both the sprain and the wage models. Notice also that the slope coefficient estimates in all models are larger than those reported when the claimed amount was treated as exogenous, consistent with the notion that claimed amounts respond positively to higher payment amounts. In the fixed-effects models, the basic payment schedule shows that, overall, claims are compensated only about 94 cents on the dollar. The estimates which partition claims into sprains and nonsprains show that nonsprain claims receive about 96 cents on the dollar, while sprain claims receive only about 92 cents. Similarly, claims which include past wages lost receive only 98 cents on the dollar, and claims which include future wages lost receive only 78 cents on the dollar, while claims for only medical losses are approximately fully compensated.[18] This latter finding squares with one's intuition that it may be difficult for insurers to refuse to pay documented medical expenses, and suggests

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[17]The excluded instruments are dummy variables representing the extent of injury trauma and the types of injuries experienced by the claimant.

[18]F-tests show that the slope coefficient for medical-only claims is not significantly different from one in either version of the model.

that the flattening of the payment schedule for sprain claims relative to nonsprain claims may reflect differences in wage loss patterns across the two sets of claims.[19]

D. Total Damage Awards

As discussed earlier, liability claims are eligible for compensation of both economic damages, which we have examined in detail above, and general damages (e.g., "pain and suffering"). However, the data contain no information regarding the amount of general damages actually sought by the claimant, so that the estimation of payment schedules has necessarily relied upon the economic damages component of the claim and the settlement. Having established that the predicted relationships from our theoretical model hold for economic damages, the question nevertheless remains as to whether the characteristics of the total payment schedule follow suit.

Accordingly, this section of the paper reports estimates of the total payment schedule. Due to data limitations we estimate total claims payments as a function of the amount of economic damages claimed. Hence, the numerical values of the estimated slope parameters bear no relation to the hypotheses drawn from our theory. Nor can we make definitive predictions about the relative values of the slope parameters for claims with different falsification costs, given that we do not observe the relationship between economic damages claim amounts and general damages claim amounts for the different categories of claims. However, it is often argued in the insurance trade literature that general damages are awarded on a rule-of-thumb basis in proportion to the economic loss amount (Insurance Research Council, 1995). This has been verified in formal empirical studies of general damages payments in automobile insurance claims, which find that medical expenses are the most important predictor of general damages (Weisberg and Derrig, 1991; Hammit, 1985). If amounts of general damages requested by the claimant also conform to

[19]This would be consistent with the evidence of moral hazard in recovery time for workers compensation claims involving sprains found by Dionne and St-Michel (1991).

this pattern, then the slopes of the total payment schedules as a function of the economic damages claimed should exhibit the same relative values as found previously for the economic damages component of claims.

The hypothesis tested in this section of the paper is thus similar to that tested previously in the paper: that the slope of the total payment schedule is flatter for sprain claims than for nonsprain claims, and for wage claims than for medical-only claims. The estimation results are reported in Table 6. The table includes only the models which incorporate both the control variables and the fixed effects, since our estimates of the economic damages schedule found slope parameter estimates to be largely invariant to the model specification. The table reports both the results of estimation using censored normal regression and two-stage-least-squares, as our previous estimates showed that estimation methodology does impact the slope parameter estimates.[20] We estimate the basic payment schedule (with an identical slope for all claims) and payment schedules which allow different slopes for sprain and nonsprain injuries, and wage and medical claims, as previously. Recall, however, that we have no testable hypotheses relating to the basic model, so that it is included here for comparison purposes only.

The total payment schedule estimates are consistent with our previous findings for economic damages. The slopes of the total payment schedules are flattened for sprain claims, and for claims involving lost wages. The two-stage-least-squares fixed-effects estimates of the payment schedule slope for nonsprain claims is approximately 2.6 while that for sprain claims is only 2.1. The payment schedule for claims involving only medical losses has a slope of about 3.3, that for claims involving past wage losses has a slope of 2.7, and the slope for claims involving future wage losses is only 1.1. The differences in the relative slope parameters are highly significant for each of the estimation methodologies employed.

[20]Consistent with our previous censoring definition, the total claim payment is defined as censored if the total compensation paid equals the value of the BIL policy limit plus any payments made under other auto insurance coverages. The resulting 270 censored claims are dropped from the sample in the 2SLS regressions to avoid bias.

These findings are thus consistent with the predictions of our theoretical model regarding optimal claims payment patterns under costly state falsification.

V. Conclusions

This paper has developed and tested an incentive-contracting model of optimal insurance settlements in a third-party insurance market where injured individuals can engage in costly state falsification to exaggerate the severity of their injuries. Empirical analysis of data on automobile liability insurance claims strongly corroborates the predictions derived from the theoretical model. First, when insurers anticipate the potential for falsification, large claims tend to be compensated less generously than smaller ones. The reduced sensitivity of insurance payments to claimed amounts erodes the returns to falsification activities, and mitigates the incentives of the injured party to engage in claims inflation. Second, this pattern is most pronounced for claims where the costs of falsification are expected to be low. Accidents involving sprain or soft tissue injuries, which is an area where the potential for fraud is legendary, receive on average lower insurance payments than do nonsprain claims of equal magnitudes. In a similar vein, claims entailing only medical expenses, which by their nature tend to be well-documented, are generally paid in their entirety, while those involving wage losses, which can be manipulated by malingering on the part of the injured party, receive substantially less generous settlements. These findings provide convincing support for the notion that insurers adopt claims payment strategies which are designed to mitigate the incentives of individuals to invest resources with the purpose of inflating their injury claims.

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Table 1
Summary Statistics
Variables used in Payment Schedule Models

Variable	Description	Mean	S.D.	Min	Max
Total Damages Paid	Total claim payments for BIL special damages and general damages, PIP, UM, UIM and Medpay coverages	5112.4	10020.5	10	1887077
Economic Damages Paid	Total claim payments for BIL special damages, PIP, UM, UIM and Medpay coverages	2030.3	4599.7	0	106211
Claimed Amount	Total BIL special damages claimed	2145.4	6007.4	1	267095
Female	1 if the claimant is female, 0 otherwise	0.463	0.499	0	1
Age	Age of the claimant in years	31.72	16.10	0	99
Claimant Not in Labor Force	1 if the claimant is a full time student, spouse, minor or retired, 0 otherwise	0.238	0.426	0	1
Joint and Several Liability	1 if the insurer paid more due to joint and several liability, 0 otherwise	0.004	0.064	0	1
No Traffic Citation Issued	1 if no traffic citation issued in the accident, 0 otherwise	0.026	0.159	0	1
Sprain	1 if the claim involves a sprain, 0 otherwise	0.755	0.430	0	1
Nosprain	1 if the claim involves no sprain, 0 otherwise	0.245	0.430	0	1
Medical	1 if only medical losses are claimed, 0 otherwise	0.639	0.480	0	0
Pastwage	1 if medical and/or past wage losses are claimed, 0 otherwise	0.350	0.477	0	1
Futurewage	1 if medical, past and/or future wage losses are claimed, 0 otherwise	0.011	0.106	0	1

Table 2
Estimates of Payment Schedule
Dependent Variable = Economic Damages Paid
(standard errors in parentheses)

	1 OLS	2 TOBIT	3 OLS	4 TOBIT	5 OLS fixed effects	6 TOBIT fixed effects
Constant	327.4839** (19.7025)	312.4707** (19.7078)	341.3296** (50.6776)	326.2138** (50.8090)	-162.0322 (2135.094)	-164.5979 (2133.265)
Claimed Amount	0.8087** (0.0038)	0.8179** (0.0037)	0.8054** (0.0040)	0.8151** (0.0039)	0.7908** (0.0043)	0.8023** (0.0042)
Claimant Age	--	--	0.6976 (1.2109)	0.6148 (1.2143)	0.6199 (1.2294)	0.5463 (1.2277)
Claimant Female	--	--	-7.0621 (38.7897)	-7.0744 (38.9036)	2.6218 (39.378)	1.5978 (39.3294)
Claimant Not in Labor Force	--	--	-40.6622 (45.5251)	-33.0339 (45.6501)	-63.6281 (46.5111)	-53.6292 (46.4412)
Joint and Several Liability	--	--	-413.3999 (292.8004)	-447.5957 (293.7419)	-415.7823 (297.7712)	-450.1222 (297.4972)
No Traffic Citation Issued	--	--	-213.7210* (120.5272)	-222.6987* (120.9194)	-151.4416 (123.2183)	-161.4766 (123.108)
Adjusted R^2	0.7755	--	0.7721	--	0.7733	--
Log likelihood	--	-116249.44	--	-108979.10	--	-106902.12
Number of observations	12848	12870	12009	12031	11787	11808
F: slope=1	2483.49**	2372.50**	2322.31**	2223.10**	2329.14**	2228.56**

**denotes statistical significance beyond the 1% level, two-sided test; * denotes statistical significance beyond the 10% level, two-sided test. (Note: Columns (5) and (6) include state, firm, location and accident-year fixed effects, which are not reported.)

Table 3
Estimates of Payment Schedules for Sprain vs Nonsprain Claims
Dependent Variable = Economic Damages Paid
(standard errors in parentheses)

	1 OLS	2 TOBIT	3 OLS	4 TOBIT	5 OLS fixed effects	6 TOBIT fixed effects
Constant	158.0683** (38.7472)	154.9185** (38.8670)	217.2960** (61.7736)	211.1145** (61.9954)	-201.8000 (2111.250)	-198.9864 (2111.668)
Sprain	247.8354** (44.8460)	230.1097** (44.9588)	230.6729** (49.6065)	214.0486** (49.7219)	171.8497** (51.2527)	156.4058** (50.7531)
Nosprain*claim	0.9063** (0.0069)	0.9092** (.0068)	0.9025** (0.0073)	0.9058** (.0071)	0.8890** (0.0074)	0.8938** (0.0072)
Sprain*claim	0.7659** (0.0046)	0.7777** (.0044)	0.7638** (0.0047)	0.7761** (.0046)	0.7467** (0.0051)	0.7609** (0.0020)
Claimant Age	--	--	-0.1196 (1.2075)	-0.1157 (1.2122)	-0.0269 (1.2255)	-0.0141 (1.2252)
Claimant Female	--	--	-17.6214 (38.4561)	-17.9052 (38.6096)	-9.7899 (38.9965)	-11.0569 (38.9910)
Claimant Not in Labor Force	--	--	-57.6323 (46.1714)	-51.1656 (46.3525)	-91.8555* (47.0116)	-82.7176* (46.9133)
Joint and Several Liability	--	--	-286.3928 (289.8168)	-327.6156 (291.0312)	-275.2323 (294.5174)	-317.6456 (294.269)
No Traffic Citation Issued	--	--	-229.3927* (119.2582)	-236.8894* (119.7642)	-169.8888 (121.8238)	-178.1755 (121.8311)
Adjusted R^2	0.7804	--	0.7769	--	0.7784	--
Log likelihood	--	-116117.2	--	-108860.78	--	-106784.93
Number of observations	12848	12870	12009	12031	11787	11808
F: sprain slope=nosprain slope	290.03**	264.47**	257.70**	235.24**	264.62**	321.00**

** denotes statistical significance beyond the 1% level; * denotes statistical significance beyond the 10% level. (Note: Columns (5) and (6) include state, firm, location and accident-year fixed effects, which are not reported.)

Table 4
Estimates of Payment Schedules for Wage vs Nonwage Claims
Dependent Variable = Economic Damages Paid
(standard errors in parentheses)

	1 OLS	2 TOBIT	3 OLS	4 TOBIT	5 OLS fixed effects	6 TOBIT fixed effects
Constant	129.7211** (24.2241)	127.6728** (24.2929)	175.3969** (54.3847)	174.1326** (504.5854)	-135.8553 (2099.082)	-132.0456 (2098.659)
Pastwage	319.8387** (195.7361)	285.6070** (41.9252)	328.4565** (48.0970)	293.1289** (48.0823)	323.1692** (49.2407)	285.5925** (49.0110)
Futurewage	1749.954** (195.736)	1752.517** (196.0697)	1810.542** (206.604)	1813.652** (206.9084)	1835.393** (210.491)	1841.980** (209.8767)
Medical*claim	0.9221** (0.0073)	0.9241** (0.0072)	0.9187** (0.0078)	0.9210** (0.0077)	0.9031** (0.0081)	0.9069** (0.0080)
Pastwage*claim	0.7959** (0.0054)	0.8096** (0.0052)	0.7955** (0.0057)	0.8095** (0.0055)	0.7835** (0.0060)	0.7998** (0.0058)
Futurewage*claim	0.6671** (0.0087)	0.6771** (0.0086)	0.6659** (0.0090)	0.6760** (0.0089)	0.6624** (0.0091)	0.6730** (0.0089)
Claimant Age	--	--	-0.8734 (1.1922)	-0.9096 (1.1967)	-0.7586 (1.2123)	-0.7903 (1.2116)
Claimant Female	--	--	-18.9623 (38.0736)	-18.3134 (38.2164)	-12.1572 (38.7253)	-12.7382 (38.7040)
Claimant Not in Labor Force	--	--	14.4747 (49.0291)	14.7395 (49.2206)	-4.5514 (50.2384)	-2.6903 (50.2184)
Joint and Several Liability	--	--	-22.1552 (288.3409)	-56.2052 (289.4631)	-21.3799 (293.8488)	-52.4850 (293.7387)
No Traffic Citation Issued	--	--	-246.453* (118.308)	-255.486** (118.,784)	-181.5829 (121.1643)	-191.8446 (121.1333)
Adjusted R^2	0.7842	--	0.7805	--	0.7809	--
Log likelihood	--	-116005.90	--	-108760.19	--	-106706.75
Number of observations	12848	12870	12009	12031	11787	11808
F: med slope=pastwage slope	191.94**	164.17**	165.78**	141.24**	149.83**	126.63**
F: med slope=futwage slope	502.03**	482.97**	450.98**	434.89**	393.92**	386.11**
F: pastwage slope=futwage slope	157.02**	172.69**	147.58**	163.02**	124.94**	144.20**

**denotes statistical significance beyond the 1% level; * denotes statistical significance beyond the 10% level. (Note: Columns (5) and (6) include state, firm, location and accident-year fixed effects which are not reported.)

Table 5
2SLS Estimates of Payment Schedules
Dependent Variable = Economic Damages Paid
(standard errors in parentheses)

	1 BASIC	2 BASIC fixed effects	3 SPRAIN	4 SPRAIN fixed effects	5 WAGE	6 WAGE fixed effects
Constant	113.6458** (25.3050)	-38.3750 (1.1E+07)	73.4855 (47.7624)	-32.3750 (8.5E+06)	55.4943 (32.3546)	17.0000 (2.0E+07)
Sprain			79.5527 (57.5889)	50.8143 (60.9371)		
Pastwage					-6.0497 (60.2759)	-101.9689 (66.9512)
Futurewage					724.1162** (255.0510)	721.7278** (265.5844)
Claimed amount	0.9152** (0.0073)	0.9379** (0.0098)				
Nosprain*claim			0.9508** (0.0118)[a]	0.9578** (0.0127)[a]		
Sprain*claim			0.8909** (0.0099)[a]	0.9168** (0.0133)[a]		
Medical*claim					0.9801** (0.0152)[a,c]	1.0251** (0.0189)[a,c]
Pastwage*claim					0.9281** (0.0117)[a]	0.9819** (0.0147)[a]
Futurewage*claim					0.7693** (0.0152)[a]	0.7795** (0.0160)[a]
Claimant Age		-2.1708* (1.2991)		-2.2023* (1.2979)		-3.8289** (1.3096)
Claimant Female		-63.8106 (41.4627)		-63.5472 (41.0956)		-80.7677* (41.2325)
Claimant Not in Labor Force		59.4655 (49.2917)		44.5999 (50.1953)		-9.8659 (53.1841)
Joint and Several Liability		-775.570** (312.853)		-714.707* (310.799)		-295.2477 (313.2716)
No Traffic Citation Issued		-229.185* (129.243)		-230.062* (127.944)		-286.571* (128.465)
Adjusted R^2	0.7550	0.7509	0.7599	0.7559	0.7641	0.7546
Number of observations	11787	11787	11787	11787	11787	11787

**denotes statistical significance beyond the 1% level; *denotes statistical significance beyond the 10% level. [a]denotes significantly different from other slope parameters in the model beyond the 10% level; [c] denotes *not* significantly different from 1, beyond the 1% level. (Note: Columns (2) (4) and (6) include state, firm, location and accident-year fixed effects which are not reported.)

Table 6
Estimates of Total Damages Payment Schedules
Dependent Variable = Economic + General Damages Paid
(standard errors in parentheses)

	1 BASIC (TOBIT)	2 BASIC (2SLS)	3 SPRAIN (TOBIT)	4 SPRAIN (2SLS)	5 WAGE (TOBIT)	6 WAGE (2SLS)
Constant	-1156.200 (6579.702)	52.000 (4.1E+07)	-817.152 (6339.579)	-72.750 (3.2E+07)	-938.503 (6293.948)	-12.000 (5.0E+07)
Sprain			234.1384 (154.0306)	105.0217 (189.5919)		
Pastwage					934.1435** (149.1474)	-728.5306** (217.8995)
Futurewage					7194.837** (636.109)	4985.940** (811.452)
Claimed Amount	1.5760** (0.0136)	2.3485** (0.0372)				
Nosprain*claim			2.1404** (0.0205)[a]	2.5732** (0.0479)[a]		
Sprain*claim			1.3093** (0.0135)[a]	2.1304** (0.0474)[a]		
Medical*claim					2.2102** (0.0289)[a]	3.2750** (0.0759)[a]
Pastwage*claim					1.6397** (0.0163)[a]	2.6798** (0.0533)[a]
Futurewage*claim					0.9089** (0.0274)[a]	1.0567** (0.0490)[a]
Claimant Age	8.6252* (3.7633)	-2.6079 (4.1403)	7.7684* (3.6670)	-1.5225 (3.9941)	1.0317 (3.5974)	-15.4356** (4.1482)
Claimant Female	-143.9851 (119.0486)	-534.1370** (132.5763)	-231.4331* (115.0759)	-538.5520** (126.9555)	-217.1233* (113.6510)	-621.7432** (131.0724)
Claimant Not in Labor Force	32.0115 (140.1612)	675.3003** (157.6041)	-271.2006* (138.5913)	465.9067** (154.7948)	87.8717 (148.6232)	42.7451 (168.5103)
Joint and Several Liability	-3053.026** (917.378)	-4776.184** (992.5073)	-2169.271** (884.146)	-4117.330** (953.318)	-1021.935 (880.842)	-957.546 (985.924)
No Traffic Citation Issued	-684.127* (381.653)	-1012.898* (414.321)	-654.103* (368.442)	-940.658* (396.290)	-885.099** (312.025)	-1408.389** (409.357)
Log likelihood	-118114.28	--	-117683.09	--	-117596.59	--
Adjusted R^2	--	0.3792		0.4324		0.3952
Number observations	11808	11560	11808	11560	11808	11560

**denotes statistical significance beyond the 1% level; * denotes statistical significance beyond the 10% level. [a] denotes significantly different from other slope parameters in the model beyond the 10% level. All models include state, firm, location and year fixed effects which are not reported.

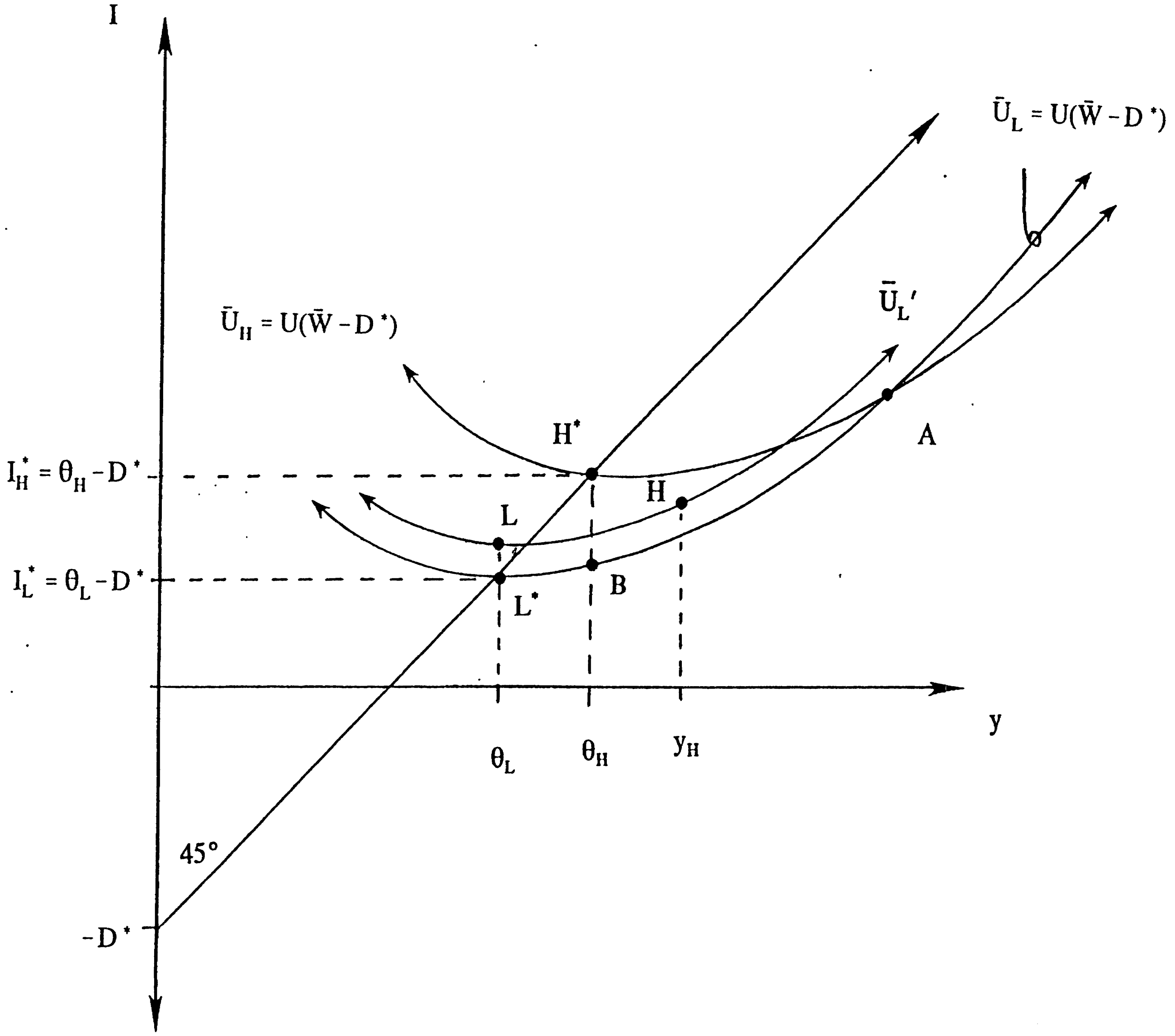
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Figure 1