An Empirical Analysis of the Effects of Product Liability Laws on Underwriting Risk

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Abstract

This article investigates the relationship between the civil justice system and the performance of the commercial liability insurance industry. It uses loss ratio data to examine whether a state's tort doctrines affect the relative prices of liability insurance and underwriting risk in that state. The empirical results suggest that tort doctrines can have an adverse effect on systematic underwriting risk and mean loss ratios.

Problems concerning the affordability and availability of commercial liability insurance continue to be of considerable concern. On the one hand, spokesmen for the insurance industry and various manufacturering associations assert that the root of these problems lies in the civil justice system. Legal factors such as the expansion of liability and large awards for non-economic damages have led to serious problems in the provision of insurance.[1] On the other hand, consumer advocacy groups claim that these problems are caused by the non-competitive ratemaking practices of the insurance industry. According to this view, the insurance crisis of the mid 1980's was manufactured by the industry as a response to a fall in the rate of return that insurers receive on their investments, and their solution would be to impose further regulation on the industry. The purpose of this article is to investigate this issue by examining the effects of tort law on the performance of commercial liability insurers.

Strict products liability is the prevailing tort doctrine for most of the United States. According to this doctrine, manufacturers are liable for all harms that are proximately caused by defective products, regardless of negligence on their part. This does not mean, however, that manufacturers are liable for all harms caused by their products. In theory, the doctrine of strict liability limits manufacturers' liability to harms caused by defective products, and then only when it is the case that the harm is proximately caused by a defect rather than

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[1] See U.S. Department of Justice, Tort Policy Working Group (1986).

by consumer misuse or voluntary assumption of risk. In practice, however, these theoretical limitations are often unclear and unpredictable.[2]

Under a doctrine of absolute liability suppliers would be liable for all accident losses that resulted from the use of their products. Thus, the difference between strict and absolute liability is that the former places limitations on suppliers' obligations and duties to consumers. When the modern doctrine of strict liability fails, in practice, to place feasible and consistent limits on the size and scope of manufacturers' liability, it tends toward a standard of absolute liability which creates serious legal hazards for the provision of insurance.

Under the doctrine of strict liability a supplier must offer an implicit warranty that the product is safe and free from defect. Strict products liability may be thought of as a type of mandatory accident insurance because it requires that manufacturers indemnify the users of their products against any harms that are the result of latent defects. Whether manufacturers self insure or purchase products liability insurance, placing limitations on the extent of their liability is necessary in order to facilitate the process of making actuarially sound estimates of expected losses. Without these limitations insurers will find it increasingly difficult to predict what harms suppliers will be liable for, and how large the damages will be. Thus as tort standards tend toward absolute liability, it becomes increasingly difficult for the insurance industry to assess risks and establish appropriate premiums.

This article uses loss-ratio data by state and insurer group to assess empirically the manner in which liability doctrines affect both relative prices and underwriting risk faced by commercial liability insurers. Tort law consists mainly of judge- made law on the state level and, therefore, varies considerably from state to state. For the purposes of the analysis conducted here, the crucial variation is the extent to which a state's tort standards place reasonable limits on the extent and scope of a manufacturer's liability.

This article argues that absolute liability makes it more difficult to predict losses and corresponding premiums accurately. In general, it was found that higher average state loss ratios and higher levels of systematic risk were associated with absolute liability tort standards. This association was not found for measurs of total and relative risk.

Research Methods

A two-stage statistical procedure is employed to determine the effects of tort standards on the performance of commercial liability insurance markets.[3] First, for each state four different measures of performance are calculated: three are measures of risk, total risk, relative risk and systematic risk, and the fourth is a measure of the relative price of insurance, the mean loss ratio for the state over the ten year period. The second stage of the procedure isolates

[2] See Trebilcock (1987), Priest (1987) or Epstein (1985) for further discussion.

[3] This methodology follows the procedures used by Witt and Urrutia(1983) in their analysis of the effects of tort law on automobile insurance markets.

the role of liability standards in explaining interstate variation in these four performance measures by regressing them on a set of independent categorical variables. These categorical variables categorize states according to their liability standards and capture the tendency for states to tend toward standards of absolute liability in tort.

The Data

The data are annual dividend-adjusted loss ratios by state and company group for 1977 through 1986, obtained from the A.M. Best Company, for the general liability (GL) insurance line.[4] They are reported as industry totals and separately for the three major insurance groups: National Agencies, Direct Writers, and State Agencies.

The most common commercial liability policy is comprehensive general liability (CGL).[5] CGL covers both bodily injury and property damage losses resulting from products liability as well as a variety of other types of liability coverages. In addition to CGL, the general liability line contains various liability policies such as products liability, contractual liability, and directors' and officers' liability. The general liability line does not include any property coverage.

It would be preferable to have CGL reported as a separate line in the data because the general liability line contains liability coverages other than products liability and this may introduce a slight bias into the statistical results. This bias will, however, most likely be small because when liability coverages other than CGL or products liability are affected by a state's tort standards these effects may be qualitatively similar to their effects on products liability insurance for the following reason. All liability doctrines can be classified as either negligence (fault) or strict liability (no fault) doctrines. Under a negligence doctrine, the tortfeasor must be shown to be at fault, i.e. negligent. Under a strict liability doctrine, it must be shown that the product was defective, i.e. unsafe. In both cases the question at issue is, what is the standard of care owed by one person, or group of persons, to another? So, to the extent that a state's tort standards broaden manufacturers' liability in products liability cases by expanding the concept of a product defect, it is reasonable to assume that they may also broaden liability in negligence based cases by expanding the concept of negligence.[6] Thus, if a state's tort standards

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[4]This line of insurance is now called "other liability" in all of Best's publications because it excludes medical malpractice coverage. However, it is still referred to as general liability in most other insurance literature.

[5]According to the Insurance Services Office (1977), 82 percent of all closed claims involving bodily injury were covered under CGL, while only 9 percent were covered specifically under exclusive products liability coverage. For claims involving property damage the figures are 82.4 percent under CGL, and 3.1 percent under exclusive products liability coverage.

[6]Priest (1985) argues that many of the intellectual presuppositions that justify the expansion of strict liability also justify the expansion of negligence liability. For example, the assumption of lack of information on the part of consumers and market power on the part of producer, and the social benefits of risk spreading.

adversely affect risk in any one of the various liability lines, it is likely that they will either have the same effect on the other lines or not affect them at all.

Loss ratios are used in order to account for interstate differences in demographics and other relevant non-legal standards. State-by-state differences in factors such as population density, the degree of urbanization, the crime rate, wage rates, medical costs, housing costs, etc., are reflected in both incurred losses and earned premiums and so should cancel out in the ratio.[7]

Measurement of Risk

The state loss ratio can be used as a measure of the relative price of insurance because it reflects the proportion of premium dollars that are returned in the form of loss payments to insureds. A low (high) loss ratio reflects a high (low) relative price of insurance. As long as the expense ratio (the ratio of expenses to losses) is constant, the loss ratio is also an inverse measure of underwriting profitability, and hence variation in the loss ratio can serve as a good proxy measure for underwriting risk.[8]

Total underwriting risk is measured by the standard deviation of the state's mean loss ratio over the ten year period. Relative risk is measured by the coefficient of underwriting risk. It is a standardized measure that reflects the variation in the mean loss ratio relative to a proxy for the mean profit and expense ratio. It is calculated as the standard deviation divided by one minus the mean loss ratio.

Total risk can be thought of as having two components, systematic risk and unsystematic risk. Systematic underwriting risk can be measured by the beta coefficient in the regression of the annual state-wide loss ratio on the annual national loss ratios for all companies. That part of the variation in the statewide loss ratio that is explained by variation in the national loss ratio is the systematic component, while the unsystematic component is the residual variation. The tendency for a state's loss ratio to move with the national loss ratio is reflected in the beta coefficient, so beta is a measure of the systematic volatility of a state's loss ratio relative to the average. Unsystematic risk is the variation in the state's loss ratio that is not explained by variation in the national loss ratio. This state-specific risk can potentially be diversified away by selling insurance in more than one state. Therefore, as companies diversify by selling insurance nationally, unsystematic underwriting risk should decrease.[9]

Systematic risk may be the appropriate measure to use because it is this sort of risk that is important to a rational diversified investor. The equation for estimating systematic risk is:

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[7]See Witt and Urrutia (1983) for further discussion.

[8]See Witt(1979) for a further discussion of why the loss ratio is an inverse measure of underwriting profitability.

[9]This will not be possible for the regional and specialty insurers who are grouped under the category State Agencies. However, they account for only a small percentage of the industry (Joskow, 1973).

$$LR_{ijt} = a_{ij} + B_{ij}\,(NLR_{jt}) + e_{ijt}$$

where: $i = 1, \ldots, 51$; $j = 1,..,4$; $t = 1, \ldots, 10$;

LR_{ijt} = loss ratio for state i, insurer group j, in year t;

$NLR_t = \sum LR_i / 51$ = the average annual loss ratio for all 50 states and the District of Columbia in year t, for insurer group j;

a_{ij} = regression constant;

B_{ij} = regression coefficient, beta, which measures the systematic underwriting risk in state i, for insurer group j;

e_{ijt} = a stochastic error term, which reflects the unsystematic risk in state i, for insurer group j.

This equation was estimated separately for each state and for each of the four company groups.

Variations in Liability Standards

The most serious difficulty in categorizing states according to their liability standards is that there are far more similarities than there are differences among them. All states have, in practice, some form of strict products liability. In the majority of cases it is strict tort liability, while in a few others it is a doctrine based on implied warranty of merchantability and fitness or the Uniform Commercial Code. Similarly, most states allow some form of assumption of risk and product misuse defenses. However, enough differences exist so that a meaningful analysis can be done.

States were divided into dichotomous categories based on variations in their tort doctrines. These categories were chosen because they were the ones in which the states exhibited the most clear-cut and meaningful variability. They are not exhaustive, but do indicate a tendency for states to relax the limitations that they impose on the extent of suppliers' liability and hence lean toward a standard of absolute liability.

The Unreasonably Dangerous Requirement

First, states were grouped into two categories according to whether they have accepted the doctrine of strict liability as it was established in *The Restatement Second of Torts*, section 402A, or the doctrine as it was established in *Greenman v. Yuba Power Products Inc.* (1962). The principal difference between these two doctrines is that in the *Restatement* formulation the plaintiff must show that the product was defective, and that the defective condition was unreasonably dangerous. The unreasonably dangerous requirement was inserted in the *Restatement* in order to guard against strict liability becoming a standard of absolute liability.

Determining what constitutes a product defect is, perhaps, the most serious problem for the doctrine of strict liability. To allege that a product is defective is to assert that something is wrong with it. It fails to meet some objective set of quality and safety standards. Products may be deemed defective in manufacturing, design, or a failure to warn of their risks. In the case of manufacturing defects, a product is considered defective if it does not meet the manufacturer's own quality control standards. The standard, *per se*, is not at issue.

Cases involving design defects and failures to warn are far more difficult. The product reaches the consumer in the condition intended by the manufacturer; it meets all the manufacturer's quality and safety standards. It is, however, the adequacy of these standards that is at issue, and the question is, what sort of criteria ought to be used in judging these standards? In the *Restatement* formulation, the unreasonably dangerous requirement is intended to provide a basis for these criteria. A product is defective only if it is more dangerous than the ordinary or average consumer would expect. Hence, under this doctrine the plaintiff must show both that the product was defective and unreasonably dangerous. If the product is defective but not unreasonably dangerous, the plaintiff cannot recover.

Some states, on the other hand, hold that such a bifurcated standard is unnecessary and introduces elements of negligence into strict liability. They have followed the California court and adopted the *Greenman v. Yuba* formulation of the doctrine, which only requires that the plaintiff show that the product was defective; that is, it is unsafe for its intended use. The problem with this doctrine is that without relying on some *a'priori* standard of reasonability, the question of how safe is safe enough has to be answered on a case-by-case basis. Thus, the standards of quality and safety that are expected of manufacturers cannot be known in advance, and so they are faced with the very real possibility of being held liable for any injuries proximately caused by their products. The states that do not require the plaintiff to show that the defect was unreasonably dangerous are Alaska, California, New Jersey, New York, Pennsylvania, Ohio, and West Virginia.

State-of-the-Art Defenses

Second, states were divided into two categories according to whether they allowed state-of-the-art defenses. Although there may be some confusion as to the actual meaning of the term "state-of- the-art," it is generally thought to refer to both industry custom and the feasibility of alternative designs. Virtually all states agree that conformity with industry custom is not an absolute defense in products liability cases.[10] However, there is a broader definition of the term, state-of-the-art, and this definition encompasses the concept of the practical and technological feasibility of design alternatives. In this view, compliance with a state-of-the-art standard is an absolute defense if the product was designed as safely as reasonably possible, given both the state

[10]This has been the practice in the common law ever since the T.J. Hooper (1932) case.

of scientific and technological knowledge at the time of manufacture, and the practical feasibility of design alternatives. Those states that do not allow a state of the art defense are Alaska, Colorado, Idaho, and Oklahoma.

Joint and Several Liability

Third, states were grouped into two categories depending on whether they had adopted any version of the doctrine of joint and several liability in products cases. Joint and several liability was originally intended to deal with cases where multiple defendants, acting in concert, caused the plaintiff's harm. Under this doctrine, if person A is harmed by persons B and C either one of them is potentially liable for all of A's damages.

In products cases several versions of this doctrine have emerged in recent years. Industry wide liability allows a plaintiff to find an entire industry jointly and severally liable. Thus, by his or her choice of defendants, the plaintiff is able to shift the cost of compensation to the party with the deepest pocket, regardless of the extent of that party's contribution to the plaintiff's harm.[11] Concert of action liability is similar except that a group of defendants must be shown to have acted in concert.

Another version that has emerged is the doctrine of market share or enterprise liability. According to this doctrine, a plaintiff who was injured by a generic product, of unknown manufacture, can bring suit against the entire industry, and if successful, damages will be apportioned among the joint defendants according to some objective criterion, which is generally market share in the jurisdiction at the time of injury. This doctrine is used most often in pharmaceutical cases where the damage caused by the drug does not become apparent for several years and the plaintiff has no way of knowing which company actually manufactured the generic form of the drug that caused the injuries.

Finally, the doctrine of alternative liability shifts the burden of proof from the plaintiff to the defendant. The defendant must show that his or her actions or product did not cause the injury. The states that have adopted some version of the doctrine of joint and several liability are California, Florida, Massachusetts, Michigan, New Jersey, New York, and Oregon.

Punitive Damages

Punitive damages are generally recoverable under most state laws as long as the plaintiff is able to show that the tortfeasor acted in a reckless manner. There is, however, an incompatibility between punitive damages and strict products liability in tort. Punitive damages are predicated on the reckless conduct of the supplier whereas under strict liability the conduct of the supplier is ignored. Thus, the *Restatement* allows only for compensatory, not punitive, damages. Some state courts, however, have been willing to award punitive damages in strict liability cases in the interest of equity. The plaintiff

[11] See U.S. Department of Justice, Tort Policy Working Group (1986) for further discussion.

must still show evidence of aggravated conduct. The states that have upheld punitive damage awards under a strict liability doctrine are Alaska, Arizona, Arkansas, California, Connecticut, Illinois, Indiana, Minnesota, Ohio, Oregon, Texas, and Wisconsin.

The Model

In order to assess empirically the manner in which liability standards affected the performance of commercial liability insurance markets, the following four equations are estimated:[12]

$$BETA_{ij} = a_j + b1_jD1 + b2_jD2 + b3_jD3 + e_{ij}$$

$$STDEV_{ij} = a_j + b1_jD1 + b2_jD2 + b3_jD3 + e_{ij}$$

$$CV_{ij} = a_j + b1_jD1 + b2_jD2 + b3_jD3 + e_{ij}$$

$$MLR_{ij} = a_j + b1_jD1 + b2_jD2 + b3_jD3 + e_{ij}$$

where: a_j, $b1_j$, $b2_j$, $b3_j$ = regression coefficients for insurer group j;

$BETA_{ij}$ = the coefficient of systematic underwriting risk for insurer group j in state i;

$STDEV_{ij}$ = the standard deviation of the mean loss ratio for insurer group j in state i;

CV_{ij} = the coefficient of variation for insurer group j in state i;

MLR_{ij} = the mean loss ratio for insurer group j in state i;

D1 = a dummy variable equal to one if the state does not require the plaintiff to show that the defect was unreasonably dangerous, and equal to zero otherwise.

D2 = a dummy variable equal to one if the state does not allow a state of the art defense, and equal to zero otherwise.

D3 = a dummy variable equal to one if the state has adopted the doctrine of enterprise liability, and equal to zero otherwise.

[12] In the first stage of the analysis approximately 85-95 percent of the betas were shown to be statistically significant. All the betas are included in this second stage of the regression so that the analysis of systematic risk will be commensurate with the analysis of total risk and the mean loss ratio. And, the fact that a coefficient is not statistically significant does not prove that the null hypothesis is true.

D4 = a dummy variable equal to one if the state has upheld punitive damages under a strict liability doctrine, and equal to zero otherwise.

e_{ij} = a stochastic error that reflects the variation in the independent variable that is not correlated with variations in liability standards.

The equations are estimated separately for each of the four company groups, so there are 16 estimations in all.

Hypotheses

The hypotheses are that in states that have exhibited a tendency toward absolute liability, all three measures of underwriting risk are higher. Absolute liability is expected to increase the variance of the pure premium distribution and this increase should be reflected in an increase in the variability of the state's loss ratio.

Claim frequency is expected to be higher in absolute liability states because more claims can be justified by the legal system. As claim frequency increases in response to an expansion in the extent of manufacturers' liability, then it should also be the case that the composition of these claims will also change, increasing the variance of the claim severity distribution. Moreover, when tort doctrines enlarge the scope of compensable damages mean severity is also expected to increase. Thus, the variance of the pure premium distribution, obtained by combining the claim frequency and claim severity distributions, is increased.[13]

Also expected is that the mean loss ratios will be higher in the riskier states. The loss ratio is a measure of the relative price of insurance because it reflects the proportion of premium dollars that are returned in the form of loss payments to insureds and, is also an inverse measure of underwriting profitability. Thus, it may seem odd to predict that an increase in risk would be associated with a decrease in the rate of return since economic theory would predict the opposite case. Witt and Miller (1980), in work on automobile insurance, found that mean loss ratios and underwriting risks were positively correlated even though theory would predict a negative correlation if risk were correctly accounted for in ratemaking formulas. This article also finds a strong positive correlation between the mean loss ratio and all three measures of underwriting risk.[14]

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[13] It should be noted that absolute liability can increase both process risk and parameter risk. During the time period under consideration, from 1977 through 1986, it increased process risk by increasing the variance of the pure premium distribution, and to the extent that insurers underestimated that increased variance it would have also increased parameter risk.

[14] For industry totals, the correlation coefficient between the mean loss ratio and the standard deviation, the coefficient of variation, and beta, are 0.46, 0.62, and 0.71 respectively. These coefficients are all significant at the 2.5 percent level or better. When broken down by company groups the results are qualitatively similar.

Although it is correct to say that interstate variation in underwriting risk is not properly accounted for, this does not imply that insurers are unaware of these differences. A likely explanation might be that insurers did not adequately foresee the magnitude of the higher costs resulting from the economic and legal changes from 1977 through 1986.[15] Harrington and Litan (1988) argue that the data on growth in jury awards and litigation are consistent with the hypothesis that liability insurers failed to anticipate rapid growth in losses in this period. One of the empirical issues that this article attempts to evaluate is whether this failure was worse in groups of states whose tort doctrines tend toward absolute liability than in others.

A test of the null hypotheses that $b1 = 0$, $b2 = 0$, $b3 = 0$ and $b4 = 0$, against the alternative that they are greater than zero, provides a test of the hypothesis that all three measures of performance are adversely affected by a state's liability standards.

Weights

Given the large differences in premium volumes, it is not appropriate to treat states equally in the regression (Witt & Urrutia, 1983). Since the units of observation on the dependant variables represent grouped data, it is appropriate to use a weighting procedure in order to account for heteroskedasticity (Danzon 1984, 1986). Each observation is weighted by the square root of the percentage of premium volume per state.[16] This weighting procedure assumes an error structure such that the variance of error decreases proportionally as the number of risk exposures increases.

Regression Results

The results of the regression analysis are presented in Tables 1-4. These results provide mixed support for the hypothesis that all four performance measures are adversely affected in states that tend toward absolute liability.[17]

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[15] I am indebted to the comments of the Associate Editor for this insight.

[16] The weights are computed according to the following formula:

$$Wij = \sum_{i=1}^{10} Pijt / \sum_{i=1}^{51} \sum_{i=1}^{10} Pijt$$

Wij = weight for state i and insurer group j.

$\sum_{i=1}^{10} Pijt$ = total premiums written in state i by insurer group j, from 1977 through 1986.

$\sum_{i=1}^{51} \sum_{i=1}^{10} Pijt$ = total premiums written by insurer group j in all 50 states and the District of Columbia from 1977 through 1986.

[17] The simple correlation coefficients between the independent variables are as follows:

	D1	D2	D3	D4
D1	1.00			
D2	0.15	1.00		
D3	0.44	-0.12	1.00	
D4	0.13	0.01	-0.09	1.00

The correlation between D1 and D3 is slightly higher than would be prefered. However, the collinearity test developed by Belsley, Kuh, and Welsh (1980) was run and the results were satisfactory. The condition index was never greater than 3.34.

Mean Loss Ratios

The regression results in Table 1 indicate that a significant proportion of the variation in the mean loss ratios is explained by differences in liability standards. For all the company groups the coefficients of determination are relatively high and statistically significant at the 2.5 percent level or better.

Table 1

Regression of the State's Mean Loss Ratio on Categories of Tort Liability Standards

Explanatory Variables	National Agencies	State Agencies	Direct Writers	Industry Totals
Intercept	62.284***	57.720***	60.500***	61.125***
	(31.80)	(20.58)	(19.04)	(30.72)
Unreasonably Dangerous Requirement	-1.759	2.217	0.513	0.138
	(-0.37)	(0.32)	(0.07)	(0.03)
State-of-the Art Defense	10.091	22.267***	10.529	12.356*
	(1.65)	(2.61)	(1.05)	(2.01)
Joint & Several	13.867***	16.322***	14.691***	13.628***
	(3.32)	(2.72)	(2.43)	(3.31)
Punitive Damages	5.814*	5.374	11.363***	6.440***
	(1.93)	(1.27)	(2.41)	(2.13)
	R2 = .298	R2 = .310	R2 = .229	R2 = .335
	F = 4.900***	F = 5.179***	F = 3.408***	F = 5.799***

Note. The t-scores are in parentheses.
* Significant at the 10 percent level (one-tailed test)
** Significant at the 5 percent level (one-tailed test)
***Significant at the 2.5 percent level (one-tailed test)

The categorical variables that have the most consistent explanatory power are joint and several liability and punitive damages. Their coefficients are positive and with one exception (punitive damages for State Agencies) are statistically significant. This is not surprising since both of these doctrines can be expected to increase average claim severity. Punitive damages does so because it enlarges the scope of compensable damages; the doctrine of joint and several liability does so because it, in effect, allows liability to be predicated on the defendant's ability to pay rather than contribution to the injury.

It is surprising that the coefficient on the unreasonably dangerous requirement is not significant for any of the company groups, indicating that rejecting the unreasonably dangerous requirement has no adverse effect on mean loss ratios. This does not, however, necessarily demonstrate that the failure to set clear limits on the safety standards required of manufacturers

has no effect on loss ratios. It may be the case that the unreasonably dangerous requirement is itself inadequate.

The principle difference between the *Restatement* doctrine and the *Greenman* doctrine is that the former relies on a version of the "reasonable man" standard. The plaintiff must show that the product is more dangerous than the average consumer would expect. Under the *Greenman* standard, all the plaintiff must show is that it is more dangerous than he or she expected. So even if the plaintiff is clumsier, less educated, and generally less lucky than the average or reasonable man, he or she can still prevail in court. So although the unreasonably dangerous requirement was intended to provide feasible and consistent limits to a supplier's liability, it may fail to do so in practice.

The effect of state-of-the-art defenses is unclear. The coefficient is positive for all company groups but significant only for State Agencies and industry totals. It may be difficult to isolate the effects of rejecting state-of-the-art defenses. In states that have ruled these defenses inadmissable, it may be that the original test they use in imposing liability takes into account the factors embodied in this defense.

Finally, it should be noted that the three states (California, New York, and New Jersey) that accept the doctrine of joint and several liability in products cases also reject the unreasonably dangerous requirement. It may be the case that when the doctrine of enterprise liability is combined with another doctrine that does not clearly delineate the safety standards required of manufacturers, the result will be an even further increase in the uncertainties inherent in the underwriting process. Moreover, two of these states, California and New Jersey, have historically been among the leaders in expanding the scope and existence of manufacturers' liability.

Total Risk

The results in Table 2 indicate that differences in tort standards explains very little of the variation in total underwriting risk. For National Agencies and Direct Writers none of the coefficients are significantly different from zero. For State Agencies and industry totals, only the coefficient on state-of-the- art defenses is positive and significant. These results indicate almost no support for the hypothesis that absolute liability has a deleterious effect on total risk.

Relative Risk

The results for relative risk in Table 3 exhibit slightly more explanatory power, than do those for total risk. For all company groups except industry totals the coefficient of variation is relatively high and significant at the 5 percent level or better.

In terms of isolating which liability standards are having the effects the results are inconsistent. For National Agencies and State Agencies the coefficient on state-of-the-art defenses is positive and significant. For Direct Writers only the coefficient on the unreasonably dangerous requirement is significant. The fact that none of the coefficients are significant for industry

Table 2

Regression of the State's Standard Deviation on Categories of Tort Liability Standards

Explanatory Variables	National Agencies	State Agencies	Direct Writers	Industry Totals
Intercept	24.456***	29.913***	27.075***	22.619***
	(12.12)	(8.14)	(7.48)	(12.94)
Unreasonably Dangerous Requirement	-1.403	-0.394	9.639	0.196
	(-0.28)	(-0.04)	(1.14)	(0.04)
State-of-the Art Defense	8.050	32.400***	4.148	9.715*
	(1.28)	(2.99)	(0.36)	(1.79)
Joint & Several	0.255	5.068	-4.118	2.083
	(0.16)	(0.65)	(-0.70)	(0.57)
Punitive Damages	3.286	3.103	4.861	3.741
	(1.06)	(0.56)	(0.90)	(1.41)
	R2 = .066	R2 = .162	R2 = .061	R2 = .100
	F = 0.681	F = 2.228*	F = 0.750	F = 1.277

Note. The t-scores are in parentheses.
* Significant at the 10 percent level (one-tailed test)
** Significant at the 5 percent level (one-tailed test)
***Significant at the 2.5 percent level (one-tailed test)

Table 3

Regression of the State's Coefficient of Variation on Categories of Tort Liability Standards

Explanatory Variables	National Agencies	State Agencies	Direct Writers	Industry Totals
Intercept	0.733***	0.498	0.922***	0.799***
	(5.83)	(0.99)	(4.93)	(3.25)
Unreasonably Dangerous Requirement	-0.051	0.460	0.965**	0.194
	(-0.17)	(0.33)	(2.20)	(0.33)
State-of-the Art Defense	1.259***	6.975***	0.248	1.056
	(3.22)	(4.55)	(0.42)	(1.38)
Joint & Several	0.430	0.498	0.169	0.239
	(1.61)	(1.39)	(0.47)	(0.47)
Punitive Damages	0.243	0.792	-0.390	0.153
	(1.27)	(1.04)	(-1.40)	(0.41)
	R2 = .225	R2 = .337	R2 = .209	R2 = .056
	F = 3.34***	F = 5.83***	F = 3.039**	F = 0.686

Note. The t-scores are in parentheses.
* Significant at the 10 percent level (one-tailed test)
** Significant at the 5 percent level (one-tailed test)
***Significant at the 2.5 percent level (one-tailed test)

totals may indicate that these differences are due more to differences inherent in the three company groups than in tort standards.

Systematic Risk

Measures of total risk and relative risk may not be the appropriate ones to use because they are both calculated using the standard deviation of the mean loss ratio and it contains both the systematic and unsystematic component of underwriting risk. The unsystematic component will reflect state-specific characteristics which are probably different among states categorized according to otherwise similar tort doctrines, while the systematic component should reflect factors that are common among them. It may, therefore, be a better measure for examining the manner in which tort law affects underwriting risk.[18]

The results for systematic risk are presented in Table 4. Overall the results are quite similar to the results for the mean loss ratios. For National Agencies, State Agencies, and industry totals the coefficients of determination are relatively high and significant at least at the 5 percent level. The most

Table 4

Regression of the State's Beta on
Categories of Tort Liability Standards

Explanatory Variables	National Agencies	State Agencies	Direct Writers	Industry Totals
Intercept	0.824***	0.679***	0.777***	0.771***
	(15.54)	(8.22)	(5.49)	(16.17)
Unreasonably Dangerous Requirement	-0.168	-0.011	0.427	-0.030
	(-1.30)	(-0.05)	(1.30)	(-0.258)
State-of-the Art Defense	0.115	0.500*	0.141	0.350***
	(.68)	(1.99)	(0.32)	(2.37)
Joint & Several	0.295***	0.400**	0.074	0.252***
	(2.63)	(2.66)	(0.27)	(2.55)
Punitive Damages	0.201***	0.294**	0.283	0.247***
	(2.49)	(2.36)	(1.34)	(3.41)
	R2 = .194	R2 = .250	R2 = .110	R2 = .321
	F = 2.763**	F = 3.826***	F = 1.418	F = 5.444***

Note. The t-scores are in parentheses.
* Significant at the 10 percent level (one-tailed test)
** Significant at the 5 percent level (one-tailed test)
***Significant at the 2.5 percent level (one-tailed test)

[18]This argument was made by Witt and Urrutia (1983) in their comparative analyses of tort liability and no-fault compensation systems in automobile insurance. They argued that systematic risk tended to capture factors that are common among states with no-fault laws.

consistent results are the coefficients on joint and several liability and punitive damages. With the exception of Direct Writers, they are always positive and significant. The evidence suggests that these tort doctrines exacerbate the systematic variability of the states' loss ratios.

The coefficient on the unreasonably dangerous requirement is never significant and in some cases is negative. As in the case of the mean loss ratios, this may suggest that the unreasonably dangerous requirement is inadequate.

For state-of-the-art defenses the results are mixed. The coefficients have the expected sign but are significant only for industry totals and state agencies. The evidence here appears to be inconclusive.

Summary and Conclusions

It has been alleged that changes in the civil justice system are responsible for many of the difficulties in commercial liability insurance. In this view, tort doctrines that have expanded the scope and size of supplier's liability are a major cause of the problems in insurance availability and affordability.

Strict products liability is the predominant tort doctrine in the U.S. According to this doctrine, suppliers are liable for all harms that are proximately caused by defective products, regardless of negligence on their part. In theory, this doctrine limits liability only to harms for defective products and then only when it is the case that the consumer has not misused the product or taken some extraordinary risk. The author of this article argues that when tort doctrines fail to establish feasible and consistent limits on the size and scope of liability, they tend toward standards of absolute liability which make it increasingly difficult for commercial insurers to assess risks and establish appropriate premiums.

Using state loss ratios, this issue was evaluated by first calculating four different measures of performance: the state's mean loss ratio over a ten year period, total risk, relative risk, and systematic risk. The next stage of the analyses attempted to isolate the role of tort standards in explaining interstate variation in these different measures by regressing them on four dummy variables which categorize states according to particular aspects of their tort doctrines.

Taken as a whole the evidence supports the hypothesis that systematic underwriting risk and the mean loss ratio are adversely affected by the tendency toward absolute liability. It provides little support for the hypothesis that total risk or relative risk are adversely affected. The tort doctrines that exhibited consistently adverse effects were the doctrine of joint and several liability in products cases and allowing punitive damages under a strict liability doctrine. The evidence was inconclusive on the effects of disallowing state-of-the-art defenses. So, although the relationship between the civil justice system and the provision of commercial liability insurance is a complex one, the evidence suggests that tort doctrines can contribute to problems already intrinsic to insurance underwriting and ratemaking.

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