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Alternative Liability Regimes for Medical Injuries: Evidence from Simulation Analysis

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ABSTRACT

An optimization model of physician choice of patient care under alternative liability regimes yields estimates of frequency of patient injury, liability insurance coverage, and utility of patients and physicians. Results are sensitive to assumptions about the physician's altruism (agency), productivity, cost and revenue functions, and experience rating. For a physician caring only about own wealth and leisure, the model confirms conventional conclusions. But for a partially altruistic physician, increasing physician liability can decrease patient care and increase injury rates. Effects of liability depend critically on the productivity of care, physicians' opportunity cost of time, and form of reimbursement (capitation or fee-for-service).

Introduction

Dissatisfaction with the current medical malpractice system in the United States has led to renewed interest in alternatives to the traditional rule of negligence liability for physicians. One extreme alternative is a rule of no liability on health care providers, with or without a special tax-financed program of compensation for patients who suffer iatrogenic injury. At the other extreme is strict liability, with financing through experience-rated liability insurance premiums. Enterprise liability, which would place liability on the health plan or hospital rather than the individual physician (Weiler, 1991) and the administrative fault-based system proposed by the American Medical Association (1988) are hybrids.

Theoretical analyses of liability rules provide insights into the efficiency of alternative rules, under restrictive assumptions. Efficiency is defined as minimizing the total social cost of injuries, including costs of prevention, injury-related losses, and administrative overhead. A rule of no liability leads to nonoptimal levels of care and compensation if consumers misperceive the risk

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of injury from medical treatment (Spence, 1977; Shavell, 1980). Either a negligence rule or strict liability can induce an optimal level of care in the context of unilateral accidents with risk neutrality or costless insurance.[1] With risk aversion, the evaluation of negligence vs. strict liability also depends on the availability of first-party and liability insurance, on the feasibility of experience rating of insurance premiums (Shavell, 1982), and on the extent to which liability imposes nonmonetary costs on defendants. Administrative costs are ignored in these models.

Several assumptions of these models are questionable in the context of medical injuries. First, in practice, the negligence rule is not a clear threshold standard, because courts lack perfect information in defining the standard of due care and in evaluating the care actually provided. The evidence suggests Type 1 and Type 2 errors in claims filing and adjudication (Danzon and Lillard, 1983; Danzon, 1985; Farber and White, 1991; Weiler et al., 1993). Thus, the status quo is at best a noisy negligence system: the probability of liability, conditional on an injury, depends on factors other than actual care relative to the efficient due care standard.

Second, traditional models of liability assume noncooperative behavior by selfish utility maximizers. However, economic analyses of physician decision making in other contexts often assume that physicians internalize to some degree their patients' well-being, because of either professional norms or altruism (Arrow, 1963; Pauly, 1980; Farley, 1986; Ellis and McGuire, 1986). Danzon (1991b) shows that, when the physician is a partial but imperfect agent for the patient, the effects of alternative liability regimes on levels of care and patient well-being are theoretically ambiguous. Conclusions depend on the magnitude of several parameters and behavioral response functions, for which accurate empirical-based estimates are not available.

This article uses simulation analysis to estimate the effects of alternative liability regimes, under alternative assumptions about physician agency and other variables. In the model, a representative physician chooses a level of patient care (his or her time per patient) and liability insurance coverage to maximize an objective function that depends on the physician's own utility of wealth and leisure and may also depend on the patient's utility, which depends on health and wealth. The physician's level of care determines the probability of injury to the patient and the money and time costs of treatment. The liability regime determines the patient's compensation, the penalty to the physician, and litigation costs.

This model is used to test the effects of alternative liability regimes on the physician's choice of care per patient and hence the frequency of patient injuries, and the utility of patients and physicians. Since these utilities incorporate the costs of injuries, precautions, overhead, and uninsured risk, a weighted sum

[1] The unilateral accident model is appropriate for medical injuries, since patient precautions are typically not relevant. Multiple defendants may be involved but are ignored here. With a negligence rule, achieving the optimal injury rate requires that physicians be liable for procedures done without informed consent.

can be interpreted as an approximation to a utilitarian social welfare function. The liability rules considered are a noisy negligence rule (the status quo), no liability, and strict (no-fault) liability of physicians for all iatrogenic injuries. I test the sensitivity of the results to the physician's degree of agency; the productivity of care in reducing injury risk; the degree of experience rating of liability insurance; patient information, as reflected in the parameters of the demand function for medical care; the availability of first-party insurance; fee-for-service vs. capitation reimbursement of physicians; ability to pass through liability insurance costs in higher fees for medical care; and the opportunity cost of the physician's time. Parameter values are selected to yield results that conform roughly to realistic mean empirical magnitudes for income, injury risks, and liability insurance premiums.

With a purely selfish physician the simulations confirm standard theoretical conclusions: placing liability on physicians leads to greater care than no liability, provided that liability insurance is experience rated. But if the physician is a moderately good agent, greater care may be provided under no liability than under strict liability. This nonstandard result depends partly on the availability of first-party insurance. If the patient has no source of compensation other than the liability system, the altruistic physician increases prevention as a substitute for insurance. If the patient is compensated through the liability system, this motivation for care is reduced, and other factors, including the physician's opportunity cost of time and the patient's out-of-pocket cost of medical care, tend to constrain the level of care.

The model is positive rather than normative in that it estimates the effect of alternative liability regimes on outcomes and utilities but does not solve for an optimal level of care. It does solve for the physician's and patient's utilities. The sum of these utilities is generally higher under strict liability. However, because the model omits some potentially significant costs of liability, these results should not form the basis for policy conclusions.

The next section describes the model and is followed by a section that reports the results. The last section summarizes the model's limitations, main conclusions, and implications for reforms of the medical malpractice system currently under debate.

The Model

Overview

In the model, a representative physician treats a representative patient. The physician's time spent per patient increases the patient's health and reduces the risk of iatrogenic injury. With fee-for-service reimbursement, the physician receives a fee per unit of time spent; with capitation, the physician receives a fixed payment per patient episode of care. The physician faces a demand for episodes that depends on price per episode and may also depend on quality (physician time per episode, a proxy for risk of iatrogenic injury) and on the patient's expected compensation if injured. The physician chooses the level of both care per patient and liability insurance coverage to maximize an objective function that is a weighted average of his or her own utility (which depends on wealth and leisure) and the utility of the representative patient (which depends on wealth and health). The selfish physician assigns a weight of zero to the patient's utility; the altruistic physician assigns a weight of 0.25.

The liability rule determines the probability of an award to an injured patient. The two polar cases are no liability and strict liability. Negligence is represented by a probability of compensation between zero and one.[2] The award to the patient is equal to the financial loss incurred, plus a one-third mark-up for pain and suffering. Administrative cost has two components: the insurance overhead or loading, which is assumed to be 15 percent for first-party or liability insurance, and the litigation costs that arise under strict liability or negligence. These plaintiff and defense attorneys' fees are payable by the defendant regardless of whether he or she buys liability insurance. Litigation cost is therefore not a loading from the defendant's perspective. From the patient's perspective, litigation cost is a loading on compensation only if the liability system has no deterrent effect.

With perfect experience rating, the liability insurance premium is equal to the expected cost of paid claims (adjusted to reflect the endogenous level of care) plus mark-ups for litigation expenses and insurance overhead. With community rating, the premium is based on a fixed probability of injury, regardless of the physician's level of care. The injured patient's first-party insurance is assumed to cover 75 percent of the monetary loss and is assumed to be perfectly experience rated.

The Structural Model

See the Appendix for a complete list of notation and base values for the terms and variables of the structural model described below.

The patient. The patient's expected utility is additively separable in health and wealth, with risk aversion in each component:

$$PTU = gEUW + (1\text{-}g)EUH,$$

where PTU = the patient's total expected utility,
PUW = the patient's expected utility of wealth, and
PUH = the patient's expected utility of health,

with U_w, $U_h > 0$ and U_{ww}, $U_{hh} < 0$. Wealth and health are assigned equal weight in overall utility ($g = 0.5$). An uninjured patient's wealth is equal to

[2] The standard model of a knife-edge negligence rule, whereby the physician is liable if and only if he or she fails to meet a clearly defined due care standard, is an unrealistic representation of the negligence system in practice. Craswell and Calfee (1986) analyze a negligence system with errors under the assumption of a risk-neutral, wealth-maximizing defendant. Danzon (1991b) develops a model with "defensive medicine," in which the probability of liability can be influenced by the frequency of tests as a signal for care. In this simulation model, the physician's care affects the probability of injury but not the conditional probability of liability, given an injury.

base wealth W_0 ($30,000) minus the out-of-pocket cost of medical care.[3] With fee-for-service reimbursement of the physician, the patient's copayment is cFh, where c is the copayment rate (0.2), F is the physician's hourly fee ($100), and h is the number of hours of physician time per episode of medical care. With capitation, the patient's copayment is zero. Each patient has at most one episode of medical care, which may entail several visits or hours of physician time—for example, a surgical episode may include pre- and post-operative office visits, in addition to the time in surgery. The simulations reported here use exponential utility functions (constant absolute risk aversion). Results were qualitatively similar with logarithmic utility functions (constant relative risk aversion). The patient's utility of wealth in state i is

$$UW_i = 1 - \exp(- r_w W_i),$$

where the absolute risk aversion parameter $r_w = -U_{ww}/U_w$ takes a base value of 0.00002.[4]

The uninjured patient's health is a concave function of physician time per episode h, given an initial health stock before treatment H_0 and a maximum potential health H^*:

$$H_3 = H_0 + (1 - \exp(-\delta h))(H^* - H_0).$$

The marginal product of h, $\delta(H^*-H_0)\exp(-\delta h)$ is proportional to the severity of the condition, measured by the difference H^*-H_0. The patient's utility of health UH is

$$UH = 1-\exp(-r_h H),$$

where the absolute risk aversion parameter r_h has a base value of 0.00002, the initial health H_0 has a base value of $0.33H^*$, and the maximum health achievable H^* is normalized to 100,000.

Medical care entails a risk of iatrogenic injury. The probability of no iatrogenic injury p(h) increases with h:

$$p(h) = 1 - \alpha[\exp(-r_p h)],$$

with $p_h > 0$, and $p_{hh} < 0$. Higher values of r_p imply that care is more productive in reducing injury risk.

If an injury occurs, the patient suffers a financial loss that is a multiple of base wealth: $L = kW_0$. With the base value of $k = 1.33$, the base value of L is $40,000. Base wealth should be interpreted as initial assets plus one year's income. The present value of an injury involving permanent disability may exceed this value; negative values of wealth reflect debt. The patient also suf-

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[3] Base wealth is net of the patient's contribution to the health insurance premium, which is assumed invariant for fee-for-service and capitation reimbursement.

[4] A base wealth of $30,000 implies relative risk aversion of 0.6. The patient's risk aversion for health was assumed to be the same as for wealth. The physician was assumed to be less risk averse than the patient. The exact values used were selected to give reasonably plausible magnitudes for predicted values of time per patient, wealth and leisure.

fers a nonpecuniary health loss I, which is assumed to be proportional to maximum health H^* and is related to the financial loss:

$$I = H^*[1 - 1/k].$$

I represents pain, suffering, and all other intangible losses.

Liability rules. The liability regime determines the probability (s) of an award to the patient, conditional on an injury. Values of s of 0 and 1 represent no physician liability and strict physician liability, respectively. Values of s of 0.2 and 0.5 represent a noisy negligence rule; only the values for s = 0.5 are reported here. If the physician is found liable, the patient receives an award Z = (1 + z)L. The mark-up for nonpecuniary loss z is set at 0.33 in keeping with allegations that juries use one-third as a rule of thumb for determining pain and suffering awards. Subscripts 1, 2, and 3 represent the states of injury and award, injury and no award, and no injury, respectively.

First-party accident insurance. In some scenarios, the patient buys first-party accident insurance, which covers 75 percent of the pecuniary loss L, with a proportional loading β of 0.15:

$$T = 0.75\ (1 + \beta)(1-p_3(h))L.$$

The premium T varies with the probability of injury but not with the probability of tort compensation, conditional on injury. This is equivalent to assuming no subrogation by first-party insurers against liability insurers or tort defendants.[5]

The physician. The physician's own expected utility is additively separable in utility of wealth VY and utility of leisure VL:

$$DTV = \sum_{i=1}^{3} p_i\ [jVY_i + (1 - j)VL_i\ ].$$

Wealth and leisure are equally weighted (j = 0.5) in the base case. The physician's wealth in the absence of a liability award is equal to base wealth plus income from medical practice minus liability insurance costs:

$$Y_i = Y_0 + N(h,cF,s,Z)Fh - B \quad i = 2,3.$$

The physician's base wealth before medical practice Y_0 is \$50,000. Gross revenue from medical practice is N(h,c,F,s,Z)Fh under fee-for-service reimbursement, where N is number of patients, h is hours per patient, and F is fee per hour; under capitation, gross practice revenue is ND, where D is the per patient capitation. The demand function for episodes of care is

$$N(h,cF,Z) = a_1 h^{b_1}\ z^{b_2}(cFh)^{-b_3},$$

where $N_F < 0$, $N_{FF} > 0$; N_h, $N_Z > 0$; N_{hh}, $N_{ZZ} < 0$. Demand depends on the patient's out-of-pocket costs cFh under fee-for-service; copayment is zero under

[5] Anecdotal evidence suggests that subrogation is not widely used in practice.

capitation. Demand may also depend on h, as a proxy for quality of care including injury risk, and on the compensation per unit loss if injured. Base values of the elasticity parameters are $b_1 = 0.9$, $b_2 = 0.25$, and $b_3 = 1.25$.[6] With these base values, the overall demand elasticity with respect to h is negative, because the negative price effect ($b_3 = -1.25$) dominates the positive quality effect ($b_1 = 0.9$). Imperfect information about the liability regime is represented by $b_2 = 0$. In some scenarios, F is assumed fixed. In others, F adjusts to pass through to patients the cost of the physician's liability insurance B: $F = F_0 + B/Nh$.

The physician determines the fraction f of liability costs that are covered by liability insurance, with $0 \leq f \leq 1$. The liability insurance premium with perfect experience rating is

$$B = (1+\lambda)(1-p(h))s\gamma f Z.$$

The litigation and administrative loadings, γ and λ, are 2 and 0.15, respectively, which correspond roughly to actual values under the current medical malpractice system.[7] With no experience rating, p(h) is replaced by a constant $\bar{p}$. The base value of $1-\bar{p}$ is 0.15, which approximates the average probability of a claim against physicians in the United States.[8] The liability insurance premium generated by the model for the case of the selfish physician with $r_p = 0.15$ is \$16,234; values range from under \$2,000 to \$30,000, depending on the liability regime and the productivity of care. If an injury occurs and the physician is liable, his or her wealth is

$$Y_1 = \text{Max}[0, Y_3 - (1 - f)\gamma Z].$$

Thus, the maximum monetary loss is the physician's base wealth plus one year's income from medical practice. This maximum loss is downward biased to the extent that it ignores possible reputational effects or liens on future earnings, in addition to nonmonetary costs.[9] If the physician does not buy insurance ($f = 0$), he or she avoids the insurance administrative load λ but still has to pay both the award and the litigation cost, γZ.

The physician's expected utility of wealth is

$$DVY = \sum_i p_i[1 - \exp(-r_y Y_i)].$$

[6] The parameter a_1 is selected so that the total time the physician spends in patient care per year Nh is reasonable.

[7] The plaintiff attorney's fee is typically one-third of the gross award, or a 50 percent mark-up on the net award, Z. On average, defense and plaintiff expenditures on litigation are similar (Danzon, 1985). The overall litigation loading of 100 percent is the same under negligence and strict liability. Costs of litigation under strict liability (no-fault) are discussed in Danzon (1985, 1993a, 1993b).

[8] The frequency of claims per 100 physicians was 16 in 1986 (Sloan and Bovbjerg 1989) but fell to roughly 13 in 1992.

[9] For the values used in the simulations reported here, the constraint $Y_1 \geq 0$ is not binding. This is plausible since the law permits liable defendants to retain a basic level of assets.

The physician is assumed to be absolutely less risk averse than the patient (r_y = 0.0000075), reflecting the physician's higher expected wealth.

The physician's utility of leisure L is

$$VL = 1 - \exp(-r_h L).$$

Leisure is equal to the maximum hours available H_{max} minus hours worked:

$$L = H_{max} - Nh,$$

where H_{max} = 4,380 (12 hours a day, 365 days a year), and the base value of the elasticity parameter r_h = 0.00075. The difference between the physician's risk aversion parameters for leisure and wealth (0.00075 and 0.0000075, respectively) was selected to give roughly equal utility from leisure and wealth, since wealth is roughly 100 times larger than leisure.

The physician as patient's agent. Since patients are often not fully informed about the risks and benefits of medical care, physicians are trained to act as agents for patients. This agency relationship is modeled by assuming that the physician's objective function is a weighted average of the patient's and the physician's utility.[10]

$$EMDV = mPTU + (1 - m)DTV,$$

where $0 \leq m \leq 1$ is the weight attached to the patient's utility.[11] Values m = 0 and m = 0.25 correspond to selfish utility maximization and partial agency (altruism), respectively. This formulation assumes that the physician correctly perceives the patient's utility and, conditional on m, assigns the same weights to the patient's utility of health and wealth as does the patient.[12]

Results of Simulation Analysis

The top half of Table 1 shows the physician's choice of care (h) and insurance coverage (f), the liability insurance premium, the probability of no injury ($p_3(h)$), and number of patients (N). The lower half of Table 1 shows the patient's utility of health and wealth, the physician's utility of wealth and leisure, and the total utility for each party.

[10] An alternative specification would maximize the utility of patients, subject to a constraint that physicians optimize on their choice of level of care and liability insurance coverage, and possibly the additional constraint that physicians maintain a reservation level of utility. Simulations that imposed a lower bound on physician utility led to qualitatively similar results with the parameter values selected.

[11] Assuming that the physician is concerned with the utility of the representative patient who is injured simplifies the analysis because it permits us to use the same probability of a claim and size of award for the physician and for the representative patient.

[12] The implications of assuming a diminishing marginal rate of substitution between own and patient's utility are discussed in Danzon (1991a).

Table 1
The Selfish Physician (m = 0), With and Without First-Party Insurance, No Cost Pass-Through, Experience Rated Liability Insurance

Probability of Award to Patient (s)		Productivity of Care (r_p) 0.15 NFP or FP	Productivity of Care (r_p) 0.40 NFP or FP
0.0 (No Liability)	h	5.38	5.38
	p_3	0.62	0.90
	f	0	0
	N	360.75	360.73
0.5 (Noisy Negligence)	h	6.20	5.74
	p_3	0.66	0.91
	f	0.79	0.82
	N	343.29	352.61
1.0 (Strict Liability)	h	6.87	6.02
	p_3	0.69	0.92
	f	0.74	0.81
	N	331.14	346.73

		Productivity of Care (r_p) 0.15		Productivity of Care (r_p) 0.40	
		NFP	FP	NFP	FP
0.0 (No Liability)	PTU	0.485	0.500	0.596	0.604
	PUH	0.777	0.777	0.810	0.810
	PUW	0.193	0.224	0.383	0.398
	DVY	0.840	0.840	0.840	0.840
	DVL	0.840	0.840	0.840	0.840
	DTV	0.840	0.840	0.840	0.840
0.5 (Noisy Negligence)	PTU	0.576	0.571	0.621	0.621
	PUH	0.795	0.795	0.817	0.817
	PUW	0.358	0.347	0.426	0.425
	DVY	0.838	0.838	0.843	0.843
	DVL	0.815	0.815	0.829	0.829
	DTV	0.826	0.826	0.836	0.836
1.0 (Strict Liability)	PTU	0.648	0.624	0.640	0.633
	PUH	0.806	0.806	0.821	0.821
	PUW	0.489	0.441	0.460	0.446
	DVY	0.836	0.836	0.846	0.846
	DVL	0.794	0.794	0.821	0.821
	DTV	0.815	0.815	0.833	0.833

Note: NFP = no first-party insurance, FP = first-party insurance, h = hours of physician time per patient episode, p_3 = probability of no injury, f = fraction of liability loss covered by liability insurance, N = annual number of patient episodes of care, PTU = patient's expected total utility, PUH = patient's expected utility of health, PUW = patient's expected utility of wealth, DVY = physician's expected utility of wealth, DVL = physician's expected utility of leisure, and DTV = physician's expected total utility. m = weight on patient's utility in physician's overall utility.

The table presents the effects of changing the liability rule to increase the conditional probability of an award s from 0 (no liability) to 1 (perfectly functioning strict liability), with values of $s = 0.5$ representing a noisy negligence regime.[13] The table columns show the effects of increasing the productivity of care in reducing injury risk r_p, from 0.15 (least productive) to 0.4 (most productive). Unless otherwise specified, all parameters take base values. Results using constant relative risk aversion were qualitatively similar to results reported here based on constant absolute risk aversion.

The Selfish Physician

Table 1 shows the effects of alternative liability rules under the standard assumption that the physician is a selfish utility maximizer ($m = 0$), with perfect experience rating and no pass-through of liability insurance premiums. The simulations confirm standard theoretical results. As the probability of liability (s) increases from 0 to 1, the physician increases time spent with the patient (h), and the probability of no injury increases. The absolute increase in h is greater when health care is relatively unproductive ($r_p = 0.15$) than when care is more productive ($r_p = 0.4$), but the absolute level of safety (p_3) and the patient's expected utility of health are much higher when care is productive. Indeed, in the range of parameter values examined here, the risk of patient injury depends more on the underlying productivity of physician care than on the liability regime: injury risk is lower under no liability with $r_p = 0.4$ than under strict liability with $r_p = 0.15$.

The selfish physician also obeys the theoretical rules for optimal purchase of liability insurance. The physician buys less than full coverage because of the proportional loading charge. Coverage is lower under strict liability ($s = 1$) than under noisy negligence ($s = 0.5$), given productivity of care (r_p); given liability probability (s), coverage increases with productivity of care r_p since the premium decreases with r_p.

The lower half of Table 1 shows the distributive effects of shifting liability, assuming that medical fees are fixed, so the incidence of liability costs is on physicians. The two columns for each r_p show utilities with and without first-party accident insurance for the patient, which affects patient utility but not the choices or utility of the selfish physician. A shift from no liability to strict liability benefits patients, primarily because liability provides compensation. The gain is therefore greatest if first-party insurance is not available and if injury risk in the absence of liability is high ($r_p = 0.15$).[14] Indeed, with no

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[13] Values for $s = 0.2$ are available from the author. Values of s between 0 and 1 could also represent a noisy strict liability system with systematic Type 1 errors (attributing bad outcomes to the patient's underlying condition rather than to medical care). The more likely case of a strict liability regime with systematic Type 2 errors (erroneously compensating adverse outcomes that are due to the underlying condition rather than to medical care) could be approximately represented by a tax on medical fees F (ignoring the physician's time costs of defending claims).

[14] With the assumption that $Z = 1.33L$, when liability probability $s = 1$, the injured patient actually has higher wealth. The patient's utility of wealth therefore decreases with r_p when $s = 1$,

liability (s = 0), the patient's expected utility of wealth (PUW) is higher with first-party insurance than without; but with strict liability, PUW is lower with first-party insurance than without because of double compensation.[15] Thus, the value of the compensation function of liability depends critically on the feasibility of subrogation to eliminate double compensation.[16] The utility value of liability-induced deterrence to patients is greatest (29 points) when r_p is low and, hence, risk of injury is relatively high in the absence of liability.

The physician's total utility (DTV) is strictly decreasing in liability. This decrease is greatest when care is relatively unproductive and results primarily from the loss of leisure, since the increase in hours h per patient is not fully offset by the reduction in number of patients N. When productivity of care is high ($r_p = 0.4$), the physician's income actually increases with liability, because the increase in practice income from spending more time per patient more than offsets the higher liability insurance premium. But overall utility falls because of the decline in leisure, even ignoring time costs and other nonpecuniary costs of liability. These simulation results are generally consistent with empirical evidence (Danzon, 1991b) that liability tends to increase physicians' income but increase hours of work and decrease utility.[17]

Total social welfare, measured as a simple average of expected utility of the patient and the physician, is higher under strict liability. However, this overstates the gains from strict liability because it omits several important components of costs that increase with liability: the utility loss to patients from reductions in episodes of care N; possible reduction in the supply of physicians in response to higher liability costs; time, and other nonmonetary costs of lawsuits to physicians.[18] Further, the patient's wealth gain from compensation is overstated if compensation under strict liability would in practice be limited to monetary loss (as in workers' compensation). Finally, the model assumes no errors in operation of the strict liability system. Even with these upward biases, patients' overall utility gain from moving from negligence with a 0.5 probability of compensation to strict liability is less than 5 percent, under the plausible assumptions that first-party insurance is available and care is relatively produc-

since the higher r_p reduces the probability of both injury and overcompensation. The utility of health is always increasing in r_p.

[15] The model understates the cost to the patient of duplicative coverage since it assumes experience rating of first-party insurance, which is rare in practice.

[16] The more widely proposed alternative of a collateral source offset—that is, an offset of other collateral insurances against the liability award—would eliminate the double compensation but also undermine the deterrence effect of liability (Danzon, 1985).

[17] Utility is, of course, unobservable, but a loss in utility may be inferred from physicians' demands for tort reform.

[18] Empirical evidence from the 1970s and early 1980s indicates that fees and reimbursement levels did adjust quite rapidly to pass through the cost of rising liability insurance premiums (Danzon, Pauly, and Kington, 1990; Danzon, 1991b). The pass-through of liability costs may now be more constrained as insurers have become more aggressive in controlling fees.

tive ($r_p = 0.4$), since, in this case, the marginal benefit of additional deterrence is low.[19]

The Altruistic Physician

Table 2 presents the choices of a partially altruistic physician; that is, the patient's utility has a weight of 0.25 in the physician's overall objective function; the physician's own utility has a weight of 0.75, with equal subweights on wealth and leisure as before. The two columns for each r_p show effects without and with first-party insurance for the patient; other assumptions are the same as those in Table 1; that is, fixed fee with no pass-through of liability costs.

Comparing the top halves of Tables 1 and 2, the effects of liability are quite different for the partially altruistic physician. Under no liability, the altruistic physician takes more care than the selfish physician, and this differential is greatest when first-party insurance is unavailable. When the patient has no first-party insurance, liability generally leads to a *reduction* in the number of hours the physician devotes to the patient (h); with first-party insurance, liability induces a slight increase in h, but the response is much weaker than with the selfish physician (m = 0.)[20] The inverse relation is stronger if the loss to the injured patient is higher (k = 2), or if the physician's risk aversion parameter for leisure is reduced ($r_l = 0.00025$).

The liability-induced reduction in h reflects the fact that, when the patient lacks first-party insurance and the probability of compensation through the liability system is low ($s < 0.5$), the altruistic physician substitutes prevention, raising h to reduce the risk of injury. This is consistent with the theory that the optimal level of care is higher if insurance is not available (Shavell, 1982). But when compensation is available under strict liability, the altruistic physician reduces h to save the patient medical expense. This substitution of prevention for insurance is mitigated when the patient has first-party insurance: for $s \leq 0.2$, h is lower with first-party insurance than without.

The incentive to reduce h is reinforced by the effects operating through the demand for medical care and the opportunity cost of the physician's time. Under the base case demand assumptions, $dN/dh < 0$—that is, the negative price effect dominates the positive quality effect—and $dN/dz > 0$—that is, demand increases with expected compensation if injured. An increase in N, ceteris paribus, reduces the physician's leisure, raising the marginal utility of leisure relative to the marginal utility of wealth. With rising opportunity costs of time as N increases, the physician reduces h per patient.[21]

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[19] $r_p = 0.4$ seems plausible since the probability of injury in the model (0.07 - 0.3) is high relative to the estimated iatrogenic injury rate per hospital admission of 0.01 for New York hospitals in 1984 (Harvard Medical Practice Study, 1990).

[20] Simulations not reported here show that the inverse relation between liability and care holds with constant relative risk aversion.

[21] The potential effect on total hours of work is not trivial: for example, an increase of roughly eight patients per year for a physician who spends seven hours per patient would reduce his or her leisure by more than one week per year.

Table 2
The Altruistic Physician (m = 0.25) With and Without First-Party Insurance, No Cost Pass-Through, Experience-Rated Liability Insurance

Probability of Award to Patient (s)		Productivity of Care (r_p) 0.15 NFP	0.15 FP	0.40 NFP	0.40 FP
0.0 (No Liability)	h	7.06	7.02	6.49	6.38
	p_3	0.70	0.70	0.94	0.93
	f	0	0	0	0
	N	327.96	328.55	337.86	339.73
0.5 (Noisy Negligence)	h	7.03	7.09	6.39	6.40
	p_3	0.70	0.70	0.93	0.93
	f	0.79	0.79	0.82	0.82
	N	328.47	327.51	339.61	339.40
1.0 (Strict Liability)	h	7.09	7.23	6.31	6.43
	p_3	0.70	0.71	0.93	0.93
	f	0.74	0.74	0.81	0.81
	N	327.50	325.32	341.18	338.9

Probability of Award to Patient (s)		Productivity of Care (r_p) 0.15 NFP	0.15 FP	0.40 NFP	0.40 FP
0.0 (No Liability)	PTU	0.529	0.544	0.617	0.621
	PUH	0.809	0.809	0.828	0.827
	PUW	0.250	0.279	0.407	0.415
	DVY	0.879	0.878	0.867	0.865
	DVL	0.787	0.788	0.806	0.810
	DTV	0.833	0.833	0.837	0.837
0.5 (Noisy Negligence Regime)	PTU	0.589	0.585	0.629	0.629
	PUH	0.809	0.809	0.827	0.827
	PUW	0.368	0.361	0.432	0.431
	DVY	0.861	0.862	0.861	0.861
	DVL	0.788	0.786	0.809	0.809
	DTV	0.825	0.824	0.835	0.835
1.0 (Strict Liability)	PTU	0.649	0.626	0.642	0.637
	PUH	0.810	0.812	0.825	0.827
	PUW	0.487	0.441	0.459	0.446
	DVY	0.843	0.847	0.854	0.858
	DVL	0.786	0.782	0.812	0.808
	DTV	0.815	0.814	0.833	0.833

Note: NFP = no first-party insurance, FP = first-party insurance, h = hours of physician time per patient episode, p_3 = probability of no injury, f = fraction of liability loss covered by liability insurance, N = annual number of patient episodes of care, PTU = patient's expected total utility, PUH = patient's expected utility of health, PUW = patient's expected utility of wealth, DVY = physician's expected utility of wealth, DVL = physician's expected utility of leisure, and DTV = physician's expected total utility. m = weight on patient's utility in physician's overall utility.

This result, that increased liability can lead to a reduction in care and an increase in injury rates if physicians are good agents in the absence of liability, implies a potential trade-off between compensation and deterrence that is absent in standard models. The liability-induced reduction in health care would be greater if, more realistically, the physician's marginal rate of substitution between the patient's and his or her own utility (m) were decreasing in the ratio of the patient's utility to the physician's utility, rather than fixed as assumed here. Patients' utility gains from switching to strict liability is less when physicians are partially altruistic than when physicians are selfish. This gain is due almost entirely to the compensation value of strict liability, because deterrence effects are weak or negative with altruistic physicians. As before, patient gain from strict liability is less if first-party insurance is available and if care is relatively productive ($r_p = 0.4$), so injury risk is low regardless of liability. The altruistic physician's personal utility is lower with strict liability, but his or her total utility defined as a weighted average of the physician's own and the patient's utility is higher under strict liability. However, this measure overstates the welfare gain from strict liability, because, as noted earlier, the model omits certain costs to patients and physicians.

Pass-Through of Liability Insurance Costs

Empirical evidence suggests that, at least through the early 1980s, physicians raised fees to pass through the costs of malpractice insurance to patients (Danzon, Pauly, and Kington, 1990). The effects of cost pass-through are shown in Table 3, for the altruistic and selfish physician without and with first-party insurance. In these models, the physician's hourly fee F is endogenous, adjusting to fully pass through the cost of liability insurance ($F = 100 + B/Nh$).

With cost pass-through, the physician always buys complete insurance ($f = 1$). Comparing the top halves of Tables 3 and 1, the effects of cost pass-through for the selfish physician depend on the productivity of care. Cost pass-through reinforces the deterrence of liability when r_p is low but undermines it slightly when r_p is high. This is because, with cost pass-through, the physician buys full insurance coverage, so his or her income is not directly affected by the injury rate or the liability regime. However, an indirect effect remains, as long as patient demand N is price-sensitive, since F increases with higher premiums. The physician adjusts h such that Nh and, hence, Y and L are constant at the optimal levels (see the lower half of Table 3). When $r_p = 0.15$, the risk of injury is relatively high and liability insurance is more costly; hence, F is higher and N is lower than when $r_p = 0.4$, ceteris paribus. The physician responds by increasing h more when r_p is lower, which reduces the premium and, hence, mitigates the increase in F and decline in N. Thus, with cost pass-through, the selfish physician's income and utility are invariant to the liability regime, but the level of care is still sensitive to liability as long as insurance is experience rated and the demand for medical services is price sensitive. This case illustrates most clearly that factors such as the demand for medical care, the physician's opportunity cost of time, and marginal rate of substitution be-

Table 3
Selfish and Altruistic Physicians: Cost Pass-Through, Experience Rated Liability Insurance

		Productivity of Care (r_p) 0.15			0.40		
	m	0	0.25		0	0.25	
s		FP or NFP	NFP	FP	FP or NFP	NFP	FP
0.0	h	5.38	7.06	7.02	5.38	6.49	6.38
	p_3	0.62	0.70	0.70	0.90	0.94	0.93
	f	0	0	0	0	0	0
	N	360.75	327.96	328.55	360.75	337.85	339.72
0.5	h	6.48	7.23	7.28	5.67	6.31	6.33
	p_3	0.68	0.71	0.71	0.91	0.93	0.93
	f	1.00	1.00	1.00	1.00	1.00	1.00
	N	299.25	294.33	293.97	342.13	332.71	332.54
1.0	h	7.38	7.54	7.66	5.91	6.19	6.31
	p_3	0.72	0.72	0.73	0.92	0.93	0.93
	f	1.00	1.00	1.00	1.00	1.00	1.00
	N	263.03	263.33	263.51	328.03	325.56	324.46

		Productivity of Care (r_p) 0.15				0.40			
	m	0		0.25		0		0.25	
s		NFP	FP	NFP	FP	NFP	FP	NFP	FP
0.0	PTU	0.485	0.500	0.529	0.544	0.596	0.604	0.617	0.621
	PUH	0.777	0.777	0.809	0.809	0.810	0.810	0.828	0.827
	PUW	0.193	0.224	0.250	0.279	0.383	0.398	0.407	0.415
	DVY	0.840	0.840	0.879	0.878	0.840	0.840	0.867	0.865
	DVL	0.840	0.840	0.787	0.789	0.840	0.840	0.806	0.810
	DTV	0.840	0.840	0.833	0.833	0.840	0.840	0.837	0.837
0.5	PTU	0.581	0.576	0.591	0.588	0.621	0.620	0.628	0.628
	PUH	0.800	0.800	0.812	0.812	0.815	0.815	0.826	0.826
	PUW	0.361	0.352	0.370	0.363	0.426	0.425	0.431	0.430
	DVY	0.840	0.840	0.861	0.862	0.840	0.840	0.858	0.858
	DVL	0.840	0.840	0.815	0.813	0.840	0.840	0.819	0.819
	DTV	0.840	0.840	0.838	0.838	0.840	0.840	0.838	0.838
1.0	PTU	0.649	0.627	0.650	0.629	0.640	0.633	0.641	0.636
	PUH	0.814	0.814	0.816	0.817	0.820	0.820	0.824	0.825
	PUW	0.485	0.440	0.485	0.440	0.460	0.446	0.459	0.446
	DVY	0.840	0.840	0.845	0.849	0.840	0.840	0.848	0.852
	DVL	0.840	0.840	0.834	0.830	0.840	0.840	0.830	0.826
	DTV	0.840	0.840	0.839	0.839	0.840	0.840	0.839	0.839

Note: s = probability of award to patient, m = weight on patient's utility in physician's overall utility, NFP = no first-party insurance, FP = first-party insurance, h = hours of physician time per patient episode, p_3 = probability of no injury, f = fraction of liability loss covered by liability insurance, N = annual number of patient episodes of care, PTU = patient's expected total utility, PUH = patient's expected utility of health, PUW = patient's expected utility of wealth, DVY = physician's expected utility of wealth, DVL = physician's expected utility of leisure, and DTV = physician's expected total utility.

tween income and leisure are critical in determining the influence of the liability regime on the level of care.

Similarly for the altruistic physician, the effects of cost pass-through reinforce deterrence if r_p is low, but undermines it if r_p is high. As for the selfish physician, this pattern results because, as the fee rises to pass-through the cost of liability insurance, the demand for medical care falls; the physician increases h in order to reduce the premium and, hence, mitigate the decline in N and in income.

Although the utility of the representative patient in the model appears to be essentially unaffected by cost pass-through, this is misleading. The model understates the cost of liability to patients overall, because this patient bears only 1/Nth of the premium cost, and the utility loss to the other N-1 patients from higher medical fees is omitted. With cost pass-through, the altruistic physician also gains from strict liability: cost pass-through permits the physician to enjoy more leisure with minimal reduction in income. These results are unaffected by first-party insurance for the patient.

Patients Uninformed about Expected Compensation

The data presented in Table 4 are based on an assumption that demand is insensitive to expected compensation ($dN/dz = 0$). Comparing the results with those shown in Tables 1 and 2, the liability-induced increase in time spent per patient (h) is greater when expected compensation (z) does not affect annual doctor visits (N), again because of the opportunity cost of physician time. When patient demand is not directly sensitive to expected compensation, the physician's utility cost of a liability-induced increase in h is lower. The physician's total hours of work (Nh) are therefore lower and utility of leisure is higher, despite higher h per patient; total utility is higher, because the increased utility of leisure dominates the loss of income.

Of course, to the extent that physicians can control N by mechanisms that are omitted from the model—for example, by raising fees, imposing scheduling restrictions, or refusing to accept new patients—the tendency for an inverse relation between h and N caused by rising opportunity cost of time is less likely. The magnitude of the effect is also sensitive to the parameters of the physician's utility function, in particular, the marginal utility of income and leisure. But the general conclusion remains, that the ability of liability to induce an increase in physician care per patient may be limited for physicians who have a high opportunity cost of time because of heavy work loads or strong preferences for leisure.

Note that if $dN/dz > 0$, the tendency for physicians to reduce h in response to rising time costs would be greatest under compensation mechanisms that place no liability on individual physicians, such as tax-financed social insurance schemes. Enterprise liability could have similar effects if the feedback from the enterprise to the individual physician is weak.

Table 4
Demand Insensitive to Liability Regime (dN/dz = 0)
No Cost Pass-Through, First-Party Insurance,
Experience-Rated Liability Insurance

		Productivity of Care (r_p)			
		0.15		*0.40*	
s	*m*	*0*	*0.25*	*0*	*0.25*
0.0	h	6.00	7.74	6.00	6.98
	p_3	0.65	0.73	0.92	0.95
	f	0	0	0	0
	N	323.27	295.79	323.27	306.69
0.5	h	6.87	7.80	6.34	6.99
	p_3	0.69	0.73	0.93	0.95
	f	0.79	0.80	0.82	0.82
	N	308.35	294.93	317.05	306.40
1.0	h	7.57	7.94	6.61	7.02
	p_3	0.72	0.74	0.94	0.95
	f	0.75	0.76	0.81	0.81
	N	298.01	293.16	312.46	306.03

		Productivity of Care (r_p)			
		0.15		*0.40*	
s	*m*	*0*	*0.25*	*0*	*0.25*
0.0	PTU	0.519	0.558	0.615	0.628
	PUH	0.791	0.818	0.821	0.833
	PUW	0.247	0.298	0.410	0.423
	DVY	0.840	0.876	0.840	0.862
	DVL	0.840	0.792	0.840	0.814
	DTV	0.840	0.834	0.840	0.838
0.5	PTU	0.582	0.594	0.628	0.634
	PUH	0.806	0.819	0.826	0.834
	PUW	0.358	0.370	0.430	0.435
	DVY	0.839	0.862	0.843	0.859
	DVL	0.817	0.790	0.831	0.813
	DTV	0.828	0.826	0.837	0.836
1.0	PTU	0.628	0.630	0.638	0.640
	PUH	0.816	0.820	0.830	0.834
	PUW	0.440	0.440	0.446	0.447
	DVY	0.838	0.848	0.846	0.856
	DVL	0.797	0.786	0.824	0.813
	DTV	0.817	0.817	0.835	0.834

Note: s = probability of award to patient, m = weight of patient's utility in physician's objective function, h = hours of physician time per patient episode, p_3 = probability of no injury, f = fraction of liability loss covered by liability insurance, N = annual number of patient episodes of care, PTU = patient's expected total utility, PUH = patient's expected utility of health, PUW = patient's expected utility of wealth, DVY = physician's expected utility of wealth, DVL = physician's expected utility of leisure, and DTV = physician's expected total utility.

Capitation vs. Fee-For-Service Reimbursement

The models so far assume that physicians are paid an hourly fee, with patient copayment to control moral hazard. This is equivalent to the traditional piece-rate (fee per service or per visit) reimbursement if the physician can either (1) increase the visit fee in proportion to time spent, or, if fees are regulated, (2) substitute multiple short visits at the regulated fee without affecting demand or costs.[22]

This traditional fee-for-service reimbursement is increasingly being replaced by capitation (fixed payment per patient) whereby the physician receives no additional income from additional services per patient. Since capitated providers have strong incentives to control costs, patient copayment is typically minimal in capitated plans. To model this form of reimbursement, Table 5 presents data on the effects of liability on selfish and altruistic physicians who are paid a fixed capitation D per patient. The key difference is that increasing h raises costs but does not generate additional revenue, except via quality effects on demand, assuming $b_1 > 0$. D is set at \$650 per patient, which corresponds roughly to mean income per patient (Fh) under the fee-for-service system, and parameters of the demand function are adjusted to maintain similar total hours Nh.[23] However, because these calibrations are approximate, comparison of absolute levels of variables between fee-for-service and capitation is less meaningful than comparisons across liability regimes within a single reimbursement regime.

Comparing the top half of Table 5 with Tables 1 and 2 (no first-party insurance columns) for the selfish and altruistic physician, respectively, shows, not surprisingly, that h responds less to increased liability under capitation. For the selfish physician, the liability-induced increase in h is less with capitation than with fee-for-service. For the altruistic physician, h is significantly lower under capitation than fee-for-service particularly under the no-liability regime. Consequently, patient utility is significantly lower under capitation if the rule is no liability (498 vs. 529) but quite similar under strict liability (643 vs. 649). Not surprisingly, altruism is a better substitute for liability when additional care generates additional revenue for physicians, as under fee-for-service, than when physicians bear the full cost of additional care as they do under capitation. This result is relevant to health care reform proposals that seek to increase the use of capitation, particularly if combined with reduced liability of physicians, for example, through enterprise liability.

[22] In practice, physicians can vary the fee per visit within bounds, by classifying a visit as intermediate or complex rather than routine. Substitution of multiple short visits for fewer long visits is imperfect to the extent that physicians or patients incur a fixed per visit cost of time or other resources.

[23] The demand parameter a_1 is set at 55.6, which yields the same caseload N = 333 at h = 6.75 under capitation and fee-for-service. The copayment elasticity b_3 is zero under capitation.

Table 5
Captitation: Selfish vs. Altruistic, No First-Party Insurance, Experience-Rated Liability Insurance, Fixed Fee (Capitation = $650 per Episode)

		Productivity of Care (r_p)			
		0.15		*0.40*	
s	*m*	*0*	*0.25*	*0*	*0.25*
0.0	h	5.30	5.83	5.30	5.69
	p_3	0.61	0.64	0.90	0.91
	f	0	0	0	0
	N	267.64	291.62	267.64	285.51
0.5	h	5.64	5.91	5.45	5.68
	p_3	0.63	0.65	0.90	0.91
	f	0.78	0.78	0.81	0.82
	N	283.18	295.27	274.52	285.17
1.0	h	5.93	6.02	5.58	5.68
	p_3	0.65	0.65	0.91	0.91
	f	0.72	0.72	0.81	0.81
	N	296.48	300.30	280.40	285.13
0.0	PTU	0.482	0.498	0.594	0.603
	PUH	0.775	0.788	0.808	0.816
	PUW	0.189	0.209	0.380	0.391
	DVY	0.814	0.834	0.814	0.829
	DVL	0.892	0.866	0.892	0.873
	DTV	0.853	0.850	0.853	0.851
0.5	PTU	0.566	0.571	0.617	0.621
	PUH	0.783	0.789	0.811	0.816
	PUW	0.349	0.353	0.423	0.426
	DVY	0.796	0.809	0.812	0.822
	DVL	0.876	0.862	0.885	0.874
	DTV	0.836	0.835	0.848	0.848
1.0	PTU	0.642	0.643	0.637	0.638
	PUH	0.790	0.792	0.814	0.816
	PUW	0.495	0.494	0.462	0.461
	DVY	0.778	0.783	0.810	0.815
	DVL	0.860	0.855	0.879	0.874
	DTV	0.819	0.819	0.844	0.844

Note: s = probability of award to patient, m = weight of patient's utility in physician's objective function, h = hours of physician time per patient episode, p_3 = probability of no injury, f = fraction of liability loss covered by liability insurance, N = annual number of patient episodes of care, PTU = patient's expected total utility, PUH = patient's expected utility of health, PUW = patient's expected utility of wealth, DVY = physician's expected utility of wealth, DVL = physician's expected utility of leisure, and DTV = physician's expected total utility.

Community Rating vs. Experience Rating of Liability Insurance

Table 6 presents data on the effects of community rating rather than experience rating of liability insurance, with the premium based on a fixed injury probability $(1-p_3) = 0.15$. When liability insurance is not experience rated and costs are not automatically passed through in higher fees, the physician's choice of coverage depends critically on his or her own risk relative to the average. The physician buys full coverage (f = 1) when he or she is a worse than average risk ($p_3 < 0.85$) because the premium is less than his or her expected loss; at $p_3 = 0.9$, the physician is an above average risk, the premium is actuarially unfair, and he or she buys either low or zero coverage.[24] When costs are automatically passed through, the physician buys full coverage, regardless of whether he or she is below or above the average risk.

Table 6
No Experience-Rating of Liability Insurance ($\bar{p}$ = 0.85),
With and Without Cost Pass-Through, With First-Party Insurance

		Productivity of Care (r_p)							
		0.15				*0.40*			
		0		*0.25*		*0*		*0.25*	
s	*m*	*CPT*	*NCPT*	*CPT*	*NCPT*	*CPT*	*NCPT*	*CPT*	*NCPT*
0.0	h	5.38	5.38	7.02	7.02	5.38	5.38	6.38	6.38
	p_3	0.62	0.62	0.70	0.70	0.90	0.90	0.93	0.93
	f	0	0	0	0	0	0	0	0
	N	360.75	360.75	328.55	328.55	360.75	360.75	339.72	339.72
0.5	h	5.88	5.57	6.99	6.70	5.88	5.82	6.61	6.46
	p_3	0.64	0.63	0.70	0.69	0.92	0.92	0.94	0.94
	f	1.00	1.00	1.00	1.00	1.00	0.03	1.00	0
	N	330.14	356.25	312.60	334.02	330.14	350.97	318.27	338.36
1.0	h	6.40	5.77	6.96	6.36	6.40	6.15	6.87	6.53
	p_3	0.67	0.64	0.70	0.67	0.93	0.93	0.95	0.94
	f	1.00	1.00	1.00	1.00	1.00	0	1.00	0
	N	303.31	351.91	296.41	340.17	303.31	344.27	297.42	337.14

Note: s = probability of award to patient, m = weight of patient's utility in physician's objective function, CPT = cost pass-through, NCPT = no cost pass-through, h = hours of physician time per patient episode, p_3 = probability of no injury, f = fraction of liability loss covered by liability insurance, and N = annual number of patient episodes of care.

The results confirm that liability insurance undermines prevention only when it is not experience rated: the liability-induced increase in hours per patient h is less in Table 6, without experience rating, than in Tables 1 and 2, with expe-

[24] When p_3 is 0.84, the physician chooses slightly less than full coverage (f = 0.9) because of the proportional loading for administrative expenses. Of course, if such accurate sorting existed as is discussed here, the community rated policy would not break even and could not survive in the long run with free entry into insurance markets (Rothschild and Stiglitz, 1976).

rience rating. This tendency for community rated insurance to undermine the deterrence effects of liability applies to altruistic as well as selfish physicians.

Experience rating of liability insurance reduces the physician's utility if he or she is a worse than average risk but increases it if he or she is a better than average risk. This conclusion might not hold with imperfect experience-rating that imposes risk on physicians.[25]

Caveats and Conclusions

These simulations confirm the standard theoretical results when the standard assumptions are made: increasing producer liability generally increases care if producers are selfish utility maximizers.[26] But these conclusions do not necessarily hold if physicians have agency concern for patients' well-being, in addition to concerns for their own wealth and leisure. Moreover, the physician's response to liability depends critically on such factors as the opportunity cost of time, the form of reimbursement (capitation vs. fee-for-service) and the ability to pass through liability insurance costs in higher fees. With the functional forms and parameter values used here, the level of care is generally more sensitive to the opportunity cost of time, the productivity of care in reducing injury risk, and the degree of altruism than to the degree of liability.

Because physicians are presumably heterogeneous in these parameters (and in other dimensions not tested here, such as wealth and risk preferences), these results imply that the incentive effects of liability vary substantially across physicians. In particular, the incentive effects of increasing liability will be low or counterproductive for physicians who would provide a high level of care even in the absence of liability because of either agency concerns for patients or high productivity at risk reduction. Liability will also have negligible effects on care for physicians who have a high opportunity cost of time because of long work hours. The effects of a rising marginal cost of time would be less if physicians could identify high risk patients ex ante, such that hours per patient h could be increased selectively where marginal product is highest. Rising time cost effects are greatest if patients are either truly homogeneous or perceived to be so, because of limited physician information ex ante, such that the decision to increase h raises total workload by Nh. Time cost constraints on h would be greater if, contrary to the assumption of the additive physician's utility function used here, the utility of leisure were increasing in wealth. Any positive deterrent effects of liability would then also be lower for high income physicians.

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[25] In these simulations, the fixed probability of injury in the non-experience rated premium is invariant to the liability regime; changing the premium to reflect changes in mean injury rates in response to liability would have a minimal effect on individual incentives. Ellis, Gallup, and McGuire (1989) show that experience rating using Bayesian inference from actual claims can impose significant risk on physicians who are good risks.

[26] For an imperfect negligence regime, the theoretical results are ambiguous (Craswell and Calfee, 1986).

The model generally confirms the standard theoretical conclusion that, if liability insurance is not individually experience rated, it reduces incentives for care. This applies, in particular, to physicians who have above average injury rates, since, for them, a community rated insurance premium has a negative load and they buy full coverage. Of course, if, in reality, physicians accurately perceive their own risk class as does the physician in our model, insurance markets are subject to adverse selection, and community rating cannot be a long-run equilibrium. The fact that medical malpractice insurance markets continue to operate with relatively little within-specialty experience rating may imply that the physicians do not know their own risk class; it may also reflect real-world errors in the judicial process and in experience rating that are not fully incorporated in the model.

These simulations incorporate all the components of the social cost of accidents that are generally included in standard models of liability rules—the utility cost of injuries, precautions, litigation, and insurance overhead—as well as some components of uninsured risk to defendants. The estimates of effects of alternative liability regimes on utility of patients and physicians are therefore useful. However, because they do not reflect all social costs and benefits of alternative liability regimes, they should be interpreted with care. The utility results are most useful in showing that effects on overall utility can sometimes be unexpected, because of substitution between utility of health and wealth for the patient and between wealth and leisure for the physician.

Implications for Real-World Alternatives

Although the model necessarily employs simplifying assumptions, the results have important implications for some of the alternatives currently under consideration for medical malpractice. Most obvious—and most important—is that the deterrent effects and overall evaluation of alternatives are very hard to predict because levels of care depend on multiple factors of which liability is only one and not necessarily the most important. Productivity of care, altruism, and opportunity cost of time are at least as important. With that caveat, several conclusions emerge.

No-fault. Consider first a no-fault rule of liability, under which patients are compensated regardless of provider fault. If this is financed by liability insurance premiums paid by physicians, it corresponds to the strict liability rule modeled here ($s = 1$) and generally induces more care than a noisy negligence rule ($s < 1$) if premiums are individually experience rated and if physicians are selfish utility maximizers but not if they are altruistic. If the no-fault scheme is financed from a broad-based tax, it is not precisely represented by the model. The deterrent effects correspond to the no-liability rule ($s = 0$), but the patient compensation effects correspond to $s = 1$. In that case, the likely effect is a reduction in h regardless of whether physicians are selfish or altruistic. This could be exacerbated if the operation of the no-fault scheme leads to a large increase in the number of claims filed and, hence, in physicians' time spent in adjudicating iatrogenicity—that is, distinguishing valid claims for injuries caused by medical care from invalid claims for adverse outcomes that are simply bad luck. Of course, there could be offsetting, positive effects on care under a no-fault scheme if elimination of fault and litigation over fault increases physicians' altruistic concern for patients.

Administrative fault-based system. The American Medical Association/Medical Specialty Societies' proposal (American Medical Association, 1988) would replace the jury system with an administrative fault-based system. Cases would be adjudicated by a new administrative agency rather than through the courts. The negligence rule of liability would be maintained but redefined to exclude claims where the standard of care was within a "reasonable" zone. Compensation for noneconomic loss would be limited, and a schedule would set bounds on some elements of compensation for economic loss. Filing a claim would be simplified, with agency attorneys available at no cost. The proposal also includes plans for strengthened non-tort procedures for quality control and for a significant element of tax-based financing.

Because this proposal involves changes in many dimensions of the tort system, net effects cannot be accurately predicted. However, it seems likely that the reduction in costs of filing would induce an increase in the number of claims filed and compensated, which corresponds to an increase in s in the model. Other things being equal, this would increase incentives for care if physicians are selfish (unless deterrence incentives are weakened) but could reduce incentives for care if physicians are altruistic. However, net effects on the probability of compensation to patients and liability on physicians depend critically on how the newly established agency adjudicates the more tightly defined negligence standard. A bright-line or threshold negligence standard has stronger deterrence effects than the noisy negligence standard ($s < 1$) modeled here. An increase in number of claims filed could increase physicians' time costs, although the time cost per case would probably be reduced, with the possibility of higher opportunity cost of time, as under no-fault. Reduction in size of awards and implicit subsidies to the litigation process would tend to reduce the expected penalty if liable, which tends to reduce incentives for care. On the other hand, if lower malpractice premiums increase net incomes of physicians, the opportunity cost of time could increase. Thus, the overall effect of this reform is highly uncertain.

Appendix
Notation and Base Values

UW_i	Patient's utility of wealth (*) in state i, i = 1,..3
UH_i	Patient's utility of health (*) in state i, i = 1,..3
$UP_i = gUW_i + (1 - g)UH_i$	Patient's overall utility (*) in state i
W_0	Patient's initial wealth ($30,000)
N	Annual number of patient episodes of care (*)
F	Physician's hourly fee under fee-for-service ($100 or *)
D	Capitation per patient under capitation reimbursement ($650)
h	Hours of physician time, per patient episode (*)
p(h)	Probability of no injury; $p_h > O$, $p_{hh} < O$ (*)
s	Probability of award to patient, conditional on being injured ($0 \leq s \leq 1$)
L	Financial loss to patient if injured ($1.33W_0$)
$Z = (1 + z)L$	Award to patient (1.33L)
VY_i	Physician's utility of wealth (*) in state i, i = 1..3
VL_i	Physician's utility of leisure (*) in state i, i = 1..3
$EMDV = (1\text{-}m)[jDVY + (1\text{-}j)DVL] + mPTU$	Physician's expected utility
m	Weight of patient's utility in physician's objective function, $O \leq m \leq 1$
Y_0	Physician's initial wealth ($50,000)
c	Patient's copayment under fee-for-service reimbursement (0.2)
f	Fraction of liability loss covered by liability insurance (*)
γ	Litigation mark-up over award (2)
λ	Liability insurance load (0.15)
β	First-party insurance load (0.15)
p_1	Probability of an injury and award = (1-p(h))s (*)
p_2	Probability of an injury and no award = (1-p(h))(1 - s) (*)
p_3	Probability of no injury = p(h) (*)
r_w	Patient's absolute risk aversion for wealth (0.00002)
r_h	Patient's absolute risk aversion for health (0.00002)
r_l	Physician's absolute risk aversion for leisure (0.00075)
r_y	Physician's absolute risk aversion for wealth (0.0000075)
PTU	Patient's expected total utility
PUH	Patient's expected utility of health
PUW	Patient's expected utility of wealth
DVY	Physician's expected utility of wealth
DVL	Physician's expected utility of leisure
DTV	Physician's expected total utility

Note: Base values are in parentheses.
* Endogenous variables.

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