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A note on judgment proofness and risk aversion

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Abstract Shavell (Int Rev Law Econ 6:45–58, 1986) established that potentially judgment-proof injurers will take less care than injurers with sufficient funds in the case of strict liability. This note considers strict liability and shows that the reverse may hold if individuals are risk averse, i.e., some potentially judgment-proof injurers expend more on care than some injurers with assets greater than the harm.

Keywords Judgment proofness · Care incentives · Risk aversion

JEL classification K13

1 Introduction

1.1 Motivation and main results

Tort law aspires—inter alia—to provide incentives for adequate care in activities that may cause harm. Among the factors that may prevent the optimal workings of tort law in this respect is the possibility that injurers lack sufficient funds to cover the harm caused. Injurers do not internalize the complete social harm, since they can externalize the part that exceeds personal funds, which gives reason to expect insufficient precaution. Indeed, Shavell (1986), using a framework with non-monetary care which reduces the accident probability, gave formal support to this

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intuition by showing that all injurers with (i) asset levels less than the harm in the case of strict liability and (ii) asset levels less than a critical value (which is less than the harm) in the case of negligence will take less care than the level taken by individuals with sufficient funds.

This note uses Shavell's framework and shows that, in the case of strict liability, the contrary may hold. That is, potentially judgment-proof injurers may take more care than injurers with assets sufficient to compensate the harm caused. We consider risk-averse injurers and contrast the care-taking behavior of injurers with and without binding asset constraint. Our finding can be explained by the asymmetric effect of increasing asset levels on the value of care for the expected utility of injurers with and without sufficient assets. For potentially judgment-proof injurers, care unambiguously increases with assets because higher assets (i) increase the loss in utility due to an accident that can be made less probable by higher care and (ii) decrease the marginal costs of care. However, injurers without binding asset constraint observe a decrease not only in the marginal costs of care but also in the marginal benefit of care as a consequence of an increase in the asset value. The latter effect results because the loss in utility due to an accident decreases owing to diminishing marginal utility. This decrease of the marginal benefit of care contrasts with the case of injurers with insufficient assets due to the fact that, for these individuals, the higher asset level has no effect on the utility in the accident state of the world. Consequently, whereas care unambiguously increases in asset value if the injurer has insufficient assets, care may fall in assets for injurers without binding asset constraint.

The literature hitherto has almost entirely focused on risk-neutral individuals. Completing the study of consequences of limited liability in the realm of risk aversion is necessary in order to more fully understand probable effects of the judgment-proofness problem with regard to the workings of the liability system. Bell and O'Connell (1997, p. 80), for instance, point out that more than 40% of the liability insurance market is self-insured. This gives reason to believe that individual behavior is often better described by risk aversion than by risk neutrality.

1.2 Relation to the literature

The literature discussed in the following assumes risk-neutral individuals unless otherwise stated. We do not touch upon the literature that discusses policy options in view of judgment proofness (see, e.g., Shavell 2005, or Pitchford 1995).

In line with Shavell (1986), Beard (1990) presumes that care lowers the accident probability but, in contrast to Shavell, assumes that care expenditures reduce the assets available for compensation, i.e., monetary care. He shows that, in the case of strict liability, potentially judgment-proof injurers may take more care than injurers who are not bankrupted by the compensation of victims. Miceli and Segerson (2003) detail Beard's results for strict liability and negligence in a simplified framework. If care is monetary and strict liability is the applicable rule, injurers with asset levels less than but close to the harm exert more care than injurers whose asset constraint does not bind in the case of an accident. The fact that care reduces the assets available for compensation de facto reduces the care costs because these only arise as costs in the case where no accident occurs.[1] The possibility that care of potentially judgment-proof individuals exceeds the care level taken by injurers with sufficient assets thus follows if, in comparison to the cost minimization problem of injurers with sufficient assets, the reduction in marginal costs of care overcompensates the reduction in the marginal benefit of care, where the latter reduction is due to limited liability. Our analysis extends to the case of monetary care and, in that case, our model also depicts this result. However, we point to another effect that is the sole driver of our result for the case of non-monetary care.

Boyd and Ingberman (1994) augment the analysis by considering the possibility that precaution might impact on the loss magnitude instead of on the accident probability, or that it might lower both. They consider the case of strict liability and find that damages that are noncompensatory can induce efficient incentives in a framework in which the magnitude of losses is affected by precaution. Consequently, in this case, actors with assets less than the harm can be induced to take efficient care. Dari Mattiacci and De Geest (2005, 2006) follow this lead and add a fourth possibility, the separate probability magnitude model in which two different precautions can be taken. In our analysis, we adhere to the convention that care reduces the accident probability. However, we comment on the results of the magnitude model in the conclusion.

MacMinn (2002) considers risk-averse individuals and both strict liability and negligence. He shows that injurers who turn out judgment proof in the case of an accident exert more (less) care under negligence than under strict liability if care is non-monetary (monetary).[2] However, he does not touch upon our focus, namely, the comparison of care incentives of individuals with sufficient funds and those of actors whose asset constraint binds in the case of an accident.

In the next section, we describe the model and derive our basic results. Section 3 concludes.

2 Model and analysis

The analysis uses Shavell's model. Injurers can reduce the probability of an accident by taking care. Victims suffer accident losses and seek remediate action but are passive otherwise. We assume throughout that individuals are risk averse and that strict liability applies.[3]

[1] Formally put with the notation explained below, expected costs are $x + p(x)[y-x] = [1-p(x)]x + p(x)y$, whereas expected costs are $x + p(x)y$ in the case of non-monetary care.

[2] In the case of non-monetary care, precaution under strict liability eventually becomes greater than care under negligence since individuals do not exert more than standard care under the latter liability rule. Notably, MacMinn considers the negligence rule that makes injurers liable only for the harm caused by their negligence (see Kahan 1989).

[3] We briefly comment on negligence in our conclusion.

Let

x = injurer care level; $x \geq 0$;
$p(x)$ = accident probability; $0 < p(x) < 1$; $p'(x) < 0$; $p''(x) > 0$;
l = magnitude of harm if an accident occurs; $l > 0$;
y = initial assets of injurers; $y \geq 0$;
$u(\cdot)$ = von Neumann-Morgenstern utility function of wealth of injurers; $u'(\cdot) > 0$; $u''(\cdot) < 0$.

In the literature, the assumption that care is non-monetary is widespread. Non-monetary care can be conceived of as precautionary effort, examples being: slowing for curves or paying attention to cyclists. However, numerous precautionary measures cause monetary costs, e.g., an anti-lock break system. Our main analysis in Sect. 2.1 assumes non-monetary care, as Shavell (1986). In Sect. 2.2, we show that the effect, which is specific to the risk aversion framework, is principally unaffected but joined by another effect which is also present in the risk neutrality framework, if we assume monetary care.

2.1 Non-monetary care

If care is non-monetary with a monetary equivalent of x, injurers maximize expected utility given by

$$V(x, y) = p(x)u(A) + [1 - p(x)]u(B) \tag{1}$$

with $A = \max\{y–l,0\}–x$ and $B = y–x$, since injurer's income given an accident is $\max\{y–l,0\}$. Potentially judgment-proof injurers have funds less than the loss, $y < l$, and their net income given an accident consists only of non-monetary costs x.

Expected utility changes with care according to

$$\frac{\partial V(x, y)}{\partial x} = p'(x)[u(A) - u(B)] - p(x)u'(A) - [1 - p(x)]u'(B). \tag{2}$$

From this follows that expected utility V and the first-order derivative are continuous in x $\forall$ $x \geq 0$. The derivative has a quite intuitive interpretation. Additional care, on the one hand, reduces the probability that the loss in utility due to an accident has to be experienced, which is the marginal benefit of care, and, on the other hand, additional care causes utility to decrease in both contingencies, which is the marginal cost of care. The first-order condition for interior solutions, i.e., in the case of initial income sufficiently greater than zero[4],

$$\frac{\partial V(x, y)}{\partial x} = 0 \tag{3}$$

is solved by the individually optimal care level, $\hat{x}(y)$. We assume that the second-order condition $\frac{\partial^2 V(x,y)}{\partial x^2} < 0$ holds, with

[4] Recognize that, since $\frac{\partial V(0,0)}{\partial x} < 0$, optimal individual care will be zero for sufficiently small initial income levels.

$$\frac{\partial^2 V(x,y)}{\partial x^2} = p''(x)[u(A) - u(B)] - 2p'(x)[u'(A) - u'(B)] + p(x)u''(A) + [1 - p(x)]u''(B). \tag{4}$$

By application of the implicit function theorem, we find that the change of optimal care with assets is given by

$$\frac{d\hat{x}}{dy} = -\frac{\frac{\partial^2 V(x,y)}{\partial x \partial y}}{\frac{\partial^2 V(x,y)}{\partial x^2}}, \tag{5}$$

which will be positive if the cross partial $\frac{\partial^2 V(x,y)}{\partial x \partial y}$ is positive. That cross partial is given by

$$\frac{\partial^2 V(x,y)}{\partial x \partial y} = \begin{cases} -p'(x)u'(y-x) - [1-p(x)]u''(y-x) & \text{if } y<l \\ \{p'(x)[u'(y-l-x) - u'(y-x)] \\ -p(x)u''(y-l-x) - [1-p(x)]u''(y-x)\} & \text{if } y \geq l, \end{cases} \tag{6}$$

and can be interpreted as follows. For small asset levels, $y < l$, increases in the asset value increase the utility loss due to an accident that care prevents, $u(y-x) - u(-x)$, and the marginal costs of care are lower at higher net income levels due to diminishing marginal utility of income. Both effects are positive and therefore unambiguously argue for higher precaution in response to increases in asset value. However, once assets are sufficient to at least compensate the harm, $y \geq l$, increasing the asset value decreases the utility loss that care prevents as net income in both states is affected and marginal utility is diminishing. This argues for a reduction in care, all else being equal. The decrease in marginal costs, on the contrary, increases incentives for precautionary expenditures. Hence, an increase in asset value decreases both the marginal benefit and the marginal costs of care if the individual has sufficient assets to compensate the harm caused. These are two opposing effects of which either might be greater than the other. Note that (6) also contains the result for the case of risk neutrality, that is, the individual with sufficient funds does not change care in response to increases in asset value, whereas potentially judgment-proof individuals continuously increase their precaution. This leads to the widely cited result that potentially judgment-proof injurers take less care than agents with sufficient funds.

The comparative statics yield the following central result.

Proposition 1 *Assume strict liability, risk aversion, and non-monetary care. Potentially judgment-proof injurers with assets less than but close to the harm take more care than some of the injurers with assets* $y \in [l, l + \Delta]$ *if the following applies to latter individuals: (i) decreasing absolute risk aversion and* $p(\hat{x}) < p^c$*, or (ii) increasing absolute risk aversion and* $p(\hat{x}) > p^c$*.*

Proof The claim is proven if (i) potentially judgment-proof injurers with assets equal to $y = l - \varepsilon$, $\varepsilon \to 0$, take care of the same level as individuals with assets equal to $y = l$, and (ii) if injurers with $y \in [l, l + \Delta]$ continuously decrease their care in response to rises in asset values under the given conditions. In that case, injurers with assets less than but close to the harm take more care than 'well-to-do' injurers with assets close to $l + \Delta$.

With regard to condition (i), the optimal care increases in y as long as $y < l$ since, in that case, $\frac{\partial^2 V(x,y)}{\partial x \partial y} > 0$. Note that this result does not need further specifications, e.g., with regard to absolute risk aversion, than what we imposed on the functions $p(x)$ and $u(\cdot)$. Thus, the care level $\hat{x}(y = l - \epsilon)$ is equal to $\hat{x}(l)$ for $\epsilon \to 0$.

Regarding condition (ii), note that for $y \geq l$, the cross partial $\frac{\partial^2 V(x,y)}{\partial x \partial y}$ is not unambiguously signed. Sweeney and Beard (1992) have shown that the sign depends in a complex way on the magnitude of the probability of causing the harm at the optimal care choice $p(\hat{x})$, and on the behavior of the absolute risk aversion function $r(NI) = -\frac{u''(NI)}{u'(NI)}$ over the interval for net income NI, $NI \in D = [y - x - l, y - x]$. We apply their Result A almost verbatim: (1) If $r(\cdot)$ is constant throughout the interval D, then $d\hat{x}/dy = 0$; (2) If $r(\cdot)$ is monotonically decreasing throughout D, then there exists a number p^c, $0 < p^c < 1$, such that $d\hat{x}/dy < (>) 0$ if $p(\hat{x}) < (>) p^c$; (3) If $r(\cdot)$ is monotonically increasing throughout D, then there exists a number p^c, $0 < p^c < 1$, such that $d\hat{x}/dy > (<) 0$ if $p(\hat{x}) < (>) p^c$. □

It is worth noting that the critical probability p^c can be approximately equal to zero or to one depending upon the specific absolute risk aversion function.[5] This implies that, if p^c is close to one, care is reduced in most cases as a consequence of increasing y for the widely used assumption of decreasing absolute risk aversion (e.g., Arrow 1976).

Our finding utilizes the fact that, whereas potentially judgment-proof injurers find it unambiguously beneficial to take more care after increases in asset value, injurers without binding asset constraint might find it advantageous to let care decrease with assets. The ambiguity of the comparative statics owes to the fact that care depends on an exogenously given accident probability function and does not in general decrease the riskiness of income prospects.[6]

Figure 1 depicts an example in which some injurers, who turn out judgment proof in the accident contingency, are more cautious than other injurers with assets higher than harm. The example is based on the accident probability function $p(x) = e^{-x}$, as, e.g., in Rubinfeld (1987), and the utility function $u(NI) = NI^{.4}$ as well as a harm magnitude $l = 10$.[7] In this example, injurers with assets $y \in [9,10)$, for instance, take more care than injurers who would not be bankrupted in the case of an accident and have assets $y \geq 15.6$.

[5] Sweeney and Beard (1992), for instance, show that $p^c \cong 1$ if $r(NI)$ remains near $r(y - x - l)$ until the net income almost equals $y - x$.

[6] In this note, we do not elaborate further but refer to Briys and Schlesinger (1990) and Sweeney and Beard (1992), for instance.

[7] In order to deal with the fact that the utility function is not defined for negative arguments, we add 4 to both contingencies.

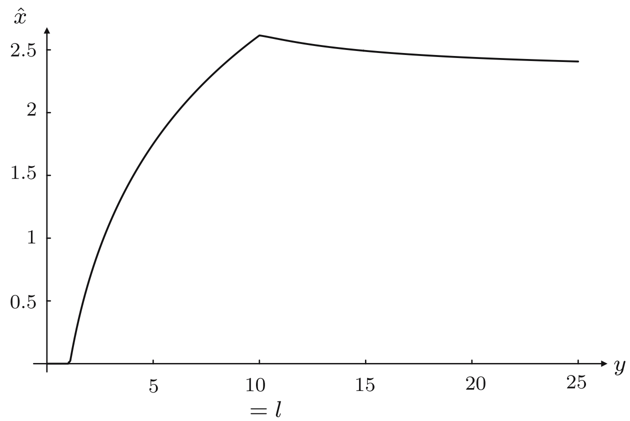

Fig. 1 Optimal care as a function of the asset value in the case of non-monetary care

2.2 Monetary care

If we assume monetary care, the income given that an accident occurs is max $\{y–l–x,0\}$. In this case, the injurer maximizes expected utility given by

$$Z(x,y) = p(x)u(\max\{y-l-x,0\}) + [1-p(x)]u(y-x). \tag{7}$$

The first-order derivative is

$$\frac{\partial Z(x,y)}{\partial x} = \begin{cases} p'(x)[u(0)-u(y-x)] - [1-p(x)]u'(y-x) & \text{if } y-l-x<0 \\ \{p'(x)[u(y-l-x)-u(y-x)] & \\ -p(x)u'(y-l-x) - [1-p(x)]u'(y-x)\} & \text{if } y-l-x \geq 0. \end{cases} \tag{8}$$

Note that the derivative of Z with respect to care is not continuous in x, which contrasts with V from the section above. This discontinuity is due to the fact that marginal costs of care do not arise in the accident state of the world for potentially judgment-proof injurers. If the individual is bankrupt in the accident state anyway, it is of no relevance for the utility of that state whether she increases precaution even more. Consequently, whereas the marginal benefit of care is continuous, marginal costs of care display a discontinuity, which translates into a discrete fall in optimal care.

Recognize that there is a range of asset levels for which it is endogenous which line in (8) applies. This holds as the injurer decides on care, the level of which determines for given l and y whether $y – l – x$ is less than, equal to, or greater than zero. To that extent, this setting of strict liability displays a parallel to the case in which negligence is the liability rule, where discontinuities in absolute and marginal terms are of great importance.

The solution to the first-order condition for $y – l – x < 0$ is individually optimal care $\tilde{x}_1(y)$ and $\tilde{x}_2(y)$ for the condition resulting for $y – l – x \geq 0$.[8] At the critical asset value $\bar{y}$, it holds that $\tilde{x}_1(\bar{y}) > \tilde{x}_2(\bar{y})$.

[8] The second-order condition clearly holds for $y–l–x < 0$, and we assume that it also does in the other case.

Regarding the question of at which asset value the switch from $y - l - x < 0$ to $y - l - x \geq 0$ occurs, we note that there is no question whether agents with $y \leq l$ will be bankrupted by compensation requests. Individuals with somewhat greater assets will have binding asset constraints even if they choose the smaller $\tilde{x}_2(y)$ instead of $\tilde{x}_1(y)$, and therefore pick $\tilde{x}_1(y)$ since the derivative for non-binding asset constraints does not apply to them. However, there will be an asset range of individuals who, in the case of an accident, are not bankrupted if they choose $\tilde{x}_2(y)$, but are bankrupted if $\tilde{x}_1(y)$ is taken. These individuals compare $Z(\tilde{x}_1(y), y)$ with $Z(\tilde{x}_2(y), y)$ to decide on the optimal precaution. We define $\bar{y}$ to be the first asset level for which $Z(\tilde{x}_1(y), y) \leq Z(\tilde{x}_2(y), y)$ holds. Individuals with asset values greater than $\bar{y}$ likewise choose $\tilde{x}_2(y)$.

Proposition 2 *Assume strict liability, risk aversion, and monetary care. Potentially judgment-proof injurers with* $y = \bar{y} - \epsilon$, $\varepsilon > 0$ *take more care than individuals with* $y = \bar{y} + \gamma$, $\gamma \geq 0$, *if* ε *and* γ *are sufficiently small.*

Proof See the above. □

This last result also holds in the case of risk neutrality because the discontinuity in the marginal costs of care is also present in that framework (Miceli and Segerson 2003). We continue and inquire whether individuals with sufficient funds decrease their care further after increases in the asset value, that is, if the effect from Sect. 2.1 remains after the change in the assumption concerning care. For that, our interest is on the sign of $d\tilde{x}_2/dy$. In analogy to Eq. (5), the following cross partial derivative is critical for this sign.

$$\frac{\partial^2 Z(x,y)}{\partial x \partial y} = \begin{cases} -p'(x)u'(y-x) - [1-p(x)]u''(y-x) & \text{if } y-l-x<0 \\ \{p'(x)[u'(y-l-x) - u'(y-x)] & \\ -p(x)u''(y-l-x) - [1-p(x)]u''(y-x)\} & \text{if } y-l-x \geq 0 \end{cases} \tag{9}$$

This term has characteristics similar to those of the cross partial derivative for the case of non-monetary care. Increases in y unambiguously call for higher care as long as assets are insufficient with respect to covering harm and care, whereas 'affluent' injurers have to weigh the two opposing effects, lower marginal benefit and lower marginal costs of care. That is, it holds that $d\tilde{x}_1(y)/dy > 0$, whereas $d\tilde{x}_2(y)/dy$ can be greater than, equal to, or less than zero, and individuals with sufficient funds decrease monetary care in response to asset value increases if conditions laid out in Proposition 1 apply. This effect can thus further contribute to the difference between care choices of agents with and without binding asset constraint in the case of an accident.

For the example given in Sect. 2.1, we obtain the results depicted in Fig. 2. We deduce that injurers with $y < 12.616$ choose care $\tilde{x}_1(y)$, whereas $\tilde{x}_2(y)$ is optimal for individuals with $y \geq 12.616$. Thus, optimal care falls from $\tilde{x}_1(\bar{y} = 12.616) = 2.68666$ to $\tilde{x}_2(\bar{y} = 12.616) = 2.53773$.

For instance, an individual with $y = 12.61$ compares the expected utility of the alternative choices. For her, choosing $\tilde{x}_1(y)$, which causes $y - l - x < 0$, promises a higher expected utility than taking $\tilde{x}_2(y)$ as precaution, although in that case $y - l - x > 0$ holds. Furthermore, we can observe that the effect detailed for non-monetary

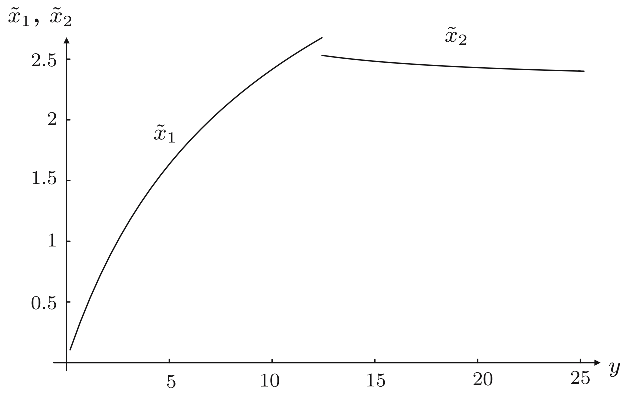

Fig. 2 Optimal care as a function of the asset value in the case of monetary care

care is present as well since injurers who are not bankrupted by compensation requests decrease their care choice for increases in asset value.

3 Conclusion

Judgment proofness is considered an important impediment to the effectiveness of the liability system in inducing efficient care. By using Shavell's model, we find that some judgment-proof injurers take more care than some injurers with sufficient assets in certain circumstances. For the case of non-monetary care, this result contrasts pronouncedly with that of the literature heretofore and originates from the risk aversion of individuals in our model. Individuals with sufficient funds may decrease care in response to increases in asset value because this change decreases both the marginal benefit and the marginal costs of care. The lowering of the marginal benefit of care does not result for judgment-proof individuals since the asset value change has no effect on the utility of the accident state. Due to this irrelevance, increases in assets actually increase the marginal benefit of care for individuals who are judgment proof in the accident contingency. For the case of monetary care, this effect combines with a discontinuity in the marginal cost of care.

Judgment proofness is very likely to be a valid description of many practical contexts. Following the considerations of Shavell (1986) concerning the consequences of judgment proofness, namely, potentially judgment-proof injurer's insufficient incentive to take precaution, several policy suggestions, including third-party liability and minimum asset requirements, have been discussed as solutions to the problem (for a discussion see, e.g., Shavell 2005). Our result certainly does not lessen the need to evaluate or to design policy measures to deal with limited liability in an optimal way, yet it certainly dampens the negative conclusions made hitherto with respect to individually optimal choices of injurers with insufficient funds. It is not generally true that potentially judgment-proof injurers exert less caution than other individuals, and this assertion does not hinge upon the nature of care, whether it be monetary or non-monetary, if behavior is best described by risk aversion.

Concluding, we comment on two variations to the analysis presented. First, the analysis focused on strict liability. If negligence is the applicable liability rule and the care standard is set at the efficient level, we expect injurers to take due care for sufficiently high assets and to maintain this care level if assets increase, where this sufficient asset level is less than harm irrespective of the care conception.[9] The risk aversion we allow for adds to the fact that negligence only implies care costs instead of care costs plus expected harm. Second, care lowers the accident probability in our set-up. If we were to use the model formulation in which care impacts on the magnitude of the loss, the outcome would be characterized by (i) a discrete jump in care from zero to a strictly positive amount at a critical asset level, and (ii) an ambiguous cross partial derivative for further increases in asset value once that jump to strictly positive care values has occurred. If the injurer finds it optimal to choose positive care, the individual's funds are greater than harm (harm plus care), given optimal care, in the context of non-monetary (monetary) care. Consequently, we cannot transfer our finding to this framework.

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[9] Note that risk aversion complicates the decision on efficient care. See the discussion in Miceli and Segerson (1995). Our reference above is to the standard referred to by Shavell (1986).