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Uncertain product risk, information acquisition, and product liability

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Philipps Universität Marburg

Uncertain product risk, information acquisition, and product liability

Tim Friehe Elisabeth Schulte*

April 10, 2017

Abstract

We describe how product liability interacts with regulatory product approval in influencing a firm's incentives to acquire information about product risk, using a very parsimonious model. The firm may have insufficient information acquisition incentives when it is not fully liable for the harm caused by its product. The firm may also have excessive information acquisition incentives under both full and limited liability. We highlight efficiency inducing liability rules.

Keywords: Innovation, Product Liability, Uncertainty

JEL Code: K13, O31, D83

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1 Introduction

In developing and marketing new products, firms face uncertainty regarding the harmful nature of their product. Pre-market experimentation in controlled environments allows for information acquisition about the products' riskiness. This note studies a firm's incentives to acquire information about the risk inherent in a new product that the firm invented when the firm is subject to strict product liability and a regulatory product approval procedure. We show that the firm's information acquisition incentives may be insufficient or excessive. We describe how this depends on the liability rule, and we identify the liability design that allows the attainment of the first-best outcome.

The fact that liability rules also influence the incentives regarding the acquisition and sharing of information about risk has been emphasized by, for instance, [1] and [10]. [11] and [12] argue that the law in fact often instills perverse incentives; that is, due to the actors' misaligned interests, it deters them from generating more information. Such misalignments are central to our paper.

Our inquiry is related to [10]. In that paper, parties can buy information about whether or not there is a risk in a setting in which the value of information stems from the ability to lower social costs by tailoring the level of care to the circumstances at hand. Strict liability with full compensation ensures efficiency. In contrast, strict liability with partial compensation may be required for efficiency in our setup. In [2], information about the acci-

dent technology is obtained via learning-by-doing which may make distorted negligence standards optimal, for example. Similarly, [7] study the scenario in which additional information can only be obtained when a sufficient number of firms are actually marketing the product innovation. In contrast, our study focuses on experimentation that occurs before the marketing of the product. In addition, there is a vast literature about how liability rules or other policy instruments influence the incentives to innovate (e.g., [6], [8]), whereas our paper focuses on the acquisition of information about risk for a new product that the firm already invented.

Our paper is also related to the literature on information provision by interested parties, in particular, [3], [5], and [9]. [3] study the interaction between two instruments to influence a decision, information provision and monetary payments. They find that providing information may increase the expected cost of bribing the decision maker. [5] look at an interest group's preferences for information provision in a more general setting and identify factors that induce voluntary information provision by the interest group. [9] study what kind of information an interested party ideally acquires to persuade a decision maker. Our analysis also features an interested party with access to information. Her preferences for information acquisition and provision are influenced by liability since the liability rule determines both the extent to which her preferences are state-dependent as well as the extent to which her preferences are misaligned with the regulator's preferences.

2 The model

Suppose that a firm has invented a product that, if marketed, generates a rent π for the firm and a consumer surplus CS. The product may also cause harm h to society. The true harm probability is either zero or one, defining the state of the world. Due to the novelty of the product, there exists ex-ante uncertainty about the level of the harm probability such that a commonly held prior $p_0 \in (0, 1)$ applies initially. Conducting an experiment will reveal the true harm probability with a known and possibly state-dependent probability smaller than one, and will yield an inconclusive outcome otherwise. The execution of the experiment and its outcome are publicly observable. If the experiment is executed, the posterior p_1 is equal to either zero or one if the experiment is successful, and equal to $p_n \in (0, 1)$ if the experiment yields an inconclusive result. If no experiment is run, $p_1 = p_0$ holds. The firm decides about running the experiment.

Marketing the product is possible only with the approval of the regulator. The regulator's mandate is to decide about product approval, taking into account the information available about the riskiness of the product. The regulator seeks to maximize the sum of the firm's rent and consumer surplus, net of the expected harm to society.

The firm seeks to maximize her rent net of expected liability payments. The firm is liable for a fraction α of any harm caused by her product, $0 \leq \alpha \leq 1$. As in [4], for example, we consider the possibility of partial liability but consider full liability as the baseline.

The course of events is as follows: First, the product risk is drawn. Then, the firm decides about (publicly) running the experiment. Next, the firm decides whether to file the product for approval. Last, the regulator approves the product or not (and the according payoffs result).

3 The analysis

Both players have a veto right to the marketing of the product. The regulator approves the product if and only if $\pi + CS - p_1 h \geq 0$, i.e., $p_1 \leq \bar{p}_r = (\pi + CS)/h$. The firm markets the product if and only if $\pi - p_1 \alpha h \geq 0$, i.e., $p_1 \leq \bar{p}_f = \pi/(\alpha h)$. If p_1 exceeds at least one of the thresholds, the product is not marketed and both players' payoff is zero.

The firm's and the regulator's thresholds, $\bar{p}_f$ and $\bar{p}_r$, may differ because the firm ignores consumer surplus and the share $1-\alpha$ of harm. We have that $\bar{p}_r = \bar{p}_f$ when $\alpha = \pi/(\pi+CS)$. For smaller values of α, the firm is more eager than the regulator to market the product, and *vice versa*. If $\min\{\bar{p}_f, \bar{p}_r\} \geq 1$, both the firm and the regulator always want to market the product, implying that there is neither a benefit from information acquisition nor a role for a regulator in such a parameter constellation. Since this is true for the firm for any liability rule α when $\pi \geq h$, we assume $\pi < h$ and distinguish Scenario H in which $\pi + CS \geq h$ (i.e., $\bar{p}_r \geq 1$) and Scenario L in which $\pi + CS < h$ (i.e., $\bar{p}_r < 1$).

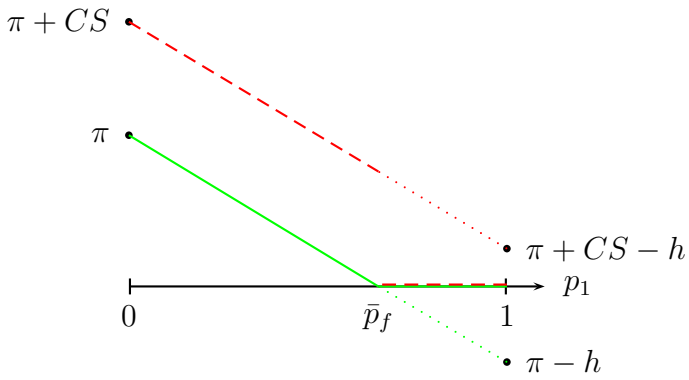

Figure 1: Full liability, $\pi < h < \pi + CS$

3.1 Full liability (i.e., $\alpha = 1$)

If $\alpha = 1$, $\bar{p}_f < \bar{p}_r$ obtains since $CS > 0$, meaning that the regulator approves the product when the firm wants to market the product.

3.1.1 Scenario H

We now assume that $h < \pi + CS$ and depict the players' expected payoffs as a function of p_1 in Figure 1.

The firm's payoff is a convex, piecewise linear function with a kink at $\bar{p}_f$. The convexity of payoffs – due to the outcomes in which the firm can ensure a payoff of zero instead of a negative one – implies that the firm is better off from running the experiment for any $p_0 \in (0, 1)$, that is, she is information-loving.[1]

The regulator's payoff exhibits a discrete jump from a strictly positive value to zero at $p_1 = \bar{p}_f$. If $p_0 > \bar{p}_f$, the regulator benefits from the firm's

[1]The firm's payoff is strictly convex if α exceeds π/h, which is smaller than one by assumption.

information acquisition because the firm will not market the product without an experiment but may do so in the light of the experiment's outcome. If $p_0 < \bar{p}_f$, the regulator prefers that the firm markets the product without collecting additional information (because running the experiment implies the risk that the firm may not market the product).

Lemma 1 *Suppose full liability (i.e., $\alpha = 1$) and $\pi < h < \pi + CS$.*
If $p_0 \leq \bar{p}_f$, the firm has excessive information acquisition incentives. Otherwise, her information acquisition incentives are efficient.

In order to deter the excessive information acquisition in the case described in Lemma 1 (ii), the firm's payoff must not be convex in p_1. This is achieved by limiting the liability payment to π, or setting α equal to π/h.

Proposition 1 *If $\pi < h < \pi + CS$ and $p_0 \leq \bar{p}_f$, efficient information acquisition can be induced by a strict liability rule with partial compensation fixed at $\alpha = \pi/h$.*

3.1.2 Scenario L

We now assume that $h > \pi + CS$ such that $\bar{p}_f < \bar{p}_r < 1$ applies. The regulator and the firm agree that the product shall not be marketed if the harm probability is one. They also agree that it shall be marketed if the harm probability is zero. If they also agree about the marketing decision in case the experimental outcome is inconclusive, they share a preference for information acquisition for all $p_0 \in (0, 1)$.

If the firm and the regulator disagree about the marketing decision in case the experimental outcome is inconclusive (i.e., if $\bar{p}_f < p_n \leq \bar{p}_r$) and $p_0 \leq \bar{p}_f$ holds, the firm's information acquisition has two opposing effects on the regulator's payoff: It prevents the marketing of the product in the case that it has proven to be harmful (i.e., when $p_1 = 1$), but the product is also not marketed when the experimental outcome is inconclusive. When $\bar{p}_f < p_n \leq \bar{p}_r$ and $p_0 \leq \bar{p}_f$, and the firm runs the experiment, the regulator's payoff is $(1-p_0)q_0(\pi+CS)$, where q_0 indicates the probability of a conclusive experiment when there is no product risk. Without experimentation, the regulator's payoff is $\pi + CS - p_0 h$. From the point of view of the regulator, experimentation is beneficial if

$$\bar{p}_r < \frac{p_0}{1-(1-p_0)q_0} := \hat{p}. \tag{1}$$

The firm prefers to run the experiment if

$$\bar{p}_f < \hat{p} \tag{2}$$

by the argument explained for the regulator. Since $p_n < \hat{p}$ holds and we have $\bar{p}_f < p_n$ by assumption, we have that (2) would apply under these circumstances.[2] This indicates scenarios in which $\hat{p} < \bar{p}_r$ as problematic. A conflict of interest regarding information acquisition can only be resolved as described in Proposition 1.

Lemma 2 *Suppose full liability (i.e., $\alpha = 1$) and $\pi + CS < h$.*

If $p_n \in (\bar{p}_f, \bar{p}_r]$ and $p_0 \leq \bar{p}_f$, the firm has excessive information acquisition

[2]To see that $p_n < \hat{p}$ holds, note that $p_n = (p_0(1-q_1))/(p_0(1-q_1)+(1-p_0)(1-q_0))$ with q_1 indicating the probability of a conclusive experiment when the product is risky.

incentives when $\hat{p} < \bar{p}_r$. Otherwise, her information acquisition incentives are efficient.

3.2 Limited liability

We will now analyze the case $\alpha < \pi/(\pi + CS)$, implying $\bar{p}_f > \bar{p}_r$. The reasoning for limited liability such that $\alpha \in (\pi/(\pi+CS), 1)$ is similar to that in the previous subsection since the ranking $\bar{p}_f < \bar{p}_r$ obtains.

3.2.1 Scenario H

If $\pi + CS > h$, neither the regulator nor the firm want the experiment to be run (as $\alpha < \pi/(\pi + CS)$ implies $\pi > \alpha h$) since $\bar{p}_f > \bar{p}_r > 1$.

3.2.2 Scenario L

Suppose that $\pi + CS < h$. In this parameter constellation, the regulator's payoff is convex in p_1, making the regulator information-loving. In contrast, the firm's payoff exhibits a discrete jump from a strictly positive value to zero at $p_1 = \bar{p}_r$, as depicted in Figure 2.

If $\alpha < \pi/h$, as in Figure 2, the firm does not acquire information if $p_0 \leq \bar{p}_r$ because she would risk not getting the product approved. If instead $p_0 > \bar{p}_r$, the firm has to acquire information in order to (at least sometimes) get product approval.

Lemma 3 *Suppose limited liability such that $\alpha < \min\{\pi/(\pi + CS), \pi/h\}$. If $\pi + CS < h$ and $p_0 \leq \bar{p}_r$, the firm has insufficient information acquisition incentives. Otherwise, her information acquisition incentives are efficient.*

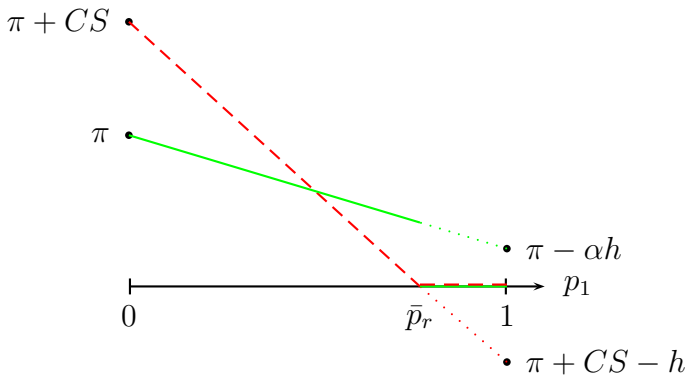

Figure 2: Limited liability, $\alpha < \pi/(\pi + CS)$, $\pi + CS < h$

If $\alpha > \pi/h$ (see Figure 3), the firm would like to learn p_1 accurately in order to not market the product if it is certainly harmful (i.e., when $p_1 = 1$), and to market the product if it is certainly harmless (i.e., when $p_1 = 0$). If the regulator and the firm agree about the right course of action if the experimental outcome is inconclusive, the firm benefits from running the experiment. Such a case arises if either $p_n \leq \min\{\bar{p}_f, \bar{p}_r\}$, or $p_n > \max\{\bar{p}_f, \bar{p}_r\}$.

The firm may not be willing to acquire information even though her preferences are convex in p_1: If $p_n \in (\bar{p}_r, \bar{p}_f]$, after an inconclusive experiment, the regulator does not approve the product but the firm would like to market the product. When $p_0 \leq \bar{p}_r$ and the firm runs the experiment, she can market the product with a lower probability (which is equal to one without the experiment), but also faces liability payments less often. She prefers to acquire information if and only if $\bar{p}_f < \hat{p}$ as defined in (1).

Lemma 4 *Suppose limited liability such that* $\pi/h < \alpha < \pi/(\pi + CS)$.

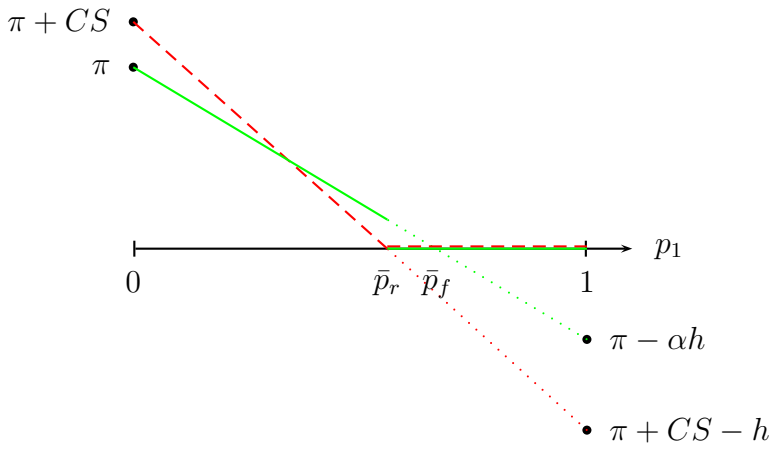

Figure 3: Limited liability, $\pi/h < \alpha < \pi/(\pi + CS)$,

If $\pi + CS < h$ and $p_0 \leq \bar{p}_r$, the firm has insufficient information acquisition incentives when $\bar{p}_f > \hat{p}$. Otherwise, her information acquisition incentives are efficient.

If the firm has insufficient incentives for information acquisition, she can be incentivized to acquire information by increasing the parameter range for p_1 for which she prefers not to market the product. This can be achieved by increasing her liability payments. A complete alignment of the firm's and the regulator's interests can be achieved by setting $\alpha = \pi/(\pi + CS)$, such that $\bar{p}_r = \bar{p}_f$. For such a liability rule, the regulator and the firm always agree on the best course of action, even if the true product risk remains uncertain.

Proposition 2 *If $h > \pi + CS$, efficient information acquisition incentives can be induced by strict liability rule with partial compensation fixed at $\alpha = \pi/(\pi + CS)$.*

4 Conclusion

We have described how product liability interacts with regulatory product approval in influencing a firm's incentives regarding the acquisition of information about product risk. Our analysis applies in situations in which the firm has the exclusive right to generate information about her product risk, and a regulator has the right to deny product approval. There are circumstances in which the firm's incentives for information acquisition are insufficient and others in which they are excessive. Tailoring the level of liability to the specific circumstances ensures welfare-maximizing choices by the firm. An open question is how such a liability rule can possibly be implemented in practice.

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