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THE JUDGMENT PROOF OPPORTUNITY

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1. INTRODUCTION

As policymaking in the areas of environmental preservation, consumer protection, and industrial safety turns increasingly to corporate liability for accidents as a way of inducing socially responsible behavior by firms, it is increasingly constrained by the so-called "judgment proof problem." This problem arises when a firm that engages in a hazardous activity may cause damages that exceed its wealth. It can then avoid legal liability for such damages through bankruptcy—thereby becoming "judgment proof"—and is, as a result, unlikely to choose a socially optimal level of care or scale of operating the hazardous activity. Starting with papers by Summers (1983) and Shavell (1986), this problem has been analyzed in a small but growing formal literature.

With very few exceptions, this literature has ignored the ability of individual firms, as well as entire hazardous industries, to respond strategically to liability. The canonical model in the literature considers only a single, representative firm (or at best two, if joint torts are at issue) with given revenues, given costs other than expenditures on safety, and given initial wealth.

The serious inadequacy of this model as a basis for analyzing the real-world judgment proof problem is illustrated by events surrounding the enactment of the U.S. Oil Pollution Act of 1990. As soon as it became clear that this law would effectively remove dollar limits on liability for oil spills, the ocean shippers and oil cargo owners targeted by the law began maneuvering to minimize their exposure to such liability. In July 1990, the *Wall Street Journal* reported that at least one (unidentified) international oil company had begun to park the title to some of its oil in transit with a company controlled by fugitive oil trader Mark Rich in Switzerland. Oil companies Royal Dutch/Shell and Elf Aquitaine announced that they would curtail U.S. oil shipments in vessels they owned or managed. Danish shipping giant A.P. Moeller, owner of one of the world's largest independent oil tanker fleets, soon followed suit. Oil refiners, too, started to shun legal ownership of oil until it arrived at their plants, instead of accepting it in the seller's port as used to be the practice.

> In fact, Texas oilman and trader Kyle McAlister says he's already canvassing U.S. refiners. For at least 10 cents a barrel, Mr. McAlister says, he is prepared to run the liability risk for them, buying their oil and holding possession of it until it reaches their refineries (*Wall Street Journal*, July 26, 1990, p. B1).

Meanwhile, some shippers were getting ready to subdivide their fleets into single-ship companies, each with minimal assets, to protect the rest of their operations from any one claim. Ketkar (1995) reports that in 1980, 29.6% of the ocean-going tankers trading in the U.S. were owned by single-ship companies, but that this figure had risen to 45.5% in 1991. Of course, even a single ocean-going tanker is a valuable asset to lose. Mid-1991, the *Wall Street Journal* reported that big shippers, rather than entering U.S. waters with such tankers, were transferring oil to small "ferry" ships in a move to further limit their liability exposure.

These events clearly show that firms view the ability to be judgment proof as an opportunity—one which they have many ways of exploiting. Moreover, competitive pressures in both capital and output markets ensure that firms will exploit this judgment proof opportunity to the hilt.

The model developed in this paper incorporates the firm's point of view by explicitly taking into account its optimal financial decisions in the face of liability, as well as the competitive environment in which it operates. Capital market competition, and the resulting endogeneity of firm wealth, is accounted for by decomposing wealth into those variables that determine how the capital market places a value on the firm's shares. Output market competition, and the resulting endogeneity of industry structure, is accounted for by allowing for entry and exit by firms of different scales, with arbitrary inherent advantages with respect to costs of production and care. These features distinguish the model from any in the existing literature.[1]

Section 2 of this paper lays out a version of the model that initially abstracts from scale economies in either production or accident prevention. This simplifies the analysis of Sections 3 and 4, which consider a firm of given scale and analyze the feedback effects—mediated by the capital market—between two sets of decisions made by the firm. On the one hand are the firm's decisions with respect to variables that directly impact welfare, namely its safety decision and, given market power, its choice of output price. On the other are the firm's purely financial decisions, whose direct effect is merely to allocate given revenues across time and across different stakeholders in the firm.

Section 3 focuses on the firm's optimal dividend policy in the face of liability. The analysis of this section clears up a persistent confusion in the existing literature concerning the care decision of potentially judgment-proof firms. Whereas some authors conclude that such firms take less than the socially optimal amount of care, a much-cited analysis by Beard (1990) suggests that, counterintuitively, they may exercise the right amount, or even *more* care than is socially optimal. It is shown here, however, that this result is counterintuitive for the wrong reason: it relies on an implicit assumption that the firms irrationally retain discretionary wealth, rather than immediately distributing such wealth as dividends.

Section 4 focuses on the financial decision that lies at the heart of the judgment proof problem, namely the decision whether or not to declare bankruptcy following an accident. Analysis of how this decision varies with the firm's scale and price leads to the main result of this section, which is that, in contrast to the well-known result by Buchanan (1969) for common pollution externalities, the externality created by the judgment proof problem is never fully offset by market power.

Section 5 expands the base model to allow for arbitrary scale economies in both production and accident prevention. The focus of this section is on how hazardous industries as a whole restructure in response

[1] A model by Boyd and Ingberman (1996), which is based on Boyd (1992) and used also by Boyd and Ingberman (1994) and Ingberman (1994) is exceptional in the existing literature in that it does treat both firm wealth and industry structure as endogenous to the imposition of liability. However, the model still treats wealth as an unexplained primitive, and imposes highly specific (and in several ways restrictive) assumptions on economies of scale. A related problem with one of Boyd and Ingberman's central results is briefly discussed in Section 5.

to liability. A very simple condition on economies of scale in accident prevention is identified under which imposing liability on a hazardous industry is guaranteed to strictly improve welfare. In contrast, if this condition fails to hold, imposing liability may amount to a high-stakes gamble on welfare outcomes. The section concludes with a discussion of some empirical evidence on economies of scale in accident prevention.

Section 6 summarizes the paper and discusses work on extensions of the model.

2. THE MODEL

Consider an industry in which all firms specialize in some hazardous activity h. The industry's technology for producing h is Leontief and is initially assumed to be constant returns to scale, with the cost of all inputs other than capital, k, absorbed in the output price m. Firms operate integer multiples of some smallest unit of capital: $k \in \{1, 2, 3, \ldots\}$.[2] Exactly one unit of capital is required to produce one unit of output, so that the production function is simply $h = k$.

Unless specified otherwise, the industry's output market is assumed to be perfectly competitive. Aggregate demand $Q(m)$ is downward sloping and $Q(m) > 1$ at all relevant prices m.

The capital market is assumed to be perfect also, in the standard sense. Firms in the industry are all-equity financed and managed by their shareholders.[3] A firm that operates k units of capital (hereafter, "a firm of size k") has k shares outstanding. Each share has a face value of 1—the price of a unit of capital—and a market value of v. Firms immediately distribute all profits as dividends.[4] Shareholders are risk-neutral and face a constant opportunity cost of investment, equal to the return r on a riskless bond.

Each unit of capital operated by a firm gives rise to accidents at times generated by a Poisson process with mean q. These accidents do not damage the firm's capital, i.e., they are of the nature of chemical spills rather than explosions. Accidents happen independently across units of capital. As a result, the times at which a firm of size k experiences accidents can be treated as if they are generated by a Poisson process with mean kq. For brevity, q is hereafter referred to as simply "the accident rate" of the firm, and kq as the firm's "overall accident rate." The damages A from each such accident are drawn independently from a distribution with density $f(A)$ and support $[0, U]$, where $U > 1$. Given that an accident occurs, expected damages equal $\overline{A} \equiv \int_0^U Af(A)\,dA$.

Firms are able to influence q through expenditures on safety. Initially, it is assumed that there are no scale economies in accident prevention: to achieve a given expected accident rate q per unit of capital, any firm must spend the same amount $s(q)$ per unit of capital on safety, regardless of its size k. The care function $s(q)$ is downward sloping and convex: $s'(q) < 0,\ s''(q) > 0$. If a firm spends enough on safety, it can make

[2] In the analysis of the model, k is treated as a continuous variable bounded below by 1.

[3] An argument along the lines of Brander and Spencer (1989) shows that firms strictly prefer equity over debt if creditors cannot verify expenditures on accident prevention.

[4] This is shown later to be the optimal financial policy for potentially judgment-proof firms.

q arbitrarily small, but never zero: $\lim_{q \to 0} s(q) = \infty$. If, on the other hand, the firm spends nothing at all on safety, q will equal some finite value $\overline{q}$. It is assumed that this upper limit is never strictly binding on the firm's optimal choice of q.

Firms are strictly liable for damages caused by accidents, but this liability is limited to the value of their assets. There are no transaction costs associated with bankruptcy, and firms have no liability insurance.[5] Under these assumptions, firms will file for bankruptcy as soon as they experience an accident of size $A > kv$, where kv is the total market value of the firm. Firms whose value falls short of U and therefore face the possibility of such a bankrupting accident are called *undercapitalized*; firms whose value exceeds U are called *fully capitalized*; firms whose value exactly equals U are called *borderline*, and are considered to be fully capitalized as well. For expositional simplicity, it is assumed that whenever a firm experiences an accident of size $A \leq kv$, i.e., a non-bankrupting accident, it simply collects the damage payments A directly from its shareholders in the form of cash contributions. Neither the number k nor the market value v of its outstanding shares is then affected by such an accident.[6] Given that an accident occurs, the expected loss incurred by the firm's shareholders equals $\ell(kv) \equiv \int_0^{kv} Af(A)\,dA + kv[1 - F(kv)]$.

Finally, for the purposes of calculating welfare W, equal weight is given to consumer surplus, firm profits, and accident damages not paid for by firms. The social discount rate is taken to equal r.

These assumptions imply the following expressions for welfare and firm value:

Lemma 1. *Welfare is given by*

$$W = \frac{\int_m^\infty Q(x)\,dx + Q(m)\left[m - r - s(q) - q\overline{A}\right]}{r}. \tag{1}$$

Firm value is given implicitly by

$$kv = \frac{k[m - s(q) - q\ell(kv)]}{r}. \tag{2}$$

Proof: All proofs are given in Appendix A.

Expression (1) is more intuitive when written as

$$W = \int_0^\infty e^{-rt} \left\{ \int_m^\infty Q(x)\,dx + Q(m)[m - r - s(q) - q\overline{A}] \right\} dt.$$

The expression in braces is just the expected increment in welfare over the course of a short time interval of length dt. The increment in consumer surplus equals dt times $\int_m^\infty Q(x)\,dx$ and the increment in firm

[5] Given that their shareholders are risk-neutral, firms have no incentive to buy insurance.

[6] The same result could be achieved in other, equivalent ways. The firm could issue k new shares, for example, announcing that it will use the proceeds to both pay off the damages A and buy up all k old shares at their post-accident market value of $v' = (kv - A)/k$.

profits, before accident damages, dt times $Q(m)[m - r - s(q)]$. For small enough dt, at most one accident will occur in the industry at the end of the interval, with probability approaching $Q(m)q\,dt$. The expected damages of that accident, if it occurs, equal $\overline{A}$.

A very useful way of rearranging expression (2) is

$$r\,kv = km - ks(q) - kq\ell(kv). \tag{3}$$

This equation can be interpreted as a no-arbitrage condition, which must hold across any time interval $(t, t + dt]$. Shareholders in a firm of size k face the following trade-off at t. If, on the one hand, they withdraw their capital kv from the firm and invest it in the riskless bond for the duration of the interval, they obtain return $r\,kv\,dt$. If, on the other hand, they keep their capital invested in the firm, their expected return will have two components. First, with k units of capital, the firm will produce and sell $k\,dt$ units of output, thereby earning revenues of $km\,dt$, all of which are by assumption distributed as dividends. Second, for small enough dt, at most one accident will occur at the end of the interval, with probability approaching $kq(k)\,dt$. If so, the shareholders incur an expected capital loss of $\ell(kv)$. In equilibrium, the shareholders must be indifferent between withdrawing their capital or keeping it invested in the firm.

3. FINANCIAL DECISIONS AND CARE

In this section, the model is used to investigate how firms' financial decisions affect their incentives to spend on safety. The care decision is of course central to the judgment proof problem, and the early literature on this problem, as exemplified by Shavell (1986), finds that undercapitalized firms unambiguously take less care than is socially optimal. As the next proposition show, the model of this paper is in agreement with this early literature:

Proposition 1. *Fully capitalized firms choose the socially optimal accident rate q^*, defined implicitly by condition*

$$-s'(q) = \overline{A}. \tag{4}$$

Undercapitalized firms choose a strictly higher accident rate $\hat{q}(\ell)$, defined implicitly by condition

$$-s'(q) = \ell(kv). \tag{5}$$

Both parts of the proposition appear very intuitive. Because fully capitalized firms fully internalize the cost of accidents, their marginal benefit of care expenditures is equal to society's, and so their privately optimal accident rate q^* is also socially optimal. In contrast, because undercapitalized firms can externalize part of the cost of accidents through bankruptcy, their marginal benefit of care expenditures is lower, and so they choose a privately optimal accident rate $\hat{q}(\ell)$ that is larger than q^*. This is exactly the result of Shavell.

This reasoning ignores, however, that undercapitalized firms' marginal cost of care expenditures may also be lower than society's. In particular, if the marginal dollar spent on care would be lost to the firm anyway in case of an accident, since the firm is then bankrupted and loses all its wealth, then the real opportunity cost of that dollar must be discounted by the probability of an accident. This is precisely the point made in a much-cited analysis by Beard (1990), which finds that undercapitalized firms may well take as much or even *more* care than is socially optimal.[7] It is shown below, however, that Beard's reasoning is flawed, at least for the case of all-equity financed firms.[8] What Beard ignores is that undercapitalized firms, if they act in the best interest of their shareholders, will never leave discretionary wealth exposed to loss in case of an accident. Instead, they will immediately distribute any such wealth to their shareholders, possibly after spending some of it on care. Every dollar spent on care then reduces the amount left to be distributed by one dollar, however, so that undercapitalized firms do face the full opportunity cost.

Although Beard does not make explicit how the firm obtains the discretionary wealth out of which it pays for safety expenditures, the most straightforward assumption is that this wealth consists of retained profits.[9] To replicate his argument using the model of this paper, a new variable x is therefore introduced, representing the rate at which the firm pays out dividends. Also, since all that is needed to replicate Beard's possibility result is an example, we can restrict ourselves to the simple case of an accident density $f(A)$ that is concentrated entirely on the single accident size U.[10] Undercapitalized firms are then bankrupted by the first accident they experience, and the function $\ell(kv)$ reduces to simply $\min(kv, U)$. Because all accidents are of size U, the average accident size, $\overline{A}$, is of course also equal to U. Lastly, for reasons that will become clear at the end of this section, it is necessary to adopt Beard's discrete-time framework with binomial accident probability. In other words, rather than considering a time interval of infinitesimal length dt, we consider a time interval of discrete length Δt, but still assume that at most one accident occurs at the end of that interval, with probability $kq\Delta t$. For notational convenience, we set $\Delta t = 1$.

With these changes, the no-arbitrage condition for shareholders in a fully capitalized firm becomes

$$r\,kv = kx + [km - ks(q) - kx] - kq\,U. \tag{6}$$

[7] The same result has also been derived, apparently independently, by Craig and Thiel (1990) and Posey (1993).

[8] The result can be produced under two radically different assumptions on how an undercapitalized firm pays for care. The firm must either (1) pay for care up front, out of wealth that it otherwise loses in case of an accident, or (2) buy care on credit, on terms that do not depend on the level of care that it chooses. Beard (1988), which is the dissertation on which Beard (1990) is based, explicitly allows for both assumptions; Craig and Thiel (1990) explicitly make the second assumption; Posey (1993) is not explicit about either. Because the model of this paper assumes that firms are all-equity financed, it can only be used to analyze the reasoning based on the first assumption.

[9] The analysis of this section would be essentially identical if the firm paid for safety expenditures out of income from assets not associated with the production of h. As pointed out in Section 5 below, an undercapitalized firm would rationally divest such assets, however.

[10] Strictly speaking, doing so is inconsistent with the assumption made earlier that the density $f(A)$ has support $[0, U]$. A result showing that for some undercapitalized firm $\hat{q}(\ell)$ is *strictly* below q^* under the degenerate density should, by continuity, hold up also under some non-degenerate density, however.