Collusion Through Insurance: Sharing the Cost of Oil Spill Cleanups

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When the Exxon Valdez snagged on an underwater mountain in March 1989, and released 11 million gallons of crude oil into Prince William Sound, part of the public outrage was due to the subsequent rise in gasoline prices. Indeed, it seemed possible that, rather than being punished, the oil industry as a whole would profit from the oil spill, and this raised questions about the industry's incentives for taking care.[1] On the other hand, it was not obvious that Exxon itself would profit from the spill, since Exxon would be responsible for much of the cleanup costs, and, in addition, its flow of oil, hence revenue, would be disrupted. While Exxon might be careless in order to earn high profits at inflated prices, it certainly would not do so to confer profits on its competitors. Or would it?

Spills disrupt supply and increase prices. Even if a spill imposes a loss on the spiller, the disruption could increase the other firms' profits enough to more than compensate.[2] A cynic might conjecture that, if the oil companies had a credible way to collude in the amount of care they took, they might reduce care and increase the frequency of spills so as to increase their joint profit. If spills were distributed randomly among firms, all firms would profit on average. Of course, an individual firm could do even better by never spilling, and benefiting from other firms' spills through the higher price. Collusion to reduce the level of care would be unstable because each firm would have an incentive to increase its level of care. The necessary ingredient for a "conspiracy theory" is that firms can commit to reduce their levels of care. We argue that sharing the cost of cleanup serves exactly this function.

Since the oil industry maintains common resources to clean up oil spills,[3] the cost of any member's spill is shared by all of the members. Since spills are random, this cost sharing is a form of risk sharing. (Cost sharing implies that a firm pays less in the event that it alone has a spill, and more when another firm has a spill, than without cost sharing.) Risk sharing should lead to moral hazard. Here, the moral hazard "problem" is that each firm will reduce its level of care relative to the amount of care it would take if it bore the entire cost of its own cleanup. When agents are risk averse, the benefits of risk sharing can offset the costs of moral hazard. Here, however, it is hard to see any direct benefits of risk sharing, since one might expect diversely held corporations to be risk neutral.[4]

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[1]See Ann Crittendon, April 14, 1989, *Los Angeles Times*, p. 14, and Charles Lave and John Quigley (1989). The latter authors estimated that the oil industry would earn $100 million in additional revenues on the West Coast alone if the 10-percent rise in gasoline prices persisted for one month. By now, a year after the spill, the cleanup costs and legal liabilities threaten to be sufficiently large that the industry as a whole will not profit.

[2]Since oil is an exhaustible resource, a supply reduction today increases the reserves available tomorrow. This intertemporal substitution can, but need not, increase the present discounted value of industry profit. When deferring sales to the future reduces the aggregate industry profit, our arguments below do not apply.

[3]The oil consortium Alyeska owns the Alaska pipeline and is responsible for cleaning up its members' spills. Subsequent to three additional oil spills in the spring of 1989, the American Petroleum Institute recommended that the oil industry jointly finance several other oil spill cleanup centers on both coasts.

[4]Furthermore, spills are typically small relative to the oil companies' net worth. Exxon's cleanup costs are

Since risk sharing does not seem, on *prima facie* grounds, to be very important, we are motivated to look for a strategic reason to share cleanup costs. If firms in an oligopoly could collude, they would typically cut supply. They cannot collude directly, since that would violate antitrust laws. However, oil spills disrupt supply, and can therefore be profitable, just as if the firms had agreed to withhold supply to raise the price. Collusion can be enforced by sharing cleanup costs. When cleanup costs are shared, each firm has less incentive to take care.

Committing to low levels of care (hence, supply disruptions) by sharing cleanup costs is an example of how firms can create incentives to behave collusively without actually violating antitrust laws and without having to monitor each other. Other ways that firms can create incentives to collude are discussed by Steven Salop (1986). For example, M. Maloney, R. McCormick, and R. Tollison (1979) suggest that unionization (which leads to supply disruptions during strikes) can be used to increase industry profits; and Timothy Bresnahan and Steven Salop (1986), and Robert Reynolds and Bruce Snapp (1986) show how joint ventures can be used by parent firms to enhance collusion.[5]

I. Model

For ease of modeling, we make the following assumptions. We will use the term "profit" to refer to a firm's net revenue, excluding costs of cleanup and of care. For simplicity, we assume there are two firms. If there is no spill,then both firms produce oil and each firm's profit is π_2. If one firm has a spill, then its supply is disrupted,[6] so that it loses all profits, and the other firm makes larger profits, denoted by π_1. If both firms have spills, neither produces and, hence, per firm profit is zero. Oil spills are all the same size and each costs C to clean up, with no residual environmental damage. The cost of taking care level e is $c(e)$, and the probability of not having a spill is $p(e)$.

If there were no supply disruption, each firm's profit would be π_2 whether or not there were spills. The industry's profit function would be $2\pi_2-2c(e)-2(1-p(e))C$, and one firm's profit function would be $\pi_2-c(e)-(1-p(e))C$. There would be no divergence between the effort level that maximizes industry profit and the effort levels exerted in equilibrium. In fact, the firms' preferred levels of effort would be efficient, as one might expect since each firm bears all the costs of care and of cleaning up its spills.

Assuming now that spills lead to supply disruptions, and assuming that both firms take the same level of care e, the industry's profit, as a function of e, is

$$(1) \quad 2\pi_1 p(e)(1-p(e))+2\pi_2 p(e)^2 -2c(e)-2(1-p(e))C.$$

The derivative of the industry's profit function is

$$(2) \quad [\pi_1+C+(\pi_2-\pi_1)2p(e)] \times p'(e)-c'(e).$$

If firm 1 takes the level of care e and firm 2 takes the level of care e^*, then firm 1's expected profit, as a function of e, is

$$(3) \quad \pi_1 p(e)(1-p(e^*))+\pi_2 p(e)p(e^*) -c(e)-(1-p(e))C.$$

now about one billion dollars. Exxon's profits (not assets) were in the neighborhood of $5 billion in 1987.

[5]Another argument that the oil consortium Alyeska is strategic, rather than naive, is given by Richard Levin, Sharon Oster, and Steven Salop (1989) who argue that Alyeska's profit-sharing agreement encourages the members to price at the monopoly price.

[6]The supply disruption due to an oil spill can take many forms. In Alaska, it was due to the loss of oil in the tanker itself, and to the fact that flow through the pipeline had to be curtailed, since resources were being devoted to the cleanup. The consumer costs of the supply disruption will partly be smoothed through inventories, and will be shared by many firms.

In a symmetric Nash equilibrium, in which firm 1 undertakes the same level of effort as firm 2, the first-order condition that describes that effort level is[7]

$$(4)\qquad [\pi_1 + C + (\pi_2 - \pi_1)p(e)] \\ p'(e) - c'(e) = 0.$$

We assumed above that $\pi_2 < \pi_1$. Therefore, at the equilibrium effort levels that solve (4), the derivative of industry profit (2) is negative. A decrease in each firm's effort level would increase industry profit.

There exists $\alpha < 1$ such that, if we substitute αC for C in expression (4), industry profit is greater in Nash equilibrium than with $\alpha = 1$. Collusion has been achieved through risk sharing. (The spiller pays αC and the nonspiller pays $(1-\alpha)C$.) But, of course, the greater industry profit has been achieved through a reduction in care and an increase in spills.

Two simplifications in this model are (i) that the costs of care $c(e)$ are separable from "profit" and (ii) that the profit of a spiller in any period is zero. Regarding (i), instead of modeling the cost of effort as a separable cost function $c(e)$, we could let the monopoly and duopoly profits depend on e, as when care increases the unit cost of producing oil. In that case the terms $-c'(e)$ in the first-order conditions (2) and (4) must be replaced by $\pi_1'(e)p(e)[1-p(e)] + \pi_2'(e)p(e)^2$, and the same argument applies: At the symmetric equilibrium effort levels, the derivative of the industry's profit function is negative. Regarding (ii), a complete model would specify a profit level for each firm, and for each possible contingency. Denote by $\pi(i,j), i, j \in \{\text{spill, no spill}\}$, the profit of a firm with realization i (spill or no spill) when the other firm has realization j (spill or no spill). In this more general model, for our results to hold it is sufficient that $\pi(\text{spill,spill}) \geq 2\pi(\text{spill, no spill})$. That is, the firm earns significantly less profits if it is the only spiller than if both firms spill. This condition is satisfied by our previous simplifying assumption that $\pi(\text{spill, spill}) = \pi(\text{spill, no spill}) = 0$.

[7]We are focusing on symmetric Nash equilibrium, although there may be other Nash equilibria. Our arguments apply if there is an interior symmetric Nash equilibrium ($0 < p(e) < 1$), as there may be if $p(e)$ and $-c(e)$ are concave.

II. Remarks on Social Welfare

The argument above showed that one consequence of risk sharing is that it facilitates collusion by encouraging spills, reducing output, and, hence, increasing profits in equilibrium. Whether social welfare is enhanced or undermined by this collusion depends on whether a social planner would prefer more or less care than firms take in equilibrium. This, in turn, depends on aspects of the market (elasticity of demand, the cost of care, and the technology by which care translates into a reduced probability of spilling) and on whether there are additional externalities, such as residual damage that cannot be cleaned up.

The welfare comparison is ambiguous even if we focus on market issues and ignore additional externalities such as arise from incomplete cleanups. We will compare the equilibrium levels of effort with the effort level that a social planner would choose. The effort levels chosen by the planner determine the probabilities of spills, and, hence the probabilities that there are zero, one or two firms active in a given period. We assume the planner cannot control firms' oil supplies once the level of care is determined.

The welfare comparison can go either way. To see the intuition for this, assume that firm 2 has a fixed level of effort, and consider firm 1's incentive to increase care versus the social planner's. Firm 1 cares only about the profits that care provides. These profits result from being in the market when it does not have a spill and they may be monopoly or duopoly profits, according to whether the other firm spills. In contrast, the social planner cares about the total social surplus (consumers' surplus plus profits) which arise from firm 1 taking care and being in the market. In the case where firm 2 has a spill and is out of the market, the social planner sees a larger total return to care by firm 1 because the planner cares about the total surplus rather than only about profit. In the case where firm 2 does not have a spill and is in the market, firm 1 may value care more than or less than the social planner. On the one hand, firm 1 receives a transfer of profit from firm 2 if firm 1 does not have a spill, (firm 2 has less output and less profit as a duopolist than it would have as a monopolist) but the social planner does not value this transfer. On the other hand, the social planner does value the additional social surplus that expanded output can generate. Which of these considerations dominates will determine whether the social planner or firms in Nash equilibrium prefer higher effort levels. For example, if the profit level π_2 is determined by Bertrand competition (so that firms make zero profits if neither has a spill) then the levels of care in the symmetric Nash equilibrium are too low even without cost-sharing agreements, and will be lower still with such agreements.

The observation that oil companies might collude to increase profit through risk sharing is rather cynical. Some people may find it hard to believe that oil companies orchestrate spills so as to increase profit. Indeed they may not... but, nevertheless, cost sharing can decrease incentives for care and thereby increase profit.

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