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**Collusion Through Insurance:  
Sharing the Costs of Oil Spill Cleanups**

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Key words: tacit coordination, collusion, oil spill, insurance.

**Abstract**

Firms in oligopoly could usually profit from collusion to reduce output. Oil spills disrupt supply, and it is therefore no surprise that oil spills increase oil companies' profits. In fact, oil companies may find it profitable in aggregate to reduce care so as to increase the frequency of spills. Since the spill is usually not profitable for the spiller, some enforcement mechanism is required. Sharing the costs of cleanup, which is "apparently" in the public interest, reduces incentives for care and facilitates collusion to disrupt supply through spills.

JEL Classification: 611, 612

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**COLLUSION THROUGH INSURANCE:  
SHARING THE COSTS OF OIL SPILL CLEANUPS**

Eddie Dekel and Suzanne Scotchmer  
April 26, 1989

1. Introduction

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 consequent rise in gasoline prices. Some intrepid commentators went so far as to suggest that Exxon would actually *profit* from the oil spill.<sup>1</sup> Indeed, the price of gasoline increased by about ten percent in the weeks following the spill. Charles Lave and John Quigley (1989) calculated that the oil companies would collect about \$100 million in additional revenue on the West Coast alone if the higher prices lasted a month. This is about 1/5 of the damage awards (current dollars) in the 1978 Amoco Cadiz spill, which was five times the size of the Exxon spill,<sup>2</sup> and therefore it seems possible that the oil industry as a whole will profit.

On the other hand, it is not obvious that Exxon itself will profit from the spill, since Exxon will be responsible for much of the cleanup costs, and, in addition, its flow of oil, hence revenue, will 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. 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

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<sup>1</sup>Ann Crittendon, April 14, 1989, Los Angeles Times, p.14.

<sup>2</sup>This is taken from a report of the National Oceanographic and Atmospheric Association, as reported by the San Jose Mercury News, April 14, 1989, p. 1.

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 benefitting 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.

The oil consortium Alyeska owns the Alaska pipeline and maintains resources for cleaning up spills. Therefore, the cost of any member's spill is shared by all of the members. Sharing the cost of cleanup is insurance, which should lead to moral hazard problems. 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.<sup>3</sup>

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.

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<sup>3</sup>Furthermore, spills are typically small relative to the oil companies' net worth. Exxon's costs due to the spill in Prince William Sound are predicted to be in the neighborhood of \$600 million. Exxon's profit (not assets) were in the neighborhood of \$5 billion in 1987.

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 Salop (1986). For example, Maloney, McCormick and Tollison (1979) suggest that unionization (which leads to supply disruptions during strikes) can be used to increase industry profits; and Bresnahan and Salop (1986) and Reynolds and Snapp (1986) show how joint ventures can be used by parent firms to enhance collusion.

## 2. 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 per-firm profit is  $\pi_2$ . If one firm has a spill, then its supply is disrupted,<sup>4</sup> so that it loses all profits, and the other firm makes larger profits, denoted by  $\pi_1$ . 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  $\pi_2$  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

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<sup>4</sup>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.

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

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

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:

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

In 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<sup>5</sup>

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

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  $\alpha C$  for  $C$  in expression (4), industry profit is greater in Nash equilibrium than with  $\alpha = 1$ . Collusion has been achieved through insurance. (The spiller pays  $\alpha C$  and the nonspiller pays  $(1-\alpha)C$ .) But, of course, the

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<sup>5</sup>We are focussing 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.

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 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  $\pi(\text{spill,spill}) = \pi(\text{spill,no spill}) = 0$ .

### 3. Concluding Remarks

A regulator with the power to encourage or discourage sharing costs of cleanup should be aware of its consequences. 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 social 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  $\pi_2$  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 insurance, and will be lower still if firms collude through insurance.

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, Exxon's recent spill due to carelessness did seem to increase profit, and this is worth thinking about. Other evidence that the oil consortium Alyeska is strategic, rather than naive, is given by Levin, Oster and Salop (1989) who argue that Alyeska's profit-sharing agreement encourages the members to price at the monopoly price.

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