The Deterrence of Collusion by a Structural Remedy

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Abstract

As a penalty for illegal collusion, this paper shows that a structural remedy makes collusion unprofitable when collusion is most stable, and that it can be a greater deterrent than fines or damages.

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1 Introduction

In a recent paper, I proposed the use of a structural remedy as a penalty for firms having illegally colluded (Harrington, 2017a). More specifically, cartel members are required to divest assets in order to make the market less inclined towards collusion by, for example, creating a new competitor. Though the primary rationale of a structural remedy is to make future collusion less likely, it would also generally have the effect of lowering competitive profits in the post-conviction environment. Here, we explore this latter effect and the extent to which it offers an effective deterrent distinct from the traditional penalties of government fines and customer damages.[1]

2 Model

Consider an infinitely repeated oligopoly game where firms have a common discount factor $\delta \in (0,1)$. If firms do not collude, they achieve a stage game Nash equilibrium that yields firm profit $\pi^n > 0$. If firms were instead to collude, each would earn profit $\pi^c\,(> \pi^n)$. Let $\pi^d\,(> \pi^c)$ denote a firm's maximal static profit if it were to deviate from the collusive outcome. Our attention will focus on when the collusive outcome is sustained using the grim punishment; that is, permanent reversion to the non-collusive outcome.

In each period that firms are colluding, there is an exogenous probability $\alpha \in (0,1)$ that the cartel is discovered, prosecuted, and convicted. In that event, firms are levied a penalty and are assumed not to collude thereafter. A penalty could be financial or involve divestiture of assets as part of a structural remedy. The financial penalty is as modelled in Harrington (2004, 2005, 2014). For each period the cartel has existed, a firm is assessed an amount $f > 0$. Due to the greater difficulty in documenting collusion that is in the more distant past, the penalty is assumed to depreciate over time. If F_t is the penalty that a firm would have to pay if caught and convicted in period t then $F_{t+1} = (1-\beta)\,F_t + f$, where $\beta \in (0,1)$ is the depreciation rate. If firms collude forever (without having been caught) then the steady-state value for the penalty is defined by: $F^{ss} = (1-\beta)\,F^{ss} + f \Rightarrow F^{ss} = f/\beta$. As it is assumed the cartel starts operating in period 1, $F_0 = 0$ and $F_t \in [0, f/\beta]\,,\,\forall t \geq 1$.

A second type of penalty that the cartel could face is a structural remedy which has each of the cartel members divest assets to create a new firm. The only property of that remedy which we will use here is that the post-cartel environment is more competitive than the pre-cartel environment, as reflected in each of the former cartel members earning profit $\pi^p \in [0, \pi^n)$. π^p is defined to include both post-divestiture product market profits plus the (amortized) payment for the assets divested. An example of the construction of π^p is provided in Section 5.[2]

The primary rationale for a structural remedy is that it reduces the likelihood of recidivism; that is, a less concentrated market structure makes it less likely the cartel reforms or that tacit collusion arises in its stead. That benefit from a structural remedy is assumed

[1] Katsoulacos et al. (2015) provide a comparative analysis of fines and damages. For a general survey of the theory of collusion with antitrust enforcement, the reader is referred to Harrington (2017b).

[2] The model is also subject to the interpretation that the cartel was not all-inclusive and the assets are divested to non-cartel members. In that case, π^c, π^n, π^d, and π^p apply only to cartel members.

away by our assumption that, upon conviction, firms never collude again, whether or not a structural remedy is used. As conditions will be identified whereby a structural remedy is a greater deterrent than financial penalties, the result would only be strengthened if a structural remedy were also to reduce the likelihood of future collusion.

3 Equilibrium Conditions for Cartel Stability

Let us begin by characterizing the collusive value after the cartel has formed. With a slight modification of what is in Harrington (2014), the expected present value of profits to a cartel member when the accumulated penalty is F is defined recursively by

$$V(F) = \pi^c + \alpha\left[\delta W - ((1-\beta)F + f)\right] + (1-\alpha)\delta V((1-\beta)F + f),$$

where W is the post-cartel continuation payoff after a conviction and

$$W = \begin{cases} \frac{\pi^n}{1-\delta} & \text{if there is no structural remedy} \\ \frac{\pi^p}{1-\delta} & \text{if there is a structural remedy} \end{cases}.$$

Solving for $V(\cdot)$, it can be shown that

$$V(F) = \frac{\pi^c + \alpha\delta W}{1-(1-\alpha)\delta} - \left(\frac{\alpha(1-\beta)\left[1-(1-\alpha)\delta\right]F + \alpha f}{\left[1-(1-\alpha)\delta(1-\beta)\right]\left[1-(1-\alpha)\delta\right]}\right).$$

In specifying the deviation payoff, it is assumed that the cartel could be caught in the period of deviation but has no chance of being caught in the future when firms are no longer colluding. The incentive compatibility constraints (ICCs) are then:[3]

$$V(F) \geq \pi^d + \delta\left(\alpha W + (1-\alpha)\left(\frac{\pi^n}{1-\delta}\right)\right) - \alpha((1-\beta)F + f),\ \forall F \in [0, f/\beta].$$

Note that

$$\begin{aligned} & \frac{\partial\left[V(F) - \pi^d - \delta\left(\alpha W + (1-\alpha)\left(\frac{\pi^n}{1-\delta}\right)\right) + \alpha((1-\beta)F + f)\right]}{\partial F} \\ = & -\frac{\alpha\delta(1-\beta)(1-\alpha)(1-\beta)}{1-(1-\alpha)\delta(1-\beta)} < 0, \end{aligned}$$

which implies the ICC is more stringent when F is higher. Hence, the binding ICC is at the steady-state when $F = f/\beta$. Thus, collusion is stable (i.e., a grim trigger strategy is a subgame perfect equilibrium) if and only if (iff)

$$V(f/\beta) = \frac{\pi^c + \alpha\delta W - \alpha(f/\beta)}{1-(1-\alpha)\delta} \geq \pi^d + \delta\left(\alpha W + (1-\alpha)\left(\frac{\pi^n}{1-\delta}\right)\right) - \alpha(f/\beta). \quad (1)$$

[3]Note that a firm's penalty is the same whether it complies or deviates because it is the act of agreeing to coordinate on prices that is illegal, and not the price that a firm sets.

4 Deterrence

The analysis will focus on when firms highly value future profits, which is the situation most conducive to collusion. The stability and profitability of collusion are then examined when $\delta \to 1$. As α is kept fixed as δ goes to one, the presumption is that a higher value for δ comes from firms' time preferences rather than the length of the period.[4] However, I suspect that results hold as long as δ goes to 1 faster than α goes to zero.

Let us begin by considering the standard case of financial penalties without a structural remedy, so the post-conviction payoff is $W = \frac{\pi^n}{1-\delta}$. (1) is then

$$\frac{\pi^c + \alpha\delta\left(\frac{\pi^n}{1-\delta}\right) - \alpha\left(f/\beta\right)}{1-(1-\alpha)\delta} \geq \pi^d + \delta\left(\frac{\pi^n}{1-\delta}\right) - \alpha\left(f/\beta\right)$$

or, equivalently,

$$\Lambda(\delta) \equiv (1-\delta)\left(\frac{\pi^c - \alpha\left(f/\beta\right)}{1-(1-\alpha)\delta}\right) + \left(\frac{\alpha\delta\pi^n}{1-(1-\alpha)\delta}\right) - (1-\delta)\pi^d - \delta\pi^n + (1-\delta)\alpha\left(f/\beta\right) \geq 0.$$

Given

$$\lim_{\delta\to 1}\left((1-\delta)\left(\frac{\pi^c - \alpha\left(f/\beta\right)}{1-(1-\alpha)\delta}\right) + \left(\frac{\alpha\delta\pi^n}{1-(1-\alpha)\delta}\right)\right) = \pi^n$$

and

$$\lim_{\delta\to 1}\left((1-\delta)\pi^d + \delta\pi^n - (1-\delta)\alpha\left(f/\beta\right)\right) = \pi^n,$$

then $\lim_{\delta\to 1}\Lambda(\delta) = 0$. Thus, $\exists\varepsilon > 0$ such that $\Lambda(\delta) > 0\ \forall\delta \in (1-\varepsilon, 1)$ iff $\lim_{\delta\to 1}\Lambda'(\delta) < 0$. Since

$$\begin{aligned}\Lambda'(\delta) &= \frac{\left(\alpha\pi^n - \left(\pi^c - \alpha\left(f/\beta\right)\right)\right)\left(1-(1-\alpha)\delta\right) + \left((1-\delta)(\pi^c - \alpha\left(f/\beta\right)) + \alpha\delta\pi^n\right)(1-\alpha)}{\left(1-(1-\alpha)\delta\right)^2} \\ &\quad + \pi^d - \pi^n - \alpha\left(f/\beta\right)\end{aligned}$$

then

$$\lim_{\delta\to 1}\Lambda'(\delta) = -\frac{\left(\pi^c - \alpha\left(f/\beta\right)\right)}{\alpha} + \pi^d - \alpha\left(f/\beta\right).$$

Hence, $\lim_{\delta\to 1}\Lambda'(\delta) < 0$ requires

$$\pi^c - \alpha\left(f/\beta\right) > \alpha\left(\pi^d - \alpha\left(f/\beta\right)\right). \tag{2}$$

In sum, collusion is stable (i.e., (1) holds) when firms are sufficiently patient and (2) holds.

Having formed a cartel, collusion could be stable even though, from an ex ante perspective, collusion is less profitable than competition. Firms can always avoid penalties by not forming a cartel but, once having cartelized, a penalty cannot be avoided for sure. Forming a cartel is a profitable enterprise when the collusive payoff evaluated at $F = 0$ exceeds the non-collusive payoff:

$$V^c(0) = \frac{\pi^c + \alpha\delta\left(\frac{\pi^n}{1-\delta}\right)}{1-(1-\alpha)\delta} - \left(\frac{\alpha f}{\left[1-(1-\alpha)\delta(1-\beta)\right]\left[1-(1-\alpha)\delta\right]}\right) > \frac{\pi^n}{1-\delta},$$

[4] To appreciate this issue in the context of collusion with imperfect monitoring, see Sannikov and Skrzypacz (2007).

which can be simplified to

$$\pi^c - \frac{\alpha f}{1 - (1-\alpha)\,\delta\,(1-\beta)} > \pi^n.$$

Summing up, as $\delta \to 1$, collusion is stable if

$$\pi^c - \alpha\,(f/\beta) > \alpha\left(\pi^d - \alpha\,(f/\beta)\right) \tag{3}$$

and is profitable if

$$\pi^c - \frac{\alpha f}{1 - (1-\alpha)\,(1-\beta)} > \pi^n. \tag{4}$$

Note that for both (3) and (4) to hold, α must be sufficiently close to zero. Deterrence occurs when either or both of (3) and (4) are violated, which requires that the probability of being caught and convicted or the penalty is sufficiently high. This result is in line with standard intuition.

Now suppose there is a structural remedy, so the post-conviction payoff is $W = \frac{\pi^p}{1-\delta}$. For our purposes, it will be sufficient to examine the profitability of collusion. Collusion is profitable iff

$$V^c\,(0) = \frac{\pi^c + \alpha\delta\left(\frac{\pi^p}{1-\delta}\right)}{1-(1-\alpha)\,\delta} - \left(\frac{\alpha f}{\left[1-(1-\alpha)\,\delta\,(1-\beta)\right]\left[1-(1-\alpha)\,\delta\right]}\right) > \frac{\pi^n}{1-\delta},$$

or, equivalently,

$$\frac{(1-\delta)\pi^c + \alpha\delta\pi^p}{1-(1-\alpha)\,\delta} - \left(\frac{(1-\delta)\alpha f}{\left[1-(1-\alpha)\,\delta\,(1-\beta)\right]\left[1-(1-\alpha)\,\delta\right]}\right) > \pi^n. \tag{5}$$

Letting $\delta \to 1$, (5) becomes $\pi^p > \pi^n$, which does not hold. With firms valuing future profits as much as current profits, all that matters is long-run profit which, given conviction occurs almost surely, is π^p when they collude and π^n when they do not collude. Hence, collusion is unprofitable to highly patient firms when conviction involves a structural remedy. This is true even if there are no financial penalties (i.e., $f = 0$) and irrespective of the likelihood of being caught and convicted as long as it is positive (i.e., $\alpha > 0$).

In summary, when firms are sufficiently patient, a structural remedy always deters collusion, while financial penalties deter collusion only when they are sufficiently severe (e.g., the probability of being caught and convicted is sufficiently high). The source of this difference in deterrence resides in the distinction between retrospective and prospective penalties. Government fines and customer damages are retrospective in that their magnitude is based on the extent of *past* collusion, which realistically implies the magnitude of the penalty is bounded.[5] Hence, there must then be a sufficiently high chance of having to pay that finite penalty if collusion is to be deterred. In contrast, a structural remedy is prospective in that it affects the *future* path of the industry. By making the post-cartel environment more competitive, a structural remedy adversely affects the future profit stream and the associated penalty is unbounded (as $\delta \to 1$).

[5]The boundedness of fines is also due to the depreciation rate $\beta > 0$. However, that is a realistic feature in that, the longer is a cartel's duration, the increasingly difficult it is to document when the cartel started.

5 Constructing Profit under a Structural Remedy

The result that a structural remedy is deterrent when firms are sufficiently patient relies only on the profit under a structural remedy, π^p, being less than the competitive profit if firms had never colluded, π^n. This section offers a construction of π^p.

Consider the case of a Cournot oligopoly with linear demand, $a - bQ$, and a common constant marginal cost c. Assume $a, b > 0$ and $c \in [0, a)$. With $n \geq 2$ firms, the equilibrium profit under competition is

$$\pi^n = \frac{(a-c)^2}{b(n+1)^2}.$$

Suppose a firm has some asset necessary for production, and that divestiture has each cartel member sell an equal amount of the asset to create a new firm. The asset could be capacity with one unit of capacity being required to produce one unit of output. In that case, the ensuing analysis applies as long as the capacity constraint is not binding.[6]

The post-divestiture equilibrium profit is

$$\frac{(a-c)^2}{b(n+2)^2}.$$

As payment for the assets sold to create the new firm, suppose each of the original firms receives $1/n^{th}$ share of the stream of profit earned by the new firm, which is the value of those assets. This assumption presumes sufficient competition among prospective firms for those assets and delivers an upper bound on π^p. Each of the former cartel members will then receive a per period payment of

$$\frac{(a-c)^2}{b(n+2)^2 n}.$$

The post-divestiture profit of a former cartel member is the new competitive profit plus the payment it receives each period from the new firm for the assets:

$$\pi^p = \frac{(a-c)^2}{b(n+2)^2} + \frac{(a-c)^2}{b(n+2)^2 n} = \frac{(n+1)(a-c)^2}{bn(n+2)^2}.$$

Note that

$$\pi^n - \pi^p = \frac{(a-c)^2(n^2+n-1)}{bn(n+1)^2(n+2)^2} > 0,$$

which measures the reduction in profit in the post-cartel environment because of the structural remedy.

[6]If each of the n firms has K units of capacity then we need $K > \frac{(a-c)(n+1)}{b(n+2)n}$. Capacity in excess of that level is sufficient to ensure that all capacity constraints are not binding at the post-divestiture Nash equilibrium.

6 Concluding Remarks

When there is the prospect of a structural remedy, collusion presents firms with an intertemporal trade-off: higher profits in the near-term while colluding, possibly lower profits in the long-term after having been caught and convicted. If firms sufficiently value future profits then the long-term loss from divestiture will weigh heavier in their calculus and that could deter cartel formation. In those same circumstances, fines and damages would not necessarily be effective. Given that collusion is most stable when firms highly value future profits, a structural remedy delivers a severe penalty when it is most needed.

The takeaway from this paper should not be that a structural remedy is always more deterrent than financial penalties, but rather that it is more deterrent under certain circumstances and, therefore, it enriches the set of penalties. This deterrence benefit is considered as part of a more comprehensive examination of the costs and benefits of a structural remedy for illegal collusion in Harrington (2017a), where the broader case is made for competition authorities to add structural remedies to their toolkit in the fight against cartels.

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