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Penalties and the deterrence of unlawful collusion☆

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HIGHLIGHTS

- Stability of collusion is examined when the penalty is increasing in cartel duration.
- A lower bound is derived for the minimum penalty for deterring collusion.
- Lower bound is significantly lower than previous analyses.

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ABSTRACT

This paper investigates the size of penalties required to deter cartel formation. Allowing the penalty to be increasing in duration within the infinitely repeated game framework, penalties do not need to be as severe as previous research would suggest.

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1. Introduction

How large must penalties be in order to deter firms from forming a cartel and colluding? One approach is based on making collusion unprofitable. If the incremental profit from colluding is V and the probability of detection is α then the fine F required to deter collusion is $V - \alpha F < 0$ or $F > V/\alpha$. On the basis of this approach, Connor and Lande (2012) conclude that, in practice, penalties are far short of what is required to deter collusion. However, as pointed out by Buccirossi and Spagnolo (2007), it is not necessary to make collusion unprofitable in order to deter cartel formation; it is sufficient to make collusion unstable. That is, the penalty just has to be high enough so that there does not exist an equilibrium in which firms are able to sustain supracompetitive prices.[1] This approach is taken in Allain et al. (2011) who, quite contrary to Connor and Lande (2012), do not conclude there is under-deterrence and instead raise concerns that the fines being levied by the European Commission could be in the region of over-deterrence (though, for a different view, see Combe and Monnier, 2011).

A critical feature of penalties that has not been properly taken account of is the relationship between cartel duration and penalties. While the penalty formula can vary considerably across jurisdictions, an almost universal feature is that the penalty is increasing in cartel duration. The analyses mentioned above either assume the penalty is fixed and focus on the minimum penalty required to make collusion unstable or allow the penalty to depend on cartel duration but focus on the minimum penalty required to make collusion unprofitable (rather than make it unstable). The objective of this paper is to integrate the two approaches by allowing the penalty to depend on duration within the context of an infinite

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[1] In other words, the original approach focuses on the participation constraint, while the more recent approach focuses on the incentive constraint.

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horizon oligopoly setting, and to then characterize the minimum penalty required to make collusion unstable. We find that these two factors – dynamic penalties and dynamic conditions for cartel stability – are complementary and result in a significant reduction in the minimum penalty required to deter cartel formation.

2. Model

Consider an infinitely repeated oligopoly game for which the non-collusive (static Nash equilibrium) per period profit is π^n and the present value of the non-collusive profit stream is $W \equiv \pi^n/(1-\delta)$ where firms have a common discount factor $\delta \in (0, 1)$. The per period collusive profit is π^c $(> \pi^n)$ and our attention will focus on when firms seek to sustain collusion using the grim punishment; that is, deviation from the collusive outcome results in permanent reversion to the non-collusive outcome.[2] As long as firms collude, a firm will have a constant profit stream of π^c which has a present value of $\pi^c/(1-\delta)$. If a firm deviates from the collusive outcome, it earns profit π^{dev} $(> \pi^c)$ in that period and, as a consequence of the grim punishment, π^n thereafter. Thus, in the absence of a competition authority, collusion is sustainable (that is, the grim trigger strategy is a subgame perfect equilibrium) if and only if

$$\frac{\pi^c}{1-\delta} \geq \pi^{dev} + \frac{\delta \pi^n}{1-\delta}.$$

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. The penalty scheme has each firm assessed an amount $f > 0$ for each period that firms colluded. Thus, in principle, if the cartel colluded for T periods prior to conviction then they are liable for a penalty of fT. In practice, the penalty is generally less than that value because it is based on *documented* cartel duration rather than *true* cartel duration. If it is more difficult to uncover supportive evidence of collusion for years farther in the past then documented duration will be less than actual duration. A second reason for the actual penalty to fall short of fT is that, at least in the US, interest is not assessed which means once again, the effective penalty is smaller, the farther back in time it was incurred.[3]

Based on the preceding arguments, the effect of time on penalties will be modeled by assuming that penalties exponentially depreciate over time. Using the specification in Harrington (2004, 2005), if F_t denotes the penalty that a firm would have to pay if caught and convicted in period t, it is assumed to evolve as follows:

$$F_{t+1} = (1-\beta) F_t + f,$$

where $\beta \in (0, 1)$ is the depreciation rate. For future reference, if firms collude forever (without having been caught) then the steady-state value for the penalty, F^{ss}, is

$$F^{ss} = (1-\beta) F^{ss} + f \Rightarrow F^{ss} = f/\beta.$$

Assuming the cartel starts operating in period 1 and therefore $F_0 = 0$ then, on the equilibrium path, $F_t \in [0, f/\beta], \forall t \geq 1$.

In comparing this structure with penalty schemes used in practice, the most recent European Commission Guidelines (2006) specify the base penalty to equal $SaT + Sb$ where $a \in (0, .3]$, $b \in [.15, .25]$, S is the value of the firm's sales in the last full business year of the firm's participation in the cartel, and T is the number of years of a firm's participation in the cartel. In comparing this formula with the specification here, $f = Sa$ but we have no fixed component to correspond to bS.

A second common formula is for the penalty attributed to a particular period to be proportional to some measure of either the gain to colluding firms or the harm to customers. In the US, the standard formula for customer damages is $d \equiv \left(P^c - P^{bf}\right) q^c$, where P^c and q^c are the collusive price and quantity, respectively, and P^{bf} is the but-for or counterfactual price; that is, the price that would have occurred but for collusion (which is typically taken to be the static Nash equilibrium price). If firms are found guilty by a court of law then they are obligated to pay triple the amount of calculated damages though, in practice, a very high fraction of cases are settled out of court and damages are probably more on the order of single rather than treble (Lande, 1993). In some jurisdictions, government fines follow a similar calculation. For the US Department of Justice, the Federal Sentencing Guidelines referred to in the Antitrust Division Manual (July 2013) state: "(T)he defendant may be fined not more than the greater of twice the gross gain or twice the gross loss". Thus, US fines can be as high as double damages, while government fines in Australia and Germany allow for up to treble damages. If we let $\gamma > 0$ denote the damage multiple then, in our formulation, $f = \gamma d$, and, in the US for example, $\gamma \in (0, 5]$.

In concluding this section, let me discuss two of the model's assumptions. First, there is no component to the penalty which is independent of duration. Such a fixed component is clearly present with the European Commission and is probably generally a feature of most jurisdictions.[4] A fixed component could be easily encompassed but would make the analysis a bit messier without substantively altering the paper's conclusions. Second, and more substantively, collusive profit is assumed fixed and, in particular, firms are not allowed to adjust the collusive outcome in response to the formula for penalties. The endogeneity of the collusive outcome to the penalty scheme is allowed for in Harrington (2004, 2005) but its inclusion here would significantly complicate the analysis. That extension is left for future research.

3. Deterrence of collusion: theory

Let us conjecture that, on the equilibrium path, collusion is sustainable in all periods (which, given that only F_t is changing over time, means for all values for F_t that occur on the equilibrium path). Letting $V(F)$ denote the collusive value given an accumulated penalty of F at the end of the previous period, it is defined recursively by:

$$\begin{aligned} V(F) &= \pi^c + \alpha\left[\delta W - ((1-\beta)F + f)\right] \\ &\quad + (1-\alpha)\delta V((1-\beta)F + f). \end{aligned} \tag{1}$$

It can be shown that[5]

$$\begin{aligned} V(F) &= \frac{\pi^c + \alpha\delta W}{1-(1-\alpha)\delta} \\ &\quad - \left(\frac{\alpha(1-\beta)\left[1-(1-\alpha)\delta\right]F + \alpha f}{\left[1-(1-\alpha)\delta(1-\beta)\right]\left[1-(1-\alpha)\delta\right]}\right). \end{aligned} \tag{2}$$

[2] Focusing on a particular class of collusive equilibria limits the generality of the analysis and, in particular, leaves open whether there is another punishment that will be more effective. However, the paper's insight is less tied to the particular equilibrium and more to the dynamic nature of penalties.

[3] Blackstone and Bowman (1987) estimated that not assessing interest reduced the real value of penalties by 50% in the mid-1970s, based on the average length of a cartel (at that time) of 8.6 years.

[4] If a cartel was found to be largely ineffective – in which case damages are close to zero – I doubt that government fines would be close to zero. For example, the US system allows for fines to be set by either of two procedures; one based on damages and a second not tied to damages with an upper bound of $100 million. Even if penalties were indeed zero, there are still the attorney fees incurred by the defendants.

[5] The correctness of this expression can be easily verified by using it in the right-hand side of (1) for when the accumulated penalty is $(1-\beta)F + f$, and then showing that the derived expression is the expression in (2).

Equilibrium requires that the payoff from colluding, $V(F)$, is at least as great as the payoff from deviating. In specifying the deviation payoff, it is assumed that the cartel could be caught in the current period but has no chance of being caught in the future when firms are no longer colluding.[6] The equilibrium conditions are then:

$$V(F) \geq \pi^{dev} + \delta W - \alpha\left[(1-\beta)F + f\right], \quad \forall F \in [0, f/\beta]. \tag{3}$$

Substituting for $V(F)$ from (2) in (3) and re-arranging yields:

$$\frac{\pi^c + \alpha\delta W}{1-(1-\alpha)\delta} - \left(\frac{\alpha(1-\beta)\left[1-(1-\alpha)\delta\right]F + \alpha f}{\left[1-(1-\alpha)\delta(1-\beta)\right]\left[1-(1-\alpha)\delta\right]}\right)$$
$$-\pi^{dev} - \delta W + \alpha\left[(1-\beta)F + f\right] \geq 0, \quad \forall F \in [0, f/\beta]. \tag{4}$$

Taking the derivative of the expression with respect to F,

$$-\frac{(1-\alpha)\delta(1-\beta)\alpha(1-\beta)}{1-(1-\alpha)\delta(1-\beta)} < 0.$$

The equilibrium condition in (4) is then more stringent when F is higher. Given that firms are more likely to end up paying penalties when they continue colluding, deviation (with subsequent cartel breakdown) becomes more attractive when the accumulated penalty is larger.[7]

From the preceding analysis, if (4) holds for the steady-state penalty of f/β then it holds for all values of F on the equilibrium path. Evaluating the collusive value function at $F = f/\beta$,

$$V(f/\beta) = \frac{\pi^c + \alpha\delta W - \alpha(f/\beta)}{1-(1-\alpha)\delta},$$

and inserting it into (3), the critical equilibrium condition is

$$\frac{\pi^c + \alpha\delta W - \alpha(f/\beta)}{1-(1-\alpha)\delta} \geq \pi^{dev} + \delta W - (\alpha f/\beta). \tag{5}$$

Thus, equilibrium conditions are not satisfied – and collusion is said to be deterred – if and only if (5) does not hold:

$$\pi^{dev} + \delta W - (\alpha f/\beta) > \frac{\pi^c + \alpha\delta W - \alpha(f/\beta)}{1-(1-\alpha)\delta}. \tag{6}$$

After substituting $\frac{\pi^n}{1-\delta}$ for W and performing a few manipulations, (6) is equivalent to

$$\frac{f}{\pi^c - \pi^n} > \left(\frac{\beta}{\alpha}\right)\left[1 - \left(\frac{1-(1-\alpha)\delta}{(1-\alpha)\delta}\right)\left(\frac{\pi^{dev} - \pi^c}{\pi^c - \pi^n}\right)\right]. \tag{7}$$

In sum, collusion is deterred if and only if (7) holds.

In interpreting (7), recall from the damage-based penalty formulas described in Section 2 that the per period penalty assessment is $(P^c - P^n)q^c$ where P^c and q^c are the collusive price and quantity, respectively, and P^n is the non-collusive price. If market demand is highly inelastic – so that $q^c \cong q^n$ – then $\pi^c - \pi^n$ is a good approximation for $(P^c - P^n)q^c$.[8] With this approximation, $f/(\pi^c - \pi^n)$ can then be interpreted as the penalty multiple. Thus, (7) provides a lower bound on the penalty multiple in order for collusion to be deterred.

[6] Though complicating the analysis, the approach could be modified to allow for some declining probability of detection and conviction after firms are no longer colluding. For examining different questions, this extension is considered in Harrington (2004). Also see Katsoulacos and Ulph (2013) who have an analysis of optimal penalties that takes account of a cartel possibly collapsing before it is caught and being convicted years after it has collapsed.

[7] While breakdown of the cartel could enhance the chances of detection (for example, a price war may create suspicions among customers), it still seems reasonable that the likelihood of paying penalties is higher if firms continue colluding, and that is the property required for the equilibrium condition to be more stringent when the accumulated penalty is higher. For an analysis in which the probability of paying detection depends on the observed price path, see Harrington (2004).

[8] Most cartels occur in intermediate goods markets where, over a significant range of prices, market demand is likely to be highly inelastic because the input sold by the cartel makes up a small fraction of the cost of producing the final product.

Table 1
Documented duration.

β	True duration		
	4	8	12
.010	3.94	7.73	11.36
.025	3.85	7.33	10.48
.050	3.71	6.73	9.19
.075	3.57	6.19	8.10
.100	3.44	5.70	7.18
.125	3.31	5.25	6.39
.150	3.19	4.85	5.72
.175	3.07	4.49	5.15
.200	2.95	4.16	4.66

4. Deterrence of collusion: calibration

Given the lower bound on the penalty multiple in (7), we will now evaluate that lower bound at plausible parameter values in order to assess how severe penalties must be in order to deter collusion.

First note that, given the bracketed term on the RHS of (7) is less than one, a sufficient condition to deter collusion is that the penalty multiple is at least β/α. In other words, β/α is an upper bound – based on $\pi^{dev} - \pi^c \cong 0$ – to the lower bound on the penalty multiple that deters collusion. Recall that α is the per period probability of detection and conviction and β is the per period depreciation rate for penalties.

Several studies have sought to estimate α. Given that the data sets necessarily comprise discovered and convicted cartels, the estimated value is actually the annual probability of discovery and conviction *conditional on a cartel being discovered and convicted*. For 184 convictions by the Antitrust Division of the US Department of Justice over 1961–1988, Bryant and Eckart (1991) estimated α to lie between .13 and .17, at the annual level. For 86 convictions by the European Commission over 1969–2007, Combe et al. (2008) estimated α to be around .13. In calibrating the lower bound, I will consider $\alpha \in [.05, .2]$.

What is a reasonable value for β is more difficult as there are, to my knowledge, no studies that directly speak to it. To get some sense of what might be plausible values, I will relate values for β to the difference between actual and documented cartel duration. If T is actual duration then documented duration is $\sum_{t=1}^{T}(1-\beta)^t$. While one may not have much prior intuition as to the depreciation rate for damages, economists and lawyers may have some sense about the extent to which the cartel duration that is negotiated between the lawyers of the competition authority (or plaintiffs) and defendants may fall short of actual duration. For example, it seems plausible that a cartel that lasted for 8 years could end up paying penalties for 6 or 7 years but it seems unlikely that it would be as low as 3 or 4 years.

The results of this exercise are in Table 1 where – for when true cartel duration is 4, 8, and 12 years – documented duration is reported depending on the depreciation rate. For example, when $\beta = .05$, if the cartel actually lasted 4 years then the penalty is based on documented duration of 3.71 years; if it lasted 8 years then the documented duration is 6.73 years; and if it lasted 12 years then the documented duration is 9.19 years. A reasonable upper bound on β would seem to be .125 which has a 8 year cartel paying penalties based on only 5.25 years and a 12 year cartel based on only 6.39 years. In practice, I doubt that so many years of actual duration are missed by competition authorities and plaintiffs.
A reasonable lower bound on β is .025 which has a cartel that lasted 12 years having 10.48 documented years. When $\beta = .01$, documentation is almost fully accurate for 4 and 8 year cartels and misses only 8 months out of a 12 year cartel which seems excessively optimistic. Based on what seems a reasonable gap between actual and documented duration, I focus on $\beta \in [.025, .125]$.

Given $\alpha \in [.05, .2]$ and $\beta \in [.025, .125]$ then $\beta/\alpha \in [.125, 2.5]$. Thus, an upper bound on the lower bound on the penalty multiple sufficient to deter collusion ranges from .125 to 2.5. According to this analysis, collusion is deterred for reasonably low penalty multiples. In the US, a penalty multiple of 5 is, in theory, possible with treble private customer damages and a DOJ penalty at its upper limit of double damages. While that is probably never attained, even if customers only acquire single damages and DOJ penalties are based only on single damages then the total penalty multiple is 2 and, according to my analysis, could well be sufficient to deter collusion.[9]

It is instructive to compare this lower bound of β/α with that derived for when the standard assumption is made that the penalty is fixed independent of duration; that is, regardless of how long the cartel was in operation, it faces some penalty X. It is not difficult to see that this is a special case of our model: $\beta = 1$ and $X = f$. Thus, when the penalty is independent of duration, the corresponding upper bound on the lower bound for the penalty multiple is $1/\alpha$ for deterring collusion. Given $\alpha \in [.05, .2]$, this bound lies in $[5, 20]$ which implies that the penalty multiple may need to be far higher than what is currently used in calculating penalties.

To appreciate the source of these different results, the dynamic model presented here has a different equilibrium condition for each period because the penalty grows over time. Equilibrium requires that all of these conditions hold in which case it is the most stringent equilibrium condition that determines cartel stability. Given that the equilibrium condition is more stringent as the accumulated penalty is higher, and that the penalty converges to a maximum value of β/α, cartel formation is then deterred if collusion is not stable when the penalty is β/α. By comparison, the approach which presumes a fixed penalty is equivalent to requiring that equilibrium conditions are violated in *all* periods if collusion is to be deterred. Thus, it requires that a newly formed cartel – which has no accumulated liability – be unstable (in the sense that the equilibrium condition for that period is violated) which is only the case if the penalty multiple is very high (given that it is applied only to incremental profit earned in first period of the cartel's life). But that is not necessary to deter collusion. As long as firms know that collusion is unstable when the cartel has lived long enough (and, therefore, the penalty is high enough) then that will deter a cartel from forming in the first place.

5. Concluding remarks

Our finding that a reasonably low penalty multiple is sufficient to deter collusion comes from a confluence of recognizing that it is sufficient for deterrence to make collusion unstable rather than unprofitable (which was originally noted in Buccirossi and Spagnolo, 2007) and that, in practice, the penalty rises with documented duration. It is then the combination of the dynamic equilibrium conditions – which support cartel formation only if collusion is stable given the maximal penalty – and having the penalty increasing in duration – which results in the maximal penalty being quite high – which significantly lowers the penalty multiple necessary to deter collusion.

Of course, this conclusion is subject to many caveats, of which I will just mention a few. In terms of the oligopoly model, it is assumed there is perfect monitoring and the grim punishment sustains collusion. Allowing for imperfect monitoring would make collusion more difficult (which would lower the required penalty multiple to deter collusion), while allowing for more severe punishments would make collusion less difficult (which would raise the required penalty multiple to deter collusion). Most critically, the analysis is predicated on having sophisticated and far-sighted managers who recognize that if penalties were to eventually reach a level that undermines future cartel stability that it would undermine cartel stability in all periods. While choosing to form a cartel already shows some level of sophistication and far-sightedness, it might not be at a level consistent with that specification. In that case, managers could collude early on only to eventually learn that collusion is no longer stable once penalties are sufficiently large. Cartel formation would then not be deterred though it would eventually collapse.

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[9] The implication for the European Union is less clear because the European Commission bases the penalty on revenue rather than the incremental profit from colluding. When the penalty is proportional to revenue, deterrence depends on a cartel's overcharge. There is a debate in the literature regarding the historical distribution on overcharges for cartels and whether the revenue-based penalty formula used by many jurisdictions is sufficient to deter. For some research on overcharges and a discussion of this issue, see Oxera (2009), Connor and Lande (2012), Boyer and Kotchoni (2012), and Smuda (2014).