Trade Associations: Why Not Cartels?☆

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Abstract

The relevance of special interests lobbying in modern democracies can hardly be questioned. But if large trade associations can overcome the free riding problem in order to form effective lobbies, why do they not also threaten market competition by forming cartels? We argue that key to understanding the difference lies in supply elasticity. The group discipline which works in the case of lobbying can be effective in forming a cartel only if it is difficult to increase output - otherwise the incentive to deviate is too great. The theory helps explaining a number of stylized facts.

Keywords: labor unions, lobbying, cartels, special interests, peer pressure, political economy, monitoring costs, self organizing groups

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1. Introduction

It is conventional to think that political competition leads to inefficiency while economic competition tends towards efficiency. Certainly we observe that special business interests such as farmers, the chamber of commerce and others are effective at lobbying government for subsidies and for entry and trade restrictions. These organizations, which we refer to as *trade associations*, are small as a share of the economy but often quite large in absolute size. Because of their large absolute size they face a substantial free rider problem in raising resources for lobbying: this is well documented by Olson (1965) and his successors. Still, they are able to overcome this free rider problem to be effective at lobbying (see, for example, Grossman and Helpman (2001)). In the case of farming for example, in the U.S. agriculture represents slightly more than 1% of GDP but there are more than 2 million farms, and they command around 0.5% in subsidies; in Japan the GDP share is similar, there are over 3 million farms and subsidies exceed 1% of GDP.[4] Trade associations would also benefit from cartelization - from restricting output. And the free riding problem appears similar: produce more and reap extra profits in the cartel case, do not contribute to the lobbying effort in the lobbying case. This raises a puzzle: if trade associations are so effective at overcoming the free rider problem in order to lobby, why are they not equally effective at overcoming the free rider problem of forming a cartel? Why is not economic competition rendered ineffective by the formation of large cartels? It may be argued that public policy and anti-trust law are directed more against cartel formation than lobbying; or that monitoring is more difficult in a cartel setting than in a lobbying setting. But we do not view these as exhaustive explanations. On the other hand in some cases large cartels do form. A relevant example is workers exploiting their monopsony power by informal agreements not to "work too hard" - an output restriction.

In order to understand when trade associations are successful at lobbying and at cartelization we need a theory of how they overcome free rider problems. We know from the work of Ostrom (1990) and her successors how this can be achieved: groups can self-organize to overcome the free rider problem and provide public goods through peer monitoring and social punishments such as ostracism. Formal theories of this type originate in the work of Kandori (1992) on repeated games with many players and have been specialized to the study of organizations by Levine and Modica (2016) and Dutta, Levine and Modica (2018). The basic idea is that groups choose social norms consisting of a target behavior and social penalties for failing to meet the target; these social norms are endogenously chosen in order to advance group interests. Specifically the group designs a mechanism to promote group interests subject to incentive constraints for individual group members. Here we apply the theory to compare the public goods problem of lobbying to that of cartelization.

The key feature of peer monitoring and punishment models is that overcoming free rider prob-

[4] The share of agriculture in value added is from `http://data.worldbank.org/indicator/NV.AGR.TOTL.ZS`. Total agricultural support as a percent of GDP is from `http://stats.oecd.org/viewhtml.aspx?QueryId=70971&vh=0000&vf=0&l&il=&lang=en`. Data on the number of farms is from Lowder, Skoet and Raney (2016).

lems is costly - and the cost increases with the incentive of individual members to deviate. We argue that this is the key difference between lobbying and cartelization. In lobbying the incentive to deviate is the gain from avoiding contributing to the lobbying effort, hence is proportional to the level of contribution demanded. In cartelization when price is above marginal cost the optimal deviation is not merely to produce the competitive level of output, but to produce more than the competitive level of output. The flatter the marginal cost curve, the larger is the optimal deviation from the cartel quota hence the greater the incentive to deviate. We show, indeed, that as marginal cost becomes flatter the optimal cartel output approaches the competitive level: the benefit of deviating is so large that it does not pay to try to prevent it.

Our theory explains a number of stylized facts. First: we observe trade associations that lobby but do not cartelize, but rarely ones that cartelize but do not lobby. This is because the greater incentive to deviate makes cartelization less attractive than lobbying. Some trade associations both lobby and cartelize - most notably trade unions. In this case individual members are tightly constrained in how much they can increase the number of hours they work; that is, in this case marginal cost is inelastic for individual workers - more than in typical production settings. The theory says that elastic marginal cost works against cartelization, while inelastic marginal cost works in favor of cartelization - that is, as is the case, we should not see diffuse large production cartels, but we should see trade unions cartelize.[5]

2. The Model

We study a trade association made up of a continuum of members with unit mass. Members produce output x. Because there is a unit mass of members per capita and aggregate quantities are in the same units: if each member produces x then aggregate output is also x. If x is aggregate output, the aggregate social value of the output is $Vh(x)$ where we refer to $V > 0$ as the *value*. We are interested in comparing lobbying activity and production activity. In the former case social value is a public good. We have in mind a situation where the group engages in a lobbying effort, where x is the aggregate expenditure of the group on lobbying, and where $Vh(x)$ represent subsidies, or favorable laws, obtained through lobbying. The case of production applies to a market where a group of firms hold a monopoly over a good to be sold to competitive buyers. In this case output x has a price, equal to marginal social value $Vh'(x)$; letting $r(x) = h'(x) + xh''(x)$ the marginal revenue is $Vr(x)$. We make the following

Assumption. *There is $\overline{x} > 0$ such that $h(x) = \overline{x}$ for all $x \geq \overline{x}$. For $x \in [0, \overline{x}]$ the function $h(x)$ is smooth with $h'(x) \geq 0, h''(x) < 0$ with the former inequality strict unless $x = \overline{x}$. We also assume $r'(x) < 0$. Finally $Vh'(0) > 1$.*

[5] We do not by any means reject the traditional "small cartel" theory in which collusive arrangements are enforced by threat of future price retaliation. Our interest is in larger organizations where a common punishment such as a price war cannot provide adequate incentives: see for example Fudenberg, Levine, and Pesendorfer (1998).

We refer to $\overline{x}$ as the *satiation level*; production is concave and marginal revenue is declining with aggregate output.

Output - or lobbying effort - is produced at constant marginal cost normalized to 1 up to a basic capacity constraint also normalized to 1. Production greater than 1 is feasible but has a greater marginal cost: for example, nighttime shifts have to be added or overtime hours worked. For simplicity we assume that above basic capacity marginal cost increases linearly so that for $x > 1$ marginal cost is equal to $1 + \sigma(x-1)$, where σ denotes the reciprocal of supply elasticity. The cost function for each member is therefore $C(x) = x + (\sigma/2)\max\{0, x-1\}^2$.

A *social norm* for the group consists of a target level of output $\xi \geq 0$ and a punishment $P \geq 0$. Each group member chooses an output level x and some members of the group observe a noisy binary signal of whether $x = \xi$, that is, whether the social norm was adhered to or not.[6] The signal is either "good, followed the social norm" or "bad, violated the social norm." If the social norm is followed, that is, $x = \xi$, then the bad signal is generated with probability $\pi > 0$; If the social norm was violated, that is $x \neq \xi$, the bad signal is generated with probability $\Pi > \pi > 0$. The ratio $\pi/(\Pi - \pi) \equiv \theta > 0$ is the *monitoring difficulty.* When the bad signal is generated the individual is sanctioned by the group and suffers a utility loss of P. The social norm is *incentive compatible* if all members find it individually optimal to follow it given that the others are doing so. The group collectively chooses the incentive compatible social norm $\hat{\xi}$ that maximizes the utility of the members.

As a benchmark we define the *social optimum* χ as the social norm that maximizes social value minus aggregate cost $Vh(x) - C(x)$. This objective function is continuous and concave, with $Vh'(0) > 1$ and $h'(\overline{x}) = 0$; hence the maximum is given by the unique solution to $Vh'(\chi) = C'(\chi) = 1 + \sigma \max\{0, \chi - 1\}$. In the case of production this means price equal marginal cost - it is the competitive equilibrium. Cartelization consists of restricting output - in the limit to the monopoly output - so a norm close to the competitive outcome χ means the cartel effectively does not form. In the case of lobbying on the contrary the group effectiveness is measured by output - the higher $\hat{\xi}$ the better.

For the formal analysis in the sequel we observe that the maintained continuity assumption enables us to define bounds which are used in the proofs: for $x \in [0, \overline{x}]$ we have $0 < \underline{\eta} \leq |h''(x)| \leq \overline{\eta}$ and $0 < \underline{\rho} \leq |r'(x)| \leq \overline{\rho}$. These bounds depend only on h. We will denote by H_i, $i = \{1, 2, 3, 4\}$, positive constants that depend only on h (and not on V, σ and θ).

3. Lobbying

With lobbying we take the social value of output to be a public good for the group. That is, each group member receives $Vh(x)$ where x is aggregate output. If a member follows the social norm by contributing ξ she receives a utility $Vh(\xi) - C(\xi) - \pi P$. If she deviates from the social norm

[6] For a discussion of the peer network structure underlying this model we refer the reader to Levine and Modica (2016), Levine and Modica (2017), Levine and Mattozzi (2017) and Dutta, Levine and Modica (2018).

the best deviation is to produce 0 and not contribute to the public good at all, resulting in utility $Vh(\xi) - \Pi P$. Deviating is not optimal if and only if $C(\xi) - (\Pi - \pi)P \leq 0$. The utility of following the social norm is decreasing in P so the least incentive compatible punishment $P = C(\xi)/(\Pi - \pi)$ should be used. We can then write the utility of a group member as $U(\xi) = Vh(\xi) - (1+\theta)C(\xi)$.

Theorem 1. *The unique optimal social norm $\hat{\xi}$ satisfies*

$$0 < \chi - \hat{\xi} \leq H_1 \min\left\{[\theta/V](1+\sigma), \theta + \sqrt{\theta}\right\}, \quad \hat{\xi} = 0 \text{ for } 1 \leq H_2 [\theta/V].$$

In summary, lobbying is absent if monitoring difficulty relative to value θ/V is large; and it is successful if this is small and θ is also small (the effect of θ/V alone can be offset by large σ). In particular a large value V is not enough to induce lobbying but other than that its effect is straightforward and unsurprising: for given θ and σ, if the prize is worthless no effort is put into obtaining it, and if it is very valuable then monitoring does not inhibit efficient production.[7] Similar considerations can be made about monitoring difficulty.

Notice that inverse supply elasticity σ is essentially irrelevant in this context: even for given θ, V anything can happen both for small and large values of σ. In contrast we shall see that σ is central in the cartel setting.

Proof of Theorem 1. The objective function is continuous and strictly concave on the compact set $[0, \overline{x}]$ so an optimal social norm exists and is unique and may be characterized by the derivative $U'(\xi) = Vh'(\xi) - (1+\theta)C'(\xi)$.

At $\xi = 0$ we have $C'(0) = 1$ so the necessary and sufficient for a corner solution in which the optimal social norm is $\hat{\xi} = 0$ is $Vh'(0) - (1+\theta) \leq 0$. Since $\theta/V < (\theta+1)/V$ the second condition in the theorem with $H_2 = 1/h'(0)$ is sufficient for a corner solution.

Suppose $Vh'(0) - (1+\theta) > 0$ so the solution is interior. For $\xi \geq \chi$ we have $U'(\xi) = Vh'(\xi) - (1+\theta)C'(\xi) \leq Vh'(\chi) - (1+\theta)C'(\chi) = -\theta C'(\chi) < 0$ so the optimum social norm satisfies $\xi < \chi$. Set $z = \chi - \xi > 0$. We have

$$U'(\xi) = Vh'(\chi - z) - (1+\theta)(1 + \sigma \max\{0, \chi - z - 1\}).$$

Using $Vh'(\chi) = 1 + \sigma \max\{0, (\chi - 1)\}$ we may write this as

$$\begin{aligned} U'(\xi) &= V[h'(\chi - z) - h'(\chi)] + \sigma(\max\{0, \chi - 1\} - \max\{0, \chi - z - 1\}) - \theta(1 + \sigma \max\{0, \chi - z - 1\}) \\ &\geq V\underline{\eta} z - \theta(1 + \sigma \max\{0, \chi - z - 1\}). \end{aligned}$$

There are two cases: $z \geq \chi - 1$ and $z \leq \chi - 1$. In the former case we have $U'(\xi) \geq V\underline{\eta} z - \theta$ so that

[7] This latter case, very high V, is less important than it might seem in the case of lobbying because special interests are small relative to the economy. So if the prize is a transfer from everyone else and it is very large the others will have a strong incentive to lobby too and with greater resources are likely to win. As shown in Levine and Modica (2017) the rule of special interests is "do not be too greedy" because if the prize is large enough they will lose.

the necessary and sufficient condition for the social optimum $U'(\xi) = 0$ requires $V\underline{\eta}z - \theta \le 0$ or $z \le (1/\underline{\eta}) \cdot (\theta/V)$. If $z \le \chi - 1$ (so that in particular $\chi > 1$) then we have $U'(\xi) \ge V\underline{\eta}z - \theta(1+\sigma\overline{x})$ so that $z \le (1/\underline{\eta})(1+\sigma\overline{x})\theta/V$. From $Vh'(\chi) = 1 + \sigma(\chi - 1)$ we have $Vh'(1) \ge \sigma(\chi - 1)$ so that $\chi - 1 \le Vh'(1)/\sigma < Vh'(0)/\sigma$. Hence

$$
\begin{aligned}
z &\le \max\left\{\frac{1}{\underline{\eta}}\frac{\theta}{V}, \min\left\{\frac{1}{\underline{\eta}}\frac{\theta}{V}(1+\sigma\overline{x}), \frac{Vh'(0)}{\sigma}\right\}\right\} \le \min\left\{\frac{1}{\underline{\eta}}\frac{\theta}{V}(1+\sigma\overline{x}), \frac{1}{\underline{\eta}}\frac{\theta}{V} + \frac{Vh'(0)}{\sigma}\right\} \\
&\le \frac{1}{\underline{\eta}}\frac{\theta}{V}(1+\sigma\overline{x}) \le \left[\frac{1}{\underline{\eta}}\max\{1,\overline{x}\}\right](1+\sigma)\frac{\theta}{V}
\end{aligned}
$$

giving the first half of the first condition in the theorem.

For the second half, starting from the first line above

$$
z \le \min\left\{\frac{1}{\underline{\eta}}\frac{\theta}{V}(1+\sigma\overline{x}), \frac{1}{\underline{\eta}}\frac{\theta}{V} + \frac{Vh'(0)}{\sigma}\right\}
$$

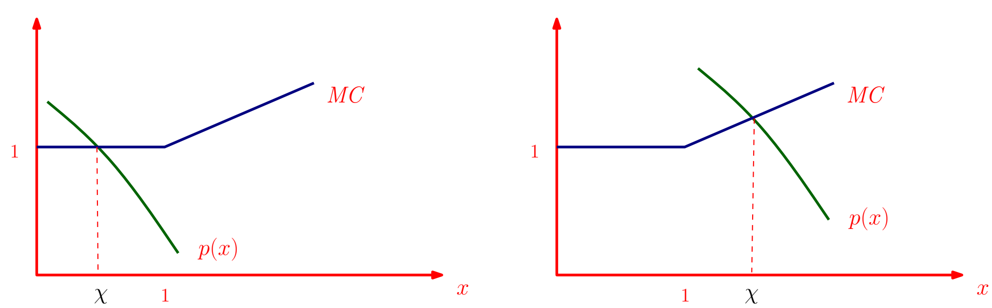
we can write

$$
\begin{aligned}
z &\le \left[\frac{1}{\underline{\eta}}\overline{x} + h'(0)\right]\min\left\{\frac{(1+\sigma)\theta}{V}, \frac{\theta}{V} + \frac{V}{\sigma}\right\} = \left[\frac{1}{\underline{\eta}}\overline{x} + h'(0)\right]\left[\frac{\theta}{V} + \sqrt{\theta}\min\left\{\frac{\sigma\sqrt{\theta}}{V}, \frac{V}{\sigma\sqrt{\theta}}\right\}\right] \\
&\le \left[\frac{1}{\underline{\eta}}\overline{x} + h'(0)\right]\left(\frac{\theta}{V} + \sqrt{\theta}\right) \le \left[\left(\frac{1}{\underline{\eta}}\overline{x} + h'(0)\right)\max\{1, h'(0)\}\right]\left(\theta + \sqrt{\theta}\right),
\end{aligned}
$$

which ends the proof letting $H_1 = \min\left\{(1/\underline{\eta})\max\{1,\overline{x}\}, \left((1/\underline{\eta})\overline{x} + h'(0)\right)\max\{1, h'(0)\}\right\}$. □

4. Cartels

We now study the trade association holding a monopoly over a good to be sold to competitive buyers. Price is given by marginal social value $p(x) = Vh'(x)$ and the social optimum characterized by $p(\chi) = C'(\chi)$ is the competitive equilibrium. The figure below depicts the two cases where $\chi \lesseqgtr 1$.



If the cartel does not form equilibrium is competitive; on the other hand no $\xi > \chi$ would be enforced since group members would be worse off than at χ. Therefore we restrict attention to norms $\xi \le \chi$. Observe that in this range $p(\xi) \ge 1$.

If industry output is ξ the profits of a group member who adheres to the social norm is $p(\xi)\xi - C(\xi) - \pi P$. Denoting gross profit by $W(\xi) = p(\xi)\xi - C(\xi)$ profits can be written as $W(\xi) - \pi P$. What is the best thing to do if violating the social norm? The key point is that the answer is *not* to produce χ: it is to produce more than that. Indeed, since there are a continuum of members each member is a price taker. Hence given the price $p(\xi) \geq 1$ the profit maximizing output is the highest for which marginal cost does not exceed that price. Denoting this by $\hat{x} = \hat{x}(\xi)$ we then have $\hat{x} \geq \max\{1, \chi\}$ characterized by the equality $p(\xi) = 1 + \sigma(\hat{x} - 1)$; thus $\hat{x}(\xi) = 1 + (p(\xi) - 1)/\sigma$. The profit from this plan is $p(\xi)\hat{x} - C(\hat{x}) - \Pi P$, where $p(\xi)\hat{x} - C(\hat{x}) \geq W(\xi)$ with equality only for $\xi = \chi$.[8]

Equating payoffs from adhering and violating the norm gives the least incentive compatible punishment $P = P(\xi)$, given by $(\Pi - \pi)P = p(\xi)\hat{x} - C(\hat{x}) - W(\xi)$ that is $\pi P(\xi) = \theta\left[p(\xi)\hat{x} - C(\hat{x}) - W(\xi)\right]$. Notice that $P(\xi) \geq 0$ with equality only for $\xi = \chi$; also, for $\xi < \chi$ the incentive compatible P is higher the lower ξ is. The expected utility from the social norm is then

$$U(\xi) = W(\xi) - \pi P(\xi) = W(\xi) - \theta\left(p(\xi)\hat{x} - C(\hat{x}) - W(\xi)\right).$$

We denote the monopoly output by μ, maximizer of W. Closeness of the norm $\hat{\xi}$ to the monopoly outcome thus measures success of the cartel. Since we have assumed marginal revenue $Vr(x)$ decreasing and marginal cost weakly increasing μ is unique. Moreover $\mu < \chi$, since concavity of h implies that marginal revenue is lower than price hence at χ it is lower than marginal cost.

Theorem 2. [Main Theorem] *The optimal social norm $\hat{\xi}$ satisfies*

1. $\mu < \hat{\xi} \leq \chi$, with second inequality strict if $\chi > \theta/(1+\theta)$

2. $\hat{\xi} - \mu \leq H_3\theta\,(1 + [V/\sigma])$ and $\chi - \hat{\xi} \leq H_4/\theta(1 + [V/\sigma])$

Payoff differences are similarly bounded:

3. Assuming $\chi \geq 1$, $[W(\mu) - U(\hat{\xi})]/W(\mu)$ has the same bounds as $\hat{\xi} - \mu$, and $[U(\hat{\xi}) - W(\chi)]/W(\mu)$ has the bounds of $\chi - \hat{\xi}$.

We prove this at the end of the subsection. Note that here, provided $\chi \geq 1$, we also show that utility differentials have the same bounds as quantities differentials.

Monitoring difficulty goes as in the lobbying case - small θ favors cartel formation, large θ tends to prevent it. The crucial difference between the cartel and public good case is the central role σ plays here. If σ is small, that is supply elasticity is high, so that the marginal cost of exceeding basic capacity rises slowly then the optimal social norm is close to competition - the cartel is not enforceable. The reason is that the temptation to cheat on the cartel is too great: in the face of a price above marginal cost it is cheap to increase output hugely and reap a large profit. The cost of providing incentives not to take advantage of this is high: large and costly punishments must be used. The trade association does not find it in its best interest to do this.

[8]If $\xi < \chi$ then $p(\xi) > C'(\chi) \geq C'(\xi)$ so $p(\xi)\hat{x} - C(\hat{x}) > p(\xi)\xi - C(\xi) = W(\xi)$. If $\xi = \chi$ deviation is to $\hat{x} = \max\{\chi, 1\}$; so if $\chi \geq 1$ the equality is immediate; if $\chi < 1$ then $p(\chi) = 1 = C'(x)$ for all $\chi \leq x \leq 1 = \hat{x}$ so $p(\chi)\hat{x} - C(\hat{x}) = p(\chi)\chi - C(\chi)$.

The other interesting point is that the value V works in the opposite way than in the lobbying case. A large V pushes the optimal social norm towards χ in both cases. In the public good case, this is desirable for the trade association. In the case of a cartel, however, it means failure. Why does not large V lead to more collusion? The answer is that a reduction in output raises price and hence industry profits by order V. On the other hand it raises the per unit incentive to deviate by the same amount but also raises the amount a firm wants to deviate by order V, meaning that the incentive to deviate goes up by roughly V^2. Hence as V increases the incentive to deviate goes up more than profits and so the trade association optimally restricts output less.

In short, if output elasticity is high (small σ) it is difficult for a trade association to self-organize, that is, to set up a cartel. For this to be possible one has to have low θ (as in lobbying), moderate V (unlike in lobbying), and high σ (no analogue in lobbying).

To be pedantic on the meaning of "no cartel forms" in the above: if $Vh'(1) > 1$ - implying that at the competitive equilibrium marginal cost and price are greater than 1 and members of the trade association earn a competitive rent - it is always the case that $\hat{\xi} < \chi$. Hence strictly speaking a cartel always form. The point is that if the difference is small so is the profit gain from the cartel. Given that in practice there is certainly some fixed cost involved in organizing a cartel, it is unlikely that a cartel leading to a tiny decrease in output and yielding practically no gain in profit would be worth forming.

Proof of Theorem 2. We need to compute the derivative of $U(\xi) = (1+\theta)W(\xi) - \theta\left[p(\xi)\hat{x}(\xi) - C(\hat{x}(\xi))\right]$. Since $\hat{x}$ is characterized by $p(\xi) = C'(\hat{x})$ the derivative of the second term is just $\theta p'(\xi)\hat{x}$. After substituting the expressions of $C'(\xi)$ and $\hat{x}$ we then get

$$U'(\xi) = (1+\theta)\left[p(\xi) + p'(\xi)\xi - C'(\xi)\right] - \theta p'(\xi)\hat{x}$$

First we show that the optimal social norm satisfies $\mu < \xi \leq \chi$ with second inequality strict when $(1+\theta)\chi > \theta$. For $\xi \leq \mu$ we have $U'(\xi) \geq -\theta p'(\xi)\hat{x}$ so the optimum satisfies $\xi > \mu$. For $\xi > \chi$ lowering ξ increases profits and relaxes the incentive constraint, so certainly $\xi \leq \chi$. Moreover when $\xi = \chi$ then $p = C'$ and $\hat{x} = \max\{1, \chi\}$ so $U'(\chi) = \left[(1+\theta)\chi - \theta \max\{1, \chi\}\right] p'(\chi)$ which is strictly negative for $(1+\theta)\chi > \theta$. This proves the point 1.

To get bounds on the social norms we start from U'. Recall that $p(\xi) = Vh'(\xi)$, $p(\xi) + p'(\xi)\xi = Vr(\xi)$, $C'(\xi) = 1 + \sigma\max\{0, \xi - 1\}$ and $\hat{x} = 1 + (p(\xi) - 1)/\sigma$. Therefore we may write

$$U'(\xi) = (1+\theta)\left[Vr(\xi) - (1 + \sigma\max\{0, \xi - 1\})\right] - \theta V h\text{''}(\xi)\left[1 + (Vh'(\xi) - 1)/\sigma\right].$$

We now take $z = \xi - \mu$ and look for an upper bound on U'. We have

$$\begin{aligned} U'(\xi) &= (1+\theta)\left[Vr(\mu + z) - (1 + \sigma\max\{0, \mu + z - 1\})\right] - \theta V h''(\xi)\left(1 + (Vh'(\xi) - 1)/\sigma\right) \\ &\leq -(1+\theta)V\underline{\rho}z + \theta V\overline{\eta}\left(1 + (Vh'(0) - 1)/\sigma\right). \end{aligned}$$

This is negative for

$$z > \frac{\theta}{1+\theta} \frac{\overline{\eta}\,(1 + (Vh'(0) - 1)/\sigma)}{\underline{\rho}}$$

so

$$\xi - \mu \leq \frac{\theta}{1+\theta} \frac{\overline{\eta}\,(1 + (Vh'(0) - 1)/\sigma)}{\underline{\rho}} \leq \left[\frac{\max\{h'(0), 1\}\overline{\eta}}{\underline{\rho}}\right] \theta\,(1 + [V/\sigma]) = H_3\theta\,(1 + [V/\sigma])\,.$$

Next take $z = \chi - \xi$ and look for a lower bound on $U'(\xi)$. From $Vh'(\chi) = 1 + \sigma \max\{0, \chi - 1\}$ we have

$$\begin{aligned}
U'(\xi) &\geq (1+\theta)\left[V\underline{\eta}z + Vh''(\xi)(\chi - z)\right] - \theta Vh''(\xi)\left(\chi + V\underline{\eta}z/\sigma\right) \\
&= (1+\theta)\left[V\underline{\eta}z - Vh''(\xi)z\right] + (1+\theta)Vh''(\xi)\chi - \theta Vh''(\xi)\left(\chi + V\underline{\eta}z/\sigma\right) \\
&\geq 2(1+\theta)V\underline{\eta}z - V\overline{\eta}\overline{x} + \theta V^2\underline{\eta}^2 z/\sigma.
\end{aligned}$$

This is positive for

$$z > \frac{\overline{x}}{2(1+\theta) + \theta V\underline{\eta}/\sigma}$$

so

$$\chi - \xi \leq \frac{\overline{x}}{2(1+\theta) + \theta V\underline{\eta}/\sigma} \leq \left[\frac{\overline{x}}{\min\{2, \underline{\eta}\}}\right] \frac{1}{\theta(1 + V/\sigma)} = \frac{H_4}{\theta(1 + V/\sigma)}.$$

In order to bound payoff differences, first we compute a lower bound on monopoly profits: $W(\mu) \geq (Vh'(1/2) - 1)\,(1/2)$, and the assumption $\chi \geq 1$ is equivalent to $Vh'(1) \geq 1$, so that $W(\mu) \geq (Vh'(1/2) - Vh'(1))\,(1/2) = (h'(1/2) - h'(1))\,V/2 \equiv \underline{W}$.

We then notice that $W(\mu) - U(\xi) > W(\xi) - U(\xi) = \pi P(\xi) \geq 0$. For the upper utility bound on $W(\mu) - U(\xi)$ observe that the optimal social norm satisfies $U(\xi) \geq U(\mu)$ so that $W(\mu) - U(\xi) \leq W(\mu) - U(\mu)$. We have $U(\mu) = W(\mu) - \theta(p(\mu)\hat{x} - C(\hat{x}))$ and $p(\mu)\hat{x} - C(\hat{x}) \leq Vh'(\mu)\hat{x} - \hat{x}$. Combining these with $\hat{x} = 1 + (Vh'(\mu) - 1)/\sigma$ gives $W(\mu) - U(\xi) \leq \theta\,(Vh'(\mu) - 1)\,(1 + (Vh'(\mu) - 1)/\sigma)$. Observe that $Vh'(\mu) - 1 \leq Vh'(0)$ giving $W(\mu) - U(\xi) \leq \theta Vh'(0)\,(1 + Vh'(0)/\sigma) \leq \theta Vh'(0)\max\{1, h'(0)\}(1 + [V/\sigma])$. Dividing by the lower bound on monopoly profits $\underline{W}$ gives the bound in the theorem:

$$\frac{W(\mu) - U(\xi)}{W(\mu)} \leq \left[\frac{2h'(0)\max\{1, h'(0)\}}{h'(1/2) - h'(1)}\right] \theta\,(1 + [V/\sigma])\,.$$

Next, $U(\xi) - W(\chi) > 0$ since $P(\chi) = 0$. For the upper utility bound observe that the utility gain from ξ over χ is less than the profit gain because $P(\xi)$ gets larger as ξ goes down. Reducing output by $\chi - \xi$ raises price by no more than $\overline{\eta}V(\chi - \xi)$ and saves at most marginal cost times $\chi - \xi$ and that marginal cost is at most $Vh'(1)$. Hence $U(\xi) - W(\chi) \leq V(\overline{\eta}\overline{x} + h'(1))(\chi - \xi)$, and dividing by $\underline{W}$ we get

$$\frac{U(\xi) - W(\chi)}{W(\mu)} \leq 2\frac{\overline{\eta}\overline{x} + h'(1)}{h'(1/2) - h'(1)})(\chi - \xi).$$

□

5. Conclusion

In practice trade associations can both lobby and form cartels and must allocate resources between the two. Our goal here is to understand a simpler and more conceptual point: what is the difference between the free rider problem in lobbying and in forming a cartel? We have used the same model for both lobbying and cartel formation in order to isolate the effect of market organization. There is no reason to presume that the technology for producing resources to be used for lobbying is the same as market production technology. What our results show, however, is that this is probably not an important reason why lobbying is so much more common than cartel formation. In particular, the value of the prize or market plays little role in cartel formation and while it plays an important role in lobbying (with more valuable prizes likely to elicit greater lobbying effort) there is reason to think that the size of the prize is limited in practice by opposition from those who have to pay the subsidy (Levine and Modica (2017)). Rather, our results direct attention to two key variables: the difficulty of monitoring and the elasticity of supply. The difficulty of monitoring plays a key role in both lobbying and cartel formation: if monitoring is difficult then public goods such as lobbying and cartels will not be provided by trade associations. It may be that there are important differences in these costs between lobbying efforts and cartel formation - but it is neither obvious nor evident that this is the case. The second key variable is supply elasticity. We find this unimportant in lobbying but crucial in cartel formation. If it is relatively low cost to increase output, incentives to cheat on a cartel are great and cartel formation will be inhibited. If - by contrast - it is difficult to increase output beyond basic capacity the cartel formation problem is relatively similar to the lobbying problem.

We can illustrate our results by contrasting three industries:

1. Manufacturing firms: it is relatively easy for manufacturers to observe each others activities but firms can easily expand in size by hiring more inputs.

2. Plant workers: it is relatively easy for workers on a factory floor to observe each others effort but workers are physically limited in how much they can increase individual output.

3. Hair dressers: like plant workers hair dressers are physically limited in how much they can increase individual output, but they are diffused in many locations and cannot easily monitor each other.

The theory then predicts the pattern given in the table below: manufacturers should be effective at lobbying but not cartelization, plant workers at both, and hair dressers at neither.

industry	monitoring cost	supply elasticity	lobbying	cartel
manufacturing	low	high	yes	no
plant workers	low	low	yes	yes
hair dressers	high	low	no	no

This we observe is indeed the case.

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