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4 Strategic Delegation Improves Cartel Stability

Abstract. In the one-shot Cournot game, strategic delegation reduces profits of the firm (Fershtman and Judd, 1987; Sklivas, 1987). Allowing for infinitely repeated interaction, strategic delegation improves cartel stability, thereby actually increasing firm profits for discount factors for which a cartel in the one-shot Cournot game is unstable.

This chapter is based on the identically titled paper, available online at carteltheory.com/delegation. I thank Jeanine Miklos-Thal, Patrick Rey, Maarten Pieter Schinkel, Bert Schoonbeek, Randolph Sloof, Jan Tuinstra, and Jeroen van de Ven for constructive discussions and comments.

4.1 Introduction

The strategic delegation literature shows how firms' profitability is *reduced* by delegating control to a manager being remunerated with a fraction of profit and sales—see Fershtman and Judd (1987) and Sklivas (1987) (hereafter: FJS).[88] This chapter extends FJS's seminal model to an infinitely repeated setting, thereby allowing firm owners as well as managers to collude. Strategic delegation can then actually *increase* firms' profitability through improving cartel stability compared to the non-delegation Cournot game.[89]

The intuition is two-fold. First, a manager defecting from collusion can be fiercely punished by the owner as she can stop delegating control and fire him. Second, this punishment strategy is more stable than normal collusion in the infinitely repeated standard Cournot game, because it is supported by the threat of reverting to FJS's unprofitable one-shot delegation equilibrium. Thus, FJS's key result of "unprofitable delegation" helps owners to credibly commit to a fierce punishment strategy, thereby increasing cartel stability and increasing firm profits when collusion in the static Cournot game is unstable.

4.2 The Repeated Strategic Delegation Model

Consider FJS's delegation game. Two homogenous firms $i =\in \{1, 2\}$ produce at unit cost $c \geq 0$ and compete in quantities facing linear demand

$$p = a - bQ, \qquad\qquad b > 0, a > c,$$

where p is market price, q_i is output of firm i, and $Q = q_1 + q_2$ is total output. Each firm i is owned by profit-maximizing owner i (female) who may delegate control to manager i (male) by remunerating him with a fraction α_i of profit π_i, plus a fraction $1 - \alpha_i$ of sales S_i, that is,

$$M_i = \alpha_i \pi_i + (1 - \alpha_i) S_i,$$

which can be rewritten as $M_i = (p - \alpha_i c) q_i$. If the owner does not delegate control to her manager, and instead fires him, then the manager earns his outside option which is normalized to zero.

In their original framework, FJS consider rewards $A_i + B_i M_i$. Since the managerial outside option is normalized to zero, owners can optimally set $A_i = 0$ and B_i arbitrarily

[88] This result holds for FJS's most elaborate case of Cournot competition.

[89] Lambertini and Trombetta (2002) extend Vickers' (1985) model—which can be rewritten in terms of FJS—and derive different results by implicitly assuming that firm owners do not react rationally on a managerial defection. Han (2010) comments on their analysis by considering rational owners. De Lamirande, Guigou and Lovat (2011) investigate cartel stability with relative performance contracts.

small, say $B_i = \epsilon_i > 0$.[90] With delegation, owner i then earns $\pi_i - \epsilon_i M_i$ and manager i earns $\epsilon_i M_i$. In the limit when $\epsilon_i \downarrow 0$, (i) term $\epsilon_i M_i$ has an infinitesimally small impact on owner i's payoff and, therefore, she essentially behaves so as to maximize profit π_i, whereas (ii) manager i's payoff only consists of $\epsilon_i M_i$ and, therefore, she maximizes M_i.

The timing of the stage game is:

1. Both owners simultaneously decide whether to delegate or to keep control.

2. If owner i delegates, she sets incentives α_i (possibly) simultaneously with her rival.

3. The players in control of the firms simultaneously set quantities on the market.

Extending FJS, this stage game is played in each period $t \in \{1, 2, ..., \infty\}$, thereby allowing for collusion on three dimensions: the delegation decision, incentives, and quantities.

Owners and managers maximize their discounted stream of payoffs using discount factor δ_o and δ_m, respectively. To keep the analysis clean and to stay in line with the literature, collusion is on the monopoly quantity and punishment on the product market is characterized by reversion to the static Nash equilibrium forever. Everything is common knowledge and fully observable to all players. I focus on symmetric equilibria and denote i's rival by j.

4.3 Delegation Improves the Stability of Collusion

To save on notation, (i) superscripts $\{N, C, D\}$, respectively, denote the Nash, collusion, and deviating variables in the standard Cournot game; (ii) superscripts $\{dN, dC\}$, respectively, denote the Nash and collusion variables in FJS's Cournot delegation game; while (iii) the deviating variables in the delegation game do not have a superscript as there are going to be several ways to deviate.

Collusion by player $p_i \in \{\text{owner } i, \text{manager } i\}$ is stable if and only if

$$\delta_{p_i} \geq \frac{\text{“defection payoff of player } p_i\text{”} - \text{“collusive payoff of player } p_i\text{”}}{\text{“defection payoff of player } p_i\text{”} - \text{“punishment payoff of player } p_i\text{”}}, \ \forall i \in \{1, 2\}, \tag{4.1}$$

where mathematical symbols are avoided, because there are several ways to deviate and to punish. Since the owners optimally set $A_i = 0$ and $B_i = \epsilon_i$ as discussed above, (i) the term ϵ_i cancels out in determining the managerial stability condition, and (ii) the term $\epsilon_i M_i$ can be effectively neglected in the owner's stability condition as ϵ_i is infinitesimal.

[90] The purpose of this model is to isolate the impact of strategic delegation on collusive stability; it, therefore, abstracts away from the impact of fixed payments on collusive stability by normalizing the manager's outside option to zero. For a discussion of fixed payment issues and collusive stability, see Section 3.4.

4.3.1 Benchmarks

Consider the following benchmarks, which are formally derived in Appendix C.1. In FJS's one-shot Cournot delegation game, owners are captured in a prisoner's dilemma and cannot avoid delegation, resulting in equilibrium incentives, quantities and payoffs

$$\alpha_i^{dN} = \frac{6}{5} - \frac{a}{5c}, q_i^{dN} = \frac{2(a-c)}{5b}, M_i^{dN} = \frac{4(a-c)^2}{25b}, \pi_i^{dN} = \frac{2(a-c)^2}{25b}, \quad (4.2)$$

which entails a lower profit than if owners would have been able to escape delegation and play the standard Cournot game,

$$q_i^N = \frac{a-c}{3b}, \pi_i^N = \frac{(a-c)^2}{9b}. \quad (4.3)$$

In the infinitely repeated standard Cournot game, collusion is stable if and only if

$$\delta_o \geq \frac{\pi_i^D - \pi_i^C}{\pi_i^D - \pi_i^N} = \frac{9}{17}, \text{ with}$$

$$q_i^C = \frac{a-c}{4b}, \pi_i^C = \frac{(a-c)^2}{8b}. \quad (4.4)$$

4.3.2 Collusive Equilibrium with Delegation

In the infinitely repeated version of FJS's delegation game, the collusive delegation equilibrium yielding full monopoly profits entails owners delegating control by giving *no* incentives for sales, thereby "selling the store" to managers whose objective then is to maximize profit. Appendix C.2 formally derives that in the delegation game the Collusive equilibrium is characterized by

$$\alpha_i^{dC} = 1, q_i^{dC} = \frac{a-c}{4b}, M_i^{dC} = \frac{(a-c)^2}{8b}, \pi_i^{dC} = \frac{(a-c)^2}{8b}, \quad (4.5)$$

which is stable if and only if owners as well as managers have no incentive to defect.

Owner's defection. Owners can defect in two ways: they can (i) defect in stage 2 by setting incentives different from α_i^{dC}, or (ii) defect in stage 1 by not delegating at all.

If owner i defects by setting different incentives, then managers optimally react with Nash competition in stage 3 so as to punish the deviant owner. Conditional on owner i defecting to incentives α_i, Nash quantities in stage 3 are $q_i(\alpha_i) = \frac{a+(1-2\alpha_i)c}{3}$ and

$q_j(\alpha_i) = \frac{a+(\alpha_i-2)c}{3}$, yielding

$$\pi_i(\alpha_i) = \left(a - b\left(\frac{a+(1-2\alpha_i)c}{3} + \frac{a+(\alpha_i-2)c}{3}\right) - c\right)\frac{a+(1-2\alpha_i)c}{3},$$

which is maximized at $\alpha_i = \frac{5}{4} - \frac{a}{4c}$ with $\pi_i = \frac{(a-c)^2}{8b}$. As defection profit equals collusive profit, while triggering future punishment, owners would never make such a defection.

If instead owner i defects by not delegating, this triggers Nash competition with her rival's manager j in stage 3. Owner i and manager j respectively maximize $\pi_i(q_i, q_j) = (a - b(q_i + q_j) - c)q_i$ and $M_j(q_i, q_j) = B(a - b(q_i + q_j) - c)q_j$, resulting in profit $\pi_i = \frac{(a-c)^2}{9b}$, which is lower than the collusive profit. Therefore, owners do not defect from the delegation decision. Lemma 4.1 summarizes.

Lemma 4.1 *Independent of the discount factor δ_o, owners do not defect from collusion.*

Managerial defection. If manager i defects from the collusive quantity $q_i^{dC} = \frac{a-c}{4b}$, she does so by maximizing

$$M_i(q_i) = \left(a - b\left(q_i - \frac{a-c}{4b}\right) - c\right)q_i,$$

yielding deviant quantity $q_i = \frac{3(a-c)}{8b}$ with payoff $M_i = \frac{9(a-c)^2}{64b}$. To optimally prevent such a managerial defection, owners will try to commit to avoid delegating control in future periods and fire them, thereby fiercely punishing the manager with a zero payoff.[91] Using condition (4.1), i.e., $\delta_m \geq \left(\frac{9(a-c)^2}{64b} - \pi_i^{dC}\right) / \left(\frac{9(a-c)^2}{64b} - 0\right)$, Lemma 4.2 states the resulting stability condition.

Lemma 4.2 *Managers do not defect from collusion if and only if $\delta_m \geq \frac{1}{9}$.*

Owner's commitment to avoid delegation. Whether owners are indeed able to punish managers by avoiding delegation depends on the owners' patience δ_o. Appendix C.4 shows that the owners' commitment to *not* delegate suffers from FJS's prisoners dilemma when owners compete in quantities while keeping control, but it is no concern when owners collude on quantities while keeping control.

When owners punish a deviant manager by keeping control and colluding on quantities themselves, equilibrium profit during punishment is $\pi_i^C = \frac{(a-c)^2}{8b}$, while defection

[91] Appendix C.3 checks that such punishment is indeed optimal taking into account the owners' ability to commit to such punishment.

results in profit $\pi_i^D = \frac{9(a-c)^2}{64b}$, but triggers FJS's one-shot delegation equilibrium with profit $\pi_i^{dN} = \frac{2(a-c)^2}{25b}$. Using condition (4.1), i.e., $\delta_o \geq \left(\pi_i^D - \pi_i^C\right) / \left(\pi_i^D - \pi_i^{dN}\right)$, Lemma 4.3 states the resulting stability condition.

Lemma 4.3 *After a manager defected, owners can commit to avoid delegation iff.* $\delta_o \geq \frac{25}{97}$.

Since discount factors are determined on financial markets, rational owners and managers with access to such markets can be assumed to be equally patient, i.e., $\delta_o = \delta_m = \delta$. Combining Lemmas 4.1, 4.2, and 4.3, I then arrive at the following proposition.

Proposition 4.1 *Collusion is more stable in the infinitely repeated Cournot delegation model* $\left(\delta \geq \frac{25}{97}\right)$ *than in the infinitely repeated standard Cournot model* $\left(\delta \geq \frac{9}{17}\right)$.

The intuition is that managers face an extremely bad consequence from defection as owners will punish them by firing them. Owners can commit to such punishment for a large set of discount factors, because an owner's defection from this punishment results in FJS's unprofitable one-shot delegation equilibrium.

Comparing profits in the infinitely repeated version of FJS's Cournot delegation model with those in the infinitely repeated standard Cournot model yields a lower equilibrium profit $\frac{2(a-c)^2}{25b} < \frac{(a-c)^2}{9b}$ for low discount factors $\delta < \frac{25}{97}$, but a higher equilibrium profit $\frac{(a-c)^2}{8b} > \frac{(a-c)^2}{9b}$ for intermediate discount factors $\frac{25}{97} \leq \delta < \frac{9}{17}$, and the same equilibrium profit $\frac{(a-c)^2}{8b}$ for high discount factors $\delta \geq \frac{9}{17}$. Proposition 4.2 summarizes.

Proposition 4.2 *In an infinitely repeated setting, FJS's static key result that delegation reduces firms' profitability does not hold for high discount factors, is reversed for intermediate discount factors, and survives for low discount factors.*

4.4 Concluding Remark

Whether delegation improves cartel stability and increases profits in more general frameworks is an ongoing debate. Recent contributions, such as Aubert (2009) and Chapter 2 of this dissertation model, model this question in principal-agent frameworks, thereby studying issues related to information asymmetries.