

# Quantity-setting games with lifetime employment contracts as a strategic commitment

---

Kazuhiro Ohnishi

Institute for Basic Economic Science, Japan

This paper considers lifetime employment contracts as a strategic commitment and examines the respective equilibrium outcomes of the two cases of a quantity-setting duopoly game with substitute goods and a quantity-setting duopoly game with complementary goods. First, in the quantity-setting game with substitute goods, we find that there is an equilibrium in which both the firms adopt lifetime employment. Next, in the quantity-setting game with complementary goods, we find that there is an equilibrium in which at least one firm adopts lifetime employment, and that lifetime employment is beneficial for both firms.

**JEL classification:** C72, D21, L13

**Keywords:** quantity-setting model, substitute goods, complementary goods, lifetime employment contract

---

## 1. Introduction

Modern oligopoly theories are essentially a set of different models that have been analysed. These models include capacity investment, cost-reducing R&D investment, advertising, patent licensing, network competition, and so forth.<sup>1</sup> Most studies then consider substitute goods or homogeneous goods. Therefore, we discuss not only substitute goods but also complementary goods.

---

<sup>1</sup> See, for example, Spence [1977], Dixit [1979, 1980], Eaton and Lipsey [1981], Spulber [1981], Ware [1984], Basu and Singh [1990], and Poddar [2003] for capacity investment. See Tirole [1988], Gilbert [1989], and Shapiro [1989] for excellent surveys of oligopoly behavior.

In the case in which goods are complements, if only one firm sells a product in a market, it chooses the levels of price and output that maximize its profit. Here, suppose that there is another firm that sells a complementary product. Each firm's output and profit will increase if the other firm reduces its price and sells more of its product. Therefore, each firm will hope that the other firm will reduce its price.

We consider an employment contract between a firm and its employees as a strategic commitment. There are many studies that investigate strategic decisions of managerial incentive contracts in oligopolistic markets. Fershtman and Judd [1987], Sklivas [1987], Fumas [1992], Basu [1995], Miller and Pazgal [2001, 2002], and Kräkel [2002] examine two-stage delegation games in which in the first stage, profit-maximizing owners choose the incentive schemes they will give to their managers, and in the second stage, each manager chooses the strategy that maximizes his utility, given his incentive scheme and his rival's behavior. Each study shows that owners use the incentive schemes that influence their managers' behavior and alters the equilibrium outcome. Furthermore, Ohnishi [2001] proposes a lifetime employment contract as a strategic commitment and shows its effectiveness by examining entry deterrence. If a firm legally enters into a lifetime employment contract with its employees, then its wage cost sinks and its marginal cost decreases. Ohnishi [2002] shows concretely in what kinds of cases lifetime employment as a strategic commitment is effective by using a quantity-setting duopoly model.

We also consider lifetime employment as a strategic commitment. The practice of lifetime employment is mainly found in Japan and is one of the main features that characterize the Japanese labor market.<sup>2</sup> The elements of the Japanese employment system include lifetime employment, a seniority system of compensation, a seniority system of promotion and appraisal, generalist training, enterprise unionism, and consensus decision making. Many large Japanese firms focus their hiring on new male graduates from schools or universities, and these firms offer lifetime employment to the employees they recruit. The employees are recruited at the outset of their career without any particular concern for specific acquired skills. These firms expect to keep the employees they recruit until the age of compulsory retirement, which generally occurs at between 55 and 65 years of age. Hashimoto and Raisian

---

<sup>2</sup> Since the pioneering work of Abegglen [1958], a great many works dealing with the Japanese lifetime employment system have been published. See, for example, Ito [1992], Nomura [1996], Brown et al. [1997], Daly [1998], and Kneller [2003] for recent surveys.

[1985] show that the numbers of cumulative new jobs held by males of various ages in the United States for 1978 and Japan for 1977 are 4.40 and 2.06 at age 20-24, 7.40 and 3.11 at age 30-34, 10.25 and 4.21 at age 40-54, and 10.95 and 4.91 at age 55-64, respectively. That is, the numbers of cumulative new jobs held by males are much lower in Japan than in the United States. The Organisation for Economic Co-operation and Development (OECD) [1986] reports that employment arrangements in Japan tend to be the most durable among all OECD countries.

Although Japan is a small island society that possesses few natural resources, it achieved rapid economic growth from the end of World War II to the great oil shock of 1973 and became the world's second-largest economy. Japan also produced a bubble economy in the second half of the 1980s. The Japanese economy received the world's attention during most of the 1970s and 1980s, and the Japanese lifetime employment system was considered an indispensable ingredient of the successful Japanese economy.<sup>3</sup>

However, the Japanese economy faced a serious recession with the collapse of the bubble economy in the 1990s. The economic slowdown has allegedly been eroding the environments favorable to the lifetime employment practice. Therefore, Kato [2001] analysed whether the practice of lifetime employment had survived in Japan since the burst of the bubble economy, and showed that contrary to the popular rhetoric of its demise, evidence points to the enduring nature of this practice in Japan. Specifically, he found little evidence for any major decline in the job retention rates of Japanese employees from the period prior to the end of the bubble economy in the late 1980s to the post-bubble period. In addition, Ono [2007] examines whether lifetime employment in Japan is changing and shows that the incentives among workers, managers, and executives are aligned to preserve the lifetime employment system.

We examine the respective equilibrium outcomes of the two cases of a quantity-setting game with substitute goods and a quantity-setting game with complementary goods by using lifetime employment contracts as a strategic commitment.<sup>4</sup> In this paper, there is no possibility of entry or exit. The two-

---

<sup>3</sup> See, for example, Christensen and Hogendorn [1983], Leibenstein [1987], and Peterson and Sullivan [1990].

<sup>4</sup> Ohnishi [2006] examines the two cases of a price-setting lifetime-employment-contract game with substitute goods and a price-setting lifetime-employment-contract game with complementary goods, and shows that in each case, the equilibrium coincides with the Bertrand solution with no lifetime employment. We find that our results are different from those of Ohnishi [2006].

stage quantity-setting duopoly model of this paper runs as follows. In the first stage, each firm simultaneously and independently decides whether to adopt lifetime employment or not. If a firm adopts lifetime employment, then it chooses its output level and legally enters into a lifetime employment contract with the employees necessary to achieve the output level. At the end of the first stage, each firm observes its rival's behavior. In the second stage, each firm simultaneously and independently chooses its actual output.

The purpose of this paper is to show the respective equilibrium outcomes of the quantity-setting game with substitute goods and the quantity-setting game with complementary goods when duopolists use lifetime employment contracts as a strategic commitment.

First, in the quantity-setting duopoly game with substitute goods, we find that if one firm unilaterally adopts lifetime employment, then the adopting firm's payoff increases and the unadopting firm's payoff decreases. In addition, we show that there is a Cournot equilibrium in which both firms adopt lifetime employment. However, this equilibrium is not necessarily more beneficial for each firm than the Cournot equilibrium with no lifetime employment.

Next, in the quantity-setting duopoly game with complementary goods, we find that if one firm unilaterally adopts lifetime employment, then both the firms' payoffs increase. In addition, we show that there is an equilibrium in which at least one firm adopts lifetime employment, and that lifetime employment is beneficial for both the firms.

This paper proceeds as follows. In section 2, we formulate the quantity-setting model. Section 3 discusses the respective equilibrium outcomes of two cases of substitute goods and complementary goods. Section 4 contains some concluding remarks. All proofs of propositions are provided in the appendix.

## 2. The basic model

There are two firms, designated firm 1 and firm 2. For the remainder of this paper, when  $i$  and  $j$  are used to refer to firms in an expression, they should be understood to refer to 1 and 2 with  $i \neq j$ . Firm  $i$ 's payoff is

$$\Pi_i(q_1, q_2) = P_i(q_1, q_2)q_i - v_i q_i, \quad (1)$$

where  $P_i : \mathbf{R}_+^2 \rightarrow \mathbf{R}_+$  is firm  $i$ 's inverse demand function,  $q_i$  is firm  $i$ 's output, and  $v_i$  is firm  $i$ 's constant marginal cost for output.

The two stages of the quantity-setting model run as follows. In the first stage, each firm simultaneously and independently decides whether to adopt lifetime employment or not. If firm  $i$  adopts lifetime employment, then it chooses its output level  $q_i^*$  and legally enters into a lifetime employment contract with the employees necessary to achieve  $q_i^*$ . In the second stage, each firm simultaneously and independently chooses its actual output  $q_i$ . At the end of the second stage, the market opens. Therefore, firm  $i$ 's payoff changes as follows:

$$\hat{\Pi}_i(q_i^*, q_1, q_2) = \begin{cases} \Pi_i(q_1, q_2) & \text{if } q_i \geq q_i^* \\ \Pi_i(q_1, q_2) + (q_i - q_i^*)r_i & \text{if } q_i \leq q_i^* \end{cases} \quad (2)$$

where  $r_i \in (0, v_i]$  is firm  $i$ 's constant wage cost per unit of output. If firm  $i$  chooses  $q_i^*$  and enters into a lifetime employment contract with all of the employees necessary to achieve  $q_i^*$ , then the cost of  $r_i q_i^*$  is sunk; that is, firm  $i$ 's marginal cost is affected by the lifetime employment contract. Therefore, if  $q_i < q_i^*$ , since firm  $i$  employs extra employees, firm  $i$  has to bear the extra cost of  $(q_i^* - q_i)r_i$ . Hence, firm  $i$ 's marginal cost exhibits a discontinuity at  $q_i = q_i^*$ .

Now, the following assumptions are made.

**Assumption 1.**  $\Pi_i$  is twice continuously differentiable.

**Assumption 2.**  $\partial \Pi_i / \partial q_i < 0$ .

**Assumption 3.**  $\partial^2 \Pi_i / \partial q_i^2 + \left| \partial^2 \Pi_i / \partial q_i \partial q_j \right| < 0$ .

Assumptions 1-3 are standard in Cournot models. Assumption 2 means that a firm's marginal payoff with respect to its own output goes down with its own output. Assumption 3 means that the own effects dominate the cross effects. It is well known that if Assumptions 1-3 hold, then the quantity-setting model will have unique Cournot equilibria.<sup>5</sup>

Given  $q_j$ , firm  $i$  maximizes its payoff with respect to  $q_i$ . If firm  $i$ 's marginal cost for output is constantly equal to  $v_i$ , then its Cournot reaction function is defined by

$$R_i^v(q_j) = \arg \max_{\{q_i \geq 0\}} \Pi_i(q_1, q_2) \quad (3)$$

<sup>5</sup> For instance, Friedman [1977] shows that these assumptions yield unique Cournot equilibria.

and if firm  $i$ 's marginal cost for output is constantly equal to  $v_i - r_i$ , then its Cournot reaction function is defined by

$$R_i^{v-r}(q_j) = \arg \max_{\{q_i \geq 0\}} [\Pi_i(q_1, q_2) + r_i q_i]. \quad (4)$$

Therefore, if firm  $i$  chooses  $q_i^*$  and adopts lifetime employment, then its best response changes as follows:

$$R_i(q_i^*, q_j) = \begin{cases} R_i^v(q_j) & \text{if } q_i > q_i^* \\ q_i^* & \text{if } q_i = q_i^* \\ R_i^{v-r}(q_j) & \text{if } q_i < q_i^* \end{cases} \quad (5)$$

The Cournot equilibrium is defined as a pair  $(q_1^C, q_2^C)$  of output levels, where  $q_1^C \in R_1(q_2^C)$  and  $q_2^C \in R_2(q_1^C)$ .

Throughout this paper, we use pure strategy subgame perfect Cournot equilibria as our equilibrium concept.

### 3. Equilibrium outcomes

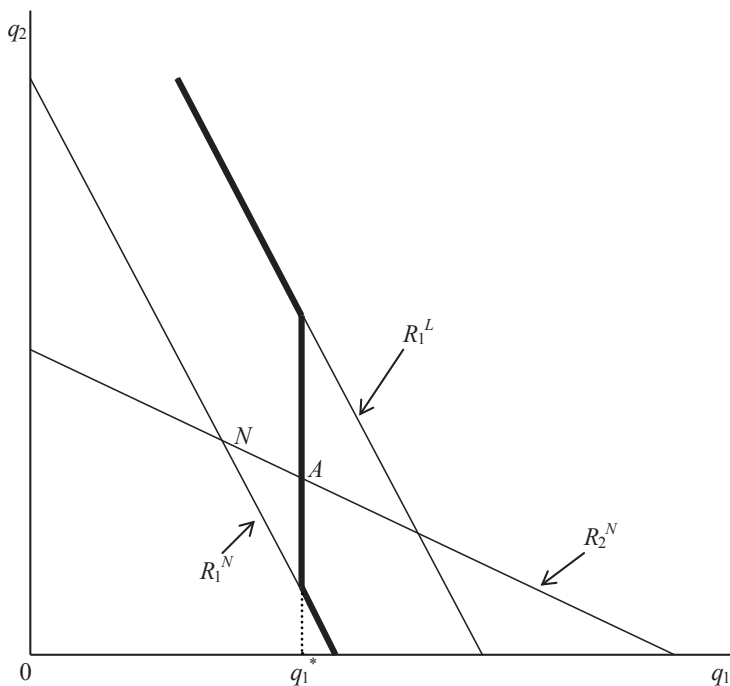
In this section, we discuss the respective equilibrium outcomes of two cases of substitute goods and complementary goods.

*Case 1:  $\partial \Pi_i / \partial q_j < 0$  and  $\partial^2 \Pi_i / \partial q_i \partial q_j < 0$*

In this subsection, we examine the case of strategic substitutes in which goods are substitutes.<sup>6</sup> Figure 1 depicts both firms' reaction curves for the quantity-setting game with substitute goods when one firm unilaterally adopts lifetime employment.  $R_1^N$  is firm 1's reaction curve when the marginal cost for output is constantly equal to  $v_1$ ,  $R_1^L$  is firm 1's reaction curve when the marginal cost for output is constantly equal to  $v_1 - r_1$ , and  $R_2^N$  is firm 2's reaction curve when the marginal cost for output is constantly equal to  $v_2$ . From (2) and (5), we see that lifetime employment specifies a lower marginal cost for output. If firm 1 selects  $q_1^*$  and legally enters into a lifetime employment contract with the employees necessary to achieve  $q_1^*$ , then its reaction curve shifts to the right and is illustrated by the kinked bold line in the figure. The equilibrium is decided in a Cournot fashion; that is, the intersection of the reaction curves gives us a unique

---

<sup>6</sup>The concepts of strategic substitutes and complements are due to Bulow, Geanakoplos, and Klemperer [1985].



**Figure 1. The quantity-setting game with substitute goods**

equilibrium. Hence, the equilibrium occurs at  $A$  as shown in the figure. We can state the following proposition.

**Proposition 1.** In the quantity-setting game with substitute goods, if one firm unilaterally adopts lifetime employment, then the adopting firm gets a higher payoff than in the Cournot game with no lifetime employment, while the other firm gets a lower payoff than in the Cournot game with no lifetime employment.

Now, the equilibrium of the quantity-setting game with substitute goods is shown in the following proposition.

**Proposition 2.** In the quantity-setting game with substitute goods, there exists an equilibrium in which both firms adopt lifetime employment.

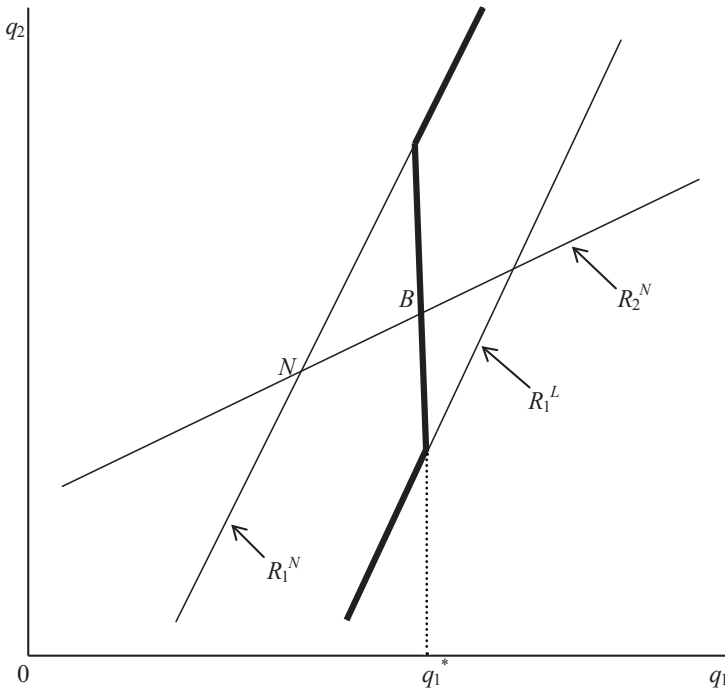
In the quantity-setting game of strategic substitutes in which goods are substitutes, lifetime employment is not necessarily beneficial for firms. That is, as stated by Proposition 1, unilateral lifetime employment leads the adopting firm to a higher payoff, while leading the other firm to a lower payoff. This does not imply that if both firms adopt lifetime

employment, they get higher payoffs than in the Cournot game with no lifetime employment. We can understand intuitively that if both firms adopt lifetime employment, they may get lower payoffs than in the Cournot game with no lifetime employment. However, the equilibrium becomes as stated by Proposition 2.

*Case 2:  $\partial\Pi_i/\partial q_j > 0$  and  $\partial^2\Pi_i/\partial q_i\partial q_j > 0$*

In this subsection, we examine the case of strategic complements in which goods are complements. If firm  $i$  increases its output, firm  $j$ 's amount of demand increases because of complementary goods. That is, increasing firm  $i$ 's output leads firm  $j$  to increase its output. This states that the quantity-setting game with complementary goods makes firms strategic complements.

Figure 2 depicts both firms' reaction curves for the quantity-setting game with complementary goods when one firm unilaterally adopts lifetime employment. Both firms' reaction curves are sloping upward because of



**Figure 2. The quantity-setting game with complementary goods**



strategic complements. Lifetime employment specifies a lower marginal cost for output. If firm 1 selects  $q_1^*$  and offers lifetime employment, then its reaction curve shifts to the right and is illustrated by the kinked bold line in the figure. The intersection of the reaction curves gives us a unique equilibrium. Hence, the equilibrium occurs at  $B$  as shown in the figure. We present the following proposition.

**Proposition 3.** In the quantity-setting game with complementary goods, if one firm unilaterally adopts lifetime employment, then both firms get higher payoffs than in the Cournot game with no lifetime employment.

Proposition 3 states that the unilateral lifetime employment solution generates a higher payoff for each firm than in the Cournot solution with no lifetime employment. Hence, we can see intuitively that there exists no equilibrium in which neither firm adopts lifetime employment. The equilibrium of the quantity-setting game with complementary goods is presented in the following proposition.

**Proposition 4.** In the quantity-setting game with complementary goods, there exists an equilibrium in which at least one firm enters into a lifetime employment contract with its employees. At equilibrium, both firms get higher payoffs than in the Cournot game with no lifetime employment.

Propositions 3 and 4 imply that lifetime employment is beneficial for both firms in the quantity-setting game of strategic complements in which goods are complements.

#### **4. Concluding remarks**

We have examined the respective equilibrium outcomes of the quantity-setting game with substitute goods and the quantity-setting game with complementary goods. First, in the quantity-setting game with substitute goods, we have shown that if one firm unilaterally adopts lifetime employment, then the adopting firm's payoff increases and the unadopting firm's payoff decreases. Furthermore, we have shown that there is a Cournot equilibrium in which both firms adopt lifetime employment. However, this equilibrium is not necessarily more beneficial for both firms than the Cournot equilibrium with no lifetime employment.

Next, in the quantity-setting game with complementary goods, we have shown that if one firm unilaterally adopts lifetime employment, then both the firms' payoffs increase. Furthermore, we have shown that there

is an equilibrium in which at least one firm adopts lifetime employment, and that at equilibrium, lifetime employment is beneficial for both firms. Since lifetime employment specifies a lower marginal cost for output, the adoption of lifetime employment by firms increase their outputs, thereby improving social welfare. As a result, we see that the introduction of lifetime employment into the analysis of quantity-setting game with complementary goods increases social welfare.

In this paper, we have considered games in which firms behave noncooperatively. However, what if firms behave cooperatively? This is one of various extensions of this study that remain to be analysed in detail in the future.

## Appendix

First of all, we present the following two supplementary lemmas.

**Lemma 1.** If firm  $i$  adopts lifetime employment and an equilibrium is achieved, then in equilibrium  $q_i = q_i^*$ .

**Proof.** First, consider the possibility that  $q_i < q_i^*$  in equilibrium. From (1) and (2), firm  $i$ 's payoff is  $P_i(q_1, q_2)q_i - v_i q_i + (q_i - q_i^*)r_i = P_i(q_1, q_2)q_i - v_i q_i - (q_i^* - q_i)r_i$ . Here, since  $q_i < q_i^*$ , firm  $i$  employs extra employees necessary to produce  $(q_i^* - q_i)r_i$ . That is, firm  $i$  can increase its payoff by reducing  $q_i^*$ , and the equilibrium does not change in  $q_i \leq q_i^*$ . Hence,  $q_i < q_i^*$  does not result in an equilibrium.

Next, consider the possibility that  $q_i > q_i^*$  in equilibrium. From (2) and (5), we see that firm  $i$ 's marginal cost is  $v_i$ . It is impossible for firm  $i$  to change its output in equilibrium because such a strategy is not credible. That is, lifetime employment cannot function as a strategic commitment. Q.E.D.

**Lemma 2.** Firm  $i$ 's payoff-maximizing output is higher when it adopts lifetime employment than when it does not.

**Proof.** From (2), we see that lifetime employment will never increase the marginal cost of firm  $i$ . When firm  $i$  does not adopt lifetime employment, the first-order condition is

$$P_i + \frac{\partial P_i}{\partial q_i} - v_i = 0 \tag{6}$$

On the other hand, when firm  $i$  adopts lifetime employment and reduces its marginal cost, the first-order condition is

$$P_i + \frac{\partial P_i}{\partial q_i} - v_i + r_i = 0 \tag{7}$$

Here,  $r_i$  is positive. To satisfy (7),  $P_i + \partial P_i / \partial q_i - v_i$  must be negative. Assumptions 1 and 2 state that  $\Pi_i$  is concave with respect to  $q_i$ . Thus, firm  $i$ 's payoff-maximizing output is larger when its marginal cost is  $v_i - r_i$  than when its marginal cost is  $v_i$ . Q.E.D.

Now, we prove Propositions 1-4.

*Proof of Proposition 1*

Suppose that firm  $i$  unilaterally adopts lifetime employment. Lemma 2 states that firm  $i$ 's payoff-maximizing output is higher when it adopts lifetime employment than when it does not. Increasing firm  $i$ 's output decreases firm  $j$ 's amount of demand and payoff because of substitute goods. In firm  $j$ 's optimal strategy, its output decreases because of strategic substitutes. Decreasing firm  $j$ 's output increases firm  $i$ 's amount of demand because of substitute goods, and if  $q_i = q_i^*$ , firm  $i$ 's payoff also increases. Lemma 1 shows that in equilibrium  $q_i = q_i^*$ . Thus, firm  $i$ 's payoff exceeds its Cournot payoff with no lifetime employment. Q.E.D.

*Proof of Proposition 2*

We consider the following payoff matrix:

		FIRM 2	
		Lifetime employment	No lifetime employment
FIRM 1	Lifetime employment	$\Pi_1^E, \Pi_2^E$	$\Pi_1^L, \Pi_2^N$
	No lifetime employment	$\Pi_1^N, \Pi_2^L$	$\Pi_1^C, \Pi_2^C$

where  $\Pi_i^L > \Pi_i^C$  and  $\Pi_i^N < \Pi_i^C$  from Proposition 1. Hence, the equilibrium never occurs at (No lifetime employment, No lifetime employment). Therefore, if  $\Pi_i^N < \Pi_i^E$ , then the equilibrium is (Lifetime employment, Lifetime employment), and the equilibrium payoffs are  $(\Pi_1^E, \Pi_2^E)$ . The fact that  $\Pi_i^N < \Pi_i^E$  is clear by the same argument as that cited in the proof of Proposition 1. Q.E.D.

*Proof of Proposition 3*

Suppose that firm  $i$  unilaterally adopts lifetime employment. Lemma 2 states that firm  $i$ 's payoff-maximizing output is higher when it adopts lifetime employment than when it does not. Increasing firm  $i$ 's output increases firm  $j$ 's amount of demand and payoff because of complementary goods. Increasing firm  $j$ 's output increases firm  $i$ 's amount of demand because of complementary goods, and if  $q_i = q_i^*$ , firm  $i$ 's payoff also increases. From Lemma 1, we see that in equilibrium  $q_i = q_i^*$ . Thus, firm  $i$ 's payoff also exceeds its Cournot payoff with no lifetime employment. Q.E.D.

*Proof of Proposition 4*

We consider the following payoff matrix:

		FIRM 2	
		Lifetime employment	No lifetime employment
FIRM 1	Lifetime employment	$\Pi_1^E, \Pi_2^E$	$\Pi_1^L, \Pi_2^N$
	No lifetime employment	$\Pi_1^N, \Pi_2^L$	$\Pi_1^C, \Pi_2^C$

where  $\Pi_i^N, \Pi_i^L > \Pi_i^C$  from Proposition 3. Hence, the equilibrium never occurs at (No lifetime employment, No lifetime employment). Therefore, if  $\Pi_i^N > \Pi_i^E$ , then (No lifetime employment, Lifetime employment) and (Lifetime employment, No lifetime employment) are both equilibria, and the equilibrium payoffs are  $(\Pi_1^N, \Pi_2^L)$  and  $(\Pi_1^L, \Pi_2^N)$ , respectively. On the other hand, if each firm's payoff becomes  $\Pi_i^E > \Pi_i^N$  instead of  $\Pi_i^N > \Pi_i^E$ , then the equilibrium is (Lifetime employment, Lifetime employment), and the equilibrium payoffs are  $(\Pi_1^E, \Pi_2^E)$ . Thus, there exists an equilibrium in which at least one firm adopts lifetime employment, and both the firms earn higher payoffs than in the Cournot game with no lifetime employment. Q.E.D.

## References

- Abegglen, J. C. [1958] *The Japanese factory: aspects of its social organization*. Glencoe, IL: Free Press.
- Basu, K. [1995] "Stackelberg equilibrium in oligopoly: an explanation based on managerial incentives", *Economics Letters* 49:459-464.
- Basu, K. and N. Singh [1990] "Entry-deterrence in Stackelberg perfect equilibria," *International Economic Review* 31:61-71.
- Brown, C., Y. Nakata, M. Reich, and L. Ulman [1997] *Work and pay in the United States and Japan*. New York: Oxford University Press.
- Bulow, J., J. Geanakoplos, and P. Klemperer [1985] "Multimarket oligopoly: strategic substitutes and complements", *Journal of Political Economy* 93:488-511.
- Cheng, L. [1985] "Comparing Bertrand and Cournot equilibria: a geometric approach", *Rand Journal of Economics* 16:146-152.
- Christainsen, G. B. and J. S. Hogendorn [1983] "Japanese productivity: adapting to changing comparative advantage in the face of lifetime employment commitments", *Quarterly Review of Economics and Business* 23:23-39.
- Cooper, T. E. [1986] "Most-favored-customer pricing and tacit collusion", *Rand Journal of Economics* 17:377-388.
- Daly, G. G. [1998] "Entrepreneurship and business culture in Japan and the U.S.", *Japan and the World Economy* 10:487-494.
- Dixit, A. K. [1979] "A model of duopoly suggesting a theory of enter barrier", *Bell Journal of Economics* 10:20-32.
- Dixit, A. K. [1980] "The role of investment in entry-deterrence", *Economic Journal* 90:95-106.
- Eaton, B. and R. Lipsey [1981] "Capital, commitment and entry equilibrium", *Bell Journal of Economics* 12:593-604.
- Fershtman, C. and K. L. Judd [1987] "Equilibrium incentives in oligopoly", *American Economic Review* 77:927-940.
- Friedman, J. W. [1977] *Oligopoly and the theory of games*. North-Holland, Amsterdam.
- Fumas, V. S. [1992] "Relative performance evaluation of management: the effects on industrial competition and risk sharing", *International Journal of Industrial Organization* 10:473-489.
- Gilbert, R. J. [1989] "Mobility barriers and the value of incumbency" in: R. Schmalensee and R. D. Willig, eds., *Handbook of industrial organization*. Vol. 1. North-Holland, Amsterdam: 475-535.

- Hashimoto, M. and J. Raisian [1985] "Employment tenure and earnings profiles in Japan and the United States", *American Economic Review* **75**:721-735.
- Ito, T. [1992] *The Japanese economy*. Cambridge, MA: MIT Press.
- Kato, T. [2001] "The end of lifetime employment in Japan? Evidence from national surveys and field research", *Journal of the Japanese and International Economies* **15**:489-514.
- Kneller, R. [2003] "Autarkic drug discovery in Japanese pharmaceutical companies: insights into national differences in industrial innovation", *Research Policy* **32**:1805-1827.
- Kräkel, M. [2002] "Delegation and strategic incentives for managers in contests", *Managerial and Decision Economics* **23**:461-470.
- Leibenstein, H. [1987] *Inside the firm: the inefficiencies of hierarchy*. Cambridge, MA: Harvard University Press.
- Miller, N. and A. Pazgal [2001] "The equivalence of price and quantity competition with delegation", *Rand Journal of Economics* **32**:284-301.
- Miller, N. and A. Pazgal [2002] "Relative performance as a strategic commitment mechanism", *Managerial and Decision Economics* **23**:51-68.
- Neilson, W. S. and H. Winter [1992] "Unilateral most-favored-customer pricing: a comparison with Stackelberg", *Economics Letters* **38**:229-232.
- Nomura, M. [1996] "The concept of lifetime employment: a historical critique", *Japanese Economic Studies* **24**:39-57.
- Novshek, W. [1985] "On the existence of Cournot equilibrium", *Review of Economic Studies* **52**:85-98.
- Ohnishi, K. [2001] "Lifetime employment contract and strategic entry deterrence: Cournot and Bertrand", *Australian Economic Papers* **40**:30-43.
- Ohnishi, K. [2002] "On the effectiveness of the lifetime employment contract policy", *The Manchester School* **70**:812-821.
- Ohnishi, K. [2006] "Bertrand games with lifetime employment contracts as a strategic commitment", *The Manchester School* **74**:549-557.
- Ono, H. [2007] "Lifetime employment in Japan: concepts and measurements", SSE/EFI Working Paper Series in Economics and Finance No. 624, Stockholm School of Economics, Stockholm.
- Organisation for Economic Co-operation and Development (OECD) [1986] *Flexibility in the labour market: the current debate: a technical report*. Paris: OECD.

- Peterson, R. B. and J. Sullivan [1990] "The Japanese lifetime employment system: whither it goest?" in: S. B. Prasad, ed., *Advances in international comparative management*. Vol. 5. London: JAI Press: 169-194.
- Poddar, S. [2003] "Excess capacity: a note", *Keio Economic Studies* 40:75-83.
- Shapiro, C. [1989] "Theories of oligopoly behavior" in: R. Schmalensee and R. D. Willig, eds., *Handbook of industrial organization*. Vol. 1. North-Holland, Amsterdam: 329-414.
- Sklivas, S. [1987] "The strategic choice of managerial incentives", *Rand Journal of Economics* 18:452-458.
- Sonnenschein, H. [1968] "The dual of duopoly is complementary monopoly: or, two of Cournot's theories are one", *Journal of Political Economy* 76:316-318.
- Spence, M.A. [1977] "Entry, capacity, investment and oligopolistic pricing", *Bell Journal of Economics* 8:534-544.
- Spulber, D. F. [1981] "Capacity, output, and sequential entry", *American Economic Review* 71:503-514.
- Tirole, J. [1988] *The theory of industrial organization*. Cambridge, MA: MIT Press.
- Ware, R. [1984] "Sunk costs and strategic commitment: a proposed three-stage equilibrium", *Economic Journal* 94:370-378.

