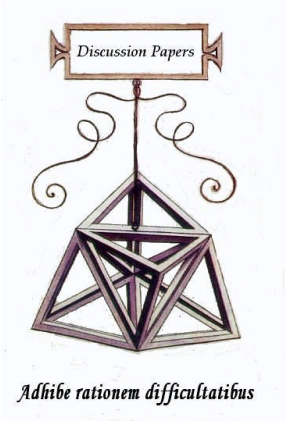
Discussion Papers

Collana di

E-papers del Dipartimento di Scienze Economiche – Università di Pisa



Luciano Fanti

Product differentiation and duopoly: when social welfare benefits from cross-shareholding

Discussion Paper n. 129

2011

***Discussion Paper* n. 129: presentato Novembre 2011**

Luciano Fanti

Department of Economics, University of Pisa

Via Cosimo Ridolfi, 10, I–56124 Pisa (PI), Italy

e-mail address: lfanti@ec.unipi.it

tel.: +39 050 22 16 369

fax: +39 050 22 16 384

© Luciano Fanti

La presente pubblicazione ottempera agli obblighi previsti dall'art. 1 del decreto legislativo luogotenenziale 31 agosto 1945, n. 660.

Product differentiation and duopoly: when social welfare benefits from cross-shareholding

Luciano Fanti*
Department of Economics, University of Pisa, Via Cosimo Ridolfi, 10, I–56124 Pisa (PI), Italy

Abstract The present paper analyses the effects on social welfare of a partial cross-participation at ownership level in a differentiated Cournot duopoly. We show that cross-participation, despite the fact it appears as an anti-competitive practice which reduces the degree of market competition, may increase social welfare when the products are complements between them, and, moreover, not only profit but also consumer's welfare is enhanced. Therefore, the policy implication is that in industries characterised by product complementarity larger cross-participations at ownership level should be allowed, despite their anticompetitive nature.

Keywords Complementary products; Cross-ownership; Duopoly; Product differentiation; Social welfare

JEL Classification D43; L13; L4

* *E-mail address*: lfanti@ec.unipi.it; tel.: +39 050 22 16 369; fax: +39 050 22 16 384.

1. Introduction

A classical tenet of industrial economics is that a reduced quantity competition reduces social welfare (i.e. the reduction in consumers' welfare is always larger than the increase in profits). The present study analyses the effects of an increase in the percentage of cross-ownership in a differentiated duopoly. In particular, we assume the case in which only one firm (i.e., its unique shareholder) acquires its rival's stock as a passive investment that gives it a share in the rival's profit but not in the rival's decision making (namely, a unilateral passive cross-shareholding).[1] Although both a vast empirical[2] as well as theoretical[3] literature on cross-ownership in oligopolies has been developed, the consequences of unilateral partial cross-ownership for social welfare in the presence of differentiated products has not so far, at the best of our knowledge, been explored.[4]

Although the cross-participation at ownership level implies less competition, we show, in contrast with the case of products substitutability, that less competition may be associated with a larger social welfare when products of different varieties are complements amongst them.

The policy content of the model investigated in the paper lies in the fact that in the presence of partial unilateral cross-ownership, competition may be substantially reduced, and although in many practical cases passive investments in rivals were granted as a? de facto exemption from antitrust liability, the cross-ownership practice, just like other practices as horizontal mergers, raise some antitrust concerns (see, for many examples, Gilo and Spiegel, 2003). Therefore, the policy relevance of this result is that for industries in which products are complement, not only the antitrust concerns are unfounded but the unilateral passive cross-ownership should be the largest possible. The reason why social welfare increases with an increasing cross-ownership when products are complements is based on the fact that the output of firm 1, while it is reducing when the owner is raising her share in firm 2 if products are substitutes, becomes rising with cross-ownership if products are complements, so that also the consumer surplus, in addition to industry profits, becomes positively related with the level of cross-participation.

The rest of the paper is organised as follows: Section 2 develops the Cournot duopoly extended with partial cross-ownership and presents the equilibrium outcomes as

---

[1] It must be noted that other different (and more complex) cases of cross-ownership exist: for instance, *i)* the case of multilateral participations in rival firms, which features industries with complex webs of partial cross ownerships (e.g. see Alley, 1997); *ii)* the case in which it is a firm's controller, that is majority or dominant shareholder, instead of the sole shareholder, which makes passive investments in rival firms.

[2] For instance, Alley (1997), as regards the automobile industry, Parker and Roller (1997) as regards the telecommunications industry, Amundsen and Bergman (2002) as regards the energy industry and Trivieri (2007) as regards the banking sector.

[3] For instance, some theoretical effects of cross-ownership has been investigated by: *i)* Macho-Stadler and Verdier (1991), as regards the managerial incentives in a managerial delegation duopoly; (*ii)* Reitman (1994), as regards the incentives of firms to engage in tacit collusion in general, and, more specifically, under either symmetric or asymmetric costs, more recently, by Gilo et al. (2006) and Gilo et al. (2008), respectively; *iii)* Barcena-Ruiz and Oilazola (2007), as regards the incentives to acquire cost-saving production technologies; *iv)* Pal (2010) as regards the level of privatization in a mixed duopoly; *v)* Osano (2011) as regards the equity transfer to strategic partners with possibility of reallocating the corporate resources by the participating firm .

[4] An exception is Fanti (2011), who, however, different from the present paper, studies a unionised duopoly with a homogenous product and focus on the effects of the presence of unions.

regards firms and industry. Section 3 examines the effect of the partial cross-ownership on the consumer and social welfare, showing the dependence of the results by the substitutability or complementarity between products. Section 4 concludes.

2. The model and the profit-maximising solution

2.1 The basic model

We consider a single industry consisting of two firms, 1 and 2, each of which produces a homogeneous good. There are two shareholders, A and B. Firm 1 is completely owned by share-holder A, that owns a participation also in firm 2. Therefore firm 2 is jointly owned by the two shareholders, with shareholder B having the majority of shares and thus also the control of firm 2. We denote by *h (0<h<1/2)* the fraction of shares that shareholder A has in firm 2. Shareholders are assumed to maximize their total profit, which means that the objective function of shareholder A is

$$\pi_A = \pi_1 + h\pi_2 \tag{1}$$

while the objective function of shareholder B is

$$\pi_B = (1-h)\pi_2, \tag{2}$$

Therefore, profits of firm i can be written as

$$\pi_i = p_i q_i - c_i q_i, \qquad i=1, 2, \tag{3}$$

where c_i capture all short-run constant marginal costs.

As regards the determination of the product market demand, following an established literature (e.g. Dixit, 1979; Singh and Vives, 1984; Qiu, 1997; Hackner, 2000), we assume that preferences[5] of the representative consumer over q are given by:

$$U(q_i, q_j) = a(q_i + q_j) - \frac{1}{2}\left(q_i^2 + q_j^2 + 2dq_i q_j\right), \tag{4}$$

where $a > 0$ is a parameter that captures the size of the market demand and $-1 < d < 1$ represents the degree of horizontal product differentiation. Now, some clarifications on the parameter d are in order. If $d = 0$, then goods of variety 1 and 2 are independent (i.e. each firm behaves as if it were a monopolist in its specific market); if $d = 1$, then goods 1 and 2 are perfect substitutes, i.e. homogeneous; $0 < d < 1$ captures the case of imperfect substitutability between goods. The degree of substitutability increases, or equivalently, the extent of product differentiation decreases as the parameter d raises; a negative value of d instead implies that goods 1 and 2 are complements, while $d = -1$ reflects the case of perfect complementarity.

The inverse demand functions of goods 1 and 2 that come from the maximisation by the representative consumer of Eq. (4) subject to the budget constraint $p_1 q_1 + p_2 q_2 + y = M$ (where y is the numeraire good[6] and M denotes the consumer's exogenously given income), are the following:

$$p_1(q_1, q_2) = a - q_1 - d\,q_2, \tag{5.1}$$

$$p_2(q_1, q_2) = a - q_2 - d\,q_1. \tag{5.2}$$

---

[5] The important feature of such preferences is that they generate a system of linear demand functions.

[6] In this class of model it is implicitly assumed that, separately from the duopoly under study, there exist a competitive sector that produces the numeraire good y.

From (1), (2), (3), (5.1) and (5.2), under profit-maximization, firm *i*'s best-reply function is

$$q_1(q_2) = \frac{(a - dq_2(1+h) - c_1)}{2} \quad (6)$$

$$q_2(q_1) = \frac{(a - dq_1 - c_2)}{2} \quad (7)$$

As $h>0$, by assumption, the best-reply functions are downward-sloping, that is, under the Cournot assumption, the product market game is played in strategic substitutes.

2.2. Firm and industry equilibrium.

From (6) and (7) we obtain equilibrium output (respectively, by firm *i*, given c_1 and c_2):

$$q_1 = \frac{\left[a(2 - d(1+h)) - 2c_1 + dc_2(1+h)\right]}{4 - d^2(1+h)} \quad (8)$$

$$q_2 = \frac{\left[a(2-d) - 2c_2 + dc_1\right]}{4 - d^2(1+h)} \quad (9)$$

It is easy to observe that, under cross-ownership, equilibrium output by firm 1 is lower than equilibrium output by firm 2 as the former firm internalises the fact that both firms compete in quantities and thus the latter one is "more aggressive".

We assume, for simplicity, that firms have the same constant marginal costs, i.e. $c_1=c_2=c$. Therefore from (8) and (9) the equilibrium quantities are derived as follows:

$$q_1 = \frac{(a-c)[2 - d(1+h)]}{4 - d^2(1+h)} \quad (8.1)$$

$$q_2 = \frac{(a-c)(2-d)}{4 - d^2(1+h)} \quad (9.1)$$

Since we want to focus on the impact of cross-ownership on social welfare in the presence of product differentiation, then the following remarks are of importance, because they reveal the crucial role of the substitutability (complementarity) between products in determining how output decisions of the shareholder A depend on the increase of her participation in the other firm:

$$\frac{\partial q_1}{\partial h} = \frac{2d(a-c)(d-2)[2 - d(1+h)]}{\left[4 - d^2(1+h)\right]^2} \lessgtr 0 \Leftrightarrow d \gtrless 0, \quad \vee d \in (-1,1) \quad (8.2)$$

$$\frac{\partial q_2}{\partial h} = \frac{d^2(a-c)(2-d)}{\left[4 - d^2(1+h)\right]^2} > 0 \quad (9.2)$$

Remark 1: While when products are substitutes ($d>0$), production in firm 1 is always reduced by an increasing percentage of cross-ownership because firm 1, in contrast with firm 2, internalises the fact that the two firms compete in the product market and thus the latter firm is "more aggressive" in terms of production, when products are complements ($d<0$) the "internalization" due to the cross-ownership implies that

also the production in firm 1 has to increase with that in firm 2 being the product of firm 1 complementary to that of firm 2.

Moreover, the total industry quantity is

$$Q = q_1 + q_2 = \frac{(a-c)[4-d(2+h)]}{4-d^2(1+h)}, \tag{9.3}$$

and we have that $\frac{\partial Q}{\partial h} = -d\,\frac{(a-c)(2-d)^2}{\left[4-d^2(1+h)\right]} \lessgtr 0 \Leftrightarrow d \gtrless 0$ (9.4)

Remark 2: As observed from Eqs. (9.3.) and (9.4), when products are substitutes (*d>0*) industry output is always reducing with an increasing cross-shareholding because the increase of output in firm 2 is always lower than the reduction of output in firm1; by contrast, when products are complements (*d<0*), as noted in remark 1, the production of both firms – and thus the industry production – is increasing with an increasing cross-ownership.

From Eqs. (3), (5), (8), (9), the equilibrium profits are given by:

$$\pi_1 = \frac{(a-c)^2\left[h(1+d)+d-2\right]\left[dh(d-1)+d-2\right]}{(4-d^2(1+h))^2} \tag{10}$$

$$\pi_2 = \frac{(a-c)^2(2-d)^2}{(4-d^2(1+h))^2} \tag{11}$$

$$\pi_A = \pi_1 + h\pi_2 \tag{12.1}$$

$$\pi_B = (1-h)\frac{(a-c)^2(2-d)^2}{(4-d^2(1+h))^2} \tag{12.2}$$

$$\Pi = \pi_1 + \pi_2 = \frac{(a-c)^2\left[d^3h(1+h)+d^2(2-d^2 2h)+8(1-d)\right]}{(4-d^2(1+h))^2} \tag{13}$$

Since the focus of the present study is on the social welfare, it is important to investigate how its important component given by the industry profit is affected by changes in the percentage of cross-shareholding.

$$\frac{\partial \Pi}{\partial h} = \pi_1 + \pi_2 = \frac{d^2(a-c)^2\left[d^3(1+h)-6d^2+4d(3-2h)-8(1-h)\right]}{(4-d^2(1+h))^3} > 0 \Leftarrow h < 0.5 \tag{14}$$

Remark 3. It is easy to see that: profits of firm 2, shareholder A, and total industry (see Eq. 14) are increased by an increase in the percentage of cross-ownership, *h*, (i.e. $\frac{\partial \pi_2}{\partial h}, \frac{\partial \pi_A}{\partial h}, \frac{\partial \Pi}{\partial h} > 0$). However, profits of firm 1 and shareholder B may decrease with

h,[7] but, in the overall industry profits always benefit from the cross-ownership, for whatever degree of product differentiation: this result is expected since the product differentiation implies a "reduction" in the product market competition.

3. Welfare analysis

The consumer surplus is defined, in the presence of horizontal differentiation, as $CS = 0.5\left(q_1^{\ 2} + q_2^{\ 2}\right) + dq_1q_2$, that is:

$$CS = \frac{\left[2d^3(1+h) + d^2(h^2 - 2h - 6) - 4dh + 8\right](a - w^\circ)^2}{2(4 - d^2(1+h))^2} \tag{15}$$

In order to determine the relationship between the consumer surplus and the percentage of cross-ownership, it is easy to observe that

$$\frac{\partial CS}{\partial h} = -d\frac{\left[d^4(1+h) - d^3(2h+5) + 2d^2(3-h) + 4d(1+h) - 8\right](a - w^\circ)^2}{2(4 - d^2(1+h))^3} \lessgtr 0 \Leftrightarrow d \gtrless 0$$

(16). Therefore we remark that:

Remark 4. The consumer surplus is decreasing (or increasing) with the percentage of cross-shareholding depending on whether products are substitutes (or complements).

Since social welfare is given by $SW = CS + \pi_1 + \pi_2$, we have

$$SW = \frac{\left[2d^3(1+h)^2 - d^2(h^2 + 6h + 2) - 4d(4+h) + 24\right](a - w^\circ)^2}{2(4 - d^2(1+h))^2} \tag{17}$$

and

$$\frac{\partial SW}{\partial h} = \frac{d(d-2)\left[\left[2dh(d-1) - d^2 + 4d - 4\right](a - w^\circ)^2\right]}{(4 - d^2(1+h))^3} \lessgtr 0 \Leftrightarrow d \gtrless 0, \quad \vee d \in (-1,1) \tag{18}$$

Given eq. (18), we claim the following result:

Result 1. *Social welfare is reducing (increasing) with an increasing percentage of cross-ownership if products are substitutes (complements).*

Given remarks 3 and 4 and result 1, we obtain the following corollary:

Corollary 1. *When products are complements not only social welfare in the overall but also both producers and consumers agree with the largest possible percentage of cross-ownership.*

The intuition behind these results is that, although the degree of competition is in general reduced by an increased cross-shareholding, when products are complements the larger productive aggressiveness of firm 2 induced by an increased participation in the firm 2 of the owner of firm 1 is no longer more than counterbalanced by a

[7] The derivatives of the profit of shareholder A, B, firm 1 and firm 2, are straightforward and thus omitted here for the sake of brevity. In particular, we note, that while in the case of homogeneous product firm 1's profit is always lowered by an increased cross-ownership, in the case of complementary products ($d<0$) it even increases provided that the percentage of cross-ownership is sufficiently low: for instance, firm 1's profit increases, when $d = -0.1$, for values of $h<0.05$ and, when $d = -2/3$, for $h<0.35$.

corresponding reduction in production by firm 1, as it occurs when products are substitutes between them, but, on the contrary, it is even increased being affected by the complementarity between goods in consumer's demand. This implies that while on the one side industry profit is increased due to the increased, loosely speaking, "degree of monopoly", on the other side also the welfare of consumer is enhanced, due to the expanded quantity.

The policy implication is that, from the perspective of antitrust agencies, our results neatly indicate when the acquisition of a passive percentage of cross-ownership should be either allowed (firms produce complement products) or disallowed (firms produce substitute products).

4. Conclusions

This paper analysed the effects on social welfare of a partial cross-participation at ownership level in a differentiated Cournot duopoly. The main result is that the existence of such a cross-participation, despite the fact it appears as an anti-competitive practice which reduces the degree of market competition, may increase social welfare when products are complements, and, moreover, not only profit but also consumer's welfare is enhanced. Therefore, the policy implication is that in the case of products complementarity, in contrast with the case of products substitutability in which, as expected by conventional wisdom, cross-ownership practices hurt consumer and societal welfare, larger cross-participations at ownership level should be allowed, despite their anticompetitive nature.

The model in the present study suggests a number of directions for future research. One direction is to consider when the partial cross-ownership is *(i)* multilateral, *(ii)* spread equally among rival firms, and *(iii)* made by the most (less) efficient firm under asymmetric costs. Another direction of research is to extend the present model to a multi-stage game with, for instance *i)* upstream suppliers, *ii)* trade unions, *iii)* tax/subsidy policy makers.

References

Alley, W. (1997), Partial ownership arrangements and collusion in the automobile industry. *Journal of Industrial Economics* 45, 191-205.

Amundsen E. S., Bergman L., (2002), Will cross-ownership re-establish market power in the Nordic power market? *The Energy Journal*,, Vol. 23, n. 2, pp. 73-95.

Barcena-Ruiz, J. C. and Olaizola, N., (2007). Cost-saving production technologies and partial ownership. *Economics Bulletin*, Vol. 15, No. 6 pp. 1-8.

Dixit, A.K., 1979. A model of duopoly suggesting a theory of entry barriers. *Bell Journal of Economics* 10, 20–32.

Fanti L., (2011). Welfare effects of cross-ownership in a unionised duopoly. Discussion Papers del Dipartimento di Scienze Economiche – Università di Pisa, n. 125 (http://www-dse.ec.unipi.it/ricerca/discussion-papers.htm).

Gilo, D., and Spiegel, Y. (2003), Partial cross ownership and tacit collusion, The Center for the Study of Industrial Organization at Northwestern University, Working Paper #0038.

Gilo, D., Moshe, Y. and Spiegel, Y. (2006), Partial cross ownership and tacit collusion. *The RAND Journal of Economics*, 37: 81–99.

Gilo, D., Spiegel, Y. and Temurshoev, U., (2008). Partial cross ownership and tacit collusion under cost asymmetries, mimeo, www.ihs.ac.at/vienna/resources/Economics/.../20090604_Spiegel_Paper.pdf.

Hackner, J., 2000. A note on price and quantity competition in differentiated oligopolies. *Journal of Economic Theory* 93, 233–239.

Macho-Stadler, I., Verdier, T., (1991). Strategic managerial incentives and cross ownership structure: A note. *Journal of Economics*, Volume 53, Number 3, 285-297.

Osano H., (2011). Partial ownership and strategic alliances with reallocation of corporate resources, *Journal of Institutional and Theoretical Economics*, 167, 2, 202-223.

Pal, R., (2010). How much should you own? Cross-ownership and privatization, Indira Gandhi Institute of Development Research, Mumbai September, http://www.igidr.ac.in/pdf/publication/WP-2010-015.pdf.

Parker P.M., Roller L.H., (1997), Collusive conduct in duopolies: multimarket contact and cross-ownership in the mobile telephone industry, *RAND Journal of Economics* Vol. 28, No. 2. Summer, pp. 304-322.

Qiu, L.D., 1997. On the dynamic efficiency of Bertrand and Cournot equilibria. *Journal of Economic Theory* 75, 213–229.

Reitman D., (1994). Partial ownership arrangements and the potential for collusion. *Journal of Industrial Economics,* 42:313–322

Singh, N., Vives, X., 1984. Price and quantity competition in a differentiated duopoly. *RAND Journal of Economics* 15, 546–554.

Trivieri F., (2007), Does cross-ownership affect competition?: Evidence from the Italian banking industry, *Journal of International Financial Markets Institutions and Money*, Volume: 17, Issue: 1, Pages: 79-101.