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Spatial Price Competition Between Cooperatives Under Hotelling – Smithies Conjectures

Panos Fousekis

Abstract

The predictions of spatial competition models with regard to the choice of pricing policies are known to be sensitive to the underlying assumptions. To investigate the role of the behavioral assumption the present paper considers a spatial competition model between two cooperatives and compares the results with those of an earlier work which has focused on Investor Owned Firms in the same market and technological environment. According to the results, the aggressive (UD,UD) price configuration is the Nash equilibrium for high intensity of competition, while the quasi-collusive (FOB, FOB) is the Pareto superior Nash equilibrium for intermediate and low intensity of competition.

Key words: *Cooperatives, Spatial Competition, Pricing*
JEL Classification: *L13, C72*

Introduction

Spatial price competition and the associated with it welfare implications has attracted the attention of several researchers in the last 25 years (e.g. Tribl, 2009; Huck *et al*., 2006; Zhang and Sexton, 2001; Espinoza, 1992; Sexton, 1990). It is generally recognized that the outcome of spatial price competition depends largely on three factors: (a) the firms' objective functions, (b) the firms' conjectures regarding the reaction of their competitors, and (c) the firms' pricing policies. Alvarez *et al*. (2000) and Zhang and Sexton (2001) considered oligopsonistic spatial price competition with rivals being Investor Owned Firms (IOFs) aiming at profit maximization. In work of Alvarez *et al*. (2000), conjectures were taken to be Loschian ones implying that each firm expects its rivals to react identically to own price changes. Also, the firms employed the Uniform Delivered (UD) pricing policy (buyers were responsible for transportation costs). With Loschian conjectures and UD pricing market areas are thought by players to be fixed. In the work of Zhang and Sexton (2001) conjectures were taken to be Hotelling-Smithies ones implying that each firm expects its rivals to ignore own price changes. The authors of the latter work examined both the UD as well as Free on Board (FOB) pricing policy (sellers were responsible for transportation costs). Moreover, they derived conditions under which the (FOB,FOB), the (UD,UD), and the mixed (FOB-UD) configurations can be the Nash equilibria of the spatial price competition game.

In the markets of primary commodities such as the agricultural ones buyers or sellers can be cooperatives (coops) which may well compete with each other. A cooperative has a variety of objectives other than profit maximization. These include maxi-

Department of Economics, Aristotle University of Thessaloniki, Greece (fousekis@econ.auth.gr)

mizing members' welfare, charging market prices for inputs and refunding surplus, minimizing (maximizing) member prices for inputs (outputs). Both in the EU and the in USA the agricultural cooperatives contribute substantial parts of the added value in the production, transformation and commercialization of farm products (COGECA, 2005; NCFC, 2008). Despite the importance of the coops in agricultural markets there have been only two works on spatial pricing policies of this unique form of private business. Those are by Tribl (2009) and Huck *et al*. (2006) who considered competition between coops with UD pricing and Loschian conjectures.

The objective of the present work is to investigate spatial price policies of coops under Hotelling-Smithies conjectures. To this end it employs a two-stage duopsony game. In the first stage of the game the coops simultaneously select the pricing regime ((FOB, FOB), (UD,UD), or mixed (FOB,UD)) and in the second they simultaneously select actual prices within the regime. The structure of the game is the same as that considered by Sexton and Zhang (2001) for IOFs; the market and the technological environment are also the same. This allows us to compare our results with those from the earlier work in order to determine how the behavioral assumption (firms' objectives) impact on the pricing policies.

In what follows, Section 2 presents some key results with regard to cooperative as a spatial monopsony. Section 3 obtains solutions for the second stage game under three different configurations of pricing regimes. Section 4 determines pure strategy Nash equilibria for the complete (two-stage) game. Section 5 offers conclusions and suggestions for future research.

The Coop as a Spatial Monopsonist

Let us assume that a homogeneous group of primary produces are continuously dispersed along a line according to the uniform density. A cooperative which process and sells the primary commodity in a downstream (final product) market is located at the one end of that line, let it be point 0. To process the primary commodity the cooperative incurs a constant marginal and average cost, c; the downstream market is perfectly competitive and the final product is sold at a constant unit price, p. Following Huck *et al*. (2006), Zhang and Sexton (2001), and Alvarez *et al*. (2000) we further assume that each primary producer has a linear supply curve x=w(r), where x is the quantity supplied, r the producer's distance from the processor and w(r) is the net price she(he) receives at the gate of the processing facility.

The constant marginal and average processing cost implies a Leontieff production technology where the primary and the processing input are employed in fixed proportions. The Leontieff technology together with the uniform density for the dispersion of the primary producers are commonly used in theoretical works of spatial monopsony and oligopsony (e.g. Tribl, 2009; Alvarez *et al*., 2000; Lofgren, 1986) since they make it possible to obtain analytical solutions. The assumption of a competitive market for the final commodity enable us to focus on the market of the primary commodity. According to Zhang and Sexton (2001) although many primary commodity markets are local and regional (thus giving rise to buyer monopsony power) the markets for final commodities can be national or international suggesting that sellers of those commodities are very likely to operate in perfectly competitive markets. The specification of the supply curve is consistent with a unitary price elasticity.

We consider two alternative pricing regimes. The first, is the FOB pricing regime (or mill pricing) in which the primary producers are responsible for the costs (freight bill) of transporting their product to the processing unit and each receives the same mill price at the processing facility's gate; the net price for a primary producer located at distance r from the mill is w(r)=w-rγ, where γ stands for the freight rate (transportation cost per unit of distance). The second, is the UD pricing regime in which the processor pays the full freight bill; the cost to processor from buying one unit of the primary input from a seller located r units of distance away is w+rγ . Under the FOB regime the processor does not discriminate among primary producers, while under the UD pricing regime the processor discriminates in favor of primary producers located far away from the mill. Besides FOB and UD there is another pricing policy termed as optimal discriminatory in which the processor offers differed delivered prices at different distances from the mill and he pays for the transportation costs (Beckmann, 1976). Often, optimal discrimination is not permitted by from authorities regulating pricing policies. At the same time, firms prefer to use FOB ot UD because they are simple and easy to implement (e.g. Anderson *et al*., 1989; Alvarez *et al*., 2000).

In the following, in order to distinguish between the two pricing policies we denote the (gross) price paid by the coop under mill pricing by m and the (net) price paid under UD pricing by u . Moreover, we adopt the suggestion of Zhang and Sexton (2001) and Alvarez *et al*. (2000) to work with the relative rather than the absolute importance of space in the market. The former is defined as the ratio of freight rate to the final product price net of processing costs, that is, $s = \gamma/(p-c)$. Setting p-c =1 (for normalization) one gets s = γ.

In the relevant literature a number possible objectives for a coop as a buyer have been proposed (e.g. Cotterill, 1987; Bateman *et al*., 1979; Le Vay, 1983). Here, as in Tribl (2009) and Huck *et al*. (2006) we consider the objective of member welfare maximization (that means, the joint maximization of member profits and profits from processing). The profit function of the individual primary producer can be obtained from the supply function through the Envelope Theorem (e.g. Chambers, 1989). Given a linear in net price supply function, the corresponding profit function of the individual primary producer is 0.5(w(r))2 (fixed cost have been set to zero since they have no impact on the subsequent analysis).

Mathematically, the coop's problem under FOB pricing is to maximize

$$(1) \quad W_{FOB} = (1-m)\int_0^{R_{FOB}} (m-sr)dr + 0.5\int_0^{R_{FOB}} (m-sr)^2 dr$$

In (1) W stands for member welfare and RFOB for the endogenously determined market radius; the first term on the Right Hand Side stands for profits from processing, while the second term for member profits from the production of the primary commodity.

An endogenously determined market boundary is consistent with an open

membership cooperative. It is straightforward to show that for an interior maximum m = 1, and RFOB = m/s = 1/s. Substituting into (1) obtains WFOB = 1/(6s). Notice that with m = 1 profit from processing is, at the equilibrium, equal to zero. This suggests that welfare maximization with FOB pricing is at the same time maximization of the price paid to members, subject to the break-even constraint in processing. Moreover, member

welfare maximization is consistent with net average revenue product (NARP) pricing. The net revenue product (NRP) is revenue from processed product sales less processing (and transportation if any) costs, $NRP^{FOB} = 1\int_0^{R_{FOB}}(m - sr)dr$. It stands for the maximum amount that can be paid for the primary commodity without entailing deficits from processing. The net average revenue product is then $NARP^{FOB} = \frac{1\int_0^{R_{FOB}}(m - sr)dr}{\int_0^{R_{FOB}}(m - sr)dr} = 1$, which is the maximum price that can be paid per unit of the primary commodity. A member welfare maximizing coop is NARP pricing since, at the equilibrium, m = NARP = 1.

The coop using UD pricing maximizes

(2) $W_{UD} = u\int_0^{R_{UD}}(1 - u - sr)dr + 0.5\int_0^{R_{UD}}(u)^2 dr = u\int_0^{R_{UD}}(1 - 0.5u - sr)dr$

where RUD stands for the endogenously determined market boundary. It is straightforward to show that for an interior maximum u =2/3, and RUD = (1-0.5u)/s = 2/(3s). Welfare maximization with UD pricing is also consistent with NARP pricing (e.g. Tribl, 2009). Notice that from (2) NRP can be written as $NRP = u\int_0^{R_{Ud}}(1 - sr)dr = uR_{UD}(1 - \frac{sR_{UD}}{2})$. Given that primary producers are uniformly distributed, uR_{UD} is the total quantity supplied and, thus, the $NARP = (1 - \frac{sR_{UD}}{2})$. Substituting in the last RUD = 2/(3s), obtains NARP = u = 2/3. Member welfare with UD pricing is WUD = 4/(27s) < WFOB (FOB pricing entails higher member welfare than UD pricing since under FOB pricing sellers pay the true social cost of transporting the primary input to the processing facility). Finally, note that with UD pricing the COOP cross subsidises between members near and far away from location 0. At its monopsony boundary the processing margin is $1 - u^C - sr = 1 - (2/3) - s(2/(3s)) = -1/3$ per unit. This loss is not a problem as the COOP earns profit of 1/3 per unit through members located at its gate and the quantities affected are exactly the same.

A Spatial Duopsony of Coops with Hotelling-Smithies Conjectures

While a coop as a welfare maximizing monopsony either with FOB or with UD pricing attains break-even in processing, this is not necessarily true for coops involved in spatial price competition (e.g. Tribl, 2009; Sexton, 1990; Staatz, 1987). In case that competition results in surpluses (deficits) from processing these must be allocated to members in the form of refunds (charges) altering, thus, their supply behaviour. The equilibrium then will be the so called Ramsey second-best optimum emerging when the coop maximizes member profits subject to break even constraint processing. It is obvious that the latter maximization problem entails NARP pricing. For this reason, in our

analysis we, as Tribl (2009) and Sexton (1990), assume that the competing coops do price according to the NARP.

Both Coops Employ FOB pricing

Under exactly the same assumptions as above we let the coops (A and B) to be located at the two ends of a line with unit length. In particular, we let coop A to be located at point 0 and coop B to be located as point 1. For small s (high intensity of competition) the market boundary between them, $\bar{R}$, is determined from the equality between net prices

$$m_A - s\bar{R} = m_B - s(1-\bar{R}) \Rightarrow$$

$$\bar{R} = \frac{m_A - m_B + s}{2s}. \quad (3)$$

Since both price according to NARP , $m_A = m_B = 1$ and as result $\bar{R} = s/(2s) = 1/2$ (the market is shared equally between the two). The competition for the market boundary is sustained until $\bar{R} = 1/s$ (the optimal market radius of a coop acting as an isolated spatial monopsony) or $s = 2$. For s > 2 competition ceases to exist; each coop offers m = 1 and buys within the radius $R^{FOB} = 1/s < 0.5$. Zhang and Sexton (2001) find that two IOFs employing FOB pricing compete with each other for values of s < 4/3. In both the present and the earlier study, however, competition evolves only over an area which equals the simple summation of the two firms' monopsony radii (2/s for coops and 4/3s) for IOFs).

One Coop Employs FOB and the Other UD Pricing

Let us, without loss of generality, assume that coop A uses FOB and coop B uses UD. When s is small, the market boundary is determined by the equality between the coops' net prices. Then it is the case,

(4) $m_A - s\bar{R} = u_B$.

Since both price according to NARP, $m_A = 1$ and $u_B = 1 - \frac{s(1-\bar{R})}{2}$. Substituting into (4) obtains $\bar{R} = 1/3$ (the FOB (UD) coop pricing obtains one third (two thirds) of the market). Given $\bar{R}$, the price of coop B is $u_B = 1 - s/3$ (Figure 1). That mode of interaction between the two coops is sustained until the value of s at which: (a) net prices are equal and (b) the UD pricing firm acts as an isolated spatial monopsony ($u_B = 2/3$ and $R^B_{UD} = 2/3s$). Mathematically, $1 - s(1-2/3s) = 2/3$ implying $s = 1$.

For intermediate values of s, the FOB pricing coop acts as a spatial monopsony with a constrained boundary $1 - 2/3s$.[1] That mode of interaction is sustained until the area the FOB pricing coop is willing to serve with $m_A = 1$ equals the area the UD pric-

ing coop leaves for it (that is, until $1/s = 1 - 2/(3s) \Rightarrow s = 5/3$). For even higher values of s the two coops become isolated spatial monopsonists.

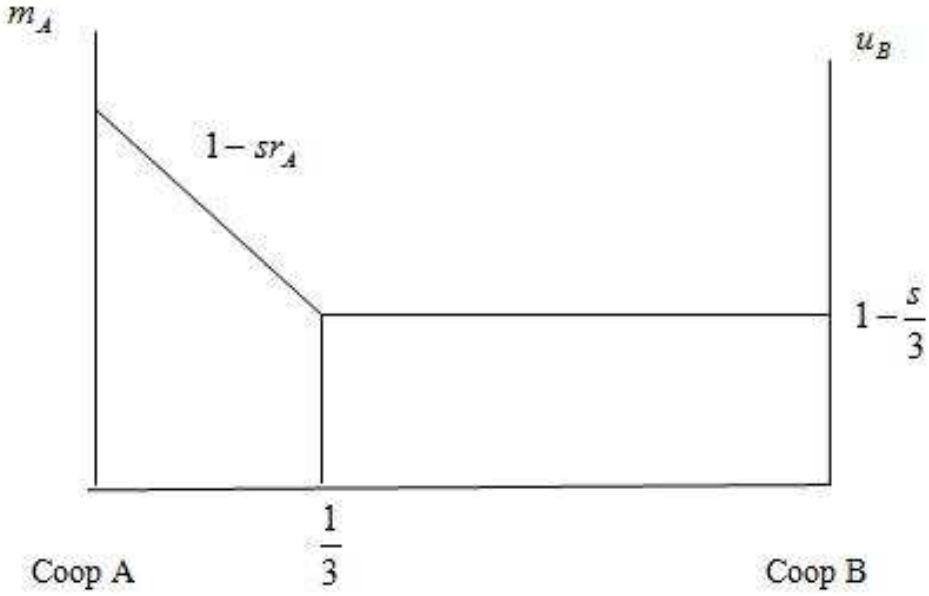

Figure 1 - Competition When Coop A Uses FOB and Coop B Uses UD Pricing

Zhang and Sexton (2001) find that when one IOF employs FOB pricing and the other employs UD pricing the market boundary is determined by the equality of net prices for s< 1.052 which is slightly higher than 1; the IOFs become isolated monopsonists for s > 5/3 suggesting that competition evolves over a larger area than the simple sum of the two firms' monopsony radii (5/3s vs 4/3s). For coops, however, competition evolves only over an area which is the simple sum of the monopsony radii (5/3s = 1/s+2/3s).

Both Coops Employ UD Pricing

It is well known that pure strategy Nash equilibria under UD pricing and Hotelling-Smithies conjectures only exist for values of s allowing the IOFs to operate as isolated spatial monopsonists (e.g. Schuler and Hobbs, 1982; Shilony, 1977; Beckmann, 1973). For lower values of s there are only mixed strategy equilibria (Kats and Thisse, 1989; Dasgupta and Maskin, 1986). A relevant question is whether the same result holds for the coops. To investigate it we follow the approach adopted in earlier studies (e.g. Beckmann, 1973; Zhang and Sexton, 2001). In particular, we attempt to verify whether a coop's the welfare function is continuous or discontinuous in the overbidding and in the conceding strategy. In the case it is continuous the equilibrium is in pure strategies, while in the case it is discontinuous the equilibrium is in mixed strategies.

When coop A overbids (it sets $u^A > u^B$) the welfare of its members is

(5) $W_{UD}^A = 0.5(u^A)^2 R_{UD}^A = (u^A)^2 (1 - u^A)/s$

where the last equation follows because of NARP pricing.[2] When coop A concedes (it sets $u^A < u^B$) the welfare of its members is

$$(6) \quad W_{UD}^{A} = 0.5(u^{A})^{2}(1 - R_{UD}^{B}) = 0.5(u^{A})^{2}(1 - 2(1 - u^{B})/s)$$

where the last equation follows because coop B uses NARP pricing as well. It turns out that welfare from conceding and overbidding coincide when $u = u^{A} = u^{B} = 1 - s/4$ for every s for which the coops interact with each other. In other words, the welfare function is not discontinuous (the Nash equilibrium is in pure strategies, the coops do not randomize between conceding and overbidding).[3] This mode of interaction lasts up to s =4/3. Note that Zhang and Sexton found that the IOFs do randomize for s<4/3. For both coops and IOFs, however, it is the case that competition ceases to exist for s>4/3 and the firms become isolated spatial monopsonists.

Pure Strategy Nash Equilibria in Pricing Regimes

As explained in the Introduction, the first stage of the game involves the optimal choice of the pricing policy (regime). A Nash equilibrium in the first stage is a combination of pure pricing policies from which no coop has the incentive to deviate unilaterally given that in the second stage of the game it expects prices for different values of s to be selected according to the rules obtained in Section 3. Figures 2a presents member welfare (which is identical to member profits from the production of the primary commodity) for coop B under FOB and under UD pricing when coop A employs FOB pricing; Figure 2b presents member welfare for coop B under FOB and under UD pricing when coop A employs UD pricing.

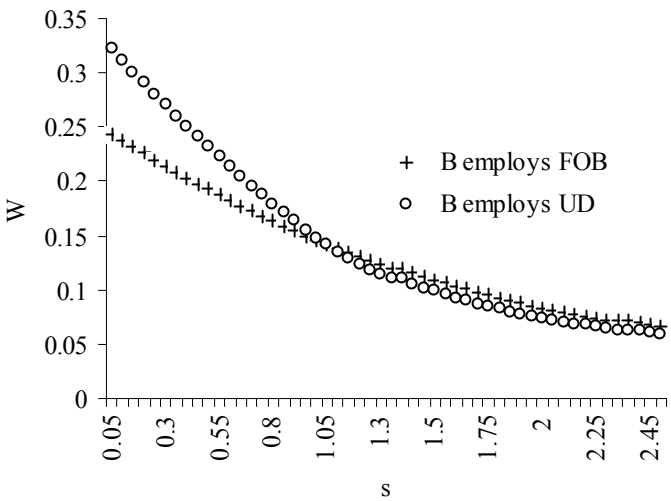

Figure 2a - Member Welfare for Coop B from FOB and UD against FOB by Coop A

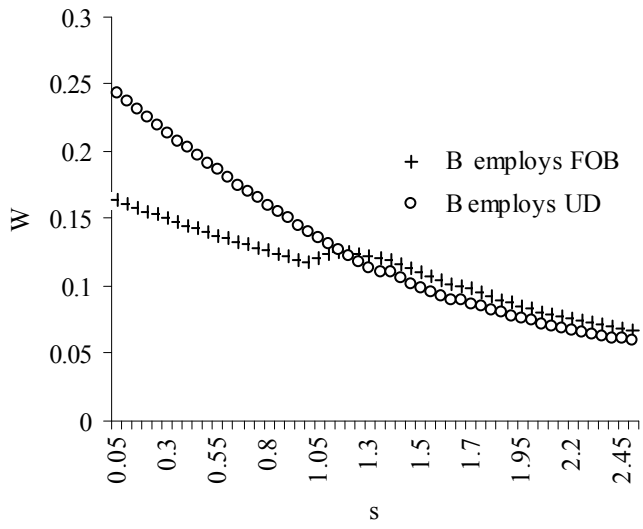

Figure 2b - Member welfare of Coop B from FOB and UD against UD by Coop A

We observe that when coop A plays FOB, coop B obtains higher member welfare from UD rather than from FOB for high intensity of competition (s < 1.03). We also observe that when coop A plays UD, coop B must play UD for s < 1.17. Table 1 presents the pure strategy Nash equilibria in pricing regimes for a duopsony of coops; for comparison purposes it also presents the Nash equilibria for a duopsony of IOFs as determined in the study of Zhang and Sexton (2001). It appears that there are 4 such equilibria. The first emerges for low values of s (implying high intensity of competition) and involves both coops playing UD. The other two equilibria occur for intermediate values of s (that is, for 1.03<s< 1.17); one of them involves both coops playing FOB while the other involves both coops playing UD. The (UD,UD) equilibrium, however, is Pareto inferior to (FOB, FOB) one. This suggests that for 1.03<s< 1.17 the two coops are involved in a Coordination game (both will benefit if somehow coordinate their choices to end up with the (FOB,FOB) equilibrium). As the intensity of competition decreases (s is getting large) (FOB,FOB) emerges as the strictly dominant pure strategy Nash equilibrium of the pricing game. It is worth noting that mixed pricing, which involves one coop playing FOB and the other playing UD, cannot be sustained as a pure strategy Nash equilibrium for any value of s.

The results in this work, therefore, differ considerably from those obtained by Zhang and Sexton (2001) for the duopsony of IOFs. This must be attributed to the fact that the behavioral assumptions of the players in the two spatial pricing games are quite different. The IOFs maximize profits from processing and with Hotelling-Smithies conjectures price according to net marginal revenue product (NMRP); the coops price according to the NARP, seeking breaking even in processing and maximizing member profits.

Table 1 - Nash Equilibria in Pricing Policies

Duopsony of Coops		Duopsony of IOFs*	
Range of *s*	Nash Equilibria	Range of *s*	Nash Equilibria
$s \leq 1.03$	(UD,UD)$^{+}$	$s < 0.413$	(FOB,FOB)$^{+}$
$1.03 < s \leq 1.17$	(FOB,FOB) $^{+++}$ or (UD,UD)	$0.413 \leq s \leq 0.601$	(FOB,UD) or (UD , FOB)
		$0.601 < s < 4/3$	(UD,UD)$^{+}$
$s > 1.17$	(FOB,FOB)$^{+}$	$4/3 \leq s < 5/3$	(FOB,FOB) or (UD ,UD)$^{++}$
		$5/3 \leq s$	Any combination of pricing policies

* From Zhang and Sexton (2001); $^{+}$ strictly dominant strategy equilibrium; $^{++}$ weakly dominant strategy equilibrium; $^{+++}$ Pareto superior Nash equilibrium

The UD pricing is an aggressive one. For low values of s the coops can play aggressively because it is relatively easy to satisfy the break-even constraint even with high net prices to members. As s rises, however, the quasi-collusive FOB strategy takes over.[4] For even larger values s, where the coops act as isolated monopsonists, FOB (under which the primary producers pay the true social cost of transporting their commodity to the factory gate) becomes the strictly dominant pricing strategy since it maximizes member welfare.

Conclusions and Suggestions for Future Research

The existence of transportation costs impacts on firm behavior, competition, and market outcomes. Optimal spatial pricing policies depend (among other things) on the rival firms' objectives. To investigate the role of the behavioral assumption the present work considers competition between coops with Hotelling-Smithies objectives using a dynamic (two-stage) game. According to the results: (a) the aggressive (UD,UD) pricing is a Nash equilibrium for small importance of space in the market (that is, for high intensity of price competition). As the importance of space rises the Nash equilibrium changes into the (FOB, FOB) price configuration; (b) the mixed (FOB,UD) pricing cannot be sustained as a Nash equilibrium for any value of s; (c) the UD pricing does not entail randomization between conceding and overbidding. As long as the coops interact with each other, they use pure strategies and they share the market equally.

The predictions of the model where players are coops are, therefore, quite different from those obtained for profit maximizing IOFs under the same market and technological environment. The difference in predictions can be attributed to pricing rules. The coop attempts to maximize member profits subject to the breakeven constraint in processing, while the IOF maximizes profits from processing.

The game considered in the present work (and the earlier by Sexton and Zhang, 2001), is a symmetric one. In the real world markets, however, coops compete with agri-food IOFs resulting in asymmetric pricing games. As a matter of fact, in the most recent years, there is a trend for consolidation of small coops to compete effectively

against large and efficient manufacturers (e.g. COGECA, 2005). Some work on spatial markets where players with different objective functions meet has already been done by Sexton (1990) using a static game with FOB pricing. It appears that a potentially fruitful direction of research in the future could be the analysis of a dynamic asymmetric game where players select among alternative pricing policies.

Also, in the present work the location of each COOP has been treated as fixed (that is, given exogenously). In the real world spatial competition, however, the location can be a choice variable along with the price and the pricing policy. Future research, therefore, should consider richer interactions where both location and pricing are employed as instruments of spatial competition. This of course will require dynamic games involving at least three stages.

References

Alvarez, A.M., Fidalgo, E.G, Sexton, R.J., and M. Zhang (2000). Oligopsony Power with Uniform Spatial Pricing: Theory and Application to Milk Processing in Spain. *European Review of Agricultural Economics*, 27:347-64.

Anderson,, S.P., de Palma, A. and Thisse, J_F (1989). Spatial price policies reconsidered. *Journal of Industrial Economics* 38:1-18

Bateman, D., Edwards, G. and Le Vay, C. (1979). Agricultural cooperatives and the theory of the firm. *Oxford Agrarian Studies* 8: 63-81.

Beckmann, M. J. (1973). Spatial Oligopsony as a non Cooperative Game. *International Journal of Game Theory*, 2: 263-68.

Beckmann, M.J. (1976). Spatial price policies revisited. *Bell Journal of Economics*, 7:619-630.

Chambers, R. (1989). Applied Production Analysis: A Dual Approach. Cambridge University Press.

COGECA (2005). Agricultural Cooperatives in Europe. Issues and Trends. www.copa-cogega.be

Cotterill, R. (1987). Agricultural Cooperatives: a Unified Theory of Pricing, Finance and Investment. USDA, Agricultural Service Report No 18.

Dasgupta, P., and E. Maskin (1986). The Existence of Equilibrium in Discontinuous Economic Games, I: Theory. *Review of Economic Studies*, 53:1-26.

Espinoza, M. P. (1992). Delivered Pricing, FOB Pricing, and Collusion in Spatial Markets. *Rand Journal of Economics*, 23:64-85.

Huck, P., Salhofer K., and c. Tribl (2006). Spatial competition of Milk Processing Cooperatives in Northern Germany. Presented at the International Association of Agricultural Economists Conference, Gold Coast, Australia, August 12-18.

Kats, A., and J-F Thisse (1989). Spatial Oligopolies with Uniform Delivered Pricing. In H. Ohta and J-F Thisse (eds), Does Economic Space Matters? St Martins Press, NY.

Le Vay, C. (1983). Agricultural cooperative theory: A review. *Journal of Agricultural Economics* 34:1-44.

Lofgren, K. G. (1986). The Spatial Monopsony: A Theoretical Analysis. *Journal of Regional Science*, 28:707-730.

NCFC (2008). Cooperative Facts. www.ncfc.org/cooperative-facts.html

Schuler, R.E., and B.F. Hobbs (1982). Spatial Price Duopsony Under Uniform Delivered Pricing. *Journal of Industrial Economics*, 31: 175-87.

Sexton, R. (1990). Imperfect Competition in Agricultural Markets and the Role of Cooperatives.

American Journal of Agricultural Economics, 72:709-20.

Shilony, Y. (1977). Mixed pricing in oligopoly. *Journal of Economic Theory* 14:373-388.

Tribl, C. (2009). Spatial Competition in Mixed Markets of Food Processors. The Cases of Uniform Delivered Pricing. Paper Presented at the International Workshop "Rural Cooperation in the 21st Century: Lessons from the Past, Pathways for the Future." Rehovot, Israel, June 15-17, 2009.

Zhang, M., and R. J. Sexton (2001). FOB or Uniform Delivered Prices? Strategic Choice and Welfare Effects. *Journal of Industrial Economics*, 49: 197-221.

[1] Here there is an important difference with the duopsony of IOFs considered by Zhang and Sexton (2001), where the UD pricing firm constraints the FOB pricing one through its effective (not its actual) boundary. As mentioned in Section 2 the UD pricing COOP cross-subsidies between members located close and away of each gate. Therefore, if it buys an irregular supply appearing at its boundary it will make loss -1/3 per unit processed; this local loss will not be offset by any additional profit and the break-even constraint will be violated. A behavior consistent with even-breaking is that of refusing to process supply from primary producers located beyond $2/(3s)$. For further details see Tribl (2009).

[2] Again, the overbidding coop cannot accept supply from producers beyond its boundary in order not to violate the break-even constraint. Note that at its boundary there is a local loss of $1-u-rs = 1-u-s(2(1-u)/s) = -1+u = -s/4 < 0$ which cannot be offset by any additional profit.

[3] One can check that $u^A = u^B = 1-s/4$ is Nash equilibrium directly. In particular, when COOP A sets its UD price equal to $u^A = 1-s/4$ it serves (because of NARP pricing) area $R^A = 2(1-u^A)/s = 0.5$ leaving for B area $R^B = 0.5$ as well. Since B also uses NARP pricing it sets $u^B = 1-(s/2)(0.5) = 1-s/4.$ Therefore with $u^A = u^B = 1-s/4$ each COOP bests responds to the other.

[4] It is called so because it restricts competition between firms to the market boundary, in contrast with the aggressive UD pricing which entails direct competition over most or all of the market area.