

# WELFARE ENHANCING COORDINATION IN CONSUMER COOPERATIVES UNDER MIXED OLIGOPOLY

MARCO MARINI, PAOLO POLIDORI, DÉsirÉE TEOBALDELLI, AND ALBERTO ZEVI

**ABSTRACT.** The recent globalization of world economies has led the retail markets of developed countries towards increasing levels of integration and strategic interdependence. A non negligible share of retail and food markets is currently served by co-operative societies. Consistently with this trend, the consumer cooperatives have recently experienced increasing levels of integration. The main aim of this paper is to study the welfare effects of coordination among consumer cooperatives competing in quantities in a mixed oligopoly against profit-maximizing firms. We show that, in absence of agency problems, whereas under increasing or constant returns to scale a higher output coordination of consumer cooperatives may not affect the total welfare as long as a nonnegative profit constraint holds, under decreasing returns to scale the consumer cooperatives may contribute more to social welfare when acting on behalf of *all* consumers. This is because, by coordinating consumers' preferences, these firms can reduce their market output, thus helping the market to come closer to the first best. All together these results seem to provide an argument in favour of the recent process of integration involving consumer cooperatives in many developed countries.

**Keywords:** Consumer Cooperatives, Mixed Oligopoly, Profit-maximizing Firms, Mergers.

**JEL codes:** L13, L21, L22, L31, L33, L81, P13.

## 1. INTRODUCTION

Many industries of advanced economies have recently witnessed an increasing participation of consumers in the role of producers.<sup>1</sup> This has occurred, for instance, with the massive diffusion of internet, where consumers often play the double role of users and producers of knowledge (e.g. *Wikipedia* and the various instances of open source software); with the diffusion of home power solar installations, which allow their users to consume as well as to sell the energy in excess; with local food distribution chains, where consumers are increasingly active in running collective purchasing groups, just to cite a few examples. However, the involvement of consumers in the production and distribution of goods is not new. Since 1844, with the Rochdale Society of Equitable Pioneers, the consumers have been the main

---

*Date:* August 2014.

Corresponding author, Marco A. Marini, Sapienza Università di Roma, Via Ariosto, 25, 00185, Rome, Italy. E-mail: marini@dis.uniroma1.it.

Paolo Polidori, Università degli Studi di Urbino "Carlo Bo", Urbino, Italy. E-mail: paolo.polidori@uniurb.it.

Désirée Teobaldelli, Università degli Studi di Urbino "Carlo Bo", Urbino, Italy. E-mail: desiree.teobaldelli@uniurb.it.

Alberto Zevi, Centro Studi Legacoop, Rome, Italy.. E-mail: a.zevi@legacoop.it.

<sup>1</sup>Toffler (1980) has denoted this type of consumers *prosumers*. See also Dean and Jurgenson (2012).

stakeholders of organizations known as *consumer cooperatives*. Although in some cases the wide and disperse membership of consumers does not allow a their full involvement in all decisional processes (see e.g., Spear 2004), they nevertheless play a role in the decision-making of these organizations. For several years the cooperative societies have operated in the retail industry of numerous countries. In Europe, for instance, more than 3,200 consumer cooperatives yield a turnover of about 70 billion euro, employing 300,000 workers and serving 25 million consumer-members (Euro-Coop 2008). In Japan, to cite another relevant example, 25.8 million members purchase products from consumer cooperatives, contributing with a turnover of approximately 38,365 billion US dollar (JCCU, 2009). In some countries, cooperative societies have gained a dominant position in retail markets. In Switzerland, for instance, the two major groups of consumer cooperatives (*Migros* and *Coop*) account for 4.5 million members and a turnover of 27.4 billion euro. In Finland, the total proportion of cooperative members on the existing population is one of the highest world-wide, with approximately 2 million of consumers-members associated to the two main groups (*S-group* and *Tradeka*) that jointly generate a turnover of more than 11 billion euro (Euro-Coop 2009).

During the last decades the retail industries of most developed economies have gone through a massive restructuring process with, in particular, a substantial increase of the retailers' market power along the whole supply chain. Consistently with this trend, the consumer cooperatives have recently experienced increasing levels of integration. In Italy, for instance, most of the existing consumer cooperatives have merged in nine major groups, covering a share of approximately 18% of the retail market (E-coop 2010). In Switzerland, a long integration process has led the two major groups, *Migros* and *Coop*, to cover up to 70% of the retail industry. In UK, the consumer cooperatives have experienced a sequence of mergers, a strategy explicitly favoured by the cooperative movement to strengthen its position in the market (Report on Co-operative Mergers and Acquisitions, Euro-Coop, 2011). As recently observed, "the British retail market is a functioning oligopoly, and cooperative mergers have occurred not a moment too soon"; moreover, referring to 2002 merger between CWS (Co-operative Wholesale Society) and CRS (Co-operative Retail Services) "...two large retail systems (were) combined, excess store capacity reduced, and staffing realigned. The combined volume and reduction of costs and duplicate retail locations was the smartest cooperative move in half a century" (David Thompson 2009).

Not surprisingly, the increasing concentration of retail industry has raised some concerns in European antitrust authorities.<sup>2</sup> However, given the peculiar objective-function of this type of firms, it is not immediately obvious whether the integration process of consumer cooperatives should raise any concern on the policy makers. If a consumer cooperative aims at maximizing the welfare of its members (i.e. consumers), why should a merger of these organizations harm the retail market competition? In contrast, the integration of these firms might help the market to reach higher levels of discipline and welfare. Additional questions arise. Which are the welfare effects of the consumer cooperatives integration in a strategic environment? Which role do firms' technology and market competition play on the incentives of these organizations to integrate?

In this paper we try to address some of the above issues, mainly from a theoretical perspective. More specifically, we introduce a simple model to compare the performances of two

---

<sup>2</sup>For an account of the recent anti-trust investigations in EC countries on the retail distribution market see, for instance, Pera and Bonfitto (2011) and the references quoted therein.

types of consumer cooperatives assumed to compete in a quantity mixed oligopoly against traditional profit-maximizing firms:<sup>3</sup>

1. **decentralized consumer cooperatives** which operate independently and maximize the utility of each atomistic consumer-member;
2. **centralized consumer cooperatives**, which operate in group and maximize the welfare of *all consumers*.

The latter type of behaviour, although abstracting from agency problems, may provide some information on the behaviour of largely integrated groups of consumer cooperatives when the number of their consumer-members approaches which of *all* consumers in the market. To simplify, we will assume that the consumers are identical, and, hence, that there are no differences between mean and median customer patronizing the cooperatives. Moreover, in accordance with the traditional models of consumer cooperatives (e.g., Anderson, Porter and Maurice, 1979 and 1980) we will assume that each consumer-member receives a share of the firm's profit proportional to his/her individual consumption, in the form of a patronage dividend.

The main difference between the two organizational models is, thus, that whereas in the *decentralized* case the cooperative acts on behalf of each atomistic consumer and cannot affect strategically the market prices, in the *centralized* case the consumers have a weight and, hence, they exert a direct influence on prices. It is already well known that, in general, under either perfect competition or monopoly, if a consumer cooperative acts on behalf of *all* consumers it has an incentive to adopt a *marginal cost pricing rule*, instead of a classic *average cost pricing rule* usually obtained for consumer cooperatives.<sup>4</sup> However, we will see that, when the group of cooperatives decide strategically their quantities against the profit-maximizing rivals, they possess an incentive to further expand their outputs (with respect to the marginal cost pricing rule) to reduce the prices charged by the rival profit-maximizing firms, whose revenue enter the budget constraints of their consumer-members.<sup>5</sup> However, if the cooperatives are not allowed to make losses, under constant or decreasing marginal costs, the final effect of integration on output will be null, and similarly the final effect on welfare.<sup>6</sup> When instead the marginal costs are increasing (and therefore higher than average costs), a centralized cooperative can induce a higher output than under a pure marginal cost rule but still lower than a decentralized cooperative. This reduction, and the consequent increase of profit-maximizing firms' output, can be shown to be beneficial for social welfare. To summarize, our model shows that: (i) *ex post* a centralized cooperative could find convenient to delegate its decision power to a manager, with the aim to avoid the losses due to the

---

<sup>3</sup>See De Fraja and Delbono (1990) for a definition of mixed oligopoly that, roughly speaking, is an oligopoly in which the firms possess different objective-functions.

<sup>4</sup>The marginal cost pricing rule maximizes the welfare of all consumers, This efficiency result is well-known and can be found, in different forms, in Enke (1945), Farrell (1985), Hart and Moore (1996) as well as in more recent papers as in Renstrom and Yalcin (2003) and Kelsey and Milne (2005).

<sup>5</sup>Active price policy of this sort have already been considered in the past: "Some co-operators, for example, believe that (co-operative) societies should follow a low price, because this might force other retailers to reduce their prices, and so benefit *all* consumers." (Yamey, 1950, p.34). For a recent discussions on the behaviour of consumer cooperatives operating in a strategic environment see, for instance, Delsey and Milne (2008).

<sup>6</sup>We just remind that in the long-run under constant marginal costs the average costs coincide with the marginal costs whereas under decreasing marginal costs the average costs are lower than marginal costs. Therefore, in both cases if a firm sets a price lower than the marginal cost, it makes a loss.

incentive of consumers to overproduce; (ii) if this occurs, a merger (or a coordination) of consumer cooperatives can be neutral or ultimately positive for social welfare.

Let us consider a oversimplified example to see the logic of our results. Suppose a small village with only two stores, one run by all (identical) consumers (villagers) and the other by a private entrepreneur. The two stores are selling two goods which are (imperfectly) substitutes, and both produced at an average cost of 1. Let the two goods be in the budget constraint of all consumers. Now, suppose that the store managed by the consumers decides to set a net price of 1 or, equivalently, a gross price higher than 1 (corresponding to a net price of 1 after the patronage dividend).<sup>7</sup> In this case, all consumers should be satisfied, since they are buying the good of the cooperative at the lowest possible price. However, such a pricing rule is not optimal. Since the consumers are also willing to buy the good sold by the private entrepreneur (who is charging a price higher than 1 to maximize his profit) the cooperative could act strategically by selling its good at a lower price (say 0.90) just to induce a reduction on the entrepreneur's price. In this case, although the consumers are still paying their good a unitary price (0.90 plus a per unit negative rebate of 0.10 to repay the loss), they can still save on the price charged by the entrepreneur. However, if generating losses is forbidden to the cooperative, the described price undercutting strategy will only be viable when the firm's marginal cost is increasing (and higher than average cost). In this case, acting strategically to maximize their own surplus, all consumers may decide to sell their product at a price lower than marginal cost without generating losses, and at the same time reducing the price charged by their profit-maximizing rival. We will see that, in term of social welfare, such a strategy can yield better results than the average cost pricing rule, provided that the marginal cost is not too low (or market competition not too high) for every centralized cooperative to expand too much their outputs and generating losses.

Our paper basically applies the logic of this example to a mixed oligopoly. We focus on quantity competition and show that, in absence of agency problems, when a nonnegative profit constraint holds, the behaviour of consumer cooperatives is either not affected by the integration process, since firms are constrained to follow an average cost pricing rule or, alternatively, causes a restrictive effect on their outputs (and an expansive effect on those of for-profit rivals), which is welfare enhancing. The first case occurs, in particular, when firms' technology exhibits increasing or constant returns to scale (and long-run average costs are decreasing or constant); the second when firms' technology exhibits decreasing returns to scale (and long-run average costs are increasing).

Overall, our paper provides an argument in favour of the integration of consumer cooperatives in oligopolistic markets. It also supports the idea that if agency problems are not too severe and the main reason for consumers to delegate their firm's control to a manager is to avoid losses, there is no reason for antitrust authorities to fear the merger activities of these organizations. Moreover, our paper provides a formal treatment of the integration effects of consumer cooperatives when competing oligopolistically against profit-maximizing firms.

The paper is organized as follows; the next section briefly reviews some of the recent contributions to the literature on consumer cooperative and customer-owned firms. Section 3 introduces a basic model to illustrate the behaviour of consumer cooperatives competing oligopolistically with profit-maximizing firms. Section 4 applies the analysis to linear-demand

---

<sup>7</sup>In the example we use price rather than quantity (as we do in the paper) as the main stores' strategy only for sake of simplicity.

and linear-cost (or quadratic-cost) mixed oligopolies to show how the interplay between firm's technology and competition can be crucial for the final effect of integration on welfare, in particular under decreasing returns to scale. Section 5 discusses and concludes.

## 2. RELATED LITERATURE

It is well known that most of the classical literature on consumer cooperatives (e.g. Bekenstein 1943, Enke 1945, Yamey 1950, Anderson, Porter & Maurice 1979 and 1980, Ireland and Law 1980, Zusman 1982, Sexton 1983, Sexton 1983, Sexton and Sexton 1987 and Farrell 1985) mainly focuses on the behaviour of these organizations under either perfect competition or monopoly. The possibility that consumer cooperatives operate in oligopolistic markets is also not explicitly considered in a number of more recent papers comparing the behaviour of investor-owned firms to which of consumer-owned firms (Hart and Moore 1996 and 1998 and Mikami 2003 and 2010). With an extreme simplification, useful for our purposes, the main results obtained by the papers mentioned above are that: (i) a consumer cooperative maximizing the net surplus of *all* consumers should set a price equal to the marginal cost (e.g. Enke 1945 and Farrell 1985); (ii) a consumer cooperative acting on behalf of a representative consumer receiving a dividend (or rebate) proportional to his/her purchases, should optimally set its price equal to the average cost (Helmberger and Hoos 1962 and Anderson, Porter & Maurice 1979). Therefore, only when the optimal number of consumer-members for which the minimum average cost is reached, the results of these two models coincide (e.g. Ireland and Law 1983, Anderson, Porter & Maurice 1980). However, as observed above, currently in many advanced economies the consumer cooperatives compete strategically against profit-maximizing firms in markets labelled as *mixed oligopolies*. The Finnish retail industry with one cooperative group (*S-group*) and one profit-maximizing group (*Kesko Oyj*) serving together 77% of the whole market, represents, in this respect, a paradigmatic example (see *S-group* 2009 and *HOK-Elanto* 2010).

To the best of our knowledge there are not many contributions studying the behaviour of consumer cooperatives competing with profit-maximizing firms in mixed oligopolies. A number of papers, as those by Rodhes (1983), Fulton (1989), Sexton (1990), Tennbakk (1995), Albaek and Schultz (1998) and more recently Fulton and Giannakas (2001), Giannakas *et al.* (2005), Pennerstorfer & Weiss (2007) and Feng and Hendrickse (2011) mostly consider models in which an investor-owned firm and an agriculture cooperative compete strategically on the intermediate input market. These papers deal specifically with *marketing co-ops* (as opposed to *purchasing co-ops*) i.e. organizations established by farmers to transform, distribute and sell their intermediate products. Thus, most of these results are of no practical use for the analysis of consumer cooperatives, except when agricultural cooperatives are portrayed in their role of inputs buyers (purchasing co-ops) on behalf of farmers who, in this case, should behave as the consumer-members of a consumer cooperative.

There are, however, a few papers which are closely related to our own paper. Kelsey and Milne (2008) study the possibility that a firm governed by its consumers sells its products in an oligopolistic market. They show that having the consumers among its own stakeholders may give the firm a strategic advantage, ultimately increasing its equilibrium profit. Their paper considers both quantity and prices competition and, therefore, represents a useful benchmark for the model developed in our paper. Goering (2008) studies a homogeneous good duopoly with one profit-maximizing firm and one nonprofit firm assumed to maximize a combination of profit and consumers' surplus. Marini and Zevi (2011) show that in a mixed

oligopoly with symmetrically differentiated goods and constant returns to scale the presence of consumer cooperatives increases the welfare if compared to a pure profit-maximizing oligopoly. In terms of separation of ownership and control, Kopel and Marini (2013) show that, differently from profit-maximizing firms, consumer cooperatives may refrain from using profit-and-sale incentive schemes to pay their managers, as due to their peculiar objective function.

The specific issue of the integration of consumer cooperatives in a mixed oligopoly has not, so far, been considered by the literature.<sup>8</sup> However, Prufer (2011) shows that in a duopoly where firms sell vertically differentiated goods the merger of two customer-dominated firms can increase the welfare, even in absence of economies of scale or of synergies due to the merger. The reason is that, if the firm's manager (in case of separation of ownership and control) sets a price above the marginal cost, after the merger has taken place, the consumers (who have a stake in the firm) can react by reducing the firm's provision of quality, with the purpose to maximize their net utility. This would mitigate the excessive quality provision of customer-dominated nonprofits (e.g., hospitals) and, hence, increase welfare. This result contrasts the idea that antitrust legislation should treat in the same way the mergers occurring among for-profits and those occurring between nonprofits (see, for instance, Philipson and Posner, 2006). It also convalidates the recent practise of US courts to treat differently hospitals mergers from other standard corporate merger cases (see, for instance, Vita and Sacher 2006 and Richman 2007). Therefore, our model extends and qualify this view, by providing a formal treatment of coordination and merger issues for consumer cooperatives competing in a mixed oligopoly.

### 3. THE MODEL

In this section we introduce a simple model of consumer cooperatives competing in a quantity mixed oligopoly against profit-maximizing firms. In order to represent the demand side of the market we assume a *continuum* of atomistic consumers  $i \in I$ , with  $I = [0, 1]$ , possessing quasi-linear preferences over a bundle of  $n$  *substitute* goods  $x_k$ , ( $k = 1, \dots, n$ ) and one *numeraire*  $y$ . Every consumer's preferences are expressed by a quasi-linear utility function,

$$(3.1) \quad U^i(x_1^i, \dots, x_k^i, \dots, x_n^i, y^i) = u_i(x_1^i, \dots, x_k^i, \dots, x_n^i) + y^i$$

where  $x_k^i$  and  $y^i$  denote the consumption of the goods and of the *numeraire* by every individual customer  $i$ . Let  $u_i(\cdot)$  be twice continuously differentiable, increasing and strictly concave in  $x_k^i$  for every  $k = 1, 2, \dots, n$ .

At the internal solution every individual inverse demand is obtained from the first-order conditions of the maximization problem (3.1) of a consumer  $i$  subject to her budget constraint

$$(3.2) \quad \sum_{k=1}^n p_k x_k^i + y^i \leq \bar{y}^i,$$

where  $\bar{y}^i$  denotes the initial endowment of the *numeraire* used by the consumer as income. Every consumer's first order conditions yields

---

<sup>8</sup>The issue of vertical integration and its effects on market competition and welfare has been considered for marketing agricultural cooperatives in competition with private firms (see e.g. Crespi et al., 2012).

$$(3.3) \quad p_k = \frac{\partial u_i(x_1^i, x_2^i, \dots, x_n^i)}{\partial x_k^i}, \text{ for } x_k^i > 0 \text{ and } k = 1, 2, \dots, n.$$

Since the market is a quantity oligopoly, in (3.2) the price of each  $k$ -th good depends on all firms' quantities as  $p_k = p_k(\mathbf{x})$  for  $\mathbf{x} = (x_1, \dots, x_n)$ .

Let the industry be populated by  $n$  firms supplying  $n$  goods (or bundles of goods), whose, in turn,  $m < n$  are supplied by consumer cooperatives and  $(n - m)$  by traditional profit-maximizing firms. Let  $M \subset N$  denote the subset of firms managed by consumers (with  $m$  indicating their arbitrary number) and  $N \setminus M$  the set of those governed as profit-maximizing firms, whose number is, therefore,  $(n - m)$ . As usual, the profit-maximizing firms ( $j \in N \setminus M$ ) are assumed to maximize their profit with respect to their output, i. e.

$$(3.4) \quad \pi_j(x_1, \dots, x_n) = p_j(\mathbf{x}) x_j - c_j(x_j),$$

where  $c_j(x_j)$  denotes a generic cost function.

We now introduce two distinct types of consumer cooperatives competing against profit-maximizing firms: (i) a consumer cooperative acting on behalf of a representative consumer (*decentralized cooperative*); (ii) a consumer cooperative coordinating its action in a pool of consumer cooperatives, assumed to act on behalf of *all* market consumers (*centralized cooperative*). These two polar cases are assumed to approximate, in turn, the behaviour of a consumer cooperative playing in an uncoordinated fashion or, in turn, which of a group of cooperatives coordinating their output decisions on behalf of all consumers. Thus, when consumer cooperatives merge or organize themselves in larger groups, it is interpreted here as if all consumers coordinate their behaviour to maximize their joint utilities.<sup>9</sup> As mentioned above, we abstract completely from the agency problems and from the synergies due to the integration of firms and we concentrate on the effects that these two simplified models of governance yield on market outcomes.

**3.1. The Decentralized Case.** Consider first the case of a consumer cooperative producing a good (denoted  $h$ ) on behalf of a representative consumer, assumed to receive a share of the firm's net profit proportional to her share of consumption of the good, i.e.  $x_h^i/x_h$ . This is a standard assumption in modelling consumer cooperatives (e.g., Anderson *et al.* 1979 and 1980) also reflecting a well known practise in which a consumer cooperative pays each member a dividend (or rebate) proportional to the monetary value of her purchases. In this case, the problem faced by each consumer cooperative is:

$$(3.5) \quad \begin{aligned} & \max_{x_h^i} u^i(x_1^i, x_2^i, \dots, x_n^i) + y^i \quad \text{s.t.} \\ & \sum_{k=1}^n p_k(x_1, \dots, x_n) x_k^i + y^i \leq \bar{y}^i + \sum_{h \in M} \frac{x_h^i}{x_h} [p_h(x_1, \dots, x_n) x_h - c_h(x_h)]. \end{aligned}$$

The problem (3.5) reduces to

$$(3.6) \quad \max_{x_h^i} \left\{ u_i(x_1^i, x_2^i, \dots, x_n^i) + \bar{y}^i - \sum_{h \in M} \frac{c_h(x_h)}{x_h} x_h^i - \sum_{j \in N \setminus M} p_j(x_1, \dots, x_n) x_j^i \right\}$$

---

<sup>9</sup>Here consumers' utilities are transferable and can be summed up.

and the FOC for an interior maximum of each cooperative  $h \in M$  is simply given by

$$(3.7) \quad \frac{\partial u_i(x_1^i, \dots, x_n^i)}{\partial x_h^i} = \frac{c_h(x_h)}{x_h} \text{ for } x_h > 0,$$

provided that the equilibrium price is sufficiently high to generate a nonnegative profit, namely,<sup>10</sup>

$$(3.8) \quad p_h(x_1, \dots, x_n) \geq c_h(x_h)/x_h.$$

A consumer cooperative sets its output to equate the representative consumer's willingness to pay for good  $h$  - equal by (3.3) to its price - to the average cost. As a result, for this type of cooperative, the *average cost pricing rule*, widely known in the literature on consumer cooperatives (Helmberger and Hoos 1962, Anderson, Porter & Maurice 1979, Ireland and Law 1983), also holds under mixed oligopoly. This depends on the fact that, whereas a price reduction has a second-order effect on the shares of profit of individual consumers, it has a first-order effect on their surplus (see also Kelsey and Milne 2005 and 2010 and Marini and Zevi 2011). However, we show now that this result does not necessarily hold if each cooperative acts coordinately to maximize the joint utilities of all consumers (see also Enke 1945 and Farrell 1985 for the monopoly case).

**3.2. The Centralized Case.** Let now every consumer cooperative to be part of a pool of cooperatives and, therefore, act on behalf of *all* consumers, with the specific aim to maximize the sum of their utilities. Under quantity competition, it can be easily proved (see the Appendix) that every cooperative  $h \in M$  faces the following maximization program:

$$(3.9) \quad \max_{\{x_h\}_{h \in M}} \left\{ u(\mathbf{x}) + \bar{y} - \sum_{j \in N \setminus M} p_j(\mathbf{x}) x_j - \sum_{h \in M} c_h(x_h) \right\},$$

where, again,  $\mathbf{x} = (x_1, x_2, \dots, x_n)$ . For every  $h$ -th centralized cooperative the first order condition of (3.9) implies:

$$(3.10) \quad p_h(\mathbf{x}) = \underbrace{\frac{\partial c_h(x_h)}{\partial x_h}}_{MC_h} + \underbrace{\sum_{j \in N \setminus M} \frac{\partial p_j(\mathbf{x})}{\partial x_h} x_j}_{\sum_{j \in N \setminus M} \frac{\partial R_j}{\partial x_h}}$$

again, under the nonnegative profit constraint, i.e. for  $p_h(\mathbf{x}) \geq AC_h(x_h)$ , where  $AC_h(x_h)$  denotes the cooperative's average cost. Note also that, in (3.10),  $R_j$  denotes the revenue of every  $j$ -th profit-maximizing firm. Expression (3.10) can be easily interpreted as follows. When a consumer cooperative acts on behalf of *all consumers*, it opts for a marginal cost pricing rule with, in addition, a distortion due to its incentive to reduce the revenues of its rival profit-maximizing firms, given that the amount spent on  $(n - m)$  goods produced by the profit-maximizing firms enters the consumer-members' budget constraints (see expression 3.2). In other terms, when competing in a quantity oligopoly, a centralized consumer cooperatives tries to reduce the prices of goods sold by the profit-maximizing firms, with the aim to favour its members. The direction of this effect on output can, in general, be positive or negative depending if goods are, in turn, complements or substitutes. In our model goods

<sup>10</sup>As mentioned in the introduction, throughout the paper we will generally assume that consumer cooperatives are not allowed to generate losses.



are *substitutes* and, thus, a centralized cooperative possesses an incentive to set a quantity which makes the price lower than marginal cost.<sup>11</sup> Now, since under quantity competition by aggregating condition (3.3) for all consumers we obtain

$$(3.11) \quad \frac{\partial u(\mathbf{x})}{\partial x_h} = p_h(\mathbf{x})$$

which defines the inverse demand of each cooperative  $h \in M$ , by (3.10) and (3.11) we can write

$$(3.12) \quad p_h(\mathbf{x}) - \sum_{k \in N \setminus M} \frac{\partial p_k(\mathbf{x})}{\partial x_h} x_k = MC_h(x_h)$$

where  $MC_h$  denotes firm's  $h$  marginal cost. Thus, under either *constant* or *decreasing* average cost, the first-order conditions of all centralized cooperatives require that

$$(3.13) \quad p_h(\mathbf{x}) < MC_h(x_h) \leq AC_h(x_h).$$

The first inequality directly follows from (3.12) and from the fact that goods are substitutes ( $\frac{\partial p_k(\mathbf{x})}{\partial x_h} < 0$ ); the second from the fact that, under either constant or decreasing average costs, the marginal costs are equal or lower than average costs. As a result, since losses are forbidden, when the technology exhibits increasing or constant economies to scale, the centralized cooperative will set a price equal to the average cost (compare 3.13 and 3.8).

It can be noticed that, if a centralized cooperative operates under monopoly or perfect competition, expression (3.10) directly implies that the quantity will be set to the level for which the price is equal to the marginal cost. Under oligopolistic competition and quantity competition instead, expression (3.10) shows that, if unconstrained, these organizations have an incentive to sell higher quantities than when they just follow a marginal cost pricing rule.

Overall, the above analysis shows that in a mixed oligopoly the integration process of cooperatives could actually induce more, and not less, competition, at least as long as the firms operate under increasing or constant returns to scale. If the cooperative group - as we assume here - requires that all its units respect a nonnegative profit constraint, the most natural pricing rule emerging for consumer cooperatives is a price equal to the average cost (higher than marginal cost under both constant and increasing returns to scale). When this is the case, the integration process of cooperatives should not cause any consequence on welfare.

As shown through a series of examples in the next section, only under *decreasing returns to scale* the welfare effect of centralization can be either positive (or null when profits are negative) depending on the interplay between cost parameters and market competition. In particular, we show that when the integration has the effect to reduce the excessive market output of cooperatives, it can help the market to come closer to the first best.

#### 4. MIXED OLIGOPOLY EXAMPLES

To illustrate in more detail the welfare effect of cooperatives coordination, it is sufficient to consider a simple case with linear demand and, in turn, linear or quadratic costs. For simplicity we assume that all firms possess identical strategy sets (i.e. output levels) given

---

<sup>11</sup>Ireland and Law (1983) discussed the possibility that consumer cooperatives could charge their members either a positive or a negative entrance fee.

by  $X_k = [0, \infty)$ . We also assume that consumers' preferences are expressed by a standard quadratic utility function:

$$(4.1) \quad U_i(x_1^i, x_2^i, \dots, x_n^i, y) = a \sum_{k=1}^n x_k^i - (1/2) \left[ \sum_{k=1}^n (x_k^i)^2 + \beta \sum_{k=1}^n x_k^i \sum_{r \neq k} x_r^i \right] + y^i$$

where  $a > 0$  and  $\beta \in (0, 1)$  represent the degree of products differentiation. For  $\beta = 0$ , goods are independent, whereas for  $\beta = 1$  goods are perfect substitutes (see, e.g., Singh and Dixit, 1984).

**4.1. Constant Returns to Scale Technology.** Let first assume a constant-return-to-scale technology such that every firm ( $k = 1, 2, \dots, n$ ) possesses a linear cost function,  $c_k(x_j) = cx_k$ , with  $a > c > 0$ . Using the results obtained in Marini and Zevi (2011) for the decentralized case (here denoted  $\mathbf{x}^{dc}$ ), we can just consider here the mixed oligopoly equilibrium (denoted  $\mathbf{x}^{cc}$ ) with  $m$  centralized cooperatives competing in quantity against  $(n - m)$  profit-maximizing firms. Relegating all calculations to the Appendix, it is easy to see that at the unconstrained equilibrium  $\mathbf{x}^{cc} = (x_1^{cc}, x_2^{cc}, \dots, x_n^{cc})$ , for every centralized cooperative  $h \in M$ ,

$$p_h(\mathbf{x}^{cc}) < c$$

and, therefore, its resulting profit is negative. Moreover, for every profit-maximizing firm  $j \in N \setminus M$ ,

$$p_j(\mathbf{x}^{cc}) > c$$

and, therefore, its resulting profit is positive. Moreover, in terms of total welfare, comparing the two unconstrained mixed equilibria, it can be checked that,  $W^{cc} < W^{dc}$ . Under the unconstrained equilibrium, the incentive of the group of cooperatives to undercut prices and maximize consumers' surplus is costly in terms of social welfare. However, if consumer cooperatives are not allowed to realize losses, under centralization they will set a price equal to average cost and, hence,  $W^{cc} = W^{dc}$ . A similar invariance result would be obtained under increasing returns of scale (corresponding to decreasing average costs).

**4.2. Decreasing Returns to Scale Technology.** We now consider the mixed oligopoly case with linear demand and quadratic cost, i.e.  $c_k(x_j) = \frac{c}{2}x_k^2$ . Again, we assume two alternative scenarios where, in turn, a number  $m$  of decentralized (or of centralized) cooperatives are competing against  $(n - m)$  profit-maximizing firms (see the Appendix for a detailed derivations of these results). In this case we obtain that, whenever the value of the cost parameter  $c$  is sufficiently high to ensure positive profits for decentralized cooperatives, the equilibrium quantity of a centralized cooperative is always lower than which of a decentralized one. Given the negative slope of best-replies, the opposite holds for the quantities of profit maximizing firms.

**Proposition 1.** *In a quantity mixed oligopoly with linear demand, quadratic costs and, in turn,  $h \in M$  decentralized (dc) or centralized (cc) consumer cooperatives competing against  $j \in N \setminus M$  profit maximizing firms, for  $c > \underline{c}(n.m.\beta)$ , the following (Nash) equilibrium outputs are obtained:*

$$x_h^{dc} > x_h^{cc} > x_k^{PO} > x_k^{PMF} > x_j^{cc} > x_j^{dc}$$

where  $\underline{c} = \underline{c}(n.m.\beta)$  is the level of the cost parameter  $c$  that makes a centralized cooperative's profit positive, whereas  $x_k^{PO}$  denotes every  $k = 1, 2, \dots, n$  firm's Pareto-optimal quantity and  $x_k^{PMF}$  every  $k = 1, 2, \dots, n$  firm's quantity in a pure profit-maximizing oligopoly.

*Proof.* See the Appendix. □

The result of Proposition 1 shows that under decreasing returns to scale and quadratic costs a decentralized cooperative always produces more output than a centralized cooperative if the level of cost is sufficiently high ( $c > \underline{c}$ ) for the latter to make positive profits. Moreover, the proposition shows that all type of cooperatives overproduce with respect to a firm adopting a marginal cost pricing rule ( $x_k^{PO}$ ), which corresponds to the Pareto optimal level. Thus, whenever the cost parameter  $c$  is sufficiently high for each centralized cooperative to be profitable, this types of firms will produce less than a decentralized one, since in this case the marginal cost is sufficiently higher than the average cost for such gap to be offset by the undercutting effect on profit-maximizing firms contained in expression (3.10). For this reason the final effect of cooperatives' coordination will be to reduce their excessive outputs increasing, in turn, the insufficiently low output of profit-maximizing firms with, overall, a negative effect on total market output but with a positive effect on social welfare. See propositions 2 and 3 below.

**Proposition 2.** *In a quantity mixed oligopoly with linear demand, quadratic costs and, in turn,  $h \in M$  decentralized (dc) or centralized (cc) consumer cooperatives competing with  $j \in N \setminus M$  profit maximizing firms, if  $c > \underline{c}(n.m.\beta)$  the following equilibrium total market outputs (denoted  $X$ ) are obtained:*

$$X^{dc} > X^{PO} > X^{cc} > X^{PMF}.$$

*Proof.* See Appendix. □

The result of Proposition 2 is illustrated in Figure 1 for the duopoly case. When the production cost is sufficiently high for the centralized cooperatives to be profitable ( $c > 0.366$  in the numerical example), a mixed duopoly with decentralized consumer cooperative (red dashed line) overproduces with respect to the centralized case (green dotted line), i.e.  $X^{dc} > X^{cc}$ . In both cases a mixed duopoly yields a higher output than a pure profit-maximizing duopoly (black squared line). As shown in Proposition 1, when the cost parameter is sufficiently high (or market competition not too intense) the consumers' coordination reduces the consumer cooperatives' outputs and increases those of profit-maximizing firms, which are suboptimally low. This causes in one shot two positive effects, thus re-balancing both firms outputs towards their first-best levels. For this reason the equilibrium market output with centralized cooperatives ( $X^{cc}$ ), although lower than the first-best ( $X^{PO}$ ), improve upon the welfare obtained in the mixed oligopoly with decentralized cooperatives (see Proposition 3).

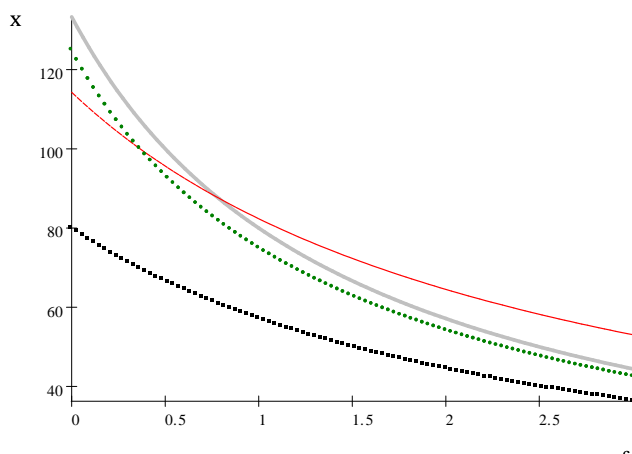


Fig. 1 - Equilibrium market outputs:  $X^{dc}$  (red dashed line),  $X^{cc}$  (green dotted line),  $X^{PMF}$  (black squared line),  $X^{PO}$  (thick grey line),  $a = 100$ ,  $\beta = 0.5$ ,  $n = 2$ ,  $m = 1$ ,  $c \in (0, 3)$ .

**Proposition 3.** *In a quantity mixed oligopoly with linear demand, quadratic costs and with, in turn,  $h \in M$  decentralized (dc) or centralized (cc) cooperatives competing with  $j \in N \setminus M$  profit maximizing firms, if  $c > \underline{c}(n, m, \beta)$ ,*

$$W^{PO} > W^{cc} > W^{dc}.$$

*Proof.* See the Appendix. □

Figure 2 shows that, under decreasing returns of scale, the level of welfare in a mixed oligopoly equilibrium with centralized cooperatives (dotted line) is always higher than that obtained in a pure profit-maximizing market (black squared line) and lower than its first-best level ( $W^{PO}$ ). Moreover, the centralized governance of cooperatives under the nonnegative profit constraint (which in the numerical example of Figure 2 holds for  $c > 0.366$ ) always enhances the welfare compared to the decentralized case (red dashed line).

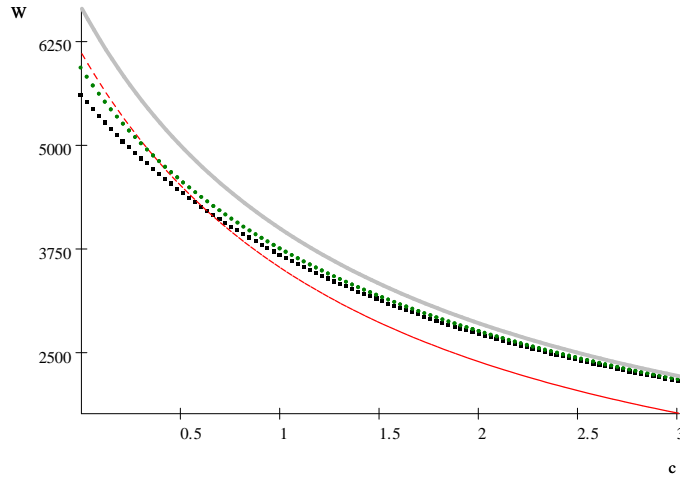


Fig. 2 - Market welfare:  $W^{dc}$  (red dashed line),  $W^{cc}$  (green dotted line),  $W^{PMF}$  (black squared line),  $W^{PO}$  (thick grey line),  $a = 100$ ,  $\beta = 0.5$ ,  $n = 2$ ,  $m = 1$ ,  $c \in (0, 3)$ .

## 5. CONCLUDING REMARKS

We have shown that in a mixed oligopoly with consumer cooperatives and profit-maximizing firms the interplay between objective-functions, existing technologies and intensity of market competition matters for the level of output and social welfare obtained in equilibrium. In particular we have shown that the way in which a group of consumer cooperatives is managed in an oligopolistic market can have consequences and, in particular, that there is a behavioural difference between an *uncoordinated* governance and a *coordinated* governance exerted on behalf of all consumers. In particular, we have shown that in a mixed oligopoly the existence of coordination between consumer cooperatives may give these firms an incentive to expand their outputs in order to reduce the prices charged by their profit-maximizing counterparts. This result can also be seen as shedding some light on the effects obtained in an imperfectly competitive market by the aggregation of the purchasing power of a group of consumers. Related to this point, our model highlights the strategic importance, for a large cooperative group, to pursuit nonnegative profits, in order to defend the consumers

from potentially dangerous budgetary losses and the whole society from improper welfare reductions.

In particular, we have seen that the existence of a nonnegative profit constraint may reestablish the incentive of a consumer cooperatives to adopt average-cost pricing rules, except when the firm's technology exhibits decreasing returns to scale and production costs are sufficiently high. In these cases the coordination between cooperatives can actually help these firms to refrain from selling excessive market outputs if compared to their Pareto optimal levels.

There are many possible extensions of the analysis presented in this paper which may be envisaged. Firstly, the paper has taken a purely theoretic perspective, looking at the consumer cooperatives as organizations with no agency problems, directly aimed at maximizing the consumers' interest. The principal-agent relationship between cooperative members and managers has been discussed intensively in the literature on cooperative corporate governance (see e.g. Spear 2004, Nilsson 2001, Cornforth 2004, Sykuta and Cook 2001, Richards *et al.* 1998). However, a more extended analysis of the existing tensions between firms' managers and consumers' objective-functions in a mixed oligopoly with consumer cooperatives would be, in our view, of great interest. Secondly, the existence of large sunk costs typical of retail industries has been assumed away from the analysis. Also this point would deserve greater attention. We hope that both issues will be matter of future research.

#### REFERENCES

- [1] Albaek S. and C. Schultz (1998), "On the Relative Advantage of Cooperatives", *Economics Letters*, 59, 397-401.
- [2] Anderson, R. K., P. K. Porter, and C. S. Maurice (1979). "The Economics of Consumer-Managed Firms", *Southern Economic Journal*, 119-30.
- [3] Anderson, R. K., S. C. Maurice, and P. K. Porter (1980), "Factor Usage by Consumer-Managed Firms", *Southern Economic Journal*, 47(2), 522-30.
- [4] Bekenstein A. L. (1943) "A Theoretical Analysis of Consumer Co-operatives: The Managerial Problem", *Journal of Political Economy*, 51, 251-257.
- [5] Cornforth, C. (2004), "The Governance of Cooperatives and Mutual Associations: a Paradox Perspectives", *Annals of Public and Cooperative Economics*, 75(1), 11-32.
- [6] Crespi, J. M., T. L. Saitone, R. J. Sexton (2012), "Competition in U.S. Farm Product Markets: Do Long-Run Incentives Trump Short-Run Market Power?", *Applied Economic Perspectives and Policy*, 34, 4, 669-695.
- [7] Dean, G. P. and N. Jurgenson (2012), "The Coming of Age of the Prosumer", *American Behavioral Scientist*, 56, 4, 379-98.
- [8] De Fraja, G. and F. Delbono (1990), "Game Theoretic Models of Mixed Oligopoly", *Journal of Economic Surveys* 4, 1-17.
- [9] Enke, S. (1945), "Consumer Cooperatives and Economic Efficiency", *American Economic Review*, March, 148-155.
- [10] EuroCoop (2008, 2009), *Activity Reports*, European Association of Consumer Cooperatives, Bruxelles.
- [11] Farrell, J. (1985), "Owner-Consumers and Efficiency", *Economics Letters*, 19, 303-306.
- [12] Feng, L. and G. Hendrickse (2011), "Chain Interdependencies, Measurement Problems, and Efficient Governance Structure: Cooperatives versus Publicly Listed Firms", *European Review of Agricultural Economics*, 32, 2, 241-255.
- [13] Fulton, M. (1989), "Cooperatives in Oligopolistic Industries: The Western Canadian Fertilizer Industry", *Journal of Agricultural Cooperation*, 4, 1-19.
- [14] Fulton, M. and K. Giannakas (2001) "Organizational Commitment in a Mixed Oligopoly: Agricultural Cooperatives and Investor-Owned Firms", *American Journal of Agricultural Economics*, 83, 5, 1258-65.

- [15] Giannakas, K., and M. Fulton (2005) "Process Innovation Activity in a Mixed Oligopoly: The Role of Cooperatives", *American Journal of Agricultural Economics*, 87(2): 406-22.
- [16] Hart, O. and J. Moore (1996), "The Governance of Exchanges: Members' Cooperatives versus Outside Ownership", *Oxford Review of Economic Policy*, 12, 4, 53-69.
- [17] Hart, O. and J. Moore (1998), "Cooperatives vs. Outside Ownership", *Harvard Institute of Economic Research Working Papers* 1816, Harvard, Institute of Economic Research.
- [18] Helmberger, P., and S. Hoos, (1962) "Cooperative Enterprise and Organization Theory", *Journal of Farmer Economics*, 44, 275-90.
- [19] HOK-Elanto (2010), Market Share of HOK-Elanto Increased to 40,9 per cent. <http://www.hokelanto.fi/index.php?id=3837>.
- [20] Ireland N. and P. J. Law (1983), "A Cournot-Nash Model of the Consumer Cooperative", *Southern Economic Journal*, 49, 706-716.
- [21] ICA (2006), *ICA Annual Report*. International Cooperative Alliance, Geneva.
- [22] JCCU (2009), *Co-op 2009, Facts & Figures*. Japanese Consumers' Co-operative Union, Tokyo.
- [23] Kelsey, D. and F. Milne (2008), "Imperfect Competition and Corporate Governance", *Journal of Public Economic Theory*, 10, 1115-1141.
- [24] Kelsey, D. and F. Milne (2010), "Takeovers and Cooperatives: Governance and Stability in Non-corporate Firms", *Journal of Economics*, 99, 193-209.
- [25] Kopel, M. and M. A. Marini (2013), "Strategic Delegation in Consumer Cooperatives under Mixed Oligopoly", *Journal of Economics*, forthcoming.
- [26] Marini, M. A. and A. Zevi (2011), "Just One of Us: Consumers Playing Oligopoly in Mixed Markets", *Journal of Economics*, 104, 3, 239-263.
- [27] Mikami, K. (2003), "Market Power and the Form of Enterprise: Capitalist Firms, Worker-owned Firms and Consumer Cooperatives", *Journal of Economic Behaviour and Organization*, 52, 4, December, 533-552.
- [28] Mikami, K. (2010) "Capital Procurement of a Consumer Cooperative: Role of the Membership Market", *Economic Systems*, 34, 2, 178-197.
- [29] Pennerstorfer D. and C.R.Weiss (2007), "Do Cooperatives Offer High Quality Products?", *mimeo*, Vienna University of Economics and Business.
- [30] Pera A. and Bonfitto V. (2011), "Buyer Power in Anti-trust Investigations: a Review", *European Competition Law Review*, 8, 414-425.
- [31] Philipson T. J., R. A. Posner, (2009) "Antitrust in the Not-for-Profit Sector", 52, *Journal of Law and Economics* 1-18.
- [32] Prufer J. (2011), "Competition and Mergers among Nonprofits", *Journal of Competition Law & Economics*, 7, 69-92.
- [33] Rhodes, V. J. (1983), "The Large Agricultural Cooperative as a Competitor", *American Journal of Agricultural Economics*, 65, 1090-95.
- [34] Renstrom, T., and E. Yalcin (2003), "Endogenous Firm Objectives", *Journal of Public Economic Theory*, 5, 67-94.
- [35] Richards, T. J., K. K. Klein, and A. Walburger (1998), "Principal-Agent Relationships in Agricultural Cooperatives: An Empirical Analysis from Rural Alberta", *Journal of Cooperatives*, 21-34.
- [36] Richman, B. D. (2007) "Antitrust and Nonprofit Hospital Mergers: A Return to Basics", *University of Pennsylvania Law Review*, 121-149.
- [37] Sandler, T. and J. Tschirhart (1981), "On the Number and Membership size of Consumer Managed Firms", *Southern Economic Journal*, 1086-1091.
- [38] Sexton, R. (1983), "Economic Considerations in Forming Cooperatives and Establishing Pricing and Financing Policies", *The Journal of Consumer Affairs*, 17, 2, 290-314.
- [39] Sexton, R. (1986), "The Formation of Cooperatives: a Game-theoretic Approach with Implications for Cooperative Finance, Decision-making and Stability", *American Journal of Agricultural Economics*, 68, 214-225.
- [40] Sexton, R. I. and A. Sexton (1987), "Cooperatives as Entrants", *Rand Journal of Economics*, 18, 581-95.
- [41] Sexton, R. J. (1990), "Imperfect Competition in Agricultural Markets and the Role of Cooperatives: a Spatial Analysis", *American Journal of Agricultural Economics*, 72, 709-20.

- [42] Singh, N. and A. Dixit (1984), "Price and Quantity Competition in a Differentiated Duopoly", *Rand Journal of Economics*, 15, 4, 546-554.
- [43] S-group (2009), S-group today, [http://mediapalvelu.s-kanava.fi/s-ryhma/aineistopankki/fi\\_FI/aineistopankki/\\_files/82089551893367828/default/S\\_ryhma\\_tanaan\\_2008\\_200309.pdf](http://mediapalvelu.s-kanava.fi/s-ryhma/aineistopankki/fi_FI/aineistopankki/_files/82089551893367828/default/S_ryhma_tanaan_2008_200309.pdf).
- [44] Spear, R. (2004) "Governance in democratic member-based organisations", *Annals of Public and Co-operative Economics*, 75(1), 33-59.
- [45] Sykuta, M. E. and M. L. Cook. (2001) "A New Institutional Economics Approach to Contracts and Cooperatives", *American Journal of Agricultural Economics*, 83(5), 1273-79.
- [46] Tenbakk, B. (1995) "Marketing Cooperatives in Mixed Duopolies", *Journal of Agricultural Economics*, 46, 1, 33-45.
- [47] Thompson, D. (2009), "Mergers, marketing and membership", *Cooperative Grocer Network*, Jan 20, 2009.
- [48] Toffler, A. (1980), "The Third Wave: The Classic Study of Tomorrow." New York, NY: Bantam and Ritzer.
- [49] Vita, M. G., S. Sacher, (2001), "The Competitive Effects of Not-for-Profit Hospital Mergers: A Case Study", 49, *Journal of Industrial Economics* 63-84.
- [50] Yamey, B.S. (1950) "The Price Policy of Cooperative Societies", *Economica*, February, 23-42.
- [51] Zusman, P. (1982) "Group Choice in an Agricultural Marketing Cooperative", *Canadian Journal of Economics*, 15, 220-34.

## 6. APPENDIX

**6.1. The Centralized Cooperative.** When a consumer cooperative acts on behalf of *all* market consumers, it maximizes the sum of their utilities (here assumed transferable). Each  $h$ -th consumer cooperative would, therefore, solve the following maximization program:

$$(6.1) \quad \max_{x_h} \int_{i \in I} U_i(x_1^i, \dots, x_n^i, y^i) di \quad \text{s.t.}$$

$$\sum_{k=1}^n p_k(\mathbf{x}) \int_{i \in I} x_k^i di + \int_{i \in I} y^i di \leq \int_{i \in I} \bar{y}^i di + \sum_{h \in M} \frac{\int_{i \in I} x_h^i di}{x_h} [p_h(\mathbf{x}) x_h - c_h(x_h)],$$

where  $\mathbf{x} = (x_1, x_2, \dots, x_n)$ . Using the fact that

$$(6.2) \quad \sum_{k=1}^n p_k(x_1, \dots, x_n) x_k^i + y^i = \bar{y}^i,$$

and  $I = [0, 1]$ , problem (6.1) can be rewritten as

$$\max_{\{x_h\}_{h \in M}} \left\{ u(\mathbf{x}) + \bar{y} - \sum_{j \in N \setminus M} p_j(\mathbf{x}) x_j - \sum_{h \in M} c_h(x_h) \right\}$$

with FOC, for every  $h \in M$ :

$$(6.3) \quad \frac{\partial u(\mathbf{x})}{\partial x_h} = \frac{\partial c_h(x_h)}{\partial x_h} + \sum_{k \in N \setminus M} \frac{\partial p_k(\mathbf{x})}{\partial x_h} x_k.$$

Since by consumers' maximization,

$$(6.4) \quad \frac{\partial u(\mathbf{x})}{\partial x_h} = p_h,$$

expression (6.3) writes as

$$(6.5) \quad p_h(\mathbf{x}) = MC_h(x_h) + \sum_{j \in N \setminus M} \frac{\partial p_j(\mathbf{x})}{\partial x_h} x_j,$$

showing that the price for an unconstrained centralized cooperative will be usually lower than those obtained using a marginal cost pricing rule.

Assuming a quadratic utility function, carrying out the derivations for each consumer in the usual way and then aggregating for all consumers yields the following inverse demand functions for all  $k$  goods as

$$(6.6) \quad p_k(\mathbf{x}) = a - x_k - \beta \sum_{r \neq k} x_r.$$

Since the demand is linear, in the first-order condition of every centralized cooperative  $h \in M$  we will have that

$$\sum_{k \in N \setminus M} \frac{\partial p_k(\mathbf{x})}{\partial x_h} x_k = -\beta(n-m)x_j$$

and, therefore, using the symmetry of all cooperatives  $h \in M$ , the first-order condition (6.3) reduces to

$$a - x_h - \beta(m-1)x_l - \beta(n-m)x_j = MC_h - \beta(n-m)x_j,$$

where  $l \in M \setminus h$  and  $j \in N \setminus M$ , implying that the marginal benefits of one additional unit of output for the consumers is exactly offset by the marginal effect that this unit has on the revenues of profit-maximizing firms. For this reason, in the case of quadratic utility (and linear demand), the best-replies of centralized cooperatives are independent of the outputs of profit-maximizing firms and depend only on the outputs of other cooperatives, as

$$x_h(\mathbf{x}_l) = a - \beta(m-1) \{\mathbf{x}_l\}_{l \in \{M\} \setminus h} - MC_h.$$

The best-replies of all profit-maximizing firms will be, instead, as usual in the case of quantity competition, negatively sloped.

**6.2. Constant Returns Oligopoly Case.** In the mixed oligopoly with linear costs, the total welfare can be easily computed as:

$$W = (a-c) \sum_{k=1}^n x_k - (1/2) \left[ \sum_{k=1}^n (x_k)^2 + \beta \sum_{k=1}^n x_k \sum_{r \neq k} x_r \right].$$

In the *decentralized case*, using (3.3), (3.4) and (3.7) and exploiting the symmetry of all cooperatives and all profit-maximizing firms, the following expression for the welfare is obtained:<sup>12</sup>

$$(6.7) \quad W^{dc} = \frac{1}{2} \frac{(n-m)(a-c)^2(1-\beta)(3+\beta(n+m-4)-\beta^2(n-1))}{(2+\beta(n+m-3)-\beta^2(n-1))^2} + \frac{1}{2} \frac{m(a-c)^2(2-\beta)}{2+\beta(n+m-3)-\beta^2(n-1)},$$

which holds for any arbitrary number of cooperatives and of profit-maximizing firms. For the mixed oligopoly equilibrium with centralized cooperatives, using the first-order conditions (3.10) and not taking into account the nonnegative profit constraint, we obtain the following Nash equilibrium quantities:

$$x_h^{cc} = \frac{a-c}{1+\beta(m-1)}$$

for every  $h \in M$  and

<sup>12</sup>See Marini and Zevi (2011). Note that, for simplicity, in what follows we will set  $y = 0$ .



$$x_j^{cc} = \frac{(a-c)(1-\beta)}{((n-m-1)\beta+2)(\beta(m-1)+1)}$$

for all  $j \in N \setminus M$ . It can be easily checked that, for  $n > m$  and  $\beta \in (0, 1)$ , the profit of every decentralized cooperative  $h \in M$  is

$$\pi_h(\mathbf{x}^{cc}) = \frac{(a-c)^2(\beta-1)(n-m)\beta}{((n-m-1)\beta+2)^2(\beta(m-1)+1)^2} < 0,$$

implying that, at an unconstrained equilibrium:

$$p_h(\mathbf{x}^{cc}) < c.$$

Moreover, it is easy to obtain the profit of every profit-maximizing firm  $j \in N \setminus M$  as

$$\pi_j(\mathbf{x}^{cc}) = \frac{(a-c)^2(1-\beta)^2}{((n-m-1)\beta+2)^2(\beta(m-1)+1)^2} > 0.$$

The total welfare is:

$$W^{cc} = \frac{1}{2} \frac{(n-m)(1-\beta)(a-c)^2(\beta(n+m-4)-\beta^2(m^2+n-mn)+3)}{(\beta(n-m-1)+2)^2((m-1)\beta+1)^2} + \frac{1}{2} \frac{m(a-c)(\beta(2m-3)-\beta^2(m-1-mn+m^2)+2)^2}{(\beta(n-m-1)+2)((m-1)\beta+1)^2},$$

which, in general, is lower than  $W^{dc}$ , i.e. the welfare obtained in the decentralized case. However, when the cooperative are constrained to yield a nonnegative profits every centralized cooperative will set a quantity such that  $p_h = c$  and, thus, the welfare obtained in the two cases will coincide.

**6.3. Decreasing Returns Oligopoly Case.** Assuming a quadratic cost function, straightforward calculations yield the following Nash equilibrium outputs in a quantity mixed oligopoly with, in turn, decentralized and centralized cooperatives ( $h \in M$ ) competing against profit-maximizing firms ( $j \in N \setminus M$ ):

$$x_j^{dc} = \frac{a(2+c-2\beta)}{4+\beta(2+c)(m+n)+c^2-2(n-1)\beta^2+4c-3\beta(2+c)}$$

$$x_h^{dc} = \frac{2a(2+c-\beta)}{4+\beta(2+c)(m+n)+c^2-2\beta^2(n-1)+4c-3\beta(2+c)},$$

$$x_j^{cc} = \frac{a(1+c-\beta)}{(2+c+\beta(n-m-1))(1+c+\beta(m-1))},$$

and

$$x_h^{cc} = \frac{a}{1+c+\beta(m-1)}.$$

Since the Nash equilibrium output of every firm in a pure profit-maximizing oligopoly is

$$x_k^{PMF} = \frac{a}{2+c+\beta(n-1)}$$

and the output maximizing social welfare is

$$x^{PO} = \frac{a}{1+c+\beta(n-1)},$$

the results of Proposition 1 can be easily obtained, where the level for  $c$  that makes positive the centralized cooperative's profit (whereas PMFs profits are always positive and decentralized cooperatives yield by definition zero profits) is

$$\underline{c}(n,m,\beta) = \frac{(n-m+1)\beta-2+\sqrt{4+4(n-m-1)\beta-\beta^2(6(n-m)-1+2mn-m^2-n^2)}}{2}.$$

Note that this threshold is increasing in  $\beta$  and  $n$ , and decreasing in  $m$ . The results of proposition 2 are easily obtained using all above expressions. Finally, for total welfare, with quadratic costs, it can be easily calculated as

$$(6.8) \quad W = a \sum_{k=1}^n x_k - (1/2) \left[ \sum_{k=1}^n (x_k)^2 + \beta \sum_{k=1}^n x_k \sum_{r \neq k} x_r \right] - \frac{c}{2} \sum_{k=1}^n (x_k)^2$$

which, using the expressions for firms' outputs yields, respectively,

$$W^{PO} = \frac{1}{2} \frac{na^2}{1+c+\beta(n-1)}$$

$$W^{PMF} = \frac{1}{2} \frac{a^2 n (c + \beta (n - 1) + 3)}{(c + \beta (n - 1) + 2)^2}$$

$$W^{dc} = \frac{1}{2} \frac{(n-m)a^2(8\beta-5c+3c\beta-2m\beta-2n\beta-cm\beta-cn\beta-c^2-2\beta^2+2n\beta^2-6)(2\beta-c-2)}{(4+\beta(2+c)(m+n)+c^2-2\beta^2(n-1)+4c-3\beta(2+c))^2} +$$

$$+ \frac{1}{2} \frac{ma^2(6\beta-2c+2c\beta-2m\beta-2n\beta-cm\beta-cn\beta-2\beta^2+2n\beta^2-4)(\beta-c-2)}{(4+\beta(2+c)(m+n)+c^2-2\beta^2(n-1)+4c-3\beta(2+c))^2},$$

$$W^{cc} = \frac{1}{2} \frac{(n-m)(4c-4\beta-2c\beta+m\beta+n\beta+cn\beta+c^2+\beta^2-n\beta^2+mn\beta^2-m^2\beta^2+3)(1-\beta+c)a^2}{(c-\beta-m\beta+n\beta+2)^2(c-\beta+m\beta+1)^2} +$$

$$+ \frac{1}{2} \frac{m(3c-3\beta-2c\beta+2m\beta+cm\beta+c^2+\beta^2-m\beta^2+mn\beta^2-m^2\beta^2+2)a^2}{(c-\beta-m\beta+n\beta+2)^2(c-\beta+m\beta+1)^2},$$

from which the results of Proposition 3 easily follow.