Cooperatives, Regulation and Competition in Norwegian Agriculture

Berit Tennbakk
e-mail: bte@econ.no.

Paper prepared for presentation at the X^th^ EAAE Congress
'Exploring Diversity in the European Agri-Food System',
Zaragoza (Spain), 28-31 August 2002

Cooperatives, regulation and competition in Norwegian agriculture

Berit Tennbakk*

Abstract
Over production is a persistent and costly problem in Norwegian agriculture. Support to agricultural production implicitly yields incentives to produce too much, i.e., causing market prices to fall below the target level, and thereby increasing the need for subsidies and additional market interventions. In order to restrict supplies, farmers are allowed to coordinate through marketing cooperatives. The paper argues that this coordination is likely to be insufficient in markets where the cooperative competes with an investor-owned wholesaler. Interventions in the market in order to remove excess supplies may induce further incentives to increase production. Levying a tax on all production in order to cover market regulation costs, moves the solution in the right direction but is impotent in restoring the target (second-best) level of production.

Key Words
Cooperatives, regulation, over production, duopoly.

JEL Classification
Q13, L21, D43

Corresponding author, ECON Centre for Economic Analysis, P.O.Box 327 Sentrum, 4002 STAVANGER, Norway. Phone: +47 51.53.95.66, fax: +47 51.53.95.69, e-mail: bte@econ.no.

1 Introduction

Despite the fact that Norwegian agricultural markets are thoroughly regulated, over production is a persistent and costly problem. The regulatory system is complex and involves a number of different goals, means and agents. Hence, it is not straightforward to penetrate and to pinpoint the major reason why regulations are not able to target total market supply better. We will argue that competition between a marketing cooperative and private wholesalers, and the cooperative's dual role as a market player and government agent contribute the problem of over production.

Marketing cooperatives play an important role in Norwegian agricultural markets. In the markets for dairy products, meat, and eggs and poultry, the large national cooperatives have market shares of about 60 % to almost 100 % in the first level handling of domestic production.[1] Moreover, the markets are protected against imports by tariffs, and most of domestic demand for the goods based on these primary products is covered by domestic production. Hence, the cooperatives' market shares in the final market are high as well.

In addition to their role as major market players, the cooperatives are used as government agents and are instrumental in the implementation of agricultural policies. This combination of being a market player and at the same time a regulator is often, and for obvious reasons, referred to as the dual role of cooperatives.

There are several reasons why the government supports domestic agriculture. The natural conditions, i.e., the Norwegian climate and landscape, are not particularly suited for efficient agricultural production, and Norwegian agriculture is generally not profitable based on world market prices.[2] Hence, in order to sustain Norwegian agriculture, farmers need income transfers or market protection to make a living from their farming. In addition to various subsidies and transfers that are differentiated in order to regulate the geographical distribution of farms, the yearly negotiations between farmers' organizations and the government determines an income target for farmers and the distribution of that income according to two main sources. The first source is the market, where analyses of the demand structure are used to estimate a target market price for an estimated total supply in the year ahead. The second source is the direct transfers, which in effect are calculated as the residual, i.e., the income needed in addition to the estimated income from the market in order to reach the income target.

In order for the targets to be reached, the large marketing cooperatives are instrumental and used as agents for the government. There are two main reasons why cooperatives are assigned such a role. First, the cooperative organization of farmers enables coordination of production and thereby control of market supply. In order to reach the target market price, it is necessary to restrict total supply. In

---

1 Agricultural cooperatives have relatively large market shares in many European countries. According to Bergman (1997) Swedish cooperatives have market shares of 70 – 100%, and have strong market positions in countries like Denmark, Germany, and the Netherlands as well.

2 To the extent that world market prices are artificially low due to agricultural policies elsewhere, this does not help improve the competitiveness of Norwegian agriculture.

other words, target market prices are above marginal costs for the estimated consumption. Second, the cooperatives distribute the entire surplus from all its activities to the members via the price of the primary product. Hence, the residual required income, which is covered by direct transfers, can be set at a minimum. Given the social cost of taxation, this minimizes the costs of regulation as well. At least this is basically the idea of how the system should ideally work.

Another basic feature is the farmers' freedom to choose wholesale affiliation. The resulting market structure is one where the cooperative holds a dominant market position, but where a proportion of farmers choose to market their production through private wholesalers. Given the cooperative's obligation to employ open membership policies, the investor-owned wholesalers have to match the cooperative's pricing policies in order to attract farmers. On the other hand, to some extent, the cooperatives 'hands are tied', i.e., it is committed to a given strategy, and in that respect, the investor-owned wholesalers can determine their market strategy, knowing the strategy of the cooperative. As a result, the cooperative can not perfectly control the total market supply.

As a market regulator, the cooperative is obliged to employ an open membership policy and it must accept all deliveries offered, even deliveries from non-member farmers. In order for the cooperative to make necessary adjustments to sustain the target price, it has to be able to handle any excess supplies. If excess supplies are not handled, the market price will fall below the target price. In the egg market this has been the case in eight of the ten years between 1989 and 1999.

Excess supplies can be handled in two basic ways; Farmers can be paid to deliver less, or production can be kept out of the market. When farmers are paid to deliver less it usually entails compensation to slaughter live stock animals earlier than what is optimal according to the production cycle, i.e., reduce the production capacity temporarily.[3] Excess production can be kept out of the market by exports, storage or processing.[4] Hence, the role of regulator involves extra costs. These costs are reimbursed. The compensation is financed by general tax money or by a special tax levied on all production of the product in question. In the egg market this tax has been positive in the years 1989 to 1999. I.e., excess production has to some extent led prices to fall below the target price, and has to some extent been 'regulated' out of the market.

In addition, a maximum price is set in order to prevent the exploitation of consumers by market power. In other words, the cooperative is chosen to act as a market regulator because of its ability to coordinate supplies, but is prevented to use this ability unduly (to set prices above the target price). The maximum price is generally not binding.

Using the egg market as an example, the resulting market structure involves a marketing cooperative that markets about two thirds of the total domestic egg production and two investor-owned wholesalers. The investor-owned wholesalers do however appear to have split the 'free' farmers geographically between them,

3 In the egg market the compensation is given to producers who slaughter hens early and do not replace them within a specified time frame.

4 In order to store agricultural produce it is often necessary to preserve or process inputs into products which yield much lower prices than fresh produce.

and hence, do not compete with each other for deliveries.[5] In effect, the regional markets are characterized by what may be termed "duopsony". The two investor-owned wholesalers employ different strategies faced with the competition with the cooperative. One reports to 'mimic' the price conditions of the cooperative exactly, but to let farmers set their quantities more freely. In that case the profitability of the wholesale operation must hinge upon an ability to do business more cost-efficiently than the cooperative. The other reports to guarantee suppliers a fixed price (the market price minus a fixed margin), but for a given production quantity. In principle, both investor-owned wholesalers can choose the number of suppliers whose production they offer to supply.

In this paper the focus is on the competitive implications of the market structure described above. The analysis demonstrates that investor-owned firms can strategically adjust to the competition from a cooperative, and be able to sustain profitability in the market. We discuss the different strategies employed by the Norwegian wholesalers and discuss the optimal strategy of an investor-owned wholesaler, given the cooperatives market role and strategy. Moreover, we demonstrate that the investor-owned firms' competitive strategies and interaction with the cooperative, may contribute to the problems of excess supply, and hence increase the social costs of regulation.

2 Theory

Generally, cooperatives come in many different sizes and forms, and there is no consensus definition of cooperatives as economic agencies in the economic literature (see, e.g., LeVay, 1983). However, in this setting we are looking at large marketing cooperatives whose primary objective is to maximize members' revenues. The members of the cooperative are independent farmers who market all their production through the cooperative, and the cooperative acts as a joint agent for its members. As members of the cooperative the farmers hold the residual claim on the profit generated in the marketing chain. The farmers are interested in maximizing the total revenue from the market, i.e., the sum of profits from the farm level and the profits from the wholesale or processing level.[6]

According to theory, a marketing cooperative can basically distribute the revenue from the market in two different ways: According to an NARP-pricing rule or according to an NMRP-pricing rule. NARP stands for Net Average Revenue Product and NMRP for Net Marginal Revenue Product. An NARP-pricing cooperative distributes all revenue through the price paid to farmers, i.e.; farmers receive a payment for each unit marketed through the cooperative which

[5] The downstream market has become increasingly concentrated and is currently controlled by 4 national retail chains. This implies that the downstream market is also divided between the wholesalers because the retail chains prefer to sign exclusive contracts with one wholesaler. This has probably made coordination between the wholesalers easier, but the basic structure of the upstream egg market has not changed significantly with the increased downstream concentration.

[6] This formulation of the cooperative's objective is accredited to Enke (1945) and Taylor (1971). Pursuing this objective, the coopeative makes the greatest possible joint revenue for the member farmers.

is equal to the average revenue of the cooperative firm.[7] An NMRP cooperative pays the member farmers a price equal to the marginal revenue from the market (net of marketing costs), and distributes remaining profits independent of the volume marketed by each individual farmer.[8] Assuming that farmers choose their production individually, the revenue distribution rule chosen by the cooperative has implications for the quantity each farmer supplies, and hence for the total supplies to the market.

The large Norwegian marketing cooperatives employ a variety of NARP pricing. In the economic literature it is generally assumed that an NARP cooperative is not able to control the individual members' production and exploit market power. Therefore, it is traditionally concluded that when an NARP cooperative is present in a market, total output is increased and efficiency enhanced, compared to the unregulated private solution where investor-owned wholesalers are able to exploit market power towards farmers (Helmberger, 1964 and 1966, and Helmberger and Hoos, 1962). Even NMRP cooperatives will expand production relative to the unregulated solution because it will not be interested in exploiting market power towards farmers (see e.g., Sexton, 1990, and Tennbakk, 1994).[9]

However, the Norwegian cooperatives implement a form of two-part tariff, in which deliveries within a preset 'quota' for each farmer are paid according to the NARP revenue distribution rule, whereas excess deliveries are paid at a much lower price, typically the export price. As argued, a major reason for choosing the cooperatives as regulatory agents, is their ability to restrict total supply. Hence, it can be argued that although the Norwegian cooperatives are NARP cooperatives in the sense that they distribute profits through prices, they are NMRP cooperatives in the sense that they restrict their members' supplies.

If the cooperative competes with investor-owned wholesalers over supplies and employs an open membership policy, the investor-owned wholesalers, too, have to raise the price paid to farmers as compared to the market without cooperatives. As mentioned, markets where cooperatives and private wholesalers compete are quite commonly found in agriculture. However, in the economic literature, this is viewed as an off-equilibrium situation. Either the cooperative is able to increase prices in the end market and offer farmers better terms than the competitors (Rhodes, 1983), or the investor-owned wholesalers are able to mimic the conditions of the cooperative (Helmberger, 1964). In both cases the long term market structure is one with one large or several small cooperatives in the former case,[10] or one with only investor-owned wholesalers in the latter case.[11] The

7 NARP = $p - k(Q)/Q$, where p is the price in the final market, $k(Q)$ is the cost of marketing, and Q is the total quantity marketed by the cooperative.

8 Zusman (1982) shows that cost distribution rules involving marginal cost pricing can be attained through majority voting.

9 Farmers are assumed to be easily exposed to exploitation by private wholesalers because they are small compared to the market and more geographically dispersed than consumers.

10 Tennbakk (1994) shows that in a market where an exclusive marketing cooperative competes with one private wholesaler in duopoly, the nonmember farmers are worse off than in private duopoly. If these farmers can not become members of the existing cooperative, their rational response is to set up their own cooperative.

NMRP cooperative, pays farmers a price for their input equal to the marginal income from the market, and distributes remaining revenues independent of patronage. Hence, a cooperative applying an NMRP pricing rule, may be much more powerful when it comes to controlling members' output, and will not be 'rendered powerless in the market', as conjectured by Rhodes (1983).

The Norwegian marketing cooperatives enjoy market power in the final market and are able to restrict their members' production. Still, we observe that there is obviously room for investor-owned wholesalers in the market. This paper presents a model where the equilibrium is a mixed market where both the open membership cooperative and the investor-owned firm make positive revenues, and farmers are indifferent as to which processor to patronize.

3 The model

3.1 Industry cost structure

At the outset the market consists of N independent farmers, one marketing cooperative and one investor-owned wholesaler. For simplicity it is assumed that the wholesale or processing plants are already set up, and investment costs are sunk. There are economies of scale in distribution or processing, exceeding the scope of the individual farm.[12] The cost function of the wholesale activity is assumed to exhibit constant marginal costs, for simplicity normalized to zero.[13]

Let the industry costs of production be expressed by the cost function $C(Q,L)$, where Q is the final product and L is a necessary input in production. The model employed is similar to models found in some of the horizontal integration literature, e.g., Perry and Porter (1985) and Gaudet and Salant (1992). In this setting, however, the number of farmers constituting the cooperative (integrating horizontally) is endogenous.[14] The production function exhibits constant returns to scale and the cost function implicitly includes the input prices of all variable factors.[15] Thus, the cost function is linearly homogeneous in Q and L. Marginal costs are homogeneous of degree zero in Q and L. Let L be the supply of land, and let the supply of land be fixed and normalized to 1. Then the marginal cost function $C_1(Q,1)$ is increasing in Q. Hence, the marginal cost function expresses the industry competitive supply curve.

---

11 The cooperative organization expands production and forces the private firms to raise their price. In the long run, all firms produce at minimum efficient scale and farmers are indifferent between supplying the private firm and the cooperative. (LeVay, 1983)

12 Assuming, e.g., a cost structure similar to the one employed in Rasmusen et.al. (1991).

13 Helmberger (1964) and Rhodes (1983), referring to Youde (1978), both argue that diseconomies are rarely encountered in food processing.

14 Kamien and Zang (1990) endogenize the decision to merge. In their model, however, the insider firms must approve of one more firm being part of the merger, an assumption that does not apply to open membership cooperatives.

15 $C = C(Q, L) \equiv \min_z vz$ s.t. $[Q - f(z, L) \leq 0]$ where v is the vector of input prices for the variable inputs z, and f is the production function.

The fixed factor is distributed among a large, but finite number of farmers, N, who produce the raw product on independent farms. Total production is given by $Q = \Sigma_i q_i,\ i = 1, \ldots, N$, where q_i is the production at farm i. For simplicity, it is assumed that all farmers own an equal share of the fixed factor and have identical cost functions.[16] Since the industry marginal cost function is homogeneous of degree zero, the individual cost structure mirrors the industry cost function. Moreover, the industry competitive supply curve does not change with the distribution of the fixed factor between firms. Hence, the identical farm cost functions are characterized by

$$c_i = c(q_i) \quad c_i > 0 \qquad\qquad c_i > 0 \tag{1}$$

where c'_i is the individual farm's supply function.

For illustrative purposes, we will do calculations on specific functional forms where needed. In these calculations we assume that the industry cost curve is of the simple quadratic form

$$C(Q) = \frac{1}{2}Q^2 \tag{2}$$

and the individual cost functions read

$$c(q_i) = \frac{N}{2}q_i^2 \quad , \quad c'_i = Nq_i \tag{3}$$

Further, let the inverse demand function be linear and expressed by

$$p = 1 - Q = 1 - Q_C - Q_P \tag{4}$$

Q_C and Q_P are the quantities marketed by the cooperative and the investor-owned wholesaler, respectively.

3.2 The cooperative's market behavior

The members of the cooperative market all their production through the cooperative. Holding the residual claim on the firm's surplus, the cooperative members share the profit from the cooperative marketing channel. The profit of each cooperative member is the sum of farm profits and the share of cooperative profits. Acting as an agent for its members, the cooperative takes the costs at the farm level into account when choosing its optimal quantity. From the literature, see, e.g., LeVay (1983), we know that the NMRP pricing cooperative maximizes joint profits, whereas the NARP pricing cooperative does not. The Norwegian cooperatives are NARP cooperatives, but employs NARP pricing in combination with a quota system. According to this system, supplies exceeding the quota are paid at a lower price (which can be normalized to zero). Since all farmers are assumed to be equal, this combined NARP pricing and quota system is equivalent to an NMRP pricing scheme. Hence, it is assumed that the cooperative can effectively control its members' supplies.

If the government is interested in minimizing the direct income transfer to the farmers, it makes sense to let farmers behave as a cartel.[17] If all farmers are

16 The system of direct transfers does to a large extent even out cost differences among farmers.

17 The cooperative monopoly price is different from the price set by an investor-owned monopoly because the cooperative does not exploit monopsony power towards farmers (see, e.g., Tennbakk, 1994). In reality of course, the government is also concerned with the distribution effects of the policies, but since the case

members of the cooperative, i.e., $n = N$, the cooperative maximizes joint profits by restricting output to the monopoly or cartel solution, Q_M, solving

$$(5) \qquad \max_{Q} \Pi^M = p(Q)Q - C(Q)$$

Each farmer earns a profit of Π^M/N.

This solution is equal to the cartel solution, and as such has the usual undesirable incentive structure.[18] Since $c_i' < p$, it is profitable for an individual farmer to deviate from the cooperative solution, where, and expand output until $c_i' = p$. In fact any $q_i > q_i^M$ as long as $c_i' \leq p$ will give extra profits. It is, however, assumed that the minimum efficient scale of marketing exceeds the production of one individual farmer. Provided that fixed costs are not too high, it may, however, be profitable for an investor-owned wholesaler to establish business if he can attract a sufficient number of suppliers.

With the specified demand and cost functions the monopoly price is equal to $p^M = 2/3$, the total quantity produced is $Q_M = 1/3$ and the marginal cost is $C_1^M = 1/3$. The farmers earn an equal share of the monopoly profit, $\pi_i^M = 1/(6N)$.

3.3 Mixed market with price/quantity contracts

Now, let there be two wholesale channels available to the farmers, one cooperative and one investor-owned wholesaler, and let the number of farmers who are members of the cooperative be n, $n \leq N$. The remaining $(N-n)$ farmers patronize the investor-owned wholesaler. The cooperative can legally coordinate and restrict its members' supplies, conditional on open membership policies. No other market regulations are employed.

3.3.1 The cooperative

As in the cooperative monopoly solution, each member of the cooperative will produce an equal share of the cooperative quantity. The aggregate cost function of the cooperative farmers is

$$(6) \qquad c(Q_C) = nc(q_i^C) \qquad Q_C = nq_i^C \text{, i = 1,...,n.}$$

The joint profit of the cooperating farmers is

$$(7) \qquad \max_{Q_C} \Pi^C = p(Q_C + Q_P)Q_C - c(Q_C)$$

The joint production of the cooperative, Q_C, is set so as to maximize total profits, given the supply of the private wholesaler. The first-order condition of the maximization problem, equation (4), yields the regular Cournot reaction function

$$(8) \qquad Q_C = R^C(Q_P; n, N) \quad , \quad \frac{\partial Q_C}{\partial Q_P} < 0 \quad \text{and} \quad \frac{\partial Q_C}{\partial n} > 0$$

And, as for the normal Cournot reaction function, the cooperative's quantity is decreasing in the rival's quantity. Moreover, the cooperative quantity must be increasing in n, because the total cost of producing any amount of output is

---

we study is the one where market prices fall below the target price, no generality is lost by this assumption.

[18] Recall that it is voluntary to participate in the cartel agreement, i.e., to be a member of the cooperative.

decreasing in n. The more farmers are members of the cooperative, the cheaper the cooperating farmers can produce any joint quantity.

3.3.2 The investor-owned wholesaler

The investor-owned wholesaler offers a contract to the *(N-n)* farmers who are not members of the cooperative. It is assumed that he knows the cooperative's objective and the terms the cooperative offers to its members (price and quota).

Let us first study the case where the wholesaler offers the (*N-n)* 'free' farmers a contract that specifies a price, w, and a quantity q_j^P to be purchased from each farmer. The price/quantity combinations are set so as to maximize profits from the wholesale operation.

(9) $$\max_{Q_P, w} \Pi^P = (p - w)Q_P$$

$Q_P = (N\text{-}n)q_j^P$, $j = n+1, \ldots, N$. Since the cooperative employs open membership policies, the investor-owned wholesaler has to offer conditions that ensure each of the 'free' farmers profits that are at least as high as the profits of each of the cooperative farmers. Each cooperative member earns an equal share of total profits, $\pi_i^C = \Pi^C / n$, $i = 1, \ldots, n$, i.e., the farmers patronizing the private wholesaler must make

(10) $$\pi_i^P = wq_j^P - c(q_j^P) \geq \pi_i^C = \Pi^C(Q_C(Q_P))/n$$

Since the investor-owned wholesaler maximizes profits, the restriction on farmers' profits must hold as equality, and the investor-owned wholesaler's maximization problem can be restated as

(11) $$\max_{Q_P} \Pi^P = p(Q_P, Q_C(Q_P))Q_P - (N-n)\left(\frac{\Pi^C(Q_C(Q_P)}{n} - c(q_j^P)\right)$$

Hence, the surplus on the farms indirectly enters into the investor-owned wholesaler's objective function. The first-order condition reads

(12) $$\frac{d\Pi^P}{dQ_P} = \left(\frac{\partial p}{\partial Q_P} + \frac{\partial p}{\partial Q_C}\frac{\partial Q_C}{\partial Q_P}\right)Q_P + p - \frac{N-n}{n}\frac{d\Pi^C}{dQ_P} - c_j' = 0$$

When determining the optimal quantity to market, the investor-owned wholesaler takes into account not only the quantity effect on market prices, but also the effect on the profit of the cooperative farmers. This is captured by the third term on the right-hand side of equation (12). Since we have that

(13) $$\frac{d\Pi^C}{dQ_P} = \frac{\partial \Pi^C}{\partial Q_C}\frac{\partial Q_C}{\partial Q_P} + \frac{\partial \Pi^C}{\partial Q_P} = \frac{\partial p}{\partial Q_P}Q_C < 0,$$

the cooperative's profit is decreasing in Q_P, and the increase in the investor-owned wholesaler's expenditure, when the private wholesaler's supplies increase, is less than the increase in costs for the 'free' farmers. Hence, the private wholesaler markets a higher quantity than in a symmetric duopoly for two reasons. First, he has to treat the 'free' farmers' costs as if they were internal costs. If his opponent was not an open membership cooperative, he could act as a monopsonist towards the free farmers and would market a lower quantity. Second, the cost effect of increasing supplies is counteracted by a reduction in cooperative profits, which induces yet higher production.

Clearly, the resulting market supply is higher than the cartel quantity, and market prices correspondingly lower. Moreover, it is higher than the 'pure'

Cournot and Stackelberg solutions as well.[19] To see this, note that the leader's optimality condition in Stackelberg duopoly would be equal to equation (12) except for the third term, which relates to the open membership policies of the cooperative. The effect of this term is to increase the supply of the Stackelberg leader as shown in equation (13).

Using the specific cost and demand functions, equations (2) to (4), yields quantities

$$(14) \qquad Q_P = \frac{2N(N-n)}{4N^2-n^2} \qquad \text{and} \quad Q_C = \frac{n(2N^2+2Nn-n^2)}{(4N^2-n^2)(2N+n)}$$

for the two wholesalers, and a total market supply of

$$(15) \qquad Q = Q_C + Q_P = \frac{2N^3+4N^2n-2Nn^2-n^3}{(4N^2-n^2)(N+2n)} > \frac{1}{3},\ 0 \le n < N$$

The mixed market yields greater supply than the cooperative monopoly ($n = N$), and total supply is greater the more farmers patronize the investor-owned wholesaler, as shown in equation (16)

$$(16) \qquad \frac{dQ}{dn} = -3nN\frac{4N^3+4nN^2+n^3}{(4N^2-n^2)^2(2n+N)^2} < 0$$

If one farmer leaves the cooperative and starts to supply a private wholesaler, total market supply increases, and vice versa. When $n = 0$, $Q = ½$, i.e. the market solution is equal to the first best or competitive solution. In other words, the option on behalf of farmers to form a cooperative is sufficient to deter the investor-owned wholesaler from exploiting monopsony power in the market. On the other hand, the presence of an investor-owned wholesaler weakens the potential market power of the cooperative, i.e. its ability to restrict market supply.

Each 'free' farmer supplies

$$(17) \qquad q_j^P = \frac{2N}{4N^2-n^2}$$

The higher the fraction of farmers who are members of the cooperative, the less do the private wholesaler market, but the quantity marketed by each 'free' farmer is greater the fewer they are. In fact, for the given demand and cost functions, when $n \to N$, i.e. when the cooperative's market share is high, $q_j^P \to 2q_i^C$, i.e., the 'free' farmers produce twice as much as the cooperative farmers. When $n \to 0$, $q_j^P \to q_i^C$. One result of competition in the mixed market is that farmers who are otherwise identical produce different quantities according to their choice of wholesale affiliation. Since farm marginal costs are increasing, this means that any given total supply is not produced in the most socially cost efficient way.

The wholesale price paid by the investor-owned wholesaler is derived from the profit function for the cooperative and equation (10). The margin made by the investor-owned wholesaler is strictly positive

$$(18) \qquad p(N,n) - w(N,n) = \frac{1}{4}\frac{n^2}{N(2n+N)} > 0$$

---

[19] The term 'pure' here relates to a situation with two competing cooperatives or two firms treating farm costs as internal costs, i.e., they do not exploit monopsony power.

The relationship between the market price, the wholesale price and the marginal cost of the 'free' farmers is as follows

$$p > c'_j > w \tag{19}$$

The price paid for the supply from the 'free' farmers is lower than their marginal costs. If the contract did not specify a quantity associated with the input price, the 'free' farmers would chose to produce less.

The private firms margin is increasing in n, i.e., the private firm makes higher profits per unit the higher the cooperatives share of farmers is. Now, total profits can be expressed as a function of n. The only extrema of the profit function, is found for $n = 0$ which is a minimum. In other words, the private wholesaler prefers that the cooperative have a high market share because that is when the market power of the cooperative is strongest. The 'cartel' effect on the market price dominates the cost effect of the change in the cooperative profits. Taking fixed costs into account, the private wholesaler will be best off establishing business at minimum efficient scale, and the market share in long term equilibrium is also determined by the level of fixed costs in marketing and/or processing.

3.3.3 Additional market regulations

The observation that the market frequently produces solutions where prices fall below and total supply above the target suggests that the target solution lies somewhere in-between the cartel solution and the duopsony solution explored above. In order to reduce direct government transfers to farmers, additional market regulations are required.

In order to maintain the target price, the cooperative removes some units from the market. As a market regulator on behalf of the government, the costs of market regulations are reimbursed. Hence, the profit of the cooperative farmers does not change, and the third term of equation (12) is zero. Moreover, the market price does not change. If the private wholesaler anticipates this, the first term on the right-hand side of expression (12) is zero, as well. The first-order condition is reduced to

$$p^T - c' = 0 \tag{20}$$

where p^T is the target price. Equation (20) states that the private wholesaler sets quantity conditions such that the farmers patronizing the private wholesaler increase production until marginal costs are equal to the target price. Hence, this induces higher supplies from the private wholesaler. Depending on the market share of the investor-owned wholesaler, the target price and the cost structure on the individual farms, supplies may excel, boosting the costs of market regulations.

To mitigate this effect, a unit tax is levied on all production. The tax is designed so that it covers the costs of market regulations, i.e., is set so that

$$t(Q) = \frac{p^T (Q - Q_T)}{Q} \tag{21}$$

We assume that excess supplies are destroyed at zero costs. Q_T is market demand at the target price, which is, per definition, lower than Q. Hence, t is increasing in Q, but at a decreasing rate.

The tax adds to the cost of the farmers. This shifts the supply curve to the left, and reduces the optimal quantity supplied. The tax reduces the optimal supply of the cooperative. Moreover, the joint profit of each cooperative farmer is

reduced due to the reduced quantity and the increased cost. The isolated response of the private wholesaler will be to increase its quantity; for given costs increased supply is the optimal response to reduced cooperative supply. In addition, its costs are reduced by the reduction in cooperative profits. However, the cost of the farmers supplying the investor-owned wholesaler increases as well, and since they produce more than the cooperative farmers, by more than the cost of the cooperative farmers. The net effect is to reduce market supply.

Hence, if excess supplies are to be removed from the market, there is a social gain from taxation because it moves the market outcome in the right direction, mitigating some of the adverse production incentives of the market intervention. However, the price signal is not efficient: The marginal cost of destruction is p^T, which is higher than t.

3.4 Further restrictions on the investor-owned wholesaler

As noted in the introduction, the major investor-owned wholesalers in the egg market follow different strategies towards the 'free' farmers, and none of them report to follow the strategy reported above, even though it is the most profitable one. The investor-owned wholesalers' contract design may be limited if the farmers object to the idea of producing quantities beyond the point where marginal costs exceed the input price paid by the wholesaler.

The observed alternatives are 1) to mimic the cooperative's conditions, i.e., pay the same price as the cooperative for a fixed quantity, and 2) to pay a fixed price $w = p - m$, and let the farmers freely choose their quantities. We will study each in turn.

3.4.1 The investor-owned wholesaler mimics the cooperative's conditions

If the investor-owned wholesaler chooses to exactly mimic the cooperative's conditions, then $Q_P = (N-n)\frac{Q_C}{n}$, $q_j^P = q_i^C$ and $w = NARP = \frac{\Pi^C}{n}$.

If this is the case, the private wholesaler cannot make positive profits unless he enjoys some kind of cost advantage relative to the cooperative. The cooperative may have a cost disadvantage because of the open membership policies, the member democracy, extra costs incurred by virtue of the market regulator role or simply less efficient processing. The open membership policies may give rise to adverse selection problems, e.g., higher transportation costs, and the role as a market regulator may require extra costs of holding a larger capacity in order to be able to handle excess supplies. However, direct transfers should compensate such costs. In a situation where the investor-owned wholesalers actually prefer a situation where the cooperative has a high market share, the cooperative is not likely to perceive competition as very hard. This can explain why the cooperative may be less efficient than an investor-owned firm may.

3.4.2 The investor-owned wholesaler offers a fixed price

In the second case we assume that the contract offered by the investor-owned wholesaler is restricted to a price offer of w, to which the 'free' farmers adjust their own production. Still the private wholesaler must make sure that the

'free' farmers are equally well off as the cooperative farmers in order to attract supplies. This situation is equivalent to the model developed by Tennbakk (2001).

According to this model, a farmer faced with the price offer w, will set his production, q_j^P, according to

(22) $$\pi_j^P = \max_{q_j^P} wq_j^P - c_j(q_j^P)$$

and her supply is implicitly defined by $w = c'(q_j^P)$. Using the explicit cost function, equation (2), $q^P = w/N$ and Q_P can be expressed as a function of w:

(23) $$Q_P(w;n) = \left(1 - \frac{n}{N}\right)w$$

where $\frac{\partial Q^P}{\partial w} > 0$ and $\frac{\partial Q^P}{\partial n} < 0$.

The sign of the first derivative follows directly from the maximization problem of the investor-owned farmers as stated by equation (11). Even in this case, the investor-owned farmers must produce more than the cooperating farmers do in order to make the same revenue. If the investor-owned wholesaler sets $w = c'(q_i^C)$, the farmers patronizing the investor-owned wholesaler will supply the same amount to the market as if he were a member of the cooperative, but without earning the share of the cooperative profit. In order to compensate for the loss in profits, the investor-owned wholesaler has to pay a higher w, and allow his suppliers to supply more, i.e., $q_j^P > q_i^C$. Hence,

(24) $$\left|\frac{\partial Q_C}{\partial n}\right| < \left|\frac{\partial Q_P}{\partial n}\right|$$

Taking into account that farmers must be indifferent between being members of the cooperative or patronizing the investor-owned wholesaler, we find the equilibrium w as a function of n:

(25) $$w = \frac{1}{2}\frac{(2N - 2n - 2\sqrt{(2nN + N^2)})N}{n^2 - 4Nn}$$

where $w \to \frac{\sqrt{3}}{3}$ as $n \to N$

$w \to \frac{1}{2}$ as $n \to 0$

For any number of members in the cooperative, n, the quantity marketed by the private wholesaler is smaller than in the price/quantity contract case. This result follows directly from inequality *(19)*. In order to keep the 'free' farmers' profits at the same level, given restriction *(22)*, each farmers supply must be reduced.

In other words, the quantity marketed by the private wholesaler is lower when he has to offer a price contract and let farmers choose their quantities freely than when he offers a price/quantity contract. Hence, the social cost of regulations is also lower since total supply is lower the lower is the supply of the private wholesaler, and the results from the unrestricted model may overstate the over production incentives of the current market structure.

4 Concluding remarks

The aim of the paper is to show that the market structure typical for some major agricultural markets in Norway contributes to the observed over production problems. One basic feature of these markets is the mixed ownership structure where large cooperatives compete with investor-owned wholesalers and the farmers are free to chose wholesale affiliation. This market structure is commonly found in several other industrialized countries.

The analysis concludes that the competition from cooperatives mitigates the private wholesalers' incentives to exploit market power towards the producers of the raw product, i.e. the farmers, and that the competition from the private wholesalers mitigate the cooperatives incentives to exploit market power towards consumers. The general model demonstrates that such a market solution may be sustained as equilibrium and as such contradicts, e.g., Rhodes (1983) intuition that the mixed market can generally be regarded as an off-equilibrium situation.

However, a major concern in Norwegian agricultural policies is to ensure that the farmers can subtract a large share of their income from the market. Therefore, it is desirable that the market supply is restricted in order to keep prices higher than the competitive price and to make sure that farmers receive a large share of the market surplus. The ability of the cooperative to restrict its members output is instrumental in order to reach the target, but since membership is voluntary, the cooperative can not guarantee the target outcome. The coordination within the cooperative induces higher prices, which makes the business attractive to investor-owned wholesalers as well.

Since the cooperative farmers' output is restricted, investor-owned wholesalers can make a business letting farmers supply a higher quantity than the cooperative members do. Except for the case where the investor-owned wholesaler exactly mimics the cooperative conditions – and can not make a profit unless he is more cost efficient than the cooperative – the competition from the investor-owned wholesaler increases total market supply. The resulting market price is lower than the target price, and additional market regulations are called for.

If market interventions simply entails removing excess supplies from the market and reimburse the costs, then the regulations contributes to the over production problem. In practice, the costs are partly or completely covered by a levy on all production. This levy mitigates the effect of the market interventions, although not perfectly.

References:

Bergman, M. (1997): *Antitrust, Marketing Cooperatives, and Market Power,* European Journal of Law and Economics, **4**, 73-92.

Enke, S. (1945): *Consumer Cooperatives and Economic Efficiency,* American Economic Review, **35,** 148-55.

Gaudet, G. and S. W. Salant (1992): *Towards a Theory of Horizontal Mergers,* in Norman, G. and M. La Manna (eds.): "The New Industrial Economics: Recent Developments in Industrial Organization, Oligopoly and Game Theory", Aldershot, UK.

Helmberger, P. G. (1964): *Cooperative Enterprise as a Structural Dimension of Farm Markets,* Journal of Farm Economics, **46(3**), 603-17.

Helmberger, P. G. (1966): *Future Roles of Agricultural Cooperatives,* Journal of Farm Economics, **48(5)**, 1427-35.

Helmberger, P. and S. Hoos (1962): *Cooperative Enterprise and Organization Theory,* Journal of Farm Economics, **44(2),** 275-90.

Kamien, M. and I. Zang (1990): *The Limits of Monopolization through Acquisition,* Quarterly Journal of Economics, **105**, 465-99.

LeVay, C. (1983): *Agricultural Cooperative Theory: A Review,* Journal of Agriculutral Economics, **34**, 1-44.

Perry, M. K. and R. H. Porter (1985): *Oligopoly and the Incentive for Horizontal Merger,* American Economic Review, **75,** 219-27.

Rasmusen, E. B., J. M. Ramseyer and J. S. Wiley, Jr. (1991): *Naked Exclusion*, American Economic Review, **81**, 1137-45.

Rhodes, V. J. (1983): *The Large Agricultural Cooperative as a Competitor,* American Journal of Agricultural Economics, **65,** 1090-95.

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.

Taylor, R. A. (1971): *The Taxation of Cooperatives,* Canadian Journal of Agricultural Economics, **19**, 13-23.

Tennbakk, B. (1994): *Marketing Cooperatives in Mixed Duopolies,* Journal of Agricultural Economics, **46**, 33-45.

Tennbakk, B. (2001): *Determining the Size of an Open Marketing Cooperative in Duopoly*. In Svein Ole Borgen (ed.): "The Food Sector in Transition – Nordic Research. Proceedings of NJR-seminar No. 313, June 2000." Oslo: NILF-Report 2001-2, Norwegian Agricultural Economics Research Institute.

Youde, J. G. (1978): *Cooperative Membership Policies,* Agricultural Cooperatives in the Public Interest, Proceedings of an NC117 Workshop, St. Louis MO, 219-26.

Zusman, P. (1982): *Group Choice in an Agricultural Marketing Cooperative,* Canadian Journal of Economics, **15**, 220-34.