Quality and Self-Regulation in Agricultural Markets: What Is the Role for Producers' Organizations?

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Abstract. This paper focuses on self-regulation by Producer`s Organizations (PO) as an alternative to market or public intervention. Using the advances of the economics of incentives, it studies the interaction of asymmetric information and the democratic process in the quality choices of a group of heterogenous producers. With a simple model of adverse selection it presents the pricing rules and the quality provision in a group of producers facing an opportunity to gain from their collective capacity to establish a reputation for their quality products.

This paper makes the choice of the PO`s pricing mechanism endogenous, extending previous analyses in which the remuneration schemes were either exogenous or not implementable because of the heterogeneity among producers. It distinguishes between a constitutional phase, in which each of the participating producers votes on the best remuneration scheme for quality, and a working phase, in which quality regulation must be enforced at the PO`s level.

It compares different equilibria, according to which type of producer is in the majority and to which constitutional rule is adopted. Irrespective of the constitutional rules adopted, it finds that the quality level provided by the group is higher than the first-best with a high-quality producers` majority and lower with a low-quality producers` majority. The analysis in this paper may easily be extended to consider producers that are heterogeneous in size or efficiency, like in the tradition of the agricultural cooperatives literature.

Keywords: economic incentives, asymmetric information, mechanism design,pricing rules, quality regulation, self-regulation.

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1. Introduction.

In 1996 the European Union (EU) introduced a reform of the fruit and vegetable common European market to finance both the establishment (50% of initial expenditures) and operations (2% of annual expenditures) of Producers` Organizations (PO). According to the EU policy goals, the PO`s should plan production in order to meet demand, decide and enforce quality standards, help reduce production costs and promote environment-friendly technology adoption. Advocates of the regulation claim that this approach to market organization should make producers more responsible for their actions and help the agricultural sector to bargain with an increasingly concentrated retail sector. In addition, by allowing an orderly marketing, it should help consumers too.

This type of market regulation is reminiscent of the Marketing Orders that were initiated after the 30`s for different perennial crops in the U.S., especially in California.[1] The Marketing Orders` experience in recent years has been subject to a considerable array of criticism because of their adverse welfare effects for consumers and sometimes even for producers. Indeed, in the best case scenario, when the Marketing Orders perform properly, they give market power to the producers at the expense of consumers (USDA, 1981; Shephard, 1986; Jesse, 1987). It would seem difficult to justify this intervention in the economy if not by the usual income distribution or political-economy arguments. But a different feature of the regulation envisioned for the European market makes the comparison with U.S. experience not completely appropriate.

In Europe, PO`s participation is voluntary, while in the U.S., once the Order is established, participation by producers and handlers is compulsory. This difference can have important consequences since it influences the behavior of farmers, their decision to participate, and the behavior of the organization. It is reasonable to think that the resulting market equilibrium is substantially different between the two cases, with the degree of market competition presumably higher in the European case. The analysis proposed in this paper is a starting point for an economic

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[1] After years of falling incomes for farmers, the U.S. Congress enacted the Agricultural Marketing Agreement Act in 1937. The Act allowed the majority of producers of certain crops to set up Marketing Orders whose rules could be extended to all producers and handlers, and whose main objectives were the orderly marketing and the quality regulation of products. The European regulation is clear about the aims of PO`s, assigning them the power to regulate quality standards and production technologies that can be extended to all producers in a region when 2/3 of them agree on it, so resembling the U.S. Marketing Orders experience.

evaluation of the welfare effects of the regulation and its focus is centered mainly on quality issues. Traditionally, the main economic analysis of agricultural policies centers on quantity, price, and risk implications of different policies. A growing part of the literature now deals with quality issues. A market failure for quality provision is often the starting point for some form of public regulation, even though it is often far from clear whether public intervention can in fact contribute to its solution.

Previous analyses of the welfare effects of quality regulation enforced at the Order`s level in the form of a minimum-quality standard show that it can not be welfare increasing (Bockstael, 1984; Chambers and Weiss, 1992). This paper focuses on self-regulation by PO`s as an alternative to market or public intervention. It explicitly considers the democratic process through which quality levels must be chosen and enforced in the PO. It distinguishes between a constitutional phase, in which each of the participating producers votes on the best remuneration scheme for quality, and a working phase, in which quality regulation must be enforced at the PO`s level. Using arguments first suggested in the constitutional economics literature (Brennan and Buchanan, 1985), the paper introduces some constitutional limits to the choices available to the PO. It then compares the equilibria attainable with an efficient pricing rule (separating mechanism) or an *equal treatment for all* producers (pooling mechanism).

The second phase, the working of the group of producers, is analyzed taking into consideration the incentives of heterogeneous producers, i.e., the constraints represented by the voluntary participation and the asymmetric information about individual producers, in the spirit of the mechanism-design literature. The results can then be compared with those resulting from the first-best. The outcome of the group`s democratic process is expressed in terms of payment schemes and quality provision for different producers.

The analysis of this paper may easily be extended to consider producers that are heterogeneous in size or efficiency, like in the tradition of the agricultural cooperatives literature. In this literature, the efficiency and fairness of different pricing mechanisms are the subject of a lively debate. One of the main contributions (Sexton, 1986) shows why it may be inefficient to have a marginal pricing rule and that it may be preferred to have also some additional lump-sum fees or rebates, even though these latter might not be feasible because of heterogeneous membership. Vercammen *et al.*(1996) show the different pricing mechanisms with heterogeneous producers and asymmetric information. In their

work, the choice of the different mechanism is exogenous, and no consideration is given to the democratic process with which the group decides upon the rules.

The next section introduces a simplified model that tries to capture the main features of the situation at hand. It is a model of hidden information, with two types of producers - high and low-quality - with a relatively simple production technology. Section three gives some preliminary results for the case in which the PO can freely implement an efficient pricing mechanism. In the fourth section the results when the PO may implement only an *equal treatment for all* pricing rule for all producers are derived. The last section sketches possible extensions of the model and closes with some conclusions.

2. The model.

Consider an agricultural commodity, i.e., an orange, an apple, etc., that can be thought of as an **experience good**. Its quality can vary and it is not known by consumers before consumption. The problem of asymmetric information could be alleviated by a brand or a label which would help to establish reputation for higher quality and facilitate confidence in the market. Agricultural firms are usually small, and since marketing investments exhibit important economies of scale, it is assumed that a single producer can not profitably set up an individual brand.[2]

The problem is for a group of farmers to decide whether or not to form a Producers Organization (PO) with common rules about production and trade of products. If a PO is formed, a management committee will be formed to execute the agreement. The PO needs to maintain the reputation for the brand and the group so it requires costly effort - i.e., quality provision - from the producers-stakeholders. Every producer is expected to supply the good at some specified quality level and the management is in charge of the monitoring and the enforcement of the rules. It is assumed that management has no divergent interests with the firm, i.e., there are no Agency problems with management.

The group is made of n heterogeneous producers. Some have better outside opportunities and

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[2] This depiction of the game resembles the working of a marketing cooperative. A group of producers can seize an opportunity only through collective action: either some large investments with increasing returns, or an increase in bargaining power, or the establishment of a brand with some collective reputation or other marketing programs.

some have better skills, i.e., lower costs of producing high-quality products. Assume for simplicity that producers can be of 2 types: θ^H denotes the high-quality type and θ^L the low-quality. High-quality means that the producer has lower cost of production for quality.[3] For convenience, assume n is an odd number and $n_L + n_H = n$.

The production technology for different producers can be represented using a technology set in the following way:

$$T_{\theta^i} = \{(x, q) : x \text{ can produce } q | \theta^i\},$$

where $x \in \Re_+$ is a vector of inputs that producers choose, $q \in \Re_+$ is the quality level, and i=L,H. Let us normalize production level to unity, so we can work only with quality levels. Producers` choices can be indirectly represented with their cost function:

$$c(q, \theta^i) = \min_x \{wx : (x, q) \in T_{\theta^i}\},$$

where w is the vector of input prices. To allow for heterogeneity among producers, assume type θ^i member`s cost of production, $c(q(\theta^i), \theta^i)$, to be twice differentiable, strictly increasing, strictly convex in q and without fixed costs. In addition, express the better skills of producers of type H as: $c_q(q, \theta^H) < c_q(q, \theta^L)$ for all q, that is the marginal cost of quality is everywhere higher for type θ^L.

We consider risk-neutral producers whose preferences are separable in income and effort and whose profits for the production of a unit of good of quality q are: $\pi(\theta^i) = y(q(\theta^i)) - wx$, where $y(q(\theta^i))$ is the price each producer receives from the PO for a unit of product of quality $q(\theta^i)$.

In this paper we consider only hidden information: each producer has private information about his own type. To simplify things, assume that the PO can perfectly observe and verify the quality level provided by each producer. Given this assumption, the PO can ensure that the payment to the producers should be a function of the quality provided, $y(q)$. The PO sells the commodity on the market and the price it receives is related to the quality that the consumers expect. We indeed assume that the consumers` willingness to pay is a function of the average quality of the good marketed by the PO.[4]

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[3] Lewis *et al.* (1989) suggest that producers may have both different costs and different outside opportunities.

[4] Even though this assumption is quite standard in the literature, for example on quality and international trade (Chang and Masson, 1988), it is not devoid of criticism. Indeed, as Tirole puts it, it leads to bootstrap equilibria in which reputation matters because consumers believe it matters (Tirole, 1988:123).

If $q(\theta^i)$ represents the quality of the good produced by the producer of type θ^i, the average quality from the n producers participating in the PO may be seen as $Q = \frac{1}{n}\sum_{i=L}^{H} n_i\, q(\theta^i)$, with i=L,H, and the consumers' willingness to pay equal to $p(Q)$. It has a general form - with $p'(Q)>0$ and $p''(Q)<0$ - to accommodate for different market structures.[5]

One feature of the group is that it is a *polity*: any PO that is formed must be governed through a democratic process or some collective choice mechanism to decide upon the rules that govern the group. To keep things simple the paper considers the case in which the decisions are made according to majority rule. Here we are interested in the rules that affect the economic behavior of the producers: in particular the payments for the quality level provided by different producers, which must be decided and known in advance by all producers.

The potential n members meet together to decide whether to form the PO and how to run it. If the PO is formed, the producers pool their production together under the collective brand and receive a market price according to the level of quality they provide. From the PO each producer receives according to what quality of commodity he has provided. Each individual behaves in his own interest and would like to see the PO adopting the policies that better suit his own needs. So he votes for those proposed rules that best suit his own interests.

Producers are heterogeneous and have different preferences. Each producer can expect that what he can get from the PO is "bounded" from above and from below. Indeed, he cannot receive less than what he would get from his outside opportunities, because otherwise he would be better off not participating; and he cannot receive more than what is allowed by the fact that the PO must break-even. Even though this paper does not consider explicitly the voting process, for the purpose of illustration it is reasonable to think that among the implementable mechanisms each producer independently votes for the one that is the best for himself. Given the assumption about types, it is sensible to think that two contracts emerge, one that is optimal for low-type and one for high-type producers. The pricing mechanism that is then decided at the PO's level is the one that is voted by the majority of the producers.

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[5] It is important to consider different market structures since is has been recognized that the higher the level of coordination or collusion in an industry is, the higher the tendency to set the minimum quality standard too high for the social welfare optimum is (Leland, 1979; Shaked and Sutton, 1981; Bockstael, 1987).

The idealized situation can be translated into a game which can be represented in the following way (figure 1). Nature at the beginning of the game decides the distribution of the n producers between the two types: n_L producers of type θ^L and n_H producers of type θ^H. Farmers have private information about their own type, but the distribution of types (Nature`s choice) is not known. If $n_L > n_H$, there is a low-quality majority, while if $n_H > n_L$ the majority is of high-quality producers. At this stage no one knows which type is the majority.

Figure 1. The timing of the game.

Phases:	***Constitutional***	***Working***
0	**1**	**2**
Nature draws n_L and n_H	Producers consider feasible contracts and vote for the welfare maximizing one	Producers execute their contracts. Outcomes and payoffs are realized.

The next phase is the **constitutional** choice, and it is represented by the period 1. The producers vote and agree on a set of initial rules - the constitution - which specifies the democratic rules of the producers` organization, the fees to be paid, the rights and obligations of each agent. Assume that producers vote for what is best for their own interest and the set of rules and regulations that gets the majority of the votes wins. The next is the **working** phase, or period 2 in figure 1. Producers can either reject or accept the contract. If they reject the contract they remain at their reservation utility.[6] If they accept the contract, they start to work with the PO and must comply with its rules.[7]

This one-shot game can be solved by backward induction. The optimal contract in the first

[6] Here we assume that producers prefer to stay in the PO when offered a contract that drives them to their reservation utility. One could argue that the PO could offer ε (small enough) above the reservation utility to induce the producer to participate. Note that we rule out the possibility of collusion among any subset of producers.

[7] At this stage, we consider the case in which all n producers must be given enough incentives to participate. This may not always be the case, since n can be endogenous. Future research will address this issue.

phase can be found taking into account the incentives in the second phase. We use mechanism-design because it allows to take into account differences in types. In addition, without imposing too much restrictions on the structure of the model, either in the demand or cost side, mechanism-design might allow to derive more general conclusions than the available results in the literature.

A mechanism in our case is the combination of payments to and quality level provided by producers. Before starting the analysis we mention one result that usually holds for mechanism design problems like the one we are considering. The revelation principle (Myerson, 1979) allows to focus on direct revelation mechanisms, mechanisms constructed so that it is in each producer's dominant strategy to tell the truth, provided that one takes into account the presence of asymmetric information. That is to say, one can design a contract in which producers tell the truth, i.e., it is implementable, provided it is incentive compatible. Hence, any payment schedule that the producers adopt has to satisfy:

$$\begin{aligned} y(\theta^L) - c(q(\theta^L), \theta^L)) &\geq y(\theta^H) - c(q(\theta^H), \theta^L)) \\ y(\theta^H) - c(q(\theta^H), \theta^H)) &\geq y(\theta^L) - c(q(\theta^L), \theta^H)). \end{aligned} \tag{1}$$

From eq. (1) it is usually derived the following lemma.

Lemma 1. *Any mechanism $(y(\theta^i), q(\theta^i))$ that satisfies eq. (1) must also satisfy:*

$$\begin{aligned} y(\theta^H) &\geq y(\theta^L), \\ q(\theta^H) &\geq q(\theta^L). \end{aligned}$$

The lemma says that the payment offered to type θ^H must be equal or greater than that offered to type θ^L. Also, the quality level chosen by type θ^H must be equal or greater than that chosen by type θ^L. Note at this point we are working only with dominant strategies and we do not consider the problem of the group dynamics, in particular the expectations of what other producers are doing.

Among the contracts that are implementable, producers have to figure out those that are feasible, i.e., those that satisfy eq. (1) and the rationality or participation constraint like the following:

$$(PC_i) \qquad y(\theta^i) - c(q(\theta^i),\theta^i) \geq \underline{u}(\theta^i) = 0,$$

which says that each producer participates on a voluntary basis and so must receive at least its reservation utility, which at this stage is set equal to zero for the purpose of exposition. In addition, the PO must break-even, that is:

$$(BC) \qquad n\, p(Q) - \sum_{i=L}^{H} n_i\, y(\theta^i) \geq F.$$

np(Q) is the revenue - net of processing costs - that the PO receives from selling the members' good in the market and is a function of the average quality Q. The aggregate revenues from the products sold in the market minus the payments to the producers must cover the fixed costs F for the Producer Organization.

Producers at the constitutional stage act under a *veil of uncertainty* (Brennan and Buchanan, 1985). They know their own type, but they do not know their payoffs in future contingencies: since they do not know their partners' types or cost structures they face some uncertainty regarding their future position, i.e., either they will end up in the majority or in the minority. The rules can have different impact on the welfare of each producer according to whether or not he is in the majority. To some extent different rules may imply different redistribution of surplus from the losing to the winning majority in the group.

Anticipating this, producers may find convenient at the constitutional stage to agree to put some limitations on the type of policies that might be implemented and so on the kind of redistribution that can be pursued. The members could impose some limits on the mechanisms that the PO can implement. One possibility is that *"equal treatment for all"* shall be adopted by the Board of Directors, which in this case may only choose the same payment scheme for all producers.[8] However, the PO still selects the level of quality and payment according to the majority vote.

This rule is in the spirit of the constitutional economics approach first enunciated by Brennan

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[8] Another limitation could be an unanimity rule which we do not consider for the moment.

and Buchanan (1986; Buchanan, 1990). In some recent literature it is applied to the choice of policy instruments in environmental economics (Boyer and Laffont, 1997) or in industrial policies (Laffont, 1996). To the best of our knowledge these are the only applications in which, even though implicitly, some of the ideas of the constitutional economics literature are applied in combination with mechanism design. What it is proposed in the paper we believe is the first attempt to use the same idea and tools in the case of a group of producers and in a different context. Indeed, the cases mentioned above are concerned with the regulation of a monopolist. In addition, the choice of constitutional limits on Government's policies is motivated with incomplete contracts arguments.

3. The constitutional phase with efficient rules - no restrictions on the rules.

In this section, we derive the optimal mechanism for the cases in which one of the two types is in the majority and decides the mechanism with no constitutional constraints. The resulting (separating) mechanisms, one for the low-quality and the other for the high-quality producers, are then compared to the two cases in which each majority of producers type must select a mechanism that is restricted by the pre-constitutional constraint to be the same for both types (fourth section) and to the first-best. All scenarios have the common constraints that each producer`s participation is on a voluntary basis, that each type should pick the mechanism intended for him, and that the PO must break even.

The outcomes of the game played in the following sections may be compared with the equilibrium that would result without the PO. One possible benchmark could be the market equilibrium, provided there is full information. Another comparison would be the case of a regulator with perfect observability of quality and an utilitarian social welfare function with unitary weights.[9] In both cases, the first-best equilibrium would be that each producer receives a price that is a function of the quality he provides, or the following first order conditions must be satisfied:

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[9] We are assuming the Agency cares mostly about producers` welfare - we do not consider yet the effects on consumers` - and does not discriminate between different types of producers. The first assumption seems in line with most of the interventions made by Government Agencies dealing with agricultural regulations, i.e., Departments or Ministries of Agriculture. The second is neutral in the sense that many interventions seem to favor small producers - even though these are not necessarily the low-quality type - and some favor the more efficient producers.

$$
\begin{aligned}
&p'(Q) = c_q(q^*(\theta^L), \theta^L), \\
(FB) \qquad &\\
&p'(Q) = c_q(q^*(\theta^H), \theta^H).
\end{aligned}
$$

According to (FB), the regulator would induce both types to produce at their marginal cost, i.e., it would be the first-best provision. This result is driven by the observability of quality: since the payment is based on an observable and verifiable characteristic, the first-best can be obtained. The same outcome would result in a competitive market provided quality were observable.

High-quality majority.

The first case we consider is when Nature draws $n_H > n_L$ and so the majority is of high-quality producers. At the constitutional stage, they have to pick the best of implementable and feasible contracts. In this case the majority of the votes goes to the optimal contract selected by high-quality types, that is the program that has the objective the maximization of their profits ($\pi(\theta^H)$) and is implementable, that is subject to the constraints specified above:

$$
\begin{aligned}
(PO) \qquad & \max_{y(\theta^i), q(\theta^i)} y(\theta^H) - c(q(\theta^H), \theta^H) \\
s.t.\ (IC_L) \qquad & y(\theta^L) - c(q(\theta^L), \theta^L) \geq y(\theta^H) - c(q(\theta^H), \theta^L), \\
(IC_H) \qquad & y(\theta^H) - c(q(\theta^H), \theta^H) \geq y(\theta^L) - c(q(\theta^L), \theta^H), \\
(PC_i) \qquad & y(\theta^i) - c(q(\theta^i), \theta^i) \geq \underline{u}(\theta^i) = 0, \\
(BC) \qquad & n\, p(Q) - \sum_{i=L}^{H} n_i\, y(\theta^i) \geq F.
\end{aligned}
\tag{2}
$$

The choice variables $y(\theta^i)$ and $q(\theta^i)$ must satisfy Lemma 1, that is $y(\theta^H) \geq y(\theta^L)$ and $q(\theta^H) \geq q(\theta^L)$. (PO) is the maximand and represents the profits of the producer that is in the drawn majority. (IC_L) and (IC_H) are the incentive compatible constraints: since the management can not verify the producers` cost of production, the PO must offer a payment $y(\theta^i)$ based on observable quality to induce each producer to select himself and pick the mechanism designed for him.

(PC_i) are the participation or rationality constraints of the two types. Outside opportunities

are denoted by $\underline{u}(\theta^i)$ assumed here to be equal to zero. (BC) is the break-even constraint: the net aggregate revenues minus the payments to the producers should cover the fixed costs F.

Following Grossman and Hart (1983), Weymark (1986) and Chambers (1997), the problem of eq. (2) above can be decomposed in two steps in the following way:

$$\max_q \ (\max_y \ y(\theta^H) \mid IC_L, \ IC_H, \ PC_i, \ BC) \ - \ c(q(\theta^H), \theta^H)). \tag{3}$$

The high-type producer first chooses the payment scheme that maximizes the total payments to his type θ^H while satisfying all the constraints, and then finds the efficient level of quality to provide. Following the steps adopted in Weymark (1986) and Chambers (1997), it can be shown that the PO`s budget constraint (BC) is binding; if not, the PO could still increase the maximand without violating the IC constraint. The budget constraint, whose negative slope is given by $\frac{dy(\theta^H)}{dy(\theta^L)} = -\frac{n_L}{n_H}$, is illustrated in figure 2. If a solution to the first stage exists then it must be on this line.

Equation (2) gives the incentive compatible constraints that must be satisfied, that is:

$$c(q(\theta^H), \theta^L) - c(q(\theta^L), \theta^L) \geq y(\theta^H) \ - y(\theta^L) \geq c(q(\theta^H), \theta^H) - c(q(\theta^L), \theta^H). \tag{4}$$

These are represented in fig. 2 as the two lines above the bisector for a fixed q and given strict inequalities in Lemma 1. The payments to producers that satisfy both the BC and the ICs are then those in the BC line between the two ICs. The last constraint to consider in this first step is the low-quality type producer`s participation constraint which can be represented as a vertical line with the intercept $y(\theta^L) = c(q(\theta^L), \theta^L)$. Here we analyze only the case in which the PC cuts the BC to the left and above point B.[10] Since the objective is to maximize type $\theta^H$`s welfare, the relevant point to consider is B.

In the first step, the relevant binding constraints are the budget constraint and the low-quality producer`s incentive compatibility constraint (the PO has to avoid that the low-type "poses" as a high-

[10] There are at least other two cases to consider. One is when the PC cuts the BC on the right of point B and to the left of point A. The other is when it cuts to the right of point A (no feasible solutions). The analysis of these further points is the subject of further research.

type). We then have the following:

$$c(q(\theta^H),\theta^L) - c(q(\theta^L),\theta^L) + y(\theta^L) = y(\theta^H),$$
$$n\,p(Q) - F - n_L\,y(\theta^L) = n_H\,y(\theta^H), \tag{5}$$

from which we obtain $y(\theta^H) = [c(q(\theta^H),\theta^L) - c(q(\theta^L),\theta^L)]\,\frac{n_L}{n} + p(Q) - \frac{F}{n}$ and $y(\theta^L) = y(\theta^H) + c(q(\theta^L),\theta^L) - c(q(\theta^H),\theta^L)$. As this latter equation shows, the payment for the low-quality type makes him just indifferent between his payment scheme and the one intended for the high-quality should he, the low-type, pose as high-type.

In the second step, the problem is the choice of the efficient quality level. From Lemma 1 we know that $q(\theta^H) \geq q(\theta^L)$, and we can define an auxiliary variable $\alpha \geq 0$ such that $q(\theta^H) = q(\theta^L) + \alpha$, which reduces the problem to a simple unconstrained nonlinear program. We then maximize the following:

$$\max_{q(\theta^L),\alpha}\; p(Q) - \frac{F}{n} + [c(q(\theta^H),\theta^L) - c(q(\theta^L),\theta^L)]\,\frac{n_L}{n} - c(q(\theta^H),\theta^H). \tag{6}$$

Remembering that $Q = \frac{1}{n}\sum_{i=L}^{H} n_i\,q(\theta^i)$, we obtain the following first order conditions respectively for $q(\theta^L)$ and α:

$$p'(Q)\frac{n_L}{n} + p'(Q)\frac{n_H}{n} + [c_q(q(\theta^H),\theta^L) - c_q(q(\theta^L),\theta^L)]\frac{n_L}{n} - c_q(q(\theta^H),\theta^H) \leq 0,\quad q(\theta^L) \geq 0,$$
$$p'(Q)\,\frac{n_H}{n} + c_q(q(\theta^H),\theta^L)\,\frac{n_L}{n} - c_q(q(\theta^H),\theta^H) \leq 0,\quad \alpha \geq 0, \tag{7}$$

where $p'(Q)$ and $c_q(\bullet)$ are the first derivatives with respect to q. After some manipulations and assuming interior solutions for both variables [11] we obtain the following solutions:

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[11] To assume interior solutions for the auxiliary variable implies there is no bunching of types. A result originally due to Guesnerie and Seade (1982) shows that an optimal mechanism with only two types cannot involve bunching.

$$p'(Q) - c_q(q(\theta^H), \theta^H) = \frac{n_L}{n}\,[c_q(q(\theta^L), \theta^L) - c_q(q(\theta^H), \theta^L)],$$
$$p'(Q) = c_q(q(\theta^L), \theta^L). \tag{8}$$

The optimal pricing mechanism requires low-quality types producing at the point at which their marginal cost equals the marginal price the PO receives from the sale of the commodity. At the same time, high-quality types produce up to a point above their marginal cost, since $c_q(q(\theta^L), \theta^L) - c_q(q(\theta^H), \theta^L) < 0$ implies $p'(Q) < c_q(q(\theta^H), \theta^H)$. Note that the distortion for the high-quality types is higher the wider the cost difference with the low-type is and the more numerous the group of low-type producers is. When both types' costs are similar and low-quality producers are few, the distortion is lower.

Proposition 1. *The Producer Organization with a high-quality majority and an efficient remuneration scheme overall produces a higher average quality level than the first-best.*

Proof. For a heuristic proof, follow Chambers (1997). Respectively from the first and second of the (FB) conditions the following can be derived:

$$(L) \qquad \frac{dq_H}{dq_L}\Big|_L = -\frac{p''(Q)\frac{n_L}{n} - c_{qq}(q(\theta^L), \theta^L)}{p''(Q)\frac{n_H}{n}},$$

$$(H) \qquad \frac{dq_H}{dq_L}\Big|_H = -\frac{p''(Q)\frac{n_L}{n}}{p''(Q)\frac{n_H}{n} - c_{qq}(q(\theta^H), \theta^H)},$$

which represent the slope of the curves L and H represented in figure 3, and which are straight lines only for exposition convenience. Curve L cuts curve H from above. The points lying on the curves satisfy the (FB) conditions; on the points below the curves, the marginal price in greater than the marginal cost, while on the points above the curves the marginal cost is higher than the marginal

price. To be consistent with eq.(8) a point must be on curve L but above curve H since $p`(Q) < c_q(q(\theta^H), \theta^H)$.

A suitable candidate could be point A: a quality combination for the two types consistent with eq. (8) would imply the high-quality type θ^H to produce more quality, that is to say $q(\theta^H) > q^*(\theta^H)$, and the low-quality type to produce less quality than the first-best, or $(q(\theta^L) < q^*(\theta^L)$. Using Lemma 1, we may conclude that eq. (8) implies a spreading of quality provision, or in other words that $q(\theta^H) > q^*(\theta^H) > q^*(\theta^L) > q(\theta^L)$. This spreading, together with eq. (8) and the convexity of the cost functions lead to the following:

$$p'(\frac{1}{n}\sum_{i=L}^{H} n_i\, q(\theta^i)) = c_q(q(\theta^L), \theta^L) < c_q(q^*(\theta^L), \theta^L) = p'(\frac{1}{n}\sum_{i=L}^{H} n_i\, q^*(\theta^i)),$$

which implies that $p'(\frac{1}{n}\sum_{i=L}^{H} n_i\, q(\theta^i)) < p'(\frac{1}{n}\sum_{i=L}^{H} n_i\, q^*(\theta^i))$. Since the price function is strictly concave in quality, we can infer that $\frac{1}{n}\sum_{i=L}^{H} n_i\, q(\theta^i) > \frac{1}{n}\sum_{i=L}^{H} n_i\, q^*(\theta^i)$, or that the average quality provided by the group when the majority is of high-quality producers is higher than the first-best.

To see it in another way, consider figure 4 which shows the marginal cost curves for the two types and the marginal price schedule, all as a function of the quality level. In the first-best, the quality level picked by the two types is denoted respectively by $q^*(\theta^L)$ and $q^*(\theta^H)$. The average quality provided by the group is given by the weighted (by their relative number n_i/n) average of the two first-best quality levels and is represented by Q^*. Now, note that another way of putting eq. (8) is $c_q(q(\theta^L), \theta^L) = p`(Q) < c_q(q(\theta^H), \theta^H)$. With a separating mechanism and high-quality majority, high-quality types would produce at a higher level of quality than the first-best, since $p`(Q) < c_q(q(\theta^H), \theta^H)$. The quality provided by the PO would then be the weighted average of the first-best level for the low type but of a higher than the first-best level for the high-quality type , i.e., a higher level than the first-best overall, assuming the same relative number for the two types. *Q.E.D.*

A policy that would implement such an optimal mechanism could be a minimum-quality standard tailored to keep the low-quality types above their reservation utility and a premium for high-quality that would be lucrative mainly for high-quality producers. The rule just described ends up being a group that commercializes only products that are devoid of any blemishes. Any consumer used to buying fruits would recognize that among the commodities traded by those groups with high-quality reputation it is almost impossible to find something different from a less than almost perfect

product.

Low-quality majority.

In this case Nature draws $n_L > n_H$ and low-type producers have the majority. The pricing rule is then crafted in order to enhance low-quality producers` welfare subject to the high-quality minority members voluntary participation in the PO. The Board of Directors enforces a pricing mechanism that can be represented as the result of the following program:

$$
\begin{aligned}
&(PO) && \max_{y(\theta^i),q(\theta^i)} \; y(\theta^L) - c(q(\theta^L),\theta^L) \\
s.t. \quad &(IC_L) && y(\theta^L) - c(q(\theta^L),\theta^L) \geq y(\theta^H) - c(q(\theta^H),\theta^L), \\
&(IC_H) && y(\theta^H) - c(q(\theta^H),\theta^H) \geq y(\theta^L) - c(q(\theta^L),\theta^H), \\
&(PC_i) && y(\theta^i) - c(q(\theta^i),\theta^i) \geq \underline{u}(\theta^i) = 0, \\
&(BC) && n\, p(Q) - \textstyle\sum_{i=L}^{H} n_i\, y(\theta^i) \geq F,
\end{aligned}
\tag{9}
$$

where the maximand represents the profits of the low-quality type and the constraints are as defined in eq. (2). Note that the choice variables $y(\theta^i)$ and $q(\theta^i)$ must be monotonic and satisfy Lemma 1. In this case the relevant participation constraint is that of type θ^H whom must be ensured enough profits in order to participate. As was done in the previous case, the problem can be decomposed in two steps. First, the choice of the payment scheme, and then the efficient level of quality:

$$
\max_q \; (\max_y y(\theta^L) \mid IC_L,\, IC_H,\, PC_H,\, BC) - c(q(\theta^L),\theta^L)). \tag{10}
$$

Using the arguments we gave in the previous case, it can be shown that the PO`s budget constraint is binding. Eq.(4) gives the incentive compatible constraints that must be satisfied and that are represented in fig. 2. In addition, the participation constraint to consider is the high-quality type`s, represented by a horizontal line with the intercept $y(\theta^H)=c(q(\theta^H),\theta^H)$. Here we analyze only the

case in which the PC cuts the BC to the right and below point B.[12] Since the optimal contract has to maximize type θ^L`s welfare, in this case the relevant point to consider is A.

The binding constraints are then the budget constraint and the high-quality producer`s incentive compatible constraint (the PO now has to take into account the incentive for the high-type "to pose" as a low type). We have the following:

$$\begin{aligned} y(\theta^H) &= y(\theta^L) + c(q(\theta^H),\theta^H) - c(q(\theta^L),\theta^H), \\ n\,p(Q) - F &- n_H\,y(\theta^H) = n_L\,y(\theta^L), \end{aligned} \tag{11}$$

whose solution is $y(\theta^L) = [c(q(\theta^L),\theta^H) - c(q(\theta^H),\theta^H)]\,\frac{n_H}{n} + p(Q) - \frac{F}{n}$. Note that the first equation in the system of eq. (11) represents the payment to the high-quality producer and it says that he must be just indifferent between his payment and the one intended for the low-quality type. The second step of the optimization problem for the choice of the efficient quality level is the following:

$$\max_{q(\theta^L),\alpha}\; p(Q) - \frac{F}{n} - [c(q(\theta^2),\theta^2) - c(q(\theta^L),\theta^2)]\,\frac{n_2}{n} - c(q(\theta^L),\theta^L), \tag{12}$$

where the auxiliary variable $\alpha \geq 0$, defined as before as $q(\theta^H) = q(\theta^L) + \alpha$ by virtue of Lemma 1, simplifies to a simple unconstrained nonlinear program. In order to solve the maximization problem, we obtain the following first order conditions respectively for $q(\theta^L)$ and α:

$$\begin{aligned} &p'(Q)\frac{n_L}{n} + p'(Q)\frac{n_H}{n} - [c_q(q(\theta^H),\theta^H) - c_q(q(\theta^L),\theta^H)]\frac{n_H}{n} - c_q(q(\theta^L),\theta^L) \leq 0,\; q_{\theta^L} \geq 0, \\ &p'(Q)\,\frac{n_H}{n} - c_q(q(\theta^H),\theta^H)\,\frac{n_H}{n} \leq 0, \quad \alpha \geq 0. \end{aligned} \tag{13}$$

After some manipulations and assuming interior solutions we obtain the following:

---

[12] As in the previous case, there are at least other two cases to consider. One is when the PC cuts the BC above point A but below point B. The other is when it cuts above point B (no feasible solutions). The analysis of these further points will be the subject of future research.

$$p'(Q) - c_q(q(\theta^L),\theta^L) = \frac{n_H}{n}\,[c_q(q(\theta^H),\theta^H) - c_q(q(\theta^L),\theta^H)],$$
$$p'(Q) = c_q(q(\theta^H),\theta^H). \qquad (14)$$

When low-quality producers have the majority, their choice of a pricing mechanism induces high-quality types to produce at the quality level implicitely defined by equating the marginal revenue for the group at their marginal cost, and offers them a payment that leaves them just indifferent between it and the payment intended for low-quality types. Low-quality producers, since $c_q(q(\theta^H),\theta^H) - c_q(q(\theta^L),\theta^H) > 0$ implies $p'(Q) > c_q(q(\theta^L),\theta^L)$, produce less quality than the first-best.

Proposition 2. *The average quality provided by the group when the majority is of low-type producers and it uses an efficient remuneration scheme is lower than the first-best.*

Proof. This can be seen by returning to figure 3 and using the same arguments of the previous section which are taken from Chambers (1997). A point consistent with eq. (14), must be on curve H and below curve L, since $p'(Q) > c_q(q(\theta^L),\theta^L)$, e.g., point B. The quality combination for the two producer types consistent with eq. (14) would imply the high-quality type θ^H to produce higher quality than the (FB) and the low-quality type to produce less than the first-best. Using Lemma 1, eq.(14) implies a spreading of quality provision, or that $q(\theta^H) > q^*(\theta^H) > q^*(\theta^L) > q(\theta^L)$, which together with eq. (14) and the convexity of the cost functions imply $p'(\frac{1}{n}\sum_{i=L}^{H} n_i\, q(\theta^i)) = c_q(q(\theta^H),\theta^H) > c_q(q^*(\theta^H),\theta^H) = p'(\frac{1}{n}\sum_{i=L}^{H} n_i\, q^*(\theta^i))$. The marginal cost being non-decreasing in quality implies that $p'(\frac{1}{n}\sum_{i=L}^{H} n_i\, q(\theta^i)) > p'(\frac{1}{n}\sum_{i=L}^{H} n_i\, q^*(\theta^i))$. Since the price function is strictly concave, we can infer that $\frac{1}{n}\sum_{i=L}^{H} n_i\, q(\theta^i) < \frac{1}{n}\sum_{i=L}^{H} n_i\, q^*(\theta^i)$.

Figure 4 may help again to see it in another way. The weighted average of the first-best level of quality for the high-quality type θ^H and the lower (than the first best) level of low-type is lower than the overall average quality provided in the first-best. *Q.E.D.*

The PO produces at a lower quality level, since the majority of producers - the low-quality type - is relatively inefficient at providing quality. In this way they maximize their profits and have

the high-quality members making positive profits. A policy that could implement this optimal mechanism would pay a relatively high price to low-quality products and would have a relatively low premium for higher quality levels.

4. Constitutional restrictions on the rules - an *equal treatment for all* remuneration scheme.

In the constitutional phase the uncertainty about the distribution of different types leads to uncertainty about the profit levels resulting from participating in the PO. For each member, profits depend on the rules voted by the majority of types, which does not necessarily coincide with the group - either low or high-quality - to which a given member belongs. Also, as it is in the tradition of cooperatives, a rule to limit the choice of the pricing mechanism that the PO might implement could be the often cited *equal treatment for all*, which could be agreed upon by all producers before the constitutional phase. The PO would offer and each producer would be allowed to vote among those pricing mechanisms that are equal for all producers, irrespective of their types (pooling mechanism). Like in the previous section, there can be two cases, according to which type is the majority.

High-quality majority and fair rules.

In this case ($n_H > n_L$) the most voted pricing mechanism in the constitutional phase is the solution of the program maximizing high-type`s welfare subject to the budget constraint for the PO and the voluntary participation by the producers. The mechanism is formed only by q and $y(q)$, that is they are the same irrespective of the type of the producers. Then there is no need to consider the incentive compatible constraint, since the PO is forced to offer the same payment-quality schedule to all producers. The problem can be represented as:

$$\begin{aligned} & (PO) && \max_{y,q}\ y(q) - c(q,\theta^H) \\ s.t. \quad & (PC_i) && y(q) - c(q,\theta^l) \geq \underline{u}(\theta^l) = 0, \\ & (BC) && n\,p(Q) - n\,y(q) \geq F. \end{aligned} \tag{15}$$

(PC_i) are the participation constraints of the two types, and (BC) is the break-even constraint in

which, given the non-discriminating nature of the payment implemented, $Q = \frac{1}{n}\sum_{i=L}^{H} n_i\, q = q$. The problem can be decomposed in two steps as before, with the first one being the following:

$$\max_y\ y(q) \qquad s.t. \qquad BC,\ PC_i. \tag{16}$$

Compared to the previous cases, and referring to fig. 2, in this case in order to satisfy the BC the solution must occur on the bisector (since $y(\theta^L) = y(\theta^H)$) and, assuming as before that the PC_L is the only rationality constraint to consider and that is not binding, we find that $y(q) = p(Q) - F/n$, which leads to the following second step maximization problem:

$$\max_q\ p(Q) - \frac{F}{n} - c(q,\theta^H), \tag{17}$$

whose first order condition is the following:

$$p'(Q) - c_q(q,\theta^H) \le 0, \quad q \ge 0, \tag{18}$$

leading to the result that $p'(Q) = c_q(q,\theta^H)$. The need to assure an equal treatment for all producers - agreed in principle by all of them - and a majority of high-quality types leads to a pricing mechanism in which the quality level provided by the entire group is such that the marginal net revenue is equal to the majority high-type`s marginal cost.

Proposition 3. *The average quality provided by the Producers` Organization with an "equal treatment for all" remuneration scheme and a high-quality majority of producers is greater than the first best.*

Proof. It is similar to the proof of proposition 1. To see it please go back to the curves L and H represented in figure 3. The points lying on the curves satisfy the first best conditions. To be consistent with eq. (18) a point must be on curve H but it must also satisfy the constitutional constraint $q(\theta^L)=q(\theta^H)$, that is it must be on the bisector, e.g., point C. Then a quality combination for the two producer types consistent with eq. (18) would imply both types producing the same level of quality. With respect to the first best it would lead to $q^*(\theta^H) > q^{PH} > q^*(\theta^L)$, where q^{PH} represents

the quality level chosen by both types when the majority is of type θ^H and uses an *equal treatment for all*, like at point C, and $q^*(\theta^i)$ represents the quality level chosen by each type in the first best. Considering these inequalities and combining eq. (18) and the corresponding type`s equation from the first best (FB), together with the convexity of the cost function, lead to the following:

$$p'(\frac{1}{n}\sum_{i=L}^{H} n_i\, q^{PH}) = c_q(q^{PH}, \theta^H) < c_q(q^*(\theta^H), \theta^H) = p'(\frac{1}{n}\sum_{i=L}^{H} n_i\, q^*(\theta^i)),$$

which implies that $p'(\frac{1}{n}\sum_{i=L}^{H} n_i\, q^{PH}) < p'(\frac{1}{n}\sum_{i=L}^{H} n_i\, q^*(\theta^i))$. Since the price function is strictly concave in quality, we can infer that $\frac{1}{n}\sum_{i=L}^{H} n_i\, q^{PH} > \frac{1}{n}\sum_{i=L}^{H} n_i\, q^*(\theta^i)$, or that the average quality provided by the group when the majority is of high-type producers and uses a pooling mechanism is higher than the first-best.

To see it in another way, note that in the case of $n_L = 0$, eq. (FB) reduces to $p`(Q) = c_q(q^*(\theta^H), \theta^H)$, i.e., the quality level would be at $q^*(\theta^H) = q^{PH}$. Now, if we slightly increase n_L we would have the low-type θ^L producers to produce $q^*(\theta^L)$ in the first best instead of q^{PH} with the pooling mechansim. They would then produce an average quality of $Q^* < q^{PH}$ and this latter would be the upper bound of the quality produced by the group. *Q.E.D.*

To summarize, the average quality provided by a group with a high-quality majority and an *equal for all* remuneration scheme would be higher than the first-best. The majority still decides the level of quality to produce but with more limitations. Since with this rule the whole group "mimics" the choice decided by the majority, distortions still result. To implement this egalitarian mechanism, a minimum-quality standard could work but it would be set relatively high.

Low-quality majority and fair rules.

In an analogous way, when the majority is composed of low-quality types who are constrained to choose the same mechanism for all producers, they face and vote the following optimal contract in the constitutional phase:

$$
\begin{aligned}
&(PO) \qquad \max_{y,q} \; y(q) \; - \; c(q,\theta^L) \\
s.t. \quad &(PC_i) \qquad y(q) - c(q,\theta^i) \; \geq \; \underline{u}(\theta^i) = 0, \\
&(BC) \qquad n \; p(Q) \; - \; n \; y(q) \; \geq \; F.
\end{aligned}
\tag{19}
$$

In this case, (PC_H) is the participation constraint of the high-quality type to consider, and we can decompose the problem in two steps as before, with the first one being the following:

$$
\max_{y} \; y(q) \qquad s.t. \qquad BC, \; PC_i. \tag{20}
$$

Again, and without repeating all the manipulations similar to the preceding case, in order to satisfy the BC the solution must occur on the bisector in which $y(\theta^L) = y(\theta^H)$ and assuming PC_H is not binding, we find that $y(q) = p(Q) - F/n$, which leads to the following second step maximization problem:

$$
\max_{q} \; p(Q) \; - \; \frac{F}{n} \; - \; c(q,\theta^L), \tag{21}
$$

whose first order condition is the following:

$$
p'(Q) \; - \; c_q(q,\theta^L) \; \leq 0, \quad q \geq 0, \tag{22}
$$

leading to the result that $p'(Q) \; = \; c_q(q,\theta^L)$. As in the previous case, the *equal treatment for all* rule and the low-quality majority induce both types of producers to provide quality implicitely defined at the low type`s marginal cost level.

Proposition 4. *The average quality provided by the Producers` Organization with an "equal treatment for all" remuneration scheme and a low-quality majority of producers is lower than that obtainable in the first best.*

Proof. Use the same arguments of the previous proposition, refer to point D in figure 3 and to the

quality level q^{PL} in figure 4. At point D, $q^*(\theta^H) > q^{PL} > q^*(\theta^L)$, with q^{PL} representing the quality level chosen by both types when the majority is of type θ^L and uses an equal treatment for all. Considering these inequalities, eq. (22), the corresponding type`s equation for the first best, and the convexity of the cost function, lead to the following:

$$p'(\frac{1}{n}\sum_{i=L}^{H} n_i\, q^{PL}) = c_q(q^{PL}, \theta^L) > c_q(q^*(\theta^L), \theta^L) = p'(\frac{1}{n}\sum_{i=L}^{H} n_i\, q^*(\theta^i)),$$

wich implies that $p'(\frac{1}{n}\sum_{i=L}^{H} n_i\, q^{PH}) > p'(\frac{1}{n}\sum_{i=L}^{H} n_i\, q^*(\theta^i))$. Since the price function is strictly concave in quality, we can infer that $\frac{1}{n}\sum_{i=L}^{H} n_i\, q^{PL} < \frac{1}{n}\sum_{i=L}^{H} n_i\, q^*(\theta^i)$, or that the average quality provided by the group when the majority is of low-type producers and uses a pooling mechanism is lower than the first-best.

To see it in figure 4, in the case of $n_H = 0$, eq. (FB) reduces to $p`(Q) = c_q(q^*(\theta^L), \theta^L)$ and the quality level would be $q^*(\theta^L) = q^{PL}$. If we increase n_H we would have the high-type θ^H producers to produce $q^*(\theta^H)$ in the first best instead of q^{PL} with the pooling mechansim. They would then produce an average quality of $Q^* > q^{PL}$ and this latter would be the lower bound of the quality produced by the group. *Q.E.D.*

6. Concluding remarks.

Using the advances of the economics of incentives, this paper studies the interaction of asymmetric information and the democratic process in the quality choices of a group of heterogenous producers. With a simple model of adverse selection we present the pricing rules and the quality provision in a group of producers (Producers` Organization) facing an opportunity to gain from their collective capacity to establish a reputation for their quality products. This paper compares different equilibria, according to the majority and to the constitutional rules adopted. Irrespective of the constitutional rules adopted, it finds that the quality level provided by the group is higher than the first-best with a high-quality producers` majority and lower with a low-quality producers` majority.

Possible developments have to consider when the minority type`s participation constraint is binding, i.e., when no informational rents are left to the minority type. One may also consider different market structures and, to make it more relevant to the european case, allow for possible

competition among different Producer Organizations. Future work should characterize the optimal rules for the group, that is whether and when it is welfare increasing to have a more efficient mechanism instead of some fairer but less flexible rules. The different constitutional rules might likely have a dissimilar impact on the distribution of profits between the producers of the two distinct types. If correct this intuition might reinstate the efficiency-equity trade-offs associated with the different remuneration schemes in cooperatives (Vercammen *et al.*, 1996). By making the choice of the PO`s constitutional rules endogenous, future extensions should likely explain why a relatively high number of groups, i.e., cooperatives, use fair rules instead of more efficient ones.

Overall, the study of the optimal contracts under different scenarios should help characterize some of the policies that can be found in the practice of Producers Organizations and allow to interpret some anecdotical evidence and empirical findings. For example, the prevalence of cooperatives among farmers with intermediate quality types found for different crops in California (Keen, 1993) and for wine in Italy (Carbone, 1996). In addition, it might explain the failures of previous attempts of the European Union to establish this form of market regulation in southern european countries. The experience with previous EU regulations in the seventies has been judged a failure, since POs did not establish as expected. In particular, the Italian case was considered by the EU as a big problem, given the extreme disorganization of supply and the consequent inability to deal with a modern and concentrated retail sector. For these reasons the EU enacted some specific regulations, e.g., Reg. n. 1360 in 1978 (Giacomini *et al.*, 1996).[13]

Last but equally important, once the positive analysis of this form of market organization is completed we may be able to give more educated guesses about its likely impact on total welfare. Analyses like those of this and other papers (e.g., Marette *et al.*, 1998) will likely allow to derive some results about the welfare effects for producers and consumers alike. The policy questions they may be able to answer are related to both the previous european and U.S. cases. Is Government intervention needed to start the self-regulation by Producers` Organizations, or can they function

[13] Some authors argue that the presence of cooperatives is the main reason for the failure of POs in Italy (Musotti and Petrella, 1996). We think however that this failure, besides being caused by the competition of cooperatives and their better political clout, might likely be explained also by the peculiar organization of the retail sector in this country. Notably, the retailing sector in Italy is heavily regulated, very disorganized and mainly based on small shops; only recently more modern structures and firms have gained market shares (OECD, 97).

without it? And when POs are indeed functioning, are they beneficial or is it better to regulate them in order to increase total welfare, especially when consumers welfare is concerned? A thorough economic analysis might prove to be useful to answer these relatively simple questions. After all, given the previous experiences with this form of self-regulation we would all be better off were we to find a way to avoid the same mistakes few years later.

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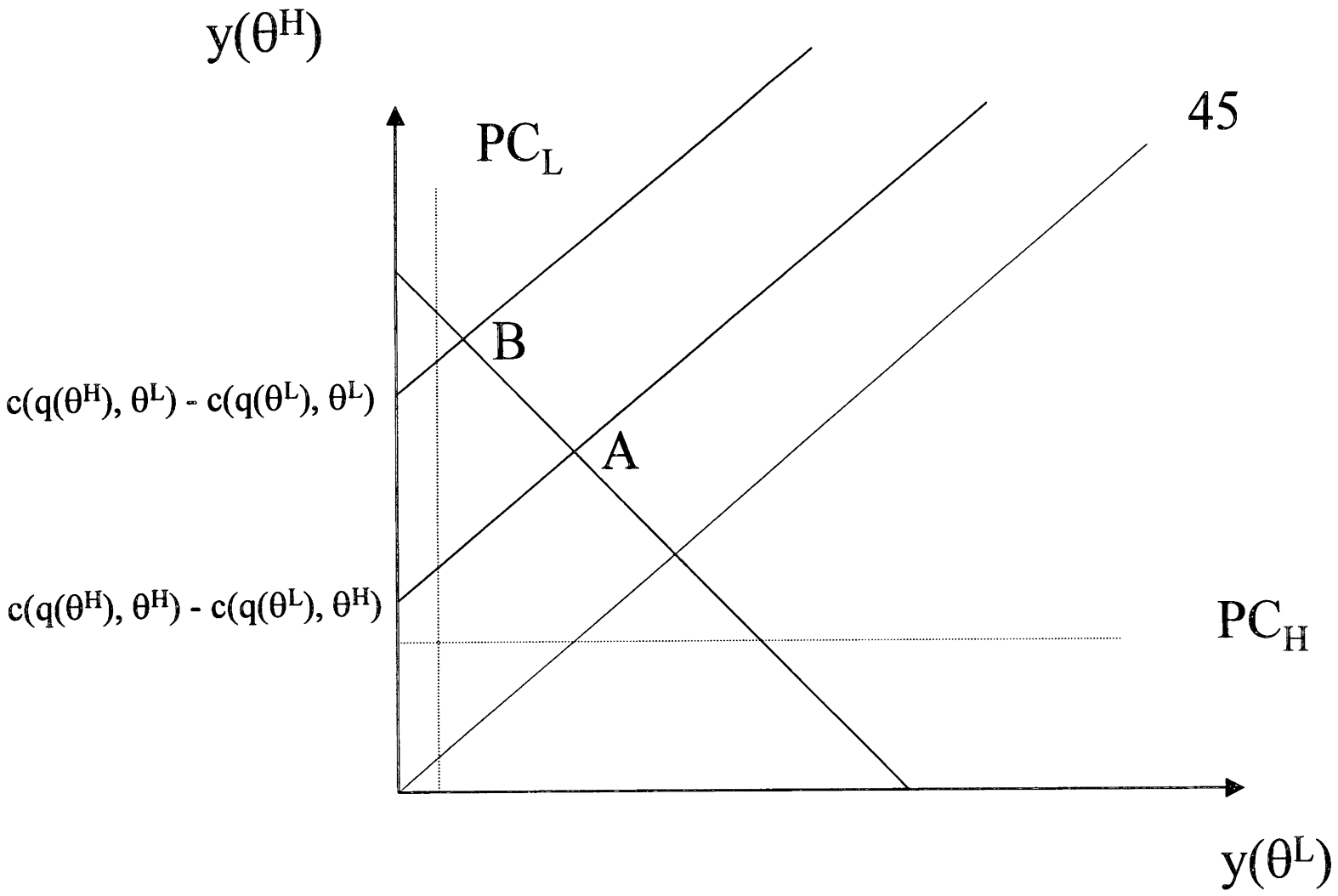

Figure 2. Budget (BC), participation (PC) and incentive compatible constraints

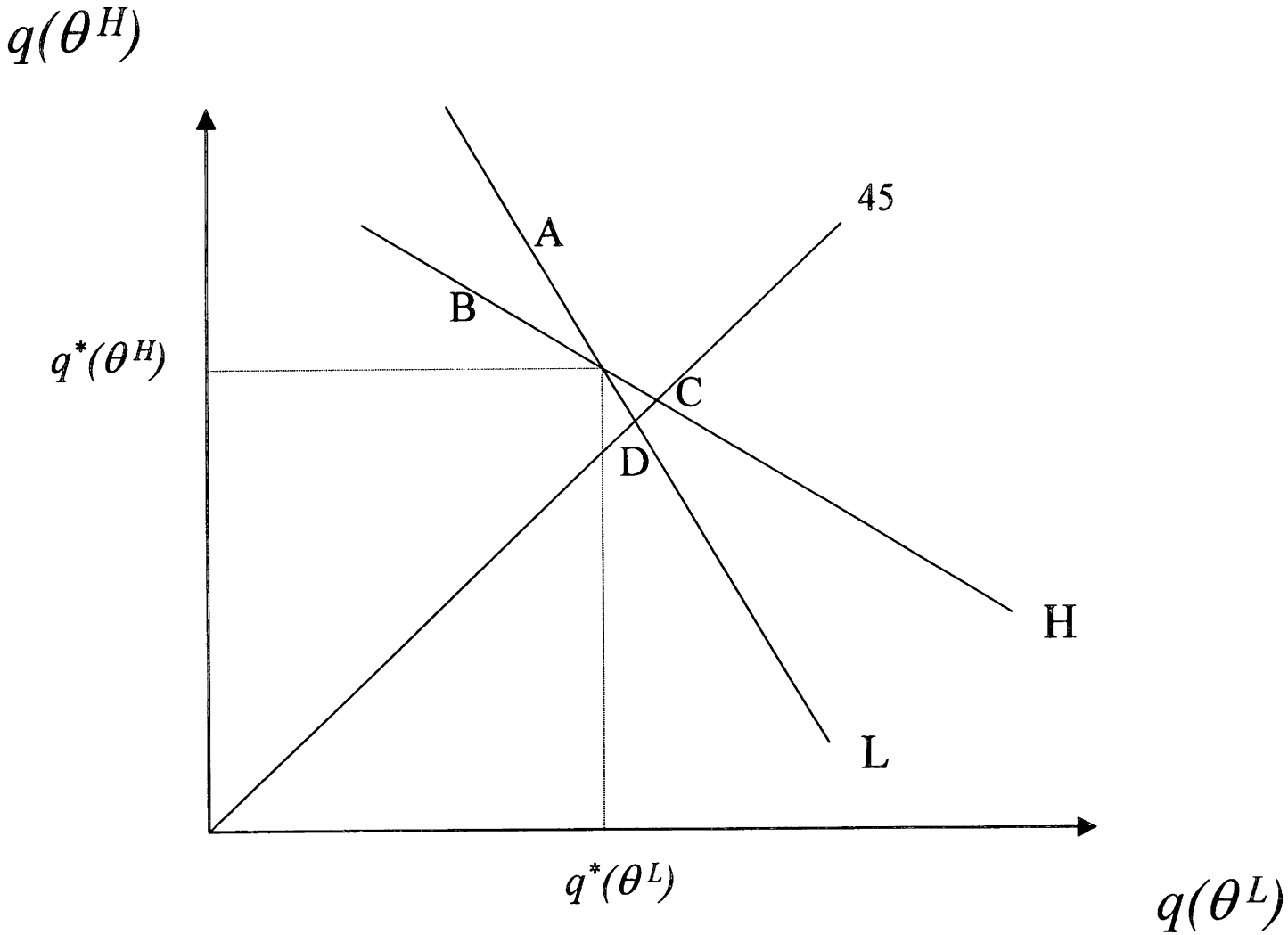

Figure 3. Quality level produced with different majorities.

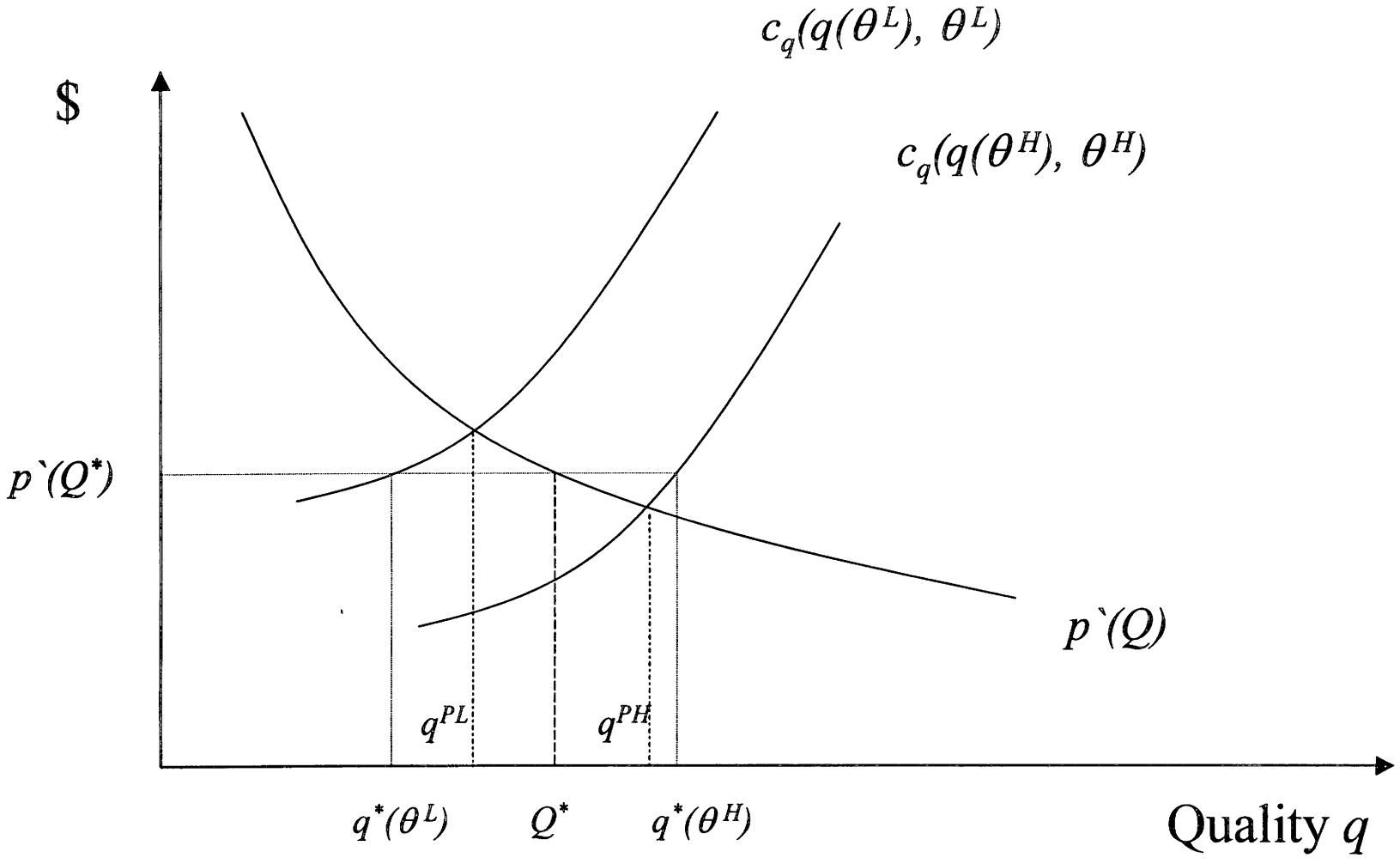

Figure 4. Marginal costs, marginal price schedule and quality levels.