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**Public regulation as a substitute for trust in quality food markets.  
What if the trust substitute cannot be fully trusted?**

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**PUBLIC REGULATION AS A SUBSTITUTE FOR TRUST  
IN QUALITY FOOD MARKETS.  
WHAT IF THE TRUST SUBSTITUTE CANNOT BE FULLY TRUSTED?**

by  
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*[Abstract]* Most food products can be classified as “credence” goods and regulations exist to provide consumers with a substitute for the lacking information and trust. The paper presents an analysis of the decisions of producers and consumers about a “credence” good in three institutional scenarios, which reflect different levels of credibility of the regulation. The first scenario is a reference scenario in which the regulation is fully credible. In the second case considered there is no regulation, or, if there is, it is totally ineffective. In the third scenario a regulation only partially credible provides consumers with an imperfect substitute for the information and trust they lack.

Some of the producers of “low” quality goods share with the producers of “high” quality goods an interest in the introduction of a regulation as long as this is not fully credible. In addition, it may be the case that even producers of “low” quality goods who know they will not be able to sell their products labeling them as being of “high” quality may have an interest in supporting a not fully credible regulation. Finally, rather than having producers of “low” quality goods “block” the introduction of a fully credible regulation, producers of “high” quality goods are better off when a compromise is reached which leads to the approval of an imperfect regulation.

*JEL Classification:* D82, L15, L51, Q13.

*Key words:* Asymmetric information; Credence goods; Product quality; Regulation; Trust.

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*1. Introduction*

Most food markets are characterized by a marked asymmetry in the information available to producers and consumers on the quality of the product. Producers know what they are selling, while consumers often do not know what they are buying. The analyses of markets characterized by information asymmetry and uncertainty on product quality have given rise to a vast body of literature starting back in the 1970s with the pioneering work of Akerlof [1970] on “one-shot” purchases and those of Klein and Leffler [1981], of Kreps *et al.* [1982] and of Shapiro [1983], which deal with repeated purchases.

In the case of “search” goods and “experience” goods (Nelson [1970]), relating to situations where the quality of a good can be known to consumers prior to purchase, and those where consumers find out the quality of a good only after consumption, respectively, there are endogenous incentives for producers to maintain quality standards (Laffont e Tirole [1991]). In fact, in the first case a reduction in standards leads to an immediate fall in sales, while in the second it leads to the growth of a bad reputation and, if purchase is repeated, to a fall in future profit levels.

Then there is a third, more complex, case, that of “trust” or “credence” goods, which refers to situations where consumers cannot possibly know the characteristics of a product even after consumption (Darby and Karni [1973]). The use of the category of “trust” to refer to these goods derives from the fact that consumers, being unable to judge the intrinsic characteristics of the product, make their choice on the basis of an act of faith in the producer. The existence of the market for a “credence” good is either made possible by the reputation of the seller, or is subject to a quality guarantee by a “third party”, often in the form of a regulation, which - by supplying consumers with the guarantee that the product they buy actually does conform to the quality description given by producers - provides consumers with a substitute for the information and trust they lack (Tirole [1988]).

Most food products can be classified as “credence” goods and regulations are needed, and exist, to provide consumers with assurances regarding the quality of what they buy (Auriol and Schilizzi [2000], Caswell and Mojdzuska [1996], Crespi and Marette [2001], Giannakas [2002], Giannakas and Fulton [2002], Marette, Bureau and Gozlan [1999], McCluskey [2000], Mojdzuska and Caswell [2000], Zago and Pick [2002]). These assurances cover a wide spectrum of food qualities related to characteristics either of the product, or the production process *per se*, regardless of those of the product obtained. Assurances include, at one end, those linked to food safety or to

the fact that the product does, or does not, contain genetically modified organisms (GMOs); at the other, they extend to include more sophisticated quality characteristics - from nutritional properties, to the geographical origin of the product, which is seen by an increasing number of consumers as an important quality attribute in itself<sup>1</sup>; from certifying that the food item is the result of “organic farming”, to providing consumers with information regarding the age and working conditions of the labor-force, the environmental impact of the production process, or compliance with specific animal welfare standards.

There are relatively few theoretical contributions on “credence goods”. Wolinsky [1993, 1995] analyzes competition in the “expert services” sector and the role of consumers’ search for multiple diagnoses in disciplining the experts. Emons [1997, 2001] examines market mechanisms that, under different hypotheses about the market structure, may lead to non fraudulent behaviors by experts. Bureau, Marette and Schiavina [1997] address the welfare implications of a quality assurance scheme when different countries produce goods of different quality; this quality assurance is assumed to provide consumers with complete information on the quality characteristics of the product, i.e. to be fully credible. Hollander, Monier-Dilhan and Ossard [1999] analyze producer voluntary grading decisions assuming that firms are of two types, both producing goods of “low” as well as of “high” quality but in different proportions, perfect grading at a fixed per unit cost, and the total volume produced being exogenously determined. Although they assume the good to be an “experience” good, under the assumptions made, the analysis and its implications hold for a “credence” good as well. Feddersen and Gilligan [2001] address the market implications of a third party (an “activist” organization providing a sort of “private collective action”) supplying consumers with partial information on the quality of a “credence” good in the context of a model involving a non cooperative game with two firms and incomplete information. Zago and Pick [2002] consider the effects of a regulation regarding a specific “credence” good characteristic, the geographical origin of a food product, on markets where goods of different qualities are sold; they assume the regulation and its implementation provide consumers with full information regarding the characteristics of the product they are not able to experience.

This paper presents an analysis of the decisions of producers and consumers of a “credence” good in three institutional scenarios which reflect different levels of credibility of the regulation providing consumers with a substitute of the trust they lack and, consequently, different levels of trust consumers place in the quality of the product. Imperfect, or not fully credible, regulations regarding quality characteristics of food products are not uncommon. In fact, the effectiveness of food certifications, even of those which deal with minimum mandatory food safety standards, is

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<sup>1</sup> Haucap, Wey and Barmbold [1997] discuss why the country of origin can be a signal for quality. Van der Lans et al. [2001] provide evidence that the region of origin is a significant factor *per se* in explaining consumers’ food

being increasingly brought into question. In September 2000, in the US, “taco shells” were found containing StarLink corn, a genetically modified corn variety which had been approved to be used as animal feed only; further investigation led to the recall by manufacturers of several hundred food products (Lin, Price and Allen [2002]). Conventional food products being offered to consumers as the result of “organic” farming has become an issue both in the US and in Europe (Giannakas [2002]). Wessells, Johnston and Donath [1999] address the trust consumers put in different potential certification agencies of eco-labeled seafood, i. e. seafood resulting from environmentally sustainable production practices. The relevance of mislabeling with reference to the geographical origin of food products is discussed in Boccaletti [1994] and Carbone [1997].

Kirchhoff [2000] develops a two-period model with a monopolistic firm in which an imperfect voluntary certification regarding the environmental “friendliness” of the production process is provided by a “third party”. The implications of imperfect regulations regarding “credence” food quality characteristics are discussed, under different assumptions from those made in this paper, in Giannakas [2002], Giannakas and Fulton [2002], and McCluskey [2000]. Giannakas and Giannakas and Fulton concentrate on the impact of different degrees of labeling untruthfulness on consumer welfare. McCluskey assumes producers may choose the quality they want to produce and, in a game theoretical framework, concludes that a regulation (or third party monitoring) and repeated purchases are both needed to assure the existence of the market for a “high” quality credence good.

Unlike the works of De and Nabar [1991], Giannakas [2002], Giannakas and Fulton [2002], Kirchhoff [2000] and McCluskey [2000], which also examines the effects of a regulation (or third party monitoring) when there is asymmetry in the information regarding the quality of the product, this paper specifically considers the implications of the degree of credibility of the regulation for producers and consumers in both markets, the one of the “high” quality product and that of the “low” quality one.

This paper considers three different scenarios with regards to the “credibility” of the regulation. The first scenario is a reference scenario in which the regulation is fully credible and it provides consumers with a perfect substitute for the lacking information and trust and, by so doing, transforms the “credence” good into a “search” one. The second case considered is that where there is no regulation, or, if there is, it is totally ineffective, which means that all producers are potentially able to offer their products as if they were of the highest quality. The third scenario is that of a regulation which is only partially credible, and provides consumers with only an imperfect substitute for the information and trust they lack.

The last section of the paper discusses the implications of the results reached to explain the political economy process involved in the introduction of regulations regarding “credence” quality attributes and why such regulations may be characterized by a limited effectiveness.

## 2. The model

The model considers a “credence” good which can be of two qualities, “high” or “low”. A regulation is considered, aimed at supporting consumer decisions by providing them with the information they lack on the quality of the products offered. The regulation has the effect of dividing the market for the good into two markets, one for the good which, based on the regulation, can be labeled as being of “high” quality (which we refer to as the H market), the other for the “low” quality good (the L market).

Examples of regulations which determine such a market split are those which define when producers are allowed to identify a food product as being of “high” quality because of its geographical origin, it being the result of “organic farming”, it not containing GMOs, or because it was not been produced by child labor.

There are two types of producers, those who produce the “high” quality good (the HP producers), and those only able to produce the “low quality” one (the LP ones); HP producers are assumed to be identical. LP producers are assumed to be identical but for their risk aversion, which is assumed to vary within a given interval.<sup>2</sup> There are  $n_H$  HP producers, and  $n_L$  LP ones. Producing the “low” quality good costs less than producing the “high” quality one.

It is assumed that the regulation is not perfect; it may occur that some, or all, of the LP producers are able to sell their products on the H market, when, in spite of the fact they are “labeled” as “high” quality products, they are not.

A known percentage,  $\lambda$ , of the producers who label their products as being of “high” quality is randomly selected and the quality of their production checked.  $\lambda$  is assumed to be less than 1 and quality controls to be error free; this means that if a firm is selected for testing the quality of the goods it produces becomes known with no uncertainty. Hence, when LP producers trying to sell their products as being of “high” quality are randomly selected for testing they are always identified as cheaters; in this case, they will have to pay a fine,  $\rho$ , and to sell their products on the L market, where they belong.

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<sup>2</sup> Without any loss for the generality of the results obtained, to simplify the analysis LP producers are assumed to be risk averse.

LP producers face the choice between selling their products on the L market, or cheating, trying to sell them on the H market as if they were of “high” quality. The decision is based on a comparison of the expected utilities of the two alternatives:<sup>3</sup>

$$U_{nc} = U[ \Pi_{nc} ] \quad \text{and} \quad U^i_c = U[ E(\Pi_c) , \lambda ] ,$$

where  $U_{nc}$  is the (non stochastic) utility for the LP producer if she decides not to cheat;  $U^i_c$  is her expected utility if she decides to cheat ( $U^i_c$  is equal for all LP producers but for  $\varphi_i$ , a parameter describing the specific risk aversion of each of them);  $\Pi_{nc}$  is the profit for the LP producer if she decides not to cheat;  $E(\Pi_c)$  is her expected profit if she decides to cheat.

The variability of  $\Pi_c$  is a function of  $\lambda$ , i.e.  $\lambda$  determines the risk involved in cheating.  $E(\Pi_c)$ , which is strictly greater than  $\Pi_{nc}$ ,<sup>4</sup> depends on the two possible outcomes when the LP producer chooses to cheat: a high profit from succeeding in selling “low” quality products on the H market, if not selected for the random quality test (with probability  $1-\lambda$ ); a low profit, as a result (i) of the lower price obtained in the L market and (ii) of having to pay fine  $\rho$ , if selected for the random testing (with probability  $\lambda$ ).

Given  $\varphi_i$  ( $i = 1, 2, \dots, n_L$ ) - the distribution of the risk aversion of the LP producers - for each pair of values of  $\lambda$  and  $\rho$  a value  $\varphi^*$  exists such that  $U_{nc} = U^*_{nc} [ E(\Pi_c) , \lambda , \varphi^* ]$ ;  $\varphi^*$  uniquely identifies a split of LP producers into two subsets: a subset,  $LP^c$ , given by the  $n_L^c$  LP producers for whom  $\varphi_i < \varphi^*$  (and  $U_{nc} < U^i_c$ ), and choose to cheat by offering their goods as being of “high” quality; and a complement set  $LP^{nc}$  containing those  $n_L^{nc}$  for whom  $\varphi_i > \varphi^*$  (and  $U_{nc} > U^i_c$ ), and prefer, instead, not to take the chance of being caught and having to pay fine  $\rho$ , and choose to offer their goods on the L market.

Among  $LP^c$  producers a percentage  $\lambda$  will be randomly selected for quality testing and will be prevented from selling their products as being of “high” quality, but  $(1-\lambda)$  will succeed in selling their products to consumers as being of “high” quality when, in fact, they are not. Among the  $n_L^c$  producers in the  $LP^c$  set, those who will succeed in selling their product as being of “high” quality will be  $n_{LH}^c = (1-\lambda) n_L^c$ , while  $n_{LL}^c = \lambda n_L^c$  will be those who will end up paying the fine and selling their products on the market of the “low” quality ones. As a result, the set of the firms selling their products on the H market (PH) will be given by all the HP producers plus  $n_{LH}^c$  of the LP producers; the  $n_L$  producers supplying the L market will be given by the  $n_L^{nc}$  LP producers who preferred not to cheat plus the  $n_{LL}^c$  ones who tried to cheat and got caught. The structure of the regulation is represented in Figure 1.

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<sup>3</sup> LP producers are assumed to have full information on producers and consumers as well as on the regulation; this means they know the prices which will characterize the equilibria in the two markets.

<sup>4</sup> Otherwise, LP producers being assumed to be risk averse, they would all prefer not to cheat.

In general, different pairs of values for  $\lambda$  and  $\rho$  exist yielding the same value of  $\varphi^*$  and, as a result, the same partition of the set of the LP producers in those who will be able to sell their products as if they were of “high” quality ( $LP^c_H$ ), and those who will sell them for what they are (PL).

It is useful to introduce at this point a synthetic measure of the “credibility”, or “trustworthiness”, of the regulation. A measure  $\theta$  of the “credibility” of the regulation is given by the percentage of producers of “low” quality goods who end up selling their products for what they are [ $\theta = (n_{LL} / n_L)$ ];  $1-\theta$ , on the other hand, gives the probability that producers of “low” quality goods sell their products on the H market [ $1 - \theta = (n_{LH}^c / n_L)$ ]. The credibility of the regulation,  $\theta$ , is positively related to both  $\lambda$  - the percentage of producers who want to sell on the H market randomly selected to undergo the quality control - and  $\rho$  - the fine a producer has to pay if caught while trying to cheat.

Different values of  $\theta$  correspond to different regulations, identifying a whole spectrum of possible alternative scenarios. At one extreme, when  $\theta = 1$ , the regulatory policy is fully “credible”, as the probability of a consumer buying a product of “low” quality labeled as being of “high” quality is equal to 0. A fully credible regulation does not imply *all* producers offering their products on the H market are subject to the testing (i.e. it does not imply  $\lambda$  being equal to 1). In fact, as long as the degree of risk aversion varies within a limited interval, for any value of  $\lambda$  there is always a value of  $\rho$  large enough to assure that no LP producers find it worthwhile to try to sell their products as being of “high” quality ( $\min \varphi_i > \varphi^*$ ). At the other end, when  $\theta = 0$  the regulation is totally ineffective, as the probability that a producer of “low” quality goods offers them on the H market is, in this case, equal to 1.<sup>5</sup> It is assumed that the cost of implementing the regulation is covered by the revenue from the fines ( $\rho n_{LL}^c$ ) and that producers obtain the quality certification at no charge. To further simplify the model, it is assumed that HP producers, because of greater production costs, never find it profitable to sell their products on the L market.

On the demand side, we assume that consumers are willing to buy products of both qualities, although they prefer the “high” quality to the “low” quality and are ready to pay a higher price for it, even if they are not able to distinguish between the two.<sup>6</sup> Consumers are assumed to have full information on the costs of production of the two qualities and on the regulation in place; this means they know the value of  $\theta$ .

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<sup>5</sup> Obviously, this is equivalent to the situation when no regulation exists.

<sup>6</sup> Empirical evidence on consumer willingness to pay for food quality attributes in the presence of asymmetric information is provided in Arfini [1999], Baker and Crosbie [1994], Bennett [1997], Blend and van Ravenswaay [1999], Burton et al. [2001], Eom [1994], Henson [1996], Holland and Wessells [1998], Latouche, Rainelli and Vermersch [2000], Noussair, Robin and Ruffieux [2002], Thompson and Kidwell [1998], Wessells and Gray [1995], and Wessells, Johnston and Donath [1999]. Nimon and Beghin [1999] found a significant willingness to pay for

Finally, markets are assumed to be perfectly competitive and no collusive behaviors can take place.

The marginal cost function of each of the LP producers is defined as

$$(1) \quad c_L = \alpha_L + \beta_L q_L$$

while the aggregate inverse supply function of the HP producers is given by

$$(2) \quad p_H = \alpha_H + \beta_H q_H ,$$

where  $\alpha_j$  and  $\beta_j$  are positive numbers;  $\alpha_L$  and  $\alpha_H$  represent the minimum entry price for the LP and HP producers, respectively (with  $\alpha_L < \alpha_H$ ).

Under the assumptions made, the supply function on the L market is given by

$$(3) \quad q_L = (\theta n_L / \beta_L) (p_L - \alpha_L) , \quad \forall p_L \geq \alpha_L , \text{ and 0 elsewhere;}$$

and that on the H market by

$$(4) \quad q_H = (\phi_H / \beta_H) (p_H - \alpha_H) + [\phi_L (1 - \theta) n_L / \beta_L] (p_H - \alpha_L) ,$$

with  $\phi_H = 1 \forall p_H \geq \alpha_H$ , and 0 elsewhere;  $\phi_L = 1 \forall p_H \geq \alpha_L$ , and 0 elsewhere.

As  $\theta$  decreases, the slope of the inverse supply function in the L market increases and the function rotates counterclockwise (Figure 2.b). In fact, when the credibility of the regulation declines, an increasing number of LP producers offer their products on the H market. This makes the inverse supply on the H market expand (Figure 2.d); when  $\theta$  is less than 1 goods of both qualities are offered on this market; the inverse supply function on the H market is now given by the sum of the supply by the HP and the LP<sup>c</sup><sub>H</sub> producers.

When the regulation is such that no trust can be placed in it and  $\theta = 0$  all LP producers sell on the H market. When this is the case, for prices below  $\alpha_H$  the inverse supply curve in the H market coincides with that in the L market when  $\theta = 1$ . In fact, when the price is below  $\alpha_H$  no HP producer finds it profitable to produce and the H market is supplied by the LP producers only. When the price exceeds  $\alpha_H$ , producers of both qualities will be offering the product in the H market.

The inverse demand function of the “low” quality good is given by

$$(5) \quad p_L = \gamma_L - [1 - (1 - \theta) v] \delta_L q_L ,$$

while the inverse demand function of the “high” quality good is given by

$$(6) \quad p_H = \gamma_H - \frac{n_H + (1 - \theta) n_L}{n_H} \delta_H q_H ,$$

where  $\gamma_j$  and  $\delta_j$  are positive numbers, and  $0 < v < 1$  is a parameter describing how the demand of the “low” quality good expands as the “trustworthiness” of the regulation declines.

Given the regulation and the value of  $\theta$  associated to it,  $\{[n_H + (1 - \theta) n_L] / n_H\}$  is the ratio between the number of producers offering their products on the H market, and the number of those among them who are offering a product which really is of “high” quality. The inverse demand for the “high” quality good rotates clockwise as  $\theta$  decreases (Figure 2.c). When  $\theta = 0$ , all LP producers offer their products on the H market alongside the HP producers. This means that consumers still face a positive probability of buying a product of “high” quality; this explains why, even if  $\theta = 0$ , they are willing to pay a premium for a good offered on the H market. However, regardless of the value of  $\theta$ , at prices below  $\alpha_H$  consumers will not be willing to buy any product offered on the H market and this “truncates” the demand on the H market at  $P = \alpha_H$  (Figure 2.c). This is so because consumers know that  $\alpha_H$  is the minimum entry price of the HP producers, and, as a result, that a product offered at a price below  $\alpha_H$  can only be of “low” quality.

This may place an implicit constraint on the possibility of LP producers succeeding in selling their products on the H market. In fact, it may be the case that the market for the “high” quality goods collapses; under the assumptions made, a necessary and sufficient condition for this to happen is if, when no regulation exists, the demand and the supply functions in the H market do not intersect. Under the assumptions made, it could be the case that the market for the “high” quality good develops even if no regulation exists, or if the regulation is totally ineffective ( $\theta=0$ ). This happens when all LP producers sell their product on the market of the “high” quality good alongside the HP producers, and the equilibrium price exceeds  $\alpha_H$ . However, to put ourselves in the most likely, and more interesting, scenario, we assume that this is not the case and that a value of  $\theta$  exists, which we refer to as  $\theta^*$ , so that for values of  $\theta$  below this threshold the “truncated” demand and the supply on the H market do not intersect and, as a result, this market collapses (Figure 4, discussed in the next section).<sup>7</sup> When this is the case, the inverse supply function on the L market, which rotates counterclockwise as  $\theta$  decreases from 1 to  $\theta^*$ , as  $\theta$  reaches  $\theta^*$  goes back to that observed when the regulation is fully trustable. This is so because when  $\theta$  equals  $\theta^*$  no exchanges occur on the H market and all LP producers now offer their goods on the L market, as is the case

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<sup>7</sup> Using different theoretical frameworks from the one assumed in this paper, Giannakas [2002] discusses how a high degree of imperfection of the regulation may cause the failure of the market of the “high” quality good, while Marette, Bureau and Gozlan [1999] discuss situations in which the existence of a regulation providing consumers with partial information regarding a “credence” good is not sufficient to prevent market closure.

when the regulation in place is fully “trustworthy”, exchanges on the H market take place, but LP producers cannot sell on that market.

The inverse demand function on the L market rotates counterclockwise as  $\theta$  decreases from 1 to  $\theta^*$ , as consumers’ expectations on the quality of the products offered in the H market decline and they partially divert their demand from the H quality to the L quality. When the market for the “high” quality good cannot develop, the demand remains that observed when  $\theta$  approaches  $\theta^*$ .

### 3. Results

We will consider three different cases regarding the existence and the credibility of the regulation.

*Case I: a regulation exists, it is fully trustable ( $q = 1$ ) and the market for the “high” quality good can develop.*

The first case we consider is when a regulation provides consumers with a fully credible guarantee that if a product is sold as being of “high” quality it is, in fact, of “high” quality.

$\theta$  is equal to 1 and no producers of “low” quality goods sell their products on the “high” quality goods market. This means that the regulation provides consumers with a perfect substitute for the information they cannot have access to and for the “trust” they cannot develop. In this case the goods of the two qualities can be treated as being two different goods with well separated markets.

Under the assumptions made, the equilibrium prices and quantities are given by

$$(7) \quad P_H^1 = \frac{\gamma_H \beta_H + \alpha_H \delta_H}{\beta_H + \delta_H},$$

$$(8) \quad P_L^1 = \frac{\gamma_L \beta_L + n_L \alpha_L \delta_L}{\beta_L + n_L \delta_L},$$

$$(9) \quad Q_H^1 = \frac{\gamma_H - \alpha_H}{\beta_H + \delta_H},$$

$$(10) \quad Q_L^1 = \frac{n_L (\gamma_L - \alpha_L)}{\beta_L + n_L \delta_L}.$$

The equilibria in the two markets are represented in Figure 3.

*Case II: no regulation exists or, if it exists, it does not provide a fully trustable guarantee and is such that the market for the “high” quality good cannot develop.*

The second scenario we consider is the other extreme case when no “third party” provides consumers with a substitute for the lack of information and for the impossibility for trust to develop. All producers of “low” quality goods can now offer their products to consumers on the “high” quality goods market. We assumed that when this is the case no equilibrium on the “high” quality market can occur; this case turns out to be no different from that when there is a regulation, but it is such that exchanges on the “high” quality market cannot take place. When this is the case, the equilibrium on the L market is given by

$$(11) \quad P_L^0 = \frac{\gamma_L \beta_L + n_L \alpha_L (1-v) \delta_L}{\beta_L + n_L (1-v) \delta_L} > P_L^1 ,$$

$$(12) \quad Q_L^0 = \frac{n_L (\gamma_L - \alpha_L)}{\beta_L + n_L (1-v) \delta_L} > Q_L^1 .$$

The outcomes on the two markets in this second scenario are represented in Figure 4 (along with the market equilibria in Case I, when  $\theta$  is equal to 1, with the inverse demand and supply functions when  $\theta = \theta^*$ , and with the hypothetical demand and supply functions when  $\theta = 0$ ).

Under the assumptions made, no “high quality” good will be exchanged; producers of “low” quality goods, being unable to collude, offer their products on the H market at a price which is below  $\alpha_H$ , the minimum offer price by producers of the “high” quality goods (Figure 4). As discussed above, when this is the case the demand and the supply functions on this market do not intersect because consumers will never buy goods offered to them as being of “high” quality at a price lower than  $\alpha_H$ ; in fact, they know that at that price the goods offered can only be of “low” quality.

As a result, the supply in the market for the “low” quality good is given by the supply of the entire set of the IP producers and  $\theta$  equals 1, as in the case when the regulation was fully trustable, and the market for the “high” quality good could develop. At least some of the consumers willing to buy “high” quality goods at a higher price, but unable to do so as no production of “high” quality goods can take place, join those demanding “low” quality goods, making the demand for the latter expand with respect to that in the first case.

The market equilibrium is such that the price and the quantity produced of the “low” quality good are higher than those when the regulation in place is fully credible and the market for the “high” quality good can develop (Figure 4). This is so because now no production of “high” quality goods can take place and consumption of “high” quality goods is (at least in part) substituted by an increased demand of “low” quality goods on the L market.

When the outcome of this second scenario is compared with the first, it emerges that producers of “high” quality goods are worse off, while producers of “low” quality goods are better off.

*Case III: a regulation exists which does not provide a fully trustable guarantee and is such that a market for the “high” quality good can develop ( $1 > \mathbf{q} > \mathbf{q}^*$ ).*

The third case addressed is the most interesting one.

It is now assumed that the regulation is such that production of “high” quality goods can occur and a certain number of producers of “low” quality goods succeed in selling them as being of “high” quality on the H market. In other words, the regulation cannot be fully trusted by consumers but now a market for the “high” quality good develops.

When this is the case,

$$(13) P_H^\theta = \frac{\gamma_H n_H \beta_H \beta_L + \alpha_H \delta_H [n_H + (1-\theta) n_L] \beta_L + \alpha_L (1-\theta) n_L \beta_H \delta_H [n_H + (1-\theta) n_L]}{n_H \beta_H \beta_L + \delta_H [n_H + (1-\theta) n_L] \beta_L + (1-\theta) n_L \beta_H \delta_H [n_H + (1-\theta) n_L]} < P_H^1,$$

$$(14) P_L^\theta = \frac{\gamma_L \beta_L + \theta n_L \alpha_L [1 - (1-\theta) v] \delta_L}{\theta n_L [1 - (1-\theta) v] \delta_L + \beta_L} > P_L^1,$$

$$(15) Q_L^\theta = \frac{\theta n_L (\gamma_L - \alpha_L)}{\beta_L + \theta n_L [1 - (1-\theta) v] \delta_L} < Q_L^0.$$

$$(16) Q_H^\theta = \frac{n_H \beta_L (\gamma_H - \alpha_H) + (1-\theta) n_L n_H \beta_H (\gamma_H - \alpha_L)}{n_H \beta_H \beta_L + \delta_H [n_H + (1-\theta) n_L] [\beta_L + (1-\theta) n_L \beta_H]}.$$

The equilibria in the two markets in this third scenario are represented in Figure 5.

The equilibrium price in the market of the “high” quality good is  $P^{\theta_H}$ . Consumers buy  $Q_H^\theta$  units of the good;  $Q_{HH}^\theta$  units are of “high” quality,  $Q_{LH}^\theta$  are of “low” quality.<sup>8</sup> Consumers know the probability of the good they buy being of “high” quality, but will never find out if it actually was of the preferred quality.  $P_H$  increases as  $\theta$  increases from  $\theta^*$  to 1.

In the L market the quantity exchanged is  $Q_L^\theta$  and the equilibrium price  $P_L^\theta$ . The latter is higher than the equilibrium price when a fully credible regulation exists and the market for the “high” quality market can develop; on the other hand, the quantity exchanged may either be higher or lower.

The equilibrium prices and quantities in each market as a function of  $\theta$  are represented in Figure 6. The price of the “low” quality good definitely decreases as we consider different regulations such that  $\theta$  increases from  $\theta^*$  to 1; when the market for the “high” quality good cannot develop, (a) the equilibrium price may either be below or above the equilibrium price when  $\theta$  approaches  $\theta^*$  from the right, but is definitely larger than that when  $\theta = 1$  and the market for the “high” quality good can develop, while (b) the quantity exchanged is definitely above the equilibrium quantity in both the other two cases considered (Figure 6).

#### 4. Conclusions

Who gains and who loses in each of the three cases considered? The rankings of the three scenarios by the three sets of producers of the good considered - HP, the producers of the “high” quality good; LP<sup>c</sup>, the producers of the “low” quality good who, given the regulation, based on their specific risk aversion, choose to attempt to sell their products as “high” quality; and LP<sup>nc</sup>, the producers of “low” quality goods who, given the regulation, prefer to sell them for what they are - are summarized in Table 1.

Producers of “low” quality goods who, under an imperfect regulation, choose to sell them on the “high” quality market prefer Case III to either of the other scenarios. In fact, because of their degree of risk aversion, IP<sup>c</sup> producers attach a higher utility to a not fully credible regulation which makes it possible for them to attempt to sell their “low” quality product as “high” quality, to that associated either to a situation where there is no regulation at all, or to a regulation which prevents *all* producers of “low” quality goods from selling their products as being of “high” quality. Between these two scenarios they prefer the former to the latter.

Producers of “low” quality products who, under an imperfect regulation, choose not to attempt to sell them as being of “high” quality definitely prefer both no regulation or a not fully

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<sup>8</sup>  $Q_{LH}^\theta$ , by construction, equals  $Q_H^\theta$  minus  $Q_{HH}^\theta$ .

credible regulation to a fully credible one. However, their ranking of a not fully credible regulation *vis a vis* no regulation at all remains, in general, ambiguous.

Finally, the scenario producers of the “high quality” goods rank first is the one where a fully credible regulation is in place and they are the only ones who can deliver to the “high” quality market. In addition, it turns out that they are better off when a not fully credible regulation exists and it is such that a market for the “high quality” good develops, compared to the cases when this market cannot exist.

Table 1 - Producer rankings of the three scenarios.

	$\theta = 1$	The market for the “high” quality good cannot develop	$1 > \theta > \theta^*$
Producers of the “high” quality good (HP)	1	3	2
Producers of the “low” quality good who, given a regulation such that $1 > \theta > \theta^*$ , choose to attempt to sell their products as being of “high” quality (LP <sup>c</sup> )	3	2	1
Producers of the “low” quality good who, given a regulation such that $1 > \theta > \theta^*$ , choose to sell their products as “low” quality ones (LP <sup>nc</sup> )	3	1 / 2	2 / 1

The implications of the results derived in the paper are not limited to the specific regulation considered (where the definition of the quality characteristic is “perfect” and it is the implementation of the regulation - the values of  $\lambda$  and  $\rho$  - which determine the fact that some of the producers of the “low” quality good may end up selling their products on the H market), but extend to the cases when the implementation of the regulation is perfect (no cheating can take place), but it is the definition of the products which can be legally labeled as being of “high” quality to be imperfect, allowing some, or all, the “low” quality goods to be sold (without cheating, in this case) as being of “high” quality.<sup>9</sup>

The rankings presented in Table 1 may help to explain the weakness of many regulations aimed at providing consumers with assurances regarding the quality characteristics of high value “credence” food products.

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<sup>9</sup> In this case quality is assumed to vary among producers and an indicator to measure it perfectly to exist.

Let us consider, for example, a typical regulation regarding a “credence” food quality attribute such as Regulation 2081/92 by the European Union which introduced the “Protected Designation of Origin” (PDO) and “Protected Geographical Indication” (PGI) denominations. If one looks at the list of the products which obtained “protection” under this Regulation, two types of products emerge, those whose names are easily recognized by consumers (which, in most cases, were already protected by national regulations), and those who are not as well recognized by consumers (and often were not protected by any previous regulation).

Our focus is on the latter PDOs and PGIs. In most cases it is not easy to identify the benefits from the protection they have been granted by the EU, i.e. to identify those regulations which have been effective in increasing the product market size and/or its price. We believe the results presented in this paper may provide some insight into what may have happened in the political economy process of defining the specifications of the product to be accorded PDO or PGI protection, which makes it partly or totally ineffective.

Producers of “high” quality goods obviously have a strong interest in seeking a regulation preventing producers of “low” quality goods from offering them as if they were of “high” quality. What we have shown is that at least some producers of “low” quality goods have an interest in joining the producers of the “high” quality goods in their effort to obtain a regulation, as long as they are able to obtain an “imperfect” regulation, i.e. a regulation which will allow some of them to label their product using the protected denomination even if its characteristics are not of the same quality as the “high” quality product bearing that name. Moreover, we have shown that it may be the case that even producers of “low” quality goods who know they will never be able to label their product using the protected denomination may have an interest in supporting a request for the introduction of a PDO or a PGI they will never be able to use! As discussed above, a necessary condition for this to happen is that the regulation is such that other producers of “low” quality goods succeed in selling them under the PDO or PGI umbrella.

Finally, the results in the paper show that, rather than having the producers of “low” quality goods “block” the introduction of the regulation, producers of “high” quality goods are better off when a compromise is reached which leads to the approval of a not fully credible regulation so that the market of the “high” quality good does not collapse (what has been referred to as a regulation with  $1 > \theta > \theta^*$ ).

The conclusions reached may well extend to regulations, either existing or being considered, involving “credence” food quality characteristics different from the product’s geographical denomination of origin, such as those currently under revision by the European Union regarding which products *can* be labeled as “GMO free” (is a product in which GMOs sum up to 5% of its

content “GMO free”, or is 1% a “better” threshold?) and which ones *must* clearly indicate on the label that “contains GMOs” (the two sets do not intersect, but do not have to be complement).

The interests involved in the introduction of a regulation go well beyond those of the producers of the “high” quality good and involve other interests which may easily be stronger and more widespread. This implies that the often lengthy process leading to the definition and approval of a regulation, while meant to ensure that the advantages deriving from the regulation are not captured by only some of the producers of the “high” quality product, may end up in providing a golden opportunity for the interests of producers of “low” quality goods to prevail in producing a political compromise which results in a regulation of little credibility.

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Figure 1: A graphical representation of the structure of the model (number of firms in parentheses).

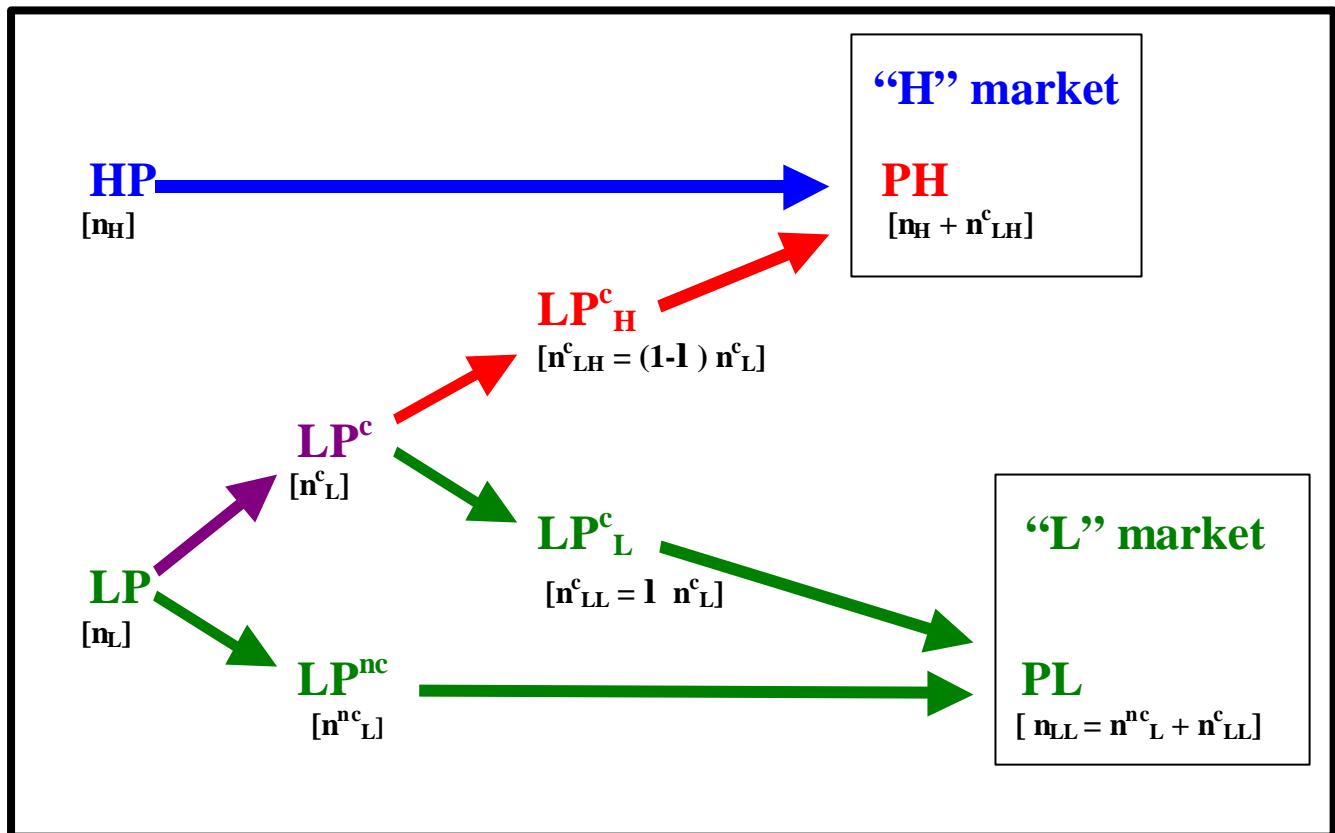
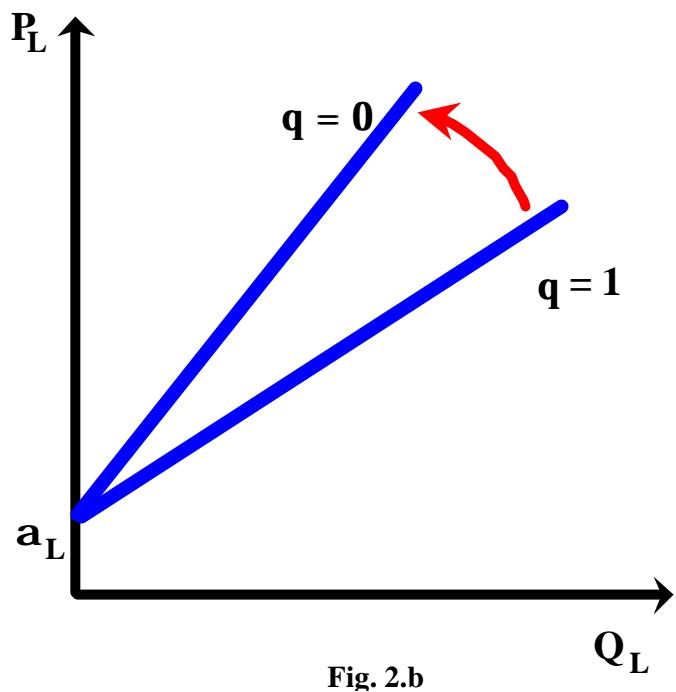
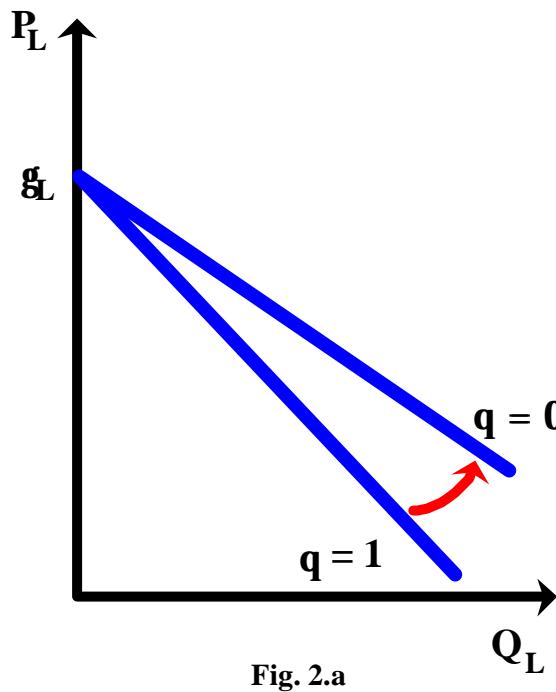
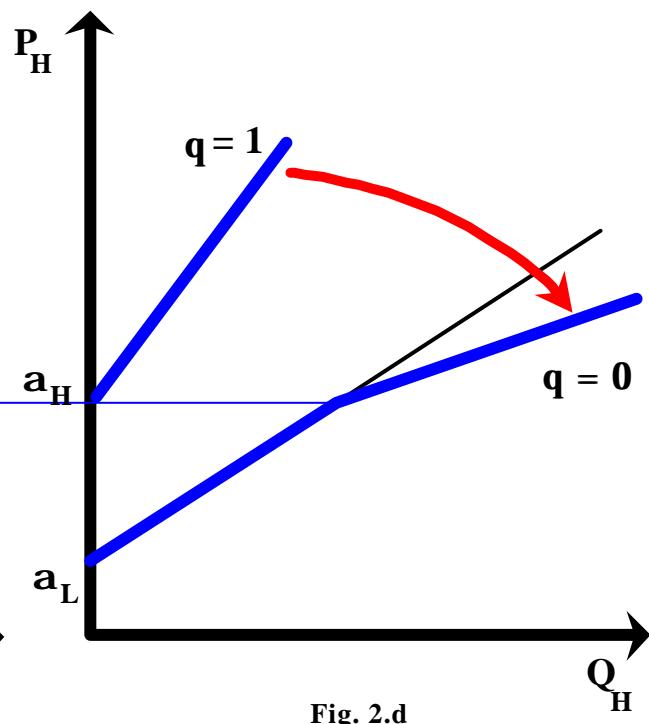
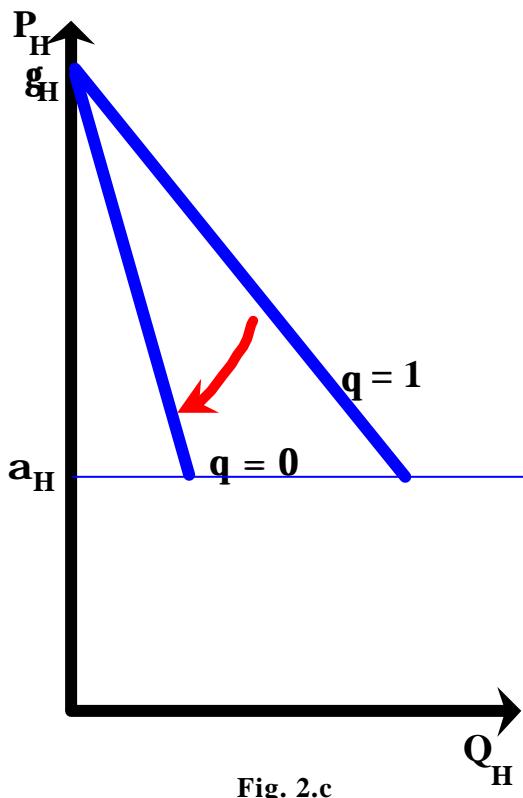


Figure 2 - Model assumptions regarding the inverse demand and supply functions of the “low” and “high” quality goods as a function of the “credibility” of the regulation.



“low” quality good



“high” quality good

Figure 3 - Market equilibria when a regulation exists, is fully credible ( $\theta = 1$ ) and the market for the “high” quality good can develop.

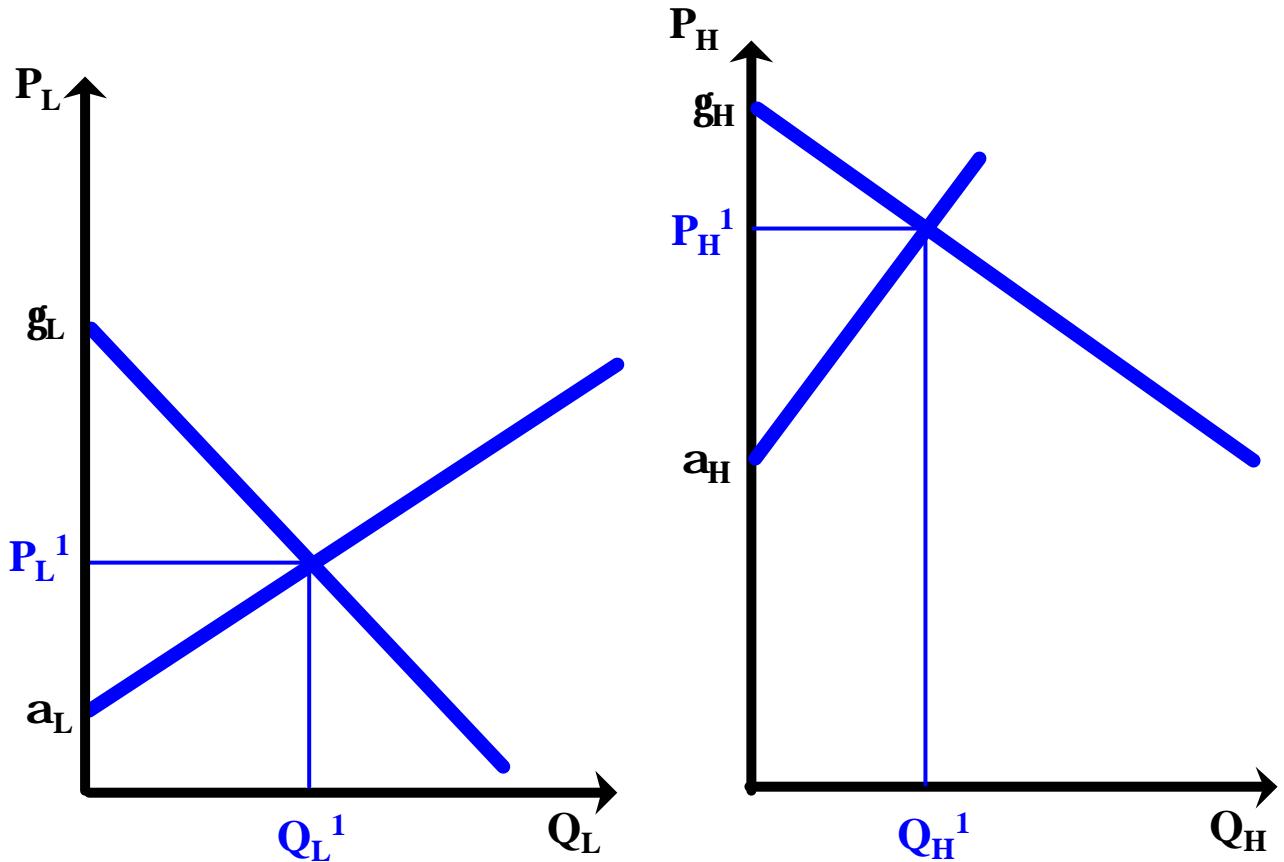


Figure 4 - Market equilibria when no regulation exists, or if it exists, it is not fully credible and a market for the “high” quality good cannot develop.

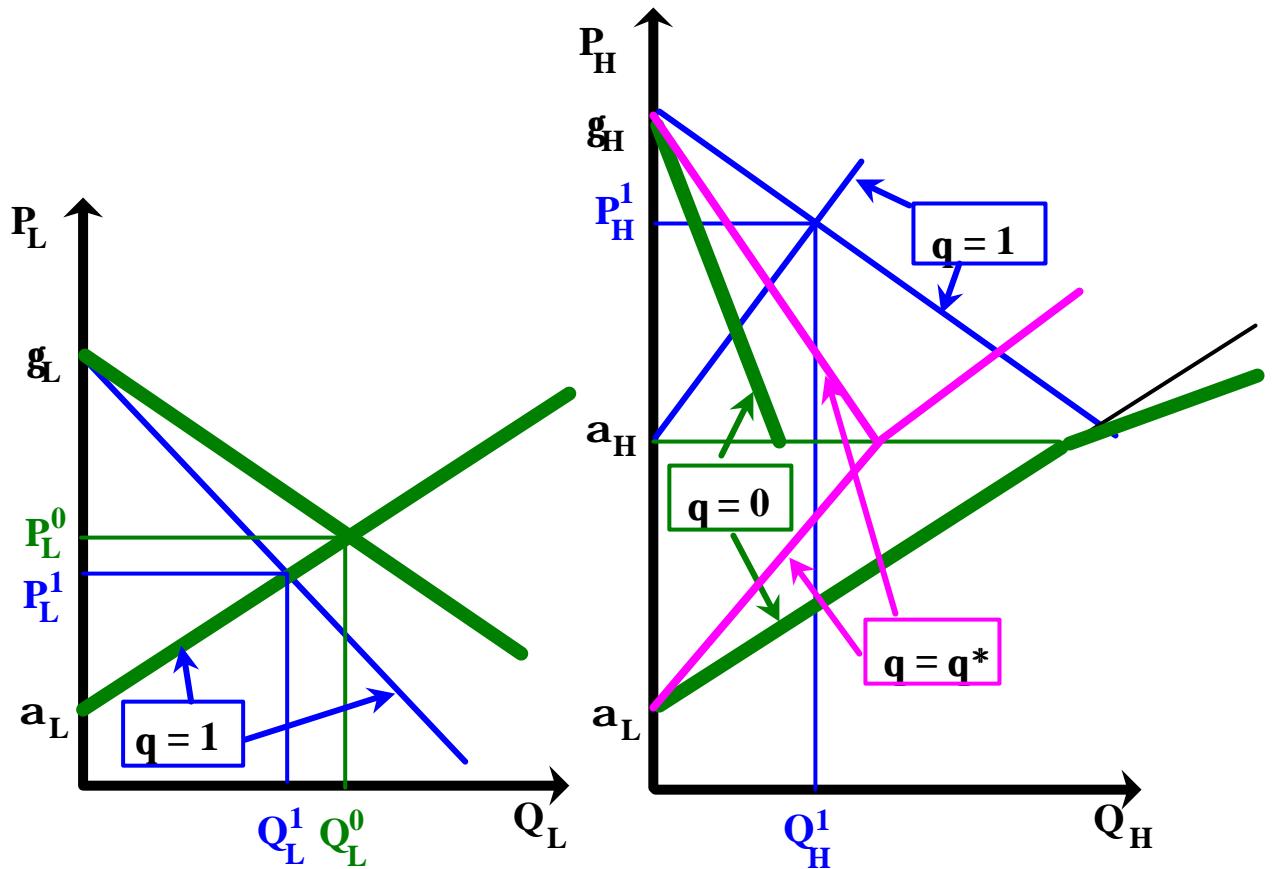


Figure 5 - Market equilibria when a regulation exists, is not fully credible and a market for the “high” quality good can develop ( $1 > \theta > \theta^*$ ).

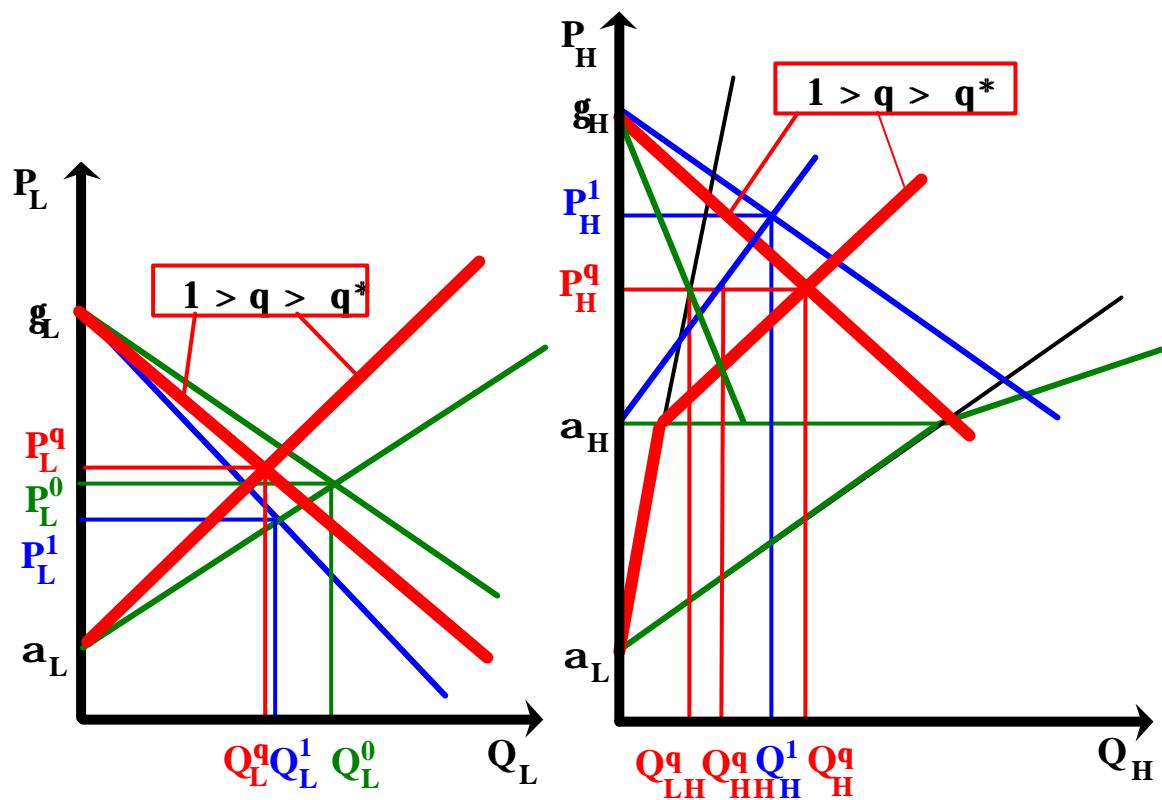
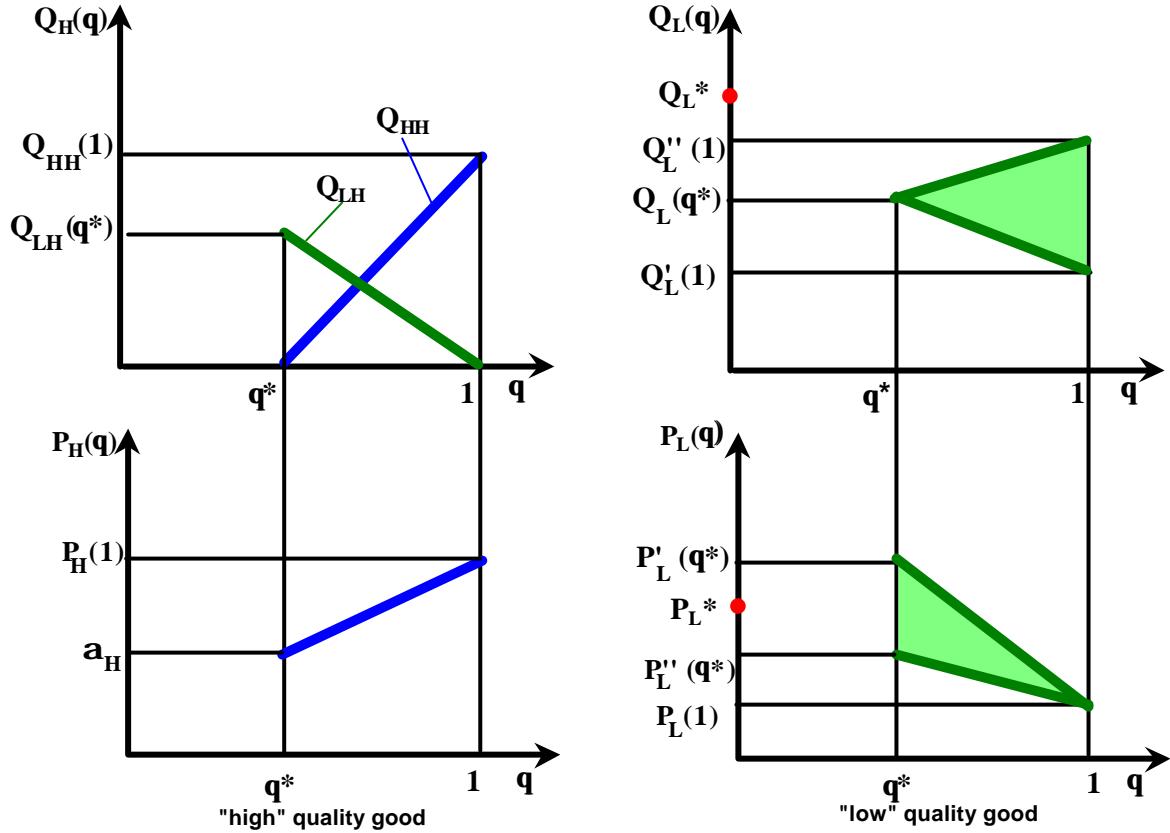


Figure 6 - The equilibrium price and quantity in the two markets as a function of the “credibility” of the regulation ( $\theta$ ).



[ $Q_L^*$  and  $P_L^*$  denote the equilibrium price and quantity on the L market when no regulation exists or is such that the H market cannot develop]