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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Most food products can be classified as credence goods, and regulations exist to provide consumers with a substitute for the lacking information and trust. Rather than having no regulation in place, producers of high-quality goods are better off when a compromise is reached that leads to an imperfect regulation. Some of the producers of low-quality goods benefit by cheating under a not fully credible regulation. Even producers of low-quality goods who will never label their products as being of high quality may profit from the introduction of an imperfect regulation. (JEL: D 82, L 15, L 51, Q 13)

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 about 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 continuing with that of KLEIN AND LEFFLER [1981] and SHAPIRO [1983] on repeated purchases.

In the case of *search* goods and *experience* goods (NELSON [1970]) – relating, respectively, to situations where the quality of the good can be known to consumers prior to purchase, and to those where consumers find out its quality only after consumption – there are endogenous incentives for producers to maintain quality standards (LAFFONT AND TIROLE [1991]). In fact, in the first case a reduction in

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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 word "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 faith in the producer. The existence of the market for such a good is either made possible by the reputation of the seller, or 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 [2003], CASWELL AND MOJDUSZKA [1996], CRESPI AND MARETTE [2001], GIANNAKAS [2002], GIANNAKAS AND FULTON [2002], GOLAN et al. [2001], MARETTE, BUREAU, AND GOZLAN [2000], MASTERS AND SANOGO [2002], MCCLUSKEY [2000], MOJDUSZKA AND CASWELL [2000], ZAGO AND PICK [2004]). These assurances cover a wide spectrum of food qualities related to characteristics either of the product or of 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 – such as certifying that the food item is the result of organic farming, providing consumers with information regarding the age and working conditions of the labor force, providing assurances regarding the environmental impact of the production process, compliance with animal welfare standards, nutritional properties, or the geographical origin of the product, which is seen by an increasing number of consumers as an important quality attribute in itself.[1]

There are rather 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 nonfraudulent behavior by experts. BUREAU, MARETTE, AND SCHIAVINA [1998] 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 qual-

[1] 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 quality perceptions and preferences.

ity characteristics of the product, i.e., to be fully credible. HOLLANDER, MONIER-DILHAN, AND OSSARD [1999] analyze producers' 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, with 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 noncooperative game with two firms and incomplete information. ZAGO AND PICK [2004] 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. In a model with repeated interaction between customers and firms, LIEBI [2002b] considers a competitive market where suppliers of a high-quality credence product differentiate themselves from low-quality producers by providing external monitoring of the label's environmental claims. It is shown that producers of the high-quality product will choose the same intensity of monitoring, which turns out to be above the socially optimal level.

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 for 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 that deal with minimum mandatory food safety standards, is being increasingly brought into question. In September 2000, in the U.S., taco shells were found containing StarLink corn, a genetically modified corn variety that had been approved for use 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 U.S. and in Europe (GIANNAKAS [2002]). WESSELLS, JOHNSTON, AND DONATH [1999] address the trust consumers put in different potential certification agencies for 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. In LIEBI [2002a] the number of labeled products offered by a monopolist serves as a signal for the quality credence attributes of its products. As the number of products labeled by the firm as being of

high quality increases, the probability of consumers detecting false claims (and, as a result, the risk for the firm of damaging its brand's reputation) increases as well; this reduces the firm's incentive to cheat. It is shown that there is a threshold value for the number of products labeled as being of high quality, above which consumers can trust label claims. 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 effect 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. VETTER AND KARANTININIS [2002] discuss the conditions under which vertical integration is a solution to nonexistent, or imperfect, public monitoring of credence quality characteristics for an agricultural product used as an input by processing firms.

Unlike the works of DE AND NABAR [1991], GIANNAKAS [2002], GIANNAKAS AND FULTON [2002], KIRCHHOFF [2000], and MCCLUSKEY [2000], which also examine 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, that of the high-quality product and that of the low-quality one.

This paper considers three different scenarios with regard to the credibility of the regulation. The first is a reference scenario in which the regulation is fully credible; 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 scenario considered is one where there is no regulation, or, if there is regulation, it is totally ineffective, which means that all producers are potentially able to offer their products as if they were of the highest quality. In the third scenario, regulation 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 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 a good that, according to the regulation, can be labeled as being of high quality (which we refer to as the H market), the other for a low-quality good (the L market).

Examples of regulations that determine such a market split are those that define when producers are allowed to identify a food product as being of high quality because it does not contain GMOs, it derives from organic farming, it has not been produced by child labor, or it is the result of environmentally friendly production practices.

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 attitude toward risk. There are n_H *HP* producers, and N_L *LP* ones. It costs less to produce the low-quality good than 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. In order to avoid making the model unnecessarily complicated, we assume that each *LP* producer sells all her products in one market, either the high-quality, or the low-quality.

A known percentage, λ, of the producers who label their products as being of high quality are randomly selected, and the quality of their production checked. Here λ 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 that case, they will be prohibited from selling their products and will have to pay a fine, ρ.

LP producers face the choice between selling their products on the L market and 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:[2]

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

where U_{nc} is the (nonstochastic) utility for the *LP* producer if she decides not to cheat, U_c^i is her expected utility if she decides to cheat (U_c^i is equal for all *LP* producers but for φ_i, a parameter describing the specific attitude toward risk of each of them), Π_{nc} is the profit for the *LP* producer if she decides not to cheat, and $E(\Pi_c)$ is her expected profit if she decides to cheat.

φ increases monotonically as the risk aversion increases (or the love of risk decreases); i.e., $\varphi_j < \varphi_k$ implies the kth producer is risk-averse while the jth is not, or the jth producer is less risk-averse (or more risk-loving) than the kth one.

$E(\Pi_c)$ 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 $1 - \lambda$); or a loss,

[2] *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.

as a result (i) of the production costs she incurred and will not be able to recover and (ii) of having to pay the fine ρ, if selected for the random testing (with probability λ). A producer who decides not to cheat will produce a quantity such that the marginal cost equals the price on the market for the low-quality goods. If, on the contrary, she chooses to cheat, the quantity she will produce will be such that the marginal cost is smaller than the price on the market for the high-quality goods; regardless of her attitude toward risk, she will produce a quantity such that the marginal cost is equal to $p_H(1-\lambda)$. Given $\varphi_i (i = 1, 2, ..., N_L)$ – the distribution of the attitude toward risk of the *LP* producers – for each pair of values of λ and ρ, a value φ^* exists such that $U_{nc} = U_c^*[E(\Pi_c), \varphi^*]$; φ^* 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 $U_{nc} < U_c^i$) and who 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 $U_{nc} > U_c^i$), and who prefer, instead, not to take the chance of being caught (i.e., being prohibited from selling their products and having to pay the fine ρ), and choose to offer their goods on the *L* market.

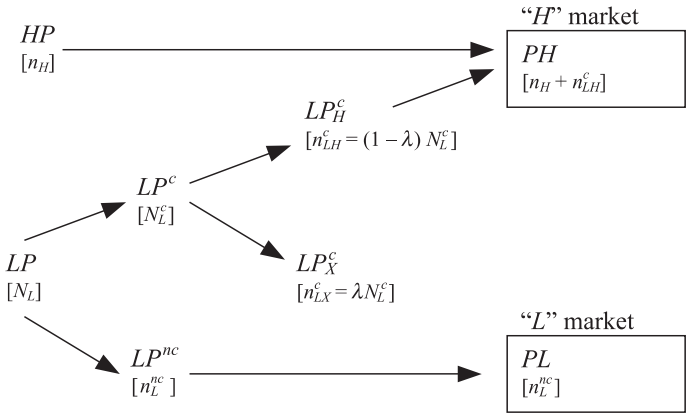
Among LP^c producers a percentage λ will be randomly selected for quality testing and will be prevented from selling their products, but $1 - \lambda$ will succeed in selling their products to consumers as being of high quality when, in fact, they are not. Among the N_L^c producers in the LP^c set, those who succeed in selling their product as being of high quality will be $n_{LH}^c = (1-\lambda)N_L^c$, while $n_{LX}^c = \lambda N_L^c$ will end up being prohibited from selling their products and having to pay the fine. As a result, the set of firms selling their products on the *H* market (*PH*) will consist of all the *HP* producers plus n_{LH}^c of the *LP* producers; the producers supplying the *L* market (*PL*) will consist of the n_L^{nc} *LP* producers who decided not to cheat. The structure of the model is represented in Figure 1.

In general, different pairs of values for λ and ρ exist yielding the same value of φ^* and, as a result, the same partition of the set of the *LP* producers into those who will attempt to sell their products as if they were of high quality (LP^c) and those who will decide to sell them for what they are (LP^{nc}).

It is useful to introduce at this point a synthetic measure of the credibility, or trustworthiness, of the regulation. A measure θ of the credibility of the regulation is given by the percentage of producers selling low-quality goods who end up selling their products for what they are ($\theta = n_L^{nc}/n_L$, with $n_L = n_L^{nc} + n_{LH}^c$); $1 - \theta$, on the other hand, gives the probability that producers selling low-quality goods do so on the *H* market ($1 - \theta = n_{LH}^c/n_L$). The credibility of the regulation, θ, is positively related to both λ (the percentage of producers who want to sell on the *H* market and who are randomly selected to undergo the quality control) and ρ (the fine a producer has to pay if caught cheating).[3]

[3] This is so because n_L^{nc} and n_{LH}^c monotonically increase and decrease, respectively, as λ and/or ρ increase.

Figure 1
A Graphical Representation of the Structure of the Model
(number of firms in parentheses)



Different values of θ 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 tested (i.e., it does not imply λ equal to 1). In fact, for any value of λ there is always a value of ρ large enough to assure that no *LP* producers find it worthwhile to try to sell their products as being of high quality ($\varphi^* < \min \varphi_i$). At the other end, when $\theta = 0$ the regulation is totally ineffective, as the probability that a producer selling low-quality goods offers them on the *H* market is, in this case, equal to 1. Under the assumptions made, $\theta = 0$ implies $\lambda = 0$, i.e., that no regulation exists or, if one exists, it is not enforced.

It is assumed that producers obtain the quality certification at no charge; the cost of implementing the regulation is covered by the revenue from the fines (ρn^c_{LX}) and through public financing, if needed. 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.[4]

[4] Empirical evidence on consumer willingness to pay for food quality attributes in the presence of asymmetric information is provided in ARFINI [2000], 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

It is assumed that consumers know N_L and n_H and 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 θ.

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

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

$$c_L = \alpha_L + \beta_L q_L, \tag{1}$$

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

$$P_H = \alpha_H + \beta_H Q_H, \tag{2}$$

where α_j and β_j are positive numbers; α_H is the minimum entry price for the *HP* producers, and α_L that of the *LP* ones on the market for the low-quality product (with $\alpha_L < \alpha_H$).

LP producers choosing to attempt to sell their products on the *H* market will produce a smaller quantity than the one that would make their marginal cost equal to the equilibrium price of the high-quality product. Each of the N_L^c *LP* producers will produce a quantity such that

$$P_H = \frac{\alpha_L + \beta_L q_L}{1 - \lambda}. \tag{3}$$

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

$$Q_L = (\theta n_L/\beta_L)(P_L - \alpha_L), \quad \forall\ P_L \geq \alpha_L, \text{ and } 0 \text{ elsewhere}, \tag{4}$$

and that on the *H* market by

$$Q_H = (\phi_H/\beta_H)(P_H - \alpha_H) + [\phi_L(1-\theta)n_L/\beta_L][(1-\lambda)P_H - \alpha_L], \tag{5}$$

with $\phi_H = 1\ \forall\ P_H \geq \alpha_H$, and 0 elsewhere; and $\phi_L = 1\ \forall\ P_H \geq \alpha_L/(1-\lambda)$, and 0 elsewhere.

As θ decreases, the slope of the inverse supply function in the *L* market increases and the function rotates counterclockwise (Figure 2b). 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 2d); when θ 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 supplies by the *HP* and the LP_H^c producers.

When no regulation exists, or, if one exists, it is such that no trust can be placed in it ($\theta = 0$), and all *LP* producers sell on the *H* market. When this is the case, for prices below α_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 α_H, no *HP* producer finds it profitable to produce, and the *H* market is supplied by the *LP* producers only. When

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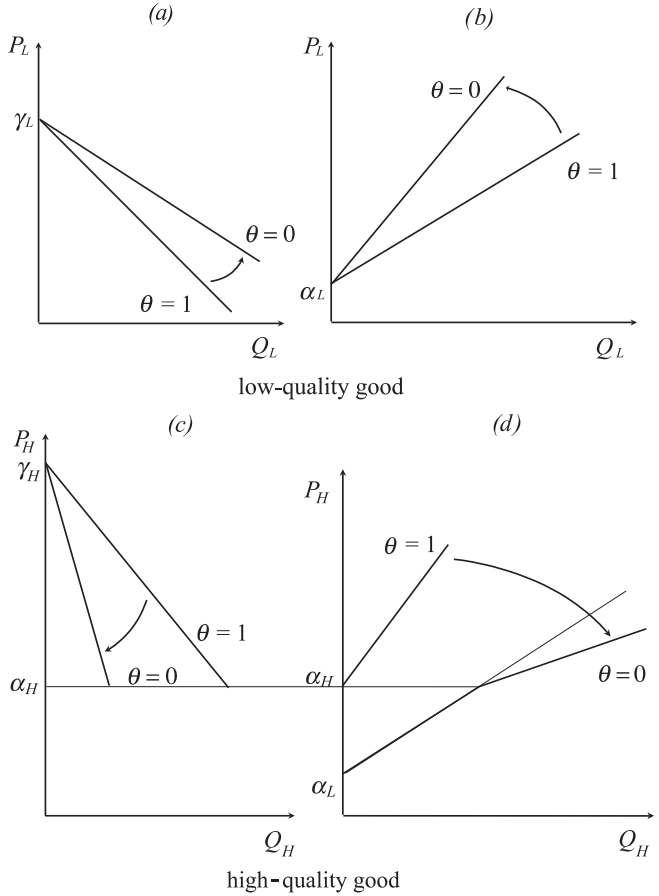
[2002], ROHEIM WESSELLS AND GRAY ANDERSON [1995], THOMPSON AND KIDWELL [1998], and WESSELLS, JOHNSTON, AND DONATH [1999]. NIMON AND BEGHIN [1999] found a significant willingness to pay for apparel goods produced using organic cotton.

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



the price exceeds α_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

$$P_L = \gamma_L - [1 - (1 - \theta)v]\delta_L Q_L, \tag{6}$$

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

$$P_H = \gamma_H - \frac{n_H + (1 - \theta)n_L}{n_H}\delta_H Q_H, \tag{7}$$

where γ_j and δ_j are positive numbers, and $0 < v < 1$ is a parameter describing how the demand for the low-quality good expands as the trustworthiness of the regulation

declines. The inverse demand function on the L market rotates counterclockwise when θ decreases (Figure 2a), 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.

Given the regulation and the value of θ associated to it, $[n_H + (1-\theta)n_L]/n_H$ in (7) 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 that really is of high quality. The inverse demand for the high-quality good rotates clockwise as θ decreases (Figure 2c). 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 θ, at prices below α_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 2c). This is so because consumers know that α_H is the minimum entry price of the *HP* producers and, as a result, that a product offered at a price below α_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 regulations exist such that the market for the high-quality goods collapses; under the assumptions made, a necessary and sufficient condition for this to happen is that, when no regulation exists, the demand and the supply functions in the H market do not intersect. On the contrary, 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 α_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 θ exists, which we refer to as θ^*, such that for values of θ 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).[5] When this is the case, the inverse supply function on the L market, which rotates counterclockwise as θ decreases from 1 to θ^*, when θ reaches θ^* goes back to that observed when the regulation is fully trustable. This is so because when θ equals θ^*, no exchanges occur on the H market and all *LP* producers now offer their goods on the L market, as is the case when the regulation in place is fully trustworthy, exchanges on the H market take place, but *LP* producers cannot sell on that market.

[5] 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 [2000] 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 market for the high-quality good cannot develop, the demand in the L market remains that observed when θ approaches θ^*.

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 ($\theta = 1$), 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.

θ 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[6]

$$P_H^1 = \frac{\gamma_H \beta_H + \alpha_H \delta_H}{\beta_H + \delta_H}, \tag{8}$$

$$P_L^1 = \frac{\gamma_L \beta_L + n_L \alpha_L \delta_L}{\beta_L + n_L \delta_L}, \tag{9}$$

$$Q_H^1 = \frac{\gamma_H - \alpha_H}{\beta_H + \delta_H}, \tag{10}$$

$$Q_L^1 = \frac{n_L(\gamma_L - \alpha_L)}{\beta_L + n_L \delta_L}. \tag{11}$$

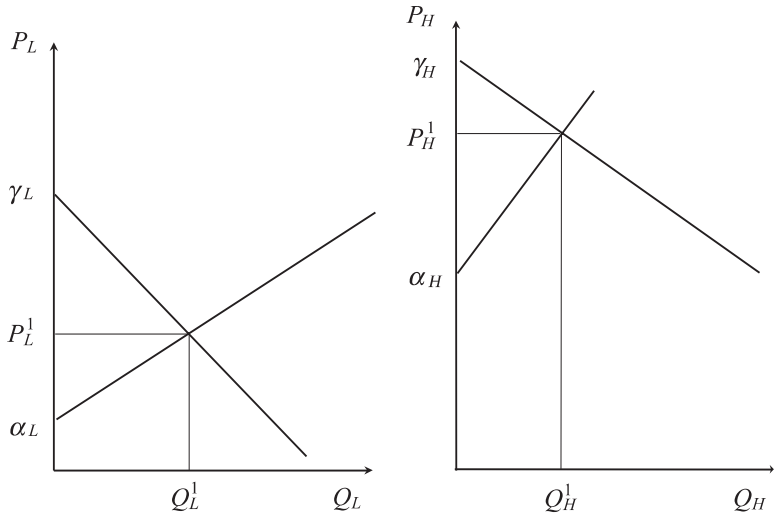
The equilibria in the two markets are represented in Figure 3.

Case II: No regulation exists, or, if one 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 remedy 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

$$P_L^0 = \frac{\gamma_L \beta_L + n_L \alpha_L (1 - v) \delta_L}{\beta_L + n_L (1 - v) \delta_L} > P_L^1, \tag{12}$$

[6] In this case $n_L = N_L = n_L^{nc}$.

Figure 3
Market Equilibria When a Regulation Exists, is Fully Credible ($\theta = 1$) and the Market for the High-Quality Good can Develop



low-quality good high-quality good

$$Q_L^0 = \frac{n_L(\gamma_L - \alpha_L)}{\beta_L + n_L(1-v)\delta_L} > Q_L^1. \tag{13}$$

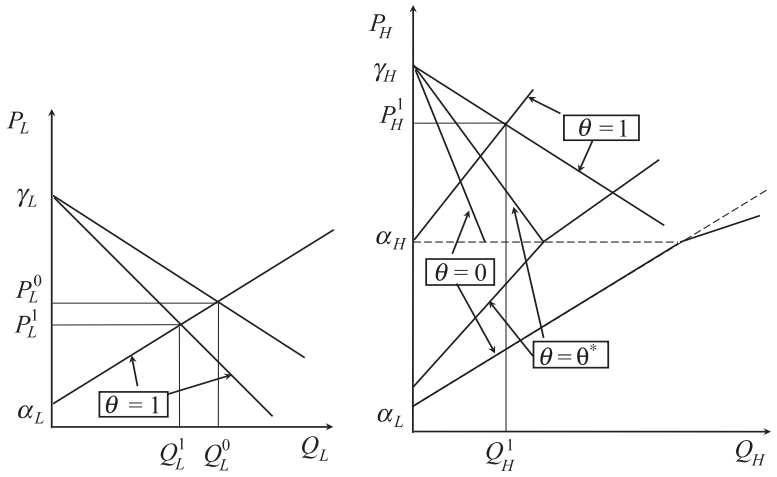
The outcomes on the two markets in this second scenario are represented in Figure 4 (along with the market equilibria in case I, when θ is equal to 1, with the inverse demand and supply functions when $\theta = \theta^*$, and with the hypothetical demand and supply functions when $\theta = 0$).

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 that is below α_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 α_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 *LP* producers,[7] as in the case when the regulation was fully credible 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 because no exchanges on the market of the high-quality good can take place,

[7] In this case too $n_L = N_L = n_L^{nc}$.

Figure 4
Market Equilibria When No Regulation Exists or, if it Exists, is Not Fully Credible and a Market for the High-Quality Good cannot Develop



join those demanding low-quality goods, making the demand for the latter expand with respect to that in case I.

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) replaced by an increased demand for low-quality goods on the L market.

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

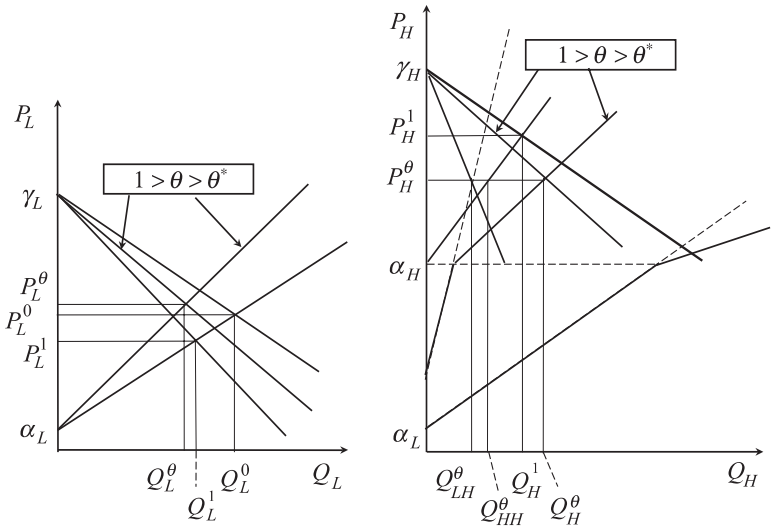
Case III: A regulation exists that does not provide a fully trustable guarantee and is such that a market for the high-quality good can develop ($1 > \theta > \theta^*$). The third case addressed is the most interesting one.

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,

$$(14)\quad P_H^{\theta} = \frac{\gamma_H n_H \beta_H \beta_L + \alpha_H \delta_H \beta_L [n_H + (1-\theta) n_L] + \alpha_L (1-\theta) n_L \delta_H \beta_H [n_H + (1-\theta) n_L]}{n_H \beta_H \beta_L + \delta_H \beta_L [n_H + (1-\theta) n_L] + (1-\theta) n_L (1-\lambda) \beta_H \delta_H [n_H + (1-\theta) n_L]} < P_H^1,$$

Figure 5
Market Equilibria When a Regulation Exists, is Not Fully Credible and a Market for the High-Quality Good can Develop ($1 > \theta > \theta^*$)



low-quality good high-quality good

$$P_L^\theta = \frac{\gamma_L \beta_L + \theta n_L \alpha_L [1 - (1-\theta)v]\delta_L}{\theta n_L [1 - (1-\theta)v]\delta_L + \beta_L} > P_L^1, \tag{15}$$

$$Q_L^\theta = \frac{\theta n_L (\gamma_L - \alpha_L)}{\beta_L + \theta n_L [1 - (1-\theta)v]\delta_L} < Q_L^0, \tag{16}$$

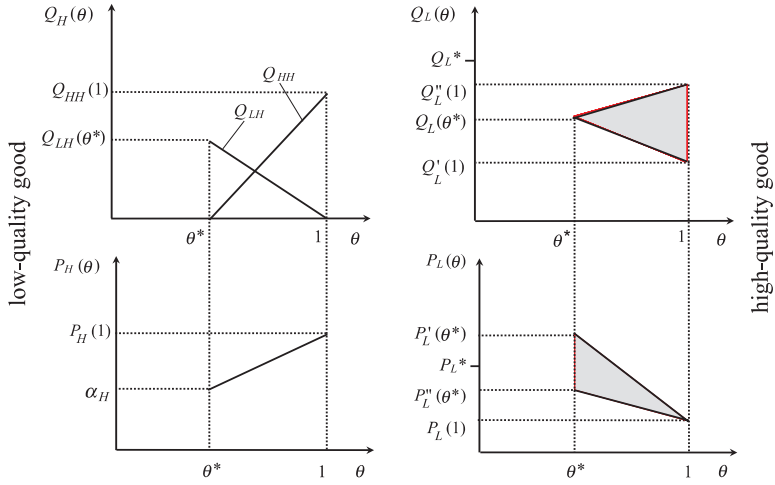
$$Q_H^\theta = \frac{n_H \beta_L (\gamma_H - \alpha_H) + (1-\theta) n_L n_H \beta_H [\gamma_H (1-\lambda) - \alpha_L]}{n_H \beta_H \beta_L + \delta_H [n_H + (1-\theta) n_L][\beta_L + \beta_H (1-\theta) n_L (1-\lambda)]}. \tag{17}$$

The equilibria in the two markets in this third scenario are represented in Figure 5. The equilibrium price in the market for the high-quality good is P_H^θ. Consumers buy Q_H^θ units of the good; Q_{HH}^θ units are of high quality, and Q_{LH}^θ are of low quality.[8] Consumers know the probability that the good they buy is of high quality, but will never find out if it actually was of the preferred quality. P_H increases as θ increases from θ^* to 1, because the demand expands and the supply decreases.

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

[8] In Figure 5, Q_{LH}^θ, by construction, equals Q_H^θ minus Q_{HH}^θ.

Figure 6
The Equilibrium Price and Quantity in the Two Markets as a Function of the Credibility of the Regulation (θ)



Note: 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.

is higher than that which would occur under a fully trustable regulation, because, at any given price, the demand on the L market is now greater and the supply smaller. The demand function rotates counterclockwise because part of the demand for the high-quality products under a perfect regulation shifts now to the market for the lower-priced low-quality product (because of the nonzero probability of buying a high-quality product that, in fact, is of low quality); the supply function rotates counterclockwise as well, because some of the *LP* producers are now able to sell their products on the H market. These simultaneous counterclockwise shifts of the supply and demand functions in the L market could make the quantity exchanged either increase or decrease with respect to the case when a fully credible regulation exists, whereas the equilibrium price definitely increases.

The equilibrium prices and quantities in each market as a function of θ are represented in Figure 6. The price of the low-quality good definitely decreases as we consider different regulations such that θ increases from θ^* to 1; when the market for the high-quality good cannot develop, (a) the equilibrium price may be either below or above the equilibrium price when θ approaches θ^* 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 considered – *HP*, the producers of the high-quality good; LP^c, the producers of the low-quality good who, given the regulation, in view of their specific risk attitude, choose to attempt to sell their products as high quality; and LP^{nc}, 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, LP^c producers attach a higher utility to a not fully credible regulation that makes it possible for them to attempt to sell their low-quality product as high-quality, than to either a situation where there is no regulation at all, or a regulation that prevents *all* producers of low-quality goods from selling their products as being of high quality. Of those two scenarios they prefer the former to the latter; in fact, when the market for the high-quality good cannot develop, the price and the quantity exchanged in the *L* market are higher than when a perfect regulation exists.

Producers of low-quality products who, under an imperfect regulation, choose not to attempt to sell them as being of high quality definitely prefer either no regulation or a not fully credible regulation to a fully credible one. However, their ranking of a not fully credible regulation *vis-à-vis* no regulation at all remains, in general, ambiguous.

Finally, the scenario that 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, than in the cases when this market cannot exist.

The implications of the results derived in this 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 λ and ρ – that determines 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 where the implementation of the regulation is perfect (no cheating can take place), but the definition of the products that can be legally labeled as being of high quality is imperfect, allowing some, or all, the low-quality goods to be sold (without cheating, in this case) as being of high quality.[9]

Any regulation determines a redistribution of welfare, and its definition is the result of the resolution of a conflict among contrasting interests. Should products containing GMOs be clearly labeled as such? What should the threshold percentage of GMO content in a food product be above which its label should clearly state that it contains GMOs? Should a bottle of olive oil labeled as "Product of Italy" contain

[9] In this case quality is assumed to vary among producers and an indicator to measure it perfectly to 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^c)	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^{nc})	3	1 / 2	2 / 1

olive oil produced in Italy, or, less restrictively, does it suffice for the olive oil to have been bottled in Italy, regardless of where the olives were grown?

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

Let us consider, for example, regulations regarding which products *can* be labeled as "GMO free" and which ones *must* be labeled that it "contains GMOs" (the two sets do not intersect, but do not have to be complements). In this case the conflict of interests may involve different countries, rather than different firms. The U.S. accounts for two-thirds of the genetically modified crops produced in the world. In the U.S. GMOs approved for human consumption by the Food and Drug Administration are not subject to any mandatory labeling requirement (i.e., consumers do not have to be told they are eating GMOs). In Australia and New Zealand all foods containing more than 1% GMOs must indicate this on the label; in the European Union this threshold is 0.9%, in Japan it is 5%. For a country where GMOs are produced in large quantities and no labeling requirements exist, such as the U.S., keeping a non-GM crop separated from the crop of the GM varieties of the same product is costly, and the cost of this "identity preservation" increases rapidly as the threshold of the maximum allowed GMO contamination for a product not to have to be labeled as containing GMOs decreases.

An example of regulation regarding a credence food quality attribute where the results obtained in this paper may help understand why regulations may provide a weak definition of the quality characteristics of the product is 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 product denominations that 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 that are not as well recognized by consumers (and often were not protected by any previous regulation). If we focus 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 that have been effective in increasing market share and/or 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 made 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 some producers of low-quality goods definitely 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 that will allow some of them to label their products as being of high quality. Moreover, we have shown that it may be the case that even producers of low-quality goods who know they will never be interested in labeling their products as being of high quality may have an interest in supporting a request for the introduction of a regulation they will never try 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 as being of high quality.

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 that leads to the approval of a not fully credible regulation, so that the market for the high-quality good does not collapse (what has been referred to as a regulation with $1 > \theta > \theta^*$).

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 more powerful and more widespread. This implies that the often lengthy process leading to the definition and approval of a food quality regulation, while meant to ensure that consumer interests are adequately taken into account and 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 producers of low-quality goods to prevail in producing a political compromise that results in a regulation of little credibility.

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