The Economics of Labels: a Review of Literature

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Abstract

Are labels good or bad for consumers and firms? In this essay we explore the views and answers of the theoretical literature on labeling on the following issues: i) the effects of labels on the market structure, ii) the distortions due to the certification process, and iii) how different agencies set the label's level. For each issue, we highlight the keys economics mechanisms and their impact on the market equilibrium and actors' payoffs. We conclude by identifying issues for further research.

Keywords: Label, Imperfect consumer information, Vertical differentiation

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1 Introduction

The past 30 years have seen the rise of consumers' preference for various "invisible" goods-attributes, that their presence in the purchased good either cannot be verified at all, or its verification requires costs that go beyond any single consumer's means (*credence attributes*). Several experimental and/or empirical studies have corroborated the existence of a positive consumer willingness to pay for attributes such as "green", "ethical", "fair-trade", "dolphin safe", "not tested on animals", "organic", "no child labor", "low cholesterol", etc. (see e.g. Disdier and Marette, 2011, Hainmueller et *al.*, 2011, Arnot et *al.,* 2006, Noussair et *al.*, 2004, Lusk et *al.*, 2005, and Teisl et *al.,* 2002). Many of the aforementioned attributes reveal a consumers preference for specific production-processes. This preference is either rooted in the belief that certain types of production provide direct private benefits, mainly health ones (*e.g.* organic products and foodstuff not containing Genetically Modified Organisms),[1] or stems from ethical issues. The latter can be defined as the consumers' desire to assume extra costs in order to participate in the collective effort to cope with an externality: consumers often buy an otherwise similar but more costly-to-produce (thus, more expensive) variety of a good, just because they believe the way it is produced contributes to environmental protection, dolphin preservation, the fight against poverty or unfair labor conditions, etc. Beyond those features of the production process, the list of credence attributes extends to other quality and/or safety characteristics of a good, the presence and amount of which cannot be assessed even after the good's consumption.

No matter what is their origin, credence attributes create severe asymmetric information problems that may have devastating consequences for the related goods markets, by either substantially reducing their volume, or leading them to total collapse, unless a way is found to assure consumers that their money is well spent. Since consumers remain unable to distinguish whether a firm's claim with respect to such attributes is true or false even after the purchased good's consumption, most market-devised mechanisms fail to improve information in markets

[1] Direct private benefits can be related to product-quality perceptions, as is the case of Geographic Indicators (GI). While some dimensions of quality, such as taste, can in principle be verified after consumption, most people rely heavily on the product's origin in order to assess its quality. For instance, even in their post-consumption evaluation of a wine, many non wine-connoisseurs rely less on their direct experience from tasting the wine, attributing more weight to their origin-related perception of the wine's quality.

related to credence attributes, leaving direct certification, usually performed by a credible third party, as the only mechanism able to do so. While in theory direct certification should be the most effective means for providing information, in practice it faces two challenges: credibility and efficiency. Leaving for the moment aside the former, note that firms may propose many product-types, each one incorporating the desired attribute at a different level. Certifying the exact level of the attribute in every product type runs into two difficulties: first it may be very costly, and second, it may provide information that is very difficult for consumers to handle.[2] For this reason, most often, instead of certifying the exact attributes of any single product, the certifying agency defines a "quality level" and certifies whether the quality of an inspected product is of, at least, that level. Products thus certified receive a "label", allowing consumers to distinguish them from other varieties that do not satisfy the established criterion. For instance, a public label in Austria and Germany guarantees consumers that the labeled foodstuff contain no Genetically Modified Organisms (GMO). As GMO and GMO-free varieties are handled by the same facilities, some mingling is unavoidable, making it therefore, practically impossible to have products that are 100% free of GMO's. Instead of certifying the percentage of GMO in each firm's final product, the label sets a maximum level of acceptable GMO content and labels products as GMO-free, accordingly. Concerning energy-efficiency, electric appliances in the European market are certified according to a five-tier label.

Many more examples of labels can be found. In the US, eggs, poultry and beef products may carry USDA-administered labels, such as "*Organic",* and "*No Hormones"*. The label by the international non-government organization *Forest Stewardship Council* guarantees consumers that the wood-made products they are using come from responsibly harvested and verified inputs. The European label *EU Ecolabel* is awarded according to high environmental and performance criteria set by the member states. Controlled-origin labels guarantee that the production of certain products (wine, cheese, olive oil, and others) has taken place within a specific geographical area. Recently, the label *Maître Restaurateur* has been implemented in the french restaurant industry, guaranteeing that meals are prepared with fresh and regional ingredients.

Are labels good or bad for consumers and firms? While the answer may seem obvious, it turns out to be not so straightforward, for various reasons. First, labels interact with market

[2] See Dranove and Jin (2011) for a theoretical and empirical survey of quality disclosure and certification.

structure, and may influence competition. Second, they may create other distortions, related to their cost or their credibility. Finally, the labelling agency may not be an unconstrained welfare maximizer. Since the introduction of a label and the quality level set as minimum requirement for the label to be conferred affect total welfare and the well-being of particular groups–consumers, firms, and others, such as environmentalist groups–in a non-uniform way, those groups will spent resources in order to either oppose the label's introduction or influence its level. In this essay, we review the theoretical literature on the economics of labels by focusing on these three issues. Section 1 examines the information problem in more detail. Section 2 addresses a key theoretical issue, namely the effects of label on market structure and the intensity of competition. Section 3 examines the impact of certification cost on welfare and addresses the question of how to regulate the market when the certification process is not 100% trustworthy. Section 4 analyzes the label's level as chosen by labelling agencies with different objectives, thus introducing the "political economy" aspect of the label. Section 5 concludes, offering also suggestions for further research.

2 The label as an information revealing mechanism

In a standard microeconomics textbook any information problems are usually overlooked and consumers are supposed to somehow know the exact nature of the goods they purchase. While this assumption fits well many cases, there are many other instances where it does not hold, even roughly: in many markets, the information gathering is so problematic that it may alter consumers and producers behavior. In analyzing information problems, goods are usually placed in one out of the following three categories, according to the way consumers can acquire the information necessary to assess each good's attributes. When the good's attributes can be known before purchase, the good is termed *search good.* The term reflects the fact that, unless research and gathering of information are too costly, they usually suffice to reveal the true nature of the good.

While this may be the case for some attributes like freshness (sometimes), some other attributes, like taste or comfort, cannot be fully assessed by other means than the good's consumption. When the purchasing decision strongly depends upon attributes that can only be

verified after purchase, the good is termed *experience good.*

Finally, there are some attributes–termed *credence attributes*– that cannot be verified even after consuming the good. The term *credence goods* describes goods the consumer mainly purchases for attributes that are of credence nature. A typical example of a credence good is a repair service. Only the seller (the expert) knows the appropriate type of repair and the amount of service provided. The consumer is potentially confronted with two forms of information asymmetry. First he does not know the type of reparation he needs, and second, he may not be able to observe whether the suggested treatment was provided or not (Darby and Karny, 1974, and Dulleck and Kerschbamer, 2006). A special, but very important, category of credence goods are goods characterized by *process-attributes*, such as "made without child labor," or "without genetically modified organisms." For such goods only the latter form of information asymmetry applies.

Labelling is not likely to be used for goods characterized by *search* attributes. Consumers may easily, and often costlessly, obtain all the relevant information, and generally this information is costless. For many food products, information about their freshness can be obtained by just looking at them, thus leaving little opportunity for producers to deceive consumers about the quality of the product they sell.

When the search cost is substantial, it reduces consumers' willingness-to-pay, eventually dissuading producers from providing some qualities they would have otherwise supplied. To the extend that the information can be *acquired* even after consuming the good, there exist market mechanisms that deal satisfactorily with this problem. The *post* consumption revelation of *experience* attributes leads to the development of two distinct mechanisms that mitigate information problems, namely "trust" and "reputation."[3] Trust is based on repetition and the possibility of punishment, the latter usually taking the form of disrupting patronage of the seller. The information gained by consumers after each purchase allows producers to spend resources in order to develop consumers' trust in the quality of their products, and subsequently derive the rents from that trust (Shapiro, 1983).[4]

[3]Confusingly, the term "reputation mechanisms" often covers both the above mentioned mechanisms. In what follows we make the distinction using the terminology proposed by Cabral (2005).

[4]The case of Charal, a French brand of meat, is a good example of the "trust" mechanism. In order to better preserve its freshness, Charal meat is vacuum-packed using an opaque packaging. By precluding any casual inspection by the buyer, this packaging turns freshness into an experience attribute. Once consumers became

The reputation mechanism consists of updating consumers' beliefs before they purchase the good. Producers use "signals," such as advertising, to inform consumers about the high quality of their products. The idea is that, while some of the money "burnt" on advertising, or other useless expenses, can be recouped by the high-quality producers in the form of future sales at higher price, such recovery is impossible for the low-quality producers, since all their sales after the first one will be at a price commensurate with their product's quality. Here, the function of advertising is just to inform consumers that a product *is* advertised (see Nelson, 1970, 1974, and Milgrom and Roberts, 1986). In other words, it is not the content of advertising, but the amount of money spent on it that really conveys the message.

When the good is mainly purchased for its credence attributes, both trust and reputation usually fail, leaving certification by a reputable agent, such as a government or an independent expert, as the only possible mechanism for signalling quality (see Caswell and Mojduszka, 1996, and Bonroy, 2009).[5] Since the certification is often costly to perform at all levels of potential product specification, and often the information provided by such detailed certification is too hard for consumers to grasp, the agent provides labels certifying that the product satisfies at least some predetermined level of the credence attribute. While labels are sometimes used in order to provide information for other categories of goods (*e.g.,* Michelin stars for restaurants), they represent a rather costly alternative to direct search, trust and reputation.[6] For credence goods markets, though, labels represent the main, and often the only, source of information, being in many cases a strict requirement for the high quality goods to even be supplied at all in such markets.

aware of Charal's quality through the use of introductory offers, they started paying a price premium for Charal meat. The fear of loosing this premium provides the company with the incentive to maintain its quality, since the day consumers will perceive a quality lower than the expected, they will stop purchasing. Consumers' awareness of this incentive induces them to trust the firm's claims for high quality.

[5] To be precise, the theoretical economics literature shows that the "reputation" mechanism may work in credence-goods markets, such as the one for repair services (see Dulleck and Kerschbamer 2006). For the special, but of particular interest case of process-attributes, building a "reputation" mechanism cannot be excluded either, it is, however, contingent on very restrictive assumptions (see Marette 2007, Bonroy and Constantatos 2008, and Garella and Petrakis 2008).

[6] See Menapace and Moschini (2010) for a study on geographical indication labels for experience goods markets.

3 Label and market structure

In this section we consider the label's impact on market structure. Assuming for simplicity that the label is mandatory, costless and that it fully reveals product quality, we survey the literature describing the potential changes in market structure following its introduction. To model the impact of labelling, we consider consumers' preferences described in Mussa and Rosen (1978). Each consumer enjoys utility

$$U(\theta) = \theta q - p \tag{1}$$

when consuming a product of quality q sold at a price p; q represents the underlying hedonic attributes that characterize a particular quality. We restrict q to one dimension with larger values of q indicating higher quality levels and define as *product line* the interval $\left[\underline{q}, \overline{q}\right]$. Consumers' valuation of quality vary in proportion to θ, so that the population of consumers is described by the distribution of θ on the interval $\left[\underline{\theta}, \overline{\theta}\right]$. Unless otherwise stated, i) the consumers distribution is assumed to be uniform with density $\frac{1}{\overline{\theta}-\underline{\theta}}$, and ii) the distribution's endpoints are normalized to $\overline{\theta} = 1$ and $\underline{\theta} = 0$, implying that the market is always uncovered in equilibrium. Finally, we assume that in an environment without label, consumers cannot distinguish a product's quality, therefore, when making a purchase, depending on the information already available they expect to buy either a) the base quality $\underline{q}$, or b) the average quality available in the market given by: $q_e \equiv \frac{S_1}{S_1+S_2} q_1 + \frac{S_2}{S_1+S_2} q_2$, where S_i represents the quantity supplied of product of quality q_i, $i = 1, 2$; in some instances c) they may have exogenous priors about the expected quality of each firm's product.

3.1 The market segmentation effect of the label

Assume, for the moment being, that a) there exist only two qualities, their level being given exogenously, b) no firm can change the quality of its product, c) there is no entry in the market. Hence, there is a fixed number n_2 (n_1) of firms selling a given quality q_2 (q_1), with $q_2 > q_1$. In the absence of label both qualities are sold in a unique market, while the label segments the market into a high- and a low-quality sub-markets. We define as *market segmentation effect of the label*, the change in market structure due to the emergence of the quality sub-markets. As an example, consider that both qualities can be produced at the same cost and that all

the firms are cost-symmetric. Concentration in the pool market is $HHI = (n_2 + n_1)^{-1}$, where HHI represents the Herfindahl-Hirshman index of concentration; after the label's introduction it increases to $HHI_2 = n_2^{-1}$ and $HHI_1 = n_1^{-1}$, in the respective sub-markets. Obviously, the increase in concentration may not be of equal importance in the two markets. Even if $n_1 = n_2$, so that the resulting HHI is the same in both sub-markets, the low quality sellers still face hard competition from their high quality rivals, but the latter do not reciprocally feel the same pressure.

Concentration is not the only dimension of market structure. Entry conditions may also be affected by the introduction of the label. If, for instance, entry is easy in the low quality product but impossible in the high quality, the introduction of the label creates a new market with entry barriers, whereas in the pre-label situation entry was easy in the pool-market.

Zago and Pick (2004) elaborates some of the above observations, by showing that if the labeled high-quality sub-market remains sufficiently competitive, the introduction of the label is welfare enhancing; if, on the other hand, the label substantially increases concentration in that sub-market, its introduction is welfare reducing. Consider the model presented in the previous section, completed with a total-industry cost function taking the following form: $C(S_i) = \frac{1}{2} b_i S_i^2$, $\forall i = 1, 2$, with $b_1 = 1 < b_2$, in accordance with $q_2 > q_1$. The aggregate behavior of a fixed number of individual producers of each quality can be described as the behavior of a representative producer who maximizes the following profit:

$$\Pi(S_1, S_2) = p_1 S_1 + p_2 S_2 - \frac{1}{2}\left(b_1 S_1^2 + b_2 S_2^2\right) \tag{2}$$

High quality producers have higher cost, and since in the absence of label their superior quality goes unnoticed, they end up being disadvantaged, both in terms of profits and market share. The label's introduction creates two separate demands for high and low quality, and it follows naturally that $p_2^L > p^U > p_1^L$, where the subscripts L, U, refer to the presence and absence of label, respectively.[7] If after the label's introduction the emerging high quality market is competitive, it can be shown that at equilibrium prices, a) the market share of the high quality expands, b) the market share of the lower quality contracts, and c) total sales increase, relative

[7] More precisely, $p^U = \frac{b_2(b_2 q_1 + q_2)}{(1+b_2)(b_2 + b_2 q_1 + q_2)}$, $p_1^L = \frac{b_2 q_1}{b_2 + b_2 q_1 - q_1^2 + q_2 + q_1 q_2}$ and $p_2^L = \frac{b_2\left(q_2 - q_1^2 + q_1 q_2\right)}{b_2 + b_2 q_1 - q_1^2 + q_2 + q_1 q_2}$.

to the unlabeled case. The label is welfare increasing.[8]

However, after full information and the resulting product segmentation, the high quality producers may behave monopolistically, preferring a lower market share at a higher price (compared to the competitive case). If this quantity restriction is substantial, the positive effects of the label may be counterbalanced by its contribution to increasing market power. Surprisingly, by restoring full information the label may reduce welfare! This seeming paradox is explained when one considers the second-best nature of the situation: out of two distortions present in the market, market structure and imperfect information, the label corrects only one. If there is no assurance that full information prices will be close to marginal costs, quality revelation is welfare enhancing only when the cost difference between qualities is not too high (see Zago and Pick, 2004).

The above conclusions are based on the assumption that, under full information, at equal prices almost all consumers strongly prefer product 2 in that they are ready to pay a price premium, albeit small, for that product. Only the consumer with $\theta = 0$ is indifferent between the two products, always choosing the cheaper one. Instead of an atomless point, one can imagine that there is an entire group of such consumers, distributed according to the surplus they get. Matoo and Singh (1994) assumes a mass of consumers with $\theta = 0$, distributed along their willingness to pay. Instead of being represented by a single consumer with inelastic demand, the segment of quality-indifferent consumers is now described by a more conventional demand function, smoothly decreasing in price. There are, therefore, two consumer groups: one willing to pay different positive premia for an environmentally friendly quality, the other simply looking at the price and choosing the cheaper product.[9] The presence of the indifferent group may challenge the inequality $p_2^L > p^U > p_1^L$: depending on the relative magnitude of the two groups, two other situations are also possible, namely, $p_2^L \geq p_1^L > p^U$. While the price of the low quality cannot exceed that of the high quality (otherwise the high quality would attract all the indifferent consumers) it may now exceed the common price in the unlabeled equilibrium. By increasing both prices the label may increase the production of both products. While this is not a problem if the label aims to increase consumption benefits, it may make the label counterproductive if its

[8] See Bureau et al. 1999, for such an analysis in an international trade context.

[9] Another example is one group of consumers willing to pay more for controled origin wines, while the other always purchasing the cheaper wine.

target is to *reduce the consumption of the low quality*, as is frequently the case with eco-labels.

3.2 The differentiation effect of the label

By creating two markets, the label does not only affect competition *within* each market, it also affects competition *between* markets. The latter depends of course on the cross-price elasticity between qualities under full information. We define as *differentiation effect* of the label its effect on competition due to allowing products to be perceived as imperfect substitutes. This effect is no more than a direct application in the context of imperfect information, of an idea initially put forward by Gabszewicz and Thisse (1979), and Shaked and Sutton (1982). To analyze the differentiation effect in a simple way, we rule out competition issues *within* each group by considering only two firms, each providing a distinct, exogenously given, quality. Assume further that a) both qualities are produced at the same constant marginal cost, equal to zero, and b) when priced at its marginal cost, the low quality product yields positive surplus to consumers. Since in the absence of label both products are considered as being of the same quality, the label transforms a homogeneous duopoly market to a differentiated one. By revealing the true nature of the low quality firm's product, the label deprives the low quality firm from the opportunity to (fraudulently) obtain quality premia, but at the same time provides that firm with the advantage of softer competition from its rival. Assuming competition takes place in strategic complements (price competition), the latter impact tends to be more important than the former. In the darkness of imperfect information, price-competition drives prices down to marginal cost, *i.e.*, $p^U = 0$ (Bertrand paradox with homogeneous products). Under the light of full information, the high-quality firm may choose to exploit consumers with high willingness to pay for quality by charging them a high price $p_2^L = \frac{2q_2(q_2-q_1)}{4q_2-q_1}$, thus leaving some room for the low-quality product (which must be offered at a lower price in order to attract consumers: $p_1^L = \frac{q_1(q_2-q_1)}{4q_2-q_1} < p_2^L$). Competition is relaxed: no firm needs to price at marginal cost, both prices now depending on demand parameters. Both firms' profits are positive with an advantage for the high-quality firm: $\pi_2^L > \pi_1^L$.

While beneficial for firms, the label's introduction is no good news for at least part of the consumers. Assume the production of both qualities requires the same cost. Without label, consumers with low θ purchase a lottery with 50% chance to obtain the high quality

$\left(q_e = \frac{q^L+q^H}{2}\right)$; with the label they consume a lower quality ($q_1 < q_e$) at a higher price $\left(p_1^L > p^U\right)$, and those with the lowest θ may even leave the market. Among the purchasers of high quality, only those with very high θ (close to $\overline{\theta}$) gain. Those with the relatively lower θ prefer the lottery of the pre-label situation to the the certain purchase of high quality at the prevailing higher price. As a consequence, the label always *reduces* consumers surplus, its overall positive effect on welfare being due to its beneficial impact on firms profits. (see Table 1).

The above scenario assumes that in the absence of a label, *both* the high and low quality firm will be in the market. Assume however, along with Roe and Sheldon (2007), a preliminary stage where each firm decides whether to enter the market, incurring a sunk cost $\varepsilon > 0$ upon entry. If two firms enter the market, none of them will be able to cover ε, since in the eyes of consumers their products are homogeneous and competition is *a la* Bertrand. Hence, in the no label situation, there are two equilibria with only one firm entering the market: all consumers expect the low-quality q_1 and only those with $\theta > \frac{1}{2}$ purchase at the monopoly price $p_1^U = \frac{q_1}{2}$. The label's introduction leads to a situation similar to that described above, but the conclusions about the label's usefulness are markedly different: price competition is intensified, all consumers are better off with the label, and total welfare increases (see Table 1). Roe and Sheldon (2007) shows that these results hold even when quality levels, instead of being exogenous, are chosen by the firms.

Instead of assuming that in the absence of label consumers expect to purchase the base or an average quality, let us now assume, along with Gabszewicz and Grilo (1992) and Bonroy and Constantatos (2008) that they have idiosyncratic beliefs about the firm who sells the high quality. Thus, while all consumers have the same willingness-to-pay for each quality (common θ), each consumer is identified by a subjective probability $\alpha \in [0, 1]$ she assigns to the event "firm 1 sells the high quality product and firm 2 sells the low quality one." These beliefs may be either the result of a subjective interpretation of some imprecise information, or simple gut-feelings. Letting firm 1 be the low quality producer, the lower the value of α of a given consumer, the closer to the truth that consumer's beliefs are; consumers with $\alpha > (<) \frac{1}{2}$ "trust" the wrong (right) firm, in that they attribute higher probability on firm 1 (firm 2) being the high quality producer. The consumer population is assumed distributed over a set of probabilities $\Gamma = [\underline{\alpha}, \overline{\alpha}]$,

with $0 \leq \underline{\alpha} < \overline{\alpha} \leq 1$, according to a uniform distribution with density $(\overline{\alpha} - \underline{\alpha})^{-1}$. Both firms know the beliefs distribution, while consumers do not.[10] Labelling qualities as h, l, with $q_h > q_l$, in order to distinguish them from the firms producing them, we write the expected utility a consumer α derives from consuming a product as:

$$U = \begin{cases} \alpha\theta q_h + (1-\alpha)\theta q_l - p_1, & \text{if it consumes good 1} \\ (1-\alpha)\theta q_h + \alpha\theta q_l - p_2, & \text{if it consumes good 2} \end{cases} \tag{3}$$

Let us note immediately that prior to the label's introduction, the structure of information *creates* product differentiation, allowing both firms to survive with *positive* profit margins. If $\underline{\alpha} < 1/2 < \overline{\alpha}$, differentiation is horizontal, in that, at *equal prices* consumers are split between the two firms. If $\underline{\alpha} > 1/2$, or $1/2 > \overline{\alpha}$, differentiation is vertical, with firm 1 or 2, respectively, having the product differentiation advantage.

Since differentiation is based on consumers' beliefs, rather than on consumers' tastes, the introduction of the label *destroys* differentiation, resulting to the survival of only a single firm. Which firm will survive? If production requires constant marginal cost, with $c_h > c_l$, the surviving firm will be the one producing the "efficient" product, *i.e.,* the quality with the higher ratio q_i/c_i, $i = h, l$. This *reverse* differentiation effect of the label may have adverse effects on profits even when the high quality is the efficient product (see Table 1). The low quality producer resists the label's introduction, since it forces its exit from the market; the high quality producer, who, under full information, becomes monopolist selling at price equal to $\theta(q_h - q_l) + c_l$, may still prefer its niche market in the pre-label situation, where it could charge a higher price to those who trusted its product as being of high quality.[11] While we treat issues of opposition to the label later on, it is worth mentioning that this is an instance where the label meets unanimous opposition from the entire industry.

The reverse differentiation effect shows that, by revealing the high quality, the label both corrects information and eliminates the dispersion of beliefs. What happens if the label is "imperfect" in the sense that its message is not perceived by all consumers? Ruling out "misleading"

[10] This rules out any sort of price signaling.

[11] This analysis is based on Bonroy and Constantatos (2008). In Gabszewicz and Grilo (1992) both qualities are produced at equal cost. A more detailed discussion on the industry's opposition to the introduction of labels is contained in section 3.1.

labels and considering only labels that reduce every consumer's α, consider two types of labels, one providing only basic information about the product in a way that is very easy for consumers to grasp (say, a colored stamp), and another providing very detailed information about the product's characteristics. The former will most likely improve the "unsophisticated" consumers' beliefs, while providing little new information to the "sophisticated" ones; the latter may be totally ignored by unsophisticated consumers–who find it too complicated to bother with–but can improve the beliefs of sophisticated consumers. As a result, while both labels push all the beliefs towards the right direction, the first reduces, while the second increases their dispersion, by modifying accordingly the width of Γ (see Bonroy and Constantatos, 2008). Thus, while the introduction of an easy-to-grasp label is always beneficial for consumers, the sophisticated label has two effects: on the one had it improves the average beliefs, but on the other hand it increases differentiation in consumers' perception, thus reducing competition and *increasing* profits; its overall effect on consumer's welfare is ambiguous.

3.3 The ranking effect of the label

Surprisingly, little work has been done on the impact of labels in vertically related markets. The few papers that analyze labels considering a longer than single-stage supply chain are found in the literature on GMOs. Lapan and Moschini (2007) assumes competitive farmers and a competitive processing industry, and focus on the relation between the optimal quality level of the label (see section 5 of this work) and the welfare of each part in the supply chain. Fulton and Giannakas (2004) consider an exogenous traditional-seed price, and a supplier of GM-seed (the life science company) with some market power selling to competitive farmers, putting in light that the preference of consumers, producers and life sciences compagnies for the labelling regimes of GM products rarely line up.

When buying their inputs, final-good producers have a preference for those types of input that yield higher return per euro spent on them. Absent consumer considerations concerning the production process (a chicken is a chicken, no matter what has been fed with) differentiation is absent from the downstream market and the return of an input is proportional to its productivity. *Often, however, the more productive inputs happen to be those that meet with consumer disapproval.* For instance, a fertilizer-intensive production is preferred by producers,

but its outcome is considered as inferior quality by consumers. Another example is foodstuff containing Genetically Modified Organisms (GMO). Its use is cost-saving for producers, but considered harmful by consumers (see Fulton and Giannakas, 2004).[12] Thus, under full information the ranking of input types according to their returns per euro spent may be the reverse of the ranking according to their productivity. This point is taken up in Bonroy and Lemarié (2012), where the impact of a label on both markets, for the input and the final product, is studied. In that work, the intermediate market is assumed to be a duopoly, in order to analyze the strategic interaction between upstream suppliers. Differing productivity of inputs, and consumer preferences over input types, create vertical differentiation in the intermediate market. The final product market is assumed to be served by a continuum of competing firms indexed by a parameter ω and uniformly distributed on $[0, \overline{\omega}]$. The higher ω is the most the firm is acutely felt by the productivity of the input used in their production process.

While all producers can identify the two input types, consumers cannot tell what has been used in producing the final product they consume, hence, in the absence of label, consumers' preferences over input types cannot be translated into higher returns. The more productive input is then charged at a higher price than the input preferred by final consumers: $r_1^U > r_2^U$. By restoring full information, a label allows consumers to express their preference for inputs, it therefore a) creates differentiation in the downstream market, which in turn softens price competition in the upstream market: $r_2^L > r_2^U$ and $r_1^L > r_1^U$ (*differentiation effect*), and b) affects and potentially reverses the quality ranking of input types, which reverses the relative magnitude of input prices: $r_1^L < r_2^L$ (*ranking effect*).[13]

Who benefits and who looses from the label? According to Bonroy and Lemarié (2012) both effects–differentiation effect and ranking effect–drive up both prices in the high quality supply chain (input and final product). The effect of the label on the price of the low quality input is ambiguous, since the differentiation effect in the downstream market tends to raise that price, but the ranking effect tends to lower it (see Table 1). Concerning profits, the label obviously increases profits in both parts of the high-quality supply chain, but its effect on the profits of

[12] Note that the second generation GM product contains attributes that increases their standing in the eyes of consumers. Giannakas and Yiannaka 2008 show that introduction of such GM products can change the relationship between GM and conventional and organic products from one of vertical to one of horizontal product differentiation and can improve the market acceptance of agricultural biotechnology.

[13] The terms are borrowed by Bonroy and Lemarié (2012).

the upstream and the downstream firms in the low-quality supply chain are ambiguous, again due to the opposite workings of the two effects. The detailed impact of each effect is presented in Table 2.

Bonroy and Lemarié (2012) shows that determinant in balancing the differentiation and the ranking effects is the ratio $\frac{\overline{\omega}}{\overline{\theta}}$, i.e. the downstream producers' heterogeneity in the return of inputs relative to consumers' heterogeneity in the valuation of quality. A higher $\overline{\theta}$ increases the differentiation effect by relaxing competition in presence of labeling, while a higher $\overline{\omega}$ relaxes competition without labeling, thus increasing the importance of the ranking effect.

4 The certification of the label

So far, we have assumed that the quality certification related to the attribution of a label is both costless and truthful. In this section we reconsider these assumptions, raising two important questions. First, what is the impact of the label's certification cost on producers and consumers surplus? Second, what is the optimal way to regulate the market when the certification process is not 100% trustworthy?

4.1 The impact of costly labeling

In some cases each product-unit must be individually tested and certified (*e.g. donner des examples*) while in other cases general inspection of a firm's premises and production methods is sufficient to certify its entire production. Consequently, in analyzing the impact of certification cost we distinguish between fixed, and per-unit of output certification cost.

The per-unit cost of certification is similar in its effects to a specific tax, it therefore affects all actors in the market, even if it leaves the market structure unchanged. As shown earlier, the introduction of a costless label in a competitive market marred by information problems produces benefits for both, producers and consumers. The results of Fulton and Giannakas (2004) show, however, that if the label requires a positive per-unit certification cost, this result may not hold. Assuming that both demand and supply are neither completely elastic nor completely inelastic, certification increases the price of the high quality but by an amount less than the increase in the corresponding cost: the certification cost is partly borne by the certified firm. Compared to the

costless certification case, less firms opt for the production of high quality, and some producers find it profitable to switch to the production of low quality in order to avoid that cost: the low-quality price decreases. The per-unit certification cost affects the two prices differently, but reduces individual-firm profits in both market segments, thus making all producers worse-off. Since an increase in the certification cost lowers industry's surplus in the environment with label, the surplus loss due to high certification costs may more than offset the surplus gains due to improved information: the industry is then worse-off with the label.

When it leaves the market structure unaffected, a fixed certification cost represents a payment with no impact on price or the quantities supplied, being entirely borne by the certified producers. However, when it induces some firms to switch from high to low quality in order to avoid its payment, a fixed certification cost may well increase concentration in the upstream market, thereby reducing, along with consumers surplus, the profits of the "excluded" producers (see e.g. Crespi and Marette, 2001). The latter may opt for sharing the fixed certification costs by forming a producers' association which generates revenue by charging individual producers a share proportional to their total output.[14] This, however, corresponds to transforming the fixed cost to a charge per unit of output produced. Moschini et al. (2008) shows that such raising of marginal cost generates a distortion by inducing some producers to abandon that market in order to avoid the payment; thus calling for public financing of the fixed certification cost.[15]

Note, finally, that whether per-unit or fixed, costly certification of the final product of a supply chain with upstream market-power may reduce the surplus of even the purchasers of the low-quality product. Consider (as in section 3.3) a final product the quality of which is determined by the quality of a specific input used in its production, and assume that the low-quality input suppliers have market power. The switch of final-good producers from high to low quality increases the demand for the low-quality input *reduces the elasticity of demand* for the low-quality input thus inducing its suppliers to increase its price. When the resulting rise in the downstream low-quality-firms' marginal cost is more important than the additional competition pressure due to the increased number of such firms, costly certification causes the low-quality

[14] Based on a database on French dairy firms, Bontemps et al. 2012, show that engaging in a producers' association in order to share the cost labeling is particularly relevant for small firms.

[15] Crespi and Marette (2001) put in light that to finance fixed certification costs by public financing instead of per-unit user fee is socialy optimal only when the opportinuty cost of public funds is low.

product's price to increase, thus leaving consumers surplus reduced (see Fulton and Giannakas, 2004).

4.2 Trustworthiness of the label

Turning to the second question, suppose that firms can cheat about the certification of their product. For example, some firms may make false claims, or affix imitations of the labels or certificates issued by the labelling agency to high-quality firms. Assume for the moment that cheating is costless. The government must monitor the high quality firms in order to protect the label's credibility and avoid a lemons-market outcome. Let us consider a competitive market with free entry. Before firms make any quality decision, the government decides that, among all firms labeled as high quality, a number m of randomly chosen ones will be inspected. Each inspection has a cost for the government, and any firm caught cheating must pay a fixed cost F. The number of inspections, m, is chosen so that the expected penalty just offsets the expected gain from cheating. The government has two labeling options, self-labeling and third-party labeling. According to the first, all high-quality and/or low-quality firms must self-label their products; self-labeling is costless. Third-party labeling is mandatory for the high-quality firms, and unlike self-labeling, requires a per-unit cost: all certified firms must pay the labeling agency a fee l for each unit of certified output.[16] Compared to self-labeling, third party labeling requires an additional cost, but may reduce inspection costs. Whether it does so depends on two effects. First, *an incentive effect*: the low-quality firms have more incentive to cheat due to higher prices in the high-quality market, therefore the government must inspect more firms. Second, *a market share effect*: the high-quality market share decreases due to higher cost, therefore the government must inspect less firms. The relative strength of these two effects in relation to the direct cost determines the optimal labeling option. In fact, as shown in Baksi and Bose (2007), self-labeling emerges as the socially optimal option in most cases, except when the per-unit monitoring cost is high and/or the number of firms to be monitored is low (i.e. *the market share*

[16] One might think of a third option, namely third-party labeling of *low-quality* firms. This option is always socially more costly than letting firms self-label their product. By raising the cost of the low quality product, third-party labeling also raises its price, thus increasing the market share of the high quality product. This increase results in an increase in the number m of firms that must be inspected. Hence, third-party labeling of the low quality involves both a positive certification cost for the firm and a higher inspection cost for the government (see Baski and Bose, 2007).

effect exceeds *the incentive effect*).

An ideal label must be *unit-specific,* meaning that every single unit supplied has been individually certified. Obviously, such an approach is often very costly, and for this reason labels are usually *firm*-specific, in that they certify the quality of a *firm's total production*, after inspecting the firm's production premises, its production methods, and/or a sample of its output. It is, thus, a *collective* label since it is attributed to all the units of the firm, including some non-inspected ones.[17] When the entire production of an industry is of either high or low quality (as it has been assumed so far) whether the label is *firm-specific* or unit-specific (only on inspected units) makes no difference. When, however, product quality may vary from unit to unit, a certified firm can hide low-quality units in its sales of labeled products. The resulting fraud damages the reputation of the label, thus producing a negative externality that affects all firms.[18]

Unlike the previous case, let us assume that fraud is no longer costless: a cheating firm must bear, in addition to any certification cost that must be also borne by the honest firm, an additional per-unit cost of disguise d. Despite the latter, fraud can be rewarding if the production of a "disguised" high-quality unit is less costly at the margin than the production of a truly high-quality good,[19] Let the level of purity in the market of labelled products be given by the proportion of high-quality product sales out of total sales, that is:

$$\rho = \frac{S_2^L}{S_2^L + S_1^{Lf}} \tag{4}$$

with S_1^{Lf} representing the sales of low-quality products hidden in the sales of labeled products. When ρ is perfectly anticipated by consumers, any increase of ρ results in a *collective reputation incentive,* shifting outwards the market demand function and benefiting all the certified firms. However, as the quality of a credence good cannot be verified even after consumption, individual-

[17] Consider, for example, the case of the french label *"label rouge"*, requiring French farmers to use 70% to 80% of cereals in their animal feed. The entire production of labeled farmers is certified, with only a part of the industry's total production having been inspected.

[18] Hargaugh et al. (2011) show that the reputation of a collective label may also be damaged when a disputable individual joins the group of certified firms. Such an effect then reduces the benefit to the disputable individual from adopting the label.

[19] Mason (2011) shows that fraud may also exist in environments where the certification test is noisy, with high quality firms more likely to pass than low quality firms.

firm reputation is impossible to build. It is, therefore, in the interest of each firm to include some amount of "disguised" products in its supplied quantity (*adverse selection incentive*). As typical with inter-firm externalities, market structure is crucial for the equilibrium value of ρ. Under competition the effect of an individual firm's purity on ρ is negligible, therefore, in equilibrium $\rho = 0$, and the collective reputation incentive disappears taking with it the entire market for labelled products. Under monopoly, any impact on sales' purity is fully internalized: adverse selection disappears and $\rho = 1$. Under oligopoly, both effects are present, and their relative strength determines the market outcome. The higher the number of firms, the more likely that the adverse selection incentive dominate the collective reputation one.

It is interesting to note that imposing a positive per-unit certification cost may *increase* the level of purity in the market.[20] As shown in Hamilton and Zilberman (2006), this somewhat surprising result is due to the fact that, by reducing the marginal return from disguising low-quality units as high-quality ones, an increase in the per-unit certification cost discourages fraud. Along with increasing the purity level, a higher per-unit certification cost increases also the per-unit cost of high quality, thereby increasing its price and reducing its market share. Hence, the average quality of the labelled product increases, but fewer consumers buy that product. That this reduction in market share may also end up reducing the labeled firm's profit can be easily seen in the extreme case of a market with unit purity: any further increase in the per-unit certification cost cannot improve purity, yet it reduces the sales, and thus the profit, of the high quality firm.

Instead of increasing the per-unit certification cost, an increase in purity can also be achieved through the use of monitoring activity and penalties to the firms caught cheating. The introduction of a monitoring-punishing system has two effects. First, because the equilibrium number of inspected firms is $m^* = m^*(\rho)$, with $m' < 0$, firms now have an additional *collective* interest in seeing the average market-purity raised: a higher value of ρ reduces the government's optimal number of inspections, and therefore the *probability of any individual firm to be inspected*. Second, for any given probability of inspection, a higher *individual* purity level assures a firm a

[20] Ibanez and Grolleau (2008) finds a similar result when the certification cost is a sunk cost. The authors assume that a high quality firm does not bear the same sunk cost than a low quality firm, $F_2 \neq F_1$. In such an environment, positive certification cost increases the level of purity in the market only when F_2 is sufficiently low and and F_1 sufficiently high. If these conditions are not respected none of the firms produce a high quality product, and the label is never adopted.

lower probability of detection. As a consequence, the monitoring-punishing system reduces the expected profitability of a disguised unit and lowers the adverse selection effect.[21] In conclusion, any given purity level in the high-quality market can be achieved through either the imposition of a positive per-unit certification cost, or the introduction of a monitoring-punishing system. The latter is welfare superior since it achieves the desired purity level without reducing the size of that market.

Finally, let us note that the certification process itself may also be untrustworthy. When the certification agency uses the certification fee for raising revenue instead of just covering certification costs (like a non-profit agency), it may have an incentive to deceive consumers. In such a case, the label looses its information value, unless the agency is able to convince consumers about its good intentions. Mahenc (2009) shows that the agency may build a bayesian reputation by using the (per-unit) certification fee as signal. The main result is that the agency may charge fees that exceed the Ramsey level, in order to prove its trustworthiness. Thus the provided label creates a welfare loss by further reducing consumption compared to the case of a label provided by a trustworthy (non-profit) agency.

5 Optimal quality-level of the label and welfare

To restore full information in a market with two products with exogenously determined qualities, requires a single label at any level between the low and the high quality.[22] In a more general setting of $n \geq 1$ products of exogenous quality in the market, only the presence of $n-1$ labels corresponding to the highest $n-1$ qualities would guarantee the full information outcome. Any number $k < n$ of labels would bunch different qualities into some labels, thus leaving consumers unable to distinguish one from another. This may affect the quantities purchased by consumers, but if we assume, total quantity, along with qualities, to be fixed, the imperfectness of information mainly impacts on the distribution of benefits between consumers and producers, and producers among themselves.[23]

[21] This last effect does not work when the detection frequency of a firm is not endogenous, see Hamilton and Zilberman, 2006.

[22] Of course, a choice of label oustide this range would provide no help in improving the problem of information.

[23] Potential exit of firms may create some further distortions.

If, however, firms can *choose* the quality level of their product, the number and level of labels become of paramount importance, since they determine the quality set supplied in equilibrium. Discrete labels at predetermined levels provide only a coarse discrimination among qualities, since they simply certify that a product's quality is not inferior to a threshold level, but offer no further comparison among qualities satisfying the criterion. With a continuous range of potentially available qualities, the full-information quality configuration can only obtained by a continuum of labels, *i.e.*, tailor-made certification of any product's quality. Since the latter is very costly and provides information that is difficult for consumers to grasp, certification through a limited set of *discrete* labels is a compromise avoiding the difficulties of tailor-made certification at the cost of altering firms' quality decisions. If a firm chooses a quality lower than the label's level it cannot have its product labelled (but still is allowed to produce and sell it), while choosing a higher quality implies paying the cost of additional quality without being able to reap the benefit.[24] Thus, with endogenous quality choices out of a continuum of feasible levels, introducing a set of labels practically corresponds to a soft way of regulating quality levels, it is therefore very important to study the characteristics–number and level of labels–of an existing set of labels. While we have found little work on the optimal number of labels–usually there are exogenously assumed one or two labels–there is substantial literature on the label's level,[25] relating the labels' level to the objective of the regulator. The related literature distinguishes certification by the following types of standard-setting agents according to their objectives, and compares the corresponding label levels: a) government, maximizing total welfare; b) non-government organization (NGO), maximizing or minimizing a specific benefit or harm, usually related to some externality (eco-labels are prime examples of this category); c) the industry.[26] In what follows, we first discuss private vs. public labels, next we consider labels

[24] In this respect, Minimum Quality Standards (MQS) and labels are similar measures, aiming at the regulation of low and high qualities, respectively. Their difference lies in the fact that any quality below the MQS must be withdrawn from the market, while ulabelled qualities are allowed to stay in. Due to this, MQS (but not labels) may have an impact even in environments of perfect information (see e.g. Ronnen, 1991, and Crampes and Hollander, 1995).

[25] See Caswell and Anders (2011) for an overview on this topic.

[26] The term "industry" is clear in the case of monopoly, but less so when the industry is composed by a number of heterogeneous firms. In that case the identification of the decision maker is problematic: is it the biggest firm, the median size one, the one producing the top quality, *etc.* This standard problem in the collective choice literature is usually sidestepped by assuming the industry composed out of similar firms. While this assumption is rooted in the need to simplify the analysis, it cannot be considered as unreasonable, since trade unions are usually formed of firms with similar interests over some issues.

One should not confuse the case where a firm (or group of firms) decides the label's *level* with the case of

set by NGO's, and finally we examine the literature on the political economy of labels.

5.1 Private vs Public Labels

We start by comparing label levels set by the industry to levels set by a social planner. The question of whether the industry sets standards that are too high or too low is of practical interest and admits no universal answer, as can be seen by the two most often cited examples, ecolabels and Geographic Indicators standards. While industry-implemented ecolabels are typically criticized for being too lenient, GI standards set by producers' associations are often criticized for being unnecessarily demanding. In what follows we try to isolate all factors producing a bias in one or the other direction, Table 3 summarizes our results.

Demand Effect. Because no firm can convince consumers about selling products of quality higher than the certified level, making the label stricter increases consumers' willingness-to-pay for the certified quality. We call this the *demand effect.* Since we assume that the social planner and the firm face the same–monotonically increasing in quality–cost function, comparing the intensity of the demand effect between these two potential level-setters is the most important building block of the analysis. According to Spence (1975), this issue can only be addressed in general terms if we restrict both agents to produce the same quantity and examine how a quality increment affects the marginal willingness-to-pay of the marginal and the average consumer. If the willingness-to-pay of the average consumer increases more than that of the marginal consumer, the monopolist undersupplies quality, and *vice-versa.*[27] For the standard utility function given by equation 1, $\frac{\partial^2 U}{\partial q \partial \theta} = 1 > 0$, hence, for this type of preferences, willingness-to-pay for quality increments decreases in quantity. This in turn implies that, compared to the social planner, the regulated firm wishes, *ceteris paribus,* the label to be attributed at a lower quality level.

Spence's argument is depicted in Figure 1.

self-labeling, where, obviously, issues of credibility, cheating and monitoring, arise. Here, we assume the existence of private parties certifying the level proposed by the "industry", or simply, the high quality firm. Thus, the label is set at the profit maximizing level and the agency simply certifies whether a given firm's product is indeed of the claimed quality level.

[27] Equivalently, one may examine the nature of the upward shift a quality increment produces on the demand curve. If the willingness-to-pay for units close to the origin increases more (less) than it does for subsequent units, the monpolist undersupplies (oversupplies) quality. Compared to a parallel shift in demand–where the monopolist and the social planner offer the same quality–this implies a more pronounced shift close to (away from) the origin.

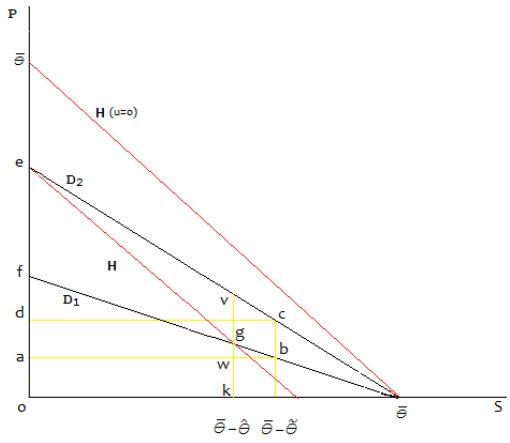

Figure 1

Lines $D_1\,(q_1)$ and $D_2\,(q_2)$ represent the demand functions before and after the quality increment, respectively. Recalling that each consumer buys only one unit, the quantity axis represents a decreasing ranking of θ's. Assume that 1 holds, and, initially quality q_1 is sold at price $0a$, and purchased by the entire segment $\left[\widetilde{\theta}, \overline{\theta}\right]$. Keeping quantity constant, the monopolist checks area $abcd$ against the cost difference between the two qualities, while the social planner uses area $fbce$ to perform the same test. For demand functions deriving from 1 it is obvious that $fbce > abcd$, therefore the social planer is more incentive than the monopolist to adopt any given quality increment.

Strategic Effect. Assuming that the value of the lowest feasible quality (base quality) is $\underline{q} > 0$, if the cost of certification is not too high there is the possibility of having two product-types in the market: an unlabeled one of quality $\underline{q}$, and a labeled one of quality exactly equal to the required by the label. If the base-quality sector is competitive, the above analysis and conclusion remain unchanged. If, however, the base quality is also produced by a single firm, the duopolists interaction brings a new element into the picture, namely strategic effects. Consider the Bertrand two-stage game where firms simultaneously choose quality at the first stage and price at the second, and assume that the production of any quality level requires a fixed cost $F\,(q)$, with $F' > 0$, and $F'' > 0$. Quality choices at the first stage are affected by the anticipation of price-competition at the second. This implies that a) if the cost of labeling a product is not prohibitively high, only one firm, say firm 2, will opt for the certified quality, the other (firm 1)

choosing the base quality in order to avoid Bertrand competition in homogeneous goods, and b) product differentiation will be more pronounced–compared to the cases where either second-stage price-competition is absent, or firms fail to realize how they quality choice impacts on its intensity–in order to soften subsequent price-competition. Since the uncertified low-quality can go neither up nor down, it is firm 2 that must further improve its product, and we term this the *strategic effect*. The strategic effect increases firm 2's incentive to provide quality, thus risking to reverse the Spence-based conclusion about quality underprovision by the market. The situation becomes blurred even further, when one recognizes that a social planner who does not regulate prices at the second stage may have an incentive to lower the high quality, precisely in order to reduce differentiation and obtain tougher price-competition.[28]

In order to answer the above questions, let $F(q) = q^2/2$. Under full information, standard calculations (see Motta, 1993) show that the the duopoly Nash-equilibrium is $\left(\left(p_1^N, q_1^N\right), \left(p_2^N, q_2^N\right)\right)$ where $q_1^N = .0482$, $q_2^N = .2533$. Assume for expositional purposes that $\underline{q} = q_1^N$. Under imperfect information, the high quality still wishes to produce and certify the quality level q_2^N, but the social planner's ideal label is at $q_2^S = .3752 > q_2^N$. Hence, the presence of strategic effects does not qualitatively alter the Spence result about quality underprovision, therefore, private labels will be less demanding than public ones.[29]

Until this point we have assumed that the price-quality decision, at least that of the high quality product, is made by a single firm, and the analysis does not change if the firm is replaced by a fully coordinated cartel. In many instances, though, the high quality product is produced by a group of producers led by an organization that controls labeling requirements and standard promotion expenses, but has no control on individual quantities. Such is the case of products characterized by geographical indicators (GI): a central organization defines the necessary production requirements for a firm to label its product, monitors the respect of these requirements

[28] This incentive of the social planner disappears if the market is covered in the duopoly equilibrium, as, for instance, in Roe and Sheldon 2007, unless the social planner attaches higher weight to consumer surplus than profits. Note also that no matter whether they increase or reduce total consumers surplus, changes in product differentiation are never Pareto improvements since they have opposite welfare effects on consumers at the high or the low end of the distribution.

[29] If we adopt a more general cost function of the type $F(q) = kq^\alpha$, $\forall \alpha > 2$, firm 2 wishes less differentiation compared to the $\alpha = 2$ case, therefore private labels will certify lower quality levels than public ones. This result may be reversed only for very flat cost-of-quality functions, *i.e.,* for $\alpha < \widetilde{\alpha} \in (1, 2)$ .We have not verified the existence of $\widetilde{\alpha}$.

in order to protect the collective reputation of the product, and eventually assumes some promotion expenditures.[30] In the absence of production quotas, the price of the product will always be equal to the individual firm's marginal production cost. Following the analysis in Merel and Sexton (2011) we will discuss below how a GI organization that cannot restrict supply using quotas,[31] may be able to increase its members' profits by properly manipulating the label's level.

Profit margin effect. The first mechanism that allows labeling at higher quality to increase industry profits, is the *profit margin effect*.[32] Suppose for a moment that an increase in q increases demand without affecting variable cost. Since $p = MC$ due to competition, at any given quantity, an individual firm's average profit is given by the difference $MC - AC$, where AC stands for average cost. If the marginal cost rises faster than the average cost, any outward shift in demand will produce higher profit margins over a higher amount of sales, thus blowing the private regulator's incentive to increase the label's level. As pointed out in Spence 1975, "when constrained to set price equal to marginal cost, the profit maximizing firm does not set quality at the optimal level."[33] Merel and Sexton (2011) nicely exploits this remark by showing that, when the variable cost function has elasticity greater than 1 with respect to both changes in quality and changes in quantity, the profit-margin effect will always induce the private regulator to set a labeling standard quality above the social optimum.

Supply restriction effect. A second factor that may eventually induce the GI organization to adopt a too high standard is the, so called, *supply restriction effect* of the label. Increasing a firm's marginal cost induces a less aggressive behavior, therefore, simultaneously increasing the marginal cost of all the firms in a sector may indirectly reduce total supply and increase price.[34] While competition assures that at the margin profit is always zero, the higher price may

[30] *E.g.,* Council of the European Union, 2006, Article 5**.** We are referring to European type GI's that not only refer to origin, but also guarantee that the production process respects some norms. In this respect, GI's become quality standards that even some producers within the designated area may fail to meet. For such GI labels, origin is a necessary, but not sufficient condition.

[31] As a matter of fact, some do. However, most organizations responsible for labeling cheese, wine and other agricultural products according to GI's do not (or are not allowed to) control total quantity.

[32] In the aforementioned work of Merel and Sexton it is called "demand effect", but we avoid this term in order to create no confusion with our previous analysis.

[33] Actually, footnote 4 in Spence 1975 presents the case where marginal valuation for quality improvements decrease with quantity (as in our analysis) but, opposite to the case in Merel and Sexton (2011) considered also here, "average costs go up faster than marginal costs as quality is increased." (see Spence 1975, footnote 4.) As a result, Spence 1975 predicts quality underprovision by the constrained monopolist, while the result in Merel and Sexton (forthcoming) is that the monopolist constrained to price at marginal cost will overprovide quality.

[34] This is, for instance the rationale behind export taxes.

increase the producer surplus form the inframarginal units, despite the marginal cost increase. If, following a change in product specification, a) producer surplus from inframarginal units increases, and b) sufficiently so as to compensate for the reduction in sales, then total producer surplus may increase, even if the change in question has no value for consumers. For this to happen, *i.e.,* for restricting supply through higher standards to be a feasible and profitable strategy, three necessary (but not sufficient) conditions must be met: variable costs must be increasing in both quality and quantity, and for any quality, as quantity increases marginal cost must rise faster than average cost. Figure 2 (inspired from Merel and Sexton) depicts the situation.

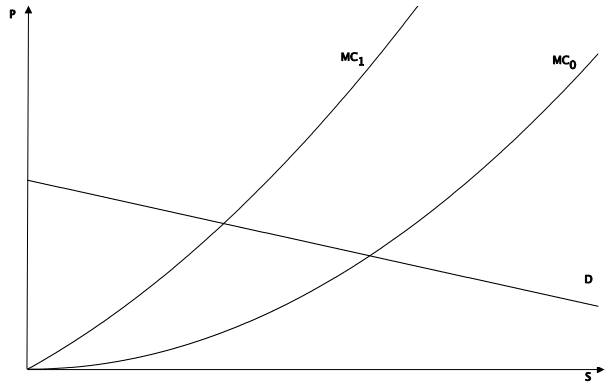

Figure 2

$MC_0 = MC(S; q_0)$, $MC_1 = MC(S; q_1)$ show the marginal cost function at two different levels of production requirements, with $q_1 > q_0$. For simplicity, we assume as in Bouamra-Mechemache and Yu (2012) that stricter production requirements provide no additional utility to consumers: granting the label at quality level q_1 instead of q_0 simply increases cost without affecting demand. However, producer surplus under the q_1 specification may be higher compared to that under q_0.[35] Obviously, no social planner would ever wish the imposition of such an unproductive increase in quality, but the organization may opt for it. It is obvious that starting for low values of q the supply limiting effect on producer surplus is important, becoming decreasing, and eventually negative, for further increases in q. Hence, if from a social point of view, the label must certify a relatively low level of quality, both the profit-margin effect and

[35]Increasing average costs go together with increasing marginal costs, whether in quality or in quantity. Obviously, if the marginal cost is flat in quality, the organization has no means to increase it, while if it is flat in quantity producer surplus is always zero.

the supply restriction effect induce the private regulator to adopt labeling at a standard higher than the socially optimal one. However, if the social standard is relatively high, then the profit-margin effect still biases the private regulator's standard upwards, but the supply restriction effect works in the opposite direction. The conclusion in Merel and Sexton (2011) is that at the socially optimal label level, the profit margin effect is always strong enough to induce (whether concurred or countered by the supply limiting effect) the private regulator at adopting a higher standard, compared to the public regulator.

Reservation-quality effect. In a study of OGM-free grain markets, Lapan and Moschini (2007) points out that, since the two types of grain share common handling premises, the presence of some OGM into the OGM-free product is almost unavoidable, therefore 100% purity of the OGM-free product is either impossible or highly uneconomical. The question that arises naturally is at what purity level a product can be labeled as OGM-free. In line with the above analysis, farmers in Lapan and Moschini (2007) desire a higher than the socially optimal purity level. While some of the factors identified in Merel and Sexton are still at work, the Lapan and Moschini (2007) analysis is worth a closer look, since it uses the following utility function, quite common in the GMO literature:

$$U_i = \begin{cases} u - \theta s_i - p_i & \text{if quality } i \text{ is purchased} \\ 0 & \text{in case of no purchase} \end{cases} \tag{5}$$

with s_i corresponding to the degree of "impurity" of product i, *i.e.,* the percentage of GM ingredients that one can find in a GM free product. Since $s_i = 1 - q_i$, translating the "bad attribute" to "good attribute", one can write this utility function as $U_i = (u - \theta) + \theta q_i - p_i$, which, in turn, is equivalent to:

$$U_i = \begin{cases} \theta q_i - p_i & \text{if quality } i \text{ is purchased} \\ \max\{\theta - u, 0\} & \text{in case of no purchase} \end{cases} \tag{6}$$

which is "almost" similar to 1, except that for the consumer group characterized by $\theta - u > 0$, the market participation constraint, $\theta q_i - p_i - (\theta - u) > 0$, becomes more stringent and decreasing in θ. At any price-quality set, the high θ consumers are now more likely to abandon the market. Consider a basic quality offered at a given price and a potential quality increment.

For those high-θ consumers who do not purchase the basic quality, the additional benefit from a quality increment must be measured against their non-purchase utility. Since the latter is higher than their utility from the basic quality, the social planner's benefit for providing the quality increment is weakened. At the same time, the quality increment induces some high-θ consumers to purchase, thus making the monopolist more eager to provide it. As a result, even if still $\frac{\partial^2 U}{\partial q \partial \theta} = 1 > 0$, a monopolist may overprovide quality relative to the social planner's wish.

Returning to Figure 1, the utility function in 6 involves a "demand function" for the no-purchase option, such as line H .[36] Note that consumers in the $\left[\widehat{\theta}, \overline{\theta}\right]$ segment, no longer participate in the market. Compared to the case corresponding to 1, on the one hand, the monopolist's incentive to improve quality increases by the area $0kwa$, since those consumers were not representing sales when $q = q_1$, and on the other hand the social planner's gain from such improvement is reduced by the area efg, since the increase in total consumers surplus for the $\left[\widehat{\theta}, \overline{\theta}\right]$ segment is only egv. It may well be that $efbc - efg < abcd + 0kwa$, in which case the monopolist is more eager to adopt any given quality increment than the social planner. This is an additional reason to those presented in Merel and Sexton for arguing that private labels will be granted at quality levels higher than the social optimal.

5.2 Labels set by NGO's

The comparison between the label's level set by the government (social planer) and that set by an NGO is rather straightforward. As NGO's we consider organizations intervening in markets where, besides the informational problem there is also an externality related to the good's production and/or consumption. Since their main concern is the externality problem itself, it is natural that they advocate for stricter standards, compared to the social planner who wishes to maximize total welfare and sees the externality as just one component of her maximization problem.[37] At the same time, governments process coercive power which the NGO's usually lack. As a result, a government may impose mandatory standards, like MQS, while NGO's can only confer labels to the firms that voluntarily conform to their norms. The coexistence

[36] The slope of line H is equal to 1, for $u = 0$ the line intersects the axes at points $\left(0, \overline{\theta}\right)$ and $\left(\overline{\theta}, 0\right)$, and increases in u shift H parallel-downwards. For simplicity, quality q_2 on the diagram has been chosen such that, at zero price the $\overline{\theta}$ consumer is just indifferent between buying the product of quality q_2 and refraining from purchase.

[37] See proposition 2 in Bottega and Freitas (2009).

and interaction of mandatory MQS with voluntary labels is an important topic of the related literature.

Consider a good such that individual utility is positively affected not only by the quality level of the product consumed, but also by the average quality level E of all product units in the market. Individual utility is described by the following variant of equation 1:

$$U = \theta q - p + \gamma E \tag{7}$$

The presence of E constitutes an externality: with a large number of consumers, each individual consumer has only infinitessimal impact on E (assume it zero), while his utility depends strongly on quality choices made by the rest of the population. Two examples, both related to environmental externalities, typically motivate the above utility function. Consider first the case of fresh produce, available in both organic and standard form. By excluding fertilizers from their production, organic produce provide health benefits, thus justifying a higher value of q relative to their standard counterpart. At the same time, the higher their market share, the lower the total use of fertilizers and the corresponding environmental harm, therefore the higher the value of E, an effect that is not taken into account by any single individual choosing the right type of produce in order to maximize his utility. The second example relates to the "warm glow" effect consumers may feel when making a "socially responsible" decision. Even if different types of a good provide exactly the same consumption benefits and no consumer can significantly affect E through his product choice, more environment-friendly types of the good are characterized by a higher q because of the satisfaction from "doing the right thing." [38]

Bottega and De Freitas (2009) assumes a monopoly market and compares consumer welfare under two regimes: a government-imposed MQS *vs* a label set by an NGO. Crucial for the comparison is the observation that, while the MQS allows for only a single quality, the non-coercive nature of the label set by the NGO induces the monopolist to introduce two distinct qualities: the basic one, $\underline{q}$, and a certified high quality.[39] Unless $\underline{q}$ and/or γ are too high, a MQS

[38] See Cremer and Thisse 1999, and Constantatos and Sartzetakis 19*xx*. Consumers are now distributed according to their environmental sensitivity, with $\theta = 0$ representing the typical microeconomics-textbook consumer who likes better environment but leaves it to others to take care of.

[39] While in most cases the monopolist would indeed take advantage of this possibility, whether the monopolist introduces one or two qualities should be enogenous in the model. As a matter of fact, with the linear utility function in equation 1 (a variant of which is used in Bottega and De Freitas, 2009), the monopolist does not

increases consumer welfare and profits.[40] As it turns out, with the NGO label some consumers–those with "middle-high willingness to pay"–are worse-off.[41] This is due to the fact that the label may create excessive differentiation, leaving those consumers with the choice between a quality that is too low relative to the one they could purchase under MQS, and a quality that is too high, and therefore, too expensive.

Another interesting issue is the interaction between the NGO label and the MQS. The presence of the label reduces the role of the MQS to control for excessive differentiation, leaving the NGO to primarily deal with the environmental target. This implies that the presence of a label pushes the optimal level of MQS downwards, but, a bit surprisingly, the NGO would wish the MQS at an even lower level! This is so since, the introduction of MQS corresponds to an improvement of the lower quality, and therefore induces, *ceteris paribus,* some consumers to switch from high to low quality, thus increasing the market share of the latter. Hence, besides improving the low quality, the MQS exercises also a negative influence on average quality–through market share–and the overall impact from its introduction at the social planner's optimal level may be the deterioration of the average quality. As γ increases, the NGO's goal comes closer to that of the social planner, therefore the MQS is set at lower levels.

5.3 The political economy of labels

The existence of three potential standard setters with different preference about the optimal standard's level introduces the "political economy" of the label setting, *i.e.,* a positive approach trying to identify which label level will most likely be finally observed. As we have seen**,** when the demand effect prevails, $s_F < s_W < s_{NGO}$, *i.e.,* the label's level that is optimal for the firm is less stringent than the social planner's optimal which, in turn, is less stringent than the optimal of the NGO.[42] The hypothesis of Heyes and Maxwell (2004) is that a social planner sets an MQS and/or an NGO sets a label and that the industry may resist the imposition of either, to the

introduce the lower quality (see Larue, Pouliot and Constantatos, 2010).

[40] If $\underline{q}$ is higher than the individual consumer's optimal level (given the monopoly pricing), the MQS forces the consumption of a too high quality. High values of γ, on the other hand, call for high MQS and again may force consumers to consume a too high quality..

[41] See Bottega and Freitas (2009).

[42] **Bottega and De Freitas** (2009) **obtain such a result on a monopoly market, and Manasakis et al.** (2012) **on an oligopoly market with a Dixit-Spence-Bowley model of demand (Dixit,** 1979**, Spence,** 1976**, Bowley,** 1924**).**

extend that it reduces its profits. The intensity of the industry's resistance is directly related to the profit difference in presence and absence of standard(s). It is shown first, that "*the threat of industry resistance leads the* [government] *to decrease* [the MQS] *so as to raise the likelihood of implementation. In doing so the level of expected social welfare falls from its no resistance level.*"[43] Second, that for any proposed MQS the resistance increases if there is the possibility that an NGO label is introduced as an alternative. Third, that the overall effect of the NGO label on MQS and welfare is ambiguous when the label represents an alternative to MQS. Forth, that when the NGO label is not an alternative to an MQS proposal but already exists and is meant to stay, its effect is to *reduce* resistance to the MQS proposal.

The hypothesis in Baron (2011) is that the label's level is set by the industry and it is the NGO who "resists" to that level.[44] Resistance is modelled explicitly as follows. After observing the level set by the labelling organization of the industry, the NGO spends some campaign amount a pressuring the industry to increase the label's level above the profit-maximizing one, while the labelling organization of the industry decides whether to concede or spend some amount r in fighting the campaign. The campaign's probability of success is $\rho = \frac{\beta a}{\beta a + r}$, where β measures the strength of the NGO relative to the firm: β is high when the NGO is strong and credible, the cause appeals to consumers, and/or the firm is vulnerable.[45] Firms and the NGO play simultaneously, deciding r and a, respectively. Each side's reaction function is derived by maximizing its expected net benefit, which is

$$\widehat{\pi} = (1 - \rho)\, \pi\left(s_F\right) + \rho \pi\left(s_{NGO}\right) - r \tag{8}$$

for the firm, and

$$\widehat{V} = (1 - \rho)\, V\left(s_F\right) + \rho V\left(s_{NGO}\right) - a \tag{9}$$

for the NGO, with $\pi\left(.\right), V\left(.\right)$, representing industry profits and NGO, respectively, at any level of the standard. As it turns out, the equilibrium $(a^*, r^*) \in \mathbb{R}^2_+$, implying that it is optimal

[43] Proposition 2 in Heyes and Maxwell (2004).

[44] In Baron (2011) the NGO is called "the activist", and "resists" to the label for being too lax, trying to pull its level up. The picture is, therefore, the exact opposite of that in Heyes and Maxwell (2004), where the NGO sets the level and the industry resists it for being too strict.

[45] Important brand-name firms may have difficulty to resist the campain, especially when resistence involves law suits.

for the NGO to undertake some positive campaign and for the firm to spend some amount fighting it. Using (a^*, r^*) and the definition of ρ, Baron (2011) shows that the equilibrium value $\rho^* \in (0,1)$, and is strictly decreasing in s_F and s_{NGO}. The latter implies that very ambitious campaigns have small probability of success. Moreover, by increasing the label's level above s_F, the industry benefits by mitigating the risk of a successful campaign, but at the cost of lowering its profits if the campaign fails. Hence, at the first stage of the game, the industry chooses the label's level by maximizing equation 8 with $\rho = \rho^*(s)$, instead of considering ρ as exogenous. In Baron (2011) is shown that i) the optimal level $\widetilde{s}$ is such that $\rho^*(\widetilde{s}) = \frac{\widetilde{s}-s_F}{s_{NGO}-\widetilde{s}}$, and ii) $s_F < \widetilde{s} < \frac{1}{2}(s_F + s_{NGO})$, *i.e.,* higher than its level under no social pressure, but lower than the average between the industry's and the NGO's optimal level.

The hypothesis of Fischer and Lyon (2012) is that firms differ according to their cost of quality improvement such that the firms are heterogenous in their preferences for the labels. In such an environment, having an NGO label alongside the industry label offers another option that is more profitable for low-costs firms.[46] The industry profit is always better with both labels. While the industry has any interest to "resist" to the implementation of a NGO label, the NGO may be worse off with an industry label.[47] This is the case when a single NGO label would attract the majority of the industry. The presence of an industry label offers then another option that is more profitable for high-costs firms, which drives down labels and reduces the quality improvement. Note that when the distribution is skewed toward low-cost firms, the NGO has any interest to "resist" to the presence of the industry label. Indeed, the presence of this one enables the NGO to supply a strict label in order to "cream" low-cost firms, while leaving those who have an higher cost to the industry label. The quality improvement is then higher than in an environment with only an NGO label.

6 Conclusion and future research

Labeling is an important instrument for facilitating consumer purchases when other forms of quality signalling are inadequate. There are many examples of labels allowing consumers to

[46] Fischer and Lyon (2012) assumes that the NGO chooses the label's level to maximize the quality on the market.

[47] Fischer and Lyon (2012) assumes that the industry choose the label's level to maximize the total profit of both certified and non-certified firms.

identify the products that meet their preference. Labels provide information through third-party certification, that can be either direct, or indirect (monitoring and punishment for self-labeled products). In some simple cases–when the product can only be available at a few discrete quality levels–the label may replicate the full information market outcome. In many other cases though, while labeling improves information, it is unable to restore full information.

When the label restores full information, its impact on welfare crucially depends on the existing market structure before the label, and the emerging market structure after the label's introduction. When the latter is fully competitive, a full-information-restoring label is always welfare-improving. In all other cases the impact of the label on market structure must be taken into account. This is a typical *second-best* type of conclusion where, in the presence of two distortions–market structure and information–correcting only one may make thinks worse.

There are three reasons for a label not to be able to restore the full-information market outcome (whether the latter is welfare superior, or not). The first lies in its potential inability to accurately convey information about the quality of existing products, due to two factors: cost and credibility. High labeling cost may prevent some firms from labeling their product. The refusal to label a high quality product due to high costs, increases expectations about the average low quality, thus reducing the product differentiation advantage of high qualities. On the other hand, high monitoring costs may induce some labeled firms to cheat, thus undermining the credibility of the label.

The second lies in the "coarseness" of the label as a certification instrument. Full certification of any quality level runs into two difficulties: high certification cost, and a resulting information that is too complex for consumers to assimilate and use when making their purchase. In order to avoid these problems, the label certifies only certain pre-specified quality levels. This turns the label into a *quality-regulation instrument* that can control the *post* label market outcome. Besides market structure, a new important factor affecting the labels impact on welfare enters now the picture: the objectives of the agent who sets the label's level. Following the literature, in section 5 we identified three potential level setters, the government, an NGO and a third party acting on behalf of the industry, and analyzed how each party's decision affects welfare. The potential conflict among agents over the certified quality level has induced the literature to focus on the "political economy" of labels, also reviewed in that same section.

The third reason impeding the label from replicating the full-information outcome is its perception by consumers. While many labels are of zero-one nature–"contains GMO" or "GMO free", environmentally friendly, or not, etc.–many others may have to provide more complex information. We termed labels providing information that is not fully grasped by consumers as imperfect labels. There is an emerging empirical literature showing that nutritional labels are a prime example of this category. According to Kiesel et *al.*, 2011, reading a nutritional label need times, and most often consumers can neither evaluate the information provided, nor relate it their planning of a healthy diet. Baixauli et *al.* (2008) find in laboratory that information about fiber content does not increase the consumers' acceptance of the healthier option, because consumers either do not understand the information, or associate it with negative food characteristics. While the impact of nutritional labels on market structure and welfare is an emerging topic in experimental literature (see e.g. Kiesel and Villas-Boas, 2011, and Berning et *al.*, 2011)[48], practically there is no theoretical research addressing these topics. Given the importance of nutritional labels, the need for further research on the impact of imperfect labels is urgent.

Another theoretical issue that requires further attention is the impact of labels in vertically related markets, where two important issues still wait to be investigated. The first is the transactions form in the input-market. In all the reviewed papers dealing with vertical supply chains (see section 3.3) it is assumed that the intermediate good is traded in a market with sellers and buyers being fully distinct. However, in many situations there are fully integrated firms that can be also either sellers, or buyers in the intermediate market. The questions of how a label in the downstream market affects the incentives to vertically integrate, and/or the incentives of integrated firms to participate in the intermediate good's market have been ignored. Moreover, in many instances, instead of spot market operations, the input's market is characterized by bilateral negotiations. What are the effects of labels on such transactions? May the implementation of a label modify the vertical structure of the market? Answering these questions would certainly improve our knowledge of the impact of labels on the entire supply chain, and help us to better evaluate the total benefits and losses, as well as those arising to consumers and the different parts of the supply chain, created by the label's implementation.

[48] Kiesel and Villas-Boas, 2011, and Berning et *al.*, 2011, use field experiment to study the effect of grocery store nutritionnal labels on the sales of microwave pocorn.

Table 1: The effects of costless label on market equilibrium and the actors' payoffs.

	p_H	p_L	π_H	π_L	Π	SC	W
Market segmentation effect	+	–	+	–	+	+	+
Differentiation effect	+	+	+	+	+	–	+
Differentiation effect with entry	n/a	–	+	–	+/–	+	+
Reverse differentiation effect	–	–	–	–	–	+	+
Ranking effect	+	–	+	–	+	+	+

Table 2: The impacts of ranking effect and differentiation effect on a supply chain.

	p_H	p_L	π_H	π_L	Π	SC	W
Supply chain with ranking effect	Up.+ Do.+	Up.– Do.–	Up.+ Do.+	Up.– Do.+	Up.+ Do.+	+	+
Supply chain with differentiation effect	Up.+ Do.+	Up.+ Do.+	Up.+ Do.+	Up.+/– Do.–	Up.+ Do.+/–	+/–	+

Table 3: Effects that drive the industry not to set a socially optimal label.

	Label's level
Demand effect	Underprovision of quality
Strategic effect	Overprovision of quality
Profit margin effect	Overprovision or Underprovision of quality
Supply restriction effect	Overprovision or Underprovision of quality
Reservation-quality effect	Overprovision of quality

References

Akerlof, G., 1970. The market for "lemons": quality uncertainty and the market mechanism. *Quarterly Journal of Economics*, *84*(3), 488-500.

Arnot, C., Boxall, P. C., and Cash., S. B., 2006. Do ethical consumers care about price? A revealed preference analysis of fair trade coffee purchases. *Canadian Journal of Agricultural Economics*, *54*, 555-565.

Baixauli, R., Salvador, A., Hough, G., and Fiszman S. M., 2008. How information about fibre (traditional and resistant starch) influences consumer acceptance of muffins. *Food Quality and Preference*, *19*, 628-635

Baron, D. P., 2011. Credence attributes, voluntary organizations, and social pressure. *Journal of Public Economics*, *95*, 1331-1338.

Baski, S., and Bose, P., 2007. Credence goods, efficient labelling policies and regulatory enforcement. *Environmental and Ressource Economics*, *37*, 411-430.

Berning, J., Chouinard, H. H., McCluskey, J. J., 2011. Do positive nutrition shelf labels affect consumer behavior? Findings from a field experiment with scanner data. *American Journal of Agricultural Economics*, *93*, 364-369.

Bonroy, O., 2009. On labels, competition and process attributes. *Farm Policy Journal*, *6*(4), 43-47.

Bonroy, O., and Constantatos, C., 2008. On the use of labels in credence goods markets. *Journal of Regulatory Economics*, *33*(3), 237-252.

Bonroy, O., and Lemarié, S., 2012. Downstream labeling and upstream price competition. *European Economic Review*, *56*(3), 447-360.

Bontemps, C., Bouamra-Mechemache, Z. and Simioni, M., 2012. Quality labels and firm survival: some first empirical evidence. *European Review of Agricultural Economics*, forthcoming.

Bottega, L., and De Freitas, J., 2009. Public, private and nonprofit regulation for environmental quality. *Journal of Economics and Management Strategy, 18*(1), 105-123.

Bouamra-Mechemache, Z. and Yu, J., 2012. Production Standard, Competition and Vertical Relationship. Mimeo.

Bowley, A. L., 1924. The Mathematical Groundwork of Economics. Oxford University Press, Oxford.

Bureau, J. C., Golzan, E., and Marette, S., 1999. Quality signaling and international trade in food products. *European Review of Agricultural Economics*, *25*, 437-462

Cabral, L. M B., 2005. The economics of trust and reputation: a primer, mimeo, 29.

Caswell, J., and Anders, 2011. Private versus third party versus government labeling. In Lusk, J.L., Roosen, J., and Shogren, J.E., (Eds). *The Oxford Handbook of the economics of food consumption and product*, Oxford University Press, 472-498.

Caswell, J., and Mojduszka, M., 1994. Using informational labeling to influence the market for quality in food products. *American Journal of Agricultural Economics*, *78*, 131-43.

Council of the European Union, 2006. Council Regulation (EC) No 510/2006 of 20 March 2006 on the protection of geographical indications and designations of origin for agricultural products and foodstuffs. Official Journal of the European Union L 93: 12-25.

Crampes, C., and Hollander, A., 1995. Duopoly and Quality Standards, *European Economic Review*, *39*, 71-82.

Crespi, J. M., and Marette, S., 2001. How Should Food Safety Certification Be Financed? *American Journal of Agricultural Economics*, *83*, 852-861.

Darby, M., and Karni, E., 1973. Free competition and the optimal amount of fraud. *Journal of Law and Economics*, *16*(1), 67-88.

Disdier, A. C., and Marette, S., 2011. Taxes, minimum-quality standards and/or product labeling to improve environmental quality and welfare: Experiments can provide answers. *Journal of Regulatory Economics*, doi:10.1007/s11149-011-9167-y.

Dixit, A., 1979. A model of duopoly suggesting a theory of entry barriers. *Bell Journal of Economics*, *10*(1), 20-32.

Dranove, D., and Jin, G. Z., 2010. Quality disclosure and certification: theory and practice. *Journal of Economic Literature*, *48*, 935-963

Dulleck, U., and Kerschbamer, R., 2006. On doctors, mechanics, and computer specialists: The economics of credence goods. *Journal of Economic Literature*, *44*, 5-42.

Fischer, C., and Lyon, T. P., 2012. Competing Environmental Labels. Mimeo, 40.

Fulton, M., and Giannakas, K., 2004. Inserting GM products into the food chain: The

market and welfare effects of different labeling and regulatory regimes. *American Journal of Agricultural Economics*, *86*(1), 42-60.

Gabszewicz, J., and Grilo, I., 1992. Price Competition when Consumers are Uncertain about which firm sells which quality. *Journal of Economics and Management Strategy*, *1*(4), 629-649.

Gabszewicz, J. and Thisse, J., 1979. Price competition, quality and income disparities. *Journal of Economics Theory*, *20*, 340-359.

Garella, P. G., and Petrakis, E., 2008. Minimum quality standards and consumers' information. *Economic Theory*, *36*(2), 283-302.

Giannakas, K., and Yiannaka, A., 2008. Market and Welfare Effects of Second-Generation, Consumer-Oriented GM products. *American Journal of Agricultural Economics*, *90*(1), 152-171.

Hamilton, S. F., and Zilberman, D., 2006. Green markets, eco-certification, and equilibrium fraud. *Journal of Environmental Economics and Management*, *52*, 627-644.

Hainmueller, J., Hiscox, J. M., and Sequeira, S., 2011. Consumer Demand for the Fair Trade Label: Evidence from a Field Experiment. SSRN.

Harbaugh, R., Maxwell, J. W., and Roussillon, B., 2011. Label Confusion: The Groucho Effect of Uncertain Standards. *Management Science*, *57*(9), 1512-1527.

Heyes, A. G., and Maxwell, J. W., 2004. Private vs. public regulation: political economy of the international environment. *Journal of Environmental Economics and Management*, *48*, 978-996.

Ibanez, L., and Grolleau, G., 2008. Can ecolabeling schemes preserve the environment? *Environmental and Ressource Economics*, *40*, 233-249.

Kiesel, K., McCluskey, J. J., and Villas-Boas, S. B., 2011. Nutritional labeling and consumer choices. *Annual Review of Resource Economics*, 3, 141-158.

Kiesel, K., and Villas-Boas, S. B., 2011. Can information costs confuse consumer choice? Nutritional labels in a supermarket experiment. *International Journal of Industrial Organization*, doi:10.1016/j.ijindorg.2010.11.002.

Lapan, H., and Moschini, G., 2007. Grading, minimum quality standards, and the labeling of genetically modified products. *American Journal of Agricultural Economics*, *89*(3), 769-783.

Larue, B., Pouliot, S., and Constantatos, C., 2009. Exports to Smuggle and Smuggling Technologies, *Review of International Economics*, *17*, 476-493.

Lence, S. H., Marette, S., Hayes, D. J., and Foster, W., 2007. Collective Marketing Arrangements for Geographically Differentiated Agricultural Products: Welfare Impacts and Policy Implications. *American Journal of Agricultural Economics*, *89*(4), 947-963.

Lusk, J. L., Jamal, M., Kurlander, L., Roucan, M., and Taulman, L., 2005. A meta-analysis of genetically modified food valuation studies. *Journal of Agricultural and Resource Economics*, *30*(1), 28-44.

Mahenc, P., 2009. Wasteful labeling. *Journal of Agricultural and Food Industrial Organization*, *7*, 1-17.

Manasakis, C., Mitrokostas, E., and Petrakis, E., 2012. Certification of Corporate Social Responsibility Activities in Oligopolistic Markets. *Canadian Journal of Economics*, forthcoming.

Marette, S., 2007. Minimum safety standard, consumers' information and competition. *Journal of Regulatory Economics*, *32*(3), 259-285.

Mason, C. F., 2011. Eco-labeling and market equilibria with noisy certification tests. *Environmental and Ressource Economics*, *48*, 537-560.

Mattoo, A., and Singh, A., 1994. Eco-labelling: Policy considerations. *Kyklos*, *47*, 53-65.

Mérel, P., and Sexton, R.J., 2011. Will geographical indications supply excessive quality? *European Review of Agricultural Economics*, doi:10.1093/erae/jbr056.

Menapace, L., and Moschini, G., 2011. Quality Certification by Geographical Indications, Trademarks and Firm Reputation. *European Review of Agricultural Economics*, doi:10.1093/erae/jbr053.

Milgrom, P., and Roberts, J., 1986. Price and advertising as signals of product quality. *Journal of Political Economy*, *94*, 796-821.

Moschini, G., Menapace, L., and Pick, D., 2008. Geographical Indications and the Provision of Quality. *American Journal of Agricultural Economics*, *90*, 794-812.

Motta, M., 1993. Endogenous Quality Choice: Price vs. Quantity Competition. *Journal of Industrial Economics*, 47, 113-131.

Mussa, M., and Rosen, S., 1978. Monopoly and product quality. *Journal of Economic Theory, 18*, 301-317.

Nelson, P., 1970. Information and consumer behavior. *Journal of Political Economy*, *78*, 311-29.

Nelson, P., 1974. Advertising and information. *Journal of Political Economy*, *82*, 729-54.

Noussair, C., Robin, S., and Ruffieux B., 2004. Do consumers really refuse to buy genetically modified food? *The Economic Journal*, *114*(492), 102-120.

Roe, B., and Sheldon, I., 2007. Credence good labeling: The efficiency and distributional implications of several policy approaches. *American Journal of Agricultural Economics*, *89*(4), 1020-1033.

Ronnen, U., 1991. Minimum quality standard, fixed costs, and competition, *Rand Journal of Economics, 22*, 490-504.

Shaked, A., and Sutton, J., 1982. Relaxing price competition through product differentiation. *Review of Economic Studies*, *49*(1), 3-13.

Shapiro, C., 1983. Premiums for high quality products as return to reputations. *Quarterly Journal of Economics*, *25*, 659-79.

Spence, A. M., 1975. Monopoly, quality, and regulation. *Bell Journal of Economics*, *6*, 417-429.

Spence, A. M., 1976. Product differentiation welfare. *American Economic Review*, *66*(2), 407-414.

Teisl, M. F., Roe, B., and Hicks, R. L., 2002. Can eco-labels tune a market? Evidence from dolphin-safe labeling. *Journal of Environmental Economics and Management*, *43*, 339-359.

Zago, A. M., and Pick, D., 2004. Labeling policies in food markets: Private incentives, public intervention, and welfare effects. *Journal of Agricultural and Ressource Economics*, *29*, 150-165.