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 impact of labeling costs on their credibility, and welfare, and iii) how different agencies set the label's level. We conclude by identifying issues for further research.

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1 Introduction

The past 30 years have seen the rise of consumers' preference for various attributes related to the production process of the goods they purchase. Several experimental and/or empirical studies have corroborated the existence of a positive and rising consumer willingness to pay for attributes such as "green", "ethical", "dolphin safe", "organic food", etc. (see e.g. Disdier and Marette, 2011, Arnot et *al.,* 2006, Noussair et *al.*, 2004, Lusk et *al.*, 2005, and Teisl et *al.,* 2002). This consumer preference for "production processes" is in some cases rooted in the belief that certain types of production provide direct private benefits, mainly health ones. Such is the case of organic products and foodstuff not containing Genetically Modified Organisms (GMO). In other cases it stems from ethical issues that can be summarized as the desire of consumers to assume extra costs in order to participate in the collective effort to cope with an externality. For instance, they buy otherwise similar but more expensive varieties of a good, just because their production helps the environment, dolphin preservation, the fight against poverty, etc.

No matter what generates consumer preference for them, process-related attributes share a common feature: their presence or absence in a good cannot be observed neither before, nor even after the good's consumption. Consequently, unless some additional information is provided to consumers, the latter will always remain in the dark concerning the well-spent of their money on goods or product varieties related to process attributes. This lack of information may have devastating consequences for such goods markets.

Since firms typically know more about the production process of their goods than consumers do, the latter are aware that they can easily be fooled into buying more expensive product varieties without necessarily obtaining the desired attribute they paid for. For this reason, they adopt an extremely cautious attitude towards products with process-related attributes, spending substantially less on them than they would otherwise do. In most instances the market for such goods may even completely collapse, unless a way is found to assure consumers that their money is well spent.

Process-related attributes represent just instances of markets with information problems, the markets for many other types of goods running into similar difficulties. A number of market-devised mechanisms have been developed in order to improve information and cope with related

market failures. Nonetheless, since process-related attributes classify amongst the most problematic cases, most of these mechanisms fail to improve information in their respective markets, leaving direct certification, usually performed by a credible third party, as the only mechanism able to do so.

Firms may propose products that incorporate the desired attribute at many different levels, thus creating many varieties with differing levels of quality. 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.[1] 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 GMO's. 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.

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 structure, and may influence competition. Second, they may create other distortions, related to

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

their cost or their credibility. Finally, the quality level set by the labeling agency as minimum requirement for the label to be conferred affects total welfare, while affecting the well-being of particular groups–consumers, firms, and others, such as environmentalist groups – differently. Following this, opposition to the the label's level (and even to the label's introduction), and the resulting resource-waist must be expected.

In this essay, we review the theoretical literature on the impact of labels on market structure and welfare. 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 the good's consumption, 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."[2] 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).[3]

[2] 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).

[3] The case of Charal, a French brand of meat, is a good example of the "trust" mechanism. Charal meat has the particularity of being sold vacuum-packed in an opaque packaging. This technology allows for better conservation. As the product is not visible, freshness is clearly an experience attribute. Initially Charal sought to build consumers' trust with special offers, so that they would come to know the product quality. Once that had been achieved, consumers were willing to pay a high price for Charal meat. This high price guaranteed Charal's

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, signalling of quality being only possible through certification by a reputable agent such as a government or an independent expert (see Caswell and Mojduszka, 1996, and Bonroy, 2009).[4] 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.[5] 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.

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

interest in producing the same quality of meat, to maintain consumers' trust. If consumers perceive a lower than the expected product quality, they will stop to purchase, and the trust will disappear.

[4] 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).

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

describing the potential changes in market structure following the introduction of a label.

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. Note that the increase in concentration is not 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 feel, reciprocally, 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:

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

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.[6] 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 to the unlabeled case. The label is welfare increasing.[7]

However, after full information and the resulting product segmentation, the high quality

[6] 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 $p_2^L = \frac{b_2\left(q_2 - q_1^2 + q_1 q_2\right)}{b_2 + b_2 q_1 - q_1^2 + q_2 + q_1 q_2}$.

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

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

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

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 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 without label both products are considered 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, on the one hand degrades that product, thus depriving the low quality firm from the opportunity to (fraudulently) obtain quality premia, but on the other hand provides that firm with the advantage of softer competition from its rival. Assuming competition to take 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 now to price at marginal cost, both prices 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 $\left(q_e = (1/2)\left(q^L + q^H\right)\right)$; 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).

In what follows, we show how the differentiation effect may be mitigated in markets where sunk costs are required, or in markets where consumers have not the same expectation about the quality in the unlabeled environment. Assume a preliminary stage before price competition in which each firm, 1 or 2, decides whether to enter the market, incurring sunk cost ε upon entry. Without labeling, a non null ε is sufficient for just one firm, say firm 1, to be present in the market.[9] All consumers expect the low-quality q_1 and the resulting price is a monopoly outcome: $p_1^U = \frac{q_1}{2}$.[10] Only consumers characterized by a $\theta > \frac{1}{2}$ consume the good in the unlabeled market.

The introduction of a label enables to the high-quality firm to enter into the market and to earn positive profit, as we saw in the previous section. But in contrast to a market configuration without sunk costs, the label does not relax price competition. The low-quality firm, which without label charged its monopoly price, has to reduce its price. This fall in the price is insufficient to avoid a decline in the low-quality demand: the low θ consumers that enter into the market and consume the low quality do not compensate the high θ consumer that shift to the high quality. The firm 1's profit is reduced and the profit of the industry, noted Π, decreases for high values of q_2. Conversely to a market free of sunk costs, the differentiation effect of label is lacking, the price competition is not relaxed. As a consequence all consumers are better off with label, both the consumers's surplus and the welfare increase (see Table 1). Roe and Sheldon (2007) find similar results in a model where firms compete in prices and in qualities.

Instead of assuming that without label consumers expect the base or an average quality, let us now assume, along with Gabszewicz and Grilo (1992) and Bonroy and Constantatos (2008) that consumers 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

[9] In the absence of label, if more than one firm enters the market, the operating profits of all frims are zero, and no firm can cover its sunk cost ε.

[10] The two stage game supports the monopoly outcome when only one firm enters.

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.[11] 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.[12] While we treat issues of opposition to the

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

[12] 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

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" labels, we consider only labels that reduce every consumer's α. Examine two types of labels, the first providing only basic information about the product in a way that is very easy to grasp (a colored stamp), and the second very detailed information about the product's characteristics. The former will most likely affect "unsophisticated" consumers, 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. In other words, we examine labels that push the beliefs towards the right direction, but may increase or reduce their dispersion. According to the information structure in Bonroy and Constantatos (2008), the first (second) implies a reduction (increase) of the width of Γ. While beneficial for consumers in its effect on the average belief, the sophisticated label may, by increasing differentiation in consumers' perception, reduce competition, and *increase* profits, leaving its overall effect on consumer's welfare 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, focusing on the effects of different labelling regimes on all the actors in the supply chain.

None of the above papers formulates the strategic interaction between upstream suppliers. This point is taken up in Bonroy and Lemarié (2011), where it is analyzed the impact of a label

is contained in section 3.1.

on both the final product market, assumed to be competitive, and the input market, assumed to be a (vertically differentiated) duopoly. 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 of 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 meet 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. 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.

The consumer preference for one type of input, though, cannot be translated into higher returns, unless consumers can identify final-products made by that input. By restoring full information, a label allows consumers to express their preference for inputs, thus i) creating differentiation in the downstream market, which in turn softens price competition in the upstream market (*differentiation effect*), and b) reversing the quality ranking of the input types, which reverses the relative magnitude of input prices (*ranking effect*).[13]

Who benefits and who looses from the label? According to Bonroy and Lemarié (2011) 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 it, but the ranking effect tends to lower it. Concerning profits, the label obviously increases profits in both parts of the high-quality supply chain, but its effect on the profits of the upstream and the downstream firms in the low-quality supply chain are ambiguous, again due to the different workings of the two effects. The detailed impact of each effect is presented in Table 1.

Bonroy and Lemarié (2011) 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

[13] The terms are borrowed by Bonroy and Lemarié (2011).

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?

In analyzing the impact of certification cost, it is necessary to consider that this cost can be either fixed and/or per unit of output. When it does not modify market structure, a fixed certification cost involves a payment with no impact on price or the quantities supplied; as a result, it is only borne by the certified producers. However, when it increases market concentration by reducing the number of labelled firms, the fixed certification cost may harm consumer surplus and also affect the profit of uncertified producers.

The per-unit cost of certification is similar in its effects to a per-unit tax, it, therefore, affects all actors in the market, even if it leaves the market structure unchanged.[14] As shown earlier, the introduction of a costless label in a competitive market marred by information problems produces benefits for both, producers and consumers. Fulton and Giannakas (2004) shows, however, that if the label requires a positive per-unit certification cost, this result may not hold. Since after revelation the price of the high quality increases but by an amount less than the increase in the corresponding cost, the high-quality producers' surplus is reduced. The market of low quality product is also affected by the certification cost, since some producers find it profitable to switch to the production of low quality in order to avoid that cost. The latter's aggregate supply increases, thereby reducing both the price of the low-quality, and the profit of each individual firm. Hence, for high certification cost producers are worse-off with the label, despite any benefits due to improved information. Note that the effects of the certification cost on the low-quality price may be reversed in the presence of market power in the low-quality supply-chain, which may reduce consumers' surplus (see Fulton and Giannakas, 2004).

[14] Crespi and Marette (2001) analyse several certifications fees under both alternative structures of certification costs (fixed and per-unit). They show that a public regulator will, in general, choose the per-unit fee.

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. Assuming 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 decision, the government decides to randomly inspect m firms among those labeled as high quality. 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.[15] 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, 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 Baski 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 effect* exceeds *the incentive effect*).

An industry-specific label usually certifies the quality of all the units produced by an industry after inspecting production premises, production methods, and/or a sample of the firms' output. It is a collective label since it is attributed to all the units of the industry, including some non-

[15] 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).

inspected ones.[16] 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 *industry-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. Unlike the previous case, 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.[17] In such an environment, the fraud damages the collective reputation of the label.

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 effect,* 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-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 effect*). Since under competition the effect of an individual firm's purity on ρ is negligible, the collective reputation effect disappears taking with it the entire market for labelled products. Under monopoly, any impact on sales purity is fully internalized: the adverse selection effect 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 effect dominate the collective reputation effect.

It is interesting to note that imposing a positive per-unit certification cost may *increase* the

[16] 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.

[17] 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.

level of purity in the market.[18] 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 can end up reducing the labeled firm's profit can be 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 the profit of the high quality firm.

Instead of increasing the per-unit certification cost, an increase in purity can also be obtained through the use of monitoring activity and penalties to the firms caught cheating. Since a higher *individual* purity level assures a lower probability of detection for a given firm, the monitoring-punishing system reduces the expected profitability of a disguised product without affecting the cost of producing the true high quality. Thus, on the one hand, the adverse selection effect is softened, and on the other hand, the collective reputation effect is higher than it would have been in the absence of monitoring. Firms have an interest to increase the average purity in the market with in order to reduce expected penalties: the production of true high-quality now serves also to launder fraud.[19] As a result, any given purity level in the high-quality market can be achieved through this system 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, 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

[18] 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.

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

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 (not-for-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.[20] In a more general setting of $n \geq 1$ products of exogenous qualities 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.[21]

If, however, firms can *choose* the quality level of their product, the number and level of labels become of paramount importance, since they affect firms' qualities. At the limit, when the range of qualities becomes continuous, full information is guaranteed only by a continuum of labels. The latter corresponds to full certification of any product's quality, and runs into well-known difficulties: it is very costly and provides information that is difficult for consumers to grasp. Discrete labels at predetermined levels, on the other hand, 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. As a consequence, certification through a limited set of *discrete* labels avoids the difficulties of full certification at the cost of altering firms' quality decisions. When qualities are endogenous, chosen out of a continuum of feasible levels, the choice of label practically corresponds to a softer way of regulating quality levels: 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

[20] Of course, a choice of label oustide this range would provide no help in improving the problem of information.
[21] Potential exit of firms may create some further distortions.

quality implies paying the cost of additional quality without being able to reap the benefit.[22]

The above discussion underlines the importance of determining the number and the level of labels in the market. 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.[23] With endogenous qualities, the optimal level of the label depends on the objective of the regulator. The related literature distinguishes certification by the following types of standard-setting agents according to their objectives: 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.[24]

The first issue we address in this section is the comparison between label levels set by the government and those set by firms. The question reduces to the comparison of the quality chosen by the monopolist and the social planner. 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*.[25] Since for the standard utility function given by equation 1, $\frac{\partial^2 U}{\partial q \partial \theta} = 1 > 0$, assuming such preferences implies that the willingness-to-pay for quality increments is higher for consumers with high θ.

[22] 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).

[23] See Casweel and Anders (2011) for an overview on this topic.

[24] 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 *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.

[25] 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.

This explains the result in Roe and Sheldon (2007) that the producer prefers the label to be conferred at a lower quality level than the one chosen by the social planner.[26]

Somewhat surprisingly, the opposite conclusion is reached in a paper published in the same year and in the same journal, and using an almost similar utility function. In analyzing the required level of purity for a product to be characterized as GMO free, Lapan and Moschini (2007) 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:

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

which is similar to 1, except that now, the market participation constraint is a decreasing function of θ: at any price-quality set, the high θ consumers are more likely to abandon the market. This implies that the utility of high θ consumers from any quality increment must be measured against their no-purchase utility, instead of their utility from buying the low quality. Figure 1 represents two demand functions, $D_1(q_1)$ for the base quality, and $D_2(q_2)$ for a higher quality.

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. From the type of demand-function increase implied by 1 it is obvious that $fbce > abcd$, therefore the social planer is more eager to adopt any given quality increment,

[26] The analysis in Roe and Sheldon (2007) is, of course, more complex than its rudimentary presentation above. Important differences are the use of a utility function à la Shaked and Sutton, and the presence of a lower quality firm (duopoly). Nevertheless, the essence of the result is the same.

setting the label's standard at a higher level than the one the monopolist would choose, as in Roe and Sheldon (2007). The utility function in 6 involves a "demand function" for the no-purchase option, such as line H on the figure.[27] Note that consumers in the $\left[\widehat{\theta}, \overline{\theta}\right]$ segment, no longer participate in the market (see Figure 1). Compared to the previous case, 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. As it turns out, $efbc - efg < abcd + 0kwa$, and the monopolist is more eager to adopt any given quality increment than the social planner, therefore desiting a higher label's standard than the latter, as in Lapan and Moschini (2007).

The comparison between the label's level set by the government and that set by an NGO is rather straightforward. 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. Individual utility is described by the following utility function, a variant of equation 1, where E stands for average quality in the market:

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

Partial internalization of the environmental externality is the usual motivation of such a utility function.[28] Since the NGO usually targets the average quality directly, while the government takes it into account only insofar it affects overall welfare, it is natural to conclude that an NGO always prefers stricter standards.[29] Bottega and Freitas (2009) assumes a monopoly market and compares consumer welfare under the two regimes. 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

[27] 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.

[28] See Cremer and Thisse 1999. The consumer with $\theta = 0$ represents the typical microeconomics-textbook consumer who likes better environment but leaves it to others to take care of. Organic produce is another example: higher quality confers private benefits but the consumer is also sensitive to the environmental consequences of total consumption.

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

a certified high quality.[30] Unless $\underline{q}$ and/or γ are too high, a MQS increases consumer welfare and profits.[31] As it turns out, with the NGO label some consumers–those with "middle-high willingness to pay"–are worse-off.[32] 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 in the presence of label the MQS is set at a lower level. Since the introduction of the MQS improves the lower quality, it, *ceteris paribus,* induces some consumers to switch from high to low quality: despite the low-quality improvement, average quality may deteriorate. The NGO would, therefore, wish the MQS to be as low as possible. As γ increases, the NGO's goal comes closer to that of the social planner, therefore the MQS is set at lower levels.

The existence of three potential standard setters with different preference about the optimal level of the 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, $s_F < s_W < s_{NGO}$, *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. 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 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).

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.[33] After observing the level set by the labelling organization of

[30] 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 Freitas, 2009), the monopolist does not introduce the lower quality (see Larue, Pouliot and Constantatos, 2010).

[31] 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..

[32] See Bottega and Freitas (2009).

[33] In Baron (2011) the NGO is called "the activist", and "resists" to the label for being too lax, tryng to pull

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.[34] 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

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

for the firm, and

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

for the NGO, with $V(.)$ representing the benefit of the NGO at any level of the standard. As it turns out, the equilibrium $(a^*, r^*) \in \mathbb{R}^2_+$, implying that it is optimal 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 of ρ, $\rho^* \in (0,1)$, 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 maximizing profits considering the value of ρ as exogenous. Baron (2011) shows that i) the optimal level $\widehat{s}$ is such that $\rho^*(\widehat{s}) = \frac{\widehat{s} - s_F}{s_{NGO} - \widehat{s}}$, and ii) $s_F < \widehat{s} < \frac{1}{2}(s_F + s_{NGO})$, *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.

In Heyes and Maxwell (2004) the resistance of the industry to a MQS and/or a label is not modelled explicitly, being simply assumed to be an increasing function ψ of the profit reduction due to either measure. It is shown first, that "*the threat of industry resistance leads*

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.

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

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.*"[35] 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.

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 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

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

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)[36], 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

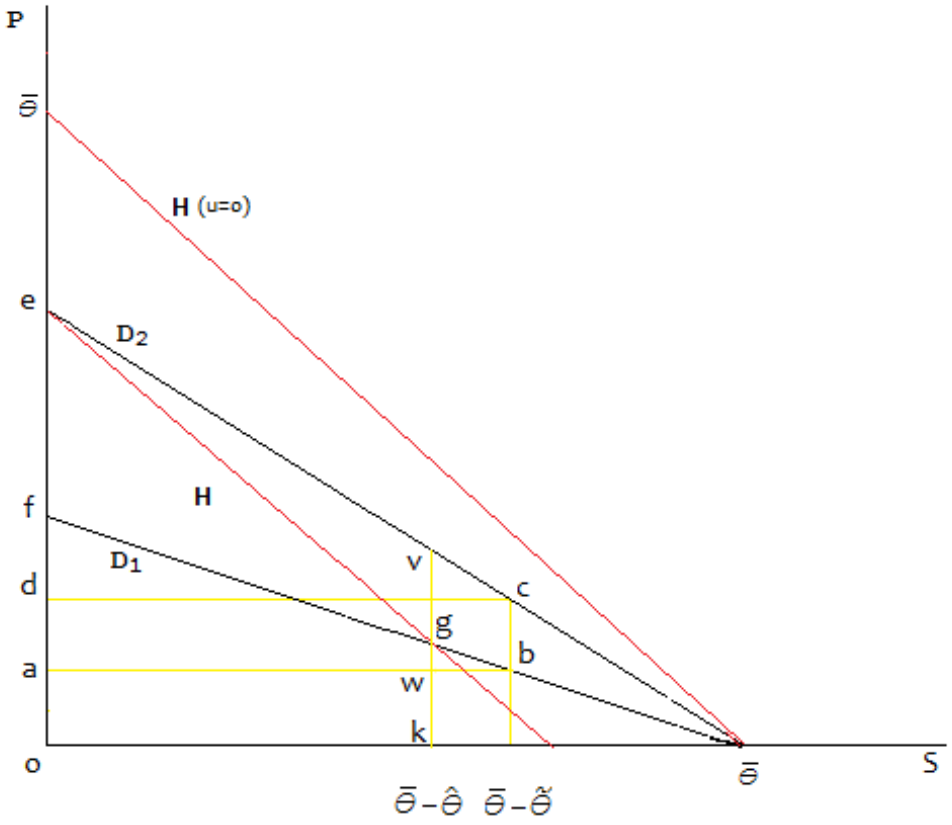
[36] Kiesel and Villas-Boas, 2011, and Berning et *al.*, 2011, use field experiment to study the effect of grocery store nutritionnal labels on the sales of microwave pocorn.

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.

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
Competitive market	+	–	+	–	+	+	+
Duopoly	+	+	+	+	+	–	+
Non-contestable market	n/a	–	+	–	+/–	+	+
Niche market	–	–	–	–	–	+	+
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.+/–	+/–	+

Figure 1:



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., 2011. Downstream labeling and upstream price competition. *European Economic Review*, doi:10.1016/j.euroecorev.2011.10.003.

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.

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.

Casweel 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.

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.

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.

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.

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

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.

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.

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.

Menapace, L., and Moschini, G., 2010. Quality Certification by Geographical Indications, Trademarks and Firm Reputation. Iowa State Working Paper No. 09024.

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

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.

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.