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# Strategies for the development of brands in the agrifood chains

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*Abstract:* This paper develops an original framework to better understand the interaction between the development of brands and the quality of raw materials. We consider different levels of consumer trust for a brand and we examine the incentive for firms to improve the quality of a processed product by requiring that upstream suppliers adopt a private standard. In contrast to previous literature, the incentive for firms to develop a more stringent private standard may increase with the level of the regulated minimum quality standard. Moreover, the creation of a private standard can reduce the risk of consumer dissatisfaction while increasing the marketed quantity. Unexpected positive effects of a reinforcement of the minimum quality standard may arise, in the sense that both market access for upstream producers and consumer surplus are improved and final price may decrease with respect to simply complying with the regulation.

*Keywords*: QUALITY, VERTICAL RELATIONSHIPS, STANDARDS, FOOD

Codes JEL : L1, L15, Q13, Q18

# 1 Introduction

As in any industrial sector, the development of brands by agrifood firms results from the intention to meet consumer demand, while forming the basis of product differentiation from competitors. Moreover, the success of a brand depends both on a specific communication politics towards consumers and on the consumer trust in firm statements about the brand (see for example, the seminal works in the marketing literature since Copeland, 1923).

However, the brand success depends, above all, on the strategic manufacturing decisions, which are made according to the technological possibilities offered to firms. Brand development is thus highly depending on upstream raw material's production conditions, from which the final product results. Therefore, the public regulation, which defines the standards concerning raw material, may be sufficient or, on the contrary, insufficient to facilitate this strategy. Hence, firms might be lead to select only the most effective producers or also to encourage their suppliers to upgrade upstream production conditions, through the creation of a private standard. This input's normalization strategy often corresponds to more or less irreversible investments and procedures (suppliers' selection, contracts' setting, norm's development, product's certification, etc.). It also may influence the firms' short term decisions concerning quantity and price to adapt *in fine* to the evolution of demand and competition environment (see for example, Maurer and Drescher, 1996, Ponssard et al., 2005).

This paper shows how a medium-long term strategic choice about the mode of input procurement influences the short-term strategies, which may be developed by the firm to provide the brand's development. By considering different contexts of consumer trust in the brand, we thus illustrate the reasons why a firm would prefer the reinforcement of the upstream production condition and the conditions such that this strategy is implemented. Moreover, we show that, unlike an accepted idea, this private standard strategy is not necessarily due to a laxity of the authorities in the definition of Minimum Quality Standards (MQS).

Two examples in the agrifood sector may illustrate how the choice of a brand development strategy is strongly affected by both the level of MQS and the communication provided to final consumers:

*i)* The wine represents an emblematic example of brand development in the presence of upstream MQS. In this sector, there exists a great number of MQS that – given the issues of sanitary safety or the respect of the region of origin – mainly concern the vine growers, which produce grapes or wine in bulk and sell it to downstream processing and/or retailing firms. Within the European Union, an important part of production concerns Appellations of Origin and some of the well known regional ones (like Bordeaux in France or Rioja in Spain) stand a lack of brand development to compete on the international market.[1] The influence of the production criteria requested for the Appellations of Origin is often considered in explaining this feature.[2] One of the most frequent arguments, which is based on the increasing trend of brands in the "New World" (for example, E&J Gallo in US or Jakob's Creek in Australia), is that too constraining upstream

[1] According to Mora (2006), for several years now, Bordeaux's vineyards have suffered from what would appear to be an interminable crisis. Some analysts view overproduction as the cause. Others blame the product Bordeaux puts out, decrying its lack of adaptation to new consumer expectations. The author argues that Bordeaux producers do not tend to spontaneously adopt a market orientation. See also ViniPortugal, Monitor Group (2003) for an analysis of the wine sector in Portugal and an illustration of strategies to improve competitiveness towards international markets.

[2] The market access conditions for an Appellation of Origin are often considered as MQS in the sense that the production of a wine outside the Appellation does not give access to the same markets and as far as an Appellation of Origin may represent a pertinent market.

production conditions are dissuasive for improving market strategies. That is the reason why a french firm as Pernod Ricard prefers to invest on a brand development strategy in Australia in order to avoid the too constraining regulations concerning grape production.[3] Nevertheless, some vineyard characterized by a high international notoriety (like Champagne, Porto or Chianti) have been able to maintain a good reputation towards consumers. In these cases, brands are quite developed and a high intermediary price has allowed the upstream producers to comply with relatively highly demanding production conditions[4].

*ii)* In the fresh products sector, a large development of high premium labels by retailers has been observed in the last decade. With respect to the wine sector, described above, one of the main interesting issues of the supply chain management is given by the creation of private standards, which reinforce the MQS. These private standards have been usually defined in response to increasing food safety concerns, namely in the meat sector (for example the "Filière Qualité Carrefour", the "Traditional Beef" of Sainsbury or the "Selected Beef" by Mark and Spencer), but also for fruit and vegetables, fish and seafood or cheese (Fearne, 1998). Specifically after the mad cow crisis, and despite the reinforcement of the MQS (such that the prohibition of using bone meal for livestock feeding), the high premium labels in the meat sector have been largely increased in the EU and have involved an increasing number of upstream producers participating in the brand creation[5]. Developed in periods characterized by a crisis of consumers' trust, these strategies have reinforced the public regulation while surprisingly leading to an improvement of upstream producer market access (see for example O'Brien and Diaz Rodriguez, 2004).

The objective of this paper is to illustrate some of these economic mechanisms associated to the brand development. We propose an economic formalization of the creation of a brand, in a context where the upstream production conditions are normalized. We thus refer to the specific case of the agricultural sector, where the upstream supply is fragmented if compared to the downstream processing and retailing sector. In this model, we consider a downstream firm with a monopolist position towards the final market and a monopsonist position towards the upstream atomized supply. Hence, the potential suppliers are numerous and price-taker in their decision whether to participate in the intermediary market. Upstream producers are differentiated according to their equipments' levels, which in turn determine the quality of their supply from the point of view of the consumers. Thus, the implementation of a MQS or a private standard might lead upstream producers to undertake investments in order to join the intermediary market.

In this context, the downstream firm faces a quality-quantity trade-off. That is, for a given level of quantity supplied on the final market, an increase of the standard concerning the raw materials implies a decrease of the "risk"[6] associated to the processed product, whereas, for a given

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[3] As illustrated by Green et al. (2006), the French group Pernod Ricard has largely invested on the international market, by developing wine brands as Jacob's Creek (Australia), Wyndham Estate (Australia), Etchard (Argentina), Río de la Plata (Argentina), Long Mountain (South Africa). As illustrated by Pomarici et al. (2006) some of the leading Italian wine companies have invested abroad (expecially in US, Argentina and Central-East Europe), see for example the strategy of Antinori with brands like Antica Napa Valley (California), Col Solare (Columbia Valley), Albaclara and Albis (Cile), or developed partnerships with foreign companies (see for example the one between the Italian Frescobaldi and the Robert Mondavi Corporation to create the brand "Luce").

[4] See Grazia (2006) for an illustration of the evolution of production conditions in the Chianti (namely, with the creation of the Appellation of Origin "Chianti Classico" in 1996) and a strong increase in intermediate price corresponding to the production conditions' reinforcement.

[5] The Group Carrefour has launched the first FQC in 1992 (la "Boule Bio"). Today, this strategy concerns 245 supply chains (in France) and 74 products and involves 35.500 producers. About 40% of the products concern the fruit and vegetable sector (Le Journal de Carrefour, 2005). With 200 suppliers in 1994, the production of the FQC fruit and vegetables has reached today a production of about 50.000 tonnes per year (Gaulet, 2000). See also Aragrande et al. (2005) for an analysis of the European quality assurance schemes and implications on supply chain.

[6] In this paper we use the term "risk" to specify the non-compliance of the processed product with respect to an expected quality. This terminology refers to the notion of "credence qualities" (Darby and Karni, 1973), which is important in the agrifood sector, especially when the product normalization concerns the aspects of certification of origin or food safety (see for example, Grunert, 2005 and Loureiro and Umberger, 2007).

level of standard, an increase of quantity increases the risk for the processed product. As a result, the implementation of a private standard is likely to be necessary to avoid the negative effects of a high procurement quantity on the risk. Therefore, firms may have different strategies for brand development, which depends both on the level of MQS and on consumers trust in the brand. Namely, if the trust is relatively high the firm has two options: *i)* choosing to select only some of the initially well-equipped producers, when the MQS is sufficiently low (what we denote by a "*Strict selective strategy*"); *ii)* choosing to select the initially well-equipped producers and also help some producers to upgrade their equipments to comply with the MQS, when this latter is higher (what we denote by "*MQS adaptive strategy*"). However, if the consumers trust is relatively low, and even if the MQS is relatively high, we show the incentive for the firm to have a proactive role and set a private standard more constraining than the current MQS (what we denote by "*MQS reinforcing strategy*"). Hence, we show that, it is not when the MQS is relatively weak that the firms have interest in substituting to the public authority and implementing a private standard. Indeed, the implementation of a private standard leads to a reduction of the risk of consumer dissatisfaction. Hence, the processing firm can benefit from an improvement of consumer willingness to pay and thus increases the marketed quantity of the processed product. We thus show that when the downstream firm has interest in remunerating the upstream producer compliance process, market access may be improved through a reinforcement of the standard. Moreover, consumers may be better off, both in terms of quantity and final price.

We thus provide an original contribution to the existing agricultural economics literature. A large swathe of this literature examines the reasons for the development of private quality and safety standards and the effects of the level of MQS on the incentive for firms to implement private standards. The main idea is that firms will arguably have the greatest incentive to implement private standards where there are missing or inadequate public food safety and/or quality standards; here private standards act as a substitute for missing public institutions (Henson, 2006; Henson and Reardon, 2005). In this spirit, Giraud-Héraud, Rouached and Soler (2006) propose an original model of vertical relationship between producers and retailers which takes into account two supply sources: *i)* a competitive spot market on which the retailers by a MQS product and *ii)* supply contracts aimed at marketing higher quality private labels (PL). The authors take into account the negotiation power-sharing between downstream and upstream firms. It is shown that if the MQS is relatively too high, then retailer will not perceive any benefit in developing the PL. Nevertheless, this literature recognizes that even if public standards are well-developed and afford a high level of food safety and/or quality, there may still be an incentive to implement private standards. Then, the main reason to argument the coexistence of private standards with highly demanding public regulation is given by the necessity for the firms to manage exposure to liability, limit exposure to potential regulatory action and/or anticipate future regulatory developments (Lutz et al., 2000). Despite, we show how the incentive for firms to implement a private standard when public regulation is relatively high may result from the strategic behavior of firms in terms of quality-quantity strategic choices in the context of a vertical relationship.

Another set of contributions deals with the compliance process of firms to a process standard and, more specifically, with the related issue of producers' capacity to comply with it. Thus, the compliance process represents a long term decision and results in more or less high adaptation costs for firms (Henson and Heasman, 1998). Hence, several contributions examine the economic implications of standards using a cost and benefit analysis, which attempts to measure the cost for firms of implementing (food safety) regulations and compare it to the benefits in terms of the reduced food borne illness (see for example Caswell and Kleinschmit, 1997; Antle, 1999; Viscusi, 2006). The main argument is that the more the standard is constraining, the higher is the risk of

firms' exclusion from the market. Hence, it is shown for example, that the compliance with standards may pose a greater burden on small firms, due to the large investments needed (Henson and Caswell, 1999, Unnevehr and Jensen, 1999). Moreover, even if a standard is not mandatory in the legal sense, it could be *de facto* mandatory (Henson, 2006). Hence, when a particular set of products or specifications gains market share such that it acquires authority or influence, the set of specifications is then considered a de facto standard (The Nature's Choice standard of Tesco Stores PLC in the UK, that commands a market share of over 30 percent, is arguably an example). Even if standards promulgated by private entities, unless referenced by regulations, can not be legally mandated, through market transactions such standards may become involuntary in practice; firms have little or no option but to comply if they wish to enter or remain within a particular market. However, the strategic behaviour of the downstream processing or retailing firm, namely the quantity strategy in response to consumer demand, may be positive for producers, even if the standard is reinforced.

# 2 Theoretical background

We consider a vertical relationship between $J$ heterogeneous upstream producers and a downstream firm, which is assumed to have a monopsonist position towards suppliers and monopolist position on the final market. The firm buys $x$ units of input and markets a quantity $y$ of output. Since each of the upstream producers is assumed to offer one unit of the input on the intermediary market, then the firm has to source from different producers in order to obtain $x$ units of input[7]. The compliance with a standard $e_s$ is requested to access to the intermediary market.

## 2.1 Heterogeneity of producer equipments and risk of product failure

Following Giraud-Héraud, Hammoudi and Soler (2006), the upstream producers are differentiated according to their "equipment" level, which is represented by a one-dimensional parameter $e$, assumed to be uniformly distributed on the interval $[0,1]$, according to the density function $f(e) \equiv 1$. Namely, the equipment level $e$ represents the technical level of the farm before the implementation of the standard[8]. Thus, given the initial equipment $e$, an upstream producer who wants to supply the intermediary market must achieve at least the level of equipment $e_s$, which corresponds to the "process standard" in force in the market. We consider that the compliance with the standard, for a producer of type $e$, implies a fixed cost, which is assumed to take a linear form $Max\{0, e_s - e\}$. Namely, the cost of compliance is given by $(e_s - e)$ for a producer, whose level of equipment is lower than the standard and zero otherwise. Hence, given the heterogeneity of upstream supply, this cost function allows to explicitly take into account the heterogeneity of the compliance costs[9].

We interpret the risk of product failure on the final market as the probability that the product does not meet consumer expectations. The risk of product failure is assumed to technically result from the upstream supply characteristics, whereas the downstream is assumed not to influence the

[7] Given the small scale of upstream producers, a downstream firm often has to source its input from a variety of suppliers. This phenomenon is frequently observed in the agrifood sector as shown by empirical evidence (see for example, OCDE, 2007).

[8] The equipment level can be interpreted as the value of the initial infrastructure of a producer (or as the cost associated with the equipment's introduction). The assumption of equipment continuity is a mathematical device for the sake of simplicity, which does not have any influence on the qualitative results of the model.

[9] For an illustration of this heterogeneity in the empirical literature, see for example Kleinwechter and Grethe, 2006.

level of risk[10]. Namely, the heterogeneity and the limited production capacity of suppliers implies that the probability of product success on the final market is altered (and the image of the brand is compromised) by the use of inputs, which do not meet the «ideal» production conditions expected by consumers ($e = 1$). Hence, we consider that the risk associated with each producer of type $e$, is affected by his level of equipment and is given by $\sigma(e)$; where $\sigma(.)$ is a decreasing function of $e$. For the sake of simplicity, we consider that $\sigma(e) = 1 - e$. Hence, the individual risk is maximal when the producer is characterized by the minimum level of equipment; otherwise the risk is zero. Hence, each producer contributes with $(1 - e)$ to the risk of product failure on the final market.

### 2.2 Processed output

The processing stage may concern processing, preserving, conditioning or packing operations. The downstream firm converts the raw material into a finished product according to a fixed-proportions production function. Here, we consider that the downstream firm does not influence, through the processing operations, either the risk or the number of units sold.

We denote by $\tilde{e}$ the threshold of equipment starting from which producers are selected by the downstream firm. Hence, the firm always selects the producers characterized by equipment between $\tilde{e}$ and 1, that is, the best level of equipment. The firm is assumed to buy *x* units of input and convert them into *y* units of finished product, according to the fixed proportion production function $y = T(x)$, where we simply set $T(x) = x$. Hence, the threshold $\tilde{e}$ is given by:

$$\tilde{e} = 1 - \frac{x}{J} \tag{1}$$

Since we consider that each producer always supplies the same quantity (one unit) of product (non-elastic individual supply), the Benchmark situation (when $e_s = 0$) is then defined by the following quantity and risk of product failure:

$$\begin{cases} y = x \\ \sigma = \int_{\tilde{e}}^{1} \sigma(e) f(e) de = \frac{1}{2}\left(\frac{y}{J}\right)^2 \end{cases} \tag{2}$$

Expression (2) represents the quantity bought and sold by the downstream firm and the associated risk of product failure when no MQS is in force. When a MQS is implemented, the initial probability of product failure given by (2) may change if at least one of the producers upgrades his equipment. Thus, the density $f(e)$ will shift to a density $f'(e)$ and change the level of $\sigma$ with respect to (2).

### 2.3 Risk perception and trust in the brand on the final market

Consumers identify the firm's product through the brand. The communication on the product's attributes is provided either by the firm or by third parties (certifiers, consumer guides, etc.). We consider that the effects of this communication on consumer purchase decisions depend on the degree of consumer trust, which in turn affects the level of perceived risk. Let us detail these mechanisms.

Firstly, consumers are assumed to be imperfectly informed about the product's attributes, in the sense that they react to the *perceived* probability of product failure rather than to the actual one.

[10] This assumption is crucial as regards the objectives of this paper. Namely, it makes it possible to isolate the influence that the downstream firm may have on the actual level of risk through its strategic behaviour (namely, short term quantity/price choice), regardless of the influence that the firm may have from a technical point of view.

The concept of risk perception includes all the risks associated with consumer choices at the point-of-purchase. Indeed, as highlighted by McCarthy and Henson (2005), risk perception concerns not only the health (for example fat content) or safety (for example food poisoning) risks associated with the product, but also the chance that the product may not meet taste expectations, money is wasted, a poor meal is served to guest, etc. Hence, this concept relates to the perception of both the probability of product failure and the negative consequences of buying/using a product or service. Consumer perception of the risk may be influenced by perceived product's consistency, interest in cooking, interest in the product, experience and confidence in purchase location (McCarthy and Henson, 2005), health loss, followed by psychological, financial, time and taste losses (Yeung and Yee, 2002). As a consequence, consumers may underestimate or overestimate the risk of product failure, with respect to the actual level of risk.

Secondly, the perceived risk of product failure is assumed to be affected by the degree of trust in the brand. Hence, as highlighted by Delgado-Ballester and Munuera Alemán (2000), trust in a brand can be defined as "a *feeling of security* held by the consumer that the brand will meet his/her consumption expectations". It is noteworthy that the process by which an individual attributes a trust image to the brand is based on his/her *experience* with that brand. Hence, trust will be influenced by the consumer's evaluation of any direct (e.g. trial, usage, satisfaction in the consumption) and indirect contact (advertising, word of mouth, brand reputation) with the brand (Keller, 1993; Krishnan, 1996). Moreover, trust is based on the two general dimensions of brand reliability and brand intentions towards the individual, which involve the role of time. The first dimension is related to the assumption that the brand has the required capacity to respond to the consumer needs, for example, by offering the new products that the consumer may need or by a constant quality level in its offering (Deighton, 1992). The second dimension is concerned with the belief that the latter is not going to take opportunistic advantage of the consumer vulnerability (Michell *et al.*, 1998). Given these premises, we focus on the perceived risk-reducing effect of the brand trust, this latter being interpreted as an exogenous market (demand side) condition[11].

Finally, the level of perceived risk affects the extent to which consumers react to a communication on the product's attributes. In a context of asymmetric information, the main approach taken by consumers to reduce the perceived risk experienced at the point-of-purchase consists in enhancing the probability of product success through the use of "risk relievers", that is "a piece of information that increases the likelihood of product success" (McCarthy and Henson, 2005; Mitchell and McGoldrick, 1996)[12]. These authors show that consumers characterized by the highest level of perceived risk ("sceptic consumers") tend to use more frequently extrinsic risk relievers to decrease the probability of product failure. When risk relievers are given by the information provided either by the firm or by third parties and the perceived risk is determined by the level of trust, *ceteris paribus*, the lower the trust in the brand, the higher the consumer reaction to a communicated decrease of the risk of product failure, in terms of willingness to pay (marginal effect).

Hence, following Polinsky and Rogerson (1983), we consider that in the end market consumers are identical and we denote by $(1-\lambda)\sigma$ each consumer's perception of the actual level of risk of product failure $\sigma$. The parameter $\lambda$ is interpreted as a measure of the extent of consumer

[11] If the level of trust would exclusively depend on the action of the firm, then the firm would choose the highest level of trust, which corresponds to the highest consumer willingness to pay for a given quantity. A different result may arise if the costs associated to the construction of brand trust are considered. Moreover, a further contribution to this analysis may results from the assumption on a level of trust depending on the level of standard in previous periods of time.

[12] See also Mitchell and Greatorex (1990) for an analysis of risk relievers in the UK food market.

trust in the brand, with $\lambda \in [-1,1]$. Hence, the aggregate inverse demand for the product, when the perceived risk is $(1-\lambda)\sigma$, is given by:

$$p_\lambda(\alpha, l, \sigma, x) = \alpha - (1-\lambda)\sigma l - x \quad (3)$$

Following (3), both the information about the likelihood of product's success and the consumer trust affect consumer willingness to pay, for a given level of quantity. Namely, given the mechanisms illustrated above, the lower the degree of trust $\lambda$, the higher the perceived risk of product failure and the stronger the consumer reaction to a communicated decrease of the risk. In equation (3), the parameter $l$ represents the monetary loss for consumers for each unit of the product that fails[13]. We assume that $\alpha$ is sufficiently high, namely $\alpha > J + 2l$ (HP1)[14].

### 2.4 The game

Given the MQS $e_0$ set by the public authority in the long term, we consider the following game.

*Stage I*. The firm chooses the level of private standard $e_1 > e_0$ or $e_1 = e_0$.

*Stage II*. The firm decides the quantity *x* of inputs to purchase (stage I.1). The firm then chooses *N* upstream producers ($N \leq J$) and proposes an intermediary price $\omega$ in order to obtain the quantity $x$ (stage I.2). The *N* producers accept or reject this offer and upgrade their equipment if necessary (stage I.3).

*Stage III*. The firm converts the obtained inputs into a finished product and sells it to the end market.

The game is solved using backward induction. We firstly analyze the firm's short term quantity/price choice, given a standard $e_s$. In this sense, we place the analysis in the context of the traditional literature on MQS which aims at analyzing the effects of MQS on the firm's strategic behaviour (see for example Ronnen, 1991; Crampes and Hollander, 1995; Scarpa, 1998) by considering that the MQS is exogenous, rather than explicitly consider the endogenous choice of a MQS which maximizes social welfare[15]. Hence, we illustrate the effects of the standard on the strategic behaviour of the firm in terms of quantity/price and the related effects on the risk, on the number of upstream producers selected and on consumer surplus.

Turning to the first stage of the game, we then examine the decision of the firm whether to implement or not a private standard which reinforces the MQS set by the public authority. In this sense, we refer to the literature dealing with the analysis of the incentive for firms to implement private standards, according to the level of MQS (see for example, Henson, 2006; Henson and Reardon, 2005). As only one product is sold on the market, only one standard can be operational.

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[13] According to McCarthy and Henson (2005), two dimensions of perceived risk can be distinguished, namely the perceived probability and the importance of loss to the individual.

[14] This first assumption is obtained as follows. The final price given by (3) is positive, for any given level of quantity, if and only if $\alpha > (1-\lambda)\sigma l + x$. Given that *i)* $x \leq J$, *ii)* the risk varies from 0 to 1 and *iii)* the degree of trust is assumed to vary from -1 to 1, the final price is positive for any given level of quantity and in any context of trust considered, if and only if the parameter $\alpha$ is sufficiently high, that is: $\alpha > J + 2l$.

[15] Even if a few contributions consider the endogenous choice of the MQS (see for example, Ecchia and Lambertini, 1997), the choice of the criterion for determining the MQS is a very complex issue. Hence, there exist several criteria for the definition of a MQS, especially in the agricultural sector. In addition to the traditional criteria of maximization of social welfare, other criteria could represent the public authority's concerns, as for example the minimization of the risk, especially in the case of product's safety, or the minimization of upstream producers' exclusion. Following the main swathe of the economic literature on MQS, we thus examine the effects of the level of MQS on the firm's strategic behaviour, on the average quality provided on the market and on the surplus of the other economic agents, without specifying the criterion of choice of the MQS.

Hence, the standard $e_s$ required on the intermediary market may be either a MQS (when $e_1 = e_0$) defined by the public authority or a private standard implemented by the firm (when $e_1 > e_0$).

The paper is organized as follows. In section 3 we analyze the firm quantity/price choice in the short term, given the standard $e_s$. In section 4, we examine the decision of the firm whether to implement or not a private standard which reinforces the MQS set by the public authority.

# 3 Short term effects of the standard on the strategic choice of the firm

In this section, we analyze the short term firm's quantity/price choice and the related effects on the level of risk, upstream producer participation in the market, final price and consumer surplus, when the standard is given by $e_s$.

## 3.1 Producer compliance process with endogenous risk

We denote by $\hat{x} = J(1 - e_s)$ the quantity demanded by the firm, whereby *all* the initially well-equipped producers are selected ($\tilde{e} = e_s$). Using (1), we verify that $\tilde{e} \geq e_s$ if and only if $x \leq \hat{x}$. The quantity choice of the firm (that is, the relative position of the requested quantity $x$ with respect to $\hat{x}$) thus determines the relative position of $\tilde{e}$ with respect to the standard $e_s$. Given that, the firm's quantity choice may result in the following two scenarios, according to whether the firm's short term quantity strategy requires an upgrade of upstream production characteristics or not (we define more precisely these scenarios below).

On the one hand, if the quantity selected by the firm is relatively low, that is $x \leq \hat{x}$ ($\tilde{e} \geq e_s$), then the firm's quantity choice does not affect upstream production characteristics. Namely, if $x < \hat{x}$ ($\tilde{e} > e_s$), then the firm selects only *some* of the initially well-equipped producers, while refusing some initially well-equipped ones, namely those located between $e_s$ and $\tilde{e}$. Hence, when $x \leq \hat{x}$ no selected producer has to modify his equipment in order to supply the intermediary market. As a consequence, the statistical distribution of producer equipment on the interval $[\tilde{e},1]$ is unchanged with respect to $f(e) \equiv 1$.

On the other hand, if the quantity selected by the firm is relatively high, that is $x > \hat{x}$, then the firm's quantity choice affects upstream production characteristics. Namely, the firm *also* involves some initially not well-equipped producers in order to obtain the quantity $x$ ($\tilde{e} < e_s$). As a consequence, the producers, who are initially located between $\tilde{e}$ and $e_s$ have to upgrade their equipment in order to supply the intermediary market. The statistical distribution then changes with respect to $f(e)$ and is given by $f'(e)$:

$$f'(e) = \begin{cases} 0 & \text{if } \tilde{e} \leq e < e_S \\ e_S - \tilde{e} & \text{if } e = e_S \\ 1 & \text{if } e_S < e \leq 1 \end{cases} \qquad (4)$$

We now detail how the firm's strategy influences the risk, depending on whether it requires an upgrading of upstream production characteristics or not. We denote by $\bar{\sigma}(e_s, x)$ the risk for a given level of standard $e_s$ and for a quantity $x$. The equipment distribution depends on the type of strategy chosen by the firm; we denote by $h(e)$ this distribution, where $h(e) = f(e)$ if $x \leq \hat{x}$ and $h(e) = f'(e)$ if $x > \hat{x}$. Using (1) and (4), we then obtain (see section 1 in the Appendix):

$$\bar{\sigma}(e_s, x) = \int_{\tilde{e}}^{1} \sigma(e)h(e)de = \begin{cases} \frac{1}{2}(\frac{x}{J})^2 & if\ x \le \hat{x} \\ (1-e_s)[\frac{x}{J} - \frac{1}{2}(1-e_s)] & if\ x > \hat{x} \end{cases} \quad (5)$$

As illustrated by expression (5), when $x \le \hat{x}$, since the firm does not have any influence on upstream supply characteristics, the risk is not affected by the standard $e_s$. Conversely, when $x > \hat{x}$, then the firm procurement strategy determines an equipment upgrading for the producers who are initially located between $\tilde{e}$ and $e_s$. As a consequence, the level of the standard $e_s$ has an influence on the risk. In both cases illustrated by (5), the risk is an increasing function of the quantity. The reason is that an increase of the quantity requested on the intermediary market implicitly leads to an increase of the number of producers involved and namely to the involvement of more and more under-equipped producers. Hence, the expression (5) illustrates the existence of a quantity-risk trade off in the following sense. Namely, the risk increases in quantity, for a given level of standard $e_s$, whereas it decreases when the standard is reinforced, for a given level of quantity.

### 3.2 Intermediary price

Since we consider that the downstream firm has a monopsonist position towards upstream producers, then it has complete negotiation power in the definition of the intermediary price $\omega$. The firm thus sets the quantity $x$ by anticipating the necessary price in order to obtain this quantity $x$ (see Xia and Sexton, 2004, for the original modelling of this decision process). The analysis is developed by the two following assumption, supported by the empirical evidence so that individual contracts rarely exist in the agrifood sector (see for example, Royer, 1998) and intermediate price is usually negotiated between the retailer and the Producers Organizations and/or the cooperatives and rarely between the processing and/or retailing firm and each of the upstream farmers (see for example, Malorgio and Grazia, 2007, for an analysis of the role of Producers Organizations in the implementation of EurepGap by fruit and vegetables farmers, Kleinwechter and Grethe, 2006).[16]

First, we assume that the intermediary price is the same for all the producers, regardless of their initial level of equipment. Hence, the downstream firm does not have the possibility to discriminate between upstream producers. Note that this assumption is consistent with the absence of individual contracts since with different intermediary prices, each producer would choose the highest price.

Second, if the requested quantity is relatively low, the firm will only select producers whose equipment is better than the standard ($x \le \hat{x}$); otherwise – and given that the production capacity of each producer is limited – the firm will be forced to also source from initially under-equipped producers ($x > \hat{x}$). This assumption is also consistent with the existence of an intermediary organization who can select the producers who want to participate to the collective transaction.

Thus, if $x \le \hat{x}$, the firm anticipates that all the selected producers enter the market without any cost and can obtain the quantity with a zero intermediary price. Conversely, when $x > \hat{x}$, the producers initially located between $\tilde{e}$ and $e_s$ have to invest in better equipment ($\tilde{e} < e_s$). In particular, the producer located in $\tilde{e}$ is the last (less equipped) producer who upgrades his equipment by investing $e_s - \tilde{e}$. Hence, he does not agree to participate in the market if the

[16] We have voluntarily left out the explicit formalization of the intermediation assured by the Producers Organization, with which the downstream firm negotiates (as shown by empirical evidence). Indeed, taking into account this intermediary in the model would not change either the analysis or the qualitative results.

intermediary price is lower than $e_s - \tilde{e}$. In order to obtain the optimal quantity of input, the downstream firm proposes a price so that the less-equipped producer can participate in the market. Thus, using (1), the intermediary price $\omega(e_s, x)$ is given by:

$$\omega(e_s, x) = \begin{cases} 0 & \text{if } x \leq \hat{x} \\ \dfrac{x}{J} - (1 - e_s) & \text{if } x > \hat{x} \end{cases} \tag{6}$$

In the first scenario, whereas all the producers located within the interval $[e_s, 1]$ would agree to enter the intermediary market, the firm exerts at the maximum level its monopsonist power by refusing the producers, whose equipment is lower than $\tilde{e}$ .

Otherwise, if $x > \hat{x}$ then the firm chooses an intermediary price $\omega(e_s, x)$, so that the less equipped producer participates in the market. As a consequence, for a given quantity, the higher the standard, the higher the compliance cost of the less equipped producer, the higher the intermediary price. Moreover, a direct consequence of the absence of price discrimination is the existence of a positive externality for all the producers, whose equipment is higher than $\tilde{e}$ .

### 3.3 Standardization, optimal quantity and effect on the risk

We now characterize the firm's expected profit. For a degree $\lambda$ of consumer trust, the firm's expected profit $\pi_\lambda(e_s, x)$ as a function of the standard $e_s$ and the quantity $x$, is given by:

$$\pi_\lambda(e_s, x) = [\, p_\lambda(\alpha, l, \bar{\sigma}(e_s, x), x) - \omega(e_s, x)]\, x \tag{7}$$

Where the risk $\bar{\sigma}(e_s, x)$ is given by (5), the final price $p_\lambda(\alpha, l, \bar{\sigma}(e_s, x), x)$ is obtained by substituting (5) into (3) and the intermediary price is given by (6).

Hence, the objective of the firm is to maximize the profit, given by (7), according to the quantity $x$. As illustrated by (7), the quantity choice affects the expected profit in different ways. On the one hand, the lower is the quantity, the lower is the intermediary price, for a given level of standard. On the other hand, the lower is the quantity, the higher is the final price. This latter result is given both by a rarity effect (direct effect of quantity on price) and by the risk-reducing (and WTP-increasing) effect of a quantity decrease. The magnitude of this indirect effect of quantity on price depends both on the actual level of risk and on consumer trust.

Using (7), we then maximize the expected profit $\pi_\lambda(e_s, x)$ with respect to the quantity $x$, given the standard $e_s$. For every degree of trust $\lambda$, and given the standard $e_s$, we show that there exist two levels of equipment, $\underline{e}$ and $\bar{e}$, decreasing in $\lambda$, such that the optimal quantity $x^*_\lambda(e_s)$ chosen by the firm is given by (see section 2 in the Appendix for details):

$$x^*_\lambda(e_s) = \begin{cases} J[1 - \underline{e}] & \text{if } e_s \leq \underline{e} \\ J[1 - e_s] & \text{if } \underline{e} \leq e_s \leq \bar{e} \\ J\Psi_\lambda(e_s) & \text{if } e_s \geq \bar{e} \end{cases} \tag{8}$$

Setting:

$$\Psi_{\lambda}(e_s) = \frac{1}{4}\left[\frac{(1-\lambda)l(1-e_s)^2 + 2(\alpha+1-e_s)}{(1-\lambda)l(1-e_s)+(J+1)}\right] \quad (9)$$

We can verify that $\Psi_{\lambda}(\bar{e}) = 1-\bar{e}$ and thus the optimal quantity choice of the firm is continuous in $e_s$. The two levels of equipment, $\underline{e}$ and $\bar{e}$ are two thresholds that identify the relative position of the optimal quantity with respect to $\hat{x}$. In order to examine the firm's strategy in all the possible cases, we place the analysis in a context of the parameters whereby $0 \le \underline{e} < \bar{e} < 1$, by assuming (see details in Appendix) that $\alpha \le 2J$ (HP2). Furthermore, in order to be consistent with (HP1), we pose $J > 2l$ (HP3), which is also consistent with the assumption of price-taker upstream producers.

Starting from the firm's optimal quantity choice, given the level of standard $e_s$, and by comparing it to the quantity $\hat{x} = J(1-e_s)$, we illustrate in Propositions 1-3 the effects of the standard on the optimal quantity choice and the related effects on the risk. Moreover, in the following sections 3.4 and 3.5, we will illustrate the effects of the standard on market access, final price and consumer surplus.

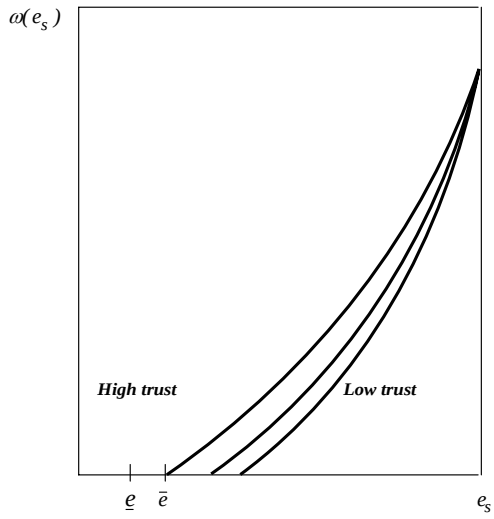
**Proposition 1**

*If the standard is relatively weak ($e_s \le \underline{e}$), the firm selects only some of the initially well-equipped producers and neither quantity nor risk are affected by the level of standard.*

If the level of standard is relatively low ($e_s \le \underline{e}$), the firm chooses a relatively low quantity ($x < \hat{x}$), which does not require involving initially not well-equipped producers. Since the firm selects only some of the initially well-equipped producers, no equipment upgrading is needed for the selected producers to participate in the market. Let us consider Figure 1, which represents the intermediary price as a function of the level of standard[17]. As shown by Figure 1, when no fixed cost is required for the selected producers to enter the market, the intermediary price is fixed at zero. Let us consider Figures 2 and 3, which represent the effect of a standard's reinforcement on the supplied quantity and on the actual level of risk, respectively. As shown by these two Figures, neither the optimal quantity nor the risk are affected by an improvement of the standard, if this latter remains lower than the threshold $\underline{e}$. Hence, the firm is not constrained in its procurement strategy with respect to the Benchmark. As a consequence, quantity and price are set as in the Benchmark, as illustrated by Figures 2 and 4, this latter representing the effects of the standard on the final price.

**Figure 1** – *Effect of the standard on the intermediary price according to the degree of consumer trust*

[17] The Figures 1-5 represent the mechanisms behind each proposition; simulations have been made according to values of the parameters ($J, \alpha, l, \lambda$) which are consistent with (HP1)-(HP3).




**Proposition 2**

*If the standard is moderate ($\underline{e} \le e_S \le \bar{e}$), the firm selects all the initially well-equipped producers and both quantity and risk are decreasing in the level of standard.*

An intermediate level of standard ($\underline{e} \le e_S \le \bar{e}$) does not affect the upstream equipment levels. Indeed, the firm selects *all* the initially well-equipped producers ($\tilde{e} = e_S$) and does not pay them any remuneration. In this context, quantity is reduced with respect to the previous situation and decreases in the standard. The firm voluntary constraints the quantity, with respect to $x(\underline{e})$. As long as $e_S \le \underline{e}$, the firm is not constrained in its quantity strategy, with respect to the Benchmark (see Proposition 1). When the level of standard rises above the threshold $\underline{e}$, the firm should switch to an *EA* strategy in order to maintain the quantity $x(\underline{e})$, i.e. it should remunerate the equipment upgrading of the initially not well-equipped producers. Hence, the firm prefers to reduce the supplied quantity (with respect to $x(\underline{e})$), regardless of the degree of trust, in order to increase the final price both through a rarity effect and a risk-reducing effect (i.e. WTP-increasing effect) of the quantity decrease. As a consequence, the risk of product failure decreases, as shown by Figure 3, and the final price increases, as shown by Figure 4, with respect to $\underline{e}$.

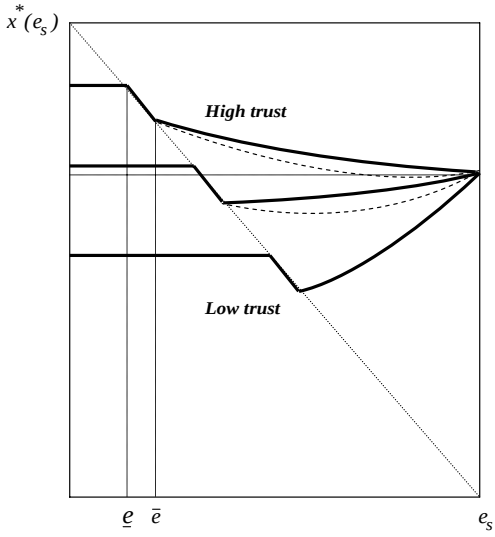


***Figure 2*** *- Effects of the standard on the firm's quantity choice, according to the level of consumer trust in the brand*

The firm then continues to select a number of producers so that $\tilde{e} = e_S$ (and $x = \hat{x}$), until the standard remains lower than $\bar{e}$. Within this context, the quantity thus decreases in the standard; as a consequence, the risk-reducing (and the WTP increasing) effect of the standard's improvement is reinforced. Hence, the risk is always decreasing within this context and the final price is always increasing as long as $\underline{e} \leq e_S \leq \bar{e}$, as shown by Figure 2 and Figure 4 respectively.

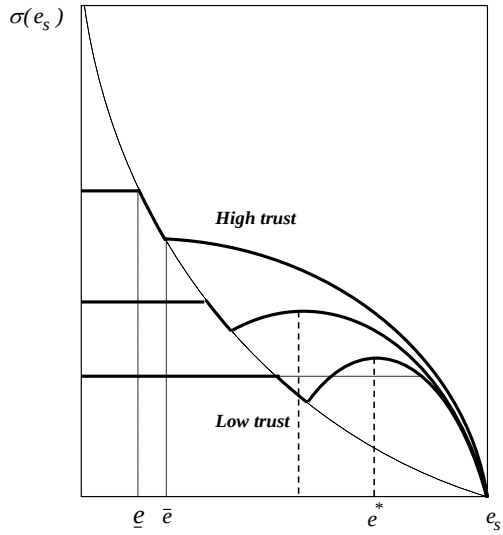



***Figure 3*** *- Effects of the standard on the risk of product failure according to the level of consumer trust in the brand*

**Proposition 3**

*If the standard is relatively strong ($e_S > \bar{e}$), then the firm involves some initially not well-equipped producers. The risk does not necessarily decrease if the standard is reinforced.*

When the level of standard rises above the threshold $\bar{e}$, the firm begins to remunerate the equipment upgrading of the initially not well-equipped producers, but may be interested in increasing or decreasing the quantity (with respect to $x(\bar{e})$) according to the degree of consumer trust.

Namely, two effects arise when the standard is reinforced (within the context $e_S > \bar{e}$), for a given level of quantity. On the one hand, a reinforcement of the standard implies an increase of the intermediary price (and thus an increase of the total procurement cost, for a given quantity). On the other hand, a reinforcement of the standard implies a decrease of the risk, and an improvement of consumer WTP (and thus an increase of the revenue, for a given quantity). The relative importance of these two effects is affected by the degree of trust. Namely, the lower the trust, the higher the risk-decreasing effect of a standard's reinforcement. Moreover, the lower the trust, the higher the WTP-increasing effect of a standard's reinforcement. Finally, since the procurement cost is not depending on the degree of trust, the lower is the trust the higher is the revenue-increasing effect of a standard's reinforcement with respect to the procurement cost-increasing effect. As a consequence, the lower the trust, the more important is the "revenue effect" with respect to the "procurement cost effect" and the firm has interest in increasing the quantity in the standard.

Otherwise, when the second effect is dominant, the firm has interest in decreasing quantity and thus remunerate a decreasing number of upstream producers. Namely, as shown by Figures 2 and 4, when trust is sufficiently high, the firm always has always incentive to decrease quantity in

order to both improve WTP (reinforcing the risk-reducing effect of a standard's reinforcement) and decrease the intermediary price, for any given level of quantity. This behaviour is reinforced in the particular case whereby consumers completely underestimate the risk ($\lambda = +1$). Indeed, the standard no longer affects the WTP. As a consequence, the firm decreases the supplied quantity in order to mitigate the intermediary price-increasing effect of the standard's reinforcement.

The quantity response of the firm to the level of standard directly influences the total risk of product failure on the final market and the final price. Proposition 3 shows how the risk-reducing effect of a standard's reinforcement is affected by the short-term strategic behaviour of the firm (quantity choice). Hence, the actual risk depends not only on the upstream production conditions – from a technical point of view – but also on the strategic behaviour of the downstream firm in the short term. Namely, as illustrated by Proposition 3, a perverse effect associated with a reinforcement of the standard may arise, when the standard is relatively high. Namely, a further *reinforcement* of the standard when $e_s > \bar{e}$ does not necessarily imply a reduction of the risk. In fact, as shown by Figure 3, the risk may have an increasing trait if the standard is reinforced, namely when the degree of trust is relatively low. Indeed, the risk is an increasing function of quantity for a given level of standard and a decreasing function of the standard, for a given level of quantity. As long as the risk-reducing effect of the standard's reinforcement is dominated by the risk-increasing effect of the rise of quantity, the actual risk increases in the standard (see Figure 3). Namely, we show that the risk may increase in the standard (i.e. it has a local maximum on the interval $[\bar{e},1]$), for degrees of trust so that the quantity increases in the standard on this interval (see Appendix for details). Finally, the perverse risk-increasing effect of the standard's reinforcement has two important consequences. First, two different levels of standard may exist whereby the same risk arises. In other words, the same probability of product success may be achieved by implementing the higher of these two levels of standard (which corresponds to the highest level of quantity supplied on the market). Secondly, if the standard is relatively high, the probability of consumer satisfaction is not necessarily improved with respect to the Benchmark[18]. Moreover, for degrees of trust whereby the quantity is always increasing in the standard (and the risk has a local maximum on the considered interval), the final price has a local minimum (see Figure 4). The increase of quantity reduces the final price both through a direct effect and an indirect effect on the risk, which contrasts the positive effect of the standard's reinforcement on consumer WTP. Hence, the final price has an initially decreasing trait when the increase of quantity dominates the WTP-increasing effect of a standard's reinforcement and an increasing trait conversely.

The strategic behaviour of the firm within this context may be compared to the Benchmark. Hence, we show that – as a consequence of the increase of quantity – if the standard is relatively high, then the quantity supplied may be higher than in the Benchmark. Hence, when trust is relatively low, quantity may be higher (and final price lower) than in the Benchmark. Moreover, we show that a relatively high standard may determine a risk reduction and – at the same time – a lower final price (and a higher quantity) with respect to the Benchmark (see Appendix section 4.1 *(i)*). Otherwise, when trust is sufficiently high, a strong regulation always implies a quantity restriction (and an increase of final price) with respect to the Benchmark. When the degree of trust is relatively very high, then a relatively high standard implies a quantity restriction (Figure 2) and an increase of final price (Figures 4) with respect to the Benchmark. Thus, even if risk is reduced, it may be better

[18] The possible quality-reducing effect of a standard has been widely illustrated by the literature on MQS. See for example Scarpa (1998), who shows that if a MQS is introduced in a vertically differentiated market with three firms, then the maximum quality level, the average quality consumed as well as the profit levels of all firms decrease. In this spirit, Maxwell (1998) illustrates that a MQS may reduce firm incentives to innovate – when the innovating firm correctly anticipates that a regulator will raise the minimum standard once an innovation has been discovered – leading to a lower level of social welfare under regulation. Furthermore, the introduction of "innocuous" minimum quality standards, namely below the lowest quality level in a market, may reduce the incentive to invest in R&D by the quality-leading firm (Garella, 2006).

not to regulate from the point of view of consumers, both in terms of quantity and final price (see Appendix section 4.1 *(ii)*). We thus show how the implementation of a standard may reinforce the monopsonistic power of the downstream firm, namely when the degree of trust is relatively high.

### 3.4 Standardization and market access

The firm's quantity reaction to the level of standard directly influences upstream producer participation in the market. Indeed, using (1) and (8)-(9), we verify that, for a given level of standard, the firm's optimal quantity choice $x_{\lambda}^{*}(e_s)$ determines *de facto* the number of upstream producers involved in the market (see Appendix for details). We denote by $\tilde{e}_{\lambda}(e_s)$ the threshold equipment starting from which upstream producers are selected by the firm, when the level of trust is $\lambda$ and the standard is given by $e_s$. We firstly consider the influence of the degree of trust on upstream producer exclusion, for any given level of standard. The quantity supplied by the firm increases in the degree of trust, for a given level of standard $e_s$, since the revenue increases. As a consequence, relatively high degrees of trust favor the choice of a standard whereby producer supplied quantity (and producer participation) is relatively high. Hence, consumer trust may benefit upstream producers, in terms of number of producers involved. If the standard is relatively low ($e_s \leq \underline{e}$), then the number of participating producers is not affected by the level of standard, as the quantity demanded by the firm is constant in $e_s$. A relatively high reinforcement of the standard implies an increase of upstream producer exclusion from the market, regardless of the degree of consumer trust. As detailed in the previous sections, the firm continues to exert her negotiation power towards upstream producers and to pay them a null remuneration, even if the standard is improved. The increasing exclusion of upstream producers is due to the incentive for the firm to decrease the supplied quantity (as illustrated by Proposition 2).

When the standard is relatively high, the number of participating producers increases in the standard when the degree of trust is relatively low. Hence, surprisingly, a further reinforcement of the MQS may determine an increase in the number of upstream producers involved. This result directly arises from the firm's incentive to increase the quantity. Moreover, since the intermediary price increases in the standard, an unexpected effect of a standard's reinforcement arises, whereby both the remuneration of upstream producers and the number of participating producers may increase if the standard is reinforced. Moreover, the quantity-increasing incentive of the firm implies two important effects in terms of upstream producer exclusion. First, when trust is relatively low, starting from a relatively high level of standard, the participation of upstream producers may be higher than in the Benchmark. Moreover, as detailed above, a strong regulation may determine a food safety improvement and – at the same time – an increase of upstream producer participation with respect to the Benchmark. Secondly, as detailed above, when trust is relatively low, two levels of strong regulation may exist whereby the same level of risk is achieved. Surprisingly, the highest upstream producer participation may be obtained when the most stringent standard is operational on the market (Figure 5).

### 3.5 Standardization, final price and consumer surplus

Let us consider the effect of the standard on the final price and on the consumer surplus. For a given level of standard $e_s$, relatively low degrees of trust imply lower levels of quantity (Figure 3) and higher levels of final price. Nevertheless, the lower is the trust, the higher is the incentive for the firm to increase quantity in the level of standard. As a consequence, a relatively strong level of standard ($e_s > \bar{e}$) does not necessarily imply a higher price, with respect to a weaker one ($e_s \leq \underline{e}$).

Hence, a strong level of standard may determine a risk reduction and – at the same time – a lower final price. The higher is the trust, the lower is the incentive for the firm to increase quantity. Indeed, introducing a standard may imply a decrease of quantity and an increase of price with respect to the Benchmark (see Figure 3).

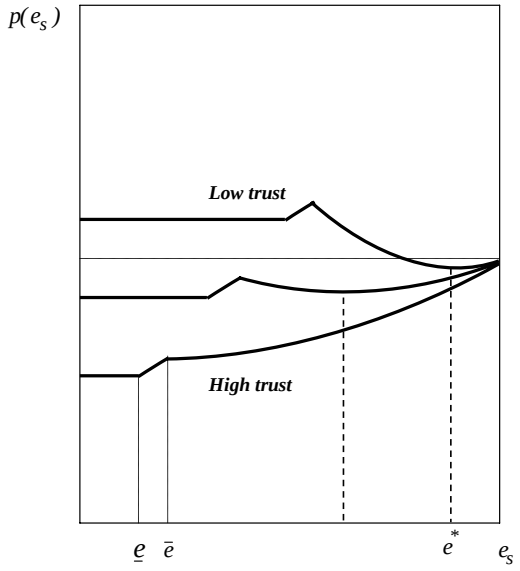



***Figure 4*** *- Effects of the standard on the final price according to the level of consumer trust in the brand*

Using (8) and (9), we can obtain the consumer surplus $S_\lambda(e_s)$:

$$S_\lambda(e_s)=\begin{cases}\frac{J^2}{2}[1-\underline{e}]^2 & \text{if } e_S\le\underline{e}\\ \frac{J^2}{2}(1-e_S)^2 & \text{if } \underline{e}\le e_S\le\bar{e}\\ \frac{J^2}{2}\Psi^2{}_\lambda(e_S) & \text{if } e_S\ge\bar{e}\end{cases} \tag{10}$$

We can verify that a reinforcement of the standard does not necessarily have a surplus-improving effect. Hence, as the standard is relatively low (that is $e_s \le \underline{e}$), consumer surplus is not affected by the level of standard. A reinforcement of the standard (switching from $e_s \le \underline{e}$ to $\underline{e} \le e_s \le \bar{e}$) always reduces consumer surplus, regardless of the degree of trust, as a consequence of the incentive for the firm to decrease quantity.

If the standard is relatively high ($e_s > \bar{e}$), a further reinforcement of the standard may have a negative effect on consumer surplus, namely when the firm has incentive to decrease the quantity in the level of standard. More precisely, we have shown that the higher is the trust, the higher is the incentive for the firm to decrease quantity as the standard increases. Otherwise, when trust is relatively low, the incentive for the firm to increase quantity as the standard is reinforced (see Proposition 3) results in an increase of consumer surplus. Moreover, we have shown that, when trust is relatively low, for a relatively high level of standard, within the context $e_s > \bar{e}$, quantity may be higher than in the Benchmark. As a result, consumer surplus may be improved, with respect to the Benchmark. Moreover, as detailed in the previous section, consumers may be better-off in terms of final price. Hence, the introduction of a relatively high MQS may have a positive effect in terms

of consumer surplus, namely when consumers willingness to pay is relatively low, but *highly* increasing in the standard, for a given quantity.

# 4 Optimal strategy for the development of brand

In this section we examine the firm's choice of the strategy for the development of the brand. Namely, given the MQS $e_0$ set by the public authority and turning to the stage 1 of the game, we now identify at which conditions the firm has incentive to implement a more stringent private standard. Hence, given the degree of consumers' trust, we determine to which extent the long term strategic choice of the firm is affected by the level of MQS set by the public authority.

The possible strategies that may be selected by the firm are illustrated by the following Definition.

**Definition 1.** A strategy for the development of brand is denoted:
*a)* "*Strict Selective*" strategy, if the firm selects only some of the initially well-equipped producers;
*b)* "*MQS-adaptive*" strategy, if the firm simply complies with the level of MQS set by the public authority;
*c)* "*MQS-reinforcing*" strategy, if the firm reinforces the MQS with a more demanding private standard.

As illustrated by the Definition 1, the firm may select only some of the initially well-equipped producers, being implicitly more demanding than the public authority, but without remunerating an upgrading of upstream supply characteristics. On the other hand, firm may be prompted to support the equipment upgrading of upstream producers, with or without reinforcing the level of MQS. Hence, the firm may simply comply with the level of MQS, by supporting the compliance process of the initially not well-equipped producers through a positive remuneration, or be explicitly more demanding than the public authority by implementing a more stringent private standard. As specified in section 1, as only one product is sold on the market, either the MQS or the private standard may be operational in the market. Hence, if a MQS-reinforcing (MQS-adaptive) strategy is implemented, only the private standard (MQS) is operational.

The firm's decision whether to reinforce the MQS set by the public authority is influenced both by the context of consumer trust and by the level of MQS set by the public authority. Indeed, both of these factors influence the short term quantity/price effects of the long term firm's strategic choice and are thus anticipated by the firm in setting its strategy for the development of the brand. Given the optimal short term quantity/price strategy (illustrated in the previous section), we now detail, the conditions, at which the firm is incentivated to reinforce the level of MQS and the effects of the long term firm's strategic choice on the short term quantity/price decision and on the risk.

**Proposition 4**

*There exists a level of MQS* $\hat{e}_0$*, increasing in* $\lambda$*, such that the firm chooses* $e_1^* > e_0$*, with* $e_1^* = 1$*, if and only if* $e_0 > \hat{e}_0$.

As illustrated by Proposition 4, it is not necessarily when the MQS is relatively weak that the firm has interest in substituting to the public authority and implementing a more stringent private standard. In this sense, we depart from the established idea that private standards generally act as a substitute for missing or inadequate public regulation (Henson, 2006; Henson and Reardon, 2005). We show that this result directly arises from the strategic behaviour of the firm, both towards the intermediary and the final market.

We now detail the mechanisms which determine the firm's long term strategic choice. As illustrated by Proposition 4, the degree of consumer trust plays an important role in the analysis. Namely, the switching level of MQS ($\hat{e}_0$) is an increasing function of the degree of trust. This means that, the lower is the trust, the higher is the incentive for the firm to reinforce the MQS. Given this premise, in the spirit of McCarthy and Henson (2005), we use the following terminology to identify three contexts of consumer trust (and perceived risk) [19]. These contexts are characterized by a significantly different extent to which the firm has incentive to reinforce the MQS with a more stringent private standard. Namely, we show that there exist two levels of consumer trust $\underline{\lambda}$ and $\bar{\lambda}$, with $-1 < \underline{\lambda} < \bar{\lambda} < 1$, such that[20]:

**Definition 2.** Consumers are denoted: *i)* "*Optimists*" if the degree of trust is relatively high ($\lambda > \bar{\lambda}$); *ii)* "*Concerned*" if the degree of trust is intermediate ($\underline{\lambda} < \lambda < \bar{\lambda}$); *iii)* "*Sceptic*" if the degree of trust is relatively low ($\lambda < \underline{\lambda}$).

Following Proposition 4 and Definition 2, we identify the following situations (see section 5 in the Appendix for details):

*i)* If consumers are *Sceptic*, the firm has always interest in reinforcing the MQS ($e_1^* > e_0$) and always sets $e_1^* = 1$;

*ii)* If consumers are *Concerned*, the firm has interest in reinforcing the MQS ($e_1^* > e_0$) only if this latter is sufficiently high ($e_0 > \hat{e}_0$);

*iii)*If consumers are *Optimist*, the firm has never interest in reinforcing the MQS and always sets $e_1^* = e_0$;

Each context of consumer trust is characterized by a different level of perceived risk. Indeed, as detailed in the previous section, lower levels of trust result in higher levels of perceived risk. Moreover, each context is characterized by a different extent to which consumers use extrinsic risk relievers to increase the likelihood of product success and react to a communication on a reduced level of risk. As illustrated by Figure 5 below, the degree of consumer trust strongly influences the extent to which the firm has the incentive to reinforce the MQS.

[19] As shown by McCarthy and Henson (2005), consumers risk perceptions relate not only to concerns about health and safety, but also to the financial, psychological, performance and social consequences of the choices made at the point-of-purchase. Hence, the authors highlight the existence of three segments of consumers that hold considerably different views on the risks associated to the product and differ in their use of alternative risk reduction strategies. Namely, the cluster *Concerned* consumers perceived significantly lower levels of risk across all of the risk facets than the *Sceptics* and significantly greater levels of risk that the *Optimists*. Moreover, it is shown that the *Sceptics* both perceive the highest level of risk and tend to use more frequently extrinsic risk relievers to decrease the probability of product failure. As detailed in section 2, we consider that for a given level of quantity, the lower is the trust in the brand (and the higher is the perceived risk), the higher is the extent to which consumers use extrinsic risk relievers and thus the higher is the consumers reaction to a communication on an increased likelihood of product success.

[20] Here, we place the analysis in a context of parameter such that the three contexts of trust arise. Since we consider a level of trust which varies from -1 to 1 and given the assumptions HP1, HP2 and HP3, we then assume that the monetary loss is sufficiently high, so that the condition $\underline{\lambda} > -1$ is always verified (see Appendix for details).

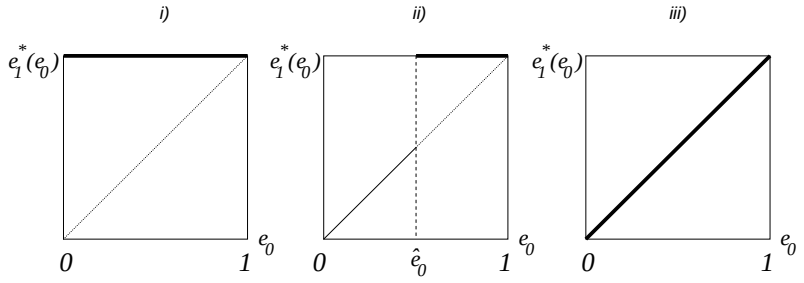



***Figure 5*** *- effect of the MQS on firm's incentive to implement an "MQS-reinforcing" strategy*

Before detailing the mechanisms, which characterize each context of trust, we identify the short term quantity/price and quality effects of the long term strategic choice of the firm, which are taken into account in its decision whether to reinforce or not the MQS. The following Proposition highlights the effects of the "MQS-reinforcing strategy" on quantity, risk, final price, consumer surplus and upstream producer market access.

**Proposition 5**

*At the conditions such that the firm implements a "MQS-reinforcing strategy", then both the likelihood of product success and the quantity are improved, with respect to simply complying with the MQS.*

*As a result, both consumer surplus and the number of upstream producers increase.*

*Moreover, the "MQS-reinforcing strategy" may result in a lower final price, provided that both the level of MQS and the degree of trust are sufficiently low, within the context of Sceptic consumers.*

As detailed in Proposition 5, we show that, at the conditions such that the firm has incentive to implement a more stringent private standard ($e_1^* > e_0$), then *both quantity and quality are improved*, with respect to simply complying with the MQS. Hence, we highlight two unexpected effects of the strategic behaviour of the firm on the other economic agents. First, consumers are better off, both in terms of quantity and risk of product failure. Second, market access of upstream producers is improved, since the quantity improvement implicitly leads to an increase in the number of upstream producers involved. With respect the latter result, we thus show that it is not necessarily when the standard is highly constraining that upstream producer market access is compromised. As highlighted in the literature, the compliance process of firms to standards results in more or less high adaptation costs for firms (Henson and Heasman, 1998) and may thus pose a greater burden on small firms, due to the large investments needed (Henson and Caswell, 1999, Unnevehr and Jensen, 1999). Moreover, it is argued that, even if a standard is not mandatory in the legal sense, it could be de facto mandatory (Henson, 2006) and firms have little or no option but to comply if they wish to enter or remain within a particular market. Departing from these results, we show that, when the downstream firm has interest in remunerating the upstream producers' adaptation effort, market access may be improved through a reinforcement of the standard[21].

Given Propositions 4 and 5 and Definition 2, we now detail the strategic behaviour of the firm in each context of consumer trust and the related effects on both consumers and upstream

[21] In this context, we consider that the cost for the firm to implement a private standard, more stringent than the MQS, is represented by the intermediary price that the firm pays to upstream producers to support the compliance process of the initially not well-equipped ones. Hence, the level of intermediary price the firm has to pay to support the upstream producer adaptation to the standard is anticipated by the firm in her decision whether to simply select upstream initially well-equipped producers or support an upgrading of upstream supply characteristics. Here, we do not consider other costs associated to the processing stage or to the certification and quality control procedures concerning the development of the brand.

producers. The strategic choice of the firm, as a function of both the level of MQS and the context of trust, is represented in Figure 6.

*i) Sceptic consumers: the firm has always interest in reinforcing the MQS*

If consumers are *Sceptic*, the firm has always interest in implementing a "MQS-reinforcing" strategy and substitutes a more demanding private standard to the public regulation (see Figure 4). Hence, only the private standard is operational in the market. Hence, the firm anticipates that, by implementing the most demanding standard, the level of risk will be minimized at zero and thus consumer WTP will achieve its highest level $\alpha$, for any given quantity. This means that the same "ideal situation" occurs as if consumer trust were maximal. When consumers are *Sceptic*, the firm anticipates that both the risk-reducing effect of a standard's reinforcement and the revenue-increasing effect of the standard's reinforcement, with respect to the cost-increasing effect, will be relatively high. Hence, firm has always incentive to reinforce the MQS in order to increase quantity (with respect to the quantity supplied under MQS). Are illustrated by Proposition 5, the "MQS-reinforcing" strategy, may imply not only an increase of quantity, but also a decrease of the final price (with respect to the final price under MQS), provided that trust is relatively low within this context and/or the MQS is not too high (see Proof in the Appendix). Hence, the effect of the "MQS-reinforcing" strategy on the final price depends on the extent to which quantity is increased (with respect to the quantity supplied under MQS). Namely, the stronger is the increase of quantity, the stronger is the decrease of final price. Finally, as a result of the quantity improvement, both the number of upstream producers involved and the consumer surplus increase. Moreover, consumers may be better off in terms of final price.

*ii) Concerned consumers: the firm reinforces the MQS only if this latter is sufficiently high*

If consumers are *Concerned*, the firm has interest in implementing a more stringent private standard only when the MQS is sufficiently high. Hence, starting from the switching MQS $\hat{e}_0$ (see Proposition 4), the firm begins to neglect the level of MQS and chooses the "MQS-reinforcing" strategy. As shown by Figure 4 if no MQS were in force, the firm would choose a "Strict-selective" strategy in order not remunerate upstream producer compliance process. If a relatively low MQS is introduced ($e_0 < \hat{e}_0$), the firm may implement either a "Strict-selective" strategy or a "MQS-adaptive" strategy, depending on the level of MQS. Namely, the lower is the trust, the lower is the switching MQS. When the level of MQS rises above $\hat{e}_0$, the firm reinforces the MQS. Highly constrained in its procurement strategy, the firm reinforces the MQS by implementing the risk-minimizing standard in order to increase quantity. Nevertheless, with respect to the case *i)*, the reinforcement of the MQS always implies a higher final price, with respect to the price under the switching MQS. For the reasons detailed in the previous case, since the degree of trust is not sufficiently low, the incentive for the firm to increase quantity is slighter and thus final price increases. As a result of the quantity improvement, both the number of upstream producers involved and the consumer surplus increase. Nevertheless, consumers are always worse off in terms of final price.

*iii)Optimist consumers: the firm has never interest in reinforcing the MQS*

If consumers are *Optimists*, the firm has never interest in implementing a "MQS-reinforcing" strategy. Hence, the firm's long term strategic choice is always influenced by the level MQS. Namely, if the MQS is relatively weak, the firm is not constrained in its strategic choice with respect to the Benchmark and chooses a "Strict-selective" strategy (see Proposition 1). For a moderate level of MQS, the firm maintains the "Strict-selective" strategy by decreasing quantity and increasing final price with respect to the Benchmark (see Proposition 2). As illustrated in

Proposition 3, for a relatively strong MQS, the firm begins to remunerate upstream producers, thus reducing its monopsonistic power towards the intermediary market. Nevertheless, when consumers are *Optimist* – for the reasons detailed above – the firm prefers to decrease the quantity, as the MQS is reinforced, in order to both reduce the procurement cost and increase final price, both through the "rarity effect" and the "risk effect". Finally, if no MQS were in force, the firm would choose not to implement any standard, in order to minimize cost and would supply a relatively high quantity at a relatively low price. Therefore, with respect to the Benchmark, both upstream producers and consumers would be worse off if a MQS were introduced.

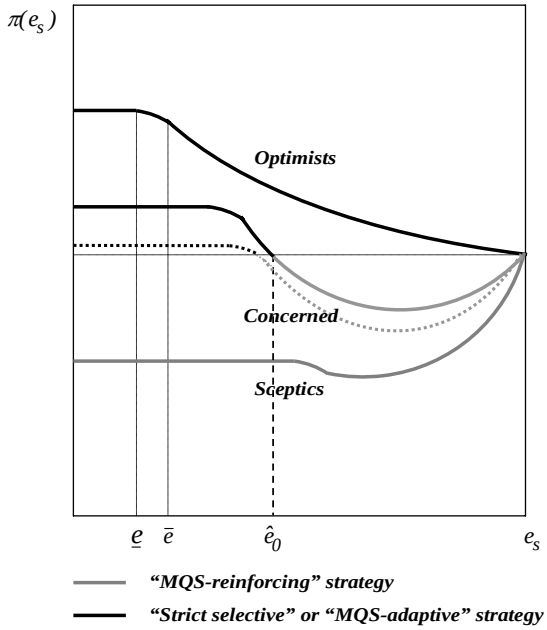



***Figure 6*** *- firms' strategic choice for the development of brand according to the context of consumer trust*

We now consider the compatibility between the strategic choice of the firm and the interests of consumers and examine how the public authority may anticipate the strategic behaviour of the firm by choosing a MQS, which maximizes consumer surplus (see Appendix for details).

**Proposition 6**

*A level of MQS such that the firm chooses a "MQS-reinforcing strategy" is implemented in the interest of consumers, provided that their willingness to pay is sufficiently low.*

Consumers have two opposite preferences. They prefer either the most demanding standard $e_s^* = 1$ when trust is relatively low ( $\lambda < \tilde{\lambda}$ ) or the absence of standard $e_s^* = 0$ when trust is relatively high ( $\lambda > \tilde{\lambda}$ ) (see Proof in the Appendix). Hence, consumers do not have "intermediate" preferences, since both $e_s = 0$ and $e_s = 1$ have own virtues. Namely, the higher is the trust, the more consumers are better off in the absence of standard, since a relatively high quantity (at a relatively low price) is supplied on the market. Otherwise, the lower is the trust, the more consumers prefer the most demanding standard, which minimize the level of risk.

When consumers are *Sceptic*, then consumer surplus is maximized when the most demanding standard is implemented and risk is minimized at zero. As detailed above, in this context the firm always implements a "MQS-reinforcing" strategy and supplies a higher quantity than in the benchmark. Hence, regardless of the level of MQS, the strategic choice of the firm always meets consumer requirements.

When consumers are *Concerned,* two situations may arise. When trust is relatively low within this context, consumers are better off when the most demanding standard is implemented, *but* the firm chooses the most demanding standard $e_1^* = 1$, only if the MQS is sufficiently high ($e_0 > \hat{e}_0$). Hence, a relatively high MQS set by the public authority ($e_0 > \hat{e}_0$) is necessary so that the firm meet consumer requirements. Hence, if no MQS were in force, the firm would choose a "Strict-selective" strategy, by reducing the quantity with respect to the "MQS-reinforcing" strategy. Thus, in this case, by implementing a MQS higher than the switching level $\hat{e}_0$, the public authority constraints the firm's strategic behaviour and maximizes consumer surplus. When trust is relatively high within the context of *Concerned* consumers, consumers are better off when the less demanding standard is implemented, *but* the firm may choose the most demanding standard $e_1^* = 1$, namely if the MQS is sufficiently high ($e_0 > \hat{e}_0$). Hence, if no MQS were in force, the firm would choose a "Strict-selective" strategy and meet consumer requirements. Thus, in this case, by implementing a MQS higher than the switching level $\hat{e}_0$, the public authority would both constraint the firm's strategic behaviour and reduce consumer surplus. Hence, in this case it is better not to regulate, rather than implementing a MQS.

When consumers are *Optimist*, then they are better off when no standard is implemented. As detailed above, in absence of public regulation, the firm does not implement any standard and supplies a relatively high quantity at a relatively low price. Hence, the strategic behaviour of the firm meets consumer interests. Nevertheless, the introduction of a MQS may incentive the firm to reduce quantity and increase final price and thus consumers would be worse off. Hence, in this case it is better not to regulate, rather than implementing a MQS.

Finally, when consumers trust (and willingness to pay for a given quantity) is relatively low, the introduction of a relatively high MQS increases consumer surplus. Otherwise, if consumer willingness to pay for a given quantity is relatively high, it is better not to regulate quality and thus preserve the firm's strategic flexibility in order to meet consumer requirements. As illustrated by Proposition 6, when consumer trust is relatively low (and thus consumer willingness to pay is relatively low), the introduction of a relatively high MQS increases consumer surplus. Otherwise, the introduction of a MQS may decrease consumer surplus, namely when consumers willingness to pay for a given quantity is relatively high. This result departs from the traditional literature on MQS. Many contributions show that the introduction of the MQS may lead to a decrease of consumer surplus for the consumers characterized by the lowest willingness to pay. In a model of multi-product monopolist with continuous array of quality levels, Besanko et al. (1987) show that some consumers might no longer purchase the product as a result of the MQS policy, because the introduction of the MQS may lead to an increase in price and a reduction in variety. In a competitive context, Cramps and Hollander (1995) show that when the cost of quality are variable costs and firms compete in price, for intermediate levels of the standard, consumers with the little appreciation of quality will lose. Valletti (2000) shows that, in a duopolistic market with Cournot competition, the consumers with the lowest willingness to pay are excluded from the market. In our analysis, it is when consumer willingness to pay is relatively low that consumers may be better off as a relatively high MQS is introduced. This result directly arises from the strategic behaviour of the firm with respect to the level of MQS. Hence, when this latter is sufficiently high, the firm has interest in reinforcing it supplies a higher level of quantity than in the benchmark, provided that trust (and willingness to pay for a given quantity) is relatively low (see the case *ii)* detailed above). Hence, the result illustrated in Proposition 6 directly arises from the incentive of the firm to increase the quantity.

# 5 Final remarks

Our paper provides an original contribution as we explicitly consider how both public and private policies are affected by consumers' information about the average quality provided on the market.

We have studied the incentive for the firm to develop private standards, more constraining that the minimum quality standard set by the public authority, in a context where product's attributes are signalled to consumers (either by the firm or by third parties) through a communication based on the product's average quality. We have shown that when consumers' trust is relatively low and even if the MQS is relatively high, the firm has interest in developing a more constraining private standard, in order to benefit from a demand's improvement and increase the supplied quantity. In addition, empirical evidence shows an increasing use of global business to business (B2B) standards in procurement from suppliers and as a governance tool in the food system, which are not communicated directly to consumers. In general, investments in quality or quality control mechanisms are seen as a way to build consumer trust and increase the value of a firm's reputation, once signalled to consumers. But why do firms exceed the legal MQS, when quality signals are not transmitted to consumers, such as use of EurepGap, or GFSI standards? Some reasons may be put forward. At first, providing consumers with products that meet consistent quality and safety standards that go beyond the minimum requirements builds reputation, the key asset for current and future earnings flows (Fulponi, 2006). Secondly, major processors and retailers implement private standards as instruments for the coordination of supply chains by standardizing product requirements over suppliers (Henson and Reardon, 2005). This becomes of greater importance as supply chains become more global and cut across differing regulatory, economic and regulatory environments. Private standards may thus be implemented in order to reduce the transaction costs and risks associated with procurement. Thirdly, firms may be prompted to develop private standards in order to limit exposure to potential regulatory action and/or anticipate future regulatory developments (Lutz et al., 2000) and manage exposure to liability. Our analysis could thus be extended by considering that the public authority jointly uses ex-ante regulation (MQS) and ex-post liability rules. The existence of an expected sanction associated with product's failure and the consequently risk of market share erosion in the long term is thus likely to incentive firms to implement private standards, even if they are not signalled to consumers (Fulponi, 2006, Henson, 2006).

Moreover, in this paper we explicitly takes into account the dimension of vertical relationships, by considering that the MQS is applied to the upstream firms, whereas the downstream firm maintains the strategic flexibility to choose both quantity and quality, given that the upstream supply complies with the MQS. Hence, empirical evidence shows that MQS often concern intermediate products[22]. In a context where the risk arises both from the upstream production conditions and from the strategic behaviour of the downstream firm, the MQS may have different effects whether it is applied to the upstream suppliers or to the downstream firm. This extends our analysis in the larger debate about the optimal public policy between "obligation of means" and "obligation of results". In the latter case, the MQS is applied to the downstream firm, which is thus constrained in the quality-quantity choice by a level of average quality fixed by the public authority. The question raised is thus whether the firm has interest in developing a private standard and which are the effects of the different policy instruments on social welfare.

[22] To the best of our knowledge, the existing literature of minimum quality standards does not take into account the dimension of vertical relationships and almost uniquely deals with MQS concerning final products markets: obligation for a car producer to install airbags, safety standards for pharmaceutical products (Boom, 1995), service quality in the market of local cable television subscription (Besanko et al., 1987) or licensing standards for medical services (Leland, 1979).

## Appendix

### 1.Producer compliance process with endogenous risk

We first determine the risk $\bar{\sigma}(e_s,\tilde{e})$ as a function of the threshold equipment $\tilde{e}$, given the standard $e_s$:

$$\bar{\sigma}(e_s,\tilde{e}) = \int_{\tilde{e}}^{1} \sigma(e)h(e)de \tag{A1}$$

If $x \le \hat{x}$ $(\tilde{e} \ge e_s)$, then the statistical distribution of the producer equipments on the interval $[\tilde{e},1]$ is given by $h(e) = f(e)$, with $f(e) \equiv 1$. Then, the risk $\bar{\sigma}(e_s,\tilde{e})$ is given by:

$$\bar{\sigma}(\tilde{e}) = \int_{\tilde{e}}^{1} \sigma(e)f(e)de = \frac{(1-\tilde{e})^2}{2} \tag{A2}$$

If $x > \hat{x}$ $(\tilde{e} < e_s)$, then the statistical distribution of the producer equipments on the interval $[\tilde{e},1]$ is no longer uniform and is given by $h(e) = f'(e)$, where $f'(e)$ is given by (4). Then using (1), the risk $\bar{\sigma}(e_s,\tilde{e})$ is given by:

$$\bar{\sigma}(e_s,\tilde{e}) = \int_{\tilde{e}}^{1} \sigma(e)f'(e)de = \frac{1}{2}(1-e_s)(1+e_s-2\tilde{e}) \tag{A3}$$

By substituting (1) in (A2) and (A3), we then obtain the risk $\bar{\sigma}(e_s,x)$ as a function of the quantity $x$, for a given the standard $e_s$, as given by (5).

### 2.Short term quantity strategy

By substituting (3), (5) and (6) into (7), we determine the firm's expected profit $\pi_\lambda(e_s,x)$ as a function of the level of standard $e_s$ and the quantity $x$. We distinguish two cases according to the degree of trust: $\lambda \neq +1$ and $\lambda = +1$.

*Case 1* $\lambda \neq +1$

When the degree of trust is given by $\lambda \neq +1$, the level of standard is $e_s$ and the quantity is $x$, the expected profit $\pi_\lambda(e_s,x)$ is given by:

$$\pi_\lambda(e_s,x) = \begin{cases} -x^3\frac{(1-\lambda)l}{2J^2} - x^2 + \alpha x & \text{if } x \le \hat{x} \\ -x^2\left[\frac{(1-\lambda)l(1-e_s)+(J+1)}{J}\right] + x\left[\frac{(1-\lambda)l(1-e_s)^2 + 2(\alpha+1-e_s)}{2}\right] & \text{if } x \ge \hat{x} \end{cases} \tag{A4}$$

Given $e_s$, the firm chooses the quantity $x$ according to the following maximization problem: $\underset{x}{Max}\,\pi_\lambda(e_s,x)$. Using (A4), we then obtain:

$$\frac{\partial \pi_{\lambda}(e_s,x)}{\partial x}=\begin{cases}-3x^2\dfrac{(1-\lambda)l}{2J^2}-2x+\alpha & \text{if } x\le \hat{x}\\ -2x[\dfrac{(1-\lambda)l(1-e_s)+(J+1)}{J}]+[\dfrac{(1-\lambda)l(1-e_s)^2+2(\alpha+1-e_s)}{2}] & \text{if } x\ge \hat{x}\end{cases} \tag{A5}$$

We verify that the function $\pi_{\lambda}(e_s,x)$ is continuous in $\hat{x}$, with $\hat{x}=J(1-e_s)$, and has two local maxima. Using (A5), we determine the optimal quantity chosen by the firm as a function of the standard $e_s$.

If $x\le\hat{x}$, the optimal quantity $\bar{x}_{\lambda}$ chosen by the firm is given by :

$$\bar{x}_{\lambda}=\frac{\sqrt{(2J^2)^2+6J^2\alpha(1-\lambda)l}-(2J^2)}{3(1-\lambda)l} \tag{A6}$$

If $x\ge\hat{x}$, the optimal quantity $\breve{x}_{\lambda}(e_s)$ chosen by the firm is given by :

$$\breve{x}_{\lambda}(e_s)=\frac{J}{4}[\frac{(1-\lambda)l(1-e_s)^2+2(\alpha+1-e_s)}{(1-\lambda)l(1-e_s)+(J+1)}] \tag{A7}$$

Using (A7), we pose:

$$\Psi_{\lambda}(e_s)=\frac{1}{4}[\frac{(1-\lambda)l(1-e_s)^2+2(\alpha+1-e_s)}{(1-\lambda)l(1-e_s)+(J+1)}] \tag{A8}$$

Using (A7) and (A8), the optimal quantity $\breve{x}_{\lambda}(e_s)$ chosen by the firm is given by:

$$\breve{x}_{\lambda}(e_s)=J\Psi_{\lambda}(e_s) \tag{A9}$$

Using (A6) we verify ex-post that $\bar{x}_{\lambda}\le\hat{x}$ if and only if $e_s\le\underline{e}$ and using (A8) and (A9), we verify ex-post that $\breve{x}_{\lambda}(e_s)\ge\hat{x}$ if and only if $e_s\ge\bar{e}$, with $\underline{e}$ and $\bar{e}$ respectively given by :

$$\begin{cases}\underline{e}=1-\dfrac{[\sqrt{(2J^2)^2+6J^2\alpha(1-\lambda)l}-(2J^2)}{3J(1-\lambda)l}\\ \bar{e}=1-\dfrac{[\sqrt{(2J^2+J)^2+6J^2\alpha(1-\lambda)l}-(2J^2+J)}{3J(1-\lambda)l}\end{cases} \tag{A10}$$

We can verify that $\underline{e}<\bar{e}$. If $\underline{e}\le e_s\le\bar{e}$ then we have $\bar{x}_{\lambda}\ge\hat{x}$ and $\breve{x}_{\lambda}(e_s)\le\hat{x}$ and the optimal quantity is given by $\hat{x}$.

*Case 2* $\lambda=+1$

When the degree of trust is $\lambda=+1$, the level of standard is $e_s$ and the quantity is $x$, the expected profit $\pi_{\lambda}(e_s,x)$ is given by:

$$\pi_1(e_s,x)=\begin{cases}-x^2+\alpha x & \text{if } x\le\hat{x}\\ -x^2\dfrac{(J+1)}{J}+x(\alpha+1-e_s) & \text{if } x\ge\hat{x}\end{cases} \tag{A11}$$

We verify that the function $\pi_1(e_s,x)$ is continuous in $\hat{x}$ and has two local maxima.

If $x \le \hat{x}$, the optimal quantity $\bar{x}_1$ chosen by the firm is given by :

$$\bar{x}_1 = \frac{\alpha}{2} \tag{A12}$$

If $x \ge \hat{x}$, the optimal quantity $\breve{x}_1(e_s)$ chosen by the firm is given by :

$$\breve{x}_1(e_s) = J\Psi_1(e_s) \tag{A13}$$

where $\Psi_1(e_s)$ is obtained by substituting $\lambda = +1$ into (A8).

Using (A12) we verify that $\bar{x}_1 \le \hat{x}$ if and only if $e_s \le \underline{e}$ and using (A13) and (A8), we verify that $\breve{x}_1(e_s) \ge \hat{x}$ if and only if $e_s \ge \bar{e}$, with $\underline{e}$ and $\bar{e}$ respectively given by :

$$\begin{cases} \underline{e} = 1 - \dfrac{\alpha}{2J} \\ \bar{e} = 1 - \dfrac{\alpha}{(2J+1)} \end{cases} \tag{A14}$$

We verify that $\underline{e} < \bar{e}$. If $\underline{e} \le e_s \le \bar{e}$ then we have $\bar{x}_1 \ge \hat{x}$ and $\breve{x}_1(e_s) \le \hat{x}$ and the optimal quantity is given by $\hat{x}$.

Using (A10) we verify that the thresholds $\underline{e}$ and $\bar{e}$ are decreasing functions of $\alpha$ and $0 \le \underline{e} < \bar{e} < 1$ if and only if $\alpha \le \bar{\alpha}(J,l)$, with $\bar{\alpha}(J,l) = \frac{1}{2}[4J + 3(1-\lambda)l]$. Using (A14), we verify that $0 \le \underline{e} < \bar{e} < 1$ if and only if $\alpha \le 2J$. Then, assuming that $\alpha \le 2J$ (HP2), we have $0 \le \underline{e} < \bar{e} < 1$, for any degree of trust considered ( $\lambda \in [-1;1]$ ).

Using (A6)-(A10) and (A12)-(A14), we finally determine the optimal quantity $x^*_\lambda(e_s)$ given by (8).

**3.Threshold equipment, risk, intermediary price, final price**

We now determine the expressions of the other relevant variables, as functions of the level of standard $e_s$.

By substituting (8)-(9) into (1), we determine the threshold equipment $\tilde{e}_\lambda(e_s)$ :

$$\tilde{e}_\lambda(e_s) = \begin{cases} \underline{e} & \text{if } e_s \le \underline{e} \\ e_s & \text{if } \underline{e} \le e_s \le \bar{e} \\ 1 - \Psi_\lambda(e_s) & \text{if } e_s \ge \bar{e} \end{cases} \tag{A15}$$

By substituting (8)-(9) into (5), we determine the risk $\bar{\sigma}_\lambda(e_s)$ :

$$\bar{\sigma}_\lambda(e_s) = \begin{cases} \dfrac{1}{2}[1-\underline{e}]^2 & \text{if } e_s \le \underline{e} \\ \dfrac{1}{2}(1-e_s)^2 & \text{if } \underline{e} \le e_s \le \bar{e} \\ (1-e_s)[\Psi_\lambda(e_s) - \dfrac{1}{2}(1-e_s)] & \text{if } e_s \ge \bar{e} \end{cases} \tag{A16}$$

By substituting (8)-(9) into (6), we determine the intermediary price $\omega_\lambda(e_s)$ :

$$\omega_\lambda(e_s)=\begin{cases}0 & \text{if } e_S\le\bar{e}\\ \Psi_\lambda(e_S)-(1-e_S) & \text{if } e_S\ge\bar{e}\end{cases} \tag{A17}$$

By using (A17), we verify that the intermediary price $\omega_\lambda(e_s)$ is an increasing function of the standard $e_s$ if $e_s \ge \bar{e}$.

By substituting (8) and (A16) into (3), we determine the final price $p_\lambda(e_s)$:

$$p_\lambda(e_s)=\begin{cases}\alpha-\frac{1}{2}(1-\underline{e})[2J+(1-\underline{e})(1-\lambda)l] & \text{if } e_S\le\underline{e}\\ \alpha-\frac{1}{2}(1-e_S)[2J+(1-e_S)(1-\lambda)l] & \text{if } \underline{e}\le e_S\le\bar{e}\\ \alpha-\frac{1}{2}(1-e_S)(1-\lambda)l[2\Psi_\lambda(e_S)-(1-e_S)]-J\Psi_\lambda(e_S) & \text{if } e_S\ge\bar{e}\end{cases} \tag{A18}$$

**4. Standardization, optimal quantity and effect on the risk**

**Proof of Proposition 1**

By using (8)-(9) and (A16), we easily verify that if $e_s \le \underline{e}$, then the both the optimal quantity and the risk are constant functions of the standard $e_s$.

**Proof of Proposition 2**

By using (8)-(9) and (A16), we easily verify that if $\underline{e} \le e_s \le \bar{e}$, then both the quantity and the risk are decreasing functions of the standard $e_s$. Given Proposition 1, we easily verify that $x(e_s) \le x(\underline{e})$ and $\sigma(e_s) \le \sigma(\underline{e})$ for every level of standard such that if $\underline{e} \le e_s \le \bar{e}$.

**Proof of Proposition 3**

By using (8)-(9) and (A16), we verify that, if $e_s \ge \bar{e}$, then the quantity $x^*_\lambda(e_s)$: *i)* is an increasing function of $e_s$ if and only if $\lambda < 1-[\frac{2(J+1)}{\alpha l}+\frac{1}{2\alpha l}]$; *ii)* has a local minimum on the interval $[\bar{e},1]$ if and only if $1-[\frac{2(J+1)}{\alpha l}+\frac{1}{2\alpha l}] < \lambda < 1-\frac{(J+1)}{\alpha l}$; *ii)* is a decreasing function of $e_s$ if and only if $\lambda > 1-\frac{(J+1)}{\alpha l}$.

Using (A16), we verify that if $e_s \ge \bar{e}$, the risk $\bar{\sigma}_\lambda(e_s)$: *i)* has a local maximum on the interval $[\bar{e},1]$ if if and only if $\lambda < 1-[\frac{2(J+1)}{\alpha l}+\frac{1}{2\alpha l}]$; *ii)* is a decreasing function of $e_s$ conversely.

*4.1.Regulation versus Benchmark*

Following Propositions 1-3, we determine the following results:

*(i)* If $\lambda<1-\frac{8(J+1)}{3\alpha l}$, then there exist a level of strong regulation $\bar{e}$, such that if $e_s>\bar{e}$ then the quantity is higher than in the Benchmark ($x(1)>x(\underline{e})>x(\bar{e})$). By using (A18), we verify that if $\lambda<1-\frac{8J^2(J+1)}{(J-2)^2\alpha l}$, then there exist a level of strong regulation $\bar{\bar{e}}$, with $\bar{\bar{e}}>\bar{e}$, such that if $e_s>\bar{\bar{e}}$ then the price is lower than in

the Benchmark ( $p(1) < p(\underline{e}) < p(\bar{e})$ ), with $1-\frac{8J^2(J+1)}{(J-2)^2\alpha l} < 1-\frac{8(J+1)}{3\alpha l}$. Then, if $\lambda < 1-\frac{8J^2(J+1)}{(J-2)^2\alpha l}$, *then for levels of strong regulation* such that $e_s > \hat{e}$ *price is lower (and quantity is higher) than in the Benchmark.*

Moreover, we show that there exist a degree of trust $\tilde{\lambda}$ with $\tilde{\lambda} < 1-\frac{8J^2(J+1)}{(J-2)^2\alpha l}$, such that if $\lambda < \tilde{\lambda}$, a sufficiently strong regulation implies *a quality improvement, a higher quantity and a lower final price with respect to the Benchmark.*

*(ii)* By using (8)-(9), we verify that if $\lambda > 1-\frac{8(J+1)}{3\alpha l}$, then regulation always implies a quantity restriction with respect to the Benchmark ( $x(e_s) < x(\underline{e})$ for every level of standard such that $\underline{e} < e_s < 1$ ). By using (A18), we verify that the final price $p_\lambda(e_s)$ is constant in the standard if $e_s \le \underline{e}$ and increases in the standard for $e_s \ge \underline{e}$ if and only if $\lambda > 1-[\frac{2(J+1)}{\alpha l}+\frac{1}{2\alpha l}]$, with $1-\frac{8(J+1)}{3\alpha l} < 1-[\frac{2(J+1)}{\alpha l}+\frac{1}{2\alpha l}]$. Then if $\lambda > 1-[\frac{2(J+1)}{\alpha l}+\frac{1}{2\alpha l}]$, *a regulation implies a lower level of risk, but a lower quantity and a higher final price with respect to the Benchmark.*

## 5. Optimal strategy for the development of brand

### Proof of Proposition 4

Turning to the first stage of the game, we now determine the firm's optimal long term choice, given the MQS $e_0$ set by the public authority. Given the firm's optimal procurement strategy, characterized by the expressions (8) and (9), we determine the firm's profit as a function of the standard $e_s$, $\pi_\lambda(e_s)$, when the degree of trust is given by $\lambda \neq 1$:

$$\pi_\lambda(e_s) = \begin{cases} \frac{(4J^2+6\alpha(1-\lambda)l)\sqrt{(2J^2)^2+6J^2\alpha(1-\lambda)l}-2J^2[4J^2+9\alpha(1-\lambda)l]}{27(1-\lambda)^2l^2} & \text{if } e_S \le \underline{e} \\ \frac{J}{2}(1-e_S)\{2\alpha-(1-e_S)[2J+(1-e_S)(1-\lambda)l]\} & \text{if } \underline{e} \le e_S \le \bar{e} \\ \frac{J[(1-\lambda)l(1-e_S)^2+2(\alpha+1-e_S)]^2}{16[(1-\lambda)l(1-e_S)+(J+1)]} & \text{if } e_S \ge \bar{e} \end{cases} \quad \text{(A19)}$$

In the particular case such that the degree of consumer trust is given by $\lambda = +1$, the firm's profit $\pi_1(e_s)$ is given by:

$$\pi_1(e_s) = \begin{cases} \frac{\alpha^2}{4} & \text{if } e_S \le \underline{e} \\ J(1-e_S)[\alpha-J(1-e_S)] & \text{if } \underline{e} \le e_S \le \bar{e} \\ \frac{J(\alpha+1-e_S)^2}{4(J+1)} & \text{if } e_S \ge \bar{e} \end{cases} \quad \text{(A20)}$$

Using (A19) and (A20), we easily verify that if $e_s \le \underline{e}$ the firm's profit is a constant function of $e_s$ ( $\pi(0) = \pi(\underline{e})$ ). If $\underline{e} \le e_s \le \bar{e}$, the firm's profit is maximized at $e_s = \underline{e}$ and decreasing on the interval $[\underline{e}, \bar{e}]$, regardless of the degree of trust. Then, $\pi(\bar{e}) < \pi(\underline{e})$. If $e_s \ge \bar{e}$, according to the envelope theorem, studying the sign

of $\frac{\partial \pi_\lambda(e_s)}{\partial e_s}$ is equivalent to studying the sign of $\frac{\partial \pi_\lambda(e_s)}{\partial e_s}[x^*_\lambda(e_s),e_s]$, with $x^*_\lambda(e_s)=J\psi(e_s)$ and $\psi_\lambda(e_s)$ given by (9). We verify that $\frac{\partial \pi_\lambda(e_s)}{\partial e_s}[x^*_\lambda(e_s),e_s]\geq 0$ if and only if $e_s' \leq e_s \leq e_s''$, with $e_s' > \bar{e}$ and $e_s'' > 1$. We easily verity that $e_s' > 1$ if and only if $\lambda > \bar{\lambda}$, with $\bar{\lambda}$ given by:

$$\bar{\lambda} = 1 - \frac{2(J+1)}{\alpha l} \tag{A21}$$

Then, if $e_s \geq \bar{e}$, the firm's profit: *i)* is a *decreasing* function of $e_s$ if and only if $\lambda > \bar{\lambda}$. In this case we have $\pi(1) < \pi(\bar{e}) < \pi(\underline{e})$, with $\pi(1) = \frac{J\alpha^2}{4(J+1)}$; *ii)* has a local minimum given by $e_s'$, conversely. In this latter case, we determine the relative position of $\pi(1)$ with respect to $\pi(\bar{e})$ and $\pi(\underline{e})$, both increasing functions of $\lambda$.

Using (A19), we easily verify that $\pi(1) > \pi(\bar{e})$ if and only if $\lambda < \hat{\lambda}$, with $\hat{\lambda}$ given by :

$$\hat{\lambda} = 1 - \frac{4(2J+5)\sqrt{(J+1)(J+7)} + 8[8 - J(J-7)]}{27\alpha l} \tag{A22}$$

Using (A19), we easily verify that $\pi(1) > \pi(\underline{e})$ if and only if $\lambda < \underline{\lambda}$, with $\underline{\lambda}$ given by :

$$\underline{\lambda} = 1 - \frac{8\left[(J+1)^{1/2}(J+4)^{3/2} - (J-7)J + 8\right]}{27\alpha l} \tag{A23}$$

Using (A21)-(A23), we verify that $\underline{\lambda} < \hat{\lambda} < \bar{\lambda} < 1$ with $\underline{\lambda} > -1$ if $\alpha > \tilde{\alpha}$, where $\tilde{\alpha} = \frac{4[8 + 7J - J^2 + (J+1)^{\frac{1}{2}}(J+4)^{\frac{3}{2}}]}{27l}$; following (HP1) and (HP2), we verify that the condition $\alpha > \tilde{\alpha}$ is always verified (and consistent with HP1 and HP2) if and only if $l > \tilde{l}$, where $\tilde{l} = \frac{-9J + \sqrt{3}[256 + 224J - 5J^2 + 32(J+1)^{\frac{1}{2}}(J+4)^{\frac{3}{2}}]^{\frac{1}{2}}}{36}$.

We are now able to define at which conditions the firm has incentive to implement a more stringent private standard $e_1$ with respect to the level of MQS $e_0$. We distinguish the following cases:

*i)* If $\lambda < \underline{\lambda}$, then $\pi(\bar{e}) < \pi(\underline{e}) < \pi(1)$. As $\pi(1) > \pi(e_0)$ for each level of $e_0 \leq 1$, the firm always chooses the "MQS-reinforcing strategy" and sets $e_1^* = 1$

*ii)* If $\underline{\lambda} < \lambda < \bar{\lambda}$, we distinguish two cases:

- If $\underline{\lambda} < \lambda < \hat{\lambda}$, then $\pi(\bar{e}) < \pi(1) < \pi(\underline{e})$ and there exists a level of MQS, $\hat{e}_0$, with $\underline{e} < \hat{e}_0 < \bar{e}$, such that $\pi(1) > \pi(e_0)$ if and only if $e_0 > \hat{e}_0$. Then, the firm chooses the "Strict selective strategy" if $e_0 < \hat{e}_0$ or the "MQS-reinforcing" strategy if $e_0 > \hat{e}_0$ (and sets $e_1^* = 1$);
- If $\hat{\lambda} < \lambda < \bar{\lambda}$, then $\pi(1) < \pi(\bar{e}) < \pi(\underline{e})$ and there exists a level of MQS, $\hat{e}_0$, with $\bar{e} < \hat{e}_0 < 1$, such that $\pi(1) > \pi(e_0)$ if and only if $e_0 > \hat{e}_0$. Then, the firm chooses the "Strict selective" strategy if $e_0 < \bar{e}$, the "MQS-adaptive" strategy if $\bar{e} < e_0 < \hat{e}_0$ or the "MQS-reinforcing" strategy if $e_0 > \hat{e}_0$ (and sets $e_1^* = 1$).

*iii)* If $\lambda > \bar{\lambda}$, then $\pi(1) < \pi(\bar{e}) < \pi(\underline{e})$ and the firm's profit is decreasing on $[\bar{e},1]$. In this case, we verify that $\pi(1) < \pi(e_0)$ for each level of $e_0 \leq 1$. Then, the firm chooses the "Strict selective" strategy if $e_0 < \bar{e}$ and the "MQS-adaptive" strategy if $\bar{e} < e_0 < 1$.

**Proof of Proposition 5**

Given (8) and (9), Propositions 3 and 4 and given $-1 < \underline{\lambda} < \hat{\lambda} < 1 - \frac{8(J+1)}{3\alpha l} < 1 - \frac{2(J+1)}{\alpha l} - \frac{1}{2\alpha l} < \bar{\lambda}$, we obtain the following result:

- if $\lambda < \underline{\lambda}$, then the firm always chooses $e_1^* = 1$ , the optimal quantity is an increasing function of the standard on the interval $[\bar{e},1]$ and $x(1) > x(\underline{e}) > x(\bar{e})$; hence $x(1) > x(e_0)$, regardless of the level of MQS;
- if $\underline{\lambda} < \lambda < \hat{\lambda}$, then the firm chooses $e_1^* = 1 \Leftrightarrow e_0 > \hat{e}_0$, with $\underline{e} < \hat{e}_0 < \bar{e}$. The optimal quantity is an increasing function of the standard on the interval $[\bar{e},1]$ and $x(1) > x(\underline{e}) > x(\bar{e})$, then $x(1) > x(e_0)$ for each level of MQS such that $e_0 > \hat{e}_0$;
- if $\hat{\lambda} < \lambda < 1 - \frac{8(J+1)}{3\alpha l}$, then the firm chooses $e_1^* = 1 \Leftrightarrow e_0 > \hat{e}_0$, with $\bar{e} < \hat{e}_0 < 1$. The optimal quantity is an increasing function of the standard on the interval $[\bar{e},1]$ and $x(1) > x(\underline{e}) > x(\bar{e})$, then $x(1) > x(e_0)$ for each level of MQS such that $e_0 > \hat{e}_0$;
- if $1 - \frac{8(J+1)}{3\alpha l} < \lambda < 1 - \frac{2(J+1)}{\alpha l} - \frac{1}{2\alpha l}$, then the firm chooses $e_1^* = 1 \Leftrightarrow e_0 > \hat{e}_0$, with $\bar{e} < \hat{e}_0 < 1$. The optimal quantity is an increasing function of the standard on the interval $[\bar{e},1]$ and $x(\bar{e}) < x(1) < x(\underline{e})$, then $x(1) > x(e_0)$ for each level of MQS such that $e_0 > \hat{e}_0$;
- if $1 - \frac{2(J+1)}{\alpha l} - \frac{1}{2\alpha l} < \lambda < \bar{\lambda}$, then the firm chooses $e_1^* = 1 \Leftrightarrow e_0 > \hat{e}_0$, with $\bar{e} < \hat{e}_0 < 1$. The optimal quantity has a local minimum on the interval $[\bar{e},1]$ and $x(\bar{e}) < x(1) < x(\underline{e})$, then $x(1) > x(e_0)$ for each level of MQS such that $e_0 > \hat{e}_0$;

As a result, *at the conditions on* $e_0$ *and* $\lambda$ *such that* the firm chooses $e_1^* = 1$, the choice of the "MQS-reinforcing" strategy always implies an increase of quantity with respect to simply complying with the MQS.

Using (A18) and Proposition 4 and given $-1 < 1 - \frac{8J^2(J+1)}{(J-2)^2 \alpha l} < 1 - \frac{4J(J^2-1)}{(J-2)^2 \alpha l} < \underline{\lambda}$, we obtain the following result:

- if $-1 < \lambda < 1 - \frac{8J^2(J+1)}{(J-2)^2 \alpha l}$, the firm always chooses $e_1^* = 1$. The final price has a local minimum on the interval $[\bar{e},1]$ and $p(1) < p(\underline{e}) < p(\bar{e})$; we verify that there exist a level of MQS $\tilde{e}_0$, with $\bar{e} < \tilde{e}_0 < 1$, such that, $p(1) > p(e_0)$ if and only if $e_0 > \tilde{e}_0$;
- if $1 - \frac{8J^2(J+1)}{(J-2)^2 \alpha l} < \lambda < 1 - \frac{4J(J^2-1)}{(J-2)^2 \alpha l}$, the firm always chooses $e_1^* = 1$. The final price has a local minimum on the interval $[\bar{e},1]$ and $p(\underline{e}) < p(1) < p(\bar{e})$; hence, we verify that there exist two levels of MQS $e'_0$ and $e''_0$, with $\underline{e} < e'_0 < \bar{e} < e''_0 < 1$, such that, $p(1) > p(e_0)$ if and only if $e_0 < e'_0$ or $e_0 > e''_0$;

- if $1-\frac{4J(J^2-1)}{(J-2)^2\alpha l}<\lambda<\underline{\lambda}$, the firm always chooses $e_1^*=1$. The final price has a local minimum on the interval $[\bar{e},1]$ and $p(\underline{e})<p(\bar{e})<p(1)$; then $p(1)>p(e_0)$ regardless of the level of MQS;
- if $\underline{\lambda}<\lambda<1-\frac{2(J+1)}{\alpha l}-\frac{1}{2\alpha l}$, the firm chooses $e_1^*=1$ if and only if $e_0>\hat{e}_0$. The final price has a local minimum on the interval $[\bar{e},1]$ and $p(\underline{e})<p(\bar{e})<p(1)$; then $p(1)>p(e_0)$ for each level of MQS such that $e_0>\hat{e}_0$;
- if $1-\frac{2(J+1)}{\alpha l}-\frac{1}{2\alpha l}<\lambda<\bar{\lambda}$, the firm chooses $e_1^*=1$ if and only if $e_0>\hat{e}_0$. The final price is an increasing function of $e_s$ on the interval $[\bar{e},1]$ and $p(\underline{e})<p(\bar{e})<p(1)$; then $p(1)>p(e_0)$ for each level of MQS such that $e_0>\hat{e}_0$.

As a result, *at the conditions on* $e_0$ *and* $\lambda$ *such that* the firm chooses $e_1^*=1$, the choice of the "MQS-reinforcing" strategy may imply a lower final price, with respect to simply complying with the MQS..

We verify that $1-\frac{8J^2(J+1)}{(J-2)^2\alpha l}>-1$ if $\alpha>\alpha'$, where $\alpha'=\frac{4J^2(J+1)}{(J-2)^2 l}$; following (HP1) and (HP2), we verify that the condition $\alpha>\alpha'$ is always verified (and consistent with HP1 and HP2) if and only if $l>l'$, where $l'=\frac{J\{[36+J(28+J)]^{\frac{1}{2}}-(J-2)\}}{4(J-2)}$.

**Proof of Proposition 6**

By using (10), we verify that consumer surplus is maximized for $e_s^*=1$ if and only if $\lambda<1-\frac{8(J+1)}{3\alpha l}$. Following *Proposition 4*, we obtain the following cases:

*i)* if $\lambda<\underline{\lambda}$, then consumers prefer $e_s^*=1$ and the firm always chooses the "MQS-reinforcing strategy" (with $e_1^*=1$);.

*ii)* if $\underline{\lambda}<\lambda<\bar{\lambda}$, then we distinguish two cases:

- If $\lambda<1-\frac{8(J+1)}{3\alpha l}$, consumers prefers $e_s^*=1$ but the firm chooses the "MQS-reinforcing strategy" and sets $e_1^*=1$ only if $e_0>\hat{e}_0$;
- If $\lambda>1-\frac{8(J+1)}{3\alpha l}$, consumers prefers $e_s^*=0$ but the firm chooses the "strict selective strategy" and sets $e_1^*=0$ only if $e_0<\bar{e}$;

*iii)* if $\lambda>\bar{\lambda}$, then consumers prefer $e_s^*=0$ and the firm chooses the "strict selective strategy" and sets $e_1^*=0$ if and only if $e_0<\bar{e}$.

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