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**Collective Reputation,
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Quality Standard**

Elodie Rouvière and Raphaël Soubeyran

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Collective Reputation, Entry and Minimum Quality Standard

Summary

This article deals with the issue of entry into an industry where firms share a collective reputation. First, we show that free entry is not socially optimal; there is a need for regulation through the imposition of a minimum quality standard. Second, we argue that a minimum quality standard can induce firms to enter the market. Contrary to conventional wisdom, a minimum quality standard should not always be considered as a barrier to entry.

Keywords: Collective Reputation, Entry, Minimum Quality Standard

JEL Classification: L11, H41, I18, Q18

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When food operators sell generic products, consumers partly base their choices on the reputation of the entire industry. For instance, following an outbreak of food poisoning, everyone along the contaminated item's supply chain may suffer the consequences of a decrease in demand. The problem arises when consumers do not link the contamination to a particular producer but to a generic product. After the Fall 2006 spinach outbreak, the Economic Research Service of the United States Department of Agriculture reported that all US spinach growers suffered a drop in demand for their product even though only one grower's spinach was contaminated. Five months later, the value of retail sales was still down 27% compared to the same period in 2005 (Calvin 2007). In another example from 1997, more than 200 people contracted hepatitis A after eating frozen strawberries. The USDA reported that concerns over the safety of strawberries affected demand for all berries. Experts estimated that the US berries industry bore losses of between \$15 million and \$40 million dollars due to the outbreak (Calvin, Avendaño and Schwentesius 2004). In 2003, following the discovery of the first cow infected by Bovine Spongiform Encephalopathy in the USA, more than 30 countries banned US beef, threatening the 2.6 billion dollars export market. Using UPC scanner data, Schlenker and Villas-Boas (2007) show evidence of a drop in domestic beef sales as well.

The literature points out that a collective reputation is at stake in food industries in which food operators sell speciality or regional products (Winfree and McCluskey 2005). This is particularly true when consumers cannot identify the producer of a food product and/or food items are not traceable. Collective reputation has two main characteristics. First, producers are hostage to each others' behavior. Namely, an entire group of firms can lose consumer trust as a result of one firm's lack of diligence. Second, collective reputation induces price premiums on the market. There are many empirical evidence which show that a positive collective reputation is a good tool to signal quality and is correlated with price premiums (Qua-grainie, Mc Cluskey and Loureiro 2003). Price premiums work as incentives for food operators to join the group.

There is little formal discussion in the literature about collective reputation. Tirole (1996) considers that collective reputation should be assumed to be the aggregate reputation of individual agents. In a context of imperfect information available to consumers about quality, he shows that the composition of the producer group matters. Winfree and Mc Cluskey (2005) assume that collective reputation is a common property resource and show that the number of firms should be considered closely because of free-rider effects. However, neither study allows for entry in or exit from the group

of producers whose size is taken as fixed.

The current article addresses the issue of free-entry when food operators share a collective reputation (the industry reputation) in a context of imperfect information about product quality available to consumers. We show that free entry is not socially optimal due to the producers' incentive to free-ride on the collective reputation. This statement supports the introduction of a minimum quality standard (MQS) to correct this market failure. In the industrial organization literature, there is a controversial debate regarding the effect of a MQS on competition (see Ronnen (1991), Crampes and Hollander (1995), Ecchia and Lambertini (1997), Valetti (2000) for competition effects of a MQS under perfect information for consumers about quality; see Leland (1979), Garella and Petrakis (2006) for competition effects of a MQS under imperfect information). In contrast to existing literature on the negative competition effects of a MQS, we show that in a context of imperfect information for consumers about quality, the introduction of a MQS can induce firms to enter the market.

The article proceeds as follows. In the light of empirical evidence, we set up the theoretical model emphasizing the free entry issue. Next, we analyze the competition effects when a MQS is imposed on the industry. Finally, we provide our conclusions and their policy implications.

Oligopoly with collective reputation

We consider an industry in which identical and risk neutral food operators sell generic products. In this case, if a quality failure occurs the collective reputation at stake is the reputation of the entire industry. We consider a two-stage game: in the first stage, profit maximizing firms choose whether or not to enter the market. When a firm enters the market, it faces a fixed (sunk) cost $F > 0$. In the second stage, the firm makes a quality decision in order to avoid quality failure, thereby contributing to the collective reputation of the industry. Once they have entered the market and paid the sunk cost F , firms face a cost $C(\cdot)$ of providing quality with $C' > 0$ and $C'' > 0$. Mankiw and Whinston (1986) analyze a situation in which firms produce an homogeneous product and the output per firm (strictly) decreases with the number of firms. Since we focus on the role of collective reputation, in our setting each firm produces one unit of the product.

Consumers only are able to imperfectly observe the average quality q_a of the product marketed. We thus assume that the reputation of the industry is "good" with a probability $R(q_a)$, with $R' > 0$ and $R'' \leq 0$. The inverse

demand function is then $P(n)$ (with $P' < 0$). The industry reputation is "bad" with probability $1 - R(q_a)$ and consequently demand drops to 0. Therefore, the expected profit of a generic firm i is $\Pi_i = R(q_a) P(n) - C(q_i) - F$. We solve the game through backward induction. In the next section, we first present two reasonable assumptions from the monopolistic case. We then examine the oligopoly situation.

Monopolist Processor

We start our analysis by considering the case where there is only one firm in the market. In the second stage, the monopolistic firm makes a quality decision q in order to maximize its profit; $\max_q R(q) P_M - C(q)$, where $P_M = P(1)$. The corresponding first order condition is as follows $R'(q_M) P_M = C'(q_M)$. In the first stage, the monopoly payoff is given by $\Pi(q_M, 1) = R(q_M) P_M - C(q_M) - F$. Let consider the two following assumptions:

Assumption 1: $F \leq R(q_M) P_M - C(q_M)$.

Assumption 2: $\lim_{q \rightarrow +\infty} \Pi(q, 1) \leq 0$.

Assumption 1 states that a firm always enters the market when it foresees that no other firm would do so. According to assumption 2, a monopolistic firm cannot make any profit when its investment in quality reaches a certain level. All through the article, we assume that Assumption 1 and Assumption 2 hold. We now analyze the situation where more than one firm enter the market.

Oligopolist Processor

Proceeding with our analysis, we consider that n identical firms enter the market. These firms produce a homogeneous good and share a collective reputation. According to the latter statement, the entire industry can fail if one firm misbehaves (Winfrey and Mc Cluskey 2005; Carriquiry and Babcock, 2007). First, we consider that firms make their quality decision, taking the decisions of the others as given. Second, we examine the welfare effects of competition.

Collective Reputation and Quality

In the second-stage, firms individually make their quality decision, q_i , in order to prevent a drop in demand. The second-stage problem for a firm

i is then $\max_{q_i} R(q_a) P(n) - C(q_i)$, where $q_a = \frac{\sum_{i=1}^n q_i}{n}$. The first order condition is $\frac{1}{n} R'(q_a) P(n) = C'(q_i)$. It defines firm i 's best response as an implicit function of the average quality level q_a and the number of firms n . Hence, each firm has an incentive to decrease its quality if the average quality increases.

In an interior equilibrium, the firms' quality decisions are all the same, i.e. for all i , $q_i = q^*(n)$ which is characterized by:

$$(1) \quad \frac{1}{n} R'(q^*) P(n) = C'(q^*),$$

q^* represents the non cooperative equilibrium quality level.

Proposition 1 *An increase in the number of firms lowers the equilibrium quality level $q^* : \frac{\partial q^*}{\partial n} < 0$.*

Proof. Differentiating condition 1 with respect to n we obtain

$$(2) \quad \frac{\partial q^*}{\partial n} = \left[\frac{1}{n} P'(n) - \frac{1}{n^2} P(n) \right] \frac{R'(q^*)}{C''(q^*) - \frac{1}{n} R''(q^*) P(n)},$$

This expression has a negative value. Indeed, $P' < 0$, then $\left[\frac{1}{n} P'(n) - \frac{1}{n^2} P(n) \right] < 0$. Moreover, $R'(q^*) > 0$ and $C''(q^*) - \frac{1}{n} R''(q^*) P(n) > 0$. ■

We distinguish two effects. On the one hand, when the number of firms in the market increases, the firms' incentive to provide quality decreases. This effect is identical to the findings of Winfree and Mc Cluskey (2005). On the other hand, competition strengthens and the price of the product consequently decreases. A firm's benefits are thus diluted and each firm provides a lower level of quality.

In the first stage, firms decide to enter the market if their ex-ante expected profit is positive. The number of firms who enter the market is then characterized by:

$$(3) \quad R(q^*(n^*)) P(n^*) - C(q^*(n^*)) = F,$$

Where n^* denotes the equilibrium number of firms, which is an implicit function of F , the sunk costs of entry. Differentiating condition 3 with respect to F we obtain: $\frac{\partial n^*}{\partial F} = \left[[R'(q^*) P(n^*) - C'(q^*)] \frac{\partial q^*}{\partial n} + R(q^*) P'(n^*) \right]^{-1}$. ■
By definition, $P' < 0$. From condition (1), $R'(q^*) P(n^*) - C'(q^*) \geq 0$ and

according to Proposition 1, $\frac{\partial q^*}{\partial n} < 0$. Then, $\frac{\partial n^*}{\partial F} < 0$. Consequently, the size of the industry decreases as the entry cost increases.

With these results in hand, we turn to the welfare effect of competition.

The ambiguous welfare effect

In order to appraise the welfare effect of a change in the number of firms, we consider the first stage equilibrium.

If n firms enter the market, they anticipate that they will implement the non cooperative equilibrium quality level q^* in the second stage. Under the assumption of quasi-linear consumer utility, the consumer's surplus is $CS(q^*, n) = R(q^*) \left[\int_0^n P(s) ds - P(n)n \right]$. The total ex-ante profit of the industry is $n\Pi(q^*, n) = n[R(q^*)P(n) - C(q^*) - F]$ where $\Pi(q^*, n)$ represents the first stage equilibrium profit per firm. The social welfare is denoted by $W = W(q^*, n)$, with $W(q^*, n)$ such that:

$$(4) \quad W(q^*, n) = R(q^*) \int_0^n P(s) ds - n[C(q^*) + F],$$

We can now evaluate the welfare effect of competition. Differentiating condition 4 with respect to n , we obtain $\frac{dW}{dn} = \frac{\partial W}{\partial n} + \frac{\partial W}{\partial q} \frac{\partial q^*}{\partial n}$. The welfare effect is twofold. The direct effect is given by $\frac{\partial W}{\partial n} = R(q^*)P(n) - [C(q^*) + F]$. As long as profits remain non negative, $\frac{\partial W}{\partial n}$ has a non negative value. This represents the classical positive effect of competition. The indirect effect is given by $\frac{\partial W}{\partial q} \frac{\partial q^*}{\partial n}$. According to Proposition 1, the average quality on the market decreases with respect to the number of firms, $\frac{\partial q^*}{\partial n} < 0$. The welfare

effect of an increase in quality, $\frac{\partial W}{\partial q}$, is given by $\frac{\partial W}{\partial q} = R'(q^*) \int_0^{n^*} P(s) ds - n^* C'(q^*)$. $P(n^*) < \int_0^{n^*} P(s) ds$, thus this term has a positive value. There-

fore, the indirect welfare effect $\frac{\partial W}{\partial q} \frac{\partial q^*}{\partial n}$ has a negative value.

When food operators share a collective reputation, the welfare effect of competition is ambiguous. An increase in the number of firms reduces each firm's market power and prices, thereby improving social welfare. Yet at the same time, it lowers the average quality on the market, reducing social welfare.

Proposition 2 *Free entry is not socially optimal.*

Proof. We evaluate the marginal variation of welfare at the free entry point. Differentiating condition 4 with respect to the number of firms n , we obtain $\frac{dW}{dn}(q^*, n^*) = \left[R'(q^*) \int_0^{n^*} P(s) ds - n^* C'(q^*) \right] \frac{\partial q^*}{\partial n}$. According to Proposition 1 and that $\frac{\partial W}{\partial q} = R'(q^*) \int_0^{n^*} P(s) ds - n^* C'(q^*) > 0$, this expression has a strict negative value. ■

Numerical example: We consider the following specification of the model. The collective reputation is characterized by a logit function of the average quality, q_a : $R(q_a) = \frac{q_a}{1+q_a}$. The inverse demand function is assumed to be linear, $P(n) = \alpha - n$ where $\alpha > 0$. The cost function to provide quality is $C(q_i) = \frac{1}{2}(1 + q_i)^2$. The individual ex ante profit function can be written as $\Pi(q^*(n), n) = \frac{(\frac{\alpha-n}{n})^{\frac{1}{3}} - 1}{(\frac{\alpha-n}{n})^{\frac{1}{3}}} (\alpha - n) - \left[\frac{1}{2} \left(\frac{\alpha-n}{n} \right)^{\frac{2}{3}} + F \right]$. Consumer surplus is given by $CS(q^*(n), n) = \frac{(\frac{\alpha-n}{n})^{\frac{1}{3}} - 1}{(\frac{\alpha-n}{n})^{\frac{1}{3}}} \frac{n^2}{2}$. Therefore, the social welfare is: $W(q^*(n), n) = \frac{(\frac{\alpha-n}{n})^{\frac{1}{3}} - 1}{(\frac{\alpha-n}{n})^{\frac{1}{3}}} n \left(\alpha - \frac{n}{2} \right) - n \left[\frac{1}{2} \left(\frac{\alpha-n}{n} \right)^{\frac{2}{3}} + F \right]$. Figure 1 represents the ambiguous welfare effects of competition.

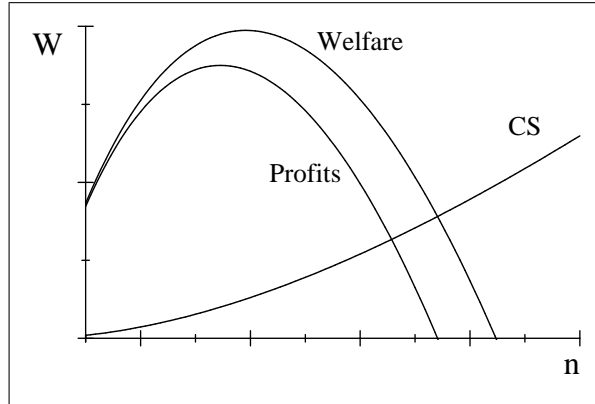


Figure 1. The Welfare Effects of Competition

When n^* firms compete in the market, the positive welfare effect of competition disappears. Therefore, the regulator needs to intervene in order to avoid free-riding incentives and to prevent the entire industry from failing to perform. This result contributes to the critical debate in the industrial organization literature concerning the justification of anti-competitive regulation. For instance, Mankiw and Whinston (1986) have shown that in

homogeneous product markets, free entry can lead to a socially excessive number of firms. They model a situation in which the output per firm falls as the number of firms in the industry increases. In our model, we assume that the output per firm is constant, however, the free-riding incentives on collective reputation lead us to the same conclusion. A minimum quality standard is the most commonly used regulatory tool in the food industry, guaranteeing product quality/safety (Marette 2007). In the next section, we examine the competition effects when a minimum quality standard is introduced by the regulator.

Minimum Quality Standard

While maintaining our focus on the entry issue, we examine the situation where the regulator imposes a Minimum Quality Standard.

Magnitude of the MQS

First, we characterize a particular quality choice, q_c , which is the cooperative equilibrium quality in the second stage. This level is the solution of $\max_{q \geq 0} R(q)P(n) - C(q)$, leading to the following first order condition $R'(q_c)P(n) - C'(q_c) = 0$. Note that q_c represents the optimal quality level for the industry.

Second, we assume that the regulator imposes a MQS denoted by q_s . q_s is exogenous and common knowledge. Firms make their entry and quality decisions according to the magnitude of q_s . Food operators are ordered to implement a quality level q_i such that $q_i \geq q_s$. Let $q^{**} = q^*(n^*)$ denote the non cooperative subgame perfect equilibrium quality level.

Proposition 3 *If $q_s \leq q^{**}$, the MQS has no effect on competition, i.e. the number of firms is n^* ; There exists $q' \geq q_c$ such that for $q^{**} \leq q_s \leq q'$, the number of firms is higher than n^* and for $q_s \geq q'$, the number of firms is lower than n^* . The number of firms is maximal for $q_s = q_c$.*

Proof. When the MQS is lower than the equilibrium non cooperative quality level $q_s \leq q^{**}$, firms implement the (non cooperative) subgame perfect equilibrium quality level q^{**} and the number of firms in the market remains n^* . When the MQS is higher than the (non cooperative) subgame perfect equilibrium quality level $q_s \geq q^{**}$, let n_m denote the number of firms who enter the market. It is characterized by $\Pi(q_s, n_m) =$

$R(q_s)P(n_m) - C(q_s) - F = 0$. Differentiating the latter condition with respect to MQS level q_s , we obtain: $\frac{dn_m}{dq_s} = \frac{-\left(\frac{\partial \Pi}{\partial q_s}\right)}{\frac{\partial \Pi}{\partial n_m}}$. As usual $\frac{\partial \Pi}{\partial n_m} < 0$. Then, $sign\left\{\frac{dn_m}{dq_s}\right\} = sign\left\{\frac{\partial \Pi}{\partial q_s}\right\}$. The number of firms n_m increases when $q^{**} \leq q_s \leq q_c$ and decreases when the MQS level is higher than the cooperative equilibrium quality level q_c . By assumption, $P' < 0$ and $\Pi(q_s, n) \leq \Pi(q_s, 1)$. Consequently, $\lim_{q_m \rightarrow +\infty} \Pi(q_s, n) \leq \lim_{q_m \rightarrow +\infty} \Pi(q_s, 1)$. From Assumption 2 (monopolist case), we conclude that $\lim_{q_m \rightarrow +\infty} \Pi(q_s, 1) \leq \lim_{q_m \rightarrow +\infty} \Pi(q_s, n_m) = 0$. Finally, $\lim_{q_m \rightarrow +\infty} n_m \leq 1$. Accordingly, there exists q' which satisfies the

conditions set in the proposition (see Figure 2). ■

If the MQS is sufficiently low, it does not influence either competition or the firm's quality choice. Increasing the level of the MQS raises the level of the collective reputation by increasing firms' quality level. The MQS does not alter competition and induces firms to enter the market as long as the cost of providing the MQS level is sufficiently low. At the cooperative equilibrium quality level (q_c), the collective reputation and the total profit are maximal. When the MQS is imposed at such a level, a maximum number of firms enter the market.

For MQS levels higher than the cooperative level, the marginal cost of providing quality overcomes the marginal benefit, leading to a drop in profits. Consequently, the MQS alters competition and less firms enter the market. The number of firms remains higher than it would under free entry as long as the MQS is low enough (up to q'). For higher MQS levels, the number of firms becomes less than the number of firms at the free entry point. This is the only situation in which the MQS can alter competition. Figure 2 illustrates these results.

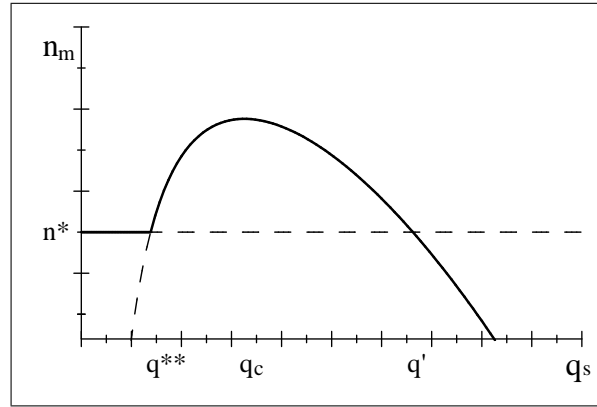


Figure 2. Number of Firms and MQS.

In the light of these statements, we turn now to analyze the welfare effect after a MQS has been imposed.

Welfare effect of the MQS

The welfare function at the free entry point when there are n^* firms in the industry who have implemented the non cooperative quality level equal to $q^{**} = q^*(n^*)$, can be written $W(q^{**}, n^*) =$

$R(q^{**}) \left[\int_0^{n^*} P(s) ds - n^* P(n^*) \right]$. At the free entry point, if the MQS is such that $q^{**} \leq q_s \leq q'$, n_s firms operate in the industry and the welfare is given by $W(q_s, n_s) = R(q_s) \left[\int_0^{n_s} P(s) ds - n_s P(n_s) \right]$. Namely, $R(q^{**}) \leq R(q_s)$. There-

fore, average quality is higher once a MQS has been introduced. The MQS increases competition, there are more firms in the industry ($n^* \leq n_s$) which increases consumers' surplus. Therefore, $\int_0^{n^*} P(s) ds - n^* P(n^*) \leq \int_0^{n_s} P(s) ds - n_s P(n_s)$. Relative to free entry, the introduction of a MQS improves welfare as long as the level of the MQS leads to a greater number of active firms. This result adds another dimension to previous conclusions on minimum quality standards and collective reputation. Winfree and Mc Cluskey (2005) argue that when firms share a collective reputation, the introduction of MQS limits incentives to free-ride. The minimum quality standard is then Pareto improving for firms but they do not take into account a competition effect.

Conclusion

The issue of collective reputation is not exclusive to firms who sell regional or specialty products. Collective reputation may be at stake when food operators sell food items that consumers consider as generic. For instance, an entire industry may suffer decreased demand following a food safety outbreak. In order to prevent quality and safety failures, food operators endeavour to sustain an accurate level of quality in the market. However, the more firms there are in the industry, the greater the incentive to free-ride on the quality of others. We show that free-entry leads to a sub-optimal number of firms in the market. Therefore, the regulator needs to intervene in order to avoid the incentive to free-ride and to prevent the entire industry

from failing to perform. A solution could be to restrict the number of firms in the market. However, such regulation would lead to an increase in price. Moreover, it would limit the incentive to free ride but it won't eliminate it. This statement supports the introduction of a minimum quality standard in the industry. Indeed, a minimum quality standard allows to avoid both negative welfare effects of the latter policy.

By focusing on entry, this article provides new results for research on collective reputation and minimum quality standards. We show that the introduction of a minimum quality standard can induce firms to enter the market and consequently it does not always alter competition, sustaining both the average quality in the industry and the level of welfare. To conclude, minimum quality standards should not be systematically considered by the regulator as an anti-competitive regulation.

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