Will Geographical Indications Supply Excessive Quality?

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1 Introduction

The European Union regulations pertaining to geographical indications (GI) were enacted in 1992 to encourage the creation of high-quality agricultural products, likely in response to the "commodification" of many agricultural markets and the comparative advantage of certain European farmers in supplying higher-quality agricultural products (Council of the European Union, 2006). By guaranteeing that products sold under the European Protected Designation of Origin (PDO) or Protected Geographical Indication (PGI) label meet publicly available, certified production criteria, the system is intended to solve the traditional "lemons" problem associated with asymmetric information regarding the quality of credence goods (Akerlof, 1970). This problem is potentially acute in agricultural markets, where production is typically atomised and spontaneous coordination between farmers to reliably certify production practices often fails to materialise.

One important element of the European PDO/PGI system is that certified production requirements (including the delimitation of the eligible geographical area), that constitute the basis for registration, are developed by producer organisations themselves (Council of the European Union, 2006). Thus, there can be little doubt that GI producer organisations (hereafter PO) choose the quality level of their products strategically, and it is natural to expect the PO to choose the quality level that will maximise aggregate producer profits.

The purpose of this study is to investigate the profit-maximising choice of product quality level by a PO, and contrast it with the first best. Two effects need to be distinguished to understand the incentives facing the PO. First, to the extent they increase quality, more stringent production requirements should increase consumers' willingness to pay for the product at all quantities, shifting out the demand curve. We call this effect the demand-enhancing effect. Second, by making production more costly, they indirectly restrict supply, which contributes to a higher market-clearing price and *may* increase aggregate producer profits in competitive equilibrium. We call this effect the supply-limiting effect. Thus, the demand-enhancing effect of an increase in product quality is the increase in producer surplus arising from a shift of the demand curve outwards, keeping the marginal cost curve constant, while the supply-limiting effect represents the change in producer surplus arising from the induced shift in the marginal cost curve, keeping the demand curve constant.

While the demand-enhancing effect is *always* beneficial to producers, the supply-limiting effect has ambiguous effects on producer surplus. We will say there exists a positive supply-limiting effect if a marginal increase in quality shifts the supply curve such that producer surplus is increased, keeping the demand curve constant.

The optimal choice of quality by a monopolist has been studied extensively, including classic studies by Spence (1975) and Mussa and Rosen (1978). In these studies, the monopoly seller can choose quantity directly and thus has no incentive to increase quality for the sole purpose of shifting the marginal cost curve upwards to raise the market-clearing price—for any quality level, he can raise price by simply restricting the quantity supplied, keeping the marginal cost curve constant. Said differently, the quality- and quantity-setting monopolist does not derive any benefit from upward shifts in the marginal cost curve, because for any quality level he can set marginal

revenue equal to marginal cost.

However, competitive producers typically make production decisions independently within a GI, making supply restriction through indirect means a potentially important consideration and the focus of recent research (Lence et al., 2007; Mérel, 2009). These studies investigate the use of production requirements as a pure means to indirectly limit supply, and thus they assume that the production requirements are "artificial"; product quality is exogenous and unaffected by the production requirements. Such studies therefore ignore the demand-enhancing effect when production requirements enhance quality. To our knowledge, the present study is the first to investigate the decisions of a PO regarding product quality when both the demand-enhancing and supply-limiting effects are present.

A regulator who had perfect knowledge regarding the cost of quality provision *and* the distribution of consumer preferences over quality could directly set the quality standard for the GI product at the socially optimal level. It is doubtful, however, that a regulator would have such information, and, moreover, even if it could be acquired, the regulatory burden of imposing such regulations would be extreme, given the number of GI products in place and under proposal. Thus, the present EU registration system, which mostly delegates the choice of quality to the PO, probably reflects the limitations of the regulatory environment, making the analysis of endogenous producer choice of quality relevant to both the current and likely future environments for GI products.

The demand side of our model is based upon a flexible version of the classic model of vertical differentiation due to Mussa and Rosen (1978). We specify heterogeneity in consumers' taste for the GI product via the beta distribution, allowing for an outside good. This allows us to model a large variety of distributions, including the special case of uniform distribution that is often adopted for convenience in applications of the Mussa-Rosen framework. This flexibility is potentially important to investigating the conditions under which GI producer organisations will supply excess or deficient quality relative to the social optimum. For example, consumers may be clustered at the low-end of the consumer taste spectrum, so that consumers with a high valuation for the GI product are few relative to those with a low valuation. Surely, detractors of the European GI system, or even ministerial departments in charge of consumer protection, may claim that GI niche markets are being tailored by producers to extract rents from a small number of wealthier consumers, leaving the bulk of consumers unable to afford these excessively high-quality (and high-price) products.[1]

The ability of producers to benefit from a positive supply-limiting effect directly depends on the responsiveness of the cost function to changes in product quality. We specify an aggregate cost function that allows us to readily define this responsiveness in terms of a constant elasticity of cost with respect to quality. In addition, the incentives facing the PO regarding the supply-limiting effect are directly related to the potential of the industry to earn quasi-rents in equilibrium, that is, to the convexity of the cost function with respect to output. Therefore, we specify an aggregate cost function that is both convex in quality and convex in quantity, so that marginal cost is increasing in both quality and quantity. We allow the degrees of convexity with respect to quality and quantity

[1]This view was articulated during interviews of French regulatory agencies and producer organisations conducted by one of the authors.

to vary freely.

The degree of flexibility we adopt regarding the distribution of consumers' tastes and the convexity of the cost function is important to achieving a meaningful investigation of the incentives facing the PO regarding quality choice. For example, one would automatically ask whether results attained under consumers uniformly distributed according to their taste for the high-quality product would still hold under a more flexible taste distribution.

Yet, despite the flexibility of the model, our conclusion is unambiguous: provided it is socially optimal to offer the GI product with finite quality level (the only case of interest), the PO will *always* choose to supply excessive quality relative to the societal optimum. This finding has policy relevance because an important justification for public intervention in GI markets is founded on the asymmetric information argument that product quality will be deficient relative to the social optimum in the absence of intervention. Thus, our result suggests that the European GI regulations may in essence have replaced a pooling equilibrium with deficient product quality in the absence of intervention with a separating equilibrium involving a "generic" product with fixed low quality and a GI product with excessive quality relative to the social optimum.

2 The model

Consider the market for a vertically differentiated product. There is a continuum of consumers of mass N and two product varieties: generic or GI. Consumers purchase one unit of either the GI product or the generic product. The quality of the GI product is measured by a scalar $\mu > 0$. The price of the GI product is p. Each consumer is characterised by a parameter $\theta \in [0, 1]$ that measures her taste for quality. The utility a consumer obtains from consuming the generic product is set to $\bar{U}$, while the utility a consumer of type θ gets from consuming the GI product is $\bar{U} - p + \theta\mu$.[2] Therefore, a consumer of type θ has a reservation price for the GI product with quality μ equal to $\theta\mu$. Larger values of θ correspond to a higher preference for the GI product and therefore a larger reservation price.

The density function for θ is assumed to be given by the beta density

$$f_{a,b}(\theta) = \frac{\theta^{a-1}(1-\theta)^{b-1}}{B(a,b)}$$

where $B(a, b) = \int_0^1 \theta^{a-1}(1-\theta)^{b-1} d\theta$, and we restrict the analysis to pairs (a, b) in $\mathbb{N}^2_{++}$. In this case the density function is unimodal (for $a = b = 1$, it coincides with the uniform distribution). We denote the corresponding c.d.f. by $F_{a,b}$. Examples of beta densities with integer parameters are depicted in figure 1.

Variation in the quantity of the GI product demanded arises from consumers shifting between the generic product and the GI product since each consumer purchases one unit at most. The taste

[2] We normalise the quality of the generic product to zero and assume it is produced at constant marginal cost by a large number of farmers, so its cost and, hence, the competitive price can be set to zero.

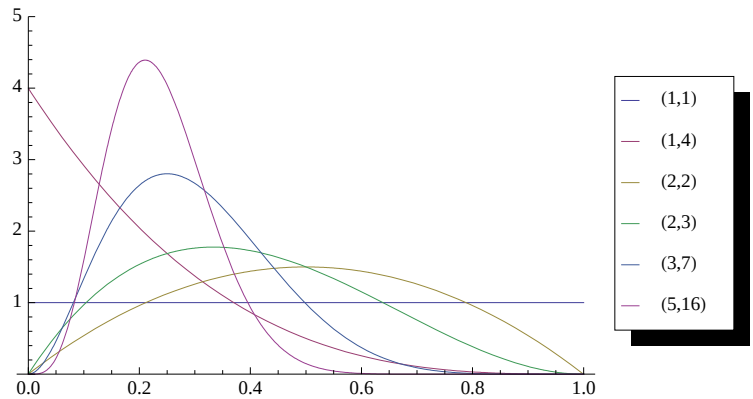

Figure 1: **Examples of taste densities from the beta distribution.**

parameter of the consumer who is indifferent between purchasing the generic product or the GI product of quality μ is $\tilde{\theta} = \frac{p}{\mu}$. Therefore, expansions in sales of the GI product must be obtained by attracting new, marginal consumers by increasing quality, decreasing price, or both.

The PO consists of a large number L of identical farmers. For a typical farmer l, the cost of producing q units of the GI product with quality μ is

$$C(q, \mu) = c\mu^{1+\alpha} q^{1+\beta}$$

where c, α and β are positive parameters. Therefore, $1 + \alpha$ represents the elasticity of total cost with respect to quality, assumed to be the same at each quantity level q, while $1 + \beta$ represents the elasticity of cost with respect to quantity. The cost function C is interpreted as reflecting the full opportunity cost of producing the GI product. For instance, in the special case where farmers can choose between producing the generic product and the GI product, C represents the opportunity cost of diverting assets away from the production of the generic product and towards the production of the GI product.

Given the farmers' individual cost functions C, the aggregate social cost of producing Q units of the GI product with quality μ can be derived as[3]

$$\mathscr{C}(Q, \mu) = cL^{-\beta}\mu^{1+\alpha}Q^{1+\beta}. \tag{1}$$

The PO is assumed to choose the quality level that maximises aggregate producer surplus, given that once quality is set producers within the appellation behave competitively. Formally, we model a two-stage game where in the second stage, individual producers maximise profits while producing at the mandated quality level, and in the first stage the PO chooses the joint profit-maximising quality level, in rational anticipation of the competitive stage-two equilibrium.

[3]Derivation available upon request to the authors.

2.1 The existence of a positive supply-limiting effect

The demand-enhancing effect and the supply-limiting effect of the PO's quality decision are illustrated in figure 2. The demand-enhancing effect always works in the same direction: keeping marginal cost constant, the industry benefits from outward shifts in demand. The impact of the supply-limiting effect, in contrast, is ambiguous: at low quality levels, a marginal increase in quality may shift the supply curve in a way that increases producer surplus, keeping the demand curve constant. Producers then have two independent incentives to increase quality further, as both effects are working in the same direction. At high enough quality levels however, the supply-limiting effect must become negative, otherwise producers would supply infinite quality. At the producer-optimal quality, both effects exactly compensate each other, so that no further change in quality is profitable.

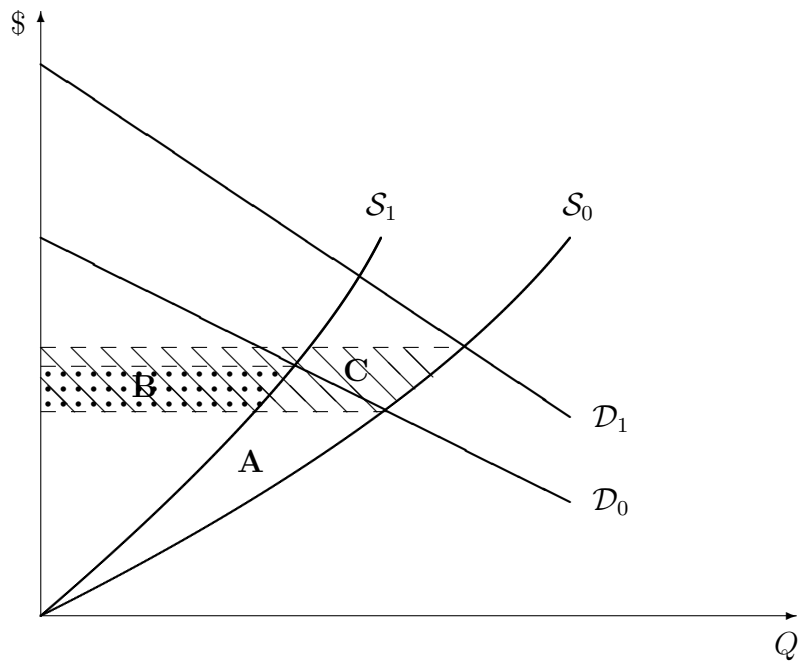

Figure 2: **The supply-limiting and demand-enhancing effects illustrated.** The supply-limiting effect is the dotted area **B** minus area **A** and the demand-enhancing effect is the shaded area **C**.

We first show that a *necessary* (but not sufficient) condition for a positive supply-limiting effect to exist is that marginal costs rise faster than average costs with quality increases, a condition that is mechanically satisfied by our cost specification in (1). This is intuitive: for a quality increase to have a large enough effect on price (holding demand constant) to more than compensate the cost increase, the increase in marginal cost (which, together with the slope of demand, determines the equilibrium price increase) must be larger than the increase in the cost of producing infra-marginal units. We then show that in our model specification, a positive supply-limiting effect is present at low enough levels of quality. Hence, our model fully captures the two fundamental incentives

regarding quality choice discussed above.

Assume that the aggregate cost function $\mathscr{C}(Q,\mu)$ has the classic properties: $\frac{\partial \mathscr{C}}{\partial Q} > 0$, $\frac{\partial^2 \mathscr{C}}{\partial Q^2} > 0$, and $\frac{\partial^2 \mathscr{C}}{\partial Q \partial \mu} > 0$. Denote by $P(Q)$ the demand curve facing the PO, with $P' < 0$. In this section, we omit the dependence of demand on quality, since by definition the supply-limiting effect assumes that the demand curve is held constant.

The relationship between the quality chosen by the PO and the resulting equilibrium quantity is given implicitly by the equation $P(Q) = \frac{\partial \mathscr{C}}{\partial Q}(Q,\mu)$. Applying the implicit function theorem to this equality, we obtain

$$\frac{dQ}{d\mu} = -\frac{\frac{\partial^2 \mathscr{C}}{\partial Q \partial \mu}}{-P' + \frac{\partial^2 \mathscr{C}}{\partial Q^2}} < 0. \tag{2}$$

Since supply is competitive, aggregate profits can be written $\Pi(Q,\mu) = \frac{\partial \mathscr{C}}{\partial Q}(Q,\mu)Q - \mathscr{C}(Q,\mu)$. Taking account of (2), the total derivative of Π with respect to μ can be written as

$$\frac{d\Pi}{d\mu} = Q\left[\frac{\partial^2 \mathscr{C}}{\partial Q \partial \mu}\left(1 - \frac{\frac{\partial^2 \mathscr{C}}{\partial Q^2}}{-P' + \frac{\partial^2 \mathscr{C}}{\partial Q^2}}\right) - \frac{1}{Q}\frac{\partial \mathscr{C}}{\partial \mu}\right] \tag{3}$$

an expression which shows that the supply-limiting effect can only be positive if marginal costs rise faster than average costs when quality increases. Equation (3) also shows the importance of the steepness of the (inverse) demand function to achieving a positive supply-limiting effect.

Now specialising equation (3) to our cost specification (1), we obtain

$$\frac{d\Pi}{d\mu} = cL^{-\beta}\beta\mu^{\alpha}Q^{\beta}(1+\alpha)Q\left[1 - \frac{cL^{-\beta}(1+\beta)^2\mu^{1+\alpha}Q^{\beta-1}}{-P' + cL^{-\beta}(1+\beta)\beta\mu^{1+\alpha}Q^{\beta-1}}\right]$$

an equation that shows there is a positive supply-limiting effect if and only if

$$-P' > cL^{-\beta}(1+\beta)\mu^{1+\alpha}Q^{\beta-1}. \tag{4}$$

In our vertical differentiation model, equilibrium price is given by $p = \mu\tilde{\theta}$, where $\tilde{\theta}$ denotes the taste parameter of the indifferent consumer, and $Q = N\int_{\tilde{\theta}}^{1} dF_{a,b}$. Therefore, we have

$$P'(Q) = \frac{\partial p}{\partial \tilde{\theta}}\Big|_{\mu}\frac{d\tilde{\theta}}{dQ} = -\frac{\mu}{N f_{a,b}(\tilde{\theta})}.$$

At the competitive equilibrium, price equals marginal cost, so we have $\mu = \tilde{\theta}^{-1}cL^{-\beta}(1+\beta)\mu^{1+\alpha}Q^{\beta}$. Condition (4) can then be written as

$$\int_{\tilde{\theta}}^{1} dF_{a,b} > \frac{\tilde{\theta}^{a}(1-\tilde{\theta})^{b-1}}{B(a,b)}. \tag{5}$$

The equality between price and marginal cost can also be written as

$$\tilde{\theta} = cL^{-\beta}(1+\beta)\mu^{\alpha}\left(N\int_{\tilde{\theta}}^{1} dF_{a,b}\right)^{\beta} \tag{6}$$

an expression which shows that as $\mu \to 0$, the taste parameter of the indifferent consumer must tend towards zero.[4] But then, for sufficiently small values of $\tilde{\theta}$, condition (5) will be satisfied. (Recall that $a \geq 1$.) Therefore, for small enough quality levels, a positive supply-limiting effect exists.

It is also clear that for sufficiently high quality, the supply-limiting effect becomes negative, and provides an incentive to the PO to decrease quality. To see why, simply note that as $\mu \to \infty$, we must have $\tilde{\theta} \to 1$, a direct consequence of equation (6). But condition (5) is violated for values of $\tilde{\theta}$ sufficiently close to one.

Whether the PO will oversupply quality compared to the social optimum depends on the incentives provided by the demand-enhancing and supply-limiting effects *at the socially optimal allocation*. The positive demand-enhancing effect will provide an incentive to increase quality further from the socially optimal quality. If the supply-limiting effect is also positive at the socially optimal allocation, it will reinforce the demand-enhancing effect and the PO will oversupply quality. Otherwise, the two effects will move in opposite direction. However, we show that in the context of our model the demand-enhancing effect will nonetheless dominate the supply-limiting effect, so that the PO will always oversupply quality.

2.2 The socially optimal quality level

The socially optimal bundle $(\bar{\theta}, \bar{\mu})$ solves

$$\max_{\tilde{\theta},\mu} \quad N\left[\int_{0}^{\tilde{\theta}} \bar{U} dF_{a,b} + \int_{\tilde{\theta}}^{1} (\bar{U} + \theta\mu) dF_{a,b}\right] - \mathscr{C}\left(N\int_{\tilde{\theta}}^{1} dF_{a,b}, \mu\right). \tag{7}$$

The first-order conditions to program (7) are

$$\begin{cases} \bar{\theta}\bar{\mu} = \frac{\partial \mathscr{C}}{\partial Q}\left(N\int_{\bar{\theta}}^{1} dF_{a,b}, \bar{\mu}\right) \\ N\int_{\bar{\theta}}^{1} \theta dF_{a,b} = \frac{\partial \mathscr{C}}{\partial \mu}\left(N\int_{\bar{\theta}}^{1} dF_{a,b}, \bar{\mu}\right) \end{cases}. \tag{8}$$

The first equation is standard and implies that at the social optimum, the willingness to pay of the indifferent consumer must equal the marginal cost of production, for the given quality. The second relation equates the social benefit of increasing quality marginally, identified as the added utility to consumers purchasing the GI product, to its cost.

[4] The parameter $\tilde{\theta}$ cannot tend towards $\theta \in (0, 1]$, for then the left-hand-side would tend towards $\theta \neq 0$ while the right-hand-side would tend towards zero.

The following proposition establishes a restriction on the model parameters which ensures that in the socially optimal allocation, the optimal quality $\bar{\mu}$ is finite and a positive quantity of the GI product is offered.[5]

Proposition 1 *For $(a, b) \in \mathbb{N}^2_{++}$, a necessary and sufficient condition for the GI product to be offered with finite quality $\bar{\mu}$ in the socially optimal allocation is that*

$$\beta < \alpha. \tag{9}$$

When $\alpha \leq \beta$, the solution to the social welfare optimisation program involves setting $\mu \to \infty$ and $Q \to 0$, an unrealistic and hence uninteresting case.

2.3 The quality level chosen by the GI producer association

Since individual producers behave competitively in the second stage of the game, the equilibrium price $p(\mu)$ is equal to aggregate marginal cost and is implicitly defined by the equation

$$p = \frac{\partial \mathscr{C}}{\partial Q}\left(N \int_{\frac{p}{\mu}}^{1} dF_{a,b}, \mu\right). \tag{10}$$

This relation, together with (8), shows that if the PO were to chose the socially optimal quality level $\bar{\mu}$, the allocation would be socially optimal altogether, since the indifferent consumer is defined by $\tilde{\theta} = \frac{p}{\mu}$.

The optimisation program solved by the PO, conditional on a competitive supply behavior by individual producers, is

$$\max_{\mu} \quad p(\mu) N \int_{\frac{p(\mu)}{\mu}}^{1} dF_{a,b} - \mathscr{C}\left(N \int_{\frac{p(\mu)}{\mu}}^{1} dF_{a,b}, \mu\right) \tag{11}$$

with first-order condition

$$N p'(\hat{\mu}) \int_{\frac{p(\hat{\mu})}{\hat{\mu}}}^{1} dF_{a,b} = \frac{\partial \mathscr{C}}{\partial \mu}\left(N \int_{\frac{p(\hat{\mu})}{\hat{\mu}}}^{1} dF_{a,b}, \hat{\mu}\right) \tag{12}$$

where $\hat{\mu}$ denotes the PO choice of quality and we have made use of (10). Equation (12) expresses the condition that at the producer optimum, a marginal increase in quality is such that the marginal benefit, defined as the increase in revenue due to the rise in equilibrium price, keeping the market share constant, must be equal to the corresponding increment in cost. Market share effects do not appear in this equation because the change in revenue from capturing additional customers,

[5] Due to space limitations, all proofs have been removed from this version of our paper. They are available upon request to the authors.

keeping price constant is exactly offset by the increase in cost at fixed quality from additional production, due to equality (10).[6]

Comparison of the sets of first-order conditions (8) and (12) reveals that the PO will supply excess quality if and only if, at the socially optimal quality $\bar{\mu}$, the benefits to producers of increasing quality marginally outweigh the social benefits of doing so (which in this case are equal to the marginal social costs $\frac{\partial \mathscr{C}}{\partial \mu}\left(N \int_{\bar{\theta}}^{1} dF_{a,b}, \bar{\mu}\right)$). This condition can be written as

$$\int_{\bar{\theta}}^{1} (p'(\bar{\mu}) - \theta) dF_{a,b} > 0 \tag{13}$$

where as before $\bar{\theta}$ denotes the taste parameter of the indifferent consumer in the socially optimal allocation. It expresses the fact that at the optimum quality level, the producer benefits from additional quality, understood as the increase in equilibrium price $p'(\bar{\mu})$ multiplied by the current market share, exceed the social benefits, defined as the additional utility obtained by current customers.

The inequality in (13) implies that for the PO to oversupply quality, the marginal increase in equilibrium price from additional quality at the socially optimal quality level, $p'(\bar{\mu})$, must be strictly larger than $\bar{\theta}$, the taste parameter of the indifferent consumer in the socially optimal allocation, although this property alone is not sufficient to guarantee the result.

For the specified functions $f_{a,b}$ and $\mathscr{C}$ condition (13) can be rewritten as [7]

$$\frac{1+\alpha}{1+\beta} > \frac{\bar{\theta}^{a-1}(1-\bar{\theta})^{b-1}[\int_{\bar{\theta}}^{1}(\theta-\bar{\theta})\theta^{a-1}(1-\theta)^{b-1}d\theta]}{[\int_{\bar{\theta}}^{1}\theta^{a-1}(1-\theta)^{b-1}d\theta]^2}. \tag{14}$$

The left-hand side of inequality (14) depends only on the quality and quantity elasticities of the cost function $\mathscr{C}$, while the right-hand side depends on all the parameters of $\mathscr{C}$ (that is, c, L, α and β), a and b, and N.

Lemma 1 *The function* $h(\bar{\theta}) = \frac{\bar{\theta}^{a-1}(1-\bar{\theta})^{b-1}[\int_{\bar{\theta}}^{1}(\theta-\bar{\theta})\theta^{a-1}(1-\theta)^{b-1}d\theta]}{[\int_{\bar{\theta}}^{1}\theta^{a-1}(1-\theta)^{b-1}d\theta]^2}$ *satisfies:*

$$\forall \bar{\theta} \in (0,1) \quad h(\bar{\theta}) < 1.$$

Proposition 1 and Lemma 1 together imply the following proposition.

Proposition 2 *For* $(a,b) \in \mathbb{N}^2_{++}$*, whenever the GI product is produced with finite quality in the socially optimal allocation, the PO oversupplies quality.*

Proposition 2 implies that within the assumptions our model, the PO will oversupply quality irrespective of the sign of the supply-limiting effect at the socially optimal allocation $(\bar{\theta}, \bar{\mu})$. Hence,

[6] Note that $p' > 0$, and an increase in quality may therefore result in an increase or a decrease in the market share of the GI product. In any event, the market share effect is nil.

[7] Derivation available upon request to the authors.

the demand-enhancing effect is always strong enough to outweigh any negative supply-limiting effect at this point. There are, indeed, instances where the supply-limiting effect is negative at the socially optimal allocation. As $\alpha \to \beta$, $\bar{\theta} \to 1$; for $\bar{\theta}$ sufficiently close to one, condition (5) is violated, and the supply-limiting effect is negative.

2.4 Discussion

The incentive of the PO to increase quality relative to the social optimum is illustrated in figure 3 for the case of a uniform distribution of consumer tastes ($a = b = 1$), $N = 1$, and a cost function quadratic in quantity ($\beta = 1$). Quality is assumed to be set at the socially optimal level $\bar{\mu}$. Marginal willingness to pay (demand) for the GI product, taking account of self selection and the availability of the generic product, is represented by the equation $p = \theta\bar{\mu}$. Marginal cost, $\frac{\partial \mathscr{C}}{\partial Q}(Q, \bar{\mu})$ is linear in quantity, therefore it is linear in θ. The figure illustrates the social optimum with $p(\bar{\mu})$ and $\bar{\theta}$, obtained where the marginal cost curve and the demand curve intersect.

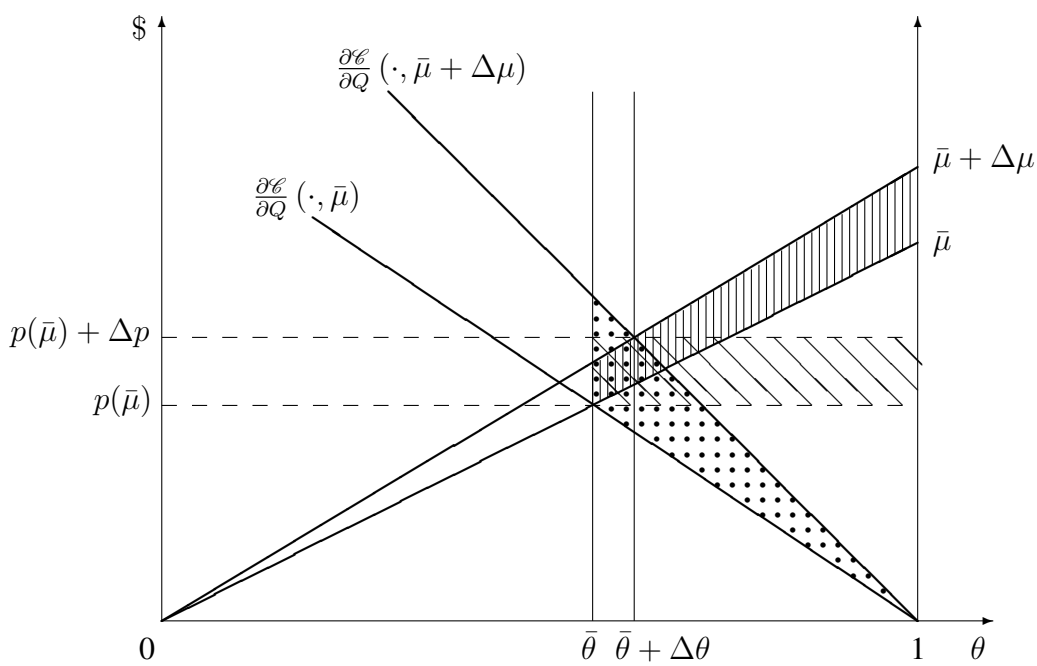

Figure 3: **Effect of a marginal increase in quality, starting from the social optimum $(\bar{\theta}, \bar{\mu})$.**

Now suppose the PO increases quality by a small amount $\Delta\mu$. Both the demand for the GI product and marginal cost rotate upward as a consequence, and the indifferent consumer moves towards the right. This move is necessary for $(\bar{\theta}, \bar{\mu})$ to represent the socially optimal allocation. As indicated by the second condition in (8), in the limit where $\Delta\mu \to 0$ the additional benefit to current customers, depicted as the darkly shaded area, must equal the increase in seller costs at the initial quantity, depicted as the dotted area. It is easily seen on the figure that if the indifferent consumer

were to move to the left, the additional social benefit from increased quality would always exceed the additional costs.

Given that the indifferent consumer moves to the right, equilibrium price rises so that $\Delta p > \bar{\theta}\Delta\mu$. This is because $p(\bar{\mu}) + \Delta p = (\bar{\theta} + \Delta\theta) \times (\bar{\mu} + \Delta\mu)$, which implies (given $p(\bar{\mu}) = \bar{\theta}\bar{\mu}$) that $\Delta p = \bar{\theta}\Delta\mu + \Delta\theta(\bar{\mu} + \Delta\mu)$. The fact that the PO oversupplies quality is illustrated in the figure by the fact that the diagonally shaded area, which represents the increase in seller revenue from existing customers, is larger than the darker, vertically shaded area—which, in the limit when $\Delta\mu \to 0$, must tend towards the dotted area, the additional cost of producing a higher quality—as required by condition (13).

Why does the demand-enhancing effect of an increase in quality always outweigh a negative supply-limiting effect at the societal optimum? For the supply-limiting effect to be negative, the shift in the supply curve resulting from a marginal increase in quality must be such that the quasi-rent to producers decreases. This is more likely to happen the *steeper* the supply curve is *relative to* the demand curve. Indeed, for the case illustrated in figure 3 where $a = b = 1$ and $\beta = 1$, from equation (4) the supply-limiting effect is negative if and only if the slope of the supply curve is steeper than that of the demand curve. The reason is that when the demand curve is relatively flat, shifting the (relatively steep) supply curve upwards does not raise price sufficiently to make up for the increased cost.

However, a supply curve that is steeply sloped also causes the demand-enhancing effect to be large. This is because, at the social optimum, the increase in consumer surplus from a small change in quality must be equal to the rise in cost—keeping the market share constant—which forces the demand curve to shift upwards by a "sufficiently large" amount. (In figure 3, this shift in demand must be large enough to cause the area shaded with vertical lines to be equal to the dotted area.) Because the shift occurs along a relatively steep supply curve, the resulting change in price—holding the supply curve constant,—which entirely drives the demand-enhancing effect, will also be large. Therefore, market settings where the supply-limiting effect is negative at the social optimum correspond to settings where the demand-enhancing effect is large—large enough, based upon Proposition 2, to dominate a negative supply-limiting effect.

3 Conclusion

This study has shown that the joint profit-maximising quality level chosen by a producer organisation will generally exceed the quality level that maximises societal welfare. The result was shown to hold within the context of the classical model of vertical differentiation for a very flexible distribution of consumers' taste for the GI product and with a cost function that is convex in quality and in quantity. Both our cost and demand specifications nest the typical specifications used in the literature to study firms' choices of quantity and quality.

In light of the relative generality of the model, we believe our finding is relevant for policy regarding GI products because it suggests that, in setting up the GI framework in response to incipient adverse selection problems, European policy makers may have "overshot" in the sense of

creating a decision-making apparatus that is likely to result in excessive quality. An appropriate policy response, thus, might be to implement procedures that would act as a brake on this tendency, for example, to include consumer representatives—or ministerial departments in charge of consumer protection—more systematically in the committees in charge of developing and managing GI specification rules, as an alternative to the current producer-driven system.

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