Sales Restriction, Quality Selection and the Mode of Competition

Nicolas Boccard* & Xavier Wauthy†

April 2003

Abstract

A regulator imposing "sales restrictions" on firms competing in oligopolistic markets may enhance quality provision by the firms. Moreover, for most restrictions levels, the impact on quality selection is invariant to the mode of competition.

JEL codes: D43, F13, L11
Keywords: Quality, Quota, Oligopolistic Competition

1. Introduction

Ensuring quality provision by monopolies or regulated utilities has always been a concern for public authorities. This problem becomes even more critical in the context of massive deregulations such as the one we are currently facing in Europe and the United States. Recent examples of quality failure in airlines industries, railways or electricity provision have lead policy makers to believe that competition could be incompatible with quality provision for the presence of strong asymmetries of information. Our aim in this note is to provide comfort to regulators by showing that a simple monitoring tool like a sales restriction can motivate firms to provide high levels of quality.

For this task we use a standard model of Industrial Organization: firms commit to quality levels in a first stage and then compete on the consumer market. This modelling choice is motivated by the long-term nature of quality decisions (sunk cost) relative to price or quantity decisions. In this context, there are two basic reasons explaining why the provision of high quality may not be optimal for firms under oligopoly competition. First, quality may be costly to produce. Therefore, a firm may wish to select a relatively

*Departament d'Economia, Universitat de Girona, Spain
†CEREC, Facultés universitaires Saint-Louis, Bruxelles and CORE, UCL. Financial support from Interuniversity Attraction Pole Program-Belgian State-Federal office for Scientific, Technical and Cultural Affairs under contract PAI 5/26

low quality level for its product, even if this leads to less sales at low prices, simply because it saves on costs. Second, even if producing quality entails no cost, a low quality profile might be optimal because it relaxes competition.

Suppose then that a public authority wishes to alter optimal quality selection by the firms. It may either intervene at the quality selection stage, or at the market competition stage (or both). Public intervention at the market stage, through taxes or subsidies, has been studied very early. This kind of intervention raises a classic issue: the impact of a specific intervention is heavily dependent on the mode of competition at the market stage. Depending on whether firms compete à la Cournot or à la Bertrand, a given policy may have opposite effect on quality selection. The relevant question at this step is therefore: does the government have enough information regarding the mode of competition?

In case of doubts the public authority may prefer to interfere directly at the quality selection stage. A typical intervention at this stage is to alter the strategy space of the firms. Removing low quality levels is typically achieved by imposing Minimum Quality Standards. However, MQS have their own drawbacks. They only constrain firms' choices while leaving untouched their incentives to select low quality levels. Therefore, a MQS requires a close monitoring by the regulator. And again, this raises non trivial informational issues.

In this note, we consider an alternative mechanism aimed at ensuring quality provision: the imposition of "sales restrictions" on the firms active in the market. This mode of regulation works at the market stage and as we show hereafter, its impact on quality selection is largely independent of the mode of competition. Therefore, it is immune against the standard criticism applying to market intervention in oligopolistic industries. Moreover, the key virtue of this mechanism is that is alters firms' incentives regarding quality selection: selecting low quality in order to relax competition is not profitable in the presence of sales restrictions. Therefore, it does not require quality monitoring, as opposed to MQS.

In order to capture the intuition underlying our proposal, we develop a very simple model. Suppose a government wishes to offer protection to an entrant facing competition by an incumbent firm. Assuming that the incumbent is already committed to its quality before the sales quota is enforced allows us to concentrate on the quality selection of the entrant only. In order to analyze the role of the competition mode, we compare the optimal quality selection of the entrant under Cournot and Bertrand competition at the market stage, as a function of the "sales restriction" level. We show that for most values of this quota, the optimal quality selection of the entrant is the same under Cournot and Bertrand competition, and is greater than the optimal quality selected in the unconstrained game. Most often, the optimal quality level is negatively related to the tightness of the sales restriction. However, as compared to Cournot, the range where the quota is effective is larger under Bertrand competition.[1]

2. The Model

Consumers preferences are derived from the model of Mussa and Rosen (1978). Consumer j exhibits a taste for quality θ_j and derives an indirect utility $\theta_j s - p$ when consuming a product of quality s, bought at price p. Not consuming yields a utility of 0. Consumers' types are uniformly distributed in the $[0,1]$ interval. The density is 1, and is taken as a measure of the market size. In order to produce a quality level s, a firm has to incur a sunk cost $c(s) = \frac{s^2}{8}$ (a more general analysis can be found in Boccard and Wauthy (2002)). Marginal cost is assumed to be zero for simplicity. An incumbent originally sells as a monopolist in the market a product of quality $s_i = 1$.[2] We assume this producer to be committed to this quality level.

The sequence of decisions is the following. The government chooses a sales restriction (or a quota) from an interval $[q^{\min}, 1]$ with $q^{\min} > 0$.[3] Given the quota, the entrant firm selects its quality s_e before both firms compete in the last stage of the game. We consider in turn Cournot and Bertrand competition. Notice that given the specification of the sunk cost, we may restrict the analysis of entrant's quality selection to $s_e \leq 1$, i.e. quality leapfrogging by the entrant is not an issue in our setting.

3. Cournot Competition

We first solve the last stage of the game, and then we go backward to study quality selection. The analysis of the unconstrained[4] Cournot game is straightforward. Given qualities and prices, demands are

$$x_i = 1 - \frac{p_i - p_e}{1 - s_e} \tag{1}$$

$$x_e = \frac{p_i s_e - p_e}{s_e(1 - s_e)} \tag{2}$$

[1] Notice that the impact of sales restrictions on quality selection has been studied recently in a specific context. Herguera, Kujal and Petrakis (2000) study the impact of a trade quota imposed on a foreign firm on equilibrium quality selection. However, their analysis is confined to Cournot competition. We compare our results to theirs in the last section of the paper.

[2] Note that $s_i = 1$ is indeed the optimal choice of a monopolist under the cost assumption $c(s) = \frac{s^2}{8}$. The case for endogenous quality selection where the incumbent might not have the highest quality is the object of a more involved paper Boccard and Wauthy (2001).

[3] The introduction of a lower bound for the quota is made to avoid technical problems in the derivation of pricing games. The importance of this assumption is discussed below.

[4] in the rest of the paper, we will use the term "unconstrained" to denote the case where no sales restriction is imposed on the incumbent.

thus the inverse demands characterizing Cournot competition are given by

$$p_i = 1 - x_i - x_e s_e \tag{3}$$

$$p_e = (1 - x_i - x_e) s_e \tag{4}$$

The unconstrained Cournot equilibrium is directly obtained as

$$x_e^c(s_e) \equiv \frac{1}{4 - s_e} \quad \text{and} \quad x_i^c(s_e) \equiv \frac{2 - s_e}{4 - s_e}. \tag{5}$$

Notice that x_e^c is increasing with s_e while x_i^c is decreasing. The entrant's profits at the Cournot equilibrium are given by

$$\pi_e^c(s_e) \equiv \frac{s_e}{(4 - s_e)^2} - \frac{s_e^2}{8}. \tag{6}$$

The only relevant real root to the first order condition for maximization of π_e^c is $s_e^c \simeq 0.363$.[5] This defines the optimal quality selection by the entrant when no sales restriction is imposed. Demand addressed to the incumbent at the unconstrained SPE is $D_i^c \equiv x_i^c(s_e^c) \simeq 0.450$.

We introduce now the sales restriction set at level q. In the analysis to follow we shall distinguish between two notions of effectiveness for the sales restriction.

Definition 1 *A sales restriction is "short-run" effective if it alters the equilibrium outcome at given qualities; it is "long-run" effective if it alters the quality selection.*

If the sales restriction is binding at the Cournot stage (after quality has been set), we have $x_i = q$. Using (4), the market clearing price for the entrant's product is

$$p_e^q \equiv (1 - q - x_e) s_e \tag{7}$$

It is then direct to show that at the "constrained" Cournot equilibrium sales of the entrant are $x_e^{cq} \equiv \frac{1-q}{2}$ and $x_i^{cq} = q$. By maximizing

$$\pi_e^{cq}(s_e) \equiv \frac{(1 - q)^2 s_e}{4} - \frac{s_e^2}{8}, \tag{8}$$

we obtain the optimal quality $s_e^{cq} \equiv (1 - q)^2$ for the entrant conditional on playing a "constrained" Cournot equilibrium afterwards. Thus, the conditional optimal quality selection is decreasing in the sales restriction: the tougher the protection granted to the entrant, the greater the quality it can elicit.

Now, we address the following question: in which range is the sales restriction binding? Once qualities have been selected, it is well known that in a Cournot game the sales

[5] To avoid cumbersome expressions, we retain here, as well as for the results to come, numerical approximations. The optimal value which solves $0 = 16 - 60y + 48y^2 - 12y^3 + y^4$ is $y = 3 - \sqrt{z/2} - \sqrt{3 - z/2 + 6/\sqrt{2z}}$ where $z = 2 + \left(\frac{297 - \sqrt{22353}}{9}\right)^{1/3} + \left(\frac{297 + \sqrt{22353}}{9}\right)^{1/3}$.

restriction is effective only if it is lesser than the demand addressed to the incumbent firm (in equilibrium). However, since the sales restriction is committed to before the quality of the entrant is selected, a sales restriction set above the unconstrained benchmark D_i^c may be effective through its effect on quality selection. These two observations are gathered into the following lemma:

Lemma 1 *Sales restrictions above the unconstrained benchmark* $D_i^c \simeq 0.45$ *are never short-run effective but can be long-run effective if chosen in the range* $[0.45; 0.461]$.

Proof Using (5), we compute the potential demand addressed to the incumbent firm when the entrant chooses s_e^{cq} as $x_i^c(s_e^{cq}) = \frac{2-(1-q)^2}{4-(1-q)^2}$. The incumbent firm is indeed constrained in the Cournot competition only if this demand exceeds the sales restriction. A simple calculation show that this occurs for $q < 0.461$ only. A larger quota does not affect the Cournot equilibrium and the quality selection of the entrant remains s_e^c. ■

As stated in the Lemma, long-run effectiveness can occur but this is up the entrant to implement it. For the constrained equilibrium to take place, the entrant has to select a quality level below the unconstrained one. Observe indeed that s_e^{cq} decreases from 0.302 to 0.293 when the quota ranges in $[0.45; 0.461]$ while $s_e^c = 0.363$. This ability to enforce a "constrained" equilibrium does not mean that it is a wise strategy to follow since quality downgrading lowers profits. In order to identify the range in which this strategy is optimal for the entrant, we have to compare the equilibrium profits $\pi_e^c(s_e^c)$ and $\pi_e^{cq}(s_e^{cq}) = \frac{(1+q)(1-q)^3}{8}$. Solving for q, we obtain as the unique relevant real root $q^c \simeq 0.456 < 0.461$ which therefore defines the critical value below which the sales restriction is effective when committed to before entrant's quality is selected. The next proposition characterizes the impact of a sales restriction under Cournot competition.

Proposition 1 *The equilibrium of the Cournot competition depends on the sales restriction level:*
- *If* $q > 0.456$, *the sales restriction is not effective, the unconstrained Equilibrium obtains.*
- *If* $q \leq 0.456$, *the sales restriction is long-run effective, entrant's quality is* $s_e^{cq} = (1-q)^2$.

Corollary 1 *When the sales restriction* q *passes below the limit* q^c *where it starts to affect the optimal quality choice, the entrant's quality jumps down from* 0.363 *to* 0.296 *(cf. figure 1 p10).*

4. Bertrand Competition

The analysis of Bertrand competition being slightly more complex, we divide it in 4 parts. We first re-derive the unconstrained benchmark equilibrium, then tackle the implications of a sales restriction in a pricing game before solving it. Lastly we turn to the choice of the optimal quality by the entrant.

4.1. Free trade

Under Bertrand competition, demands (1) and (2) enable to compute firms' best reply in the unconstrained pricing game as

$$\Phi_i(p_e) = \frac{1 - s_e + p_e}{2} \quad \text{and} \quad \Phi_e(p_i) = \frac{p_i s_e}{2}. \tag{9}$$

Straightforward computations yield the unique Nash equilibrium:

$$p_e^b = \frac{s_e(1 - s_e)}{4 - s_e} \quad \text{and} \quad p_i^b = \frac{2(1 - s_e)}{4 - s_e}. \tag{10}$$

Using these values, we note that sales are $x_e^b = \frac{1}{4-s_e}$ and $x_i^b = \frac{2}{4-s_e}$ while the entrant's profit is

$$\pi_e^b(s_e) \equiv \frac{s_e(1 - s_e)}{(4 - s_e)^2} - \frac{s_e^2}{8}. \tag{11}$$

The optimal quality selection of the entrant is computed as $s_e^b \simeq 0.1923$ and the associated demand for the incumbent is $D_i^b \equiv x_i^b(s_e^b) = 0.525$.

4.2. Effect of a sales restriction

Let us then consider the presence of a sales restriction. The analysis of quota constrained pricing game with differentiated products has been developed first in Krishna (1989).[6] As shown by Krishna (1989), the first key difference between Cournot and Bertrand competition is that, under price competition, sales restrictions above the unconstrained equilibrium demand of the incumbent are (almost) always "short-run" effective. This is so because a sales restriction deeply alters the structure of the pricing game. Therefore, we first have to study in details the implication of the sales restriction on price competition itself before we turn to the analysis of quality selection.

The key point is the following: Under price competition, consumers may be rationed by the incumbent if its demand exceeds the sales restriction level. Rationed consumers may then report their purchase on the entrant, whose effective sales increase. These rationing spillovers destroy the global concavity of the entrant's payoff and thereby make the existence of a pure strategy equilibrium problematic. Thus, the presence of the sales restriction induces Bertrand-Edgeworth competition at the market stage.

A peculiarity of the present model is that if the entrant sells the low quality, any consumer that is rationed by the high quality incumbent prefers to report his purchase on the entrant's product rather than to refrain from buying. Accordingly, whenever $x_i(p_e, p_i) > q$, the number of consumers who report their purchase on firm e is given by $x_i(p_e, p_i) - q$. It is is then direct to show that the residual demand addressed to the entrant is

$$x_e^q(p_e) = 1 - q - \frac{p_e}{s_e}. \tag{12}$$

[6] We refer the interested reader to her paper for the full analysis os such cases. Regarding price equilibrium, the present analysis is a direct application of the methodology proposed by Krishna (1989).

Using (12) we may define $p_e^q(p_i) \equiv p_i - (1-q)(1-s_e)$ such that $x_i(p_e, p_i) > q \Leftrightarrow p_e > p_e^q(p_i)$. Whenever $p_e \leq p_e^q(p_i)$, the free trade analysis applies and firms' demand are given by (1) and (2). If on the other hand $p_e \geq p_e^q$, the potential demand of the incumbent exceeds the legal limit q so that final sales are $x_e^q(p_e)$ and q respectively. Comparing the derivatives of the entrant's demand function using (1) and (12), we observe that the entrant's demand exhibits an outward kink at $p_e = p_e^q(p_i)$. This kink destroys the concavity of its profits. Thus, the existence of a pure strategy equilibrium is not guaranteed.

4.3. Price equilibrium

We now characterize the nature of equilibrium in the pricing game. The incumbent's best reply is denoted φ_i. We define $p_i^q(p_e) \equiv (1-q)(1-s_e) + p_e$, the frontier of the domain where the sales restriction is binding i.e., the solution of $x_i(p_e, p_i) = q$. Over the non-binding domain the best reply is $\Phi_i(p_e)$ as defined by (9) if it belongs to this domain. Over the binding domain, the incumbent is better off selling q at the highest possible price, which is precisely the frontier price $p_i^q(p_e)$. The formal best reply is thus the minimum of $\Phi_i(p_e)$ and $p_i^q(p_e)$. Solving for equality we obtain $\tilde{p}_e = \max\{(1-s_e)(2q-1), 0\}$. Thus,

$$\varphi_i(p_e) = \begin{cases} \Phi_i(p_e) & \text{iff} \quad p_e < \tilde{p}_e \\ p_i^q(p_e) & \text{iff} \quad p_e \geq \tilde{p}_e \end{cases} \tag{13}$$

Notice that the best reply is kinked and continuous, reflecting the fact that the incumbent's profit is concave in own price.

We turn to the entrant. The profit of the entrant when it benefits from spillovers is $p_e x_e^q(p_e)$ (cf. (12)) and is maximum for $p_e^s = \frac{1-q}{2} s_e$ yielding profits equal to $\frac{(1-q)^2}{4} s_e$. If the sales restriction is not binding, the best reply is $\Phi_e(p_i)$ as defined by (9), yielding a payoff $\pi_e(p_i) = \frac{p_i^2 s_e}{4(1-s_e)}$. Solving for equality among those two profits in the variable p_i, we obtain the critical value $\tilde{p}_i \equiv (1-q)\sqrt{1-s_e}$ for which the entrant is indifferent between the two strategies. The best reply is therefore:

$$\varphi_e(p_i) = \begin{cases} p_e^s & \text{iff} \quad p_i < \tilde{p}_i \\ \Phi_e(p_i) & \text{iff} \quad p_i \geq \tilde{p}_i \end{cases}. \tag{14}$$

Combining (13) and (14), we observe that there is only one candidate for a pure strategy equilibrium: the unconstrained equilibrium as defined by (10).[7] A necessary and sufficient condition for this candidate to be an equilibrium is that $p_i^b > \tilde{p}_i$. Direct computations show that this condition is satisfied if and only if $q > \bar{q}(s_e) \equiv 1 - \frac{2\sqrt{1-s_e}}{4-s_e}$. When this condition is not satisfied, there exist no pure strategy equilibrium.

[7] It is indeed immediate to check that $\tilde{p}_i < p_i^q(p_e^s)$, which is sufficient to rule out any pure strategy equilibrium candidate in the sales restriction binding domain of prices. Therefore, the only remaining candidates must lie in the unconstrained region. There is only one such candidate: the unconstrained equilibrium.

The natural candidate for a mixed strategy equilibrium is then the following one: The entrant randomizes between p_e^s and $f_e(\tilde{p}_i)$ while choosing the weight to put on each pure strategy to ensure that $\tilde{p}_i$ is indeed a best reply for the foreign firm against the mixture. We call this equilibrium the Krishna equilibrium.[8] The following lemma is the essence of Krishna (1989)'s findings:

Lemma 2 *As opposed to the Cournot case, a sales restriction above the unconstrained equilibrium level can be short-run effective in the Bertrand game.*

Proof Direct computations show that $\bar{q}(s_e) > x_i^b(s_e) = \frac{2}{4-s_e}$ is always true. Accordingly, whatever the entrant's quality level s_e, any sales restriction $q \in \left[x_i^b(s_e); \bar{q}(s_e)\right]$ is such that the price equilibrium is a mixed strategy equilibrium involving prices greater than those of the unconstrained equilibrium. In particular, at the unconstrained SPE we have $\bar{q}(s_e^b) = 0.528 > x_i^b(s_e^b) = 0.525$. ■

4.4. Quality selection

Let us assume for the moment that the Krishna equilibrium always exists when the unconstrained one does not and study the issue of quality selection. It is not necessary to compute the mixed strategy explicitly for our present purpose. Indeed, the key point here is to note that in this equilibrium, the entrant earns exactly $\pi_e^s = \frac{(1-q)^2}{4} s_e$ in the Krishna equilibrium.[9] Notice that this is exactly equivalent to the Cournot equilibrium payoffs under a binding sales restriction. Therefore, if the Krishna equilibrium is played at the price competition stage, optimal quality selection by the entrant firm is identical to the quality selection made under Cournot, i.e. $s_e^{bq} = (1-q)^2$, yielding a payoff $\frac{(1-q)^4}{8}$ when we take the sunk cost into account.

In order to delineate the domain in which the sales restriction affects quality selection, consider the optimal quality selection in the unconstrained equilibrium: $s_e^b \simeq 0.192$. As noted above, we need $q > q^b(s_e^b) = 0.528$ for the unconstrained equilibrium to exist in the pricing game. On the other hand, it is always possible for the entrant to enforce the Krishna equilibrium by choosing a high enough quality. In order to identify the optimal strategy, we compare the corresponding payoffs. Direct computations indicate that $\pi_e^b(s_e^b) < \frac{(1-q)^4}{8}$ whenever $q < q^b \simeq 0.530$, where q^b defines the critical value above which the sales restriction is neither long-run nor short-run effective under Bertrand competition. Our findings are summarized in the following proposition.

Proposition 2 *The equilibrium of the Bertrand competition depends on the sales restriction level:*

[8] We refer the interested reader to Krishna (1989), Theorem 2, for the detailed construction of this equilibrium.

[9] In a mixed strategy, the equilibrium payoff can be computed at any of the firm's atom. Since the entrant faces a pure strategy, its equilibrium payoff, computed at p_e^s must be $\frac{(1-q)^2}{4} s_e$.

- *If* $q > 0.530$, *the sales restriction is not effective, the unconstrained Equilibrium obtains.*
- *If* $q \leq 0.530$, *the sales restriction is long-run effective, entrant's quality is* $s_e^{bq} = (1-q)^2$.

Corollary 2 *At the limit* $q^b \simeq 0.530$ *where the sales restriction starts to affect the optimal quality choice, the entrant's quality jumps up from* 0.192 *to* $(1-q^b)^2 = 0.221$.

Let us then briefly comment on the existence of the Krishna equilibrium. Indeed, this equilibrium does not always exist. For this equilibrium to exist, the incumbent's demand must satisfy the non-negativity constraint $x_i(\Phi_e(\tilde{p}_i), \tilde{p}_i) > 0$. Direct computations show that this is the case if only $q > 1 - 2\sqrt{1 - s_e}$. In other words, there exists a lower bound on the sales restriction value, which depends positively on s_e below which the Krishna equilibrium does not exist. This condition imposes restrictions on the admissible values of the sales restriction only if $s_e > 3/4$ holds. Notice then that $(1-q)^2 > 3/4$ if only $q < 0.134$. As a consequence, our analysis is fully compelling if we assume $q^{\min} \geq 0.134$. Hence our initial assumption of a lower bound on the admissible values for the sales restriction.[10]

5. Comparing Cournot and Bertrand

As shown by Krishna (1989), the impact of a sales restriction at the market stage depends on the mode of competition. This result is best observed in our framework by noting that a sales restriction set slightly above the unconstrained SPE $D_i^c \simeq 0.450$ is never short-run effective under Cournot while it is always short-run effective under Bertrand. However, a sales restriction has also long-run implications. By comparing quality selection by the entrant producer, we may now assess the long-run effectiveness of sales restrictions with the help of Figure 1 below.

Firstly $q^b \simeq 0.530 > q^c \simeq 0.456$ implies that the range for an effective sales restriction is larger under Bertrand than under Cournot. Secondly, note that for a large domain of sales restrictions the quality selection is invariant to the mode of competition. Within this domain, a government may increase quality simply by making the sales restriction tighter. Last, as compared to their respective unconstrained values, the optimal quality cannot decrease because of the sales restriction under Bertrand competition while there exists a domain of sales restriction values, above the Free Trade benchmark for which the sales restriction induces quality downgrading under Cournot.

The intuition underlying our result is easy to summarize. The presence of the sales restriction softens competition, especially from the point of view of a low quality firm.

[10]When the Krishna equilibrium does not exist, there exists fully mixed strategy equilibria involving a finite number of atoms. We have not been able to fully characterize them. However, Levitan and Shubik (1972) provide a characterization for the particular case where $s_e = 1$. For the relevant domain of sales restriction values, the payoff of the entrant at $s_e = 1$ dominates the unconstrained benchmark. Hence, in this domain, it must be the case that the equilibrium quality is larger than the unconstrained one.

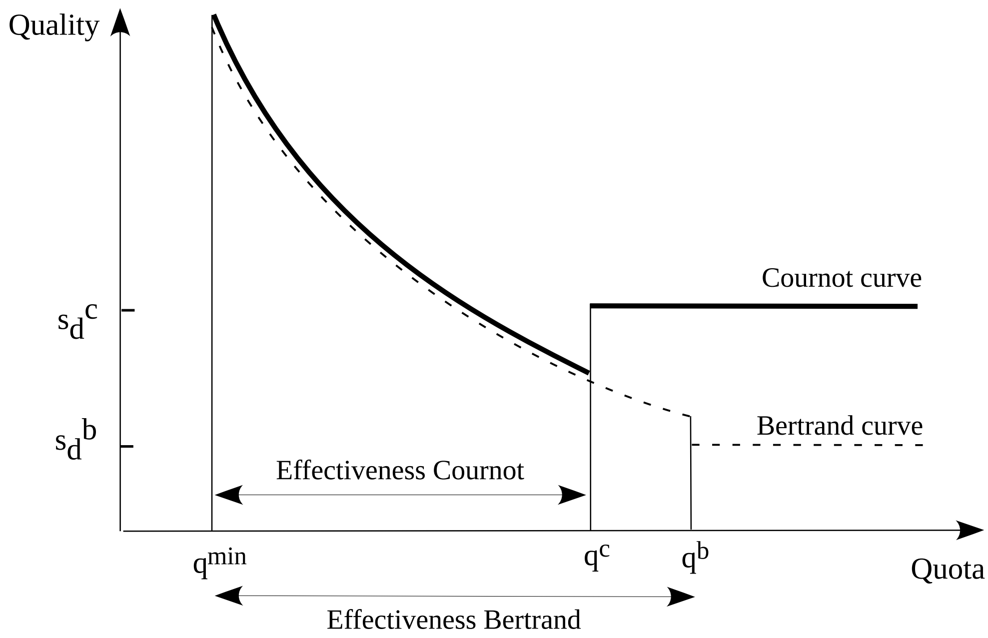

Figure 1: Comparing the two modes of competition

Under Cournot competition, this increases the marginal values of quality upgrading. Under Bertrand competition, the effect is even more striking. Sales restrictions relax price competition so drastically that they remove any strategic incentives to select a low quality level. There is indeed no need to relax price competition further.

As mentioned in the introduction, Herguera et al. (2000) considered a problem similar to ours, in the specific context of international trade. In our framework, their model corresponds to the Cournot case. The quota is imposed on the foreign firm (the incumbent in our case) and they conclude to the following: as compared to the free trade equilibrium, the domestic firm (the entrant) is likely to select a higher quality in the presence of a restrictive sales restriction (lesser than the foreign sales under free trade) (see their Proposition 2.a). If the sales restriction is set just above the foreign sales under free trade equilibrium it is still effective in the sense that it alters the quality choice of the domestic firm. More precisely, the domestic firm selects a lower quality, as compared to free trade. (see Herguera et al. (2000), Proposition 1). In this respect, our analysis shows that the risk of a local quality downgrading is entirely specific to the Cournot framework.

Our results have been obtained in a highly stylized framework. In particular, assuming that the incumbent does not alter its quality selection as a response to the sales restriction considerably eases the analysis. However, it is our belief that these results capture some basic implications of "sales restrictions" on quality selection in more general settings. In Boccard and Wauthy (2000), we consider a trade game where the domestic and the foreign firms are free to choose any quality level, and thus induce any quality ranking between the domestic and the foreign product after the sales restriction is implemented.

We reach qualitatively similar conclusions: incentives to quality selection under Bertrand competition are in line with those prevailing under Cournot whenever the sales restriction is effective. The degree of product differentiation decreases when the sales restriction becomes tighter. When it becomes long-run effective, a sales restriction induces a marked quality upgrading under Bertrand.

In substance, the present note aimed at providing a simplified example in which the role of "sales restrictions" as a mean to regulate quality provision could be exposed. It is our belief that this mechanism is worth being investigated further. Several generalizations of our example have to considered. Shouldn't the two firms be constrained? Would a firm, or two, voluntarily choose to constraint its sales? A common feature of these generalizations is that they require a more general analysis of sales-constrained pricing games with differentiated products. The characterization of price equilibria in such settings is on our research agenda.

References

[1] Boccard, N. and Wauthy, X. (2002), Equilibrium Vertical Differentiation in a Bertrand Model with Capacity Precommitment, Forthcoming *International Journal of Industrial Organization*

[2] Boccard, N. and Wauthy, X. (2001), Import quotas foster minimal differentiation in vertically differentiated industries, revision of CORE DP 9818

[3] Herguera, I., Kujal, P. and Petrakis, E. (2000), Quantity Restrictions and Endogenous Quality Choice, *International Journal of Industrial Organization* 18, 1259-1277

[4] Krishna, K (1989), Trade Restrictions As Facilitating Practices, *Journal of International Economics* 26, 251-270

[5] Levitan, R. and Shubik, M. (1972), Price Duopoly and Capacity Constraints, *International Economic Review* 13, 111-122

[6] Maggi, G. and Rodriguez-Clare, A. (2000), Import Penetration and The Politics of Trade Protection, *Journal of International Economics* 51, 287-304

[7] Mussa, M, and Rosen, S. (1978), Monopoly and Product Quality, *Journal of Economic Theory* 18, 301-317