Are Geographical Indications a Worthy Quality Signal? A Framework on Protected Designation of Origin with Endogenous Quality Choice

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ABSTRACT

The paper provides a theoretical framework to analyze the welfare effects of Protected Designation of Origin (PDO) labelling and of quality choices inside and outside the label on different types of consumers and producers, depending on whether quality is intrinsically linked to the territory of production or not.

1. Introduction

Are geographical indications (GIs) worthy quality signals for agri-food products? Does origin labelling convey relevant information and encourage quality improvement? Or is it mainly a means for agri-food chains to capture undue rents? These questions have been and remain conflicting among countries and among producer and consumer groups. The mere existence of a label certifying the place of origin of a product can suggest to consumers that localization confers some qualities to this product. If no pre-established link exists between quality and territory, and if producers granted with a GI do not undertake genuine efforts to improve quality, then origin labelling may well be considered as false advertising. In this case, GIs may relax competition intensity and provide rents to producers inside the geographical area without benefitting consumers. On the opposite, GIs are likely to be warranted if natural factors and accumulated know-how in the place of origin do confer some specific quality attributes to products, if reputation provided by GIs helps producers to improve their quality, or if consumers wish to defend for itself the fact that production took place in a given area with given methods of production.

These issues may be illustrated with the example of the European Union (EU) rules on

Protected Designation of Origin (PDO), which are one type of GIs (EU Regulation 2081/92). This regulation stipulates that PDO labelling may be granted to a product originating from a specific region, and "*the quality or characteristics of which are essentially or exclusively due to a particular geographical environment with its inherent natural and human factors, and the production, processing and preparation of which take place in the defined geographical area*". The preambule of this Regulation states that PDO protection is beneficial both for consumers and producers: for consumers, by giving them information regarding the origin of products and by making available high-quality products with guarantees as to the method of production and origin; for producers, by helping securing higher incomes in return for a genuine effort to improve quality, and by retaining rural population in less-favoured or remote areas.

In practice, this legal framework allows a lot of flexibility on production and processing rules, and PDOs are very heterogenous with this respect. For example, for some cheeses, production rules define authorized animal breeds, limit animal spatial density and forbid use of silage in animal feed, while other cheeses protected by PDO show no restriction on these criteria. Traditional versus industrial aspects of cheese processing as well as maturing length also vary widely between cheeses. These criteria may also change across time. For example, EU regulation 828/2003 modifies the geographical area and/or production/processing rules for sixteen PDOs, with criterias strenghtened or decreased depending on cases. These examples suggest that PDO labelling is quite independent from restrictiveness of production/processing rules and therefore from quality efforts. As to the link between product characteristics and inherent natural and human factors supposedly required in the Regulation, it is in effect hard to prove. While it has been questioned by some stakeholders, especially for processed products where particular attributes of raw agricultural products may be partially destroyed during the processing stage, some technology studies tend to prove that it may exist and be preserved at least through some of the possible

transformation technics.

Although a number of papers have recently discussed issues about GIs, only few have yet framed them into a theoretical model. More generally, the relevant economic literature to study GIs and PDOs is that on information asymmetry, quality signalling and firm reputation (Lucatelli 2000, Josling 2005).

One article that indeed provides many interesting insights for the issue of PDO is that of Crampes and Hollander (1995a) on denomination or appellation standards. This article builds on a stylized fact about harmonization of the standard for gold in the EU, which has led France to diminish the number of karats that a metal has to contain in order to be called "gold". The authors examine how relaxing this standard affects different producers and consumers. They model the appellation standard as certifying that quality is at least equal to a given threshold. They adopt a vertical differentiation framework where consumers value the intrinsic quality level of the good they consume as well as the presence of a label on this good, and where a high-quality firm in the standard competes with a low-quality firm outside the standard. They show that relaxing the denomination standard benefits high-quality producers.

Zago and Pick (2004) study similar issues in a paper precisely about PDO, but comparing situations with and without standard rather than considering variations in the standard level. Their framework is different, in that it considers a credence good produced under two exogenous quality levels (a high level that may possibly be labelled as PDO, and a low one), with initial perfect competition in both regions, and with PDO label introduction potentially conferring market power to PDO producers.

In connection with this literature, this paper aims at contributing to the understanding of PDO effects. Contrarily to the studies quoted above, and in line with our stylized facts from European PDO regulation, we do not assume a priori that the PDO region produces the highest quality level.

Rather, we start from assumptions on potential links between quality and territory, for consumers and for producers, from which we derive relative quality levels inside and outside the region with PDO labeling. We discuss the conditions under which the quality level is higher in the PDO region.

2. Theoretical framework

Our framework draws on standard features of vertical quality differentiation models (Mussa and Rosen 1978, Ronnen 1991, Crampes and Hollander 1995a and 1995b, Cremer and Thisse 1994, Lambertini 1996). We consider two production regions, region *a* that may pretend to PDO labelling (latter called "PDO region") and region *b* where no PDO labelling is possible (latter called "non-PDO region"). Consumers purchase zero or one unit of the product. They value gustatory quality for both goods, while they value geographic origin only for the good produced in the PDO region. Their utility is assumed additive in each characteristic and represented by the function:

(1) $U = \alpha\, Ind(a) + \beta\, q_i$,

where α and β are parameters capturing the intensity of the preference for each attribute, geographical origin (α) and gustatory quality (β), $Ind(a)$ is an indicator number equal to one if the good is produced in the PDO region and zero if it is produced in the non-PDO region, and q_i is the quality level in region *i*.

We assume that consumers have identical preferences for regional origin but differ in their preferences for quality. More specifically, we let α equal $\hat{\alpha}$ for all consumers and β be distributed uniformly on the interval $[\underline{\beta}, \overline{\beta}]$. We leave out informational problems and assume that the origin of each good is perfectly accessible to all consumers at no cost. PDO labelling may be granted to producers in the PDO area for any quality level they produce (in this, we depart from the model of

Crampes and Hollander (1995a) which assumes that appellation labelling only signals quality above a given threshold).

There exists one potential producer in each region. Fixed costs of production are zero. Variable costs of production are constant in quantity and quadratic in quality, of the form $C_i(x_i, q_i) = x_i\, t\, q_i^2$ where x_i denotes quantity and t is a parameter. Firms compete in two stages. In the first stage, they simultaneously choose their quality levels. In the second stage, they simultaneously determine prices. We study the equilibria in which the two firms, PDO and non-PDO, are active. We determine duopoly conditions and study whether both configurations are possible, the one in which the PDO firm produces the highest quality good and the one in which it produces the highest quality good.

Our demand framework is equivalent to the one used by Motta (1993), Cremer and Thisse (1994) and Lambertini (1996) (except for the addition of our constant parameter of preference for origin $\hat{\alpha}$). Our supply framework with quadratic variable costs and one firm producing each type of good is also the same as theirs. The main difference between the frameworks of these papers is their assumptions on market coverage. In terms of our model's parameters, Motta (1993) assumes that $\underline{\beta}$ is equal to zero. Then, because the utility they get from any of the two goods does not cover the price they would have to pay for it, there always exist some consumers with a low β who do not consume any of these goods (uncovered market). With this framework, Motta has to choose a numerical value for $\overline{\beta}$ in order to be able to solve the first stage of the game and determine equilibrium qualities. On the contrary, Motta and Thisse (1994) and Lambertini (1996) assume a positive value for $\underline{\beta}$ and restrict the analysis to the case where $\underline{\beta}$ is sufficiently high so that even the consumer with the lowest valuation for quality, $\underline{\beta}$, consumes one of the two goods in equilibrium (covered market). With this assumption, they are able to solve analytically for the two

stages of the game.

To be able to get to analytical solutions in our model with a preference for the origin in the PDO region ($\hat{\alpha} > 0$), we choose to study only the case where the market is covered. As Cremer and Thisse and Lambertini, we assume that $\overline{\beta} = \underline{\beta} + 1$.

3. May the PDO firm produce a lower quality than the outside firm?

We study the two cases where both firms are active (duopoly) and where the market is covered, the case where the PDO good is the high-quality good and the case where it is the low-quality good. Then, we determine the conditions on parameters $\overline{\beta}$, t and $\hat{\alpha}$ under which these equilibria arise (duopoly with covered market). We obtain that these conditions are the same in both types of equilibria. They are summarized in Condition 1 below (all proofs are given in the Appendix).

Condition 1. (a) $16\,t\,\hat{\alpha} < 9$; (b) $\underline{\beta}^2 > 1 + \left(\frac{9 - 16\,t\,\alpha}{12}\right)^2$

In Condition 1, inequality (a) ensures that the second order condition of the profit maximization at the first stage of the game holds, while inequality (b) ensures that the market is covered. Our results are summarized in Proposition 1 below.

Proposition 1. Assume that Condition 1 holds. Letting x^* denote the equilibrium value of variable x, two types of duopoly equilibria may emerge, one where $q_a^* < q_b^*$, and one where $q_a^* > q_b^*$. Demands for each good, profit levels of each firm, the degree of differentiation (difference between

high and low qualities) and total consumer welfare are identical in each of these two equilibria. In the equilibrium in which the PDO good is the low-quality good, the low and the high quality levels are higher and the difference between the high the low quality prices is lower than in the equilibrium in which the PDO good is the high-quality good.

Analytical results are summarized in Table 1.

[Insert Table 1].

To get insights on these results, it is useful to recall the results obtained in the standard case where $\hat{\alpha} = 0$ (Motta and Thisse 1994, Lambertini 1996). They are summarized in Table 2. In this case, at the duopoly equilibrium, each firm serves half of the total market, both firms obtain the same profit, and the degree of differentiation is $3 / 4\ t$.

[Insert Table 2].

With our assumption of a positive utility associated with the product of origin ($\hat{\alpha} > 0$), we logically obtain that at a duopoly equilibrium with a covered market, the PDO firm necessarily faces a higher demand and gets a higher profit than the non-PDO firm. The interesting result is that the PDO good may either be the low-quality or the high-quality good, and that profits of each firm and total consumer surplus are the same whatever which of these two possible equilibria emerges. In other words, there is a priori no reason for the PDO region to provide a higher or a lower quality than the non-PDO region. In each of these two equilibria, the degree of differentiation is identical and equal to $3 / 4\ t$, i.e. the same than in the standard model with $\hat{\alpha} = 0$.

4. Conclusion

This paper gives the first step of a study aimed at analyzing the effects of PDO labelling when no a priori assumption is made on relative quality levels in the PDO and non-PDO regions.

Thus far, the analysis is restricted to the simple case considered in the paper (one firm per region, identical cost functions for both firms, Mussa-Rosen type vertical differentiation framework with a covered market and with an attribute of preference for the good produced in the PDO region). Interestingly, we find that when quality is determined endogenously in the model, it is a priori not possible to determine whether the PDO region will produce the high-quality or the low-quality good, and each of these two possible situations yields identical profits for both firms and identical total consumer welfare.

Future research could extend this work in several directions. It could be relevant to consider an alternative assumption on preferences, where the higher the quality level, the more consumers value the geographic origin, with for example $U = (\alpha a + \beta) q_i$. We could also compare welfare with and without PDO labelling if the territorial origin is a credence attribute, unknown to consumers in the absence of labelling, while the gustatory quality of the product is known even in the absence of labelling. Our current formulation assumes identical variable cost functions in both regions. Actually, the cost of producing a given level of quality may be lower or higher in the PDO region than in the outside region, depending on whether the quality level is intrinsically linked to the place of origin through natural and human factors, whether general production conditions are harder in the PDO region, and which of these effects dominates. The assumption of identical variable cost functions for both regions has been maintained here for simplicity reasons, but extensions of this work could consider the case where these cost functions differ. At least, we could consider that minimum requirements on production/processing methods are requested to get PDO labelling and discuss the conditions under which PDO labelling encourages producers in and outside the PDO region to increase or to decrease their quality level.

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Table 1. Description of the Duopoly Equilibria With a Covered Market

		PDO good	non-PDO good
$q_a^* < q_b^*$	Quality	$q_a^{1*} = \frac{12\bar{\beta} + 16\,t\,\hat{\alpha} - 15}{24\,t}$	$q_b^{1*} = \frac{12\bar{\beta} + 16\,t\,\hat{\alpha} + 3}{24\,t}$
	Price	$p_a^{1*} = \frac{256\,t^2\hat{\alpha}^2 + 144\bar{\beta}^2 + 384t\hat{\alpha}\bar{\beta} - 96t\hat{\alpha} - 360\bar{\beta} + 441}{576t}$	$p_b^{1*} = \frac{256\,t^2\hat{\alpha}^2 + 144\bar{\beta}^2 + 384t\hat{\alpha}\bar{\beta} - 288t\hat{\alpha} + 72\bar{\beta} + 225}{576t}$
$q_a^* > q_b^*$	Quality	$q_a^{2*} = \frac{12\bar{\beta} - 16\,t\,\hat{\alpha} + 3}{24\,t}$	$q_b^{2*} = \frac{12\bar{\beta} - 16\,t\,\hat{\alpha} - 15}{24\,t}$
	Price	$p_a^{2*} = \frac{256\,t^2\hat{\alpha}^2 + 144\bar{\beta}^2 - 384t\hat{\alpha}\bar{\beta} + 288t\hat{\alpha} + 72\bar{\beta} + 225}{576t}$	$p_b^{2*} = \frac{256\,t^2\hat{\alpha}^2 + 144\bar{\beta}^2 - 384t\hat{\alpha}\bar{\beta} + 96t\hat{\alpha} - 360\bar{\beta} + 441}{576t}$

Table 1 (continued)

		PDO good	non-PDO good
Both Equilibria	Demand	$\frac{9+16t\hat{\alpha}}{18}$	$\frac{9-16t\hat{\alpha}}{18}$
	Unit Profit	$\frac{9+16t\hat{\alpha}}{24t}$	$\frac{9-16t\hat{\alpha}}{24t}$
	Total Profit	$\frac{(9+16t\hat{\alpha})^2}{432t}$	$\frac{(9-16t\hat{\alpha})^2}{432t}$
	Total Consumer Surplus	$\frac{432\bar{\beta}(\bar{\beta}-1)-256t^2\hat{\alpha}^2+864t\hat{\alpha}-621}{1728t}$	

Table 2. Equilibrium when $\hat{\alpha} = 0$

	High-Quality Good	Low-Quality Good
Quality	$\frac{4\bar{\beta}+1}{8t}$	$\frac{4\bar{\beta}-5}{8t}$
Price	$\frac{16\bar{\beta}^2+8\bar{\beta}+25}{64t}$	$\frac{16\bar{\beta}^2-40\bar{\beta}+49}{64t}$
Demand	$\frac{1}{2}$	$\frac{1}{2}$
Unit Profit	$\frac{3}{8t}$	$\frac{3}{8t}$
Total Profit	$\frac{3}{16t}$	$\frac{3}{16t}$

Appendix

Demand functions are given by $D_a = \tilde{\beta} - \underline{\beta}$ and $D_b = \overline{\beta} - \tilde{\beta}$ in the case where $q_a < q_b$, and $D_a = \overline{\beta} - \tilde{\beta}$ and $D_b = \tilde{\beta} - \underline{\beta}$ in the case where $q_a < q_b$, with $\tilde{\beta} = \frac{p_a - p_b - \hat{\alpha}}{q_a - q_b}$. Profit functions are $\pi_i = D_i(p_i - t\, q_i^2)$, $i = a, b$.

For each of the two possible cases ($q_a < q_b$ and $q_a < q_b$), the equilibrium is solved by backward induction. Solving the second stage of the game gives equilibrium prices p_a and p_b as functions of exogenous parameters t, $\hat{\alpha}$ and $\overline{\beta}$ and quality levels q_a and q_b. In each of the two cases, when solving the first stage of the game, we find that 5 couples of quality levels may qualify for first-order conditions. Out of these 5 couples, we are able to eliminate one couple that does not satisfy the condition on the relative levels of q_a and q_b and to eliminate three other couples that do not satisfy the second-order condition of profit maximization at the first stage of the game. We are then left with one couple of quality levels in each case. This couple satisfies the second order condition of profit maximization at the first stage of the game under Condition 1a.

The next stage is to determine the conditions under which the duopoly solution emerges with a covered market. In the case where $q_a < q_b$, we need: (1) $\underline{\beta} < \tilde{\beta} < \overline{\beta}$, which is always fulfilled if Condition 1a holds, and (2) $\frac{p_a - \hat{\alpha}}{q_a} < \underline{\beta}$, which is

equivalent to Condition 2b. In the same way, in the case where $q_a > q_b$, we need: (1) $\underline{\beta} < \tilde{\beta} < \overline{\beta}$, which is always fulfilled if Condition 1a holds, and (2) $\frac{p_b}{q_b} < \underline{\beta}$, which is equivalent to Condition 2b.

At least, total consumer surplus is given by $\int_{\underline{\beta}}^{\tilde{\beta}} (\hat{\alpha} + \beta q_a - p_a) d\beta + \int_{\tilde{\beta}}^{\overline{\beta}} (\beta q_b - p_b) d\beta$ if $q_a < q_b$, and $\int_{\underline{\beta}}^{\tilde{\beta}} (\beta q_b - p_b) d\beta + \int_{\tilde{\beta}}^{\overline{\beta}} (\hat{\alpha} + \beta q_a - p_a) d\beta$ if $q_a > q_b$.

Detailed solutions are available upon request.