Quality labels and rural development : a new economic geography approach

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Signes officiels de qualité et développement rural : une approche par la nouvelle économie géographique

Résumé – Certaines stratégies de développement rural reposent sur l'hypothèse que les signes de qualité peuvent engendrer, par effets induits, une croissance économique et l'arrivée de nouvelles populations et activités. Afin d'étudier la validité de cette hypothèse, un modèle d'économie géographique est proposé. Un bien agricole spécifique (" label ") est supposé être produit par des agriculteurs qui coopèrent pour fixer un prix de monopole et contrôler le nombre de producteurs. Il existe un arbitrage entre le nombre de producteurs de biens de qualité et leur revenu individuel. De plus, l'effet positif sur le développement rural dû à l'augmentation de la demande en provenance des agriculteurs est contrebalancé par un effet opposé dû à l'augmentation des salaires urbains. Un coût de transport supérieur pour le bien de qualité renforce l'effet positif sur l'industrialisation rurale, mais limite la taille du secteur agricole différencié.

Mots-clés : développement rural, appellations d'origine, nouvelle économie géographique

Quality labels and rural development : a new economic geography approach

***Summary** – Some rural development strategies are based on the assumption that quality labels may act as levers for inducing economic growth and population migration to rural areas. To investigate the validity of this assumption, we use a new economic geography model. A specific ("labelled") agricultural good is assumed to be produced by farmers who co-operate in order to set a monopoly price and control the number of producers. We find that there is a trade-off between the number of differentiated farmers and their individual income. Besides, the positive effect of agricultural differentiation on rural industrialization, due to increased demand for industrial goods, is offset by an opposite effect due to urban wages rise. Higher transport costs for the specific good favour rural industrialization but limit the size of the differentiated agricultural sector.*

***Key-words** : rural development, designation of origin, new economic geography*

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RURAL DEVELOPMENT strategies are often based on the production of differentiated agricultural goods, that may be sought after by consumers, because of their (supposed) typicality, health quality, or environmental innocuousness. These strategies are thought to be particularly suited for peripheral regions, in which such specific goods may be seen as an immobile comparative advantage [1]. The European Union indirectly supports them, by granting official labels that are linked to the area of production, namely Protected Designations of Origin (PDO) and Protected Geographical Indications (PGI). In 1997, about 17 % of the cheese produced in the EU was under PDO (Lagrange *et al.*, 2000). The success in capturing the rent resulting from differentiation varies greatly among regions and labels (Chappuis and Sans, 2000 ; Wilson *et al.*, 2000). However, the mark-up relative to generic products can be quite high. The price of labelled products may even exceed twice the price of generic products (see for instance Skuras and Vakrou (2000) for wine, Steiner (2001) for potatoes).

The objective of this paper is twofold. First, it aims at clarifying the conditions under which agricultural differentiation (quality labelled production) is profitable for farmers. Second, it investigates whether increased demand for manufactured products in the rural region, generated by specific good production, may induce other activities to settle. It is often taken for granted that a higher income for farmers would generate positive effects on the local economy, thanks to demand multiplier effects. However, this assumption needs to be studied under more scrutiny. To this end, new economic geography seems a natural framework. In most theoretical papers on economic geography, the agricultural sector is not a subject of interest *per se*, but is merely introduced as a dispersion force that tempers agglomeration effects (Fujita and Thisse, 2002). Nevertheless, some economic geography models do include refinements on the agricultural sector. For instance, Calmette and Le Pottier (1995), Fujita *et al.* (1999, chapter 7) and Puga (1999) study the effect of introducing transport costs in agriculture, and show that they act as a supplementary dispersion force. Picard and Zeng (2003) consider a model with two different and partly substitutable agricultural products, each produced in a particular region. In their model, the outcome heavily depends on the parameters of agricultural transport costs, which again temper agglomeration processes. In that model, both varieties play a symmetric role.

Closer to the purpose of our article, Kilkenny and Daniel (2001) also aim at determining the effect of specific agricultural production on rural development. They use an economic geography model in which each region produces both a generic and a specific agricultural good. Our approach differs in several important points from theirs however. The two main differences are that we introduce co-ordination in the agricultural sector, and that we study the impact of product differentiation on industry. Thus, the research questions addressed in these two papers are complementary.

[1] Note that these products need not be agricultural nor physical goods. Their main characteristic is to be linked to the region. They may well for instance consist of tourism activities.

Apart from Kilkenny and Daniel's work, there have been some attempts at microeconomic modelling of some aspects of quality labels. Most works focus on industrial organisation topics such as cartel behaviour (Marette *et al.*, 1999), and institutional regulation in a context of information asymmetries (Jayet and Fuentes-Castro, 2001), while Chambolle and Giraud-Héraud (2003) study the trade-off between a collective quality label and a private brand for an industrial firm.

In this paper, we use a microeconomic model, stemming from Krugman's (1991) seminal article on economic geography, to investigate the conditions under which a differentiation strategy based on a label may lead to economic growth in a rural region. Despite very specific functional forms, this framework fits our question well, as it has been designed to study how positive externalities in industry may lead to situations where all footloose economic activity becomes concentrated in one region. As it is a general equilibrium model, it allows us to study indirect effects between sectors [2].

The agricultural sector produces two commodities, a generic and a specific (quality) product. The specific product is supposed to be imperfectly substitutable with the generic agricultural product. It is produced by specialised farmers who collude to maximise their joint profit. This stylised assumption accounts for the fact that key success factors of quality labels are product specificity and coordination in the supply chain (Barjolle and Sylvander, 2000).

The rest of the paper is organised as follows. It first presents the basic economic geography model, and in particular the condition under which differentiation in the farming sector occurs, and the main comparative static properties of the spatial equilibrium. Then it investigates whether agricultural differentiation may induce industrial activity in a rural region first without, then with transportation costs for agricultural goods.

The model

Consumers

Following Krugman (1991), we assume that households consume two types of goods, agricultural and manufactured. The utility function is of the form :

$$U = A^{1-\mu}M^{\mu}$$

where A and M are sub-functions of each type of good respectively. Parameter μ corresponds to the share of manufactured goods in consumption. To introduce differentiation in the farming sector, following Fujita *et al.* (1999), we use a CES

[2] An alternative possibility would have been to use Ottaviano, Tabuchi and Thisse's (2002) framework, which has the advantage of leading to analytic expressions, because of the linear form of the demand functions. It cannot account for income effects however. As we want to study the impact of increased demand on other sectors, this framework was not chosen here.

(constant elasticity of substitution) form, as in the industrial sector. Sub-functions A and M are then :

$$A = \left(a_S^{\delta} + \int_0^{n_G} a(i)^{\delta} di\right)^{1/\delta} \quad (1.a)$$

$$M = \left(\int_0^{n_M} m(i)^{\rho} di\right)^{1/\rho} \quad (1.b)$$

where a_s is the quantity of the specific agricultural good, the $a(i)$ and $m(i)$ are densities of consumption for generic agricultural goods and manufactured goods respectively. These goods are situated on a continuum of varieties of lengths n_G and n_M respectively. Exogenous parameters δ and $\rho \in (0,1)$ are reverse indices of differentiation of agricultural and manufactured goods respectively. $\gamma=1/(1-\delta)$ and $\sigma=1/(1-\rho)$ are the corresponding elasticities of substitution (γ and $\sigma >1$). As in Kilkenny and Daniel (2001), the specific agricultural good does not differ in nature from the other (generic) agricultural goods from the consumer's point of view[3]. However, this good differs by its production technology and production structure.

Solving the consumer's problem yields the aggregate demand functions :

$$a_S^D = (1-\mu)Y \frac{p_S^{-\gamma}}{p_S^{1-\gamma} + \int_0^{n_G} p_G^{1-\gamma}(j)dj} \quad (2.a)$$

$$a_G^D(i) = (1-\mu)Y \frac{p_G^{-\gamma}(i)}{p_S^{1-\gamma} + \int_0^{n_G} p_G^{1-\gamma}(j)dj} \quad (2.b)$$

$$m^D(i) = \mu Y \frac{p_M(i)^{-\sigma}}{\int_0^n p_M(j)^{1-\sigma} dj} \quad (2.c)$$

where Y denotes aggregate income, p_S, p_G, and p_M being (specific and generic) agricultural and industrial prices respectively.

Agricultural sector

Let us now turn to the supply side in agriculture. The generic agricultural good is assumed to be produced with constant returns to scale under perfect competition,

[3] It may sound awkward that the specific good is not vertically differentiated with regard to the generic one. Adding a vertical differentiation would raise the price of the specific good, but would not alter qualitatively the results of that model. The choice of horizontal differentiation allows to focus on the effects of collusion on prices and profits.

labour being the only production factor. As is usual in economic geography models, productivities are assumed to be the same for all goods and normalised to one, and the generic goods' common price will be used as *numéraire* ($p_G(i) \equiv 1$).

With regard to production, specific agricultural goods differ from generic ones in two ways. First, we make the assumption that specific products require industrial inputs. This is justified by the fact that quality labels often require specific investments to fulfil various requirements. Moreover, these products often undergo transformation on the spot. For instance specific farmers may make cheese, whereas generic farmers just sell milk in bulk to dairies. The second major difference is that while "generic farmers" are independent, "specific farmers" collude and behave as a monopolist. An organization exists that manages production and trade of the specific good. Such organizations are widespread in quality label systems (Barjolle and Sylvander, 2000). They are responsible for elaborating and checking specific requirements for the production technology, and carrying out advertising. In this model, the specific product is treated as if it were produced by individual farmers, but we can also more realistically assume that there are small processing firms composed of farming workforce. We consider that no farmer can break the collusion and free-ride by setting a lower price without being excluded from the label [4].

We assume that there are two factors of production for the specific agricultural product, labour and intermediate goods. In other words, land is supposed not to be restrictive. This is justified by the fact that we are interested in remote rural areas, in which there is already much vacant land. This assumption also justifies the fact that we start from a core-periphery configuration (see below the section on space structure). This is a reasonable assumption, considering that many remote rural regions are facing a continuous decay of land use, especially in remote areas, where precisely many typical quality products come from. Suppose in addition that the production function of a unit farm has a Leontief form :

$$a_S^S(j) = \min\left(\alpha, \beta\left(\int_0^n x(i)^{(\sigma-1)/\sigma} di\right)^{\sigma/(\sigma-1)}\right) \tag{3}$$

where $a_s(j)$ denotes the supply from farm j, α is the productivity of a unit of labour, β is a productivity index of intermediate goods, and the $x(i)$ are inputs of intermediate goods. The choice of a Leontief functional form may be justified by the fact that the specific good is produced by individual farmers or small family firms, which rules out the possibility of labour-capital substitution, as well as economies of scale. This is also the form used by Kilkenny and Daniel (2001). Another justification for excluding factor substitutability is that origin labelled products often have restricting requirements about production technology. We make the same usual assumptions as Krugman and Venables (1995) for intermediate goods. In particular, intermediate goods have the same elasticity of substitution σ as in the utility function.

[4] The fact that the organization controls the attribution of the label ensures that there are barriers to entry and that any deviant farmers can be denied the right to use the label.

To complete the description of specific product supply, we need to specify the behaviour of the collusive organization. This organization controls the number of farmers (as farmers need to have an official licence to sell the specific good) and then sets the price. A first idea would be to suppose it aims at maximising *per capita* profit, but this would obviously imply that only one farmer would produce the specific good (in order to be able to set the highest possible price). So we assume that its goal is to maximize total profit in the specific sector[5]. Consequently, the organization acts in a way as a rural development agency, but **for farmers only** : it tries to maximise income flow into the farming sector of the rural region.

We are now able to derive price, income and quantities in the specific agricultural sector. In this section, industrial prices and income are taken as exogenous. Minimizing production costs, the demand for intermediary goods is given by :

$$x(i) = \frac{p_M(i)^{-\sigma}}{\left(\int_0^n p_M(j)^{1-\sigma} dj\right)^{\sigma/(\sigma-1)}} \frac{a_S}{\beta} \tag{4}$$

If we denote the price index for manufactured goods by $P_M = \left(\int_0^n p_M(i)^{1-\sigma} di\right)^{1/(1-\sigma)}$, (4) can be rewritten as $x(i) = [p_M(i)/P_M]^{-\sigma} a_S / \beta$ so that total expense necessary to produce a_s equals $\int_0^n p_M(i)x(i)di = a_S P_M/\beta$.

Using the demand function (2.a) combined with (4) yields the expression of profit :

$$\pi = (1-\mu)Y \frac{p_S^{-\gamma}}{n_G + p_S^{1-\gamma}} (p_S - P_M/\beta) \tag{5}$$

The next step is to maximize this expression in p_S, which gives for the first-order condition the implicit equation :

$$(\gamma-1)\beta p_S^{\gamma} = \gamma P_M p_S^{\gamma-1} + P_M/n_G \tag{6}$$

Equation (6) cannot be solved analytically for p_S. However, if the number of generic varieties n_G is large, a limited development of p_S at the first order in $1/n_G$ yields :

$$p_S \approx \frac{\gamma}{(\gamma-1)} \frac{P_M}{\beta} \left[1 + \frac{1}{\gamma n_G}\left(\frac{\gamma}{\gamma-1}\frac{P_M}{\beta}\right)^{1-\gamma}\right] \tag{7}$$

As expected, the more differentiated agricultural products are, the bigger the monopoly price. This is coherent with the significant mark-ups found in empirical studies (see introduction).

[5] It is a natural choice if we consider that the organization's resources are an increasing function of global profit in the specific sector (through the farmers' contributions for instance).

As we have seen, the behaviour of the collusive organization is to set a monopoly price, and to make sure that the number of farmers is such that each farmer will produce his maximum output α, and that the market will clear. This implies that labour is not in excess, *i.e.* that we are at corner points of the isoquants of the Leontief production function. Formally, the number of farmers producing the specific good L_S is :

$$L_S = a_S / \alpha = \frac{(1-\mu)Y}{\alpha} \frac{p_S^{-\gamma}}{n_G + p_S^{1-\gamma}} \tag{8}$$

We assume that the optimal number of farmers producing the specific good is small enough not to exceed the total farming population L_A. Accordingly, income in the specific sector is :

$$w_S = a_S (p_S - P_M / \beta) / L_S = \alpha (p_S - P_M / \beta) \tag{9}$$

We can also express it as a function of the ratio of expense in the specific good to expense in the generic good, $r \equiv 1 / n_G p_S^{\gamma-1}$. Combining (9) with (6), we get :

$$w_S = \frac{\alpha(1+r)P_M}{\beta(\gamma-1)} = \frac{\alpha(1+r)\left(\int_0^n p_M(i)^{1-\sigma} di\right)^{1/(1-\sigma)}}{\beta(\gamma-1)} \tag{10}$$

Rearranging (10) and noting that farmers seek to produce the specific agricultural good provided that they get a higher income than regular (generic) farmers, one can see that it is profitable for some farmers to produce the specific agricultural good if and only if :

$$w_S > w_G \equiv 1 \;\; i.e. \;\; \gamma < \bar{\gamma} \equiv 1 + \alpha(1+r)\left(\int_0^n p_M(i)^{1-\sigma} di\right)^{1/(1-\sigma)} / \beta \tag{11}$$

That condition includes parameter r (which is endogenous). Note that a sufficient condition of profitability is : $\gamma < \bar{\gamma}' \equiv 1 + \alpha\left(\int_0^n p_M(i)^{1-\sigma} di\right)^{1/(1-\sigma)} / \beta$

As we can see, collusion does not always make it advantageous to produce the specific good. This results from the existence of intermediate inputs. Product differentiation must exceed a threshold for the quality label to be profitable. This threshold depends on individual labour productivity α and on the manufactured products' price index. In particular, if labour productivity for the specific good is not high enough, it may not be profitable to produce it.

Product differentiation, when profitable, can obviously be a godsend for farmers under a quality label, who are able to capture a rent due to monopolistic organization and consumer attraction toward their product. However, can it also foster the development of new economic activities in rural areas. In the following sections, we study the impact of agricultural differentiation on industry.

Industrial sector and space structure

So far, we have studied the production of specific agricultural goods independently of the other activities in the economy. We now need to investigate the impact of agricultural differentiation on other sectors.

Income rise due to product differentiation affects only a limited number of farmers, because of entry barriers, but it is supposed to enhance the rural region's total income. That income rise may bring about two types of indirect effect: on the one hand an increase in final demand from farmers, and on the other hand a demand increase for intermediate goods. This double-sided demand increase for industrial goods could be expected to lead to the establishment of new firms in the rural region. Before examining the conditions under which this could occur, we present the economic geography framework used in that model.

The economy is assumed to be made up of two regions, U and R. In line with Krugman (1991), we start with a core-periphery configuration, where industry is fully concentrated in one region. This assumption lightens the calculations, and makes our arguments clearer. Furthermore, we assume that region U (urban) has no agriculture, whereas region R (rural) contains all farming population. Let L_M be the (exogenous) number of workers, who all initially dwell and work in region U, and are potentially mobile across regions. Let L_A be the (exogenous) number of farmers, immobile inhabitants of region R. There is a transport cost $T>1$ for manufactured goods between the two regions, which is supposed to be of iceberg (or Samuelson) type – when a consumer orders x units of manufactured good in the other region, the firm has to deliver Tx units, which is equivalent from the consumer's point of view to multiplying price by T. In a first step, we assume, as usual in economic geography models, that agricultural products are transported at no cost. We relax this assumption in the last section.

The technology in the industrial sector is $l = F + cx$ (labour is the only production factor, and the amount of labour needed to produce x units is l). Profit maximisation under monopolistic competition leads to $p_U = w_U c\sigma / (\sigma - 1)$ (due to symmetry, all industrial firms in the same region offer the same price). This simple expression is due to the fact that the elasticity of substitution between varieties of the industrial goods is the same in the utility function and in the production function of the specific agricultural good (see Krugman and Venables, 1995). As usual, we chose the units of costs such that $p_U = w_U$ (*i.e.* $c = (\sigma - 1)/\sigma$). Then, with free entry, the zero-profit condition yields the supply of any firm $x_U^S = (\sigma - 1)F/c = \sigma F$ and full-employment of workers gives the number of firms in region U : $n_U = L_M / \sigma F$. Endogenous variables are then fully determined by writing the expression of demand for a manufactured good. This is what will be done in the next section.

Price equilibrium and comparative static

Industrial price and wage

Suppose first that there is no agricultural differentiation. As we have normalized the income of generic farmers to one, the demand facing any single firm x_U^D is :

$$x_U^D = \mu\left[\frac{w_U L_M p_U^{-\sigma}}{n_U p_U^{1-\sigma}} + \frac{L_A T^{1-\sigma} p_U^{-\sigma}}{n_U (T p_U)^{1-\sigma}}\right] \tag{12.a}$$

Using $p_U = w_U$, $x_U^S = (\sigma - 1)F/c = \sigma F$ and $n_U = L_M / \sigma F$, then solving for w_U, we get :

$$w_U^0 = p_U^0 = \frac{\mu}{1-\mu}\frac{L_A}{L_M} \tag{13.a}$$

Exponent 0 indicates this is the value of urban wage before agricultural differentiation occurs.

Now suppose the specific sector is active. Using (4), x_U^D can be written :

$$x_U^D = \mu\left[\frac{w_U L_M p_U^{-\sigma}}{n_U p_U^{1-\sigma}} + \frac{(L_G + w_S L_S) T^{1-\sigma} p_U^{-\sigma}}{n_U (T p_U)^{1-\sigma}}\right] + \frac{\alpha L_S T^{1-\sigma} p_U^{-\sigma}}{\beta\left[n_U (T p_U)^{1-\sigma}\right]^{\sigma/(\sigma-1)}} \tag{12.b}$$

After substitution and rearrangement, we get an expression for w_U as a function of the variables characterising the agricultural sector w_S and L_S, and of exogenous parameters :

$$w_U = p_U = \frac{\mu(L_A + (w_S - 1)L_S)}{(1-\mu)L_M - \frac{\alpha}{\beta}T\left(\frac{\sigma F}{L_M}\right)^{1/(\sigma-1)} L_S} \tag{13.b}$$

This expression cannot be used to calculate w_U, because w_S and L_S are endogenous. However, comparing (13.a) and (13.b), we can see that $w_U > w_U^0$, *i.e.* nominal industrial wage is higher than without agricultural differentiation. This is because the numerator in (13.b) is higher than in (13.a) (as $w_S \geq 1$), while the denominator is smaller. The impact on the workers' welfare is even higher, as urban workers are now able to consume another product. Conversely, the impact of agricultural differentiation on generic farmers' welfare is ambiguous: on the one hand they can afford fewer manufactured products because of industrial price rise, on the other hand they can now buy specific agricultural products.

In the next section, we study the possibility of rural industrialisation due to the changes brought about by agricultural differentiation. Before we do that, we discuss the qualitative effects of some parameters on equilibrium values and welfare.

Comparative static

Equations (6), (8), (9) and (13.b) fully determine the equilibrium, the unknowns being p_U, p_S, w_S and L_S, given that price index for specific farmers equals $Tp_U(L_M / \sigma F)^{1/(1-\sigma)}$ and total income Y equals $p_U L_M + L_A + (w_S - 1)L_S$.

Numerical simulations are necessary to study the qualitative behaviour of the endogenous variables. Tables 1 and 2 illustrate the role of two key parameters: the level of differentiation for agricultural products (γ) and the level of transport costs (T) [6]. These tables also indicate the values of real wages for the three categories of agents, w_U *, w_G * and w_S *, computed as

$$w_U^* = w_U/P,\ w_G^* = 1/(T^{\mu}P),\ w_S^* = w_S/(T^{\mu}P)$$

where

$$P = \left(n_G + p_S^{1-\gamma}\right)^{(1-\mu)(1-\gamma)}\left(p_U n_U^{1/(1-\sigma)}\right)^{\mu}.$$

The results in table 1 illustrate the threshold over which agricultural goods are not differentiated enough for the specific good to be profitable (in this case $\bar{\gamma} \sim 2.61$). The more agricultural products are differentiated (the lower γ), the higher specific price and wage, and the higher the industrial price/wage, as predicted by the former analysis. However, the effect on the share of specific farmers (L_S / L_A) is not monotonous. When γ is high, increasing differentiation (lowering γ) lowers the number of specific farmers, which is the classical effect where collusion rises prices and decreases production. However, when γ is low, increasing differentiation may increase the number of specific farmers. This effect arises through the positive impact of agricultural differentiation on industrial income, which in turn raises demand for specific products and thus the number of specific farmers.

Table 1. **Role of the level of differentiation between agricultural products**

γ	1.25	1.50	1.75	2.00	2.25	2.50	2.75
p_U	1.232	1.215	1.205	1.199	1.194	1.190	(1.187)
p_S	8.597	5.006	3.630	3.246	2.899	2.669	(2.505)
w_S	6.954	3.385	2.221	1.648	1.307	1.082	(0.922)
L_S / L_A	0.67 %	0.88 %	0.95 %	0.94 %	0.90 %	0.85 %	(0.79 %)
w_U*	18.141	4.616	3.016	2.479	2.230	2.096	
w_G*	9.025	2.195	1.377	1.092	0.951	0.868	
w_S*	62.758	7.431	3.059	1.799	1.243	0.939	

[6] The values of the other exogenous parameters are L_A=1, L_U=2, α =1, β=1.5, μ = 0.7, σ = 2, F = 1, n_G = 10.

In terms of real income, all categories of agents are better off by an increase of differentiation, because the utility gain from a higher preference for variety more than compensates the loss due to higher specific prices. However, specific farmers are clearly the most favoured.

Let us now discuss the effect of transport costs (*cf.* table 2). Increasing regional integration (lowering T) increases industrial prices, **but** decreases specific price and wage, while it increases the share of specific farmers. The economic interpretation is the following. As industrial transport costs decrease, so do production costs for the specific good. From a collective point of view, it becomes more efficient to produce more (implying more specific farmers) at a lower price. Individual farmers lose from this evolution, while the other types of agents (generic farmers and workers) are better off. However, one can check that the total income of the specific sector rises with regional integration.

Table 2. **Role of transport costs**

T	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00
p_U	1.206	1.204	1.201	1.199	1.196	1.194	1.193	1.191
p_S	2.16	2.457	2.852	3.246	3.639	4.031	4.422	4.813
w_S	1.054	1.253	1.471	1.648	1.844	2.04	2.236	2.431
L_S / L_A	2.30%	1.63%	1.21%	0.94%	0.75%	0.61%	0.51%	0.43%
w_U*	2.139	2.135	2.130	2.126	2.123	2.120	2.118	2.116
w_G*	1.517	1.335	1.199	1.092	1.006	0.935	0.874	0.823
w_S*	1.599	1.673	1.763	1.799	1.855	1.907	1.955	2.001

To sum up, there is in general a trade-off between the (individual) income of specific farmers and the size of the specific sector. A high level of differentiation of agricultural products fosters a high inequality between a very small group of specific farmers and the generic farmers. Conversely, regional integration (low transport costs) favours a larger specific sector.

In the following section, we study whether income rise in the rural region due to product differentiation may induce the settlement of new workers and activities.

Induced effects on industry – possibility of rural industrialisation

As we are concerned with rural development, we now study the conditions under which an industrial settlement would be profitable in the rural region. The previous section shows that agricultural differentiation increases inequality between generic farmers and industrial workers. On the other hand, it implies higher wages for the specific farmers. Then, we can envisage two ways by which agricultural differentiation could induce other activities (industry in our model) to settle in the rural region. First of all, firms could take advantage of lower relative income for regular farmers (because of wage rise in the urban region) to relocate, using farmers as unskilled labour. That possibility will not be studied here, for we wish to focus on industrialization which is due to the rise in demand from specific farmers. Moreover, most rural development strategies aim at attracting new skills to rural regions. The possibility of inducing industrialization through unskilled labour has already been studied in a similar framework by Gaigné (2001)[7]. The second potential cause of industrialisation, which will be the one investigated here, is that the rise of demand from specific farmers would make it profitable for a firm to settle in the rural region. Rural demand rises for both final and intermediate industrial goods (which in our model are the same goods). We shall assume that urban workers are willing to move to the rural region, provided that a firm offers them a real wage which is at least equal to the urban real wage.

It is not clear whether the existence of agricultural differentiation is favourable or not for rural industrialisation. On the one hand, the rise of demand for industrial goods in the rural region tends to attract industry. But on the other hand, urban wage rise (see equation (13.b)) gives incentives to the workers to stay in the urban region.

As in Krugman (1991), we only study the stability of an initial situation of complete agglomeration – we do not mean to fully derive migration equilibria. The framework we use generally only yields very clear-cut equilibria, namely full agglomeration or symmetric dispersion. This is innocuous as our purpose is only to examine whether or not agricultural differentiation could possibly induce rural industrialization, and thus be a genuine way of rural development, not only a way to enrich some farmers.

The condition of rural industrialisation is given in the following proposition (see proof in appendix).

Proposition 1

A necessary condition of rural industrialisation is

$$[\mu T^{1-\sigma} + (1-\mu)T^{\sigma-1}]T^{-\mu\sigma} \geq 1 \tag{14}$$

That condition is the same as the one we would have obtained, if agricultural differentiation had not occurred! In other words, agricultural differentiation does not alter in either way the possibility of rural industrialisation. This result is quite surprising : parameters related to the specific good's production, namely α, γ, and n_G have no impact at all on the condition of differentiation. The trade-off between urban wage rise and rural demand rise happens to lead to a perfect balance. Obviously, this feature is due to the particular specifications used in the model, and to the fact that we are only considering the stability properties of the core-periphery configuration. However, this result shows that one should not take for granted that income rise in the rural region automatically implies positive induced effects in other sectors.

[7] Note that sometimes it is also considered as an "undignified" way of economic development, at least in developed countries.

The qualitative effects of the change in the other exogenous parameters are easy to study using equation (14). Not surprisingly, they are the same as in Krugman (1991). Let us quickly recall what they are. First of all, a rise of the share of industrial goods μ in consumption is detrimental to rural industrialisation, because the influence of the agricultural sector as a potential dispersion force is then lower. Concerning transport cost T, the model shows that there is a threshold T^* under which no rural industrialization may occur. This yields a pessimistic prospect for rural development: as transport costs for manufactured goods decrease, it is less and less likely for rural industrialisation to occur. This result does leave some hope for peripheral regions however. First of all, remote regions are more likely to attract industry – this is the classical protection effect of distance. Second, potential real rural wage eventually rises when transport cost is very low, but without exceeding urban real wage. Thus, if we add in our model some qualitative aspect, such as natural amenities, that makes the rural region more attractive than the urban one, it is possible that rural industrialisation may occur with very low transport costs. In particular, if there is taste heterogeneity among consumers, the rural region may become attractive for workers (see for instance Tabuchi and Thisse, 2002).

The impact of the elasticity of substitution for manufactured goods σ is again the same as in Krugman (1991), and is qualitatively similar to that of T, namely that rural industrialisation is more likely if manufactured goods are substitutable. This is not surprising as the more industrial goods are substitutable, the greater the incentive for firms to move away from the urban region to escape competition.

Introduction of transport costs for agricultural products

So far, as in most economic geography models, we have assumed that there were no transport costs for agricultural products. This simplification can be justified by the fact that there are fewer scale economies for the distribution of industrial products, but it is highly questionable in our case. Introducing transport costs in agriculture does not seem to alter our results much at first sight. As consumers spend a fixed share of their income on agricultural products, and given the specific form of transport costs we use (iceberg transport costs), expenditure for agricultural products would be unaffected by the introduction of the **same** transport cost for both generic and specific products. The situation with transport costs in agriculture is not equivalent to that without transport costs however. Indeed, transport costs for agricultural goods lower urban workers' real wages, which increases the incentive to move to the rural region, so as to save on transportation costs on agricultural products.

Same transport costs for both types of agricultural products

We first assume that there is a unique transport cost for both types of agricultural products, T_A. In the former calculations, the demand function for the specific agricultural product remains unchanged, and consequently so is the price equilibrium. However, the condition for rural industrialisation is not the same. We have :

Proposition 2

With transport costs in agriculture $T_A > 1$, a necessary condition for rural industrialisation is :

$$(\mu T^{1-\sigma} + (1-\mu)T^{\sigma-1})T_A^{(1-\mu)\sigma}T^{-\mu\sigma} \geq 1 \qquad (15)$$

In other words, the presence of transport costs in agriculture fosters rural industrialisation. This is no surprise and it is a classical result in economic geography literature (*e.g.* Calmette and Le Pottier, 1995 ; Kilkenny, 1998 ; Picard and Zeng, 2003). Again, the existence of agricultural differentiation does not play any role in this equation. However, the case when transport costs are different for both agricultural products is more interesting.

Different transport costs for generic and specific good

It is reasonable to assume that the specific product is more costly to transport than the generic product. For instance, they could be prone to more stringent regulations in order to guarantee their freshness. More generally, as the market is smaller, there should be fewer scale economies for the distribution of this product, than for the generic products. Moreover, if the specific "agricultural good" consists of tourism services, city-dwellers clearly have to travel to the rural region to consume it, which is bound to be quite costly.

Formally, suppose that there are (iceberg) transport costs T_G for the generic products and T_S for the specific product, with $T_S > T_G > 1$, and let us see how the previous results are modified.

Denoting rural and urban income by Y_R and Y_U respectively, total demand for the specific product becomes :

$$a_S^D = (1-\mu)\left[Y_R \frac{p_S^{-\gamma}}{n_G + p_S^{1-\gamma}} + Y_U \frac{T_S^{1-\gamma} p_S^{-\gamma}}{n_G T_G^{1-\gamma} + T_S^{1-\gamma} p_S^{1-\gamma}} \right] \qquad (16)$$

This equation shows that demand for specific goods will be smaller than with $T_S = T_G$. To see why, consider an initial situation when $T_S = T_G$, and then suppose that T_S rises. The value of a_S^D will decrease, fostering the decrease of both Y_R and Y_U, which will further decrease a_S^D . Finally, the demand curve given in (16) will shift to the left, and both w_S and L_S will decrease.

Consequently, the higher the ratio T_S / T_G, the fewer the differentiated farmers, the lower their income and the lower industrial prices. Higher transport costs for the specific product are thus clearly detrimental to the specific agricultural sector, in both income and size.

Let us now turn to the condition for rural industrialisation. Propositions 1 and 2 are replaced by the following proposition (proof in appendix) :

Proposition 3

With transport costs T_G and T_S in agriculture, a necessary condition for rural industrialisation is :

$$[\mu T^{1-\sigma} + (1-\mu)T^{\sigma-1}]\left[\frac{T_G^{1-\mu}}{T^{\mu}}\right]^{\sigma} \left[\frac{(1+r(T_S/T_G)^{1-\gamma})^{(1-\mu)/(1-\gamma)}}{(1+r)^{(1-\mu)/(1-\gamma)}}\right]^{\sigma} \geq 1 \tag{17}$$

Note that $\left[\frac{(1+r(T_S/T_G)^{1-\gamma})^{(1-\mu)/(1-\gamma)}}{(1+r)^{(1-\mu)/(1-\gamma)}}\right] > 1$ if and only if $T_S > T_G$.

Comparing equations (15) and (17),we can see that we need to have $T_S > T_G$ so that agricultural differentiation has a positive impact on the possibility of rural industrialisation. The existence of transport costs in agriculture is not sufficient in itself to have a positive impact of agricultural differentiation on rural industrialisation. To sum up, a higher transport cost for the specific agricultural product is detrimental to the agricultural sector, but beneficial for rural industry.

Discussion and conclusion

Using a simple economic geography model, we were able to derive some results about the factors determining the size of a differentiated agricultural sector and the relationship with industry. In order to be able to conduct a general equilibrium analysis, the model used in this paper uses daring assumptions, in particular perfect collusion between specific farmers. However, this polar case is useful to determine the maximum income that could be captured in the rural region thanks to the production of the specific agricultural good. Moreover, successful cases of quality labels frequently have this characteristic (Barjolle *et al.*, 2000). Strong co-ordination is justified by the necessity of maintaining a high level of quality control, even if it may also be viewed as being designed to capture a rent.

The previous results challenge the common opinion according to which quality labels, or other specific characteristics of rural regions, are levers for rural development. This model highlights two important trade-offs. First, there is a trade-off between the number of farmers who differentiate and the income generated by the specific sector. In particular, when the specific product is very differentiated, there is a very small specific sector capturing a very high rent. Second, there is a contradiction between total agricultural income and possibility of rural differentiation. Lower transport costs (both industrial and agricultural) rise agricultural income (and in the case of industrial transport costs, the size of the specific sector as well), but lower the possibility of rural industrialisation. This trade-off contradicts the conventional wisdom about demand multiplier effects. It arises because demand rise in the rural region is offset by an opposite effect in the urban region. In fact, the introduction of the specific good may favour the urban region more than the rural one.

However, these results should not lead to assert that quality labels are only a way of creating a rent for a minority of farmers. First of all, from a social point of view, origin-labelled products can have a positive impact on local cohesion and identity. That remark is corroborated by Barjolle and Sylvander (2000), who assess that social impact is more important than economic impact for PGO-PGIs. From a purely economic point of view, one essential reason why, in our model, the positive effect on urban wages, and increased rural demand rise compensate each other, is that industrial firms are treated as symmetrical. Demand for manufactured goods only depends on relative prices. By contrast, if there were any reason for rural inhabitants to prefer rural manufactured goods, the development of quality labels would have a more significant effect on rural industrialisation. This would in particular be the case if we supposed that rural industry would make products (inputs or final goods) that are specific to the needs of farmers. This suggests that co-ordination is important not only inside the farming sector but also between sectors in rural areas, to have positive effect on a rural region as a whole. This may leave room for policy intervention in order to favour industrial investments that are specific to the local farming production.

Another refinement that would be worth investigating is the possibility that several complementary goods, linked to the rural region, are produced in the rural region. Such products could for instance be food products and/or tourism services (see for instance Gatti *et al.*, 2002 or Lacroix *et al.*, 2000). This could increase the number of inhabitants who benefit from product differentiation and enhance the possibility of induced effects.

As more and more quality labels try to penetrate food markets, that issue probably deserves more attention, for it has many possible implications in terms of rural development policies. This work shows the relevance of using a general equilibrium framework in order to better understand the impacts of agricultural differentiation and labels on rural development.

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APPENDIX

Proof of proposition 1

Suppose a firm plans to settle in region R. If is sets price p_R, it will be faced with demand :

$$x_R = \mu\left[\frac{w_U L_M T^{1-\sigma} p_R^{-\sigma}}{n_U p_U^{1-\sigma}} + \frac{(L_G + w_S L_S) p_R^{-\sigma}}{n_U (T p_U)^{1-\sigma}}\right] + \frac{\alpha L_S p_R^{-\sigma}}{\beta[n_U (T p_U)^{1-\sigma}]^{\sigma/(\sigma-1)}}$$

Let us factorise $(p_R / p_U)^{-\sigma}$:

$$x_R = \left(\frac{p_R}{p_U}\right)^{-\sigma}\left[\mu\left(\frac{L_M}{n_U} T^{1-\sigma} + \frac{(L_G + w_S L_S)}{n_U p_U} T^{\sigma-1}\right) + \frac{\alpha L_S T^{\sigma}}{\beta n_U{}^{\sigma/(\sigma-1)}}\right]$$

Now, recall that indirect utility can be written :

$$V_U = w_U \frac{(1-\mu)^{1-\mu}\mu^{\mu}}{(n_G + p_S^{1-\gamma})^{(1-\mu)/(1-\gamma)}(n_U^{1/(1-\sigma)} p_U)^{\mu}} \text{ for workers in region } U,$$

$$\text{and } V_R = w_R \frac{(1-\mu)^{1-\mu}\mu^{\mu}}{(n_G + p_S^{1-\gamma})^{(1-\mu)/(1-\gamma)}(n_U^{1/(1-\sigma)} T p_U)^{\mu}} \text{ for workers in region } R.$$

Obviously, $V_R / V_U = w_R / (w_U T^{\mu})$. Consequently, the rural firm will have to set a wage at least slightly higher than $w_U T^{\mu}$, in order to attract workers from region U, *i.e.* we must have $w_R \geq w_U T^{\mu}$. Remembering that profit maximisation implies $p_R / p_U = w_R / w_U$ and that profit is positive if and only if $x_R \geq (\sigma - 1)F / c$, a necessary condition for rural industrialization is :

$$\mu\frac{(\sigma-1)F}{c}\left[T^{1-\sigma} + \frac{(L_G + w_S L_S)}{L_M w_U} T^{\sigma-1}\right] T^{-\mu\sigma} + \frac{\alpha L_S}{\beta[L_M / \sigma F]^{\sigma/(\sigma-1)}} T^{(1-\mu)\sigma} \geq \frac{\sigma-1}{c} F$$

The first two terms of the left-hand-side of this equation correspond to urban and rural final demands respectively, whereas the third term stands for demand of intermediate inputs. The right-hand-side is the minimal quantity a firm must produce to have a non-negative profit. This expression shows the trade-off induced by agricultural differentiation: the fact that $w_S > 1$ and $L_S > 0$ acts in favour of rural industrialisation, but the fact that $w_U > w_U^0$ acts the other way round. Substituting for w_U, from equation (13b) into the above equation eventually leads to proposition 1.

Proof of proposition 3

The previous proof does not depend on the modifications in demand for agricultural products due to the introduction of transport costs in agriculture. The only element that has to be changed is the ratio of real wages. We now have :

$$V_U = w_U \frac{(1-\mu)^{1-\mu}\mu^{\mu}}{(n_G T_G^{1-\gamma} + T_S^{1-\gamma} p_S^{1-\gamma})^{(1-\mu)/(1-\gamma)} (n_U^{1/(1-\sigma)} p_U)^{\mu}}$$

for workers in region U, while the expression of V_R does not change.

Consequently :

$$\frac{V_R}{V_U} = \frac{w_R}{w_U} \frac{(n_G T_G^{1-\gamma} + T_S^{1-\gamma} p_S^{1-\gamma})^{(1-\mu)/(1-\gamma)}}{(n_G + p_S^{1-\gamma})^{(1-\mu)/(1-\gamma)} T^{\mu}} = \frac{w_R}{w_U} \frac{(T_G^{1-\gamma} + r T_S^{1-\gamma})^{(1-\mu)/(1-\gamma)}}{(1+r)^{(1-\mu)/(1-\gamma)} T^{\mu}}$$

Derivation of condition (11) is then straightforward, the condition for attracting urban workers being :

$$\frac{w_R}{w_U} \geq \frac{(1+r)^{(1-\mu)/(1-\gamma)} T^{\mu}}{(T_G^{1-\gamma} + r T_S^{1-\gamma})^{(1-\mu)/(1-\gamma)}}$$