Space Dynamics and Improvement of the Total Factor Productivity

LASSAAD JEBALI
Laboratory LIRI (FSEGT), *Tunisia*

The new analyses in economic sciences give a strong attention to the internal and external returns to scales of an industry. These economic theories envisage the existence of a competing sector, which produces a homogeneous good, another sector in monopolistic competition, which produces differentiated good with increasing return of scale, and another sector in imperfect competition profiting from external effects. These assumptions are the base of 'New Theories of the International Trade' analysis (NTIT). By adding the assumption of freedom movement of the factors of production and spatial analysis into the economic analysis, we can speak about the New Geographical Economy (NEG). In this paper, we propose to provide a model of the regional interaction by introducing the space variable as a factor, which directs effective choices of the economic policy. Therefore in the first section the geographical character of the labor productivity is introduced. The labor productivity spatialized as being the rise of the coordination mode is described in the second section, while empirical approach of space dynamics will be the subject of the last section.

Key Words: productivity, growth, system of eqations, space

GEOGRAPHICAL CHARACTERISTICS OF ECONOMIC GROWTH

To seize the geographical character which improves the TFP, we break up the growth of technical progress by space elements in interactions. TFP integrates geographical elements, such as the competitiveness indicator of an area.

By analyzing the determinants of the total factor productivity; we try to show how the TFP is explained by the improvement of the labor productivity. New approaches (Krugman 1991) consider that industrial sector is competitive if it is able to gain success in the in-

ternational trade due to its productivity and maintaining high remunerations of labor. This definition is justified more specifically in the presence of economy, the price effect of which is limited. It is the case of small, open countries where the measurement of the labor
 productivity seems to be determined primarily by the importance of the competitiveness of nations and sectors.

Productivity is not the only determinant of the competitive position of economy. Small open economies can have certain ability in fixing their prices compared to the world market and thus reflect a possible rise of their production costs. In addition, exchange rate, wages, taxation also form the price component of competitiveness.

After having to point out the interest of TFP in the income growth of an area, we present some determinants of space natures which take the current analyses of technical progress as a starting point (Romer 1986; Helpman 1981).

DECOMPOSITION OF THE TOTAL FACTOR PRODUCTIVITY (TFP)

The apparent average productivities of each factor, respectively Q/L and Q/K are partial because they evaluate contributions from each one of these two factors to production in an isolated way.

Calculation method of TFP assumes constant returns to scale. Let us consider the following production function:

$$Q(t) = A(t) \cdot F[K(t), L(t)], \tag{1}$$

where $Q(t)$ is the added value in volume, $A(t)$ a parameter of displacement of the production function and $F[\ldots]$ a total indicator of inputs.

The total factor productivity $\prod_F$ (which coincides with $A(t)$) is equal to the relationship between the volume of the output Q and the volume of the factors F:

$$\prod_F = \frac{Qt}{F[K(t), L(t)]}. \tag{2}$$

We can express the growth income rate by three growth rates:

$$\frac{\dot{Q}}{Q} = \frac{\dot{A}}{A} + (1 - \alpha)\frac{\dot{K}}{K} + \alpha\frac{\dot{L}}{L}. \quad (3)$$

We note by: $1 - \alpha = AF_K K/Q$ and $\alpha = AF_L L/Q$, with α being the income elasticity by report to the labor force quantity employed in sector. [81]

The TFP growth rate is below:

$$\lambda = \frac{\dot{A}}{A} = \frac{\dot{Q}}{Q} - \left[(1 - \alpha)\frac{\dot{K}}{K} + \alpha\frac{\dot{L}}{L}\right]. \quad (4)$$

By symbolizing the growth rate of the TFP by λ, the growth rate of labor productivity by p and the average productivity of work by P, we can write:

$$\lambda = p - (1 - \alpha)\frac{\dot{k}}{k}. \quad (5)$$

With $P = Q(t)/L(t)$ and $k = K(t)/L(t)$.

To calculate the total factor productivity (total), we assume that the production factors are remunerated by their marginal productivity. This condition is checked for companies 'price-takers' on the factors markets organized by the pure and perfect competition. Consequently, $\alpha\exists$ and $(1-\alpha)$ are respectively the contribution of labor and capital to the added value.

Growth rate of $A(t)$ seems as an indicator of the profits TFP. It is a long period growth which is not allotted to the accumulation of the production factors (K and L), but rather with the improvement of factors productivities, in particular work. These profits as a growth rate of the total added value dissociated from the two factors of production are in the origin of the increase in the product for a given volume of the production factor. It is often useful to allot them to 'technical progress.' Actually, they represent a fascinating residue of account. All the not strictly quantitative elements contribute to the increase of the labor productivity.

Thus, technical progress is not only due to the improvement of the labor quality or the stock of capital (related to its renovation) but also to the progress in the organization and business management, as well as to any forms of externalities related for example to the contiguity, concentration of specialized labor or with the diffusion of information.

Spatial Source of TFP: The Spatial Character of the Labor Productivity

A significant teaching analysis of the economic growth model according to Solow (1956) shows that on the long run growth of income per capita is due only to the quantitative accumulation of production factors under the influence of decreasing returns to scale. Consequently, TFP evolution is only able to underlie a durable and long run growth path. In traditional models of exogenous growth, calculation of the TFP evolution makes it possible to obtain a technical progress indicator. However, this decomposition does not specify the origin of the technical progress, which is thus supposed to be exogenous (basket of the sky).

During last years, this analysis was criticized by a certain number of economists (Romer 1986). The latter developed endogenous growth models. A central idea of this new theory is that growth does not result solely from one exogenous factor but also from cumulative increase in an endogenous factor, which represents the stock of knowledge generated by investment (Romer 1986) and human capital (Lucas 1994).

We try to show that the TFP (a measurement of technical progress or growth explained by endogenous factors) is allotted to the profits of labor productivity in spite of improvement in growth due to new investments in the presence of productions functions under increasing returns. If the productivities of the primary education factors of production are cancelled in the long run, labor productivity improves due to localization effects. The labor productivity (it will be the subject of the following development) is considered as being a space variable related to the site and the density of the labor, compared to space entity. Labor localization is measured by the distance between the central area (generally considered as a leader area) and another area. The central area is not defined according to the labor productivity but with various spatialized approaches of endogenous growth.

If we introduce differences on the level of the human capital, the analysis of the NGE finds other dimensions and contributes to studies the endogenous growth models (dependent on know-how), characterized by increasing outputs of scale and a perfect mobility of the force of work between various areas and sectors.

Specialization of the Technical Progress and Spatial Effect on the Labor Productivity (The Static Technical Progress)

In the following analysis, added value or the production of an area or a country is calculated according to production function of CES type, where the economic activity is determined per unit of surface.

Each unit of surface is an area, which has particular geographical characteristics. These geographical, demographic or cultural characteristics influence human behavior responsible for the operation of production or consumption, as well as movements of the work force. Each unit of surface or area lodges a labor having specific qualifications, which depend on the human capital localization, specific cultures and clean lawful framework. The theoretical approach of modeling production geography takes the theoretical abstraction of Ciccone and Hall (1996) as a starting point.

The economic density of macroeconomic variables is an essential concept in the Ciccone's approach. In particular, the author assumes that the density of work in an area *i* (mail *i*) is a space variable, which affects the income growth rate of a particular area in one country, via the information exchange in the form of commercial trade.

Surface labor productivity per unit (by mail *i*) finds other dimensions in areas, where the working density is high (all depends on the elasticity of the value added compared to the density). Transmission channels of working repair in a system *r* influence the labor productivity of an area, economic health and the regional development. In this case *the technological* spillovers and the TIC play a significant role by the means of various measurements or mode of adoption of new production methods.

Following Ciccone and Hall's (1996) assumptions, we suppose that production function by unit of surface *i,* is as follows:

$$Y_i = Q_r\,(E_i L_i)^{\alpha}\, K_i^{\beta} \left(\frac{Y_r}{A_r}\right)^{\lambda}, \tag{6}$$

where Y_i is the added value of the region i, E_i is the labor efficiency in the region i, Q_r is a TFP indicator of all regional system, Y_r and A_r are respectively added value of the regional system (even a country) and the system area (or country r).

[84] The essential assumption of this model assumes a static technical progress, which doesn't have a regular growth rate in time and for each area.

The term Y_r/A_r is named in the NGE by the economic density, writen as an average evaluated in by km² added value. The coefficient λ is positive elasticity if the economic density affects the per unit surface production positively. Parameters α and β are elasticity, α and β are the same in all regions.

We try to break up the space and geographical character of the production operation of the regional system R by giving space characteristic to the production function. We call the regional system a state member of a perfectly integrated zone. In a regional system, the factors of production (mainly labor of an intensive sector in knowledge) circulate freely and without constraints.

The per region (i) production function shows particular regional characteristics. Labor productivity is a distinctive characteristic of the surface units. To pass to a production function of a more raised scale, country or governorate (all depends on the geographical framework used) is simple. It is enough to multiply the per unit production function by the surface of the local system (country r):

$$Y_r = \sum_i Y_i = (A_r Y_i) = Q_r \left(E_r L_r\right)^{\alpha} K_r^{\beta} A_r^{\gamma} \left(\frac{Y_r}{A_r}\right)^{\lambda}. \quad (7)$$

This aggregation is done under the assumption: $L_r = A_r L_i$, $K_r = A_r K_i$ and $\gamma = 1 - \alpha - \beta$.

We suppose that the total added value is the production of a whole company regarded as a rational agent. Consequently, we pass from the micro agent space, rational with another producing agent, by simple aggregation, while preserving the basic assumption of the rational behavior of the aggregate producing agent.

We suppose that the perfect competition exists between various producing agents on a space macro scale (between the macro-areas

r). Consequently, the rule of the maximization of profit (the price of the output is standardized with the unit), gives the following results:

- The marginal productivity of labor equals to the marginal cost of this factor, which is the wage;
- The marginal productivity of capital equals the marginal cost of this factor, which is the user cost of the capital noted C.

Optimization means that the pure and perfect space competition model presupposes areas with same sizes. Producers are atomic and do not influence (reduced sizes) price market of homogeneous good.

In the equilibrium situation (for the producing agent of an area), the last unit of work brings back only its cost and the last unit of the capital factor brings back only its user cost C. Formally, we can write the following equalities, which illustrate the theoretical approach of optimization or maximization of the aggregated profit, incorporated in the regional system.

$$\frac{\delta \pi_r}{\delta K_r} = 0 \Leftrightarrow K_r = \frac{\beta Y_r}{C}, \tag{8}$$

where π_r and C indicate respectively the profit of the aggregate regional agent (of the system or country r and the marginal cost of a unit of the capital. The latter is supposed to be constant by any r country.

The workforce of the system is in charge of qualification or of effectiveness connected to human capital acquired in the form of academic formation of hours or a space-time interaction. The effectiveness of work E_i in this model is proportional to the average S_r and of the years of studies carried out by the labor of the total system r (indicating of the human capital). We assume that η is the elasticity of the effectiveness of work (E_r) in the system r compared to the indicator of human capital S_r. This elasticity calculated on the aggregate level is constant in the various regional systems (all countries). After analytical rearrangements, the aggregate production function is as follows:

$$Y_r = \left(\frac{\beta}{C}\right)^{\beta\theta} Q_r^{\theta} S_r^{\eta\alpha\theta} A_r^{1-\alpha\theta}$$

$$\theta = \frac{1}{1 - \beta - \lambda}. \tag{9}$$

The development of the last two equations provides theoretical relations in the form of equation to be in empirical production es-

timates according to the system surfaces and labor. Certain authors built models inspired from the equation (9) with regards to the labor productivity as an endogenous variable, whereas the density of labor and the economic density are explanatory variables.

This type of estimate does not constitute a space approach of the labor productivity, insofar as the empirical approach can be a-space. I. ., the sets of data of work density and the economic density are time series of only one system, while its surface remains unchanged in time. By integrating the space dimension (i. e. to use data by localizations of the perfectly integrated areas), the empirical approach requires measurements of spatial autocorrelation between variables in the model represented in the next equation. This step of spatial econometrics implicitly implies modes of coordination and interactions between various operators of a perfectly integrated regional system.

$$\frac{Y_r}{L_r} = \left(Q\beta^{\beta}C^{-\beta}\right)^{\theta} S_r^{\eta\alpha\theta} \left(\frac{L_r}{A_r}\right)^{\alpha\theta-1} \left(\frac{Y_r}{A_r}\right)^{\alpha\theta\mu}. \tag{10}$$

Baptista (2003) supposes that the labor productivity and the economic density per unit of surface (square kilometer) are dependent according to the next equation. We presuppose in this equation that the economic density is constant in various systems r. The equation estimated by the author is as follows:

$$\frac{Y_r}{A_r} = \left(Q\beta^{\beta}C^{-\beta}\right)^{\theta} \left(\frac{L_r}{A_r}\right)^{\alpha\theta}. \tag{11}$$

The last equation is estimated by the Baptista (2003) by using American data by states. The author interprets the labor productivity as being a geographical measurement dependent only on one geographical variable, which reflects the distribution of labor in the states.

This attempt to integrate regional dimension hiding place made an intrinsic causality exerted by the space variable on the human behavior. Although the area surfaces do not change in time, the space dimension of the model estimated by Baptista (2003) is accentuated via the movements of labor between various localizations. In the absence of a true space variable, this contributes to growth rates of the areas benefiting from productive labor. The work force immigrates and emigrates while benefiting from the interactions in the form of a ball of snow. The workmen of a unit of surface profit from the movements and improve their capacities to produce. In the same manner, the workmen profit from their localizations through the interactions ensured by the NTIC while benefiting from the capacities to produce close areas.

INCREASING RETURNS TO SCALE, PROXIMITY OF CONTIGUITY AND A STEADY STATE

The majority of space economic surveys consider a production function with partially substitutable factors. This assumes hiding places, and behind them another significant assumption, checked by the operations of immigrations of the productive forces between areas. This assumption is checked by the space-time character of the production function. Production function of an area is given in time and measures the production per unit of surface, according to the quantities of the factors of the aforementioned unit. Production in an area profits from the capital of the whole system. We presuppose the absence of external effects, related to the physical stock of capital in close areas, on the production behavior of a particular area.

The per unit surface production function is as follows:

$$Q = A_0 e^{\lambda t} K^{\alpha} L^{\beta}, \tag{12}$$

where λ is the growth rate of per unit surface (TFP), α and β are parameters of returns to scale and L the employment level. Coefficient α and β are elasticities of the production per unit surface of the corresponding factor. Elasticities are the same ones in various areas of the perfectly integrated system.

By employing the logarithm on the preceding equation and by applying the total differential on the left and on the right of the equation of labor productivity (Q/L), there will be a relation which connects labor productivity growth rate p at the growth rate of the per capita capital per unit surface k and the per capita growth rate q:

$$p = \frac{\lambda}{\beta} + \frac{\beta - 1}{\beta} q + \frac{\alpha}{\beta} k. \tag{13}$$

If we assume that the capital per capita growth rate is equal to the product per unit surface growth rate, then $q = k$:

$$p = \frac{\lambda}{\beta} + \frac{\alpha + \beta - 1}{\beta} q + \zeta. \tag{14}$$

The equation above is an empirical relation, insofar as it is a random term, which follows a known distribution law.

If we suppose that $k = \gamma q$, than

$$m_1 = \frac{\gamma\alpha + \beta - 1}{\beta} \succ 0 \quad \text{and} \quad m_0 = \frac{\lambda}{\beta}$$
$$p = m_0 + m_1 q + \zeta, \tag{15}$$

where p and q are respectively the output and labor productivity or the income growth rate of this area.

m_1 is a coefficient, which represents the economy of scale. Indeed, if the value of the coefficient m_1 is equal to 0.5, an increase by 1% of output implies an increase in the labor productivity of 0.5% because of the saving effort of the workmen. It is the case of the increase in returns to scale. Workmen per unit of surface have the capacity to double the production, whereas the acquired effort of 0.5% optimal remainder.

Equation above does not show a per unit of surface labor productivity as being an endogenous variable equipped with certain space characteristics, such as the distribution of labor, working qualification, clean experiment and the space proximity. Consequently, it will be operational to explain the growth of the TFP by space factors, which influence labor productivity.

With this intention, we developed a model in order to explain the growth of TFP by the effect of the space variables and the effect of vicinity, which influence dependence between areas. It is supposed that between the integrated areas, where the movements of production factors and the products are free, there is a technology transfer from an area to another, which is generally, according to our assumptions, explained by:

- The effect of vicinity;
- Acquisition of new technologies;
- Growth of the human capital.

The endogenous growth stresses the role of TFP in the explanation of growth. The term is clarified by λ while giving it a space dimension, which generates interactions between differently localized productive forces in a particular regional system.

Coefficient λ determines labor productivity growth of an area according to localization of this area in the whole regional space.

Amelioration of Labor Productivity by the Spatial TFP

The modern growth theory started to distinguish between production factors, such as work, capital and total productivity (TFP). Initially it was considered that the total productivity was drawn by exogenous technological change. However, by preoccupation with coherence these 'exogenous' models were to postulate that the technological shocks were absorbed quickly by all the firms. However, the gain of productivity is obtained only gradually by a process of training since the new knowledge is diffused slowly.

To understand these mechanisms of the growth process, we must revisit the original trilogy of Schumpeter against innovation and diffusion:

- Invention refers to progress of technical training;
- Innovation is a cumulative process, which converts this knowledge into marketable products and methods;
- Diffusion is a sequential process which encourages the use of these new products and new methods throughout an integrated regional system.

In the model we propose to take studies as a space dependence of the coordination modes by multiples tools as a starting point, suggested previously in the preceding sections. TFP growth rate represents a space variable related to the worker behaviors in space. As we presented previously, the economies of scale are behavioral sources of saving capacity. Consequently, the improvement of TFP including the factors work is related to the growth rate of productivity of these factors in an area. In short, TFP growth rate of an area seems definitely related positively to the labor productivity growth rate of these areas.

In addition, the phenomenon of space diffusion of behavior and the modes of coordination shows the existence of a space adjacency between productive forces. Heterogeneity of labor productivity in various integrated areas built the effect of vicinity, where the productivities of the contiguous areas will be inter-connected.

$$\begin{aligned} \lambda &= \lambda^* + \phi p + \kappa W p \\ W_{ij} &= \frac{Q_i Q_j}{d_{io} d_{jo}}, \end{aligned} \tag{16}$$

where Q_i and Q_j are the income in Euro at constant prices of the respective areas, i and j, at a given date.

W is the weight matrix or of vicinity, it is known as matrix of the interregional interaction. We notice that $Q = PL$. The term P indicates the average productivity of work per unit of surface.

To normalize the matrix W, it is enough to divide each w_{ij} by the sum compared to the column of line i:

$$W^*_{ij} = \frac{W_{ij}}{\sum_j W_{ij}}. \tag{17}$$

Matrix W^* is not symmetrical as in the case of the binary matrix seen previously.

We note by $Q = PL$.

λ^* is a parameter, which summarizes the technical progress growth at the regional level. This parameter is identical in each area. It depends on the initial characteristics of the areas. The latter are generally particular regional characteristics which determine the activity of innovation extent at the local level. It is about the initial level of technology noted G and the level of the human capital s. As the level of the technology of the area is low, the region will be ready to adopt new technologies:

$$\lambda^* = \pi G + \delta s,\ \pi > 0, \text{ and}$$
$$G_i = \frac{p^* - p_i}{p^*} = 1 - ap_i\text{: } a > 0\text{: start-of-period,} \quad (18)$$

where $p_i{}^*$ is the labor productivity of the leader area (better productivity), p_i is the labor productivity of area *i*, and *G* indicates the variation of labor productivity between the leader area and a given area.

The parameter is an indicator of human capital of an area, it is a function of the localization of area *i* per contribution with the whole regional system. From this point of view, a technological indicator of proximity between the departments is incorporated in the last equation. This indicator is adapted by Fingleton (2001) and Fingleton and McCombie (1998).

The vectors of technological position of departments (areas) are made up using the variable *s*. The technological proximity indicator (*s*) is measured, then the 'resemblance' enters the technological position of a given department and the technological position of its neighbors, according to whether this area can be rural or urban. We indicate this regional characteristic by a variable which takes value 1 if the area is urban, and 0 if not.

In the same way, it is supposed that the labor qualification or the human capital of an area is a function of the distance, which separates an area and the center from the whole regional system (*l*). This center is regarded as the leader area. In this model we explained the human capital by space variables dependent on localizations of areas in the regional system and compared to the economic center of this system. This leads to the function:

$$s = \varepsilon + \theta l + \Gamma u,\ \theta < 0,\ \Gamma > 0,$$
$$E\text{: } p = \rho W p + b_0 + b_1 l + b_2 u + b_3 G + b_4 q + \zeta. \quad (19)$$

Equation *E* is a dynamic equation. Indeed, it is an interaction function between areas of space. *E* is dynamic, because it is related to *W*.

Empirical Approach of the Spatial Dynamics

The data which we use to evaluate the macro space dynamics of productive behaviors are diversified. We used the data base published by Eurostat Regio in 2000 and the World Bank data, published in

2000. The regional nomenclature in this work is that NUTS 2, increased by 6 areas for purely statistical ends. We started initially by building regional series of variables of the equation (E).

SPATIAL ECONOMETRIC ANALYSIS

The model is represented by a system of the following simultaneous equations (S). Estimating parameters of the system (S) is done for each year from 1976 to 1998. Each year we built a space econometric development with regional interaction seen by interregional weights matrices. Interaction matrices base on the assumption that the economic operations build weight areas and interactions. Using regional incomes in calculations of the elements W_{ij} represents a manner of an endogenous regional interactions.

The regional interaction type bases on optics of gravitational field (Rey and Montouri 1999). Each time the distance from certain areas to the economic center (leading area or Luxembourg) increases, the interregional weights decrease.

Spatial character of modeling brought the usage of space econometrics elements. Indeed, spatial literature shows that under endogenous weight matrix, autocorrelation between residues in a spatial mode and between European regional incomes appears. By descriptive indicators we can demonstrate easily that endogenous regional interactions in Europe form clubs of convergence (Kelejian and Robinson 1997).

In this model, all the equations are over identifiable. Consequently, the estimating method is generalized as a moment of moments (GMM).

The choice of instruments in the equation model must be robust and be proven by a statistical test. The test used is J-statistic, which justifies the choice of instruments while referring to the orthogonality between instruments and estimators. It gives a high probability to accept the H_0 othogonality assumption.

TABLE 1 Space Model with Simultaneous Equations

Year	$\hat{\rho}$	b_1	b_3	b_4	b_5	b_6
1977 (GMM)	46.37888	$-3.30e^{-7}$	−1.022586	0.012626	1.012146	1.000000
1978 (GMM)	40.70351	$2.43e^{-7}$**	−1.042980**	0.024972	1.012146	1.000000
1979 (GMM)	35.74281	$6.26e^{-7}$**	−1.027069	0.055598**	1.012146	1.000000
1980 (GMM)	79.05855	$1.21e^{-6}$	−1.069197	0.127932	1.012146	1.000000
1981 (GMM)	−15.53797	$-2.05e^{-6}$	0.006080**	0.899075	1.012140	1.000000
1982 (3sls)	13.75253	$1.89e^{-7}$**	−0.155729	0.774097	1.012146	1.000000
1983 (GMM)	177.4543	$2.91e^{-6}$	−1.195619	0.049071**	1.012146	1.000000
1984 (GMM)	41.27069	$-2.07e^{-7}$**	−1.014822	−0.00866**	1.012146	1.000000
1985 (GMM)	31.96620	$2.07e^{-7}$**	−1.065417	−0.040865	1.012146	1.000000
1986 (GMM)	42.75026	$-4.30e^{-7}$	−1.096812	−0.01874**	1.012146	1.000000
1987 (GMM)	63.17814	$1.14e^{-6}$	−1.097189	0.015051**	1.012146	1.000000
1988 (GMM)	39.96286	$9.60e^{-7}$	−0.993863	0.085487	1.012146	1.000000
1989 (3sls)	0.489419	$3.08e^{-6}$	−0.987985	0.023557**	1.012146	1.000000
1990 (GMM)	37.92498	$4.21e^{-7}$	−1.137982	−0.072566	1.012146	1.000000
1991 (MCO)	57.34329	$-6.20e^{-7}$**	−1.066316	0.163792	1.012146	1.000000
1992 (GMM)	0.521340**	$-3.70e^{-7}$**	−0.008630	1.079488	1.012146	1.000000
1993 (GMM)	142.1787	$7.05e^{-6}$	−1.353815	0.230477	1.012146	1.000000
1994 (GMM)	58.55525	$1.16e^{-6}$	$1.16e^{-6}$	0.166491	1.012146	1.000000
1995 (GMM)	5.674872	$1.23e^{-6}$	−0.992875	0.036330**	1.012146	1.000000
1996 (GMM)	−35.30919	$1.91e^{-6}$	−0.948490	0.054471	1.012146	1.000000
1997 (GMM)	44.56648	$2.69e^{-7}$	−1.027437	0.048501	1.012146	1.000000
1998 (GMM)	41.30049	$-4.27e^{-7}$	−1.026380	0.010571**	1.012146	1.000000

NOTES Values with two stars represent estimators which are not statistically significant for a risk of 5%.

In table 1, we present the estimating coefficients of the space model (S):

$$(S) = \begin{cases} p = \rho W p + b_0 + b_1 l + b_2 u + b_3 G + b_4 q + \zeta \\ G = b_6 - b_5 p \end{cases} \quad (20)$$

The majority of coefficients are statistically significant every the year. Determination coefficients of each regression are sufficiently high. The estimate of each year is overall significant while referring to the J-test statistics suggested by Davidson and MacKinnon (1993). Statistics J-test follow χ^2 to 7 degrees of freedom, it tests the best alternative of instruments used in each regression. In this model, the choice of instruments is optimal and gives a high probability, except for the years 1978, 1993 and 1998.

Each coefficient of each variable of each year provides theoretical information, concerning the effect of space interactions on the labor productivity in each area.

Interpretation of Results

The coefficient, which illustrates the space dependence between various areas of the European system is ρ. The estimated values of this coefficient are statistically significant each year. The tendency ρ represents a remarkable dispersion, whereas the values are in the majority positive.

High and positive values of the coefficient of space interaction ρ are marked by high significance. Negative Estimators of 'intensity of the space interaction' (ρ), are in 1981 and 1996. The estimated value of ρ in 1981 is not statistically significant, therefore it does not generate economic implications.

Series of space dependences between labor productivity growth rates in Europe are in fact series of space averages of interactions modes between European working forces. Series values do not have a raised variance for each year. This characteristic of spatial series (ρWp) is deduced to leave employment matrices from annual regional interactions, which depend on the economic masses measured each year. Matrices, which provide the viable space, are endogenous measurements of the space interaction.

In the majority of years these interactions have a positive effect on labor productivity in European areas. For example, value of spatial intensity (ρ), in 1977 is $\rho = 46.37888$ and stamps it interaction space, used in the empirical estimates, integrates determinants of the European areas in forms of economic interactions. In this case, the average productivities of areas depend on the averages of the labor productivity in various areas of the European system, plus the effect of the distance from a certain area to the European economic center (Luxembourg), plus the effect allotted of development (or productivity) of the area compared to the labor productivity of leader area and finally, plus the effect allotted to the growth of its added value. Labor productivity of Brussels in 1977 functions of the interregional weights which are decreasing compared to the distance and crescents compared to the income areas.

Interactions between labor productivities vary according to years because the size of Europe changes in time, although we use the same areas in 22 years of study. We cannot consider all the areas as being units of the same system each year, because Europe comprised 9 countries in 1973, 12 countries in 1986, 15 country in 1995 and finally 26 in 2004. This is why, the space effect of the regional influence reached its maximum level in 1983 and 1993.

With regards to the distance from the center effect on the labor productivities of the areas, we notice a sometimes positive, sometimes negative but always a weak effect. This remark is essential insofar as the distance to the interior of Europe does not influence productivities of the workmen in any area.

Cohesion policies and regional development in Europe do not depend on spaces but on behaviors of the factors of production at particular work. The objectives of the development funds after its constitution will ensure improvement of the labor productivities in certain areas.

With regards to the variable *G*, we notice that its coefficient (each year) is positive and statistically significant. This result is logical if the variation of productivity between an area and the leading area increases, the growth rate of labor productivity drops. Values taken by the coefficient b_3 are close to the unit for the years 1976 and 1998. The remarkable values (too weak) of this coefficient were carried out in 1983 and 1993.

Concerning the economies of scale, assuming the value of the coefficient b_4 is positive, we attend a screw and economy of scale. In this model, we notice that each year there are economies of scale in the European system except for 1976, 1989 and 1990, where increasing returns to scales are decreasing. The maximum value of b_4 can reach the vicinity of the unit. Positive value of b_4 (for example $b_4 = 0,5$) means that if the added value growth rate of an area increases by 100%, the growth rate of the labor productivity increases by 50%. The increase in the labor productivity generates growth more than proportional of the added value growth. This observation filled assumptions of the new theories of international trade (NTIT). While adding to the economies of scale, free movements of production factors, we provide answers in this case, about the conditions and the basic assumptions of the new geographical economy (NEG).

CONCLUSION

Economic policy aims to develop areas, where the income is lower than the Community average, which is influenced by national characteristics. Regional and national contexts needed to be discussed, analyzed and shared.

In the interior of a State, by distinguishing an area from the State, interesting and relevant problems which tackle regional ones are often ignored simply because the policy is committed to the national level. This idea was confirmed by the econometric approach and explains well that geographical characters exert effects of ousting on the wills of the economic policy. However, it is necessary to analyze the broad consequences of national and sub national policies if we want to include 'the hidden cost' of the national development policy into its areas.

Can we admit an initial intra national deterioration of cohesion is essential if we want to improve international cohesion?

This can be necessary for certain countries by taking account of the considerations and space characteristics of the areas. However, it is difficult 'to engage' a virtuous circle of growth for an entire country and convergence in the absence of an initial regional policy. Community policy, without drawing up characteristics of all areas of this country, contributes to a deterioration of the Community policy objectives. Going beyond the space data creates a risk of instability. A territorial focus in the short run could open the diffusion prospects of the benefits from the longer-term growth. However, in the integrated areas there is a real risk that the role of the longer-term government in as well 'as strategic organizer' is dominated by the requirement of short term and the ignorance of the geographical characteristics. The domination reduces the size of the administration and accentuates the budget deficits. If the role of the public sector compared to the private sector, like that of the national level compared to the UE, evolves in an antagonistic way, then cohesion is more likely to be degraded than improved.

European policies with the profit of the cohesions countries and the local policies exerted by the developed countries generally try to return the variations of developments between weak areas and answer the leveling growth targets.

Choices of the economic policies which mobilize transfers cannot achieve the growth targets by forgetting the concept of social integration ethics. Space and interdependence between the labor productivities exert positive effects on regional growth productive behaviors, as we show with the static space model of this paper. However, space effects of coordination modes are dynamic and depend on time in order get benefit from space dynamics in research from a leveling growth.

To take into account the dynamic aspect of space interactions, economic choices propose target growth of the areas in a perfectly integrated system and reductions of the regional inequalities.

REFERENCES

Baptista, R. 2003. 'Productivity and the Density of Local Clusters.' In *Innovation Clusters and Interregional Competition,* edited by J. Bröcker, D. Dohse and R. Soltwedel, 163–181. Berlin: Springer.

Ciccone, A., and R.-E. Hall. 1996. 'Productivity and the Density of Economic Activity.' *American Economic Review* 86(1): 54–70.

Davidson, R., and J. G. MacKinnon. 1993. *Estimation and Inference in Econometrics.* Oxford: Oxford University Press.

Fingleton, B. 2001. 'Equilibrum and Economic Growth: Spatial Econometric Models and Simulations.' *Journal of Regional Sciences* 41 (1): 117–147.

Fingleton, B., and J. McCombie. 1998. 'Increasing Returns and Economic Growth: Some Evidence for Manufacturing from European Union Regions.' *Oxford Economic Papers* 50 (1): 89–105.

Helpman, E. 1981. 'International Trade in the Presence of Product Differentiation, Economies of Scale and Monopolistic Competition: A Chamberlin-Heckscher-Ohlin Approach.' *Journal of International Economics* 11 (1): 305–340.

Kelejian, H., and D.-P. Robinson. 1997. 'Infrastructure Productivity Estimation and Its Underlying Econometric Specifications: A Sensitivity Analysis.' *Papers in Regional Science* 76 (1): 115–131.

Krugman, P. 1991. 'Increasing Returns and Economic Geography.' *Journal of Political Economy* 99 (3): 483–499.

Lucas, R.-E. 1993. 'Making a Miracle.' *Econometica* 61 (2): 251–272.
Rey, S., and B.-D. Montouri. 1999. 'US Regional Income Convergence: A Spatial Econometric Perspective.' *Regional Studies* 33:145–156.
Romer, P.-M. 1986. 'Increasing Returns and Long-Run Growth.' *Journal of Political Economy* 94 (5): 1002–1037.

Solow, R. M. 1956. 'A Contribution to the Theory of Economic Growth.' *The Quarterly Journal of Economics* 70 (1): 65–94.