Geographical-Economic Elements in Explaining the Spatial Equilibrium and Disequilibrium Theories in Regional Inequality

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The purpose of the present study is to combine the basic elements of micro-economics, macro-economics (economic growth), and geographical aspects in order to explain the economic and geographical bases which underlie both the equilibrium and the disequilibrium theories. The explanation encompasses three levels: theoretical background, spatial expression, and a new graphical introduction.

The theoretical background section surveys the main theories regarding the central question dealt with in this study: do regional disparities decrease over time without government intervention or is government intervention needed to reduce the disparities? This survey provides a scholarly basis for the graphic analysis of the two main theories: spatial equilibrium and spatial disequilibrium. The graphic analysis, which is based on economic and geographic research, constitutes the bulk of the contribution of this study.

Within the field of the spatial distribution of economic development, there are two dominant schools of thought: the 'spatial equilibrium' school and the 'spatial disequilibrium' school. The guiding principle of the spatial equilibrium school is the claim that regional inequity is a 'temporary phenomenon' deriving from the disparity between national economic growth and the spatial distribution of economic development. According to this approach, market factors—in particular the migration of the workforce and the flow of capital—act to close interregional inequalities. This school of thought has not generally been accepted and has been criticized extensively.

The disequilibrium school holds that, in essence, spatial distribution of economic development leans toward inequality, and that market factors tend to increase regional inequality rather than decrease it. According to this approach, only public intervention is capable of reducing regional inequality.

The theoretical debate between these two schools focuses on the conceptual level. Researchers from both schools use geographic-economic processes to explain their arguments, but they have not formulated these processes with a math-

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ematical-economic model and have not illustrated their statements with graphs. This study combines the concepts presented by various researchers with the economic and geographical theories and uses graphs to explain these theories.

THEORETICAL BACKGROUND

The purpose of the paper is to present a new analytical approach to the debate between the two chief schools of thought regarding trends of variation of interregional economic disparities over time, and a new graphic system with which to express it. The spatial school argues that market forces naturally reduce interregional disparities, and therefore there is no need for government intervention to reduce them; whereas the disequilibrium school maintains that market forces widen the disparities, and that only proper government intervention can reduce them.

The guiding principle of the spatial equilibrium school is the claim that regional inequality in economic development is a 'temporary phenomenon' deriving from the disparity between national economic growth and the spatial distribution of economic development (for a survey of these theories, see Lipshitz 1992). The closing of the gap between regions over a period of time has been illustrated through the famous inverted 'U' curve suggested by Williamson (1965). The curve illustrates how in the first stages of national economic growth, regional inequality grows in a parallel manner. From a certain point, the national economic growth (W) is accompanied by a reduction of regional inequality (V_w). In other words, the curve shows that in a poor country there exists regional equality of poverty. In the course of national economic growth, regional inequality increases up to a certain point. After this point, national economic growth is accompanied by a decrease in regional inequality, generating regional equality of prosperity.

Researchers who quote Williamson view the theory as a 'transition theory' which every country must pass through in the process of national economic growth (see Mera 1979). In other words, it is sufficient to improve the rate of national economic growth in order for interregional gaps to narrow 'automatically' (without intervention from above). Mera states:

> In recent papers I have demonstrated, on the basis of the development experiences of Japan and Korea, that economic development not only raises the average per-capita income but also decreases income disparity among regions and thereby reduces the magnitude of other regional problems (Mera, 1979:1129).

Mera then makes the following far-reaching conclusion:

> Thus the urban-rural imbalances are considered to be a *temporary problem* that can be overcome in a *shorter span of time* by accelerating the growth rate of the economy [author's emphasis], (Mera, 1979:1120).

Mera and other scholars—for instance, Courchene (1981), Courchene and Melvin (1986) and Vanderkamp (1990)—reflect the neo-classical approach to regional economics. The main point of their argument is that national growth produces regional adjustment; in other words, it is sufficient to create the conditions for interregional migration of labor, for movement of capital, and for the flow of information in order for national economic growth to be adjusted spatially in the long run and for interregional disparities to decrease. For example, Thomas argues that Canadian government intervention to reduce gaps—inter alia by transferring funds from the government in Ottawa to the residents of the weak provinces—causes the adjustment process of reducing disparities to fail.

The results of Harris's research concerning trends in regional inequality in the United States supposedly support this theory, as indicated in the following: " ... factor movements tend to bring about an equalization of income among regions" (Harris 1957:191). Further empirical support can be found in studies by Markusen (1994) on the United States in 1950–1992, and by Smith (1987) on the United States. There is evidence of a decrease in interregional disparities in several developing countries that are experiencing economic growth, such as Mexico, especially in tourism and transportation (Malick and Carayannis, 1994), and Spain (Suarez-Villa and Cuadrado Roura, 1993).

Fan and Casetti (1994), on the other hand, argue that Williamson's approach may not be valid with respect to the most developed countries in the 1980s. They believe that it is countries such as the United States, Germany, and Great Britain that have shown evidence of moving from convergence to divergence due to structural changes in the world economy.

Borts and Stein (1964) explain the theory of spatial equilibrium by means of equations which represent the relationship between income per worker in region i (W) and value of marginal product per worker (VMPL) in region i. Accordingly, migration of the labor force from low-income regions with a surplus of available labor to high-income regions with a demand for labor reduces the regional gaps in unemployment and income. The reduction of interregional inequality by means of labor migration can only be understood in the short-term if the character of the migrant is ignored. In such an event, the migration of employees and their families from peripheral regions to core regions reduces the number of employees in the periphery. It reduces, for example, the large number of workers in agricultural regions of developing countries, while increasing the number of employees in the core region. In the short run, this results in an increase of marginal output (production) in the periphery and a reduction in the

core region. The correlation (equation) between marginal output and wages per worker (W = VMPL) leads to the reduction of interregional inequality of income. In other words, reduction of interregional differences in value of marginal product per worker, as a result of migration from peripheral regions to core regions, leads to reduction of interregional differences in income per worker, without any government intervention.

This school of thought has been criticized extensively on the following grounds:

1. The historical facts indicate that the interregional inequality in economic development is not a phenomenon of 'temporary disadaptability', but rather a long-term phenomenon existing in most countries of the Third World (for example, see Aryeety-Attoh and Chatterjee, 1988; Simon, 1986; and Gugler, 1982).
2. Modern industries, which spur the growth process, are concentrated in metropolitan regions, whereas in backward regions, 'unsophisticated' industries develop which rely mainly upon primary raw materials. These 'simple' industries are characterized by a low regional income.
3. Despite migration from peripheral regions to core regions, a rise in per-capita income in the former is precluded by the high rate of natural increase. Furthermore, migration to core regions is selective, composed of the young, the skilled, the highly educated, and the like. Thus, such migration detracts from the growth potential of peripheral regions, that is technological deterioration in 'human capital'.

The disequilibrium school holds that, in essence, spatial distribution of economic development leans toward inequality, and that market factors tend to increase regional inequality rather than decrease it. According to this approach, only public intervention is capable of reducing regional inequality. Several theoretical approaches have attempted to explain and describe the factors which lead to increase of regional inequalities. In other words, they explain why some regions—generally metropolitan—have grown more rapidly than others. Specific arguments are presented by Myrdal (1957), Friedmann (1973), Hirschman (1958), Pred (1977), and Richardson (1973, 1978).

According to Myrdal (1957), in the long run, capital and labor (primarily the young and talented) will leave the 'declining regions' and move to 'growing regions'. This process is defined by Myrdal as 'backwash effects'; it exacerbates regional inequality in the level of development. In a later period of national economic growth, opposite flows can be created. These flows are composed of capital and labor moving from growing regions to declining regions, from the core to the periphery. This process is defined by Myrdal as 'spread effects'. The effect of this process is negligible, and thus its influence on the economic development of declining regions is minimal. Myrdal therefore claims that exogenous change is essential for reducing regional inequality. This aid can come from government

institutions within the country or international institutions. Myrdal is, however, pessimistic about the results of such aid.

Hirschman (1958) developed a theory similar to that of Myrdal. He defines the flow of capital and labor from peripheral regions to core regions as 'polarization', and the opposite flow as 'trickling down'. Contrary to Myrdal, Hirschman believes more in the efficacy of government aid in reducing regional inequality. In addition, he views regional inequality as a necessary stage in the process of economic growth. The necessity of regional inequality is a result of one of the major economic goals of every country, namely, national economic growth. For the purpose of achieving this goal on a high level, it is necessary to develop one or two regions more than the rest.

Myrdal, Hirschman, and some of the researchers of the 'location theory approach' put greater emphasis on the role of capital and labor in the growth of a region and less or none at all on the role of technological innovation. One of Friedmann's more significant contributions is the addition of technological innovations to the two above-mentioned parameters (labor and capital) and the examination of their influence on regional inequality in economic development (Friedmann, 1973).

Friedmann builds a wide theoretical framework, which is composed of four main factors: population migration, flow of capital investment, spatial diffusion of technological innovation, and spatial organization of political power. Their simultaneous influences cause instability in the spatial system resulting in the increase of inequality between the core and the periphery. The main centers for innovation are defined by Friedmann as core, and all other regions as periphery. The relations between the core and the periphery are defined by Friedmann as authority-dependency. Friedmann (1973) and Friedmann and Weaver (1979) have suggested in their books several approaches to spatial policy to reduce regional inequality.

Richardson (1973, 1978), like Friedmann, places great importance on distribution in the creation of technological innovation and on spatial distribution in the absorption of such innovations in order to explain the increase of interregional inequality in economic development. According to one of his explanations (Richardson, 1973), the regional growth function is applied as follows:

$$Y = [aK+(1-a)\,L]^{\alpha}+T$$

where:

Y = rate of growth of regional output
K = rate of growth of regional capital
L = rate of growth of regional labor
T = rate of growth of technological innovation
α = exponent

By developing subfunctions for K, L, and T, he explains how market factors (capital and labor) and technological innovations tend to increase interregional inequality (i.e., tend to strengthen the metropolitan area).

The purpose of the present study is to develop the 'regional growth function' in *another direction* in order to explain the economic and geographical bases underlying both the equilibrium and the disequilibrium theories. To this end, a new graphic system is introduced that provides an analytical explanation of the verbal debate between the two schools described in this section.

PREMISES AND POINT OF DEPARTURE[1]

a. The area dealt with is made up of two regions possessing different economic features: a core, denoted below as C; and a periphery, denoted below as P. The core is characterized by such factors as a high level of per-capita income, high concentrations of sophisticated industries, and a high level of services; whereas the periphery is characterized by low income and high unemployment, a concentration of traditional industries, and a low level of services.

b. Each of these regions is characterized by a different regional growth function. The difference between the functions stems not only from the difference in amount of capital and labor, but mainly from the regional inequality in the quality of production factors and in the level of technological knowledge. This difference leads to a situation where, for each given level of capital per worker, output per worker (and hence also income per worker) is higher in the core region than in the periphery.

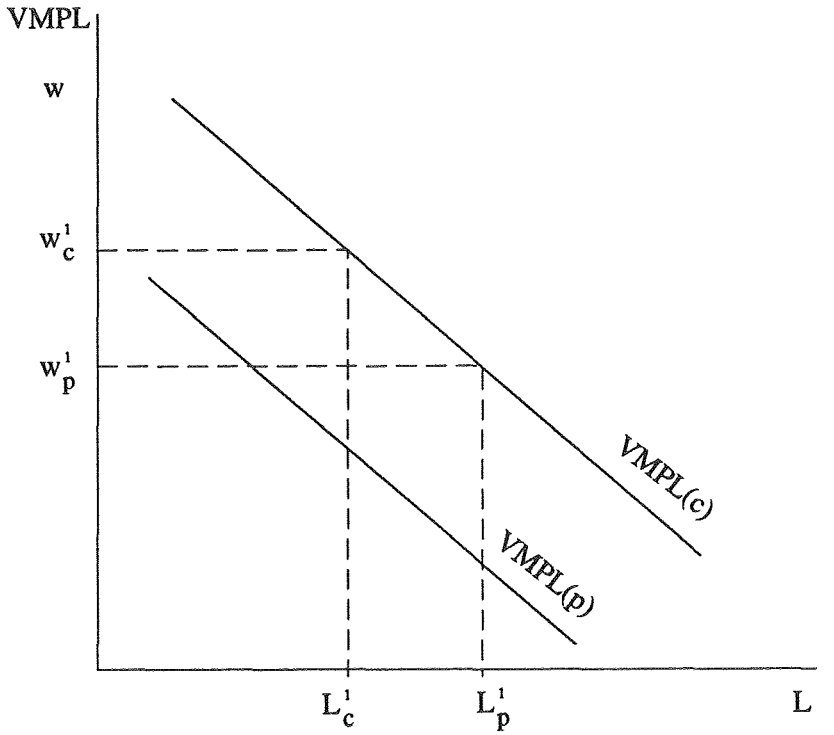
c. Employers (i.e., the capitalists) in each region pay wages to their workers in keeping with the value of their marginal output. In other words, the economic theory that wages per worker equal the value of his/her marginal output (W = VMPL), and that then the capitalist's profit is maximal, should be taken into account during our present discussion.

The point of departure for our present study lies in the assumption that there exists a gap in income per worker between the core region and the periphery. This inequality is based on the fact that the quality of capital and of labor and the level of technological knowledge are high in the core region in comparison to the periphery, in any given quantity of the workforce (labor)—and thus, the value of marginal output per worker is higher in the core in comparison to the periphery. The capitalist in the core region would thus be willing to pay each worker a high wage, as long as the maximum profit is thus attained.

Fig. 1 clarifies this point of departure. Here we see that in the core region, L_c^1 workers are employed, and in the peripheral region, L_p^1 workers (L = Labor; 1 = our point of departure—'first stage'; c = core region; and p = peripheral

region). The gap in income per worker between the regions in the first stage is expressed by the difference between W_c^1 and W_p^1; $W_c^1 > W_p^1$).

Figure 1. The relationship between value of marginal output and number of workers in core and periphery regions.



Actually, regional economic growth (or regional economic welfare) is measured according to *real income per capita*. Departing for a moment from our main line of thought, we shall consider briefly the significance of the above noted gap $(W_c^1 - W_p^1)$ in *real* terms, taking into account the interregional inequality in *level of prices* and in terms of *per-capita* income: in other words, taking into account the gap in the rate of interregional population growth.

REGIONAL INEQUALITY IN TERMS OF REAL INCOME AND OF INCOME PER CAPITA

By taking into account the spatial distribution of prices, the extent of the interregional gap will be less clearly understood than on the basis of the preceding explanation ($W_c^1 - W_p^1$ in Fig. 1). That is, if the index of prices is higher in the core region than in the periphery, the interregional inequality in *real income* (nominal income divided by index of prices) will be lower than that described by

the nominal income (less than $W_c^1 - W_p^1$ in Fig. 1). If the index of prices is higher in the periphery than in the core region, the interregional inequality will be relatively greater according to real income than according to nominal income.

Generally, there are certain economic forces which lead to relatively higher prices in core regions, and other factors which alternatively cause such relative prices to be higher in the periphery. For instance:

- The low threshold in the periphery, particularly in terms of 'purchasing power', has not enabled several kinds of goods and services to develop in the peripheral regions. Thus, persons in the periphery must add 'transportation costs' to the price as determined in a central place (core region).
- In peripheral regions, some goods and services are provided solely by one firm. Economically, this represents a 'monopoly', and thus the firm can raise the price above that which is fixed under free competition.
- In core regions there exist numerous stores, offices, and other business units providing identical goods and services. This situation fosters free competition between firms, leading to a decrease in prices.
- In core regions, as a result of the larger number of residents and their level of purchasing power, most goods and services are located relatively close to residential areas. Therefore, the 'transportation cost' in core regions is lower relative to that in the periphery.
- As a result of metropolitan growth, middle and upper class have moved to suburban areas, though they continue to work in the central city. The suburbanization process brings about a great increase in commuting distance, raising the cost of living for those in the core regions.
- The tendency toward consumption derives, of course, in part from family pressures to 'keep up with the Jones'. Therefore, family expenditures increase as a result of the 'demonstration effect', in turn causing the real value of identical income to be higher in the peripheral regions (rural society) than in core regions (urban and consumptive society).

From our discussion, it appears that whereas in terms of nominal income per worker, the differences between regions (for example, between core and periphery) are clear-cut, they are not so obvious in terms of real income per worker. They are determined by the volume of the regional differences in price-levels and cost of living (see Shefer, 1970; Moyes, 1980; Brîcker, 1994).

Let us now turn to the discussion of income per capita. Assuming that we possess data on spatial distribution of prices—enabling us to calculate real income per worker—we can translate real income per worker into real income per capita. Here we can also mention that many investigators (especially among the neo-classical regional economists) have selected regional income per capita as an index for regional economic growth (Richardson, 1978; Fisch, 1984).

In this issue there is little doubt that the facts argue 'against' the peripheral regions. That is, in almost every level of real income, real income *per capita* is higher in the core region than in the periphery. There are many explanations for this: the general one is that urban society is characterized by 'modernization', which includes demographic-social-cultural aspects, as well as economic noes. The peripheral society (mostly rural society) is characterized by 'traditional' aspects. Therefore, generally the family in the periphery is larger in size than that in the core regions.

In summary, the economic theory as described in Fig. 1 facilitates understanding of the economic basis for interregional inequality only in *nominal* terms. When turning to *real income*, interregional inequality ($W_c^1 - W_p^1$) may have increased or decreased in comparison with nominal income, depending on the extent of the difference between prices in the core and in the periphery. However, when we take into account the 'population size', there is no doubt that regional inequality in terms of income *per capita* is greater than that of income *per worker* ($W_c^1 - W_p^1$).

DIVERGENCE OR CONVERGENCE IN THE SHORT TERM

This section is intended to clarify, by means of the function of regional growth, the economic arguments adopted by the spatial equilibrium school, as opposed to the spatial disequilibrium school. Economic theory, of course, defines 'short term' as the span of time in which a single production factor can be changed—generally labor—within the growth function, whereas the other production factors remain stable. Thus, in this section—dealing, as it does, with the short term—the two schools of thought are examined solely by means of the spatial flow of labor (L), while the other factors of production (K and T) remain constant.

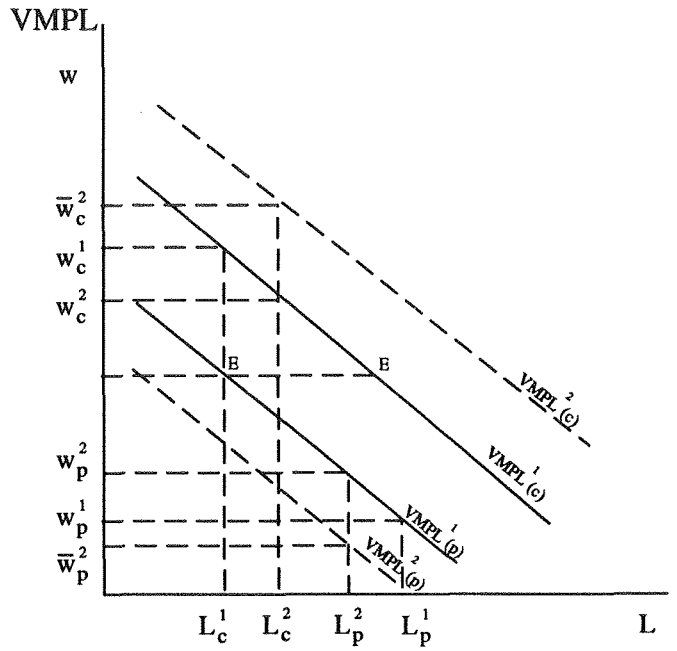
Reduction of interregional inequality through migration of labor in the short term can be understood only if the character of the migrants is ignored. In this event, the migration of employees and their families from peripheral regions to the core reduces the amount of employees in the periphery—for example, it reduces the large number of workers in agricultural regions in developing countries, and increases the number of those employed in the core region. In the short term, the result is increase of marginal output in the periphery and its reduction in the core region. Because of the connection between marginal output and wages per worker, this process leads to the reduction of interregional inequality in income per worker.

The above becomes clearer with the aid of Fig. 2. Points L_c^1 and L_p^1 denote the amount of the labor (workforce) in the first state, in the core and in the periphery respectively. The vertical distance $W_c^1 - W_p^1$ denotes the gap in income per

worker (as a result of the difference in marginal output) between the core and the periphery during the first stage.

In the wake of the migration process, the amount of those employed in the core region increased, from L_c^1 to L_p^1 and, in parallel, the amount of those employed in the periphery decreased, from L_c^1 to L_c^2 (see Fig. 2). The respective shift to the right and downward on the line $VMPL^1$ (C), and the respective shift to the right and upward on the line $VMPL^1$ (P), indicates the reduction of the gap in marginal output, and hence the reduction of the interregional inequalities in income per worker ($W_c^1 - W_p^1 > W_c^2 - W_p^2$). According to the spatial equilibrium school, the process of migration should continue to the point where income per worker in the two regions would be equal (point E in Fig. 2).

Figure 2. The relationship between value of marginal output and number of workers in core and periphery regions (two stages).



We shall now turn to examine the spatial disequilibrium school of thought. It should be noted that the basic premise of this school is that, within the framework of regional economic growth, migration is regarded as the spatial flow of 'human capital'. In other words, the socioeconomic characteristics of migration should be examined, as well as quantity and geographical direction. Research has clearly shown (see Brown and Lawson, 1989) that migration from the periphery to the core is selective, encompassing younger, trained persons and those possessing a higher level of education. The entry of such trained workers into the core

region indeed increases the amount of labor in the core, but it does nothing to reduce its quality and possibly even increases the overall quality of the workforce there.

We shall assume—and this assumption might be somewhat weak—that the trained migrants do contribute to the increase in production per worker in the core region.[2] In this event, in which production per worker increased, it is clear that marginal output increased for any given amount of labor. Graphically, this change is expressed by a shift to the right and upward of the line $VMPL^1(C)$ in Fig. 2.

Concurrently, the departure of trained workers from the peripheral region leads to a decrease there in production per worker.[3] In other words, the marginal output decreases for any given amount of labor. Graphically, this change is expressed in a shift to the right and downward of the line $VMPL^1(P)$, toward $VMPL^2(P)$ in Fig. 2. We now see that, in the second stage, the gap between the respective marginal output of the two regions has increased despite the fact that the workforce in the core region has increased, from L_c^1 to L_c^2, and has decreased in the periphery from L_p^1 to L_p^2. We also observe that the income per worker in the core, at the level of L_c^2 workers, is W_p^2, and thus that $W_c^2 - W_p^2 > W_c^1 - W_p^1$. This is the economic expression of an increased interregional inequality in the short term.

In summary, the spatial equilibrium school does not take into account in the short term (or, for that matter, in the long term) the differences among the characteristics of the migrants. Thus, the graphic expression of migration is a shift on the line describing the regional growth function, and hence on the line describing the marginal output of each of the regions. The increase of L_c and the reduction of L_p leads to the convergence of the respective marginal outputs (and hence of wages) till point E. The spatial disequilibrium theory emphasizes the socioeconomic differences in the character of the migrants. Thus, the graphic expression of migration is the shift of the regional growth function, and hence a shift of the respective curves describing marginal output. The increase of L_c and the reduction of L_p thus leads to a greater inequality between the core and the periphery in income per worker.

Another economic model that is relevant to our subject is Lewis' model (as described in Todaro, 1989) of the differences in economic development between two sectors: the urban-industrial sector and the rural-subsistence sector. The model is presented in the form of a different kind of graph, although the parameters are similar to those of the approach presented in this section. As Lewis describes it, national economic growth is spurred by migration of workers from the rural sector (where there is a surplus of labor and zero marginal output) to the urban sector, which is characterized by economic growth (due to an increase in capital stock) and demand for labor. Lewis assumes a 30 percent gap at least in average wages between the urban and rural sectors. This migration of workers from the rural sector to the urban sector—prompted by wage differentials and

the disparity in the demand for labor—does not change marginal output in the rural sector, which remains at zero because of a surplus of labor. In the urban sector, however, it boosts employment and increases marginal output for any given amount of labor. This growth is made possible by the increase in capital that results from the reinvestment of capitalists' profits in this sector.

Lewis' approach has several drawbacks (Todaro, 1989). First, the capital amassed by the capitalists in the local economy might not be reinvested in the economy of the same country; rather, it may 'flee' to another country. Second, most Third World countries currently have a labor surplus in the urban sector and not full employment. Third, the wage disparity between the urban and rural sectors is not constant; it may widen as a result of various factors, such as institutional factors and the expansion by multinational corporations of economic activity in the urban sectors of developing countries.

DIVERGENCE OR CONVERGENCE IN THE LONG TERM

The application of economic theories—based mainly on Solow (1956, 1969)—in elucidating the spatial equilibrium and spatial disequilibrium theories in the long term requires, at the outset, the presentation and explanation of several parameters:

(1) Y_i – total output in region i;

(2) L_i – total workforce (labor) in region i;

(3) ΔL_i – change in total workforce in region i;

(4) $y_i = Y_i / L_i$ – output per worker in region i;

(5) K_i – amount of capital in region i;

(6) ΔK_i – change in amount of capital in region i (planned investment);

(7) $k_i = K_i / L_i$ – rate of increase of population in region i (economic theory assumes that this is also the rate of increase of the workforce in region i);

(8) $n_i = \Delta L_i / L_i$ – rate of increase of population in region i (economic theory assumes that this is also the rate of increase of the workforce in region i);

(9) s_i – rate of savings in region i;

(10) $s_i Y_i = S_i$ – amount of savings in region i. According to Solow, in the long term, planned investment = savings; that is:

(11) $\Delta K_i = s_i Y_i$

(12) $Y_i = F(K_i, L_i)$ – in the long term, the output of each region is the function of amount of capital and amount of workforce. Assuming a constant return to scale, we can multiply any

parameter in an equation by a particular size. Multiplying each parameter by $1/L_i$, we obtain:

(13) $Y_i / L_i = F(K_i / L_i; L_i / L_i)$

According to (5) and (7), we can also express (13) as follows:

(14) $y_i = F(k_i)$ – In other words, in the long term, the output per worker in each region is the function of the proportion of capital per worker there.

Increase of the proportion of capital per worker in each region would raise output per worker there, while a decrease of this proportion would lower output per worker. Thus, it is clear that an increase in the amount of capital in a given region at a rate identical to the rate of growth of the workforce would leave output per worker in that region unaffected. This situation is defined in economic theory as a 'steady state' (a balanced growth).

The following equations may make the term 'steady state' clearer:

(15) $\Delta k_i / k_i$ – relative change in the proportion of capital per worker.

Equation (15) can also be expressed as follows:

(16) $\Delta k_i / k_i = \Delta K_i / K_i - \Delta L_i / L_i$. In other words, the relative change in the proportion of capital per worker is equal to the relative change in the amount of capital less the relative change in the total of the workforce. If the relative change in the amount of capital in the long term over a time span in a given region equals the relative change in the workforce there, then the region would remain in a steady state.

According to (8) and (11), we could express (16) as follows:

(17) $\Delta k_i / k_i = \Delta s_i Y_i / K_i - \Delta L_i / L_i$.

and

(18) $s_i Y_i - n_i k_i = \Delta k_i$.

According to (14,) we can also express (18) as follows:

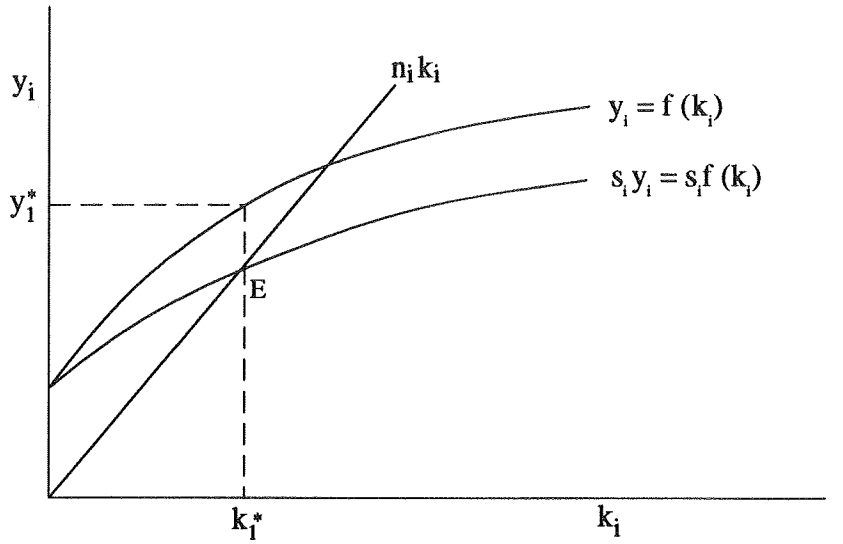
(19) $\Delta k_i = s_i F(k_i) - n_i k_i$

In other words, the rate of change in k in the long term is a function of k itself, for s and n are constant.

We may note that $s_i F(k_i)$ represents the savings in region i. Part of it serves to maintain the proportion of capital per worker, and part serves to raise that proportion. $n_i k_i$ is the investment required to maintain a steady state. If investment in a given region (that is, savings) is larger than its $n_i k_i$, then the proportion of capital per worker has increased and, with it, output per worker there (y_i).

Fig. 3 graphically represents equations (19) and (14). The vertical axis denotes output per worker in region i (y_i) The horizontal axis denotes the proportion of capital per worker in region i (k_i). The line $n_i k_i$ shows the amount of investment required in order to maintain a steady state. The curve $s_i Y_i$ shows the amount of savings in region i. Point E reflects a steady state; that is, planned investment equals planned savings ($n_i k_i = s_i Y_i$), which is one of the premises of economic theory on which this research is based. In a steady state, capital per worker is k_i^*, and output per worker y_i^*.

Figure 3. Determination of steady state with variable output per worker and capital per worker.



The detailed explanation given above, concerning the regional growth function in the long term, facilitates clarification of the economic considerations put forth by those who would reduce the interregional inequality in the long term (spatial equilibrium theory), as well as the economic considerations of those who would seek to increase them (spatial disequilibrium theory).

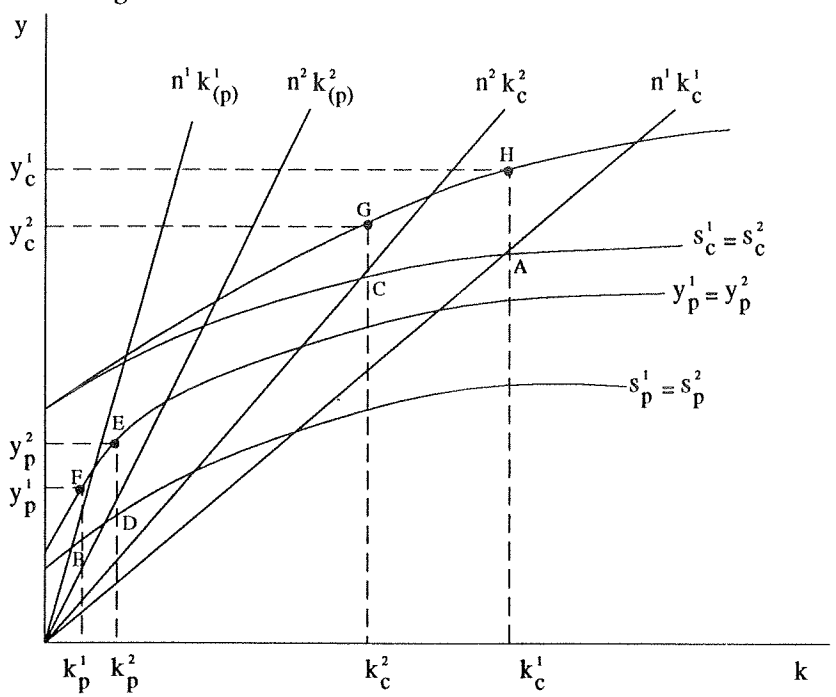
Fig. 4 clarifies the point of departure and facilitates explanation of the spatial equilibrium theory. The point of departure is the existence of a gap between output per worker (income per worker) in the core region (y_c^1) and that in the peripheral region (y_p^1). The curve y_c^1—denoting the relationship between output per worker and capital per worker in the core region—lies above the y_p^1 curve, denoting the relationship between output per worker and capital per worker in the periphery; this is so because of the differences in efficiency, in technological level and the like. Thus, on each identical level of proportion of capital per worker, the output per worker is higher in the core than in the periphery.

The differences of the curves of the output per worker in the different regions lead to differences between them in the curves for regional savings as well. Regional savings, as noted, are a function of regional output, and thus in Fig. 4 the curve s_c^1, denoting savings in the core region, lies above s_p^1. Since the rate of natural increase is higher in the periphery than in the core region, the line $n_p^1 k_p^1$ is located to the left of and above the line $n_c^1 k_c^1$.

In such a state (the point of departure), the core region is in a steady state, on the level of y_c^1. Point A (in Fig. 4) indicates equality between $n_c^1 k_c^1$ and s_c^1. In this equality, capital per worker is k_c^1 and output per worker is y_c^1. The peripheral region is in a steady state on the level of y^1. Point B indicates the equality between $n_p^1 k_p^1$. The gap between the core region and the periphery at the point of departure is $y_c^1 - y_p^1$.

The inequality does not remain static. The gap in income per worker between the regions comprises, of course, a central factor in the migration of families from the periphery to the core: this migration reduces the rates of population growth in the periphery and increases that in the core. The graphic expression of this process is the shift to the left and upward of the line $n_c^1 k_c^1$, toward $n_c^2 k_c^2$ (2 denoting the second stage, i.e., the state following the migration process). In parallel, there is a shift to the right and upward of the line $n_p^1 k_p^1$, toward $n_p^2 k_p^2$ (see Fig. 4).

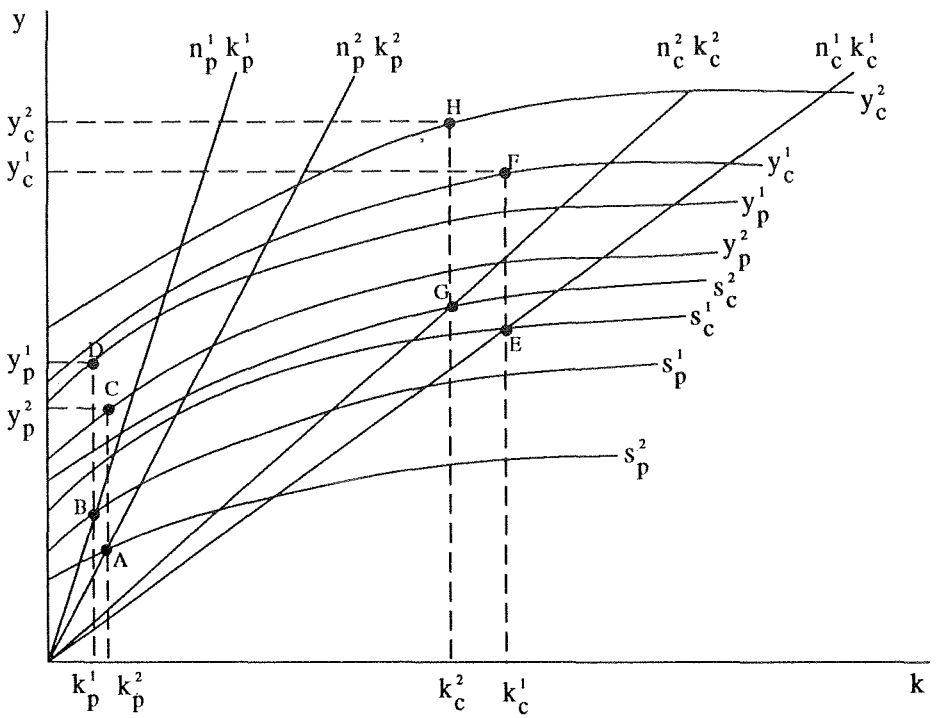
Figure 4. Equilibrium process according to the regional growth function in the long term.



In reaction to these changes, we obtain a new steady state in each of the regions. In the core region, equality is attained at point G, between the savings curve s_c^2 and line $n_c^2 k_c^2$ denoting the investment required to achieve a state of balanced growth in the core. Output per worker is y_c^2 and capital per worker is k_c^2. In the periphery the new state of balanced growth is characterized by y_p^2 and k_p^2 (point E). As can be seen; $y_c^2 - y_p^2 < y_c^1 - y_p^1$, the significance of which is a reduced regional inequality between core and periphery.

This analysis provides a better understanding of the spatial economic process which leads to convergence in regional inequality. However, as mentioned above, one of the main arguments of the disequilibrium school is that migrants to core regions are a selective group. In this manner such migration detracts from the growth potential of the periphery and to the economic growth potential of the periphery and to the economic growth of the core region. This process directly influences output per worker. Graphically, this is expressed by a shift of function y_c^1 toward y_c^2 (see Fig. 5). In other words, the new steady state in the core is on the level of y_c^2 output per worker, and at the level of k_c^2 capital per worker (point H).

Figure 5. Disequilibrium process according to the regional growth function in the long term.



In parallel, a regression in output per worker commences in the periphery. The migration of trained workers from the peripheral region leads to a state in which, regardless of the proportion of capital per worker, output per worker decreases. Thus, y_p^2 is located below y_p^1, as respectively is s_p^2 below s_p^1 (see Fig. 5). Equality between s_p^2 and $n_p^2 k_p^2$ lies at point A. Following the migration, the peripheral region can be found in a steady state at the level of Y_p^2 output per worker, and at the level of k_p^2 capital per worker.

The final results of the preceding discussion in this state are as follows (Fig. 5): k_p^2 and y_p^2 respectively represent the capital per worker and the output per worker in the periphery ($n_p^2 k_p^2 = s_p^2$ point A). In the core, k_c^2 and y_c^2 represent, respectively, the capital per worker and output worker. As can be seen in Fig. 5; $y_c^2 - y_p^2 > y_c^1 - y_p^1$. This gap indicates that regional inequality between these regions has increased.

The last argument is based only on the migration process. If other spatial aspects are considered (e.g. the spatial concentration of modern industries, which spur the growth process—or the spatial polarization of technical innovation; see Nijkamp, 1986), the divergence in long-term regional inequality would surely be even greater.

An idea similar to Solow's approach (the graphic model presented in this section is based on Solow) to national economic growth can be found in the model of Harrod and Domar (as described in Todaro, 1989). They maintain that every economic system should allocate a certain proportion of its national income to preserve the level of capital goods (equipment, buildings, materials), and an even higher percentage must be set aside in order to achieve economic growth. The formula of Harrod and Domar is as follows:

$$\Delta y/y = s/k$$

where:

y is national income;
Δy is the increase in national income;
$\Delta y/y$ is therefore the rate of change of GNP;
s is the rate of savings;
$k/y = \alpha$, the capital/output ratio.

For the rate of growth to increase, the savings rate must be greater than the ratio of capital to national output.

Harrod and Domar refer to national economic growth, and the analogy to regional economic growth is quite clear. The regional savings rate must be increased by more than the ratio of regional capital to regional output. The main problem in this application to regional data involves the geographical research unit, but this is not the subject of the present paper (for information, see Richardson, 1978).

CONCLUSION

The present study, which integrates economic theories and spatial theories, comprises a basis for understanding the central economic considerations underlying two schools of thought: spatial equilibrium and spatial disequilibrium. Most of this study relates to spatial changes of one of the three parameters of the regional growth function—i.e., the workforce.

It appears that differences between the regions in quantity and quality of the other two parameters—capital and technological improvements (Nijkamp, 1986) and land resources—would support the spatial disequilibrium theory. Indeed, most empirical studies, and mainly those concerning developing countries, would also support this school of thought [(see Semple and Gauthier (1972) on Brazil, Simon (1986) on Zimbabwe, Gilbert and Gugler (1974) on Latin American countries, and Aryeety-Attoh and Chatterjee (1988) on Ghana)]. For this reason, these countries continue to use government intervention to reduce interregional disparities.

The present study does not discuss radical theories (see survey in Wilber, 1979) which maintain that, although, in theory, governments act to reduce interregional disparities (declarative policy), they in fact join with market forces in acting to increase these disparities (effective policy).

The empirical application of the model presented here requires a regional database for various points in time with information on the following parameters: regional output, regional workforce, regional workforce by socioeconomic traits, amount of regional capital, regional savings rate, rate of regional population growth, the interregional-migration matrix, and the interregional-migration matrix by traits of the migrants. In most countries a substantial disparity exists between national and regional economic data. As a result, empirical studies on interregional disparities often have no choice but to focus more on the end result—disparities in regional per-capita income, on which data are available in many countries—than on a quantitative analysis of the *causes* of the disparities (the *parameters* of this study). The present study thus adds to our knowledge of theoretical development and leaves methodological development and empirical application for further research.

NOTES

1. Some of these premises are not essential, but are presented here to facilitate further discussion below.
2. It is clear that the migrants to the core do not lower the marginal output of the workers there—which, as noted, was the explanation of the equilibrium school.
3. Because of the departure of trained workers, total output actually drops at a quicker rate than the total of the workforce.

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