
NOTES ET DOCUMENTS

CONVERGENCE, DIVERGENCE AND NON EFFICIENCY OF PUBLIC INFRASTRUCTURE SPATIAL ALLOCATION

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1. INTRODUCTION

There is a controversy regarding the existence or inexistence of a convergence between regions, in terms of decreasing gaps between their level of economic development (see for example Jayet, Puig and Thisse, 1996). This article does not intend to deal with the controversy of the convergence/divergence arguments. It does intend to claim that there may exist a spatial market failure, which creates a bias towards too low convergence or too high divergence. Basically, the spatial market failure is caused by the fact that public investments in infrastructures (both physical and human capital) are allocated to regions on the basis of revealed pressures and not of expected rates of return.

Recent empirical analysis done in many countries supports the existence of a trend of convergence between regions, in terms of the diminution of gaps between rich and poor regions, or between metropolitan and peripheral regions, as measured by the Gross Regional Product per capita, or by other economic growth variables. (Barro and Sala-I-Martin, 1991). However, it also has been claimed in many cases that the convergence rate is too slow (Armstrong, 1994)¹. The existence of such a convergence process (either too slow or not) is basically

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¹ Fagerberg and Verspagen (1996) identify a trend of decline in the speed of convergence in Europe. See also Fagerberg, Verspagen and Caniels (1997) who investigate a few factors which may have acted against the convergence process in Europe: differences across regions in the diffusion of technology, economic regional structures, unemployment. Benchayoun and Lhéritier (1998) investigate the existence of a "club convergence" in Europe, and analyze "conditional" convergence, based on the inclusion of two dichotomic variables: poor/rich regions, and north/south regions.

explained by the diminishing importance of location factors, due to better communications, lower transport costs, better technology diffusion, etc.². If actually the peripheral regions benefit from better conditions to compete with the metropolitan regions, the possible existence of a spatial market failure could introduce a distorting factor, and explain a slower rate of convergence.

An alternative opinion suggests that there is no convergence trend at all, and that on the contrary, there is a divergence process: the main trend is one of polarization, widening the gaps between metropolitan urban centers and other regions. This trend is basically explained by the existence of "agglomeration economies". These are defined by Isard (1956) as scale economies which are external to the firm, and internal to the city or to the region. They include localization and urbanization economies³. The theoretical foundations of this phenomenon, as presented by Krugman (1991, 1993) and others relate to the fact that scale economies lead firms to concentrate in a few locations. Because of transaction costs related to distance, they also tend to locate closer to the market. The size of the market depends also on the presence of firms, which depend on the size of the market, leading to a cycle of concentration.

Again, without entering into any in-depth analysis of this approach, we can still claim that the equilibrium that is expected to be achieved between regions may be distorted by the possible existence of a spatial market failure. In other words, some of the gaps between the metropolitan region and the peripheral regions could be attenuated if the periphery had received its "fair part" of public infrastructures.

The importance of the influence of infrastructures (physical and human) on the creation of a stronger convergence process is accepted by most writers, and has even been shown by the analysis of the so-called "conditional convergence" (Benhayoun and Lhéritier, 1998). However, the point we are trying to make is completely different: the higher allocation of infrastructures should not be considered as a price to be paid in order to decrease regional gaps, but as the rectification of a distortion caused by a market failure. In other words, the decision about the quantities of public infrastructures to be allocated to each region should be made in function of an evaluation of the effect of the market failure. And therefore it should lead to a more efficient national allocation of resources.

² See Quah (1996) for an analysis of the influence of geographical factors as compared with the influence of national factors on convergence in Europe.

³ For a detailed analysis of agglomeration economies and of an empirical application to the case of France, see Catin (1991). See also Catin (1995) for an investigation of four processes which explain metropolitan growth.

2. THE FOUNDATIONS OF NON EFFICIENCY OF PUBLIC INFRASTRUCTURE SPATIAL ALLOCATION

The thesis presented here follows those main guidelines:

- Public investments in infrastructures, both physical and human, do stimulate economic activity in a region.

- The distribution of investments in public infrastructures amongst regions is not solely dictated by the economic return to investment, but mainly by demand pressures. Demand pressures are not influenced by the cost of infrastructures, since no direct payment is generally asked for the use of most of them.

- Demand pressures for public infrastructures are high in metropolitan areas, while there may be a decreasing economic return to concentration for two main reasons: the price of infrastructures may be higher in a more congested area, some of the demand for infrastructures is mainly for consumption (not production) purposes.

- The resulting distortion in the allocation of public investments does not conclude in any equilibrium, because of the existence of a vicious circle effect: higher public investments in infrastructures create more demand for economic activity, which reinforces the demand pressures and the distorting effect through an accelerator effect.

- The rate of return on infrastructure expenditures in non-metropolitan areas as perceived in the short run may be lower than the long run economic return, because of the externalities they induce.

2.1. Infrastructure as a production factor, and its influence on the marginal productivity of capital and labor

The rule of government responding to "market forces" in the allocation of infrastructures is a wrong one, because of a major distortion behind those forces. If economic efficiency is measured by the rate of return to capital investment, we should remember that the private investor measures the return to his private business investment, while from a national perspective we should measure return to all investments, including both private and public investments (in infrastructures).

Public infrastructures can actually be considered as a production factor, which influences the productivity of economic activity in any region⁴. The costs of any firm may be decreased by the availability of better roads, better communication networks, better power supply, leading to higher profitability and

⁴ The influence of infrastructures on productivity has been extensively analyzed. A leading article on this subject has been published by Aschauer (1989). Kelejian and Robinson (1997) have recently added the dimension of the spatial spillovers to the influence of public infrastructure.

higher production volumes. Better infrastructure facilities attract more investors to a region, as compared with other regions with poorer facilities.

In simple economic terms, if infrastructures are actually one of the production factors in a production function which include also labor and private capital, higher investments in infrastructure increase the marginal productivity of business capital and of labor, and therefore induce a higher return on private capital investments and stimulates economic activity⁵.

2.2. The lack of relationship between return to public investments and their allocation between regions

The point is that the private investor considers in his decisions only direct investment in business capital and not investments in infrastructures: those are paid also by the investor, but indirectly, through tax collection by government, and with no direct relation to the specific activity. They are therefore considered as exogenous to the decision making. From a purely theoretical point of view, perfect free market optimal decisions would be taken if the private investor had to cover the whole cost of infrastructures that are relevant to his or her specific activity. In this case investment in infrastructures would be made if and only if it generates an appropriate rate of return.

Since the government is in charge of public infrastructures, the most economically cost-efficient policy of their allocation should be dictated by the long-term rate of return in various regions. We believe that this does not actually happen, and that investments in infrastructure are not optimally allocated, leading to a spatial distortion.

The question is how does the government take the decisions regarding the distribution of investments in infrastructures. The answer is normally that government responds to economic needs as transmitted by various places. The transmission of such needs is done through revealed pressures on given infrastructures. For example, heavy traffic on a given road is a signal for the need for more roads in that region. Normally, such signals represent effectively a situation where many location factors attract economic activity, but a bottleneck is imposed by the lack of infrastructures. Therefore, the intervention of government in building infrastructures can be considered as an answer to the needs expressed by free market behavior, and such intervention would be economically efficient.

⁵ For a few empirical evidences, see for example Bajo-Rubio and Sosvilla-Rivero (1993) for an analysis of the influence of public capital on the private sector in Spain. See also Mehay and Solnick (1990) for an analysis of the influence of defense expenditures on regional development, as measured by employment and income per capita. The results show a much more significant influence of investments in infrastructures than in operation and maintenance. Finally, see Costa, Ellson and Martin (1987).

In fact, the demand pressures do not really represent market forces, because this demand is not fully conditioned by a price, and because this demand is partly generated by production needs and partly by consumption needs:

- The need for infrastructures for production purposes (roads, communications, power supply, etc.) is real, but the demand is not generally regulated by the need to pay a price, as in the regular demand/supply game. Since marginal price is practically zero, demand is high. If the private investors had to pay a full price for the use of infrastructures, some of them may have decided to select another location, with a lower price.

- Part of the demand for infrastructures is for consumption purposes (such as the use of roads for recreation travelling). In this case too, no price is directly attached to the use of infrastructures, so the demand may be high. In addition, in this case the investment in infrastructures has no economic return, and is considered as a provision of services by government to its citizens. The question here is to which extent should government equally respond to demand for infrastructures in various regions, at extremely different costs.

A recent article by Dohse (1998) already suggests that the provision of infrastructures should be centralized, for the sake of locational efficiency, and not left to the free market trend based on regional tax revenues. The introduction of mobility costs to the model also show that "such costs may be efficiency-enhancing as well as efficiency-distorting, depending on the initial allocation of firms amongst regions. However, the higher the costs of mobility the higher the probability that they cause efficiency distortions" (p. 261).

2.3. A probable decreasing return of public investments to concentration

There is a tendency to allocate more infrastructures in the central metropolitan regions, because of the apparent advantages of concentration of economic activity. This tendency is generally economically justified on the grounds of the argument that a given investment in infrastructures would have a stronger effect in a region where all other conditions are favorable. In other words, the marginal product of an investment in infrastructures is higher in a region which offers an abundant supply of other contributing factors (appropriate labor force, proximity to markets, access to services, etc.). Free market economists would pledge that:

- This reflects the advantages of economic concentration,
- The market signals more needs for investments in infrastructures in the centers,
- Peripheral regions could be helped in order to achieve equity goals, but there is no economic justification for government intervention.

But is that actually accurate? It may be true (is it?) that the construction of

one mile of roads would cause a higher increase in economic production in a metropolitan region than in a peripheral region. But the evaluation of the maximum efficiency of public investments should be done on the basis of the rate of return in various regions, in terms of benefits to the national economy as compared with costs. The benefit/cost ratio in a metropolitan region as compared with that of a peripheral region may be influenced by the following factors:

- The benefits of public investments in infrastructures are measured in terms of induced growth in gross domestic product. This is actually achieved by the attraction of investments by the private sector, as a response to the higher productivity of production factors, which is caused by the increase in infrastructures. As said above, this effect may be substantive in metropolitan regions, which enjoy an abundant supply of other production factors. However, the prevailing scarcity of infrastructures and of economic activity in peripheral regions may explain a strong impact of new investments. The lack of infrastructures would lead to a higher marginal product, in terms of attraction of new economic activities and in terms of a better exploitation of existing resources of labor force, land, natural resources. In other words, factor productivity is relatively low in peripheral regions, but investments in infrastructures there may induce a higher increase in productivity, although it would still remain lower than in metropolitan regions. Therefore, the additional product caused by investment in infrastructures in peripheral regions could be higher.

- The costs of infrastructures in metropolitan regions increase rapidly with the increase of density (both of population and of infrastructure itself): prices of land increase, constraints on infrastructures are more severe (more limited space, need for more sophisticated engineering solutions as bridges, tunnels, etc.).

- Investments in infrastructures are partly for consumption services and not for production purposes, as explained above. It may be assumed that the intensity of use of infrastructures for this purpose is higher in metropolitan regions. This means higher costs with no economic product associated to them in those regions.

We have shown here that for the least, it is not quite trivial that the economic return in terms of national growth for each dollar invested in public infrastructures is higher in metropolitan regions than in the periphery. The relative cost of infrastructures increases rapidly in the metropolitan region, and the benefits in terms of increasing productivity may be quite high in the periphery. If the benefit/cost ratio is not yet higher in the periphery, we may at least evaluate that the gap with the metropolitan region is decreasing. This by itself would justify a certain increase in the relative share of public expenditures on infrastructures in the periphery.

The existence of a decreasing return to concentration may not be strictly proven, but such a trend is supported by revealed circumstantial behaviors. The

response of investors to the increasing cost of business private investments (price of land and buildings for firms, urban congestion, etc.) against an apparently slower increase in concentration advantages has been a growing deconcentration of their economic activities. Many types of industrial activities and even of some central services have shown a tendency to seek for locations outside the big urban centers.

It is probably true that there are concentration effects that provide for economic advantages in centrally located activities. However, "the thesis that there are inherent economic disadvantages associated with periphery location is not substantiated⁶": concentration advantages are more and more balanced by disadvantages and by negative externalities⁷.

Empirical findings are not yet quite decisive, some recent signs from quantitative analysis show that the positive correlation between economic development and urban concentration is not necessarily true anymore. Moomaw and Shatter (1996) show in a recent article that urban concentration (as measured by various indicators) is generally negatively correlated to growth in economic development and to growth in export orientation. The overall level of urbanization may increase as a consequence of economic development, but the level of concentration of urbanization would decrease, allowing for a more important role to non metropolitan regions⁸.

As put by O'Donnell (1997): "*The existence of strong tendencies to regional concentration of economic activity is no longer understood as implying that industry will definitely concentrate and that regional fortunes will definitely diverge...*" (p. 77).

The ability of the periphery to compete with the center is supported by many writers. Solvell and Zander (1997) explain that "successful competition from the periphery is indeed possible if the firm is established in a strong and dynamic industry cluster", building on Porter's approach on the competitive advantage⁹.

It can certainly be argued, following the rules of free market economy, that spatial distribution of economic activities may react to changes in conditions in

⁶ See Burca (1997), p. 42.

⁷ Illeris (1993) explains the limitations of the theory of polarization between the center and the periphery, and suggests an inductive theory to explain the development of various regions as a function of their specific characteristics. See also Haughton and Hunter (1994) for their analysis of the externalities of urban environment and their conclusion that sustainable urban development requires regional settlement planning.

⁸ An additional support for the thesis that openness to external markets decreases urban concentration is provided by Krugman and Elizondo (1996) in their analysis of Third World metropolis. O'Donnell (1997) also supports the thesis that the trends of world globalization reinforce the trends of regionalization.

⁹ See Porter (1990).

the central regions. In concrete terms, higher land costs lead through market forces to the decision of many economic activities to relocate in peripheral regions (specially those activities with a relatively high land cost component), although most activities still prefer the central location. Therefore, the conclusion could be that the economic advantages of concentration may still be very strong and justify higher investments in infrastructures in the central regions. However, our argument is that such a free market behavior is distorted by a wrong policy of government in the allocation of infrastructures, leading to a repression of possible convergence forces.

2.4. The distorting accelerator effect

The spatial market failure induces also a distorting accelerator effect. The distortion that is created by the fact that some economic activities survive in the metropolitan region because they are economically viable in terms of the considerations of the private investor but not in terms of the national economy is further stimulated by the investments in infrastructures. The accelerator effect is basically due to the mutual influence between infrastructures and economic activity: not only the infrastructures stimulate economic development in a region, but also the existence of economic activity (or even expected economic activity) stimulates the building of infrastructures¹⁰, in a vicious circle.

The acceleration effect is due to the fact that the increased investments in infrastructures broaden the gap between private and national considerations, and therefore increase the distortion. More infrastructures means a higher profitability of the firm, a higher return on private investments, and therefore increased private investments and again increased demand for government infrastructures.

This point is probably best illustrated by the argument raised by many transportation experts regarding investments in roads. Traffic congestion brings to pressure of users for more investments in roads, the construction of more roads again stimulates the use of private cars (since the users do not pay directly for the use of the road), creating again more demand for more roads in a vicious circle. The conclusion is that the investment per driver increases constantly, and that equilibrium will never be reached, because of the existence of such a vicious circle.

2.5. The distortion of short term consideration

Economic advantages of concentration are initiated in many cases by the existence of a primary advantage in a given region (such as the existence of a natural port), but they are mostly endogenously generated by the process of growth itself. Peripheral regions may not have concentration advantages now, but

¹⁰ See Rietveld and Boonstra (1995).

as said above this may be to some extent due to a distortion in the allocation of infrastructures. A more healthy allocation may create an initial basis for the development of agglomeration economies (given other necessary conditions)¹¹. Therefore, economic advantages of investment in peripheral regions may not be apparent in the short run, but they can be revealed in the longer run. This is probably best illustrated by the stages of development and regional dynamics as analyzed by Catin (1995): the first and second stages of regional development are characterized by specialization based on low cost production factors and low technology products. But the third and fourth stages require the development of agglomeration economies for the increase of productivity and of competitive advantage.

3. CONSEQUENCES AND LESSONS EMERGING FROM THE SPATIAL FAILURE

3.1. Non-optimal use of economic resources

Government policy of spatial allocation of infrastructures primarily based on revealed preferences of capital investments by the free market may not lead to a sustainable economic development. The distortion of allocation of national resources leads to an inefficient economic growth, and to a depletion of economic potential in the peripheral regions. The lack of appropriate resources in those regions may lead to the well-known phenomenon of negative selection, by which the strongest elements of the periphery migrate to the metropolitan centers, further depriving the peripheral regions from their main leading forces. This may be an important factor in the oppression of convergence processes.

3.2. Social injustice-periphery subsidizing the center

Directly linked to the inefficiency of economic development is the social injustice caused by the misallocation of national resources. The fact that private investors do not directly pay for infrastructures, combined with the fact that those costs are covered by taxes that are more or less equally imposed on all the population, means that the periphery practically subsidizes the center. It can of course be argued that the periphery pays fewer taxes because of prevailing lower incomes and of the progressive tax system for direct taxes. However, a socially justified tax collection system should certainly not legitimize a reversing system of subsidies from the periphery to the center.

The probably most unacceptable aspect of that phenomenon is that the actual subsidizing of the center by the periphery is not only unjust by itself, but it also creates the seeds for a further increase of the regional income gaps. This social injustice element is even stronger if we accept the existence of a long-term

¹¹ Mehay and Solnick (1990) prove that investments in infrastructures in defense spending have a positive influence on state economic growth, only in the long term.

decrease of the return to investments in infrastructures: when a region achieves a higher level of economic development, public investments in infrastructures do not strongly influence the location decisions of firms, as they could in a less developed region.

The measures taken by government to help peripheral regions (incentives, tax reduction, etc...) have generally been considered as an economic price paid by the nation in order to help achieving social or other policy targets¹². Such an approach should be reconsidered, and the help to the periphery should be devised as an instrument for the achievement of a higher economic efficiency.

4. THE NEED FOR A NEW APPROACH

4.1. The almost optimal but not feasible answer to non efficiency of public infrastructures allocation

An effective action of market forces occurs when there is no distortion of prices of production factors, therefore providing for an optimal allocation of those factors. Such an allocation would happen if the actors in the economy were asked to pay for all the costs of concentration. The prevailing situation is that they pay only for a part of those costs: higher costs of land, wasted time in traffic, extra fuel and depreciation costs, social cost of high population density, health cost of pollution, etc.

The part of costs that is not fully covered by the users of densely populated areas relates mainly to the public infrastructures: roads, bridges, water supply, sewage systems, etc. The optimal situation would be to have the users of such infrastructures pay their whole economic price. The problem is that the implementation of such a solution is complicated, because we are dealing with public goods and because of the existence of negative externalities. Users would have to be charged for each use of the roads according the real price of building the road, for each use of bridges, etc. In addition, they should be charged for the damages caused by pollution of all kinds, by the social problems created by over congestion, etc. Some of those means are partially implemented in some countries (such as tolls on the roads), but those solutions are quite problematic. In a country with high density of roads, a road toll system would be inapplicable, specially given the fact that the crucial problem is within-city roads. The solution of a higher price for fuel is only partial: users of road infrastructures are asked to pay more taxes, but this is as a function of the quantity of use, and independently

¹² An extremely important issue that will not be covered in this paper is the question of the efficiency of such measures. The argument which is gaining more and more support is that the financial incentives are not sufficient for regional development and that measures of building infrastructures (both physical and human) are crucial. See for example Wilder and Rubin (1988) and Nissen (1989). For the case of Less Developed Countries, see Ostrom, Schroeder and Wynne (1993).

of the differentials in road prices.

4.2. Need for a normative approach for spatial policy

As in any case of economic market failure, free market forces do not lead to maximum efficiency and there is a need for government intervention. There is already a consensus on the role of government as a provider of infrastructures. The analysis in this paper suggests that the spatial allocation of infrastructures should now be considered as an important policy issue. Responding to demand pressures leads to a market failure, and therefore a normative approach should be devised.

Adopting a normative approach would mean that decisions about the allocation of public expenditures on infrastructure¹³ are made on the basis of given parameters (or norms), instead of responding to demand pressures.

For physical infrastructures, a possible parameter can be the changes in labor force in the region. Allocating annual expenditures for infrastructures between regions at the same proportions (for example) as the addition of workers would assure the determination of a similar "infrastructure intensity" (in terms of infrastructure per worker) across the regions. Naturally, the rule of equal infrastructure per worker should not be rigid, and alterations can be made in function of specific needs in each region. For example, a region can receive more than its equal share if it has been disadvantaged in the past, and shows the existence of a growth potential. Other alterations can be dictated by the specific economic structure in each region, and by the needs of its main economic branches.

For human capital expenditures, the leading norm should probably be the diminution of existing gaps between regions in education achievement. In this case too, alterations to the norms may result from differing cultures or demographic or economic structures between the regions.

5. CONCLUSION

This paper does not really take a stand for or against the existence of a process of convergence or divergence. It claims that there is a distorting factor that oppresses convergence and leads to a lower economic efficiency at the national level.

The distorting factor is the result of a spatial market failure in the allocation of infrastructures amongst regions. Infrastructures play an important

¹³ Abe (1996) shows in the case of Japan that three particular policies have contributed to the regional development: the construction of a national network of transportation and communications, the development of growth poles in local regions, and the relocation of industries from the metropolitan to the local regions.

role in the regional production function, they increase private capital productivity, but they are not traded in the free market. Marginal costs of most public infrastructures to the private investor are practically zero. Their allocation amongst regions is mainly influenced by revealed demand pressures, which do not necessarily correlate with return rates. The result is that metropolitan regions may receive more than their "fair share" of public infrastructure expenditures.

A normative approach for the allocation of infrastructures amongst regions should provide at least a partial solution to this problem. However, even a normative allocation, independent of demand pressures, is quite problematic. Should it follow the expected growth of population, or of labor force? In this case, should the ratio between public infrastructures remain fixed, or should it change with the increase in regional economic development? Should the rules be the same of the various types of public infrastructures (roads, railways, water supply, sewage networks, etc.)? Much more research work is needed to quantify the relationship between infrastructures and regional development, and therefore enable a reasonable normative regional allocation.

Another question with the implementation of such normative approach relates to the intra-regional allocation of infrastructures: inter-regional and intra-regional transport infrastructures may have opposite impacts on regional growth and convergence. Martin and Rogers (1995) show that the reduction of inter-urban transportation costs may cause an intensification of spatial concentration (and divergence), assuming a relatively low population mobility. On the other hand, assuming a higher population mobility, Ghio and Van Huffel (2000) show that the same reduction of inter-urban transportation costs would facilitate the location of firms in peripheral places.

This article has taken the role to alert against the regional allocation of public expenditures for infrastructures as a function of demand pressures. It suggests a very vague solution in terms of normative allocation, but this direction has still to be heavily researched. However, this unclear situation about infrastructures makes other instruments of more salient in the analysis of the process of convergence. The most important one is probably the policy aiming at reducing the costs of regional diffusion of technology and innovation, as shown by Martin (1998). Such a policy increases global national growth, facilitates convergence as well as gaps between return to labor and return to capital.

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