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TRANSPORT AND INFRASTRUCTURES: INTERRELATIONSHIPS AND RESEARCH FROM AN ECONOMIC PERSPECTIVE

The present work seeks to show the interrelationships existing between a country's transport and infrastructure policy and the economic results and, specifically, the location of industrial activities, regulations of a territory, economic activity and family incomes. The overall aim is to provide evidence of the importance of taking those decisions which are best adapted to the reality of a country, taking into account not only the existing needs but also the resources available and the interrelationships existing between key aspects of the economy.

Keywords: transport and infrastructure; economy.

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ТРАНСПОРТ ТА ІНФРАСТРУКТУРА: ЕКОНОМІЧНЕ ДОСЛІДЖЕННЯ ВЗАЄМОЗВ'ЯЗКУ

У статті продемонстровано взаємозв'язок між транспортом країни та інфраструктурною політикою, з одного боку, та економічними результатами, з іншого – зокрема, промисловою активністю, розвитком регіонів та добробутом родин. Представлено дані, що підтверджують важливість прийняття державних рішень з урахуванням специфіки країни та регіона, наявних ресурсів та ключових економічних факторів у їх взаємозв'язку.

Ключові слова: транспорт та інфраструктура; економіка.

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ТРАНСПОРТ И ИНФРАСТРУКТУРА: ЭКОНОМИЧЕСКОЕ ИССЛЕДОВАНИЕ ВЗАИМОСВЯЗИ

В статье демонстрируется взаимосвязь между транспортом страны и инфраструктурной политикой, с одной стороны, и экономическими результатами, с другой – в частности, промышленной активностью, развитием регионов и благосостоянием семей. Представлены данные, подтверждающие важность принятия государственных решений с учетом специфики страны и региона, ресурсов в наличии и ключевых экономических факторов в их взаимосвязи.

Ключевые слова: транспорт и инфраструктура; экономика.

1. Introduction. Nowadays, transport and infrastructure constitute two of the most important strategic aspects of a country's economy as they enable it to carry out the movement of goods and passengers in a given territory. Without doubt, they comprise a group of factors in constant change in developed countries and are, likewise, a fundamental area for the application of economic theory (Martine, 1996).

Transport changes depend on demographic, economic, sociological and technical factors. Due to their influence, transport systems must adapt to changes which

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arise in a country as it, in turn, develops. The transport system thus becomes a significant element in the analysis and projection of government policies which need to specify and qualify the quantified incidence of its impact in order to take political or economic decisions.

The aim of this work is to provide evidence of the interrelationships existing between a country's transport and infrastructure policy and the economic results and, specifically, the location of industrial activities, the regulations of a territory, the economic activity and family incomes. For this, throughout the following sections, we will show the importance which transport and infrastructure have acquired as a highly significant field of research in the area of economic theory. In particular, in the following section, the principal lines of research which have been followed over recent years in the area of economic theory with respect to transport will be reviewed. More specifically, we will highlight those lines which have focused on analyzing the effects of transport system on various economic variables.

2. Transport and infrastructure, their effects on the economy: lines of research.

Over recent years, economic theory has been concerned with analyzing different aspects related, among other questions, to the effects which the sector of transport infrastructure and its development have brought on different economic variables and indicators. In general, there exist 4 distinct approaches to the research which allow us to bring together the main studies carried out in the relevant literature on transport, infrastructure and economy. These 4 approaches can be summarized as follows:

- The influence of transport costs on the location of industrial activities;
- The role of transport infrastructures in territorial organization;
- The impact of investment and its financing on economic activity;
- The influence of transport spending on family incomes distribution.

Transport costs can be considered as production or investment costs. These costs can, in turn, be both of a quantitative type (for example: production growth) as well as qualitative (for example: modification of the structure of family incomes). It is also important to add how the transport sphere of influence can be local, regional, national or worldwide. Bearing in mind these ideas, it is not surprising that the impact of transport system on organization of production system and on economic growth has been the subject of concern for economists and reflected from the very first studies in economic science by Adam Smith (1776).

Effectiveness in provision of transport supply produces benefits for production system which is manifested in, at least, two ways (Bel i Queralt, 1994). On the one hand, transport improvement brings about direct benefits for production due to reduction of distribution costs of the output produced. On the other, it facilitates the expansion of the product and the market areas and allows the emergence of economies of scale in production.

The great importance of the relationships between transport system and productivity and competitiveness of an economy has led some authors to assert the total subordination of transport system to requirements of a production system (Batten, 1990).

Nowadays, there are many studies which directly associate the territorial development potential and the productivity of an economy to its transport system and, more specifically, to infrastructures. The positive impact of investment in transport infrastructure on productivity of an economy has contributed to generating a broad

consensus regarding the need to maintain a high level of investment in infrastructures which would permit reduction in the differences in funding between the member states of the EU, as was demonstrated by Aschauer (1989a) and confirmed by Garcia-Mila and McGuire (1992) and Aschauer (1989b). However, it is doubtful whether investment in infrastructure would on its own improve the disadvantaged regions. In these cases, infrastructures would be an essential condition for aggregate economic growth but not a guarantee for the development of certain regions in competition with others within an integrated economic framework. Other measures, such as promoting the installation of industries in the most depressed zones, would mean that investors in infrastructures would have less uncertain returns.

Biehl (1988) maintains that infrastructure or fixed stock capital is one of the principal determinants of regional development measured in income, productivity and employment levels. He bases his arguments on the potential approach or the potentiality factor of regional development.

The basic proposition is that there exists a special group of resources characterized by their eminently public nature which determine potential income, productivity and employment. In this group not only is infrastructure included but also geographical situation, advantages of population agglomeration and sectorial structure. But of these 4 categories of public resources, only infrastructure represents a direct instrument of governmental policy. It is not possible, for instance, to directly modify the geographical situation but, rather, only to improve the transport infrastructure. Nor can we directly influence the agglomeration of population, at least in democratic countries, since freedom of movement and residence is a fundamental right. The sectorial infrastructure is more open to the influence of public powers, above all if the subsidies are awarded to capital and to hiring of workers in order to attract more private resources to less developed regions. But, as previously pointed out, a long-term strategy always demands modification of the public resource facilities and that essentially means applying a policy of investment in infrastructures. Infrastructure is defined as that part of the overall capital of regional or national economies which, due to its public nature, is not usually supplied by the market or that the latter only supplies it inefficiently so that its provision is fundamentally confined to political decisions. Therefore, infrastructures represent an important instrument of economic policy which, at the same time, makes it impossible to put the infrastructural disparities down to "market failures"².

The relationship existing between the provision of infrastructures and growth has been demonstrated, based especially on the studies of Aschauer, by numerous authors (e.g., Argimon et al., 1994; Romp and De Haan, 2007; Musolesi, 2002). Nevertheless, there are other works which cast doubt or qualify the said relationship which is basic for a policy of investment in infrastructure (Evans and Karras, 1994 (a, b); Gramlich, 1994; Prud'homme, 2005; Estache and Fay, 2007 etc.). For example, some authors (e.g., Mas et al., 1995) indicate that the capacity to accelerate the convergence between different geographical areas with new investment is much less once certain levels of funding are reached.

² Different delimitations and ways of measuring the facilities considered in the definition of infrastructures can be found in Romp and de Haan (2007) and the World Bank (1994).

These qualifications are supported by numerous empirical cases, such as those of Vickerman (1987), Nash (1991), Hall and Hass-Klau (1985), in which the construction of an infrastructure does not always allow a substantial change in the bases of economic growth in the zones crossed (Vickerman, 1987). In the case of Spain, Gines de Rus and Vicente Inglada evaluated the investment in Madrid-Seville High Speed Rail Line and its impact on Andalusia, concluding that its social benefit was negative (De Rus and Inglada, 1993). Alvarez and Herce (1993) had similar findings. The latter performed an estimation of the microeconomic, sectorial, macroeconomic and regional effects of Spanish High Speed Train, concluding that it is foreseeable that the regions which have most benefited during the execution of the projects are those that already have self-sustainable growth (Madrid, Navarre, Aragon and Catalonia) and regions in expansion such as Valencia or industrial areas in decline such as the Basque Country. As regards the macroeconomic effects of Madrid-Barcelona rail project, the latter authors obtained the results which show a negative balance. The employment created would be greater (13,000 additional jobs) if the investment were devoted to road infrastructures. If the trains and electrical material were based on Spanish technology, 35,000 additional jobs would be created. Although a positive effect is produced on gross capital formation, inflation, external deficit and public deficit become worse.

Therefore, investment in public capital has the immediate effects of boosting demand, the lasting effects may be beneficial or detrimental for an economy. The construction of an infrastructure which resolves the problems of accessibility or reduces the operating time in a quantity sufficient to compensate its own costs generally increases the efficiency of an economic system (Ferreira, 1999; Agenor and Neanidis, 2006). On the other hand, investment in infrastructures not justified by the traffic which these have to handle, or the accidents which they avert, represents a burden for the society via the financial system or the public indebtedness necessary for their construction, maintenance and surveillance (De Rus, 1996; Ireland, 1994; Agenor and Yilmaz, 2006).

3. Decisions on transport and infrastructures: an economic perspective. Decisions regarding financing and planning of investment in infrastructures constitute one of the most important aspects of economic policies in any country, given their economic implications and reach. The policy of modal allocation of investment, carried out in the last decade, has fundamentally given more weight to roads with respect to the rest of alternatives.

This increase in the supply of road infrastructure has been the tool which governments have used to reduce intercity road traffic congestion and with it the social costs which it implies. But this has meant that options and priorities established in the infrastructure policy have led to very different speeds of the expansion of the infrastructures capacity and with it a very uneven reduction in travelling times by different types of transport. Thus, the priorities followed in the intercity railroad infrastructure of the 1980s-1990s have not significantly contributed to decreasing the travelling times, as has been achieved by the policy of providing road infrastructure which, as a result, has seen their competitiveness increase, this being one of the reasons which caused a decrease in the amount of traffic (Bel I Queralt, 1994).

Following the arguments of Gines de Rus, the objective of all economic policy with regard to transport must be channeled in such a way that investment in infra-

structure and industrial organization guarantees the efficient use of the resources employed within the sector, as well as a supply of services in accordance with the demands of the rest of the economy³. In order to make a transport system respond efficiently to the needs of economic policy, 4 lines of action must be met (De Rus, 1992; Agenor and Moreno-Dobson, 2006):

1. Investment in infrastructure, in accordance with the criteria of economic efficiency which avoids shortages and excesses of capacity in the transport network.

2. Internalization of the externalities in order to prevent the market from allocations of suboptimal resources⁴.

3. A determined policy of competition (deregulation) in order to introduce greater flexibility and dynamism in different industries, adapting supply to social demands.

4. The application of a distribution policy which eliminates the most undesirable effects of regional imbalance so that the efficiency gains do not impose excessive social costs in terms of fairness⁵.

Application of these 4 lines of action involves a change in distribution of traffic between optimum and efficient modes of transport. However, the reality is far different, as the current situation in Europe and Spain is characterized as marked imbalance between supply and demand. The latter has grown globally above the available capacity being able to absorb, creating serious problems of congestion in large cities and airports.

All of this moves Europe farther away from efficient allocation of resources and from an optimum modal distribution of traffic. European community transport policy is far from fulfilling the 4 lines of action previously mentioned for a coherent policy. The European Union has not formulated an infrastructure policy which avoids the problems of congestion from which the roads, main airports and urban areas suffer. The EU has been mistaken in its forecast of the infrastructures that would be required in Europe and in the spectacular development of roads at the expense of railroads as well as air transport and their development compromised by insufficient airport and air traffic control infrastructures.

The development of different modes of transport has taken place while ignoring their negative effects. The deterioration of transport by plane and private car is shown by the growing congestion (in certain places and at certain times) which markedly reduces the reliability and comfort of these means of transport. The number of accidents and the environmental impact of the roads are worrying and show that EU pol-

³ The relationship between the capital in infrastructures and the adjustment costs has been formalized in Turnovsky (1996). In the model proposed, the increase in public capital (given a level of private capital) reduces costs and facilitates the accumulation of private capital but the reduction of adjustment costs is produced at a decreasing rate.

⁴ An increase in spending on maintenance and reduction of the inefficiencies of the infrastructures would have a greater impact of the infrastructures over private investment and growth due to the increase in the duration of the public capital but also to the increase in the efficiency and duration of the private capital (Agenor (2008), Rioja (2003), Kalaitzidakis and Kalyvitis (2004)). Not to consider this effect could have as a consequence a suboptimal allocation of the resources devoted to new investment in infrastructures.

⁵ It is necessary to understand better how investment decisions in infrastructures are taken, given that this will probably affect the profitability or the efficiency of that investment. It is possible that projects which have been politically motivated are less profitable, given that their objectives are to attract voters instead of maximizing growth, it can be confirmed if we review numerous cases of investment projects determined by political decisions (Cadot et al., 2006, Robinson and Torvik, 2005).

icy has not given a satisfactory answer to the problem of transport externalities. Thus, the modal distribution is clearly affected by the absence of a policy which allows the users to see the real costs of their decisions.

The 4 lines of action outlined must be combined in order to achieve an efficient and socially acceptable policy. A policy of liberalization which is not accompanied by the other 3 policies has very contradictory results because, despite the fact that internal efficiency may rise in the industries affected by the introduction of competition, overall economic efficiency may be reduced, for example, due to an excessive increase in road transport with the consequent rise in accidents, congestion and environmental impact. On the other hand, a greater aerial freedom without necessary investment in airport infrastructures may increase congestion at the airports to the point of producing overall negative results which the users see as a consequence of the policy of competition.

The transport industries possess a set of characteristics whose simultaneous presence distinguishes them from the other industries (Carbajo and De Rus, 1991):

- The spatial nature of their output transforms them into multiproduct industries;
- The importance of the quality of the service in determining the costs for users;
- The difficulties related to their fluctuating demand and non-storable output.
- The efficient price fixing rules adopted to ensure the financial viability of firms when growing profits exist.

Apart from the previous characteristics, the essential nature of transport services is that this sector maintains significantly important relationships with almost all the production sectors – principally with agriculture and industry but also with the service sector – as well as having a growing importance within family budgets and as part of the services which are exported to other countries. In this context, it is evident that when an economy is observed from the point of view of an input-output table it can be clearly discerned that different modes of transport have an effect on the entire productive system. From there it follows that while transport is a sector which can be situated among those of derived demand, this condition is not absolute. Its relevance, from the point of view of inter-sectorial relationships, accepts that from its technical capacity and efficiency important effects and consequences are channeled towards other economic activities.

The traffic forecast represents the future estimate of the demand for transport. Modeling is an exceptional instrument for forecasting demand which has been used for many decades as an analytical, forecasting and simulation tool for transport demand in the scenarios which are designed within different planning processes. From the aggregate sequential conceptions, based on 4 classical transport stages (generation-attraction, zonal distribution, modal distribution and allocation) to those of a disaggregated type centered on the individualized behavior of economic agents (domestic economies and companies), the technological development in this regard has moved in parallel with the development of the needs for transport planning in different areas⁶.

With design and adjustment of these models, the intention is to draw up a set of tools and analytical and evaluative processes which make it possible to give responses or provide information in order to answer such questions or decisions as: if different types of

⁶ Further on different types of modeling in the transport sector and its applications, see Herranz, A. P. (2005).

transport exert an influence over economic activity, which underground network would best solve present and future problems of congestion? How would a new underground or bus line work within an existing network? How would an arterial network function in urban congestion? What would be the effect of a ring road or a relief road on city traffic or what would be the best option for a corridor among different existing possibilities?

4. Conclusions and management recommendations. The great importance which transport and its infrastructures have in the economy of countries, from a strategic point of view and given their importance for growth and development, means that it is a sector in continual change and adaptation to economic cycles. It is because of all this that economic theory seeks to analyze the repercussions by using 4 approaches, as has been shown in this work when we consider the abundant and important existing literature: the influence of transport costs on the location of industrial activities; the role of infrastructures in territorial organization; the impact of investment and its method of financing on economic activity and, lastly, the influence of transport spending on the redistribution of families.

A review of the literature shows that although there is a generalized consensus that a direct association exists between the transport system, and more specifically the infrastructures, and the potential for territorial development and the productivity of an economy, it is doubtful whether investment in infrastructures on its own improves the situation of disadvantaged regions. Infrastructure is one of the essential condition for aggregate economic growth but not a guarantee of the development of certain regions in competition with others within an integrated economic framework.

The scientific debate therefore continues to be focused on the key questions regarding the delimitation of the ways in which infrastructures affect growth and as regards the optimum level of these facilities which any economy should reach.

In this paper, we wish to leave as a conclusion that, although the transport sector has a positive and efficient bearing on the economy of a country, we should not lose sight of the fact that the real objective of any transport policy is that which is focused on ensuring that investment in infrastructures and the industrial organization of different modes of transport guarantees the efficient use of the resources employed within the sector, as well as a supply of services in accordance with the demands of the rest of the economy. Therefore, 4 lines of action must be met: (1) investment in infrastructures, in accordance with the criteria of economic efficiency, which avoids capacity shortages and surpluses in the transport network; (2) internalization of the externalities in order to prevent the market leading to allocations of suboptimal resources; (3) a consistent policy of competition in order to introduce greater flexibility and dynamism in different industries, adapting supply to social demand and (4) the application of a distribution policy which eliminates the most undesirable effects of regional imbalance so that the gains in efficiency do not impose excessive social costs in terms of fairness.

Application of these 4 lines of action involves a change in the distribution of different types of traffic between optimum and efficient modes of transport which would allow many of the transport policies applied in Europe and Spain to be corrected and which are characterized by a marked imbalance between supply and demand.

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