

## TRANSPORT INVESTMENT AND SUSTAINABLE URBAN AND REGIONAL DEVELOPMENT

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**Abstract.** *This paper constitutes a concise theoretical introduction to the complex and dynamic relationship between transport investment and sustainable urban and regional development. Its central aim is to explore and critically discuss the socioeconomic effect of transport investment within (i) the urban framework of reference, associated with the classical theory of location, and (ii) the regional framework of reference, associated with macro-economic phenomena, the neoclassical economic theory and the new economic geography. These frameworks are investigated in terms of the relationship between transport and the social and economic inequalities among cities or regions, current methodological advances. It is argued that management strategies may hold a crucial role in the developmental impact of transport improvements. Finally, these improvements cannot always be considered as an efficient tool to reduce regional disparities, so that other types of investment may be supplementarily employed for a more balanced urban and regional development.*

**Key Words:** *Transport investment, urban and regional development, social inequalities.*

### 1. INTRODUCTION

Transport refers to the movement of people and goods from one location to another. It can be viewed as a key determinant *and* consequence of the social and spatial formation and development of contemporary cities and regions. The role of transport has been traditionally investigated within two (usually, interrelated) spatio-economic and social frameworks of reference, i.e. those of urban and regional analysis. These frameworks are described here and particular emphasis is given to the relationship between transport and the social and economic inequalities among cities or regions. This relationship is principally

governed by the existence of positive or negative externalities induced by the provision of (mainly, public) infrastructure in a region to and from other (principally neighboring) regions.

On one hand, the positive externalities refer to the positive spillovers or 'network effects' of transport supply yielding aggregate productivity gains beyond the sum of local gains. These effects are mostly observed at greater levels of geographical aggregation, i.e. at the regional and state level (e.g., Aschauer, 1989; Munnell, 1992), where the productivity gains are more pronounced, compared to the local or urban level of analysis.

On the other hand, the negative spillovers arise when productivity gains realized by transport investment in a region are to some extent cancelled out by productivity losses in neighboring regions (e.g., Boarnet, 1998; Haughwout, 2002). The latter case does not imply that the region receiving the investment does not benefit from the new (or expanded or upgraded) network by increasing welfare, but the final gains in accessibility may be higher for another (usually more developed) region, thus raising concerns of equity among regions (Vickerman et al., 1999; Martin, 2000).

## 2. TRANSPORT INVESTMENT AND SUSTAINABLE URBAN DEVELOPMENT

The urban framework of reference mostly emphasizes the complex relationships of economies of scale, originating from increased productivity, and economies of urban agglomeration, which reflects the productivity benefits that individual units (firms and households) obtain from locating themselves in a concentrated market, with mobility patterns, land uses and property values. It also recognizes the critical role of diseconomies of agglomeration, due to congestion effects, which functions as decentralization force in economic activities.

This framework, closely associated with the classical theory of location (Alonso, 1964), has been typically employed to carefully understand and interpret the historical development of metropolitan areas along major (road, railway) infrastructure nodes and axes, particularly after the era of industrialization. Especially, transport infrastructure investments have been closely linked with productivity gains in manufacturing sector, due to decreased travel distances / shipping costs, and the sprawl of mega-cities.

The earlier theoretical and empirical investigations have clearly manifested the prevailing effect of site and situation factors on neighborhood and land use transformations and urban development. However, more recent investigations have raised the increasing importance of environmental and infrastructural considerations which are not (or are less) subject to local variation, such as high-speed rail networks, air transport connections, interurban highway networks and logistics systems, on spatial development patterns. Such patterns can be mostly characterized by linear corridors and isolated growth areas, thus affecting accessibility and the size and composition of urban labor markets.

The urban transport policy may generally combine four categories of instruments, i.e., investment, pricing, regulation and subsidy, to generate viable alternatives. These four, when integrated, form a complete transport policy alternative. Thus there are many strategies, instruments or actions in place in each ones. In practice, it is often easier to distinguish between those which can be quickly and cheaply implemented, and those which have longer lead times or significant budget implications.

A principal objective in the public provision and regulation of urban transport infrastructure and services nowadays is the treatment of congestion and other social and environmental (pollution, noise and fossil fuel and land consumption) externalities of road traffic which decrease welfare. In order to mitigate these externalities and improve urban living conditions, without further burdening the available public funds for expensive infrastructure investment, a range of urban 'deconcentration' policies are currently considered worldwide.

Such policies include the on-going application of Information and Communication Technologies (ICTs) to tackle congestion through traveler information provision, optimal route guidance, incident management and advanced traffic control, mechanisms for charging road use, parking, congestion and pollutant emissions, transit service improvements, and institutional and regulatory reforms like traffic rationing, carpooling and car-sharing, staggered or flexible work hours and tele-working.

Similar to the case of transport infrastructure investment, these policies can induce significant reduction in the generalized transport cost (see Litman, 2002; Kalyvitis and Dioikitopoulos, 2008), giving rise to the re-scheduling of travel choices and activities related to business and leisure trips. The gradual adjustments of generalized travel costs, in conjunction with long-term adaptations in the transport (e.g., vehicle ownership and use) and location choice behavior of households and firms, and investment policies of the public sector, can lessen the relative costs of market access for labor and materials and increase business productivity. All these benefits can possibly outweigh the potential development impacts that would otherwise be obtained from capacity expansion projects.

The determination of the wider social and economic effects of transport policies, such as those of road use taxation and transit improvements, is crucial since such effects, in the long run, can dominate the narrow transport-related benefits. A typical requirement for the social acceptability and success of a welfare-improving transport policy is to be *pro-gressive*, redistributing welfare from richer to poorer groups of society.

In this case, a number of market distortions and social inequalities should be corrected through increasing the available travel options and accessibility in poor areas, the efficiency of competition in the passenger and freight transport markets, and the equitable redistribution of revenues through compensation, tax reduction or subsidy. On the contrary, a *regressive* transport policy, benefiting mainly the richer groups or costing mostly the poorer groups of society, is expected to have a limited social acceptability, in spite of the possible improvement in total social welfare.

### 3. TRANSPORT INVESTMENT AND SUSTAINABLE REGIONAL DEVELOPMENT

The regional framework of reference typically deals with macro-economic phenomena and can be related to the neoclassical economic theory, where regional disparities are assumed to persist due to market imperfections and temporal lags inherent in the development process (Lucas, 1988; Suarez-Villa and Cuadrado-Roura, 1993). Advances in the theory of economic growth and trade, as reflected by the new economic geography (Krugman, 1991), have stressed the huge importance of increasing returns to scale and imperfect competition on the endogeneity (self-reinforcement) of regional disparities.

The theory of endogenous growth recognizes the impact of the historical growth process on the long-term growth rate, in accordance with the Myrdal's model of "cyclical and cumulative causation" (Myrdal, 1957). Such a theory has been employed to put forward the relative economic advantage conveyed to central (core) regions following the implementation of *integration policies*, such as those taking place in the European Union, which attempt to reduce inter-regional transport costs between core and periphery (e.g., through the Trans-European Networks and Free Trade Agreements).

The degree to which integration policies can actually reduce or strengthen socio-economic disparities between central and peripheral (less developed) regions can be considered as being dependent upon the tension between productivity benefits from increased market densities and congestion costs. Specifically, with high transport costs, economic activity is dispersed, as firms need to supply markets locally. By reducing transport costs, the connectivity between core and periphery increases and firms do not need to spread out to serve markets locally.

In this sense, lower intra-regional or inter-urban transport costs favor the development of system of *specialized* cities, which are dominated by a single economic activity (or industry), whereas higher transport costs favor the development of system of *diversified* cities, which involve the function of more than one economic activity (Abdel-Rahman and Anas, 2004).

It can be generally argued that, over space and time, there are certain ranges of transport costs which can achieve a desirable balance to enhance the welfare and accessibility of less developed areas, as well as to promote regional convergence and social cohesion. The attainment of these suitable cost reductions relies on a number of structural – operational and political - institutional aspects of the transport system (see Banister and Berechman, 2000; Jara-Diaz, 2007).

These aspects can give rise to variations of transport costs according to the type of transport technology, infrastructure (road, rail, port and airport) and investment, the quality of transport service, in terms of, e.g., travel time, service frequency, trip reliability, comfort and safety, and the interconnectivity and interoperability between alternative modes. For instance, operations and maintenance investment in contemporary cities with high level of saturation can be expected to have higher rate of return than investment focusing on new infrastructure or expanding the existing one.

The increase of the density of transport connections and accessibility can reduce transport input per unit of production, improve reliability of (just-in-time) good deliveries and diminish inventories and storage cost, leading to firm productivity gains, particularly in urban areas. Such improvements can also induce a clustering of facilities in a certain place, thus yielding further productivity gains (agglomeration economies). Nonetheless, enhanced accessibility may cause centrifugal forces by allowing some firms to reduce their land costs by choosing low rent locations away from dense activity centers.

These relocation decisions can possibly be fostered by establishment of intermodal freight transport facilities in the urban peripheries, which help reduce transshipment, cargo handling and storage costs. In addition, the role of suitable privatization and deregulation policies, which are increasingly adopted nowadays, can be critical in the urban and regional development process, since they can increase (privately-provided) transport infrastructure and levels of mobility and service at affordable prices, managerial efficiency and financial viability of transport facilities.

#### 4. CURRENT METHODOLOGICAL ADVANCES

The economic literature recognizes the enormous importance of public capital – typically associated with infrastructure - as an additional factor in the production process, along with labor and private capital, since it increases its productive capacity. The role of transport infrastructure (mostly roads, railways, ports, airports) and equipment is central in core infrastructure provision, together with the stock of communication and energy facilities, water system and sewers.

By and large, transport infrastructure and services can be seriously regarded as partially or purely public goods, and can result in economies of agglomeration and economies of scale in production. Since the late 1980s and throughout the early 1990s, the first studies using formal analysis to measure the effect of public capital on economic activity started to be systematically conducted. In specific, Aschauer (1989) and Munnell (1992) initiated a new exciting stream of research in the macroeconomic effect of public capital provision.

The crucial linkage between public capital stock and economic activity can possibly be modeled with a standard neoclassical framework, considering transport infrastructure as an argument in a production function, as that of Cobb-Douglas. In contrast with the production function approach, cost function approaches, such as that of translog and Leontief, which implicitly assume that input prices are exogenous, can capture behavioral responses of firms related to their cost structure to variations in public capital (e.g., see Talvitie and Sikow, 1992).

Other approaches include gravity models and regional image attractiveness models. In order to address potential problems caused by spurious regression between transport provision and economic output, Vector Autoregressive (VAR) models have been applied to allow testing the possible causality relationships between all the variables of interest in a long-run steady equilibrium, sometimes in association with Vector Error Component (VEC) models to identify the presence of short-run dynamic adjustments towards a long-run stationary state (equilibrium) (e.g., see Yao, 2005). Besides, panel data approaches incorporate the spatial dimension to capture regional variations, in comparison to the standard time series approaches, so that enable the production of more reliable estimates.

Convergence analysis allows analyzing the dynamics of the effect of public capital, and determining the convergence rate of the economy, conditional on infrastructure stock, while the examination of spillover effects allows examining the expansion of public capital stock investments from one region to its neighboring ones (e.g., see Pereira and Andraz, 2005). Also, business cycle models allow connecting fluctuations of the economy with changes in transport demand (Lahiri and Yao, 2006). However, most methodologies may not be appropriate to study spatially interconnected networks, in order to fully capture positive (e.g., on land values and rents) and negative (e.g., congestion and environmental costs) network externalities. Input-output analysis employs industry level data (Liew and Liew, 1984), while the Data Envelopment Analysis (DEA) and stochastic frontier analyses use microeconomic concepts of productivity analysis (e.g., see Alam et al., 2004).

Current trends and research needs on disentangling the complex relationship between transport and development tend to concentrate on more refined levels of temporal, spatial and social analysis. Such analysis can allow examining in more detail the feedback relationship between transport improvements at local level and behavioral, perceptual and

attitudinal adjustments of households and firms to new accessibility conditions as they are changing dynamically over time. Appropriate computational paradigms for handling these issues include microscopic simulation approaches of transport and land use interactions, agent-based models and advanced micro-econometric (discrete choice) methods of analysis.

Multi-agent systems can microscopically simulate the behavior of individuals/households and firms in a spatial context. These models allow representing such features as autonomous decision-making with bounded rationality of each individual, the heterogeneity and network effects between them, and the impact of local (partial) information and differential learning mechanisms on self-organized, self-evolved and dynamically emergent travel, activity and land-use patterns (see Otter et al., 2001; Sasaki and Box, 2003).

In this way, dynamic processes are emerging that capture interactions among (i) the micro-level of household and firm behavior and land parcels, and the macro-level of the whole urban form and territorial organization, accounting for heterogeneities and discontinuities across space, and (ii) the short-term behavioral adjustments and long-term (chaotic) dynamics, usually moving far out of a stationary equilibrium state. Dynamic (partial or generalized computable equilibrium) models that account for the wider impact of transport improvements can consistently represent indirect effects on land uses and values, relocation of households and businesses, and long-term growth of investments, trade, tourism and other services.

Besides, methods of social network analysis can allow treating transport as *both* a reflection (consequence) *and* conditioner (determinant) of social relations over space and time (e.g., see Axhausen, 2007). Specifically, transport cost reduction and enhanced accessibility may affect the spatial dimension of social networks through increasing the probability of membership, their intensity (number of contacts), co-ordination, density and geographical scale through expansion to hitherto remote locations outside major urban centers.

## 5. CONCLUDING REMARKS

Summing up, it can be argued that transport improvements, particularly those derived by the provision of physical infrastructure, cannot always be seen as an efficient policy instrument to reduce regional disparities, although they may favor local economic and social development. Often investment in transport exceeds commensurate investment in other input production factors by far, thus resulting in wasting resources and reducing efficiency. The critical question in connection with resource allocation is to carefully determine the marginal rate of return for different input factors of production. On-going policy orientation moves towards other (supplementary) types of investment to achieve a more balanced urban and regional development.

Provided that the relative decrease of social inequalities constitutes a major political target for several governments and institutions around the world, like the European Union, policies that focus on human capital investment (e.g., education and training) could be more suitable to increase the competitive position of peripheral (less developed) regions than transport investment. Finally, investments that give priority to the management (or better use) of existing transport networks can be reflexively regarded as more appro-

priate to *decouple* transport and development, in the sense of reducing external social costs while maintaining an acceptable rate of growth, in contrast with investment in new infrastructure.

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## **ULAGANJE U TRANSPORT I ODRŽIVI URBANI I REGIONALNI RAZVOJ**

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*Članak predstavlja koncizan teoretski uvod u kompleksan i dinamički odnos između ulaganja u transport i održivog urbanog i regionalnog razvoja. Njegov glavni cilj je da istraži i kritički obrazloži socio-ekonomske uticaje ulaganja u transport u urbanom kontekstu, koji je blizak klasičnoj teoriji lokacije i u regionalnom kontekstu, koji je blizak makroekonomskim pojavama, neoklasičnoj ekonomskoj teoriji i novoj ekonomskoj geografiji. Ovi konteksti se ispituju u smislu odnosa između transporta i socijalnih i ekonomskih nejednakosti u gradovima ili regionima, kao i u smislu aktuelnih metodoloških napredaka. Smatramo da strategije u menadžmentu mogu imati presudnu ulogu u razvojnom uticaju ulaganja u transport. Na kraju, ova poboljšanja se ne mogu uvek smatrati efikasnim sredstvom za smanjenje regionalnih nejednakosti, tako da druge vrste ulaganja mogu biti dodatno primenjene u cilju uravnoteženijeg urbanog i regionalnog razvoja.*

**Ključne reči:** *ulaganje u transport, urbani i regionalni razvoj, socijalne nejednakosti.*