# ON THE EFFECTS OF DEVELOPING AN EDUCATIONAL AND RESEARCH BASE IN TRANSPORT & LOGISTICS IN DEVELOPING ECONOMIES

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## ABSTRACT

In the promulgation of the process of economic development stimuli, linkages among the sectors of the economy have a resolving role to play. We are at the side of the approach that some "key" sectors act to shape the path of economic development in the sense of changing the structure of the economy in question.
Our methodology is to adopt a meso-level approach to analyse the interplay between several sectors of the economy: the market(s), transport sector and its interactive position with the rest of the economy, through logistical networks, policies vis-à-vis the industry, technology, education and their implications with infrastructure formation and regional policies
In an inter-industrial structural framework, the analysis of inter-sectoral linkages is critically important for our study. In this context, as any industry's rate of technological progress and its R&D intensity are positively and significantly correlated with other industries, the gravity of educational and research networks and their spillover effects on the coefficient of this correlation are our main concern.
It is assumed that there is a strong correlation between the human capital, technological capabilities and the transport infrastructure. Alternatively, an under-average efficient utilisation of the potential endowments (i.e., low level utilisation of educational and research capabilities) of the economy under scrutiny makes that economy even more vulnerable to utilise the transport infrastructure investments.
Our model, in fact, is based on policies to design and implement investing in educational policies aimed at fostering a research infrastructure in a developing country context. Indeed that part of the picture, R&D, particularly in transport & logistics, is the missing element in this group of countries. We intend to devise a comprehensive framework of the analysis of spillover effects of developing a model of an institutional infrastructure of education and research for the developing countries.

*Key words: institutional framework of research – transport and logistics infrastructure – micro-, meso- perspectives – key sectors – human capital - spillover effects –*

# 1. OVERVIEW AND RESEARCH METHODOLOGY

As every society has to pass through the process of a dialectical historical interaction between the forces and relations of production

(1) The developing country paradigm does not properly fit into the classical western type developed capitalistic model for a variety of reasons[1] in the developmental process and, consequently

(2) The structural formation of the developing country economy is bound to be analysed within the context of a structural transformation analysis – and not necessarily through the process of orthodox developmental model of the past (of the capitalist development process where every decision of the economic agents is to be taken by the market forces; i.e.firms – cf. invisible hand).

In other words, the market in a developing country context is an inefficient organisation and, intrinsically, does not contain the forces to make it work to compete in our present-day globally highly-competitive world. Considering the fact that no economy on earth can survive in isolation from the rest of the world, the internal dynamics of an economy is bound to be intermingled with the external / global dynamics. Then we have to treat our model economy with its internal as well as global dynamic conditions. Keeping in mind the inefficiency of the market in these countries, in our model economy, the focal point should be on building and developing a viable market – in other words, developing effective market forces to carry out the market into a competitive ground. This is synonmous to building a capable infrastructure, covering the physical as well as the research base dimensions.

Whatever definition or approach we adopt, our conception of economic development in this paper is that it is a process of structural transformation where intersectoral relations have a determining role and the transport and logistics networks possess a special place as key sectors. As globalisation movement gains momentum, on the other hand, a technological development pace surpassing that of social sciences inscribes an uncontrollable character on to the structural transformation of economies. We see that transport and logistics networks play a highly effective role in this transformation process. As the "right" design and implementation of these networks can provide favourable conditions for these effects, the results of wrong choiecs may be lasting. The right transport and logistics planning requires some prerequisites for their due implementation. We can safely put a *research base* to the top of the list to minimize the negative consequences of wrongly chosen transport policy alternatives and to maximize the benefits of well-designed transport and logistics policies. Therefore we can name the very concept of *research* as our strongest key word in this study.

Our methodological approach here is to decide the level at which we have to carry our analysis further.

In this sense the meso-area is essential for the development of lasting competitiveness and the **r**elevant fields and important measures on the meso-level are:

- The infrastructure policy shall guarantee that disadvantages on account of the transport and communications do not destroy competitive advantages in the production. Successful industries shall be able to rely on a modern infrastructure.
- Meso-policies shall proceed selective and aim at a "strengthening of the strong" to build up dynamic industrial nucleuses and efficient locations as fast as possible, which have stimulating spillover effects on other, less developed areas. Policies on the meso-level should concentrate on industrial clusters with potentials of development.[2]

[1] Market inefficiency being the first (and foremost), among others, as we underline this fact.
[2] op. cit, p. 37

In the sphere of meso-level analysis we can detect the interventions to address the market failures, both temporary as well as persistent. In other words, meso-level measures embrace

- Policies to strengthen the competitiveness of industries
- Industrial policy
- Infrastructure development
- Regional policy and
- Educational policies

In our model designed mainly to analyse the spillover effects of developing a research base for transport and logistics networks on the development of some other selected (mainly commodity-producing) sectors, we can detect more than one of these measures. Our research base depends on a properly designed educational programme devised to support that research infrastructure on purpose. For that matter, within the context of developmental purposes of the developing countries, this educational programme is, first and foremost, deemed to be modelled to serve creating an *institutional framework of research* which is the missing element for that group of countries, as it is an integral part of the economy in the case of the developed world. Therefore, the functions of the peculiar educational programme in the developing countries are twofold: First create and then support a research environment. As research provide the basis for a sound policy-making to turn the logistics and transport networks into a boosted factor to the sectors they feed, it can also bring up a more productive human power into these sectors.

Having been set to the analyse the linkages between transport and logistics infrastructure and the sectors to be affected by the improvement of the infrastructure, one of our desperate aims is to probe into the possibilities of measuring the impact of one (infrastructure development) over the other (commodity-producing sectors). In doing this, we intend to install the spillover effects of infrastructure development on the rest of the economy.

Although our principal approach depends mainly on a meso-level analysis, in our implementation of the transport & logistics infrastructure developmental effects on the rest-of-the-economy especially via the market-related-growth coverage requires an analysis based mainly on microeconomic models[3].

## 2. LITERATURE REVIEW

Historically transport issues and problems have always drawn attention of a big number of people from among the field of engineering, economics and managtement. Due to this, a variety of transport issues and problems discussed between the last quarter of 19. Century and the first quarter of 20$^{th}$ Century have kept their effectiveness in our time. A typical feature of the early transport literature of this period has been the development of a number of economic concepts earlier than they have been included into the analysis of transport problems and the main stream economics writings.

Then we observe an almost virtual lull without a notable publication till 1959 when Meyer *et al* have brough out their celebrated work[4] which is considered a classic in the literature of transport studies. From then on we can see a slow but steady growing in the momentum of transport economics literature. However we can maintain that the *economic analysis of transportation* has never been the primary concern of the leading pens of mainstream economics.

[3] Berechman (2001), pp. 124 - 5

[4] J. Meyer et al (1959), **Economics of Competition in the Transportation Industries**. Cambridge, MA: Harvard U. Press

### a. The Impact of Transportation Infrastructure

Transportation infrastructure has long been perceived as a prerequisite to economic growth and development. Besides qualitative studies and traditional aggregate growth models, there exist various quantitative approaches varying from time series models of the national economy to models based on panel data disaggregated to the level of regions.

The production function approach is one of the main approaches that have been employed to analyze the economic impact of public and/or transportation capital. This approach includes estimating the output elasticity to demonstrate that public capital accumulation induce economic growth – cf. Aschauer (1991). The analysis is based on the idea that investment in transport infrastructure positively affects the profitability of private capital which attracts new investment and labour productivity. Munnel (1990) has analyzed state-level data and Morrison and Schwartz (1996) have a focus on the cost impacts of infrastructure. Carlino and Voith (1992) have measured transport infrastructure in terms of its physical attributes. They have followed an approach that primarily is applied to regional cross-sectional or panel data from at set of regions where transport infrastructure may be represented by a variable like highway density.

Similar macroeconomic studies, as in the Aschauer tradition, have shown strong positive links between the aggregate level of infrastructure investment and economic performance as measured by GDP or productivity growth or employment (For a review see Lakshmanan and Anderson, 2002). For example, Eruygur et al. (2012) have applied a Cobb–Douglas production function in three inputs for the Turkish economy under the assumption of constant returns to scale, to assess both the short- and long-run relationships between transportation–communication capital and output for Turkey. Based on the data between 1963 and 2006, they found that a 10% increase in expenditure in transportation–communication infrastructure would have been expected to increase the output in Turkey by around 3%. Their findings also indicate that transportation–communication capital has both a positive and economically significant effect on the real output growth and non-residential capital formation for the Turkish economy. Kuştepeli et al. (2011) have explored short- and long-run relationships across transportation expenditures, growth and trade in Turkey by investigating the causal relationship between public expenditures on highway infrastructure, growth and trade over a data of annual observations extending from 1970 to 2005. They noted that although the correlation coefficients signal some relationship between the highway infrastructure, growth and trade; results fail to show evidence of a long-run relationship between these variables. Only a weak short-run causality from the share of exports in GNP on highway expenditures is reported. Authors have suggested the high proportion of maintenance and upgrading investments and insufficient funds as a reason for the lack of any evidence of an effect of public highway infrastructure on growth and trade.

The impact of transportation investment on economic development can be attributed to a set of geographical variables, such as climate, accessibility, remoteness, and population. Physical geography is highly differentiated and that these differences have a large effect on economic development. As commonly accepted, geography, along with economic and political institutions, play an important role in economic development (Gauthier, 1970). Transportation costs are only one of the costs associated with geographical distance, besides the indirect costs related to forms of interaction among regions (Henderson et. al, 2001).Total factor productivity reduces by around 0.15% with on average 10% distance from a major R&D producing economy (Keller, 2000). The costs of remoteness can be reduced by policy to facilitate trade and investment and bring countries into the world trading system, however tariff liberization might not be sufficient, since the costs of distance remain which can be reduced by improvements of transportation infrastructure.

In short, the results of macro-studies point to an important relationship between public capital and private productivity, but provide little in the way of either explanation or policy guidance. It holds methodological problems especially in representing a correlation rather than causation (Krugman, 1994), due to the uni-directional behavior of the causality. The approach is based on insufficiently detailed representations of transport infrastructure to be of direct use in project appraisal. In a world of increasing returns and imperfect competition, a more subtle evaluation of the role of infrastructure is required (Vickerman, 2007). Meso-level approach demonstrates the key role of transport costs in the process of self-balance setting in. Substantial work has been done at the meso-level which is defined as work that makes transport and other market interactions explicit.

Fujita et al. (1999) have explored the role of transport in agglomeration thoroughly in the new economic geography approaches to the spatial economy. Venables (2007) has shown that estimates of the elasticity of productivity with respect to agglomeration can be used to estimate the magnitude of the external benefits of transport improvements. They develop a theoretical model of an urban economy that links productivity to transport investment via effects on city size. Both studies claim that there is a strong positive relationship which can have a significant additional impact on the benefits from transport improvements. Graham (2007) has handled the links between agglomeration, productivity and transport investment.

Zhang and Tong (2010) have established a two-sector model for analyzing the interrelations between transportation infrastructure expansions and remaining industry production. Sue Wing et al. (2007) have proposed general equilibrium framework to clarify how changes in transport costs as perceived by network users translate into costs and benefits. The paper provides a model for the interaction between transport conditions and input and output markets, by integrating a detailed representation of transport networks with the economic model. The model shows how benefits from better infrastructure are transmitted between markets and the final equilibrium allocation shows how costs and benefits are distributed across economic agents.

Micro-level assessments follow the procedures of cost-benefit analysis (CBA), which attempts to assess present values of future benefits relative to the project's costs. An extended review of the studies which aim to address the questions both of principle and of practice in transport cost-benefit analysis is provided by Mackie and Nellthorp (2001).

### b. The Impact of R&D and Education:

Knowledge is distinct from the traditional factors of labour and physical capital. The distinguishing features are (i) non-excludability, and (ii) non-rivalry of knowledge[5]. Hence, knowledge spills over to other actors which do not pay the full cost of accessing and using the knowledge. The process of knowledge transmission from one actor to another without deliberate action is commonly referred to as 'knowledge spillovers'. This implies that the return to investments in knowledge is partly private and partly public[6].

There have been numerous attempts to assess the impacts of higher education on regional and national economies. Psacharopoulos[7] divides the university benefits into two categories as *quantifiable* and *non-quantifiable,* and analyses two main empirical entities in order to trace out the quantifiable university effects: graduate earnings and employment conditions. Goldstein *et al*.[8] identify a set of functions of modern research universities that is broader than the traditional understanding of only two university products: skilled labour and new

[5] Arrow, 1962
[6] Keller, 2005
[7] Psacharopoulos, 1985
[8] Goldstein et al.,1995

knowledge. Their framework distinguishes eight different functions, or outputs, of modern research universities that may potentially lead to economic development impacts: 1. Creation of knowledge, 2. Human-capital creation, 3. Transfer of existing know-how, 4. Technological innovation, 5. Capital investment, 6. Regional leadership, 7. Knowledge infrastructure production, 8. Influence on regional milieu.

The formulation and sharing of knowledge has been the main function of universities since their origins. The development of human capital occurs in the process of establishing new knowledge as faculty, students, and researchers develop their own intellectual and technical skills[9]. This mission is eventually perceived as the main objective of universities by industry such that in a recent study which reports on major findings derived from a literature review of knowledge flows, Bergman[10] concludes that firms' interest in university knowledge is principally directed toward the comparatively passive public science of routine academic teaching and available either locally or at considerable distance.

The transfer of technology focuses on applying existing knowledge to solve a specified problem, typically improving a product or enhancing a process[11]. Technology transfer is distinguished from technological innovation, which refers to the creation and commercialization of new products or processes at the university itself and often leads to patenting or licensing the results of university-based researchers to commercial interests[12].

There exists a broad spectrum of studies that focus on the application of scientific technologies in manufacturing studies (e.g., Goldfarb and Henrekson (2002)[13]; Lockett *et al.*(2003)[14]) and that investigate the impact of contract and co-operative research[15]. Most of the literature that measures the returns to R&D, whether at the micro or the macro level, relies on a production function framework, where the output of a firm, a sector, or an economy is related to its stock of R&D or knowledge capital, and potentially to the stock of external R&D capital, along with other inputs. Two major approaches have been followed: the primal approach (e.g. Hall (2007)[16]), which estimates a production function with quantities as inputs, and the dual approach (e.g. Bernstein and Nadiri (1991)[17]), which estimates a system of factor demand equations derived from a dual (cost function) representation of technology[18].

The estimates of R&D elasticity depend on the R&D-intensiveness of the companies, industries, regions, countries, and time periods. Many studies obtain higher R&D elasticity for the high-tech firms[19]. However, in the time-series dimension, where the R&D elasticity tends to decline or even become insignificant, the difference between the two types of firms tends to shrink[20]. Using aggregate data, Coe and Helpman[21] find that the productivity of R&D is higher in the more developed countries. Adams (2002)[22] studies geographic localization of academic and industrial knowledge spillovers. The paper shows evidence on higher localization of academic spillovers than industrial spillovers. Siegele and Stohr (2010)[23] used

[9] Drucker and Goldstein, 2007
[10] Bergman, 2010
[11] Luger and Goldstein, 1997.
[12] Drucker and Goldstein, 2007
[13] Goldfarb, B. and M. Henrekson, 2002
[14] Lockett et al. 2003
[15] Huggins and Johnston, 2009
[16] Hall, 2007
[17] Bernstein and Nadiri, 1991
[18] Hall et al., 2009
[19] Ortega-Argilés et al., 2009
[20] Hall et al., 2009
[21] Coe and Helpman, 1995
[22] Adams, 2002.
[23] Siegele and Stohr, 2010.

a regression analysis for the regional clusters that differentiate regions with high, medium or low density in Europe and have shown that an increasing endowment of human capital, technological capabilities and transport infrastructure is positively correlated with the regions´ economic performance. Despite the positive correlation of the factors of human capital, technological capabilities and transport infrastructure with the per capita income, investments in these fields will not automatically lead to an improvement of the economic performance. This is only the case, if the endowment with one or more of these factors is limiting further growth. An extended review of current literature on impact of R&D from the past 50 years of economic research can be found in Hall *et al.* (2009)[24].

Regional leadership signifies the capacity of a university and its employees to serve the region through direct participation on local committees and boards, the provision of technical resources and support, and the exercise of moral authority, and in some cases, political clout to help establish consensus and resolve conflicts. Universities are also important regional actors simply for their volume of investment in physical capital: constructing and maintaining buildings, laboratories, research parks, and additional types of facilities along with associated transportation and other infrastructure. For example, Harris (1997)[25] presents a case study over University of Portsmouth and constructs an input-output table in order to assess the total effects of direct university spending on the local economy. This table is not based on the more usual non-survey approach, but on direct information on sales, imports and exports which were collected through survey work. A current and extensive literature review on the approaches used to examine the influence of research universities on regional economic development outcomes can be found in Lendel (2010) [26]and Drucker and Goldstein (2007)[27].

# 3. INTERINDUSTRIAL ANALYSIS IN ECONOMIC DEVELOPMENT

Since the issues of economic development (and, growth, for that matter) have been taken by breeds of economists, starting by the Classics, the dynamics of structural change have appeared to be as a primary concern for them all. However, we can attribute this, in its contemporary context, to a chain of economists within the boundaries of a certain circle like A. O. Hirschman[28], H.B. Chenery[29] and P.N. Rasmussen[30], to say the least.

By the early 1970s the debate in the sphere of Development Economics got a heated turn. The debate after subsiding to a merely GNP increases, as for example in the case of neo-classical growth perspective, there appeared misgivings to a "development economics" for the failure on behalf of achievements of "underdeveloped countries" of the time. Nevertheless, with the writings of a group of economists mentioned above (i.e., Hirschman, Chenery, Rasmussen leading the efforts), approaches to the development problem deviated from the neoclassical basics.

In the assessment of dissatisfaction with the orthodox neo-classical approach to the problem of economic development, we must mention the name of Professor Passinetti as a key figure here. Seeing the importance of explaining the pattern of economic growth with uneven, non-proportional alterations of different sectors of the economy, he has embarked upon the

[24] Hall et al., 2009
[25] Harris, 1997
[26] Lendel, 2010
[27] Drucker and Goldstein, 2007
[28] HIRSCHMAN, A. O (1958). ***The Strategy of Economic Development***.
[29] H.B. CHENERY & H. ELKINGTON (1979), ***Structural change and development policy***. *WB*
[30] RASMUSSEN, P. N.(1958), ***Studies in Intersectoral Relations***.

analysis of "vertically integrated sectors", as an entirely new analytical tool and this has been followed by his celebrated book in 1981.[31]

First of all, we have to underline the fact that there appears a broad agreement about the importance of linkages between different sectors of an / any economy within the context of the process of economic development. Although it is difficult to say this on the ways of the identification of "key sectors" case, we adopt the approach of the importance of a relatively small number of some sectors which serve to stimulate an economic change, a process probably ending up with the development of an entire economy passing through a structural change not only in economic terms but in qualitative social terms as well and without going into the vicissitudes of a theoretical argument,.

In this paper we will be interpreting the importance of key sectors with a meso-level perspective, as it is already mentioned in the 1st section above, and our focus will be on the application of input-output analysis through the specification of Leontief matrix – Leontief inverse in particular. In this way we presume that the nature of structural change in the economy can best be explained and assessed to clarify the complex web of interactions characterising the functioning of the economic transformation process.

# 4. TRANSPORT AND LOGISTICS NETWORKS IN AN INTER-SECTORAL FRAMEWORK

As we adopt the approach of defining economic development as a process of structural transformation with a special reference to key sectors playing their part through the linkages within the economy, this gains a particular importance for the case of transport and logistics sectors. When we look at these sectors with their infrastructure in mind, we can interpret their position vis-à-vis the recent challenges put by *environmental issues, global competition effects* and the sheer concern over *economic productivity*, much will depend on "how we choose to meet these new challenges".[32]

International trade increasingly contributes to the amount and the nature of transportation, since world exports have grown much faster than world production. Despite the marked slowdown in the course of 2011, the 2.7 % growth of global production was accompanied by a 6.6 % expansion of the worldwide volume of imports of goods and services[33]. Global production networks have emerged as a consequence of worldwide growth of the global economy, the relaxation of trade barriers, and developments in logistics management as well as innovations in information and communications technology. Global production networks are fundamentally transport-dependent structures, although this dependency concerns the wide array of value-added activities pertaining to logistics[34]. Transport systems need to be able to facilitate these increasingly expanding logistics networks.

Transportation and logistics systems have interdependent relationships that logistics management needs transportation to perform its activities and meanwhile, a successful logistics system could help to improve transportation environment and development[35]. Transport is an integrated part of the logistics systems by providing necessary means for binding the logistic chain's various actors and facilities together, but the role that transportation plays in logistics system is more complex than carrying goods. The availability and quality of transportation infrastructure has a great effect on logistics costs, both in terms

[31] L. Passinetti (1981), ***Structural Change and Economic Growth***. Cambridge University Press.
[32] Aschauer (1990)
[33] UN, 2012
[34] Hesse, 2006
[35] Tseng et.al, 2005

of direct transport costs and the level of inventories which must be held. An efficient and well-organised transport infrastructure provides a number of operational benefits such as accelerating the supply chain process and thereby helping companies realise reduced waiting times and generating significant cost reductions, as well as environmental and social benefits. For example, by means of transport infastructure developments, inventory centralisation, which has been a long-term trend for acquiring benefits of economies of scale and risk pooling is now occurring on a larger geographical scale. Companies enjoy the inventory cost savings, while minimising additional transport costs by centralising stockholding and decentralizing handling operations[36]. As a result of the consolidation of freight flows and more integrated networks to improve the quality and professional standards of logistics services, reduction in transport costs will lead to a further globalisation of production and inventory locations, while an increase in transport costs combined with a decrease of local inventories would result in the contrary[37].

The relationship between logistics principles and transport growth is clearly bidirectional, however, the relationship between logistics organisation and transport is not straightforwardly established. A direct empirical approach trying to establish a correlation between the different types of logistics organisations and the volume of transport is almost impossible. Transport distance, speed of transport, frequency of trips, and delivery time are considered as intermediate categories developed in attempt to translate logistics principles to transportation[38]. A change in the conditions for logistics induced by e.g. a new production philosophy, a merger between companies or some new infrastructure will imply a change in the logistical organisation by effecting the logistic structure, pattern of trading links, scheduling of product flow, and management of transport resources. These changes will be revealed in transport logistics indicators of distance, speed, frequency, and point in time which changes the mode, content, distance and efficiency of transport. For example principles and philosophies, such as just-in-time (JIT) and postponement continually alter the nature and culture of operations in companies to create strategic advantages of logistics in terms of improvements in coordination and planning. JIT requires the logistical service to deliver goods within the precise time windows and synchronizes the logistical services into the production procedures with the minimal level of the stocks. Hence, when intermodality is enabled with a development in transport infrastructure such as a new freight terminal, JIT production will be improved, thereby inventory costs to producer will be decreased[39]. Positive externalities of transportation improvements will provide transport efficiency gains such as better vehicle utilization and reduction of empty trips, which again leads to a reduction of the number of trips. And transportation again will have impacts on environment, health, welfare and congestion.

Here, from a purely transport & logistics sectors' view, we can set the interactive linkages between the infrastructure development and the general economic development and the causal relationships between the two. Although economic development / growth do exert a positive impact on the development of transport & logistics networks as well, our methodology is based upon discussing the impact of transport & logistics development on the economy. In this regard Aschauer's work played a pioneering role.[40] He has questioned the strength of linkages between transportation spending and economic growth and come to the conclusion that "*there is considerable evidence that transportation spending has a positive*

[36] Jespersen and Nielsen, 2004
[37] Tavassyz, et. al., 2003
[38] Nielsen et. al., 2003
[39] Berechman, 2011
[40] *ibid*

*impact on long run economic growth*".[41] While he has taken the issue within the concept of infrastructure's effect on the "quality of life", ours is rather on the material side but with a qualitative approach rather than quantitative, due to the methodological constraints, as we will explain in the last section, "Conclusions".

The impact of infrasture expansion on the economic development in the past of the developed countries of today is a historical well-known fact. There can be no mistake to interpret this causality in the same way for the developing world of our time. Our approach here is exactly to do this. In our model of transport infrastructure – economic development interaction, we assume that the causality link is mainly in the direction from the first to the second in the developing country case although there can be assumed effects from the other way as well. The reason for this, the level of development of the transport and logistics sectors in the developing country case is comparatively below that of developed market economies, and consequently, transport and logistics networks have more to offer to the development of other industries and the regions in terms of spillovers.

Recently a new methodology has been developed to call the effects of infrastructure (in transport and logistics) development on the general economic development, "*wider economic benefits*". The biggest sources of 'wider economic benefits' are technically known as *agglomeration benefits*. Simply put, "agglomerations are geographical concentrations of workers and businesses"[42].In addition to other forms of gains caused by the agglomeration benefits our main focus is on the productivity gains among which spillover effects of transport infrastructure improvements in general and of education and research improvement in particular take the first place to be considered. In an ECMT round table meeting it was noted that "*An overall evaluation must take account not only of the quantitative but also the qualitative changes in transport patterns. ... From this standpoint, it would be fair to say that the supply of transport services goes beyond that of infrastructure alone and that due account should be taken of vehicles, organisation, technology, etc. If the qualitative aspects of transport are incorporated into the analysis, the elasticity of transport to GDP is in fact far greater than that measured solely in terms of tonne-kilometres or vehicle-kilometres*."[43]

Infrastructure in all sectors of the economy in general has much to affect the overall productivity of these sectors. This is perhaps much more so in the case of transport infrastructure. As many authors, Aschauer being one of the most prominent, have put it, transport infrastructure investment induce economic growth determining

(a) how and under what conditions and

(b) the linkages between the transport investment and economic development

As a part of infrastructure development if the logistics chains improve including the transport networks development, this will clearly affect and mold the organisational and administrative structure of the business sector. As, for instance, firms can obtain positive externalities as a result of increased intermodality and improve their just-in-time production and resultantly reduce their inventory costs. All these effects have been depicted in a diagram in J. Berechman's report to an ECMT Round Table meeting.[44] Figure 1 reflects these linkage effects:

[41] Aschauer (1991), p.3
[42] Marshall & Webber. p.1
[43] ECMT RT 119
[44] Berechman (2001).

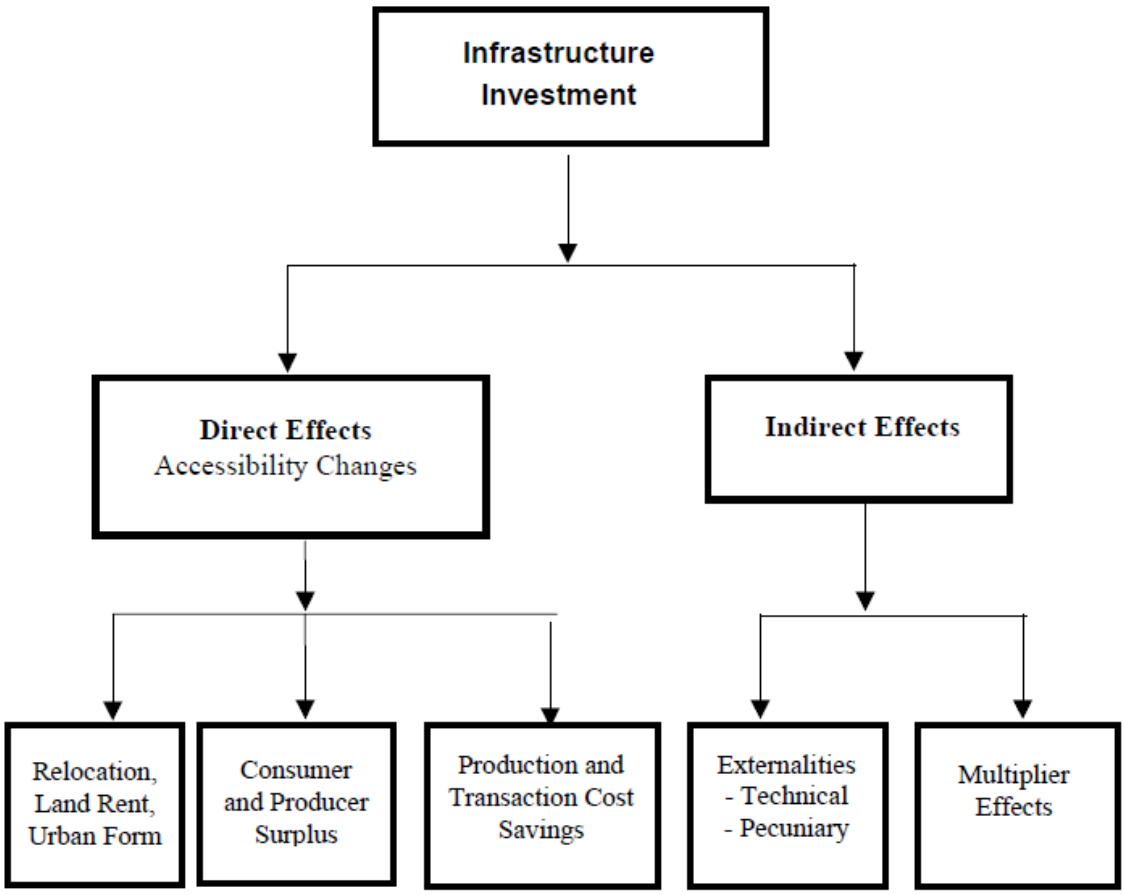


Figure 1 – Traditional view of the effects of transportation infrastructure investment - Source: Berechman 2001; p.111

Referring to Berechman's comments on what he says "*the causality linkage "public infrastructure accumulation induced growth ... is to be reversed as the present state of high growth stimulates infrastructure investment*"… and that "*Disregarding such causality possibilities might result in problems of simultaneity in the empirical analysis, which, in turn, will generate wrong estimates* "[45] for the highly productive countries, we can come to the conclusion that this negative causality should not be the case for the developing country where the state of the markets indicates that they do not possess the same qualities of highly productive countries. What is needed there is the filling of a vacuum rather than a relocating the present structure. After all, looking at the present state of low level of research and education in contemporary standards in these countries, there must be ample room for reasoning that demand for these is probably insufficient to incite. Therefore, as we presupposed, there can hardly be any reason to justify a market-oriented development of human capital investment (in our case) in transport and logistics. Indeed as the actual data supports the current position that there is virtually no spending on research in these sectors in the developing country case as spending on physical infrastructure of transport is not so low. Then it is the public capital to undertake the planning and implementation of investment in these areas – viz. transport and logistics research and education. In other words the critical units to funnel the decision-making process here are the public organisations, the universities being at the top of the scale. Yet the *type of university* here gains specific importance. The key

[45] Berechman (2001), p.121

word in this *passim* is *research* and the university type should be labelled as *Research University*.
In our model of transport infrastructure – economic development interaction, the key element of research – education vector fits into the picture of the Diagram in Figure 2 below, borrowed from J. Berechman..

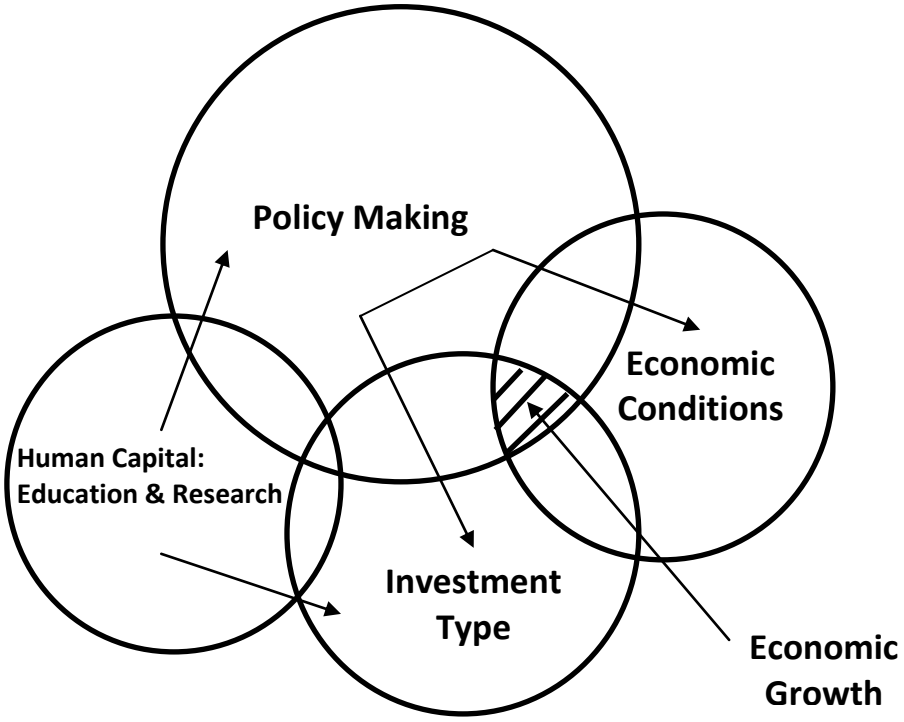


Figure 2 – The parameters of Economic Growth in an interactive format – Modified from Berechman 2001; p 131

Berechman describes the diagram as schematically depicting "*the crucial role that policy design plays in influencing and strengthening the potential impacts of transportation infrastructure investment on regional economic development. It highlights the notion that, for economic development to ensue from transportation investment, three sets of necessary conditions must be met. These are represented by the three circles in the diagram.*
*The circle labelled as* ***Investment Type***[46] *refers to the particular attributes of the investment. These include the mode type (highway, rail, harbour or airport), the investment's scale, its location and whether it is a new link in an existing network, an expansion of already-existing links in an existing network or a new link that unites two disjointed networks. The circle labelled* ***Economic Conditions*** *refers to the presence of conditions such as agglomeration economies, labour market economies, network economies or land and environmental externalities. Finally, the circle labelled* ***Policy Making*** *refers to key, non-economic factors which influence economic growth. These include the organisational structure and range of responsibility of oversight agencies, the nature of the legal system, the government level at which decisions are made and, most importantly, the capability of political leaders to resolve conflicts among stakeholders. The shaded area in the diagram, the union of all three sets of conditions, is where economic development will emerge*."
As it has been mentioned by Berechman himself "*policy and political conditions will ultimately determine the degree to which economic growth outcomes are attained*"[47], apart

[46] The authors highlighted all the bold characters in this quotation.
[47] *op cit*, p.131.

from the investment type, which falls into the sphere of institutional / human capital, the Policy Making circle is a vitally conclusive factor to prove the importance of our thesis that investment in research and education in the developing country case can be the determining element in the development process.

Our model stands at a very delicate (or even vulnerable) point here. As Berechman points out the danger that "*to provide a solid foundation for the potential relationship between transportation investment and economic development and, as an objective for future research, more ex post type studies of transportation investment projects must be made. Presently, our understanding of actual economic growth benefits from transportation improvement projects is limited and largely unsubstantiated. Moreover, we poorly understand the geographical incidence of economic growth benefits. Are they confined to areas adjacent to where the transportation project takes place or do benefits also spill over to distant regions? More generally and within the EU context, does the centre gain at the expense of the periphery or does the opposite happen? There is an urgent need to monitor differences between expectations from transportation investment and actual outcomes*."[48] However, we are convinced that even under the conditions described by Berechman, quite rightly, the most probable solution still lies in our adjunct circle of '*Education & Research*' we inserted into. It is this axis that can determine the (positive) workability of the other two spheres, *Policy-Making* and *Investment Type*. Considering the ineffectiveness of policy-makers to decide technically a proper allocation of resources a case which can easily be generalised all over the world and not necessarily to be confined to a developing country context, the very existence of research on an institutional basis and its proponent, educational system, appears to fill the gap between the two sides.) Therefore we can conclude that a high-level educational system is the first and foremost prerequisite in the formation of a Policy Making apparatus.

Here the functioning of the Human Capital vis-á-vis its interaction with Investment Type is twofold:

(1) The definition of the type of investment, in our own interpretation, differs in time of the stage of developmental process and in terms of geography – namely various countries in different stages of development or with the development strategy chosen.

(2) Investment type may either fall into the category of infrastructure investment (mostly in transport rather than logistics) or into the operational side of the industry.

Then the decision of allocating the resources into where and which bears a vital importance and a successful solution depends on the capability of decision-making apparatus which in turn depends on the quality of the the research and educational systems to alarge extent.

# 5. KNOWLEDGE ECONOMY AND EDUCATION AND RESEARCH

## a. In general

The very term "*knowledge economy*" (KE) is a relatively recent phenomenon spreaded out following the thrust of science and scientific development and the ostentatiously dominant Research & Development (R&D) activity into the 2nd half of the last century. Some authors prefer to call it "knowledge-based economy" (KBE) or even "knowledge-driven economy". We will, however, keep the brief form KE as it encompasses not only computers, ICTs, but also education and innovation systems as well as economic incentives and the legal system.

[48] Berechman (2001), p.132.

According to a KE / KBE definition of OECD they are those *"which are directly based on the production, distribution and use of knowledge and information*."[49]
As we cannot dwell on the definition problems and discussing the notion of knowledge (know-what, know-why, knowhow, know-who) here, the measurement issue follows these dimensions to enable us to analyse the knowledge – growth relationships. This dimension covers the identification of the knowledge sector and measurement of its share in GDP, share of knowledge activities in all sectors, productivity measures, input and output measures among some other criteria. Transport and Logistics networks in the realm of KE are among the most prominent to be affected by the contemporary transformation of the world economy. This transformation is technology-driven for the most part and taking place at a rate unprecedented before. If one of the pillars of this process is technological development the other can be said to be the so-called "*knowledge society*".
"*This is an important stage not only for what is known as the developed world, like EU and North America, but also for those who are lagging behind notwithstanding aiming to catch up with the globalisation movement properly. Here we have to point out the fact that knowledge is a much broader concept than information, which is generally the "know-what" and "know-why" components of knowledge. This brings us to the point which is the missing element in the developing world: scientific knowledge, research, R&D and the properly designed and run education policies*".[50]
However, as the impact of knowledge on economic growth appears to be quite convincing, the aspect of proving this linkage quantitatively is fairly problematic. The problem is connected with a lack of a theory of knowledge economy capable to show us how to measure it.

### b. With special regard to Developing Economies

With the relevance of a theory of knowledge economy on the qualitative and its yet immature state on the quantitative sides in mind, even in the developed world where the knowledge is produced and implemented, what to do with the developing part? This issue may sound absurd to some who can easily claim that there can be no outlet for the underdog in such mire. However, the authors of this paper are not convinced with what the status-quo implies.
We mentioned some measurement criteria of the knowledge sector in the economy above (cf. 5a). If and when we check the situation from the point of view of these criteria, we can see that in almost all of them the developing countries trail badly[51]. This is another reason of our contention that institutionalisation in research is a primary condition for development no matter it may seem to be controversial at first sight. The developing country has no option but to meet the challenge at a high level to be able to catch up with the momentum the world has gained: it is a matter of survival – or, if we put the matter that way: to be or not to be. For otherwise, "*Countries and regions with higher levels of human capital are supposed to expect higher growth rates than territories with lower levels*"[52] and those lagging behind are doomed to be all-time losers.
"When we look at the distinctive features of the globalisation movement what we see is the transformation of some main factors of the economic activity as the globalisation of *financial markets*, *competition*, *technology* and the *corporations and industries*. Globalisation refers above all to a *dynamic* and *multidimensional* process of economic integration whereby national resources become more and more internationally mobile while national economies

[49] Piech,(2007); p.28.
[50] Candemir, Y. & M. Hisarcıklılar. 2010. p.5
[51] Any WB Report (World Development Report) will reflect the situation.
[52] Ramos et al, p.7.

become increasingly interdependent. And through the functioning of the globalisation process it is possible to expect an increasing demand for new investment in the infrastructure capacity of the economy.
Another aspect of the development through the globalisation process, in its most orthodox understanding, is the difference of opinion about the character of the development model. Some people appear to be the proponents of a smooth, open-to-all, shared-by-all sort of development model through globalisation."[53]
Recalling our main stand to analyse the transport & logistics sectors vis-á-vis the economic development process, these two sectors are considered to play a key role in the development process of the developing countries. As we have underlined above in S.4, this role should not only be attributed to the development of the physical infrastructure of these sectors, but especially increasing the research capability and therefore raising the level of education. This scheme can be described as improving the *institutional infrastructure of transport & logistics* the betterment of which depends heavily on the foundation of a well-designed educational background. The role of education here is envisaged not only to bring forth a competent human power capable of tackling with the problems of actual life in industry but also producing a research base to meet the challenges ahead of the transport & logistics sector as it is assumed to be in a key position to lead the economy connecting to global trade on a competitive standing.
Berechman sets up a stage of decision-making apparatus for transport investments where all the actors involved (departments of transportation at various levels of governance, public and private entities, labour unions, environmental groups and all the other stakeholders in the decision-making process) put forward their vested interests and often set their own agendas and priorities. Therefore, according to Berechman, "*... in western-type democracies, ... a co-ordinated and harmonious policy, aimed at maximising the economic growth benefits from a particular transportation investment, may be difficult to attain. In general, even if the economic conditions and investment characteristics are favourable, policy and political conditions will ultimately determine the degree to which economic growth outcomes are attained*."[54] As this assessment is clear and understandable enough, we can go even further to say that it must not only be for western-type democracies but for the most part of the world that can be put under this scenario. Then, referring again to Figure 2, our inserted circle to Berechman's diagram, "Externalities – *Human Capital: Education & Research"*, serves not only to affect "*Investment Type*", which we perceive rather the physical infrastructure of transport & logistics networks, and "*Policy-Making*", but to feed the formation and development of a public opinion on transport and logistics issues as well, by creating a sort of information device. There is no need to say that Policy-Making body can benefit more by a direct linkage.
Referring back to Candemir & Hisarcıklılar we cited (cf. fn. 57 above) the dispute on the character of the development model between those who defend the smooth (and flat) sort of development[55] contending that various technological and institutional changes were to make the world more similar and less differentiated, and those who challenge this view with the idea that the world is not flat but curved and that there is also mounting evidence that the world is becoming steeper.[56] In this regard, we are convinced that the world is even more curved for the developing countries than in the case of industrialised / developed. This is perhaps much more so in the case of transport and logistics networks. Apart from the infrastructure of these sectors in the developing world lagging behind in physical terms, its

[53] Candemir, Y. & M. Hisarcıklılar, *op cit*, p.3.
[54] Berechman *op cit*, p.130.
[55] T. Friedman (2005), **The World is flat**.
[56] Philip McCann (2007), **Globalization and economic geography: the world is curved, not flat**

institutional backwardness matters much to enable the economy compete globally. Research, a colossal column in the design and implementation of policies, is the missing element in the developing world for a variety of reasons, the finance side not necessarily being at the top.

# 6. AN INQUIRY INTO THE STIMULI OF THE HUMAN CAPITAL FOR THE SECTORAL DEVELOPMENT

## a. Production Chains

Supply (or production) chains reflect all the steps within the production process of any good or service (goods or services, in the case of production chains) from the first phase of its (their) production to its (their) delivery to the final consumer. By adding the phase of transportation of them from one place to another as a part of their supply or production chain processes and considering the case of a constantly evolving world economy and its ever-changing business environment, with the continual influence of booming Information & Communication Technologies, ICT, we have to consider the interconnectivity aspect of these processes as well. In our model, economic development has been taken as a structural transformation process and interdependencies of the sectors make us to analyse the character of transport and logistics networks with a different approach from the conventional supply chains analysis. Therefore we prefer to proceed with production chains which fit into our multi-dimensional model more than a supply chain case. The reasons of our preference of taking the production chains rather than the supply chains are numerous:

1. First of all our main intention is to see the interactive nature of the connectivity between transport – logistics networks development and the growth of the economy, from the standpoint of economic development in the context of developing countries. In such a framework, as we have adopted the guidance of input-output analysis techniques, even when the I-O tables were available at their most detailed level, it is impossible to tackle with the supply chains of all goods and services.
2. Our main tools of analysis depend basically on the availability and ability of interindustry linkages. And this goes far beyond the supply chain context which depends on focusing on a single product. Our analysis depends on finding chains within the production structures at either national or regional levels and these chains are called “production chains”.

Production and distribution are conventionally considered separate functions, with distribution being dominated by production. The concept of production chain underlines a higher level of integration between both functions, as well as a shift in their relationships. The new circumstances of production thus require integration with its process of distribution, linking the various parts of production networks from raw materials procurement through the distribution of final products to consumers. Hence, the role of transportation is more than a basic support to the mobility of freight within production networks but an integral part of the value-generation process. As a result, production chains are fundamentally transport-dependent structures.

## b. Spillover Effects vis-à-vis their possible application to Educational and Research Fields

The issue of the interconnectivity between the R&D activity and economic growth has always occupied the minds of economists. This can even be traced back to Adam Smith, though apparently and not necessariy in its present context. In modern times we can detect an

ubiquitous effort to analyse the affair within the concept of production function[57] and in the territory of recent technology development and the globalisation movement. Indeed, if we assume the university as the main source of any R&D activity and the institution of producing knowledge, we have to look back to mid-1980s to see academic interest in the relationship between knowledge production and economic growth development performance and prospects have burgeoned. If one of the reasons of this increased interest lies in the impact of dramatic changes in the global economic conditions the other can be attributed to the increased importance of knowledge inputs.

When we approach the issue at our main stand / subject matter, effects of research in Transport & Logistics industry on other sectors of the economy in the context of developing world, we face a controversial situation. We are well aware that the main tenet of this paper is embedded in a very controversial ground. No matter how much the inter-industrial analysis can be deemed applicable to the developmental issues of the developing countries as much as to those of developed as well, this issue turns into an enigmatic one in the case of R&D applications and policies. It is a fact of our time that both the technology production and development and the domain of R&D activities fall into sphere of only the developed countries. Then, why and how to take this issue into the realm of developing world?

As we try to explain above (at 5.b), the developing country has no option but either to "*meet the challenge at a high level to be able to catch up with the momentum the world has gained*" or to be doomed as all-time loser. And again, controversially enough and as we openly stated in many parts of this work, the authors of this paper are convinced that investing in human capital is perhaps one of the most promising alternatives in terms of the expected rates of return in the developing world, although we cannot go so far as to say anything about transforming the people of any developing country into a knowledge society at the same rate.

Spillovers usually refer to the gains of customers who gain from the supplying industry. In our study which is based on the inter-industrial analysis to investigate into the economic development process, linkage structure is important and there the spillovers possess a specific position. First of all as Wolff & Nadiri have found out that "*among manufacturing industries, an industry's rate of technological progress is positively and significantly related to that of its supplying sectors. Another new finding is that among all sectors of the economy, a sector's R&D intensity and rate of technological progress positively affect its degree of linkage with other sectors. We also find significant spill overs from R&D embodied in new investment*"[58].

From these findings we can proceed further and set down the fact that in the particular case of investment in human capital should be centred around the university in a research-intensive mode. In other words, investing in knowledge production and knowledge infrastructure must be focused on the so-called ***research universities*** as the dominent type of knowledge-producing organisations. If this can successfully be achieved knowledge spillovers from the university to the economy can be expected to be put through other elements of the market.

## 7. CONCLUSIONS / CONCLUDING REMARKS

In this paper we tried to investigate into the possilities of the spillover effects of a research base in transport and logistics on other sectors of the economy. Our methodology is based on inter-industrial (linkage) analysis of the economy aiming to make a meso-level assessment of economic development within the context of developing country paradigm.

We also attempted to focus on transport and logistics networks as key sectors of the process of economic development, again much more so for the developing country case. Our main

[57] Cf. Griliches 1979.
[58] Wolff & Nadiri. 1993. p.315

contention there is that investment in human capital in the form of a research base fostered by a merited educational programme. What our ultimate aim here is that if such an institutionalisation effort achieve success its spillover effects would be beyond what can be estimated for the developed country sample. Our contention is based on the presumption that marginal product of such an investment is expectedly greater than the case of developed country market. This hypothesis depends on two conditions:

1. The level of the educational programme must be kept at high standards
2. The programme and its *object of desire*, institutionalisation of research, should be supported by an international network through a sort of cooperation.

The educational programme is envisaged to be research-intensive, as it is emphasized above (6.b), and this can be achieved through international networks. Here we have to underline the fact that the problem(s) lies in the absence of such a will on the part of developing country and not *vice versa*. Taking Turkey as an example, which is not so much backward as many others, the perception and understanding of a research and research-oriented educational system is far from meeting the requirements of a decent and comparatively competitive propotype. It does hardly go beyond the level of a vocational school format.[59]

Our model of analysing the spillover effects of education& research on other sectors of the economy via transport & logistics infrastructure improvements cannot be executed in quantitative terms for reasons beyond our capability - methodological and absence of data. Consequently we had to work out a qualitative model. . It is not possible to define the logistics activities within the concept of national income accounting methodology yet and this fact hinders any effort to make any quantification with logistics networks.

Looking at the main theme of our study, the positive / bolstering effects of transport and logistics networks developments on the general economic growth can substantially be augmented by investing in educational and research infrastructure of the transport and logistics sectors, face serious challenges when it is extended to the empirical / quantitative side. The blur in the definition of a logistics sector in particular makes an empirical measurement of the spillover effects of a transport and logistics networks expansion almost impossible. Yet the authors are strongly convinced that the very concept of spillover effects of developing an institutional research infrastructure on the efficiency of the physical infrastructure of transport and logistics networks is so important that makes it a serious mistake to give up discussing this controversial issue.

Our intention is to underline the importance of a research base for successful design and implementation of transport&logistics networks, mainly in the developing world, and to encourage further studies in this field by drawing attention to the significance of the subject. We also contend that persistence in conventional approaches of analysis in transport leaves some issues of critical importance in the dark. Approaching to transport issues on *micro-economic-level-only* and ignoring the macro side is our main criticism. We claim that the design and implementation of a curriculum (in the fields of transport & logistics) based on these lines will contribute much to the development of transport and logistics networks in particular and the development in general more in the developing country context than in the developed. This is the main reason of our focus on the spillover effects of education and research.

To sum up: we are firmly convinced that although this paper is incomplete in the analysis of its main tool, spillover effects, our fundamental tenet dwells on a sound basis. Our basic aim is to show the importance of our approach and draw the attention to the significance of the subject and to urge potential researchers to focus on the methodological reasons behind this failure.

[59] For more information: cf. Candemir, Y (2005) and Candemir, Y. and Candemir, Y. And M. Hisarcıklılar (2010)

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**Abbreviations:**
AER: American Economic Review
EER: European Economic Review
IRSR: International Regional Science Review
JTEP: Journal of Transport Economics and Policy
JTRC: Joint Transport Research Centre