

Transportation and Economic Development Authors: Dr. Jean-Paul Rodrigue and Dr. Theo Notteboom¹. The Economic Importance of Transportation Like many economic activities that are intensive in the use of infrastructures, the transport sector is an important component of the economy impacting on development and the welfare of populations. When transport systems are efficient, they provide economic and social opportunities and benefits that result in positive multiplier effects such as better accessibility to markets, employment and additional investments. When transport systems are deficient in terms of capacity or reliability, they can have an economic cost such as reduced or missed opportunities and lower quality of life. Efficient transportation reduces costs, while inefficient transportation increases costs. The impacts of transportation are not always intended, and can have unforeseen or unintended consequences such as congestion. Transport also carries an important social and environmental load, which cannot be neglected. The added value and employment effects of transport services usually extend beyond employment and added value generated by that activity; indirect effects are salient. For instance, transportation companies purchase a part of their inputs from local suppliers. The production of these inputs generates additional value-added and employment in the local economy. The suppliers in turn purchase goods and services from other local firms. There are further rounds of local re-spending which generate additional value-added and employment. Similarly, households that receive income from employment in transport activities spend some of their income on local goods and services. These purchases result in additional local jobs and added value. Some of the household income from these additional jobs is in turn spent on local goods and services, thereby creating further jobs and income for local households. As a result of these successive rounds of re-spending in the framework of local purchases, the overall impact on the economy exceeds the initial round of output, income and employment generated by passenger and freight transport activities. Thus, from a general standpoint the economic impacts of transportation can be direct, indirect and related:

- Direct impacts (also known as induced) the outcome of accessibility changes where transport enables employment,

added value, larger markets and enables to save time and costs.

- Indirect impacts the outcome of the economic multiplier effects where the price of commodities, goods or services drop and/or their variety increases. Indirect value-added and jobs are the result of local purchases by companies directly dependent upon transport activity. Transport activities are responsible for a wide range of indirect value-added and employment effects, through the linkages of transport with other economic sectors (e.g. office supply firms, equipment and parts suppliers, maintenance and repair services, insurance companies, consulting and other business services).
- Related impacts the outcome of economic activities and firms partly relying on efficient transport services for both passengers and freight. For instance, the steel industry requires cost efficient import of iron ore and coal for the blast furnaces and export activities for finished products such as steel booms and coils. Manufacturers and retail outlets and distribution centers handling imported containerized cargo rely on efficient transport and seaport operations.

Mobility is one of the most fundamental and important characteristics of economic activity as it satisfies the basic need of going from one location to the other, a need shared by passengers, freight and information. All economies and regions do not share the same level of mobility as most are in a different stage in their mobility transition towards motorized forms of transport. Economies that possess greater mobility are often those with better opportunities to develop than those with scarce mobility. Reduced mobility impedes development while greater mobility is a catalyst for development. Mobility is thus a reliable indicator of development. Providing this mobility is an industry that offers services to its customers, employs people and pays wages, invests capital and generates income. The economic importance of the transportation industry can thus be assessed from a macroeconomic and microeconomic perspective:

- At the macroeconomic level (the importance of transportation for a whole economy), transportation and the mobility it

confers are linked to a level of output, employment and income within a national economy. In many developed countries, transportation accounts between 6% and 12% of the GDP.

- At the microeconomic level (the importance of transportation for specific parts of the economy) transportation is linked to producer, consumer and production costs. The importance of specific transport activities and infrastructure can thus be assessed for each sector. Transportation accounts on average between 10% and 15% of household expenditures while it accounts around 4% of the costs of each unit of output in manufacturing, but this figure varies greatly according to sub sectors.

Transportation links together the factors of production in a complex web of relationships between producers and consumers. The outcome is commonly a more efficient division of production by an exploitation of geographical comparative advantages, as well as the means to develop economies of scale and scope. The productivity of space, capital and labor is thus enhanced with the efficiency of distribution and personal mobility. It is acknowledged that economic growth is increasingly linked with transport developments, namely infrastructures but also managerial expertise is crucial for logistics. The following categories of impacts can be assessed:

- Core. The most fundamental impacts of transportation relate to the physical capacity to convey passengers and goods and the associated lower costs. This involves the setting of routes enabling new or existing interactions between economic entities.
- Operational. Improvement in the time performance, notably in terms of reliability, as well as reduced loss or damage. This implies a better utilization level of existing transportation assets benefiting its users as passengers and freight are conveyed more rapidly and with less delays.
- Geographical. Access to a wider market base where economies of scale in production, distribution and consumption can be improved. Increases in productivity from the access to a larger and more diverse base of inputs (raw materials, parts, energy

or labor) and broader markets for diverse outputs (intermediate and finished goods). Another important geographical impacts concerns the influence of transport on the location of activities.

2. Transportation and Economic Opportunities Transportation developments that have taken place since the beginning of the industrial revolution have been linked to growing economic opportunities. At each stage of human societal development, a particular transport mode has been developed or adapted. However, it has been observed that throughout history that no single transport has been solely responsible for economic growth. Instead, modes have been linked with the function and the geography in which growth was taking place. The first trade routes established a rudimentary system of distribution and transactions that would eventually be expanded by long distance maritime shipping networks and the setting of the first multinational corporations. Major flows of international migration that occurred since the 18th century were linked with the expansion of international and continental transport systems that radically shaped emerging economies such as in North America and Australia. Transport has played a catalytic role in these migrations, transforming the economic and social geography of many nations. Transportation has been a tool of territorial control and exploitation, particularly during the colonial era where resource-based transport systems supported the extraction of commodities in the developing world and forwarded them to the industrializing nations of the time. More recently, port development, particularly container ports, has been of strategic interest as a tool of integration to the global economy as the case of China illustrates. There is commonly a direct relation between volumes. Due to demographic pressures and increasing urbanization, developing countries are characterized by a mismatch between limited supply and growing demand for transport infrastructure. While some regions benefit from the development of transport systems, others are often marginalized by a set of conditions in which inadequate transportation plays a role. Transport by itself is not a sufficient condition for development. However, the lack of transport infrastructures can be seen as a constraining factor on development. In developing countries, the

lack of transportation infrastructures and regulatory impediments are jointly impacting economic development by conferring higher transport costs, but also delays rendering supply chain management unreliable. A poor transport service level can negatively affect the competitiveness of regions and corporations and thus have a negative impact on the regional added value and employment. In 2007, the World Bank published its first ever report which ranked nations according to their logistics performance based on the so-called Logistics Performance Index. Investment in transport infrastructures is thus seen as a tool of regional development, particularly in developing countries and for the road sector. The standard assumption is that transportation investments tend to be more wealth producing as opposed to wealth consuming investments such as services. Still, several transportation investments can be wealth consuming if they merely provide convenience, such as parking and sidewalks, or service a market size well below any possible economic return, with for instance projects labeled "bridges to nowhere". In such a context, transport investment projects can be counterproductive by draining the resources of an economy instead creating wealth and additional opportunities. Efficient and sustainable transport markets and systems play a key role in regional development although the direction of causality between transport and wealth generation is not always clear. In a number of regions around the world, transport markets and related transport infrastructure networks are seen as key drivers in the promotion of a more balanced and sustainable development of the region or even the entire continent, particularly by improving accessibility and the situation of weaker regions and disadvantaged social groups. There is also a tendency for transport investments to have declining marginal returns. While initial infrastructure investments tend to have a high return since they provide an entirely new range of mobility options, the more the system is developed the more likely additional investment would result in lower returns. At some point, the marginal returns can be close to zero or even negative, implying a shift of transport investments from wealth producing to wealth consuming. A common fallacy is assuming that additional transport investments will have a similar multiplying effect than the initial investments had, which can lead to capital misallocation. This means quite

understandably that the economic impacts of transport investments tend to be significant when infrastructures were previously inexistent or deficient and marginal when an extensive network is already present. Therefore, each development project must be considered independently.³ Types of Transport Impacts The relationship between transportation and economic development is difficult to formally establish and has been debated for many years. At start there are different impacts on the transport providers (transport companies) and the transport users. There are several layers of activity that transportation can valorize, from a suitable location that experiences the development of its accessibility through infrastructure investment to a better usage of existing transport assets through management. This is further nuanced by the nature, scale and scope of possible impacts:

- Timing of the development varies as the impacts of transportation can precede, occur during or take place after economic development. The lag, concomitant and lead impacts make it difficult to separate the specific contributions of transport to development. Each case study appears to be specific to a set of timing circumstances that are difficult to replicate elsewhere.
- Types of impacts vary considerably. The spectrum of impacts range from the positive through the permissive to the negative. In some cases transportation impacts can promote, in others they may hinder economic development in a region. In many cases, few, if any, direct linkages could be clearly established.

Cycles of economic development provide a revealing conceptual perspective about how transport systems evolve in time and space as they include the timing and the nature of the transport impact on economic development. This perspective underlines that after a phase of introduction and growth, a transport system will eventually reach a phase of maturity through geographical and market saturation. There is also the risk of overinvestment when economic growth is credit driven, which can lead to significant misallocations of capital, including in the transportation sector. The outcome is a surplus capacity in infrastructures and modes creating deflationary pressures that undermines profitability.

In periods of recession that commonly follow periods of expansion, transportation activities may experience a setback, namely in terms of lower demand and a scarcity of capital investment. Transport, as a technology, typically follows a path of experimentation, introduction, adoption and diffusion and, finally, obsolescence, each of which has an impact on the rate of economic development. They follow a cyclic behavior where a high level of benefits and productivity is realized in the early phase while later phases are facing diminishing returns. Containerization is a relevant example of such a diffusion behavior. As most innovations are eventually abandoned, many technologies go through what can be called a "hype phase" with unrealistic expectations. In addition, transport modes and infrastructures are depreciating assets that constantly require maintenance and upgrades. At some point, their useful lifespan is exceeded and the vehicle must be retired or the infrastructure rebuilt. Thus, transport investments for their amortization must consider the lifespan of the concerned mode or infrastructure. In general, transport technology can be linked to five major waves of economic development where a specific mode or system emerged:

- Seaports. Linked with the early stages of European expansion from the 16th to the 18th centuries. They supported the development of international trade through colonial empires, but were constrained by limited inland access.
- Rivers and canals. The first stage of the industrial revolution in the late 18th and early 19th centuries was linked to the development of canal systems in Western Europe and North America, mainly to transport heavy goods. This permitted the development of rudimentary and constrained inland distribution systems.
- Railways. The second stage of industrial revolution in the 19th century was intimately linked to the development and implementation of rail systems, some transcontinental, enabling a more flexible inland transportation system.
- Roads. The 20th century saw the development of road transportation systems and automobile manufacturing. Individual transportation became a commodity available to the masses, especially after the Second World War. This process

was reinforced by the development of national highway systems.

- Airways and information. The later part of the 20th century saw the development of global air and telecommunication networks in conjunction with the globalization of economic activities. New organization, control and maintenance capacities were made possible. Electronic communications have become consistent with transport functions, especially in the rapidly developing realm of logistics and supply chain management.

4. Transport as a Factor of Production Contemporary trends have underlined that economic development has become less dependent on relations with the environment (resources) and more dependent on relations across space. While resources remain the foundation of economic activities, the commodification of the economy has been linked with higher levels of material flows of all kinds. Concomitantly, resources, capital and even labor have shown increasing levels of mobility. This is particularly the case for multinational firms that can benefit from transport improvements in two significant markets:

- Commodity market. Improvement in the efficiency with which firms have access to raw materials and parts as well as to their respective customers. Thus, transportation expands opportunities to acquire and sell a variety of commodities necessary for industrial and manufacturing systems.
- Labor market. Improvement in the access to labor and a reduction in access costs, mainly by improved commuting (local scale) or the use of lower cost labor (global scale).

A common fallacy in assessing the importance and impact of transportation on the economy is to focus only on transportation costs, which tend to be relatively low (5 to 10% of the value of a good). Transportation is an economic factor of production of goods and services, implying that relatively small changes can have substantial impacts in on costs, locations and performance. An efficient transport system with modern infrastructures favors many economic changes, most of them positive. It provides market

accessibility by linking producers and consumers. The major impacts of transport on economic processes can be categorized as follows:

- Geographic specialization. Improvements in transportation and communication favor a process of geographical specialization that increases productivity and spatial interactions. An economic entity tends to produce goods and services with the most appropriate combination of capital, labor, and raw materials. A given area will thus tend to specialize in the production of goods and services for which it has the greatest advantages (or the least disadvantages) compared to other areas as long as appropriate transport is available for trade. Through geographic specialization supported by efficient transportation, economic productivity is promoted. This process is known in economic theory as comparative advantages.
- Large scale production. An efficient transport system offering cost, time and reliability advantages permits goods to be transported over longer distances. This facilitates mass production through economies of scale because larger markets can be accessed. The concept of “just-in-time” has further expanded the productivity of production and distribution with benefits such as lower inventory levels and better responses to shifting market conditions. Thus, the more efficient transportation becomes, the larger the markets that can be serviced and the larger the scale of production.
- Increased competition. When transport is efficient, the potential market for a given product (or service) increases, and so does competition. A wider array of goods and services becomes available to consumers through competition which tends to reduce costs and promote quality and innovation. Globalization has clearly been associated with a competitive environment that spans the world.
- Increased land value. Land which is adjacent or serviced by good transport services generally has greater value due to the utility it confers to many activities. In some cases, the opposite can be true if related to residential activities. Land located

near airports and highways, near noise and pollution sources, will thus suffer from corresponding diminishing land value.

Transport also contributes to economic development through job creation and its derived economic activities. Accordingly, a large number of direct (freighters, managers, shippers) and indirect (insurance, finance, packaging, handling, travel agencies, transit operators) employment are associated with transport. Producers and consumers take economic decisions on products, markets, costs, location, prices which are themselves based on transport services, their availability, costs and capacity.⁵ Socioeconomic Impacts While many of the economic impacts of transportation are positive, there are also significant negative impacts that are assumed by individuals or by the society in one way or another. Among the most significant are:

- Mobility gaps. Since mobility is one of the fundamental components of the economic benefits of transportation, its variations are likely to have substantial impacts on the opportunities of individuals. Mobility needs do not always coincide due to several factors, namely the lack of income, lack of time, lack of means and the lack of access. People's mobility and transport demands thus depend on their socioeconomic situation. The higher the income, the higher the mobility, which may give rise to substantial mobility gaps between different population groups. Gender gaps exist in mobility as women tend to have lower incomes. Mobility gaps are particularly prevalent for long distance travel. With the development of air transport, a segment of the global population has achieved a very high level of mobility for their business and leisure activities, while the great majority of the global population has little mobility. This issue is expected to become more acute as the population of many advanced economies is aging rapidly, which implies that access to mobility will not be an income issue but an age issue. By 2020, about 10% of the global population (719 million) will be over 65 while by 2050 it will be 16% (1,492 million).
- Costs differences. Locations that have low levels of accessibility, such as landlocked countries, tend to have

higher costs for many goods (sometimes basic necessities such as food) as most have to be imported, often over long distances. The resulting higher transport costs inhibit the competitiveness of such locations and limits opportunities. Consumers and industries will pay higher prices, impacting on their welfare (disposable income) and competitiveness.

- Congestion. With the increased use of transport systems, it has become common for parts of the network to be used above design capacity. Congestion is the outcome of such a situation with its associated costs, delays and waste of energy. Distribution systems that rely upon on-time deliveries are particularly susceptible to congestion.
- Accidents. The use of transport modes and infrastructure is never entirely safe. Every motorized vehicle contains an element of danger and nuisance. Due to human errors and various forms of physical failures (mechanical or infrastructural) injuries, damages and even death occur. Accidents tend to be proportional to the intensity of use of transport infrastructures which means the more traffic the higher the probability for an accident to occur. They have important socioeconomic impacts including healthcare, insurance, damage to property and the loss of life. The respective level of safety depends on the mode of transport and the speed at which an accident occurs. No mode is completely safe but the road remains the most dangerous medium for transportation, accounting for 90% of all transport accidents on average. At the global level about 1.3 million people died in road accidents in 2010 in addition to 50 million injuries. China has one of the highest car accident death rates in the world, with more than 110,000 fatalities per year (300 per day), a factor mainly due to recent growth in vehicle ownership.

The emission of pollutants related to transport activities has a wide range of environmental consequences that have to be assumed by the society, more specifically on four elements:

- Air quality. Atmospheric emissions from pollutants produced transportation, especially by the internal combustion engine,

are associated with air pollution and, arguably, global climate change. Some pollutants (NO_x, CO, O₃, VOC, etc.) can produce respiratory troubles and aggravate cardiovascular illnesses. In urban regions, about 50% of all air pollution emanates from automobile traffic.

- Noise. A major irritant, noise can impact on human health and most often human welfare. Noise can be manifested in three levels depending on emissions intensity; psychological disturbances (perturbations, displeasure), functional disturbances (sleep disorders, loss of work productivity, speech interference) or physiological disturbances (health issues such as fatigue, and hearing damage). Noise and vibration associated with trains, trucks, and planes in the vicinity of airports are major irritants.
- Water quality. Accidental and nominal runoff of pollutants from transport such as oil spills, are sources of contamination for both surface water and groundwater.
- Land take. Transport is a large consumer of space when all of its supporting infrastructure and equipment are considered. Furthermore, the planning associated with these structures does not always consider aesthetic values as is often the case in the construction of urban highways. These visual impacts have adverse consequences on the quality of life of nearby residents.