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INFRASTRUCTURE, TRANSPORT AND PRODUCTION DEVELOPMENT IN AN AGRICULTURAL REGION: A CASE IN ARGENTINA

The development of the agricultural area in central and northern Argentina was analysed in a recent ECLAC study. More than 80% by volume of the country's agricultural exports pass through the ports in this area. Exports by the agroindustrial complex account for 58% of the total value of Argentine sales.

It is known that investments in infrastructure generally help to reduce the costs of enterprises and to enhance productivity. The main idea presented in this study is that investments in transport infrastructure are a necessary condition for the productive development of a region, especially in relation to external trade through ports and navigable waterways.

In the case of Argentina, a positive relationship has been observed between the development of port and waterway services (with reduced costs and operating times, improved reliability and new services), and expansion of the agricultural border, growth of productivity and agricultural production, and its industrialization.

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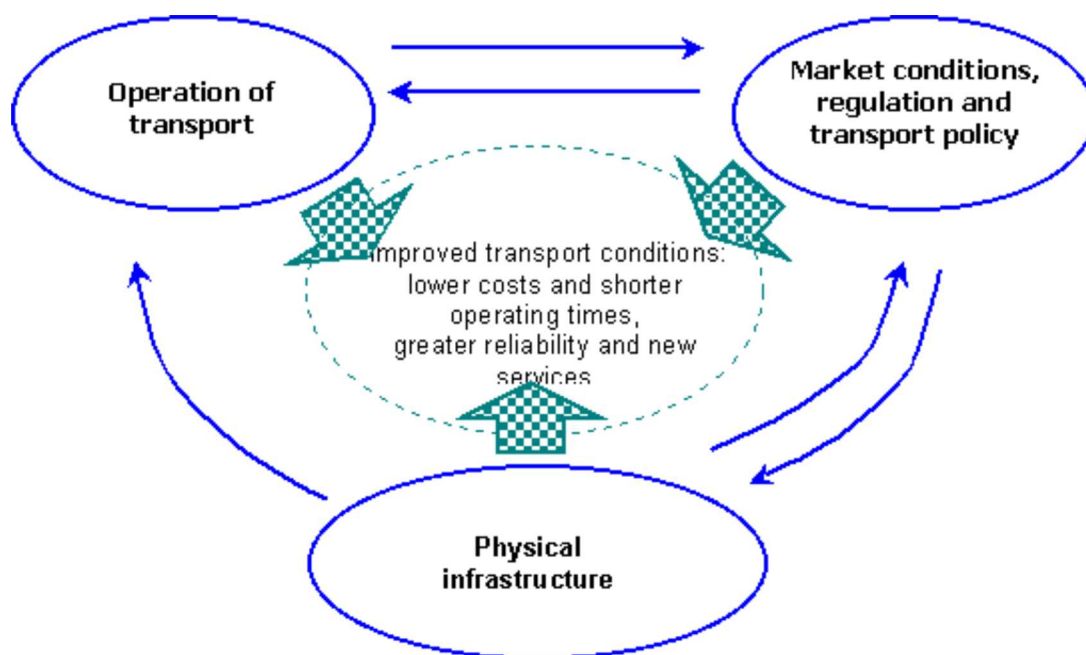
Is regional development directly related to investments in transport infrastructure?

The answer to this question is affirmative, as infrastructure investments affect the economic development of regions via their impact on business costs. They also have the potential to make the chains of input provision, storage and distribution more efficient, increasing factor productivity, the wellbeing of the population, and competitiveness. Far from assuming an automatic relationship between infrastructure investments and economic development, however, the economic literature tends to consider them a necessary but insufficient condition, and that the extent of their impact depends on their linking with other variables, such as human capital, natural resources, access to financing and technology, etc.

Investments in infrastructure probably also influence the productive profile of an area, especially in regions of basic production, where the price elasticity of transport demand is usually high, so that any improvement in the pricing conditions of transport has a significant effect on export competitiveness compared to the previous situation. Productivity gains resulting from transport improvements, however, may be expected to affect, although to a different degree, all goods that are moved internationally, even those that have a lower price elasticity of transport demand. In fact, the process of globalization of markets is connected with improvements in technologies and in the availability of storage, transport and communications facilities, just as is expected to occur when there are investments in infrastructure.

A more extensive or improved transport infrastructure is a necessary but insufficient condition for improving a region's productivity. Why is this? More efficient transport systems are obtained not by the provision of an improved physical infrastructure alone, as the aim is to achieve reduced costs and operating times and better and more reliable services. The latter do not depend solely on infrastructure, but on a combination of all the elements that function in connection with them. These elements are shown in Figure 1: the physical infrastructure, the market conditions created by transport policies and their economic regulation, and the characteristics of the transport operation market.

The concept expressed in the figure is that the quantity, quality and efficiency of cargo transport services are determined by the interaction of the three elements. The circle on the right represents a set of elements which includes regulatory standards (economic and technical), transport policies, etc., that is, it is the economic, political and technical structure of the market. In addition to the combination of transport operation and the physical infrastructure, there are also the effects of change in public policies, deregulation or re-regulation processes, the information economy and market conditions, integration agreements and other structural changes. There are also the positive effects on access to inputs, facilitation of storage and distribution, and in general a more efficient organization of firms and markets.

Figure N°1. **Components of the transport market**

Source: Based on the idea of Lakshmanan and Anderson (2002).

Table 1. **Summary of expected effects of infrastructure improvements**

Productivity	Complement/ Substitution	Location
Changes in costs encourage the growth of:	Lower production costs	Attraction of new firms

factor productivity and product	Increase in factor productivity owing to enhanced complementation	Incentive for new investments because of lower costs/increased profitability
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Source: Guild (1998)

Investments in transport infrastructure should result in an overall reduction of transport costs, and thus increase factor productivity, with improved inventory management, access to new markets and economies of scale. Table 1 presents a summary of the expected impacts.

Various studies have consistently found a positive relationship between the infrastructure stock and the product and productivity of a region, when transport is included. Table 2 shows this relationship and the variability of elasticities, from 0.06 to 0.39. There are other related issues, however, which cannot be analysed in this way, such as inter-regional equity.

In relation to the effects on the overall balance of the economy, investments in transport infrastructure produce profits by reducing operating costs and times, and increasing the reliability and quantity of services. On this basis, accessibility can be improved and then markets expanded. This leads to increased opportunities for imports and exports, and opens up channels of economic effects on markets of goods and factors, as is the case when external tariffs are reduced. Increased exports have the effect of expanding production, while imports exercise a competitive pressure on internal producers. In market conditions, such pressures should be useful for eliminating or attenuating monopoly rents, and for increasing efficiency, reducing production costs and increasing factor productivity. Consequently, it is feasible that improved transport conditions may act as an incentive for improvements in the factor market.

In an open market, the strong initial gains described would be attenuated by the same effects of market feedback. For example, changes in factor demand would also cause changes in factor prices, so that migration phenomenon would occur, and the effects would be less than initially hoped. Along the same lines, the process could bring progress in technological innovation and alter the location decisions of economic agents. In the interaction of all the mechanisms described above, investments in transport infrastructure make it possible to create conditions for improving overall economic performance, thereby supporting endogenous growth of the product.

Another large number of studies have established that agricultural productivity gains are positively associated to infrastructure availability, which acts as a predictor of the added value of agricultural production. In general, the transport and energy infrastructure are significant in explaining the productivity of the land.

Table 2. Empirical estimates of the impact of infrastructure on productivity

Study	Elasticity	Level of analysis	Productivity variable
Aschauer (1989.1)	0.39	National	national domestic product
Munnell (1990.1)	0.33	National	idem
Aschauer (1989.2)	0.24	National	idem
Hulten and Schwab (1991)	0.39	National	idem
Moomaw (1995)	0.07-0.26	State	gross state product
Moomaw and Williams (1991)	0.25	State	total factor productivity
Costa et al (1995)	0.20	State	product
Munnell (1990)	0.15	State (*)	gross state product

Aschauer (1990)	0.11	State	per capita product
Munnell (1990.2)	0.06	State (**)	gross state product
Denno (1988)	0.31	Metropolitan	industrial product
Duffy-Denno and Eberts (1989)	0.08	Metropolitan	income
Eberts (1988)	0.19-0.26	Metropolitan	industrial added value

Notes: different approximations to the infrastructure variable were used, including a group of assets such as roads, energy, water and sanitation. (*) Infrastructure in general. (**) Roads only.

Source: based on information from Guild (1998).

TRANSPORT INFRASTRUCTURE AND AGRICULTURAL ACTIVITY

IN THE AREA STUDIED

The central area of Argentina includes, from the economic point of view, the provinces of Santa Fe, Córdoba and Entre Ríos. In the two first provinces, the agricultural production profile began years ago to move towards oilseeds, derivatives and sub-products. This process then spread to Entre Ríos, and later to Chaco, Formosa, Santiago de Estero, Tucumán and even Salta, displacing other traditional activities, and taking over fractions of GDP from other economic activities that were diminishing because of changes in national policies.

The area studied covers almost 20% of the continental surface of Argentina. The oilseed production is clearly linked to exports, accounting for more than 90% of national production.

The location of the production areas and processing and export facilities followed a pattern that extended the hinterland to more than 1000 km from the ports. Traditionally, the hinterland of a port or port area has by definition been almost strictly geographical, owing to the proximity of the production areas to the port. In economic terms it is clear that the fact that the port industry has been able to overcome problems of prices, quality and capacity has extended the concept of hinterland in accordance with the efficiency of operation of the transport market and ports. Empirical evidence has shown that the hinterland of the ports located to the south of the province of Santa Fe -around Rosario, San Lorenzo and San Martín - extends to areas such as northern Argentina, parts of central eastern Brazil, and also Bolivia and Paraguay, the High Paraná and some mining production areas (in the Andes Cordillera) which use the port region mentioned as their exit point, as well as the traditional area of influence of the ports in the area south of the River Paraná.

The improvements in transport infrastructure conditions, in particular the development of port and waterway services, together with some slight improvement in road and rail services, have favoured the development of the above-mentioned agricultural region and its productivity. The main agent of agricultural expansion in the region has been soya, which is the most significant oilseed crop at the international level, with its main producers located in the United States, Brazil and Argentina.

International prices acted as a strong impetus for expanding production for a significant period, especially prior to 1998 -when prices climbed to US\$ 302/tonne. The subsequent fall in prices, however, to as low as US\$ 160/tonne, did not halt the expansion, not even during the period when the Argentine peso was at parity with the United States dollar; on the contrary, production increased.

Another important growth factor has been technology, in two areas: (a) sowing technology; (b) the use of genetically modified seeds. Both factors brought improvements in the agricultural yields per hectare (16%) and in the extension of the agricultural border to regions with less natural advantages in agri-ecological terms. Between the decades of the 1980s and 1990s, soya production increased by 178% and from 1990 to 2000/01 by 131%. In this campaign, oilseed production increased by 17.5% compared to the level of the previous period, which was already high.

The improvements in productivity and income in relation to the infrastructural factor, presented in the next paragraph, resulted in an expansion of the agricultural border. The set of 8 provinces came to account for 79.9% of total Argentine soya production in 2002. Comparing that year with 1981, sunflower production rose from 25.6% to 31.6%, corn rose from 47% to over 66%, and wheat from 32.4% to 38%.

Table 3 shows that the production of the four crops has increased significantly from 1970 to the present, except in Formosa. A similar development is observed if tobacco and cotton are added, which makes a total of six crops.

Table 3. Production of four crops for selected periods and provinces

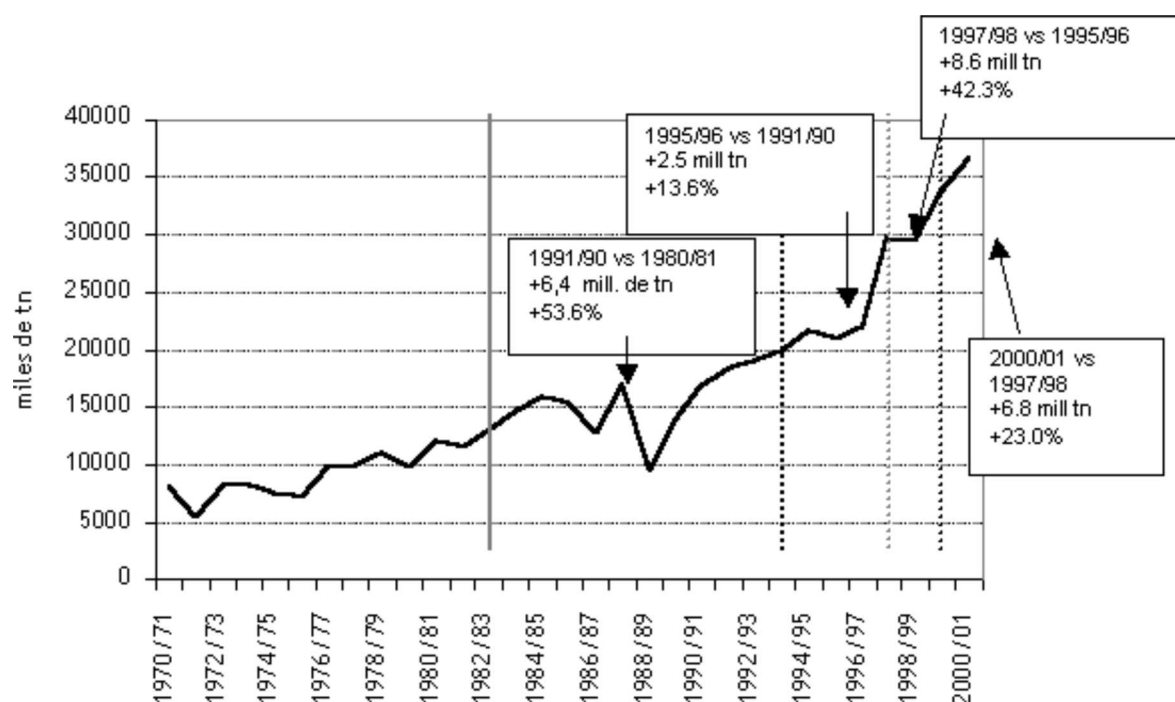
Annual average production of soya+sunflower+wheat+corn

in thousands of tonnes

Province	1970-1980	1981-1991	1992-1995	1995-1997	1997-2002
Chaco	180	275	507	596	1424
Córdoba	2760	5576	7245	9388	12143
Entre Ríos	593	546	1108	2345	2892
Formosa	39	41	51	44	63
Salta	68	283	444	589	937
Santa Fe	4517	6643	9409	10778	12752
Santiago del Estero	127	185	384	638	1277
Tucumán	122	278	323	489	781
Country total	18519	30334	37306	53199	59149

Source: Department of Delegation Coordination, Secretariat of Agriculture, Livestock, Fisheries and Food (SAGPyA)

It is interesting then to relate this expansion to certain historical facts relating to changes in infrastructure. Figure 1 shows production growth and the significant milestones in the provision of transport, physical or regulatory infrastructure: the first line is situated close to the year 1980 when the first significant regulatory change occurred for the ports. The second event is in 1991, with the approval of the current Port Law. In both cases, the events coincided with significant investments in ports, and grain storage and processing facilities. Subsequently, between 1995 and 1997 various significant events took place relating to improvements in infrastructure provision: (a) the beginning of operation of the Paraná-Paraguay-Del Plata waterway; (b) improvements resulting from road and railway reform, which included concessions and investments in the respective infrastructures and operations. In 1997, new genetically modified seeds, resistant to the herbicide Glyphosate, were introduced.

Graph 1. **Historical development of six crops + infrastructure.** Eight provinces.

miles de tn = thousands of tonnes

Source: prepared by ECLAC.

An increase in production is observed (accompanied by an increase in the area sown) after the first port reform, after the second reform and after the opening of the Paraná-Paraguay waterway. Here, clearly, the main issue of the reform was its impact on the ports and main navigable channels from the maritime entrance to the port of Santa Fe, although the port reform also involved the Bahía Blanca access channel, the re-structuring of the National Department of Port Constructions and Navigable Waterways while other functions of dredging and beaconage were decentralized.

Over the period between the first and second port reforms (10 annual agricultural cycles), the accumulated rise in production was 53.6%, while prior to the second reform, there was an accumulated growth over five cycles of 13.6%. However, over the period between the opening of the waterway and the following milestone in the figure (which consisted of improved technologies), there was accumulated growth of 42.3% in only three annual cycles. Although this may have been the result of the international price situation, there is a significant correlation with the infrastructure improvements brought by investments (in the oilseed transformation complex they exceeded 1.3 billion United States dollars between 1993 and 1999) and better operating conditions for navigation with the effective opening of the Paraná-Paraguay waterway as far as the city of Santa Fe.

One fundamental factor that reflects the importance of reform in the provision of navigation and port infrastructure is the accumulation of investments. Over the period from 1991 until 2000, investments in port infrastructure and operation, railway connections and expansion of storage capacity exceeded 700 million United States dollars. The effects on prices of the transport infrastructure improvements can be seen in the following table, which shows the significant progress made in reducing prices and operating times, both in ports and in navigation.

Table 4. Operating times in ports and navigation and the average port and river navigation charges. Selected years.

Year	1991	1995	1999
Average duration of stay in ports (Rosario + Bahía Blanca)(*)	6.0 days	3.0 days	2.8 days
Navigation from the maritime entrance to San Lorenzo/San Martín and back	5.5 days	2.5 days	2.5 days
Wait in roadstead	1.5 days	0.5 days	0.5 days
Port navigation and operation	1.86 dollars	1.25 dollars	1.13 dollars
Cargo handling, San Lorenzo/San Martín Port	3.40 dollars	2.50 dollars	2.20 dollars
Cargo handling, Rosario (city)	8.90 dollars	2.50 dollars	2.30 dollars

Note: values expressed in days, for high-activity periods, and monetary values are expressed in current dollars per tonne. (*) An additional stop in Bahía Blanca to complete the loading of the vessel was included for the calculation.

Source: Universidad Austral, Argentina.

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