

Summaries of Doctoral Dissertations

Infrastructure and Economic Growth in Spain, 1845–1935

Between the mid-nineteenth century and the outbreak of the Spanish Civil War in 1936, Spain undertook a sustained process of economic growth and structural change, but was unable to converge with the core European economies.¹ The reasons behind Spain's failure to converge have been a subject of debate among historians for decades.² This dissertation aims to analyze the role played by infrastructure in Spanish economic growth during that period, and tries to find out to what extent the potential shortage or inadequacy of the Spanish infrastructure endowment was one of the factors to blame for the country's nonconvergence.

The dissertation draws on recent research on the economic impact of infrastructure, and on the numerous attempts to measure that impact which have been undertaken in the wake of David Aschauer's work on the United States.³ One of the conclusions of this literature is the idea that infrastructure has a substantial growth impact under certain circumstances, especially in the case of construction of large-scale networks based on new technologies.⁴ This situation could indeed be found in Spain during the late nineteenth century, when the railroad network was established, as railroads constituted a completely new, large-scale network with far-reaching consequences. Moreover, on the basis of social saving estimates, transport historians have insisted that the role of railroads was especially important in countries such as Spain and Mexico, which lacked alternative waterway systems.⁵

As a consequence, the elasticity of productivity growth to infrastructure increases might be expected to have been relatively high in Spain during the period under analysis, and the hypothesis might be suggested that Spanish economic growth would have been higher if there had been a higher infrastructure investment effort. There is, however, an objection to this interpretation, because the high level of the social saving estimates available for Spanish railroads, on which this hypothesis is partially based, has been fiercely criticized by some historians. Critics insist that the failure of the Spanish railroad companies as private businesses constitutes powerful evidence that Spanish railroads were constructed ahead of demand, without paying attention to real transport requirements. On the basis of this hypothesis, they conclude that the economic effects of Spanish railroads were actually lower than those suggested by the social saving figures available.⁶

¹ This dissertation was completed in 2002 in the Department of Economic History at the London School of Economics and Political Science. The author would like to thank his supervisors Nicholas F. R. Crafts and Dudley Baines, examiners Leandro Prados de la Escosura and Max-Stephan Schulze, and Carles Sudrià, for invaluable support and criticism. Financial assistance from the British Council, the Economic and Social Research Council, the Bank of Spain and "La Caixa" is gratefully acknowledged.

² The different interpretations on this subject have been summarized, for instance, in Prados de la Escosura, "Política económica liberal," pp. 85–86.

³ See Aschauer, "Is Public Expenditure Productive?" and a survey of this literature in Gramlich, "Infrastructure Investment."

⁴ Fernald, "Roads."

⁵ See, for instance, Fogel, *Railroads*, p. 31, and O'Brien, "Transport," pp. 12–13. The social savings of freight transported by Spanish railroads was estimated in the early 1980s by Gómez Mendoza, "Railways."

⁶ See, for example, Tortella, "Introducción," pp. 250–53.

These conflicting interpretations constitute a historiographical puzzle, which this dissertation tries to clarify using a two-part approach to the problem. The first part of the thesis analyzes the available information on Spanish infrastructure, and measures the response of the economy to its growth. The second part of the thesis has a narrower focus: It examines and interprets the evidence available on the Spanish railroad sector in order to provide some answers to the ongoing debate on the matter.

THE RESPONSE OF THE SPANISH ECONOMY TO THE GROWTH OF INFRASTRUCTURE

The first part of the dissertation provides yearly estimates of Spanish infrastructure investment and stock during the first long wave of the country's industrialization, which took place between the 1840s and 1935. This is the first time that such series have been produced for the Spanish economy. The assets covered by the estimates are: transport infrastructure (railroads, roads, ports, and urban transport), communication networks (telegraph and telephone), electricity distribution and hydraulic works, which accounted for 95 to 100 percent of the Spanish "economic" infrastructure during the period. The estimation is based on the analysis of public and private statistics, companies' accounts, fiscal data, and technical literature. According to the new estimates, infrastructure investment was, on average, 1.1 percent of Spanish GDP, and 14 percent of Spanish capital formation in 1850–1935. Unsurprisingly, these percentages were lower than in more developed economies. For instance, investment in infrastructure was about 2 percent of French, German, or British GDP during the same period.⁷ As a consequence, the endowment of infrastructure per unit of output was lower in Spain than in more advanced countries.

Most of the investment was addressed to the railroad system, although the railroad share of total infrastructure investment decreased as time went by, due to the gradual diversification of investment, and the increasing importance of roads, ports, electricity distribution networks, and hydraulic works. The evolution of investment in infrastructure was closely linked to that of the entire economy. For instance, from a long-term perspective, the series contains no structural breaks, as is the case with most Spanish economic variables during the period.⁸ On the other hand, from a short-term point of view, fluctuations in infrastructure investment followed fluctuations in production with a brief time lag, in a Wagner's Law-type process. By contrast, apart from the interwar years, infrastructure investment cycles never preceded production. This may be interpreted as evidence of the absence of backward effects of infrastructure construction in the short term, a result that is consistent with previous research on railroads and other infrastructure.⁹

The geographical distribution of Spanish infrastructure was quite stable between the mid-nineteenth century and the 1930s, and the best-endowed regions were Madrid and the Northern and Mediterranean coastal areas. The thesis includes a panel data analy-

⁷ See Groote, *Infrastructure*, pp. 76 and 85.

⁸ Cubel and Palafox, "La continuidad," search for the presence of structural breaks before 1936 in the series of Spanish GDP, industrial production and investment, with no positive results. Pons and Tirado, "Discontinuidades," analyze Spanish GDP and GDP per capita in 1870–1994, and the earliest structural break they find is in 1935, which is obviously associated with the impact of the Civil War.

⁹ On the railroads, see Tortella, *Los orígenes*, pp. 12 and 339, and Nadal, *El fracaso*, pp. 158–65. On telecommunications, see Calvo, "El teléfono" and "Los inicios."

sis of the geographical distribution of railroads and roads that identifies population density and economic development as the main determinants of regional infrastructure endowments. Infrastructure seems, therefore, to have been a reinforcing factor of the economic differences among the Spanish regions. However, other determinants, such as topography and, in the case of state-financed infrastructure, equity criteria were also present in the investment decisions.

On the basis of the new series, the dissertation analyzes the response of the Spanish economy to growth in infrastructure, through the estimation of a vector autoregressive system for the 1850–1935 period, made up of three variables: industrial output, investment in infrastructure, and investment in machinery and equipment. The outcomes of the estimation provide two main findings. On the one hand, as has been said, investment in infrastructure responded closely to short-term fluctuations in production, in a Wagner's Law-type process. But, on the other hand, the model is unable to capture any positive response of the Spanish economy to investment in infrastructure, either in the short or in the medium-to-long term. In the short term, this result would be consistent with the aforementioned hypothesis that Spanish infrastructure construction had very small backward linkages. In the medium and long term, the estimation results indicate that the Spanish economy did not react to the new opportunities created by infrastructure increases, or that its reaction was too slow for the model to capture it.

Therefore, according to the results of the estimation, infrastructure would not have constituted a binding constraint for Spanish economic growth during the period under study. In other words, the estimation would imply that, if infrastructure investment efforts had been more intense, Spanish economic growth would not have been any higher than it actually was, at least in the medium-to-long term. The apparent lack of response of the Spanish economy to growth in infrastructure contrasts strongly both with Spain's relative shortage of infrastructure, and with the indispensable economic role that is usually assumed for Spanish railroads. Two possible reasons might explain this surprising result. Firstly, investors' adaptation to the new opportunities created by growth in infrastructure may have been very slow, due to Spain's low level of development. Disadvantages such as the scarcity of some crucial resources (such as skilled labor), the high cost of capital, or the inadequacy of institutions may have exceeded the advantages provided by new infrastructure and discouraged private investors from creating new firms or enlarging or relocating existing ones. Secondly, the results of the estimation might also reflect the country's geography and the extremely low population density of some regions. Obviously, Spanish investment in infrastructure was not limited to the most developed and populated areas of the country, but was spread all over the territory. This was because new infrastructure consisted, to a great extent, of national systems aimed at integrating the whole economy. In addition, investment in infrastructure was not only an instrument of economic growth, but performed other essential social and political functions. As a consequence, a substantial share of investment in infrastructure was situated in sparsely populated areas, where it had quite low economic returns.

THE ECONOMIC IMPACT OF SPANISH RAILROADS

In the second part of the dissertation, I try to reconcile the outcomes of the first chapters with the traditional idea that Spanish railroads were "indispensable" for economic growth, a hypothesis that was originally based on the high level of the social savings they provided. To this end, I re-calculate the social savings of railroad freight

transport on the basis of the most recently available evidence, and obtain much lower figures than Antonio Gómez Mendoza's previous estimates. Concretely, under the most likely assumptions, social savings are reduced from 7.5 to 2.5 percent of GDP in 1878, and from around 20 to approximately 12 percent of GDP in 1912. For 1912 these social savings are still very high, but in the case of 1878 they are comparable to figures for advanced countries with well-developed water transport systems. This striking result may only be explained by the low share of the Spanish GDP that railroad transport accounted for until the end of the nineteenth century. Due to their initial low economic weight, Spanish railroads took an extremely long time to produce their maximum potential impact. This would be consistent with the conclusions of the econometric analysis that is carried out in the first part of the thesis.

A lower level of social savings, however, does not necessarily confirm some historians' hypothesis of overinvestment in the Spanish railroad system. In fact, an estimation of the social rate of return of the Spanish railroads provides a relatively high figure even for 1878, despite the exclusion of the externalities of the railroad system from the calculation. Moreover, although those externalities are impossible to quantify, they seem to have been very relevant in Spain. Spanish railroads allowed a profound geographical re-organization of economic activity, which must have provoked substantial productivity improvements through the exploitation of scale, specialization, and agglomeration economies.¹⁰

Despite the evidence on the relatively high social returns of the Spanish railroads, there is still ground for pessimism due to the serious financial problems that the railroad companies suffered throughout their lifetime. This dissertation shows, however, that the private returns of the Spanish railroad companies were not particularly low by European standards. They were, of course, lower than the opportunity cost of the capital invested. But this situation must be understood in the context of the state's involvement in the system. The importance of the railroads for the country, not only on economic but also on social and political grounds, led the Spanish State to encourage their construction up to a level at which they could not be profitable.¹¹ This was especially true of a number of peripheral lines that were opened after the first railroad mania of 1855–1866, which carried much less traffic than the core lines that were constructed before 1866. Nevertheless, such a situation was not exclusive to Spain, as many European states tried to stimulate the extension of railroads throughout their entire territory. This was accompanied by the regulation of the system in order to guarantee service standards and returns on private capital.¹² The Spanish state, however, appears to have lacked the necessary resources to perform these functions, and would have had to resort to the "indirect taxation" of railroads users and shareholders in order to undertake them.

CONCLUSIONS

The dissertation concludes that the Spanish economy responded very slowly to the new opportunities created by growth in infrastructure, due to both geography and the level of economic development. Construction costs were high in Spain, and private

¹⁰ This process has been described in Tirado, Paluzié and Pons, "Economic Integration."

¹¹ On the State's willingness to expand the network to the whole Spanish territory, which was patent from the 1860s onwards, see especially Mateo del Peral, "Los orígenes," pp. 90–131.

¹² See, for instance, Leclercq, "L'Etat," pp. 53–54; Girard, "Transport," p. 238; and Anderson-Skog, "National Patterns," p. 37.

and social returns were slow to rise. Therefore, as far as the initial question of the dissertation is concerned, it cannot be stated that higher investment in infrastructure would have produced more growth and convergence in Spain, at least in the medium-to-long term. On the contrary, some of the investment that was actually undertaken might have been redundant from a purely efficiency point of view, although not when viewed from the perspective of equity and welfare in peripheral regions.

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Public Finance and Economic Development in a Historical Institutional Perspective: China 1840–1911

One of the central themes of modern Chinese economic history is the puzzle of "China's premodern success and its downfall after the Opium War."^{1,2} In 1644 Manchu tribes from northeast China founded the Qing Dynasty upon the ruins of the civil war that ended the Ming Dynasty (1368–1644). Despite the initial popular resistance to its rule as an alien minority, the dynasty quickly recovered. For the next two centuries, the economy steadily expanded, China solidified her regional dominance by assuming suzerainty over neighboring states and regions, and the dynasty strengthened its imperial power. Equally well known, however, is the swift economic stagnation (and decline relative to the world economy) and political disintegration of China in the decades following the First Opium War (1840–1842).³ The Opium War, as the first open military conflict with the industrializing West, was the watershed of modern Chinese history. A new geopolitical reality, symbolized by the ensuing military defeats and the resulting treaties, brought about significant macroeconomic shocks and posed unprecedented challenges for the Qing government. In particular, fiscal stability and adequacy in the earlier periods gave way to modest revenue growth that fell short of the government expenditure levels that a modernizing economy required. Not only did overall economic growth stagnate, but sustainable, large-scale modern economic growth was also absent—mechanized industrial production, modern infrastructures (such as the railway and telegraph) and economic institutions (such as modern commercial banking) developed at a very slow pace.⁴ External crises and economic stagna-

¹ This dissertation was completed in 2003 at the Department of Economics, Stanford University, under the supervision of Avner Greif, Gavin Wright, and Yingyi Qian.

² Deng, "Critical Survey."

³ Parts of China, for instance the Lower Yangzi Delta, continued to grow during this period at a rate probably comparable to the average rate of growth in Europe (see Pomeranz, *Great Divergence*). However, the Chinese economy as a whole lagged behind countries that did industrialize.

⁴ According to Jones et al., *Coming Full Circle*, in 1912 China, there existed only 353 mechanized factories, alongside thousands of small handicraft workshops. Less than 1 percent of enterprises employed more than 500 people.