State Intervention in Railway Financing: the Case of Uruguay, 1869-1913

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Abstract

Railways were an important factor in the expansion of the Atlantic economy in the late-19th century. Due to the potential impact of this technology, governments often promoted railway construction, directly financing investment or offering subsidies to private investors. The Uruguayan state offered profit guarantees to private investors and was able to attract massive investment in the railway sector. In order to evaluate the impact of government guarantees on the railway network and the economy, this paper examines the profit record the railway companies and the social returns to the capital invested in the network from 1869 to 1913. The results show that the network would not have been profitable without the subsidies. Although the partial public financing elevated the private returns to capital significantly, subsidized profitability was lower than in other countries and did not compensate the market rate of return. Social returns were also low relative to railways in other countries, yet rose significantly over time, and, by the end of the period under consideration, the railways were producing significant direct benefits to the economy. Furthermore, the level of subsidized private returns relative to social returns indicates that, compared to railway operators in other regions, the distribution of direct benefits was not heavily in favor of the railway companies and their investors, instead accruing to the users of transport services.

1. Introduction[1]

Railways were a critical factor in the expansion of the Atlantic economy in the late-19th century. They contributed to export growth, aided market integration and stimulated changes in patterns of settlement and production. In some areas, geographical constraints made railway investment a necessary condition for development. However, not all countries that received large amounts of railway capital enjoyed economic impacts to the same degree.

Due to the potential impact of this technology, governments often promoted railway construction by directly financing investment or offering subsidies to private investors. State profit guarantees for railway construction were a common policy in 19th century developing regions. In some countries, subsidies spurred the construction of large networks that allowed the development of areas that would otherwise have been virtually shut out of the expansion of international trade of the time. It was thought that the railways were indispensable for development and that the public subsidies would provide high economic returns in the medium and long-term. Without the subsidies, it was believed that investment would not come, due to the high cost of capital and excessive perceived risk (Eichengreen, 1995: 1). However, with limited resources for promoting development, public financing represented a sacrifice for the state and the economy. Public financing had to balance the need to attract sufficient investment in order to foster economic development, while not placing too much of a burden on state coffers. In addition, there was a danger that capital would be diverted away from other productive activities in search of easy government money.

The Uruguayan state, by offering profit guarantees to private investors, was able to attract massive investment in the railway sector. This led to the construction of one of the densest networks in Latin America, second only to Argentina's in railway mileage per capita (Herranz-Loncán, 2011b: 3). The development of this network accompanied and influenced the country's economic transformation in the late 19th and early 20th centuries, and helped link the country to the Atlantic economy.[2]

How did government intervention affect the development of the railway network and its impact on the economy? Thanks to the subsidies, railways were built across much of the country. However, it is possible that government intervention caused economic distortions, encouraging excessive construction and representing wasted public resources. In order to evaluate the impact of the government guarantees on the railway network and the economy, four questions must be answered. First, would the network have been profitable without the subsidies? Second, what impact did the public financing have on profitability? Third, did the capital invested in the railways produce direct benefits for the

[1] I would like to thank Alfonso Herranz-Loncan, who has supervised my work on this project, as well as Enrique Bianchi, Werther Halarewicz, Luís Bértola, Reto Bertoni, Tommy Murphy, Agustina Rayes and Juan Carlos Odisio for their comments and help with data sources.

[2] Between 1870 and 1913, real GDP increased five times, GDP per capita almost doubled and exports quadrupled (Bértola, 1998: 58).

economy? And fourth, how were these benefits distributed the between producers and consumers of transport services?

In responding to these questions, this paper examines the private and social returns to the Uruguayan railway network from 1869 to 1913. The results show that the network, as it was developed up to 1913, would not have been profitable without subsidies. Although the partial public financing more than doubled the private returns to capital, subsidized profitability was still lower than in other countries and did not compensate the domestic market rate of return. Social returns were also low relative to railways in other countries, yet not extremely low in absolute terms, and were rising over time. This suggests that, at least at the end of the period, the railways were producing significant direct benefits to the economy. Furthermore, the level of subsidized private returns relative to social returns indicates that, compared to railway operators in other regions, the distribution of direct benefits was not heavily in favor of the railway companies and their investors, instead accruing to the users of transport services.

The next section presents a brief history of the Uruguayan railway and the state's role in its financing. Section three responds to the first question by estimating the unsubsidized internal rate of return. Section four looks at the impact of the guarantees on profitability, as well as examines alternative profit scenarios that may have influenced investment decisions. Section five takes up the question of the direct benefits to the economy, and the distribution of these benefits, through an estimation of the social returns. Section six concludes.

2. History of the Uruguayan railroad and the role of the state

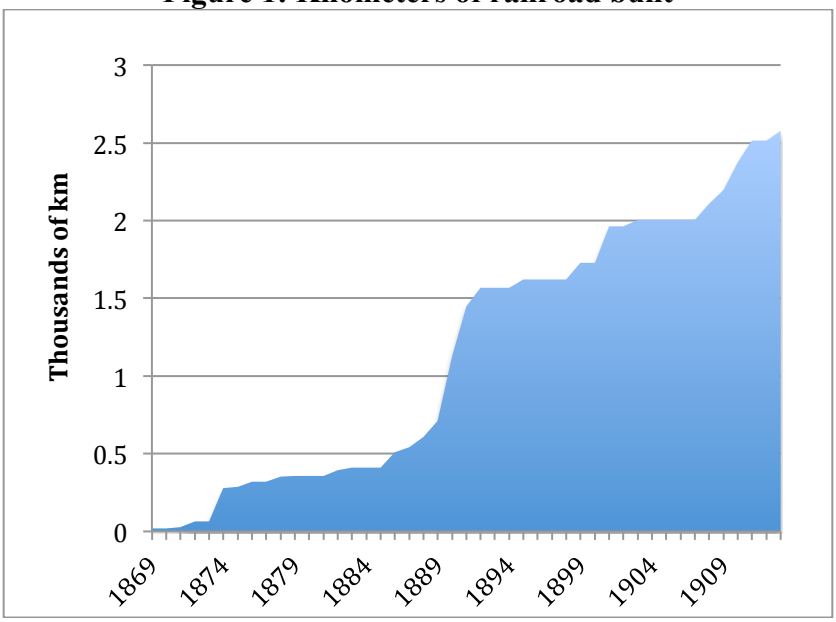
As mentioned in the introduction, by 1913, Uruguay had one of the densest railway networks in Latin America. There were over 20 kilometers of track per 10,000 people, and only a handful of countries had more track per square kilometer of surface area (Herranz-Loncán, 2011b: 3). This network represented about 6% of the country's total gross fixed investment over the 45-year period in which it was built.[3]

Development of the railway network

The railroad arrived relatively late in Uruguay. The first kilometers of track were not opened to traffic until 1869, more than a decade after neighboring Argentina and Brazil inaugurated theirs (Rodriguez Carrasco, 1998: 127, 175). The pace of construction was slow at first; fifteen years after the first line was open there were less than 500km of track in operation. During the speculative boom at the end of the 1880s, investment poured into the country, most going to the railway sector (Winn, 2010: 112-113). This led to a tripling of track length in just five years. However, the crisis of 1890 put an end to this expansion. After eight years of stagnation, construction picked up again and 1,000km more were built before 1913 (Millot and Bertino, 1996: 330). Figure 1 shows the changes in railway track length over the period.

[3] Calculated based on a gross fixed investment series from Roman and Willebald (2011) and my own figures.

Figure 1: Kilometers of railroad built



Sources: National Statistical Yearbooks and Central Uruguay Railway Company Annual Reports

After WWI, the railroad gradually began to lose importance in Uruguay. The political forces in power in the first decades of the 20th century were hostile to British capital (Nahum, 1994: 54-55), while technological change brought about a shift towards cars, trucks and highways, due to their clear transport advantages for short-to-medium distance trips and lighter loads. As a consequence, on the eve of WWII, the railway era in Uruguay was already drawing to a close.

The first railway companies to operate in Uruguay were domestic. These endeavors quickly ran into financial trouble and were bought up by British investors, who proceeded to build and operate most of the network until its nationalization in the first half of the 20th century.[4] In 1913, 60% of the network was controlled by the Central Uruguay Railway Company, which operated the main line and various extensions. The rest of the network was divided between the Midland Railway Company, which operated almost 20%, and several smaller companies. Figure 2 shows the layout of the Uruguayan railway network as it stood in 1911.

Figure 2: Uruguayan Railway Network in 1911

[4] Although the first portions of the network passed into state hands in 1915, most of it remained private during the interwar period. In 1948 the state acquired the railway lines of the four remaining privately owned companies as part of the settlement of British debts incurred during WWII (Millot and Bertino, 1996: 331).

Source: Central Uruguay Railway Company Annual Report for 1911

The state and the railroad

The state was heavily involved in the development of the railway network from the very beginning. It authorized the first proposed line, from Montevideo to Durazno in 1865, and offered to guarantee profits of 7% over a fixed value of £10,000 per mile constructed (£6,214/km). It also offered to provide a large part of the initial capital; a promise that it did not keep. Concessions for other lines were provided under similar arrangements, although little building occurred over the next few years. Given the chaotic situation of the country and the weakness of the state, it proved difficult to attract sufficient funds for railroad construction.

In response, the government institutionalized the guarantee in the Railway Law of 1884, with the hopes of alleviating investor unease and attracting more capital (Barrán and Nahum, 1971: 556). Similar to arrangements with earlier lines, the government agreed to supplement net revenue earnings below 7% of a fixed value per kilometer of track, now lowered from £6,214 to £5,000. In turn, the railway companies were obligated to return to the government part of any profits over 8% of the fixed capital per kilometer, until all guarantees paid in earlier years had been returned. The government also reserved the right to fix freight and passenger fares if profits rose above 12%, a right that they never ended up exercising. The 1884 Railway Law also established the general layout of the future network, the obligations of the government with respect to the railway companies and the regulations under which these companies would operate.

The second Railway Law of 1888 made some adjustments to the framework laid out in 1884, most notably establishing the possibility for direct state intervention in the construction of railway lines. However, the projects initiated under this regime never came to fruition.

The crisis of 1890 resulted in the government's default on public debt the following year. The subsequent settlement included a renegotiation of the guarantee agreements. The guarantee rate was reduced to 3.5% and the level at which the companies had to begin returning the subsidy was lowered to 6%.

For a network with growing traffic and heavy use, the total amount of the guarantee payments made in the early years of low profitability would be returned in later years; the subsidy would then consist of the interest payments saved on the use of those funds between the time of payment and return. However, in Uruguay, since the companies under guarantee never reported profits above the level established in the law (at least according to their accounts), the state never recovered the funds paid out and the subsidy ended up being almost one third of the total capital invested in the network.

The Uruguayan historiography has in many ways taken a negative view of the British railway companies that built and operated the network, as well as of the guarantees (Barrán and Nahum, 1971: 614-619; Ibid, 1973: 253; Millot and Bertino, 1996: 354). Among other complaints, the companies are said to have operated their business for the purposes of extracting maximum guarantee payments, being concerned only with covering costs instead of running an efficient service. In doing this, it is said, they siphoned off interest and dividends to investors, at the expense of the development of the rural economy.

3. Unsubsidized Profitability of the Railway Companies

A first step in evaluating the impact of the government subsidies is estimating the unsubsidized average profitability of the railway network from 1869 to 1913. The appropriate measure for this is the internal rate of return (IRR). This combines the annual operating revenues, operating costs[5] and capital expenditures in real terms, appropriately discounting them according to the year in which they occurred, and takes into account the value of the network at the end of the period. The unsubsidized IRR would be the average profitability of a counterfactual network with the same level of investment as the real one, but without the guarantees. The appropriate equation for calculating the IRR is:

$$PV = \sum_{t=0}^{T} \frac{(R_t - C_t - I_t)}{(1 + \boldsymbol{r}_i)^t} + \frac{V}{(1 + \boldsymbol{r}_i)^T}$$

[5] The series for operating revenues and costs were provided by Alfonso Herranz-Loncán, who estimated them using data from company reports and national statistical yearbooks.

where R_t is the operating revenues for each year, C_t is the operating costs, I_t is the capital invested in construction of the network, t indicates the year in which the spending occurs, T is the last year of the period (1913) and V is the value of the network in the last year of the period, taking into account capital depreciation. $\boldsymbol{r}_i$ is the internal rate of return when the present value (*PV)* is equal to zero.

Capital invested

To obtain internal rates of return we must know how much was invested each year in constructing the railway network. This series has been estimated from the construction costs recorded on the capital account balance sheets found in the company reports for a sample of the railway operators during this period. The companies for which information exists are the *Ferro-carril Central del Uruguay* (later *the Central Uruguay Railway Company*), *the Central Eastern Extension*, *the Central Northern Extension*, *the Central Western Extension*, *the Midland Uruguay Railway Company* and *the Uruguay Central and Hygueritas Railway Company*, which in total owned 79% of the track in operation in 1913. All these, except the *Midland*, formed an integrated system (although they maintained separate accounts), in which *the Central Uruguay Railway Company* leased and operated the other companies' lines.

Identifying the appropriate construction costs in the company accounts is no simple task. In many cases, it is not possible to use differences in the year-to-year totals because these often include discounts offered on the sale of company bonds or shares, or other financial capital movements. Therefore, the sum of all items referring to construction costs found in the capital account balance sheet has been used. Only for the first years of the *Ferro-carril Central* and for a few years of *the Central Western Extension*, the differences in year-to-year totals have been used due to lack of more detailed information. Another problem comes from the practice, common in 19th century accounting, of recording part of the construction costs in the operating account balance sheet and not the capital account balance sheet (Herranz-Loncán, 2004: 30). The lack of detail of the operating account balance sheets impedes the identification of all relevant construction costs, leading to a likely downward bias in the capital investment series (which would lead to an upward bias in the IRR estimation). However, it is also known that the companies inflated the costs of construction in order to fraudulently reduce their declared profits (Barrán and Nahum, 1971: 581-86). This would introduce an upward bias into the capital investment estimation, which could, in part, offset the downward bias mentioned earlier.

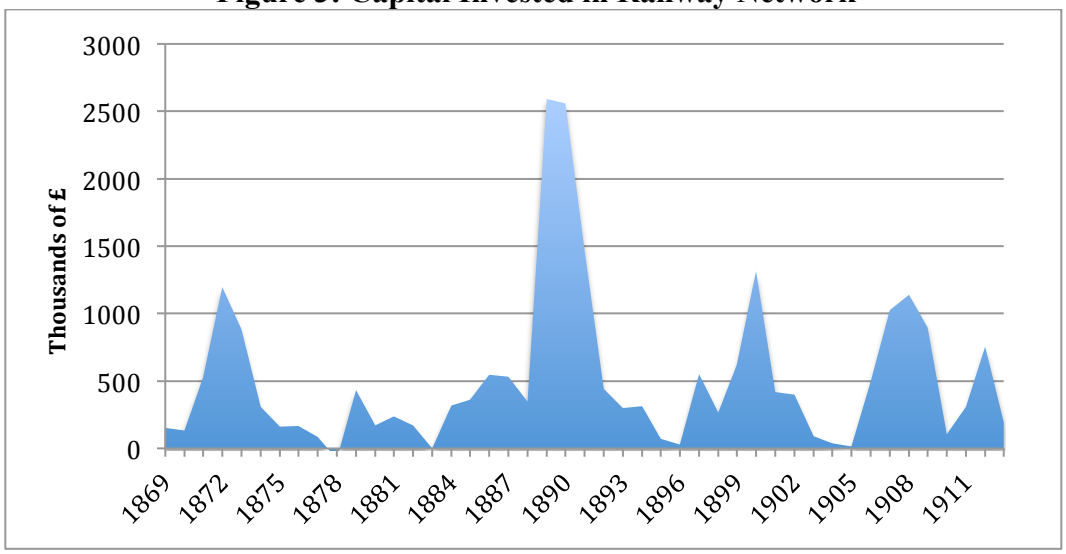
In any case, based on the sources available, a capital investment series from 1869 to 1913, in current pounds sterling, has been constructed for the sample of railway companies for which information exists. A GDP deflator estimated by Bértola (1998: 58-59) has been used to convert the series to constant 1913 prices.[6] Using this deflator is adequate because, although some construction inputs were imported from Britain, many were domestic, and given the restrictions imposed by the Gold Standard during this

[6] The GDP deflator series begins in the year 1870; due to lack of information for earlier years, the value of the index in 1870 has been applied to the year 1869. This assumes that prices remained constant from the time construction began until the first kilometers of track were opened to traffic, although due to the small amount invested relative to later years, any bias introduced because of this assumption would be minimal.

period, changes in domestic prices did not vary much with regard to changes in British prices.[7]

The average cost of construction was £8,948 per kilometer of track[8], which is in line with estimates for other settler economies, such as Argentina (£7,325/km) and the US (£9,540/km) (Cambó Batlle, 1918-1922).[9] This value has been applied to the track length of the companies for which information is not available in order to estimate the total capital invested in the network. Information on the track length operated by these companies is found in the national statistical yearbooks. The estimated total amount of capital invested in the network is £23,063,443. Figure 3 shows a graph of the capital investment series:

Figure 3: Capital Invested in Railway Network



Sources: Own calculation from Company reports and National Statistical Yearbooks. Notes: Figures are in 1913 prices

Capital depreciation

Calculating the IRR requires knowing the value of the railway network at the end of the period, taking into account the efficiency losses due to capital depreciation. The declining balance method is commonly used in the literature (Herranz-Loncán, 2004: 22), and is

[7] British prices remained relatively stable between 1869 and 1913 (Officer and Williamson, 2011), while the GDP deflator used here rises an average of about 1% per year.

[8] This is not much more than the £5,000 per kilometer (£6,214 before 1884) over which the guarantee was paid, since transforming a series of these fixed values per kilometer constructed into constant 1913 prices produces an average cost of £7,594/km. Actual reported construction costs were 18% more than the fixed value upon which the guarantee was paid.

[9] The values for Argentina and the US have been calculated using non-deflated series and therefore are not strictly comparable to the Uruguayan estimation.

applied in this case, with a geometric depreciation rate of 1.7% per year.[10] The resulting value of the existing capital for 1913 is £16,198,544.[11]

Internal rate of return

Using the aforementioned operating revenue, operating cost and capital spending series, the average unsubsidized IRR for 1869 to 1913 is 1.43% per year. In order to determine whether this was enough to compensate the opportunity cost of capital, we must compare it with alternative investments of a similar risk level. It is common to use the effective interest rate on government bonds of the same country where the railway investment occurred, since both are guaranteed by the same institution and therefore share a similar risk level (See, for example, Summerhill, 1998: 553).

The interest rate on Uruguayan public debt was relatively stable over this period: the government generally issued bonds with nominal interest rates of 5 or 6% (Nahum, 1994). The average rate for these issues, taking into account discounts offered on the sale of bonds and weighting by the amount of capital invested in the network each year, was 6.7% per year.[12] This is the return an investor would obtain by investing in public debt over the course of the period, and approximates the market rate of return, or the opportunity cost of capital, for this economy.

The IRR of 1.43% is far below the market rate of 6.7%. This indicates that the capital invested in the railway network over the course of the period did not generate enough revenue to be profitable without the government guarantees.[13]

4. Subsidized profitability

A next step in evaluating the impact of the government guarantees is to estimate the subsidized return on capital. This is the rate of return actually received by the owners of the railway network, as it included income from net operating revenues as well as the government subsidies. It is therefore necessary to determine the flow of guarantee payments and related expenses, and add them to the net income of the companies for each year in the period under study.

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[10] This paper uses the same depreciation rate employed by Herranz-Loncán (2008) in a similar exercise for the Spanish railway system. In order to obtain a depreciation rate that more accurately reflects local conditions it is necessary to carry out a systematic evaluation of the useful life of the capital goods invested in the network, a task we hope to carry out in the future.

[11] This, and subsequent series totals for the period are expressed in 1913 prices.

[12] Own estimation based on the interest rates and discounts on bonds reported in Nahum (1994) weighted by the previously mentioned capital investment series.

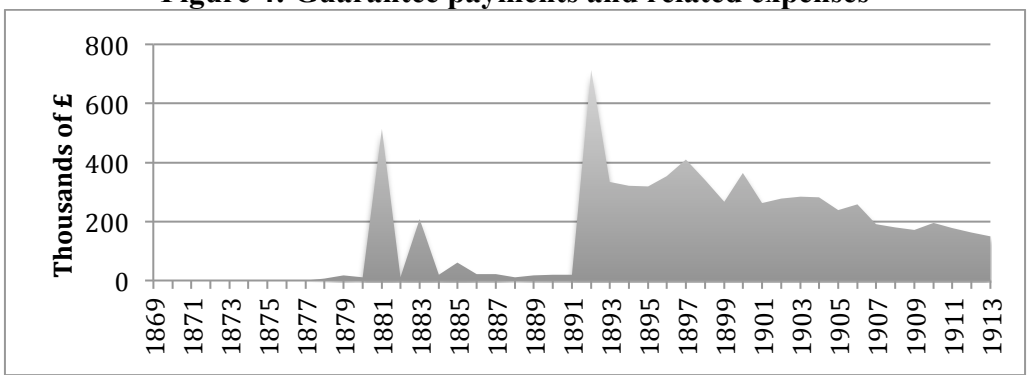
[13] As mentioned at the beginning of this section, the unsubsidized internal rate of return assumes a counterfactual economy in which the companies did not receive a subsidy, but invested the same amount they would have if they had received it. This is not realistic; in an economy without the subsidy, it is probable that the network would have been less extensive and therefore the series for revenues, costs and capital expenditure would register different values. An unaided IRR calculated for a smaller network would probably be higher than the unaided IRR estimated in this paper because the network would be limited to the most profitable lines.

Guarantee payments

For most years before 1892, the government paid little or nothing of what it owed under the guarantee agreements. In some cases it handed over government bonds to the companies as settlement for unpaid guarantees. For example, in 1878, the *Central Uruguay Railway Company* accepted £212,766 in bonds in exchange for cancelation of outstanding guarantee payments of the same amount. The company proceeded to sell the bonds, a few thousand pounds at a time, over the course of the next 30 years, collecting interest in the meantime. In addition, the company renounced future guarantee payments, was freed from the obligation to return funds to the government when its profits exceeded 8% and accepted a subsidy of a fixed £5,319 per year for 10 years. At least two other companies arrived at similar settlements with the government. The *Northwestern Railway of Montevideo* accepted £382,979 in 1881 in exchange for cancelation of outstanding guarantee payments and renouncing its right to receive guarantee payments in the future, while the *Uruguay Central and Hygueritas Railway Company* received £148,936 in bonds in 1883 under similar conditions. In 1892, all outstanding guarantee payments and related debts were absorbed in the Interior Unified Debt, and the government gave bonds to the railway companies in exchange for unpaid guarantees. From the information available it appears that most of the companies promptly sold them for approximately the value of the unpaid guarantees, except the Central, which still had bonds in its possession from the 1878 agreement. An agreement was also reached to reserve 45% of all customs receipts for direct payment of railway guarantees. From this year on, it appears that the government paid the full amount of all its guarantee obligations (which, as mentioned earlier, had been reduced from 7% to 3.5% of the value of the fixed capital per kilometer of track).

Interest payments and income from the sale of government bonds registered in the available company reports, as well as the total guarantee payments reported in the statistical yearbooks starting in 1892, have been used to construct the series of the payments from the state to the railway companies. This leaves out possible interest payments or income from the sale of bonds received by companies for which we do not have information. Because these settlements occurred in a somewhat arbitrary fashion, depending on the political and economic circumstances of the country, it is difficult to introduce reasonable assumptions that would allow us to augment the series to include all the railway companies. Due to this limitation, the series probably contains a downward bias for the years prior to 1892. However, this bias is most likely very small, since the companies not in the sample managed only a small part of the network. The total amount paid was £7,190,696 (in 1913 prices). Figure 4 shows a graph of this series.

Figure 4: Guarantee payments and related expenses



Sources: Own calculation from Company reports and National Statistical Yearbooks. Notes: Figures are in 1913 prices.

Subsidized internal rate of return

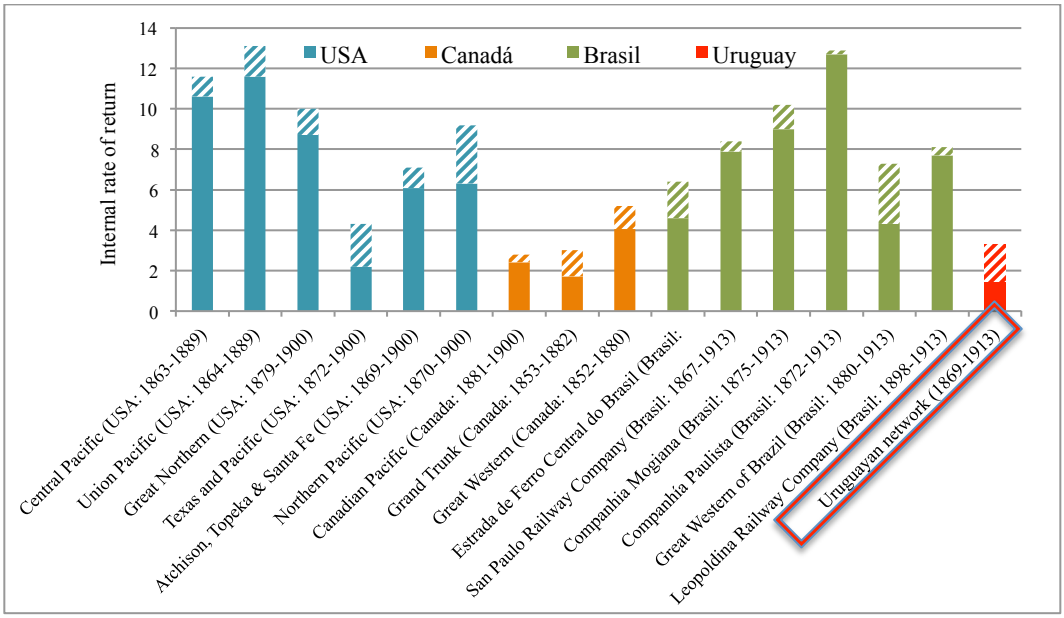
In order to calculate the average subsidized internal rate of return for the period, the equation used earlier is adjusted to include the flow of guarantee payments and related expenditures:

$$PV = \sum_{t=0}^{T} \frac{(R_t - C_t - I_t + G_t)}{(1 + \boldsymbol{r}_i)^t} + \frac{V}{(1 + \boldsymbol{r}_i)^T}$$

where G_t is the payments by the state to the railway companies, and all other variables are the same as stated earlier.

The result of the estimation of the subsidized IRR is 3.21%, which is less than half the market rate of return of 6.7%. In addition, both the subsidized and unsubsidized IRRs are below those for many railway lines built in other settler regions. Figure 5 shows the estimated IRR, with and without subsidies, for a sample of railways built during the 19th and early 20th centuries in other settler regions.

Figure 5: Internal rates of return for railway lines in settler regions, with and without subsidies



Sources: Mercer (1982), pp. 107-118; Carlos & Lewis (1992)*, p. 413; Summerhill (1998), p. 553; and my own figures. Note: solid bars represent the unsubsidized-IRR, while the striped bars indicate the level to which the IRR rises with the subsidy.
*The authors' method of estimation of the consumer surplus is not strictly comparable to that of the other authors in the sample. The method used introduces a downward bias into the estimate of the social returns.

The difference between the subsidized and unsubsidized IRRs for the railway lines represented in Figure 5 ranges from 0.2% (Companhía Paulista) to 2.9% (Northern Pacific) of the capital invested. The average is 1.32%. In Uruguay, the guarantees increased the IRR by 1.79% of capital invested, putting the size of the subsidy in relation to railway investment in the same range as that for the other countries in Figure 5.

Although in Uruguay the government subsidies raised the income of the companies significantly, this was not enough to make railway investment more profitable than purchases of public debt or railway investment in other settler regions.[14] In order to compensate the market rate of return, the subsidies paid each year would have had to be on average three times greater.

Returns under full subsidy

The total amount of subsidy received by the railway companies over the course of the period under consideration was far less than what was originally stipulated in the railway laws of 1884 and 1888. This was due in part to the government's failure to fulfill its obligations before 1892, but more importantly to the reduction of the guarantee rate from

[14] It is possible that, if the analysis were carried out for a longer period, the resulting IRR would be somewhat higher, since after 1913 few kilometers of track were added to the network and the highest levels of traffic were probably reached during the interwar period. However, the same could probably be said about the other railway networks included in figure 5.

7% to 3.5% in that year. Estimating what the IRR would have been if the government had fulfilled all of its obligations to the railway companies, on schedule, over the course of the period can give an idea of what the minimum return expected by investors during the years of heaviest construction (the 1880s) may have been.

Due to the fact that some lines renounced the guarantee before the end of the period, and to the likely manipulation of prices and reported profits, it is difficult to provide a precise estimation of the increase in earnings under a full guarantee payment scenario.[15] However, it is possible to estimate the return on capital under the assumptions that all lines remained guaranteed throughout the period and that profits on any individual line never exceeded the amount set by the guarantee. Two estimates are provided: the first assumes a 7% return over a fixed value of £6,214 per kilometer of track from 1869 to 1883, and a fixed value of £5,000 for the rest of the period; the second assumes the same fixed values per kilometer, but that the return is reduced by half, to 3.5%, after 1891. The results are compared to the true subsidized IRR in figure 6.

Figure 6: Counterfactual internal rates of return

	Internal rate of return
True subsidized IRR	3.17%
Counterfactual 1 (7% 1869-1913)	5.19%
Counterfactual 2 (7% for 1869-1883 and 3.5% for 1884-1913)	2.75%

Sources: Own calculation from Company reports and National Statistical Yearbooks

The result of the first estimation is a return on capital investment of 5.19%, much closer to the market rate of return of 6.7%. If, under this scenario, any of the lines had reported profits over the 7% guaranteed by the state, the return over the period would have been higher, making the railway a profitable investment. The second counterfactual assumes that the guarantee was reduced by half after 1891 (as actually occurred). This results in a return of 2.75% over the period, which is slightly lower than the true subsidized rate of return. This means that the halving of the guarantee as part of the 1891 debt renegotiation was a huge blow to the railway's overall return over the period. Without this readjustment, the Uruguayan network as a whole would likely have operated much closer to profitability.

[15] For example, the Central Uruguay Railway Company and the extension companies, although officially separate entities, operated as a single system, in which the Central leased and operated the other companies' lines. This allowed them to manipulate prices in order to maximize the amount of subsidy received from the government. The Central, which had renounced the guarantee on its main trunk line in 1878, raised shipping prices on this portion of track and lowered prices on the guaranteed extension lines. In this way, it maximized profits on the trunk line, with no obligation to repay any guarantees, while reducing profits on the guaranteed portions, thereby raising the amount of subsidy it was owed (Winn, 2010: 135). If the government had fulfilled its obligations in the first years of the period, it is possible that all lines would have continued to operate under the guarantee agreement. In this case, we cannot know what the reported profits, and therefore the guarantee payments, would have been.

The low unsubsidized IRR indicates that, on average over the whole of the network, the railway did not generate enough traffic to be profitable on its own. It is possible that this was due to an operation of the service aimed only at covering costs and capturing as much state subsidy as possible. The subsidized IRR, more than twice the unsubsidized rate, shows that the guarantees contributed significantly to the profit performance of the investment. However, this was not enough to compensate the opportunity cost of capital or average returns to railway investment in other settler regions.

During the years in which most investment occurred, the minimum returns expected under the guarantee agreements in effect at that time were likely high enough to justify a large investment. However, even after the guarantee was reduced in 1891, another thousand kilometers of track were built before WWI. What led to this continued investment? Investors may have not had much choice but to bet on further expansion in the hopes of encouraging settlement, fostering economic development and generating greater traffic.[16] Although there were signs of progress towards the end of the period, they were not enough to make Uruguayan railway investment a profitable endeavor.

5. Benefits of Railway Investment to the Economy

The third question of interest for evaluating the impact of government subsidies is whether they produced benefits to the economy as a whole. One way of approaching this question is by means of an estimation of the social returns of the capital invested in the railway network. This measures the benefits provided by the railways, not only to the companies that operated them, but also to the consumers of the transport services offered. It also takes account of the cost borne by the economy owing to the partial public financing. In this calculation, the subsidized internal rate of return discussed in the preceding section represents the benefits to the providers of the transport services, while the guarantees and related payments represent the public expenditure. An estimation of the social savings is commonly used to represent the benefits to the consumers of transport services.

[16] This was a concern throughout the period. For example, in the Report of the Directors to the Shareholders of the Central Uruguay Railway Company for the half-year ending Dec. 31st, 1883, George W. Drabble, the Chairman, writes, "This necessarily brings us to the question of immigration and agricultural colonies, and I may say that I consider the items of immigration and country roads as the two essential points of our future prosperity. If we continue, as at present, we shall gain a steady dividend, but if the suggested improvements be realized, our railway will become a great success." Twenty years later, in the Report for the year ending June 30th, 1903, George R. Cable, Secretary of the Board of Directors for the same company, writes in regard to the Northern Extension, " Fortunately … there is a movement towards colonization in the districts served by [the Northern Extension] which is calculated to bring about a radical change in their prospects, especially if the government continue their present work of fomenting agriculture and extending the zone of that industry."

Social savings

Because we cannot directly observe a counterfactual economy without the railways, it is impossible to precisely determine the income gains to due to the existence of this infrastructure. The social savings methodology examines what the cost to the economy would be of shutting down the railroad sector in a particular year, and in doing so approximates its economic impact (Summerhill, 2000: 8). It is an estimation of the resources saved on account of the lower transport costs generated by the railway service.[17] Under certain assumptions, the social savings is the appropriate measure of the increase in the consumer surplus derived from access to the network (McClelland, 1972: 474-77). This estimation measures the difference between the unit costs of railway transport and those of the next best alternative, multiplied by the value of goods and passenger transport in a particular year, and can be calculated using the following equation:

$$SS = (P_{alt} - P_{rw}) * Q_{rw}$$

where P_{alt} is the price of alternative means of transport, P_{rw} is the price of railway transport, Q_{rw} is the quantity transported in a particular year and SS is the social savings in that year. The result is then adjusted by the price elasticity of demand for transport services in order to account for the reduction in the amount that would be transported in an economy with higher transport prices.

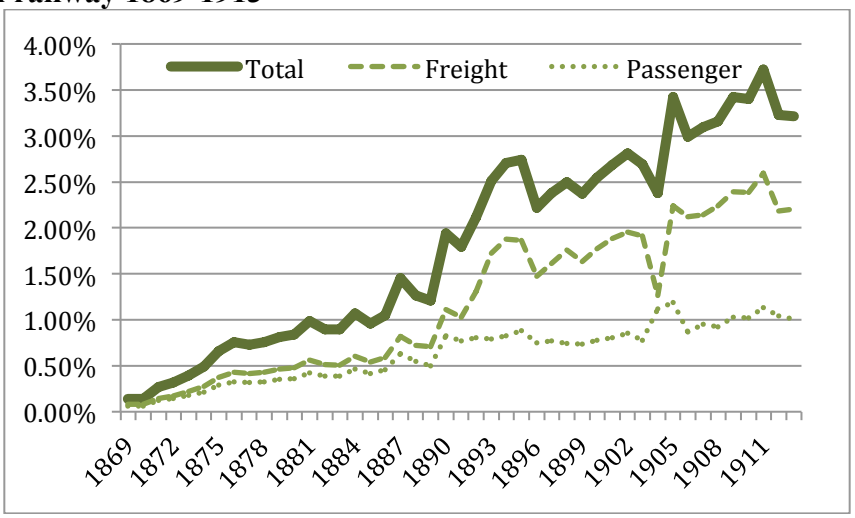
Herranz-Loncán (2011) has estimated the social savings generated by the Uruguayan railway network based on information about freight and passenger transport prices and quantities, as well as information about water, carting and droving prices for freight, and water, road and travel time costs for passengers. The social savings in 1913 were £2,197,872, or about 3.1% of GDP that year.

In order to calculate the social returns for the period from 1869 to 1913, an estimate of the social savings for each year in the period is necessary. This has been done using price and quantity series to project Herranz-Loncán's estimate for 1913 back to 1869. The appropriate information regarding ton-miles transported, railway prices per ton-mile, passenger-miles and railway prices per passenger-mile are available for the years 1891 to 1913 from the company reports. For earlier years, railway transport price and quantity series from Bértola (1998: 56) have been used. Travel time costs have been adjusted using a nominal wage index from Bértola *et al*, (1999). Prices for alternative modes of transport have been assumed to remain constant over the period.[18] Figure 7 shows the freight, passenger and total social savings from 1869 to 1913.

[17] This method assumes, among other things, that transport prices equal marginal cost, marginal costs are constant, and that the presence of the railways does not affect the prices charged by alternative modes of transport. For an in-depth discussion of the assumptions involved in social savings estimates, see McClelland (1972; 474-77) and Leunig (2010: 11-15).

[18] A precise estimation must take into account changes in the prices and in the distribution of traffic across alternative transport methods over time, a task we hope to complete in the future. In particular, droving transport costs rose over the last decades of the period, due to changes in the final destination of cattle, from the salting house for production of *tasajo* in the 19th century, to the meatpacking plant for cooling and freezing in the early 20th century. *Tasajo* was produced by removing all fat from the animal, meaning that

Figure 7: Freight, passenger and total social savings as a percentage of GDP for the Uruguayan railway 1869-1913



Sources: Own estimation based on Herranz-Loncán (2011b); Bértola (1998); Company reports

Social savings grew steadily over the course of the period, as the network was extended to the far reaches of the country. The level of 3.1% of GDP for 1913 places Uruguay at the lower end of the spectrum of estimates of social savings for late 19th and early 20th century railway networks in other countries, and much lower than the large Latin American economies of Argentina, Brazil and Mexico (Crafts, 2004: 20). Herranz-Loncán suggests several reasons for this (2011b: 27). Uruguay's small size reduced the share of long distance trips over which the railway represented a clear advantage in terms of cost and time, and access to navigable rivers made water transport a competitive alternative in many areas. The country's productive specialization also reduced the need for this new technology; the share of livestock that was moved by droving remained high until the last few years of the period under consideration. In this sense, geography limited the potential direct economic impact of the railways on the Uruguayan economy.

Social returns

The following equation is used to calculate the social returns:

$$PV = \sum_{t=0}^{T} \frac{SS + (R_t - C_t - I_t) + E}{(1 + \boldsymbol{sr}_i)^t} + \frac{V}{(1 + \boldsymbol{sr}_i)^T}$$

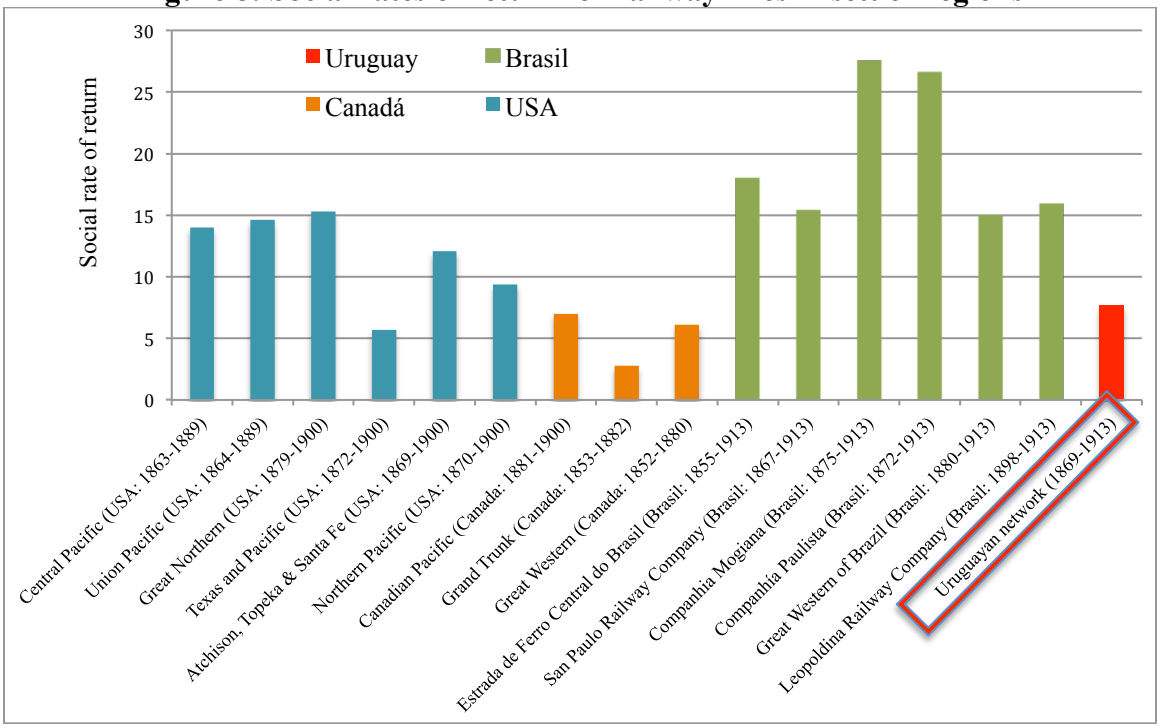
where *SS* is the social savings for the year, *R* is the operating revenues, *C* is the operating costs, *I* is the capital investment, *t* indicates the year in which the spending occurs, *T* is

weight loss from walking did not affect the sale price of the cattle at the salting house door. In contrast, meatpacking plants prized fatty meat and heavier animals; in this case droving represented an additional cost due to the reduction in weight from walking (Herranz-Loncán, 2011b: 10-11). Water transport prices may have fallen over time with the introduction of steam technology. In addition, the proportion of railway traffic diverted to other modes of transport under the alternative scenario would likely change over time in accordance with patterns of settlement and the location of production.

the last year of the period (1913), *V* is the value of the network at the end of the period and ***sr*** is the social returns when the present value (*PV*) is equal to zero. *E* represents the indirect externalities generated by the existence of the network. These could include economies of scale or agglomeration that are achieved thanks to the railways, as well as benefits due to political integration or the exercise of military control that this infrastructure allows. In general, the existence of positive externalities is recognized, but no attempt is made to measure them; this therefore introduces a downward bias of an unknown amount into the estimation of the social returns.

The average social returns for the 1869 to 1913 period were 7.7% over the capital invested. This is a weighted average of the return on all railway capital in existence each year, factoring in depreciation at a rate of 1.7% per year. The downward biases due to the exclusion of positive externalities make the social returns estimate a lower bound. This lower bound estimate of the average social returns on railway capital is higher than the estimates for both the private returns and the market rate of return. Furthermore, the social returns were rising throughout the period, reaching 15.6% in 1913.

Figure 8: Social rates of return for railway lines in settler regions



Sources: Mercer (1982), pp. 107-118; Carlos & Lewis (1992)*, p. 413; Summerhill (1998), p. 553, and my own figures.
*The authors' method of estimation of the consumer surplus is not strictly comparable to that of the other studies in the sample. The method used introduces a downward bias into the estimate of the social returns for the Grand Trunk and Great Western of Canada.

Figure 8 shows estimates of the social returns for several railway lines in other settler regions. These are average rates of return over periods of 19 to 58 years. A rate of 7.7% for the period indicates that the Uruguayan railway generated social returns that were at the lower end of the range of the railways in the chart. Although the Uruguayan rate was rising over time, it is likely that so too were the rates for the other networks. This

suggests that the social returns to the capital invested in the railway network were relatively limited in Uruguay.

Did the resources invested in the railway sector obtain the maximum possible social returns for this economy? In order to know this, it is necessary to compare the estimated average social rate of return with those of possible alternative investments feasible in Uruguay at the time (Summerhill, 1998: 560).[19] Due to the difficulty of obtaining these estimates, it is not possible to give a definitive answer to whether there was overinvestment in the railway network. In other words, it is not possible to verify whether the resources directed to the railway sector achieved the maximum possible direct economic benefit to society compared to the returns from alternative investments.

However, unless it can be shown that a feasible alternative investment – one that the government could conceivably use public resources to encourage, either directly or through subsidies – would have produced a higher social rate of return, we cannot say that the capital invested in the railways represented wasted resources, especially if we take into account the exclusion of the potential externalities of railway investment.

In any case, although social returns were lower in Uruguay than in other regions, by the end of the period under consideration, the railway capital was producing significant returns to the economy.

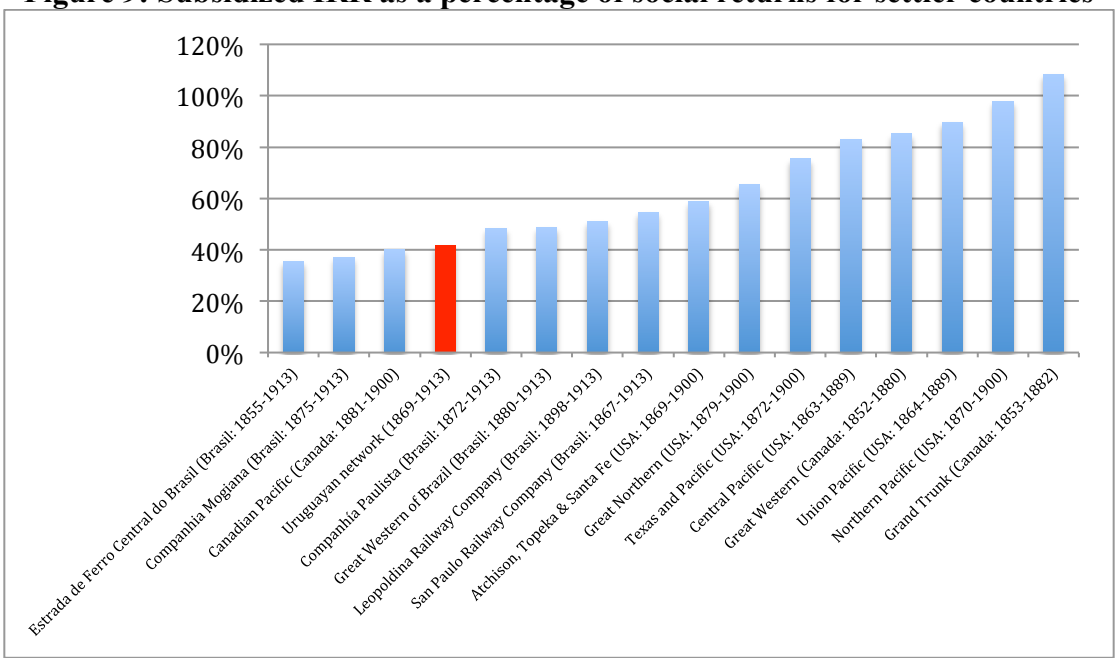
Distribution of benefits

The social returns indicate the degree to which the capital invested in the railway network produced direct benefits to the economy as a whole. From the perspective of evaluating the impact of public financing, the distribution of those returns between the railway companies and the consumers of transport services matters as well. If it were the case that the private returns were as high, or even higher (due to the subsidies) than the social returns, it would mean that the railway companies captured a large part of the increases in income generated by the network. If this were so, it could be claimed that the existence of direct income gains due to railway investment did not, on their own, justify the public financing.

To compare the distribution of benefits between producers and consumers of railway services, we must look at the size of the subsidized private returns in relation to the overall economic benefits. The ratio of the subsidized IRR to the social returns indicates the portion of the overall benefits that was captured by the railway companies during the period under consideration. In Uruguay, the subsidized IRR is 42% of the social returns from 1869 to 1913. This result can be compared with those for other countries, as can be seen in figure 9.

[19] Summerhill points out that, for Brazil, the most appropriate alternative for this comparison would possibly be central sugar mills subsidized by the government; the social returns on this type of investment were most likely very low or even negative. Another possible comparison could be to unrealized investments, such as greater education spending. Due to the lack of sufficient information about these alternatives, it is not possible to obtain a persuasive estimate.

Figure 9: Subsidized IRR as a percentage of social returns for settler countries



The proportion of benefits captured by railway companies, through profits and subsidies, varies from 36% for the Estrada do Ferro Central do Brasil to 108% for the Grand Trunk of Canada. In this last case, the company received more in profits and subsidies than the overall social returns generated by the network. The average for railways in the sample is 64%. The Uruguayan network is at the lower end of the range of railways in the sample, indicating that the companies that operated it managed to capture less of the overall direct benefits than operators of railways in other settler regions.

This is not to say that the benefits were received only by residents of Uruguay. The beneficiaries included the final consumers of Uruguayan goods in other parts of the world, as well as producers of products imported to Uruguay. Furthermore, both the railway companies and the consumers of transport services may have received other benefits from the existence of the network. For example, railway companies may have had ties to the manufacturers of railway equipment, which would have benefitted from increased demand for their products. And, as already mentioned, positive externalities such as greater market integration or the state's ability to assert political and military control over the national territory, were likely present, and possibly large. These indirect benefits would have accrued to both producers and consumers of transport services.

However, the distribution of social returns shows that railway companies did not capture exceptionally large part of the direct economic benefits for themselves, at least in comparison with other countries. If the British railway companies tried to extract the income gains that arose from their investment, it appears they were not overly successful. Insofar as exploitation occurred, it was not through the capture of an exceedingly large part of the direct economic benefits.

6. Conclusions

In the second half of the 19th century, the Uruguayan state offered profit guarantees to foreign owned companies in order to attract investment in a technology that was thought to be indispensible for the region's development. This drew in a relatively large amount of capital for such a small, low population density country. This investment accompanied and aided Uruguay's development during the late 19th and early 20th centuries. However, in comparison to railways in other regions, the railways underperformed in terms of private profitability as well as in providing social returns.

Subsidized private returns for the Uruguayan railway network were low compared to the market rate of return and to returns for networks in other countries. However, without the government guarantees, the private returns would have been much lower. This testifies to the importance of the role of public financing and indicates that without it railway investment would likely have been greatly reduced. In addition, returns would have been much higher if, in 1891, the guarantee rate had not been reduced by half. The minimum return under a scenario in which all lines were guaranteed by the full 7% would have been closer to the market rate of return and to subsidized returns for railways in other countries.

The direct impact of the railway on the larger economy was on average higher than both the private returns and the market rate of return, and rising over time. Without knowing the social returns of possible alternative investments, we cannot say definitively whether the capital invested, and the public funds that incentivized the investment, were the best use of these resources. Direct economic benefits were lower than in other countries. However, the available information indicates that the social returns were not insignificant, and rising over time. Furthermore, the distribution of these benefits shows that the railway companies did not capture an exceedingly large portion of the social returns of their investment in comparison to operators in other settler regions.

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