

Developmental States?:
Explaining Cross-Country Differences in Private vs. State Ownership of
New Railroad Miles, 1860-1912

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Abstract

One theory argues that state ownership of infrastructure is greater in poor countries because the social returns from investment exceed the private returns by a wider margin. Another theory argues that state ownership is greater when legal and political institutions provide weak enforcement of private property rights or weak limits on government excess. I test these theories using cross-country data on state and private ownership of new railroad miles between 1860 and 1912. The results from a panel analysis show that private ownership of new railroad miles increased when G.D.P. per capita increased. They also show that state ownership was greater in countries with civil law legal systems compared to common law legal systems. The findings suggest that state ownership of new railroads was symptomatic of insecure property rights in some cases, but the dominant consideration was the level of income and its implications for private returns.

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1. Introduction

Infrastructure can be owned by private companies or the state. The degree to which a society relies on private ownership—as opposed to state ownership—has implications for both efficiency and equity. It can affect investment, operational costs, prices, and the quality of services. Private and state ownership can also determine whether the gains from infrastructure are channeled to a narrow group of individuals or more broadly throughout society.

There are several theories which try to explain why private or state ownership is more prevalent in some contexts than others. One explanation is based on the hypothesis that states try to promote economic development by intervening in sectors that are prone to market failures. The private and social returns from infrastructure capital are different because infrastructure providers do not internalize the externalities, particularly effects on economic development. According to this hypothesis, the ‘developmental-state’ responds to a large divergence between the private and social returns by subsidizing private provision or owning infrastructure directly. The state is especially likely to build and own railroads in poor countries because the social returns exceed the private returns by a greater extent.

Another explanation argues that state ownership is the result of insecure property rights. According to this view, private companies will be hesitant about constructing and owning infrastructure when legal and political institutions place few limits on the ability of the state or other private actors to expropriate their investments. In such cases, the state emerges as the only group willing to own infrastructure because it can’t expropriate from itself, nor does it fear expropriation from others. A related view argues that state

ownership is designed to provide employment, subsidies, and other benefits to supporters of the regime. The state's ability to deliver these economic rents is arguably greatest in countries with weak legal and political institutions.

This paper tests these theories by examining why states or private companies owned newly-constructed railroad miles between 1860 and 1912. Ownership was a major policy issue in the railroad sector during this period and was known among contemporaries as 'the railway question.' Initially in the 1860s, private companies financed, constructed, and operated most railroads, while the state usually provided assistance to private companies with interest guarantees, dividend guarantees, and land grants. After 1870, states played a more direct role in financing, constructing, and operating their own railroads. States also nationalized many private railroads to the point that they owned over half of the world's railroad miles by 1913.

In this paper, I use new data to identify private versus state ownership over newly-constructed railroad miles in 35 countries or colonies between 1860 and 1912. I then analyze which factors influenced the likelihood or extent of private ownership by incorporating variables for real G.D.P. per capita, population density, the military capability of neighboring countries, constraints on the executive branch of government, democracy, and the origins of the legal system. I also examine the evidence from three countries, Brazil, Argentina, and Japan in greater detail.

The results from a panel analysis show that after controlling for a variety of factors, private ownership over new railroad miles increased when G.D.P. per capita increased. This finding is consistent with the developmental state hypothesis which suggests that private ownership should increase when economic growth narrows the difference

between the private and social returns from railroads. The results from the panel analysis also show that after controlling for changes in G.D.P. per capita, state ownership over new railroad miles was greater in countries with civil law legal systems compared to countries with common law legal systems. This finding is consistent with a large literature showing that countries with civil law legal systems tend to have greater regulation and more insecure property rights.¹ The results from the panel analysis also show that greater constraints on the executive branch or greater democracy temporarily increased private ownership, but they did not have a significant persistent effect on private ownership. Thus there is stronger evidence that state ownership was more common in countries where legal institutions did not provide a credible commitment to protect property rights. This conclusion is also supported by more detailed evidence from Japan.

The findings relate to the historical literature examining state ownership of infrastructure in the late 19th and early 20th century. The result that state ownership was higher in poor countries supports Alexander Gerschenkron's (1962) famous conjecture that states responded to 'backwardness' by intervening more in the economy. This view is also supported by the evidence from Brazil which shows that the state built several railroads with developmental benefits. Conversely, the evidence from Argentina shows that in a setting where economic growth was high, private companies were willing to invest and develop an extensive and efficient railroad network. Overall the evidence suggests that the ownership of new railroads was often selected based on the level of income because it determined the gap between the private and social returns.

¹ For the literature on legal origins see La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1997); Djankov, La Porta, Lopez-de-Silanes, and Shleifer, and Vishny (2002); La Porta, Lopez-de-Silanes, Pop-Eleches, Shleifer (2002); and Mahoney (2003).

The findings also build on a large empirical literature examining the role of political and legal institutions in determining private versus state ownership since 1960. The empirical literature generally finds that countries with greater democracy and stronger political checks and balances have more private ownership, and that countries with lower democracy and weaker checks and balances have more state ownership (see Bortolotti *et al.*, 2003; La Porta *et al.*, 2002; Keefer and Knack, 2007; Blanc-Brude and Jensen, 2006; Gosh Banerjee *et al.* 2006). This paper extends this literature in two ways. First, it checks the consistency of the findings for the post-1960 era with cross-country data on the most important transportation investments between 1860 and 1912. The main conclusion is that legal origins influenced state ownership both in the past and today. Second, most studies using post-1960 data cannot control for unobserved heterogeneity using country-fixed effects because variables for political and legal institutions are essentially constant. In my case, however, I observe countries before and after political changes that reduced the powers of the executive vis-à-vis the legislature or expanded the suffrage. The results show that after incorporating country fixed effects there is weak evidence that greater checks and balances or democracy persistently increased private ownership.

The paper is organized as follows. Section 2 introduces the data on state and private ownership. Section 3 discusses the main hypotheses and the data sources for explanatory variables. Section 4 presents the estimation results. Section 5 examines the evidence from Brazil, Argentina, and Japan. Section 6 concludes and discusses the implications.

2. An Overview of State and Private Ownership of Railroads: 1860-1912

Most of the literature on railroad ownership has relied on qualitative information regarding the degree of private vs. state ownership. This study is the first to assemble and use data on the number of miles owned by companies and the state across countries between 1860 and 1912.² Much of the cross-country data on ownership comes from *The Statistical Abstract for the Principal and Other Foreign Countries* and *The Statistical Abstract for the Several Colonial and other Possessions of the United Kingdom*, both of which were published by the British Board of Trade annually between 1874 and 1913. For some countries, the *Statistical Abstracts* do not distinguish between miles owned by companies and the state. I use several additional sources to identify the ownership of railroads in such cases. For example, the *Estadística de los Ferrocarriles en Explotación* reports ownership data for all railroads in Argentina before 1913. In many cases, it was straightforward to fill the gaps by identifying state-owned and operated lines and privately-owned and operated lines. When track miles were state-owned, but privately-operated, I chose to assign miles to the state because it retained control over extensions to the network, and it was the ultimate residual claimant.

Elsewhere I document the world-wide trends in the number of railroad miles owned by companies or the state from 1860 to 1912 (Bogart, 2007). The analysis shows that in 1860 companies owned more than 70 percent of all railroad miles, and by 1910 they owned just over 40 percent. The decrease in private ownership was driven by three factors: states constructed more railroads, states nationalized more railroads previously owned by companies, and privatizations of state-owned railroads remained relatively rare. This paper focuses on why states or private companies owned newly-constructed

² Millward (2005) analyzes cross-section data on railroad ownership in 1913 but does not have information on the change over time.

railroad miles. The aim is to identify why states or companies constructed more of the network in some countries or time periods.

I cannot directly infer the number of miles initially owned by companies or the state in year t from the number of miles owned by companies or the state in year t because some miles were nationalized or privatized in previous years. One way around this problem is to simply add miles nationalized and subtract miles privatized from the total miles owned by companies in any year. Similarly I can add miles privatized and subtract miles nationalized from the total owned by the state in any year. Unfortunately, the *Statistical Abstracts* and other sources give only partial information on miles nationalized and privatized, and so it is necessary to use estimates.

Building on another paper (Bogart, 2007), I assume that the number of miles nationalized between year $t-1$ and t equals the absolute decrease in miles owned by private companies between year $t-1$ and t and the number of miles privatized in t equals the absolute decrease in miles owned by the state between $t-1$ and t . An example illustrates the calculations. The data show that in Russia between 1894 and 1895 privately-owned railroad miles decreased from 9480 to 8421 and state-owned miles increased from 11,218 to 13,527. It is implausible that private companies shut down 1059 miles of track between 1894 and 1895, while the Russian state completed more than 2309 miles of track. Instead it is more likely that the state nationalized around 1059 miles and completed around 1250 new state-owned miles. Similar calculations for Russia in the years between 1888 and 1895 show that approximately 5885 railroad miles were nationalized by 1895 and no miles were privatized. Therefore, I subtract 5885 from

13,527 to estimate the number of railroad miles initially-owned by the state in 1895. I also add 5885 to 8421 to estimate miles initially owned by companies by 1895.

The preceding calculations introduce some measurement error into the data of miles initially-owned by companies and the state. On the whole, the errors are likely to be small and should not dramatically affect the conclusions. Later I also discuss how my estimation procedure addresses these problems.

Figure 1 plots the average fraction of miles initially owned by companies between 1870 and 1910 across the countries in my data. The figures are weighted averages with the weights corresponding to the size of the network. The data show that companies initially owned around 70 percent of total railroad miles constructed by 1870. Afterwards the fraction decreased and by 1900 private companies initially owned just under 50 percent of the miles constructed.

Table 1 shows the fraction of miles initially-owned by private companies across the countries in my sample from 1860 to 1910. I grouped countries into five categories to clarify the patterns. In countries under the label “private throughout,” companies owned the vast majority of new railroad miles between 1860 and 1910. They include the U.K., Spain, France, the U.S., Uruguay, Turkey, Switzerland, Greece, Mexico, and Canada. In the U.K., private companies obtained the authority to build railroads through private acts of Parliament. The acts gave companies rights of way, set maximum freight rates, and determined capitalization. A similar procedure was used in the U.S. during the mid-nineteenth century, except that state governments gave private companies authorization to build railroads. Later the U.S. federal government gave land grants to transcontinental railroads, like the Union Pacific. Public subsidies were common in many other countries

where private ownership was predominant, although in most cases the state guaranteed dividends or interest payments on bonds. The aim of most guarantee policies was to attract foreign investment, particularly from Great Britain (Eichengreen, 1994).

Countries under the “state or mixed” label had high levels of state ownership from the beginning of their railroad construction up to 1912. The most extreme case was Egypt, which never had a privately-owned railroad. Serbia had some private ownership in the early 1900s, but the vast majority of its miles were state-owned from the beginning. Australia and New Zealand were also cases where state ownership predominated from the beginning. Their policies were different from Canada, which shared a similar colonial status and economic environment. Chile was unique in that around half of all railroads were initially owned by the state between 1875 and 1912. Private ownership predominated in the north near the mining industry, while state ownership was common in the south where agriculture was the dominant sector (Splawn, 1928).

Many countries moved to state ownership after an initial period of private ownership. I label this group “private then state.” Italy provides one example. In 1860 all railroads in Italy were privately-owned, but starting in the 1870s the state began constructing new railroads. This trend continued up to 1900 when only 55 percent of the miles were initially owned by companies.

China is one of the few countries that began with state ownership and then switched to greater private ownership. The Chinese government owned most lines prior to the first war with Japan in 1894-95. In the next decade, the Chinese government entered into agreements with Russian, French, German, and British investors who built over 1000 miles of privately-owned railroads (Splawn, 1928). The result was a mixed system,

where companies initially owned 35 percent of the miles in 1910. In Japan, the state owned the first railroad lines before private ownership increased dramatically in the 1880s and 1890s. Afterwards there was a shift back to greater state ownership.

Argentina followed a different path. Greater private ownership was replaced by greater state ownership in the 1870s. This was followed by a move to greater private ownership during the 1880s and 1890s (Lewis, 1983). Denmark had a similar pattern.

3. Explaining State versus Private Ownership: Hypotheses and Data

What explains why private companies or states owned more new railroads in some countries or time periods than others? The developmental-state hypothesis argues that state ownership should have been more common in poor countries because the social returns from railroads exceeded the private returns by a wide-margin. This argument has deep intellectual roots and was especially prominent in the work of Alexander Gerschenkron (1962). In the case of railroads, state intervention is viewed as being necessary because transportation infrastructure generates economic development benefits. David Bannister and Joseph Berechman (2000) argue that transportation investments can contribute to development by enabling firms to exploit scale and agglomeration economies, by increasing their efficiency through market expansion and competition, by better utilization of inputs, by linking disconnected markets, and by making firms more receptive to innovation (p. 134). The important point for my analysis is that these effects are not fully internalized by the companies which provide infrastructure. To see how the social returns might diverge from the private returns, it is useful to briefly examine the gains from market integration, which were partly due to the lower transport costs

engendered by railroads in the 19th century.³ Greater market integration raised productivity by encouraging specialization along the lines of comparative advantage. It also contributed to the concentration of economic activity in urban areas, which further raises productivity due to agglomeration effects. The rise in productivity will increase demand for railroad services, and thus add to profits. However, railroad companies may not reap enough of these gains to justify investment. The large fixed costs associated with railroad construction imply that companies need a minimal level of revenue to ensure profitability. If the expected revenues from railroads are too low, companies will not invest and the benefits from market integration will be lost.

Consider figure 2 which illustrates the cost and demand conditions for a monopolist railroad company that is considering whether to invest. For the demand curve, d , the company will lose money because the price is below average cost. Anticipating these losses, the company will choose not to invest. However, the social benefits in terms of market integration may be sufficiently large that the railroad should be built from an efficiency point a view.

A divergence between the private and social returns from railroads can occur in many contexts, but there are reasons to believe that it is more significant in poor countries. Lower income leads to a lower demand for railroad services, and as a result lower private returns for railroad companies. The social returns to railroads also decrease with income but they will be less sensitive to such changes. One reason has to do with economies of scale. Consider figure 2 again. If income per person decreased then the demand curve

³ Many scholars have cited the narrowing of wheat prices between markets as evidence that railroads contributed to market integration in the 19th century (O'Rourke and Williamson, 1999). Recent research by David Jacks (2005) has questioned this conclusion, but still it is clear that railroads made at least some contribution to market integration.

for a monopolist railroad might shift leftward from d' to d and the railroad investment becomes unprofitable. As a result, the private incentives for investment decrease significantly with income, but the social returns change relatively little.

Poor countries might also experience a greater divergence between the private and social returns because the 'gestation period' is longer. Lower transport costs from railroads create incentives for innovation and investment, which in turn increase railroad profits through higher traffic. If firms respond to these incentives more slowly in poor countries, perhaps because of a scarcity of entrepreneurial talent, then it will take longer for railroads to realize the gains. Therefore a company with a short-term planning horizon will build fewer railroads, but the state might be willing to build more, especially if it has a longer planning horizon.

The preceding analysis provides an analytical basis for the argument that the state could improve social welfare in poor countries by investing in railroads. The developmental-state hypothesis suggests that states in poor countries recognized there was a divergence between private and social returns and responded by building and owning more railroads. The corollary of this argument is that private companies will want to build and own more railroads in rich countries because the private returns are higher. Moreover, the state will allow companies to own railroads in rich countries, because it can then cut taxes or devote its resources to other sectors with high social returns.

The theory of incomplete contracts provides another argument as to why the state will defer railroad ownership to private companies in rich countries. The theory predicts that investment incentives will be most efficient when projects are owned by 'crucial'

individuals because they can appropriate more of the returns from their investments.⁴

Construction managers were crucial for the success of railroads because they had to build lines in difficult terrain and keep costs to a minimum. Financiers were also crucial because they had to convince investors to purchase new railroad bonds or shares. Therefore, when the potential to earn profits was high, states should have permitted private individuals, like construction managers and financiers, to own railroads because it increased efficiency.

Another framework which can explain why private companies or states owned new railroads focuses on the security of private property rights. Brian Levy and Pablo Spiller (1996) have applied this framework to modern telecommunications, arguing that private ownership and investment will be minimal without a credible commitment to protect the property rights of providers.⁵ These arguments also apply to railroads in the 19th century. Railroad construction involved large sunk investments which could be expropriated by a wide range of actors. Perhaps the most severe threat was expropriation by the state. Between 1870 and 1910 states nationalized a total 50,000 miles, which represented approximately 10 percent of the miles constructed by 1910 (Bogart, 2007). Most companies were compensated by the state, but they did not always receive the market value of their assets.⁶ The state might also change regulatory rules in a manner which

⁴ The theory of incomplete contracts focuses on projects where owners and employees make non-contractible, relationship-specific investments. In the standard model, ownership gives an individual the right to claim the surplus from the project in the event that all parties are unable to negotiate a division of the surplus after investments are made. In other words, ownership makes an individual the residual claimant over the profits from a project. The theory suggests that the joint surplus of all investors is greater when the project is owned by the individual whose investments have the highest marginal effect on profitability at all investment levels. See Grossman and Hart (1986); Hart and Moore (1990).

⁵ For similar work on 19th century telecommunications see Wallsten (2005).

⁶ For example, Michelli (1898) discusses the initial offer made by the Swiss Federal Council to purchase private railroads following the passage of the Nationalization law. He shows that the initial offer was well

transfers the surplus to other groups. For instance, the state might promise that private railroads can charge customers certain fees, only to reduce those fees once the investments have been made. The state might also promise restrictions on competition from other railroads, only to allow other companies to enter at a later date.

The implication of this analysis is that private companies are less likely to build and own railroads if there is little commitment to protect their property rights. In such cases, the state may be the only entity which is willing to construct and own railroads because it is difficult to expropriate from the state. One testable implication of this argument is that private ownership should be greater in countries where political institutions limited the power of the executive branch. Presidents, prime ministers, or monarchs had strong incentives to nationalize railroads in the 19th century because they could extract rents through the direct provision of railroad services. This strategy proved to be extremely effective for Prussia, which earned substantial revenues from nationalized railroads (Fremdling, 1980). Central government leaders might find it more difficult to expropriate private railroads if there were checks and balances. For example, if the legislature was independent then the executive would have to expend effort and resources to convince legislators to nationalize railroads. As a result, private companies would recognize that the potential for expropriation was lower, and they would be more willing to build and own railroads.

A related hypothesis suggests that the legal system can influence the security of property rights, and therefore, whether private companies or the state construct more railroads. Legal systems are usually defined by their codes, modes of thought, and

below the market value of their shares on the eve of the nationalization announcement. He suggests that the Federal council was trying to use its political authority to impose a low takeover price.

ideologies. Several scholars have argued that there is a greater capacity for the executive or the legislature to interfere in the judiciary in civil law legal systems compared to common law systems (Mahoney, 2001; La Porta et al. 2004). This argument would imply that state ownership should be greater in civil law countries because courts provided fewer checks on state expropriation. Rafael La Porta, Florencio Lopez-de-Silanes, Andrei Shleifer, and Robert Vishny (1997) also argue that in civil law countries investors had fewer protections against opportunism by private actors. For instance, the courts might make it difficult for shareholders to sue railroad managers for damages if they engaged in malfeasance, or they could make it difficult for creditors to seize assets if the railroad went bankrupt. If so, then private companies would have difficulties obtaining financing, and they would build fewer railroads. Of course, the state might also face difficulties in obtaining financing, and therefore, state-ownership would be more common in civil law countries only if companies were less effective in accessing capital markets relative to the state.

Another explanation for state ownership focuses on government excess. Most politicians, from heads of state to legislators to mayors, can gain from state ownership because it allows them to deliver economic rents to their supporters. In return, supporters provide votes, political contributions, and bribes which enrich the politician or help maintain their power (Shleifer, 1998). State-owned railroads would seem to be an excellent vehicle for delivering rents to supporters because they provided employment to a large work force and they delivered localized benefits to constituencies. La Porta, Lopez-de-Silanes, and Shleifer (2007) hypothesize that differences in laws, tools, and attitudes make civil law countries more prone to the ‘social-control’ of economic

activities than common law countries. This argument suggests that it would have been easier for states to deliver rents to supporters by building and owning state-owned railroads in countries with civil law systems. A similar argument suggests that it may have been easier for states to deliver rents through state ownership when political checks and balances were weak.

3.1 Data

To test the main implications of the developmental state hypothesis it is necessary to have data on real G.D.P. per capita. Fortunately, there has been substantial research in recent years measuring real G.D.P. across countries between 1860 and 1913. Angus Maddison (2004) reports estimates for many countries or colonies in 1870, 1890, 1900, 1910, and 1913. For many, Maddison also reports annual estimates beginning in the 1860s and 1870s. I use his figures for real G.D.P. per capita whenever they are provided. In the case of Russia, Hungary, Argentina, Turkey, and Egypt, I also incorporate real G.D.P. per capita estimates by other scholars for years when Maddison does not provide the data. The sources are described in the appendix.

There are several indices in the literature which measure limits on the power of the executive and democracy. The PolityIV index for “constraints-on-the-executive” quantifies whether a country has effective checks on the authority of central government leaders, such as the monarch, emperor, or president.⁷ The lowest value of 1 implies there are no checks on the executive (i.e. China before 1910). The highest value of 7 implies

⁷ See the Polity IV webpage for more details, <http://www.cidcm.umd.edu/inscr/polity/>. Polity IV classifies political institutions in some colonies but not all. There are no indicators for Egypt before 1922, India before 1950, or Australia before 1901. Rather than drop these colonies, I assumed that Australia’s political institutions were constant from 1870 to 1901 and that Egypt’s and India’s institutions were constant between 1870 and 1912. The choice of the level of institutions has no effect on the later results because of country fixed effects which control for time-invariant unobservable characteristics.

that the executive is strongly limited (i.e. Japan after 1868). The “polity2” variable is an index for the degree of democracy versus autocracy. The lowest value of -10 corresponds to complete autocracy (i.e. Russia before 1904), and the highest value of 10 corresponds to the greatest degree of democracy (i.e. the U.S. after 1871).

It is important to note that the indices for constraints on the executive and democracy are highly correlated.⁸ Therefore in the regressions below I include constraints on the executive or democracy, but not both. Another important feature of these variables is their variation within countries. Several countries experienced political changes reducing the powers of the executive vis-à-vis the legislature or expanding the suffrage. As a result, there was a shift towards higher constraints on executive authority and greater democracy in some countries, but in others there was little change or even a reduction.

La Porta, Lopez-de-Silanes, and Schleifer (2007) provide data on legal origins in most countries. They distinguish between common law, French civil law, German civil law, and Scandinavian civil law, noting that French civil law and German civil law are more derivative of Roman law. I use their classifications to identify countries with common law and Scandinavian civil law systems.⁹ There are some problems in using their classifications of French and German civil law countries in the early 20th century because the distinctions were not so sharp (Sherman, 1922). Therefore, I group together all French and German civil law countries.¹⁰ One of the limitations in using the dummies for legal origins is that they are constant for most countries between 1860 and 1912.

Most legal systems were transplanted (in part or whole) through colonization and the

⁸ In my sample, the correlation coefficient between constraints on the executive and democracy is 0.85.

⁹ The common law countries in my data include the U.K., U.S., India, Canada, New Zealand, and Australia. The Scandinavian civil law countries include Finland, Norway, Sweden, and Denmark.

¹⁰ The French and German civil law countries are Russia, Holland, Belgium, France, Portugal, Spain, Italy, Austria, Hungary, Egypt, Japan, Mexico, Chile, Brazil, Uruguay, Argentina, and Germany.

military conquests of Napoleon in the early 19th century. With the exception of Japan, no country adopted a legal system with a different origin before 1913.

I also incorporate data on other factors which might influence ownership. One possibility is that state ownership was greater in countries where the threat of military invasion was higher (Millward, 2005; Bogart, 2007). I measure the severity of external military threats using data on the military capability of neighboring countries in the Correlates of War database (see Singer, Bremer, and Stuckey, 1972; Singer, 1987; Sarkees, 2000). It includes an average of six indicators: military expenditure, military personnel, energy consumption, iron and steel production, urban population, and total population. The military capability of neighboring countries is defined as the population-weighted average of the military capability index among contiguous countries, which are also identified in the Correlates of War database.¹¹

Another possibility is that higher population density increases private ownership because the private returns from railroads are higher when the demand for services is spatially concentrated. On the other hand, higher population density might be correlated with higher transaction costs associated with purchasing property in urbanized areas. This would tend to favor state ownership because companies will find it more difficult to negotiate with property-owners over rights-of-way. To address these possibilities I incorporate population density into the analysis using data on population and land area in Maddison and the *Statistical Abstracts*.

¹¹ There is no military capability data for Australia and New Zealand which were British colonies. This is problematic because they are the only neighbors to one another. I assumed that the military capability was constant for both countries.

Lastly, the analysis incorporates data on government bond yields, price indices, and exchange rates from the sources in *Global Financial Data*.¹² I use the difference between yields on British government bonds and the consumer price index in Great Britain as a proxy for real interest rates in the world economy. The rationale is that Great Britain had substantial foreign investment in railroads before 1913 and therefore its interest rates might influence ownership in all countries. I also use the spread between yields on government bonds in a country and yields on British government bonds as a proxy for country risk, and more specifically sovereign credit risk. Finally, I use the log difference in exchange rates to allow for the effects of currency depreciations on ownership.

4. Results

This section analyzes which factors influenced whether the state or private companies owned more new railroad miles. I begin by examining the relationship between the fraction of total railroad miles initially-owned by private companies in 1910 and several variables. The regression in column 1 of table 2 shows that higher real G.D.P. per capita in 1870 and a higher growth in real G.D.P. per capita between 1870 and 1910 are correlated with a higher fraction of total miles initially-owned by companies in 1910. The regression in columns 2 and 3 show that higher average constraints on the executive and higher average democracy between 1870 and 1910 are also correlated with a higher fraction of total miles initially-owned by companies in 1910. In column 4 the results show that the state initially owned more miles in Scandinavian civil law countries than common law countries, but the reverse was true when comparing French/German civil

¹² See <http://www.globalfinancialdata.com> for more details.

law countries with common law countries. Most of these correlations are consistent with the hypotheses discussed earlier, but none of them is statistically significant.

The findings are generally similar when all the variables are combined in a single multivariate regression along with controls for population density and the military capability of neighboring countries. The estimates in columns 5 and 6 of table 2 show that higher G.D.P. per capita as well as higher constraints on the executive and democracy are positively related to the fraction of miles initially-owned by private companies after controlling for other factors, but none of them are statistically significant.

The preceding results reveal some basic relationships, but it is difficult to draw firm conclusions because there is unobserved heterogeneity across countries. I can control for some of these unobservable factors by analyzing the evolution of private versus state ownership within countries over time. I begin by analyzing a fixed-effects logit model where the dependent variable equals 1 if companies owned more than half of the new railroad miles completed in a country in each year. There are several advantages to this analysis. First, unobserved heterogeneity can be accounted for by including country fixed effects and dummy variables for each year. Second, there are no assumptions about how the country fixed effects are related to the explanatory variables of interest (Wooldridge, 2002; p. 491). Third, measurement error in the number of new miles completed by companies or the state will matter little because I am assigning countries into two categories based on whether companies or the state completed more new miles in a year. In other words, if I estimate that companies owned 5 percent of the new miles, but they really owned 10 or 20 percent of the new miles, I will still correctly identify the state as owing more new miles than companies.

There are some disadvantages to the fixed effects logit model. First, it is not possible to estimate coefficients for countries where private companies or the state owned more new miles in every year. Second, it is not possible to estimate coefficients for legal origin dummies because they are constant across the sample period. In one specification below I estimate a random effects logit model which incorporates countries with all private or all state ownership, and allows for the estimation of legal origin dummies. However, the random effects model makes the strong assumption that unobserved country effects are uncorrelated with the explanatory variables of interest, and they are distributed as a normal with mean zero and variance σ^2 (Wooldridge, 2002, p.485).

Equation (1) specifies the fixed-effects logit model:

$$prob(y_{it} = 1) = \Lambda(\alpha_i + \delta_t + x_{it-j}\beta) \quad (1)$$

where y_{it} equals 1 if companies owned more than half of the new railroad miles completed in country i and year t . y_{it} equals 0 if the state owned more than half of the new miles completed in country i and year t .¹³ On the right-hand side, α_i is a country fixed effect, δ_t is dummy variable for year t , and x_{it-j} is a vector of explanatory variables dated in year $t-j$. The main specification includes the growth of real G.D.P. per capita in $t-3$ and $t-4$ and the log of G.D.P. per capita in $t-5$. It also includes the difference in constraints on the executive between $t-3$ and $t-4$ and between $t-4$ and $t-5$ as well as the level of constraints on the executive in $t-5$. The variables are dated in $t-3$, $t-4$, and $t-5$ because it usually took three to four years to complete a railroad project and therefore, ownership decisions about railroad miles completed in year t were associated with

¹³ If no new miles were completed then the observation is dropped.

economic and political factors in the years t-3, t-4, and t-5.¹⁴ The specification also allows for temporary as well as persistent effects from higher G.D.P. per capita and constraints on the executive. For example, a positive coefficient on the growth of G.D.P. per capita in t-3 or t-4 would imply that higher G.D.P. per capita temporarily increased the probability of greater private ownership over new miles, while a positive coefficient on the log of G.D.P. per capita in t-5 would imply that higher G.D.P. per capita persistently increased the likelihood of private ownership in the years that followed.

Table 3 reports results for various specifications. According to the estimates, the probability that private companies completed more new railroad miles than the state in year t increased when G.D.P. per capita increased in t-5.¹⁵ This result suggests that higher G.D.P. per capita had a positive persistent effect on private ownership. Moreover, it is consistent with the developmental state hypothesis which suggests that private ownership should increase when economic development narrows the difference between the private and social returns from railroads.

The other main findings are that changes in constraints on the executive in t-3 had a positive and significant effect on the probability of greater private ownership over new miles in t, but there is no effect from higher constraints on the executive in t-5 (see column 1). Similarly, changes in democracy in t-4 had a positive and significant effect on the probability of greater private ownership in t, but higher democracy in t-5 had no significant effect (see column 2). Both of these results suggest that greater checks and balances or greater democracy temporarily encouraged companies to own more new

¹⁴ The lagged timing also minimizes problems with simultaneity; specifically that ownership decisions influenced G.D.P. per capita, constraints on the executive, and democracy.

¹⁵ They also show that higher growth in G.D.P. per capita in t-3 and t-4 increased the probability of greater private ownership in t, although these coefficients are not statistically significant.

railroad miles, but there is no evidence that they resulted in a persistent increase in private ownership.

Column 3 reports estimates after adding more control variables, like population density, the military capability of neighboring countries, the real yield on British government bonds, government bond spreads, and the log difference in exchange rates. The estimates continue to show that the probability of greater private ownership increased when G.D.P. per capita increased. They also show that greater constraints on the executive temporarily increased private ownership over new miles, but again there is no persistent effect.¹⁶ Unreported results from a similar model show that greater democracy in t-5 has a positive effect on the probability of private ownership after including more controls. The coefficient is not statistically significant, but it is very close with a p-value of 0.102. This suggests that after including controls there is some evidence that greater democracy contributed to more private ownership, but it is relatively weak.

Column 4 in table 3 reports the estimates from a random effects logit model after adding dummy variables for French/German civil law countries and Scandinavian civil law countries. Notice that the sample size is now larger because the random effects estimator does not drop countries like the U.S., the U.K., Spain, and Uruguay that had more private ownership in every year. It also includes Egypt which had more state ownership in every year. The main result is that the probability of private ownership was lower in French/German civil law countries as well as Scandinavian civil law countries compared to common law countries. This finding could be interpreted in several ways.

¹⁶ The coefficients for British government bonds, government bond spreads, and the log difference in exchange rates in t-3 and t-4 are not reported. Interestingly, none of these variables were significantly related to the probability of greater private ownership.

One is that private companies built fewer railroad projects in countries where the legal system placed fewer limits on expropriation by the state or other actors. This would be consistent with the argument of La Porta *et al.* (1997) that investor protection is generally stronger in common law countries. Another interpretation is that civil law systems made it easier for states to deliver rents to supporters through state-owned railroads. Below I present some evidence that the adoption of the German civil code in Japan coincided with the creation of regulatory bodies which were more favorable to state ownership.

The other main finding from the random effects model is that greater military capability in neighboring countries decreases the probability of greater private ownership. This suggests that external military threats encouraged states to build more railroads in order to provide protection against the military aggression of their neighbors. The rest of the results are similar to the fixed effects logit model. In particular, higher G.D.P. per capita in t-5 and changes in constraints on the executive in t-3 are positively and significantly associated with the probability of private ownership in year t.

The logit analysis focuses on the extensive margin of the ownership decision. That is, whether more new railroad miles were completed by the state or by private companies. I now consider the intensive margin by examining the fraction of new railroad miles completed by private companies within countries and over time. Equation (2) specifies a linear fixed effects model:

$$y_{it} = \alpha_i + \delta_t + x_{it-j}\beta + \varepsilon_{it} \quad (2)$$

where the dependent variable y_{it} now equals the fraction of newly-completed railroad miles owned by companies in country i and year t . A fraction less than 0.5 implies that more new railroad miles were completed by the state in year t , while a fraction above 0.5

implies that more new railroad miles were completed by companies in year t . The right-hand side variables are the same as before: α_i is a country fixed effect, δ_t is dummy variable for year t , and x_{it-j} is a vector of explanatory variables dated in year $t-j$. Also like before, I estimate four specifications of the model. The first two include variables for G.D.P. per capita, constraints the executive, and democracy. The third adds more control variables and the fourth uses random effects to estimate the coefficients for legal origin dummies.

The results show that a higher fraction of new railroad miles were owned by private companies in t when the log of G.D.P. per capita increased in $t-5$ (see table 4). This finding is consistent with the earlier result that higher G.D.P. per capita had a positive, persistent effect on the probability of private ownership. The estimates also show that greater constraints on the executive and greater democracy temporarily increased the fraction of new railroad miles owned by private companies, but they had no persistent effect.

The results from the random effects specification show that private companies owned a lower fraction of new railroad miles in French/German civil law countries. This finding is consistent with the earlier result that common law countries had a greater probability of private ownership. The main difference with the logit analysis is that greater population density and greater population growth are associated with a lower fraction of new railroad miles owned by companies. These findings suggest that greater spatial concentration of demand did not contribute to greater private ownership. Instead they suggest that other factors were at work. For example, the transaction costs of negotiating

with property owners in dense urban environments may have made state ownership more cost effective than private ownership.

5. Case Study Evidence from Brazil, Argentina, and Japan

The econometric analysis suggests that low economic development contributed to more state construction of railroads and conversely that higher economic development contributed to more private construction of railroads. In this section, I examine this result in light of the literature on railroad ownership in Brazil, Argentina, and Japan. The evidence from these three countries supports the conclusion that economic development had a large impact on ownership. It also suggests that political and legal institutions were influential as well.

5.1 Brazil

The Brazilian case provides an excellent illustration of how the state built more railroads when economic development was low. Like in many European countries, Brazil began by courting investors to establish private railroads, but it faced an additional challenge because it was a poor country and it was far from the London capital market. In order to provide an extra inducement to private companies, the emperor Dom Pedro II and his Council of State, passed a law in 1852 which eliminated import duties on construction materials, granted privileged zones, and guaranteed a 5 percent return on the capital invested (Smith-Duncan 1932, p. 52). Several companies sought concessions under this law, including the *Estrada de Ferro Dom Pedro II*, which had the right to build the first line near Rio de Janeiro. This particular company started construction but quickly it had difficulties obtaining financing. Facing the prospect of an unfinished line

as well as substantial payments on dividend guarantees, the Federal government decided to purchase the railroad in 1865. Later it was renamed the *Central do Brazil* and became the largest state-owned railroad in the country.

During the next 25 years, private companies played a greater role and built around 62 percent of the new miles before 1889. The Brazilian state continued to guarantee a 5 percent return on the capital invested by private companies, and made payments totaling 61 million U.S. dollars by 1887 (Smith-Duncan, p.43). The state also built eight new railroad lines over this period. Several were built because private companies could not obtain capital, and the state wanted to ensure their completion (Smith-Duncan, p.37). Others were state projects from the outset. One of these, the *Estrada de Ferro Sobral*, was built by the federal government to provide relief to the drought-stricken state of Ceara (Smith-Duncan, p.36). Another state constructed railroad, the *Pauo Affonso*, provided trans-shipment around the waterfalls of the Sao Francisco. It was distinctive in that it never earned a profit before 1913 (Smith-Duncan, p.37).

After 1895 the state played a greater role by constructing a higher proportion of the new railroad miles. Figure 3 plots the fraction of new miles owned by private companies in each year from 1870 to 1912 along with G.D.P. per capita in the same years. Between 1870 and 1895 companies owned an average of 67 percent of the new miles constructed, but between 1896 and 1912 they owned a lower average of 47 percent. Slower economic growth appears to be one of the main reasons for the decline in private construction after 1895. G.D.P. per capita was increasing, albeit slowly from 1870 to 1890, but following its peak in 1890 G.D.P. per capita decreased and did not return to its earlier level until

1911. With no growth in per capita income, the demand for railroad services also stagnated, providing few opportunities for profitable investment.

Changes in the political environment were another factor that contributed to state ownership in Brazil. The Empire was abolished in 1889 and replaced by a republic. The immediate effect was a substantial depreciation of the currency in the early 1890s (Duncan-Smith, p. 47). Depreciation was significant because many of the guarantees to private railroads were payable in gold, which was now much more expensive. The Republic initiated a new policy of purchasing private railroads with gold guarantees. It also tried to encourage new companies to accept guarantees payable in *milreis*. This policy worked to some degree but many companies were hesitant about assuming the currency risks, especially since many were expatriating the profits.

One of the assumptions of the developmental state model is that the social returns to railroads are relatively high when income per capita is low. Bill Summerhill (2005) estimates that the marginal social rate of return on railroads in Brazil was between 7 and 9 percent in 1913, which is much higher than similar estimates in more developed countries like the U.S., Britain, and France (Fogel, 1964, Fishlow, 1965, O'Brien, 1983). A 7 to 9 percent return is also higher than the yield on Brazilian government bonds and most other private investments. Thus there is some evidence to suggest that added railroad construction by the state was beneficial for Brazilian development.

5.2 Argentina

Argentina provides an interesting contrast with Brazil because its economy grew more rapidly between 1870 and 1913. Railroad development was also different in that private companies constructed most of the new mileage before 1913. In the early phase,

both private companies and the state constructed railroads in Argentina. The first concession was granted to a private company, the *FC Oeste*, but the company was struggling to raise finances for construction. The provincial government of Buenos Aires purchased the *FC Oeste* in 1861, and completed construction of the route originally granted to the company (Lewis, 1983, p. 9). The national government also played an early role in promoting private foreign investment. Several of the large private railroads, like the Great Southern and the Central, were financed in the 1860s and 1870s with British capital. The state guaranteed investors a 7 percent return on the capital invested. The guarantees were paid to the Great Southern and the Central during their initial years, but very quickly they earned returns above 7 percent and stopped receiving assistance (Lewis, 1983, p. 16, 48).

The high returns of the early railroad companies in Argentina paved the way for the railway mania of the 1880s. The existing companies expanded their networks by building upon their early success. In addition, British foreign investors and their domestic agents began submitting more proposals for new railroads to the Congress. In 1887, the Chamber of Deputies and Senate authorized 4900 new railroad miles which exceeded the total number of miles in operation at that time. Virtually all of these projects carried a guaranteed return of 5 percent (Lewis, 1983, p. 69).

The boom in private railroad promotion was due to many factors, but perhaps the most important was the high level of economic growth in the 1880s. Figure 4 shows the evolution of real G.D.P. per capita and the fraction of new miles owned by private companies in each year from 1875 to 1912. From 1880 to 1890, G.D.P. per capita is estimated to have doubled in Argentina. Growth was driven by technological changes,

like innovations in beef refrigeration on ocean-liners, as well as the railroad-induced expansion of cultivation to more fertile lands. The result was greater opportunities for profitable investment, which private railroads increasingly seized upon. The fraction of new miles completed by companies increased from an average of 0.42 between 1875 and 1883 to an average of 0.73 between 1884 and 1890.

The elimination of political instability was another factor in the expansion of private ownership during the 1880s. In 1880, the national government and the province of Buenos Aires came to a final agreement that the capital would be in Buenos Aires. This marked the end of a long period of political instability and warfare. It also marked the beginning of a three-decade period in which the Presidency was controlled by a small circle of elites who had an interest in perpetuating stability. These political changes likely provided an inducement to private investment in railroads because the risks of military seizure or raids by indigenous groups were now lower. At a basic level, the property rights of railroad companies had become more secure.

The Barings Crisis of 1890 brought an abrupt end to the railroad mania of the 1880s. Foreign investors feared that the Argentine government could not meet its debt obligations, including its guarantees to private railroads. British investors became nervous about the prospects of railroad development in Argentina and many of the concessions awarded to private railroads were cancelled. The Barings Crisis brought an end to the system of dividend guarantees for private railroads (Lewis, 1983, p. 117). It also contributed to the privatization of several state-owned railroads like the *FC Oeste* (Lewis, 1983, p. 131). However, the Barings Crisis did not result in any permanent shift away from the construction of privately-owned railroads. Throughout the 1890s and

1900s private companies built an average of 83 percent of the new miles in each year. The state played a minor role in the construction of new railroads.

Like before, high economic growth was one of the main factors underlying the continuance of private railroad construction. After a brief downturn in the early 1890s, the Argentine economy entered a long expansion fuelled by increases in cultivated acreage as well as the development of new industries in Buenos Aires. The high rate of growth, especially after 1900, contributed to higher profits and dividends for investors in the large British-owned railroads (Lewis, 1983, p.199). These in turn provided an inducement for greater foreign investment, which continued up to 1914 when hostilities in Europe ended the expansion.

Other factors also played a role in the continuance of private railroad construction after 1890. One was the positive feedback from innovations by private railroads themselves. Colin Lewis has argued that private railroads introduced new innovations which reduced operating costs and lowered fares (1983, p. 214). Lower fares contributed to economic growth by increasing the number of cultivated acres, which in turn provided greater opportunities for private railroad investment.

Favorable regulations were another contributing factor. The Argentine state permitted railroad mergers creating regional networks. It also passed legislation in 1907 which established a 3 percent tax on net railroad profits in lieu of all national, provincial, and municipal taxation. Equally important, the 1907 law extended the concessions of all private companies for another 40 years, which reduced uncertainty because the original concessions for several companies were set to expire, at which point the state could easily purchase the assets of companies (Lewis, 1983 pp. 192-195).

5.3 Japan

Japan provides another interesting case study because it shifted to greater state ownership in the 1890s and early 1900s much like Brazil. However, the Japanese economy experienced relatively high growth in this same period, which suggests that its shift to greater state ownership was not driven by lower private returns.

The first railroads in Japan were built by the state in the 1870s because private companies were unable to obtain financing (Ericson, 1996, p. 107). Very quickly, however, the state began to realize that it was unable or unwilling to finance substantial railroad construction. The Cabinet decided to follow the policies of most countries and grant concessions to private companies along with dividend guarantees. Several private companies were formed in the early 1880s to construct railroads. The Nippon railway company was one of the first to begin operations. In 1884, it reported a profit of over 10 percent on its invested capital (Ericson, 1996; p. 115). These high initial profits led to a tremendous demand for private railroad concessions. Between 1885 and 1892 fifty applications were made to the Cabinet for the establishment of companies. Out of these emerged 15 companies which owned 70 percent of the railroad mileage in Japan by 1893 (Ericson, 1996; p. 135).

At least two factors were at work in the rise of privately-owned railroads in Japan. The first factor was the growth of the Japanese economy. Figure 5 shows the evolution of G.D.P. per capita and the fraction of new railroad miles owned by companies in each year between 1880 and 1912. Between 1885 and 1890 when private ownership increased, the average annual growth of G.D.P. per capita was a healthy 3.3 percent. A second factor was the acquiescence of the Japanese state. During the 1880s the Cabinet

wanted to restrict government expenditure to stabilize its finances, but it also wanted more railroads to be constructed. There was a view expressed by the finance minister, Masayoshi Matsukata, that the state should take advantage of the private sectors' interest in constructing railroads. In 1887, he stated that "by far the best policy is to permit construction of the railroads west of Kobe by private companies and to grant them appropriate subsidies."¹⁷ Matsukata's views were not shared by all, including the head of the State Railway Bureau Inoue Masura. He continually advocated state ownership based on a belief that private railroads would not build lines of strategic or social value and would hamper the development of a nationwide network (Ericson, 1996, p. 120).

The financial crisis of 1890 shocked the Japanese economy and brought the issue of railroad ownership into the forefront of debates about economic policy. Many investors blamed the crisis on speculation in railroad, mining, and textile companies. The advocates of state ownership seized upon this opportunity and introduced a bill in the legislature calling for the construction of state-owned lines as well as another bill calling for the nationalization of private railroads. The first bill came to fruition in the Railroad Construction Law of 1892, which provided a new legal, financial, and bureaucratic framework for the construction of state-owned railroads. The nationalization bill was rejected, but it remained on the agenda until 1906 when a broad-scale nationalization law was passed. The railroad construction law of 1892 did not eliminate the construction of privately-owned railroads, but it did mark a turning point. After 1898 there was a gradual shift to greater construction of state-owned railroads (see Figure 4). The low point for private ownership was reached after the nationalization law of 1906, when on average less than 14 percent of the new miles were owned by companies.

¹⁷ Quoted in Ericson (1996), p. 116.

What accounts for the shift to greater state ownership? Lower profitability is unlikely to be the main explanation. Between 1897 and 1906 economic growth averaged 2.2 percent per year, which was lower than the previous period, but still large enough to increase demand for railroad services. Moreover, the average profit rate of five private railroads was 7.4 percent in 1894, which suggests that profitability was high just before the shift to greater state ownership (Ericson, 1996; p. 137).

Changes in the political and legal environment provide an alternative explanation for the shift to greater state ownership. In 1890, the first election was held for Members of the House of Representatives, who along with the House of Peers and the Cabinet were the central political authorities in Japan. Members of the new House of Representatives wanted to direct government spending to their constituencies. As a result, they joined with long-time advocates of state ownership, like the Army and the Railroad Bureau, in pushing for state railroad construction (Ericson, 1996, p. 193-197).

Between 1896 and 1898 Japan also modified its legal structure by adopting a new civil code which was based on the German code, but also incorporated aspects of the French code (Sherman, 1922). One direct effect of the code was to introduce regulations concerning the proportion of the par value of corporate shares that subscribers had to pay at the time the company was established. Previously there were no regulations and companies collected installments from shareholders as the need arose (Ericson, 1996; 123). The new regulation on stock subscriptions is potentially significant because it may have contributed to state ownership by increasing the burdens on shareholders.

The adoption of the new civil code also coincided with a change in the way the Japanese state regulated private railroads. An imperial ordinance of 1892 created the

State Railway Council as part of the railroad construction law. It was modeled after the Prussian Railway Council, which was created at the same time that Prussia nationalized its railroads in the early 1880s. The Prussian council had the legal authority to advise state-owned railroads on the rates they could charge. It was also distinctive in that its members were composed of business groups from throughout the country (Meyer, 1897)

The Japanese State Railway Council had considerably greater authority than the Prussian Council because it had advisory powers over the construction of new private railroads and the regulation of fares charged by private railroads. The Japanese Railway Council also had little representation by business leaders, and instead it was composed of members from various ministries and the legislature (Ericson, 1996, p. 240). The effect of the State Railway Council on private railroads remains the subject of debate, and as yet there is no consensus in the literature. What is clear is that the proportion of new miles owned by companies gradually declined after 1898 despite reasonably high economic growth. One explanation is that the broad regulatory authority of the Council and the lack of representation by business groups provided few assurances that the Council could commit to protect the property rights of private railroads.

6. Conclusion

Why do private companies or the state own infrastructure in some countries or time periods but not in others? The developmental state hypothesis argues that state ownership is more common in poor countries because the private returns diverge from the social returns by a greater extent. Other hypotheses argue that state ownership is more common in countries where there is weaker protection of private property rights or

few limits on government excess. This paper examines these hypotheses using new cross-country data on private and state ownership of new railroad miles between 1860 and 1912. The finding that private companies owned more new railroad miles when real G.D.P. per capita increased is consistent with the developmental state hypothesis. In particular, it suggests that states allowed companies to build railroads when economic growth increased the private returns, and that states built more railroads when economic stagnation decreased the private returns.

There is some evidence that state ownership was symptomatic of insecure property rights and the potential for government excess. The results show that countries with civil law legal systems had greater state ownership than countries with common law legal systems. This is consistent with the general claim that property rights were less secure in civil law countries, or that it was easier for politicians to deliver rents to supporters in civil law countries. The effect of political institutions appears to be more mixed. The results suggest that greater constraints on the executive or greater democracy were associated with greater private ownership, but the relationship is somewhat weak.

To conclude, the results have implications for the current policy debate surrounding private versus state ownership in developing countries. There is a view that states in low to middle income countries should be forced to divest all state-owned enterprises. The findings in this paper suggest this may not be a good policy, especially if there is evidence that state-owned enterprises are contributing to economic development by investing in projects with high social returns. But if there is evidence that a country has weak institutions, then it would be advisable to address those problems first because state ownership alone is unlikely to lift the economy out of poverty.

7. Appendix 1: Data Sources

7.1 Sources for Railroad data

Data on railroad miles owned by companies and the government comes from several sources. I use several reports published by the British Board of Trade. They include *The Statistical Abstract for the Principal and Other Foreign Countries* (various years), *The Statistical Abstract for the Several Colonial and other Possessions of the United Kingdom* (various years), *The Statistical Abstract for British India* (various years), *Report on State Railways, British Possessions and Foreign Countries*, and *Railways, Foreign Countries and British Possessions*. I also use other sources. For Italy, I consulted *Sviluppo delle ferrovie italiane dal 1839 al 31 dicembre 1926* published by the Direzione generale delle ferrovie dello Stato. For Chile, I used additional information from the *Anuario Estadístico de la Republica de Chile* published by Oficina Central de Estadística. For Brazil, I used additional information from *the Ministério da Indústria, Viação e Obras Públicas* (1893-1909) and *Viacao E Obras Publicas* (1909-1914). For Argentina, I used additional information from *Estadística de los Ferrocarriles en Explotacion* published by the Ministerio de Obras Publicas. For China, I used additional information Huenemann, *The Dragon and the Iron Horse*.

7.2 Sources and Methods for real G.D.P. per capita

Angus Maddison provides real G.D.P. per capita estimates in constant 1995 dollars for several countries and British colonies in 1820, 1850, 1860, and every year after 1870. In some cases, however, Maddison provides real G.D.P. for 1870, 1890, and 1913 only. To fill the gaps, I use other sources for annual G.D.P. and convert them into 1995 dollars using Maddison's estimate from 1913. For example, I use Gregory (1982), Schulz (2000)

for Hungary, Yousef (2002) for Egypt, Braun et. al. (2006) for Chile, della Paolera and Taylor (2003) for Argentina, and Koc, Filiztekin, and Pamuk (2006) for Turkey.

7.3 Sources for Population

Whenever possible I used population data from Maddison. However, Maddison's figures did not always apply to boundaries in the 19th century. I supplemented Maddison's figures with Lahmeyer and *the Statistical Abstracts*.

7.4 Sources and Methods for Bond yields, Bond Spreads, and exchange rates

All bond yield and exchange rate data come from the Global Financial Database. To calculate real on British govt. bonds in year t , I subtract the average of the percentage change in the British consumer price index in year t , $t+1$, and $t+2$ from the bond yield in year t . Government bond spreads equal to the yield on government bonds in country i minus the yield on British government bonds. To measure the change in exchange rates, I first calculate the average monthly exchange rate and then calculate the log difference in log of the average between year t and $t-1$.

References

- Argentina, Ministerio de Obras Publicas. *Estadística de los Ferrocarriles en Explotación*. Buenos Aires, 1916.
- Banister, David and Joseph Berechman. *Transport Investment and Economic Development*. London: UCL, 2000.
- Bogart, Dan. "Nationalizations and the Development of Transport Systems: Cross Country Evidence from Railroad Networks: 1860-1912." Working Paper, 2007.
- Bortolotti, Bernardo, Marcella Fantini, and Domenico Siniscalco. "Privatization around the World: Evidence from Panel Data." *Journal of Public Economics* 88 (2003): 305-332.
- Braun, Juan, Ignacio Briones, José Díaz, Rolf Luders, and Gert Wagner. "Economía Chilena 1810-1995: Estadísticas Históricas," P. *Universidad Católica de Chile, Departamento de Economía, Documento de Trabajo # 187*, Chile, 2000.
- Brazil. *Ministério da Indústria, Viação e Obras Públicas*, annual series, 1893-1909, Sao Paulo: Brazil.
- Brazil. *Viação E Obras Publicas*. annual series, 1909-1914, Sao Paulo: Brazil.
- Chile, Oficina Central de Estadística. *Anuario Estadístico de la República de Chile*, Santiago: Soc. Imprenta Y Litografía Universo, 1912.
- Della Paolera, Gerardo and Alan M. Taylor. *A New Economic History of Argentina*. Cambridge: Cambridge University Press, 2003.
- Duncan, Julian Smith. *Public and Private Operation of Railways in Brazil*. New York: AMS Press, 1932.

- Djankov, Simeon, Rafael La Porta, Florencio Lopez-de-Silanes, and Andrei Shleifer. "The Regulation of Entry." *Quarterly Journal of Economics* 117 (2002):1-37.
- Eichengreen, Barry. "Financing Infrastructure in Developing Countries: Lessons from the Railway Age." *The World Bank Research Observer* 10 (1995): 75-91.
- Ericson, Steven J. *The Sound of the Whistle: Railroads and the State in Meiji Japan*. Cambridge: Harvard University Press, 1996.
- Fishlow, Albert. *American Railroads and the Transformation of the Antebellum Economy*. Cambridge: Harvard University Press, 1965.
- Fremdling, Rainer, "Freight Rates and State Budget: the Role of the National Prussian Railways, 1880-1913," *Journal of European Economic History* 9 (1980): 21-39.
- Fogel, Robert. *Railroads and American Economic Growth: Essays in Econometric History*. Baltimore: John Hopkins, 1964.
- Gerschenkron, Alexander. *Economic Backwardness in Historical Perspective*. Cambridge: Belknap Press, 1962.
- Gosh Banerjee, Sudeshna, Jennifer Oetzel, and Rupa Ranganathan. "Private Provision of Infrastructure in Emerging Markets: Do Institutions Matter?" *Development Policy Review* 24 (2006): 175-202.
- Great Britain, Board of Trade. *Statistical Abstract for the Principal and other Foreign Countries in each Year*, annual series, London: HM Stationary.
- Great Britain, Board of Trade. *the Statistical Abstract for the Several Colonial and other Possessions of the United Kingdom*, annual series, London: HM Stationary.
- Great Britain, Board of Trade. *the Statistical Abstract for British India*, annual series, London: HM Stationary.

- Great Britain, Board of Trade. *Report on State Railways (British Possessions and Foreign Countries)*, London: HM Stationary, 1913.
- Great Britain, Board of Trade. *Railways (Foreign Countries and British Possessions)*, London: HM Stationary, 1907.
- Gregory, Paul. *Russian National Income, 1885-1913*. Cambridge: Cambridge University Press, 1982.
- Grossman, Sanford and Oliver Hart. "The Costs and Benefits of Ownership: A theory of Vertical and Lateral Integration." *Journal of Political Economy* 94 (1986): 691-719.
- Gurr, Ted Robert, Monty G. Marshall, and Keith Jagers, The PolityIV Project, available online at <http://www.cidcm.umd.edu/inscr/polity/>.
- Hart, Oliver and John Moore. "Property Rights and the Theory of the Firm" *Journal of Political Economy* 98 (1990): 1119-1158.
- Huenemann, Ralph W. *The Dragon and the Iron Horse: The Economics of Railroads in China, 1876-1937*. Cambridge MA: Harvard University Press.
- Jacks, David. "What Drove 19th Century Commodity Market Integration?" *Explorations in Economic History* 43 (2006): 383-412.
- Jensen, Olivia and Frederic Blanc-Brude. "The Handshake: Why do Governments and Firms Sign Private Sector Participation Deals? Evidence from the Water and Sanitation Sector in Developing Countries." World Bank Working Paper 3937, 2006.
- Italy. Direzione generale delle ferrovie dello Stato. *Sviluppo delle ferrovie italiane dal 1839 al 31 dicembre 1926*, Roma, Tipografia ditta L. Cecchini, 1927.

- Keefer, Philip and Stephen Knack. "Boondoggles, Rent-Seeking, and Political Checks and Balances: Public Investment under Unaccountable Governments." *The Review of Economics and Statistics* 89 (August 2007): 566-572.
- Koc, Sumru Altug, Alpay Filiztekin, and Sevket Pamuk. "Sources of Long-term Economic Growth for Turkey, 1880-2005." Working Paper, 2006.
- La Porta, Rafael, Florencio Lopez-de-Silanes, and Andrei Shleifer. "Government Ownership of Banks." *Journal of Finance* 57 (2002): 265-301.
- La Porta, Rafael, Florencio Lopez-de-Silanes, and Andrei Shleifer. "The Economic Consequences of Legal Origins." Working Paper, 2007.
- La Porta, Rafael, Florencio Lopez-de-Silanes, Christian Pop-Eleches, and Andrei Shleifer. "Judicial Checks and Balances." *Journal of Political Economy* 112 (2004): 445-470.
- La Porta, Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer, Robert Vishny. "Legal Determinants of External Finance." *Journal of Finance* 52 (1997): 1131-1150.
- Lahmeyer, Jan. "Populstat Website," <http://www.library.uu.nl/wesp/populstat/populhome>
- Levy, Brian and Pablo Spiller. *Regulations, Institutions, and Commitment: Comparative Studies of Telecommunications*. Cambridge: Cambridge University Press, 1996.
- Lewis, Colin. *British Railways in Argentina 1857-1914: A case Study in Foreign Investment*. London: Athlone, 1983.
- Maddison, Angus. *The world economy: historical statistics*. Paris: Development Centre, OECD, 2003.
- Mahoney, Paul. "The Common Law and Economic Growth: Hayek Might be Right." *Journal of Legal Studies* 30 (2001): 503-25.

- Meyer, Balthasar. "Railroad Ownership in Germany." *Annals of the American Academy of Political Science* 10 (1897): 399-421.
- Micheli, Horace. "State Purchase of Railways in Switzerland." *Economic Studies* 3 (1898): 356-420.
- Mitchell, B.R. *International Historical Statistics: Africa, Asia, & Oceania, 1750-1988*. New York: MacMillan, 1995.
- Mitchell, B.R. *International Historical Statistics: The Americas, 1750-2000*. New York: Palgrave MacMillan, 2003.
- Mitchell, B.R. *International Historical Statistics: Europe, 1750-1988*. New York, MacMillan, 1992.
- Millward, Robert. *Private and Public Enterprise in Europe: Energy, Telecommunications, and Transport, 1830-1990*. Cambridge: Cambridge University Press, 2005.
- O'Brien, Patrick (eds.), *Railways and the Economic Development of Western Europe, 1830-1914*. MacMillan, St. Anthony's College Oxford, 1983.
- O'Rourke, Kevin, and Jeffrey Williamson. *Globalization and History: The Evolution of a Nineteenth Century Atlantic Economy*. Cambridge: M.I.T. Press, 1999.
- Sarkees, Meredith Reid. "The Correlates of War Data on War: An Update to 1997," *Conflict Management and Peace Science*, 18 (2000): 123-144.
- Schulz, Max-Stephan. "Patterns of Growth and Stagnation in the Late 19th Century Hapsburg Economy," *European Review of Economic History* 4 (2000).
- Sherman, Charles Phineas. *Roman Law in the Modern World*. New Haven: New Haven Law Book Company, 1922.

- Shleifer, Andrei. "State Versus Private Ownership" *Journal of Economic Perspectives* 12 (1998): 133-150.
- Singer, J. David. "Reconstructing the Correlates of War Dataset on Material Capabilities of States, 1816-1985" *International Interactions* 14 (1987): 115-132.
- Singer, J. David, Stuart Bremer, and John Stuckey. "Capability Distribution, Uncertainty, and Major Power War, 1820-1965." in *Peace, War, and Numbers*, edited by Bruce Russett, Beverly Hills: Sage, 1972.
- Splawn, Walter. *Government Ownership and Operation of Railroads*. New York: The MacMillan Company, 1928.
- Summerhill, Bill. "Big Social savings in a Small Laggard Economy: Railroad-Led Growth in Brazil." *Journal of Economic History* 65 (March 2005): 72-102.
- Stinnett, Douglas M., Jaroslav Tir, Philip Schafer, Paul F. Diehl, and Charles Gochman. "The Correlates of War Project Direct Contiguity Data, Version 3." *Conflict Management and Peace Science* 19 (2002): 58-66.
- Wallsten, Scott. "Returning to Victorian Competition, Ownership, and Regulation: an Empirical Study of European Telecommunications at the Turn of the Twentieth Century" *Journal of Economic History* 65 (September 2005): 693-722.
- Wooldridge, Jeffrey. *Econometric Analysis of Cross Section and Panel Data*. Cambridge: M.I.T. Press, 2002.
- Yousef, Tarik. "Egypt's Growth Performance Under Economic Liberalism: A Reassessment with New GDP estimates, 1886-1945." *Review of Income and Wealth* 48 (December 2002): 561-579.

Table 1: The Fraction of Railroad Miles Initially-Owned by Private Companies: 1860-1910

Country	Fraction of Miles Owned by Companies					
	1860	1870	1880	1890	1900	1910
“Private throughout”						
UK	1.00	1.00	1.00	1.00	1.00	1.00
Spain	1.00	1.00	1.00	1.00	1.00	1.00
France	1.00	1.00	0.93	0.89	0.90	0.90
U.S.	1.00	1.00	1.00	1.00	1.00	1.00
Uruguay	1.00	1.00	1.00	1.00	1.00	1.00
Turkey	1.00	1.00	1.00	1.00	1.00	1.00
Switzerland	1.00	1.00	1.00	1.00	1.00	0.94
Greece		1.00	1.00	1.00	1.00	1.00
Mexico		1.00	1.00	1.00	1.00	0.93
Canada			0.84	0.90	0.91	0.93
“State or Mixed throughout”						
Egypt	0.00	0.00	0.00	0.00	0.00	0.00
Belgium	0.57	0.70	0.56	0.52	0.51	0.50
Australia		0.03	0.08	0.06	0.08	0.14
Chile		0.49	0.47	0.61	0.52	0.53
Germany		0.56	0.49	0.41	0.36	0.32
New Zealand			0.00	0.08	0.10	0.09
Serbia				0.00	0.00	0.09
Finland						0.08
“Private Then State”						
Norway	1.00	0.19	0.06	0.04	0.09	0.16
Italy	1.00	0.87	0.78	0.63	0.55	0.55
Brazil	1.00	0.82	0.74	0.73	0.76	0.67
Austria	1.00	1.00	0.93	0.80	0.75	0.69
India	1.00	0.99	0.66	0.44	0.35	0.33
Hungary	1.00	1.00	0.80	0.72	0.76	0.78
Holland	1.00	0.43	0.43	0.48	0.47	0.48
Portugal	1.00	1.00	0.48	0.39	0.32	0.32
Russia		0.90	0.96	0.79	0.62	0.56
Romania		1.00	0.89	0.50	0.40	0.39
Bulgaria		1.00	1.00	1.00	0.21	0.20
“State then Private”						
Sweden	0.50	0.36	0.67	0.68	0.68	0.70
Japan			0.00	0.52	0.76	0.65
Costa Rica			0.00	0.00	0.38	0.60
China				0.00	0.00	0.35
“Private then State then back to Private”						
Argentina	1.00	0.79	0.52	0.66	0.70	0.76
Denmark	1.00	0.35	0.36	0.40	0.53	0.55

Sources: See text.

Table 2: Determinants of the Fraction of Total Railroad Miles Initially owned by Private Companies in 1910

Variable	(1) Coef. (std. err.)	(2) Coef. (std. err.)	(3) Coef. (std. err.)	(4) Coef. (std. err.)	(5) Coef. (std. err.)	(6) Coef. (std. err.)
Average Growth rate, G.D.P. per capita 1870-1910	.117 (.103)				.011 (.097)	-.010 (.099)
Log of G.D.P. per capita 1870	.108 (.101)				.146 (.132)	.138 (.129)
Average Constraints on the executive 1870-1910		.015 (.023)			.027 (.028)	
Average Index for Democracy 1870-1910			0.006 (0.009)			.014 (.011)
Dummy for French/German Civil Law				.027 (.146)	-.015 (.215)	.021 (.217)
Dummy for Scandinavian Civil Law				-.207 (.208)	-.345 (.232)	-.291 (.238)
Average Log Pop. Density 1870-1910					-.061 (.042)	-.066 (.042)
Average Military Capability neighboring countries 1870-1910					.016 (.050)	.033 (.051)
Constant	-.35 (.72)	.548 (.116)	0.62 (0.63)	.580 (.131)*	-.583 (1.028)	-.367 (1.042)
N	34	32	33	35	29	29
R-Square	0.08	0.01	0.01	0.05	0.33	0.35

Notes: * indicates statistical Significance at the 90% level and above.

Table 3: Determinants of the Probability that Private Companies Owned More New Railroad Miles than the State: Panel Logit Estimates

Variables	(1) Coef. (std. err.)	(2) Coef. (std. err.)	(3) Coef. (std. err.)	(4) Coef. (std. err.)
Real G.D.P. per capita Growth in t-3	2.58 (2.44)	2.49 (2.41)	4.66 (2.85)	3.31 (2.77)
Real G.D.P. per capita Growth in t-4	1.66 (2.44)	1.43 (2.38)	3.79 (2.92)	2.70 (2.78)
Log Real G.D.P. per capita in t-5	3.21 (1.12)*	3.17 (1.11)*	4.64 (1.37)*	2.87 (0.36)*
Change in Constraints on Exec. in t-3	0.80 (0.47)*		1.06 (0.53)*	0.84 (0.40)*
Change in Constraints on Exec. in t-4	0.15 (0.46)		0.35 (0.51)	0.18 (0.46)
Constraints on the Executive in t-5	-0.04 (0.16)		0.22 (0.22)	-0.09 (0.06)
Change in Democracy index in t-3		.101 (0.12)		
Change in Democracy index in t-4		0.24 (0.14)*		
Democracy index in t-5		0.08 (0.06)		
Dummy for French/German Civil Law				-1.61 (0.75)*
Dummy for Scandinavian Civil Law				-4.28 (0.92)*
Population Growth in t-3			-4.93 (18.40)	-8.26 (17.66)
Population Growth in t-4			-20.67 (21.29)	-18.93 (19.49)
Log Population Density in t-5			1.30 (2.11)	0.13 (0.13)
Change neighbors' military cap. in t-3			0.61 (2.33)	0.89 (2.19)
Change neighbors' military cap. in t-4			-2.39 (2.14)	-1.80 (1.91)
Neighbors' military cap. in t-5			-1.46 (1.15)	-0.44 (0.16)*
Year Fixed Effects	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	No
Country Random Effects	No	No	No	Yes
Other Controls Included?	No	No	Yes	Yes
Log Likelihood	-270	-277	-223	-302
N	719	759	562	793

Notes: The dependent variable equals 1 if private companies owned more than half of the new miles in country i in year t and 0 otherwise. The other controls include the real yield on British govt. bonds, govt. bond spreads, the log difference in exchange rates in $t-3$ and $t-4$. * indicates statistical significance at the 90% confidence level.

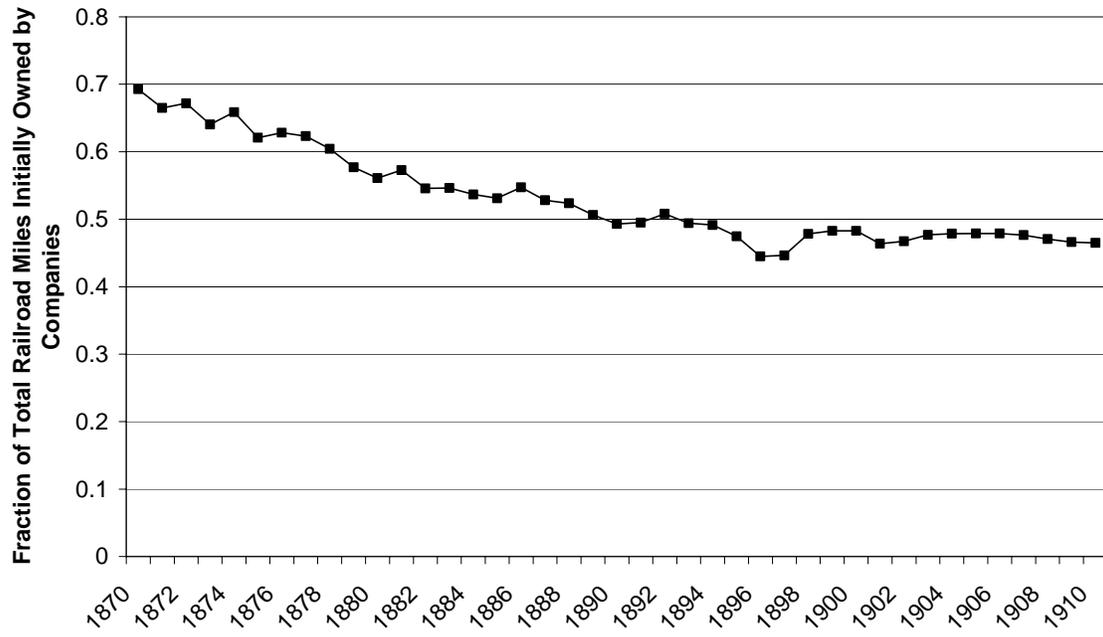
Table 4: Determinants of the Fraction of New Railroad Miles Owned by Private Companies: Panel Estimates

Variables	(1) Coef. (std. err.)	(2) Coef. (std. err.)	(3) Coef. (std. err.)	(4) Coef. (std. err.)
Real G.D.P. per capita Growth in t-3	0.24 (0.21)	0.21 (0.21)	0.41 (0.23)*	0.38 (0.31)
Real G.D.P. per capita Growth in t-4	0.20 (0.22)	0.17 (0.22)	0.42 (0.24)*	0.36 (0.32)
Log Real G.D.P. per capita in t-5	0.21 (0.10)*	0.22 (0.10)*	0.35 (0.12)*	0.21 (0.03)*
Change in Constraints on Exec. in t-3	0.04 (0.02)		0.06 (0.03)*	0.07 (0.04)*
Change in Constraints on Exec. in t-4	0.004 (0.03)		0.03 (0.03)	0.05 (0.04)
Constraints on the Executive in t-5	-0.01 (0.01)		0.01 (0.02)	0.002 (0.008)
Change in Democracy index in t-3		0.01 (0.01)		
Change in Democracy index in t-4		0.02 (0.01)		
Democracy index in t-5		0.01 (0.01)		
Dummy for French/German Civil Law				-0.10 (0.05)*
Dummy for Scandinavian Civil Law				-0.08 (0.05)
Population Growth in t-3			-0.73 (1.47)	-6.06 (1.81)*
Population Growth in t-4			-1.02 (1.54)	-7.71 (1.87)*
Log Population Density in t-5			-0.03 (0.16)	-0.02 (0.01)*
Change neighbors' military cap. in t-3			0.31 (0.21)	0.73 (0.29)*
Change neighbors' military cap. in t-4			-0.12 (0.20)	0.28 (0.27)
Neighbors' military cap. in t-5			-0.09 (0.09)	-0.07 (0.01)*
Year Fixed Effects	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	No
Country Random Effects	No	No	No	Yes
Other Controls Included?	No	No	Yes	Yes
R-Square	0.07	0.07	0.09	0.05
N	894	897	793	793

Notes: The dependent variable equals the fraction of new RR miles completed in country i and year t that were owned by private companies. The other controls include the real yield on British govt. bonds, govt. bond spreads, the log difference in exchange rates in t-3 and t-4. * indicates statistical significance at the 90% confidence level.

Figures

Figure 1: Fraction of Total Railroad miles Initially Owned by Private companies, 1870-1910



Sources: see text.

Figure 2: The production decision for a Railroad Monopolist Facing High and Low Demand

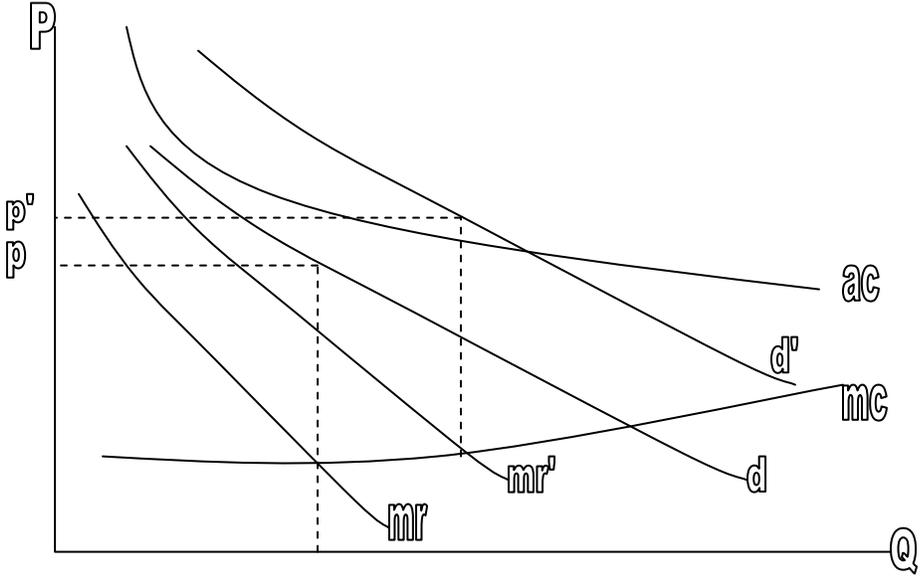
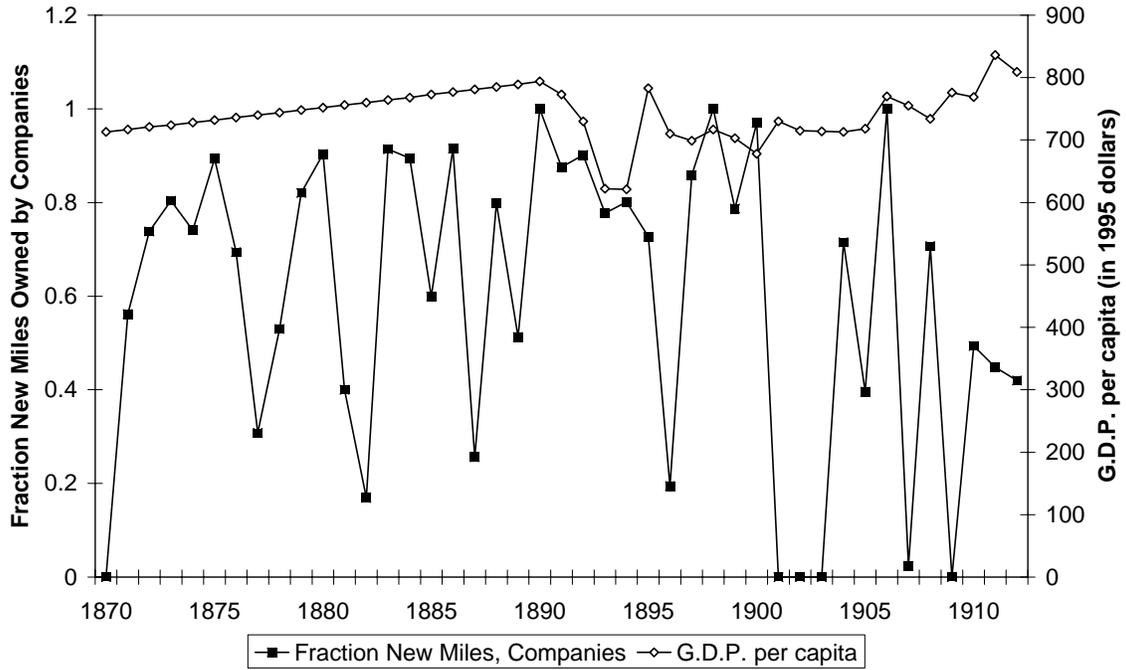
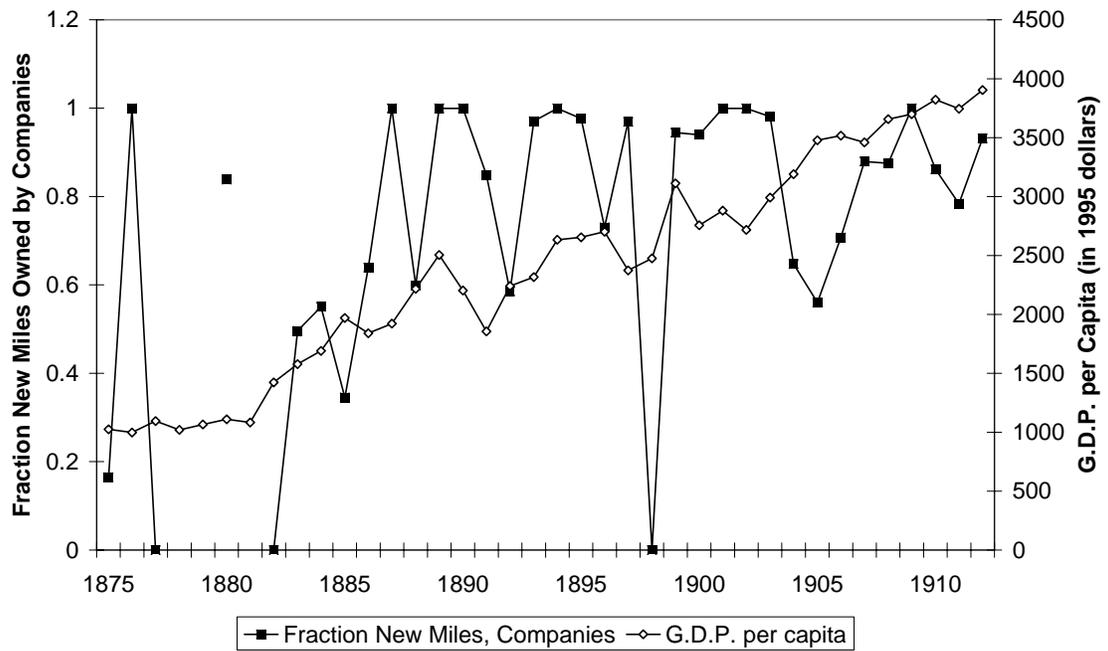


Figure 3: The Evolution of G.D.P. per capita and the Fraction of New Miles Owned by Companies: Brazil 1875-1912



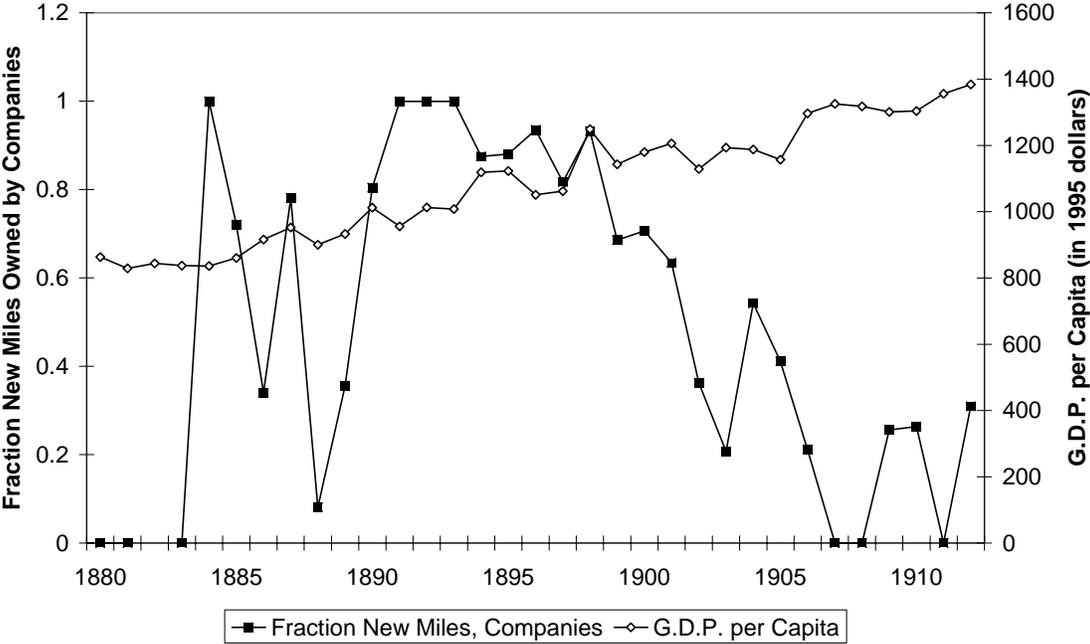
Sources: see text.

Figure 4: The Evolution of G.D.P. per Capita and the Fraction of New Miles Owned by Companies: Argentina 1875-1912



Sources: see text.

Figure 5: The Evolution of G.D.P. per Capita and the Fraction of New Miles Owned by Companies: Japan 1880-1912



Sources: see text.