Regulation, Ownership and Costs:
A Historical Perspective from Indian Railways

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Version: April 2011[‡]

Abstract

This paper provides a historical perspective on the relationship between operational costs and state ownership focusing on the railway network in colonial India. The institutional setting offers a unique natural experiment to identify the effects of state ownership because all the private railway companies were taken over by the colonial Government of India between 1874 and 1912 at predetermined dates set by contracts negotiated in the 1850s. Using a new historical dataset, we find the move to state ownership decreased operating costs by 14 percent within the same railway. The observed cost declines are not driven by anticipation effects, changes in reporting or accounting standards, or long run trends. Rather, the evidence suggests the Government reduced operational costs by cutting labor costs. Our surprising results can be explained by the undemocratic colonial nature of the Government of India, a fiscal system heavily reliant on railways for revenues, and a regulatory environment under private ownership that weakened incentives to lower costs.

Keywords: Nationalization, State Owned Enterprises, India, Railways, Institutions.

JEL codes: D2, D23, H54, L33, N75, O2

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1 Introduction

Infrastructure investments in sectors such as gas, electricity and transportation are critical to economic growth and development. But, such investments are also notoriously difficult to administer, contract and regulate especially in developing economies (Laffont 2005, Estache and Wren-Lewis 2009). Unlike rich countries that can rely on domestic capital markets to finance projects owned either by the public or private sector, developing countries generally have to borrow money on international capital markets or attract foreign capital that is often not forthcoming without an implicit subsidy or guarantee. For many developing countries such investments are not a choice between the public and private sector, rather between a public enterprise and a private enterprise that receives some form of government support. If countries opt for the latter option, they have to worry about the appropriate form of regulation and the balance of public versus private ownership.

The literature has sought to inform the policy making process by examining the effects of ownership and regulatory structures. Several recent theoretical studies analyzing the contractual foundations of public private partnerships in infrastructure emphasize the need for governments to insure risk-averse private providers because of demand uncertainty (for example, Engel, Fischer and Galetovic 2009, 2010). On the other hand, minimum income guarantees and related government inducements may weaken incentives to decrease operating costs and improve efficiency. To date there is relatively little empirical work on the effects of such regulatory policies. There is a more substantial body of research examining the effects of state versus private ownership on firm-level performance. In many cases, however, it is difficult to identify the effects of ownership because of endogeneity concerns (see Megginson and Netter 2001, Djankov and Murrell 2002, and Estrin et al. 2009 for reviews). Some studies have found evidence that the recent wave of privatization in Eastern Europe boosted firm performance (for example, Brown, Earle, and Telegedy 2006), but the broader debate on the efficacy of private ownership is far from settled.

Our paper provides a historical perspective on these issues by empirically studying the transition from private to colonial state ownership of Indian railways from 1874 to 1912. It adds to the literature by exploiting a unique natural experiment where the ownership change was industry-wide and the timing was exogenous to individual firm performance. In the mid-19th century the British Government in London prompted by British merchant houses and railway promoters encouraged railway development in India. It opted for a system of private British owned and operated railways. The concession contracts stipulated a 5 percent dividend guarantee on share capital payable by the colonial Government of India.

In return, the Government was given broad powers to regulate railway companies.

On account of conflicts and decades of disappointing performance, the Government of India began to takeover the former private companies. Because of a clause in the original concession contract, the Government could only takeover private companies on the 25th or 50th anniversary of their contract. The Government exercised the takeover option in every case and by 1910 formed an extensive ownership stake in the railway sector. The takeover process did not eliminate the private sector entirely. Some companies were allowed to retain operations although with more stringent state control and supervision.

Our empirical analysis studies whether this change in ownership influenced working expenses, which capture the cost of delivering railways services for a given level of fixed network investment. Using administrative reports from the Government of India, we construct a new historical dataset on the major railway systems operating in India. The data include detailed information on working expenses, mileage, passenger and goods traffic, fuel prices, accidents, employment and ownership status from 1874 to 1912.

We estimate a variable cost function where the dependent variable is working expenses for a railway system in a given year. Our right hand side includes common variables in a cost function such as output, fixed capital, and input prices along with a dummy for state ownership. The state dummy takes the value 0 under the initial regime where there was majority private ownership with guarantees. It takes the value 1 under the subsequent regime where railways had majority Government of India ownership. We also include railway fixed effects, year fixed effects, and individual railway specific trends to control for unobservable factors trending up or down that may contaminate the estimates on state ownership. Our results show that variable costs declined under Government of India ownership compared to private British ownership. Working expenses were 14 percent lower on average following the ownership change and these changes were not achieved at the expense of poor quality. The frequency of accidental injuries and deaths was unchanged following state takeovers.

Unlike traditional cross-sectional comparisons, our institutional setting mitigates common endogeneity problems. There is no selection bias because the Government took over all the original private companies. In addition, the contractual environment ensured the Government could not endogenously time takeovers to coincide with periods of increasing or decreasing costs. But, private companies could perhaps foresee organizational changes ahead of their contract deadlines and take actions to increase or decrease variable costs in anticipation of a state takeover (i.e., anticipation effects). To investigate such dynamics, we construct a sequence of dummy variables for intervals before and after state takeovers. We find no evidence of a rise in costs either 3 or 5 years before takeovers. We also find no

heterogeneous anticipation effects between early switchers relative to post-1900 switchers where there was less uncertainty about a takeover.

One interpretation of our findings is that the Government of India had hidden costs that were reported under private ownership and not under state ownership. To address such concerns, we examine the dynamics of working expenses by interacting state ownership with dummies for five-year intervals following takeovers. If hidden costs are driving our results, we expect a sharp decline in costs immediately after a state takeover and perhaps a return to trend in subsequent years. But, the big decline in working expenses occurs 11 to 15 years after takeover.

Using information on detailed sub-categories of working expenses and total employment, we show how Government of India ownership achieved the observed cost reductions. The sub-categories under total working expenses include expenses in the traffic, engineering, locomotive, carriage and wagon, and general administrative departments. We observe a general decline across the different sub-categories, but the negative effect of state ownership is large and statistically significant only for the traffic, engineering, and carriage and wagon departments. We draw two conclusions from these results. First, the weak and insignificant relationship between state ownership and general administrative expenses further suggests that accounting changes following takeovers are not driving the findings on state ownership. A number of costs enumerated in this sub-category could presumably be shifted to other state balance sheets. Second, labor costs are a major component of the expenses in the departments for which we observe large cost declines. For example, the traffic department consists almost entirely of wages for station staff and managers. This indicates Government of India ownership likely reduced working expenses by cutting labor costs. We directly test this conjecture by examining the relationship between state ownership and total employment. Controlling for railway and year fixed effects, railway specific trends, and railway capital, we find the total number of railway workers decreased by 22 percent on average following takeovers. Similar to the patterns for working expenses, the declines also continued for a period of 15 years after takeovers.

Greater cost efficiency under state ownership can be explained by the political institutions of colonial India. The Government of India had strong fiscal incentives to minimize costs because railway revenues were a significant source of tax revenues. By 1913, almost 35 percent of total tax revenues came from railways. The undemocratic nature of the Government also ensured that fiscal objectives were not overwhelmed by political considerations. It could avoid the temptation to expand public employment in railways in exchange for votes. We also believe the initial combination of private ownership and regulation produced weak

incentives to cut costs. Dividend guarantees decreased the incentives for shareholders to monitor railway managers because they received a 5 percent return irrespective of operating performance. While we recognize it is difficult to assign causal motives to the mechanisms underlying the Government of India's actions, our emphasis on political institutions and regulation is consistent with the historical literature and the arguments of numerous contemporaries such as Government of India officials.

Our paper relates to several strands in the literature. First, it contributes to the empirical literature on ownership. A number of studies find a negative relationship between firm performance and state ownership. Some of these studies suggest that bloated payrolls and large public sector employment are responsible for the negative relationship (Ramamurti 1997, La Porta and Lopez-de-Silanes 1999, Lauren and Bozec 2001, Dewenter and Malatesta 2001). Unlike this literature, we find positive effects of Government of India ownership driven by lower labor costs. Second, our results highlight the importance of objectives facing public and private actors. Politicians may use public enterprises to promote political objectives such as increasing public sector employment rather than maximizing efficiency (Boycko, Shleifer, and Vishny 1996, Shleifer 1998). But, in our context the Government placed greater weight on the costs to the treasury and hence their objectives were not that different from a private firm. Third, our paper relates to the theoretical literature on public private partnerships, which emphasizes the trade-offs of minimum income guarantees, a common feature of infrastructure contracts (Engel, Fischer and Galetovic 2008, 2010, Iossa and Martimort 2009). Consistent with this literature, we find that minimum income guarantees weaken incentives to lower operating costs. Fourth, our paper contributes to a growing literature on Indian railways (examples of recent works include Donaldson 2010, Andrabi and Kuehlwein 2010).[1] As far as we know, no study has empirically investigated the effects of ownership on railway performance. Our work demonstrates that ownership and regulation had a significant impact on the operational costs of Indian railways.

2 The Indian Railways Context

2.1 Private Railways

The first passenger line in India totaling 20 miles was opened in 1853 and by the early 1900s India had the fourth largest rail network in the world totaling 34,656 miles in 1913 (Government of India 1955). Ten private companies incorporated in Britain constructed

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[1]Other works on Indian railways include McAlpin (1974), Hurd (1975), Adams and West (1979), Derbyshire (2007), Hurd (2007) and Kerr (2007).

and managed the early lines. By 1869 there were two mergers, leaving eight major railway companies, namely the (1) East Indian, (2) Great Indian Peninsula, (3) Eastern Bengal, (4) Bombay, Baroda and Central India, (5) Sind, Punjab and Delhi, (6) Madras, (7) South Indian, and (8) Oudh and Rohilkhand. The eight original private railways formed the trunk lines of the network connecting ports like Calcutta, Madras, Bombay, and Karachi with interior districts (see figure 1 showing the network in 1870). Most of the passenger and freight traffic was carried on these lines well into the 20th century.

Private railways were organized as joint stock companies set up via concession contracts entered into with the Secretary of State for India, a member of the British Cabinet housed in London and vested with formal control over British administration of India. The contracts were enforced and administered by the Government of India headed by the Viceroy General, a colonial agent of the British government appointed by the Secretary of State. More than 90 percent of the company shareholders were British and almost all the capital was raised through equity rather than debt. The shareholders were represented by a board of directors in London, which included the heads of British companies with interests in India, retired members of the British military and other members of the British financial elite (Mukerjee 1994). Railway companies were organized as multi-departmental organizations. An 'agent' resident in India was the general manager and acted as a liaison to the board of directors.

Guarantees were a key feature of the early concession contracts. The Government of India provided a 5 percent guarantee on the capital at a fixed exchange rate of 1s. 10d to the rupee. Net earnings (i.e., gross earnings minus working expenses) were paid into the treasury and rebated to the company. If the net earnings as a proportion of capital outlay yielded less than the guaranteed return of 5 percent in any year, the Government compensated the company the difference up to 5 percent. Such guarantee payments were treated as debt. When annual net earnings exceeded the guaranteed level, the company was required to repay any past guarantee payments by transferring half of their surplus profits over 5 percent to the Government. After all past guarantee payments were paid off, the company received the entire surplus profits.

Similar to India, railway investors in Brazil, France, Russia, and elsewhere also insisted on guarantees (Eichengreen 1995). The Indian experience with guarantees was mixed. The early lines were unprofitable for several decades (i.e., earned less than 5 percent) because traffic developed slowly and revenues were modest. Hence, the Government was forced to honor the 5 percent guarantee to shareholders. Guarantee payments continued after the 1860s and in many cases into the 1900's. For example, the rate of return for companies such as Madras, Oudh and Rohilkhand, and South Indian was 3 percent, well under the 5

percent guarantee. In general private companies averaged a return of 4.8 percent with a few exceptional companies such as the East Indian earning returns over 5 percent.[2]

Contemporaries expressed mixed views about the guarantee system. Some argued that it weakened the company's incentives to limit construction and operational costs (Bell 1894, Sanyal 1930). Government viceroys and officials were among the most vociferous critics in this group. For example, the finance member of the Viceroy's council, S. Laing, contended that guarantees neutralized the advantages of private enterprise because "no adequate motive existed for restraining the outlay on the works" (Bell 1894, p. 65-66). Other observers argued that local capital markets in India were inadequate to support large infrastructure projects. They emphasized the difficulty of raising British capital for a potentially risky Indian infrastructure project without an explicit guarantee noting that attempts to finance private railways without guarantees failed (Bell 1894, p. 73). Proponents of private enterprise also cautioned against Government provision of railways contending that if Indian railways had been constructed on funds raised by a direct Government loan, "it would not in all probability have been half completed by this time, instead of being nearly finished as it is" (Bell 1894, p. 67).

The concession contracts also gave the Government of India regulatory powers over private railway companies. Government officials had the authority to set maximum and minimum freight rates and passenger fares. The Government also had formal control over construction, placement of lines and operation. A Government of India representative, appointed by the Secretary of State, sat on the company boards and in principle had the authority to veto decisions. The Government also appointed a consulting engineer who approved all decisions relating to construction. Although strong in theory, Government representatives often found it difficult to implement their preferred policies. According to Ian Kerr, a leading historian of Indian railways, "the railway companies' men did not want to wait for their operations. In practice, they went ahead, did things, and later told the Government what they had done" (2007, p. 84).

The lack of effective Government control and the weak incentives on account of the guarantees contributed to the poor governance of private companies. Kerr (2007, p. 34) notes that most of the shareholders and the boards of directors were non-resident. Thus, it was difficult for them to control the resident agents. For example, the agent of the Sind, Punjab, and Delhi railway company was accused of incompetence, nepotism and embezzlement. Several of their employees were also eventually prosecuted. Kerr also quotes a Government

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[2]Calculations based on information provided in the *Administration Reports on Railways*. See section 3 for more details on data sources.

of India official who argued in 1869 that the best remedy for operational mistakes, errors, and irregularities was to establish effective control on the part of the Government over the accounts and audits of the guaranteed companies (2007 p. 35).

The Government was not very effective at regulating private railways for two reasons. The first was due to lack of experience. In the 1850s and 1860s, few Government officials in India had any practical knowledge in constructing and operating railways (Sanyal 1930, p. 63). In contrast, the companies had a more experienced and technically sophisticated work force. Second, the subordinate authority of the Government of India to the Secretary of State was another limiting factor. Railway companies could appeal to the Secretary of State if they opposed a policy change initiated by the Government. In the 1860s, for example, the Government pressed for a merger among the private railways in southern India. The Madras railway company refused and was successful in getting the Secretary to defeat the merger (Sanyal 1930).[3] Over the late 19th century both these issues diminished in importance as Government engineers became more experienced and as the Government of India became stronger vis-à-vis the Secretary of State.

2.2 The Transition to Government Ownership of Railways

Due to the disappointing performance of private companies, the initial regime of private ownership with state assistance did not last and was slowly eliminated through clauses in the original concession contracts. These clauses allowed the Government to purchase a majority of the shares in railway companies at predetermined dates, an important institutional feature for our empirical analysis. The Government could only repurchase the companies on the 25th or the 50th anniversary of the original concession contract and the purchase price was based on the mean market value of the company's stock in the preceding three years (Bell 1894, p. 66-72).

The East Indian was the first company whose concession contract reached its 25th year in 1879. As the date approached, it was still unclear whether the Government would exercise its takeover option. After negotiations between the board of directors, the Government, and the Secretary, it was announced that the Government would purchase four-fifths of the shares in the East Indian and a reconstituted company controlling the remaining one-fifth of the shares would manage railway operations under a new concession contract for a minimum of 25 years starting in 1880. The profits would be split between the Government and the

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[3]Another example relates to a proposal by the Government in 1885 to create a 'clearing house' to settle inter-railway disputes and secure unification and simplification of rates and working. It also failed because of opposition from private companies (Sanyal 1930, p. 181).

reconstituted company in proportion to their respective capital shares.

The Government used a similar procedure to purchase all the original private railway companies. A majority were bought on the 25th year of the original contract in 1884, 1886, 1889, and 1891. For the remainder, the Government exercised the purchase option on the 50th year (Great Indian Peninsula in 1900, Bombay, Baroda and Central India in 1906, and Madras in 1908). There was a delay for the last three railways because they renegotiated their contracts with the Secretary of State in 1869.[4] In five cases the Government entered into agreements with directors of the former companies to operate the railways following the takeover. The contract terms were similar to the revised concession contract of the East Indian described above. In the other three cases the Government chose to operate railways directly without company assistance.[5] The colonial Public Works Department managed the lines and made personnel decisions. Surpluses were paid into the treasury and capital was provided through annual appropriations from the Government budget. Guarantees were completely eliminated on these state operated lines. Guarantees were retained on the company operated lines, but they were lowered to 3 or 4 percent and became an insignificant issue because Indian railways began to generate higher returns (above 4 percent on average) beginning in the late 19th century.

In addition to Government takeovers of private companies, the Government of India also constructed new Government owned and operated lines in the 1870s. Government construction was spurred by dissatisfaction with the guarantee system. Lord Lawrence, the Viceroy from 1864 to 1869, believed the Government's borrowing capacity had improved sufficiently for it to build railways directly. One of his main goals was to place the Government of India in a better fiscal position by building revenue-generating railways (Bell 1894). The era of state railway construction, however, was short-lived. The 1870s economic depression coupled with the war in Afghanistan increased the Government's borrowing costs. And, famines in 1877 highlighted the need for a rapid extension of the network, which the Government was unable to achieve. Beginning in the 1880s, any new railway companies were set up as Government owned and privately operated, similar to the five original reconstituted companies taken over by the Government in the 1880's, 1890's and 1900's. The Government owned a majority of the capital and shared surplus profits with the companies in proportion

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[4]As part of the deal the Secretary cleared company debts and voided the Government's right to repurchase at the 25th year of the contract. In return companies had to share half of all surplus net profits (i.e.,above the guarantee) with the Government from that point forward.

[5]After takeovers the Government chose to operate Eastern Bengal, Sind, Punjab and Delhi, and Oudh and Rohilkhand railways, but the precise reasons for managing operations were different in each case. We do not focus on these operational changes because operational choices were likely endogenous. Unlike the timing of changes in ownership, operational switches may be driven by performance.

to their respective capital shares. The public-private partnership model was common up to the 1920s when the Government initiated a series of policy changes leading to the eventual takeover of all railway operations.

The magnitude of Government takeovers can be seen in Figure 2 which plots the fraction of route miles by private and state ownership from 1874 to 1912 in our sample. In the 1870s, private ownership accounted for almost 90 percent of the total mileage falling to just over 10 percent by 1912. A significant portion of this decline was achieved by state takeovers of private companies which comprised almost 30 percent of total mileage by 1912.[6] The remaining 60 percent of Government owned mileage is on account of new construction and extensions to the existing state owned network between 1870 and 1912.

2.3 Operations on Government of India Owned Railways

Following Government takeovers of private companies, there were key organizational and operational changes. First, a number of mergers occurred shortly after takeovers, but most were insignificant in size because they brought large railway lines together with smaller lines. For example, the Great Indian Peninsula railway merged with the Indian Midland railway in 1901. The Indian Midland railway had less than a third of the traffic of the Great Indian Peninsula.

Second, Government control substantially increased over both railways that came under direct state operation and those under company operations (Robertson 1903). Unlike the initial phase of private ownership, the Government now enjoyed greater authority to impose managerial or operational changes without intervention by the Secretary. Moreover, the Government also had greater experience with railway management because of its direct involvement with railway construction and operation beginning in the 1870s. The Government began to organize regular railway conferences, which initially introduced a code of general rules for the working of all lines including agreements for the interchange of rolling stock, a uniform classification of goods, and accounting standards. Subsequent conferences in the 1880s and 1890s tried to assimilate the construction of rolling stock. A special committee met regularly to adopt standards, arrange experiments, and publish research (Bell 1894, p. 114). Eventually a Government railway board was established in the late 1900s exclusively devoted to regulating railways.

Third and most importantly, the Government's financial stake in the railway sector

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[6]The organizational evolution of total route mileage under-estimates the magnitude of state takeovers because the original eight private companies owned important trunk lines and carried the bulk of the goods and passenger traffic. For example, the ton-miles carried by the East Indian represented 45 percent of total goods traffic in 1879 even though route mileage was 17 percent of total mileage at that time.

increased significantly following takeovers. As a majority shareholder of several railway lines, the Government now stood to financially gain if railways successfully cut costs. Figure 3 graphs Government railway revenues as a fraction of total Government revenues (gross) from 1868 to 1913. Although railways contributed a small share to public income in the 1870s, by 1913 almost 35 percent of total tax revenues came from railways.[7] As early as the 1880s increasing railway profits had became a key policy objective for the Government. In support of their position, colonial officials pointed to the unstable exchange rate of the rupee and the precarious position of opium revenues (then an important source of revenue). While officials admitted that the substitution of railway profits for taxation was not ideal, "the practical necessities of the financial situation might oblige them to recognize those profits as a source of income in the immediate future" (quoted in Bell 1894, p. 37). And by the early 1900s, the Government began earning a large surplus with earnings exceeding operating costs and guarantee payments (Sanyal 1930, p. 200).

There are also documented cases where the Government changed labor practices and eliminated redundant labor once it became the majority owner. After the takeover of the Sind, Punjab, and Delhi railway, locomotive workshops were centralized in the city of Lahore. The move eliminated redundancies in the labor force and helped the railway become a center for technology adoption in the region (Kerr 2007, p. 85). In another case, the East Indian railway operated a telegraph on one side of its railway and the Government operated a telegraph on the other side. During negotiations surrounding the takeover, the Government agreed to repair and maintain the companies' telegraph and thus the East Indian railway administration no longer needed a staff for this purpose (Huddleston 1906, p. 76). Whether these are exceptional examples or evidence of a broader pattern of labor savings following takeovers is unclear. Hence, we also study changes in employment before and after takeovers in the empirical analysis.

Did working expenses increase, decrease or stay the same following Government takeovers? The qualitative evidence suggests Government objectives in the Indian context were similar to cost minimizing firms because of the fiscal importance of railways to the colonial Government. Contemporaries of the period and Indian nationalists also criticized the efficiency of private British companies on account of the guarantee system. This would suggest takeovers reduced working expenses. However, a large theoretical and empirical literature has documented the negative effects of state ownership in a variety of contexts. In many countries, governments use state owned enterprises as employment programs and cost minimization is

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[7]Calculations based on total gross public revenues of British India and total public revenues derived from railways. Both series are reported in the *Statistical Abstracts of British India* (1915).

often not a policy objective. Whether the financial objectives of the Government of India combined with its colonial status were sufficient to overcome the traditional problems of state ownership is an empirical question, which we study below using detailed information on Indian railway companies, their costs and employment practices.

3 Data

We create a new dataset of Indian railways from 1874 to 1912 for the econometric analysis using *Administration Reports on the Railways in India* (Director General of Indian Railways), *The Statistical Abstracts of British India* (Board of Trade), and *History of Indian Railways* (Government of India 1947). We use data from the *Administration Reports* published annually from 1882 in conjunction with the *Report to the Secretary of State for India in Council on Railways in India* for the pre-1882 years. The latter report is less detailed, but we obtained information on variables essential to our regressions. We thus begin the analysis in 1874 and end in 1912 shortly before World War 1; a thirty-eight year period when all the former private companies were transferred to Government ownership.

Our data are extracted primarily from the tables titled "General Results of Working of the Principal Indian Railways" reported annually before 1900 and for each half year after 1900. The tables include working expenses, fuel prices, train miles, passenger miles and ton miles (i.e., the number of tons carried one mile).[8] Working expenses measure the operational costs of railways and include the wage bill for train staff and station staff, spending on fuel, spending on maintenance to the track, plant, and equipment. Construction costs and the purchase of new capital goods such as locomotives are included in capital outlay, not working expenses. Working expenses are disaggregated by individual departments including engineering (i.e., maintenance to track and buildings), locomotive, carriage and wagon, traffic, and general administrative plus miscellaneous.[9] Our analysis studies both the total and the detailed working expenses.

To get an exogenous measure of labor costs, we use information on average monthly wages for agricultural workers between 1874 and 1912 reported in *Prices and Wages in India* (Government of India 1896, 1922).[10] For each railway system, we average the wages

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[8]Passenger miles are unreported for state owned railways from 1874 to 1879. We construct this variable by multiplying the number of passengers transported and the average trip length in 1880 for each state owned railway.

[9]Engineering and locomotive expenses are reported uniformly for the entire period, but other categories are reported differently between the pre- and post-1882 reports. To construct consistent categories, we combined the general administrative and miscellaneous categories into a single group and plotted the annual share of each category to ensure we were capturing the same categories over time.

[10]As a robustness check, we also use wages for skilled workers (common mason, carpenter or blacksmith)

across the relevant regions (i.e., provinces) traversed by the railway lines. In a few instances of missing information, we interpolate wages using the nearest year available. Although the wage series are not without problems (Datta 1915), these sources are the only available information on long run wages for British India and have been heavily used by economic historians. We also extract information on the number of injuries and deaths from train accidents. Injuries and deaths are reported separately for passengers and employees, and in our calculations we exclude injuries and deaths that were the fault of the passenger or employee, such as suicides or terrorist acts.

We would ideally like to follow an individual railway line for the entire time period even after it merges with another line. We are, however, unable to code individual lines because of two reporting problems. First, if there is a merger between two lines, we only have data on the new merged line. Second, there is a significant reporting change in 1900: the pre-1900 reports provide data on the "principal standard and metre gauge lines" but after 1900 they report data on the "principal railway system" aggregating the main company or state line with any other secondary lines worked by the same company or state. Although the pre-1900 reports occasionally include secondary lines with primary lines, data on secondary lines are reported separately for several cases. On average, the secondary lines account for less than 10 percent of the total mileage of the system.

To illustrate the problem, consider the case of the East Indian Railway. For the 1880s and 1890s, the East Indian managed the operations of three privately owned lines (Tarakessur from 1885, Delhi-Umballa-Kalka from 1891 and South Behar from 1899). Data on the latter are reported separately before 1900, but beginning in 1900 the East Indian is only reported as one system including the three company lines.

We address the pre- and post-1900 difference by creating a consistent series of the fifteen principal railway systems from 1874 to 1912. The systems account for 90 percent of the total mileage in India. We only focus on the standard and metre gauge lines ignoring the smaller narrow gauge lines for which data are not consistently reported. Since data on the secondary lines are reported separately in other tables of the pre-1900 reports, we merge their information to the primary system managing their operation.[11] We refer to the panel of principal railways as the 'solo' panel because it drops any smaller lines in the years before they merge to a primary system. Merged lines may have differed in unobservable ways, such as their terrain or composition of freight. Therefore, as a robustness check, we also use a

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and the average of skilled and unskilled wages. Our main results for state ownership are unchanged.

[11]Fuel costs are only reported for the principal railway lines and we assume they are equal to the costs faced by the system. Other variables such as working expenses, gross earnings, unit mileage, etc. are reported separately for the main line and other secondary lines.

'joint' panel which sums operational data, like working expenses and capital on merged lines in the years before they merge. Wages and fuel prices for the joint system are defined by the line with the largest mileage prior to merger. Finally, we exclude the four main Native State owned lines from the analysis because of the complicated relationship between Native States and the Government of India.[12]

We code ownership in two ways. First, the dominant railway lines within a system are coded as either private or state owned based on whether shareholders or the Government of India owned a majority of shares.[13] Second, we also code the fraction of miles of each type within the system such as the fraction of state-owned miles. For most railways the fraction of state owned miles is close to 0 or 1 since the dominant railway represented a majority of the system mileage on average.[14] Table 1 reports summary statistics for the main variables used in the analysis.

4 Empirical Strategy

A large empirical literature has examined the effects of ownership, public or private, on different measures of firm performance. Megginson and Netter (2001), Djankov and Murrell (2002) and Estrin et al. (2009) provide excellent empirical reviews of this literature. While early studies relied on cross-sectional comparisons of public and privately owned firms, the more recent literature on the privatization experience in Eastern Europe has adopted stronger identification techniques relying on within firm variation to identify the effects of ownership. Our empirical strategy follows the common reduced-form practices of this literature and our historical setting is akin to a unique natural experiment mitigating problems of omitted variables and selection bias.

We focus on working expenses as our outcome variable because they represent an important performance indicator. Moreover, we have detailed information on the different sub-categories of expenses to uncover the mechanism driving the relationship between ownership and costs. We begin with a Cobb Douglas variable cost function augmented with a dummy for state ownership using the following specification:

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[12]This refers to the Nizam's Guaranteed State Railway, Jodhpore-Bikaner, Udaipur-Chittoor, Bhavnagar-Gondal-Junagarh-Porbander. The only exception is Mysore state railways, which begins the period as a Native State railway but is merged with the Southern Mahratta Railway Company in 1887.

[13]In a few cases, provincial governments and district boards owned public lines. We also code them as state owned.

[14]The fraction variable captures a few Native State lines constructed and managed by private companies or the Government of India, and that are reported along with the data for a primary line. For example, GIPR manages the Amraoti and Khamgaon lines (14 miles total) owned by the Berar State and GIPR data always includes these lines.

$c_{it} = \beta q_{it} + \gamma p_{it} + \delta_t + \alpha_i + \lambda dstateown_{it} + \epsilon_{it}$

where c_{it} is the natural log of working expenses for railway system i in year t, q_{it} is the natural log of ton-miles, passenger-miles, rail miles, locomotives, and vehicles for system i in year t, p_{it} is the log price of average labor and fuel costs for system i in year t, δ_t are year fixed effects, α_i are railway-system fixed effects, and ϵ_{it} is the error term. In this cost function, outputs, fixed capital, and input prices function as the independent variables and working expenses are the dependent variable. Increases in labor and fuel costs should contribute to greater working expenses because they imply higher input prices. Increases in ton-miles and passenger-miles should also contribute to higher working expenses because they imply greater output. Increases in rail miles, locomotives, and vehicles can increase or decrease working expenses depending on the substitution patterns and the utilization of capital.[15]

We include railway system fixed effects to control for any time-invariant unobserved heterogeneity at the railway-system level. Geography and railway gauges are two important sources of heterogeneity. Constructing and operating railway lines in mountainous terrain prone to land slides is perhaps more expensive than operating railways over a flat terrain. Railway gauges are also relevant because metre gauge railways (3 feet 3/8 inches) in India may have had different operating costs than standard gauge railways (5 feet 6 inches). We also include year fixed effects to control for time-varying shocks common to all railways. Our main variable of interest is $dstateown_{it}$: a dummy taking the value 1 in years when the railway system is state owned and 0 when it is privately owned. As the specification includes railway system and year fixed effects, we identify the effects of ownership and regulatory changes from variation within the same railway system over time. If variable costs were lowered as a result then the coefficient on $dstateown_{it}$ would be negative and statistically significant.

While railroad and year FE provide some reassurance against problems of unobservable heterogeneity, individual long run trends within railway companies can also bias the results if costs were declining within some companies as they were taken over by the state. A recent paper by Brown, Earle and Telegedy (2006) offers a solution to this problem in the form of individual firm specific trends. We follow this approach and augment the above equation with individual linear railway trends for each railway system in our dataset. By including such railway specific trends, we are identifying the effects of state ownership from deviations in working expenses within each railway system relative to their individual railway trend

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[15]Several railway studies starting with Caves et. al. (1980) use the Translog functional form, which nests the Cobb Douglas. Our results are robust to using the Translog functional form and hence we focus on the more parsimonious Cobb Douglas form.

before and after the change to state ownership. To further alleviate concerns of long run trends driving the findings on state ownership, we also present robustness checks using the first difference in log costs as a dependent variable.[16]

Our institutional setting mitigates the traditional endogeneity problems of omitted variables, selection bias and unobservable heterogeneity noted in the literature. First, by 1908 the Government had purchased all the private railways established before 1874. Thus, there is no selection problem of the Government taking over the best or worst performing private railways. Second, the Government could not time the switch to state ownership because the year in which the Government purchased private railways was determined far in advance of the purchase date. As discussed in section 2, the initial contracts stipulated the Government's right to purchase the railway at 25 or 50 years from the first year of the contract. Five railways were purchased on the 25th year of their initial contract. Three were purchased on the 50th year of their contract because of the renegotiation with the Secretary in 1869. The 'deal of 1869' was a unique event. There were no further renegotiations of the purchase date, in part because of the Government's protests to the Secretary and Parliament in 1870 (Sanyal 1930, p. 70). Thus for our purposes, the timing of Government takeovers was independent of operating performance in the 1880s, 1890s, and 1900s. Moreover, in our study the change to state ownership is evenly spread over the 38 years. Only two railways, the Bombay, Baroda, and Central India and Madras, switch to state ownership in the last 10 years of the panel.[17]

The predetermination of the purchase date, however, raises the potential for a different type of identification problem: anticipation effects by private companies. Given the company knew in advance the Government was likely to exercise the takeover option, it may have responded by adjusting operational expenses in the years before the takeover. One possibility is company boards, agents, and shareholders exerted less effort in managing or monitoring because they expected unfavorable treatment by the Government when their assets were transferred. A related possibility is private management chose to forgo opportunities that yielded long-term profits after state takeovers. In either of these cases, working expenses would begin to rise before the takeover, continue to rise until the year of the takeover, and then decline.

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[16]There is a concern that coefficient estimates for ton-miles, passenger-miles, track miles, locomotives, and vehicles are biased because these variables may be endogenous. However, the bias should be restricted to these coefficients only. If the timing of the transition to state ownership is exogenous after adding railway fixed effects, year fixed effects, and railway system specific trends, then our estimate on state ownership should be unbiased.

[17]As a robustness check, we ran regressions excluding these two late switches to state ownership. The results were unchanged.

An alternative anticipation response involves private managers and shareholders exerting greater effort because they wanted to increase share prices. The average market value of railway shares over the three years prior to takeover determined the purchase price. Some private companies were also awarded an operational contract after the takeover allowing them to continue working and profiting from the railway. Managers may have exerted greater effort prior to the takeover to convince the Government of their capability in operating the railway.

To study anticipation effects, we rely on the panel nature of our dataset and conduct an event study analysis of the dynamics of working expenses several years before and after ownership changes. Specifically, we interact state ownership with 3-year and 5-year dummies for the immediate years before takeovers. This allows us to test whether costs increased or decreased before state takeovers.

We also use the same framework to examine the long-run evolution of expenses by interacting state ownership with dummies for 0 to 5 years after the state takeover, 6 to 10 years, 11 to 15 years, and 16 years after takeover. There are several possible short-run and long-run effects implying different trajectories for residual working expenses. On the firm side, private companies may have had incentives to report higher costs in their accounts before takeovers than what was actually incurred on account of the guarantees. If that were the case, we may expect a sharp decline in the years immediately following takeover and a return to trend because the Government did not face similar incentives to misreport their costs.

On the Government side, there are two possibilities. First, the colonial Government may have immediately reduced track and locomotive maintenance upon takeover in order to boost railway profits. Lower maintenance expenditures should have reduced working expenses for a period of years, but at some point expenses may have increased as the fixed and rolling capital depreciated, train services were delayed, and accidents increased in frequency. If the effects of lower maintenance were particularly severe, then working expenses would eventually exceed their pre-takeover level. This suggests an initial decline in working expenses followed by a sharp rise after a certain point. Second, the state may have also taken actions to lower costs over the long-run. For example, the Government may have cut high cost workers or eliminated administrative redundancies by relying on the existing administrative set-up for state owned railways. These cases imply a modest decrease in working expenses for a period of years after the takeover, followed by a more rapid decline when the reorganization yielded larger cost savings. Studying the long run dynamics of working expenses in the years following state takeovers allows us to distinguish

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between these alternative hypotheses.

5 Results

5.1 Baseline Results

Table 2 presents our first set of results. Specifications 1 to 5 focus on the dummy variable for state ownership, while specifications 6 and 7 use the fraction of state owned miles within a railway system. Given our long panel and potential concerns of serial correlation, we cluster the standard errors at the railway system in all the regressions.[18] In specification 1 we focus on the solo panel controlling for input costs, output, capital, year and railway fixed effects. Working expenses are 9 percent lower for state owned railways as compared to private railways.

Specification 2 further addresses concerns of omitted variables and unobservable heterogeneity by including individual railway system trends. We still find large and statistically significant effects of state ownership. Working expenses decline by 14 percent relative to trend following a switch to state ownership. Hence, our preferred specification includes railway and year fixed effects, and railway specific individual trends. Unless noted, all the subsequent regressions include them as standard controls. Since some railway systems have longer mileage compared to others, we report results from weighted regressions in specification 3 with total mileage serving as weights. Specifications 4 and 5 focus on the joint panel, which includes secondary lines in a railway system before they merge to the main system and address concerns surrounding mergers at the time of takeovers. Our findings on state ownership are robust to railway specific individual trends, weighting and the joint panel.[19]

Specifications 6 and 7 use the fraction of state owned mileage within a railway system instead of the dummy variable. A 100 percentage point increase in state owned lines reduces operating expenses by 14 to 15 percent relative to trend, similar to the coefficient on the dummy for state ownership. The results are similar because the dominant railway company represented a majority of the mileage within a system.

While Government ownership decreased costs, an obvious concern may be that the cost declines documented in table 2 came at the expense of quality. To test this hypothesis, we use data on accidental injuries and deaths to passengers and employees in table 3. Accidents are

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[18]All our results are robust to using robust standard errors without clustering.

[19]As a robustness check, we also ran regressions focusing only on the switching railway companies and dropping the non-switching companies. The coefficients on state ownership were essentially the same regardless of whether we exploited the between or within variation in this case (i.e.,with and without fixed effects).

a good proxy for quality of service because cutting corners to reduce costs could increase the probability of railway accidents. For example, if lower engineering costs decreased the safety on state owned railways, then accidents could increase. If the Government was lowering expenses by hiring poorly trained but cheaper train drivers, this would also increase the number of accidents.

We test this hypothesis by running regressions of deaths or injuries per unit of output on a dummy for state ownership, log of total mileage, railway fixed effects, year fixed effects, and railway specific trends (specifications 1, 2, 4 and 5). Output is the weighted average of passenger and ton miles. The weights are the respective shares of passenger and goods earnings to total earnings. In addition, we estimate a negative binomial regression with the count of injuries or deaths on the left hand side and log of total mileage as a control on the right hand side (specifications 3 and 6).

The coefficient on state ownership is small in magnitude and statistically indistinguishable from zero across all the specifications. Thus, safety was not sacrificed in order to lower operating expenses. There are, however, other aspects of quality, for example train speeds and overall comfort. Unfortunately, we do not observe such measures over time, but there is no evidence to our knowledge that suggests quality deteriorated along these dimensions following a shift to Government ownership.[20]

5.2 Dynamics of Detailed Working Expenses

The evidence thus far indicates that the change to Government of India ownership led to significant cost declines. In this subsection, we exploit our long panel to study the evolution of working expenses before and after a change to state ownership. Such an event study analysis rules out other potential explanations for our findings like firms anticipating the takeovers and reducing costs in advance of takeovers, systematic accounting or reporting changes correlated with a switch to state ownership, and long run trends biasing the coefficient on state ownership. We address each of these concerns in detail below.

First, to test for anticipation effects, table 4 explores different intervals in the years leading to a takeover.[21] Specification 1 includes dummies for years -5 to -1 before takeover.

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[20]Train speeds and comfort were discussed by Thomas Robertson (1903) in the first extensive survey of Indian railways. Roberston (pp. 57-60) states that train speeds for passengers and goods traffic were generally lower in India than the United States, but he does not describe a slowing of speeds following Government takeovers. Robertson (p. 61) also notes that inadequate space is provided for third class passengers, but again there is no discussion of deterioration in comfort following takeovers.

[21]We believe the solo panel is more appropriate for this analysis because anticipation effects by private companies could be mis-measured in the joint panel that artificially joins lines before they actually merge. Our results are essentially robust to the choice of panel (solo or joint). Hence, we only present results for

The omitted group in this specification is year -6 and below, before the takeover in year 0. The coefficient on the pre-takeover dummy is small and statistically insignificant. Given the purchase price at takeover was based on the average stock price over the 3 years before takeover, perhaps a more appropriate time interval is year -3 to -1 before takeover. But, we find no significant effects for either the 3 years before takeover or years -6 to -4 before takeover (specification 2).

In specifications 3 and 4, we exploit the uncertainty in the probability of a takeover between the early and late takeovers. In principle, anticipation effects should be stronger for companies that participated in the 1869 deal, which delayed their takeover to the 50th anniversary of their original contract. Given the fate of the private companies before them, the probability of a takeover was less uncertain for them. To assess whether these companies behaved differently in the years before takeover, we interact dummies for years -3 to -1 and -6 to -4 before takeover with a dummy for the companies in the 1869 deal. Although the coefficients are positive on the interaction terms, they are not statistically different from zero. Specifications 5 to 8 report similar specifications for our weighted regressions and the results are unchanged.[22] Table 4 confirms that anticipation effects did not lead to a statistically significant hump or decline in costs just before state takeovers of private railways.

Second, table 4 also explores what happened to working expenses five, ten, and fifteen years after the switch to state ownership. We examine these dynamics by constructing a sequence of dummy variables for years 0 to 5, years 6 to 10, years 11 to 15, and years 16 and above after takeovers. Across the different specifications, working expenses declined in the first 5 years following a takeover, but the big declines occurred 6 to 15 years after switching to state ownership. Of additional interest is the coefficient on years 16 and over after takeover, which indicates whether working expenses were significantly less than, equal to, or greater than their pre-takeover level. Although the coefficient is marginally smaller than earlier years, cost reductions appear to have continued for state owned railways even after 16 years. These findings are consistent with a long run decline in operating costs following Government of India takeovers. Neither short run cost cuts by the Government, nor a misreporting of costs by private companies that would perhaps create a one time reduction in costs immediately after a takeover appear to be significant.

Third, table 5 presents similar regressions of the pre- and post-takeover dynamics using first differences in log costs as the dependent variable. In these regressions, we replicate the fixed effects specifications from table 4 in first differences. As per Wooldridge (2002), we also

the solo panel in this and the subsequent section. Results for the joint panel are available upon request.

[22]As an additional check, we also dropped the 1869 companies and the results were essentially the same.

first difference the sequence of dummy variables for each 5 year bin pre- and post-takeover as well as the input prices, capital and output controls.[23] We find similar patterns in the evolution of these first differences estimates compared to those reported in the fixed effects specifications in table 4. Regardless of specification, working expenses decline significantly following a change to state ownership and continue to decline for 15 years after takeovers.

Our empirical analysis has focused on how state ownership influenced the levels of working expenses in a variable cost framework. And, we find that a switch to Government of India ownership produced a permanent reduction in the level of working expenses. A change in ownership, however, can also influence the rate of growth of working expenses (Estrin et. al, 2009). To assess the evolution of the annual growth rate of working expenses, table 6 presents specifications using the first difference in log costs (essentially the average annual growth rate) as the dependent variable and state ownership interacted with the 5 year dummies for pre- and post-takeovers. Note, this is different from table 5 that tests the robustness of our fixed effects findings in a first differences framework. In table 6, we do not first difference the pre- and post-takeover dummies because we are interested in how the growth rate of working expenses changed following takeovers. In keeping with our variable cost framework, table 6 also includes first differences of the input prices, capital and output controls. The coefficients on the 5-year dummies indicate whether state ownership was accompanied by a change in the annual growth rate of working expenses. The results suggest that growth rates declined on average by 2 to 3 percentage points in the first 10 years after takeover before levelling off. There were no further declines in the growth rates 10 years after takeover.

Figure 4 graphically ties together the different regressions discussed in this section. In this graph, we plot the residuals of the log of working expenses for switching and non switching railways from regressions controlling for the log of input costs, capital and output controls, railway and year fixed effects, and railway specific trends against years since takeover. For the non-switching railway companies we use 1896, the mean year of takeovers, as the switch year. As seen in the graph, a change to state ownership produces a significant level-effect on the residual costs of switching railway companies. Their residual working expenses are at a

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[23]Differencing the 5 year state ownership dummies essentially means that the first differencd dummy for say years 0 to 5 after takeover is 1 for year 0, 0 for years 1 to 5, and then -1 for year 6 after takeover. Dummies for the other 5 year bins follow the same pattern. Wooldridge (2002) stresses the importance of first differencing the independent variables to generate comparable FE and FD estimates. Since the panel is greater than 2 time periods, the FE estimation is different from FD, but according to Wooldridge (2002) "the choice between FD and FE hinges on the assumption about the idiosyncratic errors, u_{it} (p. 284)." If the errors are serially uncorrelated, then FE is more efficient and if the errors follow a random walk, then FD is more efficient. Since clustering addresses concerns of serial correlation, we believe FE is preferable in our case although the FD results are essentially the same.

lower level following a change in ownership relative to non-switching railways. The graph also confirms why we observe negative effects on the growth rate of working expenses only in the first 10 years after a takeover because after 10 years there are no continuous annual declines in costs for switching railways relative to non-switching railways. Thus, railway companies taken over by the state in colonial India experienced significant level declines in working expenses that continued for almost 15 years after takeovers although the effects on annual growth rates tapered off after the first 10 years.

5.3 Detailed Working Expenses and Labor Costs

Our findings yield a surprising result: the transition from private to state ownership lowered working expenses for a period of at least 15 years. How did the Government of India achieve these declines? In this section, we provide evidence that Government ownership lowered labor costs, a big component of working expenses.

To understand the negative relationship between working expenses and state ownership, we first document the effects of state ownership on working expenses in five different departments. These include engineering expenses pertaining to the maintenance of permanent way, locomotive expenses, carriage and wagon related expenses, traffic expenses and a final category of general administrative expenses. On average, engineering accounted for 25 percent of total working expenses, locomotives 31 percent, carriage and wagon 9 percent, traffic another 17 percent and the general category accounted for the rest. Thus, over 80 percent of working expenses were associated with operational expenses incorporated in the engineering, locomotive, traffic, and carriage and wagon departments.

Table 7 provides a detailed percentage breakdown of expenses within each department for the year 1900. Over 50 percent of the engineering expenses went to materials and wages for track maintenance. The rest involved general superintendence and repairs to bridges, stations, and buildings. General superintendence expenses appear to be associated with mid-level management. Fuel was the largest expense under locomotives followed by maintenance and renewal, and wages for drivers, firemen, and other skilled train operatives. Maintenance and renewals to vehicles were the largest expenses in the carriage and wagon department. Labor costs for management, station, and train workers were the predominant expenses in the traffic department. A variety of expenses related to audits and accounting comprised the general category.[24]

Across the different departments, labor charges are a common expense. For example,

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[24]The home office probably relates to costs incurred in London by the board of directors, while the agent's office covers the agent's costs in India.

in engineering, wages for maintenance to the permanent way and general superintendence expenses totaled 47 percent on average. There were also labor costs in repairing bridges, stations and buildings, but these are not reported separately. Under locomotives, wages for drivers, firemen, etc. plus general superintendence accounted for 26 percent of the total. Under traffic expenses, more than three- quarters of the total was devoted to labor (wage bill for station and train staff plus general superintendence). Labor costs in the different sub-categories thus comprised at least 33 percent of total working expenses.

Similar to our earlier regressions for total working expenses, table 8 reports the evolution of the different sub-categories of detailed working expenses pre- and post-state takeovers. Traffic expenses, which were almost entirely labor costs, declined continuously in the years following takeovers. Engineering expenses declined significantly in years 6 to 15, as do expenses related to locomotives. The small category of carriage and wagon also experienced a decline from year 6 onwards after takeovers. State ownership, however, had no clear effect on general expenses. The coefficients are negative, but statistically insignificant.

We draw two conclusions from these results. First, if the observed declines in total working expenses are driven by changes in accounting rules, we would not expect to observe across the board declines in all the different sub-categories related to operations. Moreover, general expenses would perhaps be the most likely category of expenses to be moved to other government budgets following takeovers. For example, the cost of an accountant or auditor could have been placed in the Public Works Department budget to show greater profitability of state railways. Transfers between railways might have been eliminated to satisfy certain constituents. But, we find no evidence of significant declines in the general category. Second, it appears that state ownership reduced working expenses by lowering labor costs because they represent a major component of traffic and engineering expenses, the two sub-categories for which we observe large and significant declines mirroring those documented for total expenses.

To further investigate whether state ownership did in fact reduce labor costs, we collected annual data on total railway employment for each railway in the years covered in our study, 1874-1912. Government ownership could have reduced labor costs just by reducing the labor force. We test this hypothesis in table 9, which reports regressions of the log of railway workers on dummies for different 5 year intervals before and after state ownership along with controls for the fixed inputs such as railway miles, locomotives and vehicles, and the standard railway and year fixed effects and railway specific trends. Total employment declined continuously in the years following a switch to Government ownership. The coefficient points to a 26 percent decline in the railway labor force 15 year after takeovers.

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This effect is sizeable and broadly matches the timing of the overall decline in total working expenses.

Government ownership may have also lowered the daily wages and salaries paid to workers. Although we do not have railway wage and salary data to test this assertion, we can test whether Government ownership differentially reduced employment by race. Although Indians were the most numerous workers representing 95 to 97 percent of the total work force, there was significant sorting by race. European workers, mostly British, tended to be engineers, engine drivers and station masters, while Indians usually performed lower skill tasks (Kerr 2007). The separate regressions on European and Indian workers indicates that Government ownership did not differentially reduce employment for the highest paid workers—Europeans—any more than the lowest paid workers—Indians. Both groups saw declines of 15 to 25 percent on average following takeovers.[25] Nonetheless, the cost savings from cutting European labor were probably more significant because they were higher paid on average compared to Indians. Government ownership of Indian railways, thus, generated a large reduction in the labor force accounting for a substantial portion of the observed declines in total working expenses.

6 Conclusion

Using a new historical dataset on Indian railways, this paper shows that a switch from private to state ownership within the same railway system reduced working expenses by 14 percent on average. The results are not driven by declines in quality, anticipation effects, short run cost reductions at the expense of long run cost increases, or biases associated with accounting changes and trends. Rather, we observe broad declines in several sub-categories of working expenses especially those where labor costs were a major component. An analysis of total employment further confirms the link between labor costs, working expenses and state ownership. The total number of railway workers decreased significantly following a transition to Government of India ownership.

Many readers may be surprised that state ownership was associated with lower labor costs in the Indian railways sector. Researchers often argue that state ownership can increase labor costs because political actors have different objectives from private firms (Boycko, Shleifer

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[25]The weighted regressions suggest that European employment declined in the five years preceding Government takeovers with further decreases following takeovers. This may be related to European workers leaving private companies in anticipation of a state takeover. However, our earlier results on working expenses find no decline in costs in anticipation of Government takeovers. Thus, we conclude that declines in European employment, at least prior to Government takeovers, were not a significant factor in changing working expenses.

and Vishny 1996). Politicians are likely to hire more labor in state owned firms because they reap large political benefits from unions and interest groups. The objectives and nature of the Government of India are instrumental to understanding our results. In our context the political benefits of excessive spending on labor were arguably swamped by the costs of forgone profits to the treasury. The Government of India had strong incentives to minimize costs in the railway sector. They were majority owners of the rail network and stood to profit handsomely from any cost reductions. The Government of India also relied heavily on railway revenues as a key source of state revenues and continually expressed the necessity of state owned railways yielding profits to the treasury. Thus, railway profits were a key component of state policy.

The colonial and undemocratic nature of the Government of India also tended to limit political gains from inefficient input choices. The Government was unencumbered by labor unions demanding higher wages or more employment because it did not depend on their votes for political support. Hence, the Government could safely cut employment (or slow its growth) as necessary. While the Government of India was successful in cutting railway costs in this period, we are not suggesting the colonial Government's objectives were static and always targeted to cost minimization. There is qualitative evidence that Government owned railways were poorly maintained during the two World Wars in order to better serve British war needs (Kerr 2007). We are also not arguing that colonial ownership was successful in every sector of the economy. For example, the Government of India was a poor provider of mass education in this same period (Chaudhary 2009). Government ownership of railways succeeded in the pre-1913 period in part because officials recognized the financial importance of railway revenues to the state budget and had the authority to make necessary changes without political repercussions.

Why were private British companies unable or unwilling to make similar changes? The recent theoretical literature on optimal infrastructure contracts provides an answer: minimum income guarantees. Although necessary when returns are uncertain, minimum income guarantees can also lead to moral hazard problems among private companies (Engel, Fischer and Galetovic 2008, 2010, Iossa and Martimort 2009). This matches qualitative accounts of private British railway companies suggesting they had weak incentives to cut costs because they received a 5 percent guarantee regardless of operating profits (Thorner 1977, Kerr 2007). In principle, more effective regulatory oversight by the Government of India may have mitigated some of these problems, but this was not forthcoming perhaps because it lacked the necessary regulatory apparatus in the mid-19th century and was not as financially invested in the railways sector.

Lastly, the Indian case has policy implications for the use of minimum income guarantees in public private partnerships. Our results suggest that minimum income guarantees can significantly increase operating costs. However, inefficiencies in operations should be weighed against the benefits, most importantly increased incentives to undertake network investments. In the Indian case, the rapid introduction of railways contributed to substantial economic gains, but on several occasions the Government was unsuccessful in encouraging companies to build railways without a 5 percent guarantee. Thus, we think it is appropriate to regard minimum income guarantees as a necessary evil in developing countries like India. They are necessary to attract international capital to build infrastructure, but once implemented they weaken incentives to reduce operational costs.

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Figure 1: Map of Indian Railways, 1870

Indian Railways Map - 1870

RAILWAYS COMPLETED
RAILWAYS UNDER CONSTRUCTION
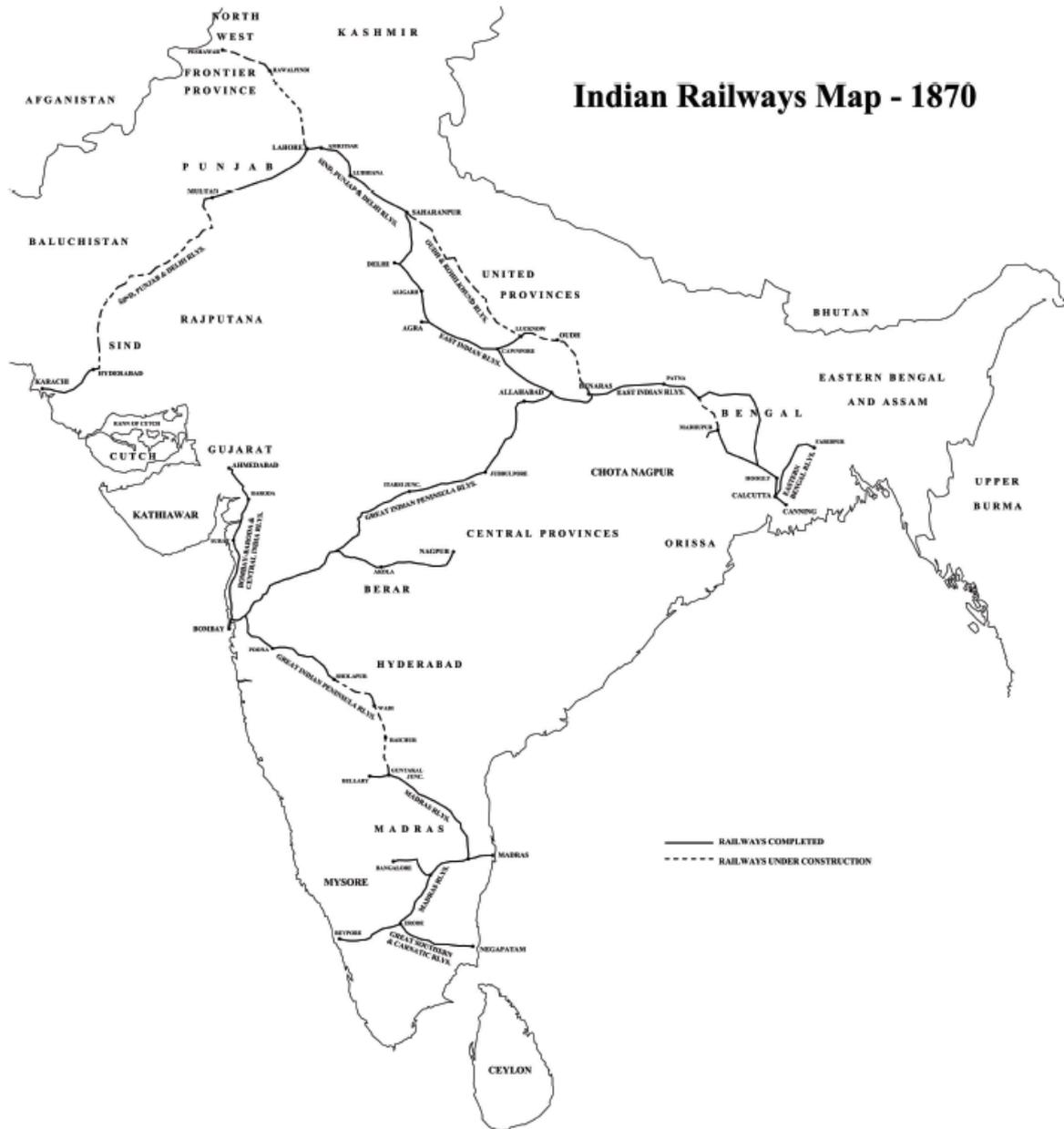
Figure 2: State and Private Ownership of Indian Route Miles, 1874-1912
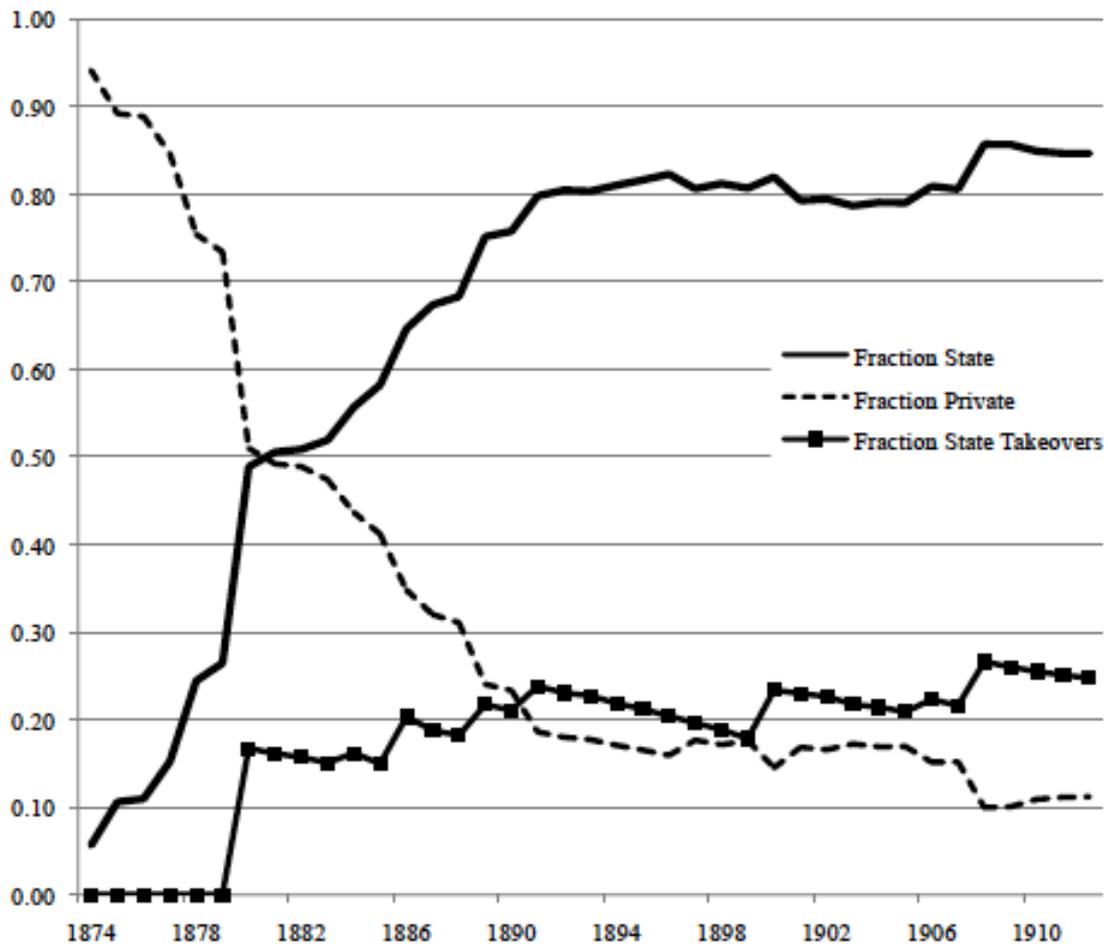
Figure 3: Railway Revenues as a Share of Total Government Revenues, 1868-1913
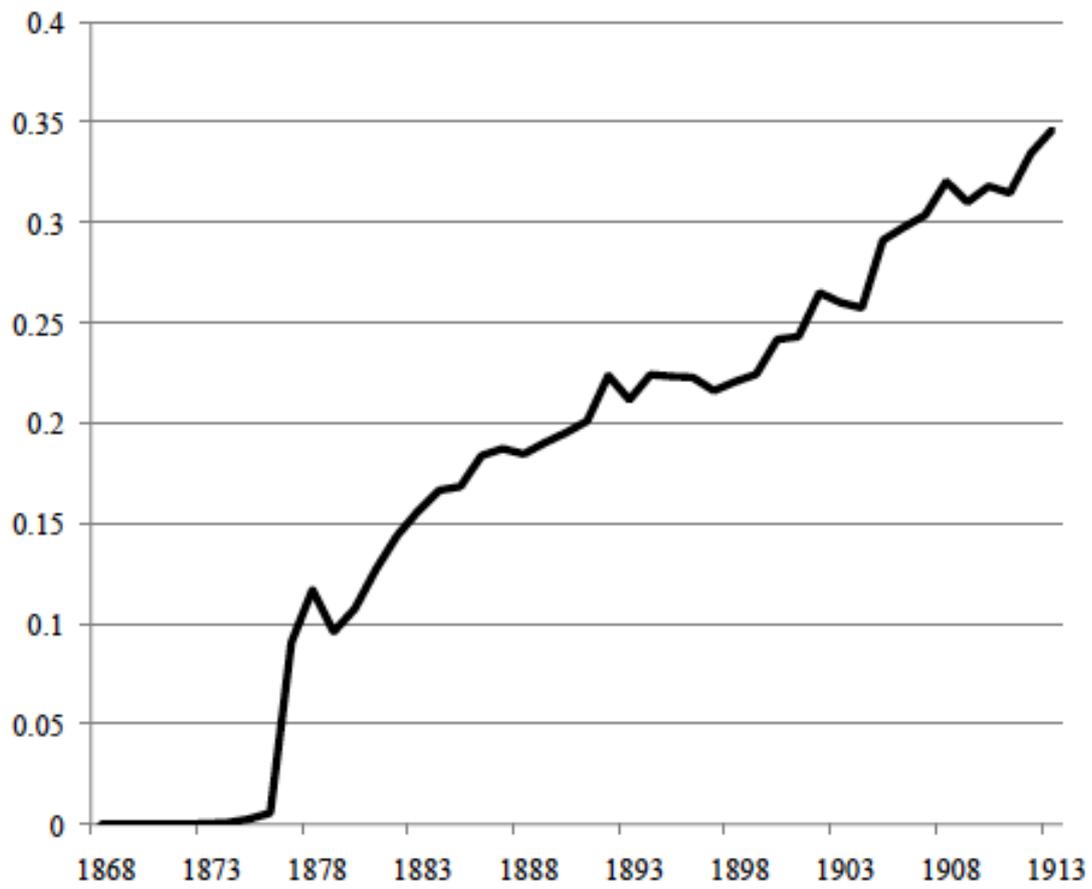
Figure 4: Residuals of Log Working Expenses Against Years Since Takeover
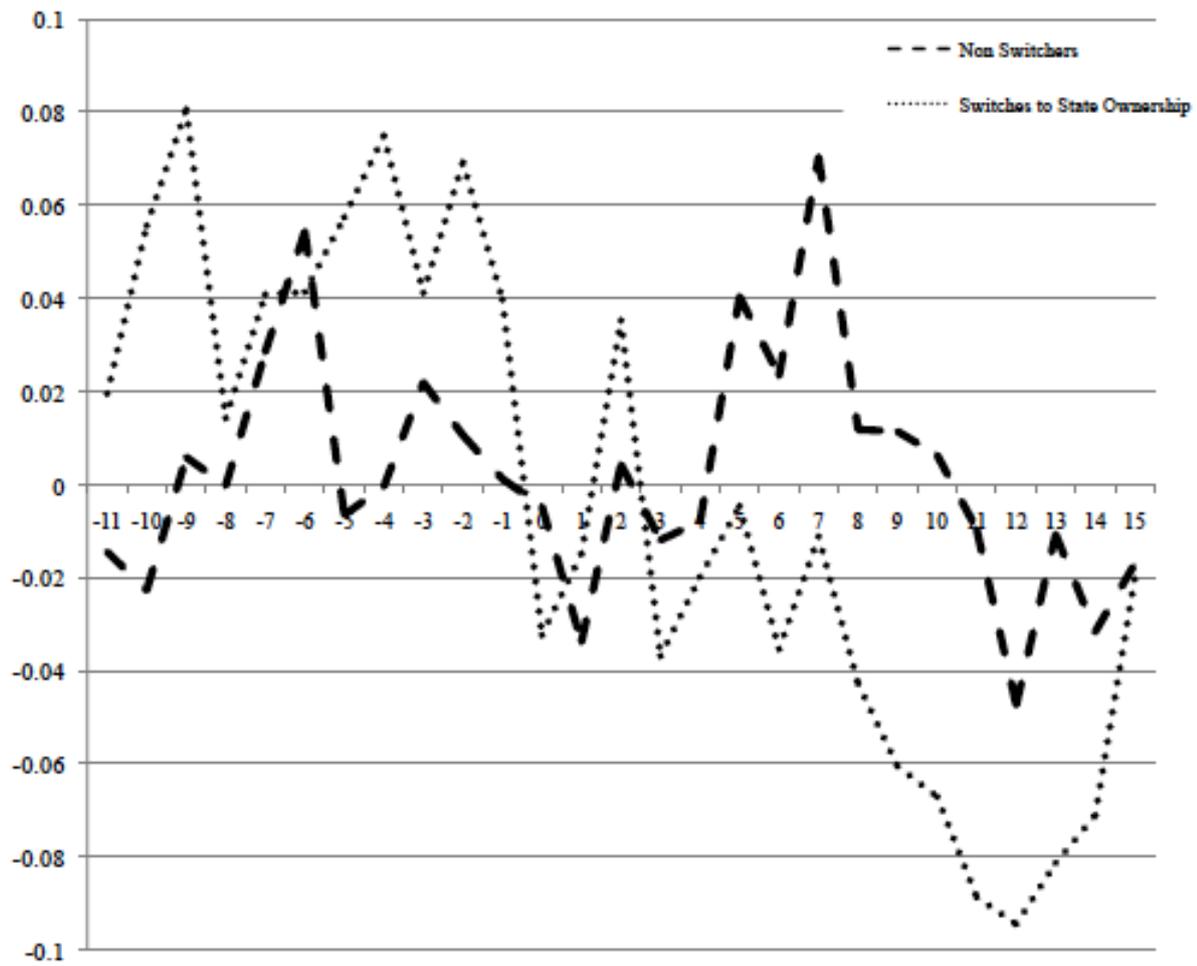
Table 1: Summary Statistics

	1874-1912	1880	1890	1900	1910
Working Expenses	9,308,966	4,819,099	6,785,228	8,869,493	18,300,000
	(9,291,395)	(4,941,381)	(5,917,258)	(6,988,886)	(14,500,000)
Input prices					
Avg Fuel Costs / Ton in Rupees	11	17	10	11	10
	(6)	(6)	(6)	(5)	(4)
Avg Agricultural Wages in Rupees	6	6	6	7	7
	(3)	(3)	(2)	(4)	(3)
Capital					
Total miles	1,179	586	1,002	1,320	1,967
	(850)	(470)	(654)	(797)	(1,083)
Locomotives	278	170	245	283	473
	(247)	(167)	(210)	(234)	(331)
Vehicles	6,227	3,581	5,289	6,273	11,184
	(4,888)	(2,927)	(3,540)	(4,223)	(6,910)
Traffic					
Passenger Ton Miles	439,000,000	208,000,000	320,000,000	416,000,000	908,000,000
	(412,000,000)	(201,000,000)	(247,000,000)	(326,000,000)	(573,000,000)
Goods Ton Miles	399,000,000	148,000,000	240,000,000	401,000,000	839,000,000
	(599,000,000)	(239,000,000)	(278,000,000)	(501,000,000)	(953,000,000)

Notes: Mean and standard deviation in brackets. Summary statistics are for solo panel only.

Table 2: Effect of State Ownership on Log of Working Expenses

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
State Ownership	-0.0851*	-0.1406***	-0.1399***	-0.0962***	-0.1087***		
	[0.040]	[0.025]	[0.033]	[0.022]	[0.023]		
Fraction of State Owned Miles						-0.1547***	-0.1363***
						[0.034]	[0.044]
(in logs)							
Avg Cost of Fuel	0.0427	0.0655**	0.0246	0.0643**	0.0222	0.0688**	0.0270
	[0.034]	[0.029]	[0.029]	[0.027]	[0.024]	[0.031]	[0.032]
Avg Wage	0.0070	0.0412	0.1252	0.0329	0.1460	0.0406	0.1213
	[0.101]	[0.086]	[0.089]	[0.089]	[0.096]	[0.089]	[0.091]
Passenger Miles	0.1180*	0.1853***	0.1115**	0.2444***	0.1304**	0.1866***	0.1092*
	[0.062]	[0.059]	[0.052]	[0.055]	[0.056]	[0.058]	[0.052]
Ton Miles	0.3010***	0.2536***	0.2478***	0.2425***	0.2256***	0.2626***	0.2554***
	[0.044]	[0.048]	[0.028]	[0.047]	[0.025]	[0.050]	[0.032]
Total Mileage	0.2995***	0.3116***	0.2422***	0.2649***	0.2856***	0.3111***	0.2211**
	[0.067]	[0.045]	[0.072]	[0.058]	[0.073]	[0.048]	[0.079]
Locomotives	0.1485	0.1648*	0.1210	0.2260***	0.1364**	0.1715**	0.1319
	[0.113]	[0.081]	[0.086]	[0.071]	[0.060]	[0.080]	[0.090]
Vehicles	0.0710	0.0705	0.2266**	0.0187	0.1918***	0.0621	0.2218**
	[0.103]	[0.112]	[0.088]	[0.101]	[0.064]	[0.108]	[0.092]
Year and Railway FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Railway Specific Trend	No	Yes	Yes	Yes	Yes	Yes	Yes
Weights	No	No	Yes	No	Yes	No	Yes
Panel	Solo	Solo	Solo	Joint	Joint	Solo	Solo
Observations	513	513	513	518	518	513	513
R-squared	0.99	0.99	0.99	0.99	0.99	0.99	0.99

Robust standard errors clustered at the railway system in brackets. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 3: Did Safety Decline following a Switch to State Ownership?

	Deaths			Injuries		
	(1)	(2)	(3)	(4)	(5)	(6)
State Ownership	0.0008	0.0005	-0.2884	0.002	0.001	0.0205
	[0.0009]	[0.0006]	[0.5701]	[0.0017]	[0.0007]	[0.4982]
Weights	No	Yes	Neg Bio	No	Yes	Neg Bio
Panel	Solo	Solo	Solo	Solo	Solo	Solo
State Ownership	0.0001	-0.0001	-0.4246	0.0016	0.0007	-0.0263
	[0.0004]	[0.0004]	[0.4429]	[0.0015]	[0.0008]	[0.3939]
Weights	No	Yes	Neg Bio	No	Yes	Neg Bio
Panel	Joint	Joint	Joint	Joint	Joint	Joint
Observations	530	530	531	530	530	531

Robust standard errors clustered at the railway system in brackets
*** p<0.01, ** p<0.05, * p<0.1
All regressions include log of total mileage, railway and year FE, and
railway specific trends.
In columns 1, 2, 4 and 5, deaths and injuries are per 100,000 of output

Table 4: Evolution of the Log of Working Expenses

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
State Ownership*Years -5 to -1 before takeover	-0.0006 [0.051]				0.0157 [0.056]			
State Ownership*Year -6 to - 4 before takeover		0.0124 [0.047]	0.0113 [0.047]	-0.0012 [0.061]		0.0241 [0.045]	0.0230 [0.045]	-0.0050 [0.070]
State Ownership*Year -3 to -1 before takeover		-0.0141 [0.056]	-0.0333 [0.049]	-0.0362 [0.052]		0.0106 [0.061]	-0.0377 [0.056]	-0.0438 [0.064]
Deal 1869*Year -3 to -1 before takeover			0.0477 [0.078]	0.0541 [0.083]			0.0911 [0.069]	0.0995 [0.075]
Deal 1869*Year -6 to - 4 before takeover				0.0319 [0.055]				0.0504 [0.055]
State Ownership*Years 0-5 after takeover	-0.1259** [0.050]	-0.1281** [0.051]	-0.1290** [0.050]	-0.1286** [0.049]	-0.1134* [0.057]	-0.1105* [0.058]	-0.1130* [0.056]	-0.1148* [0.056]
State Ownership*Years 6-10 after takeover	-0.2114*** [0.063]	-0.2149*** [0.066]	-0.2162*** [0.063]	-0.2156*** [0.062]	-0.1678** [0.061]	-0.1649** [0.060]	-0.1683*** [0.056]	-0.1701*** [0.056]
State Ownership*Years 11-15 after takeover	-0.2778*** [0.089]	-0.2825*** [0.088]	-0.2835*** [0.085]	-0.2822*** [0.084]	-0.2271*** [0.074]	-0.2241*** [0.070]	-0.2269*** [0.063]	-0.2282*** [0.060]
State Ownership*Years 16 and over after takeover	-0.2199** [0.100]	-0.2266** [0.098]	-0.2270** [0.096]	-0.2252** [0.096]	-0.1494 [0.088]	-0.1464 [0.084]	-0.1474* [0.079]	-0.1484* [0.076]
Weights	No	No	No	No	Yes	Yes	Yes	Yes
Panel	Solo	Solo	Solo	Solo	Solo	Solo	Solo	Solo
Observations	513	513	513	513	513	513	513	513
R-squared	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99

Robust standard errors clustered at the railway system in brackets. *** p<0.01, ** p<0.05, * p<0.1

All regressions include log of fuel and labor costs, passenger and ton miles, locomotives, engines and total mileage, plus railway FE, year FE, and railway specific trends.

Table 5: Evolution of First Differences of the Log of Working Expenses

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ State Ownership*Years -5 to -1 before takeover	-0.0121 [0.052]	-0.0088 [0.052]	-0.0118 [0.057]	-0.0097 [0.058]				
Δ State Ownership*Year -6 to - 4 before takeover					0.0039 [0.031]	0.0067 [0.032]	0.0096 [0.027]	0.0106 [0.029]
Δ State Ownership*Year -3 to -1 before takeover					-0.0295 [0.053]	-0.0230 [0.055]	0.0080 [0.045]	0.0114 [0.047]
Δ State Ownership*Years 0-5 after takeover	-0.0937* [0.048]	-0.0843 [0.049]	-0.0992* [0.047]	-0.0927* [0.049]	-0.1112 [0.089]	-0.0987 [0.093]	-0.0793 [0.068]	-0.0712 [0.072]
Δ State Ownership*Years 6-10 after takeover	-0.1323** [0.053]	-0.1193** [0.054]	-0.1481** [0.053]	-0.1401** [0.055]	-0.1498 [0.088]	-0.1340 [0.094]	-0.1279 [0.075]	-0.1182 [0.080]
Δ State Ownership*Years 11-15 after takeover	-0.1586** [0.055]	-0.1428** [0.054]	-0.1751*** [0.058]	-0.1661** [0.060]	-0.1763** [0.076]	-0.1578* [0.080]	-0.1546** [0.069]	-0.1438* [0.073]
Δ State Ownership*Years 16 and over after takeover	-0.1477** [0.057]	-0.1309** [0.055]	-0.1281** [0.054]	-0.1183** [0.056]	-0.1658** [0.066]	-0.1463* [0.069]	-0.1072* [0.055]	-0.0957 [0.060]
Weights	No	No	Yes	Yes	No	No	Yes	Yes
Railway FE	No	Yes	No	Yes	No	Yes	No	Yes
Panel	Solo	Solo	Solo	Solo	Solo	Solo	Solo	Solo
Observations	498	498	498	498	498	498	498	498
R-squared	0.67	0.67	0.51	0.51	0.67	0.67	0.51	0.51

Robust standard errors clustered at the railway system in brackets. *** p<0.01, ** p<0.05, * p<0.1
All regressions include first differences of the log of fuel and labor costs, passenger and ton miles, locomotives, engines and total mileage.

Table 6: Effects of State Ownership on the Growth Rate of Working Expenses

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
State Ownership*Years -5 to -1 before takeover	-0.0079	-0.0016	-0.0081	-0.0022				
	[0.014]	[0.019]	[0.016]	[0.018]				
State Ownership*Year -6 to - 4 before takeover					0.0001	0.0065	-0.0077	-0.0019
					[0.017]	[0.022]	[0.021]	[0.022]
State Ownership*Year -3 to -1 before takeover					-0.0127	-0.0058	-0.0047	0.0020
					[0.016]	[0.024]	[0.016]	[0.021]
State Ownership*Years 0-5 after takeover	-0.0231**	-0.0163*	-0.0197**	-0.0139	-0.0231**	-0.0157	-0.0196**	-0.0131
	[0.010]	[0.009]	[0.009]	[0.009]	[0.010]	[0.011]	[0.009]	[0.009]
State Ownership*Years 6-10 after takeover	-0.0333***	-0.0276	-0.0303*	-0.0252	-0.0332***	-0.0269	-0.0302*	-0.0243
	[0.011]	[0.017]	[0.016]	[0.022]	[0.011]	[0.019]	[0.016]	[0.022]
State Ownership*Years 11-15 after takeover	0.0080	0.0132	0.0032	0.0088	0.0080	0.0139	0.0034	0.0097
	[0.011]	[0.014]	[0.011]	[0.014]	[0.011]	[0.016]	[0.011]	[0.014]
State Ownership*Years 16 and over after takeover	-0.0011	0.0065	0.0014	0.0099	-0.0010	0.0072	0.0015	0.0109
	[0.007]	[0.017]	[0.005]	[0.013]	[0.007]	[0.020]	[0.005]	[0.014]
Weights	No	No	Yes	Yes	No	No	Yes	Yes
Railway FE	No	Yes	No	Yes	No	Yes	No	Yes
Panel	Solo	Solo	Solo	Solo	Solo	Solo	Solo	Solo
Observations	498	498	498	498	498	498	498	498
R-squared	0.66	0.67	0.50	0.51	0.67	0.67	0.50	0.51

Robust standard errors clustered at the railway system in brackets. *** p<0.01, ** p<0.05, * p<0.1
All regressions include first differences of the log of fuel and labor costs, passenger and ton miles, locomotives, engines and total mileage.

Table 7: Percentage Breakdown of Working Expenses by Department, 1900

	Average	Std. Deviation
Engineering		
General superintendence	17.5	5.85
Maintenance way, wages	29.0	10.39
Maintenance way, materials	24.2	12.14
Repairs of bridges	11.3	6.22
Repairs, stations and buildings	10.0	3.74
Locomotive		
General superintendence	8.2	2.82
Wages (drivers, fireman, fueling, cleaning engines)	18.3	5.01
Fuel	37.0	10.44
Water	2.8	1.07
Oil tallow and other stores	3.7	0.98
Maintence and renewal of locomotives	22.7	9.99
Maintence and renewal of machinery	1.8	1.05
Carriage and Wagon		
General superintendence	11.9	7.05
Repairs and renewals of coaching vehicles	34.1	13.02
Repairs and renewals of goods vehicles	42.0	18.77
Repairs and renewals of machinery	2.1	1.29
Cleaning and oiling	14.4	6.69
Traffic		
General superintendence	16.3	4.11
Station staff	47.5	8.5
Train staff	12.4	4.87
Fuel lighting and general stores	10.2	3.49
Printing stationary and tickets	6.7	2.6
Charges for delivery and collection of goods	1.6	3.19
General Administration & Miscellaneous		
Home expenditure or general administration	15.2	7.86
Agents office	8.7	7.66
Audit accounts and pay office	16.3	5.47
Stores department	4.3	1.8
Medical department	3.4	1.31
Rents and misc.	4.8	1.49
Police	6.1	2.76
Electric telegraph	16.9	5.51
Rates and taxes	2.3	3.37
Payments and other lines	14	13.37

Note: The totals by department do not always add up to 100 because we only report the significant categories of expenditures. The smaller categories are often unreported in the records.

Table 8: Dynamics of Detailed Log Working Expenses by Department

	Engineering (1)	Locomotive (2)	Carriage & Wagons (3)	Traffic (4)	General Adm. & Misc. (5)
State Ownership*Years -5 to -1 before takeover	-0.0014 [0.141]	-0.0492 [0.044]	-0.0043 [0.111]	-0.0745 [0.043]	0.0583 [0.067]
State Ownership*Years 0-5 after takeover	-0.1488 [0.104]	-0.0901 [0.078]	-0.1549 [0.137]	-0.1921** [0.072]	-0.0986 [0.148]
State Ownership*Years 6-10 after takeover	-0.2879** [0.120]	-0.1824** [0.066]	-0.3070** [0.136]	-0.2644*** [0.069]	-0.1987 [0.152]
State Ownership*Years 11-15 after takeover	-0.3990** [0.148]	-0.1883* [0.100]	-0.5568*** [0.175]	-0.3432*** [0.113]	-0.1670 [0.213]
State Ownership*Years 16 and over after takeover	-0.4251* [0.218]	-0.1799 [0.161]	-0.5851** [0.234]	-0.3701** [0.150]	-0.0932 [0.281]
Weights	No	No	No	No	No
Panel	Solo	Solo	Solo	Solo	Solo
Observations	511	512	512	512	512
R-squared	0.95	0.99	0.97	0.99	0.97

Robust standard errors clustered at the railway system level in brackets. *** $p<0.01$, ** $p<0.05$, * $p<0.1$
All regressions include log of fuel and labor costs, passenger and ton miles, locomotives, engines and total mileage, plus railway FE, year FE, and railway specific trends.

Table 9: Dynamics of Log Labor

	Total Labor (1)	Europeans (2)	Native Indians (3)	Total Labor (4)	Europeans (5)	Native Indians (6)
State Ownership*Years -5 to -1 before takeover	-0.0107 [0.033]	-0.0987* [0.050]	-0.0098 [0.034]	-0.0114 [0.044]	-0.1322** [0.047]	-0.0082 [0.046]
State Ownership*Years 0-5 after takeover	-0.1983** [0.081]	-0.2297*** [0.064]	-0.2055** [0.084]	-0.1164** [0.044]	-0.2480*** [0.068]	-0.1164** [0.044]
State Ownership*Years 6-10 after takeover	-0.2638** [0.106]	-0.2497** [0.086]	-0.2726** [0.110]	-0.1490** [0.052]	-0.2570** [0.092]	-0.1498** [0.054]
State Ownership*Years 11-15 after takeover	-0.2634* [0.142]	-0.1686 [0.112]	-0.2720* [0.148]	-0.1782** [0.073]	-0.2291* [0.127]	-0.1788** [0.075]
State Ownership*Years 16 and over after takeover	-0.1968 [0.179]	0.0072 [0.141]	-0.2061 [0.187]	-0.1420 [0.081]	-0.0851 [0.193]	-0.1445 [0.083]
Weights	No	No	No	Yes	Yes	Yes
Panel	Solo	Solo	Solo	Solo	Solo	Solo
Observations	511	511	511	511	511	511
R-squared	0.97	0.99	0.97	0.98	0.99	0.98

. *** p<0.01, ** p<0.05, * p<0.1
plus railway FE, year FE and railway specific trends.