

# Private to Public Ownership: A Historical Perspective from Indian Railways

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## Abstract

Using a new dataset on Indian railways, we study the effects of state ownership on performance between 1874 and 1912. Over this period all the former private railway companies in India were taken over by the Government of India at predetermined dates set by contracts negotiated in the 1850s. Exploiting changes in ownership within the same railway systems, we find the move to state ownership decreased operating costs by 12 percent. We do not find any evidence of biases associated with anticipation effects. In contrast, we find evidence of the Government eliminating redundancies by encouraging mergers and reducing general and administrative expenses. More generally, the findings imply that switching from private to state ownership does not necessarily lower firm performance in the infrastructure sector and may even enhance it.

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## 1. Introduction

Economists have long been interested in the relationship between public or private ownership and performance. A classical case for state provision of goods and services can be made in the event of market failures such as natural monopolies, externalities and public goods. But, strong economic arguments have also been made against state provision on the basis of ‘government failures.’ According to this latter view, greater contracting costs and soft budget constraints can make state provision less efficient than private.<sup>1</sup> Economists have empirically tested these theories by studying the wave of privatizations across the world in the 1980s and 1990s. A substantial number of these studies find evidence for significant productivity increases following privatization.<sup>2</sup>

Drawing on the growing body of evidence in favor of improved performance under private ownership, the privatization literature thus suggests that firm level performance should decrease if private ownership is replaced with state ownership. While nationalizations were common in the early to mid-20<sup>th</sup> century, there have been relatively few in recent history and very few studies examining this question use rigorous empirical methods.<sup>3</sup> Our paper addresses this void by estimating the effects of public ownership on performance using the transition of private railway companies to public ownership in late 19<sup>th</sup> and early 20<sup>th</sup> century India.

Colonial Indian railways provide a great context to study the effects of ownership on performance for three reasons. First, railways are the classic example of an infrastructure sector rife with market failures on account of externalities and natural monopoly power. If state

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<sup>1</sup> For recent theoretical work on contracting costs and soft budget constraints see Hart et al. (1997), Shleifer (1998), Besley and Ghatak (2001), and Kornia, Maskin, and Roland (2003).

<sup>2</sup> For a survey of privatization see Megginson and Netter (2001), Djankov and Murrell (2002), and Estrin et al. (2009). For a sample of works showing that privatization generally increases productivity see La Porta and Lopez-de-Silanes (1999), Claessens and Djankov (2002), and Brown et al. (2006).

<sup>3</sup> For an analysis of nationalizations in British trucking see Hart (1953). For a comparative analysis of the rise of state owned enterprises see Toninelli (2000).

ownership cannot out perform private ownership in this type of sector, it is unlikely to succeed in other contexts. Second, the institutional setting mitigates the traditional endogeneity problems of selection bias and omitted variables that plague many of the privatization studies. Instead of relying on cross sectional comparisons between privately owned and state owned railways, we exploit changes in ownership within the same railway company to precisely identify the effects of ownership. Third, there is an abundance of information on the finances and operations of Indian railway companies over a long time period allowing for a detailed econometric analysis. We exploit the long time horizon to test various hypotheses relating to the behavior of private firms before the change in ownership (i.e. anticipation effects) and potential state responses after takeover.

The first Indian railway lines were constructed in 1853 by private British joint stock companies relying on capital raised in Britain with a 5 percent dividend guarantee backed by the Government of India. By the late 1870s eight ‘guaranteed private’ companies were the major players in the field of railways, but beginning in 1879 the Government of India began to takeover these lines. A clause in the original concession contract, however, allowed the Government to purchase a private railway company only at a specified future date. For the purpose of our analysis, this contractual arrangement ensures that the Government could not endogenously time the takeovers during periods of increasing or decreasing costs.

By the 1900s the Government of India had exercised the takeover option in every case and gradually formed an extensive ownership stake in the railway network through takeovers and new construction. Interestingly, the private sector was not eliminated through this process. In a number of cases, private companies entered into contracts to operate state owned railways and often they were reconstitutions of the original companies that owned the railways. This

form of public ownership but private operation was rare in this period. In most other countries the state operated railways after they were nationalized (Bogart 2009).

For our empirical study, we constructed a new historical data set on 18 railway systems operating in India. These systems jointly account for 90 percent of the mileage of Indian railways in this period. Using *Annual Reports on the Administration of Indian Railways* and *Reports to the Secretary of State for India in Council on Railways in India*, we collected detailed information on mileage, passenger and goods traffic, fuel consumption, wages and working expenses among other variables from 1874 to 1912. The *Reports* allow us to precisely identify the ownership and operation status of each railway system including when the state took ownership of private lines. All the former private companies switched to state ownership over these decades. In addition some railway lines also switched from private operation to state operation, and vice versa.

We find that working expenses (i.e. operation costs) are 11 percent lower on average following a switch from private to state ownership controlling for outputs, input costs, network density, railway and year fixed effects. Our findings are robust to railway specific trends, which control for any unobservable factors trending up or down that may contaminate our estimates on ownership. The results are also robust to any serial correlation in the data.

Unlike ownership changes, we find little evidence that operational changes influenced costs. The coefficient on state operations is economically and statistically insignificant in the regressions—railways that retained private operation following a shift to state ownership experienced similar declines in working expenses as railways that switched to state ownership and operation. Hence, ownership is the prime driver of the results.

Given the positive findings of the recent privatization literature, how can we account

for these contrary findings for Indian Railways? One obvious explanation may be that even though the Government of India was unable to time the takeover, private companies may have exerted less effort in anticipation of a state takeover. To test this hypothesis, we construct a sequence of dummy variables to capture 5-year intervals before and after state takeovers. We, however, find no evidence of a rise in costs 5 years before takeovers. We also use these dummies to test if the state engaged in short run profit taking wherein state owned railways lower maintenance expenditures in the first couple years following the takeover to boost short-run profits, but raise long-run costs through a dilapidated capital stock. We find no evidence of the state engaging in this behavior. If anything, the big decline in working expenses occurs 11 to 15 years after takeover and continues for 20 years.

An alternative explanation for our results focuses on the guarantee system and its contribution to the failings of private railway companies. The guarantee system arguably dulled incentives because shareholders earned 5 percent even if their expenses implied an accounting return of 3 or 4 percent. Although attractive in theory, we do not think guarantees are the primary explanation for our findings. Our analysis shows that the beneficial effects of switching to state ownership (i.e. cost declines) were similar for railways receiving guarantees (returns below 5 percent) at the time of takeover compared to those earning returns above 5 percent. Moreover, we find no significant differences in working expenses between railways that switched from private to state operation or vice versa.

Drawing on the detailed breakdown of working expenses and the institutional history, we attribute India's success with state ownership before World War I to direct actions taken by the Government of India. The Government encouraged railway mergers and eliminated redundancies (general and administrative expenses declined sharply following takeovers); it

helped establish agreements for the exchange of traffic and rolling stock between railway operators; it organized railway conferences promoting new locomotive technologies; and it introduced profit-sharing agreements for government employees.

Why did the Government do this? Arguably it had a strong incentive to promote efficiency because railways contributed to a substantial portion of total government revenues—35 percent by 1913. We also think the colonial context was extremely important. Efficient administration of railways was of great strategic interest to the British. Moreover, unlike democratically elected governments, the Government of India was unencumbered by the everyday concerns of elected officials. There was little influence from labor unions demanding higher wages or locals demanding a train station and frequent services irrespective of the need. In contrast, the Government faced pressures for a stronger representation of Indians in railway positions of authority, which tended to reduce rather than increase operational costs.

We broadly view our findings as evidence for how a proactive state with ‘high-powered’ incentives and unconstrained by private interest groups has the potential to improve efficiency. Hence, they are not at odds with the privatization literature, which also emphasizes the importance of incentives and the institutional background within which reforms occur. We recognize that in other political and economic contexts, the outcomes may be different. Historically, railway nationalizations were associated with lower efficiency in a number of other countries (Bogart 2009) and in recent decades privatization of railways in Canada and Argentina have conferred significant productivity gains (Lauren and Bozec 2001, Ramamurti 1997). Moreover, the Government of India was less successful in providing public services such as education (Chaudhary 2009) where the link to total revenues was perhaps more ambiguous.

Our paper also contributes to the Indian economic history literature, which has analyzed the impact of railways on social savings and trade issues such as the expansion of markets, price and wage convergence, and increased commercialization (McAlpin 1974, Hurd 1975, Adams and West 1979, Kerr 2007). Finally, it adds to a more recent complementary literature studying Indian economic history from a quantitative and theoretical perspective (Andrabi and Kuehlwein 2009, Donaldson 2008, Iyer 2009, Chaudhary 2009).

## **2. Background on the Development of Indian Railways**

The first passenger line in India totaling 20 miles was opened in 1853 and by the early 1900s India had the fourth largest national rail network in the world at 34,656 miles in 1913 (Government of India 1955). Throughout India's early railway development, the interests of private companies were at odds with the state, but even in the public sphere different groups clashed with each other. The Secretary of State, housed in London, was a British Cabinet member and had formal control over administration in India. The Viceroy was appointed by the Secretary and served as the administrative head for the Government of India. British officials working for the Government were more in tune with Indian interests and strongly advocated for greater efficiency and accountability. The Secretary of State, in contrast, was more influenced by the demands of private British companies.

Ten private companies incorporated in Britain constructed and managed the early lines under the 'guarantee system' up to 1868. Figure 1 shows a map of the rail network and the major private companies operating in 1870. Most lines linked the major port cities to the interior but there were a few interior-to-interior lines along the Ganga river. The private railways were organized as joint stock companies through concession contracts entered into with the Secretary of State. The contracts had the following general terms. Capital was raised in Britain primarily

through shares. The Government provided a 5 percent guarantee on the share capital at a fixed exchange rate of 1s. 10d to the rupee. The net receipts were paid into the Government treasury and rebated to the company. If the net receipts yielded less than the guaranteed return to shareholders, the Government compensated the company. If they exceeded the guaranteed return, the Government was entitled to receive half of all surplus profits and company shareholders received the other half. After the interest payments were paid off, the company would receive all profits.

The Government provided further assistance by giving land free of charge. The companies thus avoided the expense and delay of negotiating directly with landowners. In return for assistance, the Government retained substantial control. It had a veto over the placement and gauge of the lines. It could also influence operations through a government director who sat on the company board. The Government also retained the right to purchase private railways after 25 or 50 years. The contracts stipulated that the Government had to announce the repurchase within six months after the 25<sup>th</sup> year or the 50<sup>th</sup> year of the original contract. This institutional detail is critical for our empirical analysis. The purchase price was to be based on the mean market value of the company's stock in the preceding three years (Bell 1894, p. 66-72).

Guarantees were thus a key feature of the first phase of Indian railway development. British railway promoters in the 1840s emphasized the difficulty of raising British capital for a potentially risky Indian infrastructure project without an explicit guarantee and subsequent attempts to finance private railways without guarantees failed (Bell 1894, p. 73). Similar to India, railway investors in France, Argentina, Russia, Brazil, and elsewhere also insisted on guarantees (Eichengreen 1995). In India, the experience with guarantees was mixed. The early lines were unprofitable for several years (i.e. earned less than 5 percent) and the Government was forced to

honor profit guarantees to shareholders. Guarantee payments continued after the 1860s but a few companies such as the East Indian began earning in excess of 5 percent.

Government control was another notable feature of the early concession contracts, but in practice the authority and reach of Government officials was limited. The Government appointed engineers “were not experienced enough in railway construction and the fear of causing delay to the progress of work often led them to overlook the negligence of companies (Sanyal 1930, p. 63).” The Government also exercised weak control over many aspects of operations because railway companies could appeal to the Secretary when they opposed a policy change. 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 defeating the merger.

The Government option to repurchase private railways remained in the background until the late 1860s. Several companies were indebted to the Government on account of past guarantee payments. The Government, under the authority of Viceroy Lawrence, began pressing for state ownership and the end of the guarantee system (Bell 1894, p. 75-76). In 1869, the Secretary of State, however, offered to clear company debts and void the Government’s right to repurchase at the 25<sup>th</sup> year of the contract. In return companies had to share half of all surplus net profits with the Government from that point forward. The Great Indian Peninsula, Madras, and Bombay, Baroda and Central India railways accepted the offer, while the East Indian refused.<sup>4</sup> The 1869 episode had a number of lasting effects (Bell 1894, p. 26-27). The most significant for our purposes is that three major private railways were assured of their right to own and operate railways through the 1900s.

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<sup>4</sup> The Government opposed the renegotiation because it forgave interest debts just as private companies were beginning to earn profits above 5 percent, but they had no authority to veto the agreement because it came from the Secretary.

State owned and state operated railways marked a second phase in Indian railway policy under Lord Lawrence, viceroy from 1864 to 1869, and his successor Lord Mayo. Beginning in 1869 no new contracts were signed with private companies and the Government constructed several new lines. Many of the new lines broke from the standard gauge to a smaller meter gauge (3 feet 3 3/8 inches). 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. Advocates of private provision capitalized on the Government's failures and argued for a reintroduction of the private sector.

The Government purchase of the East Indian railway in 1879 marked the beginning of the third phase in Indian railway policy. As late as 1877 it was unclear whether the Government would exercise its option to take over the East Indian. In the same year, the Secretary sent a letter to company directors indicating the Government's intention to purchase the line. The Secretary also suggested the possibility of a new arrangement in which the company could operate the railway in exchange for a portion of the profits and a reduced guarantee (Huddleston, 1906 p. 101). The new 'arrangement' was enacted in 1879 wherein investors were given government annuities equivalent to the market value of their shares over the previous three years. The line was subsequently worked by the newly formed East Indian Company, which retained one-fifth of the capital, now guaranteed at 4 percent, and also received one fifth of surplus profits for working the lines.<sup>5</sup>

Over the 1880s, 1890s, and 1900s, the Government purchased all of the original private

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<sup>5</sup> It was believed that greater profits were the Government's objective in purchasing the East Indian and leaving its management in the hands of the company (Huddleston 1906, p. 106). The East Indian did not receive any guarantee payments in the 1870's and was the most profitable of all Indian railways at the time.

railway companies. Several were bought when the 25<sup>th</sup> year of the original contract arrived.<sup>6</sup> The Government exercised the purchase option when the 50<sup>th</sup> year arrived for Great Indian Peninsula in 1900, Bombay, Baroda and Central India in 1906, and Madras in 1908 on account of their 1869 renegotiated contracts. Since the Government took over all private companies, selection bias is not a concern for our study.

After takeover the Government chose to operate the railway in a few cases such as the Eastern Bengal, the Sind, Punjab and Delhi, and the Oudh and Rohilkhand railways. The public works department managed these lines in a similar manner as the state owned lines constructed in the 1870s. In most other cases, the Government entered into agreements with directors of the former railway companies. The newly formed companies generally held less than 20 percent of the capital. The profits were guaranteed, at lower rates of 3 to 4 percent and at smaller capital values. Surplus profits were shared with the Government in proportion to their respective capital shares. Government control and supervision also substantially increased following the shift to state ownership (Huddleston 1906).

The public-private partnership model became increasingly common after the 1880s as many state-owned and operated railways were transferred to private operation, and new companies were set up on similar terms. However, public opinion turned against private operation and beginning in the 1920s the Government gradually took over all railway operations. Thus, the move to state ownership between 1874 and 1912 was the key first step in India's move to complete nationalization of its railways. Our study exploits this transition to identify the effects of state ownership on costs.

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<sup>6</sup> This includes Eastern Bengal in 1884, Sind, Punjab and Delhi in 1886, Oudh and Rohilkhand in 1889 and South Indian in 1891.

### 3. Data

We created a new data set of Indian Railway systems 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 used 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 compared to the *Administration Reports*, but we were able to obtain information on working expenses, fuel costs and unit mileage that are essential to our regressions. We thus begin the analysis in 1874 and end in 1912 just before the beginning of World War 1—a thirty-eight year period when all the former private companies were transferred to state 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. For the post-1900 variables, we either aggregate or average the variables over the two half years to construct an annual observation.<sup>7</sup> The tables include capital outlay, passenger and goods earnings, gross earnings, working expenses, train miles, passenger miles and ton miles (i.e. the number of tons carried one mile). 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.

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

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<sup>7</sup> We construct capital outlay in the post-1900 years using the ratio of net earnings to capital outlay adjusted for steamboat earnings and expenses to be consistent with the measure of capital outlay reported in the pre-1900 years.

are included in the capital outlay, not working expenses. To better understand the costs underlying total working expenses, we also extracted detailed information on individual costs such as maintenance to track and buildings, locomotive, carriage and wagon, traffic, general and miscellaneous expenses included in total working expenses. Although maintenance and locomotive expenses are reported uniformly for the entire period, other categories for example, traffic and miscellaneous expenses are reported differently between the pre- and post-1882 reports. To construct consistent categories, we combined the general and miscellaneous categories into a single group and plotted the annual share of each category to ensure we are capturing the same categories over time.

To get an exogenous measure of labor costs, we used information on average monthly wages for agricultural workers reported in the *Price and Wage Reports* between 1874 and 1912.<sup>8</sup> For each railway system, we averaged the wages across the relevant regions (i.e. provinces) traversed by the railway lines. In a few instances of missing information, we interpolated wages using the nearest year available. Although the price and wage series are not without problems (Datta 1915), these reports are the only available information on long run wages for British India and have been heavily used by historians and economic historians alike.

In our regression analysis, 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 and more importantly, 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

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<sup>8</sup> As a robustness check, we also use wages for skilled workers (common mason, carpenter or blacksmith) and the average of skilled and unskilled wages. Our main results for state ownership are unchanged.

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.

To illustrate the problem, consider the case of the East Indian Railways, a private company and the first to be taken over by the state in 1879. For the 1880s and 1890s, the East Indian includes the main East Indian line and three small state-owned lines worked by the East Indian (Patna-Gaya, Sindia and Dildarnagar-Ghazipur). In the same period, East Indian also manages the operations (i.e. working) of three private assisted company lines (Tarakesur 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 East Indian is only reported as one system including state lines and assisted company lines.

We address the pre and post 1900 difference by creating a consistent series of the “principal railway system” from 1874 to 1912. Since data on the secondary lines is reported separately in other tables of the pre-1900 reports, we merge their information to the primary system managing their operation.<sup>9</sup> A detailed appendix is available upon request, which describes the principal railway systems and the secondary lines included in the system. To handle mergers, we follow the “principal railway system” and drop secondary lines in the years before they merge. We thus exclude Tirhoot State Railways, Bengal Central, East Coast State and Indian Midland Railways before their mergers to principal systems. We could also include these merged lines in the panel in the years before they merge. To ensure excluding these lines before they merge does not influence our results, we run regressions on both panels.

Our analysis focuses on the main standard and metre gauge railway systems of British

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<sup>9</sup> 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.

India that accounted for almost 90 percent of the network. We do not study the smaller narrow and special gauge lines for which consistent information is unavailable. We also exclude the Native State owned lines from the analysis because of the complicated relationship between Native States, the Government of India and private companies, and the resulting ambiguity in their organizational form.<sup>10</sup>

We code ownership in two ways given our observations are defined for the “principal railway system.” First, we use the organization of the dominant railway line within a system to code the entire system. Dominant railways lines represent the majority of the system mileage on average so any measurement error from this approximation should be small. Second, we also code the fraction of miles of each type within the system such as the fraction of state-owned miles. Our results are robust to both the fraction and dummy variables for ownership.

Figure 2 plots the fraction of total miles under different ownership and operational structures for our analysis period from 1874 to 1912. In the early 1870s, privately owned railway lines comprised over 90 percent of the system but by 1912 they accounted for less than 10 percent. As private mileage decreased, there was a parallel increase in state owned miles that were either operated by the state (25 percent) or operated by privately companies (65 percent by 1912). Our analysis exploits this change to public ownership seen in the figure.

Table 1 displays the summary statistics on total mileage, working expenses, and fuel and labor costs by year and ownership. Privately owned lines had lower working expenses on average than state owned lines, but their systems were also smaller on average (743 miles versus 1,398). In comparison, state-owned lines enjoyed lower fuel costs but higher labor costs. Net earnings per capital outlay were also higher for state owned railways. The averages,

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<sup>10</sup> 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.

however, mask the increasing trend toward greater profitability of Indian railways in general from the 1870s to the 1900s. Interestingly, the contribution of goods revenues and passenger revenues remained stable over these decades at 58 percent and 38 percent respectively.

While these summary patterns are informative, it is difficult to infer the effects of ownership on costs because of differences in observables such as size and placement of lines and concerns about unobservable differences across lines. In the next section, we outline a fixed effects strategy to better identify the effects of ownership by comparing the same railway system before and after it changes to state ownership.

#### 4. Empirical Strategy

We study the effects of state ownership by focusing on operational costs. The ‘working expenses’ for a railway system are assumed to be a function of its outputs, network size, input prices, and residual operating expenses. Specifically, we set up the following equation,  $C = f(Q, P, E)$  where  $C$  are total working expenses,  $Q$  is a vector of outputs and network size,  $P$  is a vector of input prices, and  $E$  are the residual working expenses. Many relevant factors influence residual working expenses ( $E_{it}$ ) such as the geography and economic characteristics of the railway’s region and also include what we refer to as operational inefficiency. Drawing an analogy to productivity analysis, we assume operational costs are greater if there is a misallocation of inputs or a failure to utilize best practice managerial structures and technologies (Kumbhaker and Lovell 2000).

With this framework in mind, we test for the effects of state ownership using the following specification:

$$c_{it} = \sum_{k=1}^K \beta^k q_{it}^k + \sum_{j=1}^J \gamma^j p_{it}^j + \delta_t + \alpha_i + \lambda dstateown_{it} + \varepsilon_{it} \quad (1)$$

where  $c_{it}$  is the natural log of working expenses for railway system  $i$  in year  $t$ ,  $q_{it}^k$  is the natural log of ton-miles, passenger-miles, and rail miles for system  $i$  in year  $t$ ,  $p_{it}^j$  is the log price of average labor and fuel costs for system  $i$  in year  $t$ ,  $\delta_t$  are year fixed effects,  $\alpha_i$  are railway-system fixed effects, and  $\varepsilon_{it}$  is the error term. The functional form for outputs and input prices resembles the Cobb-Douglas cost function. Higher labor and fuel costs should contribute to higher working expenses as in a conventional cost function framework. Higher ton miles and passenger miles should also contribute to higher working expenses, but if there are economies of scale the sum of the coefficients on ton miles and passenger miles should be less than one. The coefficient on rail miles gives the effect of increasing network size while holding ton miles and passenger miles constant. If there are economies of density, then working expenses should rise with greater mileage.

The railway system fixed effects  $\alpha_i$  control for any time-invariant unobserved heterogeneity at the railway-system level. Geography and railway gauges are two important sources of heterogeneity. For example, 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 meter gauge railways (3 feet 3/8 inches) in India had lower costs than standard gauge railways (5 feet 6 inches). We also include year fixed effects  $\delta_t$  in the specifications to control for time-varying shocks common to all railways. For example, depreciation in the value of the rupee would be one factor affecting costs for all railways in a particular year.

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 from changes within the same railway system over time. If ownership changes lowered residual working expenses and increased operational efficiency, then the coefficient on  $dstateown_{it}$  would be negative and statistically significant.

Railway system and year fixed effects address a variety of identification problems, but there could still be railway specific time varying heterogeneity correlated with working expenses and a switch to state ownership. If the Government of India happened to purchase private lines when their costs were trending upwards or downwards, the coefficient on state ownership would be biased. We therefore include individual railway time trends in the regressions, which control for unobservable trends at the railway system level. By including such trends, we identify the effects of state ownership by comparing deviations in working expenses from the railway trend before and after the change to state ownership within a railway system.

Our institutional setting and estimation approach has a number of advantages in terms of identification. First, all private railways established before 1874 were purchased by the Government by 1908 and so there is no selection problem of the Government of India 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 that the Government had the right to purchase the railway at 25 or 50 years from the first year of the contract. The repurchase dates were modified for three private railways in 1869 when the Secretary of State stipulated that repurchase could be exercised at 50 years only. All other private railways were purchased when the 25<sup>th</sup> year arrived.

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 that private railway managers and shareholders exerted less effort because they expected unfavorable treatment by arbitrators and the Government when their assets were transferred. A related possibility is that private management may have chosen to forgo long-term investment opportunities associated with greater long run profits that would appear after state takeover. 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.

An alternative anticipation response involves private managers and shareholders exerting greater effort because they wanted to increase share prices or convince the Government of their capability to operate the railway. 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. These considerations may have caused residual working expenses to decrease prior to the takeover.

We use two approaches to address anticipation effects. First, we drop  $dstateown_{it}$  and plot residuals from our regression for private railways ten-years before and after they were purchased by the Government. If there are strong anticipation effects, then arguably they should be visible in the residuals graph. Second, we explore anticipation effects in our regressions by interacting state ownership with 5-year dummies for before and after the state takeover. This allows us to test dynamic responses by both private companies and the Government.

## 5. Results

Table 2 presents our first set of results using the railway panel excluding pre-merger secondary lines in the years before they merge to primary systems. Specifications 1 to 5 focus on the dummy variable for state ownership, while specifications 6 to 8 use the fraction of state owned mileage within a railway system. Specification 1 is our parsimonious OLS specification where we control for input costs, network density and year fixed effects. This regression exploits cross-sectional variation in ownership and finds that working expenses are 16 percent lower for state owned railways as compared to private railways.

Since there are numerous differences across railway systems, specification 2 adds railway fixed effects to control for all time invariant unobservables at the railway level. The effect of state ownership is still negative and statistically significant. Specification 3 further addresses concerns of omitted variables and unobservable heterogeneity by including railway trends. This is our preferred specification and we find large statistically significant effects of state ownership on operational efficiency—working expenses decline by 12 percent following a switch to state ownership. Given our long panel and potential concerns of serial correlation, we cluster the standard errors in specification 4 and estimate panel corrected standard errors in specification 5. Our findings are robust to these additional tests. State ownership is, thus, strongly correlated with improving the efficiency of Indian railways.

Specifications 5 to 8 in table 2 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 13 percent, similar to the coefficient on the dummy for state ownership. The fraction of state owned miles captures both state and native state lines within a

railway system, but our results are robust to controlling for native state mileage separately.<sup>11</sup>

Appendix table 1 reports regressions similar to table 2 using the panel that includes secondary lines before they merge and the results on state ownership are essentially the same.

In table 2, we also include controls for input costs such as fuel and labor. Fuel costs increase working expenses in most of the regressions. The wage coefficient has a positive sign in the FE regression although the coefficient is insignificant [reword]. Coefficients on passenger miles, ton miles and total mileage are positive and significant across all the specifications highlighting economies of scale and density because the sum of the coefficients is less than one. Unlike traditional cost functions, we do not include a direct measure of capital costs faced by each railway system. The only measure is the value of fixed and rolling capital per railway mile reported by each railway system. Although this variable is probably correlated with the cost of capital faced by the line such as bricks and iron, reported capital is also likely to be endogenous to ownership and working expenses. Hence, we exclude them from our cost regressions, but in appendix table 2 we report regressions including the log of capital per mile as an additional independent variable and the findings on state ownership are similar to those reported in table 2. We thus believe our FE and railway trends are doing a decent job of capturing changes in input costs faced by each line.

By comparing railways before and after they change ownership, we find strong and robust effects of state ownership on operational efficiency. While these findings establish that ownership reduced operational expenses, it is unclear whether the effects are confounded by changes to state operation that occurred at the same time for certain lines such as Sind, Punjab Delhi, Eastern Bengal and Oudh and Rohilkhand. Section 2 describes how certain railway

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<sup>11</sup> The fraction variable only refers to 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.

companies were allowed to retain private operations, albeit under lower guarantees, when they were taken over by the state as compared to other companies where both ownership and operation was taken over the by state at the same time.

To explore the effects of operations on efficiency, table 3 includes a dummy variable for state operations in specifications 1 to 5 in addition to the dummy variable for state ownership. Although state operated lines have higher working expenses in the OLS regression (specification 1), state operations confer no statistically significant advantage or disadvantage on efficiency once we control for railway system fixed effects (specification 2 to 5). Specifications 5 to 8 provide an additional test of operation by including a dummy variable for state owned and privately operated railway systems to assess whether these unique organizational forms were associated with differential efficiency gains relative to state owned and operated railways (privately owned and operated lines are the omitted form). The coefficients on the state owned and privately operated dummy are small and statistically insignificant in all three regressions. State ownership, thus, appears to be the main driver of the observed reduction in costs.

In our fixed-effects framework, we are identifying the effects of state ownership by comparing railway systems before and after they switched to state ownership. This estimation approach assumes the timing of the switch to state ownership is exogenous to any unobservable factors correlated with working expenses. As explained in the previous section, we are not concerned about the Government of India timing the takeover because of the institutional structure of the contracts. We are, however, concerned about potential anticipation effects by private companies in the years leading up to the takeovers that could bias the coefficients on state ownership if companies drove up the costs in the years before takeover.

We test for anticipation effects by first plotting the residuals of working expenses from

regressions controlling for input costs, year fixed effects, and railroad fixed effects against years since takeover in figure 3. We plot residuals separately for the railways companies taken over by the state and those that did not switch ownership in our period of study. For the non-switchers we use 1896, the mean year of takeovers, as the switch year. There is a strong trend of declining working expenses over these decades highlighting the need for including railway trends in the regressions. Companies that were taken over by the state, however, experienced significant declines in working expenses in the years following takeover with the biggest declines in years 5 to 10 after which costs began to increase. There is no strong evidence in favor of a ‘hump’ in the immediate years leading up to the takeover. In contrast, there is some evidence in favor of private managers exerting greater effort in the years just before the takeover. But, the residuals of non-switching railways have a similar pattern making it difficult to conclude that declining costs before the takeovers were purely driven by positive anticipation effects. Moreover, these types of anticipation effects should bias our coefficient on state ownership down toward finding a smaller effect.

Figure 4 plots the residuals of the biggest private companies taken over by the state—Great Indian Peninsula, East Indian, Madras, and Bombay, Baroda and Central India. Residuals on the individual companies confirm the patterns observed in figure 4. The big decline in costs is especially large in the case of the Great Indian Peninsula and East Indian Railways, two of the biggest systems in India. In the case of the East Indian, costs actually increased for the first couple of years after the takeover in 1879 before big declines in the mid to late 1880s. The Great Indian Peninsula on the other hand was taken over later in 1900 and costs went down sharply in the first couple years after the takeover. Despite some heterogeneity in the timing of the decline, both these companies realized big cost reductions after a switch to government ownership.

What happened to working expenses five, ten, or fifteen years after the switch to state ownership? There are several possible short-run and long-run effects implying different trajectories for residual working expenses. For example, the government may have immediately reduced track and locomotive maintenance in order to boost railway profits. Lower maintenance expenditures should have reduced residual working expenses for a period of years, but at some point expenses should increase as the fixed and rolling capital depreciate, train services are delayed, and accidents increase in frequency. If the effects of lower maintenance are particularly severe, then residual working expenses may eventually exceed their level at the time of the takeover. This suggests an initial decline in working expenses followed by a sharp rise after a certain point.

The state may have also taken actions to lower costs over the long-run. For example, the Government of India might have introduced new technologies and improved coordination between the former private and government-owned lines. It might have also eliminated administrative redundancies by merging former private and government-owned lines. The Indian Government was also very effective in accessing British capital markets. As a result, it might have had an advantage in exploiting economies of scale by investing in new track and locomotives. These cases imply a modest decrease in residual working expenses for a period of years after the takeover, followed by a more rapid decline when new investments or technologies yield efficiency gains.

We examine these dynamics by constructing a sequence of dummy variables to capture the evolution of working expenses several years before and after the state takeover of private companies (table 4). The omitted group in the specifications is year -6 and below before the takeover in year 0. Similar to the residuals, the regressions confirm that anticipation effects did

not lead to a statistically significant hump or decline in costs just before state takeovers of private railway systems. The coefficients on years -5 to -1, years -5 to -2 and year -1 are small and statistically insignificant across all specifications.

The coefficients on the five dummies for years 0 to 5, years 6 to 10, years 11 to 15, years 16 to 20, and years 21 and above capture the evolution of working expenses after government takeovers. 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. Costs continued to decline between years 16 and 20, but the efficiency gains were lower than in previous years. Of additional interest is the coefficient on years 21 and over after takeover, which indicates whether residual working expenses were significantly less than, equal to, or greater than their pre-takeover level. Although the magnitude is similar to years 16 to 20, the coefficient on 21 and above is statistically insignificant suggesting there were no significant cost reductions for state owned railways after 21 years.

## **6. Detailed Analysis of Working Expenses, State Ownership, and Organizational Change**

The results, thus far, support the view that government ownership of Indian railways translated into substantial cost reductions that continued for a period of 20 years after takeovers. There is no evidence suggesting the Government was using shortsighted strategies such as lowering maintenance or locomotive expenses to achieve modest declines in the short run at the expense of creating long run inefficiencies. Given the long trajectory of cost declines post takeover, it appears the Government of India did undertake measures to lower costs and increase efficiency in the long run. An examination of the detailed working expenses provides further insights into how state ownership achieved such cost reductions.

Table 5 reports findings on the effects of state ownership on the different categories of

expenses included under total working expenses such as maintenance, locomotive, carriage and wagon, traffic and general plus miscellaneous grouped as one category. Traffic and general expenses experienced significant declines after state takeovers falling by 9.1 and 16.7 percent respectively. The findings on traffic and general expenses are robust to using the fraction variable for state ownership and estimating panel corrected standard errors. Both these categories together accounted for one-third of total operating expenses (traffic 17 percent and general 16 percent) and thus were an important component of operational costs. In comparison, maintenance and locomotives, two big cost categories, did not experience similar declines. The coefficients on state ownership are negative but statistically insignificant in specifications 1 and 2.

General and miscellaneous include a variety of expenses such as general administration, audits, agent's office, stores and medical departments, telegraph, law charges, taxes, etc. State ownership reduced these expenses in part by eliminating redundancies. Costs associated with accounting, audits and law charges had a significant fixed cost component. After taking over private companies, the government could reduce such costs by relying on their existing general and administrative setup for managing state owned lines. To give one example, the East Indian railway operated a telegraph on one side of its railway and the government operated a telegraph on the other side. In 1877, during the negotiations for the state takeover of the railway, the government agreed to repair and maintain the companies' telegraph and thus the East Indian railway administration no longer needed a staff of its own for this purpose (Huddleston 1906, p. 76).

Traffic expenses largely include wage payments for the station and train staff. The results thus imply that state ownership contributed to lower labor costs. This finding may be very surprising at first because modern forms of state ownership are often associated with an

excessive and expensive labor force due to the power of public sector unions. In colonial India, however, unions were less developed, at least before the 1920s, and therefore part of the pressure for higher wages was attenuated (Kerr 2007, p. 128). Moreover, at this time native Indians provided an abundant and under-utilized labor force in railway traffic and locomotive departments. The Government may have been more disposed to hiring native Indians than British companies, in which case state ownership would have encouraged a shift to cheaper labor. There is more direct evidence that the Government encouraged the hiring of workers from lower castes in an effort to prevent labor unrest. Viceroy Curzon wrote in 1899 “that it has been a folly to appoint as signalers so large a proportion of Brahmans [one of the highest castes]; and that in the future the railways must mix up the races and religions” (quoted in Kerr 2007, p. 83).

There is further evidence of changes in railway operation following the shift to state ownership. For example, the Government of India often used takeovers as an opportunity to merge neighboring lines to the newly acquired railway system. Takeovers were also used to reorganize existing networks in different regions with a stated purpose of improving efficiency and reducing fare wars. Figure 5 plots the mileage of private railway systems against time since takeover. Some of the biggest increases in mileage occurred at the time of takeovers via mergers. For example, the Government of India reorganized the Eastern Bengal system in 1884 shortly after taking over the Eastern Bengal Railway Company. When Sind, Punjab and Delhi was taken over in 1886, it was merged with the Indus Valley and Punjab Northern lines, both of which were owned by the state. Great Indian Peninsula Railways was taken over in 1900 and merged with the Indian Midland Railways (a state owned and privately operated system) in 1901. In 1908 when the contract of the Madras Railway Company came due, the government reorganized and merged the railway lines in South India. Interestingly, the Government of India had

attempted to orchestrate such a merger between Madras and South Indian in the late 1860s. The private companies refused and hence the reorganization had to wait 40 years until the Government came to own the railway.

Mergers of different railways provided the opportunity to exploit economies of scale and reduce costs. Mergers also allowed for efficiencies from a reorganization of inputs. For example, repairs to locomotives and carriages were centralized in the Lahore workshop following the merger of the Sind, Punjab, and Delhi railway with the Indus Valley and Punjab Northern lines in 1886. Concentrating the repair process in a single location contributed to the use of more sophisticated technology and avoided the redundancy of having three individual workshops in the region (Kerr 2007, p. 85).

The evidence, thus, suggests that the Government of India reduced operating costs following state takeovers by introducing a number of organizational changes. This explanation, however, begs a larger question – why did private companies fail to exploit such opportunities to reduce costs and improve efficiency? One reason may be because of the guarantees enjoyed by private companies whereby the Government of India guaranteed returns up to 5 percent. Contemporaries generally regarded the guarantee system as ineffectual in restraining construction and operational costs. Officials often criticized the system because “shareholders had their 5 percent whatever happened (Bell 1894, p. 66).” The Secretary of State in 1868 advocated the use of guarantees, but admitted, “the system tends to weaken the ordinary motives to efficient management and superintendence (Bell 1894, p. 19).” Orate railway stations and luxury cabins testify to some private extravagance on a public purse.

If guarantees alone are driving the cost reductions, we would expect heterogeneous effects of state ownership for companies that were receiving guarantees at the time of takeovers.

The negative rhetoric and large guarantee payouts notwithstanding, some private companies such as the East Indian received guarantees in the 1850s and early 1860s but then enjoyed high returns—above the guaranteed dividend—before being taken over in 1879. Other companies such as Madras and South Indian, however, received guarantees for many more years.

To assess the effects of guarantees, we created a dummy variable for lines that were receiving guarantees at the time of takeovers and interacted it with state ownership (table 6). The coefficient on the interaction between state ownership and railway companies receiving guarantees is small in magnitude and statistically insignificant. Regardless of whether we use the fraction or dummy variable and cluster or not, the interaction term is never statistically significant. The magnitude and statistical significance on the coefficients for state ownership, however, are negative, statistically significant and similar in magnitude to table 2. While this test does not conclusively rule out that guarantees may have generated some inefficiency in the operations of private railway companies, table 6 does highlight that guarantees alone cannot explain the cost reductions observed after state takeovers. The Government of India made important changes to existing railway systems upon taking them over, changes that private companies were perhaps unable or unwilling to make such as reorganization of lines, etc.

The unique features of the Government of India may help in explaining why state ownership contributed to greater operational efficiency. The Government of India was especially reliant on railway revenues for its income. By 1913 almost 35 percent of its total tax revenues came from state owned railways (calculation using data in Statistical Abstract relating to India 1915). Given the fiscal significance of railways, the Government had greater incentive to operate railways efficiently. As an illustration, the Government introduced a profit sharing agreement with state railway employees in 1880. The Railway Provident Fund contributed a portion of state

railway earnings, disbursing them to employees in proportion to their salary and position. The Government also organized 'railway conferences,' to create exchanges between state railway officials and companies. The first railway conference in 1880 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). The introduction of the Railway Provident Fund and the Railway conferences suggest that the Government operated railways like a profit maximizing monopolist. It seems to have known that it stood to gain financially by motivating employees and maximizing the cooperation between railways departments and regional units.

The authoritarian nature of the Government of India is another reason why state ownership contributed to greater efficiency in railways. There is a saying that 'under a Democratic constitution State railways corrupt politics and politics corrupt state railways' (quoted in Ghose 1927, p. 6). The Government of India was far from having a democratic constitution. It was composed of British public officials accountable to the British Government. Thus it was perhaps less beholden to social pressures at odds with profit maximization. As an example, there were requests from farmers and merchants to extend the network of the East Indian railway into less populated regions and to expand its wagon stock to handle exceptional periods of freight. The Government of India refused these requests on the grounds that they were uneconomical (Huddleston 1906). It could safely make such a choice because there were few political consequences from ignoring constituent demands.

## 7. Conclusion

In this paper, we measure the efficiency gains achieved by Indian railways when they switched to state ownership. Using a novel data set on the principal Indian railway systems and by comparing changes within systems, we find a switch from private to state ownership reduced working expenses by 12 percent controlling for input costs, density and railway specific trends. The results are not due to anticipation effects or short run cost reductions at the expense of long run cost increases. A switch to state ownership reduced costs for a period of 20 years and is due to lower general, traffic and administrative expenses.

Our findings are surprising in light of the recent literature on privatization. We show that switching from private to state ownership does not necessarily lower firm performance and may even enhance it. Our results can be rationalized by considering that railways are large enterprises with greater potential for market failures. Even when private ownership prevails there is often some form of government regulation. It is an empirical matter whether private ownership with government regulation is better for railway efficiency than government ownership. In the context of colonial India it is clear that government ownership was more efficacious. The Government of India had strong incentives to operate railways cheaply and they were not encumbered by constituent demands for high wages and redundant services. By contrast private companies seem to have had weaker than normal incentives because of profit guarantees and absentee foreign ownership.

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Figure 1: Map of Indian Railways in 1870

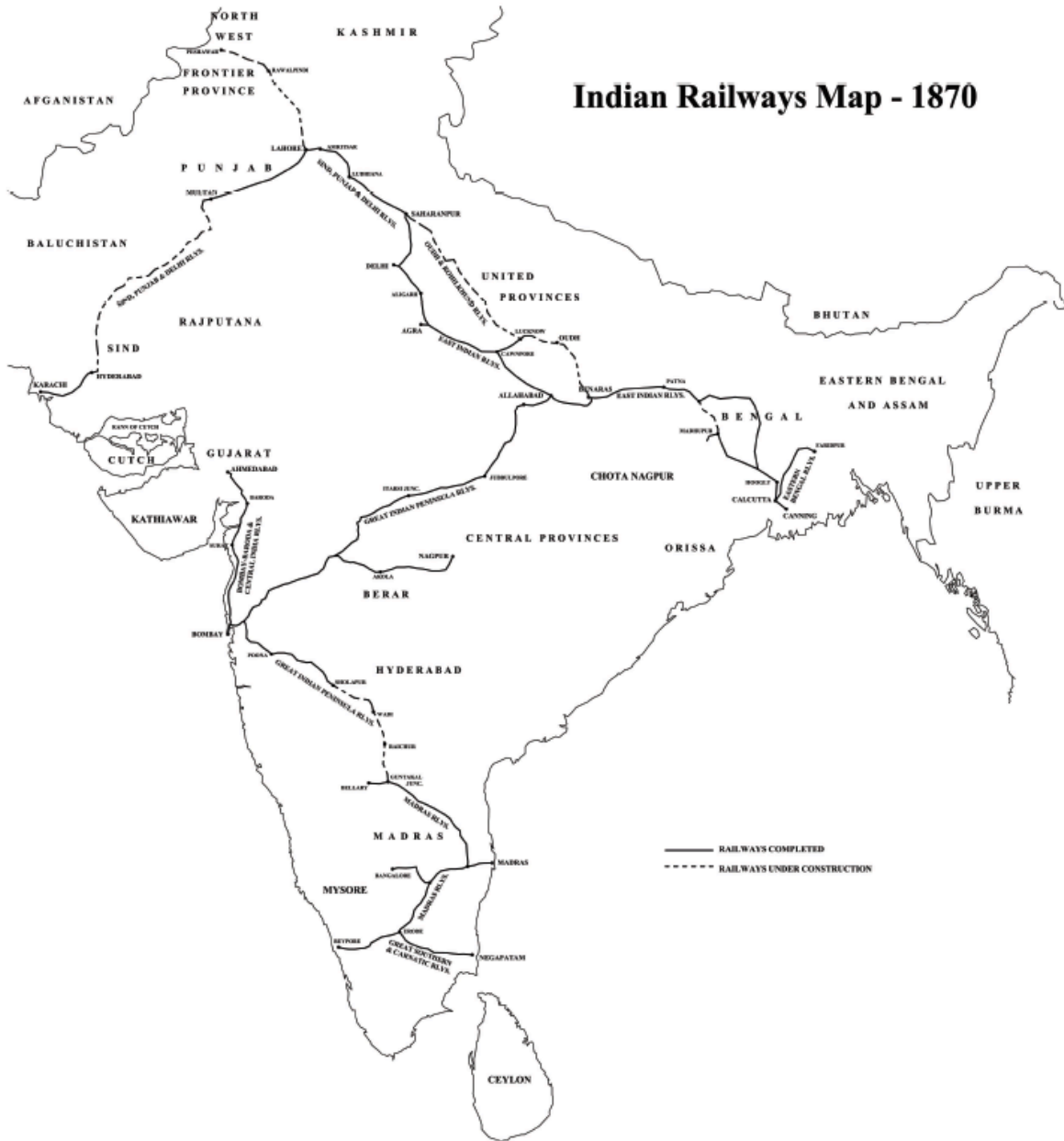
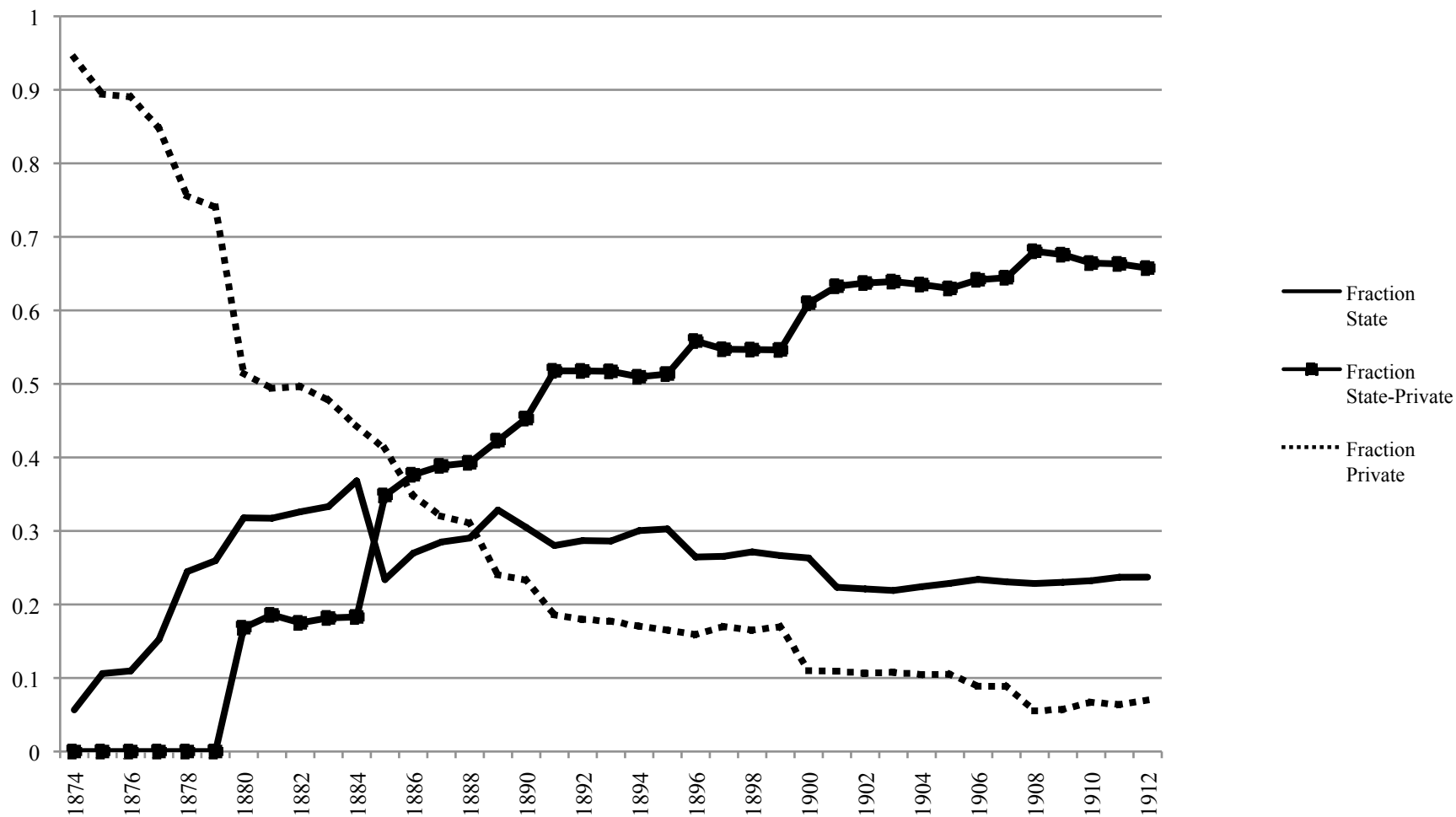


Figure 2: Indian Railways by Organization



**Figure 3: Working Expenses Residuals Against Years Since Switch**

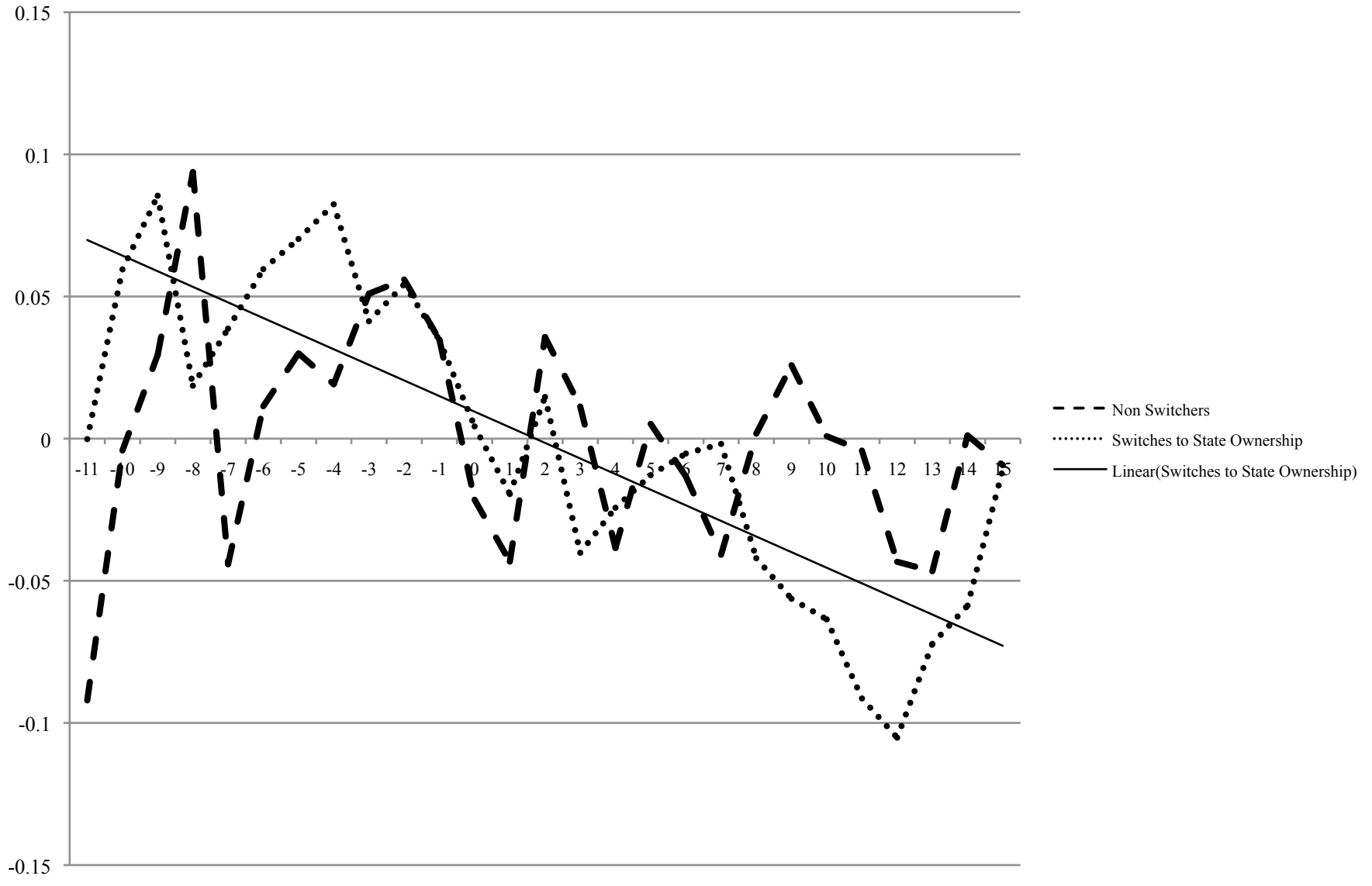


Figure 4: Working Expenses Residuals for Individual Private Companies

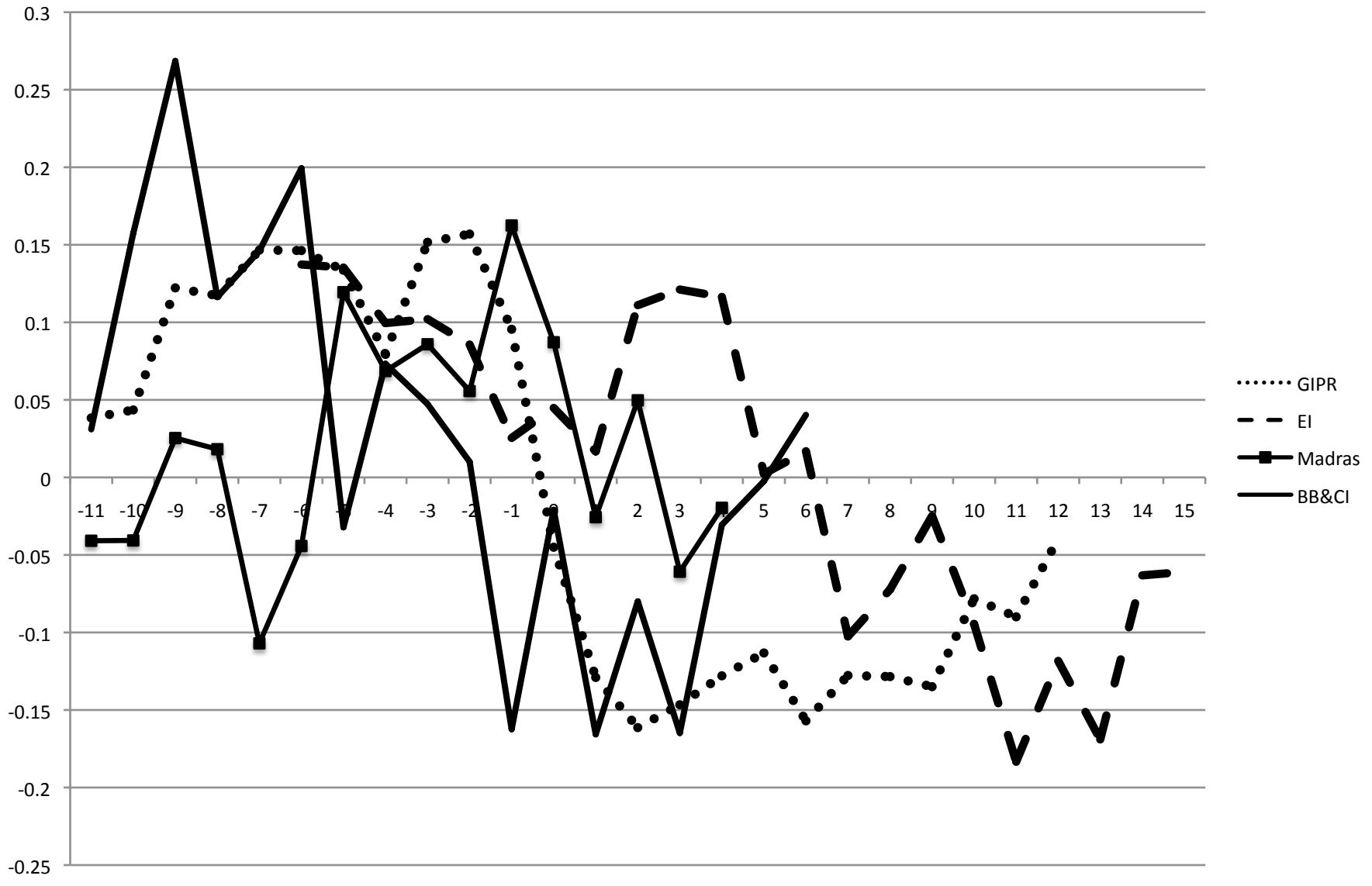
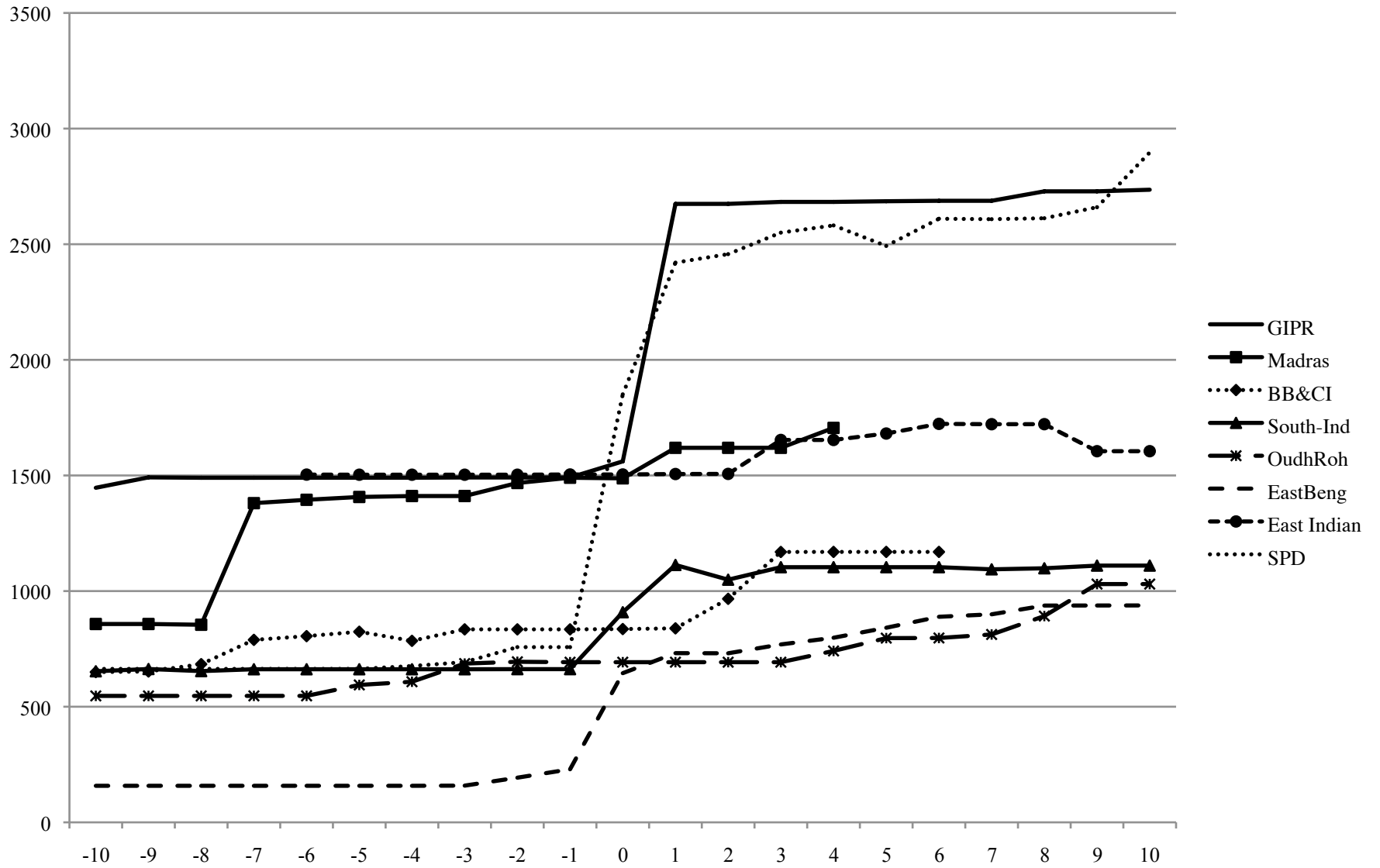


Figure 5: Mileage of Railway Systems Before and After Takeovers



**Table 1: Summary Statistics by Ownership**

	1874-1912	1880	1890	1900	1910
<b>All railways</b>					
Total miles	1244	639	1,002	1,320	1,836
Working Expenses	9,439,038	3,642,254	5,551,550	8,869,492	17,900,000
Avg Fuel Costs / Ton	11	13	9	11	11
Avg Agricultural Wages	5.9	4.6	4.8	6.8	7.8
Net Earnings/Capital Outlay	5.1%	4.3%	4.9%	5.5%	5.4%
<b>State owned railways</b>					
Total miles	1398	609	1,062	1,395	1,836
Working Expenses	10,700,000	3,340,198	5,077,313	8,970,761	17,900,000
Avg Fuel Costs / Ton	10	12	8	10	11
Avg Agricultural Wages	6.5	4.9	5.1	7.1	7.8
Net Earnings/Capital Outlay	5.1%	4.3%	4.5%	5.5%	5.4%
<b>Privately owned railways</b>					
Total miles	743	656	852	830	0
Working Expenses	5,390,390	3,814,858	6,737,142	8,211,250	
Avg Fuel Costs / Ton	13	13	11	16	
Avg Agricultural Wages	4.4	4.4	4.1	5.4	
Net Earnings/Capital Outlay	5.0%	4.3%	6.0%	5.4%	

Source: See text for details. Working expenses, fuel and labor costs are expressed in real 1900 rupees.

**Table 2: Effect of State Ownership on Log of Working Expense**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Logs</i>								
Avg Cost of Fuel	0.0880*** [0.0121]	0.0214 [0.0247]	0.0712*** [0.0228]	0.0712* [0.0384]	0.0562** [0.0218]	0.0748*** [0.0230]	0.0748* [0.0391]	0.0587*** [0.0221]
Avg Wage	0.2414*** [0.0212]	0.0409 [0.0518]	0.0358 [0.0530]	0.0358 [0.0886]	0.0616 [0.0622]	0.0399 [0.0541]	0.0399 [0.0933]	0.0638 [0.0624]
Passenger Miles	0.1709*** [0.0239]	0.1476*** [0.0525]	0.1781*** [0.0541]	0.1781*** [0.0363]	0.2310*** [0.0370]	0.1789*** [0.0536]	0.1789*** [0.0369]	0.2311*** [0.0370]
Ton Miles	0.4877*** [0.0186]	0.3139*** [0.0372]	0.3061*** [0.0375]	0.3061*** [0.0397]	0.2365*** [0.0283]	0.3130*** [0.0374]	0.3130*** [0.0415]	0.2391*** [0.0282]
Total Mileage	0.2709*** [0.0253]	0.4193*** [0.0405]	0.4345*** [0.0440]	0.4345*** [0.0395]	0.4411*** [0.0359]	0.4351*** [0.0440]	0.4351*** [0.0388]	0.4479*** [0.0368]
State Ownership	-0.1566*** [0.0224]	-0.0738*** [0.0219]	-0.1234*** [0.0237]	-0.1234*** [0.0317]	-0.1034*** [0.0269]			
Fraction of State Owned Miles						-0.1294*** [0.0255]	-0.1294*** [0.0357]	-0.1149*** [0.0305]
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Railroad FE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Railroad Trend	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Clustered S.E.	No	No	No	Yes	No	No	Yes	No
Panel Corrected S.E.	No	No	No	No	Yes	No	No	Yes
Observations	520	520	520	520	520	520	520	520
R-squared	0.976	0.989	0.992	0.992	0.99	0.992	0.992	0.99

Robust standard errors in brackets. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 3: Effect of State Operation on Log Working Expenses**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Logs</i>								
Avg Cost of Fuel	0.0737*** [0.0126]	0.022 [0.0250]	0.0712*** [0.0230]	0.0712* [0.0390]	0.0571*** [0.0219]	0.0712*** [0.0230]	0.0712* [0.0390]	0.0571*** [0.0219]
Avg Wage	0.2191*** [0.0201]	0.0445 [0.0545]	0.0358 [0.0527]	0.0358 [0.0876]	0.0631 [0.0622]	0.0358 [0.0527]	0.0358 [0.0876]	0.0631 [0.0622]
Passenger Miles	0.1606*** [0.0250]	0.1469*** [0.0521]	0.1781*** [0.0541]	0.1781*** [0.0354]	0.2303*** [0.0370]	0.1781*** [0.0541]	0.1781*** [0.0354]	0.2303*** [0.0370]
Ton Miles	0.4837*** [0.0189]	0.3131*** [0.0374]	0.3061*** [0.0378]	0.3061*** [0.0383]	0.2338*** [0.0281]	0.3061*** [0.0378]	0.3061*** [0.0383]	0.2338*** [0.0281]
Total Mileage	0.2873*** [0.0258]	0.4206*** [0.0401]	0.4345*** [0.0443]	0.4345*** [0.0370]	0.4443*** [0.0362]	0.4345*** [0.0443]	0.4345*** [0.0370]	0.4443*** [0.0362]
State Ownership	-0.2087*** [0.0247]	-0.0707*** [0.0249]	-0.1234*** [0.0262]	-0.1234*** [0.0385]	-0.0908*** [0.0280]	-0.1233*** [0.0322]	-0.1233*** [0.0385]	-0.1276*** [0.0451]
State Operation	0.0941*** [0.0208]	-0.0061 [0.0247]	0.0001 [0.0327]	0.0001 [0.0459]	-0.0368 [0.0465]			
State Ownership*Private Operation						-0.0001 [0.0327]	-0.0001 [0.0459]	0.0368 [0.0465]
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Railroad FE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Railroad Trend	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Clustered S.E.	No	No	No	Yes	No	No	Yes	No
Panel Corrected S.E.	No	No	No	No	Yes	No	No	Yes
Observations	520	520	520	520	520	520	520	520
R-squared	0.977	0.989	0.992	0.992	0.99	0.992	0.992	0.99

Robust standard errors in brackets. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 4: Evolution of Working Expenses**

	(1)	(2)	(3)	(4)	(5)	(6)
State Ownership*Years -5 to -1 before takeover	0.0077 [0.0258]	0.0077 [0.0505]	0.0049 [0.0263]			
State Ownership*Years - 5 to -2 before takeover				0.0141 [0.0263]	0.0141 [0.0495]	0.0107 [0.0265]
State Ownership*Year - 1 before takeover				-0.0267 [0.0434]	-0.0267 [0.0677]	-0.0289 [0.0375]
State Ownership*Years 0-5 after takeover	-0.1018*** [0.0363]	-0.1018 [0.0655]	-0.0912** [0.0376]	-0.1048*** [0.0363]	-0.1048 [0.0667]	-0.1045*** [0.0387]
State Ownership*Years 6-10 after takeover	-0.1750*** [0.0525]	-0.1750** [0.0709]	-0.1469*** [0.0509]	-0.1798*** [0.0528]	-0.1798** [0.0731]	-0.1606*** [0.0518]
State Ownership*Years 11-15 after takeover	-0.2586*** [0.0680]	-0.2586*** [0.0866]	-0.2088*** [0.0632]	-0.2648*** [0.0683]	-0.2648** [0.0909]	-0.2252*** [0.0643]
State Ownership*Years 16-20 after takeover	-0.2014** [0.0832]	-0.2014* [0.0997]	-0.1552* [0.0798]	-0.2099** [0.0836]	-0.2099* [0.1057]	-0.1766** [0.0805]
State Ownership*Years 21 and over after takeove	-0.1845* [0.1101]	-0.1845 [0.1402]	-0.1481 [0.0998]	-0.1954* [0.1108]	-0.1954 [0.1472]	-0.1741* [0.1010]
Year and Rairoad FE, Railroad Trend	Yes	Yes	Yes	Yes	Yes	Yes
Clustered S.E.	No	Yes	No	No	Yes	No
Panel Corrected S.E.	No	No	Yes	No	No	Yes
Observations	520	520	520	520	520	520
R-squared	0.992	0.992	0.99	0.992	0.992	0.99

Robust standard errors in brackets, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

All regressions include fuel and labor costs, passenger miles, ton miles and total mileage.

**Table 5: Detailed Working Expenses (in logs)**

	Maintenance (1)	Locomotive (2)	Carriage (3)	Traffic (4)	General & Misc (5)	Traffic (6)	General & Misc (7)
<i>Logs</i>							
Avg Cost of Fuel	0.0601 [0.1008]	0.0695 [0.0404]	-0.0122 [0.0774]	-0.0042 [0.0465]	0.0364 [0.0431]	0.0037 [0.0460]	0.044 [0.0422]
Avg Wage	0.0927 [0.2327]	-0.027 [0.1225]	0.0625 [0.1507]	-0.1046 [0.1383]	0.0967 [0.1302]	-0.091 [0.1184]	0.1075 [0.1389]
Passenger Miles	0.0354 [0.0829]	0.1245** [0.0454]	0.0838 [0.0713]	0.1709** [0.0603]	0.2233** [0.0910]	0.1562** [0.0603]	0.2167** [0.0887]
Ton Miles	0.2865*** [0.0766]	0.3508*** [0.0398]	0.5045*** [0.0480]	0.2268*** [0.0464]	0.2668*** [0.0512]	0.2263*** [0.0457]	0.2734*** [0.0546]
Total Mileage	0.5054*** [0.0910]	0.3532*** [0.0664]	0.2735** [0.1048]	0.2906*** [0.0618]	0.4880*** [0.0805]	0.3413*** [0.0466]	0.5140*** [0.0797]
State Ownership	-0.1185 [0.0985]	-0.0664 [0.0521]	-0.1216 [0.0923]	-0.0912* [0.0476]	-0.1673* [0.0813]		
Fraction of State Owned Miles						-0.1872** [0.0772]	-0.2213** [0.0771]
Year and Railroad FE, Railroad Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clustered S.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	519	520	520	520	520	520	520
R-squared	0.952	0.984	0.966	0.986	0.973	0.987	0.973

Robust standard errors in brackets, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 6: Heterogeneous Effects of Guarantees?**

	Log Working Expenses			
	(1)	(2)	(3)	(4)
<i>Logs</i>				
Avg Cost of Fuel	0.0707*** [0.0228]	0.0707* [0.0385]	0.0740*** [0.0230]	0.0740* [0.0391]
Avg Wage	0.0367 [0.0530]	0.0367 [0.0906]	0.042 [0.0544]	0.042 [0.0976]
Passenger Miles	0.1797*** [0.0552]	0.1797*** [0.0377]	0.1832*** [0.0559]	0.1832*** [0.0392]
Ton Miles	0.3040*** [0.0386]	0.3040*** [0.0394]	0.3101*** [0.0382]	0.3101*** [0.0412]
Total Mileage	0.4356*** [0.0439]	0.4356*** [0.0404]	0.4363*** [0.0440]	0.4363*** [0.0396]
State Ownership	-0.1367*** [0.0378]	-0.1367*** [0.0401]		
State Ownership*Receiving Guarantee	0.0215 [0.0464]	0.0215 [0.0637]		
Fraction of State Owned Miles			-0.1524*** [0.0385]	-0.1524*** [0.0485]
Fraction State Owned Miles*Receiving Guarantee			0.037 [0.0480]	0.037 [0.0702]
Year and Railroad FE, Railroad Trend	Yes	Yes	Yes	Yes
Clustered S.E.	No	Yes	No	Yes
Observations	520	520	520	520
R-squared	0.992	0.992	0.992	0.992

Robust standard errors in brackets, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Appendix Table 1: Effect of State Ownership on Log of Working Expense (Panel including Premerged Lines)**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Logs</i>								
Avg Cost of Fuel	0.0815*** [0.0117]	0.0246 [0.0242]	0.0736*** [0.0226]	0.0736* [0.0378]	0.0589*** [0.0167]	0.0773*** [0.0228]	0.0773* [0.0385]	0.0616*** [0.0171]
Avg Wage	0.2475*** [0.0210]	0.0415 [0.0512]	0.0395 [0.0532]	0.0395 [0.0879]	0.0641 [0.0428]	0.0431 [0.0543]	0.0431 [0.0926]	0.0661 [0.0443]
Passenger Miles	0.1777*** [0.0228]	0.1587*** [0.0496]	0.1959*** [0.0516]	0.1959*** [0.0348]	0.2479*** [0.0285]	0.1958*** [0.0512]	0.1958*** [0.0356]	0.2473*** [0.0288]
Ton Miles	0.4794*** [0.0183]	0.3098*** [0.0345]	0.3029*** [0.0354]	0.3029*** [0.0379]	0.2424*** [0.0168]	0.3096*** [0.0353]	0.3096*** [0.0397]	0.2452*** [0.0172]
Total Mileage	0.2669*** [0.0239]	0.4173*** [0.0388]	0.4312*** [0.0425]	0.4312*** [0.0396]	0.4329*** [0.0321]	0.4330*** [0.0425]	0.4330*** [0.0387]	0.4394*** [0.0337]
State Ownership	-0.1736*** [0.0217]	-0.0726*** [0.0217]	-0.1242*** [0.0235]	-0.1242*** [0.0319]	-0.1051*** [0.0217]			
Fraction of State Owned Miles						-0.1318*** [0.0253]	-0.1318*** [0.0362]	-0.1173*** [0.0223]
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Railroad FE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Railroad Trend	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Clustered S.E.	No	No	No	Yes	No	No	Yes	Yes
Panel Corrected S.E.	No	No	No	No	Yes	No	No	Yes
Observations	549	549	549	549	549	549	549	549
R-squared	0.977	0.989	0.992	0.992	0.99	0.992	0.992	0.99

Robust standard errors in brackets. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Appendix Table 2: Effect of State Ownership on Log of Working Expense (including capital costs per mile)**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Logs</i>								
Avg Cost of Fuel	0.1124*** [0.0121]	0.0287 [0.0247]	0.0714*** [0.0227]	0.0714* [0.0392]	0.1140*** [0.0119]	0.0336 [0.0250]	0.0750*** [0.0229]	0.0750* [0.0400]
Avg Wage	0.1669*** [0.0227]	0.0575 [0.0515]	0.0414 [0.0519]	0.0414 [0.0901]	0.1742*** [0.0220]	0.0528 [0.0514]	0.0454 [0.0531]	0.0454 [0.0948]
Passenger Miles	0.1815*** [0.0232]	0.1288** [0.0538]	0.1728*** [0.0535]	0.1728*** [0.0409]	0.1780*** [0.0232]	0.1303** [0.0532]	0.1735*** [0.0530]	0.1735*** [0.0412]
Ton Miles	0.3886*** [0.0254]	0.2877*** [0.0386]	0.2903*** [0.0376]	0.2903*** [0.0450]	0.3876*** [0.0251]	0.2889*** [0.0387]	0.2971*** [0.0376]	0.2971*** [0.0465]
Total Mileage	0.3502*** [0.0280]	0.4641*** [0.0495]	0.4672*** [0.0498]	0.4672*** [0.0599]	0.3642*** [0.0275]	0.4646*** [0.0494]	0.4678*** [0.0498]	0.4678*** [0.0584]
Capital per mile	0.2360*** [0.0359]	0.1509 [0.0968]	0.1055 [0.0801]	0.1055 [0.1058]	0.2335*** [0.0347]	0.1471 [0.0957]	0.1057 [0.0789]	0.1057 [0.1035]
State Ownership	-0.0793*** [0.0245]	-0.0627*** [0.0218]	-0.1217*** [0.0245]	-0.1217*** [0.0317]				
Fraction of State Owned Miles					-0.1140*** [0.0283]	-0.0745*** [0.0250]	-0.1275*** [0.0266]	-0.1275*** [0.0362]
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Railroad FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Railroad Trend	No	No	Yes	Yes	No	No	Yes	Yes
Clustered S.E.	No	No	No	Yes	No	No	No	Yes
Observations	520	520	520	520	520	520	520	520
R-squared	0.978	0.989	0.992	0.992	0.979	0.989	0.992	0.992

Robust standard errors in brackets. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1