Competing on the Rails: Evidence from the UK Experience[1]

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Abstract

The paper investigates the effects of privatisation using evidence from the British rail industry. I collect and analyse an extensive database of firm and industry characteristics for passenger services in an annual time series from 1984 to 2004. Observations from the newly created passenger operators and infrastructure manager are pooled to create an artificially integrated monopolist. Using a general-to-specific inspired econometric approach I model operating efficiency in a dependent relationship with output, quality, safety, competition, employment, incentives and government support. By including a vertical separation dummy the analysis takes into account vertical economies that may be present in the rail industry. Results support theories on privatisation that emphasise the importance of the introduction of competition (at least ex-ante with competitive franchise bidding). Vertical economies outweigh the positive effects of competition. Incentives do not appear to be of effect whereas train accidents and fatality rates have a negative impact on operating efficiency. Forecasting techniques highlight the poor performance of the post-privatisation regime and show increases in costs per unit of output of around 30 per cent. Furthermore the difference is shown to be stable over the ten-year post-privatisation period.

JEL Classifications: L33, L92, G38, D40

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1 Introduction

On July 29th 1991 a EU (then called EC) directive was released which required the separation of railway infrastructure from operations and mandated the introduction of competition in construction, maintenance and provision of services:

> The aim of this Directive is to facilitate the adoption of the Community railways to the needs of the Single Market and to increase their efficiency;
>
> - by ensuring the management independence of railway undertakings;
> - by separating the management of railway operation and infrastructure from the provision of railway transport services, separation of accounts being compulsory and organizational or institutional separation being optional,
> - by improving the financial structure of undertakings,
> - by ensuring access to the networks of Member states for international groupings of railway undertakings and for railway undertakings engaged in the international combined transport of goods.
>
> (Council Directive 91/440/EEC of 29 July 1991: Article 1)

Further the Directive required that

> Member States shall take the measures necessary to ensure that the accounts for business relating to the provision of transport services and those for business relating to the management of railway infrastructure are kept separate. Aid paid to one of these two areas of activity may not be transferred to the other. The accounts for the two areas of the activity shall be kept in a way which reflects this prohibition. Member States may also provide that this separation shall require the organization of distinct divisions within a single undertaking or that the infrastructure shall be managed by a separate entity.
>
> (Council Directive 91/440/EEC of 29 July 1991: Article 6)

One year later in July 1992 the UK White Paper New Opportunities for the Railways was published by the Department of Transport. These new opportunities were meant to arise from the introduction of private management and liberalisation of the sector. The steps that were consequently undertaken between 1994 and 1997 were the most radical to be introduced in Europe up to today. Although there has been some movement back to a less market-oriented approach (like creating a new infrastructure manager that runs as a non-for-profit company rather than being owned by share holders like the original infrastructure manager was), the complete separation of infrastructure and all types of operations (i.e. passenger and freight services, maintenance, rolling stock provision, infrastructure services, etc.) is still in place. (The privatisation process and its shortcomings have been elaborated in some detail, see for example Nash (1993), Nash (2002), Curwen (1997), Gourvish (2002), Pollitt & Smith (2002))

Even though the literature occasionally describes railway privatisation and restructuring as having become a mainstream policy option (and certainly one to be supported recent EU directives), the questions surrounding the complete separation continues to be subject to considerable debates. In the light of EU mandates and the trend in low-income countries to privatise railways, it seems obvious, even unavoidable, to ask some key questions. Do vertical economies matter in a separated rail industry? If so, how large is their impact on cost efficiency? Is competition for monopoly effective in decreasing expenditure per unit of output? Does one of those effects dominate the other? Beyond those issues of efficiency and competition this paper considers what are often viewed as critical areas like safety and employment.

Theoretical models alone cannot provide a satisfactory answer to such questions, especially when one considers that many different factors may influence the outcome of a deregulation process. With regard to the rail industry in general and the British case in particular, we find that there are not many studies (especially with a long enough time series) and that a research project with quality data and sound econometric analysis is long overdue. Hence, we feel that the need for a thorough empirical investigation is a strong one — a view that Megginson & Netter (2001) in their literature survey support:

> It is tempting to point to the spread of privatisation programs around the world during the past two decades and conclude that

> the debate on the economic and political merits of government versus private ownership has been decided. But such a conclusion is flawed, since 25 years ago proponents of state-ownership could just as easily have surveyed the postwar rise of state-owned enterprises ... (Megginson & Netter 2001, 321)

However, it should be noted that our approach is not first and foremost aimed at answering the private vs. public ownership debate. The railroad industry is a network industry and as such exhibits some particular features. First of all it can be broadly divided into fixed infrastructure, traffic control systems and operations (Knieps 2000). The rail infrastructure is subject to sunk costs, since when demand falls, parts of the network cannot easily be transferred to another geographical market. The particular features of the rail industry mean that our results should be especially relevant for natural monopolies with significant sunk costs and the infrastructure/operations dichotomy. One needs to point out that for natural monopolies the considerations for private ownership and competition are not quite the same as for industries where the market performs well. So the question really is whether in this case the efficiency gains can set off any adverse effects from dissolving a natural monopoly.

There are two main reasons to look at the railway industry in Great Britain. Firstly, the process of privatisation and events ever since (i.e. Hatfield and subsequent problems) gave rise to heated discussions within and far beyond academia whether the privatisation of British Rail was hasted or even unnecessary. Secondly, very few other railways have followed the UK example and attempted a separation of tracks and rolling stock operations. The more common policy is to split the private monopoly into several freight and passenger units that enjoy quasi local monopolies. Other countries (e.g. Argentina, Brazil, Switzerland, Japan, Sweden, Germany, France...) wouldn't be as suitable to investigate the impact of franchise competition and vertical economies on efficiency.

I develop a time series model that is based on a general-to-specific econometric approach. An artificially integrated operator is created for the period of the liberalised regime to compare pre- and post privatisation performance. The paper is structured as follows. Section 2 outlines the framework for the analysis and discusses the key models with regard to rail liberalisation. Section 3 offers a brief overview of the sample and data collection methods

and outlines the methodology that will be applied in this paper. Section 4 presents the empirical results, and Section 5 concludes.

2 Theoretical Perspectives and Empirical Interpretations

The modern economics of regulation centers around the two cornerstones of incentives and competition. This section discusses the relevant theoretical predictions of modern regulatory economics. The new economics of regulation aims to design a normative theory on optimal regulation in an incomplete information framework. Laffont & Tirole (1993) and Laffont (1994) emphasise how previous approaches to regulation were lacking in serious attempts to achieve an outcome with a least cost outcome with optimal quality levels while establishing appropriate incentives. Against the backdrop of the development of principal-agent theory it was recognised that optimal regulatory policy needed to be designed with respect to incentive-compatibility.[3]

In addition when an industry contains monopolistic (track and stations) as well as potentially competitive elements there are two major options for a decision maker. The first is to restructure prior to privatisation and force the integrated incumbent to divest or keep the vertically integrated monopolist regulating the incumbent in a way that fosters competition and entry. The former was for example the case with the British electricity market and the latter with the British telecommunications market (for an overview of the early privatisation programme in Britain see Vickers & Yarrow (1988)). Vickers (1995) models this setting in the presence of imperfect competition and imperfect information. He shows that depending on demand conditions separation or integration might be preferable.

In theory regulation should be incentive-compatible whether or not we are dealing with a divested or integrated industry structure. However there is a large literature on the importance of (inappropriate) incentives in publicly owned enterprises. One major factor is the lack of financial discipline caused by "soft" budget constraints. An overview of public and private ownership and incentive issues in this context is given by Laffont & Tirole (1991).

[3]Excellent overviews of these developments are provided for example by Laffont (1994), Vogelsang (2002) and Armstrong & Sappington (2006)

2.1 Vertical Economies

One of the criticisms of the divesture approach (i.e. breaking up the vertically integrated firm and prohibiting the owner of essential facility to participate in the competitive business) is the presence of vertical economies. Often decision makers have therefore opted for the less radical option of letting the vertically integrated incumbent continue operations while simultaneously regulate access charges and foster some competition. The separation of different stages of production and distribution on the other hand implies that transfer and connection costs arise that would not apply to an integrated monopolist. Williamson (1971) offers an early attempt to systematically show the attractiveness of vertical integration and internalisation. Sources of vertical economies can include costly contractual arrangements, coordination failures in provision of services (which is particularly relevant for the rail industry), costly market transfers, information problems and a higher degree of uncertainty and risk aversion. Kaserman & Mayo (1991) develop and examine a model of vertical economies in the electricity industry and detect the presence of significant vertical cost complementaries. Empirical evidence from Jensen & Stelling (2005) finds significant vertical economies for the Swedish rail industry.

2.2 Competition for Monopoly: Franchise Bidding

The merits of franchise bidding for the right to monopolise were highlighted in a seminal discussion by Demsetz (1968). Early formal models on the optimal design of franchise auctions include Laffont & Tirole (1987) and Riordan & Sappington (1987). However empirical tests seldom address the effectiveness of franchise bidding in a public utility setting. This is regrettable as the success (failure) of vertical separation and divesture of a network industry largely depends on the (un)successful attempts to introduce competition in the downstream (operations) sector.

Although it is important to analyse franchising in the British railway context, it should be noted that the franchise bidding process in Britain can only loosely be termed a franchise auction in the economic sense suggested by theory. Since the start of the new framework there has been a degree of uncertainty surrounding the exact process for franchising. Since 1996 franchises have first been awarded by the Office of Passenger Rail Franchising

(OPRAF), from 2001 by the Strategic Rail Authority (SRA) and then jointly by the SRA and the Department for Transport (DfT Rail). The franchises are awarded on the basis of the base services specification, bidder's priced options and bidder-generated options. Pre-qualified bidders receive an Invitation to Tender (ITT) sets out the frequency of service, and other essential requirements. Bidders are invited to set out delivery plan for reliability, cost reduction and revenue increase. Decisions are based on a Value for Money appraisal that includes factors like risk management. The first round of franchise auctions were characterised by optimistic bids by prospective operators resulting in a number of renegotiations and one early termination of the South Eastern franchise. Nevertheless even the British franchising process does introduce some competition (or contestability rather) and therefore needs to be evaluated.

3 Data and Methodology

3.1 The Data

The data collected for this research mainly stems from the National Archives (where British Railways Boards documents were transferred to), from the Department for Transport and the industry regulators: Office of Passenger Rail Franchising (OPRAF), Office of the Rail Regulator (ORR), Strategic Rail Authority (SRA), Health and Safety Executive (HSE) and the Rail and Safety Standards Board (RSSB). Additional firm information was obtained from the firms themselves and the FAME database which contains information on UK and Irish companies and businesses. The documentations and publications which were used to construct the data base fall into eight categories: (1) audited financial statements; (2) industry consultations; (3) policy reports; (4) firm prospectuses; (5) internal memoranda between officials; (6) quarterly and annual statistical publications; (7) evaluations of franchise performance; (8) press and statutory notices; and (9) industry reports.

The database includes data for all 25 passenger franchises, Railtrack, Network Rail and the British Railways Board (BRB) over 20 years from 1984 until 2004 (in practice 1984 corresponds to the financial year 1983/1984 and 2004 to the financial year 2003/2004). Although the limited number of cross section observations would generally be problematic for estimation, in this particular case the sample represents the entire population of train operating

companies in Britain (including non-franchised services like Heathrow Express). The variables in the database and their description can be found in Table I. Firm, industry and franchise characteristics are arranged in groups: (1) production; (2) competition; (3) employment; (4) government support; (5) incentives; (6) quality; (7) safety; and (8) vertical economies.

Table I: Description of the Variables

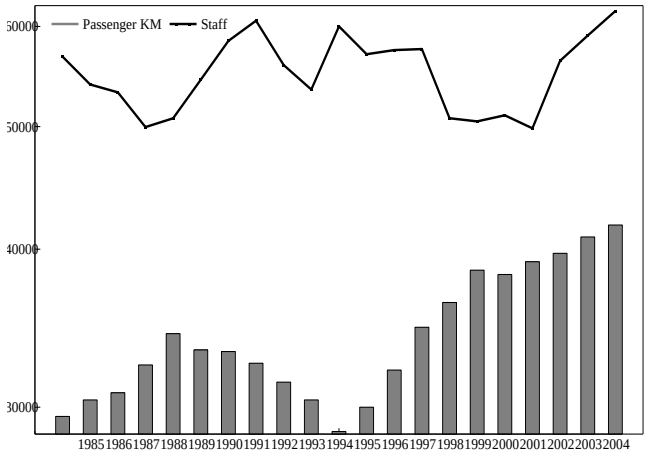
Variable Group	Variable Name	Description
Production	Y^N	Output divided by network size in kilometres.
	C	Operating costs divided by passenger kilometres
	INV	Investment proxied by fixed assets excluding depreciation.
Competition		
	NUM^{FRAN}	Number of franchises in year t.
	$COMP$	Number of companies in the industry in year t (i.e. franchise holders).
Employment	$STAFF$	Number of staff employed.
	$WAGES$	Annual wages and salaries.
Government Support	$FRANGRANT$	Franchise grants.
	SUB	Subsidies granted for infrastructure.
Incentives		
	PAY^{DIR}	Remuneration of Directors.

TABLE I (CONTINUED)

Variable Group	Variable Name	Description
Quality		
	AGE	Average train age.
	AGE^{SQ}	AGE squared.
	$PERF$	Number of services delayed by more than 5 or 10 minutes
	$CANCEL$	Number of services cancelled
Safety		
	$SPAD$	Signals passed at danger (not available for BRB).
	$FATAL$	Fatalities per train kilometre (excluding trespasses classified as suicides).
	$ACCIDENTS$	Number of train accidents per train kilometre (includes fires, excludes broken windscreens).
	$FIRE$	Number of accidents caused by outbreak of fires on trains.
Vertical Economies		
	D^V	Dummy variable equal to 1 from 1994 onwards, 0 otherwise.

Notes: All variables are reported $\forall i, t$ (unless stated otherwise) and in real terms.

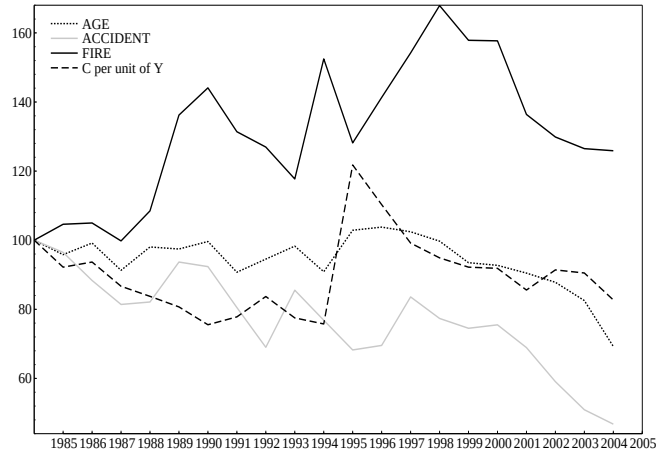
Figure I: Passenger Kilometres (m) and Railway Staff



In attempts to preserve the originality of the data, any manipulation and adjustments were kept to a minimum. Financial data for two train operators is reported for calender years and had to be quite crudely transformed into financial years (by summation and dividing by 2). Wages and salaries reported for train operating companies in their early years of existence partially included costs for pensions and social security. However, this was not considered to be a major problem, since in the first few years these costs were negligible. Some values for $PERF$ and $CANCEL$ were missing and had to be filled using statistical interpolation (this concerns solely BRB years). During the period of privatisation (1994-1997) the introduction of Railtrack and the separation of BR meant that the transferal of assets, staff, tasks etc. most certainly lead to measurement error in reported figures. Similarly the train operators did not come into existence at exactly the same time rendering the pooled financial data less reliable for this period. For the variable $ACCIDENT$ train incidents caused by broken windscreens had to be excluded as those figures were only required to be reported after 1995. Eurostar was excluded from the analysis because of consistency the special nature of its operations.

Figure I and Figure II reveal some trends and developments in variables of special interest. Passenger kilometres (in million) have experienced a considerable rise in the past 10 years compared to a stable pattern in railways

Figure II: Evolution of Costs, Fires, Accidents and Train Age



staff numbers. It follows that the simple measure of labour productivity in terms of output per employee has also risen over that period. One could easily debate the usefulness of this type of measure, however, it is quite regularly used to compare the 'efficiency' of railways across countries. It would also be premature to attribute this growth in passenger kilometres to privatisation or deregulation, indeed, it would be equally possible to make a connection with economic performance (or investment and subsidies for that matter). Similarly, looking at modal shares for example (i.e. by considering other modes of transport) this growth in passenger output looks far less impressive.

Using 1984 as the index year (1984=100) Figure II traces the evolution of costs, fires, accidents and train age. All of these variables are adjusted for output and where applicable adjusted to account for inflation. Costs per unit of output (measured in terms of passenger km) do not appear to follow a definite trend although the years of privatisation (1994-1997) saw a rise in unit costs. One matter which becomes apparent is that, as far as quality or safety variables are concerned, the picture changes depending on the focus. Looking at accidents and train age for example there appears to be a clear downward trend, with cancelled trains, accidents caused by fires or fatalities there is a higher degree of ambivalence.

3.2 Methodology

For the time series approach cross section observations post 1994/5 are pooled to create one single artificially 'integrated' passenger operator. Loosely based on the idea of a general to specific approach (using the general-to-specific mode in *PcGets*) the model is estimated as

$$\boldsymbol{C}_t = f(\boldsymbol{X}_t, \boldsymbol{P}_t), \tag{1}$$

where the dependent variable $\boldsymbol{C}_t$ is operating expenditure divided by output. On the right hand side $\boldsymbol{X}_t$ as the base specification comprises a constant, time, $COMP_t$, $\ln Y_t^N$ and D_t^V. The base specification is motivated by theoretical models that demonstrate on the one hand the importance of economics of density for the railroad industry (Braeutigam, Daughety & Turnquist 1984) and on the other hand the presence of vertical economies. Although the choice of time t may seem ad-hoc at first, it is quite likely that over a 20 year period one does require at least a proxy for technological change or innovations of some kind. Economic theory suggests that competition and vertical economies are an important factor in determining costs per unit of output.

Quality, safety, incentive, employment, government support and performance variables are included in $\boldsymbol{P}_t$ (see Table I for reference). The inclusion of variables in $\boldsymbol{P}_t$ is based on formulating a general model and then testing down to obtain the best model. Such an approach is used to at least partially avoid to what is referred to as 'data mining' in the literature (Lovell 1983), i.e. models are revised from bottom to top, given evidence already obtained from the data. Especially the existence of a database with few observations and a relatively large number of variables implies that randomly running regressions may lead to controversial (and not replicable) results. As much as theory is one guide on which decisions about the inclusion of variables and the structure of the model can be based, testing down from a general model can offer additional advantages. This has been demonstrated to great effect in recent literature (Hendry (2000), Hoover & Perez (1999)).

This paper however does not (yet) follow a computer automated *Gets* or Bayesian approach. Neither is it attempted to start with a general specification that allows for differenced variables or error correction terms. The limited number of observations also means, that in the general model, I only

allow for a static, autoregressive and distributed lag model with lag-length set to one (or zero respectively). After estimating and testing a model, progress analysis reports are evaluated and either the general model is rejected or it is not. The decision on whether to reject the more general model is based on values for log-likelihood, the AIC, BIC and HQ criteria and ultimately on critical values for F-tests for reduction of previously specified models.

The first step when searching for the specification of the model is to exclude variables with a very large p-value (typically 0.8 or higher). Then the next most general model that can feasibly be tested will allow for an autoregressive as well as distributed lags structure for the remaining variables. If applicable further reductions will be attempted by reducing the number of parameters. Ideally, the model thus eventually selected additionally meets the requirement of performing well in diagnostic tests and of being consistent with economic theory.

4 Results

The results from time series estimation are presented in Table II. Column (1) and (1BR) report results applying the preferred model to the full sample and the British Rail sample respectively. Column (2) and (2BR) report results for the second-best model found by the technique described in Section 3.2.

Using the Cook-Weisberg test for heteroscedasticity the null hypothesis of constant variance cannot be rejected with $\chi^2(1)$ of 2.33 and 2.11 respectively for a critical value of 3.841. Additionally rerunning the models in robust regression mode alters the results only marginally. To test for serial correlation I examine the Durbin-Watson d-statistic for the full and the sub samples and again find that no correlation cannot be rejected. Using a Breusch-Godfrey LM test the presence of higher order serial correlation cannot be detected either. Since both models do not perform as well in the subsample of British Rail I conduct a Chow test for model (1) which yields 1.6243. The critical value for 0.05 is $F(5, 15) = 2.9$ so the null hypothesis of structural stability cannot be rejected.

SC, HQ and AIC show that (1) is superior which is confirmed by F-test of model reduction. $F(1, 13) = 1.4865$ (critical value 4.66) for (1) as a reduction of (2) which would imply acceptance of the (1) but as the Schwarz Bayesian and Akaike information criteria are close I report both models.

Table II: Estimation Results, Time Series

Explanatory Variable	OLS (1)	OLS (1BR)	OLS (2)	OLS (2BR)
Y^{NET}	-0.0375	-0.0582	-0.0247	-0.0186
	(-1.77)	(-1.49)	(-1.06)	(-0.32)
D_t^V	0.0716	0.0701	0.0719	0.0085
	(11.18)	(8.81)	(11.4)	(7.83)
$ACCIDENT$	-0.9554	-0.7934	-0.8826	-0.9774
	(-2.75)	(-1.41)	(-2.55)	(-1.55)
$FATAL$	-0.0085	-0.0086	-0.0113	-0.0166
	(-1.81)	(-1.34)	(-2.19)	(-1.74)
$CANCEL$			-0.3618	-0.4289
			(-1.22)	(-0.79)
$COMP$	-0.0014		-0.0016	
	(-2.46)		(-2.74)	
t	-0.0046	0.0044	-0.0045	-0.0051
	(-5.98)	(-4.32)	(-6.10)	(-4.38)
$CONS$	9.850	9.794	9.691	10.748
	(7.10)	(5.48)	(7.07)	(5.45)
$\bar{R}^2$	0.9411	0.9442	0.9431	0.9371

Values for the t-statistic are reported in parenthesis. $\bar{R}^2$ is the adjusted R^2. The dependent variable in all models is cost per unit of output in year t.

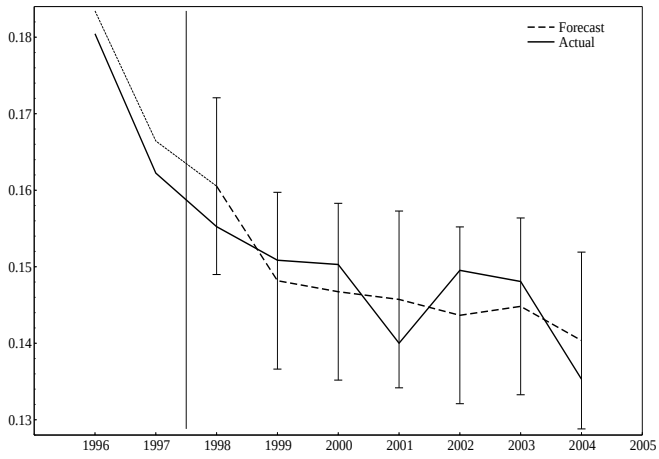
Reducing the model further by restricting the coefficients of $FATAL$ or $ACCIDENT$ to 0 yields F-test model reduction results of $F(1,14) = 7.7253$ and $F(1,14) = 7.5611$ respectively (with critical value equal to 4.6). Therefore further reductions of model (1) are not considered.

Both models deliver some interesting insights and yet leave considerable room for debate. As expected $COMP$ and D^V are highly significant and of the right sign. Y^{NET} in (1) is only just significant at the 10 per cent level which implies that in Great Britain economies of density may not be that relevant. Quality and safety indicators in general have negative explanatory power for unit costs. One explanation for the negatively signed $ACCIDENT$, which is consistently significant at the usual confidence intervals, might be that it proxies for well maintained coaching stock and locomotives and therefore decreases costly disruptions caused by delays or by major work. Variables meant to capture incentives do not appear in the final model. However this may well be due to the fact that finding a satisfactory proxy for incentives over the whole sample proved to be extremely difficult. Only director's remuneration is available $\forall t$ but it is dropped from the model at an early stage because of an extremely high p-value.

Scope for discussion is delivered by the long-time downward trend in unit costs which could be also interpreted as ongoing restructuring measures prior to privatisation. Empirical studies (see Megginson & Netter (2001) for an overview) have shown that efficiency gains for (formerly) publicly owned enterprises can be observed in the run up to privatisation as-well as afterwards. Indeed, it is unlikely that the British Railways Boards woke up totally surprised in 1994 realizing that they were about to be turned into 105 privately owned companies. On the other hand, the railroad industry was one of the last big industries in Great Britain to be privatised and liberalised, a move that was not yet openly discussed in 1984. Moreover, there was a positive signal when contrary to expectations prevailing at the time, the electrification of the East Coast Mainline was carried out under the government of Margaret Thatcher. Debates about the restructuring of BR only started around 1989 and although a decision came about in late 1992, most questions about the exact industry structure were still unanswered. Therefore, it is likely that the downward trend also captures another effect like technological change rather than simply highlighting the effect of prior restructuring measures.

Figure III: Predicted and Actual Costs per Unit of Output (Integrated)

Figure IV: Predicted and Actual Costs per Unit of Output (Separated)



Allowing for a forecast error band Figure III shows that the actual values of $\boldsymbol{C}_t$ are well above those forecasted using data from the integrated British Rail. Figure IV shows the forecast for a scenario where a separated firm does not face any competition.

5 Conclusion

The empirical analysis and results in this paper leave considerable room for debate and further research. Depending on how conservative one is about forecasting error bands the effect of vertical economies on unit costs could be around 30 to 40 %. This prediction of course cannot take into account that some of the downward trend in BR unit costs was due to restructuring measures prior to privatisation. Further, one also has to be aware that the practical implementation of the post-privatisation structure has often been described as being far from optimal. The analysis of vertical economies in this paper is based on observations from an actual separation experience not an efficient one. Therefore a dummy variable will act as a fairly crude proxy for vertical economies and will also pick up on those effects. On the other hand the difference in actual and predicted operating efficiency appears to be of such magnitude and persistence that vertical economies most certainly matter.

Further it should be noted that industry-wide risk-aversion after the accidents in Potter's Bar and Hatfield has led to quite dramatic increase in costs (especially for the infrastructure manager). Therefore, it should be concluded that even though vertical economies do matter, it is entirely possible that careful industry design in combination with the stimulation of competition imply higher cost efficiency for vertically separated railway industry rather than an integrated monopolist. Competition as this paper shows could be the essential tool in this context. Consequently a careful reconsideration of the franchising process and the number of franchises should be a priority on the policy agenda. Especially the ongoing reduction of the number of franchises seems questionable in the light of this study.

A further general policy direction suggested by the results is the serious consideration of the option of local integrated monopolies that compete through franchise bidding may be a suitable alternative to a separate infrastructure manager. Noting the structure of the rail industry in Great

Britain today one cannot deny that considerable concentration is already in place anyways. Most of the franchises are owned by three major players who in turn mostly operate in related transport industries (bus operators, sea freight). It would be unrealistic to expect that a bus and rail operator owned (or "franchised") by the same parent company will compete with itself any more than British Rail fostered yardstick competition between its Intercity and Regional segments. One should keep in mind in this context that especially in Great Britain externalities arising from road congestion, noise and environmental pollution are such that they should not simply be used to justify subsidies for railways but more importantly a well-designed regulatory structure and thought-through franchising mechanism.

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