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The Impact of Structural and Contractual Arrangements on a Vertically Separated Railway*

LUISA AFFUSO**
London Business School
DAVID NEWBERY
University of Cambridge

Abstract: The unbundling of railways in Britain has been heavily criticised as undermining the passenger rail system. Economic theory suggests that structural separation and short-lived contracts hinder incentives to invest in relation-specific assets. This paper consitutes an initial investigation of this proposition. It investigates whether the investment pattern of the rail passenger franchisees responds to structural and contractual characteristics using a unique panel of data on the privatised railways in Britain. Its findings suggest that unbundling and competition for franchises combined with commercial objectives can provide strong incentives towards better performance, as is the case for investment behaviour.

I INTRODUCTION

Between 1994 and 1997 a process of radical restructuring and privatisation of British Rail (BR) took place, unbundling the vertically integrated monopolist BR into almost 100 separate companies. A large number of contracts, monitored by two regulators, tied these companies together.

The operation of passenger railway services was transferred by means of public auctions to 25 Train Operating Companies (TOCs). Thus 25 monopoly franchise contracts were awarded to about twelve companies, for a duration

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** Contact details: London Business School, Regent's Park, London NW1 4SA, United Kingdom. E-mail: laffuso@london.edu

varying between seven and fifteen years. The longer franchises involved a higher level of investment, while the seven-year franchises only involved minor or no investment requirements. Apart from the committed investment TOCs had the ability to invest additional amounts as they deemed appropriate.

However, a short contract of seven years might hinder incentives to expend further resources beyond those that were necessary to obtain the franchise. Given that most of these investments are specific (for example the refurbishment of a station or the acquisition of rolling stock that would be specific to that particular franchise) TOCs therefore face the risk of hold-up problems. There are good theoretical reasons for concern. Railway assets have a thirty-year physical life and are quite specific. Rolling stock assets for rail franchise operations vary considerably, thus determining important incompatibilities. Electric trains require electrified track, and even electric assets can be of different types. Because of the auction framework, and a problem of "asset specificity", the TOCs face a potential hold-up.

In order to make the market more flexible and avoid the entire risk of specific investment being held by TOCs, rolling stock companies (ROSCOs) were created with the objective of owning and leasing rolling stock to the TOCs. Therefore, an investment for a TOC consists of ordering new rolling stock to a ROSCO. The ROSCO will buy and own the assets, and will lease it to the TOC for the entire duration of its franchise. The leasing fee charged would generally cover the investment cost and generate profit for the ROSCO. Does this also expose the ROSCOs to potential hold-up by the new entrants at the re-procurement stage?

It is unclear whether the vertical separation of TOCs and ROSCOs eliminated hold-up problems or simply transferred them to these additional players in the industry. One way to eliminate or mitigate a potential hold-up problem is via vertical integration. This was the route followed by the train operator Stagecoach and the ROSCO Porterbrook. Regulatory authorities, however, decided to discourage further vertical integration in the industry to avoid creating an unbalanced market between operators that were integrated with assets providers and those that were not, as this would create barriers to entry at the next auction round.

Since privatisation the railway network in Britain has experienced many problems. Very different views have been expressed as to what the sources of these problems were, and what actions should be taken to address them. One common point to many different views was the criticism of vertical and horizontal separation. It was believed that contractual arrangements, far from injecting competition in this market, would bring it to a halt. And the initial decline in the level of investment experienced in new rolling stock, despite the

surge in demand revealed since privatisation was thought to confirm this belief.

In this study we conduct an initial analysis of the problem, and investigate whether the investment pattern of the TOCs responds to structural and contractual characteristics and to general market conditions.

There are various novel elements in this paper. First, it is the first analysis of the consequences of contractual arrangements on firms' behaviour (investment) in the British rail passenger market. Second, the way the asset specificity is measured is based on a unique indicator constructed to account for the different types of assets and their degree of specificity. Third, the data used in this paper are a unique panel that was specifically built for our research.

II THEORETICAL PREDICTIONS AND EMPIRICAL IMPLEMENTATION

Williamson (1985) discusses auctions of short-term monopoly franchise contracts. He notes that such contracts have not been widely used because of the high risk that the lowest bidder might turn out to be unable to perform. This risk is evident in the high number of cases of contract-term renegotiation, especially for industries of national interest such as transport. This theory suggests that vertical integration or long-term contracts should be favoured in order to facilitate investment.

Laffont and Tirole (1993) expand on Williamson's theory and demonstrate that the prospect of being replaced by an entrant would lower the incumbent's incentive to invest in capital which it would not be able to transfer at the correct price. In the rail industry assets are transferable though not perfectly observable (Nichols and Welsby, 1999), so Laffont and Tirole's model implies the desirability of departing from bidding parity in order to provide incentives for investment. Indeed in the year 2000 the government suggested that at the next franchise auction the contracts auctioned should include an option to extend the contract, provided that performance during the life of the franchise is satisfactory, instead of re-auctioning the franchise in order to avoid underinvestment.

We now study the empirical validity of the theoretical predictions that vertical separation and auctions of short duration contracts depress investment in the British passenger railway industry. We investigate these propositions by means of the following model:

$$I_{it} = \alpha + \beta \underline{C}_{it} + \gamma \underline{U}_{it} + \delta \underline{F}_{it} + u_{it}$$

The dependent variable I represents the investment in new rolling stock

carried out by TOC i at time t. This is the "spontaneous" investment, which the companies have made as their commercial decision, i.e., not deriving from any contractual obligation. The "committed investment" is the investment that the companies agreed to carry out as a condition of their franchise. This is included amongst our explanatory variables.

We explain the investment behaviour by means of three main vectors of variables. $\underline{C}$ is a vector of variables measuring contract characteristics (e.g., length of the contract, request of renegotiation, award of extension, asset specificity). $\underline{U}$ is a vector of variables which proxy market conditions (demand, variance of demand, and future state of competition). Finally, $\underline{F}$ is a vector of firm characteristics describing the initial state of the stock adopted by company i, the level of profits, and its vertical and horizontal structure, plus any merger (horizontal or vertical) or contract that it might have entered with other firms in the industry, etc. α is a constant, and u_{it} is a stochastic error term.

III DATA SPECIFICATION AND ESTIMATIONS

Our data set consists of a panel including all 25 franchisees (passenger TOCs) from the start of their operation (which varies between 1995-1997; the franchising timetable is given in OPRAF, 1997, p.8) until February 2000. Therefore, we have three full years of data representing the entire population, so in our model $i = 25$ and $t = 3$. Our data sources are OPRAF Annual Reports, TOCs' accounts and specialised publications such as: *Modern Railways*, and *British Rail, Locomotives and Coaching Stock*.

Given the small size of the panel, and its recent completion, the analysis performed and illustrated here constitutes a preliminary investigation. Future research will be conducted to investigate our hypotheses in further depth and by means of various econometric techniques. The analysis that follows is therefore to be seen as a first step towards this goal.[1]

Investment is modelled using a random effects (RE) specification. This choice reflects the fact that different elements come into play in the commercial decision to invest. Other agents are also involved in financing decisions, this makes a RE specification more appropriate. From a practical point of view, a fixed effects (FE) model is very costly in terms of degrees of freedom.

We estimated our model by means of a Probit, transforming our dependent variable into a binary variable 0-1 (1 being the case when spontaneous

[1] Summary statistics and detailed description of the data and variables can be found in Affuso and Newbery (2002).

investment occurred). This model specification is more appropriate to our analysis as it more closely reflects the nature of the investment under investigation. Investments in railways assets are generally "lumpy and jumpy", hence the critical decision is whether to invest or not, rather than the size of the investment. The variables of our model were normalised by the number of train miles per each TOC, in order to control for the different scale of the operations. The results of our Probit estimations are reported in Table 1.

We also estimated this model under alternative specifications, with the dependent variable being the capital value of the assets bought – in excess of their franchise conditions. These results are reported in Table 2. We tested the RE specification by means of a Hausman test. The test statistic, reported in Table 2, suggested that the RE is the correct specification. As an additional test we estimated the model using a fixed effects specification. The results confirm that this model is not the correct specification, as the F-statistic for the joint significance of the coefficients and the F-test for the joint significance of the individual dummies demonstrate.

IV EMPIRICAL RESULTS

The first finding contrary to our expectations across the two sets of results is that the coefficient of the contract length variable is negative and significantly different from zero. This implies that shorter contracts generate higher rates of investment, or, put differently, that TOCs tend to invest towards the end of their contract. One possible explanation is that TOCs facing re-procurement have responded sooner to threats of non-renewal of franchises from the regulator. If this explanation is correct, it suggests that the repeated nature of the game may help overcome some of the problems of asset specificity (Gilbert and Newbery, 1994). This result, if robust, would suggest that higher degrees of competition, as injected by a frequent auction process due to the short-duration of the franchises, result in improved investment performance, contrary to what vertical separation critics have been claiming. This result is consistent also with findings of Abel and Eberly (1993, 1994) investigating the impact of uncertainty over investment. Unfortunately, our data does not include uncertainty measures.

The time dummies are non-significant in all specifications. Perhaps this is not surprising, as there have been so many changes and announcements each year that they have probably confused any simple time effect.

The variable capturing the contract renegotiation had to be excluded from the probit model as it created problems to the estimation. However, this variable is not significantly different from zero in Tables 1 and 2.

Table 1: *Probit Results for the Spontaneous Investment per Train Mile (N=74)*

	Probit Model (Random Effects)				
Independent Variable	(1)	(2)	(3)	(4)	(5)
Length of Contract (days)	–.008***	–.007**	–.006***	–.004***	–.001***
	(.003)	(.003)	(.001)	(.001)	(.0004)
Request of franchise extension: (0/1)	1.882	.977			
	(1.57)	(1.45)			
Asset specificity††	–18.57*	–16.1*	–13.7**	–10.24**	–6.01**
	(10.43)	(9.92)	(6.03)	(5.75)	(2.7)
Total number of passengers/train mile	–.263~	–.357	–.325	–102	
	(.159)	(.286)	(.209)	(.18)	
Total passenger miles/train mile	.012				
	(.009)				
Horizontal consolidation (0/1)	+				
Coach company ownership	1.469	1.62**	1.41**		
	(1.373)	(.774)	(.60)		
Joint ownership (no. of companies owned)	.961**	.957**	.092***	.875**	
	(.466)	(.381)	(.323)	(.374)	
Vertical consolidation (0/1)	+				
Subsidy remaining/train mile (£/mile)	–.045**	–.055**	–.049***	–.025**	
	(.019)	(.027)	(.018)	(.012)	
Profits per train mile (£/mile)	.002**	.002**	.0024***	.0018***	.0007***
	(.001)	(.001)	(.0007)	(.0006)	(.0001)
Committed Investment per train mile (£/mile)	.114	.017			
	(.193)	(.163)			
Age of stock (fraction old stock)	7.506***	6.055***	5.28***	4.13**	1.44~
	(2.73)	(2.03)	(1.52)	(1.68)	(.99)
Time dummy: t99	1.269				
	(1.316)				
Constant	25.9**	24.43*	20.03**	12.3**	4.84**
	(11.61)	(14.54)	(7.4)	(5.77)	(2.15)
χ^2	99.92***	25.25***	39.13***	12.09*	64.8***

Robust standard errors in parentheses.
+ variables dropped by the probit estimations; * p <0.10, ** p <0.05, *** p <0.01.
~ marginally significant at 10 per cent.
†† The types of rolling stock considered are: Diesel, Electric overhead, Electric third rail, Electric dual, Electro-diesel overhead, and Electro-diesel third rail. These are further divided between short distance and long distance. An index is then constructed to account for the degree of specificity of the composition of the stock of each TOC with respect to all the others. Additional details on the construction of this index are available from the authors on request.

Table 2: *Results for the Spontaneous Investment (£ million) (N=72)*

	Random Effects (GLS)			*Fixed Effects*
Independent Variable (units)	(1)	(2)	(3)	(4)
Length of Contract (days)	–.0053** (.002)	–.018** (.009)	–.017** (.007)	dropped
Remaining Contract time (days)				–.20 (.021)
Application for franchise extension (0/1)		–9.09 (14.35)		–21.79 (18.87)
Renegotiate extension: (0/1)	–.28 (7.57)	8.99 (15.78)		21.9 (20.86)
Asset Flexibility: (1- Asset specificity)	21.87 (20.45)	20.47 (22.25)		dropped
Total number of passengers (million)	.097 (.83)	.155** (.069)	.143*** (.049)	2.49 (1.71)
Total passenger miles (million)	–.003 (.004)			–0.38 (.13)
Age of stock (fraction old stock)	11.91* (9.82)	8.62* (10.4)		dropped
Horizontal consolidation (0/1)	–7.16 (6.38)	–9.21* (5.62)	–7.88' (5.07)	–11.39 (8.34)
Coach co. ownership (0/1)	4.71 (4.45)	3.17 (4.22)		dropped
Joint ownership (number of companies owned)	1.71 (1.47)	1.33 (1.47)	1.99* (1.16)	4.0 (8.71)
Vertical consolidation (0/1)	3.54 (11.07)		6.48 (10.57)	
Subsidy remaining (£ million)	–.003 (.004)	–.001 (.004)		–0.005 (0.02)
Profits (£ million/yr)	.00043* (.0002)	.00053*** (.00019)	.0053*** (.0017)	0.0006 (0.0004)
Committed Investment (£ mill)	–.009 (.023)	–.002 (.074)		
Time dummies:				
t97		–2.59 (3.4)		
t98		.104 (3.2)		
t99			2.43 (3.32)	
Constant	–4.03 (9.26)	21.74 (24.52)	–4.14 (12.93)	–102.57 (119.58)
F-test				1.32
F test for individual effects				F=0.87
R^2 Within/Between	0.54	0.58	0.55	0.28
χ^2	20.31*	24.72**	25.16***	
Hausman Test χ^2	8.45	7.64	3.85	

Standard errors in parentheses; * p <.10, ** p <.05, *** p <.01; ' p ≃ 0.1.

The coefficient on *asset specificity* in Table 2 is consistently negative, and correspondingly, the coefficient *asset flexibility (1- asset specificity)* in Table 1 is consistently positive, but this is significantly different from zero only in the probit specification. This suggests that the investment decision has been adversely affected by this problem.

Passenger miles per train mile, and total passengers per train mile are non significant in Table 1. These variables both measure demand, and have a positive impact on the scale of the investment, the total number of passengers in Table 2 is positive and significant, once the correlated passenger miles is eliminated.

The age of stock variable, measured by the fraction of old stock (older than 14 years) held by each TOC, is significant and positive in Table 2. This indicates that a higher probability of investment taking place is associated with a higher percentage of old stock.

Coach-company ownership, that is, franchises held by bus operators, is positive, although the coefficients are not always significant. Coach companies might behave more aggressively to win the next franchise auction because of possible synergies with road transport in "integrated transport plans".

We expected that if TOC *i* consolidates (by merging horizontally or vertically) with other companies in the industry, this would reduce risk and hence stimulate investment. Unfortunately both variables had to be excluded from our probit estimates as they created problems to the estimations. However, in the estimations reported in Table 2 where these variables could be used, we find that although the effect of vertical consolidation is not significantly different from zero, horizontal consolidation is. This is marginally significant, though contrary to our hypothesis, it has a negative sign. This could suggest the presence of economies of scale in investment.

Joint ownership, which is measured by the number of TOCs owned by the same parent company, is positive and significant in our probit results reported in Table 1, and it becomes significant only when we exclude the "coach-company ownership" variable in Table 2. This result seems to suggest that larger groups are better able to undertake discretionary investment. This is also consistent however with a signalling explanation, that would see larger groups that intend to acquire more franchises in future, trying to signal their "good behaviour" to the regulator. Therefore, it is hard to tell whether it is the lower degree of vertical and horizontal separation that determines a higher propensity to invest, or a form of strategic behaviour that induces such companies to behave more aggressively in order to expand at the next franchise auction.

The committed investment variable is surprisingly insignificant, indicating that the spontaneous investment is not a substitute for committed

investment, as we expected. This could become the case when TOCs are willing to commit their planned additional investment in order to secure a franchise extension, in which case less discretionary investment is needed, but does not appear to be true otherwise.

The subsidy remaining variable, measuring the effect of financial incentives, has a significant negative effect on the investment decision (Table 1). This can be explained by the fact that the "market driven" incentives to invest are missing in those cases (franchises) that mainly operate loss-making routes, and therefore there are no incentives to make any additional investment.

Finally, the profit*s* variable is positive and significant in both Table 1 and Table 2. This suggests that investment decisions respond to commercial incentives independently of the degree of horizontal or vertical separation, thus casting doubt on the need to intervene in the market for the regulator to redraw the boundaries of railways franchises in Britain.

V CONCLUSIONS

In this paper we studied the impact of structural and contractual arrangements of rail passenger franchises in Britain over their investment performance. We investigated the theoretical prediction that a higher degree of vertical separation by means of short duration franchise contracts hinders incentives towards investment in the presence of asset specificity. Conversely, our empirical findings identify a pattern of investment which increases in response to competitive forces in the market. Our analysis leads us to conclude that there is little justification for the calls by advocates of a change in the current structure for extending franchises to a duration of 15-20 years, and moving from the existing 25 franchises to 5 larger ones, in an attempt to move towards a more integrated structure. Although these are preliminary findings, they suggest that further research is needed to assess the current proposals for greater integration.

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