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AND FRANCHISE CONTRACT  
LENGTH IN THE BRITISH  
RAILWAY INDUSTRY**

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## **ABSTRACT**

### **Investment, Reprourement and Franchise Contract Length in the British Railway Industry\***

This Paper studies the interaction between repeated auctions of rail franchises of different lengths, uncertainty, and incentives for investment in rolling stock, following the privatization of British Rail. Theoretical predictions are tested empirically using a unique panel of data. Theory suggests that short franchise lengths reduce incentives to invest in specific assets. Our empirical results suggest that competition and strategic behaviour at the re-procurement stage can create incentives for delayed investment. Investing just before the end of the franchise enhances the incumbent's probability of having the contract re-awarded and provides it with a first-mover advantage, while raising the entry cost for other potential bidders.

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## **NON-TECHNICAL SUMMARY**

The 1993 Rail Act resulted in a dramatic restructuring and subsequent privatization of British Rail. The single vertically integrated railway company was unbundled in 1994 into over 70 suppliers of different services, overlaid with a web of contractual relations and subject to two regulators – the Office of the Rail Regulator (ORR) and a governmental body, the Office of Passenger Rail Franchising (OPRAF), recently reformed as the Strategic Rail Authority (SRA). The hope was that a more commercial structure operating under competitive pressures would better deliver the services that customers required and would drive down costs to achieve better value for public money. The obvious concern was that breaking up a vertically integrated industry would cause the economies to lose the coordination essential to the seamless delivery of nation-wide services and investment in rail and rolling stock.

The background to the dramatic restructuring of BR was one of static or declining traffic, and a history of under-investment but steady fiscal drain on the exchequer. The early experience of privatization gave mixed messages. Both passenger and freight demand increased rapidly after 1995, reversing decades-long declines. However, against this optimistic background, the collapse in rolling stock investment was quite dramatic, suggesting that fears about the loss of coordination between the different parts of the railway system were well founded.

The question that we seek to answer in this Paper is whether the collapse in rolling stock investment can be attributed to vertically separating the industry, or whether it reflects the uncertainties created by the transition from one structure to another and difficulties in predicting demand. There are good theoretical reasons for concern. Railway assets are durable and highly specific. Not only is British rolling stock significantly different from that of other countries, even within Britain there are important incompatibilities. Track and trains exhibit a high degree of technical complementarity. Electric trains require electrified track and even these can be of different types.

Rolling stock is also very durable, with an asset life of 30 years or more. This contrasts with the length of the franchises for the Train Operating Companies (TOCs) that were mainly for seven years. Seven years is a small fraction of the life of typical rolling stock assets. TOCs therefore face high risks if they buy rolling stock. They need to predict its realizable value at the end of the franchise. In view of this problems three Rolling Stock leasing companies (ROSCOs) were created to provide continuity of asset ownership.

Whereas there are 25 TOCs, there were only three ROSCOs at privatization, raising fears of market power, which the ROSCOs might exercise by restricting the supply of suitable rolling stock, i.e. under-investing.

The Government hoped that rolling stock provision would become competitive with entry by finance companies, but active competition in the rolling stock leasing market has not materialized. Instead, the ROSCOs enjoy a strong oligopolistic position and face little entry threat. But the ROSCOs also face considerable uncertainty about the demand for new rolling stock, as they have to decide whether the recent growth in demand represents a change in a long-term static trend. Thus either (or both) the specificity of assets and the difficulty of forecasting demand could explain under-investment in rolling stock. The first explanation would suggest that vertical integration or long-term contracts should be favoured in order to facilitate investment. That is what we seek to test in this study.

The SRA has responded to the problems of underinvestment in rolling stock after privatization by (a) extending contract length so that the new franchise contracts will have a minimum duration of 15–20 years, with a periodical review; (b) acting as a procurement agent by buying new rolling stock with the aim of transferring this to the successful franchisee; and (c) offering larger franchises at re-procurement. We examine whether these responses are justified in the light of our findings.

Our first contrary finding is that discretionary investment is stimulated by shorter rather than longer contracts, casting some doubt on the view that longer contracts are needed to address the under-investment problem. This is contrary to the theoretical hypotheses and sufficiently surprising to require interpretation. One possible explanation is that TOCs facing re-procurement sooner (i.e. those with the shortest contracts) respond with increased investment to signal their commitment to the regulator and thus increase their probability of being rewarded with the franchise. Investing near the end of the franchise is also a way to signal aggressive behaviour to potential entrants to the market and to raise their entry costs. It has moderately low risk for the TOCs, as the risk is largely borne by the ROSCO.

Our finding that investment appears to respond as predicted to commercial incentives (demand and profitability) also casts doubt on the need for market intervention by the SRA in rolling stock orders. The increased interoperability of the new stock ordered seems to suggest that an increasingly flexible market is developing, which reinforces the suggestion that longer franchise contracts are not the correct solution for under-investment in British railways.

Finally, we expected that if a given TOC merges (either horizontally or vertically) or enters a contractual arrangement with other companies in the industry, this would reduce risk and hence stimulate investment. Contrary to our expectation larger franchises do not seem to result in higher investment. Size may be valuable in obtaining economies of scale and scope, though apparently not for increasing the amount of overall investment.

## 1. Introduction

The 1993 Rail Act resulted in a dramatic restructuring and subsequent privatisation of British Rail (BR). The single vertically integrated railway company was unbundled in 1994 into over 70 suppliers of different services, overlaid with a web of contractual relations and subject to two regulators – the Office of the Rail Regulator (ORR), and a governmental body, the Office of Passenger Rail Franchising (OPRAF), recently reformed as the Strategic Rail Authority (SRA).<sup>1</sup> The hope was that a more commercial structure operating under competitive pressures would better deliver the services that customers required and would drive down costs to achieve better value for public money. The obvious concern was that breaking up a vertically integrated industry would lose the economies of co-ordination essential for the seamless delivery of nationwide services and investment in rail and rolling stock.

The background to the dramatic restructuring of BR was one of static or declining traffic, a dramatic and inexorable decrease in rail's share of total passenger and freight kilometres (documented in Figure 1), extensive line closures in the 1960s, and a history of under-investment but steady fiscal drain on the exchequer. Whether the government genuinely believed that a commercial railway could attract adequate private finance and relieve the fiscal burden, or merely wanted to transfer responsibility for managing the continued withdrawal from the British transport scene is unclear. Certainly, the idea of putting train services out to competitive tender to see who could deliver the services required for the least subsidy appeared attractive to the Treasury. The resulting decrease in the subsidy required over the first franchise period suggested that at last a method had been found to contain public expenditure on the railways.

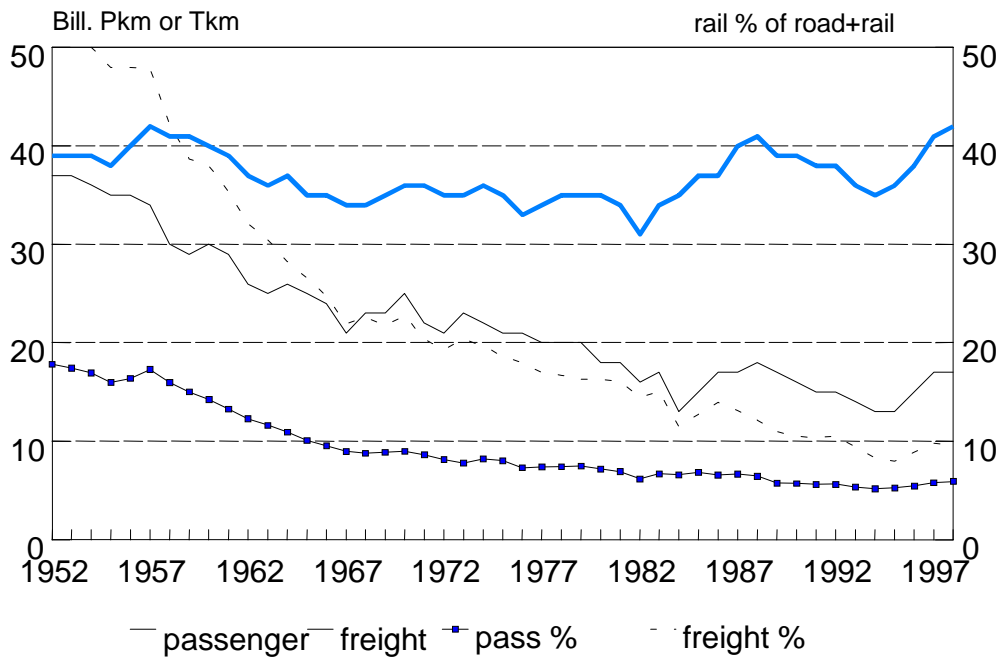
The early experience of privatisation gave mixed messages. Both passenger and freight demand increased rapidly after 1995 (see Figure 1), reversing decades-long declines. Proponents argued that this demonstrated the greater customer focus of the new Train Operating Companies (TOCs), while sceptics pointed to the buoyant economy and the failure to invest in adequate road infrastructure as more plausible causes. Against this optimistic background, the collapse in rolling stock investment revealed by Figure 2 suggested that fears about the loss of co-ordination between the different parts of the railway system were well founded. The pause, followed by a considerable expansion in infrastructure investment, highlighted the contrast between the regulated Railtrack, with its obligation to deliver services combined with guaranteed funds to finance this, compared with the commercial orientation of the TOCs and the

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<sup>1</sup> *Shadow* until legislation is passed.

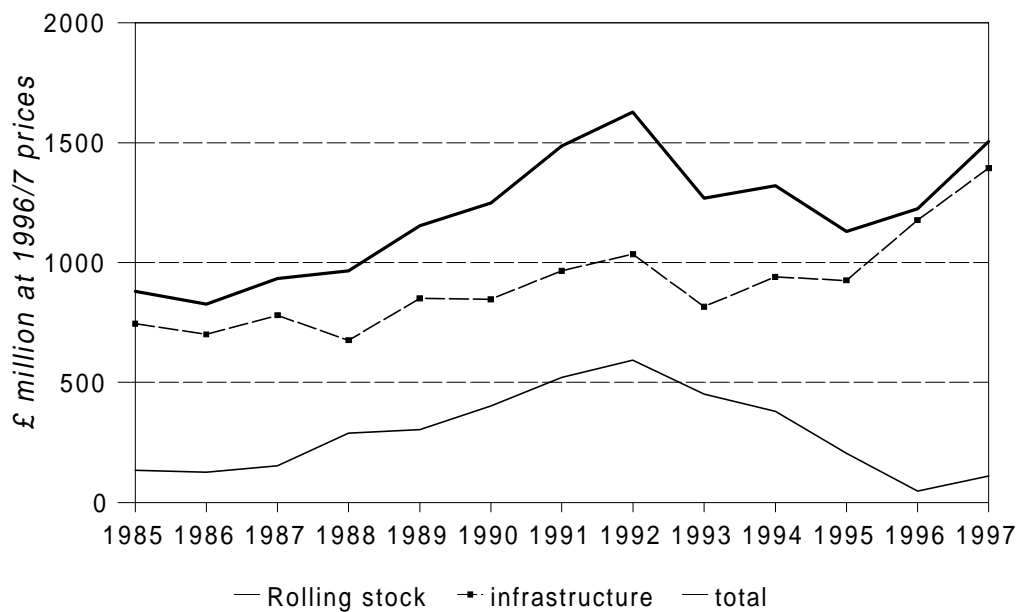
Rolling Stock Companies (ROSCOs), who based their investment decisions on commercial perceptions.

### Figure 1 Rail demand



\* share of road+rail  
Transport Statistics Great Britain

### Figure 2 Rail Investment 1985-97 at 1996/7 prices



Transport Statistics GB

The question that we seek to answer in this paper is whether the collapse in rolling stock investment can be attributed to vertically separating Railtrack from the TOCs and from the ROSCOs, or whether it reflects the uncertainties created by the transition from one structure to another and difficulties in predicting demand.<sup>2</sup> One of the major benefits of privatising other network utilities has been the considerable increase in capital productivity and reduction in the investment cost per unit of capacity provided. If the collapse in investment is short-lived and soon reversed, and if the benefits of improved procurement lower the cost of investment, then the restructuring may have been worthwhile. Here the evidence is encouraging. New competition from foreign companies has resulted in price reductions of up to 30% compared to the last stock ordered by BR (NAO, 1998, p.68). Similarly, if the restructuring leads to a more commercial approach to investment with a reduction in socially unprofitable investment, then again there will be benefits from restructuring. But if vertical separation creates avoidable risks and transaction costs that undermine investment incentives, the aim of improving Britain's transport infrastructure will have been jeopardised.

There are good theoretical reasons for concern. Railway assets are durable and highly specific. Not only is British rolling stock significantly different from that of other countries, even within Britain there are important incompatibilities. Track and trains exhibit a high degree of technical complementarity. Electric trains require electrified track, and even here there are different types: overhead power and the third-rail systems that are used in different parts of the country. According to a National Audit Office report (NAO, 1998), only 8% of electric vehicles could run on both power sources in 1994. Some trains are restricted to certain routes because of their weight and weight distribution (i.e. route availability) and dimensions (i.e., loading gauge). There are also interdependencies between track capacity and train service improvements. Increases in train speeds resulting from investment in new rolling stock may require associated infrastructure investment.

Rolling stock is also very durable, with an asset life of 30 years or more. This contrasts with the length of the franchises for the TOCs that were mainly for seven years. It was soon realised that introducing competition *on* the tracks, that is between different TOCs offering services between the same origins and destinations, raised a variety of intractable problems, not least over the setting of efficient and fair access prices and handling timetabling. Instead, competition *for* the tracks was the preferred solution, with competitive bidding for TOC

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<sup>2</sup> The level of rolling stock investment needed just for replacement on a long-term basis has been estimated by ORR (1998, 5.3) as £250 million per year, so the collapse in investment is substantial even if there were no need to invest to accommodate growing demand.



franchises. As a result, TOCs have a franchise monopoly for a large fraction of the area they serve. If these companies are not to mature into sleepy monopolies, the franchises must be periodically re-tendered. The chosen franchise length of seven years reflects a balance between the need for periodic contestability and the requirement to make adequate investments in company-specific assets.

Nevertheless, seven years is a small fraction of the life of typical rolling stock assets. TOCs therefore face the risk of hold-up problems. If they buy rolling stock at the start of their franchise, they need to predict its realisable value at the end of the franchise. Subsequent franchise bidders may offer a very low price confident that the asset cannot be used elsewhere and hence have low residual value. Faced with the risk that its investment will be stranded and will need to be written down rapidly over the life of the franchise, the TOCs may limit their investments to the most profitable that can be assured of recovering their cost over the franchise, leading to under-investment.

This problem was recognised and addressed by creating the rolling stock companies (ROSCOs). These companies invest in and own the rolling stock, which they lease to the TOCs. If they have made wise investment decisions, then the rolling stock they offer will be best suited and most economic for the franchises, and each potential bidder will be equally placed to acquire appropriate rolling stock and meet the conditions of the franchise at the successive tendering rounds. The ROSCOs only need to predict the market demand in each area, not the particular whims of transient TOCs.

Does this adequately solve the problem? Whereas there are 25 TOCs, there were only three ROSCOs at privatisation. This would seem to give the ROSCOs some market power, which they might choose to exercise by restricting the supply of suitable rolling stock, i.e. under-investing. Of course, TOCs can contract directly for new rolling stock, but they run the risk of asset hold-up at the end of their franchise, and so the market for rolling stock is not sufficiently contestable. The ROSCOs also face considerable uncertainty about the demand for new rolling stock, as they have to decide whether the recent growth in demand represents a change in a long-term static trend.

Finally, the ROSCOs are operating at some distance from the final market. They need to co-ordinate their proposed investments with Railtrack to make sure that complementary investments are undertaken. New high-speed trains or tilting trains require substantial investment in rail and signalling technology to be feasible. The ROSCOs have to be in close touch with the TOCs who in turn are more knowledgeable about consumer demand and the kind

of innovative services that they plan to introduce. They must weigh the risk that one TOC's bright idea to attract custom may be commercially catastrophic, and the equipment may then prove unattractive to subsequent bidders. In short, the continuing existence of ROSCOs does not completely avoid the problem of asset specificity and hold-up, and introduces an additional link in the flow of information needed to select the appropriate investment.

We would therefore like to see whether the evidence on investment behaviour across the different TOCs and ROSCOs provides any support for concerns that the vertical unbundling has prejudiced investment. The two main explanations for the apparent collapse in rolling stock investment are, on the one hand that asset-specificity and the short franchise length resulting from the unbundling has prejudiced investment; and on the other hand that the uncertainty about future traffic demand and the disruption created by the transition have temporarily reduced investment, which will recover to normal levels once these problems have been resolved.

The issue is of great topical importance, for dissatisfaction with the performance of the rail industry has resulted in a whole series of initiatives designed to address the perceived problems. The Strategic Rail Authority has been set up in shadow form, awaiting legislative confirmation. The Government's *Transport 2010: The 10 Year Plan* suggests that public support for rail investment will be dramatically increased, and will run at three times the level of strategic road investment (that carries 67% of road freight, and hence far more than the entire rail system). If their diagnosis is incorrect, large sums of public money and new possibly inflexible contracts will have been committed prematurely.

## **2. The new railway structure**

The 1993 Railway Act created a completely new structure in which the industry is divided into separate companies: train owners, train operators, a track owner and many providers of supporting services. Train Operating Companies (TOCs) operate the passenger services over specific franchised routes. The TOCs lease trains from Rolling Stock Companies (ROSCOs), and pay for access to the track network provided by the monopoly operator Railtrack, from whom they also lease (some) railway stations. Our concern is investment in rolling stock, though this will be affected by the vertical structure of the industry, and involves both ROSCOs and TOCs directly.

### **2.1 The Rolling Stock Companies**

The ROSCOs play a central role in the new railway structure, and already there is some

evidence that their performance falls short of the initial expectations of the Government. The sale of the three rolling stock leasing companies – Angel Train Contracts Limited (Angel), Eversholt Leasing Limited (Eversholt) and Porterbrook Leasing Company Limited (Porterbrook) – was completed by the Department of Transport in February 1996. All three ROSCOs have subsequently changed ownership, revealing a market valuation of their assets 50% higher (on average) than the value at which the Government sold them.<sup>3</sup> One explanation for such high returns and the high willingness to pay by new investors is that the investors expected to enjoy monopoly profits. The report of the National Audit Office (NAO 1998) on the privatisation of the ROSCOs reveals that one ROSCO expected that competition would not develop and that the TOCs would continue to lease most of their rolling stock, given that the alternative of outright purchase would be more expensive. Financiers of new rolling stock (potential entrants into the leasing market) would charge more because they provide funds on the basis of a *long-term* assessment of the riskiness of the market (NAO, 1998, p.61) whereas the TOC contracts for ROSCOs' services were mostly comparatively *short term*.

The Government hoped that the provision of rolling stock would become competitive, but active competition in the rolling stock leasing market has not materialised. Instead, the ROSCOs enjoy a strong oligopolistic position. They faced little threat entry<sup>4</sup> and competition among the incumbent ROSCOs was hindered because of a twin problem of asset specificity and short-termism.<sup>5</sup>

Due to the differences in the specifications of vehicles, tracks and signalling systems, a competitive market seems unlikely to develop. Indeed, the ROSCOs are reluctant to invest in specific assets for companies whose life is shorter than the required assets' life because there is no guarantee that they will be able to re-lease the new stock beyond the lives of existing franchises. This exposes the ROSCOs to potential hold-up by the new entrants at the re-procurement stage. One possible way to eliminate or mitigate a potential hold-up problem is via vertical mergers. This was the path followed by the train operator Stagecoach and the ROSCO

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<sup>3</sup> Porterbrook was sold to Stagecoach Holding in August 1996 at a price 56% higher than the original. This was recently divested by Stagecoach. In February 1997 the Forward Trust Group, part of HSBC Holdings plc, bought Eversholt at a price 40% higher. Finally, after an intermediate transaction, Angel was sold to the Royal Bank of Scotland Group in December 1997, for a price 58% higher than the original one.

<sup>4</sup> GL Raillease is the only new entrant due a specific order placed by Virgin Rail (OPRAF, 1999).

<sup>5</sup> One representative example of asset specificity and short-termism is that faced by GNER (Great North Eastern Railway). Despite an intensive search they were unable to find any surplus high speed powered vehicles. At the same time two ROSCOs found limited demand for their surplus assets, especially for older refurbished ones (NAO, 1998, pp.64-65). Furthermore, GNER was unable to order new rolling stock because the new high speed trains they needed could not easily be used elsewhere on the network, and they could not enter the necessary contracts with ROSCOs because their franchise was only seven years (ibid., p.68).

Porterbrook. However, ORR says that further ROSCO-TOCs mergers are undesirable<sup>6</sup> as they might create barriers to the entry of new leasing suppliers (ORR, 1998, 5.22).<sup>7</sup>

Limits on the interchangeability of the rolling stock increase concentration in certain market segments; for example, high-speed trains were given only to Angel and Porterbrook. A commonly held view was that due to the lack of competition in this market the ROSCOs should be subject to regulation as well as the other major players in this industry<sup>8</sup>. This was investigated by ORR (1998) in order to assess the extent of their market power and whether the underinvestment was a result of the exploitation of a monopoly position. ORR investigated whether the lack of surplus assets which constrained ability to meet demand (Welsby, 1997) was attributable to ROSCOs' attempts to exploit market power. They found that while the ROSCOs held a dominant position in this market, there was no evidence that they were abusing this position. ORR's assessment was nevertheless that the degree of market concentration, combined with the tight balance between demand for stock and available supply creates the potential for abuse. This might prove of particular significance during the next franchise round. ORR therefore expressed the need to reassess the situation at TOCs' franchise renewal, when the balance between supply and demand could give the existing lessors of rolling stock market power.<sup>9</sup> To sum up, long-lived specific assets and short-term demand create (i) uncertainty and (ii) risk of hold-up. Both these factors could explain underinvestment in rolling stock assets.

## **2.2 The Train Operating Companies**

The duration of franchise contracts awarded to the TOCs varies between seven and fifteen years. The longer franchises involve a higher degree of commitment in the form of investment obligations; the seven-year franchises do not generally have any investment requirements (see

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<sup>6</sup> Detailed analyses of welfare effects of mergers in railways are very scarce. A very good one is Pittman (1990).

<sup>7</sup> Also at <http://www.rail-reg.gov.uk/docs/64/contents.htm>

<sup>8</sup> According to the design of the regulatory structure of the industry set out in the Railway Act 1993, rolling stock leasing companies were left outside the regulatory framework, being subject only to competition law.

<sup>9</sup> 'In considering the future balance between supply and demand, and also the development of factors relevant to determining residual values, there seems to be a clear contrast between the multiple unit market and the market for high speed InterCity trains. The multiple unit fleet is large - around 7,500 vehicles - and increasing standardisation of vehicles is likely to result in greater flexibility and market liquidity, and in falling lease costs. InterCity trains, on the other hand, are likely to be specialised, one-off builds. This is likely to result in higher costs, not least because of the limited alternative uses of stock for the ROSCO, with the attendant increase in residual value risk in the absence of longer leases. A further issue which affects the future development of the rolling stock market is the extent to which changes in the railway infrastructure will reduce some of the current restrictions on use. More generally, some routes require particular types of rolling stock (for example incorporating different technical standards for services through deep tunnels, such as WAGN services to Moorgate), while other types of rolling stock (such as Networkers) may effectively be limited to certain routes because of the need for, and expense of, modification of track circuits to avoid electrical interference,' (ORR, 1998, pp. 75-77).

OPRAF's reports for more details). While the franchise contracts are currently exclusive, the Government declared its intent to introduce open access competition at some stage in the future.<sup>10</sup>

Because of the 'repeated auction' framework, and the problem of 'asset specificity', the TOCs also face a potential hold-up problem if they seek to sell-on their assets to new entrants at the end of their franchise. Given that there are few alternative economic uses for the incumbent's rolling stock assets, the entrant can threaten to lease assets from the ROSCOs, or even buy on the market, though this would not necessarily be credible, for the same reasons that discourage TOC investment in the first place.<sup>11</sup> The risk of being replaced at the next franchise procurement stage could reduce the incentive on TOCs to invest, and the expectation of open access competition might be expected to reinforce this effect. This risk is increased where the TOC negotiates and part-funds improved infrastructure investment by Railtrack to provide capacity for the new rolling stock, as they face the risk that other companies might enter and take advantage of the improved infrastructure (Dodgson, 1994, p246). Nash and Preston (1997) report that many franchisees indicated that they would not be interested in bidding unless they received exclusive rights to run the service. The Government has responded to some of these concerns by postponing competition within franchise areas, which have been made exclusive for the first round. At present, though, the threat of open access competition remains for future franchises at the next procurement stage.

In addition to fears about future competition, there is considerable uncertainty about future demand (CRUCC, 1999). It will take time to discover whether this unexpected increase in demand is temporary or, instead, it marks a change in trend. Real option theory suggests that uncertainty that may be resolved by waiting makes it worthwhile to delay investment, providing an additional explanation for initial underinvestment (Dixit and Pindyck, 1994). In some instances the problems caused by underinvestment were so acute as to induce requests from TOCs to renegotiate their franchise with the SRA (OPRAF, 1999).

### **2.3 Railtrack**

Railtrack is a regulated monopolist. The track access price it charges to the TOCs is subject to

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<sup>10</sup> The intention of the rail reform was to stimulate intramodal competition for passenger traffic by promoting open access to the rail network. However, this has been postponed until the year 2002, thus sheltering the TOCs from competition until 1999, from when limited competition could be introduced at the discretion of the regulator. In the course of 1999 open access competition plans were suspended even though this was not officially announced.

<sup>11</sup> The TOCs' franchise contracts do not include 'asset-transfer' rules because the rolling stock business was

price-cap regulation. As a consequence of the initial structure of access charges, it had almost no incentive to invest in upgrading the quality or capacity of the track network, though this has been addressed in the Draft Conclusions of the first Periodic Review (ORR, 2000).<sup>12</sup> The resulting level of investment in network infrastructure has spillover effects on investment in rolling stock because of complementarities. In one case the market has generated a possible solution through vertical contractual arrangements with the Virgin Trains-Railtrack agreement for the upgrade of the West Coast Main Line (WCML). Under this contract the train operator agrees to share its revenues with the network provider in return for contributing to new track investments.

Deals that facilitate investments which would not have been made otherwise appear to be Pareto improving, and hence efficient. However, such agreements create de facto vertical integration between a favoured downstream provider and a monopolistic input provider, raising concerns about market foreclosure (see Grimm, Winston and Evans, 1992).<sup>13</sup> Railtrack may find it profitable to give preferential access to its partner TOC, and restrict access to other companies using the same tracks, and to potential new entrants.

As a monopolist, Railtrack has the bargaining power to extract surplus by carrying out or contributing to investments, thus determining the future shape of the network and access to it. This would not matter if bargaining between Railtrack, TOCs (and ROSCOs) were efficient, but with incomplete and asymmetric information, there must be concerns that some desirable ROSCO investments are delayed while a satisfactory division of the gains between the parties is agreed.

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intended to be kept separate from train operation.

<sup>12</sup> The original access-price structure involved only 3% of track-access income varying with being the number of trains and a further 5% to cover electric traction (Railtrack, 1998). ORR has partially responded to Railtrack's suggestions for greater incentives for increasing capacity, partly by a value-based adjustment to the Regulatory Asset Base at the next Periodic Review of the difference between the actual and assumed growth in passenger miles multiplied by a rate per passenger mile (ORR, 2000, 9.26). The proportion of the track access charges that are variable (including the traction electricity charge of 5% of the total) will rise from 8% to 41%, providing "much stronger incentives for Railtrack to be responsive to the needs of its customers than under the current regime." (ORR, 2000, 9.42)

<sup>13</sup> Railtrack designs the timetable and so allocates the paths between train operators who share the same track. Railtrack might foreclose access to the track to other companies in order to favour access of the company with which it has an investment agreement and whose revenues it shares. *Modern Railways* (June 1999, p.392) reports that problems are being faced by companies running on the WCML (the passenger train operator Silverlink and by the freight operator EWS) to obtain the number of paths promised by Railtrack at the time of approval of the contract with Virgin Trains. Moreover, requests for additional paths from EWS have been turned down. Therefore operators have to find alternative routes which are less efficient (as they are longer) and require a different type of asset (EWS had to buy train of different specification to make use of the alternative route, see *Modern Railways*, November 1999, p.788).

### 3. The theory

We now examine two theoretical explanations for the observed investment behaviour in rolling stock and therefore two possible solutions: (a) *contractual incompleteness and incentives*, and (b) *uncertainty and option value*.

#### (a) *Contractual incompleteness and incentives*

Williamson (1985) considers the limitations that arise from incomplete long-term contracts and highlights problems relating to non-compliance. Posner (1972) suggests that the duration of these franchise contracts should be short in order to avoid the problems arising from incomplete long-term contracts (such as a lack of incentive for efficiency). However, short-term contracts have serious shortcomings. Among these is the impossibility of maintaining bidders' parity at renewal. Posner argues that, to overcome this, the assets should be transferred to the winner at a pre-agreed rate. Competition among bidders will then prevent any exploitation of monopoly by the new winner. However, Williamson (1976) disputes this because the incumbent enjoys an advantage over its competitors due to (i) imperfect transferability of physical/human capital, and (ii) imperfect measurability of the residual value of investments. If investments are specific, short-term contracts will not be efficient and the greater the degree of specificity, the longer will be the term of contract required.

Williamson points out that recurrent short-term franchise contracts have not in fact been widely used. He investigates the case of franchises for cable television, most of which have been awarded with 10-15 year contracts. Appropriate penalties have to be devised for unsatisfactory performance and setting up conditional responses to contingent events can promote efficiency and mitigate litigation expenses.

In auctions of monopoly franchises, as Williamson (1985, p.337) put it, there is always a "risk of inability to perform of the lowest bidders. History is full of cases of renegotiation." The probability of renegotiation is higher for industries of national interest (such as defence and transport). This is well illustrated by the case of Argentina's Railways, where freight and passenger concessions have faced similar challenges. Initial demand projections by the winning operators proved too optimistic and made them unable to fulfil their investment commitments (Thompson and Budin, 1997). Although this could be explained by opportunistic behaviour of the contractors, the regulator has nevertheless to guarantee that the companies do not fail (or at least that service continuity is maintained). In this sense, short-term contracts have the

advantage of enabling adaptive sequential decision making. However, when assets are specific and their transfer is not straightforward, by backward induction one can expect that little or no investments will take place. The mechanism of asset transfer should therefore be pre-specified (ibid. p.341), though this too could be manipulated.

This theory therefore suggests that vertical integration or long-term contracts should be favoured in order to facilitate investment, though the leasing arrangement with long-lived ROSCOs is clearly intended as a means of addressing this problem. Williamson's prediction of contract renegotiation also seems to fit our case. The shadow Strategic Rail Authority has recently announced that it is willing to renegotiate the franchise contracts expiring within five years, 'and will modify the steep downward trend in the government funding which supplements farebox revenues, but only in return for solid commitments to invest in core developments in the franchises...' (SRA, 1999). The SRA is also willing to offer new contracts having a duration of 15-20 years.

Laffont and Tirole (1993) develop a theory based on Williamson's points (i) and (ii) above. They assume that the investment is non-transferable and that the regulator can observe cost and profits from the accounting data, but cannot deduce the precise value of the investment. They develop a two-stage model where at time 1 the regulator offers an incentive contract to a single firm and at time 2 reprocurement occurs. 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. When the investment is non-observable (i.e., non-contractible) it cannot be fully compensated and the incumbent has too little incentive to invest. The regulator can offset this with an optimal reprocurement ('break-out') rule that favours the incumbent at the reprocurement stage. This departure from bidders' parity, according to Laffont and Tirole, implies only a small loss in productive efficiency and increases investment. Laffont and Tirole conclude: "That a second source may not be of much use when investment is transferable (but not perfectly observable) leads us to a somewhat pessimistic assessment of how much regulators can hope to gain by using second sourcing in a natural monopoly situation involving substantial investment" (ibid. p.355).

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. This could consist of an option to extend the contract, provided performance is satisfactory, instead of re-auctioning the franchise.



(b) *Uncertainty and Real Option explanations*

Dixit and Pindyck (1994) demonstrate that delaying investment in the presence of uncertainty has an option value. According to orthodox theory, an investment should take place whenever the expected net present value (NPV) of the investment is greater than, or equal to, zero. Dixit and Pindyck note that this theory ignores a number of factors, namely that investment is irreversible, may be delayed until a later date, and that the project returns are subject to uncertainty (NPV is based on the mean and does not consider the expected variance of the returns). Dixit and Pindyck note that under these conditions, the ability to delay investment has a value that they compare to a financial call option, which is cashed when the investment takes place. Therefore, the value of not investing is not zero, as traditionally thought, but it is positive, and the NPV test must exceed this positive value for investment to be justified.

This theory is relevant in our investigation because (i) uncertainty derives from the final demand for railway transport,<sup>14</sup> future competition, costs and regulation<sup>15</sup> for Railtrack and the TOCs (see Armstrong, Cowan and Vickers, 1994, pp.85-86); (ii) irreversibility derives from the specificity of assets; and (iii) firms have the ability to delay the investment without losing the option to invest due to their monopoly licence.

Guiso and Parigi (1999) point out that although irreversibility is an important variable in the determination of the sign of the investment-uncertainty relationship, ‘other more subtle assumptions have been shown to be relevant,’ (p.186). Even in the presence of irreversibility Abel and Eberly (1993, 1994) find that uncertainty has a non-negative effect on investment if the firm operates in a competitive market. Caballero (1991) also finds that the relationship between the degree of irreversibility of the investment and the degree of competition in the final market is important in determining the effect of uncertainty over investment. This relationship however can become ambiguous when there are time lags for the delivery of the capital goods (e.g., construction lags), as this might speed up capital accumulation to meet a higher-than-predicted demand.

Guiso and Parigi conclude that the sign and intensity of the investment-uncertainty relationship must be resolved on empirical grounds. Unfortunately, because of the difficulty of measuring uncertainty, such empirical research is very scarce. They refer to only one other study using micro data (Leahy and Whited, 1996). They find that uncertainty has a

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<sup>14</sup> As pointed out above, there has been a very high unpredicted increase in demand for passenger rail services since privatisation.

<sup>15</sup> The regulator might hold-up the company after the investment has been sunk. Therefore, an ex-ante credible commitment is needed. Removal of regulatory uncertainty over the treatment of such investments is necessary to

substantially stronger negative effect on the investment decision of firms that cannot easily dispose of their capital in second hand markets than those that can. This is certainly the case for investment by ROSCOs (and also by TOCs).

In the next section we investigate the empirical validity of these theoretical predictions in the British passenger railway industry.

#### 4. Empirical analysis

We now investigate investment in new rolling stock 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 carried out by TOC<sup>16</sup>  $i$  at time  $t$ . More specifically, we study 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 taken into account in the equation among the right hand side variables. The level of committed investment is a possible explanatory variables, since the level of committed investment might trade-off against the level of additional ‘spontaneous’ investment.

Following the theories above we explain the investment behaviour by means of three main vectors of variables described in Table 1 below.  $\underline{C}$  is a vector of variables measuring contract characteristics (e.g., length of the contract, request of renegotiation, award of extension) and asset specificity (measuring the degree of specificity of the assets adopted by TOC  $i$ ).  $\underline{U}$  is a vector of variables which proxy uncertainty (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  $i$ , proxied by its age, the level of profits, any merger (horizontal or vertical) or contract that it might have entered with other firms in the industry, etc.  $\alpha$  is a constant, and  $u_{it}$  is a stochastic error term.

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prevent underinvestment (Railtrack, 1998; Gilbert and Newbery, 1994)

<sup>16</sup> The rolling stock assets are actually acquired on TOC’s order by the ROSCOs, who then lease the assets to the TOCs for the entire duration of their contracts and thereby repay the investment.

**Table 1 Explanatory variables for spontaneous investment**

Model	Variable	Predicted effect on Investment
Williamson and Laffont & Tirole	<u>C</u> <ul style="list-style-type: none"> <li>• Contract length</li> <li>• Extension Requested</li> <li>• Extension Awarded (Renegotiation)</li> <li>• Asset Specificity/Flexibility</li> </ul>	Positive Positive Positive Negative/Positive
Dixit & Pindyck	<u>U</u> <ul style="list-style-type: none"> <li>• Future competition</li> <li>• Demand</li> <li>• Demand Variance</li> </ul>	Negative Positive Negative
General Factors: Integration vs. Separation Financial incentives Uncertainty/Delay	<u>F</u> <ul style="list-style-type: none"> <li>• Age of stock</li> <li>• Horizontal Consolidation</li> <li>• Vertical Consolidation</li> <li>• Joint Ownership</li> <li>• Coach-company Ownership</li> <li>• Subsidy profile (subsidy left)</li> <li>• Profits</li> <li>• Committed Investment</li> <li>• Time dummies</li> </ul>	Positive Positive Positive Positive ? Positive Negative Increasing

Appendix 1 gives the sources and methods for constructing these variables.

#### 4.1 The data

Our data set consists of a panel of all 25 franchisees (passenger TOCs) from the start of their operation until February 2000. These companies did not all start operation at the same time because not all the auctions were simultaneous (the franchising timetable is given in OPRAF, 1997, p.8). We therefore have only three full years of data so in our model  $i = 25$  and  $t = 3$ .

One advantage of our panel of data is that it represents the entire population. Its main limitation is that the short time span since the start of railway privatisation provides only 72-74 observations, depending on the variable. The small sample size does not lend itself to econometric techniques that would enable us to explore dynamics. It would have been interesting to estimate this model in a specification with all the variables taken as differences from their time series mean. We leave this for future research when the size of the panel increases sufficiently. Appendix 3 reports the summary statistics of our data.

## 4.2 Econometric methodology and results

Investment is modelled using a random effects (RE) specification. This choice reflects the fact that many elements come into play in the commercial decision to invest. First, the ROSCOs provide the initial finance in most cases, and second, in cases of loss-making operations, the local Passenger Transport Authorities (PTAs) provide finance. As other agents are involved in financing decisions, a RE specification is more appropriate. From a practical point of view, a fixed effects (FE) model is very costly in terms of degrees of freedom. Nerlove and Balestra (1992) in Baltagi (1995) emphasise the view that the population consists not of an infinity of individuals but of an infinity of decisions that the individuals might make (see also Greene, 1993, and Hsiao, 1986).<sup>17</sup>

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. We also estimated this 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.

We also estimated our model correcting for the possible presence of heteroskedasticity. The results obtained, and the robust standard errors, were very close to those obtained without this correction and are not reported separately. We tried alternative specifications of the dependent investment variable measured by the number of assets bought - in excess of their franchise conditions- rather than their capital value, and with a binary dependant variable 0-1 (1 being the case when spontaneous investment occurred). Both alternative specifications produced very similar results to those reported here.

The first point to note from Table 2 is that the coefficient on the *number of passengers* is significant and positive (when the conflating effect of *passenger miles* is dropped), and so is the coefficient on *profits*. These suggest that scale is, not surprisingly, an important determinant of the absolute level of investment. We therefore re-estimated the model normalising by the natural scale variable of the number of train-miles. The model was estimated by means of a random effects model corrected for heteroskedasticity. The results are presented in Table 3 and represent our preferred set, though we discuss both sets of results below.

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<sup>17</sup> Mundlak (1978) argues that all individual effects should be treated as random.

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

Independent Variable (units)	Random Effects (GLS)			Fixed Effects
	(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)
Std. dev. of passenger no.s	+	+	+	+
Std. dev. of passenger miles	+	+	+	+
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 t98 t99			-2.59 (3.4) .104 (3.2) 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 <sup>2</sup> Within/Between	0.54	0.58	0.55	0.28
$\chi^2$	20.31*	24.72**	25.16***	
Hausman Test $\chi^2$	8.45	7.64	3.85	

Standard errors in parentheses. + eliminated from the estimations (<50 data points); \* p <.10, \*\* p <.05, \*\*\* p <.01; ' p ≈ 0.1.

**Table 3 Results for the Spontaneous Investment per train mile** (N=74)

Independent variable	Random Effects (GEE <sup>♦</sup> )					
	(1)	(2)	(3)	(4)	(5)	(6)
Length of Contract (days)	-.0001* (.0001)	-.0001* (.0001)	-.0001* (.0001)	-.0001** (.00008)	-.0001* (.00008)	-.0001** (.00008)
Renegotiation of franchise extension: (0/1)	.612 (.687)	.560 (.691)				
Asset specificity	-.397 (.848)	-.799 (.817)	-.924 (.883)	-.925 (.764)		
Total number of passengers/train mile	-.036 (.05)					
Total passenger miles/train mile	.003* (.002)	.0003* (.002)	.003* (.002)	.003* (.002)		
Horizontal consolidation (0/1)	-.544* (.312)	-.584* (.310)	-.598** (.244)	-.497*** (.183)	-.384* (.210)	-.432** (.211)
Coach company ownership	.481** (.216)	.460** (.217)	.493** (.196)	.449*** (.169)	.313* (.172)	.315* (.172)
Joint ownership (no. of companies owned)	.083 (.067)	.071 (.063)	.083 (.062)	.082 (.055)	.080 (.059)	
Vertical consolidation (0/1)	.404 (.361)	.509 (.335)	.402 (.312)			
Subsidy remaining/train mile (£/mile)	-.0004 (.001)	-.00004 (.0001)	-.00007 (.001)			
Profits per train mile (£/mile)	.00006 (.00009)	.00006 (.00008)	.00009 (.00008)	.0001 (.00008)	.0002** (.0001)	.0002** (.0001)
Committed Investment per train mile (£/mile)	-.010** (.005)	-.009* (.004)	-.003 (.005)		-.005 (.004)	
Time dummy: t99	.40 (.281)	.409 (.284)	.339 (.298)			
Constant	-.166 (.739)	-.42 (.63)	-.453 (.654)	.562 (.576)	-.20 (.33)	-.26 (.33)
$\chi^2$	116.6***	57.28***	47.72***	19.52***	10.41*	9.53*

Robust standard errors in parentheses.

+ eliminated from the estimations (<50 data points); \* p <0.10, \*\* p <0.05, \*\*\* p <0.01.

♦ Liang and Zeger (1986)

The striking finding in both Tables 2 and 3 is that the coefficient of the *contract length* variable is negative and significantly different from zero, which implies that shorter contracts generate higher rates of investment. This is contrary to the asset specificity hypothesis and sufficiently surprising to require interpretation. One possible explanation is

that TOCs facing re-procurement sooner (i.e. those with the shortest contracts) respond with increased investment to signal their commitment to the regulator and thus increase their probability of re-award of the franchise. Clear messages were sent by the SRA about its expectations with regard to investment by TOCs: ‘OPRAF takes every opportunity to encourage and facilitate such initiatives (investments) in dialogue with operators, [...]. It has become clear that TOCs should become investment vehicles,’ (*The Utilities Journal*, 2000). Public threats of fines and non-renewal of franchises from the regulator (SRA) have served as a strong incentive. 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).

Investing near the end of the franchise is also a way to signal aggressive behaviour to potential entrants and to raise their entry costs. It has moderately low risk for the TOCs, as the risk is largely borne by the ROSCO, while the incumbent TOCs will have a clearer idea of the value of the investments they have chosen in the next round of bidding. The result is also consistent with the findings of Abel and Eberly (1993, 1994) mentioned in the discussion of theory (b) above on the relationship between investment and uncertainty. Abel and Eberly find that uncertainty can have a positive effect on investment in a competitive market. The threat of competition at the next TOC franchise auction might explain our finding that companies invest towards the end of their contract. Unfortunately our data cannot directly capture such factors,<sup>18</sup> although our results are nevertheless consistent with this explanation.

The *time dummies* are non-significant in both specifications, though they are consistent with investment delays (and hence the option value explanation, or the disruption of restructuring explanation). We tried to capture the effect of the postponement of plans to introduce open access competition by means of a 1999 time dummy but this was not significant. 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* is not significantly different from zero in Table 2 and 3, and changes sign between tables. This might be because some additional investment may be committed in exchange for the contract extension, and alter any plans for further spontaneous investment.

The coefficient on *asset flexibility (1- asset specificity)* in Table 2 is consistently

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<sup>18</sup> We had to exclude from the estimations the main variable proxying uncertainty, the standard deviation of demand, because the construction of this variable reduces the number of observations by one year. As this reduced the number of observations for this variable to 50, it was excluded.

positive, and correspondingly, the coefficient *asset specificity* in Table 3 is consistently negative, but the both are not significantly different from zero. Again, this is a surprising result. It suggests that investment in new assets may not have been adversely affected by this problem. One explanation is that the new assets have a much higher degree of interoperability than old rolling stock fleets. For example, dual voltage facilities have been installed on all new electric multiple unit stock ordered and several orders for flexible diesel multiple units have been placed. This has considerably increased the degree of flexibility of the rolling stock. The demand for new *flexible* investment may be the best response to the obstacles created by asset specificity.

Once we normalise for size in Table 3, *passenger density*, that is *passenger miles per train mile*, is weakly positively significant and clearly correlated with profits per train mile. They each pick up the demand side, with crowding requiring investment and producing profits.

The *age of stock* variable, measured by the fraction of old stock held by each TOC, is significant and positive in Table 2, but insignificant and was dropped from Table 3. It suggests, plausibly, that a higher level of investment is associated with a higher percentage of old stock.

*Coach-company ownership*, that is, franchises held by bus operators (e.g., Stagecoach and National Express), had a positive effect. Although the coefficients are not significant in Table 2, they are in Table 3. There is therefore some support for our hypothesis on industry consolidation. Such companies may feel that they are better placed to win the next franchise auction and hence are more willing to invest in advance.

We expected that if TOC  $i$  merges (either horizontally or vertically) or enters a contractual arrangement with other companies in the industry, this would reduce risk and hence stimulate investment. Although we find the *horizontal consolidation* coefficient consistently significantly different from zero, it has a negative sign, contrary to our hypothesis. This could suggest the presence of economies of scale in investment. For example Virgin and Stagecoach, who have some joint ownership, have invested in trains that could be adopted for both operations.

The effect of *vertical consolidation* is not significantly different from zero in any specification. Joint ownership, which is measured by the number of TOCs owned by the same parent company, becomes significant when we exclude the ‘coach-company ownership’ variable in Table 2, where it may be picking up a scale effect: larger firms do more



investment.

The *committed investment* variable becomes (marginally) significant in the normalised model of Table 3 provided the *contract renegotiation* variable is included, and with which it seems to interact. This suggests that contractual commitment to investment reduces the willingness (or need) to undertake additional discretionary investment, particularly when this is the outcome of renegotiation. This suggests that the TOCs are willing to commit their planned additional investment in order to secure a franchise extension, in which case less discretionary investment is needed

The variable measuring *subsidy remaining*, included to control for the effect of financial incentives, or their lack, does not have a significant effect on investment.

The *profits* variable is positive and significant in Table 2, where it is probably picking up a scale effect) but is also positive and significant in models (4) and (5) in the normalised version of Table 3, when passenger density (passengers per train) is dropped (with which it is collinear). This suggests that investment decisions respond to commercial incentives (passenger demand which produces profits requires extra capacity), though the size of the coefficient is quite small.

## 5. Conclusions

In this paper we considered the pattern of investment in rolling stock in the British railway industry from its restructuring in 1994 through privatisation in 1995/96 until 2000. We have been concerned that repeated auctions of rail franchises of different length, as well as other sources of uncertainty, may have adverse effects on rolling stock investment. Theory suggests that the length of a franchise contract plays a major role in determining the franchisee's incentives to invest in specific assets. The high degree of specificity of rolling stock assets lead us to expect that short-term franchise contracts –such as the seven years franchises awarded to some TOCs after BR privatisation- together with uncertainty as to the winner at the next franchise auction, would weaken incentives to invest. This effect is reinforced by uncertainty from (i) the potential threat of future open access competition, and (ii) uncertainty about future demand.

Surprisingly our empirical findings did not confirm this simple interpretation of the apparently adverse interaction between asset specificity and short contract lengths. Several explanations suggest themselves. The structure of long-term leasing companies (the ROSCOs) owning the assets and leasing them to whoever wins the particular franchise

reduces the risk of stranding assets considerably, though not completely. Given their considerable market power, deriving from their small numbers and barriers to entry, the ROSCOs may feel that demand for continued leases is sufficient to support investments in assets of considerably greater durability than franchise lives.

The time pattern of investment (increasing towards the end of the contract) is consistent with the option value of delaying in the face of uncertainties over future demand, as well as the disruption caused by the restructuring. Excess supply of rolling stock building capacity and a slump in new build prices would also encourage some delay. We also suggest that delaying investment until later in the contract life can be explained by companies' strategic behaviour. Investing just before the end of their contract potentially enhances the probability of having the contract re-awarded. Very explicit messages from the regulator suggest that this will be an element taken into account in the re-franchising process. Moreover such behaviour provides the incumbent operator with a first-mover advantage, while raising the entry cost for other potential bidders

We find that investment appears to respond positively to other commercial incentives such as profits and demand (proxied by the number of passengers, or total passenger miles), and that investment per train mile also responds to the number of passengers per train.

The current policy adopted by the SRA in response to the problems of underinvestment in rolling stock after privatisation has been (a) to extend contract length so that the new franchise contracts will have a minimum duration of 15-20 years, with a review taking place every five/seven years; (b) to act as a procurement agent by buying new rolling stock with the aim of transferring this to the successful franchisee,<sup>19</sup> and (c) to offer larger franchises at re-procurement. Are these responses justified in the light of our findings?

Our first contrary finding is that discretionary investment is stimulated by shorter rather than longer contracts, casting some doubt on the view that longer contracts are needed to address the under-investment problem. Longer contracts may be required for radical changes in strategy such as introducing high speed tilting trains, but not necessarily for "business as usual" scenarios. Our finding that investment appears to respond as predicted to commercial incentives (demand and profitability) also casts doubt on the need for market intervention by the SRA in rolling stock orders. The increased interoperability of the new stock ordered seems to suggest that an increasingly flexible market is developing, which

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<sup>19</sup> See SRA announcement of 11 February 2000 on rolling stock orders for the Connex South Central and South West Trains franchises to remove slam door stock (due to take place by January 2005. See [http://www.sra.gov.uk/SSRA\\_news/Default.htm](http://www.sra.gov.uk/SSRA_news/Default.htm)).

reinforces the suggestion that longer franchise contracts are not the correct solution for under-investment in British railways. Finally, larger franchises do not seem to result in higher investment, on the contrary our results show a negative relationship between horizontal consolidation and investment. Size maybe valuable in obtaining economies of scale and scope, though not for increasing the amount of overall investment.

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## **Appendix 1 The Description of the variables and data sources**

### **1. Spontaneous Investment.**

This variable measures the amount spent on new rolling stock not deriving from any contractual obligation with the franchise requirements. To take account of the delivery lag involved in building the equipment, we decided to enter the total monetary value of the investment at the date when the rolling stock was ordered rather than delivered.

*Source:* OPRAF and *Modern Railways*, issue March 2000.

### **2. Contract Length.**

Duration of the franchise contact measured in number of days.

*Source:* OPRAF Annual Reports

### **3. Contract Length remaining.**

Number of days remaining to the end of the franchise contact.

*Source:* OPRAF Annual Reports

### **4. Extension Requested**

This variable indicates whether there has been a request by a TOC to renegotiate the franchise agreement in regard to the length. This is a 0/1 dummy variable, with 1 indicating that a request was presented to OPRAF by TOC  $i$  at time  $t$ .

*Source:* OPRAF Annual Reports

### **5. Extension Awarded (Renegotiation)**

This indicates a successful outcome of the above process. It is a 0/1 dummy where 1 corresponds to the award of a franchise extension.

*Source:* OPRAF Annual Reports

### **6. Asset Specificity/Flexibility**

See Appendix 2 for a detailed explanation of the construction of this variable.

### **7. Future Competition**

There is no obvious way of measuring expected competition, in particular gradual introduction of open access competition. We tried to measure this variable indirectly by trying to capture the effect of the postponement of competition. For this purpose we introduced some time dummies. The 1999 dummy should account for the fact that the originally envisaged 'partial' competition to be introduced from 1999 did not take place.

### **8. Demand**

Total passenger numbers and Total passenger miles per year.

*Source:* OPRAF

### **9. Demand Variance**

Standard deviation of the above variables: Total passenger numbers and Total passenger miles.

*Source:* Our estimates based on data on demand as described above.

## **10. Age of Stock**

We classified all the stock in old, medium and new, and measured the percentage of rolling stock of each category adopted by each TOC. For the analysis we only adopt the fraction of old stock leased by each TOC.

*Source:* *British Railways. Locomotives and Coaching Stock* (1995 edition)

## **11. Horizontal Consolidation**

To capture the degree of *horizontal* consolidation we use a 0-1 dummy variable, with value 1 in any case of contractual arrangements entered by TOCs, as well as outright changes in ownership and control across TOCs. Some examples of events that are classed (or not) as instances of horizontal consolidation are:

- Stagecoach, operators of Island Line and South West Trains, acquired a 49% stake in Virgin Rail Group, operators of CrossCountry and West Coast Trains; classed as horizontal consolidations in 1998-99.
- MTL, operators of Northern Spirit and Merseyrail Electrics, reorganised their franchises into MTL Services plc with little change in control, (no extra benefits sought by Franchising Director). As it was just a technical change it was not classed.

*Source:* OPRAF *Annual Reports* and Press Notices.

## **12. Vertical Consolidation**

To capture the degree of *vertical* consolidation we also adopt a 0-1 dummy variable. This includes any vertical contractual arrangements entered by TOCs. Some examples are:

- The acquisition of the ROSCO Porterbrook by the company Stagecoach.
- The West Coast Main Line contractual arrangement between Railtrack and Virgin Trains.

*Source:* OPRAF *Annual Reports* and Press Notices, Industry Press.

## **13. Joint Ownership**

This is a stock variable, as opposed to the variables above that indicate the flow of consolidation in the industry. In other words this variable indicates the number of companies that are owned by the same parent company as company  $i$  at time  $t$ .

*Source:* OPRAF *Annual Reports* and Press Notices, TOCs *Annual Reports*.

## **14. Coach-company Ownership**

This is a dummy variable, which is equal to one for those TOCs that are owned by a coach company and zero otherwise.

*Source:* OPRAF *Annual Reports* and Press Notices, TOCs *Annual Reports*.

## **15. Subsidy Remaining**

The SRA makes/receives payments to/from the TOCs under two regimes, the basic regime and the incentive regime. This variable only takes into account the basic regime in order to avoid the interference of other elements that could alter its interpretation. The Basic Regime defines the basic franchise payment, indexation, access charge supplement and fares incentive

adjustment payment.

*Source: OPRAF's Annual Reports.*

### **16. Profits**

This variable measures the profits of the TOCs before taxation and other exceptional items. The data provided by the companies' accounts are not directly comparable due to the fact that in the first year of operation the accounts published refer to periods other than one year. We calculated this variable by adjusting the profits to be representative of homogeneous time intervals.

*Source: Our calculations based on TOCs' accounts.*

### **17. Committed Investment**

This variable gives the investment requirement to which a TOC committed itself when it signed its franchising agreement with the Franchise Director.

*Source: OPRAF.*

### **18. Time Dummies**

These are 0-1 dummies for the years 1997, 1998 and 1999.



## Appendix 2 Construction of the asset specificity variable

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.

The *asset specificity* index per each TOC<sub>*i*</sub> (*S<sub>i</sub>*) is calculated as follows:<sup>20</sup>

- First we calculate the proportion of TOCs that adopt each type of rolling stock, this will give us an index for each category *P<sub>a</sub>*, where the subscript *a* indicates the corresponding type of asset, for example *P<sub>d</sub>* for diesel, *P<sub>eo</sub>* for electric overhead, etc.
- Then we calculate the number of trains of each specification per each TOC, *T<sub>i</sub>*. If TOC<sub>*i*</sub> has a fleet of trains of different type, then we calculate a weighted average. That is, if for example a TOC has 3 Diesel and 8 Electric overhead trains our calculation is as follows  $T_i = 3 * P_d + 8 * P_{eo}$ . We then calculate a measure of *flexibility*  $F_i = T_i / 11$ .
- It follows that if all trains of TOC *i* are of the same type (e.g.,  $T_i = 5 * P_{etr}$ ), then the asset flexibility variable *F<sub>i</sub>* is equal to the proportion of TOCs that use that type of asset (i.e.,  $F_i = T_i / 5 = P_{etr}$ ).

*F<sub>i</sub>* is therefore an indicator of flexibility rather than of specificity which is independent of the size of the fleet and only measures the degree of flexibility of each TOC's assets, ranging from 0 to 1. Our index of *asset specificity* is  $S_i = 1 - F_i$  which also lies between 0 and 1.

This index of asset specificity is constructed to suit the particular scope of this study. An alternative measure of specificity (flexibility) of the assets of each TOC would take account of the proportion of the total network on which the assets *T<sub>i</sub>* can be used. However, this would imply that diesel trains, which can run on almost all track are not specific at all, so that  $P_d = 100\%$ . Although this may be true in a technical sense, our intention is to capture the more subtle effect of the bargaining power of each TOC. Although it might be the case that all TOCs could run diesel trains over their entire track, they typically choose not to do so, presumably as they are less suited to some routes. We choose instead to assume that an asset of a certain specification can be adopted by all other TOCs that already make use of that type of asset.

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<sup>20</sup> Additional details on the calculation of this index are available from the authors on request.

### Appendix 3 Summary Statistics

<b>VARIABLE</b> (units)	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min</b>	<b>Max</b>
Length of Contract (days)	3306.6	1169.6	1826	5480
Remaining Contract time (days)	2910.2	1195.4	927	5480
Application for franchise extension (0/1)	.05	.219	0	1
Renegotiation of franchise extension: (0/1)	.04	.196	0	1
Asset Flexibility: (1- Asset Specificity)	.322	.117	.173	.48
Number of passengers (million/yr)	33.072	32.44	.69	122.9
Passenger miles (million/yr)	846.71	647.94	3.1	2291.6
Standard deviation of number of passengers	1.38	1.26	0	5.33
Standard deviation of passenger miles	36.82	31.02	.085	164.61
Age of stock (fraction old)	.263	.309	0	1
Horizontal Consolidation (0/1)	.12	.327	0	1
Coach company ownership (0/1)	.66	.47	0	1
Joint ownership (no. of companies owned)	3.08	1.3	1	5
Vertical Consolidation (0/1)	.0641	.246	0	1
Subsidy remaining (£ million)	311.35	519.27	-1017	1959.6
Profits (£ million/yr)	5270.87	8730.5	-13227.69	38337.82
Committed Investment (£million)	21.53	84.05	0	592
Spontaneous Investment (£million)	3.706	16.953	0	120
Committed Investment / Train Miles (£/mile)	2.213	8.614	0	55.327
Spontaneous Investment / Train Miles (£/mile)	.198	.814	0	4.347
Profits / Train Miles (£/mile)	499.83	1175.39	-3431.6	3688.2
Total number of passengers/ Train Miles	3.582	2.09	1.102	8.5
Total passenger miles/ Train Miles	90.49	51.02	17.81	215.43

