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BARRIERS TO ENTRY IN THE RAILWAY INDUSTRY

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CONTENTS

1. INTRODUCTION

The aim of this paper is to examine the degree to which the economic characteristics of the railway industry lead to barriers to entry, in the light of recent theoretical and empirical evidence and in response to policy developments in Britain. In particular, the US railroad industry was deregulated in 1980, the Canadian railroad industry was liberalised in 1987 (Grimm and Rogers, 1991), whilst there have been important organisational reforms in, amongst others, Britain, Sweden and Japan (see, for example, Nash, 1990, Truelove, 1991). In both Britain and Sweden, the intention is to allow competing operators into the market; in both Britain and Japan it is intended to privatize existing operators. Furthermore, in a policy statement issued in 1989, the EEC outlined details of a Community rail policy which includes proposals to separate infrastructure from operations and to allow access to the infrastructure by competing operators (Nash, 1991). The latter issue is now the subject of an EC Directive. Legal rights of access to railway infrastructure in EC countries have been established for:

- international groupings of railway undertakings - defined as two or more operations from different countries wishing to run international services between the Member States where the undertakings are based
- any railway undertaking wishing to run international combined transport goods services between any Member States.

The structure of this paper will be as follows. In section 2, we discuss the economic characteristics of the railway industry and examine likely barriers to entry. In section 3 we examine empirical evidence on economies of scale and the impacts of organisation on the rail industry. In section 4 we go on to examine the current proposals for organisational and regulatory reform for British Rail in the light of this evidence. This leads us, in section 5, to draw some tentative conclusions as to the best way forward for the British railway industry.

2. ECONOMIC CHARACTERISTICS OF RAILWAY INDUSTRIES

Rail operators are traditionally responsible for providing their own infrastructure, principally track, signalling and terminals and as a result fixed costs form a large element of total costs. Studies suggest that between 50% and 80% of infrastructure costs are fixed in the short run (University of Leeds/BRB, 1979), whilst the capacity and signalling systems remain unchanged. Moreover, this infrastructure has a long asset life and is geographically-specific, it can not be re-deployed elsewhere and has minimal scrap value. In other words, it represents a sunk cost. In addition, even in the longer run, when capacity and signalling can be adjusted, it is subject to major indivisibilities (as are the vehicles used) and economies of scale. Moving from single track to double track involves a less than double cost increase, but, due to the removal of vehicle conflicts, often quadruples capacity, although further increases in track capacity exhibit less marked economies (Nash, 1982).

The other main feature of railways is that they are a multi-product industry involved not only in serving different origins and destinations at different times, but also in providing for different types of passengers and freight. Given fixed costs and indivisibilities, this means that there are a large number of joint costs which are difficult to allocate between products. It also gives rise to expectations of marked economies of scope, although the evidence here is more mixed.

As a result of these economic characteristics, the railway industry has normally been thought of as one with declining costs, and hence a natural monopoly requiring unitary ownership at the network level and either public control or ownership. This is the way that the industry has evolved in most countries of the world (although, not necessarily for the reasons given above). However, this view has come to be questioned on a number of counts. Firstly, the theory of contestable markets provided "an uprising in the theory of industry structure" (Baumol, Panzar and Willig, 1983) that suggested that natural monopoly no longer automatically justified public control or ownership. The implications of this theory will be discussed in the rest of this section. Secondly, a body of empirical evidence has emerged that questions the conventional wisdom concerning scale economies in the rail industry. Thirdly, there has been both theoretical and empirical concern that the conventional forms of railway organisation lead to what has been termed X-inefficiency (Liebenstein, 1966). This empirical evidence will be reviewed in section 3.

Contestability theory specifies a number of conditions whereby firms will act efficiently irrespective of the number of firms in the market. Its importance lies in the fact that it shows that, in some instances, potential competition may be preferable to actual competition and can result in a natural monopolist serving a market efficiently given a break-even constraint, by adopting Ramsey optimal prices and outputs. However, one of these conditions is that the industry should exhibit no sunk costs and hence no barriers to entry or exit and this clearly does not apply to the railway industry as a whole. Nonetheless, contestability theory has been widely applied to the railway industry, particularly in the United States (Tye, 1990), reflecting a belief that, although sunk costs are relevant to the provision of rail infrastructure, they are not relevant to operations. Furthermore, it is believed that rail traffic faces potential and actual competition from other modes, other destinations, other activities (in the case of passengers) and other goods (in the case of freight).

However, experience from other transport industries suggest that other forms of barriers to entry may exist (see, for example, Jaffer and Thompson, 1986, Levine, 1987 and Preston, 1991). The deregulated airline and inter-city coach industries suggest that access to terminals, to retail outlets (travel agents, computerised reservation systems) may act as barriers whilst experience from the local bus industry suggests that access to depots may also be important. For these tangible barriers, it may be possible to legislate to ensure competitive access (as the 1985 Transport Act did in the UK for local bus terminals). Other strategic barriers may be more difficult to deal with, in particular the use of branded ticketing such as frequent flyer programmes in the airline industry or travelcards in urban public transport. Similarly, innocent barriers - such as the economies of experience in the form of management and staff knowledge and training, brand loyalty, and the different motivation between public or newly privatized firms and new entrants, may all give existing operators a strategic advantage.

We now turn to evidence relating specifically to the rail industry.

3. RECENT EMPIRICAL EVIDENCE

3.1 Scale Economies

Table 1, derived from Caves et al, 1985, indicates that a number of econometric studies of the rail industry have found constant returns to scale with respect to firm size for "all but the smallest railroads" (Dodgson, 1985). However, these studies are exclusively North American, involving, predominantly, long haul freight with a high degree of specificity of rolling stock. Moreover, they tend to concentrate on the larger railroads, which are likely to have achieved minimum efficient scale. An earlier econometric study in the US, carried out when average firm size was much smaller, did suggest increasing returns to scale (Klein, 1953).

Similar evidence from Europe on economies of scale with respect to firm size is not readily available, as there is not the diversity of firms that exists in North America. However, there have been two recent historical studies of the British rail industry. Foreman-Peck (1987) found very small economies of scale in the 1865 industry but more substantial economies of system integration or economies of scope. Dodgson (1989) concluded that overall there were constant returns to scale in the period 1900 to 1912, although the evidence here was mixed. For example, a translog model indicated increasing returns to scale for the three largest companies but "ad-hoc" quadratic models found decreasing returns for the larger companies.

The only other relevant study we are aware of is an exploratory analysis of 13 European state railway operations using flexible cost functions (Vigouroux-Steck, 1989). The results of this study need to be treated with caution given the shortcomings of the data and the very different environments in which the companies are operating but the preferred model results are given in Table 2. (It should be noted that no satisfactory and comparable series for depreciation could be derived, and as a result capital costs were omitted from the analysis.) In terms of size alone, the results suggest that the largest railways are too large (SNCF, DB, BR, FS) and the smallest railways are too small (CIE, DSB, NS). The optimal size operators appear to be OBB and VR, with networks of up to 6,000 routes miles, or broadly one third that of BR.

In contrast to the evidence on firm size, there is strong evidence of there being economies of scale with respect to density, as Table 1 illustrates. Moreover, work by Brauetigam et al (1984) indicates that if quality of service measures are included these economies of density are even more pronounced. This result should not be too much of a surprise. Declining average costs do not occur because a rail company is big, per se, but because it is making intense use of its fixed assets. However, economies of density are related to size. For a given fixed cost, a rail operator will usually have lower costs the greater its output. However, there are clearly limits to this. For example, Table 2 shows there are diseconomies of density for NS and CFF, both heavily trafficked networks (although the results for FS and to a lesser extent, OBB are more difficult to explain). Similarly, Dodgson (1989) found diseconomies for the most densely trafficked railways.

Table 1
Comparison of Returns to Scale and Density from Various Rail Studies (Computed at the Sample Means)

Study	Returns to Density	Returns to Scale	
		Fixed haul and length	Increased haul and length
Friedlander & Spady 1981	1.16	0.88-1.08	1.07-1.37
Caves et al 1980	-	1.01	1.13
Harmatuck 1979	1.92	1.01	1.02
Harris 1977	1.72	0.93	1.02
Keeler 1974	1.79	1.01	-
Caves et al 1985	1.76	0.98	1.00

Source: Caves et al 1985

Table 2
Companies of Returns to Scale and Density for 13 European State Railways

Operator (state)	Length of line (km-1987)	Elasticity of rail costs with respect to:		Return to scale
		Total train kilometres	Total train kilometres per length of line	
BR (UK)	16630	1.17	-0.45	0.86
CFF (Switzerland)	2990	0.74	0.12	1.35
CIE (Eire)	1944	0.66	-0.30	1.51
DB (West Germany)	27427	1.29	-0.72	0.78
DSB (Denmark)	2476	0.69	0.01	1.45
FS (Italy)	15983	1.21	0.56	0.83
NS (Netherlands)	2809	0.69	0.20	1.46
NSB (Norway)	4217	0.87	-0.55	1.15
OBB (Austria)	5747	1.04	0.44	0.96
SJ (Sweden)	11194	1.13	-0.83	0.88
SNCB (Belgium)	3568	0.81	-0.07	1.23
SNCF (France)	34646	1.39	-0.96	0.72
VR (Finland)	5884	0.97	-0.79	1.04

Source: Vigouroux - Steck, 1989

Given their importance, the underlying causes of these economies of traffic density need to be fully understood. Keeler (1983, p130) conjectured that a "large part of economies of traffic density ... are achieved by larger trains and better utilisation of the equipment and crews ... rather than a better utilisation of the fixed track." Grimm and Harris (1983) noted that increasing density not only allows for longer trains, but also makes it possible to provide direct train connections between an increasing number of terminals. Keaton (1991) examined the economies of density of general carload freight for three US rail networks of between 5,500 and 9,000 km route length. He found that at the highest density examined average operating cost per car mile was about half that of the lowest density. Around 60% of this reduction was due to spreading crew costs over a larger number of cars (ie operating longer trains), 10% of this reduction was due to reduced marshalling and 30% due to savings in car time (ie operating more direct services). If service levels are allowed to vary (ie operate more direct services as well as longer trains) the estimated returns to density are below the 1.7 to 1.9 range computed in four of the six studies given in Table 1 at around 1.23 for US Class 1 railroads average density (but this is similar to Friedlaender and Spady's finding). These results do not seem to vary with length of haul and network structure. If service levels are held constant (ie only run longer trains), the estimated economies of density are greater ranging from 1.90 to 2.65 and are positively correlated with length of haul. Other types of freight traffic are also considered: unit train operations of bulk commodities may not enjoy the same economies but intermodal operations should experience some economies of density.

These economies of operating longer trains and more direct services are also likely to be relevant to the passenger business and, where traffics are service sensitive, are likely to have revenue as well as cost implications. Some elements of what we have so far referred to as economies of density may be thought of as being economies of scope. As a result of producing a network of services (ie having multiproduct output) cost efficiencies can be achieved, particularly as a result of better utilisation of staff and vehicles. One possible exception may be the joint operation of passenger and freight services. Empirical work suggests that there may be some diseconomies of scope here although the reasons are not clear (Brown et al, 1979, Hasenklamp, 1976, Oum and Yu, 1991). Perhaps they relate to congestion, and the delays caused by operating trains of very different characteristics in terms of speed and acceleration over the same tracks.

3.2 Organisational Economies

The most common form of organisation for the railway industry involves some form of public control, normally nationalisation. It has been argued by Liebenstein and others that this will lead to technical inefficiency due to employee motivational inefficiency and lack of understanding of the firm's production function due to to the regulated environment in which railway firms operate.

There have been a number of international studies that have examined the efficiency of railway operators including work undertaken at Leeds University (University of Leeds/BRB, 1979, Nash, 1985a). These early studies showed that there were large variations in partial factor productivity measures and these differences could often be attributed to government policy but the degree of causation was difficult to quantify.

However, advances in the estimation of total factor productivity indices based on the translog cost function and, latterly, data envelopment analysis techniques have allowed some useful insights. In an early study, Caves and Christensen (1980) compared publicly

and privately owned Canadian rail operators and concluded that there was little difference statistically between ownership types; in fact there was weak evidence for suggesting that public firms might be more efficient. Further evidence on organisational effects is given by Oum and Yu (op cit) in an international study of 17 rail operators. They find weak evidence that increased subsidy decreases total efficiency and rather stronger evidence on subsidy's effect on partial productivity measures. An increase in the subsidy ratio of 10% might reduce labour productivity by 1.2%, energy productivity by 1.3% and rolling stock productivity by 0.8%, findings which are consistent with other empirical studies (Kim and Spiegel, 1987). There is also some evidence that if railways are provided as a government agency they will be 11% less efficient and if they are provided as a quasi public corporation (eg Amtrak) they may be 20% more efficient than the organisational 'norm'. Similar findings have been produced by Gathon and Pestieau (1991) who composed indices of managerial autonomy for 19 European rail operators and found that this explained around one third of the variation in technical efficiency.

More generally, it should be noted that the development of linear programming based techniques, such as data envelopment analysis, has allowed estimation of firms' relative efficiency with poorer data and less strict assumptions than conventional econometric approaches (Banker, Conrad and Strauss, 1986). However, the method is not immune from conflicting results. For example, in Oum and Yu's study DSB is one of the top performers in terms of productivity and efficiency but in Gathon and Pestieau's study it is the worst. However, small variations may produce large changes in rankings as Oum and Yu estimate that in 1988, 7 out of the 15 operators for which gross indices could be estimated were producing on the technically efficient frontier.

3.3 Overview

We may thus identify two key barriers to entry that may be of relevance in the rail transport field:

1. Economies of scale in both infrastructure and operations. Contestability theory suggests that the traditional view of this as a barrier to entry is incorrect. However, the fact that an entrant may need to supplant the incumbent rather than simply take a small market share surely remains something of a barrier to entry.

2. Sunk costs of infrastructure. This means that the provision of rail infrastructure must almost certainly be seen as an uncontestable natural monopoly.

On the other hand, there is a lack of clear evidence of economies of scope and of economies of firm size beyond some efficient minimum. Hence the current interest in structures which combine a monopoly provider of track (at least for a particular area) with competitive operations. We will discuss the extent to which these may be both feasible and desirable in the context of a specific case study of the various options that have been put forward for the privatization of British Rail.

4. A CASE STUDY OF ORGANISATIONAL REFORM - BRITISH RAIL

4.1 Organisational Developments

Following nationalisation in 1947, British Rail (BR) adopted the traditional hierarchical organisational form on a mainly geographical basis consisting of central Headquarters, Regions, Divisions and Areas that, to some extent, had its roots in the military organisation model. This organisational form evolved over the years but was throughly revised in the early 1980s when a new layer of management, the business sectors, was created, resulting in a matrix management approach in which organisation was split by function, region and sector (Allen and Williams, 1985). This organisational form has been recently revised by a programme called Organising for Quality (OfQ), whereby the firm has adopted a multi divisional approach based on separate businesses. There are eight businesses overall. Four of these businesses deal with passenger services.

- InterCity which is further divided into five routes (the East Coast Main Line, the West Coast Mainline, the Great Western Mainline, the Midland Mainline/Cross Country and Gatwick/Norwich).
- Network South East which is further divided into nine divisions (Thames and Chiltern, North, West Anglia and Great Northern, Great Eastern, London, Tilbury and Southend, Thameslink, South East, South Central and South West)
- Regional which is further divided into five regions (Scotrail, North West, North East, Central and South Wales and West)
- European Passenger Services.

Freight is split into two businesses.

- Trainload Freight which consists of four businesses (Coal, Metals, Construction and Petroleum)
- Rail Freight Distribution which consists of two businesses (Continental and Deep Sea).

The former parcels sector is now operated jointly by the three main passenger businesses, whilst ancillary services are split into two businesses (BR Telecommunications and Central Services Division).

However, further organisational reform seems inevitable given the Government's commitment to privatization and the low level of esteem with which BR is viewed by the public. Privatization of BR was first seriously proposed by Beesley and Littlechild (1983) who suggested that BR's large property endowment should be used to attract private investment. In the meantime, BR has divested itself of its ancillary activities; British Transport Hotels, Sealink Ferries, British Rail Engineering Limited and the Vale of Rheidol railway, whilst it has encouraged private investment, particularly in the freight sector where a joint venture company, Charterail, has been set up with the private sector and 40% of wagons are now privately owned. Furthermore,the Channel Tunnel has been constructed entirely with private funds and a private firm, Eurotunnel, will operate the shuttle service. Similarly, the Heathrow Express rail link is to be 80% financed by the privatized British Airports Authority (BAA). Nonetheless, the calls for privatization have continued with at least four organisational forms having been considered.

1. Privatization as a single unit. This option was at one time favoured by the British Railways Board but, given the difficulties of developing effective competition for utilities privatized in this form (British Gas, British Telecom), is not believed to be in serious contention, although it has recently been suggested that this option is worthy of further consideration (Dodgson, 1992).

2. Splitting BR into a number of regional independent companies. This option was put forward by Gritten (1988) and would effectively be a denationalisation programme. Critics argue that it would merely convert a national monopoly into a series of local monopolies, with competition limited to boundary areas. However, it would introduce the possibility of yardstick competition (Vickers and Yarrow, 1988) and has been used as the basis for commercialising Japanese National Railways with apparent success (Hirooka, 1991).

3. An alternative for splitting BR might be on the basis of the main business sectors (Inter City, Network South East, Regional and Freight) but this would again achieve little effective competition.

4. The separation of infrastructure and operations. This was initially put forward by Starkie (1984) who argued that the natural monopoly characteristics of the rail industry lay in the sunk costs of the infrastructure. If this remained in state ownership or control, then operations would represent a contestable activity. This proposal was taken up by Irvine (1987) who proposed that the track should be leased to competing companies.

Table 3
British Rail - Financial Results (£m)

	Revenue	Surplus
Inter City	851.2	49.7
Network South East	998.3	(154.9)
Regional	303.7	(503.4)
Trainload Freight	509.5	98.7
Railfreight Distribution	172.8	(152.3)
Parcels	115.8	(25.8)
TOTAL	2951.3	(688.0)
Grant	671.5	(16.5)

Source: BRB Annual Report and Accounts 1990/91

Table 3 indicates that there are at least two parts of the rail business where full-scale privatization without subsidy is feasible namely InterCity (106% cost recovery in 1990/91) and TrainLoad Freight (124% cost recovery). However, for InterCity to be attractive to the private sector it would need a higher return. This might be achieved by withdrawing from the least profitable routes, largely on the periphery of its network. TrainLoad Freight would clearly be attractive to the private sector. There might be some concern about the scope for monopoly rents, particularly in carrying coal, but this might be reduced by product competition and, if open access was granted, by increasing

contestability. Network South East (87% cost recovery) would not be attractive to the private sector but could be if some inner suburban routes (generally, loss making) were transferred to London Transport and price increases greatly above inflation were permitted. Political constraints mean that this is unlikely to occur and thus, like the loss making Regional Railways (38% cost recovery), the most relevant form of privatization would probably include competitive tendering or franchising for subsidy.

4.2 Increasing Competition

With any of the above methods of privatising BR, it is likely that attempts would be made to stimulate competition in two ways:

(a) by giving access rights to the infrastructure to other operators
(b) by moving towards competitive tendering for the provision of subsidised services.

We may now consider what barriers to entry are likely to be faced by a new company wishing to indulge in either of these forms of competition under the alternative organisational structures put forward above.

(a) In the case of on-the-tracks competition, where tracks are owned by a competing firm, it would clearly be necessary to regulate access and price, so that the incumbent operator is prevented from using its ownership of the tracks to make entry unattractive. This poses big problems for the regulator, in determining whether the existing timetable has been deliberately designed to inhibit entry, and in determining a fair price for use of the track. For instance, to price at marginal cost in a decreasing cost industry, is not sustainable; the owner of the track would be placed at a competitive disadvantage by having to pay for the fixed costs of infrastructure. On the other hand, if the price is above marginal cost, then the owner of the track is at an advantage in that it can operate any services which at least cover their marginal cost and cover the fixed costs as and where market conditions allow. At the same time, successful entry which did not totally displace the incumbent operator would lead to loss of economies of density, and may also disbenefit passengers (eg. if a ticket for Inter City's 5.10 train is not also valid on Virgin's 5.40).

   All of these points apply more strongly to passenger services than freight (even in these days of just-in-time, freight is still less time sensitive than passengers) and there are also more advantages of entry on the freight side than passenger. For instance, the big distribution companies have the sort of relationship with shippers of general merchandise that it would be very difficult for BR ever to achieve. On the other hand this might lead one to expect BR to seek joint ventures with these organisations anyway, and recent developments (eg. Charterail) suggest that this is beginning to happen.

(b) There appears to be a much more clearcut case for the introduction of competitive tendering for operation of subsidised rail sevices. Indeed, given the above difficulties with on the track competition, it may be that the best way forward would be a mix of competitive tendering for subsidised services and franchising of commercial services, as has been suggested as optimal for the bus industry (Gwilliam et al, 1985). Nevertheless, there are important differences relative to bus:

- the issue of regulating access to shared infrastructure and terminals again arises, unless the tenders relate only to small self contained parts of the network
- rolling stock is a major problem. Rail rolling stock is more expensive and longer lived than bus. There is unlikely ever to be such a lively market in second hand or leased passenger rolling stock within the UK as for bus, and most foreign rolling stock cannot run in Britain (whilst British rolling stock can run abroad it is generally not very suitable without extensive alterations). The best solution here might be for the tendering authority to own the rolling stock (as in Sweden)
- it is much more difficult to arrange to have railway equipment maintained than is the case with buses. Would the operator have to set up its own depots, or would it have access to existing ones? If the latter, would this confer monopoly power on whoever owned the depot, and create another need for regulation?
- Management knowledge and staff training may be more important than for the bus industry. For instance, whereas a bus driver who has a PSV licence can drive on any route in the country, in the existing state of technology the safe operation of trains depends largely on the route knowledge of the driver. A new entrant would either have to recruit drivers from an existing operator or arrange training on an existing operators trains. This is another potential barrier to entry which may need regulation; an early study recommended the setting up of a national training college and an inspectorate to license management companies, train drivers and crew (Redwood, 1988).

4.3 Separating Operations from Infrastructure

It thus appears that there are likely to be significant barriers to entry under any of the above organisational structures, although there is less scope for deliberate strategic entry forestalling where the infrastructure authority is separate from all operators. However, there are other reasons to doubt whether this is likely to be an efficient solution. One of the strengths of the sector management approach as adopted by British Rail (and copied by other railways, including French and Spanish Railways) has been the strong links between commercial planning and infrastructure planning and the commercial decisions of the sectors. Broadly, the approach has been that on each stretch of track the prime user has first been asked what level and quality of infrastructure it requires and is able to pay for. Then the other sectors in turn have been given the choice of making use of any spare capacity within the infrastructure as specified by the prime user, or paying for it to be enhanced. The result has been a major improvement in the efficiency with which the infrastructure is provided and used. For example, the ratio of annual train operating revenue to track miles increased from £96,831 per mile in 1985/86 to £125,619 in 1990/91 (at 1990/91 prices), an increase of 30%. Similarly, annual track, signal and telecommunication costs per track mile have reduced from £42,759 in 1985/86 to £34,937 in 1990/91 (down 18%).

Furthermore, the idea that paths over the infrastructure could be allocated between operators by some kind of auction faces all sorts of practical problems. On a rail network carrying a variety of types of train over a variety of routes, there is no simple way of defining a timetable slot. Running a particular train requires allocations of platforms at all the stations used, and paths over the track space and through the junctions between

them. All of these can be used in a wide variety of ways to provide trains between different points at different speeds and with different stopping patterns. There is no sensible alternative but to have a single track owning authority which tries to timetable the services as a whole in the way which most closely meets the aspirations of the various operators over the track. Whilst it is no doubt possible to devise contractual arrangements for a variety of operators to run over a single stretch of the track (and this already happens in the US), the theoretical simplicity of the 'bidding' model is an illusion. American experience of one company operating over the tracks of another has not been particularly happy, and has often been cited as a major reason for the quality of service problems of Amtrak.

In practice, two European railways already have a degree of segregation of financial responsibility for their infrastructure. In Switzerland, the state has already taken over financial responsibility for the infrastructure of CFF. In return, it simply charges CFF a lump sum based on what CFF can afford. Thus there is no element of marginal cost pricing in the arrangement.

The situation in Sweden is more interesting. Swedish Railways has been divided into two totally separate organisations - Affärs-SJ, which operates services, and Banverket, which provides the infrastructure. A complicated tariff on very much the same lines as road taxation has been worked out, with a fixed charge per vehicle and a running charge per vehicle mile for each type of vehicle. The latter is supposedly based on marginal cost pricing principles, with the former being a balancing charge to recover part - but by no means all - of the difference between marginal and average cost (Jansson and Cardebring, 1989). There is as yet no peak/off peak differential.

In neither case is there any real competition between alternative operators over the same route. However, in Sweden there is competition for the contract to operate subsidised services, and in one case a local bus operator has won the contract in competition with Swedish Railways. Clearly such competition is facilitated if either the local authority owns the rolling stock (as in Sweden) or it can be leased, and if contractual arrangements regarding its maintenance can be obtained, so that the sunk costs of entering the market are minimised. This is essentially the way in which much privately owned freight rolling stock is provided at the present time.

Finally, there remains concern about the track authority's natural monopoly, even if it is regulated to ensure reasonable pricing for its assets. Should it remain in the public sector, there would be concern over the lack of incentives for the efficient management of its resources. Transfer to the private sector would lead to greater concern about monopoly pricing abuse and might increase transaction costs and information asymmetries. Traditional rate of return regulation would lead to inefficient operations (in particular, there would be capital over-investment), whilst price regulation of the RPI $\pm$ X might, in the longer term, have similar effects (Helm, 1989).

5. CONCLUSIONS

In this concluding section we shall make comments on two issues. Firstly, we shall draw some conclusions about the role of barriers to entry in the rail industry. Secondly, in the light of our first set of findings, we shall draw up some policy recommendations.

5.1 Barriers to Entry

The most obvious barrier to entry in the railway industry is the sunk cost of the infrastructure. However, even assuming that operations can be costlessly separated from infrastructure and a workable regulatory regime can emerge, a number of barriers remain. These include the sunk cost of training staff (recently estimated to be £25,000 a driver; with around 20,000 drivers this represents a sunk cost to BR of £0.5 billion), the lack of a second hand market for rolling stock, access to maintenance and depot facilities, the sunk costs of advertising and promotion and access to travel agents and seat reservation systems.

Furthermore, for rail operations to be contestable, 'hit and run entry' must be feasible in that the incumbent can not respond quickly to entry by either reducing price and/or increasing output. Given the nature of the railway industry it is likely that the reaction periods in the rail industry are longer and adjustment costs higher than those in the bus industry but they may not be sufficient to make hit and run entry feasible. The exception may be in the trainload freight market which is dominated by a few very large customers and here it may be possible for entrants to develop secret contracts which vertically tie customers into their rail services for a certain period of time. To pre-empt this, the incumbent may develop a 'never knowingly undersold' policy.

We have seen that network operations of both freight and passenger services exhibit economies of scale. Efficient entry would have to be at a large scale, there may be only a few companies with the managerial skill and/or bravado to attempt such entry. The pool of potential entrants may be quite limited. Furthermore, given the minimum efficient scale of some aspects of operations, the incumbent operator will be a large firm; not necessarily as large as British Rail but possibly as large as, say, the Inter City sector. Given its size, it may be able to develop a tough reputation in order to deter competition as has happened in the bus industry. Access to investment capital is also likely to be easier for a large incumbent, who is also likely to have a weaker bankruptcy constraint than entrants. Predation is likely to be a feasible and rational strategy for the incumbent and, unless specifically legislated for, the threat of predation will act as a major barrier. The other entry deterrence strategy that might be expected is for the incumbent to fill all the main paths on profitable routes to make sure there are no gaps in the market. The result is likely to be the high fare, high frequency outcome predicted for the bus industry (Evans, 1987) but quality competition is also possible. Excessive brand proliferation may result.

It should be clear that in the above we are referring to domestic traffic. For international traffic a series of additional constraints emerge. A recent UIC (1992) report identifies problems concerning locomotive changeovers, driver and train crew rostering, technical visits, checks on dangerous goods consignments, the compilation of transport documents and of train consists. In addition, formalities concerned with transport law, forwarding agents, customs operations and plant and veterinary controls can act as obstacles.

5.2 Policy Recommendations

We have seen in 4.2 that BR privatization is feasible but is it desireable? Our view here is that, without competition which we have shown to have both practical and theoretical problems, ownership is largely an irrelevance. More important are organisation and objectives. In terms of organisation, there may be some diseconomies of size due to lack

of managerial control and unfocussed strategy but these have been reduced by sectorisation and the transfer of assets to four main businesses (Inter City, Regional, Network South East and Freight). We believe that economies of density and of scale (below a certain size) mean that networks of services should be operated as a unified whole. This is particularly relevant to InterCity and RailFreight Distribution but may also apply to Network South East and parts of Regional railways ("Express" services and services in PTE areas).

The main advantage of privatization of the whole industry, namely setting it free from the public sector borrowing requirement, can be achieved in other ways. There may be some scope for privatization or competitive tendering for discrete sections of the business, such as self contained local passenger operations or some parts of the Trainload Freight business where existing local transport operators and own account operators respectively will provide effective competition (and in the latter case product competition may also be relevant). Consideration should be made of operating rather than complete tenders and franchises (ie. rolling stock and depots under public control as well as infrastructure). American experience suggests that there may be some advantages in terms of increasing workforce flexibility, adopting (lower) local wage rates and increasing management responsiveness but there may be diseconomies in procurement and maximising equipment use (Due, 1987). However, overall, we believe that the scope for improvements in technical efficiency in BR are limited compared to, say, those achieved in the local bus industry and given recent decreases in unit costs (for example, operating expenses per train mile down 11% 1985/6 to 1990/91). The main scope for reductions is likely to be reductions in wage levels rather than improvements in productivity, although further contracting out (eg of track maintenance) may be beneficial.

In terms of separation of infrastructure and operations, we believe that there are strong arguments in favour of vertical integration. If the industry was to be disintegrated, we believe that the provision of infrastructure, even if by a private agency, would become less efficient.

Given the practical problems that privatization faces, we would therefore suggest that BR should remain in public ownership, along the lines of the multi-divisional organizational form that it is currently developing. BR's re-organisation into a small number of business units, trading with each other, seems to be sensible and this process of commercialisation should be allowed to continue and embrace further reforms. Joint venture companies should be encouraged in both the passenger and freight businesses, whilst experiments with tendering/franchising might also be worth considering, although this will probably require the development of arrangements for vehicle leasing and maintenance. There may be some scope for developing open access to the InterCity and Freight markets, with the development of this process regulated by a new body (OFRAIL?) that might also subsume responsibility for passenger complaints. Any privatization should take a hybrid form taking into account the different characteristics of the railway industry; small regional companies could develop rural railways (eg. North Scotland, South West England) or commuter networks (Merseyrail, South West division of Network South East) on a tender or franchise basis. Specialist freight and InterCity passenger firms might also emerge. However, we would recommend a policy of experimentation with increased access and limited competitive tendering (somewhat akin to Williams, 1992, but putting less emphasis on yardstick competition) rather than full-scale privatization at this stage.

It is, however, in terms of BR's objectives that we see the strongest case for review. The operation of InterCity and Freight without subsidy would only be efficient in a situation in which road transport covers all of its social costs. With growing congestion outside urban areas, and growing concern about the environmental effects of road transport, there is considerable reason to doubt whether this is the case, particularly in the case of freight vehicles (Fowkes et al, 1992). There may be strong second-best arguments for subsidising these sectors, at least in terms of providing capital grants for investments that appear socially desirable but do not offer an adequate financial rate of return. There may also be even stronger reasons for subsidising the Network South East and Regional railways networks on similar grounds, but it is not clear how far current grants are based on such arguments. A shift away from a block grant to targetted subsidy may be timely, especially as this will facilitate assessment of value for money and the introduction of competitive tendering. In short, we believe that, due to the economic characteristics of railway industries and the resultant barriers to entry, there is limited scope for efficient organisational reform, over and above that which has already taken place, to increase competition, but there may be scope for beneficial reform in the areas of objectives and finance. That, however, is really another subject (see, for example, Nash, 1985b).

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