GETTING BACK ON-TRACK OR GOING OFF THE RAILS? AN ASSESSMENT OF OWNERSHIP AND ORGANISATIONAL REFORM OF RAILWAYS IN WESTERN EUROPE

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To be presented to the Sixth International Conference on Competition and Ownership in Land Passenger Transport, Cape Town, South Africa. Theme 5: Ownership and Organisation of Public Transport and Infrastructure. 20-23 September, 1999.

ABSTRACT

This paper reports on work undertaken for the European Commission (EC) between 1996 and 1999. It is shown that despite reforms initiated by the EC Directive 91/440, the performance of 17 state owned western European rail operators is poor. Work using non-parametric index numbers indicates only modest productivity growth and mixed financial and commercial performance. Work using cost functions indicates that many railways appear to be of the wrong size and the wrong density to minimise costs. Work using demand functions indicates that there may be substantial scope for pricing up and for reconfiguring service levels. Modelling of cross border flows suggests that international services require increases in service levels and quality.

It is argued that Europe's railways are in need of radical reform. A first phase of reform would build on the process already initiated by the EC and involve separate infrastructure authorities, continued commercialisation and privatisation of train operations, creation of rolling stock leasing companies, development of transparent infrastructure access and pricing, the promotion of off-track competition and of coach deregulation. However, it is possible that this first phase of reforms may not be sufficient to achieve the desired results. It is therefore likely that a second phase of reforms will be required including horizontal separation and re-agglomeration of train operations, vertical re-integration and network re-configuration. The scope for off-track competition for vertically integrated concessions might be considered in this second phase.

1. INTRODUCTION

This paper draws upon a research project carried out for the Commission of the European Communities entitled the Strategic Organisation and Regulation in Transport – Interurban Travel (SORT-IT). The project began in January 1996 and was completed in April 1999. The project aim was to develop policy measures that would address the organisation of the European transport system in order to improve the efficiency of the transport sector. In addition, the project was to design measures to promote inter operability and inter connection, economic efficiency and spatial co-ordination of pan European transport systems.

SORT-IT therefore studied the effects of the organisation and regulation of transport systems on their performance. The project considered all major inter-urban modes, for both passenger and freight traffic, i.e. road haulage, bus/coach public transport, railways, inland navigation, aviation, short sea shipping and inter-modal transport. For the purposes of this paper we will concentrate on railways. The SORT-IT Final Report (Shires, 1999) can be obtained from the authors.

In Section 2 of this paper we outline the European legislation that affects the railways and its implementation by European countries. In Section 3, the modelling techniques used to assess the performance of European railways are outlined and the results of the modelling reported. The work carried out using non parametric index numbers indicates only modest productivity growth and mixed financial and commercial performance. Work using cost functions indicates that many railways appear to be of inappropriate size and density to minimise costs, whilst work using demand functions indicates that there may be substantial scope for pricing up and for reducing service levels. Finally, the modelling of cross border flows suggests that there may be a need to increase service levels and service quality. In section 4, we argue that Europe's railways are in need of radical reform and this reform may have to invoke two phases. Finally, in section 5, we draw some overall conclusions.

2. EUROPEAN LEGISLATIVE REFORM

There has been four key pieces of European legislation affecting railways since 1991. These are:

1. Regulation EC/91/1893 concerning public service obligations;
2. Directive EC/91/440 on the development of the Community's railways;
3. Directive EC/95/18 on the licensing of Railway Undertakings; and
4. Directive EC/95/19 on allocation of railway infrastructure capacity and the charging of infrastructure fees.

In Table 2.1 we outline the key points of each legislative reform. Whilst, they are all important it is the three EC Directives that have had the most bearing on the European rail industry to date (Holder, 1999). The first Directive to be legislated was Council Directive 91/440. This grants the right of access to railway infrastructure to undertakings wishing to provide international combined services and to associations of railway undertakings wishing to offer international services between the countries in which they are established. The four key elements of this Directive were:

1. Management independence of railway undertakings;
2. Separation of infrastructure management and transport operations;
3. Improvement of the financial situation; and
4. Access to railway infrastructure.

The underlying aim of the Directive was to liberalise the rail market by opening it up to competition through the concept of 'open access' and to reduce the financial burden on state governments by restructuring financial debt. If liberalisation results in a number of competing rail companies there is a danger to harmonisation, for example the loss of through ticketing and integration benefits. Similarly, if one were to allow open access on any part of the route there would be difficulties in ensuring that the public service obligation was met. There are difficulties in taking into account the spatial cohesion requirements when promoting new rules in the definition of infrastructure user charges. Finally, there is the problem of privatisation reducing public control over transport policy.

It is because of these opposing aims that the implementation of the three EC Directives has been very piecemeal and in many cases been left open to interpretation. For example, in the United Kingdom, the Directives have been implemented to the letter and beyond. The exception is that as yet ‘open access’ is not permitted on passenger services.

Despite the piecemeal introduction of the legislative reform (EC, 1998), the SORT-IT project has attempted to assess what impact it has had on the performance of railway companies in terms of production and allocative efficiency. However, given our use of 1994 data we were unable to test the effect of Directives 95/18 and 95/19 and so have concentrated on the effects of Directive 91/440. In addition the project wished to test whether barriers to interoperability and interconnection existed and if so what impact they were having.

3. MODELLING AND DATA SETS

3.1 Model Outlines

We used several of the model types identified by Oum et al. (1999) to assess the efficiency of the European railway industry. Our first set of models analysed the cost structures of the rail markets to determine whether a competitive market existed or was feasible and whether there was a need to regulate or deregulate the market. These Cost and Productivity Models consisted of two broad approaches. First, non-parametric index numbers helped to highlight the differences in cost and productivity performances between the firms in the market. The basic form of the model was:

$$\frac{\text{Total revenue}}{\text{Total cost}} = \frac{\text{Total revenue}}{\text{Total traffic units}} \times \frac{\text{Total traffic units}}{\text{Total vehicle kms}} \times \frac{\text{Total vehicle kms}}{\text{Total no. of staff}} \times \frac{\text{Total no. of staff}}{\text{Total staff cost}} \times \frac{\text{Total staff cost}}{\text{Total cost}}$$

Secondly, a parametric cost model was developed based on a translog function which relates the operating cost with the level of output and input prices. The specific form was:

Total cost = f(total vehicle kms, total network size, labour price, fuel price, material price, organisational type)

Table 2.1 Key Requirements of ECMT Resolutions and EU Directives and Regulations

Regulation EC/91/1893 concerning the obligations inherent in the concept of public service in transport

• Public Service Obligations must be provided for in a contract. Urban, sub-urban and regional services may be excluded from this requirement but their accounts must be separated from non-PSO activities.
Directive EC/91/440 on the development of the Community's railways Governments must: • Afford railway operators independence to behave commercially. • Ensure infrastructure and operations are managed separately - optional - with separate accounts – compulsory. Prevent aid given to infrastructure passing to operations and *vice versa.* • Establish rules for payment for infrastructure use based on non-discrimination. • Grant rights of access for international groupings to run international services. • Grant track access to international combined transport operations. • Ensure PS0s and related contracts are made according to commercial principles. • Ensure sound financing structure for public railway undertakings. • Reduce indebtedness to levels that do not impede sound financial management. • Provide State Aid to reduce debts only in accordance with Articles 77, 92 and 93 of EEC Treaty. The Commission will set up an advisory commission on application of the Directive.
Directive EC/95/18 on the licensing of Railway Undertakings • Operators require: 1. An operating license 2. A safety certificate 3. A path allocation 4. Insurance • States shall designate licensing authorities
Directive EC/95/19 on allocation of railway infrastructure capacity and the charging of infrastructure fees Governments must, in general: • Ensure non-discriminatory access for international consortia and combined transport operators as defined in 91/440. • Ensure optimum use of infrastructure. • Ensure no discrimination in charging for the use of infrastructure. In particular (within 2 years of 27 June 1995): • Define an infrastructure manager. • Ensure infrastructure managers accounts balance income (including PSO payments) and expenditures. • Lay down rules for determining infrastructure fees based on type of service, time-tabling and infrastructure wear. Publish procedures for allocation of capacity. • Define an allocation body. • Explain reasons for refusals to allocate capacity. • Appoint an independent body for appeals.

Source: ECMT (1997)

Following on from these models we attempted to assess the impact of various forms of competition and related regulations, on net social benefit was made using a series of Competition Simulation Models. Two models were developed: an intercity rail model based on UK experience (Preston et al., 1999); and a simulation model of long distance road competition between air, car, coach and rail in Sweden developed by the Swedish Institute for Transport and Communications Analysis in conjunction with VTI, Stockholm Transport and Linne Trafiksystem AB.

Another issue of interest was that of interoperability namely, the ability of national and geographically defined transport networks to provide efficient operations and services across national borders and across physical and technical barriers respectively. Models were estimated which related transport system performance to the existence, or otherwise, of barriers to entry and exit. A taxonomy of barriers was identified that included technical, physical, institutional, capacity, strategic, innocent, organisational and environmental barriers.

The basic forms of the interoperability model were:

Generalised cost = f(distance, demand, market concentration, barriers), and

Demand = f(distance, generalised cost, demand, market concentration, barriers)

Finally, two demand models (for the passenger and freight sectors) were estimated, the basic form of both models was as follows:

Passenger kms = f(fare, train kms, GDP, population), and

Tonne kms = f(price, train kms, GDP, population)

3.2 Data Sources

A comprehensive data set was assembled for the following 17 state railway operators:

Austria (OBB)	Greece (CH)	Portugal (CP)
Belgium (SNCB)	Ireland (CIE)	Spain (RENFE)
Denmark (DSB)	Italy (FS)	Sweden (SJ/BV)
Finland (VR)	Luxembourg (CFL)	Switzerland (CFF)
France (SNCF)	The Netherlands (NS)	United Kingdom (BR)
Germany (DB)	Norway (NSB)	

The data set assembled took 1994 as its base year. This year was chosen because at the time of the project's inception meeting (1996) it was considered to be the most up to date and complete data available. For a comprehensive outline of the data see Edwards et al. (1997).

3.3 Results of the Modelling

3.3.1 Non-Parametric Index Numbers

A series of partial index numbers were built up for the 17 rail operators, covering the period 1971-94. The different indices allow individual firms to be compared and contrasted under three main headings: operating performance, commercial performance and financial performance. In this section we concentrate on the year 1994, however in Shires (1998) a time series comparison is presented as well.

In the analysis we differentiated the rail companies by the type of regulatory/commercial environments they experienced in 1994. The group that appears under the heading *State Controlled Firms* refers to operators directly under the control of a Government agency or department, whereas the other group, *Commercialised Firms*, includes both private firms and public firms with a high degree of autonomy, were significant steps towards deregulation/commercialisation have taken place. The classification, which is admittedly contentious, first appeared in the PETS (Pricing European Transport Systems) project and was adopted by SORT-IT (see Table A1 in the appendices). The results are presented in Table 3.1 from which several broad conclusions can be drawn.

1. Commercial operators appear to outperform operators tightly controlled by the state both operationally and financially with the average number of train kms produced per member of staff being 3,318 for commercial operators and 2,522 for companies tightly controlled by the state. A similar picture is reflected if one looks at the cost-recovery ratios, which for operators tightly controlled by the state is around 0.42 and for commercial firms around 0.48. We found that whilst there was a statistical significant difference in the means at an operational level (at the 10% level) there was no such differences at a financial level.
2. Firms tightly controlled by the state appear to outperform commercial firms at a commercial level, with traffic units per vehicle of 185 and 164 respectively (although this might also be explained by variations in traffic mix). However, a two-sample t-test proved that this difference is statistically insignificant.
3. From the time series graphs (Shires, 1998), it is clear that all rail operators have improved their operational performance. The picture isn't quite as clear for commercial and financial performance.

However, such analysis has its limitations, for example high productivity performance in one input may come at the expense of low productivity of other inputs (McGeehan, 1995). It is also difficult to compare the performance of different railways given their different spatial and social environments (Oum et al., 1999).

Table 3.1 also highlights the changes in performance since 1994 which in certain cases have been substantial. The main changes have been in terms of labour productivity where an increase has taken place across the board, with the exception of NSB. The mean and standard deviation of the mean have not been calculated for the 1997 data given that a number of firms that were previously classified as state-controlled firms have restructured and would now be considered commercial firms. These include DB, SNCF and RENFE who have all seen considerable improvements in both their operating performance and, with the exception of SNCF, their financial performance. Data is also missing for a number of operators, in particular BR. There has been little change in operating performance for many firms who were classified as commercial firms in 1994, although SJ is an important exception. This may suggest that gains in operating performance from commercialisation are one-offs. Finally, the 1997 data reinforces our opinion that the effects of European rail reform should be constantly monitored in order to fully assess it.

Table 3.1 Results of the Non-Parametric Models (1994 and 1997)

State-Controlled Firms	Operating Performance	Commercial Performance	Financial Performance

	Vehicle Kms/Number of Staff		Traffic Units/Vehicle Kms		Total Revenue/Total Cost	
	1994	*1997*	*1994*	*1997*	*1994*	*1997*
VR	2,540	(3,059)	301	(304)	0.87	(0.81)
SNCF	2,747	(3,120)	224	(225)	0.50	(0.44)
DB	2,694	(3,593)	150	(158)	0.40**	(0.74)
CH	1,060	(1,722)	144	(119)	0.17	(0.13)
CP	2,449	(3,711)	195	(140)	0.37	(0.38)
RENFE	3,746	(4,536)	151	(167)	0.36	(0.44)
CFL	2,416	(2,539)	129	(121)	0.29	na
Mean	2,522 (298)*		185 (23.1)*		0.42 (0.84)****	
Commercial Firms						
	1994	*1997*	*1994*	*1997*	*1994*	*1997*
OBB	2,170	(2,505)	163	(167)	0.38	(0.39)
SNCB	2,355	(2,560)	163	(159)	0.21	(0.30)
DSB	3,866	na	132	(112)	0.45	(0.89)
CIE	2,773	na	134	(89)	0.79	na
FS	2,256	(2,876)	222	(210)	0.44	(0.29)
NS	4,435	(4,674)	147	(147)	0.54	(0.41)
NSB	3,862	(2,580)	137	(150)	0.39	(0.75)
SJ	4,926	(8,990)	252	(237)	0.42	(0.51)
CFF	3,516	(3,758)	165	(175)	0.46	(0.44)
BR	3,017	na	120	na	0.74***	na
Mean	3,318 (302)*		164 (13.3)*		0.48 (0.054)***	

* Standard deviation of the mean. na – not available.

** The DB figure is for 1993, since the financial statistics for the newly merged DB-AG appear to be out of synch with previous years.

*** The BR figure is for 1993, since the statistics didn't take into account the huge increases in track access charges levied by Railtrack in 1994.

Source: Shires (1998)

3.3.2 Cost Modelling Results

Railway costs were modelled using a transcendental logarithmic (translog) cost function that was estimated from a data set consisting principally of total operating costs, three input prices (labour, energy and materials) and three outputs (passenger train kms, freight kms and length of route). From this model, returns to density and returns to scale were estimated for each operator and can be seen in Table 3.2. From Table 3.2 it is possible to split the railways into four types with regard to returns to density:

1. Railways with large increasing returns to density (greater than 2 or less than 0): NSB, SJ, VR, CP, RENFE, CFL, CH and CIE;
2. Railways with modestly increasing returns (greater than 1.1 and less than 2): DSB, FS, OBB, SNCB and SNCF;
3. Railways with constant returns (between 0.9 and 1.1): BR, CFF and DB;
4. Railways with decreasing returns (greater than 0 but less than 0.9): NS.

These results suggest that most railway operations are too sparse and that either the network should be reduced or that there should be an increase in train kms in order for costs to be minimised. With respect to returns to scale, three groups were identified:

1. Those with increasing returns (greater than 1.1 or less than 0): CIE, DSB, CH and CFL;
2. Those with constant returns (between 0.9 and 1.1): CFF, CP and NS;
3. Those with decreasing returns to scale (greater than 0 but less than 0.9): all other railways.

The overwhelming conclusion to be drawn from these results is that 9 of the 17 railway operators are too large. Only CFF appears to have come close to achieving an optimal railway configuration in terms of scale and density and this may largely be accident of geography. In terms of costs, all other things being equal, SNCB and OBB appear to have costs some three times the base level and SNCF half the base level (based on the operators' comparisons column). For SNCB and OBB, the explanation may be due to the fact that throughout much of the period studied these railways were not cost minimisers but employment maximisers. For SNCF, low operating costs might be explained by high capital costs.

Table 3.2 Average Value of Key Variables by Operators (1971-94)

	Operators' Comparisons	Returns To Density	Returns to Scale	Train Km per Annum (000's)	Length of Line (kms)	Density (train kms per line km)
BR	1.05*	0.96	0.50	431,349	17,313	24,920
CFF	2.60	0.97	0.92	104,242	2,962	35,161
CIE	1.48*	-8.83	1.35	12,868	2,003	6,453
DB	0.69*	1.08	0.45	614,083	28,588	21,511
DSB	2.45	1.33	1.12	48,674	2,216	22,019
FS	1.44	1.20	0.51	298,721	16,263	18,375
NS	1.75	0.84	0.92	112,382	2,845	39,548
NSB	1.46	12.92	0.89	33,918	4,185	8,108
OBB	2.96	1.67	0.71	103,550	5,776	17,973
SJ	0.94*	4.77	0.61	100,348	11,195	8,969
SNCB	3.02	1.23	0.81	92,242	3,978	23,448
SNCF	0.49	1.58	0.43	486,945	34,787	14,014
VR	1.41	8.56	0.77	42,619	5,949	7,163
CP	2.70	5.39	0.93	34,498	3,466	10,039
RENFE	1.21	2.53	0.56	147,349	13,099	11,290
CH	1.89	-43.75	1.15	17,338	2,533	6,783
CFL	1.00	3.40	-4.24	9,742	823	17,282

Source: Shires (1998) * Not significant at the 95% level.

Table 3.3 Explanatory Regressions (t-stats in brackets)

Dependent Variable	Independent Variable	Intercept	Slope	R^2
Returns to Density	$Density^{-1}$	-2.821 (-8.97)	87.059 (20.07)	0.58
Returns to Scale	Length of $Line^{-1}$	0.416 (77.96)	1701.98 (84.09)	0.96

Source: Shires (1998)

Taken together, the two conclusions beg the question as to what is the optimally configured railway network? From the regression results in Table 3.3 we find that returns to density are related to density and allow us to estimate that the optimal density of an operator would be around 22,784 train kms per track km per annum. From the same table, we find that returns to scale are related to length of line and that our estimations point to an optimal network of around 2,914 kms. For a network of this size the optimal company would be running over 60 million train kms per annum. If these two key results would have been applied to the recent privatisation of British Rail then the company would have been split up into around 6 train franchise operators rather than the 25 franchise operators and the 6 or so freight operators that were proposed. It is interesting to note that four large groups have already emerged in the passenger sector (Virgin/Stagecoach, National Express, Firstbus/Great Western and Connex) and one in the freight sector (EWS).

3.3.3 Demand Modelling Results

Freight Model

This model was estimated using the data sources as for the cost models and was compiled by Tzannis, 1997. The data consisted of tonne kms (dependent variable), freight train kms (independent output variable), total freight receipts (independent price variable after being divided by tonne kms) and gross domestic product (independent variable to reflect economic performance). Estimation of the demand model was carried out using Ordinary Least Squares, with the model taking a log linear functional form, primarily so that direct elasticities could be calculated from the coefficients. From the results derived it was possible to calculate both short and long term constant price and service elasticities as well as GDP elasticities for the average European railway, which are presented in Table 3.4. It is clear that demand is very inelastic for all three variables, in both the short and the long run. The use of country specific dummies allowed the calculation of country specific price elasticities in the short and in the long run. In the long run demand for CFF, DB, DSB, NSB, RENFE, SNCB, SNCF, SJ/BV and VR becomes price elastic (Table 3.5). This variation in elasticities is difficult to explain, but may reflect market shares, product mix, the degree of competition and pricing structures.

Table 3.4 Short and Long Run Freight Elasticities

Elasticity Type	Short Term	Long Term
Price	-0.11	-0.22
Service	0.34	0.83
GDP	0.21	0.51

Source: Tzannis (1997)

Table 3.5 Country Specific Price Elasticities

National Railways	Short Run Elasticity	Long Run Elasticity	National Railways	Short Run Elasticity	Long Run Elasticity

BR	-0.03	-0.14	OBB	-0.04	-0.18
CFF	-0.71	-3.02	RENFE	-0.86	-3.66
CIE	-0.03	-0.71	SNCB	-0.99	-4.20
CP	-0.20	-0.85	SNCF	-0.71	-3.02
DB	-0.75	-3.17	SJ/BV	-0.72	-2.97
DSB	-0.84	-3.58	CH	-0.17	-0.71
FS	-0.10	-0.41	CFL	-0.01	-0.21
NS	-0.40	-1.69	VR	-0.55	-2.32
NSB	-0.53	-2.25			

Source: Tzannis (1997)

Passenger Model

The initial estimation work for this work was carried out by Nielsen (1997), with follow up work carried out by Shires (1998a), using the same data bases as used in the cost and the freight demand models. The model was again estimated using Ordinary Least Squares regression, taking a log linear functional form for the following data: demand (passenger kms); price (passenger receipts/passenger kms); service (train kms/line kms and line kms/country area); other modes (car ownership); and exogenous factors (population and GDP).

The modelling experienced some estimation difficulties, a direct result of the different characteristics associated with European countries and railways, e.g. different topography, population densities etc This was particularly the case for the estimations run by Neilson (1997) that estimated highly inelastic price and service elasticities. In an effort to improve upon the model results it was decided to re-estimate the model after carefully examining the database. After examining the database it was concluded that three of the operators were including non-rail revenues in their revenue totals (CIE, CP and CH) and so these observations were excluded. In Table 3.6 we present both elasticity estimations and compare them to earlier rail passenger demand studies. It is clear from this Table that Neilson's estimations are very low in comparison to those estimated by Palomo (1996) and Fitzroy & Smith (1995) and not significant with respect to price and frequency. The re-estimated price elasticity of Shires appears more in line with earlier work, however, the GNP and service elasticity appear considerably more inelastic than those estimated by Palomo and Fitzroy and Smith, and in the case of GNP, is not significant.

Table 3.6 Comparison of Passenger Rail Demand Studies

	Fitzroy & Smith (1995)		Palomo (1996)		SORT-IT (1998)	
	(1)[1]	(2)[2]	BR	RENFE	Neilson*	Shires*
Price	-0.10	-0.44	-0.47	-0.49	-0.02 (-.99)	-0.46 (-10.3)
GNP	0.83	0.59	0.87	0.39	0.38 (4.35)	0.02 (.747)
Service	0.44	0.52	0.95	0.20	0.11 (1.55)	0.20 (2.93)

1: The elasticities for the unrestricted specifications.

2: The elasticities for the zero restrictions on the coefficients of petrol price and station spacing.
* t-stats in brackets.

The reason for low elasticity estimations may be a reflection of the aggregate nature of the data used, which combines differing passenger flows, for example commuting, inter-city business and inter-city leisure. If an operator's flows were dominated by commuting, then the underlying price elasticity would tend towards being highly inelastic, as is the case with this study. Nonetheless, the results of all the studies seem to suggest on average there may be substantial scope for pricing up and for service reductions in order to make European passenger railways more revenue adequate.

3.3.4 Competition Simulation Models

To facilitate an assessment of the impact of on-track competition, a rail operations model and evaluator has been developed (see Preston et al., 1999). On the demand side, the three different data sets were analysed so as to build a disaggregate demand model examining the choice of ticket type, class of travel and mode of travel. On the supply side, an accountancy cost model detailing both capital and operating costs was specified. The template for the operations model is an actual rail line in Great Britain. Examples of the model's output are given in Table 3.7.

Taking the incumbent's existing service pattern and fare structure as the base situation we attempted to look at three possible scenarios for on-the-track competition: cream skimming, major head on competition and price wars. After over 100 simulation runs the work suggested that whilst head-on competition will be unprofitable for the entrant, cream skimming entry with a few key trains may be profitable. With head-on competition, the fall in the incumbent's profit means that overall welfare is reduced in spite of an increase in consumer surplus in all competitive scenarios examined. The interpretation of this is that the incumbent monopolist is able to exhibit a high degree of price discrimination. In economic efficiency terms, this means that the resultant fares/service combination is close to being optimal, although there may be undesirable equity implications as the operator gains at the consumers' expense. Competition leads to a higher frequency level than optimal and reduces the incumbent's ability to price discriminate.

Table 3.7 Sample Simulation Results (£ per day)

Scenario	Fare Difference (entrant)	Entrant Service Pattern	Inter-availability of tickets	Incumbent Profit	Entrant Profit	Consumer Surplus Change (business)	Consumer Surplus Change (leisure)	Welfare Change
11	0	1*	Y	30,815	1,267	1,529	82	-9,051
12	0	1*	N	31,962	-847	891	82	-10,657
19	-20%	1*	Y	12,419	16,670	4,686	791	-8,178
20	-20%	1*	N	17,799	10,379	3,510	512	-10,544
31	0	2*	Y	804	-15,280	8,436	3,747	-36,208

39	-20%	2*	Y	-33,880	4,514	14,308	6,726	-37,000
61	0	2*	Y	-14,004	-471	8,436	3,747	-36,208
69	-20%	2*	Y	-60,165	30,800	14,308	6,726	-37,000

Notes:
1* entrant provides four additional return peak period services
2* entrant matches incumbent's services, effectively doubling frequency
11 cream skimming in the peak (0 fare discount) with transferable tickets
12 cream skimming in the peak (0 fare discount) without transferable tickets
19 cream skimming in the peak (20% fare discount) with transferable tickets
20 cream skimming in the peak (20% fare discount) without transferable tickets
31 head-on competition (0 fare discount) with transferable tickets
39 head-on competition (20% fare discount) with transferable tickets
61 head-on competition (0 fare discount) with transferable tickets, entrant only pays marginal costs
69 head-on competition (20% fare discount) with transferable tickets, entrant only pays marginal costs. The incumbent's forecast base profit is £42,745.

Source: Whelan et al. (19987)

In addition to on-track competition, off-track competition was also examined. A model was developed from a hypothetical franchise bidding survey of 38 potential UK rail franchisees. Four attributes had been identified for inclusion in the experiment: subsidy requirements, contract length, exclusivity and degree of regulatory control. The design was customised for five different franchises that, in effect, allowed a fifth attribute, franchise size, to be estimated. The results of the franchise model are shown in Table 3.8. The model has a reasonable fit with correctly signed coefficients that, with one exception, are significant at the 5% level. The parameter estimates show a preference for longer franchises. It is estimated that extending franchises by 5 years would reduce subsidy requirements for an average franchise by around £3.8 million per annum. In addition, there was a strong preference for franchises to be exclusive, typically reducing required subsidy by around £6.5 million per annum. A more relaxed regulatory regime would suggest reductions in subsidy requirements of £6.4 million per annum for a typical franchise. Overall, the analysis suggests that a move to longer (around 12 years), exclusive and loosely regulated franchises could lead to an annual subsidy reduction of up to £415 million compared to the proposed regime (a decrease in the total subsidy bill of some 21%). In the event, 7 out of the 25 franchises have been awarded for 10 years or more, whilst some form of exclusivity has been guaranteed until 2002.

Table 3.8 Results of the Franchising SP Experiment

Variable	Coefficients and associated t-statistics (in brackets)				
	ICEC	ICWC	SCOTRAIL	CHILTERN	SOUTH WEST
Franchise Dummy	-3.181 (3.1)	-6.295 (3.6)	-35.78 (8.6)	-11.68 (8.2)	-11.68 (8.2)
Subsidy	0.112 (4.1)	0.112 (4.1)	0.193 (8.8)	0.357 (9.1)	0.193 (8.8)
Franchise Length	0.078 (2.0)	0.175 (2.3)	0.017 (0.4)	0.308 (5.4)	0.108 (3.1)
Exclusivity	0.622 (2.3)	1.222 (6.0)	1.222 (6.0)	1.222 (6.0)	1.222 (6.0)
Regulation	-0.492 (2.6)	-1.282 (4.1)	-1.282 (4.1)	-2.495 (5.4)	-0.492 (2.6)

Percentage of Responses	30	7	18	17	28
No. of Obs.	1,022				
Rho Squared	0.1690				

Source: Whelan et al., 1998

Further simulation work was undertaken by SORT-IT's sister research project MINIMISE. A Capacity Model was used to simulate the impacts of alternative capacity allocation policies on different types of train services when they compete for the use of track (Borgnolo et al., 1998 – see also the SORT-IT/MINIMISE joint deliverable on rail (Shires et al., 1999). The model simulated the likely impacts of adopting alternative charging criteria for the use of infrastructure, to either maximise the revenue of the infrastructure manager or to maximise social welfare. An 80 kms section of line operated by Italian Railways (Milan to Piacenza) was selected to reflect conflicting capacity and operational requirements of passenger (regional and inter-city) and freight (bulk and unitised) services. The simulation output took a similar form to that of Table 3.7 and showed that when infrastructure charges are calculated to cover marginal costs, this leads to a level of commercial service that is close to the social optimum output level (in the absence of capacity constraints). In addition, in the presence of capacity constraints, charges set to maximise social welfare may not be very different from those that maximise the profit of the infrastructure manager and result in socially optimum volumes and compositions of traffic.

Our work has suggested that off-track competition can reduce subsidy for most franchises, whilst maintaining current services and fare levels and is thus likely to be welfare positive. Larger franchises, looser regulation and protection from competition will all reduce subsidies although they may have other disadvantages. Further subsidy reductions can be achieved, but they may be at the expense of fare increases and service reductions, with uncertain welfare implications.

Our work also suggests that the most likely form of on-track competition is cream skimming. This can increase benefits to users but reduces welfare because of reductions in producer surpluses. We conclude that on-track competition is likely to be welfare negative unless it is very carefully regulated to prevent cream skimming behaviour. Moreover, the interaction with off-track competition is likely to lead to higher subsidy requirements.

3.3.5 Interoperability Models

Two models were estimated, using ordinary least squares, with the intention of determining whether interoperability barriers existed in the rail industry. The models took the following forms:

Generalised Cost = f(distance, demand, market concentration, barriers)

Demand = f(distance, generalised cost, market concentration, barriers)

With regard to market concentration, two measures were used, the first being a measure of competition within mode (the number train operators) and the second a measure of inter modal competition (the number of train, coach and air operators). It had initially been suggested that several barrier type variables be constructed, covering three main areas: technical, organisational and juridical. However, it was found that national frontiers largely coincided with technical and organisational barriers and that market concentration coincided with juridical barriers. Several functional forms were tried during model estimation, with the linear model giving the best results for both models. The main findings are given in Table 3.9. All the explanatory variables were significant and correctly signed in the first two models (with the exception of generalised cost in the second), with each explaining around 76% of the variation in the observations and a Durbin Watson statistic of around 1.0 (Shires, 1998b). Model 3 exhibits poor diagnostic statistics, explaining just over 40% of the variation in the variables and a low Durbin Watson statistic of 0.5. All the variables were significant with the exception of the Belgium dummy. Models 4 and 5 have similar diagnostic statistics but have substantially higher t-statistics for their explanatory variables.

The results from both types of interoperability model illustrate that barriers exist and have substantial impacts, both on passenger demand and generalised cost. The magnitude of the impacts range from a 30% to 60% reduction in passenger demand, to a 25% to 85% increase in generalised costs associated with the crossing of various borders. The presence of a direct rail competitor (only), has significant effects on market share (a 55% reduction) and on generalised costs (a 48% reduction). In the latter case, this is a combination of falling operating costs and reduced waiting and interchange time. The effect of another competitor of any mode (rail, coach or air) was seemingly less marked, leading to falls in demand and generalised cost of around 14% and 5% respectively.

Table 3.9 Effects of Barriers on Passenger Flows and Generalised Costs (%)

Demand Model	% change in average passenger flows (2,380,000)			
	Market Concentration	Belgium Dummy	Netherlands Dummy	German Dummy
Model 1	*-55*	*-67*	*-68*	*-60*
Model 2	**-14**	**-32**	**-31**	**-29**
Generalised Cost Model	% Change in Generalised Cost (£138)			
	Market Concentration	Belgium Dummy	Amsterdam Dummy	German Dummy
Model 3	*-48*	*+25*	*+47*	*+54*
Model 4	**-5**	**+63**	**+85**	**+86**
Model 5	**Na**	**+63**	**+86**	**+87**

Italics – denotes intra modal market concentration measure.
Bold – denotes intra and inter model market concentration measure.
Source: Shires (1998)

These results suggest that important barriers still exist in international rail travel but are these barriers real or just perceived? The Dutch and German borders have about 40 to 50% less international services crossing them than the Belgium border yet the barrier effect of all three borders is broadly the same in terms of demand. This suggest that national boundaries remain an important cultural barrier in Europe.

4. RAILWAY REFORMS

Based on the findings of our models, an extensive literature review and interviews with around 40 rail operators, track authorities, regulators, customers and government officials the following recommendations might be made (Shires, 1999).

4.1 Policy Recommendations for a First Phase of Reforms

Assuming that the EC is intent on implementing Directive 91/440 to its natural conclusion, namely a legal/organisational separation of rail infrastructure from rail operations then a series of policy recommendations that would help maximise both productive and allocative efficiency is required. The principle mechanisms to achieve this are assumed to be competition and privatisaton, in various forms and guises.

4.1.1 Suitable corporate status of rail undertakings

Our study confirmed that there is strong support for the conversion of rail companies into either Stock Exchange listed private companies or public companies with limited liabilities. The main reasoning behind such a move is that it allows management objectives to be more clearly defined and reduces political interference. Such a view is also supported by our partial productivity indices (such as train kms per member of staff), which would suggest that those rail companies who enjoy a modicum of freedom from state interference outperform those rail companies who have stronger ties to state government. In addition, full privatisation (with shares listed on the stock exchange) subjects a company to three important disciplinary constraints, namely: take-over, bankruptcy and shareholder constraints. The performance of private rail operators in the UK, Sweden, Germany, Switzerland and elsewhere needs to be monitored to assess whether these theoretical advantages have resulted in practical improvements.

4.1.2 Independent Infrastructure Authorities

It is perceived that separate track authorities were still tied to operators and favoured them in preference to third parties. Some authorities, who were approached during the study appeared to admit this by saying they preferred to deal with just one operator and were not inclined towards outside parties. To combat this a truly independent infrastructure authority, owned and operated as a government agency and policed by a regulator backed with ‘real’ powers is required. However, we would contend that the definitive case for separate ownership of the rail infrastructure and rail operations (vertical separation) has not yet been proven, with the possibility of failure at the strategic level (land use, investment), the tactical level (maintenance planning) and the operational level (treatment of delays etc.), although incentive systems can reduce these problems. Further empirical work on vertical separation is therefore required. However, even in cases of vertically integrated rail operations, competition between rail operators (on-track competition) will require resolution of the issues of access to the rail infrastructure and the price to be charged.

4.1.3 Off-track Competition

The results of both MINIMISE and SORT-IT capacity and competition simulation modelling lead us to advocate that off-track competition (through franchising) may be preferred to on-track competition. MINIMISE pointed out that on-track competition may be feasible only in the absence of capacity constraints provided that charges are set to cover only marginal infrastructure cost. For passenger rail services, SORT-IT forecast that on-track competition, in the absence of capacity constraints, will lead to cream skimming in which an entrant only operates train services during peak hours taking a share of the incumbent operator's most profitable traffic. This is likely to be a welfare negative situation in the absence of different types of services and price (i.e. product differentiation) and/or cost reductions. In Britain, off-track competition has also led to an increase in train kms (10% from 1993/4 to 1997/8) and an increase in passenger kms (12% from 1993/4 to 1997/8). There has been a dramatic improvement in labour productivity e.g. a 24% increase in passenger kms per employee between 1993/4 and 1996/7 and a 14% increase in train kms per employee (Preston, 1998). In addition, OPRAF (1997) has forecast that in the final year of the present franchises, the subsidy required will be £530 million compared with £1,201 million the year before privatisation and £2,161 million in the year of privatisation. Although there have been some favourable external circumstances, it seems likely that off-track competition will prove to be welfare positive in the UK. Similarly encouraging experiences are emerging elsewhere (Van de Velde, 1999).

There has also been a revival in the rail freight industry, with a growth in tonne kms of some 22% between 1993/4 and 1997/8. This has been due, in part, to the Channel Tunnel, although rail freight faces even more intense modal competition with the introduction of 40 tonne lorries in the UK in January 1999.

On-track competition may be a sensible option for international corridors. A dramatic improvement of timetable planning is a key requirement to creating a competitive market for timetable slots. This may be facilitated by the creation of rail freeways, which are rail routes designed to minimise interoperability and managed by a single infrastructure authority that acts as a one-stop shop. The eradication of technical interoperability problems will be helped by the European Rail Traffic Management System (ERTMS) which is at an advanced stage of development.

4.1.4 Rolling Stock Leasing Companies

In order to ensure that off-track competition is competitive, potential operators need assurance that they can obtain rolling stock. In the UK this was achieved through the creation of three rolling stock companies (ROSCOs), to ensure that a bidder for a franchise could lease out the rolling stock they required. By contrast, in the Netherlands the first open access company Lovers Rail had to obtain its rolling stock from Belgium railways SNCB as there was none available in the Netherlands. To facilitate off-track competition we would recommend that leasing stock be made available at an non-discriminatory rate to any potential operator. We also note the problems experienced in the UK, where a rail franchise operator, Stagecoach, now owns one of the ROSCOs. The lack of regulation of the ROSCOs seems to have been an oversight, as was the lack of claw back provisions for future sales given that all three ROSCOs have been sold on for large profits (National Audit Office, 1998).

4.1.5 Introduction of Coach Deregulation

Competition/simulation modelling work in Sweden leads us to suggest that the introduction of coach deregulation would have a beneficial effect on rail efficiency through two effects, both of which have been confirmed by empirical evidence from Britain. The first is the significant competition that coach provides for rail. This is supported by work carried out in UK estimated a mean rail leisure cross elasticity with respect to coach price of 0.14 and a mean coach leisure cross elasticity with respect to rail price of 0.30 (MMC, 1996). This suggests that where competition on the rails is not possible (for example, due to capacity constraints), substantial competition can be introduced at the margins (those passengers who are indifferent to either rail or coach travel) by deregulating coach services.

The second effect highlights the benefits of deregulation as a pre-cursor to off-track competition. In the UK, part of the unforeseen advantage of coach and bus deregulation and privatisation (as a result of the 1980 and 1985 Transport Acts) was the creation of a pool of private transport operators who, by 1993, had a great deal of experience and finance behind them. This created the market conditions to introduce off-track competition in the rail industry and was one of the main reasons that the franchise process appears to have been competitive with around five bidders for every franchise.

4.1.6 Infrastructure/Track Access Pricing

Opinions amongst those interviewed seemed split as to whether track access pricing should be based on a marginal cost approach or an average cost approach. Other issues include whether the costs considered should be private or social and short run or long run. An initial starting point should be short run marginal social costs, however over time attempts should be made to ensure that these are better aligned with long run marginal social costs. This would be achieved through reconfiguration of rail networks. Some researchers have called for the introduction of auctioning schemes (Starkie, 1993) or more complex pricing approaches (Nilsson, 1995). Similarly, in the presence of capacity constraints, MINIMISE strongly recommends that charges be set equal to the opportunity costs of train operators through competitive auctions, jointly with effective measures to reduce barriers to entry/exit and to level the playing field for competition amongst incumbents and new entrants. For vertically integrated, but horizontally separated railways, one approach that appears to have some merit (although it has some problems too) is the efficient component pricing rule, also known as the Baumol-Willig (BW) rule (Baumol, 1983).

4.1.7 Interoperability Barriers

From the modelling carried out by SORT-IT and MINIMISE it was concluded that whilst technical barriers to interoperability are important, organisational barriers may be more important for both passenger and freight traffic. Our passenger models suggested that crossing state boundaries increased generalised costs by between 25% and 87% depending upon the state boundary (Shires, 1998) and can reduce demand by between 14% and 68%. This implies that the pattern of European rail services may still be too constrained by state boundaries and should be re-bundled.

Our freight analysis suggests that the lack of a one-stop shop is proving an important barrier to the development of the European rail freight industry. The rail freight freeway concept needs to be developed and entrepreneurial cross entry from the private sector road freight and short sea shipping industries encouraged. For example, an assessment of combined transport costs along the North-South corridor (Rotterdam-Milan-Genoa-Gioia Tauro) compared maritime-road haulage with maritime-rail. The assessment suggested that on average costs could be reduced by 38% (TRT, 1998). In corridor sections where more efficient rail-based services could compete with all road transport, 300 million ecus a year of net revenue (after rail infrastructure charges) would become available from operating a meaningful proportion (from the present 370,000 to 1,850,000 TEU) of the volume of traffic that the main port container terminals of the corridor expect to handle in the year 2005.

4.2 Policy Recommendations for a Second Phase of Reforms

The first phase of EU rail reforms (of which we are approximately half way through) emphasises the vertical and, to some extent, horizontal separation of railways. It is our feeling that these reforms are necessary in order to identify the true costs of infrastructure and to promote competition in operations. However, once achieved, a second phase of reforms may well need to be considered.

4.2.1 Horizontal Separation With Vertical Integration

There are a number of problems with vertical integration, given that technical linkages are greater in rail than other transport sectors and the natural monopoly characteristics of rail infrastructure. To overcome both points it is suggested that that rail companies should be permitted to vertically re-integrate but remain horizontally separated. This might still involve off-track competition, but with bids for fully integrated concessions. It is likely that this policy may be most appropriate at the urban and regional levels. This is supported by evidence from abroad, for example Argentina and Japan (see Shires et al.

1994 and Van de Velde et al. 1998). For intercity passenger and freight movements on core routes, the freeway concept may retain its relevance as it is likely that it is these routes for which competition has the greatest potential benefit, although even here there may be problems of cream skimming.

Vertically separated infrastructure management should therefore be encouraged to have similar geographical sub-divisions to those of train operators. This would have two potential advantages. First, the performance of the separate infrastructure sub-divisions could be compared through benchmarking, thus permitting yardstick competition and providing essential regulatory information. Secondly, it would provide a potential market test of vertical separation if the re-amalgamation of particular geographic infrastructure and operation sub-divisions was permitted.

4.2.2 Horizontal Integration

In the first phase of horizontally separating railways it may be advisable to unbundle the state railway into more than the optimal number of subsidiary companies. For example, although our theoretical work might suggest that the British rail network might be best served by six network operators, the 30 or so operators that were originally created in the reform process might not have been excessive. It may be desirable to split railways into too many small units, provided market processes are allowed to put the system back together in a better configuration and the transition costs are not too high.

4.2.3 Network Re-Configuration

In the European rail industry, from our interviews and literature review it is clear that every most countries have a high proportion of lines that only generate small amounts of revenue. For example, in Italy 80% of the rail network produces only 30% of revenue (TRT, 1997). At the same time, many countries have rail bottlenecks, particularly on the approaches to main stations and on the main trunk routes, which constrain the development of new services. Redirecting investment away from the lightly trafficked parts of the network towards the more heavily trafficked sections may be required.

5. OVERALL CONCLUSIONS

Our overall conclusion is that although there is some evidence to support the current proposals to liberalise European railways, there are also some serious concerns. Vertical separation has had some advantages in promoting specialisation, a better understanding of infrastructure costs and encouraging competition. However, there are also a number of problems stemming from the natural monopoly characteristics of rail infrastructure, which mean that costs are usually minimised by one firm, giving it considerable market power. If the first phase of reforms fails to revitalise the railways' future, consideration should be made of alternative regimes in a second phase. We would recommend some form of off-track competition for vertically re-integrated concessions, which may be based upon lines, for inter city traffic, and areas for regional and urban networks. Open access could still be permitted for, for example, international passenger traffic and freight traffic using some variant of the minimum efficient component-pricing rule.

Paradoxically, this regime might be more successful following a process of vertical separation in the first phase of reforms, which might assist in establishing starting infrastructure charges. Moreover, it may be possible to devise market tests for vertical integration by permitting both vertically integrated and vertically separated bids in off-track competition. In such bidding, we would recommend that alternative proposals with respect to network configurations should also be permitted. We would also recommend that, where possible, such a regime should be preceded by privatisation and deregulation, where applicable, of rival transport modes, particularly express coach and air services. We also believe that the type of regime we are proposing may be assisted by the horizontal separation of passenger and freight operations and the existence of a competitive on-track or between the track fringe. This would greatly assist in preventing collusion and other anti-competitive processes. With respect to pricing we acknowledge that the starting point of a pricing scheme should be based upon short run marginal social costs but feel that a determined effort should be made to eventually align these with long run marginal social costs.

In short, we do not see the achievement of an efficient and interoperable European rail industry as being a steady-state achieved by a single package of reforms, applied uniformly in time and space. We see the reforms being a dynamic process involving inter related packages of reforms, with some variations in where and when these reforms should be applied. There is considerable work required to assess the optimal sequencing of these reforms. Currently, we believe that the reform process is helping European railways to get back on track but there should also be an acknowledgement that the process could go off the rails, particularly if vertically separated infrastructure authorities are permitted to exert excessive market power.

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APPENDIX ONE

Extent of Deregulation in European Railways (in 1994)*

Company	Year of Deregulation	Adopted Deregulation Measure
OBB (Austria)	1993	Change in law with effect as from 1/1/93. EU requirements.
SNCB (Belgium)	1993	Public autonomous company since October 1992.
DSB (Denmark)	1990	Tariff full autonomy since March 1990.
CIE (Eire)		Reorganisation Act 1986. Implemented on 2/2/1987.
VR (Finland)	1987	No significant deregulation measure adopted in the period.
SNCF (France)	-	No significant deregulation measure adopted in the period.
DB (Germany)	-	No significant deregulation measure adopted in the period.
CH (Greece)	-	No significant deregulation measure adopted in the period.
FS (Italy)	1990	Internal re-organisation in 1990 (more commercial).
NS (Netherlands)	1988	Re-organisation in 1988 into autonomous business units.
NSB (Norway)	1993	Fully re-organised as from 1993.
CP (Portugal)	-	No significant deregulation measure adopted in the period.
RENFE (Spain)	-	No significant deregulation measure adopted in the period.
SJ, BV (Sweden)	1988	1988 Transportation Act.
CFF (Switzerland)	1987	1987 Service Mandate Act
BR (United Kingdom)	1994	Vertical separation implemented (1993 Railways Act)

* Luxembourg was not included in this Table but was included as a state-controlled firm.

Source: Betancor and Campos (1997)