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EUROPEAN RAILWAY COMPARISONS AND THE FUTURE OF RENFE*

by

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DOCUMENTO DE TRABAJO 94-09

June 1994

- * This work was financed by the Bank of Spain's Fund for the financing of a series of studies on the Regulation of Services in Spain. These studies have been coordinated by FEDEA. This work was carried out as University of Leeds Innovations Limited Contract CBD 3530.

European Railway Comparisons and the Future of RENFE Management Summary

The aim of this project was to compare the performance of RENFE with other European railways, and to consider the extent to which proposed or suggested changes might impact on the future performance of RENFE. The approach used adopted a combination of examining a range of partial productivity and other indicators which together serve to explain differences in the degree of cost coverage achieved together with an econometric analysis designed to reveal the degree to which RENFE experiences economies of scale, density and/or scope.

Overall, the financial performance of RENFE is relatively weak, with its rail businesses covering only some 54% of operating costs and 42% of all costs. The explanation for this does not appear to lie in the efficiency with RENFE operates its services. It has achieved major improvements in labour productivity and reductions in unit costs over the past decade, putting it in line with some of the best operators in Europe (only Swedish Railways appear noticeably more efficient). The only caveat here is that the figures may be somewhat distorted by a greater degree of subcontracting of maintenance work than on most other railways.

RENFE's problems appear to lie rather on the commercial side. In common with most railways it has rapidly lost market share in both freight and passenger markets; more seriously in recent years it has lost traffic in absolute terms in all sectors other than suburban and high speed passenger. At the same time as this it has experienced a steady reduction in real fares and freight rates over the years, leaving it with some of the lowest

charges in Western Europe. In part these trends may have been inevitable given the structure of the markets and the relatively poor quality and quantity of infrastructure which RENFE has inherited.

RENFE has already reorganised on a similar model to some other progressive railways, on the basis of a small number of business units trading with service and supply units. The results of our econometric analysis suggest that this structure is sensible, with further disaggregation likely to lead to loss of economies of density and scale. To the extent that greater private sector involvement may be sought to improve the performance of RENFE, it is possible that a greater degree of competition with private companies for provision of services such as infrastructure and rolling stock maintenance could achieve further reductions in costs. However, it is again on the commercial side that the greatest improvement is needed. Here it appears that the greatest potential is in combined transport, where an injection of commercial practices and capital from major private sector freight companies might well lead to improvements in service quality, traffic volumes and price. Our limited evidence suggests that there would be no loss of economies of scope from separating freight from passenger operations, and that the intense competition from road services would remove any fear of monopolistic exploitation even if there were a single private sector rail freight operator.

In the passenger field, we believe that there would be substantial disadvantages from further disaggregating the passenger sector beyond the business units already established.

Thus there is little hope of establishing competitive rail passenger operations, and the combination of a continued need for subsidy, social service obligations and a degree of monopoly power make franchising the most appropriate approach if privatisation were preferred. There are many complications, however, and it might be wise to wait and learn from the British experience in franchising rail passenger services before proceeding in this direction.

What is clear is that serious consideration needs to be given to the way in which targets are determined for the passenger businesses, the degree to which low density routes provide value for money, and pricing and investment policies. Currently targets appear often unrealistic, and the incentive payments made for commuter traffic do not appear to be soundly based on research on the benefits of expanding this form of traffic. Setting realistic budget constraints, within which RENFE is required to maximise passenger improve budgetary control. The scope for selective price increases demands urgent study. To the extent that the likelihood that this would divert traffic to modes with higher social costs is a worry, pricing policies for other modes of transport also need review to ensure that these are fully covering their social costs. At the same time a more systematic service can increase rail market share and the price rail can charge, it may help improve markets in which rail has no hope of competing without a totally disproportionate cost, and investing in these is simply likely to burden rail with increased depreciation and interest charges without a commensurate increase in receipts.

1. INTRODUCTION

1.1 Objectives, Methodology and Resources

This work was commissioned by the Bank of Spain in June 1993. The aim of this work is as follows:

To outline and explain the difference between the performance of RENFE and other European railways in terms of their internal and external circumstances and thus reach some understanding of the way in which proposed or suggested changes both in the organisation of RENFE itself and of other competing modes may impact on the future performance of RENFE.

In terms of methodology, the study involved three stages:

1. Published data was collated from RENFE, the Spanish Ministry of Transport and the Union Internationale de Chemins de fer.
2. Aggregate investigation of the data was undertaken to understand differences in performance between European railways and the reasons for them. This stage included the development of a translog cost model for a pooled data set of 15 Western European railways, including RENFE.
3. A review of the literature on railway organisation, and the various proposals being put forward for changes, was undertaken, together with the effect of those changes in those cases where they have been implemented.

This study was undertaken by the Institute for Transport Studies in tandem with a project they carried out for the British Railways Board between March 1992 and December 1993 entitled "European Railway Comparisons" (Preston et al., 1993). In addition major contributions to the study were made by two of the students of the MA course in Transport Economics at the University Carlos III in Madrid. These two students undertook dissertations in the summer of 1993 on a comparative study of RENFE's performance, using partial productivity indices, and an assessment of RENFE's costs using the translog cost function respectively (Estevez, 1993; Garcia, 1993). This work was complemented by two further dissertations undertaken by MA students from the University Carlos III, undertaken at Liverpool University under the supervision of Dr John Dodgson (Alvarez, 1993; Savignat, 1993).

1.2 Report Outline

The rest of this report will be structured as follows. Section two will look at background and organisational issues, by providing a company profile and by reviewing relevant literature. Section three will examine RENFE's trends in intermediate outputs (train kilometres) and final outputs (passenger kilometres, freight tonne kilometres). Section four will examine trends in market share and service quality and make comparisons with other European railways. Section five will examine some partial performance indices whilst section six will outline the econometric studies of performance that were undertaken. Lastly in section seven some possible developments for RENFE will be considered and in section eight some conclusions will be reached.

2. BACKGROUND AND ORGANISATIONAL ISSUES

2.1 Ownership and Organisation

RENFE is a state owned company established in 1941. It is headed by an administrative council appointed by the Government. The current philosophy is, however, to reduce the amount of state control, with a possible long term aim of dividing it into a number of separate companies and introducing private capital. Since 1991 RENFE has been sectorised into a number of Unidades de Negocios (Business Units) as follows:

- (i) Alta Velocidad Española (AVE – Spanish High Speed) operates services on the standard gauge line between Madrid and Seville.
- (ii) Largo Recorrido are the main line services on the radial corridors from Madrid and on some cross-country and international lines.
- (iii) Cercarias are the commuter services operating in twelve main cities.
- (iv) Regionales comprise the remaining passenger services.
- (v) Cargas completas are freight services involving full-load trains, full load wagons and internal transport.
- (vi) Transporte Combinado are freight services that involve containers and wagon load express trains.
- (vii) Paqueteria (parcels) consists of three main products, Pacquexpress (small parcels), Cargoexpress (large parcels) and Mail. RENFE lost its monopoly on mail services in 1992.

In addition to these seven operations business units, there are three providers of services (Traction (including crew), Rolling Stock Maintenance and Stations and Joint Services) and two infrastructure management units (Infrastructure Maintenance and Traffic Control). This organisational structure replaces the old one based on geographical areas and functional departments.

It should be noted that there is a separate national narrow gauge railway company (Ferrocarriles Espanoles de Via Estrecha – FEVE) and separate – mainly metre gauge – suburban companies, for instance in Barcelona and Valencia.

2.2 Objectives and Controls

The 1987 Law for the Ordination of the Surface Transport (Ley de Ordenación de los Transportes Terrestres – LOTT) regulates both road and rail transport. This law states that services should be provided in a free market framework but with regulation to ensure comparability between operators and modes. RENFE has the role of running the lines and services of the Integrated National Network as defined by the State (Perez, 1992).

There are three sets of plans that are relevant to RENFE:

- (i) In 1987, the PTF (Plan de Transporte Ferroriario (Railway Transport Plan)) was approved. This is a long term plan (to the year 2000) designed to promote the railway, establish service and pricing policy and oversee a massive investment programme of 2000 billion pts, including new high speed

stretches of main line, upgrading of existing lines and major investment in the Madrid suburban system.

- (ii) A three year contract (Contrato Programa) was signed with the State in 1988. RENFE was obliged to carry a specific number of passenger and tonne-km (with a rise each year), supply services with specified levels of quality, improve economic results, undertake planned investments, develop new systems of tariffs and pricing and rationalise decision making. In return, the Government was committed to providing finance for the investment programme, paying pre-1988 debts and paying subsidies and compensation. However, within these guidelines there was no explicit remit to RENFE for investment and pricing (Carbajo and de Rus, 1991).
- (iii) Firm Plans set the annual objective management from the economic and technical view point. They need to be consistent with the medium term plans. For example the 1992-93 Firm Plan needed to be consistent with the medium term objectives of obtaining a positive contribution balance in five years for Largo Recorrido, Cargas Completas and Transporte Combinado and in three years for Paqueteria, and maintaining a fixed unit cost per passenger for Cercarias and Regionales.

Each business unit has its own account, consisting of own receipts and costs, transfer receipts and costs and depreciation and provisions. Rather than administrative co-ordination, there is trading between the units based on transfer prices (Gould, 1964). These transfer prices should be based on the opportunity cost of providing services to the firm as a whole. In perfect markets this should be equal to the marginal cost. However, there are at least two problems. Firstly, RENFE's internal markets are not likely to be

perfect; in particular there are likely to be large fixed costs and problems related to the resultant monopoly power. These problems will be compounded if customers can not go to alternative suppliers. Secondly, given joint and common costs (and revenue), marginal costs (and revenue) will be difficult to determine. RENFE's approach to this problem was to, in 1991, allocate total costs to business units according to accountancy conventions based on certain physical units (train-km, train-hours, gross tonne kms hauled etc). In 1992 the prices were calculated by multiplying the 1991 transfer prices by a series of coefficients that included (i) increases of the prices borne by Business Unit (e.g. energy costs, labour costs) and (ii) specific targets of productivity improvements. This approach is similar to the R.P.I. (Retail Price Index) – Y (Specified Productivity Improvements) form of price regulation practised in the United Kingdom on private utilities.

2.3 Regulation and Competition

RENFE has pricing freedom on long distance passenger services and has introduced higher fares on the AVE. Regional fares are controlled by the state. In the Madrid region, RENFE services are part of the integrated ticketing system of the Consorcio de Transportes de Madrid, and the local authority compensates RENFE for the losses involved. Similar arrangements exist in other cities.

In the main cities, bus services are provided by the local authority or by a private company on a long term monopoly franchise. In rural areas, bus services are mainly privately operated and free to compete with RENFE. There are domestic air services between many major cities and it is believed that European air deregulation will make these more competitive in terms of both price and frequency.

Rail is in principle protected from road freight competition by a quantity licensing system. Licences are issued either for the entire country or for a specific area. In practice, the amount of protection given has been small as there is free entry into the own-account sector. Liberalisation would thus probably affect the balance between the hire and reward and own account sectors of the road freight industry, rather than between modes, though lower costs may restrict rail tariff adjustments.

2.4 Overview

Most of western Europe's railways are considering reform. In part, this is due to their disappointing performance in terms of attracting market share and spiralling deficits. The extent to which this is true for RENFE will be examined in subsequent sections. However, the popularity of railway reform in Europe may also be attributed to a revised view of railway economics (Nash and Preston, 1992; Preston, 1994). Traditionally, railways have been viewed as natural monopolies, with large fixed costs resulting in decreasing average costs, and the welfare optimal price-output combination requiring Government subsidy. A revised view of railway economics criticises the traditional view on three grounds:

- (i) Although the provision and use of rail infrastructure may exhibit decreasing average costs and be a natural monopoly, it is argued that rail operations exhibit constant costs. Whether this is true or not will be examined in section six. The policy implications of this revised view are that operations and infrastructure should be separated and operations could, if desired, be fragmented between a number of companies.

- (ii) Even if rail operations in a particular country are supplied by one firm, a perfectly competitive outcome will emerge as the industry may be perfectly contestable. The main assumptions required for this to be true are that entry and exit to the rail industry is cost-less (in practice, there may be problems with respect to access to rolling stock and trained staff) and hit and run entry is feasible (incumbents can not re-act quickly to entry). If these assumptions hold then potential competition, from other railway operators, from other modes or from other products and activities will ensure competitive pricing. As a result, it is argued that regulations limiting entry to the rail market should be lifted and a policy of open-access be encouraged.
- (iii) It has been argued that publicly owned, heavily subsidised firms are intrinsically inefficient (referred to as X-inefficiency). As a result, it is argued that privatising railways and reducing subsidies will promote cost efficiency.

This revised view of railway economics has been most readily embraced in Britain but it also has affected the RENFE reforms, in particular the reorganisation into operation and service provision units, compliance with the EC directive 91/440 on open access and the attempts to reduce subsidy.

RENFE's move in 1991 from a hierarchical, geographically based, production-led organisational structure to a multi-divisional, business based, customer-led structure partly reflects the impact of the sectorisation of British Rail in 1982, which introduced an organisational structure based on products. To a greater or lesser extent, this policy has also been adopted by a number of other Western European railways such

as CIE (Ireland), DSB (Denmark), SNCF (France) and SJ (Sweden). However, the RENFE reforms of the 1990s go further than the British Rail reforms of the 1980s in that they separate business operations from service provision and infrastructure maintenance and attempt to encourage inter-business trading through internal markets rather than administrative control. The only other railway in Europe to have gone so far in this particular direction is the Netherlands Railway, NS, for which there are three business units (Passenger, Freight and Real Estate) and three service units (Infrastructure, Traction and Rolling Stock). The business units trade with the service units based on standard two-part tariffs, regulated by an RPI -2% per annum formula (Preston and Nash, 1992). By the year 2000 it is proposed that all operational subsidy will be withdrawn.

The RENFE reforms are different from the reforms proposed by British Rail in the OfQ (Organising for Quality) programme introduced in 1992 in that operations, traction and infrastructure are vertically separated for RENFE but integrated for the five BR sectors (InterCity, Network South East, Regional, Trainload Freight and Railfreight Distribution). However, the 1993 Railways Act, which will lead to the privatisation of BR, also proposes that:

- The ownership of infrastructure and operations should be separated, with infrastructure being owned by Railtrack, although a number of stations may be sold to the private sector.
- Infrastructure maintenance will be undertaken by a number of competing Infrastructure Support Units, which will eventually be privatised, and the private sector.

- Three Passenger Rolling Stock companies will be established.
- British Rail Maintenance Limited and the Level 5 Group of heavy maintenance depots will be privatised and compete with the private sector for rolling stock maintenance.

Thus the BR reforms will be similar to those of RENFE but with an emphasis on external markets and the fragmentation of service suppliers to avoid monopolistic exploitation.

3. TRENDS IN OUTPUT

3.1 Intermediate Outputs

Table 3.1 shows the trends in some of RENFE's intermediate outputs during the period 1971 to 1990. During that period passenger train kms increased dramatically from 81 million km per annum to 120 million km per annum (up 48%). Freight train km tended to show greater fluctuations than passenger train km but still exhibited an upward trend, increasing from around 42 million km per annum to 48 million (up 16%). (In the same period BR's freight train km reduced from 111 million per annum to 60 million – down 46%.) Total train km increased from 123 million per annum in 1971 to 169 million in 1990 (up 37%).

For most of the period 1971 to 1984 the total length of line operated by RENFE was around 13,400km and the total length of route was 20,000km. The only

major closures occurred in 1985, with length of line being reduced by around 5.6% (around 750km) and length of track being reduced by 7.4% (around 1500km).

Table 3.2 compares some characteristics of the Spanish railway network with those of 16 other European countries. There are 321 km of rail route per million population in Spain, placing it 12th out of the 17 countries studied. Furthermore, there are around 13,700 train km per route km per annum on the Spanish rail network, again placing it 12th but this time out of 16 countries, as data for Greece is not available. It should be noted from Table 3.1 that the traffic density on the Spanish network has increased from 9,126 to 13,447 train km per route km per annum, up 47% (note that the figures in Table 3.1 exclude departmental traffic). Only around 22% of RENFE's route km consists of at least double track, with the system yet again being ranked 13th out of 17. However, RENFE has a relatively high proportion of its route km electrified (51%), placing it 8th out of the 17 countries.

Data on the mean speeds permitted by rail infrastructure are not readily available but Nash et al (1993) have undertaken work comparing the high speed and trans european networks for three 'developed' regions (France, Great Britain and Denmark) and eight 'lagging' regions (Greece, Portugal, Eire, Northern Ireland, the former DDR (East Germany), Mezzogiorno (Italy), Spain as a whole and the lagging regions of Spain). The results are summarised by Table 3.3. The average speed on the Trans European Network in Spain is similar to that of Great Britain, whilst the speed on the High Speed Network is greater than that of Great Britain. However, if the AVE is excluded, the weighted average for the rest of the Spanish High Speed Network falls to 109.9km/hour.

Though Spain does have some fast trains, the figures in Table 3.3 are somewhat misleading in that many routes have just one fast train a day, using expensive Talgo technology to nullify the poor quality infrastructure. In general, the average speed of RENFE passenger and freight services is low.

3.2 Final Outputs

Table 3.4 shows that the number of passenger kms carried by RENFE increased from 13.3 billion in 1970 to 16.4 billion in 1992 (up 23%). The increase for the period 1971 to 1990 was, however, only 13%, compared to an increase in passenger train km of 48%, suggesting a decrease in passenger train load factors of almost 24%. The number of freight tonne km carried by RENFE has fluctuated, being 9.7 billion in 1970 and 9.4 billion in 1992, a decrease of 3%. However, between 1971 and 1990 there was an increase of 18%, compared to an increase in freight train km of 16%, suggesting an increase in freight train load factors of almost 2%. With one or two exceptions Cargas Completas has shown a consistent downward trend, whereas Combinado showed some growth in the period 1977 to 1981 and has since declined. There are clear indications from Table 3.4 that the freight business, in particular, is sensitive to the state of the Spanish economy and is being affected by the current recession. Table 3.5 shows that RENFE's carryings of virtually all commodities has declined, with the partial exception of chemicals. Particular decline has occurred in the fruit, flammable liquids and mineral categories due to competition from road and industrial restructuring.

Table 3.4 shows that the biggest growth in passenger traffic has occurred in the commuter sector, which carried 3.2 billion passenger km in 1987 and 5.9 billion in 1992 (up 82%). Table 3.6 shows that commuter services are operated in 12 cities. In 1992, 54% of these passenger kms were carried in Madrid and 23% were carried in Barcelona.

Table 3.4 shows there has also been some modest growth (overall) on traffic on the Largo Recorrido, up 11% between 1970 and 1992, although peak usage was achieved in 1983. Since 1987 there has been a steady decline in both long distance and regional passenger traffic, reversed only in 1992 with the opening of the AVE. Table 3.7 shows that seven routes accounted for 83% of passenger traffic, with the most important route being the Transversal Mediterráneo. Table 3.8 also shows that there have been important changes in the type of train used by passengers on the Largo Recorrido. In 1980, 79% of passengers were carried by Ràpidos y Expresos, 13% by Talgo and 8% by Electrotrén. By 1992, the figures were 56%, 30% and 13% respectively.

Table 3.9 shows that for the eight railways for which we have data, RENFE has the fourth highest dependence on passenger traffic and the fifth highest dependence on inter city traffic. The share of Regional traffic seems relatively high for RENFE (but note that there are definitional problems). In terms of freight traffic, RENFE has a low dependence on 'classic' bulk goods such as solid fuel, petroleum, ores and building materials. Out of 11 railways, only one (SJ – Sweden) has a lower dependence, but two others have a similar level of dependence (NSB – Norway and OBB – Austria).

Table 3.1: Trends in Intermediate Outputs

	Passenger Train km (000)	Freight Train km (000)	Total Train km (000)	Length of Line (km)	Length of Track (km)
1971	81286	41874	123160	13495	19249
1972	84036	42866	126902	13406	N/A
1973	84122	46295	130417	13928	19187
1974	82651	47389	130040	13315	19356
1975	83754	44081	127835	13380	19927
1976	86255	45356	131581	13392	19945
1977	91227	44249	135476	13423	19991
1978	92781	43546	136327	13418	19984
1979	92189	41497	133686	13420	19987
1980	94685	42311	136996	13431	20003
1981	100083	40767	140850	13432	20004
1982	103191	40899	144090	13461	20264
1983	103107	41944	145051	13464	20052
1984	104132	46606	150738	13466	20437
1985	102984	48854	151838	12710	18929
1986	105741	50402	156403	12721	18946
1987	107969	48352	156321	12686	18893
1988	109955	48959	158954	12550	18691
1989	109853	48214	158067	12565	18713
1990	120278	48628	168906	12560	18706

N/A Not Available

Source: UIC

Table 3.2: Rail Network - Quantified Indicators

	Rail route km per head of population (million)	Train km per route km	Rail route km with 2+ track (%)	Rail route km electrified (%)
Great Britain	290.6	26055	70.1	29.7
Switzerland	440.0	41099	51.0	99.7
Eire	549.2	7342	26.7	1.9
Portugal	333.7	13033	13.4	14.7
West Germany	439.4	22405	45.9	43.4
Denmark	457.0	23522	39.5	9.8
Italy	279.7	19560	35.9	59.2
Netherlands	190.2	41927	64.0	69.9
Norway	962.9	9076	2.4	60.0
Austria	693.3	20827	29.5	57.7
Spain	320.9	13695	21.5	51.1
Belgium	350.7	44206	74.3	65.9
France	606.4	14313	46.3	37.0
Sweden	1477.7	9255	11.0	64.7

Source: Preston et al, 1993

Greece	274.3	-	12.1	0.0
Northern Ireland	211.2	9430	38.5	0.0
East Germany	805.7	18344	30.7	29.3

Source: Nash et al, 1993

Table 3.3: Average Speeds on High Speed and Trans European Networks

	France	Great Britain	Denmark	Three Combined
High Speed				
- Route length (km)	4247	1588	765	6600
- Weighted average (km/h)	168.1	132.6	91.8	150.7
Trans European (TE)				
- Route length (km)	7477	4015	108	11600
- Weighted average (km/h)	104.1	90.1	78.7	99.0
High Speed and TE Combined				
- Route length (km)	11724	5603	873	18200
- Weighted average (km/h)	127.3	102.1	90.2	117.7

	Former DDR	Mezzogiorno Italy	Spain All	Spanish Regions
High Speed				
- Route length (km)	1499	1305	1690	1470
- Weighted average (km/h)	83.9	92.1	131.9	138.9
Trans European (TE)				
- Route length (km)	1412	1422	4774	3499
- Weighted average (km/h)	79.4	76.5	89.3	85.7
High Speed and TE Combined				
- Route length (km)	2911	2727	6464	4969
- Weighted average (km/h)	81.7	84.0	100.4	101.4

Source: Nash et al., 1993

Table 3.4: RENFE Passenger Kms and Tonne Kms (Millions) 1970 - 1992

	PASSENGER					CARGAS COMPLETAS			COMBINADO		PAQUETERIA				FREIGHT	
	AVE	L.RECORR	REGIONAL	CERCANIAS	REG.& CERCANIAS	TOTAL	FULL WAGON	INTERNAL TRANSPORT	TOTAL	TOTAL	CARGO EXPRESS	PAQUETE EXPRESS	CORREOS	TOTAL	TOTAL	TOTAL
1970	0	7003	N.A.	N.A.	N.A.	(13293)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	9693
1971	0	N.A.	N.A.	N.A.	N.A.	(13467)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	9523
1972	0	N.A.	N.A.	N.A.	N.A.	(14391)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	10221
1973	0	N.A.	N.A.	N.A.	N.A.	(15640)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	11561
1974	0	N.A.	N.A.	N.A.	N.A.	(16079)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	11577
1975	0	8497	N.A.	N.A.	N.A.	(16146)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	10693
1976	0	N.A.	N.A.	N.A.	N.A.	(16686)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	10766
1977	0	N.A.	N.A.	N.A.	N.A.	(17163)	9350.1	400.3	9750.4	956.1	286.5	60.8	371.5	432.3	11425	
1978	0	N.A.	N.A.	N.A.	N.A.	(16578)	8688.7	331	9019.7	962.3	295.2	66.5	364	430.5	10708	
1979	0	7623	N.A.	N.A.	N.A.	12671	8628.3	329.5	8957.8	904.7	295.2	69.2	364.7	433.9	10592	
1980	0	8287	N.A.	N.A.	N.A.	13527	8663.8	609.7	9273.5	931	322.5		360.4	682.9	10887.3	
1981	0	8897	N.A.	N.A.	N.A.	14261	8370.7	513.5	8884.2	1056.1	273.1	63.6	361.9	598.6	10603	
1982	0	9151	N.A.	N.A.	N.A.	14703	8119.3	465.7	8585	1287.8	224.6	65.1	341.3	631	10503.8	
1983	0	9437	N.A.	N.A.	N.A.	15092	8118.5	529.4	8647.9	1343.1	216.2	63	328.5	607.7	10598.7	
1984	0	9730	N.A.	N.A.	N.A.	15574	8956.4	406.3	9362.7	1682.6	207.5	62.8	329.4	599.7	11654	
1985	0	9186	N.A.	N.A.	N.A.	15979	8676.9	335.2	9015.1	2029.2	209.7	57.2	345.6	612.5	11653.8	
1986	0	9387	N.A.	N.A.	N.A.	15693	8232.9	307.5	8540.4	2163.6	199.3	47.5	340.9	587.7	11291.7	
1987	0	9251	2903	3240	6143	15394	8066.4	303.2	8369.6	2524.6	195.9	49.5	335.2	580.6	11474.8	
1988	0	9432	2364	3870	6234	15716	7972.6	428.6	8401.2	2724.4	196.4	50.9	342.9	590.3	11715.8	
1989	0	8627	2323	3765	6088	14715	8086.7	460	8546.7	2522.6	159	46.9	343.4	549.3	11618.6	
1990	0	8455	1975	4595	6570	15025	7745	464	8209	2473	134	53	337	524	11206	
1991	0	7991	1900	5131	7031	15022	7146	485	7631	2395	111	53	318	482	10507	
1992	513	7793	2154	5890	8044	16350	6302.6	286.7	6589.3	2249.4	125.5	60.2	227.9	414	9361	

Source: Annual reports. Management reports 1991, 1992, RENFE

Note: (.) Denotes that before 1979 the figures were calculated by a different method than the current one, and they are inconsistent with later results

Table 5. Cargas completas Tonne-Kms (by type of product)

Table 3.5: Freight Tonne Kms (Millions) by Commodity Group 1970 -1992

	CEREAL	COAL	TIMBER	CEMENT	LIME STONES	MINERALS	IRON & STEEL	FLAMMABLE LIQUIDS	CHEMI CHALS	PROPANE BUTANE	FERTILI SERS	MOTOR NATION.	MILITAR	FRUIT	MOTOR INTERN.	OTHER INTERN.
1970	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1971	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1972	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1973	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1974	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1975	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1976	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1977	734	404	N.A.		443	1144	1286	1440	336	244	458	233	N.A.	773	N.A.	N.A.
1978	612	298	N.A.		488	959	1081	1444	418	224	466	222	N.A.	761	N.A.	N.A.
1979	632	243	N.A.		458	1025	1085	1298	445	230	461	220	N.A.	683	N.A.	N.A.
1980	657.2	379	N.A.		375.5	994	1148	1311	489.5	223	429	213.4	N.A.	N.A.	N.A.	N.A.
1981	679.2	807.4	296		336.8	970	997.6	998	551.4	211.5	435.2	189.5	N.A.	596.8		646.5
1982	659.8	908	301.7		326.1	799.2	1114.8	792.7	587.5	198.1	433.1	191	N.A.	544.1		647
1983	821	832	342		278	762	1227	522	597	205	464	157	74	561		616
1984	1019	738	550		244	795	1350	435	679	203	612	180	67	687		725
1985	1107	497	606		254	667	1422	432	666	189	633	180	68	445		811
1986	1046.6	573.3	445.4	193.6	51.4	623.5	1393.1	443.1	597.8	171.5	600.9	188.8	39.1	427		754
1987	846	571	413	197	70	412	1526	518	614	148	508	267	46	354		843
1988	800	516	422	195	60	338	1633	388	588	187	436	250	73	224		987
1989	613	576	490	209	73	403	1778	386	571	214	395	265	80	153		1103
1990	641	523	447	224	72	253	1582	397	606	248	314	232	73	121	184	6
1991	492	506	513	240	73	310	1407	336	560	262	316	213	38	91	189	
1992	422	397	431	240	46	234	1277	296	510	256	225	241	31	95	179	850

Source: Annual reports. Management reports 1991, 1992. RENFE

Table 3.6: Commuter Passengers (Millions) 1990 - 1992

Cercanías: number of passenger (millions)					
	1990	1991	1992	% 90/91	% 91/92
Madrid	109.3	144.6	172.41	32.3	92.2
Barcelona	53.37	63.83	72.56	19.6	13.7
Bilbao	23.89	26.08	24.48	9.2	-6.1
Valencia	11.35	14.48	17.35	27.6	19.8
Asturias	4.61	5.07	5.48	10	8.1
Málaga	10.04	10.07	7.53	0.3	-25.2
Sevilla	3.81	3.18	6.14	-16.5	93.1
San Sebastian	4.83	6.8	7.28	40.8	7.1
Murcia	2.19	2.54	3.07	16	20.9
Cádiz	0.78	1.25	1.71	60.3	36.8
Santander	0.98	1.02	1.01	4.1	-1
Tarragona	0.3	0.54	0.16	80	-70.4
9 centres	38.89	44.95	49.73	15.6	10.6

Source: 100 datos estadísticos 1990-91-92. RENFE.

Note: 9 centres means all centres apart from Madrid, Barcelona and Bilbao.

Table 3.7: Main Corridors of Largo Recorrido 1990 - 1992

Largo Recorrido: passenger-Km (million)					
	1990	1991	% 90/91	1992	% 91/92
Madrid-Cornisa Cantábrica	1004.1	898.6	-10.5	834.3	-7.2
Madrid-Zaragoza/Barcelona	946.6	889.7	-6	813.1	-8.6
Madrid-Valencia/alicante/Murcia	703.9	739.8	5.1	745.8	0.8
Madrid-Andalucia/Extremadura	1210.5	1133.2	-6.4	986.1	-13
Transversal Estrella	1134	1100.7	-2.9	1094.4	-0.6
Transversal Mediterráneo	1217.3	1264	3.8	1570.5	24.2
Internacional	483.7	454.7	-6	466	2.5

Source: 100 datos estadísticos 1990-91-92. RENFE.

Table 3.8: Passenger Km in Largo Recorrido by Train Type 1980 - 1992

	1980	1984	1985	1986	1987	1988	1989	1990	1991	1992
Rápidos y Expresos	5940	7063	7270	6952	7100	7004	5927	5251	4715	4389
Talgo	938	1324	1338	1381	1475	1572	1661	2121	2213	2375
Electrotrén	601	690	685	615	666	856	1039	1083	1063	1029

Source: Annual Reports. 100 Datos estadísticos 1990-91-92. RENFE.

Table 3.9: Distribution of Traffic by Market Sector (%)

	Passenger km			Freight tonnes km	
	Commuter	InterCity	Other	Bulk ⁽¹⁾	Other
BR	45	38	17	76	24
CFF	25	75	0	61	39
CIE	18	82	0	60	40
CP	62	38	0	50	50
DB					
DSB	27	73			
FS				39	61
NS				46	54
NSB				34	66
OBB	43	35	22	34	66
RENFE	30	54	16	34	66
SJ				22	68
SNCB				70	30
SNCF	14	75	11	38	62

Source: Preston et al., 1993

(1) Consists of solid fuels, petroleum, ores, metals and building materials

4. TRENDS IN MARKET SHARE AND SERVICE

4.1 Market Share

Table 4.1 illustrates the trends in rail's market share in Spain. Between 1960 and 1990, the absolute volume of passenger km carried by rail increased from 8.9 billion to 16.7 billion (up 88%) but during this period rail's relative share of the travel market declined from 30% to 7%. As in other developed countries, the reason for this relative decline is due to the explosion of travel caused by increased car ownership. Road travel increased between 1960 and 1990 by a staggering 954%. Air travel has also had a spectacular increase in volume, increasing by 683% between 1960 and 1990, much of which is likely to have been at the expense of RENFE's Largo Recorrido services.

A similar picture emerges for the freight market. Between 1960 and 1990, the absolute volume of freight tonne km carried by rail increased from 8.0 billion to 11.6 billion (up 46%), but during this period rail's relative share of the freight market decreased from 20% to 5%. Again much of this decline is due to the dramatic expansion in road freight (up 780%) but also due to the increase in freight moved by pipeline (up from 0 in 1960 to 4.2 billion tonne km in 1990) and by sea (up 119%).

Based on an alternative data source, Table 4.2 compares rail's passenger market share in Spain with 13 other European countries. This suggests that the Spanish railways had a market share of around 7.6% in 1990, the fourth highest of the 13 countries for which we have data (only in Austria, Switzerland and France does rail have a higher market share, albeit by a large margin). It is also noticeable, that Spain is one

of the ten countries where rail has gained volume between 1980 and 1990, one of the fourteen countries where car has gained volume and one of eight countries where bus and coach has gained volume.

Table 4.3 compares rail's freight market share with that of 13 other European countries. At 7.0% rail's share in Spain is the 13th lowest out of 14 – only in the Netherlands, with its short distances and widespread use of water for bulk traffic, does rail have a lower market share. Spain is one of eight countries where rail increased its volume between 1980 and 1990, whereas road increased its volume in 13 of the 14 countries studied (Portugal providing the exception).

4.2 Service

Table 4.4 compares some aspects of RENFE's passenger services with those of 13 other European countries. The mean length of passenger journeys on RENFE is 56km, with RENFE being ranked 5th out of the 14 railways being studied for this measure. The mean load of RENFE passenger trains is 129 passengers, with RENFE being ranked 4th out of the 14 railways for this measure, albeit with loadings considerably below those found in Portugal (CP), France (SNCF) and Italy (FS). In terms of mean train length (engine and coach kms divided by engine kms), the average passenger train formation in Spain consists of over six units. RENFE is ranked 3rd out of the 11 railways for which we have data. In terms of mean receipts per passenger km, the figure for RENFE in 1990 was 5.2 pts which, using a purchasing power parity rate (shadow exchange rate) of 178.98 pts to the £, is equivalent to 2.8 pence. RENFE is ranked 9th out of the 10 railways for which we have data, with only Portugal (CP) having lower

passenger fares. The impression we form of RENFE's passenger services are that they serve medium to high trip lengths, have high passenger loads per train but also have relatively long trains and low fares. From Table 3.1 we estimate that in 1990 there were roughly 26 passenger trains per route km per day (i.e. one train an hour) on the RENFE network. By contrast, the comparable figure for Switzerland (CFF) is 87 passenger trains per route km (i.e. almost four trains an hour). RENFE may, therefore, be characterised as a low fare, low output passenger rail operator.

Table 4.5 compares some aspects of RENFE's freight services with those of 13 other European countries. The mean shipment length of RENFE's freight is 386km, which is the longest length of haul of all the railways studied, although France (SNCF), Sweden (SJ) and Italy (FS) have similar lengths. RENFE's mean freight train load, at 285 tonnes, places it 8th out of the 14 railways studied. RENFE's mean freight train length involves 15 wagons, placing it 6th out of the 8 railways for which we have data. RENFE's mean receipts per tonne km, at 2.9 pence (5.2 pts), places it 7th out of the 10 railway companies for which we have data. RENFE therefore again emerges as a low fare operator, although in this case this may be due to the types of commodities being carried and, particularly, the length of haul.

Figure 4.1 shows that in recent years (since 1978), rail fares for both passenger and freight have failed to keep up with inflation. An increase of around 48% would be required to return fares to their 1978 levels, in real terms. Figure 4.2 illustrates the relative low frequency of Spanish train services, with only a relatively small part of the (non-commuter) network carrying more than 80 trains a day.

Table 4.6 presents some data on the punctuality of passenger trains. Comparisons of data of this type are difficult but it seems that late running is more prevalent on the RENFE system than many other western European railways. Despite this, there appears to have been a marked improvement in punctuality in 1990. However, for the seven systems for which we have data in 1990 RENFE is ranked 5th, with only the BR and SJ InterCity networks having a greater degree of late running. It is noticeable from Table 4.6 that commuter services are more punctual than InterCity services. Part of RENFE's improvement in punctuality may be explained by the increased provision of commuter services.

Table 4.1: Market Share of Domestic Passenger and Freight Traffic (Passenger Kms and Tonne Kms and Percentages)

	ROAD	RAIL	AIR	SEA	TOTAL	ROAD	RAIL	AIR	SEA
1960	20000	8900	900	-	29800	66.9	29.7	1.34	-
1965	38967	13901	927	-	53785	72.4	25.9	1.70	-
1970	85257	14992	1966	-	102145	83.4	14.7	1.90	-
1975	128946	17643	3928	-	150517	85.7	11.7	2.60	-
1980	165700	14047	6000	-	185747	89.2	7.56	3.23	-
1985	153680	17038	5216	888	176822	86.91	9.64	2.95	0.5
1986	164986	16429	5539	1001	187955	87.78	8.74	2.95	0.53
1987	175638	16601	6028	1018	199285	88.13	8.33	3.02	0.51
1988	186678	16888	6308	1095	210969	88.49	8	2.99	0.52
1989	197787	15999	6583	1066	221435	89.32	7.23	2.97	0.48
1990	206905	16733	7050	1057	231745	89.28	7.22	3.04	0.46
1991	210848	16357	7234	1258	235697	89.46	6.94	3.07	0.53

	ROAD	RAIL	PIPEL.	SEA	AIR	TOTAL	ROAD	RAIL	PIPEL	SEA
1960	17048	7976	-	15912	-	40936	41.6	19.5	-	38.9
1965	31691	9202	109	19972	-	60974	52.0	15.1	0.20	32.7
1970	51000	10399	1023	24800	-	87222	58.5	11.8	1.20	28.5
1975	84533	11079	2118	26870	55	124725	67.81	8.89	1.70	21.56
1980	98898	11300	3005	31125	77	144402	68.50	7.82	2.08	21.55
1985	110500	11906	3165	33694	77	159342	69.35	7.47	1.99	21.15
1986	114000	12120	3632	29388	76	159216	71.6	7.61	2.28	18.46
1987	124600	11952	3923	31136	73	171684	72.58	6.96	2.29	18.14
1988	134900	12145	3886	34439	91	185461	72.74	6.55	2.1	18.57
1989	145000	12049	4092	35988	101	197230	73.52	6.11	2.07	18.25
1990	150000	11613	4215	33043	91	198962	75.39	5.84	2.12	16.61
1991	152250	10802	4780	34853	90	202775	75.08	5.33	2.36	17.19

Source: Anuarios Estadísticos. MOPT/Annual Reports. RENFE

Table 4.2: Passenger Transport (Thousand Million Passenger Km)

		Rail %		Private Cars %		Buses and Coaches %		TOTAL
Austria	1980	7.38	11.6	43.54	68.7	12.45	19.6	63.37
	1990	8.46	11.1	54.10	71.0	13.62	17.9	76.19
Belgium	1980	6.96	8.5	65.38	80.3	9.08	11.1	81.41
	1990	6.54	N/A	80.75	N/A	N/A		N/A
Switzerland	1980	9.18	10.7	72.60	84.9	3.78	4.4	85.55
	1990	11.06	10.8	87.08	84.7	4.97	4.8	102.87
West Germany	1980	40.50	7.0	470.30	81.6	65.60	11.4	576.40
	1990	43.60	6.3	593.80	85.7	55.50	8.0	692.90
Denmark	1980	4.31	8.7	38.10	76.6	7.30	14.7	49.71
	1990	4.86	7.1	53.60	79.1	9.30	13.7	67.76
Spain	1980	14.83	8.5	130.90	75.3	28.10	16.2	173.82
	1990	16.73	7.6	164.22	74.8	38.68	17.6	219.64
France	1980	54.66	10.0	453.00	83.0	38.00	7.0	545.66
	1990	63.74	9.2	586.00	84.8	41.30	6.0	691.04
Italy	1980	39.59	9.4	324.03	76.9	57.84	13.7	421.46
	1990	46.43	7.1	522.59	80.1	84.38	12.9	652.49
Eire	1980	1.03	3.5	21.69	73.4	6.81	23.1	29.53
	1990	1.29	3.6	26.97	79.1	5.91	17.3	34.11
Norway	1980	2.75	7.1	31.30	80.4	4.88	12.5	38.93
	1990	2.43	5.1	39.34	83.7	4.88	10.4	46.98
Netherlands	1980	8.89	6.9	107.10	82.9	13.20	10.2	129.19
	1990	11.06	6.9	136.20	85.0	13.00	8.1	160.26
Portugal	1980	6.08	11.1	41.00	75.0	7.60	13.9	54.68
	1990	5.66	7.0	65.00	80.3	10.30	12.7	80.96
Sweden	1980	7.00	8.6	66.70	82.3	7.30	9.0	81.00
	1990	6.17	6.1	85.60	84.9	9.00	8.9	100.77
UK	1980	30.26	6.7	367.00	81.6	52.00	11.6	449.26
	1990	34.20	5.4	550.00	86.5	46.00	7.2	636.20
TOTAL (excluding Belgium)	1980	226.46	8.4	2167.26	80.3	304.86	11.3	2698.58
	1990	255.69	7.2	2964.50	83.3	336.84	9.5	3557.03

Source: ECMT

Table 4.3: Freight Transport (Thousand million tonne-km)

		Rail %		Roads %		Inland Waterways %		Pipelines %		TOTAL
Austria	1980	11.00	39.9	2.88	28.7	1.56	5.7	7.06	25.6	22.50
	1990	12.68	46.1	6.75	24.6	1.66	6.0	6.37	23.2	27.46
Belgium	1980	8.04	23.6	18.31	53.9	5.85	17.2	1.80	5.3	34.00
	1990	8.35	17.8	32.05	68.4	5.45	11.6	1.02	2.2	46.88
Switzerland	1980	7.39	50.3	6.03	41.0	0.16	1.1	1.11	7.6	14.69
	1990	8.30	41.6	10.32	51.7	0.15	0.7	1.17	5.9	19.94
West Germany	1980	63.80	25.2	124.40	49.2	51.44	20.4	13.10	5.2	252.74
	1990	61.40	20.6	169.80	57.0	54.80	18.4	11.74	3.9	297.74
Denmark	1980	1.62	17.1	7.85	82.9					9.47
	1990	1.79	16.0	9.35	83.9					11.14
Spain	1980	11.30	10.9	89.50	86.2			3.01	2.9	103.81
	1990	11.61	7.0	152.25	91.8			4.22	2.5	165.83
France	1980	66.37	31.6	98.10	46.7	10.87	5.2	34.67	16.5	210.02
	1990	51.53	26.7	114.80	59.4	7.17	3.7	19.61	10.2	193.11
Italy	1980	18.38	12.2	119.60	79.7	0.20	0.1	11.94	8.0	150.12
	1990	21.22	10.1	177.95	84.5	0.12	0.1	11.10	5.3	210.38
Eire	1980	0.62	11.0	5.01	88.8					5.64
	1990	0.59	10.3	5.13	89.9					5.72
Norway	1980	1.66	24.0	5.25	75.9					6.91
	1990	1.63	14.3	7.69	67.6			2.06	18.1	11.38
Portugal	1980	1.00	7.81	11.80	92.2					12.80
	1990	1.59	12.71	10.92	87.3					12.51
Netherlands	1980	3.40	5.7	17.67	29.7	33.48	56.2	5.04	8.5	59.59
	1990	3.07	4.6	22.89	34.4	35.66	53.6	4.87	7.3	66.50
Sweden	1980	16.65	43.8	21.36	56.2					38.01
	1990	19.61	42.5	26.52	57.4					46.13
UK	1980	17.64	14.8	91.10	76.4	0.4	0.3	10.08	8.4	119.22
	1990	15.80	9.9	132.90	83.1	0.2	0.1	11.04	6.9	159.94
TOTAL	1980	228.87	21.9	618.86	59.1	103.96	9.9	94.87	9.1	1046.56
	1990	219.17	17.1	879.32	68.5	106.87	8.3	79.20	6.2	1284.56

* Includes transport for hire and reward only.

** Excludes own account operations

Source: ECMT

Table 4.4: Characteristics of Passenger Services

	Mean journey length (km)	Mean train load (pax)	Mean train length	Mean receipts per pax km (pence)
BR	41.0	89.0	2.92	6.21
CFE	42.0	116.7	7.78	–
CIE	49.0	124.2	6.36	4.05
CP	25.0	206.5	–	1.92
DB	41.8	107.8	3.26	–
DSB	33.4	100.1	2.54	3.97
FS	106.0	193.1	–	–
NS	43.3	104.6	4.31	3.52
NSB	61.1	83.2	5.06	3.78
OBB	50.8	113.7	6.05	2.92
RENFE	56.4	128.8	6.26	2.79
SJ	78.5	103.4	5.41	5.17
SNCB	45.9	56.7	2.42	2.88
SNCF	76.4	200.2	–	–

Source: Preston et al., 1993

Table 4.5: Characteristics of Freight Services

	Mean shipment length (km)	Mean train load (tonnes)	Mean train length (wagon km/train km)	Mean receipts per tonne km (pence)
BR	128.3	343.2	–	4.15
CFE	161.4	299.4	22.0	–
CIE	179.7	134.8	11.0	4.20
CP	246.2	235.6	–	2.58
DB	221.8	305.9	–	–
DSB	215.4	245.1	–	5.29
FS	324.6	318.0	–	–
NS	166.9	365.5	15.3	2.08
NSB	120.1	224.3	18.0	2.75
OBB	202.3	314.6	29.7	3.70
RENFE	385.7	285.4	15.2	2.93
SJ	349.5	471.1	33.6	1.23
SNCB	124.5	217.5	11.2	2.52
SNCF	358.7	303.7	–	–

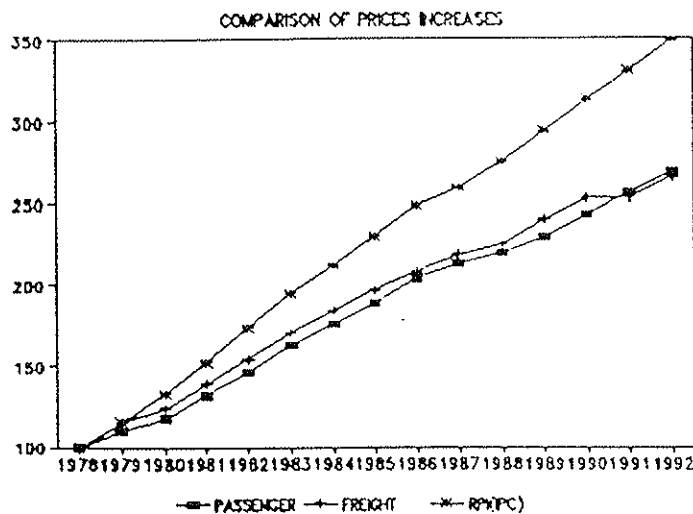
Source: Preston et al., 1993

Table 4.6: Percentage of Trains Arriving within 5 minutes of booked time (unless indicated otherwise)

	1985	1989	1990	1991
SNCB	94.2	94.7	93.8	93.5
DSB -InterCity				81.0
-Commuter				94.6
SNCF -InterCity				78.3
-Commuter				93.2
-Regional				92.5
BR -InterCity		87.0	85.0	84.1
-Commuter		92.0	90.0	91.0
-Regional		90.5	90.5	91.0
FS -InterCity				80.0
-Commuter				93.7
CIE -InterCity				89.1
-Commuter				98.1
NS -InterCity				97.1
-Commuter				92.8
NSB -InterCity				78.0
-Commuter				92.8
RENFE	76.6	78.4	87.5	-
SJ -InterCity	66.2	78.3	79.1	80.7
-Commuter				93.0
CFE	90.0	93.0	92.0	-

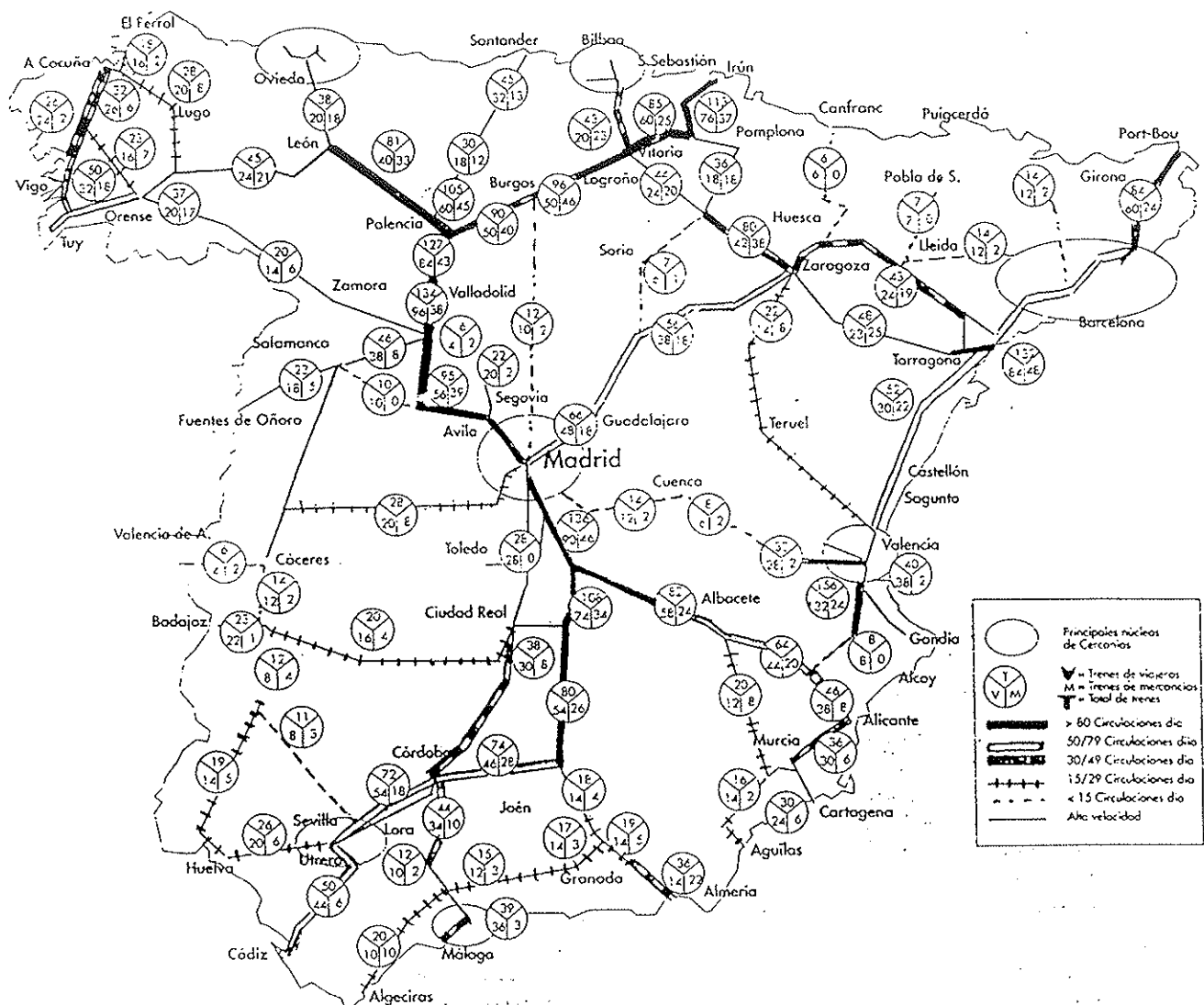
Source: Railway Gazette International, July 1992

Figure 4.1: Comparison of Price Increases (RENFE Passenger and Freight Prices compared with the Retail Price Index)



Source: Alvarez, 1993

Figure 4.2: Average Daily Frequency of Trains by Lines



SOURCE: LINEAS DE GESTION, No. 54, 19TH JULY 1993

5. PARTIAL PRODUCTIVITY MEASURES

In this section, we develop a cross section and a time series of partial productivity and other indices which multiply together to explain the ratio of receipts to total costs as follows:

$$\begin{aligned} & \frac{\text{Receipts}}{\text{Traffic Units}} \cdot \frac{\text{Traffic Units}}{\text{Train kms}} \cdot \frac{\text{Train km}}{\text{Staff Nos}} \cdot \frac{\text{Staff Nos}}{\text{Staff Costs}} \cdot \frac{\text{Staff Costs}}{\text{Total Costs}} \\ &= \frac{\text{Receipts}}{\text{Total Costs}} \end{aligned}$$

Of these indices, we would classify Train km/Staff Nos as being the key measure of operating performance, Receipts/Traffic Units and Traffic Units/Train kms as measures of commercial performance and Receipts/Total Costs as a measure of financial performance. Staff Nos/Staff Costs and Staff Costs/Total Cost are best regarded as largely determined by factor price.

5.1 Commercial Performance

Table 5.1 summarises three cross-sectional measures of commercial performance. The data for traffic units per train km and receipts per traffic unit disaggregated by passenger and freight services are given by Tables 4.4 and 4.5. In Table 5.1 we combine passenger km and freight tonne km to produce an aggregate traffic unit measure. RENFE's average train load is 171 traffic units per train km, giving it a ranking of 7th out of the 14 railways studied. Around 53% of RENFE's traffic units are

passenger kms (note this is based on a different data source than that for Table 3.4 where the percentage is estimated at 57%), being ranked 9th out of the 14 railways for this measure. RENFE's mean receipts per traffic unit were estimated at 2.6 pence (4.65 pts). This figure is below the two figures given by tables 4.4 and 4.5. We suspect that this is due to the fact that the total receipts and total traffic unit figures include subsidiary activities, in particular road haulage.

Figure 5.1 compares the trends in traffic units per train km for RENFE in the period 1971 to 1991 with those of BR, DB, FS and SNCF. This measure has fluctuated for RENFE, with peaks in 1974 and 1985 but has shown a downward trend, whereas FS has shown an upward trend and the other three railways have exhibited a broadly constant pattern.

Figure 5.2 compares the trends in receipts per traffic unit for RENFE with the four largest railways in Western Europe. RENFE's receipts per traffic unit declined sharply during this period, a pattern matched by FS. BR's receipts per traffic unit fluctuated but remained broadly constant as did SNCF's, whereas DB showed a marked upward trend.

5.2 Operating Performance

Table 5.2 shows that almost 3,500 train km are produced per annum per member of RENFE staff, with RENFE being ranked 3rd out of the 14 railways. Ideally, these figures should be broken down between passenger and freight services but only BR, NS, SNCB and SNCF have been able to provide a breakdown of staff by business sector.

However, only a fraction of total staff seem to have been allocated to these two businesses for three of the four railways (with NS being the exception). Earlier work (Nash, 1985) found that freight traffic was more labour intensive than passenger traffic. Thus in the final column of Table 5.2, we adjust our results by weighting passenger train km by 0.45 (the relative weight suggested by Nash). As a result the (national) figure for RENFE reduces to around 2,000 train km per member of staff but RENFE remains ranked 3rd. The data for NS suggests that freight services require 35% more staff than passenger services and a more appropriate weighting for passenger km may be 0.74. Although this would change the absolute values in the final column of Table 5.2, it is unlikely that it would dramatically change relativities.

Table 5.3 presents a more detailed breakdown of staff productivity. RENFE produces around 13 thousand train km per member of terminal staff, 26 thousand train km per member of administrative staff, 17 thousand train km per member of train operations staff and 56 thousand train km per member of maintenance staff. Out of the 13 railways studied, RENFE is ranked 5th (out of 13) for terminal staff productivity, 5th in terms of administrative staff productivity, 9th (out of 12) in terms of traction staff productivity and 2nd (out of 12) in terms of maintenance staff productivity. However, the productivity of maintenance staff may be affected by contracting out (which is also likely to be an important factor for SNCF).

Figure 5.3 shows the trends in staff productivity for RENFE and the four other large railways between 1971 and 1991. Between 1971 and 1984 RENFE, BR, SNCF and DB all exhibited similar upwards trends but from 1984, the productivity gains for BR and RENFE increased. Productivity for BR peaked in 1989 and has begun to decline, but for

RENFE productivity has continued to increase. Between 1971 and 1990 train km per member of RENFE staff increased from 1,491 to 3,459 (up 132%), representing a per annum productivity increase over this 20 year period of 2.8%.

Table 5.4 compares the utilisation of traction units for 14 railway companies. RENFE produces 61,000 km per annum per diesel locomotive, 115,000 km per annum per electric locomotive, 66,000 km per annum per diesel multiple unit and 102,000 km per electric multiple unit, being ranked 6th, 9th (out of 13), 3rd (out of 12) and 1st respectively.

Table 5.5 presents similar data in terms of gross tonne km per traction unit. The average diesel locomotive on RENFE hauled 23 thousand tonne kms in 1990. The corresponding figures for electric locomotives was 57 thousand, for diesel multiple units was 14 thousand and for electric multiple units was 20 thousand. For these criteria, RENFE was ranked 6th, 7th (out of 13), 2nd (out of 12) and 1st (out of 13) respectively. Table 5.6 presents data on the utilisation of freight wagons. The average load carried by a RENFE freight wagon is 19 tonnes, placing RENFE 2nd out of the 8 railways for which we have data. However the average distance travelled in a year by a RENFE freight wagon was 18,000 km, with a ranking of 7th. As a result RENFE's tonne km per annum per wagon, at 335,000 ranks RENFE 5th out of the 8 operators for which we have data.

5.3 Financial Performance

Table 5.7 shows three financial measures. RENFE employs around 51 people per million £ of staff costs and is ranked 9th out of the 14 railways, suggesting RENFE

has relatively high unit labour costs, equivalent to £19,455 per member of staff per annum (or around 3.482 million pts). However, staff costs only make up around 54% of RENFE's total costs, with RENFE being ranked 7th for this measure.

Three cost recovery ratios are also presented in Table 5.7. In terms of the rail business only, receipts represent around 42% of all costs and 54% of operating costs (total costs minus depreciation and interest), with RENFE being ranked 10th and 6th equal (with NS and NSB) respectively. If non rail businesses are also taken into account RENFE covers 60% of costs and is ranked 8th out of the 14 railways studied.

Table 5.8 gives a further financial measure, namely that of subsidy per capita. Comparisons are difficult here but it appears that RENFE receives a relatively small amount of subsidy per head of population (at around £25 or 4,500 pts per annum), being ranked 10th out of the 14 railways studied. However, Table 5.8 also shows that Government support is equivalent to 56% of RENFE's receipts. On this criterion, RENFE is ranked 3rd out of the 14 railways, with only FS and SNCB having higher percentages.

Figure 5.4 compares the cost recovery ratio of RENFE with the four major railway operators in western Europe. At the start of the period (1971) RENFE's cost recovery ratio was similar to that of SNCF and above that of DB. However, between 1971 and 1982 there was a marked deterioration in RENFE's finance, with the cost-recovery ratio more than halving and only FS having a lower ratio. Since 1983 the ratio has increased slightly and then fallen back in recent years.

Table 5.9 illustrates the recent trends in more detail. Between 1984 and 1990 costs, in real terms, were reduced by 21 % and receipts by 3 %, so that, on these figures, the cost-recovery ratio increased from 0.33 to 0.47. However, in 1991 and 1992 the ratio decreased to 0.39, largely due to increased depreciation and interest payments attributable to the AVE programme. By 1992 depreciation and interest accounted for 30% of total costs, compared to 26% in 1984. The other feature of Table 5.9 is that RENFE made operating losses, even when subsidy is taken into account, throughout the period. Excluding subsidy, Alvarez (1993) estimates that all RENFE's operating businesses make a loss, with Largo Recorrido accounting for around 38% of losses, Cercenias 23 %, freight 23 % and AVE 5 %.

Table 5.10 compares RENFE's plans for investment between 1993 and 2000. Overall, in this period RENFE intends to invest over £11.5 billion (over around 2000 billion pts). This works out as being equivalent to around £37 per person per annum (6,600 pts). On this criterion, RENFE is ranked 6th out of the 14 railways studies. Work on the High Speed line AVE between Madrid and Seville was commenced in 1986 and completed in 1992. and involved the construction of a new route between Madrid, Ciudad Real and Cordoba in addition the 1987 investment plan proposed two new stretches.

- Bilbao - Vitoria cut-off (50km) to improve Bilbao services.
- The Guadarrama line (60km) to improve services between Madrid and Valladolid.

It is also proposed to upgrade three corridors (Madrid-Zaragoza-Barcelona, Madrid-Valencia and Barcelona-Valencia), as well as the double tracking of four sections

of line. These improvements will be based on the existing broad gauge rather than the standard gauge that, rather controversially, has been adopted by AVE (Gomez - Mendoza, 1993). At one time other new routes were to be built to standard gauge and most of the existing network converted. However, the cost of doing so is now seen as prohibitive and, with the exception of the line between Barcelona and the French border, any further high speed lines are likely to be built (or rebuilt) using broad gauge track with convertible sleepers. Improved suburban services also formed part of the investment plan and in recent years they have tended to take priority. There have been few attempts to undertake social cost-benefit analysis in order to determine investment priorities and this is clearly an area where additional work could be undertaken (Savignat, 1993).

Table 5.1: Measures of Commercial Performance

	Traffic unit/ Train km	% of Traffic units passenger kms	Receipts/Traffic units (pence)
BR	114.0	67.5	5.77
CFF	158.1	57.1	3.89
CIE	127.5	67.6	3.63
CP	175.2	78.1	2.10
DB	173.8	41.5	4.28
DSB	119.3	73.8	4.32
FS	212.3	68.2	2.37
NS	120.5	78.3	3.20
NSB	127.3	45.0	3.45
OBB	181.5	40.3	3.36
RENFE	170.6	52.7	2.60
SJ	249.2	24.5	2.24
SNCB	96.9	43.9	2.96
SNCF	234.7	55.7	3.38

Source: Preston et al., 1993

Table 5.2: Measures of Operating Performance – Train Kilometres per Staff

	Total (unadjusted)	Passenger	Freight	Total (adjusted)
BR	3193	10996	27467	1673
CFF	3033	–	–	1728
CIE	2693	–	–	1667
CP	1857	–	–	1117
DB	2559	–	–	1607
DSB	2709	–	–	1399
FS	1568	–	–	861
NS	4484	5139	3818	2261
NSB	2504	–	–	1555
OBB	1750	–	–	1101
RENFE	3459	–	–	2065
SJ/BV	3501	–	–	2328
SNCB	3402	20309	11536	1998
SNCF	2413	3803	4599	1518

Source: Preston et al., 1993

Table 5.3: Labour Productivity - Detailed Breakdowns. (Train km per staff)

	Train km/ Terminal Staff	Train km/ Admin Staff	Train km/ Train Crew	Train km/ Maintenance Staff
BR	18,904	84,745	16,393	29,412
CFF	7,189	31,949	15,243	14,706
CIE	12,469	22,123	N/A	N/A
DB	7,918	20,876	26,666	6,849
DSB	13,071	15,503	27,174	35,714
FS	5,126	15,576	11,862	4,464
NS	13,908	24,630	32,467	16,949
NSB	13,642	23,364	24,752	12,048
OBB	5,434	24,691	21,505	5,102
RENFE	12,500	25,974	17,391	55,556
SJ	11,086	35,587	35,842	29,390
SNCB	11,351	35,088	20,121	11,628
SNCF	7,519	14,599	24,509	76,923

Source: Preston et al., 1993

Table 5.4: Utilisation of Traction Units

	Diesel loco km/ Diesel loco	Electric loco km/Electric loco	DMU vehicle km/ DMU vehicle	EMU vehicle km/EMU vehicle
BR	69571	164483	63624	21863
CFF	2904	79294	n/a	92415
CIE	97373	n/a	n/a	24600
CP	125000	140527	61736	61638
DB	30230	165010	43309	23152
DSB	131244	189000	65242	21572
FS	17814	109288	43631	42999
NS	6987	170089	51783	48049
NSB	32910	123705	45136	50057
OBB	22796	105703	61649	28079
RENFE	61378	115452	65608	101652
SJ	9819	121952	69630	31701
SNCB	74119	108160	68417	59570
SNCF	18075	120608	40509	21113

Source: Preston et al., 1993

Table 5.5: Gross Tonne Km per Traction Unit (Thousands)

	Diesel Locom	Electric Locom	D.M.U.'S	E.M.U.'S
Operator	Total	Total	Passen.	Passen.
BR	50.00	72.93	10.93	4.71
CFF	0.46	16.38	N/A	15.09
CIE	24.02	N/A	N/A	N/A
CP	55.11	51.87	6.91	14.34
DB	8.70	85.82	0.26	4.97
DSB	33.81	16.30	19.90	8.86
FS	5.33	53.06	3.71	7.70
NS	3.48	74.79	6.09	9.41
NSB	7.40	59.87	4.20	4.49
OBB	4.67	53.70	3.68	6.29
RENFE	22.69	56.92	13.79	20.32
SJ	5.00	69.56	4.10	5.14
SNCB	32.71	50.83	4.13	7.93
SNCF	8.81	76.53	3.18	8.51

Source: UIC

Table 5.6: Utilisation of Freight Wagons

	Tonne km/ Wagon km	Wagon km/ Wagon	Tonne km/ Wagon
CFF	13.62	22012	299803
CIE	12.27	25265	310002
NS	17.28	27248	470845
NSB	12.45	33437	416291
OBB	10.61	34003	360772
RENFE	18.83	17780	334797
SJ	14.00	52480	734720
SNCB	19.45	13690	266271

Source: Preston et al, 1993

Table 5.7: Financial Indices

	Staff Nos/ Staff Costs (£m)	Staff Costs/ Total Costs	Receipts/Total Costs		
			Rail business only		Rail and Non Rail business
			Total Costs	Operating Costs	
BR	66.4	0.59	0.82	0.87	0.85
CFF	47.2	0.57	0.51	0.64	0.89
CIE	47.2	0.77	0.46	0.52	0.46
CP	96.4	0.52	0.34	0.42	0.73
DB	38.0	0.61	0.44	0.52	0.58
DSB	74.8	0.43	0.45	0.63	0.78
FS	46.9	0.44	0.16	0.20	0.27
NS	53.4	0.50	0.46	0.54	0.58
NSB	73.6	0.60	0.49	0.54	0.51
OBB	67.0	0.49	0.35	0.39	0.72
RENFE	51.4	0.54	0.42	0.54	0.60
SJ/BV	67.4	0.45	0.59	0.72	0.73
SNCB	40.7	0.68	0.27	0.31	0.49
SNCF	53.4	0.49	0.50	0.64	0.68
Mean:			0.46	0.53	0.63

Source: Preston et al, 1993

Table 5.8: Direct Government Support per Annum (1990)

	Support (£m)	Receipts (£m)	Subsidy per capita (£)	Support/Receipts
BR Great Britain	736.70	2843.19	12.9	20.6
CFF Switzerland	164.62	753.33	24.9	17.9
CIE Eire	55.74	67.73	15.8	45.1
CP Portugal	116.49	149.81	11.3	43.7
DB West Germany	2866.74	4486.65	46.8	39.0
DSB Denmark	139.01	283.90	27.1	32.9
FS Italy	5454.20	1580.38	95.0	77.5
NS Netherlands	412.68	452.80	28.0	47.7
NSB Norway	162.74	161.40	38.7	50.2
OBB Austria	608.13	713.19	80.0	46.0
RENFE Spain	989.12	763.33	25.3	56.4
SJ/BV Sweden	280.61	555.78	33.0	33.6
SNCB Belgium	852.78	440.80	86.0	65.9
SNCF France	2015.37	3867.27	36.1	34.3

Source: Preston et al., 1993

Table 5.9: Recent Trends in RENFE's Operating Results (1992 Prices - pts million)

	1984	1985	1986	1987	1988	1989	1990	1991	1992
Revenue	203,527	203,918	193,518	190,803	187,589	186,049	197,737	178,601	182,233
Costs	611,221	523,884	465,421	445,955	422,282	415,880	422,989	455,419	480,209
of which depreciation and interest									
Subsidy	158,293	140,150	130,298	120,948	117,996	113,575	114,635	125,730	143,591
Revenue - costs	296,003	247,164	232,839	225,254	217,076	206,707	201,950	210,091	227,862
(Revenue + Subsidy) - Costs	-407,694	-320,466	-291,903	-255,151	-234,693	-229,830	-224,752	-277,357	-297,976
Revenue/costs	-11,691	-73,301	-59,064	-29,898	-17,617	-23,123	-22,802	-67,267	-70,144
Revenue/costs	0.33	0.39	0.40	0.43	0.44	0.45	0.47	0.39	0.39

Source: Alvarez, 1993

Table 5.10: Estimates of Future Investment 1993-2000 (1990 prices)

	Investment (£m)			Per capita investment per annum (£)
	Track & Signalling	Rolling Stock	Total	
BR Great Britain	4240	3760	8000	17.5
CFR Switzerland	2150	1420	3560	67.4
CIE Eire	n/a	n/a	40	1.4
CP Portugal	1484	326	1810	22.0
DB West Germany	10400	3660	14060	28.7
DSB Denmark	1030	630	1660	40.5
FS Italy	15500	1720	17220	37.5
NS Netherlands	4050	1580	5630	47.8
NSB Norway	500	350	850	25.3
OBB Austria	2040	530	2570	42.3
RENFE Spain	n/a	n/a	11520	36.8
SJ/BV Sweden	990	310	1300	19.1
SNCB Belgium	1280	450	1730	21.8
SNCF France	9600	2770	12370	27.7

Adapted from: Department of Trade and Industry (1990) "West European Railway Component Study - Volume II".

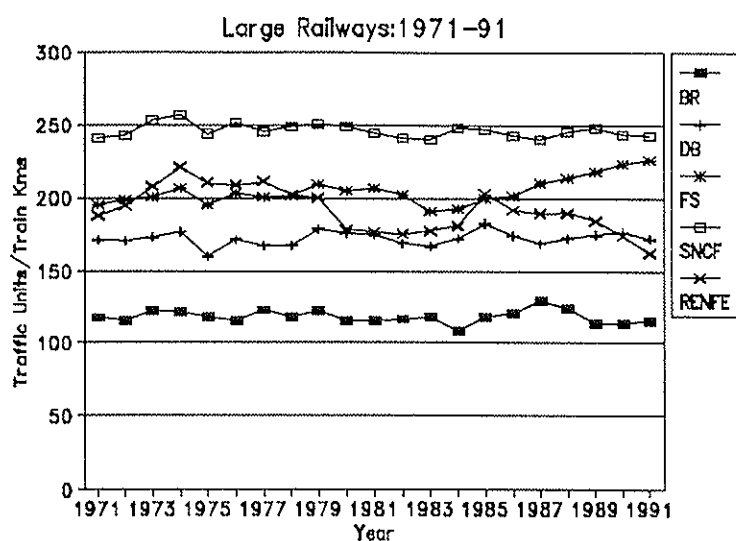


FIGURE 5.1

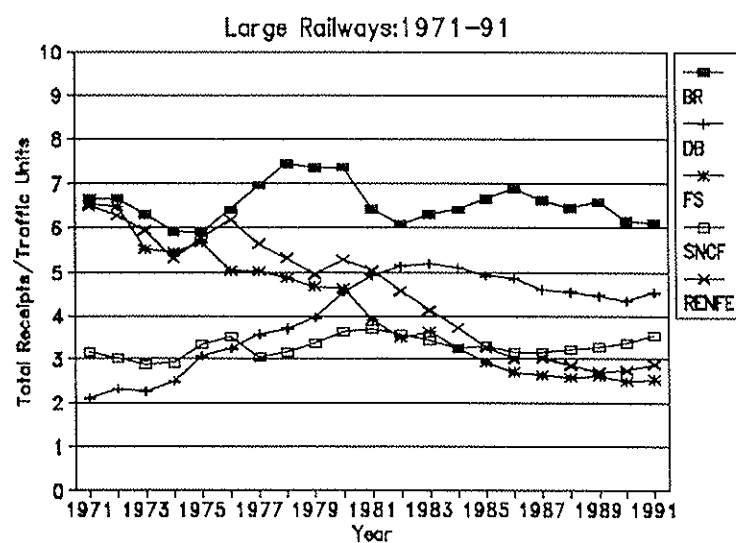


FIGURE 5.2

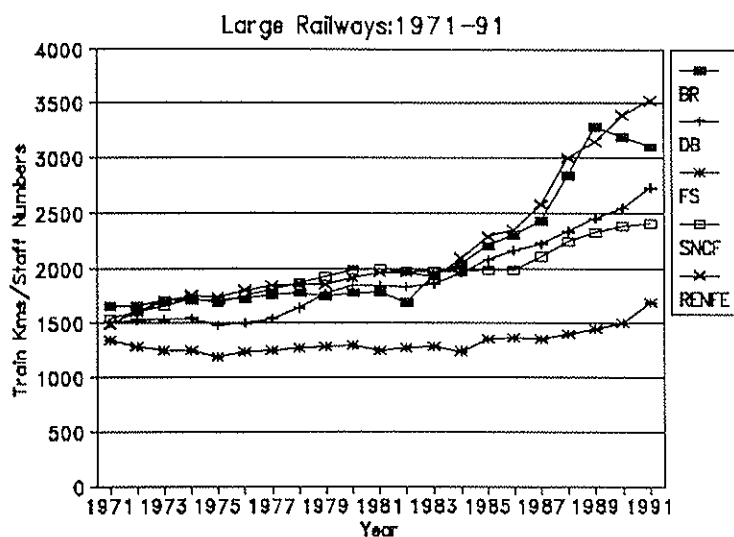


FIGURE 5.3

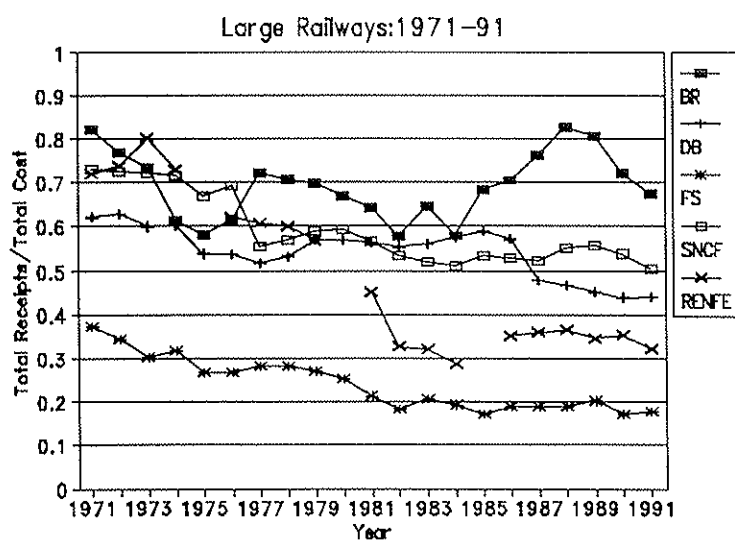


FIGURE 5.4

6. ECONOMETRIC STUDIES OF PERFORMANCE

Earlier work by the Institute for Transport Studies undertook econometric studies of 13 European railways for the period 1971 to 1987 (Vigoroux - Steck, 1989) and for the period 1971 to 1990 (Preston and Nash, 1993), based on data collected by VIC. This work has recently been extended to include two new railways, CP and RENFE (Garcia, 1993, Preston, 1994). The statistical cost model developed had the following structure:

$$RTC = f(TKT, \%TKP, LL, WM, WE, WV, YEAR, \sum_{i=1}^{14} DV_i)$$

Where

- RTC = Railway Total Operating Costs - depreciation and interest charges are excluded because of the differing accounting conventions adopted by European railways.
- TKT = Total Train Km for all types of traction. Intermediate measures of output rather than final measures of output due to differing government policies concerning fares, subsidy levels and the regulation of competition.
- %TKP = Percentage of total train km operated by passenger services. This variable was used rather than passenger train km and freight train km in order to avoid the statistical problem of multicollinearity.

LL	=	Length of Route.
WM	=	Price of labour, calculated as salary costs (SC) divided by staff numbers.
WE	=	Price of energy, calculated as energy costs (EC) divided by staff numbers.
WV	=	Price of materials and services, calculated as materials and service costs (MC) divided by total train km (TKT).
YEAR	=	Time trend variable.
$\sum_{i=1}^{14} DV_i$	=	Firm specific dummy variables.

The model form used was the translog which is a flexible logarithmic function that incorporates all first order cross effects. The model was restricted to ensure linear homogeneity of degree one in input prices (and hence $RTC = WM(SN) + WE(TKT) + WV(TKT)$) and cost share equations were estimated jointly with the operating cost equation in order to improve the efficiency of the estimation. The model was estimated using the Statistical Analysis Systems (SAS) package. It should be noted that all firms are assumed by the model to be cost-minimisers, which may not be strictly true for some firms in our sample (e.g. FS).

From the translog operating cost model we can estimate returns to density as:

$$RTD = (\delta \ln RTC / \delta \ln TKT)^{-1}$$

This examines the ratio of the proportionate change in output (measured by train kms), holding length of line constant, to the proportionate change in costs. If this

measure is greater than one, we have increasing returns to density (economies of density), if it equals one we have constant returns to density and if it is less than one we have decreasing returns to density (diseconomies of density).

We can also estimate returns to scale as:

$$RTS = \left(\frac{\partial \ln RTC}{\partial \ln TKT} + \frac{\partial \ln RTC}{\partial \ln LL} \right)^{-1}$$

This examines the ratio of a proportionate change in two outputs (train kms and length of line) to a proportionate change in costs. If this measure is greater than one we have increasing returns to scale (economies of scale or size), if it equals one we have constant returns to scale, and if it is less than one we have decreasing returns to scale (diseconomies of scale or size).

In Table 6.1 the RTD and RTS measures for RENFE are given for the period 1971 to 1990. It can be seen that RENFE exhibits returns to density throughout the period, but these returns decrease consistently (with the exception of 1974) from 4.077 in 1971 to 2.081 in 1990. Assuming a linear rate of change, continuation of existing policies (increase train kms, reduce line kms) would result in constant returns to density at around the turn of the century. In terms of returns to scale, there is rather less change. RENFE exhibits decreasing returns to scale throughout the period, with RTD being 0.702 in 1971 increasing slightly to 0.739 in 1990.

Table 6.2 compares the econometric results for RENFE with 14 other European railway operators. A measure of cost efficiency, all other things being equal, can be

determined by taking the exponential of the dummy variable coefficient. The results indicate that only one railway (SJ - Sweden) has lower costs (albeit by 30%) than RENFE, with RENFE's costs levels not being different from those in Britain, Ireland, West Germany, the Netherlands, Norway, France and Finland.

Table 6.2 also shows that RENFE has similar increasing returns to density to Portugal and France (with only four railways exhibiting higher returns), countries with similar traffic densities. In terms of returns to scale, RENFE's results are most similar to the British, Swedish and Italian networks, which are of a similar size to RENFE.

The analysis described so far refers only to operating costs. In Table 6.3, two assumptions are tested concerning capital costs. Firstly, it is assumed that capital costs are fixed, they do not change at all with output. Secondly, it is assumed that capital costs are variable, increasing in proportion to changes in output. In reality, we suspect that something like 50% of capital costs might be fixed and hence for RENFE a return to density of around 2.17 (up from 2.08) and a return to scale of around 0.86 (up from 0.73) may be appropriate. Overall, our work suggests that the optimal cost minimising network should have around 5,500 km and an optimal density of around 40,000 train km. This would suggest that if the RENFE network were to be fragmented the maximum number of units into which it should be separated should be three.

Table 6.4 examines the issue of whether economies of scope (EOS) result from operating jointly passenger and freight services. This is calculated as:

$$EOS = (RTC + RTC_F) / RTC_{PF}$$

Where RTC_P = Estimated total costs of producing passenger train km only
 RTC_F = Estimated total costs of producing freight train km only
 RTC_{PF} = Estimated total costs of producing passenger and freight train km together.

Where EOS is greater than one there are increasing returns to scope (economies of scope), whereas if it is less than one there are decreasing returns to scope. It can be seen that only BR seems to exhibit increasing returns to scope, whilst the results for RENFE seem to suggest that separate operation of freight and passenger services would reduce operating costs by 29%. However, very different results can be obtained using the same or similar data (Garcia, 1993, Jara-Diaz and Munizaga, 1992) and seem to be sensitive to model form. On the other hand other econometric studies have also found diseconomies of scope between passenger and freight operations (reviewed by Preston, 1994) and the separation of these businesses in Japan appears to have been successful (Maeda, 1993).

We have little evidence on the effect of the separation of infrastructure from operations as all but 2 of our 300 observations (SJ in 1989 and 1990) are vertically integrated. A separate translog model has been run with a dummy variable for these two observations. The coefficient of the dummy variable was statistically significant and implies an 11% reduction in operating costs. However, the cost-recovery ratio for Swedish Railways has declined from 0.81 in 1988 to 0.72 in 1990 (Preston and Nash, 1993) leading to some suspicions that operating cost efficiencies have been offset by increased inefficiencies in the use capital.

Table 6.1: Returns to Density and Scale for RENFE 1971-1990

	RTD	RTS		RTD	RTS
1971	4.077	0.702	1981	2.918	0.707
1972	3.942	0.712	1982	2.779	0.707
1973	3.895	0.722	1983	2.739	0.708
1974	4.21	0.728	1984	2.646	0.714
1975	3.67	0.703	1985	2.382	0.725
1976	3.53	0.704	1986	2.263	0.723
1977	3.40	0.707	1987	2.255	0.723
1978	3.455	0.711	1988	2.227	0.733
1979	3.681	0.713	1989	2.262	0.733
1980	3.280	0.713	1990	2.081	0.739

Table 6.2: Cost Efficiency (1971-1990), Returns to Density (1990), Returns to Scale (1990)

	Operators comparisons	Returns to Density	Returns to Scale	Train Km per annum (000)	Length of line (km)	Density (train km per line km)
BR	1.17*	1.11	0.72	445060	16584	26837
CFE	1.46	0.81	1.22	122394	2978	41099
CIE	0.86*	6.00	1.23	14237	1944	7324
DB	1.03*	1.33	0.64	603797	26949	22405
DSB	1.38	1.10	1.26	52160	2344	22252
FS	1.39	1.48	0.69	314255	16066	19560
NS	1.17*	0.77	1.25	117314	2798	41928
NSB	0.99*	4.44	1.02	36705	4044	9076
OBB	2.00	1.25	0.88	117201	5624	20839
SJ	0.70	6.04	0.76	99634	10801	9225
SNCB	1.82	1.00	1.10	92802	3479	26675
SNCF	0.73*	2.37	0.60	487670	34070	14313
VR	0.94*	53.83	0.89	41026	5867	6993
CP	1.65	1.98	1.05	33693	3064	10996
RENFE	1.00	2.08	0.73	168960	12560	13452

* Not significantly different from 1.0 at the 5 % level

Source: Preston, 1994

Table 6.3: Sensitivity of Returns to Density and Scale to Assumptions concerning Capital

	Returns to Density		Returns to Scale	
	Capital Costs Fixed	Capital Costs Variable	Capital Costs Fixed	Capital Costs Variable
BR	1.17	1.10	0.76	0.73
CFF	1.01	0.84	1.52	1.17
CIE	6.71	3.66	1.41	1.20
DB	1.59	1.26	0.76	0.68
DSB	1.55	1.06	1.79	1.18
FS	1.82	1.35	0.86	0.73
NS	0.91	0.80	1.47	1.20
NSB	5.05	3.38	1.13	1.02
OBB	1.39	1.22	0.98	0.89
RENFE	2.65	1.69	0.93	0.78
SJ	7.14	3.17	0.92	0.79
SNCB	1.16	1.00	1.28	1.08
SNCF	3.06	1.82	0.77	0.66
CP	2.42	1.66	1.30	1.04
VR	62.50	5.15	1.09	0.91

Source: Preston, 1994

Table 6.4: Economies of Scope between Passenger and Freight Operations (Approximations)

BR	1.13	OBB	0.77
CFF	0.65	SJ	0.74
CIE	0.77	SNCB	0.66
DB	0.65	SNCF	0.77
DSB	0.80	VR	0.68
FS	0.83	CP	0.79
NS	0.82	RENFE	0.71
NSB	0.66		

Source: Preston, 1994.

7. FUTURE DEVELOPMENTS

Before outlining future developments, it is worth assessing the current organisational reforms. Overall, these seem sensible being based on the product-based or sector management approach successfully implemented by British Rail during the 1980s. We would, though offer a number of suggestions for improvement. Firstly, the target output levels sets for the businesses seem unrealistic. Table 7.1 shows that during the period 1989 to 1991 only one of the six operating businesses (Cercerais) achieved its targets. Secondly, if existing price and service level controls are maintained we doubt whether any of the six businesses will meet their financial targets. These targets were: Paqueteria to achieve a positive contribution balance by 1996 (the 1992 loss was estimated at 7,314 million pts), Largo Recornido to achieve a positive contribution by 1998 (1992 loss, 12,782 million pts) as should Cargos Completas and Transporte Combinado (1992 loss 19,702 million pts), whilst Regionales and Cercerais should maintain a fixed unit cost per passenger. Thirdly, we believe that offering Cercerais a 3 pts subsidy for each passenger km carried above target levels requires further consideration. This seems to be borne out by Table 7.2 which shows between 1991 and 1993 these incentive payments increased from 4,452 million pts to a projected 9,282 million pts. An increase of this magnitude will only be justifiable in social terms if the net social benefits of commuter rail are at least 3 pts per passenger km. The usefulness of an objective of fixed costs per passenger km for an expanding business with likely economies of scale (or more precisely economies of density) also needs to be considered. Fourthly, we believe that it may be useful to inject some competition into the service provision units. This could be usefully done by opening up these markets to external competition through sub-contracting. We would therefore suggest that the following options be considered:

- (i) Maintain the current organisational system, but redefine each businesses objectives. Our preferred objective would be to maximise passenger miles subject to a budget constraint set by Government (Nash, 1987). The service provision units could also be reorganised further to allow internal competition and, if required, opened up to external competition.
- (ii) If privatisation is to be considered we would suggest that it should focus firstly on the freight business as this is the sector facing most competition (and hence likely to require only minimal regulation), one which might benefit from an injection of private sector capital and know-how and has been performing poorly compared to the passenger sectors. We see particular scope for the development of long distance inter-modal freight, although the lack of a standard gauge may represent an important constraint.
- (iii) If privatisation of the passenger businesses were to be considered, we would recommend that the businesses should not be split into too many units and, for reasons of continuity as much as anything else, we would suggest that any division should be based on products rather than geography. In some cases, there may be scope for integrating RENFE's operations with those of other rail operators. A more realistic alternative to privatisation of passenger services may be franchising. This should be done, if at all, within the context of a planned national network. Our main concern is whether there would be any genuine competition for these franchises, although the experience from Sweden is generally encouraging.
- (iv) RENFE's weak financial position stems from the very low charges it makes in both passenger and freight transport. In part these stem from the nature of the traffic and the weak competitive position it is in. Nevertheless, the scope

for selective price increases (along with service improvements, in the case of freight traffic in particular) should be investigated. Given that there is a concern that this would shift traffic to more environmentally and socially damaging modes (road and air), the extent to which prices cover social costs should also be examined.

- (v) To the extent that investment may improve the quality of passenger and freight services, permitting higher volumes and market shares, it may be helpful, but these benefits need to be assessed carefully and compared to the costs involved. The increasing burden of depreciation and interest payments is a serious problem.

Table 7.1: Target Traffic levels and Outcomes (Million passenger/tonne kms

	1989		1990		1991	
	Target	Achieved	Target	Achieved	Target	Achieved
Largo Recornido	9738	8827	10127	8455	10583	7991
Regionales	2941	2323	2971	2426	3000	1900
Cercerais	3378	33765	3510	4595	3647	5131
Largos Completas	8147	8087	8228	7745	8294	7146
Transporte Combinado	2850	2523	3050	2473	3251	2395
Paqueteria	902	549	947	524	965	482

Source: Estevez, 1993

Table 7.2: Break-down of Subsidies

		1991	1992	1993(a)
PSO Passenger	Regional	18650	19139	19641
	Cercanias	17109	17793	18500
	Incentive	4452	6300	9282
PSO Infrastruct.	Infrastructure Vigilance and Conservation	58193	58755	86448
	Inf. depreciation	21101	33895	
	AVE infrastructure	-		12558
PSO Others	ak Traffic Lines	3639	4698	4805
	Normalisation	954		
Others	State Account	29665	36164	109667
	Interest and other	74288	87262	
	Subsidy Decree 1986	11075	3000	
Losses	Losses	56672	57508	

Source: Management Reports and Operating Budget 1993

8. CONCLUSIONS

Our conclusions are as follows. Between 1970 and 1990 RENFE increased the passenger kms carried by 23% but freight tonne-kms declined by 3%, leading to an increase in total traffic units of 12%. However, in recent years, until the opening of the AVE, the only absolute growth has been in commuter traffic, which could prove to be a high cost, low returns business. In relative terms, between 1960 and 1990 rail's share of the passenger market decreased from 30% to 7% and for freight the decline was from 20% to 5%. Rail's share of the passenger market in Spain is similar to that of other western European countries but rail's share of the freight market is low (although this may be partly due to the structure of the Spanish economy). RENFE's passenger operations may be characterised by low service quality (except where there has been recent investment), high loadings, long trains, medium to long mean distances travelled and low fares. RENFE's freight business may be characterised by below average train length and loadings, long lengths of haul and low charges. Since 1970 there have been decreases in traffic units per train km. Some of this deterioration may be rectified if greater attention is paid to pricing.

In terms of operating performance, RENFE's labour productivity is only bettered by the Dutch and the Swedes and this is due to improvements in recent years (between 1971 and 1990 staff productivity increased by 2.8% per annum). However, counterbalancing this somewhat is the fact that RENFE's staff is relatively expensive and there is some concern about the treatment of contract labour in our data set. RENFE also seems to achieve good utilisation of its traffic units, although its utilisation of freight wagons is relatively poor. The overall impression, confirmed by our econometric study,

is that RENFE is a cost efficient operator on a par with the British and the Dutch, and bettered only by the Swedish.

RENFE's financial performance is less good. Compared to other European railways the proportion of costs covered by revenue is on the poor side of medium. There is a low level of subsidy per capita but subsidy is high in relation to receipts and is tending to increase. RENFE's cost recovery ratio showed a particularly severe decline in the 1970s but has been more stable subsequently. However, a possibly over ambitious investment programme and accumulated operating losses threaten to lead to major financial problems in the future. We suggest that the investment programme should be reviewed within a social cost-benefit framework and that pricing and service policies be reviewed, along with business unit objectives, in order to ensure that financial targets are met. The plans to reduce Largos Recorridos services by 5.8% and Regionales services by 4% may be consistent with this.

Our econometric work suggest that, in order to minimise operating costs, RENFE ought to split into around three units, although further work would be required to identify the precise sources of the diseconomies resulting from unified ownership. It also ought to be noted that we have not taken into account the revenue benefits of operating a national network (e.g. integrated marketing, information and fares). However, our work suggests that, at most, RENFE should be re-organised in four units, which is close to how the company is currently organised. There is some, weak, evidence to suggests that there are diseconomies of scope between passenger and freight services and if privatisation of the rail network is to be considered then the freight services should be the first candidate. At the very least, public and private sector joint venture companies

should be encouraged in the rail freight industry. Re-organisation of the passenger businesses would be best based on an AVE/Largos Recorridos, Regionale, Cercanias basis but an alternative re-organisation based on geographic regions might be another option, particularly if there were advantages of integration with the narrow and metre gauge networks.

Our econometric work also indicates that RENFE, along with most of the major rail operators, in Europe exhibits economies of density, that is the network is not used intensively enough. However, this problem has declined in the period 1971 to 1990 as train kms have increased by 37% and route km have decreased by 7% and hence traffic density has increased by 47%. Nevertheless, there may be cost advantages from concentrating traffic on core routes and from closing down peripheral parts of the network, although social considerations need to be taken into account. Once again social cost-benefit analysis could prove a useful tool.

In terms of future markets, the commuter market has provided most recent growth and could undoubtedly provide further growth, although analysis should be undertaken to ensure that RENFE does not over expand in this area. Social cost-benefit analysis should be used to determine the optimal level of urban rail subsidy, possibly in a similar manner to the work of Glaister (1987) on transport subsidy in London and six other cities in England. Investment in inter city traffic should be cautious. The existing rail infrastructure is not conducive to high speeds and many of the main flows are at a distance where air remains competitive (Madrid - Lisbon, Madrid - Barcelona). A review of investment in inter-city services would be timely. International passenger travel faces the same problems, compounded by the lack of harmonisation in rail gauge. Long

distance, inter-modal freight may represent another growth area, particularly when the European economy moves out of recession.

We conclude that RENFE is a representative western European railway, with a good recent record with respect to operating performance. However, it is not immune to the Europe wide problems of declining market share and escalating financial deficits. Therefore further organisational reform is probably required for RENFE just as it is for all other European railways. Our suggestions in the short term are for RENFE to develop its knowledge of its demand and cost functions so as to be able to set prices and service levels consistent with its given objectives, that the investment programme is reviewed using social cost-benefit analysis and competitive forces be encouraged in areas where they do most help (eg the freight business, infrastructure maintenance). In the longer term the reforms being carried out in Britain, Sweden, Japan and elsewhere should be continued to be monitored and their applicability to Spain assessed.

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