
White Rose Research Online

eprints@whiterose.ac.uk
https://eprints.whiterose.ac.uk
Universities of Leeds, Sheffield and York

Deposited via The University of Leeds.

White Rose Research Online URL for this paper:
https://eprints.whiterose.ac.uk/id/eprint/2326/

Monograph:
Rickard, J.M. and Nash, C.A. (1986) Factors Influencing the Propensity to Make Long Distance Trips by Rail. Working Paper. Institute of Transport Studies, University of Leeds , Leeds, UK.

Working Paper 229

Reuse
See Attached

Takedown
If you consider content in White Rose Research Online to be in breach of UK law, please notify us by emailing eprints@whiterose.ac.uk including the URL of the record and the reason for the withdrawal request.



White Rose Research Online
http://eprints.whiterose.ac.uk/

ITS

Institute of Transport Studies
University of Leeds

This is an ITS Working Paper produced and published by the University of Leeds. ITS Working Papers are intended to provide information and encourage discussion on a topic in advance of formal publication. They represent only the views of the authors, and do not necessarily reflect the views or approval of the sponsors.

White Rose Repository URL for this paper:
http://eprints.whiterose.ac.uk/2326/

Published paper

Rickard, J.M., Nash, C.A. (1986) *Factors Influencing the Propensity to Make Long Distance Trips by Rail.* Institute of Transport Studies, University of Leeds. Working Paper 229

White Rose Consortium ePrints Repository
eprints@whiterose.ac.uk

Working Paper 229

July 1986

FACTORS INFLUENCING THE PROPENSITY OT MAKE LONG DISTANCE TRIPS BY RAIL

J M Rickard

and

C A Nash

ITS Working Papers are intended to provide information and encourage discussion on a topic in advance of formal publication. They represent only the views of the authors and do not necessarily reflect the views or approval of sponsors.

Abstract

J. M. Rickard and C. A. Nash (1986) Factors influencing the propensity to make long distance trips by rail, Working Paper 229, Institute for Transport Studies, University of Leeds.

This paper discusses some of the major results of the inter-urban rail trip generation models developed during the studentship of J M Rickard under the supervision of Drs C A Nash and A S Fowkes. The trip rates of distinct groups in the population are examined and possible explanations for the differences discussed. It is found that rail business trip rates are explained by SEG, age and location - other variables such as sex and car ownership do not have an independent effect. Location in a major urban area increases use of rail for business travel by 50-100%, largely at the expense of car. For non-business travel, SEG, age, household type and whether the district has a main-line rail station are the principal determinants of rail trip rates. The highest trip rates are found for students, members of the armed forces and profefessional employees, particularly those aged 18-24 and living in one person or many adult households. Amongst pensioners, it is those living in 2-pensioner households who travel most; pensioners living alone make few journeys by any mode. Accessibility to a main line rail station appears to raise the use of rail by high-usage SEGs at the expense of car, but for other groups, effect is ambiguous.

Acknowledgements

The authors would like to acknowledge the helpful co-operation of members of the Policy Unit of British Railways Board, particularly Alan Bennett and John Segal, throughout the research. Thanks are also due to Dr A S Fowkes for his comments on drafts of this report.

Contents

List of Tables

1. Introduction

This report discusses some of the major results of the inter-urban rail trip generatino models that formed the basis of a three year ESRC CASS studentship carried out by the author. The technical details of the models are discussed elsewhere (Rickard 1986) and are not dealt with in the present note. The purpose of the research is to produce a series of trip generation models which could be used to aid the understanding of variations in rail trip rates and the identification of unexploited market areas. This would be of value, for instance, in suggesting and evaluating new stations, including parkway stations, and major service revisions. The basic premise is that socio-economic, demographic and geographical information that can be made available from the census can be used to predict market potential. Such ideas are frequently applied to urban trip making but very few attempts have been made to apply them to inter-urban trip making, primarily because of data limitations.

The methodology adopted in the original project resulted in the division of the sample into a series of non-overlapping subgroups of the population with different trip rates. The subgroups have been selected in a thorough statistical manner to be the most efficient groups available. The current report discusses the composition of these groups. It is the aim of the current project to use the groups to calculate the trip rates of areas of interest. This will be achieved by multiplying the average trip rates of each group by the number of people in the group in the area (from the census). The accuracy of the estimates will then be tested by a comparison with trip rates recorded on the Long Distance Travel Survey and - where available - British Rail's area surveys.

2. Data and Methodology

The trip rate models were developed from analysis of the Long Distance Travel Survey of 1978/9. Although the survey is now a little old, it is still the most up-to-date national survey of long distance travel behaviour available.

The Long Distance Travel Survey (LDTS) was carried out on a continuous basis from 1974 to 1980. It took the form of a self-completion postal survey. A variety of the respondents' characteristics were requested along with details of trips over 25 miles in length carried out within the two weeks prior to receipt of the questionnaire. The definition of a long distance trip was altered to trips over 50 miles in length for the current work to include only truly inter-urban trips as a proportion of trips between 25 and 50 miles in length are between a town and its catchment area. Table 1 shows the length of the trips recorded on the survey. Note that 41.1% of the trips are between 50 and 100 miles in length. There is a gradual decline in the number of trips made with increasing distance.

Table 1: Length of long distance rail trips recorded on the LDTS 1978/9

(1) Business trips

Length (in miles)	Number of trips	Percentage of trips
51 - 100	79	41.1%
101 - 150	48	25.0%
151 - 200	42	21.9%
201 - 250	9	4.7%
251 - 300	4	2.1%
301 - 400	7	3.6%
401+	3	1.6%
	192	100%

(2) Non-business trips

Length (in miles)	Number of trips	Percentage of trips
51 - 100	325	45.1
101 - 150	158	21.9
151 - 200	143	19.9
201 - 250	47	6.5
251 - 300	8	1.3
301 - 400	26	3.6
401+	5	0.7
	720	100%

Being a household survey, the LDTS records details of infrequent and non-travellers who will necessarily be excluded from or under-represented in on-train surveys. It also records long distance car trip rates. These can be used to help understand the rail trip rates. For example, do those groups with low rail trip rates have high car trip rates or do they simply make few trips by either mode?

Trip rate models were developed from the LDTS data by relating the characterstics of the respondents and their geographical location to the number of buseinss and non-business trips they made by rail within the two week period. The methodology used fell into two stages: an exploratory analysis phase that gives insights into the nature of the market structure and a modelling phase which invovles rigorous statistical testing of the findings. Poisson regression models were used, estimated using maximum likelihood techniques. The product of these procedures is two simple models; one describing business trip rates by rail and one describing non-business rail trip rates.

3. The Business Rail Trip Rates Model

The characteristics of respondents selected by the modelling procedures as important in determining the number of business trips an individual makes by rail are shown in Table 2.

Table 2: Rail Business Usage Groups

Variable	High Rail Usage Group	Low Rail Usage Group
Socio-economic group of the respondent	Employer/managers, Professionals, Intermediate non-manual workers, Students, Members of the armed forces.	Junior non-manual, Manual, Not economically active (except students).
Age of the respondent	18-54 years	Under 18 or over 55 years
Type of origin	Conurbation central cities, London, Other urban areas.	Outer metropolitan areas, rural areas

Each characteristic listed in the left-hand column is used to divide the sample into two groups; a high usage group and a low usage group. These groups have been carefully selected and have

a significant effect on trip rates. All variables that are present on both the census and LDTS were included in the initial selection procedure. Those variables that were not selected are listed in Table 3.

Table 3: Variables Not Selected by the Rail Business Modelling Procedures

1. Sex of the respondent	6. Number of vans in the household
2. Socio-economic group of the head of the respondents' household	7. Access to the rail network
3. Number and age of adults in the household	8. Level of origin in the urban hierarchy
4. Number and age of children in the household	9. Region of origin
5. Number of cars in the household	10. Distance of origin from London

'Socio-economic group of respondent' represents the respondent's occupation. Not surprisingly, employers and managers, professionals and intermediate non-manual workers are found to make significantly more business trips by rail than junior non-manual workers, manual workers and those that are not economically active. Students and members of the armed forces also have relatively high trip rates. This reflects the LDTS' definition of a business trip as an 'appointment or call in the course of work' which clearly includes more than the stereotype briefcase-carrying business traveller.

Two occupation groups 'employer/manager group II' (employers or managers in establishments employing fewer than 25 people) and professional employees have considerably higher trip rates than the rest of the high usage group. Socio-economic group can, therefore, be redefined into three groups:

1. High usage group - Employer/manager group II and professional employees.

2. Medium usage group. The remainder of the high usage group from table 1 (i.e. employer/manager group I (employer managers in establishments employing 25 or more people), self-employed professionals, intermediate non-manual workers (employees in non-manual occupations ancilliary to the profession not normally requiring qualifications of university degree standard, artists and non-manual supervisors), students and members of the armed forces).

3. The low usage group - as in table 1 (junior non-manual workers, manual workers and those not economically active (except students)).

The medium usage group is fairly diverse in character. Employer/managers group I (employer/managers in organisations

with twenty-five or more employees) and the professional self-employed are in the group because although they have high business trip rates overall, the vast majority of their trips are made by car rather than by rail. These occupational groups are associated with particularly high levels of car ownership (see table 4). Note that these levels are higher than those of employer/manager group II and professional employees which comprise the high rail usage group. Two-thirds of the employer/manager group I come from households with two or more cars. Our analysis of business trip rates by car has shown that the presence of 2 cars is an important indicator of an individual's propensity to make trips by car. Intermediate non-manual workers, on the other hand, make less business trips overall than the professional and managerial groups but make a relatively high percentage of their trips by rail (33%). Students and members of the armed forces have relatively high rail business trip rates, probably at least partly as a result of access to railcards.

Table 4: Levels of car ownership in employer/managerial and professional groups on the LDTS 1978/9

SEG category		Emp/man I	Prof-self employed	Emp/man II	Prof employee	Entire sample
Number of cars in the household	0	3.3%	6.4%	12.0%	10.8%	34.0%
	1	30.1%	51.4%	51.4%	56.1%	49.9%
	2+	66.6%	42.3%	36.3%	33.1%	15.8%

NB: The numbers do not necessarily add to 100% due to rounding error

The 'age' variable is used to produce a high usage group consisting of those respondents aged 18-54 years and a low usage group consisting of the remainder of the sample. The former group represents the majority of those that are economically active. Those aged 55-65 have a relatively low trip rate and do not warrant inclusion in the high trip rates group.

The 'type of origin' variable divides the sample into an upper rail usage group consisting of those individuals residing in the central cities of metropolitan areas (i.e. Manchester, Liverpool, Sheffield, Newcastle, Birmingham, Leeds and Glasgow), in London and in other large non-metropolitan areas (free-standing towns such as those in the East Midlands (e.g. Derby, Nottingham), Lancashire (e.g. Blackpool, Preston), East Anglia (e.g. Lincoln and Norwich) and South Wales (e.g. Swansea and Cardiff) and a lower usage group consisting of those living in the outer urban areas of the metropolitan conurbations, smaller towns and rural areas. The districts in the upper usage group tend to be business centres which naturally generate many business trips. The majority of these districts have high levels of access to a high quality railhead. A variable representing access to, and quality of, the rail service was entered into early runs of the

model but was rejected as it did not fulfill statistical criteria for inclusion. It is probable that the type of origin variable represents access to the rail network and the proximity business centres.

The trip rates associated with all combinations of these characteristics are shown in table 5. Note that there is much variation between the groups. The trip rates vary between an average 0.001 trips per 2 weeks (or one trip every 38 years!) to 0.042 trips per 2 weeks (or approximately one trip a year). Obviously there is much variation around the average in each group. Our research has shown that in each case, the majority of respondents of the group do not make a trip within the two week period.

The original model shows that occupation has the largest effect on trip rates of all the characteristics examined. Membership of the 'high' socio-economic usage group particularly increases an individual's trip rate.

The fifth column of table 5 shows the trip rates per individual for business trips carried out by car (both as driver and as passenger). There are approximately three times as many car business trips as rail business trips of over 50 miles recorded on LDTS. Note that with one exception the car trip rates of all groups are higher than the corresponding rail trip rates. Once again, the groups exhibit a large range of trip rates.

It is clear that employer/managers Group 2 and professional employees 18-54 have by far the highest trip rates. For those people in this socio-economic group but outside this age range, the trip rate is halved. In general, the trip rate for car is substantially above that for rail, but there is clear evidence that those located in urban areas make more use of rail, at the expense of car, than do those located elsewhere. To this extent, it appears that the type of origin is acting as a proxy for rail accessibility, rather than being important in its own right.

Amongst employers and managers group, self-employed professionals, students and members of the armed forces, trip rates are generally much lower. Again, there seems to be a clear tendency to substitute rail for car when the origin is in an urban area, and it is these cases that the rail share of the market is highest.

For other socio-economic groups, trip rates are much lower, but with the same tendency towards higher rates for the 18-54 group than others. Within this group, location again appears to influence the choice between rail and car.

Column 6 shows the percentage of members of each group that live in households with a car. Once again, there is much variation between the groups (ranging from 42.7% to 93.4%). The car business trip rates and to a lesser extent rail business trip rates tend to increase with the increasing proportion of

Business trip rates associated with groups selected in the rail business model

Number of LDTS respondents in the group	Rail trip rate observed on the LDTS (no. trips per individual per 2 weeks)	Rail trip rate expected from the model (no. trips per individual per 2 weeks)	No. of rail trips observed on LDTS	No. of rail trips expected from the model	Car trip rate observed on LDTS (no. trips per individual per 2 weeks)	% households with a car	Car trip rates		Rail trip rates	
							Households without a car	Households with a car	Households without car car	Households with a car
6656	0.001	0.001	3	6.055	0.003	51.1	0.001	0.005	0.000	0.001
4251	0.001	0.002	5	6.452	0.003	43.7	0.002	0.005	0.000	0.002
5960	0.005	0.004	28	22.630	0.010	66.1	0.007	0.012	0.005	0.005
10279	0.002	0.002	22	21.841	0.014	73.8	0.002	0.018	0.001	0.002
685	0.005	0.005	4	3.189	0.019	86.1	0.000	0.022	0.000	0.007
403	0.009	0.005	4	3.799	0.005	74.9	0.000	0.007	0.000	0.013
1328	0.020	0.022	26	29.853	0.025	79.2	0.007	0.030	0.028	0.017
1907	0.015	0.013	28	24.630	0.031	98.5	0.009	0.034	0.014	0.015
316	0.020	0.010	7	3.226	0.057	89.2	0.029	0.060	0.000	0.025
192	0.021	0.018	4	3.419	0.042	75.0	0.000	0.056	0.000	0.028
764	0.042	0.042	32	32.450	0.098	83.5	0.016	0.114	0.024	0.045
1349	0.021	0.024	29	32.900	0.108	93.4	0.112	0.108	0.022	0.021
34090	0.006	0.006	192	190.44	0.017	66.0	0.004	0.024	0.003	0.007

households with cars. In addition, in the majority of groups, those households with a car have higher business trip rates by both modes than those in households without a car. This suggests that car ownership is here standing proxy for some other variable, such as status in the company.

4. The Non-business Rail Trip Rates Model

The characteristics selected as important in determining non-business trip rates are shown in table 6.

Table 6: Rail non-business usage groups

	HIGH USAGE GROUPS	LOW USAGE GROUPS
Socio-economic group of respondent	Professional employees, members of the armed forces, students	Other occupations
Age of respondent	18 - 24 and 65+	Other age groups
Household type	1 adult <65, 2 adults 65+, large adult households	Other household types
Access/quality of rail service	Mainline station	Feeder or no service

Once again, all variables that are present on both the census and LDTS were included in the selection procedure.

Table 7: Variables not selected by the rail non-business modelling procedures

1. Sex of the respondent
2. Socio-economic group of head of household
3. Number and age of adults in the household
4. Number and age of children in the household
5. Number of cars in the household
6. Number of vans in the household
7. Level of origin in the urban hierarchy
8. Region of origin
9. Distance of origin from London
10. Type of origin (whether rural, urban, etc)

As with the analysis of rail business trips, the socio-economic group of the repsondent (occupation) is the most important characteristic determining trip rates. However, the composition of high and low usage categories are different from those shown by the rail business. The high usage group consists of professional employees, members of the armed forces and students.

It is no surprise to find students and members of the armed forces in this group, since they tend to live away from family and friends, and have relatively low car availability and access to railcards. More surprising is the presence of professional employees.

Professional employees are members of this group because they have above average incomes but lower car ownership rates than do employer/managers or self-employed professionals. There may well be the effect of non-availability of company cars. The combination of these factors results in a relatively high vfr trip rate, with a high proportion of trips being made by rail.

The age of the respondent also appears to be an influence on rates. Those aged 18-24 and over 65 years form the high high usage group. Members of these groups have access to railcards, and are more likely than those of other groups to travel independently rather than in family units, making rail travel comparatively economical.

A third characteristic of respondents - their household type - is also important. The upper group consists of one adult under 65 years, 2 adults over 65 years and large adult households. At first sight this appears to be a fairly diverse group. One adult under 65 would be expected to make more trips to visit friends and relatives than other groups as they live alone.

Two pensioner households are also in the upper group. More surprisingly, households comprising only one adult aged over 65 are not in the upper group as might be logicaly suggested by the arguments above. This category has a low average trip rate. It is possible that such housholds are comprised of older than average pensioners, many of whom have outlived their partners. Advanced age may be an impediment to the rail travel of this group.

The final characteristic in table 6 is the level of accessibility of the individual's district of residence to the InterCity rail network. The optimum division of the sample appears to be into a high usage group who live in districts with a station that has a mainline service and a low usage group which live in districts with rail feeder services or no station at all. The high usage group make significantly more trips than this low usage group.

The non-business rail trip rates associated with individuals with each combination of characteristics are shown in table 8. As was the case with the results of the rail business model, the trip rates show much variation, ranging from 0.010 trips per 2 weeks

(or 1 trip every 3 2/3 years) to 0.126 trips per 2 weeks (or 3.276 trips per year). Once again, note that these are average trip rates. Each group includes a large number of people who make no trips in the two week period.

The structure of the non-business model is slightly more complex than that of the business model. The effects of all the characteristics listed on trip rates are statistically significant. The interaction between socio-economic group and age is also significant. This means that if an individual is a member of high usage groups for both age and socio-economic group, his trip rates are likely to be particularly high.

As was the case in the rail business model, socio-economic group is the characteristic which has the largest effect on trip rates. Consequently the five groups with the highest non-business trip rates contain members of the high socio-economic group usage groups.

The non-business car trip rates are given in the fifth column of table 8. Again, there is much variation between groups. As with the rail non-business trip rates, the groups with the highest trip rates are all high socio-economic group usage groups.

The highest trip rates are achieved by students, professional employees and members of the armed forces aged 18-24 and living in 1 person or many-adult households. These people appear very sensitive to the accessibility of the rail service they receive; where they have a main-line rail service available within the district, they make more trips by rail than by car, but elsewhere the reverse is the case. For members of these groups who are not in the 18-24 age group and/or live in other household types the trip rates are lower, but rail service quality remains a very major determinant of choice of mode.

For other socio-economic groups, age and household structure continue having a similar effect on trip rates. However, the effect of rail service quality becomes ambiguous. This is because, although high rail accessibility raises rail trip rates, it raises car trip rates too. There is a clear implication that within these groups it is some other factor correlated with the availability of a main-line rail station within the district that is raising trip rates by both modes.

As one might expect, there is a positive relationship between the proportion of the group with a car and the groups' car trip rates. However, there is not a strong relationship with rail trip rates. Those groups with below average rail trip rates have a broad range of levels of car ownership. This includes those low car owning households that have low trip rates by both modes and those high car owning households that have high trip rates by car.

As was the case with business trips, those households with access to a car generally have higher car trip rates than those without.

Conversely, the majority of these households have lower rail trip rates than households without cars. Six groups do have higher rail trip rates among those with cars than those without. However, little should be read into this finding as in each case the number of households without a car is very small, increasing the probability of producing a spurious high trip rate by chance.

Non-business trip rates associated with groups selected by non-business model

Number of LDTS respondents in this group	Rail trip rate observed on the LDTS (no. trips per individual per 2 weeks)	Rail trip rate expected from the model (no. trips per individual per 2 weeks)	No. of rail trips observed on the LDTS	No. of rail trips expected from the model	Car trip rate observed on LDTS (no. trips per individual per 2 weeks)	% households with a car	Car trip rates		Rail trip rates	
							Households without a car	Households with a car	Households without a car	Households with a car
4856	0.010	0.011	50	52.60	0.087	70.9	0.023	0.092	0.015	0.008
1176	0.014	0.013	16	15.56	0.039	35.8	0.019	0.076	0.015	0.012
2281	0.015	0.020	42	46.55	0.050	36.2	0.019	0.104	0.023	0.011
2880	0.015	0.015	44	44.48	0.077	68.6	0.017	0.104	0.023	0.012
5887	0.024	0.024	144	140.20	0.079	69.4	0.023	0.103	0.036	0.019
9025	0.017	0.017	150	150.80	0.093	73.4	0.030	0.116	0.031	0.011
3995	0.028	0.029	110	116.10	0.057	57.3	0.015	0.088	0.035	0.022
1897	0.024	0.020	46	37.77	0.055	56.3	0.017	0.084	0.018	0.029
197	0.020	0.021	4	4.19	0.168	88.8	0.000	0.189	0.000	0.023
509	0.047	0.032	24	16.43	0.147	88.8	0.140	0.148	0.105	0.040
38	0.026	0.055	1	2.09	0.184	73.7	0.100	0.214	0.000	0.036
93	0.097	0.085	9	7.90	0.086	79.6	0.053	0.095	0.158	0.081
210	0.010	0.030	2	6.27	0.043	83.8	0.000	0.051	0.000	0.011
547	0.040	0.046	22	25.17	0.135	86.7	0.027	0.152	0.055	0.038
103	0.055	0.079	6	8.09	0.165	87.4	0.000	0.189	0.000	0.067
396	0.126	0.121	50	47.92	0.109	79.0	0.036	0.128	0.157	0.118
34090	0.021	0.021	720	722.12	0.062	66.0	0.017	0.086	0.028	0.017

Conclusion

The above analysis has revealed enormous differences in the propensity to make long distance trips by rail, according to socio-economic group, age, household type and location.

Within the business travel market, it is no surprise to find that socio-economic group is the most important variable. There is clear evidence that use of rail is much higher amongst those located within urban areas, and that this is at the expense of car.

More surprising, perhaps is the importance of socio-economic group in the non-business market; whilst it would be expected that there would be high use of rail amongst students and members of the armed forces, it is interesting to find that professional employees also join this group. This may be the result of a combination of relatively high incomes and low car ownership, perhaps partly because of the low level of company cars in this group. For these groups, accessibility to an inter city railhead again appears very important. Household structure again has an interesting affect. Generally speaking, one person or many-adult households have higher rail trip rates at the expense of car, but in the pensioner category, it is two-person households that have the higher trip rates. Pensioners living alone make few trips by any mode.

The next stage in the project will be to check the validity and usefulness of the rail trip rate models discussed in this note by using them in conjunction with available census data to predict trip rates in particular areas and comparing the results with the trip rates recorded on LDTS and, where possible, BR area surveys.

References

Rickard, J.M. (1986) 'Modelling the factors influencing long distance rail passenger trip rates in Great Britain' (unpublished PhD thesis, forthcoming).

WP229/JR (11)
JR/gmh
24.7.86