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DEMAND FORECASTING FOR NEW LOCAL RAIL SERVICES:
A CASE STUDY OF A NEW SERVICE BETWEEN LEICESTER AND BURTON-ON-TRENT

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and

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ABSTRACT

Preston, J. and Wardman, M. (1988) "Demand Forecasting for New Local Rail Services: A Case Study of a New Service between Leicester and Burton-on-Trent". Working Paper 260, Institute for Transport Studies, University of Leeds.

This paper assesses the potential for a new rail service between Leicester and Burton-on-Trent. In order to do this, three sets of demand forecasts were produced. These were based on Revealed Preference (RP) models that had been developed in West Yorkshire, a Stated Intentions (SI) survey of the Leicester-Burton corridor and Stated Preference (SP) models developed for the Ashby/ Coalville and Outer Leicester areas. It was found that these three approaches gave a wide range of forecasts but it was felt that the SI survey, adjusted for the findings from the SP models, were likely to give the most reliable estimates of usage. As a result, it was concluded that, given patronage growth over time, total usage of the line would amount to between 3,000 and 4,000 trips on an average day.

The demand forecasts were then used as input to an evaluation framework which took into account capital costs, operating costs, revenue and time savings. Even if actual usage reached the upper level of our forecasts it was shown that, although operating costs would be covered, only some of the capital costs would be paid back. Consideration of user time savings strengthens the case for the scheme but even so a return on capital would still not be achieved. Therefore, it was concluded that the case for a rail service between Leicester and Burton is, at best, marginal, although a number of ways to continue the feasibility study are suggested.

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CONTENTS

1. INTRODUCTION

This paper reports on work carried out for Leicestershire County Council in evaluating the potential for a new local rail service between Leicester and Burton-on-Trent. This work was carried out between November 1986 and October 1987 and involved five person-months of Institute staffs' time. The people employed on the project and their main tasks were as follows:

(a) Ken Mason (2 months) - statistical modelling;
(b) Jonathan Preston (2 months) - stated intentions survey design and analysis, evaluation and conclusions;
(c) Mark Wardman (1 month) - stated preference survey design and analysis.

Dr Chris Nash acted as project manager, whilst Dr Tony Fowkes was also involved at a number of stages. Leicestershire County Council took responsibility for the printing of questionnaires, their distribution, coding and data processing.

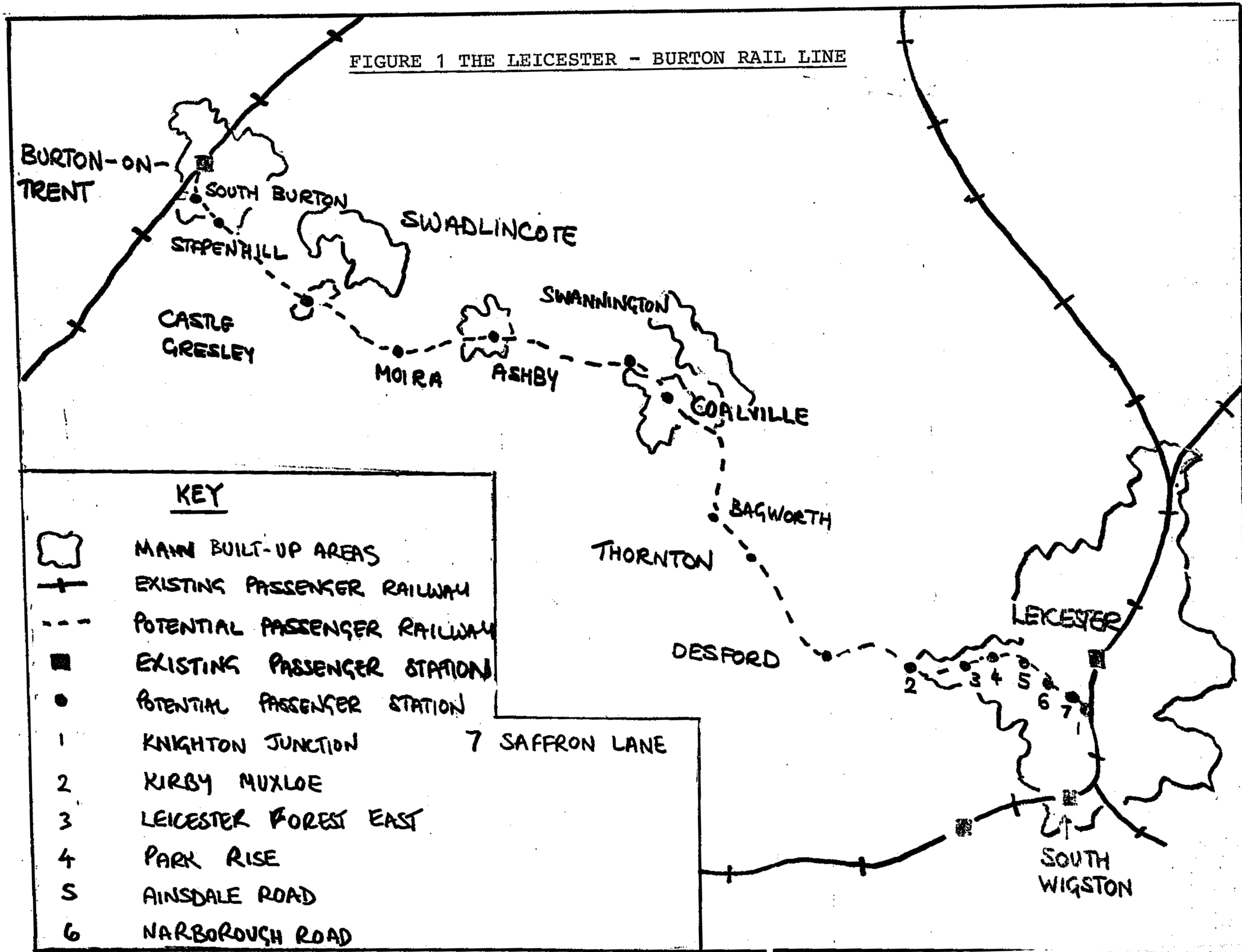
1.1 Background to the Research

Leicester County Council's recent interest in investment in railways originated with a study of the potential for opening new stations on existing lines (Hockenhull, 1984). This culminated in the opening of South Wigston station in 1986. This station has been well used and has been perceived as a success. As a result, the County Council has pursued further rail investment schemes. For example, new stations at Barrow-upon-Soar, Sileby and Syston on the Leicester-Loughborough line are being investigated, whilst a new service between Leicester and Burton-on-Trent is being considered. It is this latter scheme which is of concern to this report. Currently, Leicester and Burton are linked by a freight only line, approximately 32 miles long, which in 1984 principally served five collieries (Cadley Hill, Swains Park, Rawdon, Coalfield Farm and Bagworth), two quarries (Bardon Hill and Cliffe Hill) and two power stations (Drakelow and Leicester). In the short term prospects for freight on this line are good but in the medium and long term they are poor, as the North West Leicestershire and South Derbyshire coalfield becomes exhausted. As a result, it will be possible to re-introduce regular passenger services on this line for the first time since 1964. Figure 1 shows that up to 17 intermediate stations may be served with a population of up to 170,000 within 2 kilometres of these sites (from the 1981 census), with a further 67,000 within 2 kilometres of the existing stations at Burton and Leicester. The main intermediate settlements are Coalville (total population 28,899), Ashby-de-la-Zouch (total population 10,098), and Swadlincote (total population 33,739, although the rail line only traverses the periphery of the main built-up area).

1.2 Report Outline

This report aims to produce forecasts of the demand for the Leicester-Burton rail service and then use these forecasts as input to an evaluation stage to determine whether re-opening the line to regular passenger trains represents a good investment. This will be done in a number of stages:

FIGURE 1 THE LEICESTER - BURTON RAIL LINE



In section 2, a series of models, developed initially for new stations on existing services in West Yorkshire (Preston, 1987), will be described and their demand forecasts assessed. It will be argued that these models are inappropriate for a new rail service serving major settlements.

The results of a Stated Intentions (SI) survey will be described in section 3. Such an approach is more appropriate to forecasting demand in the specific circumstances under consideration here. However, there is a risk that the forecasts derived will seriously overstate the demand for the new train service. In an attempt to reduce the biases which are involved in using SI data, a Stated Preference (SP) experiment was conducted. This offered travellers a series of choices between hypothetical travel scenarios and it is discussed in section 4.

In section 5, the different forecasts provided by the methods discussed in the previous three sections are compared and a chosen set of forecasts are used as input to the evaluation stage.

In a final section the policy implications of our work are examined and some of the theoretical issues that have emerged are identified as being issues worthy of further research.

2. APPLICATION OF THE WEST YORKSHIRE MODELS

2.1 Description of Models Used

This work has been described in detail by Mason and Preston (1987) and will only be discussed briefly here. Two kinds of models based on Revealed Preference (RP) data were used: trip rate models (TRMs) and a direct demand model which we have somewhat grandly called the aggregate simultaneous model (ASM). Both these models were designed to give quick answers and hence have simple structures.

In fact two kinds of TRM were developed; one for the six new stations that were opened in West Yorkshire between 1982 and 1984 and another based on South Wigston station. It can be seen from Table 2.1 that the TRMs simply forecast weekly rail usage as a function of the population within 0 to 800 metres and 800 metres to 2 kilometres of the station. A major weakness of such a simple approach is that it does not take into account the level of rail service offered.

Table 2.1: Description of Trip Rate Models

	Weekly rail trips per thousand population		% of demand coming from beyond 2 km
	0 - 800 m	800 m - 2 km	
West Yorkshire	126	26	13
South Wigston	181	13	21

The ASM attempts to overcome some of the limitations of the TRM. The ASM is a regression equation which predicts rail flows between two stations (FLOW) as a function of:

- the population within 0 and 800 metres of the origin station (OPOP);
- the proportion of this population in social classes 1 and 2 (RSOC);
- the population within 800 metres and 2 kilometres of the origin station (OPOP2);
- the ratio of the number of workplaces within 800 metres of the destination station to the economically active number of residents (DRX);
- the times and costs of rail travel expressed in a generalised cost form (GCRA);
- times and costs of competing modes (bus and car) expressed in generalised cost form and in a logit type formulation (GCOTH).

The ASM was calibrated for 39 stations in West Yorkshire and was as follows (Preston, 1987):

$$LFLOW = 5.946 + 0.380\ LOPOP + 0.164\ LOPOP2 + 0.246\ LRSOC + 0.296\ LDRX - 1.341\ LGCOTH - 1.239\ LGCRA$$

and L denotes that a logarithm has been taken.

The ASM has been applied to over 70 potential new stations throughout the UK, of which 13 have been opened (although not necessarily as a result of the model's recommendations !). Validation work shows that the ASM gives mixed results; in some instances the results were fairly accurate but in others they were not. The ASM's transferability to Leicestershire is brought into doubt by the fact that at South Wigston actual demand was around 58% higher than the ASM's forecast. This result is not too surprising given the different nature of the transport systems of Leicestershire and West Yorkshire.

2.2 Forecasts

The demand forecasts from the two TRMs and the ASM are shown by Table 2.2. Although there are slight difficulties in comparing the different results, it can be seen that there is a wide range of forecasts. The South Wigston TRM predicts over 17,000 trips per week, the West Yorkshire ASM forecasts only 7,000 whilst the West Yorkshire TRM provides forecasts roughly half way between the two. It should be noted that Option 10 (on which the ASM run was based) was based on the initial service package offered by BR which consisted of a complicated daily service of 3 trains each way between Leicester and Burton, 8 trains each way between Leicester and Coalville, 2 trains each way between Leicester and Desford and 4 trains each way between Leicester and Kirby Muxloe. Later runs of the ASM (see 5.1) are based on simpler, and more realistic, service packages.

It was felt that the models that had been developed in West Yorkshire were likely to underestimate demand for two main reasons.

(i) They were calibrated for small town, suburban and rural stations, where the majority of users come from within 800 metres of the station and the dominant access mode is walk. At larger town stations (such as Ashby and Coalville) and/or where mechanised access modes may be important (Castle Gresley and Desford), rail-heading may be expected in that greater than forecast numbers of users come from beyond 800 metres.

(ii) Usage of a new station on a new service may be greater than usage of a new station on an existing service due to a phenomenon similar to the "sparks effect" experienced by many electrification schemes.

The tendency for the TRM and ASM to underestimate demand was, to an extent, confirmed in work by Peakall (1987) on the Nottingham-Mansfield line which gave, what were felt to be, unrealistically low forecasts.

Table 2.2: Forecasts from TRMs, ASM and Stated Intentions

	West Yorks Trip Rate Model	S Wigston Trip Rate Model	West Yorks Agg. Sim. Model (Option 10)	Stated Intention Survey
Knighton Jct*	2354	2686	1212	4431
Narborough Rd	1751	2518	714	2820
Ainsdale Rd	1309	1717	732	2030
Park Rise	1038	1327	510	3031
Leicester F.E.	819	1231	564	2607
Kirby Muxloe	542	814	510	2235
Desford	254	315	312	1035
Thornton	122	163	174	482
Bagworth	-	-	-	1101
Coalville	1121	1563	432	6709
Swannington	261	359	174	1256
Ashby	1014	1481	420	3224
Moira	266	345	186	1342
Castle Gresley	509	555	252	2298
Stapenhill	799	1102	300	-
Burton South	932	1407	258	-
Weekly Patronage	12991	17583	6996	36165
Annual Revenue (£000)	584.6	791.2	291.5	

Note: * Includes Saffron Lane for forecasts in columns 1-3.

3. THE STATED INTENTIONS SURVEY

3.1 Methodology

Given that the modelling approaches used appeared inadequate, it was decided to conduct an SI survey. In this survey, individuals were asked questions concerning the socio-economic

composition and travel patterns of their household and how often, and for what journeys, they would use the new rail service. An example of the survey questionnaire is given by Appendix 1.
The questionnaires were distributed to all households within 800 metres of a potential station and a quarter of households within 800 metres to 2 kilometres of a station. 14 potential sites were surveyed. These were the 16 stations for which the statistical models had been used except Saffron Lane (too near to Knighton Junction) and Burton South and Stapenhill (in Staffordshire), whilst Bagworth was added at the request of the District Council. Altogether, some 29,873 household questionnaires were distributed, with some 4,820 returned, representing a response rate of 16.1%. The response rate varied from around 10% within Leicester to over 25% for sites beyond Leicester Forest East except Desford and Coalville. These latter two sites had lower response rates because areas beyond 2 kilometres were included in the survey, namely Newbold Verdon and Thringstone/Whitwick respectively.

In section 3.2 the results of the SI survey with respect to the socio-economic characteristics of the population will be discussed, whilst in section 3.3 existing trip patterns will be examined and in section 3.4 attitudes to the new rail service and likely usage will be analysed. Except for the forecasts of rail usage in section 3.4, all results are weighted by the product of two grossing factors:

(i) Grossing factor A weights all households from beyond 800 metres by 4 (households within 800 metres weighted by 1).

(ii) Grossing factor B weights all households in the 0-800 metres and 800 metres - 2 kilometres bands of each of the 14 stations by the inverse of the response rate (expressed as a proportion).

As a result the data set has been expanded to almost 61,000 households and around 166,000 individuals, with a mean household size of 2.72.

3.2 Socio-Economic Characteristics

Table 3.1, which is based on our SI survey, shows that 50.8% of the population is female, 21.9% of the population is 15 and under and 16.4% of the population is of pensionable age. This indicates that 61.7% of the population is potentially economically active. Comparison with the 1981 Census suggests that our survey population is broadly representative of the actual population.

Table 3.1: Age-Sex Profile

	0-4	5-15	16-24	25-39	40-59	60-64	65+	Total
Males	5971	11757	11175	19418	18322	4241	10658	81542
Females	6378	12165	11266	19803	17970	5530	11065	84177
Total	12349	23922	22441	39221	36292	9771	21723	165719

Table 3.2, however, indicates that only 39.6% of the population

is in full-time employment, with a further 8.9% in part-time employment. 21.4% of the population is in full-time education, whilst 17.6% are retired.

Table 3.2: Occupation

	Full time employed	Part time employed	Student	Retired	Other	Total
	60075	13477	32472	26719	18815	151558
%	39.6	8.9	21.4	17.6	12.5	

NB: This table is affected by missing values as are subsequent tables.

Table 3.3 indicates that only 20.5% of households do not own a car, with 24.3% of households owning two or more cars.

Table 3.3: Car Ownership

	No Car	One Car	Two Cars	More than Two Cars	Total
	10901	29311	11381	1493	53086
%	20.5	55.2	21.5	2.8	

3.3 Trip Patterns

Table 3.4 indicates that, on an average day, 74,133 trips to work are made and 36,970 trips to school/college. For work trips the three most popular start times are 09.00 (19.2% of work trips), 08.00 (18.7% of work trips) and 08.30 (16.4%), whilst the most popular finishing times are 17.00 (27.5% of work trips), 17.30 (11%) and 16.30 (9.7%). The fact that these start and finish times only account for around a half of all workers indicates that significant numbers work non-standard hours and/or make use of flexi-time. This makes timetabling a commuter rail service difficult.

Table 3.4 shows that up to 30,000 mandatory trips per day are made to Central Leicester, whilst Ashby, Coalville and Burton only attract between 2,000 and 4,000 trips each from outside their own locality. It is estimated that only around 51% of work trips are potentially served by rail, whilst the figure for education trips is only 26% (reflecting that most education trips are made within the local area).

Table 3.4: Mandatory Trips - Destination

	Local	Central Leic.	Rest of Leic.	Coal-ville	Ashby	Rest of Leics.	Burton/ Swadlin-cote	Else-where
Work	13941	24720	14926	2944	1682	9136	2210	4574
Educ.	22374	4921	3515	931	643	2733	1233	620

From Table 3.5 it can be seen that the most popular modes for the journey to work are car driver (55.3% of work trips), bus (19.8%) and walk (12.2%). For education the most important modes are walk (53.0%), bus (23.6%) and car passenger (7.5%).

Table 3.5: Mandatory Trips - Mode Used

	Car Driver	Car Pass	Bus	Motor-cycle	Pedal-cycle	Walk	Train	Other
Work	40057	1934	14322	1932	2722	8847	258	2327
Educ.	2229	2365	7447	123	929	16682	135	1587

Table 3.6 indicates the number of optional trips (shopping and social/leisure). From this table it can be estimated that on an average day around 30,118 trips are made to Central Leicester, compared to 10,740 trips to Coalville, 7,137 to Ashby and 2,985 to Burton town centres. However, many trips to Coalville and Ashby are likely to originate in the locality. This is hinted at by Table 3.7 as 11.5% of trips to Coalville and 11.9% of trips to Ashby are made by other modes, principally walking. The corresponding figures for Leicester and Burton are 4.4% and 1.1% respectively. Table 3.7 shows that in each case the main mode for optional journeys is car, accounting for 78.4% of optional trips to Burton, 74.3% of trips to Ashby, 69.1% of trips to Coalville and 50.2% for trips to Leicester. Only in the latter case does bus have a comparable share (42.3%). By contrast, bus's share of optional trips to Burton is 19.3%, to Coalville 16.3% and to Ashby only 11.5%.

Table 3.6: Optional Trips - Frequency

	Infrequent	1 a month	2 a month	1 a week	2-4 a week	5+ a week	Total
Leicester	57488	18190	15107	30080	27739	9622	158,226
Burton	144751	5401	3766	3885	2434	689	160,866
Coalville	127679	4115	3009	6904	10633	3935	156,275
Ashby	139052	4100	2504	4005	4307	4001	157,979

Table 3.7: Optional Trips - Mode Used

	Car	Bus	Motor-cycle	Pedal-cycle	Other	Total
Leicester	57419	48718	1212	2063	5014	114,426
%	50.2	42.3	1.1	1.8	4.4	
Burton	11732	4372	172	129	242	22,620
%	78.4	19.3	0.8	0.6	1.1	
Coalville	23681	5590	315	740	3956	34,286
%	69.1	16.3	0.9	2.2	11.5	
Ashby	18657	2895	237	331	2986	25,106
%	74.3	11.5	0.9	1.3	11.9	

The above results indicate that, if local trips etc. are excluded, on an average day in the Leicester-Burton corridor, there are around 37,000 trips to work that might be served by rail, up to 10,000 trips to school/college and around 45,000 optional trips, making up to 92,000 trips that might be rail served (or around half a million trips per week). However, it is likely that rail will only be an attractive alternative for a small proportion of these trips.

3.4 Usage of, and Attitude to, the New Rail Service

Table 3.8 indicates how useful respondents thought the new rail service would be. 43.2% thought the service useful compared to 53.2% who think that the service is of little use. Two trends were, however, apparent:

(i) The perceived usefulness of the rail service tends to increase with distance from Leicester. For example, over 87% of respondents thought that a new service from Castle Gresley would be useful. This figure was also over 80% for Bagworth and over 70% for Moira, Coalville, and Ashby. By contrast the figure for Ainsdale Road was less than 20%.

(ii) Rail is more useful for those people living within 800 metres of the station than for those living between 800 metres and 2 kilometres of the station. This is particularly marked for those sites close to Central Leicester. For example 42% of those living within 800 metres of Knighton Junction consider the service useful compared to just 24% from within 800 metres and 2 kilometres.

Table 3.8: Usefulness of Leicester-Burton Line (%)

Very Useful	Useful	Not very Useful	No Use	Don't Know	(No. of Obs.)
19.0	24.2	19.4	33.8	4.6	(59076)

In terms of general comments analysis, a sub-sample of 400 questionnaires were analysed. 215 respondents did not comment. Of the 185 respondents who did make comments, 58.9% were in favour of the scheme, 20.5% were in favour of the scheme but also made suggestions with regards to possible improvements. The remaining 20.6% were against the scheme mainly because they would not use the service as existing transport was believed to be adequate, whilst a small, but vociferous, number of households expressed concern at the effect of increased rail traffic close to their homes. Around half the adverse comments came from respondents living in Leicester.

In calculating the number of rail trips per annum being made on this new service it is assumed, following the example of Heggie and Papoulias (1976), that non-respondents are non-users. Thus only grossing up factor A is applied in producing the forecasts shown in Table 3.9. Altogether it can be seen that some 1.9 million trips per annum are forecast of which 28.9% are work trips, 7.6% are education trips, 47.5% are shopping trips and 16.2% are trips for other purposes (principally social/recreational). 71.4% of trips are to/from Leicester. It should be noted that these factors are based on a hourly service between Leicester and Burton between 07.00 and 21.00 hours, with trains arriving at Burton at 15 minutes past the hour and at Leicester at 45 minutes past.

Table 3.9: Annual Rail Trips - Stated Intention Forecasts

A = 0-800 m   B = 800 m - 2 km

		WORK		EDUCATION		SHOPPING		OTHER		
		Leicester	Other	Leicester	Other	Leicester	Other	Leicester	Other	Total
Knighton	A	23092	4072	4720	48	40576	4638	17484	2552	230384
Junction	B	49360	3376	2592	400	54096	6512	26180	4608	
Narbor-	A	32628	10412	10744	1500	41732	8660	11352	7532	145682
ough Road	B	1392	192	2000	-	12576	192	3264	2496	
Ainsdale	A	25120	5744	3472	4664	29808	3444	6360	3408	105564
Road	B	6400	2096	400	-	10160	480	2480	2176	
Park Rise	A	27368	3024	2100	4500	45980	6152	14644	6201	157592
	B	14400	-	2000	3200	23232	3648	1472	864	
Leicester	A	28116	4620	2700	1900	34972	4000	8924	4284	135532
Forest	B	13392	-	400	1200	26032	4112	400	672	
Kirby	A	17764	4864	4024	1524	31396	4124	4032	1580	116220
Muxloe	B	15200	-	4000	3200	22384	672	1072	384	
Desford	A	300	-	-	-	784	120	216	288	136940
	B	41696	10256	14400	-	45248	9280	9376	4976	
Bagworth	A	1300	1924	896	248	5684	9152	2044	1940	57252
	B	6400	3600	-	-	8208	9120	3984	2752	
Thornton	A	972	500	1000	-	2228	2412	3392	96	25240
	B	4288	-	-	-	7776	992	1584	-	
Coalville	A	15812	5024	9872	820	38596	13592	9060	6112	348868
	B	48848	15584	10000	4400	86608	39760	19712	25824	
Swanning-	A	8092	3848	3200	2124	8652	6472	3448	3672	65316
ton	B	3600	-	96	-	9136	8288	3600	1088	
Ashby	A	8900	15388	6024	7224	22332	21440	8572	8788	167676
	B	13792	7488	400	2992	17728	11072	9888		
Moira	A	924	2200	2020	700	1524	4224	1524	840	67812
	B	-	4000	-	5200	11024	21088	7408	5136	
Castle	A									
Gresley	B	1700	22924	3436	6085	20779	29801	11428	19054	115210
TOTAL		410856	131136	90491	51929	659251	233537	179248	122978	1876278

However, it seems likely that the forecasts in Table 3.9 are over-estimates even though it has been assumed that non-respondents are non-users. This is also indicated by Table 2.2 which shows that the SI forecasts are much greater than those given by the statistical models. The fact that an SI survey is likely to lead to an overprediction of the demand for a new service has been well documented (Chatterjee et al, 1983; Couture and Dooley, 1981; Gensch, 1981; Hartgen, 1972). This was apparent from Hockenhull's (1984) SI survey at South Wigston which has subsequently been found to overpredict demand by between 38% and 73%. The cause of this overprediction is likely to be due to non-commitment bias. Individuals are not committed to behave in the way they have responded. As there is likely to be a desire amongst some respondents to influence policy (i.e. to get the new service opened) and because of perceived imperfections in the methods of financing such a project (financed by all ratepayers but only of a benefit to some), there will be an incentive for some to state that they will use the service even though they are unlikely to. Thus, knowing that the SI survey is biased, we need to find a way of measuring the extent of this bias. A possible way of doing this might be to make use of an SP experiment, which, because it is less explicitly linked to policy and focusses more on trade-offs across travel attributes, is considered less likely to attract such policy response bias.

4. THE STATED PREFERENCE SURVEY

4.1 Introduction

SP experiments present individuals with a series of hypothetical choices amongst travel options. They contain trade-offs across a number of attributes and the responses supplied yield information on the relative importance of these attributes. Empirical evidence suggests that SP responses provide a reasonably accurate account of actual preferences (Bates, 1984; Benjamin and Sen, 1982; Louviere and Hensher, 1982; Wardman, 1988). In addition to providing a cross-check of the forecasts derived from the SI data, the SP experiment also allows the estimation of values of time which can be used in a welfare appraisal of the new service.

SP experiments have a number of attractions over methods based on actual travel choice data, for example, the travel scenarios are under the complete control of the researcher and more data can be collected per person than is possible with the RP approach. An obvious attraction of the SP approach in the circumstances being investigated here is that the train service does not yet exist and thus actual preferences towards it cannot be examined.

Section 4.2 provides the background to the SP experiment, section 4.3 details the design of the SP experiments and section 4.4 reports some of the tests which were conducted on the designs to ensure that they were satisfactory. Modelling issues are considered in section 4.5 whilst section 4.6 presents the results of the calibrated models. Section 4.7 contains the rail market share forecasts derived from these models and evaluation measures are provided in Section 4.8.

4.2. Background to the Stated Preference Experiment

The two main modes from which the new train service can attract passengers are car and bus and the main destination is Central Leicester. In the SP experiment, existing travellers were asked to choose between their current mode and train for a number of hypothetical scenarios.

The SP experiment therefore focusses on mode switching and does not consider generated trips and trip re-distribution. The latter are likely to be negligible for commuting journeys although they will be more important for leisure journeys. There are difficulties involved in examining trip generation and trip distribution effects and it was not possible to investigate these issues within this study using the SP approach. However, it must be borne in mind that the SP approach will on this account understate the amount of travel by the new train service for leisure purposes. In a study of new local station usage in West Yorkshire, Preston (1987) found that 12.5% of trips were generated. This proportion would be higher for non-work trips.

Since the aim of the SP experiment is to provide a means of checking and amending the SI forecasts, SP questionnaires were not distributed at all the potential new station sites but at the following locations only:

1. Park Rise (PR)
2. Leicester Forest East (LF)
3. Kirby Muxloe (KM)
4. Coalville (CV)
5. Swannington (SW)
6. Ashby (AS)

The expense of surveying at all the station sites is avoided by assuming that the relationship between the SP and SI forecasts apparent for these six locations applies to the other sites.

Table 4.1 lists the number of SP questionnaires distributed, the number returned and the response rate for each of the six station sites. 638 questionnaires were returned in total and, although not all were fully completed, the usable sample is adequate. Forecasts could be obtained for 571 of these individuals.

<u>Table 4.1: Distribution of the Stated Preference Questionnaires</u>

	FORMS SENT OUT	FORMS RETURNED	RESPONSE RATE
PR	279	148	53.0%
LF	303	175	57.8%
KM	278	146	52.5%
CV	233	94	40.3%
SW	41	25	61.0%
AS	120	50	41.7%
TOTAL	1254	638	50.9%

4.3 The Experimental Design

Separate SP designs were used for car and bus users but they both included the same variables which were deemed to represent the main influences on the choice of travel mode. These variables were:

1) In-Vehicle Time (IVT) by Train and Car/Bus
2) Out-of-Vehicle Time (OVT) by Train and Car/Bus
3) Cost by Train and Car/Bus
4) Train Service Frequency ($FREQ_t$)

Walking and waiting time were combined so as to simplify the SP experiment. This assumes that these two variables have a common valuation. For car users, OVT contains walking time only, for example, from the parking place to work.

Train service frequency was presented in the form of a timetable denoting the number of trains per hour and respondents were informed of the location of the new station. Bus users were required to assume that bus frequency ($FREQ_b$) would be at its current level. Car costs were represented by parking charges and petrol costs.

In addition to collecting SP data, respondents also stated the costs and times for their actual journey and the amount of walking and waiting time they would expect if the new train service was used.

It was decided to offer individuals 16 choices between train and car/bus. The experiences of previous SP experiments have shown 16 choices to be a manageable number for respondents. The SP experiments are based on orthogonal fractional factorial designs, drawn from Kocur et al. (1982a), for the differences in variables between modes. This means that there are zero correlations between the differences in attributes between modes. Thus problems of multicollinearity, which are often apparent in data relating to actual choices, are avoided.

In addition to different SP exercises for bus and car users, a distinction was also made according to location in order to avoid the situations presented being too different from individuals' actual circumstances. As the hypothetical travel scenarios become less realistic, the reliability of the responses supplied can be expected to fall. For both the car-train and bus-train choices, separate questionnaires were used for those travelling from Park Rise, Leicester Forest East and Kirby Muxloe (LEICESTER SUBURBS) and for those travelling from Coalville, Swannington and Ashby (ASHBY/COALVILLE).

The four designs are given in Tables 4.2 and 4.3. Train service frequency is specified in terms of the number of trains per hour and the other variables are presented as differences between train and car/bus and relate to a daily one-way journey to Leicester. The costs and times are in pence and minutes.

To obtain precise estimates of the parameters reflecting the assumed underlying decision processes involved in the choice of mode requires that the individual can trade-off across attributes, for example, time savings can be 'purchased' by spending more money.

In the train-bus scenarios, train is assigned a lower IVT, given that this would most likely apply in practice, except in a quarter of cases where it is the same as for bus. In some cases train is cheaper than the bus, in others it is dearer and in others it is the same price. Similarly, OVT for train can be greater, less or the same as for bus.

Table 4.2: Train Minus Bus Differences

	Leicester Suburbs				Ashby/Coalville			
	IVT	COST	OVT	$FREQ_t$	IVT	COST	OVT	$FREQ_t$
1	0	0	0	2	0	0	0	2
2	0	-20	-5	1	0	-30	-5	1
3	0	+15	+10	1	0	+20	+10	1
4	0	+30	+10	0.5	0	+40	+10	0.5
5	-5	0	+10	1	-5	0	+10	1
6	-5	-20	+10	0.5	-5	-30	+10	0.5
7	-5	+15	-5	2	-5	+20	-5	2
8	-5	+30	0	1	-5	+40	0	1
9	-10	0	-5	0.5	-10	0	-5	0.5
10	-10	-20	0	1	-10	-30	0	1
11	-10	+15	+10	1	-10	+20	+10	1
12	-10	+30	+10	2	-10	+40	+10	2
13	-15	0	+10	1	-20	0	+10	1
14	-15	-20	+10	2	-20	-30	+10	2
15	-15	+15	0	0.5	-20	+20	0	0.5
16	-15	+30	-5	1	-20	+40	-5	1

Table 4.3: Train Minus Car Differences

	Leicester Suburbs				Ashby/Coalville			
	IVT	COST	OVT	$FREQ_t$	IVT	COST	OVT	$FREQ_t$
1	-10	0	+10	1	-10	0	+10	0.5
2	-10	-20	+10	2	-10	-20	+10	2
3	-10	-30	+5	2	-10	-40	+5	2
4	-10	-50	+5	1	-10	-60	+5	1
5	-15	0	+5	2	-15	0	+5	2
6	-15	-20	+5	1	-15	-20	+5	1
7	-15	-30	+10	1	-15	-40	+10	0.5
8	-15	-50	+10	2	-15	-60	+10	2
9	0	0	+10	1	0	0	+10	1
10	0	-20	+10	2	0	-20	+10	2
11	0	-30	+5	2	0	-40	+5	2
12	0	-50	+5	1	0	-60	+5	0.5
13	+10	0	+5	2	+10	0	+5	2
14	+10	-20	+5	1	+10	-20	+5	0.5
15	+10	-30	+10	1	+10	-40	+10	1
16	+10	-50	+10	2	+10	-60	+10	2

In the choice between car and train, train is made quicker in half the cases presented. Whilst the new train service would not be a high speed service, road congestion was given as a reason for longer car travel times. Train was also made as cheap or cheaper than car in all cases. The latter is not unrealistic given that parking charges in Leicester are relatively high and rail fares can be fixed at any level. Since car must be assigned a lower OVT for realism, and given that OVT is relatively highly valued, it is necessary to make train cheaper and quicker so that train will be chosen as preferred in some scenarios and the choices made yield useful information.

These attribute differences are considered to be realistic. The attributes were presented to individuals in absolute form for each mode rather than as differences and the values were also chosen to realistically reflect individuals' actual experiences. An example of the SP questionnaire is given in Appendix 2.

4.4. Testing the Designs

Before conducting the surveys, it is important to test that the designs are capable of recovering accurate estimates of individuals' preferences from their stated choices between the two relevant modes. A poor experimental design detracts from the attractions of the SP approach. Any shortcomings which are identified in the process of testing the designs can be rectified before conducting the survey.

Simulation exercises were therefore conducted across a wide range of underlying preferences. This involved the use of synthetic data sets where the choice of mode is made dependent on the attribute values of the SP design and known underlying preferences. This comprises the deterministic component of utility (U) and to this is added a stochastic element (ϵ) to represent the errors introduced because of individual idiosyncracies and errors in making the SP choices in practice. Assuming a linear-additive function, the random utility of mode 1 for individual i can be represented as:

$$RU_{1i} = \alpha_0 + \alpha_1 X_{11i} + \alpha_2 X_{21i} + \ldots\ldots + \alpha_k X_{k1i} + \epsilon_{1i}$$

The individual will choose that mode which has greatest utility. However, we can only observe the deterministic component but choice may be influenced by the error term. Assuming that the errors are independently and identically distributed and have a Weibull distribution yields the multinomial logit model of:

$$P_1 = \exp(U_1) \;/\; \Sigma\exp(U_m)$$

where P_1 is the probability of choosing mode 1 from the m modes on offer. In this binary choice context of the choice between modes 1 and 2, this model reduces to:

$$P_1 = 1 \;/\; [1 + \exp(U_2 - U_1)]$$

The restrictive assumption regarding independent and identical errors for each mode is irrelevant in the binary choice context since the model can be formulated in terms of differences between modes. Calibration of this binary choice model provides estimates of $\Omega\alpha_k$. The coefficients are estimated in units of residual deviation, that is in whatever units give a standard deviation of error differences (σ) of $\pi/\sqrt{3}$. Thus the scale factor is:

$$\Omega = \pi/\sqrt{3}\ \sigma$$

Given that the standard deviation of the error differences is known in this simulation exercise, the estimated coefficients ($\Omega\alpha_k$) can be transformed (by division by Ω) and compared with the parameters input to the simulation (α_k).

The simulations were conducted on all four designs separately and involved 1600 simulated choices in each case, that is as if 100 individuals had each made 16 SP choices. The errors were kept relatively small so that the estimates lie in a narrow range. This simplifies the comparison of the actual and estimated parameters, although different error assumptions could be made, for example, to examine the consequences of a very large stochastic component of random utility. Table 4.4 shows some of the results of the simulation tests for the car-train design for the shorter distance journeys to Leicester. The estimated coefficients have been equivalenced to be in the same units as the actual coefficients. The alternative specific constant (ASC) reflects a preference for car over train, ceteris paribus.

Table 4.4: Simulation Exercises - Actual and Estimated Parameters

ACTUAL					ESTIMATED				
ASC	IVT	OVT	FREQ	COST	ASC	IVT	OVT	FREQ	COST
0	1	1	1	1	INSIG	1.12	1.10	1.04	1.02
0	2	2	2	1	INSIG	1.93	2.14	2.10	1.02
0	3	3	3	1	INSIG	3.18	3.51	3.06	1.05
0	4	4	4	1	INSIG	4.39	3.80	3.74	1.05
0	5	5	5	1	INSIG	4.86	4.70	3.85	0.83
0	2	4	3	1	INSIG	1.85	3.56	3.14	0.95
0	3	5	2	1	INSIG	3.02	4.73	1.86	1.03
0	4	6	3	1	INSIG	3.97	5.78	3.26	1.03
25	2	2	2	1	27.09	2.11	1.98	2.23	1.08
25	3	5	4	1	23.69	3.12	4.87	4.14	1.10
50	2	4	2	1	55.34	2.10	4.34	1.94	1.00
50	3	3	3	1	52.65	3.27	3.04	2.89	0.81
100	1	3	1	1	119.37	0.87	2.75	0.90	0.96
100	4	6	3	1	84.27	4.13	5.79	3.21	1.06

Notes: FREQ was defined in terms of expected waiting time, which was equated to half the service headway, and the value of expected waiting time was estimated.

In all cases, except where the ASC was given a zero value, the estimated coefficients were highly significant. It can be seen that the design performs well and accurate estimates of underlying preferences can be recovered. These results are typical of those derived for the other three SP designs.

4.5 Modelling the Stated Preference Data

Two methods have been used to model the SP responses. These are termed aggregate and disaggregate.

4.5.1 The Aggregate Approach

Aggregate methods are based on measures of group behaviour, such as the number or proportion of individuals choosing a particular option. The collective choices in different situations are explained by reference to variations in relevant variables across these situations.

Thus the SP responses aggregated across travellers can be examined for each scenario. Since two designs were used for both car users and bus users, and each contained 16 hypothetical scenarios, we have 32 travel choice situations for both the choices between bus and train and between car and train. For each of these 32 situations in turn, the proportion using train (P_{ti}) is calculated and this proportion is then entered into the commonly used logit model of:

$$\text{Log}[P_{ti}/(1 - P_{ti})] = \alpha_0 + \alpha_1 IVT_i + \alpha_2 OVT_i + \alpha_3 COST_i + \alpha_4 FREQ_{ti}$$

where IVT_i, OVT_i and $COST_i$ denote the <u>differences</u> between train and bus/car for a particular travel scenario and $FREQ_{ti}$ is the number of trains per hour. The coefficients α_k are estimated by Weighted Least Squares to avoid heteroscedasticity. Each observation is multiplied by the weight $1/\sqrt{V_i}$ (Pindyck and Rubinfeld, 1981) where:

$$V_i = (n_i + 1)(n_i + 2) / [n_i(r_i + 1)(n_i - r_i + 1)]$$

and n_i equals the number of individuals and r_i equals the number choosing train in the particular travel scenario.

Given the estimated values for α_k, the proportion using train in any particular situation can be forecast by solving for P_t as:

$$P_t = 1 / [1 + \exp(-Y)] \quad \text{where:}$$

$$Y = \alpha_0 + \alpha_1 IVT + \alpha_2 OVT + \alpha_3 COST + \alpha_4 FREQ_t$$

The money value of IVT is obtained as the ratio of α_1 and α_3 and likewise the ratio of α_2 and α_3 estimates the value of OVT.

4.5.2 <u>The Disaggregate Approach</u>

Disaggregate methods use as input data the choices made by each individual rather than the collective choices of groups of individuals. Each individual's 16 choices are entered into the model along with the hypothetical times and costs. Thus if we have say 200 individuals and each individual completes the SP exercise, the calibrated model will contain 3200 observations. The calibration of the model provides estimates which are scale transformations of the utility weights attached to each attribute. Value of time estimates are obtained as the ratios of appropriate coefficients.

The discrete choice between train and bus/car can be modelled by the same method which was used in the tests conducted on the experimental design and reported in section 4.4. The disaggregate binomial logit model takes the form:

$$P_t = 1 / [1 + \exp(-UD)]$$

where UD denotes the difference in utility between train and bus/car. This is a function of the attributes for each mode.

There are two methods which can be used to obtain forecasts from disaggregate models. The deterministic method assigns an individual to that mode with highest utility (U) given the estimated utility weights and the costs and times which would prevail for train and bus/car in the situation to be forecast. Aggregate demand forecasts are obtained by aggregating across individuals' discrete choices.

The probabilistic method calculates the probability of choosing train (P_t) given the estimated utility difference between modes for the situation to be forecast. This probability is calculated for each individual and an aggregate demand forecast is obtained as the weighted sum of individual probabilities.

4.5.3 The 'Scale Factor' Problem

What we have termed the scale factor problem arises because choice models are calibrated in units of residual deviation. In the case of the binomial logit model, the estimated coefficients are $\Omega\alpha_i$, where Ω equals $\pi/\sqrt{3}\ \sigma$ and σ is the standard deviation of the error differences between modes. A problem arises where σ is not the same as that which would apply to the actual choices made. It may be that due to difficulties involved in undertaking the SP exercise and uncertainties as to which mode would be used, σ is increased in relation to what it would be in practice.

The consequences of this are that the estimated coefficients ($\Omega\alpha_k$) will be too low. In predicting the demand for a minor mode, which we expect to be the case for train in these circumstances, the choice probabilities derived using the probabilistic forecasting method will be overstated. The problem increases as the 'true' choice probability increasingly diverges from 0.5.

This problem of units and the scale factor does not arise within the deterministic forecasting method since the scale factor applies equally to all coefficients and thus the relative utility of each mode is unaffected by the standard deviation of the error differences in the calibrated model. However, the deterministic method does not take any account of the stochastic component of random utility.

The deterministic method will assign all individuals with a mode choice probability in excess of 0.5 (in the binomial case) to that mode. In cases where we are forecasting a minor mode (such as rail in most instances), all those with probabilities of say 0.9 will be assigned to the major mode. Neglecting the 0.1 probabilities of choosing the other mode may understate the minor mode's market share. If this is the case, and given that the probabilistic method tends to overstate the market share of a minor mode, the forecasts derived by the two methods provide upper and lower bound estimates.

This problem of units can be overcome by estimating a scale factor (β) to relate actual choices to the overall utility difference (Z) derived from the utility weights of the SP model and the attribute levels of the actual choice situation (Kocur et al., 1982b). The coefficient β rescales the utility difference derived from the SP model to be in the same units as for actual choices. Thus we would calibrate the following:

$$P_t = 1 / [1 + \exp(-\beta Z)]$$

However, this approach is not possible here since the train service does not yet exist.

4.6 Empirical Findings

4.6.1 Aggregate Models

The calibrated aggregate models, for those choosing between train and bus and between train and car, are listed in Table 4.5. The original intention was not to calibrate aggregate models but rather to use a disaggregate modelling approach. However, although the models are based on relatively small sample sizes, we are provided with an additional set of forecasts.

Table 4.5: Aggregate Stated Preference Models

	BUS		CAR	
IVT	-0.0145	(1.11)	-0.0313	(2.57)
OVT	-0.0415	(2.28)	-0.1493	(4.23)
COST	-0.0283	(4.38)	-0.0169	(2.95)
$FREQ_t$	INSIG		+0.4009	(2.37)
Value of IVT	0.51	(1.06)	1.85	(1.96)
Value of OVT	1.47	(2.05)	8.84	(2.96)
Value of $FREQ_t$	--	--	23.72	(2.06)
Observations	32		32	
Adj R Squared	0.29		0.41	

Notes: $Freq_t$ denotes the number of trains per hour. Values of Time are in pence per minute. t ratios are given in brackets. The adjusted R squared statistics are for the same models but with the constant included.

In both models, the ASC's were highly insignificant (t ratios of 0.38 and 0.26 respectively) and hence were dropped. In the bus-train model, $FREQ_t$ was found to have a very insignificant influence (t = 0.07) and is thus omitted. The inclusion of $FREQ_b$ in the model would have required taking the average across individuals of their current bus service frequency. Since this will be constant across the various hypothetical travel scenarios, any effect would reflect itself in the ASC. Although IVT in the bus-train model is not significant at the usual 95% level of confidence, it is retained since it should have a major influence upon choice and its value in relation to OVT is plausible. All four coefficients in the car-train model are significant and of the correct sign.

As might be expected, the values of time of car users are higher than bus users. The values of OVT are higher than the values of IVT; walking and waiting can be expected to generally incur greater disutility than IVT. The value of OVT is around three times higher than IVT for bus users and around five times higher for car users. The value of an extra train per hour for car users is 23.72 pence.

4.6.2 Disaggregate Models

In a preliminary study, a number of disaggregate models were calibrated on the SP data by a Leeds University statistics student (Kwong, 1987) and the results were used in his MSc dissertation. As a result of this analysis, a distinction between IVT for train and car/bus did not appear to be merited but, for both the bus-train and the car-train choices, it appeared that OVT was valued differently according to whether train or car/bus would be used. There was also evidence that frequency, in terms of vehicles per hour, was valued differently between bus and train. It also appeared to be worthwhile examining the effects of several socio-economic variables upon choice. These were entered as dummy variables to determine, for example, whether males were more or less likely to choose train than females. The final models calibrated are reported in Tables 4.6 and 4.7.

Table 4.6: Disaggregate Bus-Train Model

IVT	-0.0856	(10.21)
OVT_t	-0.0667	(9.84)
COST	-0.0564	(19.61)
$FREQ_t$	+1.3269	(15.73)
$FREQ_b$	-0.8628	(3.34)
MALE	+0.3590	(3.70)
LEISURE	-0.1885	(1.88)
LEIC SUBURBS	-1.0220	(7.64)
V of IVT	1.52	(10.97)
V of OVT_t	1.18	(9.36)
V of $FREQ_t$	23.52	(10.52)
V of $FREQ_b$	15.29	(3.26)
Adj RHO Squared	0.25	
Observations	2549	

Notes: OVT_t denotes OVT for train and $FREQ_t$, $FREQ_b$ represent the number of trains and buses per hour.

In the bus-train model, the ASC was insignificant (t = 0.50) and OVT_b was surprisingly found to be insignificant (t = 0.62). Four income categories were initially examined (in relation to a fifth 'base' category). However, no strong income effects were apparent and this remained so when fewer income categories were included. Nor was any significant influence apparent from age. It was found that males, those travelling to work/college and those living in Ashby/Coalville were more likely to choose train.

The estimated value of IVT is higher than that of OVT_t. Given this finding, and that OVT_b was insignificant, it may be that some individuals are ignoring variations in OVT, perhaps to simplify the task of answering the SP questions. The effect of service frequency upon choice is now significant, unlike the aggregate model. The SP experiment required bus users to assume that bus service frequency would be the same as at present and thus it can influence the choice of mode. It will vary across observations, unlike in the aggregate model, since the individual is the unit of observation, although it is constant across any individual's SP choices. An extra train per hour is valued at 23 pence whilst an extra bus is valued at 15 pence. Bus service frequency was greater in practice, on average, than the train service frequencies introduced in the SP experiment and the differences in their valuations may stem from non-linear values of an extra service an hour whilst an extra train will have a greater effect on the ability to travel at the optimal time and on the amount of waiting time involved.

Table 4.7: Disaggregate Car-Train Model

ASC (Train)	-1.9070	(8.89)
IVT	-0.0641	(16.96)
OVT_t	-0.0822	(5.69)
OVT_c	-0.0399	(1.88)
COST	-0.0351	(17.35)
$FREQ_t$	+1.4519	(18.72)
INCOME ≥ £10000	-0.1511	(2.09)
AGE ≥ 40	-0.1348	(1.90)
LEISURE	+0.5917	(7.19)
LEIC SUBURBS	-0.5805	(7.08)
V of IVT	1.83	(12.90)
V of OVT_t	2.34	(5.35)
V of OVT_c	1.14	(1.90)
V of $FREQ_t$	41.36	(12.77)
Adj RHO Squared	0.22	
Observations	4314	

Notes: Notation as for Table 4.6 and OVT_c is OVT for car.

The disaggregate car-train model contains a significant ASC in favour of car, reflecting the comfort and convenience involved in car use in relation to using the train. The sensitivity to variations in OVT varies somewhat by mode. OVT_t has a greater influence upon choice than IVT but the effect of OVT_c is somewhat less. It may be that some motorists have ignored OVT for car because in practice it is a small amount. Since it is a small amount in practice, there should not be a large influence on the forecasts derived if OVT_c is too low. The value of an extra train per hour is somewhat larger than for current bus users.

Of the socio-economic variables which were examined, no significant effect was apparent with respect to sex. There were no strong relationships between choice and several categories of age and income groups and the models reported stratify only according to whether the respondent had an income of £10000 or more and was aged 40 or over. It was found that the higher age and income groups were less likely to choose train. It was again found that respondents in Leicester suburbs were less likely to choose train although, in contrast to the bus-train model, those making journeys to work or school/college were less likely to choose train.

4.6.3 An Overview of the Models

Given the relatively small sample sizes of the aggregate models, it was not considered worthwhile examining socio-economic variables or making the coefficients alternative specific rather than generic. In terms of travel attributes, the aggregate and disaggregate models yield values of time which are relatively small, although that for bus users is in line with recent findings (MVA et al, 1987). The models contrast in that OVT is found to be more highly valued than IVT in the aggregate models but the reverse is generally the case in the disaggregate models. The disaggregate models recovered stronger and more significant influences for service frequency and the values appear plausible.

Given the time constraints involved, the SP data has not been analysed in as much detail as would have been liked. Further analysis could involve the estimation of non-linear utility functions and alternative means of modelling the influence of socio-economic variables. The latter could allow the socio-economic variables to influence the sensitivity to attribute variations by specifying interaction variables which combine socio-economic variables and travel attributes. Further work might reconcile some of the apparently discrepant findings with each other and with theory. However, we have obtained reasonably well fitting models with coefficients which are generally significant and, in many instances, highly significant.

4.7. The Forecasts

Market share forecasts for the new train service are produced from the SP data by three means:

i) An aggregate approach based on the logit models given by Table 4.5.

ii) A deterministic forecast (DF) based on the disaggregate binary logit models given by Tables 4.6 and 4.7. This method assumes that an individual uses rail if its utility is greater than that of bus/car.

iii) A probabilistic forecast (PF) based on the disaggregate binary logit models of Tables 4.6 and 4.7. Rail's share is forecast as the weighted sum of individual choice probabilities rather than an "all or nothing" approach.

The aggregate approach takes the average across individuals of the relevant variables for the particular location and enters them into the calibrated logit model to obtain forecasts of the proportion using train at that site. Data on the costs and times of an individual's actual journey were collected in the SP questionnaire as was information on the likely OVT if train was used. The forecasts for the disaggregate models are based on the same data as is used to forecast using the aggregate models but instead forecasts are derived separately for each individual.

Table 4.8: Average Attribute Values for Trips to Leicester

	IVT_b	OVT_b	$COST_b$	IVT_c	OVT_c	$COST_c$	IVT_t	OVT_{tb}	OVT_{tc}	$COST_t$
PR	18.46	12.56	30.30	14.73	6.40	47.92	13.0	28.64	25.08	40.0
LF	16.20	11.31	46.21	15.01	4.93	54.23	15.0	28.76	26.01	50.0
KM	19.64	11.38	56.03	17.70	6.59	59.49	18.0	23.87	26.06	60.0
CV	47.39	21.13	128.16	30.04	9.21	138.89	40.0	28.51	29.57	120.0
SW	34.00	11.00	151.00	30.77	6.61	152.50	43.0	23.75	26.04	125.0
AS	56.00	18.92	151.81	40.83	6.74	144.29	50.0	28.53	27.28	145.0

Notes: The subscripts b, c and t refer to bus, car and train. The train service frequency is one train per hour. OVT_{tb} and OVT_{tc} denote the average OVT_t for bus and car users. Times and costs are for a daily one-way journey. Car costs include half any daily parking charges in addition to one-way petrol costs.

Table 4.8 lists the average attribute values for each station site except that IVT and COST for train are not averages but relate to the proposed service. As expected, car has a lower IVT and OVT than bus, there is a tendency for journey time and cost to increase with distance and both OVT_b and OVT_c are fairly constant across the different locations. The amount of walking and waiting time which would be involved in using train varies little between current bus and car users.

The forecast train market shares at each of the six new station sites considered in the SP experiment and for the three forecasting methods are given in Table 4.9. Given that OVT_b was found to be insignificant in the disaggregate bus-train model, but it should influence choice, it has been assigned the same utility weight as OVT_t. Those who did not supply data concerning the characteristics of their current journey or OVT_t have been omitted and the forecasts are based on 210 bus users and 361 car users. Table 4.9 also contains the SI forecasts for comparison.

Table 4.9: SP and SI Estimates of Rail's Market Shares

(A) Assuming SP Non-Respondents Same As Respondents

	SI Forecast	SP Forecasts		
		Aggregate	Disaggregate	
			DF	PF
Park Rise	5.48	21.56	16.28	26.16
Leicester Forest East	9.90	18.64	9.74	19.06
Kirby Muxloe	12.94	20.63	8.15	17.55
Coalville	24.84	12.48	21.60	33.68
Swannington*	83.72	14.88	13.63	29.76
Ashby	19.02	17.62	16.67	27.48
Total	10.17	17.62	13.33	23.37
Total (excl. Park Rise)	14.51	16.46	10.89	22.85

(B) Assuming SP Non-Respondents Are Non-Users

Park Rise	As	11.43	8.63	13.33
Leicester Forest East	Above	10.77	5.63	11.02
Kirby Muxloe		6.79	4.28	9.21
Coalville		8.31	8.70	13.57
Swannington*		7.61	8.31	18.15
Ashby		6.20	6.95	13.98
Total		8.97	6.78	11.90
Total (excl. Park Rise)		8.35	6.25	11.78

Notes: * Swannington values unreliable due to small number of observations. All Figures are Percentages.

We have stated that we expect the train market shares forecast by the disaggregate logit model using the probabilistic method and the forecasts derived from the aggregate logit model to be too high due to the scale factor problem. It can be seen that in all cases the deterministic method produces forecasts which are less than those of the probabilistic method in the disaggregate models and in most cases they are also less than the aggregate models' forecasts. The deterministic forecasts are also those which we consider to be the most plausible. Moreover, the choice probabilities in the logit model can be seriously biased in the presence of inter-personal taste variations, the presence of which we take to be axiomatic, but the relative coefficients seem to be more robust. This is a further reason for preferring the deterministic forecasts and these are subsequently used in evaluating the feasibility of the new train service.

The SI shares were produced for those households which contained individuals who had responded to the SP survey. Direct comparison between the SI and SP shares is, however, difficult because:

i) Not all respondents to the SP survey were identified in the SI data set, although 625 (out of 638) individuals were correctly identified.

ii) The SI shares are based on household data and include some individuals who did not respond to the SP survey, although other members of their household did do so.

iii) In calculating the SI shares an individual may make regular trips to Leicester for up to four purposes, whilst in the SP survey this is limited to one purpose, with priority given to work and education trips.

In Table 4.9, when non-respondents are assumed to behave in the same way as respondents, it can be seen that, in total, all three SP forecasts exceed the SI forecast. This phenomenon is particularly marked at Park Rise. However, this site may be affected by points (ii) and (iii) above, particularly as it is the nearest site to Leicester. In addition, it should be noted that much of the overestimate at Park Rise (and elsewhere to some extent) is due to an over-prediction of rail journeys abstracted from bus. The disaggregate bus-train model obtained an insignificant coefficient for OVT_b. Even though OVT_t was used in its place, this was found to have a lesser influence upon choice than IVT. It can be seen from Table 4.8 that on average IVT for train is less than that for bus but that OVT for bus is less than that for train and the latter difference is much greater than for IVT. The inability to produce a value of OVT in excess of the value of IVT, which we believe would be more reasonable, casts train in a better light than it really is and tends to overstate the degree of abstraction from bus to train.

If observations from Park Rise are excluded, it can be seen that of the three SP forecasts, only the DF gives a total share less than that forecast by the SI survey. This result, which we expect to be the most reliable one, suggests that the SI survey, even assuming non-respondents to the SI survey to be non-users, may overstate demand by around 33%.

In the second part of Table 4.9, it is assumed that non-respondents to the SP survey are non-users. Although superficially consistent with the approach adopted for the SI survey, it may be considered an extreme position as individuals have been given a second chance to non-respond and hence shares are bound to be lower. It can be seen that when this assumption is made that the total shares from two of the three SP forecasts are lower than the SI forecasts, with the DF implying that the SI survey over estimates demand by between 50% and 132%. In reality we might expect that, compared to the SP data, the SI data is over-estimating demand by a value between 33% and 132%.

4.8 Train User Benefits

In addition to forecasting the demand for the new train service and calculating whether it is a financially worthwhile proposition, an assessment of the welfare implications of the new service can be conducted. This requires an estimate of the benefits to each individual of the new train service. Table 4.10 presents the benefits on average of the new service at each of the six station sites. This is done for the same individuals for whom demand forecasts were obtained and OVT_b has again been assigned the same value as OVT_t. The figures represent the average reduction in generalised cost in pence across those individuals (current bus and car users separately) who are forecast using the deterministic method to switch to train. This average benefit per person is for a daily round trip.

Table 4.10: Train User Benefits Per Person (Pence)

	BUS	CAR
PR	32.10	56.49
LF	73.63	59.72
KM	13.73	69.77
CV	64.53	69.72
SW	132.69	177.31
AS	81.48	33.72

5. EVALUATION

5.1 Assessment of Forecasting Approaches

So far, we have used three forecasting approaches based on RP models developed in West Yorkshire, SI data and SP data. The results, in terms of daily usage, are shown by Table 5.1. It can be seen that there is a very wide range of predicted demand of between 1,200 and 6,000 per day. However, we know that the ASM prediction given by option 1 (this was based on an hourly service between Leicester and Ashby with two-hourly extensions to Burton and was the nearest of the modelled runs to the service pattern used in the SI survey) is likely to be an under-estimate. If the ASM result is adjusted for the findings at South Wigston predicted demand increases to 2,000 trips per day. Moreover, we know the results from the SI survey are likely to be an over-estimate of demand. If these results are adjusted for Hockenhull's findings at South Wigston the predictions are reduced to between 3,500 and 4,300 trips per day (mid-point 3,900).

Table 5.1: Comparison of Forecasting Approaches

		Average daily usage of Leicester to Burton Service
1.	Modelling Approaches	
a)	ASM - Option 1	1,247
b)	ASM - Option 1 - Adjusted for findings at South Wigston	1,970
c)	West Yorkshire Trip Rate Model	2,165
d)	South Wigston Trip Rate Model	2,931
2.	Stated Intentions Approach (including Castle Gresley)	
a)	Initial Findings	6,047
b)	Initial Findings - Adjusted for findings at South Wigston	3,503 - 4,367
3.	Stated Preference Approach	
a)	Initial Findings - excluding Park Rise	4,526
b)	Adjusted Findings - excluding non respondents	2,605 - 4,031

The results from the TRMs are within this narrowed range of between 2,000 and 4,300 trips per day, although at the bottom end of the scale. By contrast, the SP results are at the top-end of the scale with forecasts being between 4,500 trips per day and 2,600 to 4,000 trips per day (mid point 3,100), depending on the treatment of the anomalous case of Park Rise.

The above results indicate the difficulty in accurately forecasting a new rail service. However, it appears that the modelling approaches developed for new stations on existing services in West Yorkshire are not appropriate. In addition, even if non-respondents are assumed non-respondents, it is evident that the SI survey over-estimates demand.

If the SI results are adjusted to take into account the findings of the deterministic SP forecast, excluding the atypical case of Park Rise, total daily usage may be estimated as in excess of 4,500 trips (forecast 3a, Table 5.1). If this result is modified so that non-respondents to the SP survey are also considered non-users and Park Rise again excluded then this figure may be as low as 2,600 (forecast 3b, Table 5.1). Actual demand might be expected to be somewhere between these two extremes (see, for example, forecasts 1d) and 2b) in Table 5.1). Hence, in the next section, evaluation measures will be developed based on forecasts of daily usage of 3,000 and 4,000 trips. The use of such rounded estimates indicates the tentative nature of our work.

5.2 Evaluation Measures

5.2.1 Costs

Total capital costs were assumed to be £5.806 million, of which civil engineering costs accounted for £2.45m, station building costs accounted for £1.541m, sprinter diesel multiple units accounted for £1.2m and signalling accounted for £0.615m. If only 8, rather than 14, stations are built capital costs may reduce to £5.206m.

In calculating operating costs it was assumed that an hourly service between Leicester and Burton was operated involving 28 trains per day (i.e. as specified in the SI questionnaire). This involves around 290 thousand train miles per annum. It should be noted that usage of between 3,000 and 4,000 trips per day implies a high average number of boarding passengers per train run of between 107 and 143 passengers, but it is assumed that this level of demand could be accomodated by the proposed rolling stock provision. Operating costs were based on figures produced by BR/West Yorkshire PTE (1982) and updated to 1986 prices as follows:

Table 5.2: Operating Costs (Estimates)

Fuel Costs	Train Maintenance		Crew Costs	Station Maintenance etc.	TOTAL
	Time Related	Mile Related			
65.1	34.0	107.2	240.7	27.7	474.7

Notes: Figures in £000. For further details see Mason and Preston (1987) but note that train crew costs per loaded train mile recalculated as 82.8 pence. These figure are based on a service operated by pacer-type units rather than sprinters.

If the number of stations is reduced from 14 to 8 the only variable affected was station maintenance etc., which becomes £18,700, but we were unable to determine the effect on other costs.

In addition, it is necessary to take into account the costs of infrastructure operation and maintenance and administration. Although the allocation of fixed costs has still to be negotiated by Leicestershire County Council and BR's Provincial and Freight sectors, it may be expected to be based on avoidable costs similar to that operated between the PTEs and the Inter City sector of BR. For example, a recent study by BR (Provincial Sector), West Yorkshire PTA and PTE (1987) shows that the avoidable costs for the 21 mile Leeds to South Elmsall service for 1986/7 was around £160,000. On a similar basis the avoidable fixed costs for the Leicester-Burton line might be expected to be roughly £263,000, although this might be thought of as a low estimate. Total annual costs might, therefore, be of the order of £700-750,000.

It should be stressed that these cost figures are tentative but have been developed so as to assess, in broad terms, the overall net benefits of a Leicester-Burton rail service.

5.2.2 Benefits

Mean revenue was estimated from the SI surveys. The number of trips to Leicester was multiplied by the standard single fare whilst the number of trips to other destinations was multiplied by a mean line fare of 90 pence. On this basis, for the 14 stations studied, Leicester based flows account for about 69% of revenue (71% for the top 8 stations). The implied mean fare is 80 pence for the 14 stations (and 81 pence for the top 8 stations). It is assumed that none of this revenue was abstracted from existing rail services.

Benefits for forecast rail users (i.e. time and cost savings) were estimated directly from the SP models for the 6 sites studied (see Table 4.10). Values of user benefit for the 8 sites where benefit could not be measured directly were based on the value for the nearest site where benefit had been measured. On this basis the mean value of benefit per single rail trip was estimated to be about 34 pence, with a range from 18 pence for Inner Leicester sites to 81 pence for Swannington. It is interesting to note that the deterministic forecasts from the disaggregate SP models imply that around 62% of rail usage is abstracted from bus and 38% abstracted from car. Similar figures for West Yorkshire's new stations were 78% and 22% respectively. This suggests that the Leicester-Burton line may be more successful in abstracting car users than the West Yorkshire new stations thus leading to non user benefits (through reduced congestion) and reductions in accidents. However, it is beyond the scope of this study to quantify such benefits.

5.2.3 Evaluation Measures

Table 5.3

Evaluation Measures - NPV, 7% Interest Rate
30 years Project Life, £000 - 1986 Prices

(A) All 14 Stations Opened

Average Daily Usage	Capital Costs	Operating Costs	Financial benefits (revenue)	Social benefits (revenue and time savings)
3,000	5806	9154	7619	10434
4,000	5806	9154	10174	13933

(B) Best 8 Stations Opened

Average Daily Usage	Capital Costs	Operating Costs	Financial benefits (revenue)	Social benefits (revenue and time savings)
2,163	5206	9042	6292	8352
2,880	5206	9042	8402	11153

Some summary evaluation measures are shown by Table 5.3. All results are based on Net Present Values (NPVs) with a 7% discount rate and a 30 year project life. This table shows capital costs, operating costs, financial benefits (i.e. revenue to the rail operator) and social benefits (i.e. revenue to the rail operator and user time savings).

It should be noted that, following findings from West Yorkshire and elsewhere, it is assumed that patronage grows over a five year period, so that patronage in year 5 is 75% higher than in year 1. Thus if daily usage is 3000 in year 5, initial usage may only be 1714 with this figure being 2286 if usage in year 5 reaches 4000. This assumption has a significant reducing effect on the financial and social benefit NPV measures and may be considered conservative given that our SI/SP work was largely based on current trips.

The results in Table 5.3 (A) are based on all 14 stations being opened. With total daily usage of 3000 it can be seen that operating costs exceed revenue by a figure (discounted to 1986 prices) equivalent to £1.535 million over 30 years. If time savings are also included it can be seen that benefits exceed costs by £1.280m. With total daily usage of 4000, revenue now exceeds operating costs by £1.020, whilst if time savings are included benefits exceed costs by £4.779m.

The results in Table 5.3 (B) are based on the top 8 stations only being opened. These would be (in descending order of total revenue): Coalville, Ashby, Castle Gresley, Desford, Park Rise, Leicester Forest East, Knighton Junction and Kirby Muxloe. This is a more realistic number of stations, as with all 14 stations opened it is unlikely that the journey times quoted in the SI questionnaire could be achieved. From Table 5.3 (B) it can be seen that 43% fewer stations only leads to a 28% fall in patronage. Although there are significant changes in NPVs, the overall pattern is similar to Table 5.3 (A). With daily usage of 2163 trips it can be seen that operating costs again exceed revenue, this time by £2.757m. However, even if time savings are included, operating costs exceed benefits by £0.690m. If daily usage is increased to 2,800 it is evident that operating costs exceed revenue by £0.640m, but if time savings are taken into account, benefits exceed operating costs by £2.111m.

It should be noted that there are no instances in Table 5.3 (A) and (B) where benefits exceed operating costs by an amount greater than the capital costs. Other benefits that might be included but which we have not attempted to quantify include the effects of reduced road congestion, accident savings, reductions in bus operating costs (although these may be exceeded by reductions in bus revenue) as well as developmental and environmental effects.

6. CONCLUSIONS, POLICY IMPLICATIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH

The following conclusions may be drawn:

1. Forecasting usage of a new rail service has proved difficult. For example we have had difficulties in forecasting through trips between Leicester and Burton. Table 5.1 shows that we have produced a broad range of

forecasts with daily usage from 1247 to 6047. Our preferred approach has been based on the SI survey, assuming non-respondents are non users and further modified by results from the SP surveys which suggested daily usage in the range 2605-4526. Since the two extreme values are unlikely, our evaluation, with all 14 stations included from the SI surveys, was based on daily usage of 3000 and 4000. If a more realistic option involving only 8 intermediate stations is pursued then daily usage is more likely to be between 2000 and 3000.

2. Our evaluation results, which should only be considered as rough estimates, suggest that the case for the Leicester-Burton rail scheme may, at best, be marginal. It is interesting to note that our findings were described in the Surveyor (3/12/87, p. 10) as being "a very optimistic report which has been well received by the transportation committee". We hope by optimistic it is meant that the County Council found the results encouraging rather than that our demand forecasts were believed to be over estimates. If usage reaches the upper level of our forecasts the scheme may cover operating costs and pay-back some of the capital costs. However, under none of our assumptions is a financial return on the capital costs achieved and hence at least some of the capital costs would need to be covered by a grant from the local authority. Inclusion of user benefits strengthens the case for developing the Leicester-Burton rail line, but net benefits still fail to exceed capital costs. Thus on a social cost-benefit basis the case for reopening the line at present capital cost estimates appears weak.

Our findings suggest that the feasibility study for the Leicester to Burton line should be continued with the following tasks receiving attention:

i. The preferred level of rail service and number of stations to be opened should be further examined. This may not be any of the services studied in this paper. For example, an hourly service between Leicester and Ashby with only 6 intermediate stations may lead to a reduction in operating costs (compared to the option evaluated in Table 5.3 (B)) of around 25%, together with scope for significant reductions in capital costs. We believe that if the scheme were to go ahead, then an hourly Leicester-Ashby service might represent the best option for initial development.

ii. Leading on from the above, it is clear that more accurate cost figures are required, particularly with respect to capital and operating costs.

iii. Lastly, further attention needs to be paid to the measurement of user and other social costs and benefits. This will be particularly important if application for a Section 56 grant is contemplated.

There are also a number of items of academic interest that need to be explored. In particular, the problems of modelling bus out-of-vehicle time from the SP experiment needs to be investigated (a similar problem was also apparent in the SP analysis reported by Wardman (1988)), better ways of reconciling the SI and SP results need to be found, the differences between deterministic and probabilistic forecasts need to be studied further and ways of producing accurate elasticity estimates from SP data need to be found. Some of these issues may be investigated in work currently being undertaken for Nottinghamshire County Council in forecasting demand for a new rail service between Nottingham and Mansfield.

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APPENDIX 1 EXAMPLE OF A STATED INTENTION QUESTIONNAIRE

INSTITUTE FOR TRANSPORT STUDIES
THE UNIVERSITY OF LEEDS
LEEDS LS2 9JT

FOR OFFICE USE ONLY

LEICESTER TO BURTON PUBLIC TRANSPORT SURVEY

Undertaken by the Institute for Transport Studies, University of Leeds, on behalf of Leicestershire County Council and Blaby, Hinckley and Bosworth, Leicester and North West Leicestershire District Councils.

[ ][ ][ ][ ][ ] 1–5

We are undertaking a survey of the demand for local public transport facilities in the Leicester - Burton corridor. We would be very grateful if you could help by completing this questionnaire and returning it in the FREEPOST envelope provided. NO STAMP IS REQUIRED. The success of this study depends on a high response rate.

1a. How many people (including YOURSELF) are in your household ? ....
(Please state number) [ ] 6

b. Of these how many are

	Under five	5-15	16-24	25-39	40-59	60-64	65 and over
Male	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Female ?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

(Please write numbers in relevant boxes)

[ ][ ][ ][ ][ ][ ][ ] 7–13
[ ][ ][ ][ ][ ][ ][ ] 14–20

2. How many members of your household (aged 5 and over) are in the following categories

Full time employed	[ ]	Part time employed	[ ]
Schoolchild/student	[ ]	Not in paid employment ?	[ ]
Retired	[ ]		

(Please write numbers in relevant boxes)

[ ][ ][ ][ ][ ] 21–25

3. For each employed person in your household please give the address of their workplace, the means of transport normally used to reach work, the number of days per week normally worked and typical times they start and finish work.

Person	Address of workplace	Means of transport used	No. of days per week worked	Typical start time	Typical finish time
1					
2					
3					
4					

(Please give details in relevant boxes)

[ ][ ][ ][ ][ ][ ][ ] 26
[ ][ ][ ][ ] 36
[ ][ ][ ][ ][ ][ ][ ] 37
[ ][ ][ ][ ] 47
[ ][ ][ ][ ][ ][ ][ ] 48
[ ][ ][ ][ ] 58
[ ][ ][ ][ ][ ][ ][ ] 59
[ ][ ][ ][ ] 69

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4. Please state the name of the school or college attended by any member of your household, the means of transport used to get there and the number of days per week normally attended.

Person	Name of school/ college	Means of transport used	No. of days per week attended
1			
2			
3			
4			

(Please give details in relevant boxes)

70

81

5. How often do you, or members of your household, normally visit the following places for shopping or other leisure trips ? (Please write in the boxes provided the number of members of your household in each category)

	Less than once a month	Once a month	Once a fort-night	Once a week	2 - 4 times a week	5 times a week or more
Leicester City Centre	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Burton Town Centre	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Coalville Town Centre	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Ashby Town Centre	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

82

105

6. If you, or members of your household, make shopping or leisure trips to these destinations at least monthly, what form of transport do you normally use ? (Please write in the boxes provided the number of members of your household in each category)

	Car/Van	Bus	Motor-cycle	Pedal-cycle	Other (Please state)
Leicester City Centre	[ ]	[ ]	[ ]	[ ]	[ ].........
Burton Town Centre	[ ]	[ ]	[ ]	[ ]	[ ].........
Coalville Town Centre	[ ]	[ ]	[ ]	[ ]	[ ].........
Ashby Town Centre	[ ]	[ ]	[ ]	[ ]	[ ].........

106

125

7. How many cars and vans are usually available for use by your household ? (Please state number)
[ ]

126

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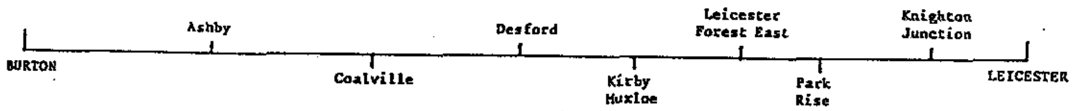
8. Suppose that a railway station at Knighton Junction (off Knighton Road West) was opened to passengers, with trains running to Leicester and Burton approximately every hour between 7.00am and 9.00pm, Monday to Saturday, and with stations at the following places (see map).



Typical journey times, fares and arrival times might be as follows:

To	Time (in minutes)	Fare (in pence) Single	Return	Arrival time (minutes past the hour)
Leicester	4	25	45	45
Burton	64	195	350	15

How often would you, and members of your household, use such a train service for the journeys listed below ? (Please write in the boxes provided the number of members of your household in each category)

	Less than once a month	Once a month	Once a fort-night	Once a week	2 - 4 times a week	5 times or more a week
Work to Leicester	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Work elsewhere (please specify ....)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Education to Leicester	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Education elsewhere (please specify ....)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Shopping to Leicester	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Shopping elsewhere (please specify ....)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Other to Leicester	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Other elsewhere (please specify ....)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

127

174

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9. Do you think that a new station at Knighton Junction and a rail service between Leicester and Burton would be useful for you and your household ? (Please tick one box)

[ ]	[ ]	[ ]	[ ]	[ ]
Yes - very useful	Yes - useful	No - not very useful	No - no use	Don't know

175

10. If you are willing to take part in the second stage of this survey please give your name and address below.

Name: Mr/Mrs/Miss/Ms ....
Address: ....
....
.... Post code ....

176

11. If you have any comments you would like to make regarding transport in Leicestershire in general or, more specifically, the possible introduction of a rail service between Leicester and Burton please make them in the space below.

If you have any questions about this survey please contact John Preston at the Institute for Transport Studies on Leeds (0532) 431751 extension 7215.

THANK YOU VERY MUCH FOR YOUR HELP

Please fold, place in the envelope provided and return by FREEPOST.

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In a previous questionnaire completed by yourself or another member of your household, we were informed that you regularly travelled to central Leicester by bus and the purpose of your journey was ____________. We would be very grateful if you would answer the following questions which refer to the last journey you made to Leicester by bus for the purpose mentioned above.

[ ][ ][ ][ ] 1 4

1. At what time did you start this journey to central Leicester ? (Please give the time and whether am or pm) ____________

[ ][ ][ ][ ] 5 8

2. How long did it take you to get from your home to your final destination in central Leicester ? (Please give the time in minutes) ____________

[ ][ ][ ][ ] 9 12

3. How much of this time involved waiting for the bus (or buses) ? (Please give the time in minutes) ____________

[ ][ ] 14

4. How much of this time involved walking to and from bus stops ? (Please give the time in minutes) ____________

[ ][ ] 16

5. Was there a particular time at which you wanted to arrive at your final destination in central Leicester ? (Please tick one box)

No [ ]
Yes [ ] If Yes, please specify at what time ____________

[ ][ ][ ][ ] 17 20

6. How many buses did you use when making this journey to Leicester ? (Please give the number of buses used and their service number(s)) ____________

[ ] 21

7. How frequent are the buses to Leicester at the time of day at which you travelled ? (Please tick one box)

About every 5 mins [ ] About every 10 mins [ ]
About every 15 mins [ ] About every 20 mins [ ]
About every 30 mins [ ] About every hour [ ]
Other (Please Specify) ____________

[ ] 22

8. How much did this journey cost you ? (Please give the cost for a single journey, in pence) ____________

[ ][ ][ ] 23 25

9. Did you use a concessionary permit or cheap fare travelcard to help with the cost of your journey ? (Please tick one box)

No [ ]
Yes [ ] If Yes, please give details ____________

[ ] 26

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Suppose that a new station was opened at ____________________
and you made the journey described above by train instead.

10. How long would it take you to get to the new station? (Please give the time in minutes) ____________ 28

11. How would you get to the new station ? (Please tick one box) 29

Walk [ ] Bus [ ] Car Driver [ ]
Car Passenger [ ] Taxi [ ] Other [ ]

12. How long would it take you to get from Leicester London Road station to your final destination ? (Please give the time in minutes) ____________ 31

13. How would you get from Leicester London Road station to your final destination ? (Please tick one box only) 32

Walk [ ] Bus [ ] Car [ ]
Taxi [ ] Other [ ]

14. How long in advance of departure time would you arrive at the new station in order to catch a train to Leicester ? (Please give time in minutes) ____________ 34

We would be very grateful if you could give some details about yourself. As with all other information received from this survey, it will be treated in the strictest confidence.

15. Please state in which age group you are: 35

Under 16 [ ] 16-24 [ ] 25-39 [ ] 40-59 [ ] 60-64 [ ]
65 + [ ]

16. Are you Male [ ] Female ? [ ] 36

17. Do you have a full driver's licence ? 37

Yes - car [ ] Yes - motorcycle [ ] Yes - both [ ] No [ ]

18. Please specify your gross household income (Here we mean income before the deduction of taxes, National Insurance etc.) 38

£ 5000 or less per year/£100 or less per week [ ]

£ 5001-10000 per year/£101-200 per week [ ]

£10001-15000 per year/£201-300 per week [ ]

£15001-20000 per year/£301-400 per week [ ]

£20001 or over per year/£401 or over per week [ ]

In this final section we would like you to consider again your journey to Leicester but now you would also have the opportunity to travel by train. We would like to know how you would react if travel by bus and by train to Leicester was as described by the 16 situations listed on the following 2 pages.

In comparing the two methods of travel, you must assume that everything else besides the costs and times presented would be the same as for the journey you actually made, for example, you would still want to be at your final destination at the same time.

Train and Bus are described in terms of the following factors:-

(a) IN-VEHICLE TIME. This is the time, in minutes, actually spent on the train or bus.

(b) OUT-OF-VEHICLE TIME. This consists of the time, in minutes, spent getting to or from the bus or train and the time spent waiting.

(c) FARE. This is how much you would have to pay, in pence, for a single journey. Do NOT adjust these fares in order to take into account any travel cards etc. you may possess or other reductions you would be eligible for.

(d) THE NUMBER OF TRAINS AND BUSES PER HOUR (FREQUENCY). Buses would arrive in Leicester at the same times as at present. Trains may depart for Leicester, Mondays to Saturdays, every half hour, every hour and once every two hours, arriving at Leicester at the following times:-

Every half hour	Every hour	Once every two hours
6.45 am	6.45 am	6.45 am
7.15 am	7.45 am	8.45 am
7.45 am	8.45 am	10.45 am
8.15 am		12.45 pm
8.45 am	and then at 45 minutes past the hour	2.45 pm
		4.45 pm
and then at 15 and 45 minutes past the hour		6.45 pm
		8.45 pm
until	until	
	6.45 pm	
8.45 pm	7.45 pm	
9.15 pm	8.45 pm	

In each case the last train back from Leicester would be at 9.15 pm.

In the EXAMPLE below, if your choice would be to travel by bus then you would tick the box associated with bus as shown.

	In-vehicle time	Out-of-vehicle time	Fare	Frequency	Choice
Train	20 mins	15 mins	65 pence	1 train every 2 hours	[ ]
Bus	20 mins	5 mins	45 pence	As Now	[✓]

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Now please consider the 16 different situations presented below and in each indicate which means of travel you would use. IT DOES NOT MATTER IF THE COSTS AND TIMES WE HAVE OFFERED YOU ARE VERY DIFFERENT FROM THOSE YOU WOULD NORMALLY FACE.

	In-vehicle time	Out-of-vehicle time	Fare	Frequency	Choice
Train	15 mins	10 mins	55 pence	1 train every 30 mins	[ ]
Bus	15 mins	10 mins	55 pence	As Now	[ ]
Train	15 mins	5 mins	45 pence	1 train every hour	[ ]
Bus	15 mins	10 mins	65 pence	As Now	[ ]
Train	20 mins	20 mins	65 pence	1 train every hour	[ ]
Bus	20 mins	10 mins	50 pence	As Now	[ ]
Train	20 mins	20 mins	70 pence	1 train every 2 hours	[ ]
Bus	20 mins	10 mins	40 pence	As Now	[ ]
Train	15 mins	20 mins	55 pence	1 train every hour	[ ]
Bus	20 mins	10 mins	55 pence	As Now	[ ]
Train	15 mins	20 mins	45 pence	1 train every 2 hours	[ ]
Bus	20 mins	10 mins	65 pence	As Now	[ ]
Train	20 mins	5 mins	65 pence	1 train every 30 mins	[ ]
Bus	25 mins	10 mins	50 pence	As Now	[ ]
Train	20 mins	10 mins	70 pence	1 train every hour	[ ]
Bus	25 mins	10 mins	40 pence	As Now	[ ]

39

46

Please turn over

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	In-vehicle time	Out-of-vehicle time	Fare	Frequency	Choice
Train	15 mins	5 mins	55 pence	1 train every 2 hours	[ ]
Bus	25 mins	10 mins	55 pence	As Now	[ ]

Train	15 mins	10 mins	45 pence	1 train every hour	[ ]
Bus	25 mins	10 mins	65 pence	As Now	[ ]

Train	15 mins	20 mins	65 pence	1 train every hour	[ ]
Bus	25 mins	10 mins	50 pence	As Now	[ ]

Train	15 mins	20 mins	70 pence	1 train every 30 mins	[ ]
Bus	25 mins	10 mins	40 pence	As Now	[ ]

Train	15 mins	20 mins	55 pence	1 train every hour	[ ]
Bus	30 mins	10 mins	55 pence	As Now	[ ]

Train	15 mins	20 mins	45 pence	1 train every 30 mins	[ ]
Bus	30 mins	10 mins	65 pence	As Now	[ ]

Train	20 mins	10 mins	65 pence	1 train every 2 hours	[ ]
Bus	35 mins	10 mins	50 pence	As Now	[ ]

Train	20 mins	5 mins	70 pence	1 train every hour	[ ]
Bus	35 mins	10 mins	40 pence	As Now	[ ]

47

54

If you have any comments to make about this questionnaire, please write them in the space provided below.

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE. WHEN YOU HAVE FINISHED PLEASE FOLD, PLACE IN THE ENVELOPE PROVIDED AND RETURN BY FREEPOST. NO STAMP IS REQUIRED.