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THE IMPACT OF RAIL FARE INCREASES ON LOCATIONAL BEHAVIOUR

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ABSTRACT

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Many people who work in London live over 30 miles from their jobs and travel to work by rail. Their decisions about the choice of home and job have been influenced by the cost of travel at the time of the decision and the anticipated changes, with subsequent implications for the value of housing. Over the past ten years there has been a decline in employment in central London, with a concomitant growth in employment in the surrounding area, leading to a shift from rail to road for the journey to work and implications for the economic base of central London. Further rises in the real cost of rail travel to central London will have serious implications for the lower paid commuter, who tends to live to the east of London in north Kent and south Essex, who will be faced with a declining living standard through having to pay extra fares or move closer to London and so incurring higher housing costs or a lower housing standard. This will have a further impact on house prices, making the problem even worse for those who respond later.

The implications of these effects for analysis of the underlying behavioural response to rail fares increases are complex and are being studied in a major research project in the Institute for Transport Studies at the University of Leeds. The immediate need is for longitudinal data on people's past responses to changes in transport costs, and so a survey will be carried out as part of the project. Any responses to rail fare charges will be made against the dynamic background of birth, death, marriage, household formation, promotion and so on, hence information will be gathered on all these processes, as well as the potentially transport cost sensitive processes of residential and employment relocation, entry and leaving the job market for marginal workers and car purchase and sale. These processes will all be represented in an accounting framework which will underpin the other models to be used, and relates to both an existing integrated land use transport model at a macro scale, and more recent ideas about simulating individual behaviour at a micro level. There are complex issues involved in modelling these processes, including representing the choices and decisions of individuals, and linking these together within the household, relating individual behaviour to observed changes at the macro level and representing the effects of time. These issues are currently being examined in the project and are discussed in the paper.

THE IMPACT OF RAIL FARE INCREASES ON LOCATIONAL BEHAVIOUR

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1. INTRODUCTION

The effects of transport cost increases on the lifestyles of individuals and on the function and form of cities, is a field of growing interest. It is, however, often difficult to study the problems, because the increases are often marginal (in real terms), and may not be perceived fully by those concerned. The type of area that is most suitable for research in this field is one where the trips are long, so that fares increases are large in absolute amounts, where many trips are by public transport, so that the trip-makers pay their share of the cost of travel directly (that is, they do not divide their payment between overheads and running costs) and one where there have been large increases in travel costs in the past and there are expected to be even larger increases in the future. In Britain the example that best meets these criteria is long distance rail commuters to central London. A three year project to study the impact of rail fare increases on location and commuting decisions in London and south east England began in October 1979 at the Institute for Transport Studies at the University of Leeds. The project (described in Kirby, Mackett and Nash, 1979) contains two main elements: a survey of past location and related decisions, and the development of a range of models of different aspects of the processes. At this stage, the problems are being examined as part of the design processes for both the survey strategy and model definition. There have been several studies of the effects of transport costs on locational behaviour (for example, de Langen and Verster, 1979, Butler *et al*, 1969, and Brown 1975, but none of these have modelled the choice processes for individuals. However, there has been a great deal of modelling in a variety of fields that are very relevant, for example, of the residential location process, of migration, of the relationship between housing costs and transport costs and so on (see Mackett, 1979c). Most of these studies have been aggregate studies, with very few focussing on the behaviour of individuals. However, models of individual choice have been developed in the transport planning field over the past few years, and there is an excellent opportunity to draw together the two streams of ideas in this project to produce new, operational models. The objective of this paper is to outline some of the behavioural responses to large transport cost increases, both observed and potential, to discuss the information required to study these changes, and then to describe some of the techniques and ideas that are available for the analysis of these effects, some of which will be used in the current project. The recent changes in London and south east England are described in the next section of this paper. In section 3, the potential behavioural responses, the information required to study them and our survey strategy are discussed, and then in section 4, the analysis methods are examined. These ideas are still evolving, but in view of the topicality of the subject, and the stages that have been reached in the two design processes, it is an appropriate time to state our current thinking, so that others have an opportunity to contribute ideas and to learn from our work.

2. THE CHANGES IN SOUTH-EAST ENGLAND

Over the period 1961 to 1977 the cost of a monthly British Rail season ticket for a 30 mile journey rose by about 55% in real terms (SCLSERP, 1977). Over the same period, employment in central London fell by about 250 000 jobs, which was reflected in the loss of rail commuters. In fact, there was a differential decline between long and short distance commuters. Patronage on the inner suburban services has been declining since the early 1960s, while long distance trips reached a peak in 1973 and have been declining since, suggesting that the physical expansion of the London commuting belt has ceased. In fact, combining data from two sources (SCLSERP, 1977, British Railways Board, 1979) suggests that there are recent signs of a slight increase in the number of commuters into central London. Nonetheless, London is becoming relatively more dependent on long distance commuters. Such commuters are less able to switch modes since they have less choice of mode than those living nearer central London, who can travel by bus, underground, bicycle or even walk. British Rail's fare structure is such that it is cheaper to travel by rail than by car for trips from more than about 50 kilometres from central London, but cheaper by car (in petrol costs) for shorter journeys (assuming the rail traveller purchases a second class annual season ticket). However, the cost of commuting by rail from, say, Rugby is currently (March 1980) £957 per annum, which is a great deal of money which must be paid out of disposable income. Consequently, long distance commuters are liable to be very sensitive to large increases in rail fares, but may well switch location rather than mode, in which case, they are not likely to be attracted back to rail even if fares were to drop.

We cannot, at this stage, assess the extent to which the decline in commuting to, and employment in, central London has been due to the cost of travel. However there have been at least two other factors at work. Firstly, car ownership has been rising rapidly, and once a person has a car available for the journey to work it becomes much easier to cross-commute, that is to live in one town and work in another. There is evidence that this is happening, with the development of new employment centres around London, for example near Heathrow Airport (SCLSERP, 1977). There is an obvious problem of cause and effect here: did people purchase cars to enable them to travel to their new jobs outside central London, or did they start searching for new jobs having purchased a car? The second factor is the deliberate policy of decentralization from London which was encouraged by all governments from the mid-1940s up to the 1970s. Initially this meant building the New Towns about 45 kilometres from central London, partly to help post-war reconstruction, and partly as a result of the belief in deterministic planning at that time. The objective was to build self-contained towns, with little or no commuting to London, at the same time taking jobs and population away from London. In a fairly recent paper Thomas (1977) states that regional policy for south-east England was to develop 'counter-magnets' to London's growth and argues that this policy is reducing London's commuting problem, without actually defining it, but presumably regards the large numbers who commute as the problem. As well as the New Towns, there has been a general policy of dispersal from London. In fact, it has been argued elsewhere (Mackett, 1980b) that the two factors of the growth of car ownership and the deliberate policy of decentralization have lead to the 'inner-city crisis' of the late 1970s. The Government's response to the crisis has been the reversal of the previous policy of decentralization (House of Commons, 1977) but it is an open question whether this will have any significant effect on London. Many people have already found jobs outside central London and have bought their cars; there seems little incentive for them to move back to jobs in central London. The policy change may slow down the rate of decline, but seems unlikely to do more than that, in which case British Rail is going to require further subsidy on its commuting services into London.

Indeed, the document by the Standing Conference on London and South East Regional Planning (SCLSERP,1977) was written in response to a suggestion by the Government that the London commuter services should cover their costs by 1981, on the grounds that these commuters earn salaries above the national average and so such subsidies are regressive. The response to this argument is that there are many lowly paid commuters, who would suffer seriously from the fares rise following the reduction in subsidy and that the central London economy would be affected adversely. The poorest London commuters live in north Kent and south Essex, many of whom bought their houses when travelling was much cheaper. If rail fares were increased significantly they would be faced with the choice of having to pay the extra cost or moving nearer to London and so incurring higher housing costs or a lower housing standard. There are two interesting points associated with these areas, firstly they have the highest proportions of commuters to central London and hence experienced less of a decline than other sectors, and secondly, commuters from these areas have the poorest quality service (British Railways Board, 1979). It is these areas where there is a shortage of jobs and significant dependence on London as a source of employment (SCLSERP 1977). Consequently, it is the people in these sectors who will suffer most if rail fares rise: they have fewer alternative local jobs, and so are more captive to British Rail, but, in addition, have the service most in need of improvement.

The extra cost of travel and housing in south-east England is ameliorated for many people by the payment of a London Weighting, which is designed to compensate for the extra cost of housing and travel for those working in London. A survey was carried out (Pay Board, 1974) to compare these costs for those working in London with the rest of the country. It was found that bank and assurance company employees who tend to receive assistance with housing costs spend less on housing than those in the public sector, and travel further to work. That is, they are spending part of the money they save on housing on travel,giving them a wider choice of residential locations. Williams (1978) has used these data for an analysis of the difference between the cost of travel time and the value of travel time, which has implications for this project.

The locational changes that have been going on in south-east England during the 1970s have been complex, and there are insufficient data for a comprehensive analysis of the underlying factors. In the next section some of the possible effects of rail fare increases on individuals will be considered.

3. BEHAVIOURAL RESPONSES

Let us suppose British Rail increases its fares substantially, so that a commuter is required to pay several hundred pounds extra per year. He or she is faced with a variety of alternatives. Firstly, the increase can be paid, but this may mean reducing savings, or general economy on other items. The commuter can switch mode, but for the long distance commuter, the only possible alternative may be car, and parking spaces in central London are both expensive and limited, and congestion on the road may make it impossible. It this is a feasible option some households might purchase a car (or be given one). The whole household can change its residential location, but a move towards London will mean an increase in housing expenditure or a drop in standards; in addition, the process of moving home is very expensive. The worker can change his or her workplace from central London to a more local job. Another alternative is to increase the householder's income by one or more members taking a part-time job, or a marginal worker entering the job market locally. However, if the commuter to central London is a marginal worker, he or she might cease being in employment. If the person concerned is not the head of the household he or she might decide to leave the household to set up a new home in London. If it is the head of household he or she might start renting a flat in London from which to travel to work on some days, or he or she could decide to travel

to central London on fewer days each week, and work at home on the other days.

A wide range of possible responses have been mentioned above, and not all are applicable to every household, but several issues emerge from the discussion. Firstly, whilst only one member of the household may be affected directly all others could be included in the response. Secondly, although several of the possible responses described are not likely to be brought about solely by the fares increase, they might be triggered off or brought forward in time because of the fares rise. It will be important to establish the degree of sensitivity of the various responses to transport costs. There are other aspects of behaviour that are not sensitive to transport costs, but do, partially, affect the decision unit and its economic and social status at a particular point in time and so need to be represented in any dynamic analysis; the type of process being considered here are promotion at work, household formation and producing children. The analysis is made even more complex by the workings of the housing finance system in Britain. Because income tax relief is given on the interest payment on mortgages some people move home in order to reduce their tax liability. Other people enter the owner-occupation sector from the private rented sector, or living with others in order to gain this tax relief, and because house purchase is a very good and safe investment. This is related to another difficult issue - that of expectation, some decisions are made not on past or current costs but on the basis that a move of home would be a good future investment. For example, inflation has been at a fairly high level in Britain in recent years, and this has affected house prices. Consequently it is wise to invest money in a house which is an asset that will appreciate in value, yet with a reasonable expectation that there will not be a rise in the cost of the repayment of the loan.

It is clear from the discussion above that some complex data will be required to study the response to transport cost changes and other relevant processes in south-east England. Several survey strategies have been considered (Mackett, 1980a) and the following seems best able to meet our requirements within the resources available: a sample of firms in central London will be selected and an unstructured interview held with the management about their responses to rail fare increases, and to acquire their permission to survey their employees. All workers in the selected firms will be sent a fairly simple self-completion questionnaire on their recent locational behaviour, housing and transport cost concessions received and their household characteristics. At the end of the questionnaire they will be asked to indicate whether they would be willing to be interviewed. A selection will be made from those giving a positive answer, and those selected will be interviewed at home, so that other members of the household can supply information. Questions will be asked on the location decisions and the journey to work over the past ten years, plus information on changes in the composition and economic activity of the household over the same period. It will be clear from the above discussion that the information required is complex and it will need great skill to obtain it. In the next section some of the analytical methods to be used will be outlined, so that the detailed data requirements can be seen.

4. ANALYSIS AND FORECASTING OF THE RESPONSES

Several underlying themes emerge from the discussion above. Firstly, an axiom of the project is to increase understanding of the behavioural processes that underlie the responses to rail fare increases in south-east England. We do not intend to produce models that merely replicate the processes, rather we want to understand the choices that are available to people in a particular situation then to be able to represent the decisions that are made. This principle has underlain the work of Hagerstrand (1970) on space-time interdependencies, and the development of models of individual choice behaviour by Luce (1959) and others. However, we are also interested in the impact of the outcome of all the individual decisions that are made in response to the fare

increases. This means we need to be able to aggregate across the individual behaviour in order to understand the overall impact of the changes, and because there are supply-side constraints, particularly in the housing market that can only be treated at a macro-level, but have important implications for individuals. See Drewe (1974) for discussion of some of the issues in aggregation in this field.

Many of the decision processes being examined here take place over a period of time, for example, the decision to move home. The process itself takes time, and so the response to a change may not occur for quite a long period. For these reasons time must be represented explicitly in the models. The final basic principle of the analytical methods of this study is the obvious need to relate the processes at work to transport cost changes. This will be no easy task, as there will always be a wide variety of processes at work, many of which are potentially sensitive to transport costs, but could be taking place for other reasons. It would be very easy to attribute incorrectly decisions to rises in rail fares, when they were quite irrelevant, and then to overestimate the future effects.

It is important in this work that we examine not only the effects of transport costs upon individual decisions, but also the interrelationships between different decisions. For example, Beesley and Dalvi (1974) and Weinberg (1979) have argued that the residential and employment location processes are interdependent, and should be modelled as such. Further empirical evidence has been supplied by Brown (1975). An analytical framework to describe mobility of residence and workplace has been devised by Verster and de Langen (1978) as part of a project investigating similar concepts to our project on south-east England.

Although the emphasis in this paper has been on the behaviour of individuals, we are also interested in the relationship between the economic and demographic components of the urban system, in particular the relationship between the supply of jobs and the requirements of the economically active population. Models of these relationships have been developed by Madden, Batey and Worrall (1979) and Gordon and Ledent (1980); both models involve the integration of an input-output model with a demographic accounting framework.

A framework that is based upon some of the principles discussed above is shown in figure 1. The individuals in the study area at time t form the population; they also form households of one or more persons. Many of the population are economically active and so if they have a job, are employed residents. When they make a journey to work they become the employment sector. As time passes by, the individuals can go through several processes. They can join others to form new households. These and existing households can produce further individuals. People can become economically active and so take jobs, others can cease to work and become economically inactive. Migration between houses and between workplaces can occur. At the end of the period at time t+1 the new levels of population, households, employed residents and employment can be enumerated. Survivors are those who have not changed their state over the time period. It will be appreciated these are some of the processes discussed in Section 3 above. It should be noted that no spatial labels have been attached to the variables. Space can be represented by using a zoning system and so considering the number of individuals in each zone, or by attaching a spatial label to each individual. The former method is that used in macro models the latter in micro-simulation models and related to work by Wilson and Pownall (1976) on efficient methods for representing urban systems. The processes over time can be represented in a variety of ways. For example, there are well established techniques for forecasting the population in a set of zones whereby various rates are applied to the existing population to find the number of survivors and births (see for example, Rees and Wilson, 1977). A similar method can be used for the employment process, with entry to the job market analogous with birth and retirement equivalent to death. Employment accounting is much more interesting than the deomographic method because individuals can enter and leave the job market more than once in a lifetime, and so the employment accounts

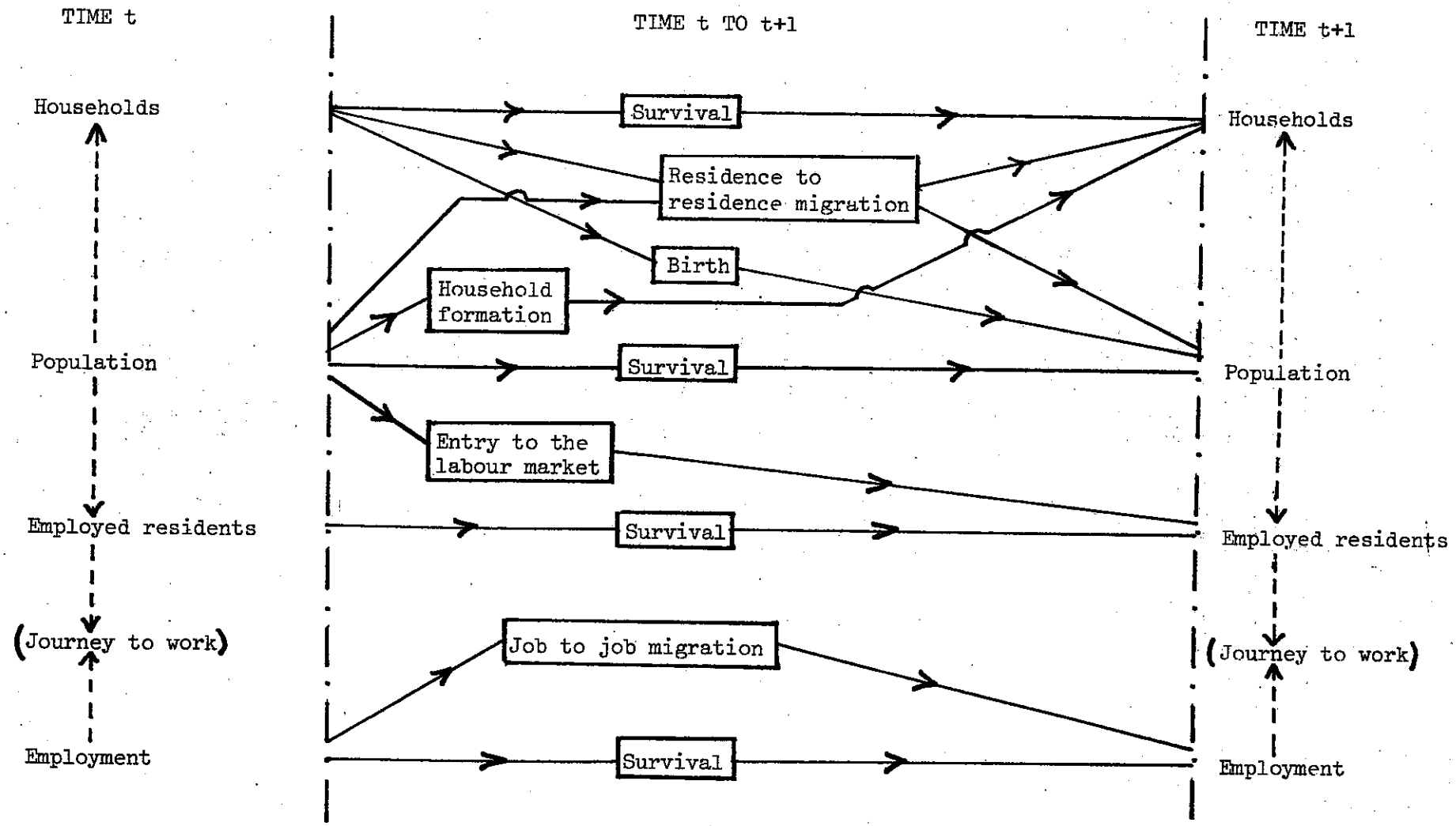

Fig. 1. The urban accounting framework.

may be regarded as policy-sensitive. These concepts can be used at various levels of resolution and related to planning policy as shown by Mackett (1976).

An alternative to the use of models of the individual components would be a comprehensive model. Indeed the framework was conceived to underpin an operational macro-level integrated land use-transport model (Mackett, 1979a,b), which does not explicitly represent the spatial dynamics of population and employment change; in the model people are only represented when they survive in or move into a dwelling or job, at which point they are given a spatial location. If they do not survive over time they are, in effect, lost to the system. This is common to all such models, but the accounting framework would represent people explicitly as they change location and status. Conversely, the integrated land use- transport model includes some of the spatial and temporal processes in the accounting framework, and would be one way to make the various processes sensitive to changes in transport costs. Modifications to the model for use in the current project are described in Mackett (1979c).

As mentioned above, the framework in figure 1 could be used to represent individuals moving from one state to another over time. In the aggregate case, in which rates are applied to individuals we are, in effect, dealing with averages. Thus, for example, if we have a survival rate of 0.4 we are saying that 40% of the population survives from time t to time t+1. However, if we are dealing with individuals, that person either survives or does not, that is, the resulting value must be 0 or 1. The easiest method here is to regard the publicity of survival as 0.4 and then use random numbers to determine for each case whether the person actually does or not. The technique of using random numbers to simulate the outcome of a process is called the Monte Carlo method (see for example, Hammersley and Handscomb, 1964). As the population size grows, the closer the average will be to the aggregate value, but using the micro-approach means that we are considering individual behaviour, and can link the modelling very closely to the observations from the survey, rather than averaging over a wide range of observed behaviour on the assumption that the behaviour of one person compensates for that of another. This method of considering individuals has been termed 'microsimulation', and, in this case, the appropriate labels of location, economic activity, social status and so on, would be attached to each individual by means of the Wilson and Pownall (1976) technique. This method has been used to simulate a car-sharing scheme (Bonsall, 1979) and the interaction between the labour and housing markets (Clarke, Keys and Williams, 1979). A similar, but rather simpler, method has been used for urban growth by Mason (1977), but he used a deterministic method based on income levels rather than an element of randomness to determine the outcomes.

Over the past few years models of individual choice based upon the theories of Luce (1959) have been used in transport planning, particularly for modal split. More recently attention has turned to locational choice, for example McFadden (1978) and Louviere (1979) have considered the choice of residential location, Tardiff, Lam and Odell (1978) have a simple model of residential and employment location choices and Moss (1979) has developed models of the migration decision. All these models require testing and validation, but appear to offer very useful insights into locational choice processes.

There is a wide range of exciting techniques being developed in fields relevant to this project. This will be drawn upon in the development of new methods for examining the effect of transport costs on locational decisions. Furthermore, we shall be able to use the data from the survey for model calibration and testing, and so shall be able to make a useful contribution to the field.

5. CONCLUSIONS

In this study we are examining the impact of rail fare increases in London and south-east England. The supply of labour in central London is dropping and so the city is becoming more dependent on long-distance commuters who are likely to be very sensitive to large rail fare increases. Some of the commuters,

particularly to the east of London, have fairly low incomes and could suffer greatly if fares increase because there are few alternative local jobs available. However, all these trends have been determined from aggregate data and there is a real need for an examination of the underlying behaviour that is bringing about these changes. For this reason, we shall be undertaking a survey of the behaviour of individuals over the past few years. These data will be used in the development of a variety of models of the responses of individuals to increases in rail fares. From this analysis we should then be able to understand why the past changes have occurred, and make an assessment of likely future changes.

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