DEMOGRAPHIC CHANGE AND FUTURE TRANSPORT DEMAND: AN ANALYSIS OF THE BRITISH SITUATION 1989-2006

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ABSTRACT

Forecasts of the growth in transport demand which underpin the planning of new transport infrastructure generally make very simple assumptions about the future numbers and geographical distribution of the population making trips. This paper builds and evaluates a methodology for linking official population projections for subnational areas with the survey data necessary to predict transport demand. This involves reconciling the administrative geography used in demographic analysis with the settlement typology used in national travel surveys. At the end of the paper a brief account of the official forecasts for settlement types is provided.

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1. INTRODUCTION

The planning of transport infrastructure requires as one ingredient sets of forecasts of transport demand. One of the factors that influences transport demand is the composition of the population in terms of person types, with considerable variation in trip making and trip distances between persons by age, sex, economic position, car availability and income (Siu et al 1994). Normally, attention is paid to the way trip rates for each person category are changing as a result of income or car availability changes. However, the age and sex structure of the population is also changing and may have influence on future trip making. Also of potential importance is the redistribution of the population over time, predominantly in the direction of lower density areas, which can have very different model mixes from higher density areas.

This paper describes work that attempts to link conventional category analysis based trip forecasting with knowledge of the changing demographic and geographic make-up of the British population. This should, in principle, be an easy task. Trip rates and trip mileages can be computed from one or more National Travel Surveys (NTS) for a highly diagnostic person classification. These trip rates are then trended or a scenario developed, and the forecast trip rates or mileages applied to the forecast population in each category to yield forecasts of the number of trips to be expected in the future, under the assumptions used in the two component forecasts. The 1985/86 NTS dataset is used in this study.

However, it turns out that there is relatively little to link the 1985/86 NTS sample with official forecast populations. Only two variables were common to both data sets - age and sex. Both contained geographic classifications - planning regions (P2) and settlement types (P5) in the NTS and administrative areas in the demographic projections. The matching of planing regions (P2) with the constituent administrative areas was straightforward but relatively little variation in trip making is accounted for by such geographic classification (besides compositional effects). Much more important is the settlement type (P5) classification of the NTS which recognises the sizes of the settlements in which members of the interviewed sample lived. The question asked was therefore whether a method could be developed to use the information contained in the projection of settlement type populations.

Specifically as part of a research project (Ref. No: L119251915) being undertaken under the Economic and Social Research Council (ESRC) Transport and the Environment initiative in the Institute for Transport Studies (ITS) at the University of Leeds, a need was identified to be able to transform the official mid-1989 based population projections for England, Wales and Scotland official into four area types defined in the National Travel Survey (NTS) 1985/86. The four area types are:

(1) 'London' (includes Inner and Outer London)
(2) 'Other Conurbations' (includes West Midlands, Greater Manchester, West Yorkshire, Glasgow, Liverpool and Tyneside)
(3) 'Urban' areas (population over 25,000)
(4) 'Rural' areas (includes urban areas less than 25,000 population)

The objectives of this paper are two:

(1) to explain and critically evaluate the methods used to transform official OPCS subnational projections for one set of general areas into subnational projects for a transport-relevant set of areas (i.e. the four broad area types defined in NTS 1985/86);

(2) to present the projected populations for these new areas and for transport relevant age/sex/groups, interpreting and analysing the likely impact on transport demand or demographic developments.

2. THE GEOGRAPHIC TRANSFORMATION PROBLEM

It will be useful to develop a formal account of the problem of geographic transformation we are faced with. We have a vector of populations $\underline{p}$ classified by administrative area i which needs to be transformed into a vector $\underline{p}$ of populations classified by settlement type u.

$$\underline{p}^u \leftarrow \underline{p}^i \tag{1}$$

where the arrow signifies the transformation to be achieved. If the administrative areas could be aggregated into settlement types, then *aggregation* of the P population elements would suffice

$$P^u = \Sigma_{i\ u} P^i \tag{2}$$

Unfortunately, none of the administrative areas fit into settlement types. The two classifications overlap in a complex way.

A second method might be to use *overlap* analysis (a technique used in the analysis of geographical information systems). However, this would only work if the distribution of population inter-administrative areas were uniform with respect to the settlement type classification. In fact, the distribution is highly uneven, so this method could not be used.

The third set of methods involves derivation of a set of conditional probabilities that the population of administrative areas fell into the settlement type categories. If such a matrix of probabilities could be devised then the transformation could be effected by multiplying the administrative area population by the conditional probabilities and summing

$$P^u = \Sigma_i\, p(u|i) P^i \tag{3}$$

where p(u|i) is the conditional probability of a person being in settlement type u given residence in area i. What was needed therefore was a data source from which the conditional probabilities could be computed

$$p(u|i) = K(u,i) / \Sigma_u\, K(u,i) \tag{4}$$

where K represents a population. Several alternative 'populations' were used to derive the conditional probabilities (the details are described below).

The transformation method specified in equation (3) does make the assumption that the conditional probabilities are time-independent. It is likely that the distribution of population across settlement types within administrative areas will change over time just as the distribution of population across administrative areas changes, particularly in the direction downwards in the settlement hierarchy. No direct evidence of the magnitude of such shifts is available but it is possible to introduce shifts in the probabilities if required.

$$P^u(t) = \Sigma_i \, p_t(u|i) P^i(t) \qquad (5)$$

A final assumption that this methodology involves is that the conditional probabilities for the all age/sex population apply uniformly to each age/sex group. This assumption could be relaxed by using detailed age-specific population data to compute the conditional probabilities.

The next section of the paper, Section 3, discusses the specific data sources used for measuring travel demand, population projections and deriving the conditional probability inputs needed.

3. DATA SOURCES

To study the effect of the ageing and geographical redistribution of population on transport demand, we need to use population forecasts for local areas and link them with survey data on the trip making behaviour of the population. Because the geographical areas used in official forecasts do not match very closely to the spatial categories used in the National Travel Survey, we need to employ more detailed population data from which can be constructed the links between demographic areas and transport settlement types.

The primary datasets used for the study are therefore (Table 1):

(1) The National Travel Survey (NTS) conducted in 1985/86 by the Department of Transport (DoT) and deposited with the ESRC Data Archive at the University of Essex;

(2) The mid-1989 based population projection data obtained from the Office of Population Censuses and Surveys (OPCS) and other bodies for all local areas in Great Britain. These data give the projected populations of local areas by single years of age and sex from 1989 forwards.

(3) The 1981 Census for Local Authorities and for Urban Areas in Great Britain.

Table 1: Primary data used in the study

Dataset	Data Source	Study Area	Period Covered	Data Used
NTS data 1985-86	ESRC Data Archive at the University of Essex. Data depositor: DoT.	Great Britain	12 full months in 1985/86.	Variables of area, household, individual and journey records.
Mid-1989 Based Population Projection Data	OPCS WO GRO(S)	Great Britain	England: 1989-2015. Wales: 1989-2008. Scotland: 1989-2001.	Population projection data by sex, age and locations in single years.
Census 1981: Key statistics for urban areas	OPCS	Great Britain	1981	Usually resident Population for urban areas in 1981.
Census 1981: Key statistics for local authorities	OPCS	Great Britain	1981	Usually resident Population for local authorities in 1981.

Abbreviations:

NTS = National Travel Survey
ESRC = Economic and Social Research Council
DoT = Department of Transport
OPCS = Office of Population Censuses and Surveys
WO = Welsh Office
GRO(S) = General Register Office (Scotland)

3.1 The National Travel Survey data for 1985/86

The NTS is a nationally representative sample of 25,785 interviews carried out for the Department of Transport and made available for academic analysis via ESRC Data Archive. The data are now ten years old and other NTS surveys (1989/91 and 1991/93) have been completed, but at time of carrying out this research, these had not been released for academic use. The 1985/86 NTS data have been used in an extensive category analysis of trip rates and trip mileages (Siu et al 1994).

3.2 The Subnational Demographic Projections

Three organisations are responsible for carrying out subnational projections in Great Britain.

The Office of Population Censuses and Surveys (OPCS) is responsible for producing projections for 108 local areas in England. The Welsh Office (WO) produces projections for the 8 county populations of Wales, whilst the General Register office (Scotland) (GRO(S)) carries out the projections for the 12 Scottish Regions and Island Areas. OPCS uses a methodology that incorporates an analysis of the migration flows between the 108 areas, while WO and GRO(S) use simpler net migration terms tacked on to the normal cohort-component model. All three projections are controlled to the respective country projections produced by the Government Actuary's Department and OPCS in collaboration. National trends in fertility, mortality and international migration are used with appropriate differentials. However, for internal migration reliance is placed almost exclusively on the

migration patterns of the 1981 Census. Revision of these projections to incorporate 1991 Census migration results came too late for incorporation in our forecasts.

The mid-1989 based population projection data was obtained in mid-1993 from the relevant offices of England, Wales and Scotland by sex and age for all regions for all years form 1989 to the latest available projection end-year. The following operational problems were encountered in integrating the projections data in our analysis.

3.2.1 Inconsistent computer formats

The three demographic offices supplied data in their own format which needed modification on incorporation into one large database for Great Britain. Work was done on creating this particular population projection database in Lotus 1-2-3 for Windows© computer readable format. The established population projection data base is by sex and age for each year for the counties, metropolitan districts and London Boroughs in England, the counties in Wales and Scottish Regions and Island Areas in Scotland.

3.2.2 Inconsistent projection end-years

The three demographic offices end their projections in different years. The year 2006 is adopted as the projection end-year for England, Wales and Scotland for simplicity. This gives a reasonable period of 16 years for the purposes of modelling and projection. In this study, a very simple extrapolation is used to project the existing data from the base year to the specified projection end-year where this falls short of 2006. The extrapolation is mainly based on computing the proportional shares of district population by age and gender among a specific region in the base year and the computer figures are used to estimate the population projections for the subsequent projection years, assuming a constant rate of increase. For instance, for Scotland the population projection data are supplied only to the year of 2001 by the General Register Office for Scotland (GRO(S)). We need estimate data from the years of 2002 to 2006. in this case, work is done on computing the percentage change of population by age and gender for each respective district in Scotland from 2000 to 2001. Based on the year 2001, populations in the subsequent projections years are then calculated assuming a constant rate of increase/decrease.

3.3 The 1981 Census data on urban areas and local authorities

The settlement typology used in the NTS derives from a typology for classifying the built up areas of the country into urban areas of different sizes developed by the Department of the Environment (DoE) and implemented for the 1981 Census of Population by OPCS and GRO(S). A similar exercise is underway for the 1991 Census but, at the time of writing had not been completed. The published volume (OPCS 1984b) from the 1981 Census contains lists of settlements (urban areas) and their associated populations. Aggregation of the populations in urban areas by the 4 settlement types used in the NTS (Section 1) for each administrative area can be used to product the doubly classified populations needed for the computation of the conditional probabilities needed.

The population data for local authorities (OPCS 1984a) are used to derive rural area populations (part of settlement type category 4) by subtraction.

We now describe three methods for deriving the conversion matrix of conditional probabilities.

4. METHODS FOR COMPUTING THE CONVERSION MATRIX

4.1 Method 1: use of the NTS sample numbers

The 1985/86 NTS provides a crosstabulation of respondents (Table 2) by a 15 Planning Region classification (the variable labelled P2) and a 14 Area Type classification (the variable labelled P5). Method 1 is simply to use the 1985/85 NTS sample numbers to derive the conditional probability. Dividing each table element by its row sum provides the necessary matrix of conditional probabilities. Table 3 contain the conditional probabilities of area type given residence in planning regions. Table 4 present the conditional probabilities for the 4 settlement types. The projected populations for the OPCS 126 sub-national units were summed to yield totals for the 15 planning regions into which they sum exactly. Multiplication of the planning region populations by the conditional probabilities produces estimates of projected populations by the NTS area type.

Method 1 is easy to use and the data needed can directly be obtained from the NTS which is useful when up-to-date population datasets for urban and rural areas are not obtainable. However, the drawback with this method is its reliance on the distribution of sample numbers across the non-zero cells of the planning region by NTS area type table. It was felt that there could be considerable divergence of the sample probabilities from the true population parameter because of the small size and clustered nature of the sample in any one planning region.

Table 2: The 1985/86 NTS sample numbers by planning region (P2) and area type (P5).

						P5 Area Type										
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	
P2	P2 Planning Region Names	Inner London	Outer London	West Midlands Built-up	Man-chester Built-up	West York-shire Built-up	Glasgow Built-up	Liverpool Built-up	Tyneside Built-up	Other urban over 250K	Other urban over 100K to 250K	Other urban over 50K to 100K	Other urban over 25K to 50K	Other urban over 3K to 25 K	Rural	Row Totals
1	Northern (Metropolitan)	0	0	0	0	0	0	0	453	0	95	0	0	0	0	548
2	Northern (Non-Metropolitan)	0	0	0	0	0	0	0	0	198	0	250	100	183	230	961
3	Yorkshire/Humbershire (Metropolitan)	0	0	0	0	742	0	0	0	339	133	62	0	362	0	1638
4	Yorkshire/Humbershire (Non-Metropolitan)	0	0	0	0	0	0	0	0	180	78	143	0	144	220	765
5	East Midlands	0	0	0	0	0	0	0	0	468	340	40	370	607	107	1932
6	East Anglia	0	0	0	0	0	0	0	0	0	287	79	0	327	229	922
7	South East (excluding London Boroughs)	0	560	0	0	0	0	0	0	589	972	920	352	829	737	4959
8	London Boroughs	882	1860	0	0	0	0	0	0	0	0	0	0	0	0	2742
9	South West	0	0	0	0	0	0	0	0	511	83	231	133	718	376	2052
10	West Midlands (Metropolitan)	0	0	969	0	0	0	0	0	73	0	0	0	0	104	1146
11	West Midlands (Non-Metropolitan)	0	0	27	0	0	0	0	0	174	0	310	32	259	335	1137
12	North West (Metropolitan)	0	0	0	1051	0	0	247	0	202	97	89	54	192	0	1932
13	North West (Non-Metropolitan)	0	0	0	0	0	0	0	0	187	377	151	111	192	113	1131
14	Wales	0	0	0	0	0	0	0	0	261	52	253	104	524	166	1360
15	Scotland	0	0	0	0	0	346	0	0	166	197	128	325	1094	304	2560

Source: The Department of Transport, National Travel Survey: 1985/86.
Total sample size = 25785.

Table 3: Computed conditional probabilities for the 14 area types (P5) using the 1985/86 NTS sample numbers (Method 1).

						P5	Area	Type								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	
P2	P2 Planning Region Names	Inner London	Outer London	West Midlands Built-up	Man-chester Built-up	West York-shire Built-up	Glasgow Built-up	Liverpool Built-up	Tyneside Built-up	Other urban over 250K	Other urban over 100K to 250K	Other urban over 50K to 100K	Other urban over 25K to 50K	Other urban over 3K to 25 K	Rural	Row Totals
1	Northern (Metropolitan)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.83	0.00	0.17	0.00	0.00	0.00	0.00	1.00
2	Northern (Non-Metropolitan)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.26	0.10	0.19	0.24	1.00
3	Yorkshire/Humbershire (Metropolitan)	0.00	0.00	0.00	0.00	0.45	0.00	0.00	0.00	0.21	0.08	0.04	0.00	0.22	0.00	1.00
4	Yorkshire/Humbershire (Non-Metropolitan)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.10	0.19	0.00	0.19	0.29	1.00
5	East Midlands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.18	0.02	0.19	0.31	0.06	1.00
6	East Anglia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31	0.09	0.00	0.35	0.25	1.00
7	South East (excluding London Boroughs)	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.20	0.19	0.07	0.17	0.15	1.00
8	London Boroughs	0.32	0.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
9	South West	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.04	0.11	0.06	0.35	0.18	1.00
10	West Midlands (Metropolitan)	0.00	0.00	0.85	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.09	1.00
11	West Midlands (Non-Metropolitan)	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.27	0.03	0.23	0.29	1.00
12	North West (Metropolitan)	0.00	0.00	0.00	0.54	0.00	0.00	0.13	0.00	0.10	0.05	0.05	0.03	0.10	0.00	1.00
13	North West (Non-Metropolitan)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.33	0.13	0.10	0.17	0.10	1.00
14	Wales	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.04	0.19	0.08	0.39	0.12	1.00
15	Scotland	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.06	0.08	0.05	0.13	0.43	0.12	1.00

Source: Computed from Table 2.

Table 4: Computed conditional probabilities for the 4 NTS area types using the 1985/86 NTS sample numbers (Method 1).

			The 4 NTS Area Types			
		1	2	3	4	
P2	P2 Planning Region Names	'London'	'Other Conurbations'	'Urban'	'Rural'	Row Totals
1	Northern (Metropolitan)	0.00	0.83	0.17	0.00	1.00
2	Northern (Non-Metropolitan)	0.00	0.00	0.57	0.43	1.00
3	Yorkshire/Humbershire (Metropolitan)	0.00	0.45	0.33	0.22	1.00
4	Yorkshire/Humbershire (Non-Metropolitan)	0.00	0.00	0.52	0.48	1.00
5	East Midlands	0.00	0.00	0.63	0.37	1.00
6	East Anglia	0.00	0.00	0.40	0.60	1.00
7	South East (excluding London Boroughs)	0.11	0.00	0.57	0.32	1.00
8	London Boroughs	1.00	0.00	0.00	0.00	1.00
9	South West	0.00	0.00	0.47	0.53	1.00
10	West Midlands (Metropolitan)	0.00	0.85	0.06	0.09	1.00
11	West Midlands (Non-Metropolitan)	0.00	0.02	0.45	0.52	1.00
12	North West (Metropolitan)	0.00	0.67	0.23	0.10	1.00
13	North West (Non-Metropolitan)	0.00	0.00	0.73	0.27	1.00
14	Wales	0.00	0.00	0.49	0.51	1.00
15	Scotland	0.00	0.14	0.32	0.55	1.00

Abbreviations:

'London' = Inner & Outer London.

'Other Conurbations' = West Midlands, Greater Manchester, West Yorkshire, Glasgow, Liverpool and Tyneside.

'Urban' = population over 25,000.

'Rural' = urban areas between 3,000 to 25,000 of population and rural areas of population under 3,000.

4.2 Method 2: use of the 1981 Census of Population urban area populations grouped by planning region

Method 2 is designed to rectify the drawback of Method 1. According to the National Travel Survey 1985/86 Document (pp 245-246), the survey area types were derived originally from the classification by the Department of the Environment (DoE) and OPCS of the Great Britain population into urban areas (OPCS 1984b) using population data from the 1981 Census.

The procedure used in this method was as follows.

Step 1. A list of the urban areas and their usually resident population was compiled from the tables produced in OPCS (1984b). Urban areas are continuously built-up territory with a dense occupation by households. They are two types: those with population of 25,000 or more, and those with less than 25,000 inhabitants.

Step 2. Each urban area of 25,000 people or more in the list was assigned to a planning region either as a whole or in part through the detailed inspection of the urban area boundary maps produced in OPCS (1984b). Where an urban area overlapped two planning regions, an estimate of the part population falling in each was made.

Step 3. The population of the individual urban areas within local planning region were summed for thirteen area types, from 'Inner London' through to 'Other urban over 3K to 25K'.

Step 4. The population living in 'rural areas' (the fourteenth area type) which were computed as a residual. From the total planning area populations were subtracted the sum of the populations falling in the thirteen urban categories. Table 5 shows the results of this process: a matrix that classifies population by planning region and area type.

Step 5. From these populations were computed conditional probabilities of area types (NTS variable P5) given planning region (NTS variable P2), which are shown in Table 6.

Step 6. The area type categories were then collapsed and the probabilities summed to the four NTS area types. The resulting conditional probabilities are shown in Table 7.

Step 7. The conditional probabilities in Table 7 were then applied to the projected populations by age and sex group for planning regions, and summed to yield the projected numbers by the four area classification. Table 8 shows the results of these computations. Table 9 converts the changes in population resulting from the projected population time series in Table 8 into percentage change form so as to reveal the significant trends by area type and broad age-sex category.

Table 5: The 1981 Census population classified by planning region (P2) and area type (P5) (Method 2).

						P5 Area Type										
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	
P2	P2 Planning Region Names	Inner London	Outer London	West Midlands Built-up	Man-chester Built-up	West York-shire Built-up	Glasgow Built-up	Liverpool Built-up	Tyneside Built-up	Other urban over 250K	Other urban over 100K to 250K	Other urban over 50K to 100K	Other urban over 25K to 50K	Other urban over 3K to 25 K	Rural	Row Totals
1	Northern (Metropolitan)	0	0	0	0	0	0	0	776	0	201	52	28	0	78	1136
2	Northern (Non-Metropolitan)	0	0	0	0	0	0	0	0	381	0	335	244	93	878	1932
3	Yorkshire/Humbershire (Metropolitan)	0	0	0	0	1467	0	0	0	635	259	177	68	20	688	3314
4	Yorkshire/Humbershire (Non-Metropolitan)	0	0	0	0	0	0	0	0	322	260	197	28	0	689	1497
5	East Midlands	0	0	0	0	0	0	0	0	998	527	184	536	130	1407	3782
6	East Anglia	0	0	0	0	0	0	0	0	0	526	121	68	47	1083	1845
7	South East (excluding London Boroughs)	0	0	0	0	0	0	0	0	1361	1731	2017	1276	314	3245	9945
8	London Boroughs	2426	4183	0	0	0	0	0	0	0	0	0	0	0	0	6609
9	South West	0	0	0	0	0	0	0	0	837	570	327	344	154	2019	4252
10	West Midlands (Metropolitan)	0	0	2339	0	0	0	0	0	290	0	0	0	0	0	2628
11	West Midlands (Non-Metropolitan)	0	0	0	0	0	0	0	0	374	0	777	223	68	1029	2470
12	North West (Metropolitan)	0	0	0	2320	0	0	748	0	281	350	141	89	66	85	4079
13	North West (Non-Metropolitan)	0	0	0	0	0	0	0	0	259	667	529	156	46	627	2284
14	Wales	0	0	0	0	0	0	0	0	577	116	197	471	66	1322	2750
15	Scotland	0	0	0	0	0	755	0	0	409	359	471	747	186	2108	5035

Note: Population is rounded in thousands.

Table 6: Computed conditional probabilities for the 14 area types (P5) using the 1981 Census population data (Method 2).

						P5 Area Type										
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	
P2	P2 Planning Region Names	Inner London	Outer London	West Midlands Built-up	Man-chester Built-up	West York-shire Built-up	Glasgow Built-up	Liverpool Built-up	Tyneside Built-up	Other urban over 250K	Other urban over 100K to 250K	Other urban over 50K to 100K	Other urban over 25K to 50K	Other urban over 3K to 25 K	Rural	Row Totals
1	Northern (Metropolitan)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.68	0.00	0.18	0.05	0.02	0.00	0.07	1.00
2	Northern (Non-Metropolitan)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.17	0.13	0.05	0.45	1.00
3	Yorkshire/Humbershire (Metropolitan)	0.00	0.00	0.00	0.00	0.44	0.00	0.00	0.00	0.19	0.08	0.05	0.02	0.01	0.21	1.00
4	Yorkshire/Humbershire (Non-Metropolitan)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.17	0.13	0.02	0.00	0.46	1.00
5	East Midlands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.14	0.05	0.14	0.03	0.37	1.00
6	East Anglia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.07	0.04	0.03	0.59	1.00
7	South East (excluding London Boroughs)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.17	0.20	0.13	0.03	0.33	1.00
8	London Boroughs	0.37	0.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
9	South West	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.13	0.08	0.08	0.04	0.47	1.00
10	West Midlands (Metropolitan)	0.00	0.00	0.89	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	1.00
11	West Midlands (Non-Metropolitan)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.31	0.09	0.03	0.42	1.00
12	North West (Metropolitan)	0.00	0.00	0.00	0.57	0.00	0.00	0.18	0.00	0.07	0.09	0.03	0.02	0.02	0.02	1.00
13	North West (Non-Metropolitan)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.29	0.23	0.07	0.02	0.27	1.00
14	Wales	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.04	0.07	0.17	0.02	0.48	1.00
15	Scotland	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.08	0.07	0.09	0.15	0.04	0.42	1.00

Table 7: Computed Conditional probabilities for the 4 NTS area types using 1981 Census population data (Method 2).

		The 4 NTS Area Types				
		1	2	3	4	
P2	P2 Planning Region Names	'London'	'Other Conurbations'	'Urban'	'Rural'	Row Totals
1	Northern (Metropolitan)	0.00	0.68	0.25	0.07	1.00
2	Northern (Non-Metropolitan)	0.00	0.00	0.50	0.50	1.00
3	Yorkshire/Humbershire (Metropolitan)	0.00	0.44	0.34	0.21	1.00
4	Yorkshire/Humbershire (Non-Metropolitan)	0.00	0.00	0.54	0.46	1.00
5	East Midlands	0.00	0.00	0.59	0.41	1.00
6	East Anglia	0.00	0.00	0.39	0.61	1.00
7	South East (excluding London Boroughs)	0.00	0.00	0.64	0.36	1.00
8	London Boroughs	1.00	0.00	0.00	0.00	1.00
9	South West	0.00	0.00	0.49	0.51	1.00
10	West Midlands (Metropolitan)	0.00	0.89	0.11	0.00	1.00
11	West Midlands (Non-Metropolitan)	0.00	0.00	0.56	0.44	1.00
12	North West (Metropolitan)	0.00	0.75	0.21	0.04	1.00
13	North West (Non-Metropolitan)	0.00	0.00	0.71	0.29	1.00
14	Wales	0.00	0.00	0.49	0.51	1.00
15	Scotland	0.00	0.15	0.39	0.46	1.00

Abbreviations:

'London' = Inner & Outer London.

'Other Conurbations' = West Midlands, Greater Manchester, West Yorkshire, Glasgow, Liverpool and Tyneside.

'Urban' = population over 25,000.

'Rural' = urban areas between 3,000 to 25,000 of population and rural areas of population under 3,000.

Table 8: The projected populations by age and sex for the four NTS area types, 1989 to 2006, using the Method 2 conditional probabilities.

NTS Area Types	Age/Sex Groups	1989	1991	1996	2001	2006
'London'	Persons < 16	1329	1357	1471	1536	1546
	Males 16-29	789	782	713	670	686
	Males 30-59	1254	1273	1338	1396	1396
	Males 60 & over	552	543	519	506	517
	Females 16-29	794	782	698	652	665
	Females 30-59	1264	1285	1360	1418	1421
	Females 60 & over	774	752	696	655	643
	Total Population	***6756***	***6774***	***6795***	***6834***	***6875***
'Other Conurbations'	Persons < 16	1731	1736	1792	1793	1743
	Males 16-29	942	906	787	724	719
	Males 30-59	1554	1577	1657	1700	1691
	Males 60 & over	711	711	710	716	749
	Females 16-29	919	881	757	692	691
	Females 30-59	1526	1548	1633	1680	1674
	Females 60 & over	1004	994	964	938	945
	Total Population	***8385***	***8353***	***8299***	***8243***	***8212***
'Urban'	Persons < 16	4568	4633	4879	5009	4954
	Males 16-29	2538	2471	2219	2067	2102
	Males 30-59	4253	4357	4694	4949	5010
	Males 60 & over	2047	2053	2108	2182	2338
	Females 16-29	2438	2368	2117	1962	1991
	Females 30-59	4264	4360	4687	4936	4987
	Females 60 & over	2794	2814	2836	2866	2988
	Total Population	***22902***	***23055***	***23540***	***23971***	***24369***
'Rural'	Persons < 16	3511	3565	3752	3850	3831
	Males 16-29	1982	1907	1714	1595	1618
	Males 30-59	3269	3349	3609	3809	3876
	Males 60 & over	1597	1595	1640	1698	1823
	Females 16-29	1879	1828	1635	1511	1529
	Females 30-59	3285	3359	3611	3807	3866
	Females 60 & over	2166	2184	2206	2232	2335
	Total Population	17690	17787	18168	18503	18878
	Grand Total Population	***55733***	***55970***	***56801***	***57551***	***58334***

Note: Population is rounded in thousands.

Table 9: Trends in projected population changes by age and sex for the four NTS area types, 1989 to 2006, using the Method 2 conditional probabilities.

NTS Area Types	Age/Sex Groups	1989-1991 (in %)	1991-1996 (in %)	1996-2001 (in %)	2001-2006 (in %)	1989-2006 (in %)
'London'	Persons < 16	2.16	8.38	4.42	0.68	16.40
	Males 16-29	-0.96	-8.84	-5.96	2.43	-13.02
	Males 30-59	1.47	5.17	4.33	-0.01	11.33
	Males 60 & over	-1.72	-4.34	-2.52	2.08	-6.45
	Females 16-29	-1.47	-10.79	-6.60	2.11	-16.17
	Females 30-59	1.72	5.80	4.29	0.17	12.42
	Females 60 & over	-2.93	-7.48	-5.84	-1.80	-16.96
	Total Population	***0.26***	***0.31***	***0.58***	***0.61***	***1.76***
'Other Conurbations'	Persons < 16	0.31	3.19	0.09	-2.83	0.67
	Males 16-29	-3.84	-13.16	-8.02	-0.67	-23.71
	Males 30-59	1.49	5.05	2.60	-0.48	8.86
	Males 60 & over	-0.04	-0.09	0.78	4.71	5.39
	Females 16-29	-4.05	-14.06	-8.58	-0.27	-24.82
	Females 30-59	1.47	5.47	2.93	-0.37	9.75
	Females 60 & over	-0.91	-3.08	-2.66	0.78	-5.79
	Total Population	***-0.38***	***-0.65***	***-0.67***	***-0.37***	***-2.07***
'Urban'	Persons < 16	1.41	5.33	2.66	-1.11	8.45
	Males 16-29	-2.62	-10.19	-6.88	1.72	-17.16
	Males 30-59	2.45	7.73	5.45	1.22	17.80
	Males 60 & over	0.28	2.67	3.52	7.14	14.18
	Females 16-29	-2.86	-10.60	-7.35	1.48	-18.35
	Females 30-59	2.24	7.51	5.32	1.03	16.95
	Females 60 & over	0.71	0.80	1.05	4.25	6.94
	Total Population	***0.67***	***2.10***	***1.83***	***1.66***	***6.40***
'Rural'	Persons < 16	1.53	5.25	2.62	-0.50	9.11
	Males 16-29	-3.80	-10.09	-6.95	1.44	-18.35
	Males 30-59	2.47	7.75	5.53	1.77	18.57
	Males 60 & over	-0.10	2.78	3.55	7.35	14.13
	Females 16-29	-2.71	-10.55	-7.55	1.18	-18.59
	Females 30-59	2.25	7.50	5.42	1.55	17.67
	Females 60 & over	0.80	1.03	1.18	4.60	7.78
	Total Population	***0.55***	***2.14***	***1.85***	***2.03***	***6.72***

4.3 Method 3: use of the 1981 Census of population urban area populations grouped by sub-national units used with projection

Careful inspection of the results produced using Method 2 revealed a couple of important problems.

The first problem was that of rather heterogeneous groupings of the sub-national units into planning regions. For example, the method produced a probability that a person living in Yorkshire and Humberside's metropolitan counties would reside in the West Yorkshire built-up area. This probability is, of course, very different for a person living in West Yorkshire metropolitan country (very high but not quite one) from a person living in South Yorkshire metropolitan county (the other constituent of the planning region) for which the probabilities would be zero.

The second problem was the assumption that urban areas fell entirely inside only one planning region. In fact, there were a number of instances where urban areas overlapped two planning regions. For example, the Coventry-Bedworth urban area falls in to the West Midlands metropolitan county and in the West Midlands region remainder (see Figure 1).

Because of the problems as mentioned above, further refinements of method 2 are required. To solve these problems, work was carried out to compute a matrix of populations and conditional probabilities for a full 126 sub-national unit by 4 area type table. This makes maximum use of the available data. The list of urban areas to be classified by sub-national unit and NTS area type will be extended by including all urban sub-areas in the OPCS tables and by assigning appropriate weights to double entry of urban areas or sub-areas where they overlap two sub-national units. In effect, we construct what is known, in the Geographical Information Systems (GIS) field, as a 'Gazetteer file' at the level of the smallest building block available in the OPCS tables.

Table 10 lists the derived urban/local area population ratio for the 4 NTS area types using 1981 population data for the local authorities and urban areas. Tables 11, 12 and 13 report the computed results using the refined method 3.

Figure 1: The boundary problem encountered in the classification of populations by planning regional area type: the case of Coventry-Bedworth urban area.

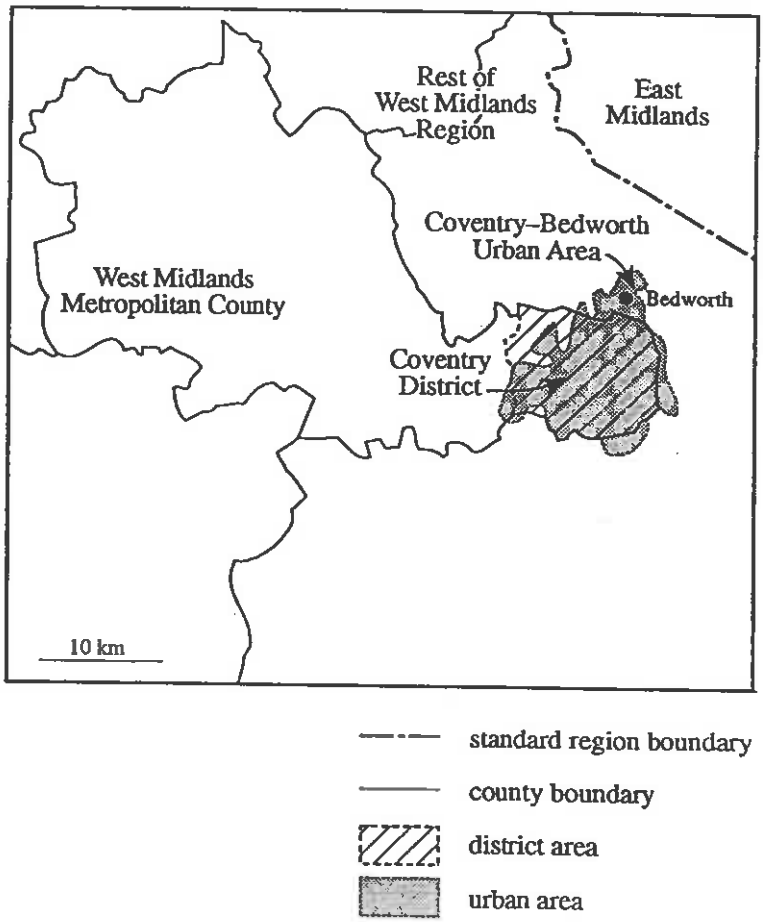

Table 10: Computed conditional probabilities for the 4 area types using the 1981 population data by Projection Area (Method 3).

Projection Area	London	Other Conurb-ations	Urban	Rural	Total
Cambridgeshire			0.42	0.58	1.00
Norfolk			0.41	0.59	1.00
Suffolk			0.41	0.59	1.00
Derbyshire			0.80	0.20	1.00
Leicestershire			0.64	0.36	1.00
Lincolnshire			0.35	0.65	1.00
Northamptonshire			0.60	0.40	1.00
Nottinghamshire			0.63	0.37	1.00
Cleveland			0.84	0.16	1.00
Cumbria			0.42	0.58	1.00
Durham			0.48	0.52	1.00
Northumberland			0.30	0.70	1.00
Tyneside		0.93		0.07	1.00
Sunderland			0.95	0.05	1.00
Greater Manchester		0.95		0.05	1.00
Lancashire			0.80	0.20	1.00
Cheshire			0.67	0.33	1.00
Merseyside (all except Liverpool)			0.97	0.03	1.00
Merseyside (Liverpool only)		0.96		0.04	1.00
Border Region				1.00	1.00
Central Region			0.54	0.46	1.00
Dumfries and Galloway Region			0.22	0.78	1.00
Fife Region			0.41	0.59	1.00
Grampian Region			0.40	0.60	1.00
Highland Region			0.20	0.80	1.00
Lothian Region			0.62	0.38	1.00
Orkney Islands			0.00	1.00	1.00
Shetland Islands			0.00	1.00	1.00
Strathclyde Region (except Glasgow)			0.57	0.43	1.00
City of Glasgow		1.00			1.00
Tayside Region			0.62	0.38	1.00
Western Isles				1.00	1.00
Bedfordshire			0.67	0.33	1.00
Berkshire			0.78	0.22	1.00
Buckinghamshire			0.66	0.34	1.00
East Sussex			0.52	0.48	1.00
Essex			0.64	0.36	1.00

Table 10 (Continued)

Projection Area	London	Other Conurb -ations	Urban	Rural	Total
Hampshire			0.75	0.25	1.00
Hertfordshire			0.75	0.25	1.00
Inner London		1.00			1.00
Isle of Wight			0.17	0.83	1.00
Kent			0.69	0.31	1.00
Outer London		0.99		0.01	1.00
Oxfordshire			0.36	0.64	1.00
Surrey			0.69	0.31	1.00
West Sussex			0.85	0.15	1.00
Avon			0.76	0.24	1.00
Cornwall and Isles of Scilly			0.19	0.81	1.00
Devon			0.53	0.47	1.00
Dorset			0.61	0.39	1.00
Gloucestershire			0.49	0.51	1.00
Somerset			0.27	0.73	1.00
Wiltshire			0.42	0.58	1.00
Clwyd			0.41	0.59	1.00
Dyfed			0.14	0.86	1.00
Gwynedd				1.00	1.00
Gwent			0.70	0.30	1.00
Mid Glamorgan			0.57	0.43	1.00
Powys				1.00	1.00
South Glamorgan			0.91	0.09	1.00
West Glamorgan			0.76	0.24	1.00
Hereford and Worcester			0.51	0.49	1.00
Shropshire			0.44	0.56	1.00
Staffordshire			0.70	0.30	1.00
Warwickshire			0.60	0.40	1.00
West Midlands: Birmingham		1.00			1.00
West Midlands: Coventry		1.00			1.00
West Midlands: Dudley		1.00			1.00
West Midlands: Sandwell		1.00			1.00
West Midlands: Solihull		0.47		0.53	1.00
West Midlands: Walsall		0.67		0.33	1.00
West Midlands: Wolverhampton		1.00			1.00
Humbershire			0.67	0.33	1.00
North Yorkshire			0.37	0.63	1.00
South Yorkshire			0.77	0.23	1.00
West Yorkshire: Calderdale		0.39		0.61	1.00
West Yorkshire: Leeds		0.84		0.16	1.00
West Yorkshire: Bradford		0.84		0.16	1.00
West Yorkshire: Kirkless		0.67		0.33	1.00
West Yorkshire: Wakefield		0.57		0.43	1.00

Table 11: The projected populations by age and sex for the four NTS area types, 1989 to 2006, using Method 3 conditional probabilities.

NTS Area Types	Age/Sex Groups	1989	1991	1996	2001	2006
'London'	Persons < 16	1320	1349	1462	1526	1537
	Males 16-29	785	777	708	666	682
	Males 30-59	1246	1265	1330	1388	1388
	Males 60 & over	549	539	516	503	513
	Females 16-29	789	777	693	648	661
	Females 30-59	1256	1277	1352	1410	1412
	Females 60 & over	769	747	691	651	639
	Total Population	6714	6731	6752	6791	6832
'Other Conurbations'	Persons < 16	1710	1722	1786	1787	1734
	Males 16-29	941	901	776	711	711
	Males 30-59	1521	1543	1620	1662	1650
	Males 60 & over	702	699	691	690	717
	Females 16-29	916	876	750	685	686
	Females 30-59	1492	1513	1594	1641	1631
	Females 60 & over	1005	990	948	912	912
	Total Population	***8287***	***8246***	***8165***	***8088***	***8042***
'Urban'	Persons < 16	4789	4857	5110	5243	5164
	Males 16-29	2641	2572	2306	2144	2180
	Males 30-59	4456	4549	4894	5153	5218
	Males 60 & over	2114	2128	2187	2265	2429
	Females 16-29	2567	2496	2228	2061	2058
	Females 30-59	4502	4600	4938	5193	5157
	Females 60 & over	2920	2942	2970	3004	3087
	Total Population	***23990***	***24144***	***24634***	***25063***	***25292***
'Rural'	Persons < 16	3322	3363	3536	3632	3709
	Males 16-29	1856	1818	1644	1535	1561
	Males 30-59	3138	3197	3452	3650	3739
	Males 60 & over	1538	1535	1583	1644	1776
	Females 16-29	1754	1710	1536	1424	1450
	Females 30-59	3089	3163	3408	3599	3687
	Females 60 & over	2044	2064	2093	2125	2245
	Total Population	***16743***	***16849***	***17251***	***17609***	***18168***
All area types	Person < 16	11142	11291	11894	12189	12143
	Males 16-29	6223	6068	5435	5057	5134
	Males 30-59	10362	10554	11296	11853	11994
	Males 60 & over	4902	4901	4976	5101	5436
	Females 16-29	6026	5860	5208	4817	5006
	Females 30-59	10339	10553	11291	11842	11822
	Females 60 & over	6738	67444	6702	6691	6884
	Total population	***55733***	***55970***	***56801***	***57551***	***58334***

Note: Population is rounded in thousands.

Table 12: Trends in projected population changes by age and sex for the four NTS area types, 1989 to 2006, using Method 3 conditional probabilities.

NTS Area Types	Age/Sex Groups	1989-1991 (in %)	1991-1996 (in %)	1996-2001 (in %)	2001-2006 (in %)	1989-2006 (in %)
'London'	Persons < 16	2.16	8.38	4.42	0.67	16.40
	Males 16-29	-0.97	-8.85	-5.96	2.44	-13.05
	Males 30-59	1.47	5.18	4.34	-0.01	11.34
	Males 60 & over	-1.73	-4.34	-2.52	2.09	-6.45
	Females 16-29	-1.47	-10.80	-6.60	2.11	-16.19
	Females 30-59	1.72	5.81	4.30	0.17	12.45
	Females 60 & over	-2.93	-7.49	-5.84	-1.80	-16.97
	Total Population	***0.26***	***0.31***	***0.58***	***0.61***	***1.76***
'Other Conurbations'	Persons < 16	0.70	3.68	0.09	-2.98	1.39
	Males 16-29	-4.18	-13.88	-8.35	-0.01	-24.38
	Males 30-59	1.44	4.99	2.60	-0.76	8.44
	Males 60 & over	-0.36	-1.23	-0.18	3.99	2.16
	Females 16-29	-4.34	-14.42	-8.68	0.25	-25.04
	Females 30-59	1.44	5.31	2.95	-0.60	9.32
	Females 60 & over	-1.45	-4.28	-3.82	0.05	-9.21
	Total Population	***-0.49***	***-0.99***	***-0.94***	***-0.57***	***-2.96***
'Urban'	Persons < 16	1.40	5.22	2.60	-1.51	7.82
	Males 16-29	-2.61	-10.35	-7.01	1.64	-17.48
	Males 30-59	2.09	7.59	5.29	1.26	17.09
	Males 60 & over	0.66	2.78	3.57	7.25	14.92
	Females 16-29	-2.77	-10.74	-7.50	-0.16	-19.85
	Females 30-59	2.16	7.36	5.16	-0.69	14.54
	Females 60 & over	0.77	0.94	1.14	2.79	5.74
	Total Population	***0.64***	***2.03***	***1.74***	***0.91***	***5.43***
'Rural'	Persons < 16	1.22	5.16	2.71	2.11	11.63
	Males 16-29	-2.10	-9.54	-6.64	1.70	-15.91
	Males 30-59	1.86	7.97	5.75	2.43	19.13
	Males 60 & over	-0.19	3.11	3.87	8.06	15.50
	Females 16-29	-2.52	-10.16	-7.29	1.82	-17.33
	Females 30-59	2.37	7.75	5.62	2.46	19.36
	Females 60 & over	0.96	1.40	1.55	5.65	9.83
	Total Population	***0.63***	***2.39***	***2.08***	***3.17***	***8.51***
All Area Types	Persons < 16	1.33	5.34	2.48	-0.37	8.99
	Males 16-29	-2.49	-10.44	-6.95	1.53	-17.50
	Males 30-59	1.85	7.04	4.93	1.19	15.75
	Males 60 & over	-0.02	1.53	2.51	6.56	10.88
	Females 16-29	-2.77	-11.13	-7.49	0.79	-19.43
	Females 30-59	2.07	7.00	4.88	0.38	14.97
	Females 60 & over	0.08	-0.62	-0.16	2.88	2.16
	Total Population	***0.42***	***1.49***	***1.32***	***1.36***	***4.67***

Table 13. Annual rates of population change by age and sex for the four NTS area types, 1989 to 2006, using the Method 3 conditional probabilities.

NTS Area Types	Age/Sex Groups	1989-91 (% pa)	1991-96 (% pa)	1996-2001 (% pa)	2001-06 (% pa)	1989-2006 (% pa)
'London'	Persons < 16	1.08	1.62	0.87	0.13	0.90
	Males 16-29	-0.49	-1.84	-1.22	0.48	-0.82
	Males 30-59	0.73	1.01	0.85	-0.00	0.63
	Males 60 & over	-0.87	-0.88	-0.51	0.41	-0.39
	Females 16-29	-0.74	-2.26	-1.36	0.42	-1.03
	Females 30-59	0.86	1.14	0.84	0.03	0.69
	Females 60 & over	-1.48	-1.54	-1.20	-0.36	-1.09
	Total Population	***0.13***	***0.06***	***0.11***	***0.12***	***0.10***
'Other Conurbations'	Persons < 16	0.35	0.73	0.02	-0.60	0.08
	Males 16-29	-2.11	-2.94	-1.73	-0.00	-1.63
	Males 30-59	0.72	0.98	0.51	-0.15	0.48
	Males 60 & over	-0.18	-0.25	-0.04	0.79	0.13
	Females 16-29	-2.19	-3.07	-1.80	0.05	-1.68
	Females 30-59	0.72	1.04	0.58	-0.12	0.53
	Females 60 & over	-0.73	-0.87	-0.78	0.01	-0.57
	Total Population	***-0.25***	***-0.20***	***-0.19***	***-0.11***	***-0.18***
'Urban'	Persons < 16	0.70	1.02	0.52	-0.30	0.44
	Males 16-29	-1.31	-2.16	-1.44	0.33	-1.12
	Males 30-59	1.04	1.47	1.04	0.25	0.93
	Males 60 & over	0.33	0.55	0.70	1.41	0.82
	Females 16-29	-1.39	-2.25	-1.55	-0.03	-1.29
	Females 30-59	1.07	1.43	1.01	-0.14	0.80
	Females 60 & over	0.39	0.19	0.23	0.55	0.33
	Total Population	***0.32***	***0.40***	***0.35***	***0.18***	***0.31***
'Rural'	Persons < 16	0.61	1.01	0.54	0.42	0.65
	Males 16-29	-1.05	-1.99	-1.36	0.34	-1.01
	Males 30-59	0.93	1.55	1.12	0.48	1.04
	Males 60 & over	-0.09	0.61	0.76	1.56	0.85
	Females 16-29	-1.27	-2.12	-1.50	0.36	-1.11
	Females 30-59	1.18	1.50	1.10	0.49	1.05
	Females 60 & over	0.48	0.28	0.31	1.10	0.55
	Total Population	***0.32***	***0.47***	***0.41***	***0.63***	***0.48***
All Area Types	Persons < 16	0.66	1.05	0.49	-0.07	0.51
	Males 16-29	-1.25	-2.18	-1.43	0.30	-1.12
	Males 30-59	0.92	1.37	0.97	0.24	0.86
	Males 60 & over	-0.01	0.30	0.50	1.28	0.61
	Females 16-29	-1.39	-2.33	-1.55	0.16	-1.26
	Females 30-59	1.03	1.36	0.96	0.08	0.82
	Females 60 & over	0.04	-0.12	-0.03	0.57	0.13
	Total Population	***0.21***	***0.30***	***0.26***	***0.27***	***0.27***

5. PROJECTED POPULATIONS BY THE FOUR NTS CATEGORIES

Tables 11, 12 and 13 report the results of a study of converting the mid-1989 based population projections to four NTS area types (i.e. 'London', 'Other Conurbations', 'Urban', and 'Rural') and seven age/sex groups.

5.1 Comparison of 1989 and 1992 based projections

Before discussing the nature of the population changes forecast and their implications for trip making, it is useful to compare these 1989 based projections with more recent projections that use the mid-1992 population as a base. The 1989 based projections predict a Great Britain population of 58.334 millions in 2006 while the mid-1992 based projections raise this figure to 58.923 millions, an increase of 589 thousand (OPCS 1995, Table 2, p45). This increase is in small part accounted for by an upward revision of the population estimate base consequent on the 1991 Census of some 22 thousand. But the major reason for the upward revision is the improvement in elderly mortality assumptions that reflect better survival chances in late middle and early old age. Because the extra population will be old this will reduce the impact of the upward revision on trip mileage rates in the future. The 1989 based projection foresees 4.7% population growth to 2006 while the 1989-2006 growth implicit in the 1992 based projection is 5.6%.

5.2 The shifts in population across area type

Table 11 shows that the population is projected by the Census Offices to continue to shift in long established ways from higher density areas to lower. The share of the population in 'Rural' areas (small urban places between 3,000 and 25,000 and non-urban areas) continues to increase from 30.0% of the GB population in 1989 to 31.1% in 2006. The 'Urban' area type population share also increases but only from 43.0% to 43.4%. 'Other Conurbations' lose population share, moving from 14.9% to 13.8% of the GB population. 'London' also loses share from 12.0% to 11.7%, but does experience population growth, while the 'Other Conurbations' actually lose population. These shifts are in the direction of encouraging further growth in trip making and mileage because households in rural areas have much higher than average trip mileage rates.

5.3 The pattern of change by age/sex group

The pattern of age/sex group change is more complicated. The under 16 age group is projected to grow both absolutely and in share of the population from 20.0% to 20.8%. This is a result of the increase in the female population in the childbearing ages over the period (a baby boom echo effect) combined with an assumption of some recovery in fertility rates towards replacement level. In the 1989 based projections it is assumed a total fertility rate of 2.1 is achieved, though in subsequent projection this ultimate level has been lowered to 2.0 (in 1991) and 1.9 (in 1993), as no signs of a fertility rate recovery have appeared.

Both males aged 16-29 and females aged 16-29 experience substantial declines in all area types over the 1989-2006 period as the baby boom cohorts (1957-1971) move entirely out of this age range by 2006. The flip side is a substantial increase in the 30-59 age group for both sexes as these larger cohorts move into the older working ages.

The pattern of change for the elderly (60+) differs a little between the sexes. While males age 60+ experience gains of 5.6%, females experience some losses in intermediate years and an overall gain in 1989-2006 of only 0.9%. The explanation of this divergence of male and female trends is rooted in their different recent and assumed future mortality experience. Male death rates at ages 45-74 have been improving considerably faster over the last quarter century than those for women, though of course female mortality is still much lower at any given age. Table 14 sets out selected male and female mortality rates in 1971 and 1992. The percentage improvement in male mortality is between 7 and 12 percent more than that for females. The bottom part of the table suggests why this might be occurring. Males reduced their smoking earlier than women and this has resulted in later decreases in lung cancer rates. Ischaemic heart disease rates are also falling for males. For women the cohort of heavy smokers is now entering vulnerable ages and lung cancer and heart disease rates are on the increase. Although most other causes of death are in retreat, the table picks out two serious epidemics of cancer among men (prostate) and women (breast) which are still on the increase, the latter despite extensive screening and awareness campaigns.

5.4 The combined pattern of area type and age/sex change

5.4.1 NTS Area Type 1: 'London'

From 1989 to 2006, the 'London' population is projected to rise from 6.7 million in 1989 to 6.8 million in 2006, i.e. increasing by 1.76% in total (or 0.1% p.a.) within this period. In terms of population compositions, the figures show that there is a rapid decline in population between ages 16 and 29, and age 60 or over. It is notable that the decline for females in London is significantly higher than for male counterparts for ages 60 and over. From 1989 to 2006, the decrease is 16.97% in total (or 1.09% p.a.) for females and 6.45% (or 0.39% p.a.) in total for males . For the age group 16-29, the decrease is 13.05% in total (or 0.82 p.a.) for males and 16.19% in total (or 1.03% p.a.) for females. For ages 15 and under, there is an increase of population by 16.4% in total (or 0.9% p.a.) over the projection years.

5.4.2 NTS Area Type 2: 'Other Conurbations'

From 1989 to 2006, population in 'Other Conurbations' is projected to fall from 8.3 million in 1989 to 8.0 million in 2006, i.e. by 2.96% in total (or 0.18% p.a.). In terms of population compositions, the population analysis shows that there is a significant decline in population between ages 16 and 29 for both males and females. The male population between ages 16 and 29 declines by 24.38% in total (or 1.63% p.a.) and the female population falls by 25.04% in total (or 1.68% p.a.). For ages 60 or over, the decline for the female population is 9.21% in total (or 0.57% p.a.) and for the male population 2.16% in total (or 0.13% p.a.).

Table 14. Selected male and female mortality rates in 1971 and 1992

Sex and age group	1971	1992	1992 as % of 1971
Male			
45-54	7.1	4.3	56
55-64	20.1	13.4	67
65-74	50.5	37.3	74
Female			
45-54	4.3	2.7	63
55-64	10.0	7.9	79
65-74	26.1	21.5	82
Causes of death			
Male			
Lung cancer	105.2	90.3	86
Prostate cancer	16.9	32.7	193
Ischaemic heart disease	347.5	315.5	91
Female			
Lung cancer	22.2	42.0	189
Breast cancer	44.3	52.2	118
Ischaemic heart disease	237.9	254.9	107

Notes:

1. The age-specific mortality rate = deaths per 1,000 population per annum.
2. The cause-specific mortality rates = deaths per 100,000 population per annum.

Source: OPCS (1995), Table 13, p.57 and Table 14, p.58.

5.4.3 NTS Area Type 3: 'Urban'

Contrary to the 'Other Conurbations' area type, the population in 'Urban Area' is projected to rise from 23.99 million in 1989 to 25.29 million in 2006, i.e. by 5.43% in total (or 0.31% p.a.). In terms of the structure of age and sex, population between ages 16 to 29 falls by 17.48% in total (or 1.12% p.a.) for males and 19.85% in total (or 1.29% p.a.) for females. For people age 60 or above, there is an increase of the population of 14.92% in total (or 0.82% p.a.) for males and 5.74% in total (or 0.33% p.a.) for females. From our findings, it is notable that the increase of males aged 60 or above is significantly higher than females in the same age group. In general, there is an increase of population for all the other age groups.

5.4.4 NTS Area Type 4: 'Rural'

In 'Rural' areas, there is an increase of the overall population of approximately 8.51% in total (or 0.48% p.a.) for all ages over the projection years. In terms of age and sex compositions, there is a significant decrease of total population between ages 16 to 29. The average rate of decrease is 15.91% in total (or 1.01% p.a.) for males and 17.33% in total (or 1.11% p.a.) for females. For all the other age groups, rates of increase vary differently. In particular, the increase of males aged 60 or above is significantly higher than for females in the same age group (10.88% in total, or 0.61% p.a., for males and 2.16% in total, or 0.13% p.a., for females).

6. IMPLICATIONS FOR TRIP MAKING

Is the future demographic and geographic evolution of the GB population going to have an impact on transport demand, that is, on trip making and trip distances covered? It is useful here to carry out some very simple calculations to get a feel for the likely order of magnitude of the effects. A more detailed analysis is in preparation. Table 15 summaries our estimates of the distribution of the Great Britain population according to the two classifications of settlement type and age/sex which can be produced from the projected populations. Column (2) contains the percentage shares across the classifications in 1989 and column (3) shows the projected percentage shares in 2006. Column (4) shows how population is projected to redistribute between categories. 'London' and 'Other conurbations' lose share; the smaller 'Urban' places and 'Rural' areas gain share. The population under 16 years of age becomes a higher proportion of the total population between 1989 to 2006; males and females aged 16-29 both lose share along with females aged 60 and over, while the older labour force ages (males and females aged 30-59) gain share. The final piece of information in Table 15 is the average trip mileage rate (miles per person per week) for each population stratum. This is listed in column (1).

Table 15. Data for the calculation of the effect of demographic change on transport demand

	Trip Mileage Rate 1985/86	Population 1989	Population 2006	Change in % Share
	(Miles per person per week)	(% Share)	(% Share)	(1989 to 2006)
	(1)	(2)	(3)	(4)
'London'	109.44	12.0	11.7	-0.3
'Other Conurbations'	83.90	14.9	13.8	-1.1
'Urban'	106.12	43.0	43.4	0.4
'Rural'	130.67	30.0	31.1	1.1
All categories	*111.19*	*100.0*	*100.0*	*0.0*
Persons < 16	64.70	20.0	20.8	0.8
Males 16-29	159.64	11.2	8.8	-2.4
Males 30-59	192.14	18.6	20.6	2.0
Males 60+	82.29	8.8	9.3	0.5
Females 16-29	120.64	10.8	8.6	-2.2
Females 30-59	107.88	18.6	20.3	1.7
Females 60+	52.99	12.1	11.7	-0.4
All categories	*111.19*	*100.0*	*100.0*	*0.0*
Absolute nos. Population (=100%)		**55,733**	**58,334**	**2,601**

What increase in trip mileage would we expect if the only factor at work was simple population growth? The increase would merely be that of the population which grows by 2,601 thousand or by 4.7%.

What influence does changing spatial distribution of the population have on future trip mileage rates? Assuming no change in trip mileage rates for the settlement categories, the average trip mileage rate in 2006 would be:

$$ATMR_t = \sum_i (Pop_{t,i} / 100) * TMR_{85/86,i} \quad (6)$$

where $ATMR_t$ = The average trip mileage rate where t = 2006.

$Pop_{t,i}$ = Percentage share of population in area i where i =1 to 4. which represents the 4 NTS area types, and t = 2006.

$TMR_i^{85/86}$ = The 1985/86 trip mileage rate in area i.

The average trip mileage rate in 2006 is:

(11.7/100*109.44)+(13.8/100*83.90)+(43.4/100*106.12)+(31.1/100*130.67) = 111.09

In 1989 the equivalent average using the population shares shown in Table 15 rather than the sample shares in the 1985/86 NTS is:

(12.1/100*109.44)+(14.9/100*83.90)+(43.0/100*106.12)+(30.0/100*130.67) = 110.59

This is an increase in the trip mileage rate of 0.5 miles or 0.45%. The shift to lower density settlements is likely to have only a small additional effect on the average trip mileage rate.

What influence does changing demographic structure have on future trip mileage rates? Assuming no change in trip mileage rates from their 1985/86 base as before, the average trip mileage rate based on the age/sex classification would be in 2006:

(20.8/100*64.7)+(8.8/100*159.64)+(20.6/100*192.14)+(9.3/100*82.29)+(8.6/100*120.64)
+(20.3/100*101.88)+(11.7/100*52.39) = 113.14

while in 1989, using the population weights it was:

(20.0/100*64.7)+(11.2/100*159.64)+(18.6/100*192.14)+(8.8/100*82.29)+(10.8/100*120.64)
+(18.6/100*101.88)+(12.1/100*52.39) = 113.23

The average trip mileage rate under these assumption decreases by 0.07% (or 0.09 miles), as a result of the pattern of age-sex structure changes. The changes in population age structure have a countervailing effect as population shifts from the economic active groups to the retirement groups.

7. CONCLUSIONS

In this paper, three different methods used to transform official OPCS 1989-based subnational projection data for use in transport analysis were examined and the findings of the third transformation method were reported. A good deal of effort was expended on successively improving the way in which official projection results were converted into results of greater significance for transport analysis. From the findings, changes in the future demographic and geographic distribution of the GB population have the following impacts on travel demand.

(1) Population change alone, holding other things constant will add 4.7% to trip making.

(2) The shift to lower density settlements is likely to have only an additional small effect, but to increase trip mileage rates by 0.45%.

(3) The changes in population age structure will have a countervailing effect as population shifts from the most mobile ages to less mobile ages, but this is probably only going to be of the order of -0.07%.

These changes in trip mileage rates are very small compared with the changes in annual trip mileage per person of 20.92% that have occurred between the NTS Survey of 1985/86 (used in this study) and that of 1991/93. Our conclusion must be that future spatial population dynamics in Great Britain will have only marginal effects on the number and length of trips that are made in 2006.

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