# MIGRATION AND SETTLEMENT:
# 1. UNITED KINGDOM

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## FOREWORD

Interest in human settlement systems and policies has been a central part of urban-related work at the International Institute for Applied Systems Analysis (IIASA) from the outset. From 1975 through 1978 this interest was manifested in the work of the Migration and Settlement Task, which was formally concluded in November 1978. Since then, attention has turned to dissemination of the Task's results and to the conclusion of its comparative study, which under the leadership of Dr. Frans Willekens is focusing on a comparative quantitative assessment of recent migration patterns and spatial population dynamics in all of IIASA's 17 National Member Organization countries.

The comparative analysis of national patterns of interregional migration and spatial population growth is being carried out by an international network of scholars who are using methodology and computer programs developed at IIASA.

In this report, the first of a series, Dr. Philip Rees of the University of Leeds analyzes population dynamics in the United Kingdom and discusses the effects of national population distribution policies. Conventional methods and recently developed multiregional techniques are used to explore the impacts of recent demographic changes.

Reports summarizing previous work on migration and settlement at IIASA are listed at the end of this report.

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## ACKNOWLEDGMENTS

Andrei Rogers deserves my thanks for leading the way in the field of multiregional population analysis in such an innovative fashion. Frans Willekens earns my gratitude and thanks for running my rough and ready British data through his elegantly written computer programs. Rosanna Whitehead and Susan Hughes did an excellent job in converting my original manuscript into typed form, and Gordon Bryant and John Dixon skillfully translated my draft figures into finished illustrations. The responsibility for errors or omissions in the paper, however, lies solely with me.

CONTENTS

# 1 INTRODUCTION

## 1.1 PRIOR WORK AND PROPOSED TOPICS FOR FURTHER STUDY

The distribution of population in the United Kingdom of Great Britain and Northern Ireland has long been of interest to social scientists, and this interest has been coupled with a concern for understanding how migration patterns affect population distribution. Thus, Ravenstein (1885) analyzed the pattern of migratory flows into and out of the counties of the British Isles (then one country). More recently, the pattern of population change has been reviewed in several works (Eversley 1971; Lawton, 1973, 1977; Champion, 1976), and a major study by the Department of the Environment has reported on regional change in the period 1951 to 1969 (Department of the Environment, 1971).

In this paper, an attempt is made to build on those previous reviews in 2 ways. The picture of migration and settlement is extended well into the 1970s in terms of time-series data, and a long look into the future is taken, using models developed by Rogers (1975) and Rees and Wilson (1977) that enable the multiregional dynamics of population change to be studied.

Current patterns of spatial population growth are reviewed in Section 2 of the paper, and the multiregional analysis is described in Section 3. Section 4 reviews the extent to which a population distribution policy has existed and to what degree this policy has been effective. In the remainder of this first section of the paper, the broad historical picture of population change in the regions of the United Kingdom is described, after a brief consideration of the way in which the set of British regions have been defined over time.

## 1.2 DEFINITION OF THE SET OF REGIONS

Regions are divisions of national territory that share common characteristics of one kind or another. In the United Kingdom they have not in modern times been governmental units (with a few exceptions) but rather have been created for statistical or analytic purposes. Since the Second World War "standard" regions have been defined, for which many governmental statistical series are published, and for which advisory Economic Planning Councils have been established. The intention has been that the regional boundaries of dispersed offices of central government departments and nationalized industries follow those of the standard set, although this has rarely been achieved in practice.

The number of regions defined has in this period fluctuated around 11. There seems to be broad agreement that such a number provides sufficient variation across the country to be interesting without involving excess detail and problems of statistical variability characteristic of very small areas. Such a number is also convenient from a population modeling standpoint.

Unfortunately, in their relatively short history the standard regions have changed shape and size considerably, as Figure 1 reveals. Prior to 1 April 1965 there were some 10 standard regions in England and Wales to which we have added the 2 "national" units of Scotland and Northern Ireland, making a total of 12. After 1 April 1965 the number was reduced to 11 with the reorganization of the Eastern, London and South Eastern, and Southern regions into the South East and East Anglia regions, and with further boundary changes elsewhere. These were the regions current at the Census of 1971, the source of much of the migration data analyzed in Section 3. After 1 April 1974 the regional boundaries were further adjusted to accord with the reorganization of the local government county and district boundaries in England and Wales.

The region set used here is as follows:

| | | | |
|---|---|---|---|
| North | England | England and Wales | United Kingdom |
| Yorkshire and Humberside | | | |
| North West | | | |
| East Midlands | | | |
| West Midlands | | | |
| East Anglia | | | |
| South East | | | |
| South West | | | |
| Wales | | | |
| Scotland | | Great Britain | |
| Northern Ireland | | | |

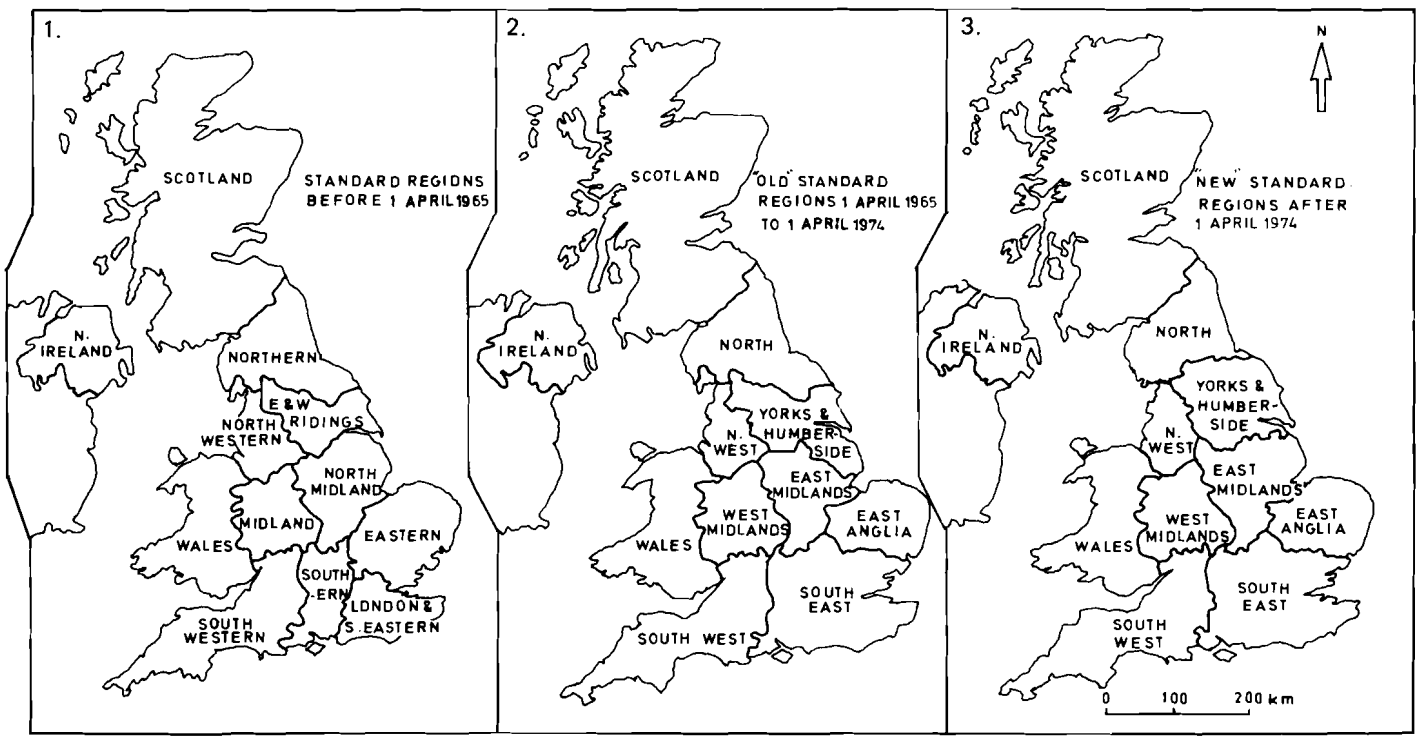


FIGURE 1 The changing regional definitions in the United Kingdom.

Some analyses that follow refer to the regional boundaries current from 1 April 1965 to 1 April 1974 and some to the post-1 April 1974 boundaries. The first set is referred to as the "old" regions (Figure 1.2) and the second set as the "new" regions. Some analyses include Northern Ireland, and hence are truly analyses of the United Kingdom. Others exclude Northern Ireland and refer only to the 10 regions of Great Britain. The 4 national units (England, Wales, Scotland, Northern Ireland) retain constant regional boundaries throughout, but of the English regions only the West Midlands (called the "Midlands" prior to 1 April 1965) is as fortunate. Table 1 sets out the approximate conversion matrices that convert one set of regional data to another.

## 1.3 BROAD HISTORICAL TRENDS

Table 2 shows the estimated regional breakdown of the population in absolute numbers and percentage shares (using the "old" region definitions) from 1801 (the year of the first Great Britain census) to 1971 (the year of the latest UK census). The final column of the table gives the mid-1971 estimate of the regional population under the "new" region definitions. Figure 2 plots the percentage shares on a graph against the relevant year. It is worth considering the trends in some detail – they reveal the rise and fall of the fortunes of the various regions and also give a warning that trends in population should not be expected to continue indefinitely.

The largest region throughout the period was the South East, containing the capital London. Its share of the national population expanded continuously from 22 percent in 1801 to 31 percent in 1971, although 1801–1851 saw little change. Conversely, throughout the period the second largest region in 1801, Scotland, suffered a continuous decline from just over 14 percent of the UK population to just above 9 percent. Of the other "Celtic" fringe countries, Wales saw its share of the national population "cake" hover around 5 percent throughout the period, whereas Northern Ireland saw a substantial relative loss, particularly during the Potato Famine of 1848 and its aftermath. In fact, Northern Ireland has yet to regain its population peak recorded in 1841. High volume emigration has been characteristic of this region.

The northern regions of England (the North, Yorkshire and Humberside, and the North West) attained peaks in their shares of the national population "cake" in the 1891–1931 period and declined thereafter. The West and East Midlands maintained or increased their

shares moderately from 1891. These trends reflect the earlier boom in the staple industries of the northern regions (coal, steel, textiles, shipbuilding) with their subsequent slower growth or decline, and the greater success of the more diverse (engineering, cars, and aircraft) base of the Midlands' economy in the twentieth century.

Finally, we may note that throughout the period to 1931 the dominantly agricultural populations of the South West and East Anglia declined in relation to the other regions. Since 1931 they have experienced gains as the locational attraction for industry has shifted from those areas providing raw materials and power to those with proximity to market place (the South East) and amenity.

These shifts in population shares among the regions were taking place across a background of largely continuous national and regional population growth (the only decreases in Table 2 being in 1841–1851, 1851–1891, and 1911–1931 in Northern Ireland). Rates of growth, expressed as annual averages per 1000 in Table 3, show, however, a substantial deceleration of the population increase by the 1911–1931 period to a level that fluctuates around 5.0 per 1000, or 0.5 percent, per year up to the 1961–1971 period. The decline from growth rates averaging 14 per 1000 per annum to rates of 5 per 1000 constitutes the net result of the demographic transition as it has taken place in North West Europe (Bogue, 1969). One should note that in only one instance (the North West between 1801 and 1851) did regional growth rates attain the rate current for the world population in 1970–1971 (around 2 percent), and all these rates fall far below those in the majority of developing countries today.

The reasons for this lack of historical parallel are twofold: mortality in nineteenth-century Britain was greater, and fertility was lower than in the contemporary Third World. Figure 3 documents for England and Wales the course of the demographic transition. Parts 1 and 2 of Figure 3 show that fertility began to fall in the 1870s and that the transition to low fertility levels (as indexed by a net reproduction rate of 1 or below) was attained by 1915–1920. The fall in mortality paralleled that of fertility until the period 1911–1915, after which it slowed down. Only then did natural increase rates fall below 10 per 1000 per annum. Zero natural increase was almost achieved in the 1930s. The period following the Second World War saw fluctuating fertility levels, higher on average than the 1930s, until the post-1964 decline had continued far enough for zero natural increase (or slight decrease) to be achieved in 1976 and 1977. The net migration component of population change played a relatively minor role at the national level in England and Wales, although in Scotland and Northern Ireland it played a very important part.

TABLE 1A Regional conversion matrices showing the proportional distribution of the population of "before" regions into "after" regions, United Kingdom.

| Regions before 1 April 1965 ("Before") | Regions 1 April 1965 to 1 April 1974 ("Old" regions (OR)) ("After") | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | YH | NW | EM | WM | EA | SE | SW | W | S | NI | Total |
| Northern | 1 | | | | | | | | | | | 1 |
| East & West Ridings | | 1 | | | | | | | | | | 1 |
| North Western | | | 1 | | | | | | | | | 1 |
| North Midland | | 0.1404 | | 0.8492 | | 0.0104 | | | | | | 1 |
| Midland | | | | | 1 | | | | | | | 1 |
| Eastern | | | | | | 0.3714 | 0.6286 | | | | | 1 |
| London & South Eastern | | | | | | | 1 | | | | | 1 |
| Southern | | | | | | | 1 | | | | | 1 |
| South Western | | | | | | | | 1 | | | | 1 |
| Wales | | | | | | | | | 1 | | | 1 |
| Scotland | | | | | | | | | | 1 | | 1 |
| Northern Ireland | | | | | | | | | | | 1 | 1 |

TABLE 1B Regional conversion matrices showing the proportional distribution of the population of "before" and "after" regions, United Kingdom.

| Regions 1 April 1965 to 1 April 1974 ("Before") | Regions after 1 April 1974 ("New" regions (NR)) ("After") | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | YH | NW | EM | WM | EA | SE | SW | W | S | NI | Total |
| North (N) | 0.9184 | 0.0816 | | | | | | | | | | 1 |
| Yorkshire & Humberside (YH) | | 0.9656 | | 0.0344 | | | | | | | | 1 |
| North West (NW) | 0.0152 | | 0.9734 | 0.0115 | | | | | | | | 1 |
| East Midlands (EM) | | 0.0029 | | 0.9971 | | | | | | | | 1 |
| West Midlands (WM) | | | | | 1 | | | | | | | 1 |
| East Anglia (EA) | | | | | | 1 | | | | | | 1 |
| South East (SE) | | | | | | | 0.9893 | 0.0107 | | | | 1 |
| South West (SW) | | | | | | | | 1 | | | | 1 |
| Wales (W) | | | | | | | | | 1 | | | 1 |
| Scotland (S) | | | | | | | | | | 1 | | 1 |
| Northern Ireland (NI) | | | | | | | | | | | 1 | 1 |

SOURCE: Rees (1978b).

TABLE 2 Population at selected censuses 1801–1971, UK regions.[a]

| Region | Population (1000s) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1801 | 1851 | 1891 | 1911 | 1931 | 1951 | 1961 | 1971 | 1971[b] |
| N | 634 | 1,161 | 2,215 | 2,815 | 3,038 | 3,137 | 3,250 | 3,296 | 3,137 |
| YH | 809 | 1,794 | 3,115 | 3,877 | 4,285 | 4,522 | 4,635 | 4,479 | 4,868 |
| NW | 885 | 2,531 | 4,714 | 5,796 | 6,197 | 6,447 | 6,567 | 6,743 | 6,602 |
| EM | 651 | 1,166 | 1,776 | 2,263 | 2,531 | 2,893 | 3,100 | 3,390 | 3,635 |
| WM | 854 | 1,705 | 2,664 | 3,277 | 3,743 | 4,423 | 4,758 | 5,110 | 5,121 |
| EA | 625 | 1,049 | 1,105 | 1,192 | 1,232 | 1,382 | 1,470 | 1,669 | 1,686 |
| SE | 2,499 | 5,102 | 9,171 | 11,744 | 13,539 | 15,127 | 16,271 | 17,230 | 16,994 |
| SW | 1,349 | 2,255 | 2,471 | 2,687 | 2,794 | 3,229 | 3,411 | 3,781 | 4,088 |
| W | 587 | 1,163 | 1,771 | 2,421 | 2,593 | 2,599 | 2,644 | 2,731 | 2,723 |
| S | 1,608 | 2,889 | 4,026 | 4,761 | 4,843 | 5,096 | 5,179 | 5,229 | 5,217 |
| NI | (1,649)[c] | 1,443 | 1,236 | 1,251 | 1,243 | 1,371 | 1,425 | 1,528 | 1,538 |
| TOTAL UK | (20,183)[c] | 22,259 | 34,264 | 42,082 | 46,038 | 50,225 | 52,709 | 55,507 | 55,610 |
| TOTAL EW[d] | 8,893 | 17,927 | 29,002 | 36,070 | 39,952 | 43,758 | 46,105 | 48,750 | 48,854 |
| TOTAL GB | 10,501 | 20,816 | 33,028 | 40,831 | 44,795 | 48,854 | 51,284 | 53,979 | 54,071 |

| Region | Shares of the UK population | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1801[e] | 1851 | 1891 | 1911 | 1931 | 1951 | 1961 | 1971 | 1971[b] |
| N | 5.49 | 5.22 | 6.46 | 6.69 | 6.60 | 6.25 | 6.17 | 5.94 | 5.64 |
| YH | 7.02 | 8.06 | 9.09 | 9.21 | 9.31 | 9.00 | 8.79 | 8.65 | 8.75 |
| NW | 7.68 | 11.37 | 13.76 | 13.77 | 13.46 | 12.84 | 12.46 | 12.15 | 11.87 |
| EM | 5.65 | 5.24 | 5.18 | 5.38 | 5.50 | 5.76 | 5.88 | 6.11 | 6.54 |
| WM | 7.40 | 7.66 | 7.77 | 7.79 | 8.13 | 8.81 | 9.03 | 9.21 | 9.21 |
| EA | 5.42 | 4.71 | 3.22 | 2.83 | 2.68 | 2.75 | 2.79 | 3.01 | 3.03 |
| SE | 21.67 | 22.92 | 26.77 | 27.91 | 29.41 | 30.12 | 30.87 | 31.04 | 30.56 |
| SW | 11.70 | 10.13 | 7.21 | 6.39 | 6.07 | 6.43 | 6.47 | 6.81 | 7.35 |
| W | 5.09 | 5.22 | 5.17 | 5.75 | 5.63 | 5.10 | 5.02 | 4.92 | 4.90 |
| S | 13.95 | 12.98 | 11.75 | 11.31 | 10.52 | 10.15 | 9.83 | 9.42 | 9.38 |
| NI | 8.92 | 6.48 | 3.61 | 2.97 | 2.70 | 2.73 | 2.70 | 2.75 | 2.77 |
| TOTAL UK | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| TOTAL EW[d] | 77.13 | 80.54 | 84.64 | 85.71 | 86.78 | 87.12 | 87.47 | 87.83 | 87.85 |
| TOTAL GB | 91.08 | 93.52 | 96.39 | 97.03 | 97.30 | 97.27 | 97.30 | 97.25 | 97.23 |

[a]The regions are the "old" standard regions, current at the 1971 Census; source: OPCS (1974c), Table 2, p. 2. The elements in each column of the table and the column totals were independently rounded from figures in the table source. In certain cases this may lead to a difference in the last figure between the sum of column elements and the column total given.

[b]These are the populations and shares of the "new" standard regions (post 1 April 1974) as at mid-year 1971; source: OPCS (1975b), Table 8, p. 40.

[c]These are 1841 populations; source: OPCS (1974a), Table A1, pp. 2–3.

[d]EW is the abbreviation used for England and Wales.

[e]The shares of the United Kingdom are estimated for 1801.

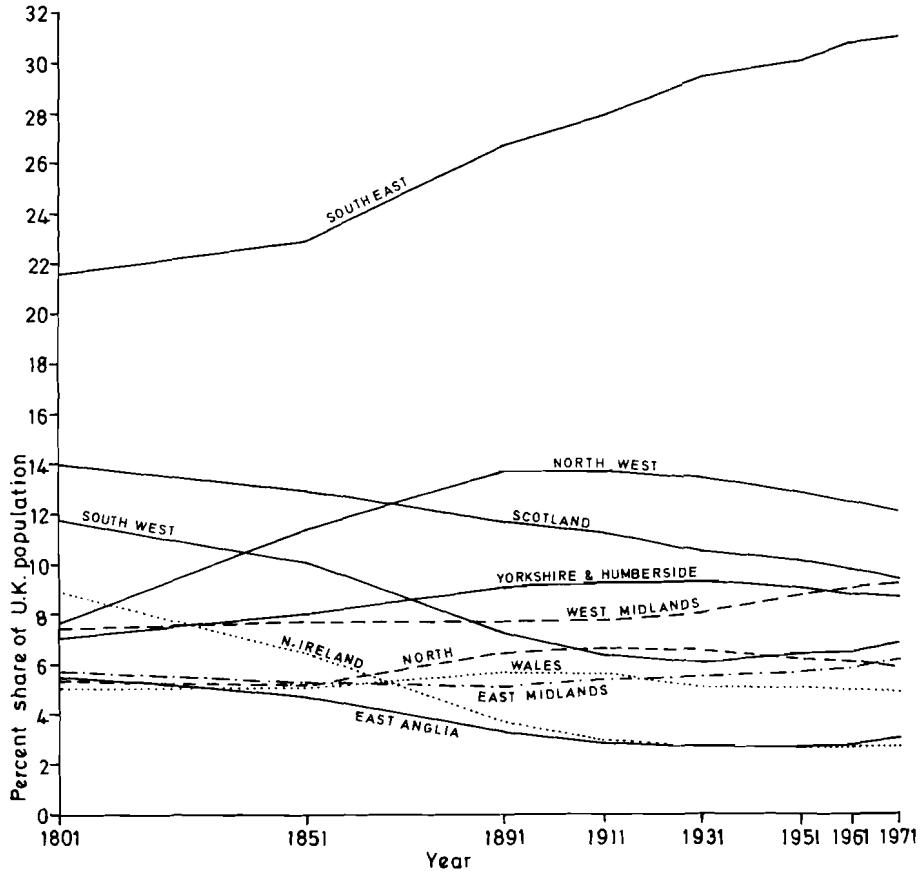


FIGURE 2 Regional shares of the UK population, 1801–1971.

Detailed data for the components of growth for the regional level are not available, although a reworking of the county-level information and the census tabulations of Ravenstein (1885) and Friedlander and Roshier (1966) would yield the required figures; some indication of regional general fertility and child mortality trends is, however, provided by Brass (1977). Table 4 compares general fertility rate levels (live births in a year divided by number of women aged 15 to 44 at mid-year) in 1876, 1928, and 1974 drawing on Tables 2A and 3 in Brass (1977) and regional statistics in Office of Population Censuses and Surveys (1977b). Although the comparison between the 2 sets of regions (those in Figure 1.1 and Figure 1.3 respectively) cannot be exact, and although the general fertility rate is influenced by the sex and age structure of the population, we can

TABLE 3 Average annual population growth rates per 1000 people. UK regions, 1801–1971.[a]

| Region | 1801–51 | 1851–91 | 1891–1911 | 1911–31 | 1931–51 | 1951–61 | 1961–71 |
|---|---|---|---|---|---|---|---|
| N | 12.1 | 16.1 | 12.0 | 3.8 | 1.6 | 3.5 | 1.4 |
| YH | 15.9 | 13.8 | 10.9 | 5.0 | 2.7 | 2.5 | 3.5 |
| NW | 21.0 | 15.5 | 10.3 | 3.3 | 2.0 | 1.8 | 2.6 |
| EM | 11.7 | 10.5 | 12.1 | 5.6 | 6.7 | 6.9 | 8.9 |
| WM | 13.8 | 11.2 | 10.4 | 6.6 | 8.3 | 7.3 | 7.1 |
| EA | 10.4 | 1.3 | 3.8 | 1.7 | 5.7 | 6.2 | 12.7 |
| SE | 14.3 | 14.7 | 12.4 | 7.1 | 5.5 | 7.3 | 5.7 |
| SW | 10.3 | 2.3 | 4.2 | 2.0 | 7.2 | 5.5 | 10.3 |
| W | 13.7 | 10.5 | 15.6 | 3.4 | 0.1 | 1.7 | 3.2 |
| S | 11.7 | 8.3 | 8.4 | 0.9 | 2.5 | 1.6 | 1.0 |
| NI | −13.3 | −3.9 | 0.6 | −0.3 | 4.9 | 3.9 | 7.0 |
| UK | 9.8 | 10.8 | 10.3 | 4.5 | 4.4 | 4.8 | 5.2 |
| EW | 14.0 | 12.0 | 10.9 | 5.1 | 4.5 | 5.2 | 5.6 |
| GB | 13.7 | 11.5 | 10.6 | 4.6 | 4.3 | 4.9 | 5.1 |

[a]Derived from Table 2 using the formula

$$g = \frac{1}{n} \ln (P(t+n)/P(t)) \times 1000$$

where $n$ = number of years in period, $P(t)$ = initial population, $P(t+n)$ = final population.

TABLE 4 General fertility rates for GB regions.

| | General fertility rates (GFRs) | | | | | |
|---|---|---|---|---|---|---|
| Brass's regions | 1876 | 1928 | 1965 | 1970 | 1974 | Current regions |
| London and S.E. | 139.0 | 59.0 | 89.6 | 79.3 | 64.8 | South East[c] |
| Eastern | 152.0 | 66.0 | 88.5 | 81.9 | 71.1 | East Anglia |
| Midland | 174.0 | 74.0 | 93.0 | 87.4 | 69.2 | West Midlands |
| North Western | 163.0 | 67.0 | 94.6 | 88.6 | 69.6 | North West |
| North Midland | 165.0 | 70.0 | 92.5 | 85.9 | 69.9 | East Midlands |
| Northern | 193.0 | 85.0 | 89.7 | 79.9 | 66.0 | North |
| South Western | 137.0 | 63.0 | 92.4 | 81.1 | 67.4 | South West |
| East/West Ridings | 170.0 | 68.0 | 92.3 | 89.0 | 68.5 | Yorkshire & Humberside |
| Southern | 144.0 | 67.0 | 89.6 | 79.3 | 64.8 | South East[c] |
| Wales | 170.0 | 77.0 | 88.7 | 82.8 | 70.0 | Wales |
| Scotland | 149.0[a] | 80.0[b] | 96.6 | 86.6 | 68.0 | Scotland |
| England and Wales | 157.0 | 68.0 | 91.8 | 83.6 | 67.6 | Great Britain |
| Regional map | Figure 1.1 | | Figure 1.2 | | Figure 1.3 | |
| Max/Min | 1.40 | 1.33 | 1.09 | 1.12 | 1.10 | |
| Coefficient of variation | 10.7 | 10.9 | 2.89 | 4.35 | 2.84 | |

| Brass's regions | Ranks 1876 | 1928 | 1965 | 1970 | 1974 | Current regions |
|---|---|---|---|---|---|---|
| London and S.E. | 10 | 11 | 8= | 10= | 10= | South East[c] |
| Eastern | 7 | 9 | 11 | 7 | 1 | East Anglia |
| Midland | 2 | 4 | 3 | 3 | 5 | West Midlands |
| North Western | 6 | 7 | 2 | 2 | 4 | North West |
| North Midland | 5 | 5 | 4 | 5 | 3 | East Midlands |
| Northern | 1 | 1 | 7 | 9 | 9 | North |
| South Western | 11 | 10 | 5 | 8 | 8 | South West |
| East/West Ridings | 4 | 6 | 6 | 1 | 6 | Yorkshire & Humberside |
| Southern | 9 | 8 | 8= | 10= | 10= | South East[c] |
| Wales | 3 | 3 | 10 | 5 | 2 | Wales |
| Scotland | 8 | 2 | 1 | 4 | 7 | Scotland |
| Correlation[d] | | 0.76 | 0.31 | 0.58 | 0.41 | |

[a]This is the Scottish GFR for 1870–1872 (average).
[b]This is the Scottish GFR for 1930–1932 (average).
[c]The South East is not included twice in post-1965 comparisons.
[d]Spearman's rho, $\rho_t$, is used

$$\rho_t = 1 - 6 \Sigma d_l^2/(N^3 - N),$$

where $d_l$ is the difference in rank on the two measures for the 7th region,

$N = 11$ for $\rho_{1876,1928}, \rho_{1928,1965}$;
$N = 10$ for $\rho_{1965,1970}, \rho_{1970,1975}$.

SOURCES: GFR, England and Wales regions, 1876 and 1928: Brass (1977), Table 2A, p. 83, GFR, Scotland, 1876, 1928, 1965 and 1970: Registrar General (1972), Table S1.5, p. 95. GFR, England and Wales regions, 1965: OPCS (1967), Table GG, pp. 146–147. GFR, England and Wales regions, 1970: OPCS (1972b), Table GG, pp. 147–150.

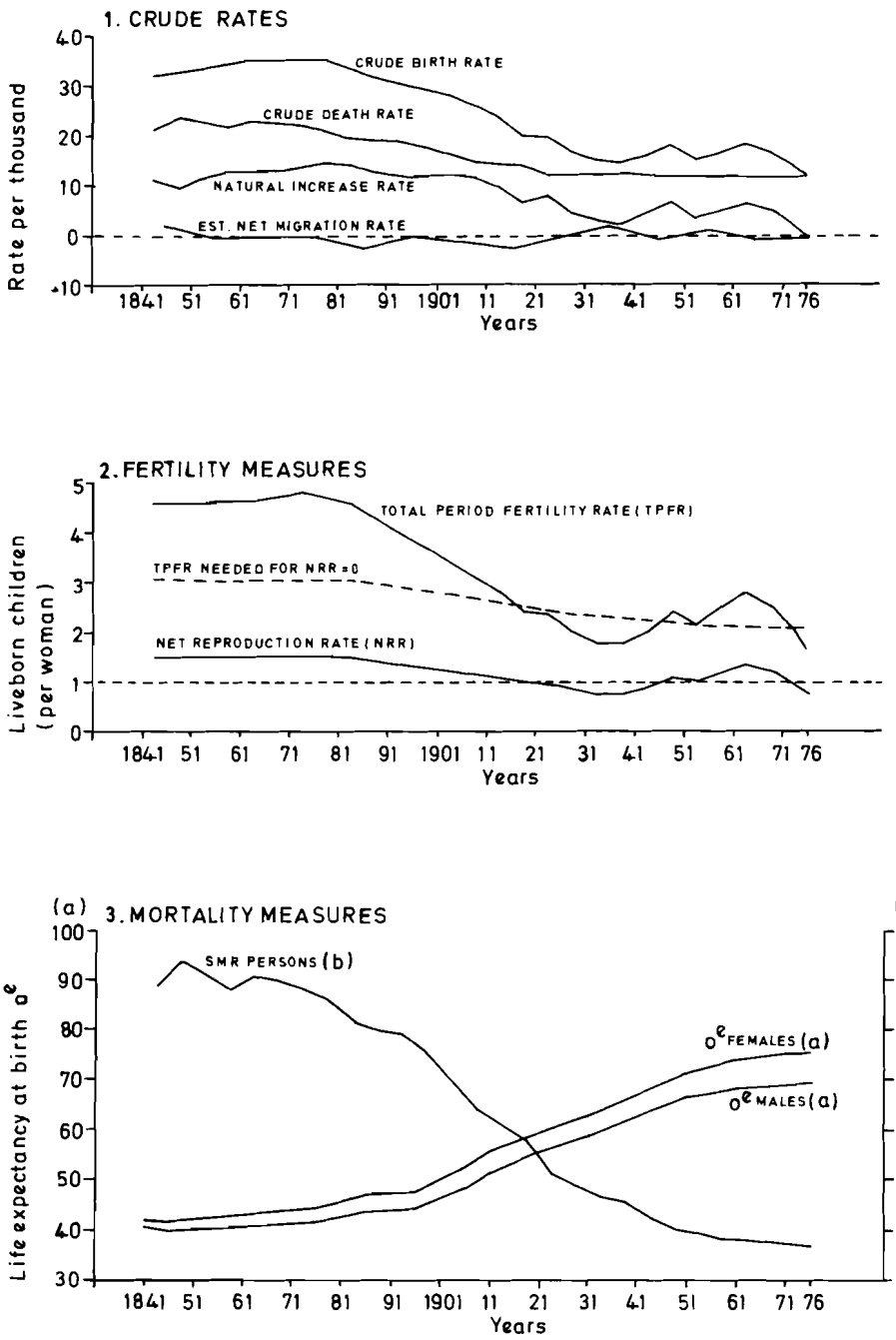


FIGURE 3 Time series of vital rates, England and Wales, 1841–1976, annual averages for 5-year periods. Source: OPCS (1974a, 1977a, 1978a,b).

make some broad generalizations. In the period of the demographic transition between 1876 and 1928 the regions exhibited parallel decline in fertility with little change in rank order. The rank correlation between the 1876 and 1928 general fertility rates was high (0.76). In the period of fluctuating fertility after 1928 the rank order of regions changed considerably, and the correlations between successive years in the table are low. East Anglia, for example, changed from being the lowest-ranked region in 1965 to the highest in 1974. Scotland changed from a first rank in 1965 to a seventh in 1974.

The variation among regions (within Great Britain, at least) in fertility levels has never been great, and the maximum–minimum ratio and coefficient of variation rows in Table 4 show that it has declined to almost zero. Fertility differentials have some influence on the pattern of population growth in 1876: the correlation (Pearson's $r$) between the "1851–91" column in Table 3 and the "1876" column in Table 4 is +0.55. This influence disappears for later years (the correlation between the "1911–31" column of Table 3 and the "1928" column of Table 4 is −0.25), and we show in Section 2 that most of the variation in rates of growth in the recent past among regions is due to migration. Natural increase levels (determined after 1921 predominantly by fertility levels) for the nation set the overall growth levels for the regions, but the variation among regions is controlled by the patterns of migration from one region to another.

To sum up, the regions of the United Kingdom in the early 1970s were characterized by low rates of growth, the general level of which was set by low and declining fertility; and the variation among growth and fertility rates was governed by migration. The established population trends were relative losses in the Northern and Celtic regions, and relative gains in the Midland and Southern regions. In Section 2 the components of UK multiregional demographic growth for the past one and a half decades are examined in detail, and particular attention is given to the 1970–1971 period when the most recent data on multiregional migration became available.

# 2 CURRENT PATTERNS OF SPATIAL POPULATION GROWTH

## 2.1 POPULATION CHANGE, 1965–1976

The focus in this section of the paper is on the last decade for which a full spectrum of regional data is available, for either "old" standard regions (Figure 1.2) or "new" standard regions (Figure 1.3). Particular attention will be paid to the pattern of population change around 1970–1971 for 2 reasons. This is the latest period for which census data on population and migration are available; the population and migration data from 1972 to 1976 are imperfect estimates rather than totally reliable statistics. The second reason is that in this period patterns of migration and settlement can be compared cross-nationally in the IIASA Comparative Migration and Settlement Study (Rogers, 1976a; Willekens, 1978).

Within the last decade population growth has ceased in the United Kingdom as a whole and in 7 out of 11 regions (Table 5). The full statistics of population change are set out in the form of aggregate population, components of change accounts in Appendix A, and the corresponding rates are set out in Appendix B. Table 5 extracts figures for selected years from Appendix B. All figures in Appendixes A and B are for the "new" regions (Figure 1.3) and are therefore not directly comparable with the figures in Table 2.

Among the 11 regions, 3 patterns of change can be discerned. First, the populations of Scotland, the North, Yorkshire and Humberside, and the North West all peaked in the early 1970s. The 4 regions were characterized by falling shares of the UK population throughout the 1965–1976 period (Figures 4 and 5). Second, the populations of Northern Ireland, the South East, and the West Midlands also peaked in the

TABLE 5 Population and percentage shares of UK regions, 1965, 1970, 1976.

| "New" region | Population (1000s) | | | Share (%) | | |
|---|---|---|---|---|---|---|
| | 1965 | 1970 | 1976 | 1965 | 1970 | 1976 |
| N | 3,126.0 | 3,134.0 | 3,121.6 | 5.77 | 5.65 | 5.58 |
| YH | 4,790.0 | 4,853.0 | 4,891.9 | 8.83 | 8.76 | 8.75 |
| NW | 6,519.0 | 6,589.0 | 6,553.4 | 12.02 | 11.89 | 11.72 |
| EM | 3,468.0 | 3,606.0 | 3,734.5 | 6.40 | 6.51 | 6.68 |
| WM | 4,910.0 | 5,094.0 | 5,164.5 | 9.06 | 9.19 | 9.23 |
| EA | 1,553.0 | 1,686.0 | 1,802.7 | 2.86 | 3.04 | 3.22 |
| SE | 16,609.0 | 16,965.0 | 16,893.7 | 30.63 | 30.61 | 30.21 |
| SW | 3,879.0 | 4,059.0 | 4,256.4 | 7.15 | 7.32 | 7.61 |
| W | 2,686.3 | 2,717.0 | 2,766.1 | 4.95 | 4.90 | 4.95 |
| S | 5,209.9 | 5,213.7 | 5,205.1 | 9.61 | 9.41 | 9.31 |
| NI | 1,468.2 | 1,527.4 | 1,538.1 | 2.71 | 2.76 | 2.75 |
| UK | 54,218.4 | 55,421.1 | 55,928.0 | 100.00 | 100.00 | 100.00 |
| EW | 47,540.3 | 48,680.0 | 49,184.8 | 87.68 | 87.84 | 87.94 |
| GB | 52,750.2 | 53,893.7 | 54,389.9 | 97.29 | 97.24 | 97.25 |

| "New" region | Year of peak population | | Year of peak share | |
|---|---|---|---|---|
| | 1801–61 | 1965–76 | 1801–61 | 1965–76 |
| N | 1961 | 1972 | 1911 | 1965 |
| YH | 1961 | 1975 | 1931 | 1965 |
| NW | 1961 | 1973 | 1891 | 1965 |
| EM | 1961 | 1976 | 1961 | 1976 |
| WM | 1961 | 1974 | 1961 | 1972 |
| EA | 1961 | 1976 | 1801 | 1976 |
| SE | 1961 | 1972 | 1961 | 1968 |
| SW | 1961 | 1976 | 1801 | 1976 |
| W | 1961 | 1976 | 1911 | 1965 |
| S | 1961 | 1971 | 1801 | 1965 |
| NI | 1841 | 1973 | 1801 | 1972 |
| UK | 1961 | 1974 | — | — |

SOURCES: Population, England and Wales regions, 1965, 1970, 1976: OPCS (1978e), Table 17, p. 45. Population, Scotland and Northern Ireland, 1965, 1970, 1976: OPCS (1978e), Table 2, p.33. Year of peak population and share 1801–61: Table 2. Year of peak population and share 1965–76: this table.

period (in 1973, 1972, and 1974, respectively); thereafter the regions were characterized by falling shares. In the first part of the period (to 1972, 1968, and 1972, respectively), however, these regions were still gaining in terms of UK population shares. Four regions continued to show population growth – namely, East Anglia, the South West, the East Midlands, and Wales. The first 3 showed gains in shares throughout the period; Wales joined the regions gaining shares after 1969 (Figures 4 and 5).

The most dramatic reversal of fortunes evident in Figures 4 and 5 is that of the South East region. The continuous population growth and accretion of population shares over the 1901–1971 period changes to loss of shares, and then to absolute loss of population. Underlying these population shifts is the decentralization of population out of London. Greater London experienced large net outflows of migrants of 75,000–100,000 each year and the Rest of South East gained slightly smaller net inflows of 12,000–100,000 each year (figures from Appendix A). There is evidence, however, of a marked slowdown in the growth of the Rest of South East, and a considerable reduction in the rate of net in-migration into the subregion towards the end of the period (see the appropriate table in Appendix B).

## 2.2 SIMPLE COMPONENTS OF POPULATION CHANGE, 1965–1976

It is possible to reconstruct, in part from published statistics and in part by estimation, a time series of the components of population change (Appendix A) for the new regions (Figure 1.3). From these simplest of "accounts", population change, natural increase, and net migration rates were computed and plotted for each region on a time-series graph (Figure 6). It is clear from these graphs that the variation amongst regions in terms of natural increase is very low, and that the pattern of change is very uniform. Natural increase reached a peak in 1964–1965 of between 5 and 9 per 1000 per annum, falling to a level of between 2 and 7 per 1000 by 1970–1971, and declining further to a range of −2 to 2 per 1000 in 1975–1976. Northern Ireland's natural increase rates remain about 5 per 1000 above the range on the British mainland, but show a parallel decline, at least from 1966 to 1967.

Net migration, on the other hand, shows no such uniform pattern over time over all regions. However, it is clear from the graphs that the patterns of population change discussed above stem largely from the levels and direction of net migration. This influence is confirmed by calculation

of the coefficients of correlation among the population change rate, the natural increase rate, and the net migration rate variables for the regions taken as a set in each mid-year to mid-year period (Table 6). The simple correlation between regional rate of population change and regional natural increase averages only + 0.20, whereas the equivalent average correlation between rate of population change and net migration rate is + 0.96.

The 4 regions losing relative shares throughout the whole period and absolute numbers in the latter part of the period – the North, Yorkshire and Humberside, the North West, and Scotland – all experienced net migration losses. The relative size of the losses (as measured by the net migration rate) decreased over the period, however, for all regions with the exception of the North West.

The change in the status of the South East from a region having a relative population gain to one having a relative population loss in 1968 (Table 5) was anticipated by conversion of a net migration gain to a loss in 1965–1966 and thereafter. This change in relative migration position of the region is due mainly to declining net migration to the South East outside Greater London. Greater London itself experienced a slightly lower net out-migration rate in the latter part of the 1965–1976 period (Figure 6). Northern Ireland was characterized by fairly high net out-migration rates with a marked change in direction in 1969–1970 (perhaps at the onset of "the troubles"). From 1965–1966 to 1969–1970 net migration was becoming less negative; since 1969–1970 it has become more negative.

Three of the regions that have gained in their population shares – East Midlands, East Anglia, South West – showed net in-migration throughout almost all of the period, and they were joined by Wales after 1970–1971.

These patterns are summarized in 4 maps (Figure 7). Net migration rates are plotted on a base map derived by Craig (1977) in which the area of a region is proportional to its population. The first map shows why there was concern in the early 1960s about "the drift to the South East". By 1965–1966 the South East and West Midlands had become the migration-loss regions. The 1970–1971 pattern is very close to that of 1965–1966, but by 1975–1976 the ranking of regions within the "loss" column had changed, with the North and Scotland improving their position. Wales during the same period had moved into the migration-gain column. In Section 4 of the paper the relationship between these shifts and regional policy will be examined.

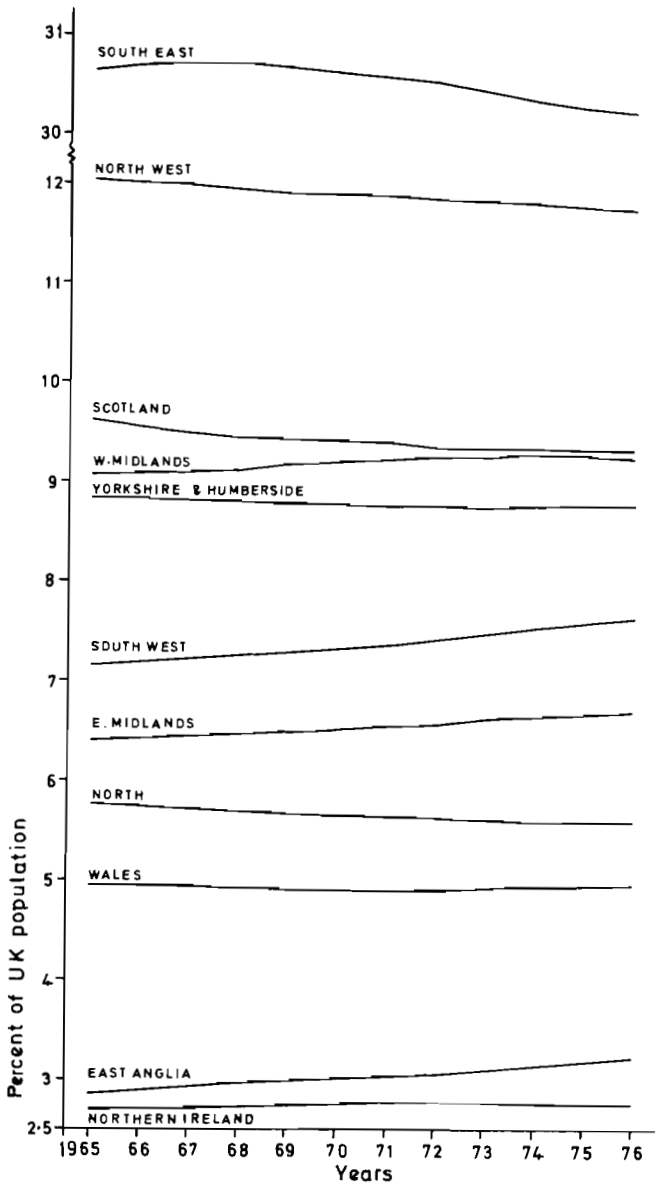


FIGURE 4 Regional shares of UK population, 1965–1976.

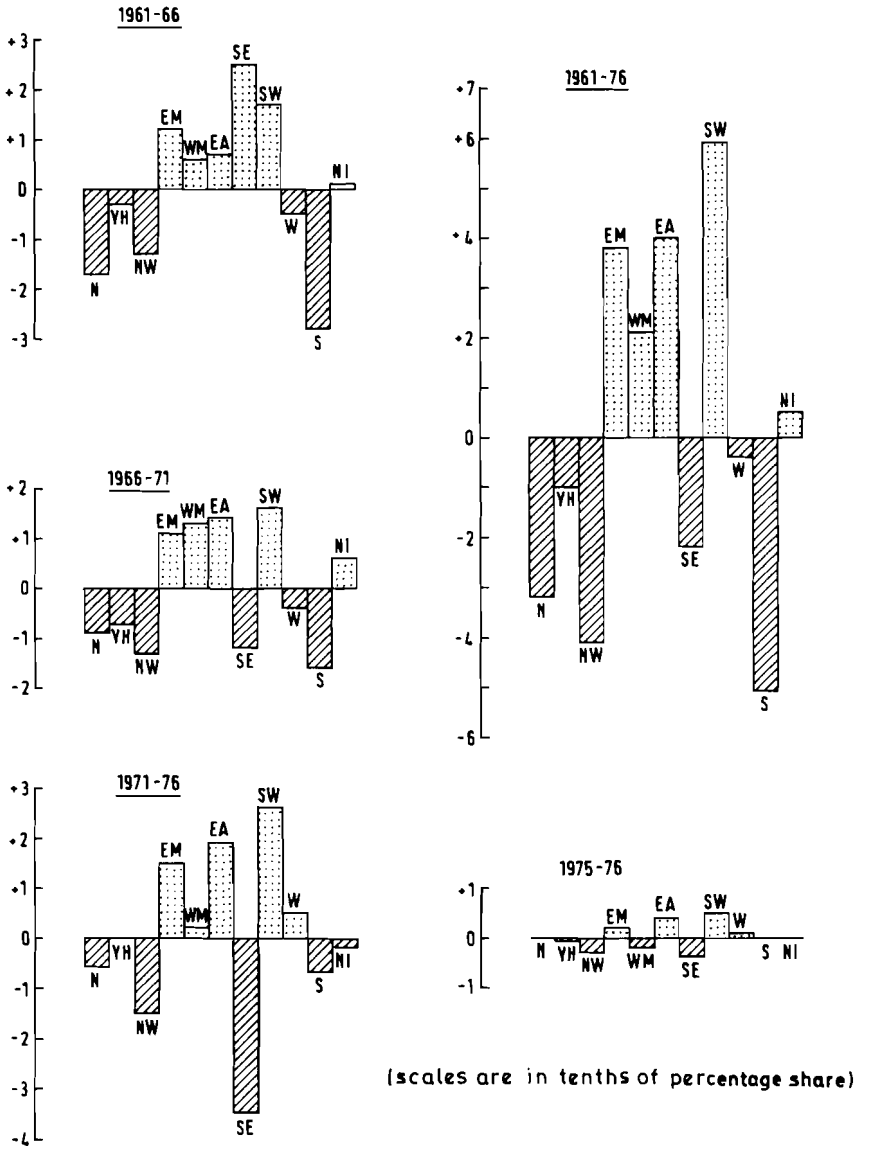


FIGURE 5 Shifts in population shares for UK regions, 1961–1976.

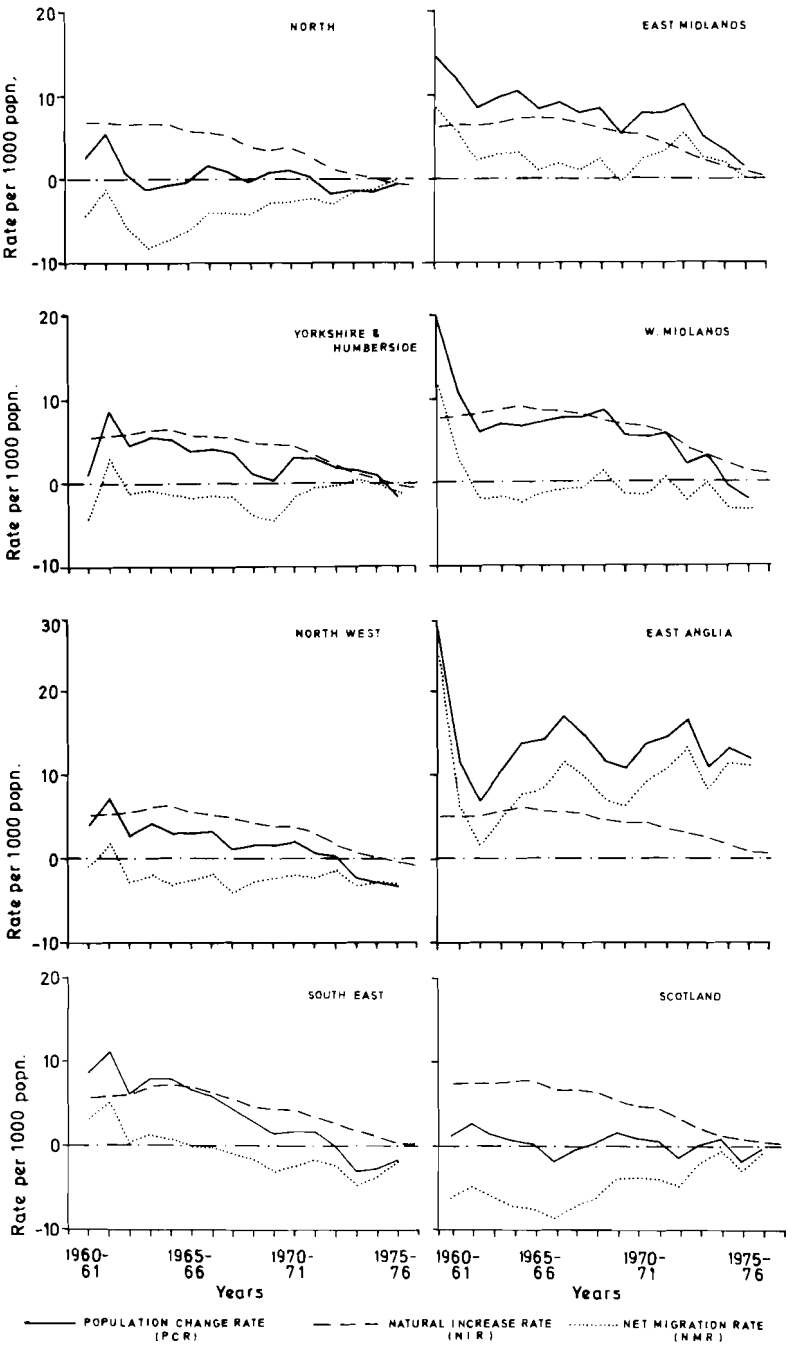


FIGURE 6 Components of population change in the United Kingdom: rates, 1960–1961 to 1975–1976.

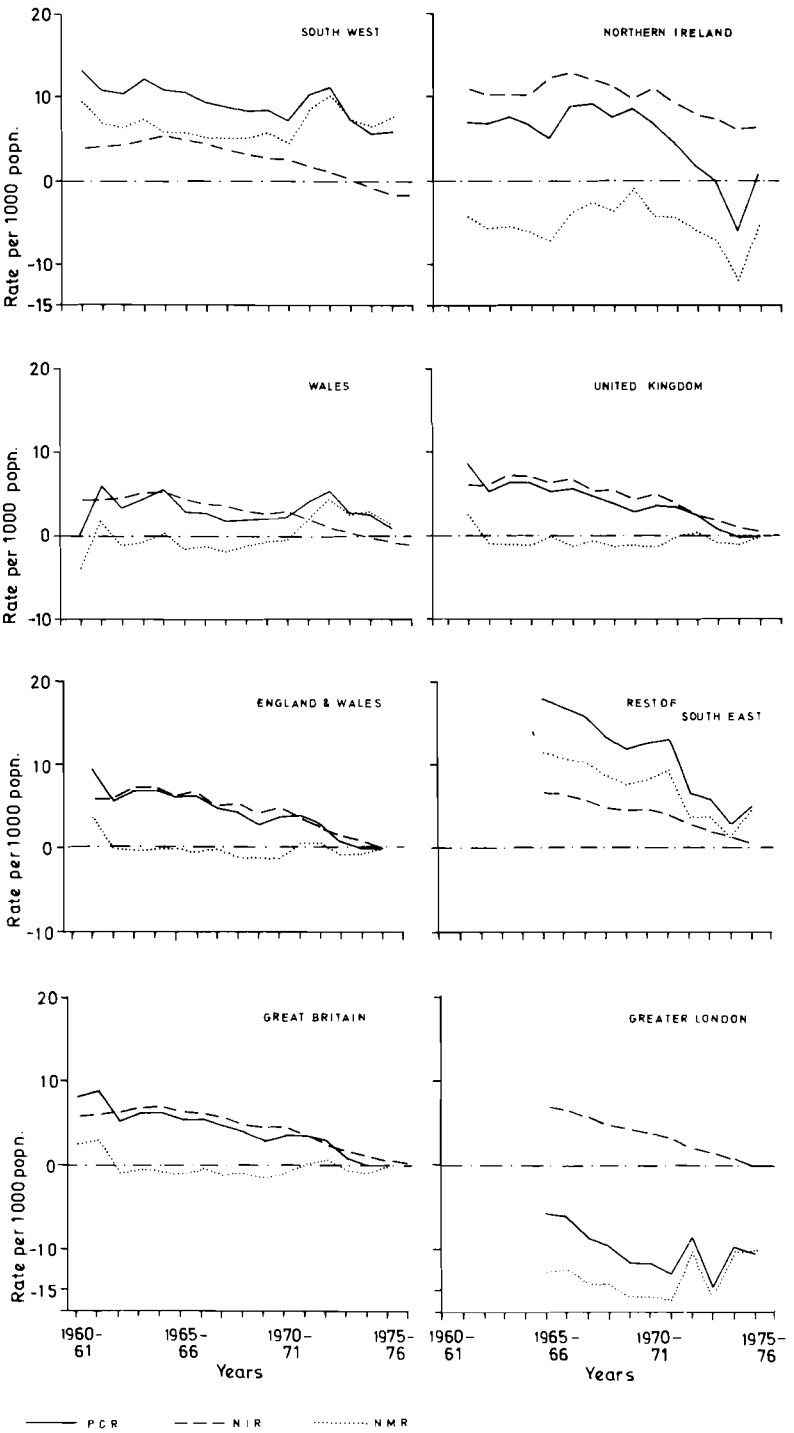
SOUTH WEST
NORTHERN IRELAND
WALES
UNITED KINGDOM
ENGLAND & WALES
REST OF SOUTH EAST
GREAT BRITAIN
GREATER LONDON
Rate per 1000 popn.
20
10
0
-10
-15
1960-61
1965-66
1970-71
1975-76
Years
PCR
NIR
NMR

TABLE 6 Association of the components of population change.

| Period | Correlation coefficients[a] | | | |
|---|---|---|---|---|
| | PCR[b] vs NIR[c] | PCR[b] vs NMR[d] | NIR[c] vs NMR[d] | PCR[b] vs NIR,[c] NMR[d] |
| 1965–66 | 0.16 | 0.96 | −0.13 | 1.00 |
| 1966–67 | 0.22 | 0.96 | −0.07 | 1.00 |
| 1967–68 | 0.22 | 0.95 | −0.09 | 1.00 |
| 1968–69 | 0.38 | 0.95 | 0.07 | 1.00 |
| 1969–70 | 0.12 | 0.94 | −0.23 | 1.00 |
| 1970–71 | 0.20 | 0.95 | −0.11 | 1.00 |
| 1971–72 | 0.15 | 0.97 | −0.10 | 1.00 |
| 1972–73 | 0.22 | 0.98 | 0.04 | 1.00 |
| 1973–74 | 0.32 | 0.97 | 0.09 | 1.00 |
| 1974–75 | 0.16 | 0.98 | −0.05 | 1.00 |
| 1975–76 | 0.01 | 0.98 | −0.19 | 1.00 |
| Average | 0.20 | 0.96 | −0.07 | 1.00 |

[a]Correlation coefficients = Pearson's coefficients; the correlations are calculated for the regions of Great Britain only
[b]population change rate
[c]natural increase rate
[d]net migration rate

## 2.3 MULTIREGIONAL COMPONENTS OF POPULATION CHANGE, 1965–1976

The simple accounts discussed in the preceding section give only a single-region view of the components of population change. The net migration flow statistic for each region consists, in fact, of 2 sets of migration flows from other regions to each region, and from each region to the other regions. A multiregional view of the components of population change is provided by sets of population accounts for the UK regions.

Tables 7, 8, 9, and 10 present a selection from a time series of population accounts developed by the author. Tables 7 and 8 are extracted from Rees (1976), Figures 2 (p.8) and 3 (p.10), respectively; Tables 9 and 10 from Rees (1978b). The theory underlying the definition and estimation of "closed demographic accounts" is described in detail in Rees and Wilson (1977). Here the accounts tables are regarded as the best estimate of the transitions of the population from origin regions to destination regions. The bulk of the transitions are for people who exist at

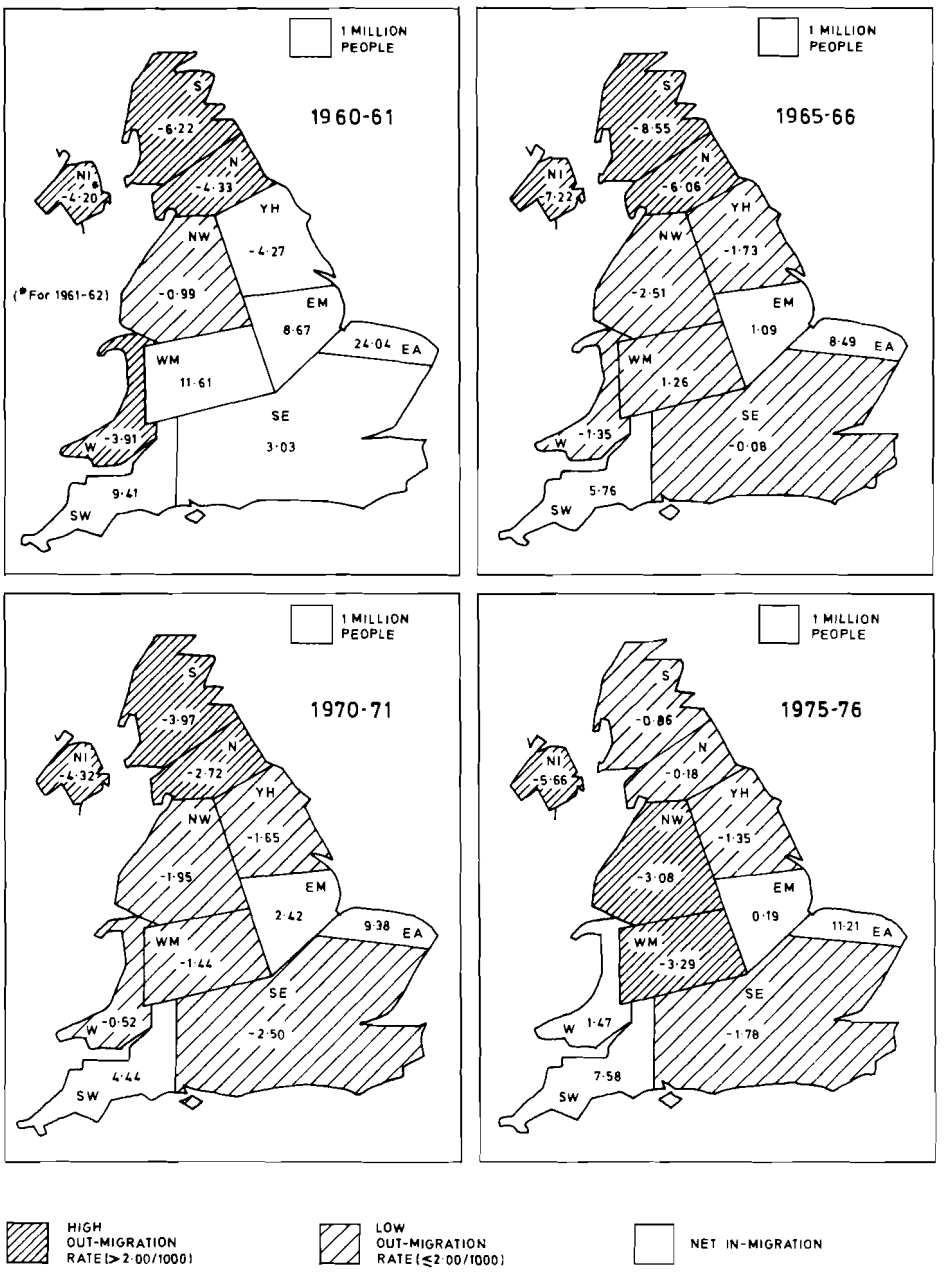


FIGURE 7 Net migration rates in UK regions, selected years.

TABLE 7 Multiregional population accounts, for GB "old" regions, 1965–1966 (year before 1966 Census).

| Initial state | Final state: Survival at 1966 Census | | | | | | | | | | | Death in 1965–1966 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | YH | NW | EM | WM | EA | SE | SW | W | S | RW | N | YH | NW | EM | WM | EA | SE | SW | W | S | RW | Total |
| Existence at 1965 Census | | | | | | | | | | | | | | | | | | | | | | | |
| N | 3,195,207 | 10,024 | 6,118 | 3,997 | 5,468 | 1,633 | 13,412 | 2,638 | 1,288 | 4,170 | 24,964 | 38,603 | 61 | 38 | 22 | 29 | 9 | 79 | 17 | 8 | 27 | 149 | 3,307,961 |
| YH | 10,856 | 4,556,799 | 10,774 | 13,057 | 4,089 | 2,800 | 15,259 | 4,545 | 2,171 | 3,419 | 27,624 | 65 | 55,902 | 68 | 72 | 21 | 16 | 90 | 30 | 14 | 22 | 167 | 4,707,860 |
| NW | 6,097 | 10,815 | 6,496,139 | 6,392 | 7,913 | 2,252 | 21,732 | 6,513 | 8,411 | 3,825 | 44,797 | 36 | 65 | 82,752 | 35 | 41 | 13 | 128 | 42 | 55 | 25 | 282 | 6,698,360 |
| EM | 2,739 | 12,499 | 5,479 | 3,151,580 | 8,279 | 4,231 | 15,654 | 3,774 | 1,400 | 2,394 | 23,247 | 16 | 76 | 34 | 35,102 | 43 | 24 | 92 | 25 | 9 | 15 | 127 | 3,266,839 |
| WM | 3,247 | 4,961 | 9,878 | 9,918 | 4,812,591 | 2,424 | 21,368 | 11,176 | 5,750 | 2,809 | 31,307 | 19 | 30 | 62 | 54 | 51,089 | 14 | 126 | 73 | 38 | 18 | 164 | 4,967,116 |
| EA | 1,521 | 2,870 | 2,180 | 4,665 | 2,322 | 1,473,695 | 17,656 | 3,337 | 781 | 1,268 | 26,319 | 9 | 17 | 14 | 26 | 12 | 17,341 | 104 | 22 | 5 | 8 | 151 | 1,554,323 |
| SE | 12,018 | 15,435 | 20,547 | 19,664 | 19,705 | 30,141 | 16,347,869 | 53,740 | 11,338 | 14,938 | 189,199 | 72 | 93 | 129 | 108 | 103 | 173 | 196,043 | 349 | 75 | 96 | 1,118 | 16,932,953 |
| SW | 2,789 | 4,036 | 4,544 | 3,874 | 7,363 | 2,992 | 40,201 | 3,424,762 | 4,909 | 2,890 | 34,449 | 17 | 24 | 29 | 21 | 39 | 17 | 238 | 45,346 | 32 | 19 | 224 | 3,578,815 |
| W | 1,187 | 1,927 | 5,192 | 1,978 | 6,288 | 710 | 12,038 | 5,405 | 2,610,280 | 1,795 | 9,315 | 7 | 12 | 33 | 11 | 33 | 4 | 71 | 35 | 34,815 | 12 | 61 | 2,691,209 |
| S | 5,497 | 4,756 | 6,754 | 4,787 | 5,558 | 1,633 | 19,786 | 3,438 | 1,187 | 5,037,917 | 48,865 | 33 | 29 | 42 | 26 | 29 | 9 | 117 | 22 | 8 | 65,498 | 313 | 5,206,304 |
| Rest of World | 13,052 | 17,636 | 25,263 | 13,742 | 23,569 | 17,170 | 175,073 | 25,902 | 7,332 | 21,662 | 0 | 78 | 107 | 159 | 75 | 123 | 99 | 1,034 | 168 | 48 | 139 | 0 | 342,431 |
| Birth in 1965–1966 | | | | | | | | | | | | | | | | | | | | | | | |
| N | 57,463 | 89 | 54 | 35 | 48 | 14 | 119 | 23 | 11 | 37 | 221 | 344 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 58,459 |
| YH | 98 | 83,558 | 97 | 118 | 37 | 25 | 138 | 41 | 20 | 31 | 249 | 0 | 508 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 84,921 |
| NW | 56 | 99 | 120,374 | 58 | 72 | 21 | 198 | 59 | 77 | 35 | 409 | 0 | 0 | 761 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 122,221 |
| EM | 25 | 114 | 50 | 58,751 | 76 | 39 | 143 | 35 | 13 | 22 | 213 | 0 | 0 | 0 | 324 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 59,806 |
| WM | 31 | 47 | 94 | 95 | 93,292 | 23 | 204 | 107 | 55 | 27 | 299 | 0 | 0 | 0 | 0 | 491 | 0 | 1 | 0 | 0 | 0 | 1 | 94,767 |
| EA | 13 | 24 | 19 | 40 | 20 | 25,711 | 150 | 28 | 7 | 11 | 223 | 0 | 0 | 0 | 0 | 0 | 149 | 0 | 0 | 0 | 0 | 1 | 26,396 |
| SE | 108 | 138 | 184 | 176 | 177 | 270 | 298,182 | 481 | 102 | 134 | 1,695 | 0 | 0 | 1 | 0 | 0 | 1 | 1,772 | 2 | 0 | 0 | 5 | 303,428 |
| SW | 24 | 35 | 39 | 33 | 63 | 26 | 347 | 60,400 | 42 | 25 | 297 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 395 | 0 | 0 | 1 | 61,728 |
| W | 10 | 16 | 44 | 17 | 53 | 6 | 102 | 46 | 45,089 | 15 | 79 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 298 | 0 | 0 | 45,775 |
| S | 52 | 45 | 64 | 46 | 53 | 16 | 189 | 33 | 11 | 97,603 | 466 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 629 | 1 | 99,209 |
| Rest of World | 227 | 307 | 440 | 239 | 410 | 299 | 3,047 | 451 | 128 | 377 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 9 | 1 | 0 | 1 | 0 | 5,942 |
| TOTAL | 3,312,317 | 4,726,230 | 6,714,327 | 3,293,262 | 4,997,446 | 1,566,131 | 17,002,867 | 3,606,934 | 2,700,402 | 5,195,404 | 464,237 | 39,300 | 56,925 | 84,123 | 35,877 | 52,054 | 17,870 | 199,907 | 46,527 | 35,405 | 66,509 | 2,769 | 54,216,823 |

SOURCE: Rees, 1976.

TABLE 8 Multiregional population accounts for GB "old" regions, 1970–1971 (year before 1971 Census).

| Initial state | Final state: Survival at 1971 Census | | | | | | | | | | | Death in 1970–1971 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | YH | NW | EM | WM | EA | SE | SW | W | S | RW | N | YH | NW | EM | WM | EA | SE | SW | W | S | RW | Total |
| Existence at 1970 Census | | | | | | | | | | | | | | | | | | | | | | | |
| N | 3,241,640 | 9,290 | 7,370 | 3,630 | 3,790 | 2,190 | 15,040 | 3,870 | 1,220 | 4,910 | 25,575 | 38,271 | 55 | 46 | 20 | 19 | 12 | 83 | 24 | 8 | 29 | 149 | 3,357,241 |
| YH | 12,790 | 4,644,500 | 13,290 | 13,190 | 5,970 | 4,320 | 21,580 | 5,610 | 2,570 | 3,470 | 27,886 | 74 | 55,831 | 83 | 72 | 31 | 24 | 119 | 34 | 16 | 21 | 165 | 4,811,646 |
| NW | 6,790 | 10,650 | 6,567,400 | 6,320 | 9,750 | 2,980 | 29,210 | 8,950 | 10,370 | 5,200 | 43,952 | 39 | 63 | 82,920 | 35 | 50 | 17 | 161 | 55 | 65 | 31 | 274 | 6,785,282 |
| EM | 4,200 | 12,170 | 5,300 | 3,229,569 | 9,610 | 6,030 | 19,110 | 6,680 | 2,330 | 3,100 | 25,545 | 24 | 72 | 33 | 36,111 | 49 | 33 | 106 | 41 | 15 | 18 | 140 | 3,360,286 |
| WM | 3,550 | 5,400 | 9,750 | 12,600 | 5,009,250 | 3,040 | 25,630 | 12,590 | 6,350 | 3,340 | 27,877 | 21 | 32 | 61 | 69 | 52,000 | 17 | 142 | 77 | 40 | 20 | 143 | 5,171,999 |
| EA | 1,150 | 2,510 | 1,970 | 4,490 | 2,540 | 1,584,217 | 20,460 | 3,820 | 1,170 | 1,650 | 28,194 | 7 | 15 | 12 | 25 | 13 | 17,982 | 113 | 23 | 7 | 10 | 156 | 1,670,534 |
| SE | 12,070 | 16,570 | 22,920 | 26,390 | 21,410 | 35,410 | 16,697,512 | 66,570 | 12,050 | 17,610 | 193,299 | 70 | 98 | 143 | 145 | 110 | 196 | 187,508 | 409 | 76 | 105 | 1,069 | 17,311,740 |
| SW | 2,970 | 4,600 | 4,860 | 4,230 | 8,680 | 3,390 | 49,030 | 3,589,220 | 4,730 | 4,810 | 35,450 | 17 | 27 | 30 | 23 | 44 | 19 | 271 | 45,000 | 30 | 29 | 218 | 3,757,678 |
| W | 1,450 | 2,040 | 6,390 | 2,420 | 5,650 | 1,280 | 13,160 | 7,000 | 2,647,069 | 1,650 | 10,185 | 8 | 12 | 40 | 13 | 29 | 7 | 73 | 43 | 33,607 | 10 | 64 | 2,732,200 |
| S | 5,540 | 4,810 | 7,220 | 4,910 | 4,630 | 2,070 | 23,790 | 5,330 | 1,700 | 5,033,830 | 57,612 | 32 | 28 | 45 | 27 | 24 | 11 | 132 | 33 | 11 | 60,633 | 342 | 5,212,760 |
| Rest of World | 14,570 | 19,630 | 27,330 | 16,650 | 23,140 | 20,280 | 197,220 | 29,390 | 8,840 | 28,160 | 0 | 85 | 116 | 170 | 91 | 118 | 112 | 1,090 | 181 | 55 | 167 | 0 | 387,395 |
| Birth in 1970–1971 | | | | | | | | | | | | | | | | | | | | | | | |
| N | 52,151 | 73 | 58 | 29 | 30 | 17 | 119 | 31 | 10 | 39 | 200 | 305 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 53,063 |
| YH | 109 | 80,569 | 113 | 112 | 51 | 37 | 184 | 48 | 22 | 30 | 238 | 0 | 480 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 81,995 |
| NW | 57 | 90 | 112,263 | 53 | 82 | 25 | 246 | 75 | 87 | 44 | 370 | 0 | 0 | 703 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 114,097 |
| EM | 36 | 103 | 45 | 55,666 | 81 | 51 | 161 | 56 | 20 | 26 | 216 | 0 | 0 | 0 | 308 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 56,770 |
| WM | 31 | 47 | 85 | 110 | 88,686 | 26 | 223 | 110 | 55 | 29 | 243 | 0 | 0 | 0 | 0 | 457 | 0 | 1 | 0 | 0 | 0 | 1 | 90,104 |
| EA | 9 | 20 | 16 | 36 | 20 | 25,873 | 163 | 30 | 9 | 13 | 224 | 0 | 0 | 0 | 0 | 0 | 145 | 0 | 0 | 0 | 0 | 1 | 26,559 |
| SE | 94 | 129 | 179 | 206 | 167 | 277 | 265,676 | 520 | 94 | 138 | 1,510 | 0 | 0 | 1 | 1 | 0 | 1 | 1,478 | 2 | 0 | 0 | 4 | 270,477 |
| SW | 23 | 35 | 37 | 32 | 66 | 26 | 376 | 56,279 | 36 | 37 | 272 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 349 | 0 | 0 | 1 | 57,570 |
| W | 11 | 16 | 51 | 45 | 45 | 10 | 104 | 55 | 42,507 | 13 | 81 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 268 | 0 | 0 | 43,206 |
| S | 47 | 41 | 61 | 42 | 39 | 18 | 201 | 45 | 14 | 86,708 | 488 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 518 | 1 | 88,224 |
| Rest of World | 256 | 344 | 481 | 294 | 406 | 356 | 3,456 | 512 | 156 | 494 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 10 | 2 | 0 | 1 | 0 | 6,774 |
| TOTAL | 3,359,544 | 4,813,637 | 6,787,189 | 3,381,024 | 5,194,093 | 1,691,923 | 17,382,651 | 3,796,791 | 2,741,409 | 5,195,301 | 479,417 | 38,954 | 56,830 | 84,288 | 36,941 | 52,945 | 18,577 | 191,291 | 46,273 | 34,198 | 61,592 | 2,732 | 55,447,600 |

SOURCE: Rees, 1976.

TABLE 9 Multiregional population accounts for GB "new" regions, 1970–1971 (year before 30 June, 1971).

| Initial state | End state: Survival at M.Y. 1971 | | | | | | | | | | | Death in 1970–1971 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | YH | NW | EM | WM | EA | SE | SW | W | S | RW | N | YH | NW | EM | WM | EA | SE | SW | W | S | RW | Total |
| Existence at M.Y. 1970 | | | | | | | | | | | | | | | | | | | | | | | |
| N | 3,034,831 | 10,145 | 6,820 | 3,511 | 3,234 | 1,604 | 12,080 | 2,869 | 1,067 | 4,869 | 15,252 | 37,354 | 62 | 43 | 20 | 17 | 9 | 68 | 17 | 7 | 29 | 93 | 3,134,001 |
| YH | 8,508 | 4,689,670 | 12,397 | 12,962 | 5,816 | 3,774 | 19,210 | 5,387 | 2,575 | 3,685 | 30,396 | 51 | 58,000 | 79 | 73 | 30 | 21 | 108 | 33 | 17 | 22 | 185 | 4,852,999 |
| NW | 6,840 | 9,687 | 6,385,174 | 8,151 | 9,403 | 2,707 | 24,794 | 8,146 | 9,885 | 5,205 | 36,256 | 42 | 59 | 82,023 | 46 | 50 | 16 | 141 | 51 | 64 | 31 | 230 | 6,589,001 |
| EM | 3,704 | 12,289 | 6,871 | 3,468,607 | 10,096 | 6,570 | 18,341 | 6,918 | 2,475 | 3,532 | 26,427 | 23 | 75 | 44 | 39,602 | 54 | 37 | 104 | 44 | 16 | 21 | 149 | 3,605,999 |
| WM | 3,103 | 5,480 | 9,861 | 13,549 | 4,935,894 | 2,932 | 22,589 | 12,134 | 6,322 | 3,562 | 25,024 | 19 | 34 | 63 | 77 | 52,943 | 17 | 128 | 76 | 41 | 21 | 133 | 5,094,002 |
| EA | 964 | 2,763 | 2,011 | 5,034 | 2,648 | 1,577,950 | 19,205 | 3,811 | 1,211 | 1,831 | 26,853 | 6 | 16 | 13 | 28 | 14 | 18,336 | 108 | 24 | 8 | 11 | 153 | 1,662,998 |
| SE | 11,266 | 19,757 | 24,707 | 30,365 | 23,102 | 37,189 | 16,343,621 | 68,485 | 12,984 | 20,302 | 182,777 | 69 | 120 | 157 | 171 | 123 | 211 | 187,926 | 428 | 83 | 122 | 1,035 | 16,965,000 |
| SW | 2,499 | 6,148 | 5,655 | 6,015 | 10,044 | 3,816 | 51,196 | 3,876,944 | 5,376 | 5,955 | 35,143 | 15 | 38 | 36 | 34 | 53 | 21 | 290 | 49,432 | 35 | 36 | 220 | 4,059,001 |
| W | 1,207 | 2,144 | 6,578 | 2,768 | 5,695 | 1,241 | 11,871 | 6,555 | 2,628,045 | 1,770 | 14,519 | 7 | 13 | 42 | 15 | 30 | 7 | 67 | 41 | 34,283 | 10 | 94 | 2,717,000 |
| S | 5,167 | 4,917 | 6,652 | 4,949 | 4,363 | 1,877 | 20,101 | 4,841 | 1,592 | 5,052,514 | 44,574 | 32 | 30 | 43 | 28 | 24 | 11 | 114 | 31 | 11 | 61,563 | 268 | 5,213,702 |
| Rest of World | 9,773 | 23,524 | 26,788 | 18,573 | 23,016 | 20,009 | 189,715 | 30,361 | 9,584 | 27,895 | 0 | 59 | 143 | 170 | 105 | 122 | 113 | 1,074 | 190 | 62 | 168 | 0 | 381,444 |
| Birth in 1970–1971 | | | | | | | | | | | | | | | | | | | | | | | |
| N | 49,109 | 80 | 54 | 28 | 26 | 12 | 96 | 23 | 9 | 39 | 121 | 300 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 49,897 |
| YH | 72 | 80,688 | 105 | 109 | 50 | 32 | 163 | 46 | 21 | 32 | 256 | 0 | 495 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 82,070 |
| NW | 57 | 81 | 107,906 | 68 | 78 | 23 | 207 | 68 | 36 | 53 | 301 | 0 | 0 | 688 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 109,568 |
| EM | 31 | 102 | 57 | 59,255 | 84 | 54 | 153 | 58 | 21 | 29 | 220 | 0 | 0 | 0 | 335 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 60,400 |
| WM | 27 | 48 | 86 | 118 | 87,392 | 26 | 197 | 106 | 56 | 31 | 218 | 0 | 0 | 0 | 0 | 465 | 0 | 1 | 0 | 0 | 0 | 1 | 88,772 |
| EA | 7 | 22 | 16 | 40 | 21 | 25,684 | 153 | 29 | 9 | 14 | 212 | 0 | 0 | 0 | 0 | 0 | 147 | 0 | 0 | 0 | 0 | 1 | 26,355 |
| SE | 86 | 153 | 191 | 235 | 180 | 289 | 257,529 | 529 | 100 | 158 | 1,412 | 0 | 0 | 1 | 1 | 0 | 1 | 1,466 | 2 | 0 | 0 | 4 | 262,337 |
| SW | 20 | 46 | 42 | 45 | 76 | 29 | 388 | 60,069 | 41 | 45 | 265 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 378 | 0 | 0 | 1 | 61,446 |
| W | 9 | 16 | 52 | 21 | 44 | 10 | 94 | 51 | 42,103 | 14 | 114 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 272 | 0 | 0 | 42,800 |
| S | 43 | 41 | 55 | 41 | 36 | 16 | 168 | 40 | 13 | 85,633 | 372 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 518 | 1 | 86,977 |
| Rest of World | 78 | 198 | 222 | 155 | 200 | 157 | 1,430 | 299 | 75 | 233 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 4 | 1 | 0 | 1 | 0 | 2,986 |
| TOTAL | 3,137,401 | 4,867,999 | 6,602,300 | 3,634,599 | 5,121,498 | 1,686,001 | 16,993,301 | 4,087,699 | 2,723,600 | 5,217,401 | 440,712 | 37,977 | 59,086 | 83,403 | 40,535 | 53,926 | 18,947 | 191,601 | 50,748 | 34,897 | 62,553 | 2,571 | 55,148,755 |

SOURCE: Rees, 1978b.

# TABLE 10 Multiregional population accounts for GB "new" regions, 1975–1976 (year before 30 June, 1976).

| Initial state | Final state: Survival at M.Y. 1976 N | YH | NW | EM | WM | EA | SE | SW | W | S | RW | Death in 1975–1976 N | YH | NW | EM | WM | EA | SE | SW | W | S | RW | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Existence at M.Y. 1975 | | | | | | | | | | | | | | | | | | | | | | | |
| N | 3,029,781 | 9,328 | 5,891 | 3,082 | 2,816 | 1,473 | 11,124 | 2,907 | 1,057 | 4,885 | 13,185 | 38,830 | 57 | 36 | 17 | 16 | 9 | 66 | 19 | 7 | 31 | 84 | 3,124,701 |
| YH | 9,349 | 4,736,602 | 11,504 | 12,509 | 5,568 | 3,811 | 19,444 | 6,006 | 2,802 | 4,066 | 28,575 | 59 | 58,938 | 72 | 70 | 31 | 22 | 115 | 39 | 18 | 25 | 175 | 4,899,800 |
| NW | 7,893 | 10,283 | 6,374,852 | 8,260 | 9,455 | 2,869 | 26,359 | 9,535 | 11,294 | 6,029 | 27,140 | 50 | 63 | 80,006 | 46 | 53 | 16 | 156 | 62 | 74 | 37 | 168 | 6,574,700 |
| EM | 4,359 | 13,300 | 6,986 | 3,588,067 | 10,352 | 7,101 | 19,885 | 8,260 | 2,884 | 4,173 | 21,230 | 28 | 82 | 43 | 40,814 | 59 | 41 | 118 | 54 | 19 | 26 | 119 | 3,728,000 |
| WM | 3,616 | 5,874 | 9,930 | 13,868 | 5,012,116 | 3,138 | 24,250 | 14,344 | 7,294 | 4,165 | 19,359 | 23 | 36 | 62 | 77 | 57,311 | 17 | 144 | 93 | 48 | 26 | 109 | 5,175,900 |
| EA | 1,126 | 2,971 | 2,033 | 5,172 | 2,699 | 1,694,983 | 20,693 | 4,522 | 1,404 | 2,150 | 23,377 | 7 | 18 | 13 | 29 | 16 | 19,879 | 122 | 29 | 9 | 14 | 134 | 1,781,400 |
| SE | 12,212 | 19,698 | 23,143 | 28,907 | 21,817 | 37,022 | 16,321,921 | 75,214 | 13,936 | 22,092 | 146,632 | 77 | 121 | 143 | 161 | 123 | 212 | 196,185 | 490 | 91 | 136 | 869 | 16,921,202 |
| SW | 2,580 | 5,838 | 5,045 | 5,455 | 9,032 | 3,618 | 48,685 | 4,046,199 | 5,495 | 6,172 | 36,767 | 16 | 36 | 31 | 30 | 51 | 21 | 288 | 53,727 | 36 | 38 | 240 | 4,229,400 |
| W | 1,244 | 2,031 | 5,858 | 2,505 | 5,113 | 1,174 | 11,267 | 6,851 | 2,675,127 | 1,832 | 15,604 | 7 | 13 | 37 | 14 | 29 | 7 | 66 | 44 | 35,364 | 11 | 102 | 2,764,300 |
| S | 5,156 | 4,512 | 5,738 | 4,337 | 3,794 | 1,718 | 18,477 | 4,899 | 1,573 | 5,054,614 | 37,777 | 32 | 28 | 36 | 24 | 21 | 10 | 109 | 32 | 10 | 63,071 | 233 | 5,206,201 |
| Rest of World | 7,635 | 23,283 | 23,004 | 15,166 | 18,462 | 23,926 | 170,857 | 27,652 | 9,767 | 27,982 | 0 | 48 | 143 | 143 | 85 | 104 | 137 | 1,011 | 180 | 63 | 173 | 0 | 349,821 |
| Birth in 1975–1976 | | | | | | | | | | | | | | | | | | | | | | | |
| N | 36,722 | 74 | 47 | 25 | 24 | 11 | 88 | 23 | 9 | 40 | 79 | 234 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 37,376 |
| YH | 78 | 57,949 | 98 | 104 | 46 | 32 | 164 | 50 | 23 | 34 | 172 | 0 | 358 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 59,109 |
| NW | 66 | 86 | 79,265 | 70 | 79 | 23 | 218 | 80 | 40 | 62 | 167 | 0 | 0 | 494 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 80,652 |
| EM | 35 | 111 | 56 | 45,300 | 87 | 57 | 166 | 69 | 24 | 34 | 132 | 0 | 0 | 0 | 255 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 46,326 |
| WM | 30 | 51 | 84 | 121 | 63,195 | 27 | 212 | 125 | 63 | 35 | 121 | 0 | 0 | 0 | 0 | 359 | 0 | 1 | 0 | 0 | 0 | 0 | 64,424 |
| EA | 7 | 22 | 16 | 43 | 19 | 21,630 | 163 | 33 | 9 | 16 | 145 | 0 | 0 | 0 | 0 | 0 | 125 | 0 | 0 | 0 | 0 | 0 | 22,228 |
| SE | 94 | 153 | 178 | 222 | 170 | 286 | 197,994 | 581 | 108 | 172 | 876 | 0 | 0 | 1 | 1 | 1 | 1 | 1,180 | 2 | 0 | 1 | 3 | 202,024 |
| SW | 20 | 42 | 37 | 39 | 70 | 27 | 369 | 46,305 | 40 | 45 | 206 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 305 | 0 | 0 | 1 | 47,507 |
| W | 9 | 16 | 46 | 18 | 40 | 10 | 89 | 53 | 33,778 | 15 | 97 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 221 | 0 | 0 | 34,392 |
| S | 42 | 37 | 47 | 36 | 31 | 14 | 154 | 41 | 12 | 66,305 | 244 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 411 | 1 | 67,375 |
| Rest of World | 46 | 140 | 142 | 94 | 115 | 149 | 1,021 | 154 | 60 | 181 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 1 | 0 | 2,106 |
| TOTAL | 3,122,100 | 4,892,401 | 6,554,000 | 3,733,400 | 5,165,100 | 1,803,099 | 16,893,600 | 4,253,903 | 2,766,799 | 5,205,099 | 371,885 | 39,411 | 59,893 | 81,117 | 41,623 | 58,174 | 20,497 | 199,566 | 55,076 | 35,960 | 64,001 | 2,240 | 55,418,944 |

SOURCE: Rees, 1978b.

the start of the period and who survive at its end. These people are located in the top left quadrant of the table. Additions to the population through births are represented in the bottom left quadrant. Subtractions from the regional populations through death are represented in the right hand half of the table with infant deaths in the bottom right quadrant and deaths to people already in existence at the start of the period in the top right quadrant.

Each table contains a great deal of interacting information on fertility, mortality, and migration. Here we concentrate on the information on spatial relocation. The first impression from Tables 7 to 10 is of the importance of external migration. The migrant flows to and from the rest of the world are the largest movements. Only the exchange of migrants between the South East and South West regions approach the scale of the external flows. This is unfortunate from the point of view of population accounting and of population projection, since emigration flows, in particular, are difficult to estimate, and there is considerable discrepancy between the various statistical sources (Rees, 1978b, gives more details).

This point is further emphasized if we cumulate the migrant flows of the exist–survive quadrant of the accounts tables into the totals of internal and external in-migrants, out-migrants, and net-migrants (Tables 11 and 12). Immigrants from outside Great Britain made up 32 percent of total interregional in-migrants, and emigrants accounted for 39 percent of total interregional out-migrants in 1965–1966. The comparable figures for 1970–1971 are 32 and 36 percent ("old" regions), 31 and 34 percent ("new" regions), and for 1975–1976 they are 29 and 30 percent. In other words about one-third of all interregion migrants entered or left Great Britain in a year. By 1975–1976, the slight decline in the relative importance can be attributed to an overall increase in the level of internal migration between the regions, and a decrease in external emigration. This decrease in the 1970s was due to the greater difficulty of emigration of Britons to traditional destinations, such as Australia, New Zealand, Canada, and America, and the reduced job opportunities there. Immigration into Britain did not decline as much between 1970–1971 and 1975–1976.

The pattern of gains and losses through internal and external migration is summarized in Figure 8. Regions are classified as having either positive migration (gain) or negative migration (loss) balances for both internal and external migration. Regions with positive gains from 1 set of flows and negative from the other are further classified according to whether they gain or lose overall through migration. Four regions maintained their class throughout the 3 periods: the East Midlands and the

South West gained from internal migration, lost through external migration, but gained overall. The North West and West Midlands lost population through both internal and external migration in 1965–1966, 1970–1971, and 1975–1976. Two regions, East Anglia and the South East, changed their position in relation to external migration. East Anglia in 1965–1966 and in 1970–1971 gained from internal migration only, but in 1975–1976 gained from both sources – the only region to do so. The external immigration and emigration rates for this region were very high, in fact, and this is probably a reflection of the relatively large size of the foreign student and U.S. Air Force populations in the region. Both populations were subject to a continuous turnover.

The South East in 1965–1966 lost through both internal and external migration streams; in 1970–1971 and 1975–1976 the region gained from external migration. In fact, the South East in 1975–1976 attracted 49 percent of the immigrants to Great Britain from abroad, but contributed only 40 percent of the external emigrants.

The North and Scotland showed a shift in 1975–1976 to gains from internal migration, whereas previously they had lost through both internal and external migration. Wales exhibited losses through external migration, but gains from internal migration with variable total outcome. Yorkshire and Humberside showed a gain from internal migration in 1965–1966, but otherwise experienced losses from both migration streams.

In discussing the patterns of total internal and external in- and out-migration, the role of change has been stressed. However, it is clear that to a great extent the time series of accounts shows great stability in the overall pattern of large and small flows. In Figure 9, the most important flows (roughly one-third of all flows) in the exist–survive quadrant of the 1965–1966, 1970–1971, and 1975–1976 accounts are plotted. The maps are virtually identical, and the changes marginal.

Detailed examination of the processes underlying the interregional migration flows matrix is beyond the scope of this paper, however, we should note that substantial and continuous attention has been paid to the problem of "explaining" migration by means of various forms of gravity, intervening opportunity, entropy maximizing, kinetic and probabilistic models (see Stillwell, 1975, for a review; Hyman and Gleave, 1978; Gleave and Cordey-Hayes, 1977; Weeden, 1973; Hart, 1970; Masser, 1970; Stillwell, 1977a, 1977b; Stillwell, 1978). Integration of this kind of predictive and potentially policy-connected model with the demographic models discussed later in this paper is clearly an important research activity, foreshadowed as always by the work of Rogers (1968).

By using the information in the accounts directly in a set of

TABLE 11 Total inflows and outflows of exist-survive migrants in the population accounts of 1965–1966, 1970–1971, "old" regions, Great Britain.

| 1965–66 "old" region | In-migrants | | | Out-migrants | | | Net-migrants | | |
|---|---|---|---|---|---|---|---|---|---|
| | Internal[a] | External | Total | Internal[a] | External | Total | Internal | External | Total |
| N | 45.9 | 13.1 | 59.0 | 48.7 | 25.0 | 73.7 | −2.8 | −11.9 | −14.7 |
| YH | 67.4 | 17.6 | 85.0 | 67.0 | 27.6 | 94.6 | 0.4 | −10.0 | −9.6 |
| NW | 71.4 | 25.3 | 96.7 | 73.9 | 44.8 | 118.7 | −2.5 | −19.5 | −22.0 |
| EM | 68.4 | 13.7 | 82.1 | 56.5 | 23.2 | 79.7 | 11.9 | −9.5 | 2.4 |
| WM | 67.0 | 23.6 | 90.6 | 71.5 | 31.3 | 102.8 | −4.5 | −7.7 | −12.2 |
| EA | 48.8 | 17.2 | 66.0 | 36.6 | 26.3 | 62.9 | 12.2 | −9.1 | 3.1 |
| SE | 177.1 | 175.1 | 352.2 | 197.5 | 189.2 | 386.7 | −20.4 | −14.1 | −34.5 |
| SW | 94.6 | 25.9 | 120.5 | 73.6 | 34.4 | 108.0 | 21.0 | −8.5 | 12.5 |
| W | 37.3 | 7.3 | 44.6 | 36.5 | 9.3 | 45.8 | 0.8 | −2.0 | −1.2 |
| S | 37.5 | 21.7 | 59.2 | 53.4 | 48.9 | 102.3 | −15.9 | −27.2 | −43.1 |
| TOTAL | 715.4 | 340.5 | 1,055.9 | 715.2 | 460.0 | 1,175.2 | 0.2 | −119.5 | −119.3 |

| 1970–71 "old" region | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| N | 50.5 | 14.6 | 65.1 | 51.3 | 25.3 | 76.6 | −0.8 | −10.7 | −11.5 |
| YH | 68.1 | 19.6 | 87.7 | 82.8 | 27.9 | 110.7 | −14.7 | −8.3 | −23.0 |
| NW | 79.1 | 27.3 | 106.4 | 90.2 | 44.0 | 134.2 | −11.1 | −16.7 | −27.8 |
| EM | 78.1 | 16.7 | 94.8 | 68.6 | 25.5 | 94.1 | 9.5 | −8.8 | 0.7 |
| WM | 72.1 | 23.1 | 95.2 | 82.2 | 27.9 | 110.1 | −10.1 | −4.8 | −14.9 |
| EA | 60.7 | 20.3 | 81.0 | 39.8 | 28.2 | 68.0 | 20.9 | −7.9 | 13.0 |
| SE | 217.0 | 197.2 | 414.2 | 231.0 | 193.3 | 424.3 | −14.0 | 3.9 | −10.1 |
| SW | 120.4 | 29.4 | 149.8 | 87.4 | 35.4 | 122.8 | 33.0 | −6.0 | 27.0 |
| W | 42.5 | 8.8 | 51.3 | 41.0 | 10.2 | 51.2 | 1.5 | −1.4 | 0.1 |
| S | 45.7 | 28.2 | 73.9 | 60.0 | 57.6 | 117.6 | −14.3 | −29.4 | −43.7 |
| TOTAL | 834.2 | 385.2 | 1,219.4 | 834.3 | 475.3 | 1,309.6 | −0.1 | −90.1 | −90.2 |

[a] Due to slight rounding errors the totals of the internal in-migrants and out-migrants columns do not tally.

TABLE 12 Total inflows and outflows of exist–survive migrants in the population accounts of 1970–1971, 1975–1976, "new" regions, Great Britain.

| 1970–71 "new" region | In-migrants | | | Out-migrants | | | Net migrants | | |
|---|---|---|---|---|---|---|---|---|---|
| | Internal | External | Total | Internal | External | Total | Internal | External | Total |
| N | 43.3 | 9.8 | 53.1 | 46.2 | 15.3 | 61.5 | −2.9 | −5.5 | −8.4 |
| YH | 73.3 | 23.5 | 96.8 | 74.4 | 30.4 | 104.8 | −1.1 | −6.9 | −8.0 |
| NW | 81.7 | 26.8 | 108.5 | 84.8 | 36.3 | 121.1 | −3.1 | −9.5 | −12.6 |
| EM | 87.3 | 18.6 | 105.9 | 70.8 | 26.4 | 97.2 | 16.5 | −7.8 | 8.7 |
| WM | 74.3 | 23.0 | 97.3 | 79.5 | 25.0 | 104.5 | −5.2 | −2.0 | −7.2 |
| EA | 61.7 | 20.0 | 81.7 | 39.4 | 26.9 | 66.3 | 22.3 | −6.9 | 15.4 |
| SE | 199.4 | 189.7 | 389.1 | 248.3 | 182.8 | 431.1 | −48.9 | 6.9 | −42.0 |
| SW | 119.1 | 30.4 | 149.5 | 96.7 | 35.1 | 131.8 | 22.4 | −4.7 | 17.7 |
| W | 43.6 | 9.6 | 53.2 | 39.9 | 14.5 | 54.4 | 3.7 | −4.9 | −1.2 |
| S | 50.8 | 27.9 | 78.7 | 54.5 | 44.6 | 99.1 | −3.7 | −16.7 | −20.4 |
| TOTAL | 834.5 | 379.3 | 1,213.8 | 834.5 | 437.3 | 1,271.8 | 0.0 | −58.0 | −58.0 |

| 1975–76 "new" region | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| N | 47.5 | 7.6 | 55.1 | 42.6 | 13.2 | 55.8 | 4.9 | −5.6 | −0.7 |
| YH | 73.8 | 23.3 | 97.1 | 75.1 | 28.6 | 103.7 | −1.3 | −5.3 | −6.6 |
| NW | 76.0 | 23.0 | 99.0 | 92.1 | 27.1 | 119.2 | −16.1 | −4.1 | −20.2 |
| EM | 84.2 | 15.2 | 99.4 | 77.5 | 21.2 | 98.7 | 6.7 | −6.0 | 0.7 |
| WM | 70.7 | 18.5 | 89.2 | 86.5 | 19.4 | 105.9 | −15.8 | −0.9 | −16.7 |
| EA | 61.9 | 23.9 | 85.8 | 42.8 | 23.4 | 66.2 | 19.1 | 0.5 | 19.6 |
| SE | 200.3 | 170.9 | 371.2 | 253.9 | 146.6 | 400.5 | −53.6 | 24.3 | −29.3 |
| SW | 132.5 | 27.7 | 160.2 | 91.8 | 36.8 | 128.6 | 40.7 | −9.1 | 31.6 |
| W | 47.8 | 9.8 | 57.6 | 37.9 | 15.6 | 53.5 | 9.9 | −5.8 | 4.1 |
| S | 55.7 | 28.0 | 83.7 | 50.2 | 37.8 | 88.0 | 5.5 | −9.8 | −4.3 |
| TOTAL | 850.4 | 347.9 | 1,198.3 | 850.4 | 369.7 | 1,220.1 | 0.0 | −21.8 | −21.8 |

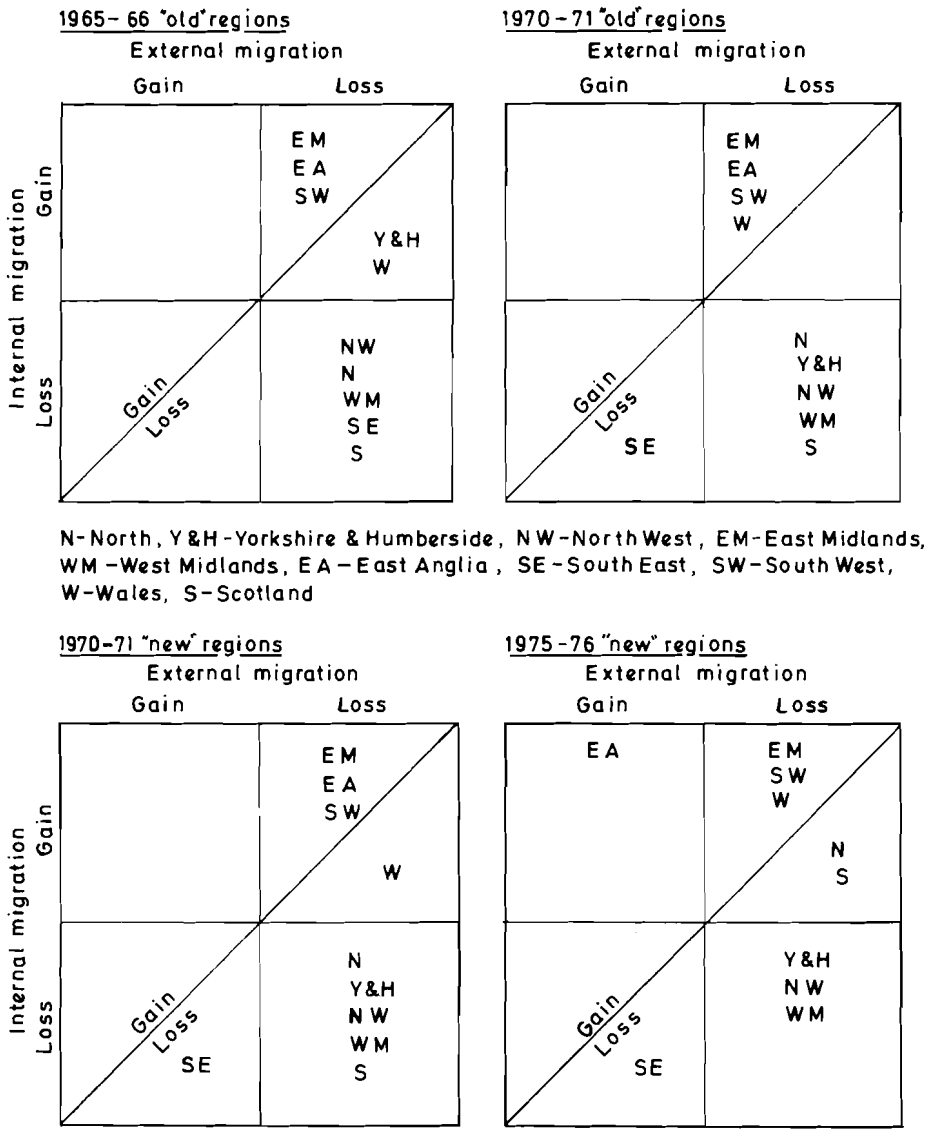


FIGURE 8 The pattern of regional internal and external migration balances, Great Britain.

projections of the population, it is difficult to show the effect that shifts in migration pattern might have on the future, because of the compounding effect of mortality and fertility differentials (see Section 3 for a description of the projection consequences of the patterns of population change shown in Tables 7 to 10). Transition rates calculated by dividing each

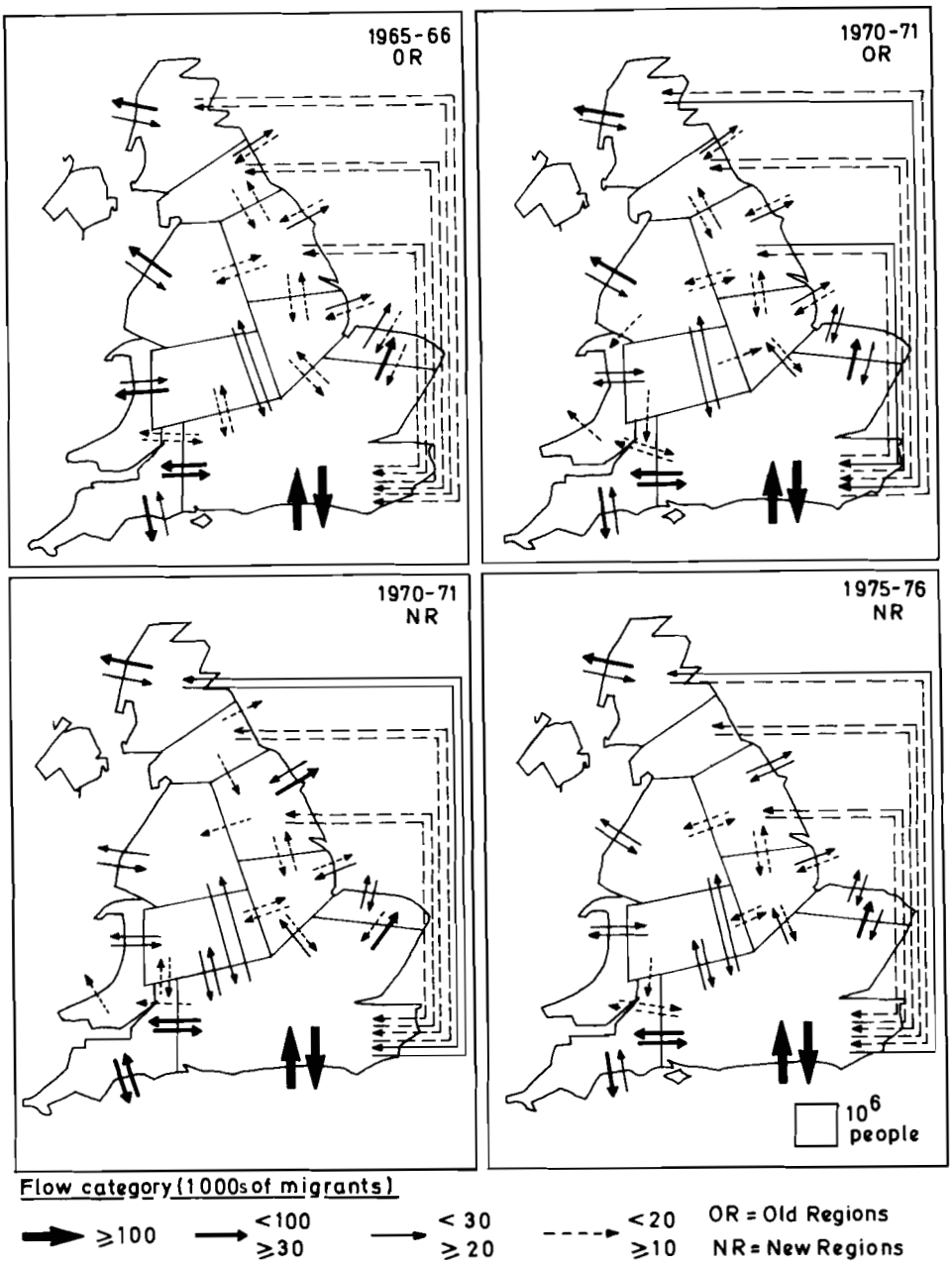


FIGURE 9 Migrant flow patterns, GB regions.

element in the accounts matrix by its row total reflect the influence of mortality as well as migration. Growth rates that form the components of the growth model of Rogers (1968) include the effect of both mortality and fertility.

It is, however, possible to compare the "pure" effect of migration by dividing each element in the exist–survive quadrant by the total of survivors in its row (shown in the middle of the accounts table) to yield probabilities of relocation conditional on survival. Figure 10 graphs these probabilities for each transition in the first 10 rows of the accounts matrix. Two separate lines are shown in each graph. The first connects the 1965–1966 value with the 1970–1971 value for the "old" regions; the second connects the 1970–1971 value for the "new" regions to the 1975–1976 value. Reference to a column of graphs yields the picture of change in the out-migration transitions that will produce the in-migrant flows to the region whose name heads the column. Reference to a row shows how the transition probabilities of out-migration from a region have shifted.

Looking at the graph, the following conclusions can be suggested:

- The trends in the transition probabilities suggest a shift over the period in favor of the North, East Anglia, the South West, Wales, and Scotland.
- They suggest a shift in the opposite direction for Yorkshire and Humberside, the North West, the East Midlands, and the West Midlands.
- The picture for the South East is ambiguous. The exact implications of these shifts in migration pattern for the future populations and future shares of the regions will be discussed in Section 3 of the paper.

## 2.4 REGIONAL FERTILITY

So far the discussion has been focused on the total population of UK regions without regard for age and sex, and on the aggregate components of population change. Attention is now devoted to the detailed age-specific patterns for the regions, beginning first with fertility.

Earlier evidence (Figure 3, Table 4, Figure 6) showed that recently in the United Kingdom (1965–1976) there was a period of falling natural increase, a result of sharply declining fertility rates (since 1964) and gradually declining mortality rates. As with migration the detailed regional and age-specific pattern is examined for 3 calendar years – 1965, 1970, 1975 – at the beginning, middle, and end of the 1965 1976 period. The relevant age-specific fertility rates, the crude birthrates, the total period

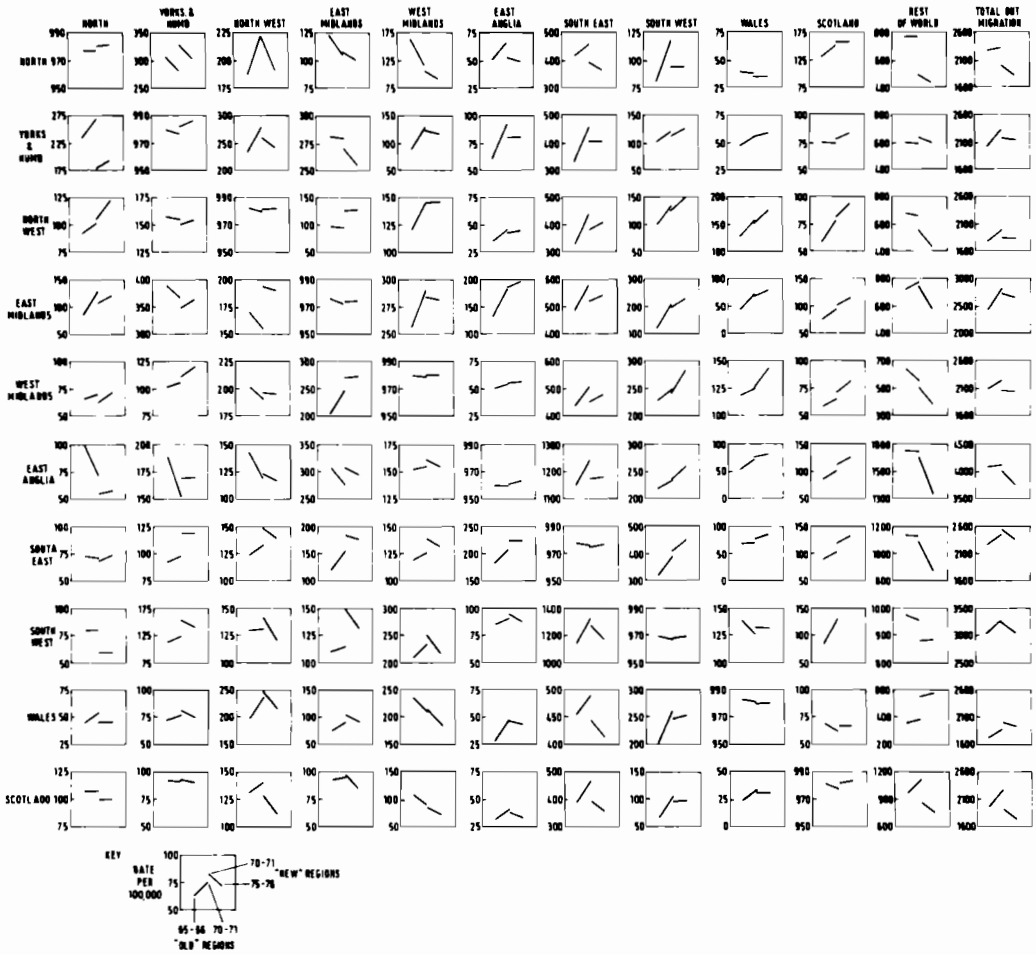


FIGURE 10 Changing relocation rates, 1965–1966, 1970–1971, and 1975–1976.

fertility rates, the general fertility rates, and the net reproduction rates for 1965, 1970, and 1975 are given in Table 13.

The experience of Northern Ireland is noticeably different from that of the rest of the United Kingdom. Fertility levels there are considerably higher than in Great Britain: 1029 per 1000 higher in 1965 in total period fertility rate terms, 974 higher in 1970, and 823 higher in 1975. The differences have been narrowing, and are likely to continue to do so. The higher fertility is, in part, accounted for by the high fertility of the Catholic minority in Northern Ireland, although the fertility of the Protestant majority is also high relative to the British population as a whole (Compton, 1978).

TABLE 13 Fertility rates, regions, 1965, 1970, 1975, United Kingdom.

| 1965 ("old" region) | Age-specific fertility rates (per 1000 women)[a] | | | | | | | Summary rates | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15–19 | 20–24 | 25–29 | 30–34 | 35–39 | 40–44 | 45–49 | TPFR[b] | GFR[c] | CBR[d] | NRR[e] |
| N | 42.5 | 171.5 | 173.3 | 98.2 | 50.7 | 13.9 | 1.0 | 2,756 | 89.7 | 18.12 | 1,291 |
| YH | 46.8 | 181.8 | 180.0 | 99.7 | 48.2 | 12.5 | 1.0 | 2,850 | 92.3 | 18.03 | 1,336 |
| NW | 47.8 | 182.7 | 183.1 | 104.4 | 53.1 | 14.1 | 0.9 | 2,931 | 94.6 | 18.48 | 1,373 |
| EM | 46.2 | 187.8 | 176.8 | 98.9 | 47.9 | 13.0 | 1.0 | 2,858 | 92.5 | 18.54 | 1,339 |
| WM | 42.9 | 180.9 | 181.5 | 105.9 | 52.1 | 13.6 | 0.9 | 2,889 | 93.0 | 19.39 | 1,354 |
| EA | 46.3 | 178.4 | 169.2 | 92.7 | 40.5 | 11.5 | 0.9 | 2,698 | 88.5 | 17.05 | 1,264 |
| SE | 43.1 | 166.2 | 177.5 | 102.4 | 46.5 | 11.4 | 0.9 | 2,740 | 89.6 | 18.05 | 1,284 |
| SW | 45.0 | 189.7 | 180.9 | 100.3 | 46.3 | 12.5 | 0.9 | 2,878 | 92.4 | 17.30 | 1,349 |
| W | 48.2 | 182.7 | 169.2 | 97.8 | 47.2 | 12.4 | 0.9 | 2,792 | 88.7 | 17.23 | 1,308 |
| S | 40.9 | 181.0 | 191.0 | 112.3 | 56.0 | 13.9 | 1.0 | 2,981 | 96.6 | 19.32 | 1,397 |
| NI | 9.3 | 92.4 | 241.4 | 241.3 | 127.6 | 47.3 | 12.5 | 3,859 | 121.9 | 23.57 | 1,808 |
| GB | 44.4 | 176.7 | 179.4 | 102.6 | 49.2 | 12.7 | 0.9 | 2,830 | 91.8 | 18.26 | 1,326 |
| UK | 43.4 | 174.5 | 181.0 | 106.4 | 51.3 | 13.5 | 1.2 | 2,857 | 92.6 | 18.41 | 1,339 |

| 1970 ("old" region) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| N | 48.2 | 167.0 | 137.4 | 73.9 | 31.0 | 8.2 | 0.4 | 2,331 | 79.9 | 15.89 | 1,110 |
| YH | 57.3 | 177.6 | 151.8 | 78.5 | 36.3 | 9.6 | 0.6 | 2,559 | 89.0 | 16.97 | 1,212 |
| NW | 55.7 | 167.7 | 153.0 | 83.7 | 38.4 | 10.0 | 0.6 | 2,546 | 88.6 | 16.78 | 1,196 |
| EM | 53.9 | 161.7 | 158.4 | 76.7 | 31.6 | 8.4 | 0.6 | 2,457 | 85.9 | 16.57 | 1,160 |
| WM | 54.0 | 153.3 | 156.7 | 84.3 | 39.6 | 10.4 | 0.8 | 2,496 | 87.4 | 17.54 | 1,180 |
| EA | 48.7 | 158.9 | 152.4 | 68.4 | 28.8 | 7.2 | 0.4 | 2,324 | 81.9 | 15.65 | 1,103 |
| SE | 43.0 | 135.9 | 150.2 | 79.3 | 33.3 | 8.1 | 0.5 | 2,252 | 79.3 | 15.50 | 1,067 |
| SW | 48.4 | 155.1 | 152.3 | 72.3 | 29.8 | 7.4 | 0.5 | 2,329 | 81.1 | 15.05 | 1,111 |
| W | 53.1 | 164.8 | 147.4 | 75.5 | 33.0 | 8.1 | 0.5 | 2,412 | 82.8 | 15.64 | 1,133 |
| S | 47.3 | 155.7 | 159.2 | 89.7 | 39.6 | 9.9 | 0.6 | 2,510 | 86.6 | 16.75 | 1,181 |
| NI | 23.5 | 123.4 | 215.3 | 178.4 | 93.3 | 33.4 | 6.5 | 3,369 | 108.7 | 21.01 | 1,579 |
| GB | 49.4 | 153.6 | 152.0 | 79.7 | 34.8 | 8.8 | 0.6 | 2,395 | 83.6 | 16.18 | 1,133 |
| UK | 48.6 | 152.8 | 153.7 | 82.3 | 36.3 | 9.4 | 0.7 | 2,419 | 84.3 | 16.31 | 1,144 |

TABLE 13 *Continued.*

| 1975 ("new" region) | Age-specific fertility rates (per 1000 women)[a] | | | | | | | Summary rates | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15–19 | 20–24 | 25–29 | 30–34 | 35–39 | 40–44 | 45–49 | TPFR[b] | GFR[c] | CBR[d] | NRR[e] |
| N | 42.8 | 123.3 | 124.0 | 49.7 | 17.1 | 3.8 | 0.3 | 1,805 | 62.9 | 12.17 | 857 |
| YH | 41.4 | 122.9 | 122.8 | 53.2 | 19.3 | 5.1 | 0.5 | 1,826 | 64.2 | 12.26 | 867 |
| NW | 42.2 | 121.3 | 123.8 | 57.0 | 21.7 | 5.3 | 0.4 | 1,859 | 65.3 | 12.47 | 883 |
| EM | 38.5 | 122.6 | 125.6 | 55.8 | 18.8 | 4.5 | 0.4 | 1,831 | 65.0 | 12.63 | 869 |
| WM | 38.7 | 119.4 | 120.0 | 59.7 | 21.8 | 6.3 | 0.7 | 1,833 | 64.5 | 12.65 | 870 |
| EA | 35.3 | 128.3 | 131.2 | 54.6 | 16.4 | 4.1 | 0.4 | 1,852 | 66.5 | 12.70 | 879 |
| SE | 30.4 | 101.9 | 122.7 | 63.0 | 20.7 | 4.7 | 0.3 | 1,719 | 61.4 | 12.14 | 816 |
| SW | 32.2 | 115.6 | 124.0 | 55.8 | 17.7 | 4.2 | 0.3 | 1,749 | 61.8 | 11.41 | 830 |
| W | 41.8 | 126.4 | 119.6 | 59.0 | 19.2 | 4.1 | 0.3 | 1,852 | 65.0 | 12.29 | 879 |
| S | 40.0 | 124.0 | 129.0 | 60.0 | 21.0 | 5.0 | 0 | 1,895 | 65.9 | 12.47 | 900 |
| NI | 36.0 | 145.0 | 173.0 | 102.0 | 52.0 | 17.0 | 0 | 2,625 | 88.8 | 17.20 | 1,246 |
| GB | 36.8 | 115.7 | 123.7 | 58.7 | 20.1 | 4.9 | 0.4 | 1,802 | 63.6 | 12.35 | 856 |
| UK | 36.8 | 116.5 | 124.9 | 59.8 | 20.9 | 5.2 | 0.3 | 1,822 | 64.3 | 12.48 | 865 |

[a]Age-specific fertility rate = 1000 x (births in calendar year to women in age group at mid-year).
[b]TPFR = total period fertility rate = (sum of age-specific rates) x 5.
[c]GFR = general fertility rate = 1000 x (births/women aged 15–44 at mid-year).
[d]CBR = crude birthrate = 1000 x (births/population at mid-year).
[e]NRR = net reproduction rate (1965 and 1975 NRRs are based on division of each TPFR by the TPFR for England and Wales that yields an NRR of 1; 1970 NRRs are based on use of life table survival rates, using the method of Shyrock, Siegel, and Stockwell (1976)).
SOURCES: England and Wales regions, 1965: OPCS (1967), Table GG, pp. 146–147. Scotland, 1965: Registrar General, Scotland (1967), Table 3, p. 100, Table 10, pp. 120–121. Northern Ireland, 1965: Keyfitz and Flieger (1971), Chapter 16, p. 478; the data for 1966 are adjusted to 1965. England and Wales regions, 1970: OPCS (1972b), Table GG, pp. 147–150. Scotland, 1970: Registrar General, Scotland (1971b), Table S2.5, pp. 90–91, Table N2.1, p. 28. Northern Ireland, 1970: Interpolated between 1965 and 1975 figures. England and Wales regions, 1975: OPCS (1978a), Table 7.1, pp. 69–71. Scotland, 1975: Registrar General, Scotland (1976b), Table S2.5, pp. 162–163, Table N2.1, p. 38. Northern Ireland, 1975: Registrar General, Northern Ireland (1977), Table E3, p. 19, Table C1, p.7.

The variation among the other regions is relatively small compared with the Great Britain–Northern Ireland difference. The range between maximum and minimum value is 283 in 1965 in total period fertility rate terms, 307 in 1970, and 176 in 1975 (some 10 percent, 13 percent and 10 percent of the Great Britain mean in each of the years).

The fall in fertility over the 1965–1975 decade is sustained and substantial in every region. The 1965 fertility rates are the second highest since the First World War (see Figure 3), just below those of the previous year. By 1975 fertility rates had fallen to 64 percent of the 1965 level, just over the equivalent of 1.8 children per woman over her childbearing age span, and well below replacement level.

Some regions made relative gains in the period such as East Anglia or Wales, and others lost in relative position such as the South West or South East. Figure 11 maps the crude birthrate and total period fertility rates for the regions. Fertility rates in the Northern part of the United Kingdom tend to be higher than those in the Southern regions, though the North region tends to have lower fertility and is included in the "lowest 3 regions" group in the 1975 maps. The correlation between different fertility indices for the same year is not perfect (Table 14), and it is of the same order of magnitude as the correlation between successive years on the same index. The picture is then one of minor change over a small range producing changes in rank for the regions placed in an intermediate position between the high fertility position of Northern Ireland, Scotland, and the North West, and that of low fertility belonging to the South East and South West.

Fertility in all regions is concentrated in the 20–24 and 25–29 age groups with the one exception of Northern Ireland where high fertility persists into the 30–34 and 35–39 age groups. The teens and twenties were the ages experiencing the least fall in fertility rates in the 1965–1975 period (83, 65, and 69 percent for Great Britain, respectively) with more substantial falls in the older age groups. In Northern Ireland fertility rates in the 15–19 and 20–24 age groups rose substantially from relatively low levels as the fertility pattern shifted to that of the regions in Great Britain. This shift is emphasized when the rates are plotted cumulatively against age. In Figure 12, the Northern Ireland curve for 1975 shows the features that characterized those of the South East in 1965.

Net reproduction rates are shown in the final column of Table 13. These were well above replacement level (NRR = 1) in 1965, but by 1975 had decreased to levels well below replacement (again with the exception of Northern Ireland). The regional patterns of fertility are not substantially altered by the NRR calculation (the 1970 correlation between

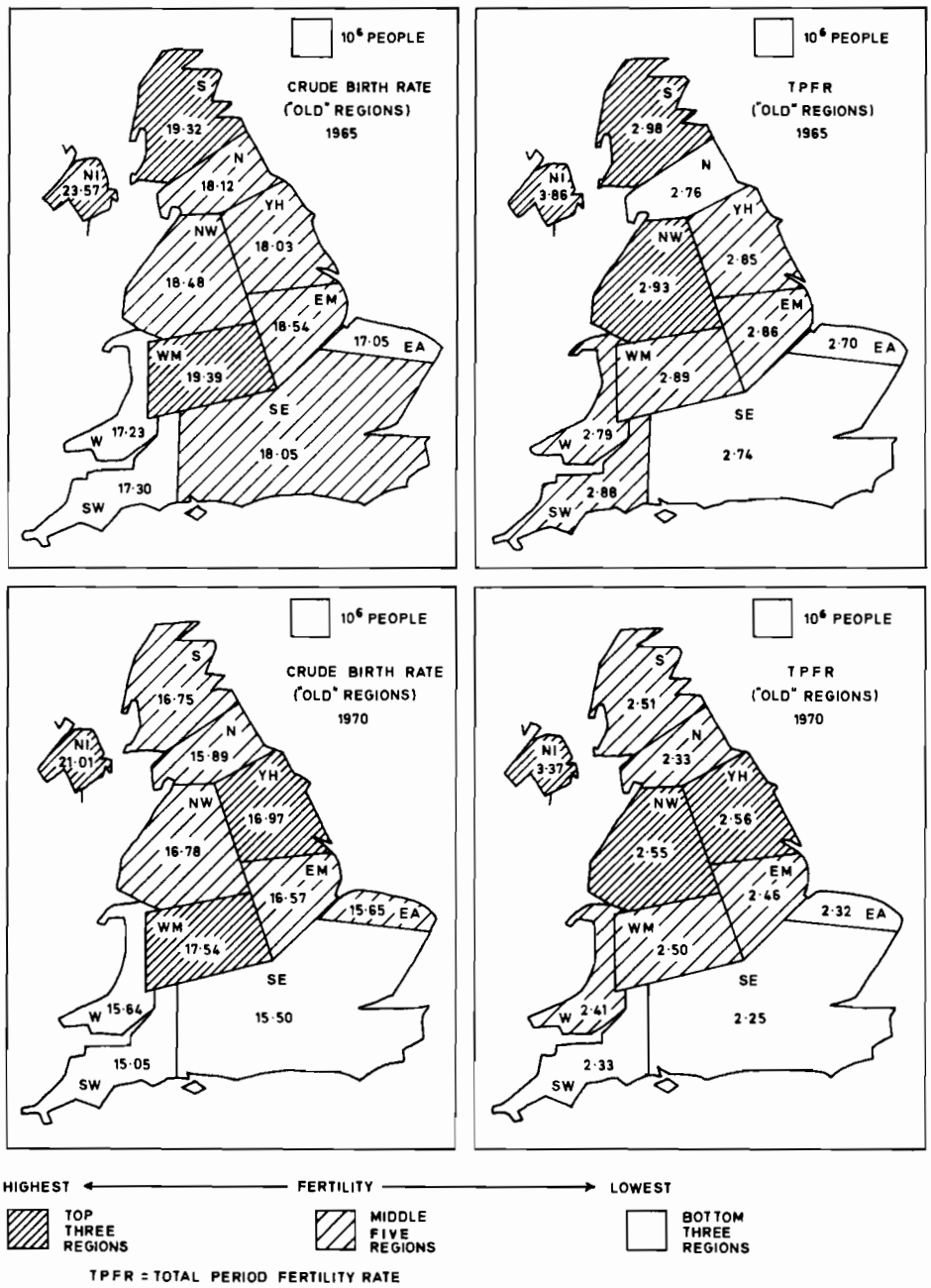


FIGURE 11 Regional fertility rates, United Kingdom, 1965, 1970, and 1975.

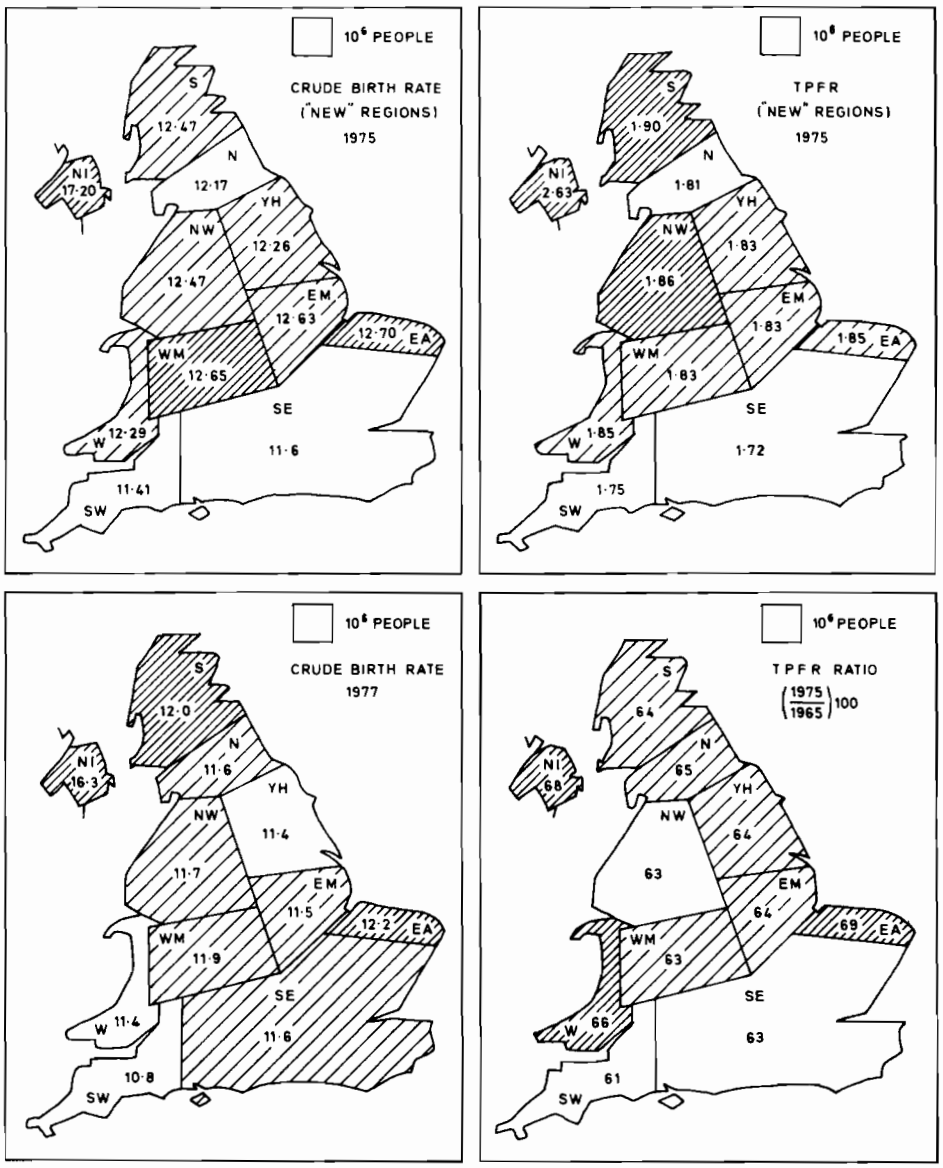
10⁶ PEOPLE
CRUDE BIRTH RATE
("NEW" REGIONS)
1975
S 12·47
N 12·17
NI 17·20
YH 12·26
NW 12·47
EM 12·63
EA 12·70
WM 12·65
SE 11·6
W 12·29
SW 11·41
10⁶ PEOPLE
TPFR
("NEW" REGIONS)
1975
S 1·90
N 1·81
NI 2·63
YH 1·83
NW 1·86
EM 1·83
EA 1·85
WM 1·83
SE 1·72
W 1·85
SW 1·75
10⁶ PEOPLE
CRUDE BIRTH RATE
1977
S 12·0
N 11·6
NI 16·3
YH 11·4
NW 11·7
EM 11·5
EA 12·2
WM 11·9
SE 11·6
W 11·4
SW 10·8
10⁶ PEOPLE
TPFR RATIO
(1975/1965)100
S 64
N 65
NI 68
YH 64
NW 63
EM 64
EA 69
WM 63
SE 63
W 66
SW 61
HIGHEST
FERTILITY
LOWEST
TOP THREE REGIONS
MIDDLE FIVE REGIONS
BOTTOM THREE REGIONS
TPFR = TOTAL PERIOD FERTILITY RATE

TABLE 14 Correlation of fertility rates.[a]

| | | CBR | | | TPFR | | |
|---|---|---|---|---|---|---|---|
| | | 1965 | 1970 | 1975 | 1965 | 1970 | 1975 |
| Crude birthrate (CBR) | 1965 | | 0.962 | 0.921 | 0.948 | | |
| | 1970 | | | 0.930 | | 0.967 | |
| | 1975 | | | | | | 0.984 |
| Total period fertility rates (TPFR) | 1965 | 0.948 | | | | 0.975 | 0.966 |
| | 1970 | | 0.967 | | | | 0.969 |
| | 1975 | | | 0.984 | | | |

[a]Pearson's correlation coefficient between the variables in the table are derived from the data for 11 regions given in Table 13 and displayed in Figure 10.

the total period fertility rates (TPFRs) and NRRs is 0.999), but given an inverse correlation between TPFRs and female life expectancies (–0.565) the variability of the NRRs amongst the regions is less than the TPFRs (the coefficients of variation are 0.1167 and 0.1209, respectively).

## 2.5 REGIONAL MORTALITY

In Table 15, which shows the crude death rates for the regions, the trend appears to be one of rising mortality. Of course, this results not from the greater depredations of disease, but from the rising age of the population and the falling fertility. The low rates for the West Midlands and Northern Ireland are a result of their younger than average age structure rather than of any better intrinsic mortality experience. The regional pattern over time is a little more stable than that for the crude birthrate.

If, instead, mortality measures based on the age-specific death rates for the regions and for the country are examined, a rather happier picture emerges. Life expectancy figures, calculated on a single-region basis in various sources, are collected together in the bottom part of Table 16. The table reveals that there has been a continuing slight improvement in life expectancy in the recent past. An improvement of 0.6 years was effected on average for both males and females in England and Wales between 1970 and 1974–1975.

The range between highest and lowest regional life expectancy values is 3.5 for males and 3.2 for females (for the 1970 figures for all UK

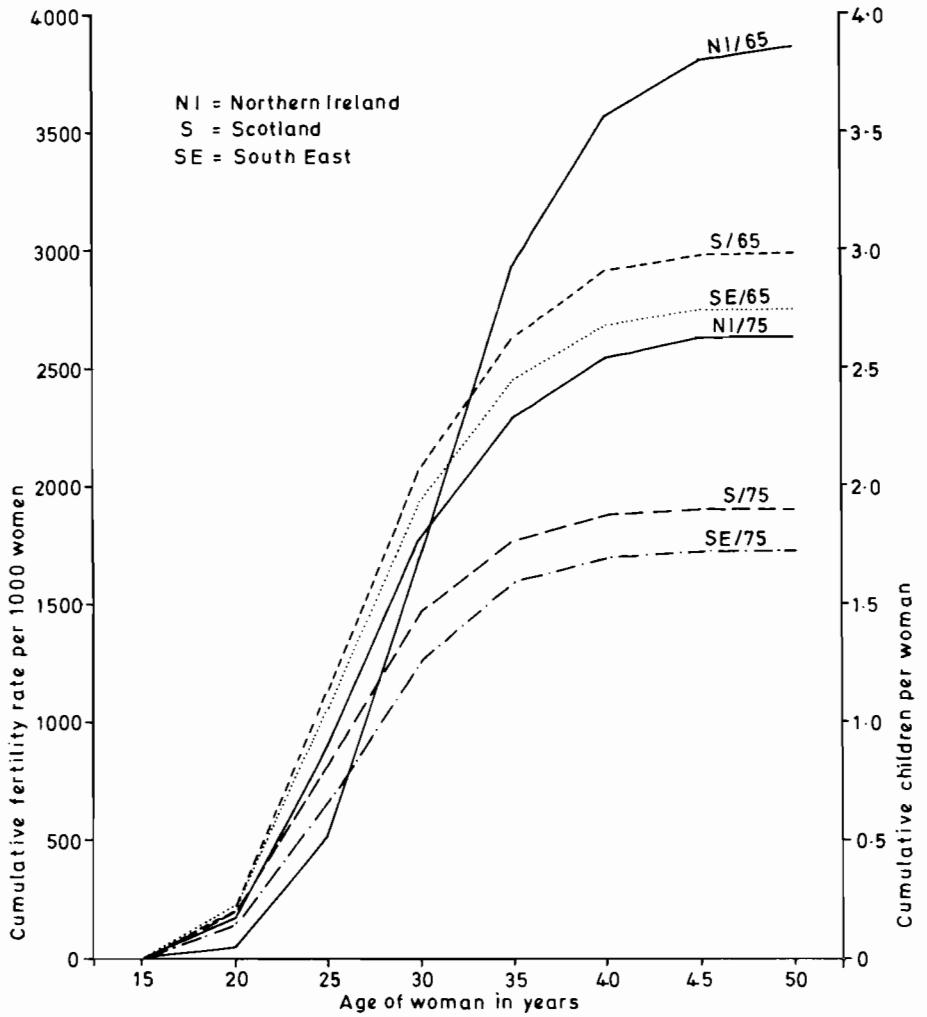


FIGURE 12 Cumulative fertility rates for selected regions.

regions given in Table 17). This range is comparable to the range of life expectancy values among the countries of the Common Market (4.76 for males and 3.51 for females for 1966, from statistics given in Keyfitz and Flieger, 1971). The most favored region in 1970, East Anglia, has mortality conditions that are almost as favorable as the Netherlands or Denmark; Scotland, on the other hand, suffers from less favorable mortality levels, comparable to those of Luxembourg.

Tables 17 and 18, and Figure 13, provide a more detailed picture of life expectancy as of 1970. These tables will be used later to compare the

TABLE 15 Crude death rate, selected years, UK "new" regions.

| Region | 1965 | 1970 | 1975 | 1977 | Regression coefficient[a] |
|---|---|---|---|---|---|
| N | 12.2 | 12.3 | 12.3 | 12.0 | 0.005 |
| YH | 11.9 | 12.2 | 12.1 | 12.0 | 0.007 |
| NW | 12.5 | 12.8 | 12.6 | 13.0 | 0.028 |
| EM | 11.0 | 11.3 | 11.3 | 11.0 | 0.005 |
| WM | 10.5 | 10.7 | 10.7 | 11.0 | 0.033 |
| EA | 11.6 | 11.4 | 11.4 | 11.0 | −0.039 |
| SE | 11.2 | 11.4 | 11.4 | 11.0 | −0.009 |
| SW | 12.0 | 12.5 | 12.7 | 13.0 | 0.077 |
| W | 12.3 | 12.9 | 12.9 | 13.0 | 0.052 |
| S | 12.1 | 12.2 | 12.4 | 12.5 | 0.033 |
| NI | 10.6 | 10.9 | 10.7 | 11.1 | 0.028 |
| UK | 11.5 | 11.8 | 11.9 | 12.0 | 0.039 |
| GB | 11.5 | 11.9 | 11.9 | 12.0 | 0.037 |
| EW | 11.5 | 11.8 | 11.8 | 12.0 | 0.035 |
| Correlation coefficient[b] | | 0.962 | 0.979 | 0.933 | |

[a]The regression coefficient is calculated by regressing the crude death rate against time starting at 1965.
[b]The correlation coefficient is Pearson's *r*.
SOURCES: England and Wales regions: OPCS (1978e), Table 31, p. 64. Scotland, Northern Ireland, and United Kingdom: OPCS (1978e), Table 9, p. 37, Table 10, p. 38, Table 11, p. 39.

information available on a single-region basis with that available from multiregional analysis. The pattern is one of higher mortality in the Northern and Western regions than in the Southern and Eastern regions (Figure 12). Scotland and the North West show a particular disadvantage in comparison with the other regions in terms of male life expectancy, and East Anglia and the South East have a particular advantage. The regional variability of female life expectancy is a little lower than that of males. Table 18 extracts from the individual life tables the $\ell(x)$ survival statistics for males, females, and persons, and makes possible an examination of regional differences in survival at particular ages. The rank ordering shown in Figure 13 is maintained at most ages, give or take a rank per region, with only one or two exceptions. The Northern Ireland male population

TABLE 16 Selected mortality indicators, England and Wales regions, 1969–1975.

| Region | SMR[a] (OR) 1969–73 Males | SMR[a] (OR) 1969–73 Females | RMR[b] (OR) 1969–73 Infants | SMR[a] (NR) 1975 Males | SMR[a] (NR) 1975 Females |
|---|---|---|---|---|---|
| N | 109 | 108 | 107 | 111 | 108 |
| YH | 105 | 104 | 112 | 104 | 103 |
| NW | 112 | 109 | 113 | 111 | 108 |
| EM | 98 | 100 | 101 | 97 | 100 |
| WM | 104 | 102 | 104 | 103 | 102 |
| EA | 89 | 93 | 88 | 88 | 93 |
| SE | 93 | 95 | 90 | 94 | 95 |
| SW | 93 | 96 | 94 | 90 | 94 |
| W | 107 | 104 | 103 | 109 | 105 |
| EW | 100 | 100 | 100 | 100 | 100 |

| Region | LE[c] (OR) 1970 Males | LE[c] (OR) 1970 Females | LE[c] (OR) 1974–75 Males | LE[c] (OR) 1974–75 Females | Gain in LE[c] 1970 to 74–75 Males | Gain in LE[c] 1970 to 74–75 Females |
|---|---|---|---|---|---|---|
| N | 68.1 | 74.1 | 68.2 | 74.4 | 0.1 | 0.3 |
| YH | 68.0 | 74.4 | 68.9 | 75.2 | 0.9 | 0.8 |
| NW | 67.2 | 73.8 | 68.1 | 74.4 | 0.9 | 0.4 |
| EM | 68.8 | 75.2 | 69.4 | 75.4 | 0.6 | 0.2 |
| WM | 68.4 | 74.8 | 69.1 | 75.4 | 0.7 | 0.6 |
| EA | 70.5 | 76.5 | 71.3 | 76.9 | 0.8 | 0.4 |
| SE | 69.9 | 76.1 | 70.6 | 76.6 | 0.7 | 0.5 |
| SW | 69.6 | 75.9 | 70.6 | 76.8 | 1.0 | 0.9 |
| W | 68.0 | 74.2 | 68.5 | 75.1 | 0.5 | 0.9 |
| EW | 68.9 | 75.1 | 69.5 | 75.7 | 0.6 | 0.6 |

[a]SMR = standardized mortality ratio, or the ratio of actual deaths in the region to deaths expected by applying the England and Wales mortality rates to the regional population at risk.
[b]RMR= relative mortality ratio, or the ratio of the infant mortality rate to the infant mortality rate for England and Wales.
[c]LE = average life expectancy.
SOURCES: SMR (OR) 1969–73, RMR (OR) 1969–73 } Chilvers (1978)
SMR (NR) 1975 OPCS (1977c)
LE (OR) 1970 Table 17
LE (NR) 1974–75 Gardner and Donnan (1977)

TABLE 17 Regional life expectancies, United Kingdom, 1970.[a,c,e]

| "Old" region | Average $_0e$ | | | | Median[d] $_0e$ | | | |
|---|---|---|---|---|---|---|---|---|
| | Persons | Males | Females | Difference between male and female | Persons | Males | Females | Difference between male and female |
| N | 71.1 | 68.1 | 74.1 | 6.0 | 74.4 | 71.2 | 77.6 | 6.4 |
| YH | 71.2 | 68.0 | 74.4 | 6.4 | 74.5 | 71.2 | 77.9 | 6.7 |
| NW | 70.5 | 67.2 | 73.8 | 6.6 | 73.8 | 70.4 | 77.4 | 7.0 |
| EM | 72.0 | 68.8 | 75.2 | 6.4 | 75.2 | 71.8 | 78.6 | 6.8 |
| WM | 71.6 | 68.4 | 74.8 | 6.4 | 74.9 | 71.4 | 78.4 | 7.0 |
| EA | 73.5 | 70.5 | 76.5 | 6.0 | 76.6 | 73.5 | 79.9 | 6.4 |
| SE | 73.1 | 69.9 | 76.1 | 6.3 | 76.3 | 72.8 | 79.6 | 6.8 |
| SW | 72.8 | 69.6 | 75.9 | 6.3 | 76.0 | 72.7 | 79.1 | 6.4 |
| W | 71.1 | 68.0 | 74.2 | 6.2 | 74.4 | 71.1 | 77.8 | 6.7 |
| S[b] | 70.2 | 67.0 | 73.3 | 6.3 | 73.6 | 70.3 | 76.9 | 6.6 |
| NI[b] | 70.7 | 67.9 | 73.5 | 5.6 | 74.0 | 71.0 | 77.0 | 6.0 |

[a] Deaths data for 5-year age groups 0, 1–4, 5–9, . . . , 85+ is estimated from data available for 0, 1–4, 5–14, 15–24, . . . , 75+ for standard regions in England and Wales, using national deaths data and mid-year population broken down by 5 year age groups 0, 1–4, 5–9, . . . , 85+. The estimation equations are

$$D_r^{jx} = A_s^{jx}\, d_r^{EWx} P_r^{jx}, \quad r \in s$$

$$A_s^{jx} = D_s^{jx} \Big/ \sum_{r \in s} d_r^{EWx} P_r^{jx},$$

where $D_r^{jx}$ are deaths in region $j$ for sex $x$ in detailed age group $r$; $P_r^{jx}$ is the population of sex $x$ in region $j$ in detailed age group $r$; $d_r^{EWx}$ is the death rate for sex $x$ and age group $r$ in England and Wales; $A_s^{jx}$ is a balancing factor for sex $x$ in region $j$ that adjusts estimated $r$ age-group deaths, so that they equal observed $s$ (more aggregated) age-group deaths, $D_s^{jx}$.

[b] Deaths data for Scotland and Northern Ireland were directly available.

[c] The life expectancies were calculated using a version of the LIFE computer program given in Keyfitz and Flieger (1971) adapted for an ICL 1906A with integer variables converted to reals.

[d] Median life expectancies are the age at which half the population has died (that is, that $x$ for which $e(x) = 0.5$). They are found by interpolation.

[e] Regional life expectancies using the single-region method were also computed using the IIASA set of programs employed in a multiregional context in Section 3 of the paper. Life expectancies for persons were as follows: N – 71.14, YH – 71.23, NW – 70.61, EM – 72.06, WM – 71.68, EA – 73.51, SE – 73.19, SW – 72.89, W – 71.16, S – 70.26. These values are slightly higher than the ones given in the table, by about 0.06 of a year on average, or 3 weeks. The higher values result from the use of one 0–4 age group rather than 0 and 1–4 age groups in the Keyfitz and Flieger (1971) program LIFE.

TABLE 18 Life table survivors out of 10,000 births from the abridged life tables for 1970, United Kingdom.

| Region | Age in years | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 20 | 40 | 50 | 60 | 70 | 80 |
| **Males** | | | | | | | | |
| N | 10,000 | 9,792 | 9,680 | 9,444 | 9,007 | 7,829 | 5,395 | 2,196 |
| YH | 10,000 | 9,765 | 9,645 | 9,418 | 9,021 | 7,908 | 5,407 | 2,148 |
| NW | 10,000 | 9,751 | 9,635 | 9,405 | 8,950 | 7,712 | 5,126 | 1,973 |
| EM | 10,000 | 9,792 | 9,681 | 9,453 | 9,078 | 8,036 | 5,621 | 2,379 |
| WM | 10,000 | 9,792 | 9,677 | 9,457 | 9,062 | 7,943 | 5,473 | 2,276 |
| EA | 10,000 | 9,818 | 9,691 | 9,506 | 9,180 | 8,289 | 6,127 | 2,842 |
| SE | 10,000 | 9,813 | 9,705 | 9,500 | 9,163 | 8,189 | 5,896 | 2,659 |
| SW | 10,000 | 9,807 | 9,695 | 9,499 | 9,163 | 8,157 | 5,864 | 2,564 |
| W | 10,000 | 9,796 | 9,689 | 9,470 | 9,038 | 7,832 | 5,348 | 2,137 |
| S | 10,000 | 9,775 | 9,652 | 9,356 | 8,875 | 7,626 | 5,101 | 2,018 |
| NI | 10,000 | 9,762 | 9,654 | 9,402 | 8,952 | 7,808 | 5,319 | 2,256 |
| **Females** | | | | | | | | |
| N | 10,000 | 9,827 | 9,762 | 9,628 | 9,324 | 8,662 | 7,193 | 4,203 |
| YH | 10,000 | 9,820 | 9,753 | 9,611 | 9,326 | 8,693 | 7,237 | 4,334 |
| NW | 10,000 | 9,824 | 9,749 | 9,602 | 9,300 | 8,601 | 7,093 | 4,154 |
| EM | 10,000 | 9,852 | 9,786 | 9,657 | 9,387 | 8,779 | 7,394 | 4,541 |
| WM | 10,000 | 9,828 | 9,754 | 9,622 | 9,361 | 8,776 | 7,379 | 4,459 |
| EA | 10,000 | 9,861 | 9,793 | 9,671 | 9,442 | 8,925 | 7,654 | 4,958 |
| SE | 10,000 | 9,856 | 9,791 | 9,655 | 9,409 | 8,858 | 7,584 | 4,861 |
| SW | 10,000 | 9,853 | 9,798 | 9,676 | 9,443 | 8,887 | 7,557 | 4,740 |
| W | 10,000 | 9,825 | 9,759 | 9,613 | 9,314 | 8,658 | 7,202 | 4,279 |
| S | 10,000 | 9,833 | 9,756 | 9,581 | 9,241 | 8,494 | 6,947 | 3,982 |
| NI | 10,000 | 9,800 | 9,730 | 9,576 | 9,285 | 8,584 | 7,036 | 3,972 |
| **Persons** | | | | | | | | |
| N | 10,000 | 9,809 | 9,720 | 9,535 | 9,162 | 8,242 | 6,280 | 3,208 |
| YH | 10,000 | 9,791 | 9,698 | 9,512 | 9,169 | 8,296 | 6,319 | 3,266 |
| NW | 10,000 | 9,786 | 9,691 | 9,501 | 9,122 | 8,158 | 6,124 | 3,103 |
| EM | 10,000 | 9,821 | 9,732 | 9,552 | 9,227 | 8,400 | 6,488 | 3,469 |
| WM | 10,000 | 9,810 | 9,714 | 9,537 | 9,206 | 8,350 | 6,407 | 3,380 |
| EA | 10,000 | 9,839 | 9,741 | 9,585 | 9,306 | 8,604 | 6,884 | 3,926 |
| SE | 10,000 | 9,834 | 9,747 | 9,576 | 9,285 | 8,526 | 6,760 | 3,844 |
| SW | 10,000 | 9,829 | 9,745 | 9,585 | 9,301 | 8,523 | 6,720 | 3,690 |
| W | 10,000 | 9,810 | 9,723 | 9,540 | 9,174 | 8,246 | 6,270 | 3,216 |
| S | 10,000 | 9,803 | 9,703 | 9,467 | 9,058 | 8,067 | 6,036 | 3,030 |
| NI | 10,000 | 9,780 | 9,691 | 9,488 | 9,119 | 8,199 | 6,187 | 3,114 |

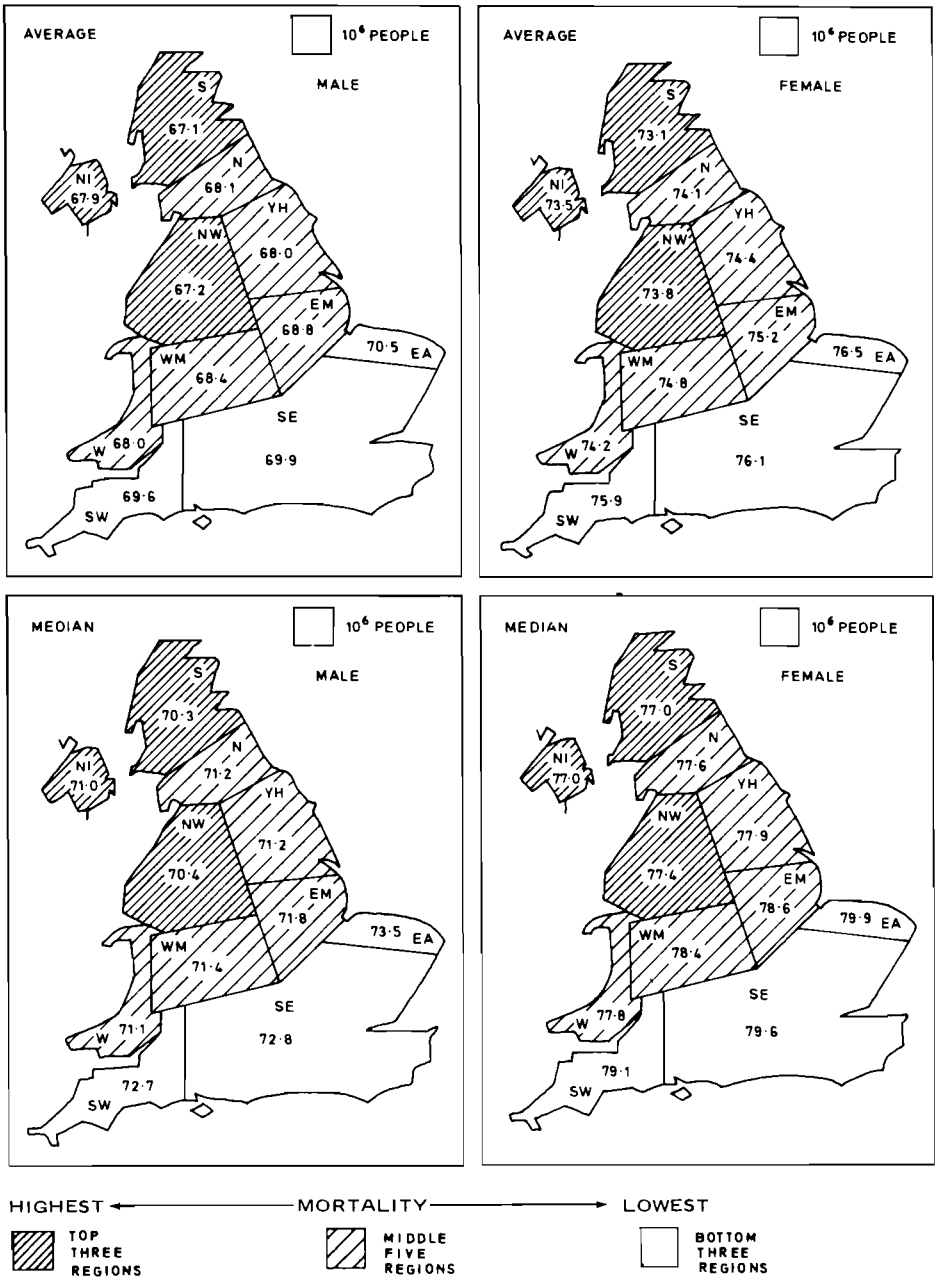


FIGURE 13 Life expectancies, single-region method, United Kingdom, 1970.

shows a higher survival propensity at the oldest ages than is indicated by its overall life expectancy position. Similarly, Scotland has a much higher survival value at age 1 than its overall position suggests.

## 2.6 INTERREGIONAL MIGRATION: PATTERNS AND RATES BY AGE

The examination of age-specific patterns of mortality and fertility is a longstanding concern. However, data of good quality on age-specific migration have only recently become available in the United Kingdom with the Censuses of 1961, 1966, and 1971. Published data for detailed age groups for interregional migration up to 75 and over are available only in the 1971 Census (OPCS, 1974b, 1975), although Joseph (1975) has used unpublished special tabulations from the 1966 Sample Census. The regions to which the data apply are the "old" regions (Figure 1.2). Unpublished tabulations of interregional migration on a uniform 5-year-age-group basis are also available for "new" regions (Figure 1.3). Selected data from these various sources are used to investigate the relationship between interregional migration and age.

Net migrant flows are examined first. Table 19 sets out a crude age disaggregation of the net internal migrant columns of Table 11 for the 1965–1966 and 1970–1971 period and adds a comparison with the earlier 1960–1961 period (data derived from the Department of the Environment, 1971). Some individual age groups display distinctive patterns that differ from the overall patterns already discussed. For example, although the South East moves from the positive net in-migration category in the early 1960s to net outflow later, in-migration both overall and for all but one age group, 15–24 year olds, remains positive throughout the period. The bright lights of the capital attracts the nation's young like moths to a lamp at night. At older ages the attractions diminish, and net out-migration occurs. By 1970–1971, 3 regions show consistent losses in all age groups, Yorkshire and Humberside, the North West, and the West Midlands. Two show a mixed pattern of mainly losses and some gains (the South East, as already noted, and Scotland). Two, the North and Wales, show a pattern of losses in the 15–24 year age group, but gains in most of the other age groups. Three regions, East Midlands, East Anglia, and the South West, exhibit consistent gains in all age groups in 1970–1971 (and in 1965–1966). Figure 14 shows these patterns for 5-year age groups in 1970–1971. The picture remains the same with one or two minor deviations, such as the 15–19 year old group in the East Midlands.

Of course, net migrants as such do not actually exist: they are simply an arithmetic concept. In order to obtain a better idea of the age-specific pattern of migration, it is necessary to examine the migrant data by means of computing the rates that relate migrants to the population at risk. A detailed matrix of interregional migrants by 5-year age groups was assembled for 1970–1971 (the methods of estimation are described in Section 3 of the paper), and migration rates were calculated using the Willekens and Rogers (1976) computer program run at IIASA.

$$ {}^{i}M_x^j = \frac{{}^{i}D_x^j}{K_x^i}, \quad \text{for} \quad \underset{j \neq i}{i,j = 1, \ldots, 10}, \tag{1} $$

where

${}^{i}M_x^j$ is the observed rate of migration (transition) from region $i$ at the start of the year to region $j$ at the end of the year for persons making the transition between age $x$ and age $x + 5$,

${}^{i}D_x^j$ is the estimated number of migrants (of both sexes) making the transition from region $i$ at the start of the year to region $j$ at the end of the year for persons making the transition between age $x$ and $x + 5$,

$K_x^i$ is the estimated number of people (of both sexes) in region $i$ in age group $x$ to $x + 5$ (whole years $x$ to $x + 4$ at last birthday) mid-way through the year.

The ${}^{i}D_x^j$ for the calendar year 1970 were assumed to be equal to the ${}^{i}D_x^j$ measured in the precensus 24–25 April 1970 to 24–25 April 1971 period. The $K_x^i$ apply to mid-year (30 June–1 July) 1970. When the ${}^{i}M_x^j$ are plotted against age $x$ on a graph, it should be remembered that the average age of migration is approximately $x + \frac{5}{2}$, and this approximation is used in computing mean age of the migrants or the migration schedule (Willekens and Rogers, 1976).

Figure 15 displays the age pattern of total internal out-migration for each of the 10 regions. The characteristic profile was described over a decade ago by Lowry (1966), and more recently by Plessis-Fraissard (1977), and has been modeled by Rogers and Castro (1976), Rogers, Raquillet, and Castro (1977), and Pittenger (1978). This profile is displayed in all regions. Each age-specific profile is characterized by a fall from age group 0–4 to age group 10–14, a sharp rise from age group 10–14 to age group 20–24, followed by a decline from the peak (at age

TABLE 19 Net interregional internal migrants, Great Britain, 1960–1961, 1965–1966, 1970–1971.

| Age group | N | YH | NW | EM | WM | EA | SE | SW | W | S |
|---|---|---|---|---|---|---|---|---|---|---|
| 1960–61 | | | | | | | | | | |
| 1–14 | −2,340 | −260 | −1,200 | 2,770 | 1,390 | 940 | 1,370 | 4,970 | −450 | −7,190 |
| 15–24 | −3,330 | −1,900 | −1,470 | 1,520 | 80 | −290 | 14,540 | 1,310 | −4,380 | −6,080 |
| 25–44 | −3,920 | −2,680 | −1,640 | 3,080 | 2,390 | 1,530 | 6,020 | 5,850 | −1,280 | −9,350 |
| 45–64 | −350 | −1,860 | −2,010 | −90 | −1,130 | 1,180 | −90 | 4,640 | 1,100 | −1,390 |
| 65+ | 250 | −680 | −700 | 10 | −690 | 850 | −1,670 | 2,550 | 240 | −160 |
| TOTAL | −9,690 | −7,380 | −7,020 | 7,290 | 2,040 | 4,210 | 20,170 | 19,320 | −4,770 | −24,170 |
| 1965–66 | | | | | | | | | | |
| 1–14 | −1,190 | 1,060 | 1,240 | 3,750 | −30 | 2,350 | −7,350 | 3,150 | 660 | −3,640 |
| 15–24 | −1,980 | 80 | −2,270 | 3,170 | −1,530 | 1,090 | 9,140 | 1,150 | −2,570 | −6,280 |
| 25–44 | 180 | 770 | 790 | 3,550 | −710 | 3,880 | −9,710 | 4,910 | 700 | −4,360 |
| 45–59 | −200 | −640 | −1,080 | 850 | −1,020 | 1,920 | −3,890 | 4,250 | 1,110 | −1,300 |
| 60+ | 440 | −910 | −1,100 | 410 | −1,200 | 2,800 | −8,350 | 7,200 | 800 | −90 |
| TOTAL | −2,750 | 360 | −2,420 | 11,730 | −4,490 | 12,040 | −20,160 | 20,660 | 700 | −15,670 |

| 1970–71 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1–14 | 660 | −3,110 | −1,210 | 2,620 | −1,820 | 5,210 | −4,370 | 6,320 | 170 | −4,470 |
| 15–24 | −2,000 | −6,270 | −5,690 | 1,540 | −1,350 | 3,660 | 14,910 | 3,970 | −2,660 | −6,110 |
| 25–44 | 60 | −3,870 | −650 | 4,040 | −2,750 | 5,850 | −5,830 | 6,790 | 770 | −4,410 |
| 45–59 | −30 | −590 | −1,820 | 680 | −1,440 | 2,590 | −7,710 | 6,060 | 1,950 | 310 |
| 60+ | 510 | −910 | −1,780 | 770 | −2,860 | 2,640 | −14,810 | 9,980 | 1,220 | 420 |
| TOTAL | −800 | −14,750 | −11,150 | 9,650 | −10,220 | 20,950 | −13,990 | 33,120 | 1,450 | −14,260 |

SOURCES: Migrant figures for 1960–1961 and 1965–1966 are taken from Department of the Environment (1971), Appendix 2. The data are originally derived from the relevant census, 1961, and 1966 Sample Census tabulations.
Migrant figures for 1970–1971 are derived from Table 3A in OPCS (1974).
The age groups are those at the end of the 1-year period of measurement, that is, at census dates in 1961, 1966, and 1971.

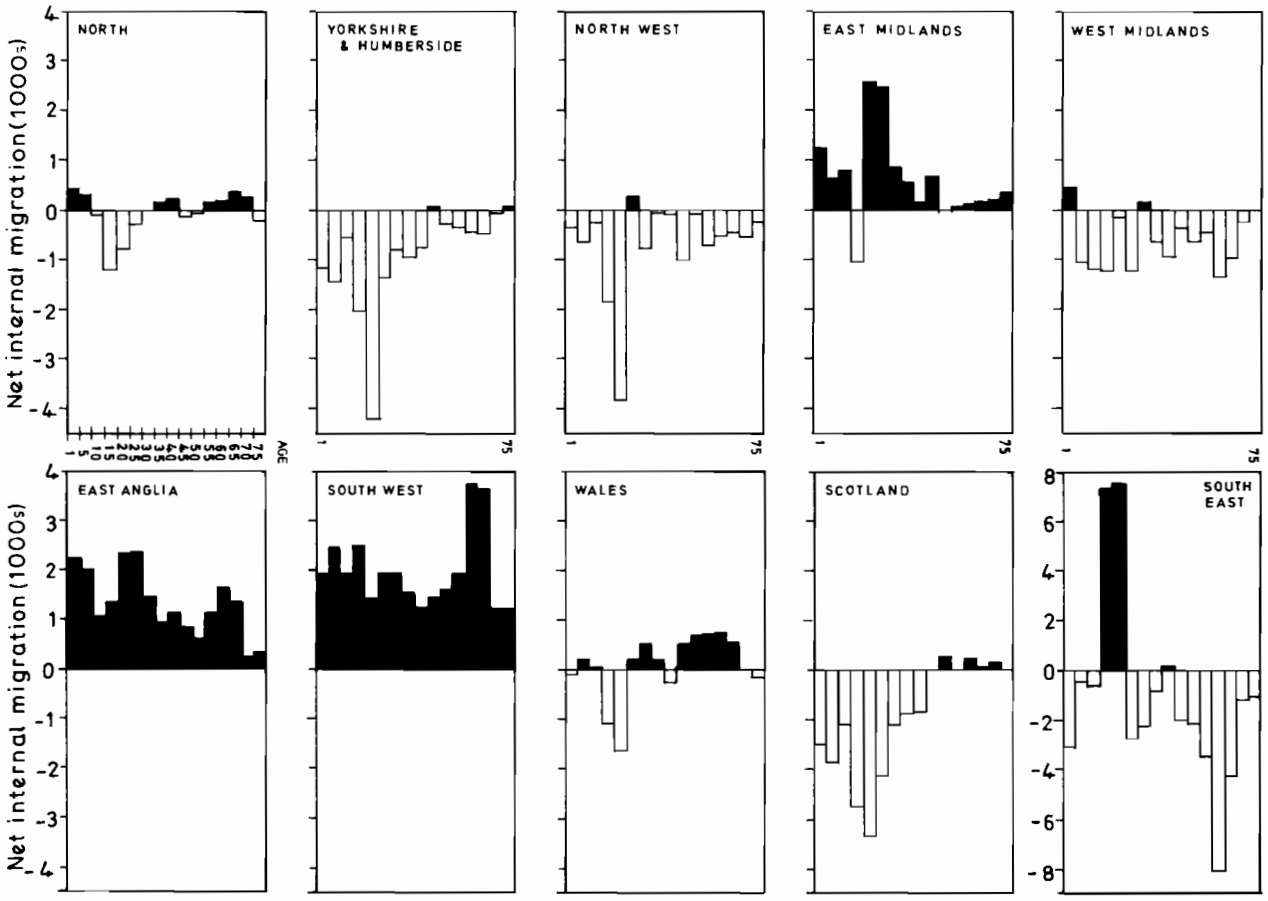


FIGURE 14 Net internal migration patterns, Great Britain.

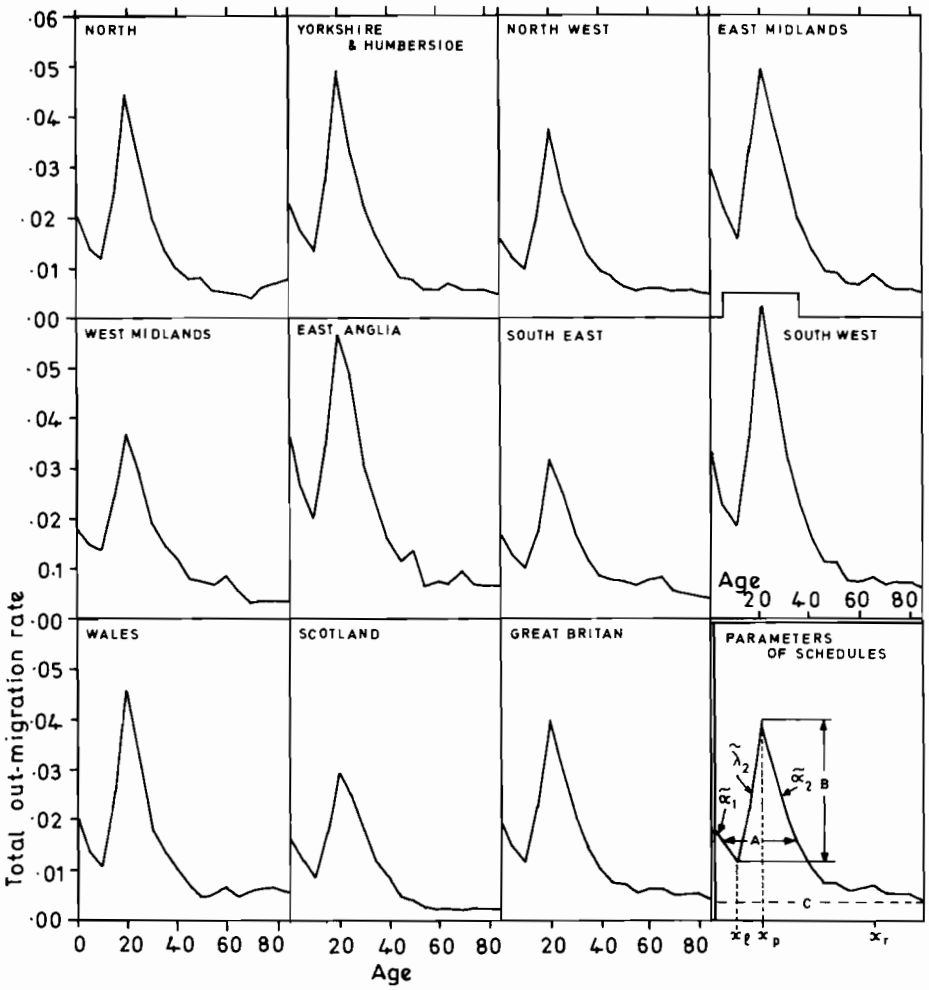


FIGURE 15 Total internal out-migration rates, 1970, Great Britain.

group 20–24 in all cases) to a leveling out at age groups 45–49, and beyond at about 40 percent of the crude rate. There is evidence of a third local maximum at retirement ages in some of the schedules, in those for the East Midlands, West Midlands, and South East.

These general observations can be repeated for a selection of inter-regional migration rates displayed in Figure 16, for the rates of immigration to the regions from outside Great Britain shown in Figure 17, for selected emigration rates taken from Rees (1977a) in Figure 18, and for selected classes of all migrants resident in Great Britain in Figure 19. Although the migration schedules have the same general shape there are a

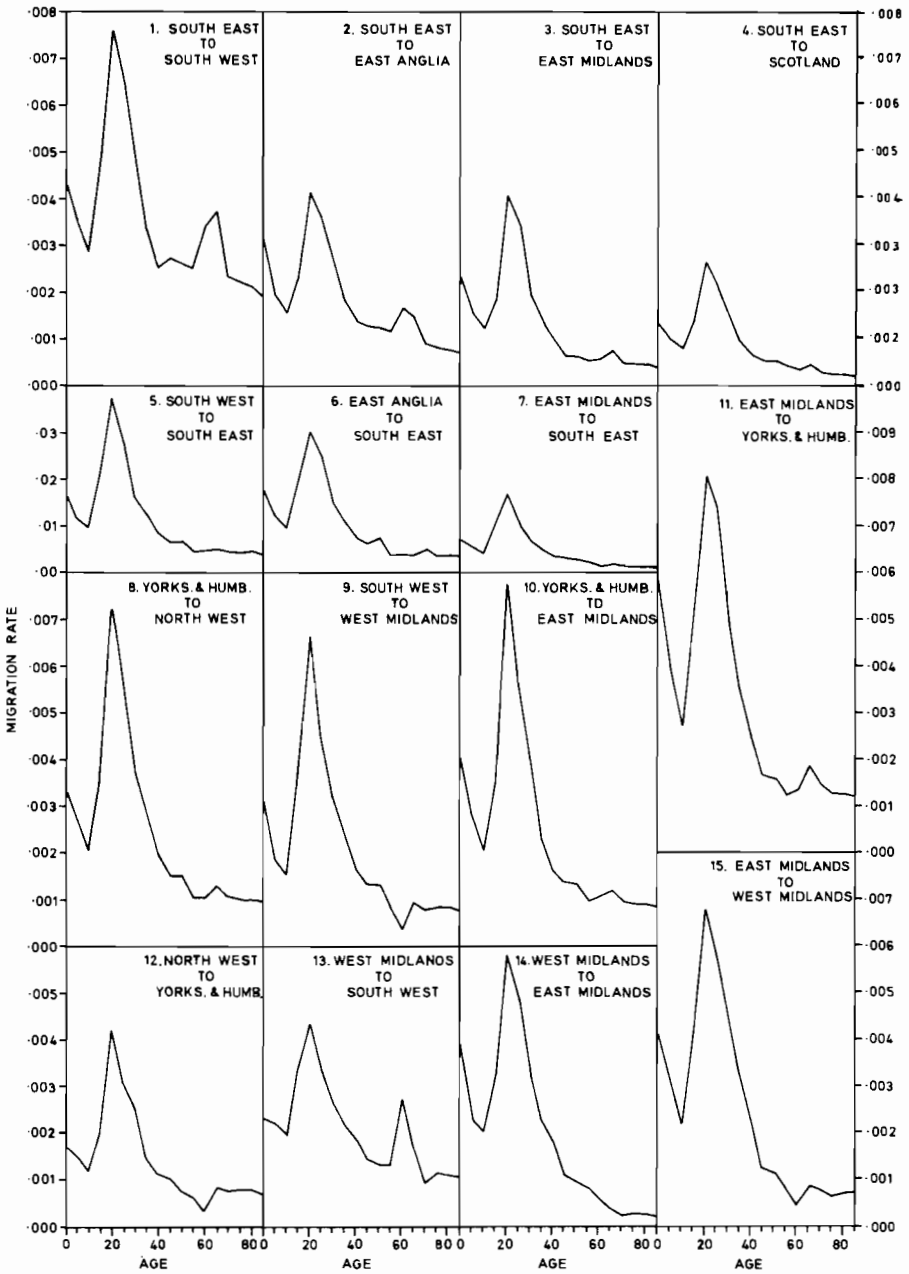


FIGURE 16 Selected interregional migration profiles (internal migration) 1970.

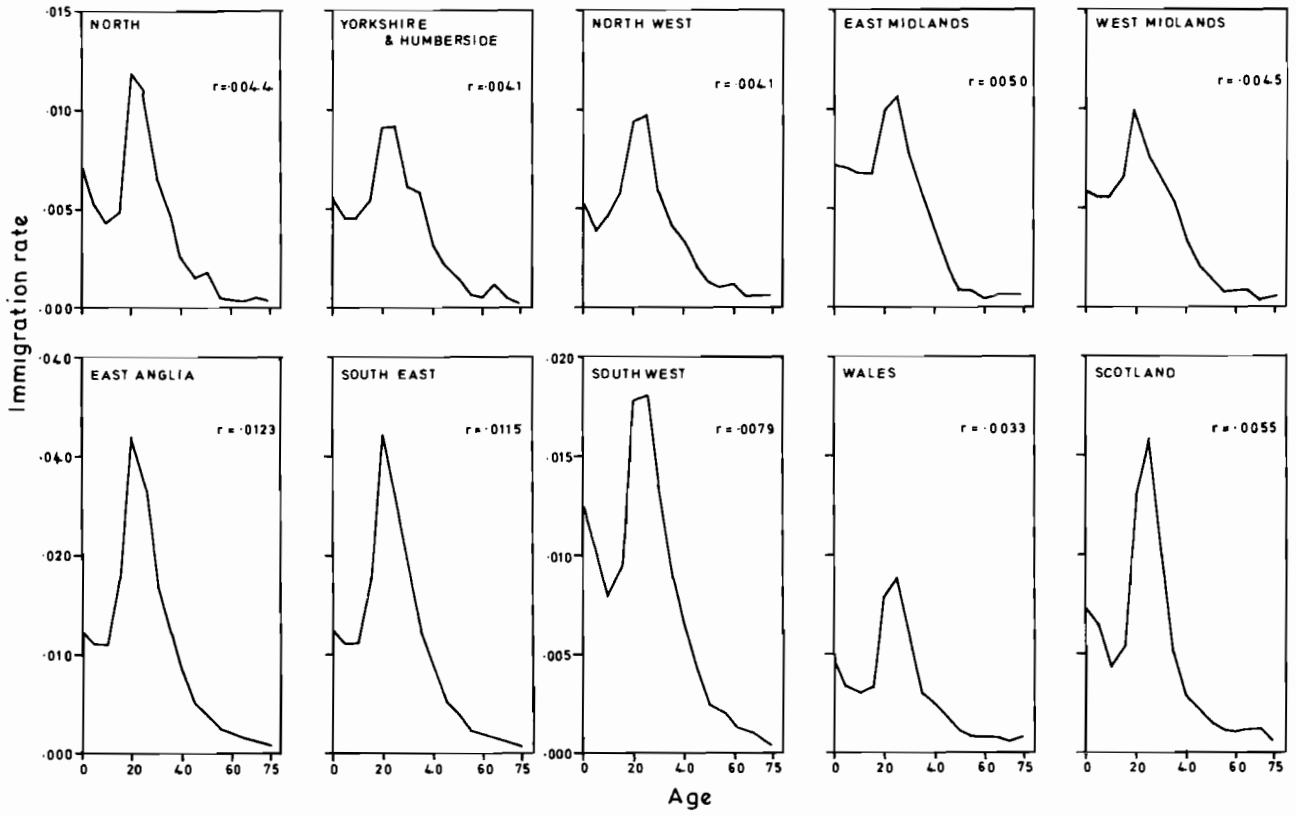


FIGURE 17 External immigration rate profiles, Great Britain, 1970.

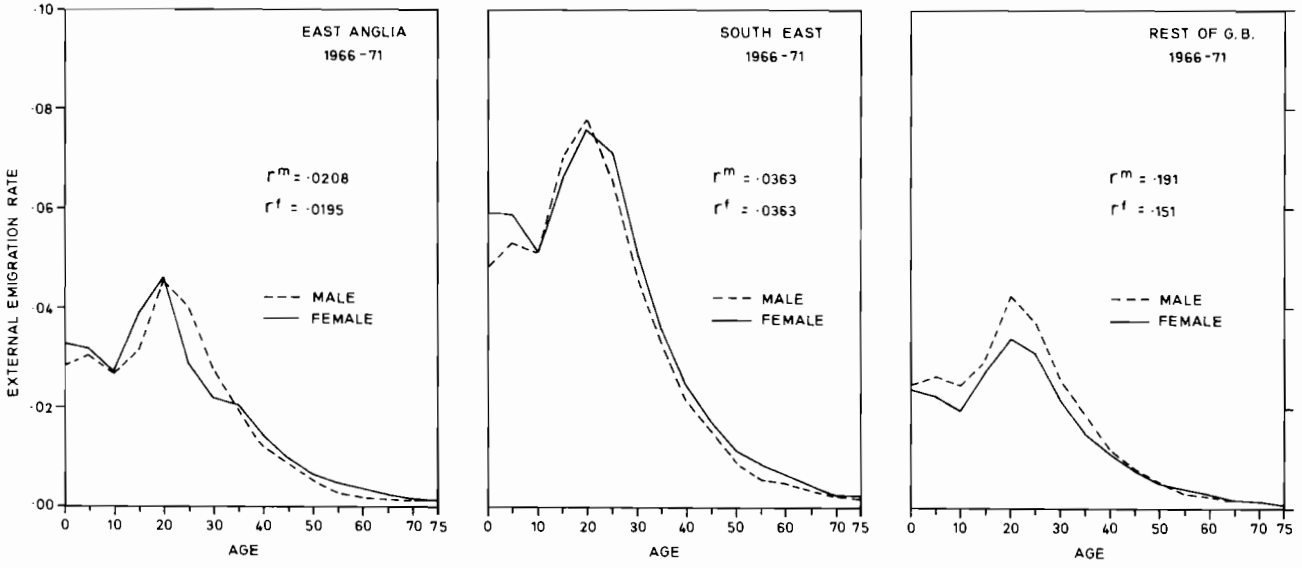


FIGURE 18 External emigration profiles, 1966–1971, selected regions. Source: Rees (1977a).

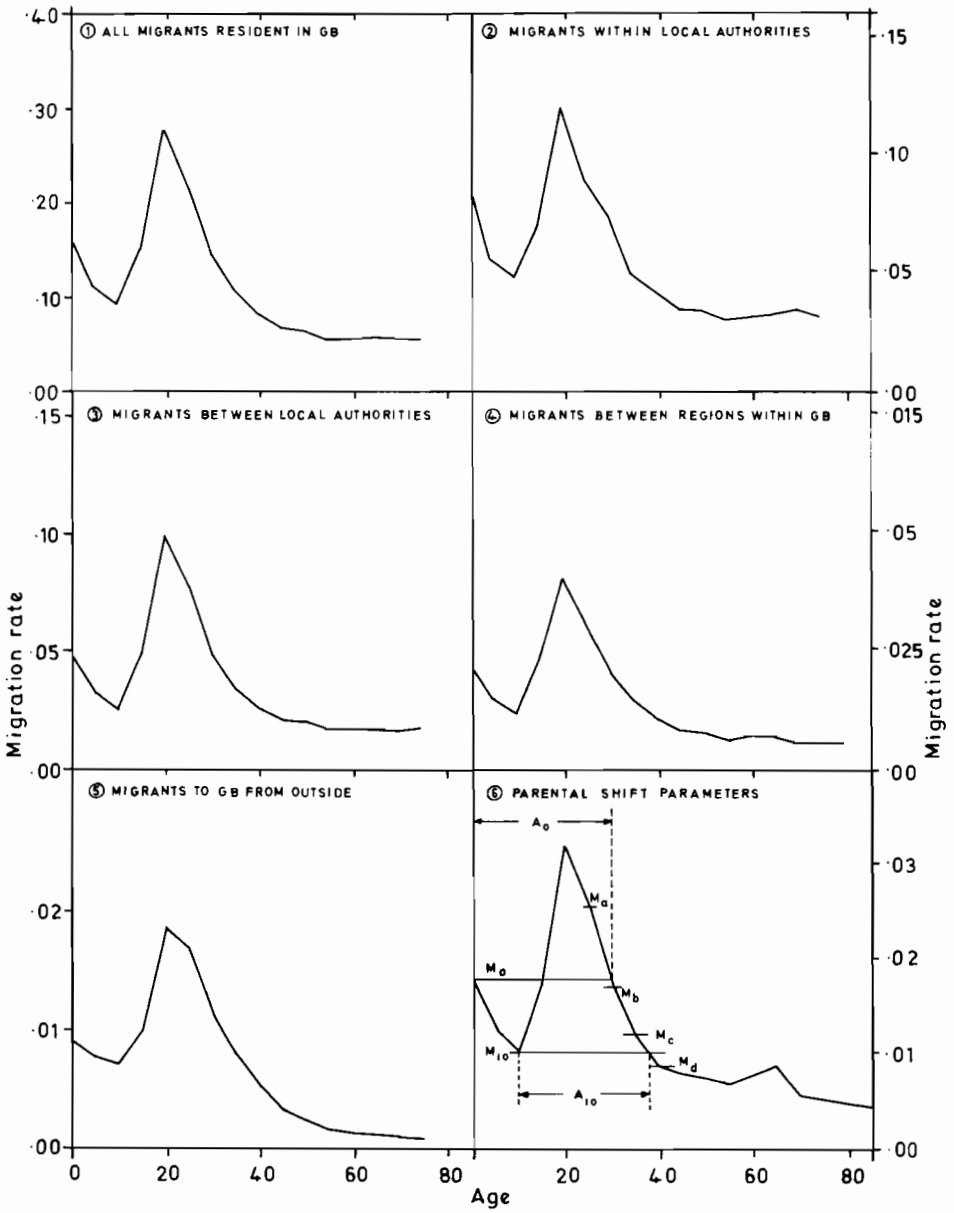


FIGURE 19 Migration profiles for various classes of migrant, Great Britain, 1970.

number of interesting differences in detail. In order to pinpoint these differences rough approximations to the model migration schedule parameters developed by Rogers, Racquillet, and Castro (1977) have been calculated for the Figure 15 and Figure 19 schedules and are recorded in Table 20. Comparisons of the regional or migration class schedules can be made, in particular, with the all migrants schedule (Figure 19.1).

The absolute levels of out-migration in the various regions or migration classes (first column of Table 20) differ so much that the schedule parameters (bottom half of Table 20) have all been normalized by division by the crude rate. The average age of migration schedules of the various classes differ little, although the variation among regions is substantial. The North West, West Midlands, South East, and Wales stand out as having "older" schedules. A detailed tabulation (Table 21) of the average ages of the migration schedules of interregional migrants reveals that destination regions tend to be more homogeneous than origin regions in this respect, and that the oldest schedules involve flows to the South West, Wales, and East Anglia. These regions are the principal destinations of retirement migrants from the South East and South West in particular. Retirement peaks in the migration schedules are evident only at muted scale in total out-migration or in-migration flows (7 out of 10 regions). They are pronounced features of only selected migration streams, such as South East to South West (Figure 16.1), West Midlands to South West (Figure 16.13), South East to East Anglia (Figure 16.2), East Midlands to Yorkshire and Humberside (Figure 16.11). The corresponding migration counter-streams (Figures 16.5, 16.6, and 16.10) fail to show marked retirement peaks.

The constant column ($C/\bar{M}$) reveals that there is, in fact, a systematic relationship between levels of migration rates at the older ages and spatial scale. For the external migrant flows there are very low rates beyond age 50; for interregional migrations the rates remain moderate; and for within region, interlocal authority and intralocal authority migration the rates remain quite high in relation to the mean rate.

On examining the younger parts of the migration schedules the initial impression is that the rate of prelabor force decline, $\alpha_1$, is very close to the equivalent parameter, $\alpha_2$, for the labor force curve. Rogers, Raquillet, and Castro (1977) suggest that their $\alpha_1$ and $\alpha_2$ values are so close for the United States, Poland, and Sweden that in a simplified model $\alpha_1$ can be assumed to equal $\alpha_2$. In their results (Table 7, p. 45) $\alpha_1$ is sometimes greater than $\alpha_2$ (indicating a steeper decline) and sometimes less than $\alpha_2$. Although the $\alpha_1$ and $\alpha_2$ measures in Table 20 are cruder than those of Rogers, Raquillet, and Castro (1977), they show that in all

TABLE 20 Parameters of the observed out-migration schedules, Great Britain, 1970.[a]

| Region or migrant class | Crude rate $\bar{M}$ | Average of schedule $\bar{x}$ | Age at low point $x_q$ | Age at high peak $x_p$ | Age at retirement peak $x_r$ | The parental shift | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | at $x = 0$ $A_0$ | at $x = 10$ $A_{10}$ | average $A$ |
| N | 0.0155 | 29.9 | 12.5 | 22.5 | – | 29.3 | 26.5 | 27.9 |
| YH | 0.0174 | 29.7 | 12.5 | 22.5 | 67.5 | 29.3 | 28.4 | 28.8 |
| NW | 0.0134 | 31.6 | 12.5 | 22.5 | – | 31.6 | 29.3 | 30.4 |
| EM | 0.0206 | 29.6 | 12.5 | 22.5 | 67.5 | 29.3 | 27.8 | 28.5 |
| WM | 0.0151 | 30.1 | 12.5 | 22.5 | 62.5 | 31.0 | 27.1 | 29.1 |
| EA | 0.0241 | 29.4 | 12.5 | 22.5 | 72.5 | 27.8 | 27.2 | 27.5 |
| SE | 0.0135 | 32.8 | 12.5 | 22.5 | 67.5 | 29.7 | 28.1 | 28.9 |
| SW | 0.0235 | 29.8 | 12.5 | 22.5 | 67.5 | 29.8 | 28.3 | 29.0 |
| W | 0.0152 | 30.4 | 12.5 | 22.5 | 62.5 | 28.8 | 28.9 | 28.8 |
| S | 0.0117 | 27.7 | 12.5 | 22.5 | – | 30.4 | 29.6 | 30.0 |
| GB: | | | | | | | | |
| All migrants | 0.1168 | 31.2 | 12.5 | 22.5 | – | 28.6 | 27.6 | 28.1 |
| Within LAs[b] | 0.0563 | 32.2 | 12.5 | 22.5 | – | 26.0 | 25.7 | 25.8 |
| Between LAs[b] within regions | 0.0378 | | 12.5 | 22.5 | – | 29.8 | 29.9 | 29.8 |
| Between regions | 0.0155 | 32.0 | 12.5 | 22.5 | 65.0 | 29.8 | 28.2 | 29.0 |
| From outside GB | 0.0072 | | 12.5 | 22.5 | – | 33.2 | 26.1 | 29.7 |

Notes on page 67.

TABLE 20 *Continued.*

| Region or migrant class | $\alpha_1/\bar{M}$ | Gradients $\alpha_2/\bar{M}$ | $\lambda_2/\bar{M}$ | Constant $C/\bar{M}$ | Jump $B/\bar{M}$ | "Peakedness" ratio $M_{x_p}/M_{x_q}$ |
|---|---|---|---|---|---|---|
| N | −0.0600 | −0.1123 | 0.2084 | 0.2471 | 2.08 | 2.9 |
| YH | −0.0603 | −0.1080 | 0.2063 | 0.2874 | 2.06 | 2.8 |
| NW | −0.0485 | −0.1052 | 0.2075 | 0.3604 | 2.07 | 2.8 |
| EM | −0.0655 | −0.0888 | 0.1650 | 0.2757 | 1.65 | 2.4 |
| WM | −0.0301 | −0.0795 | 0.1494 | 0.1942 | 1.94 | 2.4 |
| EA | −0.0759 | −0.0851 | 0.1515 | 0.2805 | 2.80 | 2.3 |
| SE | −0.0578 | −0.0859 | 0.1622 | 0.3311 | 1.62 | 2.4 |
| SW | −0.0600 | −0.1034 | 0.1953 | 0.2966 | 1.95 | 2.7 |
| W | −0.0664 | −0.1164 | 0.2289 | 0.3072 | 2.29 | 3.0 |
| S | −0.0718 | −0.0923 | 0.1812 | 0.1718 | 1.81 | 2.5 |
| GB | | | | | | |
| All migrants | −0.0599 | −0.0837 | 0.1580 | 0.4687 | 1.58 | 3.0 |
| Within LAs[b] | −0.0637 | −0.0704 | 0.1271 | 0.5575 | 1.27 | 2.5 |
| Between LAs[b] within regions | −0.0620 | −0.0974 | 0.1945 | 0.4177 | 1.94 | 3.8 |
| Between regions | −0.0574 | −0.0948 | 0.1806 | 0.3168 | 1.81 | 2.6 |
| From outside GB | −0.0244 | −0.0933 | 0.1591 | 0.0874 | 1.59 | 2.6 |

[a]These are cruder versions of the parameters of model migration schedules developed by Rogers, Raquillet, and Castro (1977).

$\bar{M}$ = average or crude migration rate

$\bar{x}$ = average age of schedule of migration rates

$x_Q$ = average age of low point in schedule in teens

$x_P$ = average age of high point in schedule in twenties

$x_T$ = average age of high point at retirement (if present)

$A_0$ = parental shift at $x = 0$ (age group 0–4)

$A_{10}$ = parental shift at $x = 10$ (age group 10–14)

$A$ = average parental shift = $(A_0 + A_{10})/2$

$$A_0 = [M_a + 5(M_a - M_0)/(M_a - M_b)]$$

$$A_{10} = [M_c + 5(M_c - M_{10})/(M_c - M_d)]$$

$M_a, M_b, M_c, M_d$: migration rates as defined in Figure 16.6

$\alpha_1$ = rate of descent of prelabor curve = $(M_{x_Q} - M_0)/(x_Q - 0)$

$\alpha_2$ = rate of descent of labor force curve = $(M_{40} - M_{x_P})/(40 - x_P)$

$\lambda_2$ = rate of ascent of labor force curve = $(M_{x_P} - M_{x_Q})/(x_P - x_Q)$ = minimum $M_x$

$C$ = constant

$B$ = jump in migration rates on entry of persons into the labor force = $(M_{x_P} - M_{x_Q})$

All the above parameters are normalized by being divided by $\bar{M}$.

[b]LA is the abbreviation used for local authority.

TABLE 21 Mean age of migrants and migration rate schedules, Great Britain, 1970.

| Origin region | Destination region | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | YH | NW | WM | EM | EA | SE | SW | W | S | Total |
| | Mean age of migrants | | | | | | | | | | |
| N | – | 26.4 | 26.7 | 27.2 | 24.4 | 25.1 | 25.8 | 26.6 | 24.2 | 26.3 | |
| YH | 26.7 | – | 27.5 | 26.3 | 25.0 | 24.0 | 24.6 | 27.7 | 26.6 | 26.8 | |
| NW | 27.8 | 28.2 | – | 27.9 | 26.6 | 26.5 | 26.5 | 28.5 | 30.6 | 25.5 | |
| EM | 23.8 | 26.3 | 25.9 | – | 25.1 | 26.4 | 25.6 | 27.6 | 27.2 | 22.5 | |
| WM | 24.6 | 24.7 | 26.2 | 24.2 | – | 25.6 | 25.5 | 30.3 | 29.7 | 27.8 | |
| EA | 31.1 | 26.1 | 23.5 | 26.7 | 24.4 | – | 26.4 | 25.3 | 27.6 | 23.0 | |
| SE | 27.3 | 26.4 | 27.5 | 26.4 | 26.7 | 29.4 | – | 32.0 | 29.7 | 27.2 | |
| SW | 24.5 | 25.0 | 27.3 | 25.1 | 27.0 | 27.4 | 27.1 | – | 27.4 | 24.1 | |
| W | 22.9 | 27.8 | 26.7 | 25.0 | 27.7 | 26.9 | 26.2 | 28.1 | – | 24.4 | |
| S | 24.4 | 22.3 | 24.8 | 22.6 | 22.7 | 25.3 | 24.1 | 23.4 | 27.8 | – | |

| | Mean age of schedule | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| N | – | 30.2 | 30.8 | 31.5 | 27.5 | 29.3 | 29.3 | 31.4 | 27.4 | 30.6 | 30.0 |
| YH | 30.0 | – | 31.6 | 30.2 | 28.2 | 27.1 | 27.7 | 32.2 | 30.2 | 30.2 | 29.7 |
| NW | 32.0 | 32.8 | – | 32.6 | 30.7 | 30.4 | 30.1 | 33.0 | 35.1 | 28.9 | 31.7 |
| EM | 26.5 | 30.6 | 29.4 | – | 28.5 | 30.9 | 28.8 | 32.9 | 32.4 | 25.5 | 29.6 |
| WM | 28.2 | 27.2 | 30.0 | 26.8 | – | 28.9 | 28.1 | 35.8 | 34.9 | 32.2 | 30.1 |
| EA | 35.8 | 29.3 | 25.3 | 30.2 | 27.6 | – | 29.7 | 29.1 | 30.5 | 25.7 | 29.4 |
| SE | 30.6 | 29.6 | 30.6 | 29.8 | 29.7 | 33.6 | – | 36.9 | 33.5 | 30.4 | 32.8 |
| SW | 26.5 | 28.3 | 30.4 | 28.2 | 30.4 | 31.0 | 30.3 | – | 30.6 | 26.4 | 29.8 |
| W | 25.0 | 32.3 | 31.2 | 27.8 | 32.4 | 31.7 | 29.2 | 32.3 | – | 27.2 | 30.4 |
| S | 28.4 | 25.5 | 29.3 | 26.2 | 26.2 | 29.5 | 27.6 | 27.5 | 31.8 | – | 27.7 |
| TOTAL (unweighted) | 29.3 | 29.5 | 29.8 | 29.3 | 29.3 | 30.3 | 29.0 | 32.3 | 31.8 | 28.6 | – |

SOURCE: Output from Willekens and Rogers (1976) program with GB regional data described in Section 3.1.

regions and in all classes of migrants $\alpha_1$ is less than $\alpha_2$, i.e., that the pre-labor force decline is less steep than the labor force decline in migration rates. This finding is confirmed when the 2 parental shift parameters are examined: in almost all cases the age 0 shift is greater than the age 10 shift. The gap between the 2 sections of the curve narrows as parental age increases. The $\alpha_1$ slope varies systematically with scale of migration: the longer the migration distance the shallower the slope. The same relation does not appear to hold for the $\alpha_2$ slope. Migrants within local authorities (intraurban migrants) exhibit less steep $\alpha_2$ values than other migrants, and $\alpha_2$ values are closest to the $\alpha_1$ values for their schedules.

To interpret these findings (and how they differ from those of Rogers, Raquillet, and Castro) is difficult. A possible explanation is that the mean age of childbearing has shifted over time so that younger adult migrants are further away on the age scale from their children than are older adult migrants. However, this interpretation is not supported by knowledge of historical shifts in mean age of childbearing for England and Wales. In 1970 the mean age at childbirth (all maternities) of women was 26.2 years (corresponding to an $A_0$ for all migrants in Great Britain of 28.6) whereas 10 years earlier (1960) it had been 27.7 (corresponding to an $A_{1\,0}$ of 27.6). The 2 sets of statistics move in opposite directions.

Thus, it appears that not only is migration on various scales selective of adults by age but it also selects families with different generation spans. Further investigation is undoubtedly needed.

## 2.7 POPULATION COMPOSITION BY AGE

The simultaneous operation of fertility, mortality, and migration processes determines the age and regional composition of the national population. Section 2 of the paper began by considering the development of regional shares, followed by an examination of the aggregate components of population change, and an analysis of those components on an age-specific basis. Here the age compositions of regional populations are briefly described for 1970.

The population pyramids for the 10 British regions, Great Britain, and Northern Ireland are displayed in Figure 20. The average age and index of dissimilarity values (D) indicate that the regional patterns differ little from the national profile, with the obvious exception of Northern Ireland. This region has much higher numbers in younger age groups, a function of its above-average fertility rates, described in Section 2.4.

The general shape of the population pyramids corresponds to that

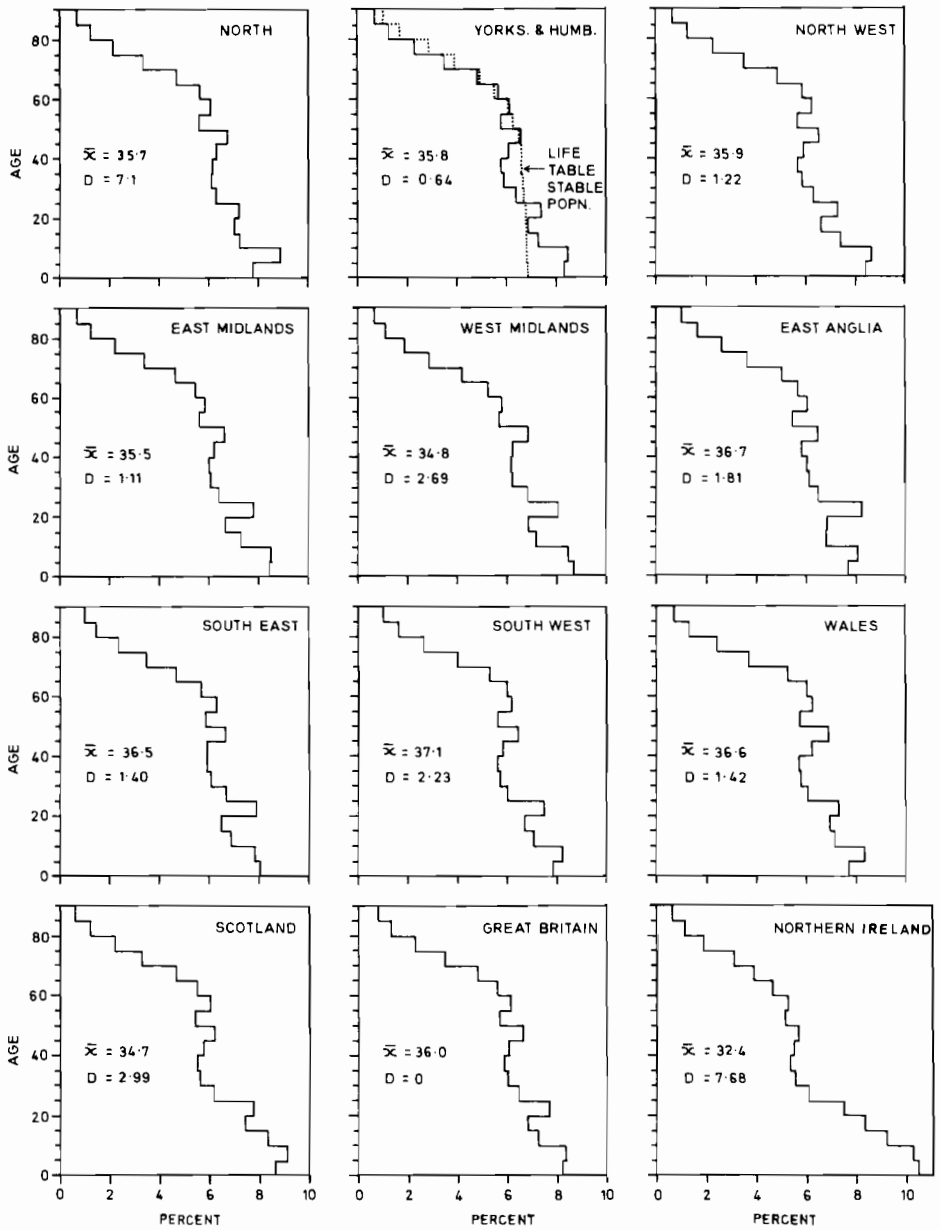


FIGURE 20 Age composition of regional populations, United Kingdom, 1970.

predicted by the single-region life table model as in the stable population profile plotted for Yorkshire and Humberside. This stable population profile is disturbed at the younger age group levels by the fluctuations in fertility experienced in each quinquennia (see Figure 3), and these are reproduced in all pyramids with the exception of that for Northern Ireland, and, in a muted form, that for Scotland. The influence of migration on regional age structures is more difficult to detect directly. The South West has more than its "fair" share of the elderly (60 and over), whereas the Northern and Midland regions have less than their "fair" share.

In order to understand how the components of population change interact to determine the changing dynamics of regional and age composition of the population, it is necessary to integrate all 3 processes in 1 multiregional model and to examine the results of such a model together with the input data on fertility, mortality, and migration described in this section.

# 3 MULTIREGIONAL POPULATION ANALYSIS

## 3.1 THE THEORY AND THE COMPUTER PROGRAMS

Multiregional population analysis has been developed to answer a number of demographic questions which single-region analysis leaves unanswered.

- Consider the traditional life table: applied at the regional scale this assumes that people die in their region of birth experiencing the region's death rates throughout their lives. This is what was done in Table 17. But how many of the 73.1 years of life expected by the population of the South East are actually spent in the region given the substantial out-migration experienced by the population (documented in Section 2.3)?
- Consider the traditional vectors of net reproduction rates for the regions listed in Table 13: if potential mothers born in a region migrate, then the children they are likely to have will be born in a region different from that in which their mothers were born.
- Consider the conventional method of single-region population projection, with allowance for migration by means of net migrant or net migration rate assumptions: this can lead to substantial errors in projection (Rogers, 1976b; Rees, 1977a).

Multiregional disaggregation of population projection models, of life table analysis, and of fertility analysis has been pioneered by Rogers (1968, 1971, 1975) and his fellow workers (Rogers and Willekens, 1976a; Rogers and Ledent, 1976b; Rogers and Willekens, 1976b; Rogers and Willekens, 1976c; Willekens, 1977; Ledent, 1978). The methods and

models employed have been summarized in 2 sets of computer programs (Willekens and Rogers, 1976; Willekens and Rogers, 1977).

The first set of computer programs (Willekens and Rogers, 1976) have been used to investigate the dynamics of population and migration patterns in a variety of countries (Rogers, 1976b; Willekens, 1978): data from each participant country have provided the input for the Spatial Demographic Analysis programs at IIASA and the results have been analyzed by participating national investigators. In this section of the paper the data and the results of a spatial demographic analysis of Great Britain's population at the standard-region scale are described.

## 3.2 A BRIEF NOTE ON DATA: CURRENT AND POTENTIAL

The data requirements of the spatial demographic analysis programs (Willekens and Rogers, 1976) were selected from the information available in the census and vital statistics time series for the United Kingdom, described in Section 2.

The regions chosen were the "old" standard regions of Great Britain, as defined at the time of the 1971 Census, mapped in Figure 1.2. These were the most practical choice at time of data preparation (1976) for the calendar year 1970. Northern Ireland was not included in the set of regions because, although migration data on the flow from Northern Ireland to GB regions were available, the reverse flows were not. In future analysis, it should be possible to use data for the new standard GB regions, since unpublished, reworked migration data became available in 1977. It should also be possible to estimate migration flows from GB regions to Northern Ireland using a combination of model migration schedules and an estimate of gross flows based on accounting and spatial interaction methods.

The period chosen was the calendar year, 1970; this was the year closest to the 1-year period for which the latest migrant data were available, i.e., for 24/25 April 1970 to 24/25 April 1971. Unfortunately, no more recent detailed age–sex disaggregated data on migrants exists. In future analysis, it should be possible to use constrained accounting methods (as in Rees, 1977a) to update sets of spatial population accounts, and perhaps to integrate unpublished interregional migrant flow data generated by the Office of Population Censuses and Surveys from the National Health Register Change of Address file. Vital statistics data are more readily available for more recent years.

Data on both sexes were assembled but aggregated before input to

the Willekens and Rogers 1976 program. In a future analysis this step could be avoided if the necessary program modifications were made to deal with the usual female-dominant fertility analysis.

Population data were extracted from Table A4 in the Office of Population Censuses and Surveys (1972b) for "the estimated home population by sex and age, as at 30 June 1970" for regions in England and Wales, and from Table N2.1 in Registrar General, Scotland (1971b) for Scotland. The home population concept – "the population, of all types, actually in England and Wales, distributed by area according to residence" – is the most appropriate and available for regional purposes, although the "total" population concept – "the home population plus members of H.M. Forces belonging to England and Wales/Scotland/Northern Ireland and serving overseas, but minus the Forces of the other countries temporarily resident in England and Wales" – is used for the national projections (OPCS, 1972b, p. vii). Population numbers are provided in the mid-year estimates for 5-year age groups up to 75 and over. Population in this latter age group was broken down further into age groups 75–79, 80–84, and 85+ by applying deconsolidation proportions derived from the more detailed breakdown for each region in England and Wales given in the 1971 Census. The full range of age-group information was available for Scotland. These data correspond with the time series displayed in Table 2 in Section 1, and have been described in Figure 20.

Births data were extracted from Table GG in the Office of Population Censuses and Surveys (1972b) and Table S2.5 of Registrar General, Scotland (1971b). The fertility rates, derived from dividing births by the relevant female population, have been analyzed in Section 2.4.

Deaths data were derived from Table 19 in the Office of Population Censuses and Surveys (1972a) and Table C2.1 in Registrar General, Scotland (1971a). For the regions of England and Wales, data were provided for the following age groups only: under 1, 1–4, 5–14, 15–24, 25–34, 35–44, 45–54, 55–64, 65–74 and 75+. Death rates for the missing 5-year age groups were computed for England and Wales as a whole and applied in the following equation:

$$\hat{D}_r^{i\delta} = A_v^i M_r^{EW\delta} K_r^i, \qquad r \in v, \tag{2}$$

for age group $r = 3, \ldots, 18$ referring to age groups 5–9, 10–14, . . . , 80–84, 85+, and for both sexes separately. The $\hat{D}_r^{i\delta}$ are the estimated number of deaths in region $i$ in age group $r$; $M_r^{EW\delta}$ is the death rate for age group $r$ in England and Wales; $K_r^i$ is the mid-year 1970 population of region $i$ in age group $r$; and $A_v^i$ is a balancing factor that ensures the estimated deaths are properly constrained to known information.

$$\sum_{r \in v} \hat{D}_r^{i\delta} = D_v^{i\delta}, \tag{3}$$

so that substituting the right hand side of Equation (2) in the left hand side of Equation (3) yields

$$\sum_{r \in v} A_v^i M_r^{EW\delta} K_r^i = D_v^{i\delta}, \tag{4}$$

and

$$A_v^i = D_v^{i\delta} / \sum_{r \in v} M_r^{EW\delta} K_r^i. \tag{5}$$

These deaths data were employed as input to the single-region life table analysis described in Section 2.6 of the paper and summarized in Tables 17 and 18.

Migrant data were estimated from the partial tabulations provided in Office of Population Censuses and Surveys (1974b, 1975). The estimation problem involved the age disaggregation available in the various tables and was solved using a crude version of the Willekens (1977) method but with better, more constrained data.

Required in the Willekens and Rogers (1976) program is the variable: ${}^iD_x^j$ (1970) – the number of moves between region $i$ and $j$ in age group $x$ to $x + 5$ (exact ages) or $x$ to $x + 4$ (single ages) at last birthday over a single year, 1970. The regions are the 10 in our system; the age groups are 5-year ones from 0–4 through to 85+.

Available from the 1971 Census are the following variables:

$K_{*v}^{ij}$ — The number of persons existing in region $i$ at the beginning of the year who survive in region $j$ at the end of the year (classified by age groups $v$ at the end of the year). The $v$ age groups are 1–4, 5–14, 15–19, 20–24, 25–29, 30–34, 35–44, 45–59, 60–64 and 65+.

$\sum_{\substack{j \in GB \\ j \neq i}} K_{*s}^{ij}$ — The total number of persons existing in region $i$ who out-migrate to another region $j$ in Great Britain over the year (classified by age groups $s$ at the end of the year). The $s$ age groups are 1–4, 5–9, 10–14, . . . , 70–74, 75+.

$\sum_{\substack{j \in GB \\ j \neq i}} K_{*s}^{ji}$ — The number of persons existing in all regions $j$ (born region $i$) at the start of the year who migrate to and survive in region $i$ in age group $s$ at the end of the year. These are the total internal in-migrants into the region $i$.

$K^{*i}_{*s}$ This is the total population in region $i$ in 5-year age groups $s$. Age groups $s = 16, 17, 18$ are the quinquennial age groups 75–79, 80–84, and 85+.

Four steps, portrayed diagrammatically in Figure 21, are employed in the estimation method.

The first consists of *deconsolidation*. The $v$ age-group data are deconsolidated into age-group data using

$$\hat{K}^{ij}_{*s} = P(s \mid v,i)K^{ij}_{*v} \qquad s \in v, \tag{6}$$

where $P(s \mid v,i)$ is the probability of a migrant from origin region $i$ classified in aggregated age group $v$ (at time $t + 1$) being in 5-year age groups. This is given by

$$P(s \mid v,i) = \sum_{\substack{j \in GB \\ j \neq i}} K^{ij}_{*s} \Big/ \sum_{s \in v} \sum_{\substack{j \in GB \\ j \neq i}} K^{ij}_{*s}, \tag{7}$$

where $s \in v$ means that the 5-year age group is embedded in the larger age group. Equation (6) should be applied to age groups 5–9, 10–14, 35–39, 40–44, 45–59, 60–64, 65–69, 70–74 and 75+.

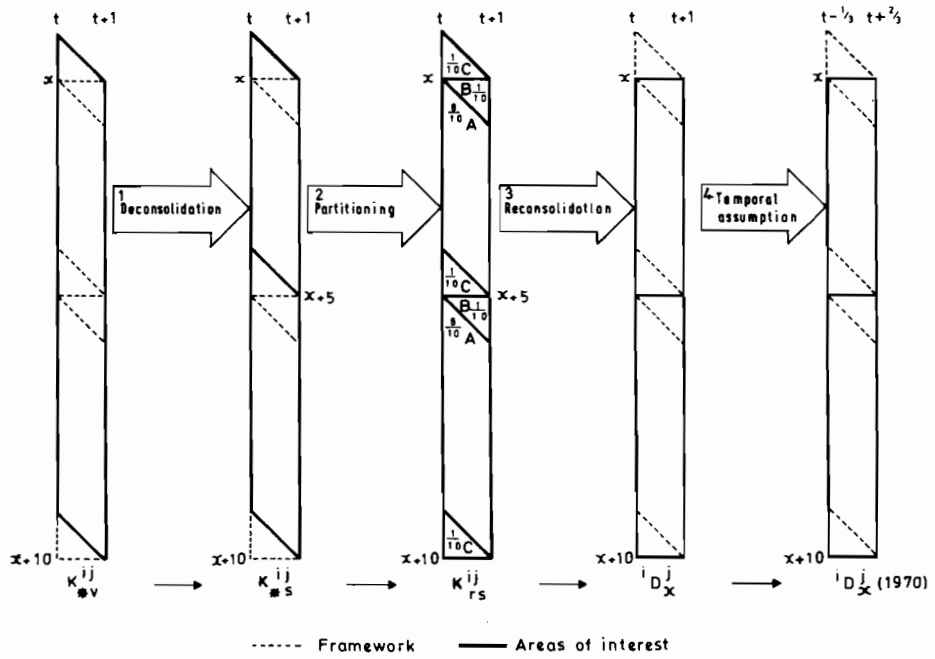


FIGURE 21 The steps in the estimation process for migrant data.

The final age group for which migrant data is available is broken up using population proportions:

$$P(s \mid v,i) = K_{*s}^{*i} \Big/ \sum_{s \in v} K_{*s}^{*i}, \tag{8}$$

for $v$ = age group 75+, $s$ = age groups 75–79, 80–84, and 85+. Unfortunately this means that the assumption has been made that the migration rate in these postretirement age groups is equal to the mean for the group together, whereas it is more likely that the migration rate falls off with age. Unfortunately no published data, even at national level, disaggregate migrants in this 75+ age group. One possible solution in future analysis might be to use model migration schedules to estimate the likely rate and to use them in a constrained equation

$$\hat{K}_{*s}^{ij} = A_v^{ij} \hat{M}_{*s}^{ij} K_{*s}^{i*}, \tag{9}$$

where $s \in v$, and $v$ refers to 75+; $\hat{M}_{*s}^{ij}$ is the model schedule estimated migration rate (fitted to previously estimated data); $K_{*s}^{i*}$ is the population at risk; and $A_v^{ij}$ is a simple balancing factor

$$A_v^{ij} = K_{*v}^{ij} \Big/ \sum_{s \in v} \hat{M}_{*s}^{ij} K_{*s}^{i*}. \tag{10}$$

The estimation could have been improved by the use of a doubly constrained model

$$\hat{K}_{*s}^{ij} = A_{*s}^{j} B_{*s}^{i} P(s \mid v,i) K_{*v}^{ij}, \tag{11}$$

where

$$A_{*s}^{j} = \sum_{\substack{j \in GB \\ j \neq i}} K_{*s}^{ji} \Big/ \sum_{\substack{j \in GB \\ j \neq i}} B_{*s}^{i} P(s \mid v,v) K_{*v}^{ij}, \tag{12}$$

and

$$B_{*s}^{i} = \sum_{\substack{j \in GB \\ j \neq i}} K_{*s}^{ij} \Big/ \sum_{\substack{j \in GB \\ j \neq i}} A_{*s}^{j} P(s \mid v,i) K_{*v}^{ij}. \tag{13}$$

However, it was felt that the gain in accuracy would not outweigh the costs of developing the computer program. Comparison of the estimated migrant figures with fully disaggregated migrant vectors, more recently available from the Office of Population Censuses and Surveys (1977e) for "new" regions, for interactions unchanged by regional reorganization suggests that the differences are fairly minor.

The second step involves the *partitioning* of migrant figures by

quinquennial age groups into 3 components: those who were in the same 5-year age group 1 year earlier, those who were in the previous age group 1 year earlier but who migrated when in the age group they achieved at the end of the period, and those who were in the previous age group 1 year earlier and migrated while still in it. These components are labeled A, B, and C, respectively, in the middle Lexis diagram of Figure 21. Simple geometrical weights were used to partition the migrant figures

$$K^{ij}_{sss} = 0.8\ K^{ij}_{\bullet s} \qquad \text{(Component A)}, \tag{14}$$

$$K^{ij}_{s-1\,ss} = 0.1\ K^{ij}_{\bullet s} \qquad \text{(Component B)}, \tag{15}$$

$$K^{ij}_{s-1\,s-1\,s} = 0.1\ K^{ij}_{\bullet s} \qquad \text{(Component C)}, \tag{16}$$

where the first age-group label applies to age group at time $t$, the second to the age at which the migration between region $i$ and $j$ took place and the third age-group label applies to the age group of migrants at $t + 1$. In case of the first age group, no $K^{ij}_{0\,1\,1}$ figures for infant migrants (0 being a label for birth during period $t$ to $t + 1$) were available, these were therefore estimated as

$$K^{ij}_{011} = 0.125\ K^{ij}_{\bullet 1}. \tag{17}$$

At the third step – *Resorting* – the migrant components were added together again to yield migrant estimates for the age groups required in the Willekens and Rogers (1976) program

$${}^{i}D^{j}_{x} = K^{ij}_{s-1\,ss} + K^{ij}_{sss} + K^{ij}_{sss+1}, \qquad 0 < x < \omega, \tag{18}$$

$${}^{i}D^{j}_{0} = K^{ij}_{011} + K^{ij}_{111} + K^{ij}_{112}, \tag{19}$$

$${}^{i}D^{j}_{\omega} = K^{ij}_{R-1\,RR} + K^{ij}_{RRR}, \tag{20}$$

where $\omega$ is last age used in the IIASA program (85); $R$ is the last discrete age group (85+); and $x$ and $s$ are appropriately related.

The final assumption made is the *temporal assumption*. The migrants observed over the year prior to the 24–25 April 1971 Census were assumed equal in number to those of the slightly earlier calendar year 1970,

$${}^{i}D^{j}_{x}(1970) = {}^{i}D^{j}_{x}(1970\text{–}71). \tag{21}$$

This assumption was considered reasonable.

## 3.3 ESTIMATION OF THE MULTIREGIONAL MIGRATION AND DEATH PROBABILITY MATRIX

Key steps in the multiregional analysis of population have always been the defining of the matrix of survival and migration probabilities for use in generating multiregional life tables, and the defining of the matrix of survivorship rates for use in population projection. The question of which methods are most suitable has generated considerable debate (Schoen, 1975; Rogers and Ledent, 1976a, 1977; Schoen, 1977; Rees, 1978a). Ledent (1978) has discussed the problems and various alternative solutions in depth, and his findings have some bearing on the results reported here.

The purpose behind the adjustments made to the migrant data was to convert the "cohort" census migration data to the "age-group" mobility basis required in the Willekens and Rogers (1976) program. However, the data still remain "transitions" data rather than "moves" data in the sense defined by Ledent (1978). Ledent (1978) suggests that, for 5-year periods, the treatment of transitions data as if they were moves data does not lead to serious bias. Similarly, Rees (1978a) suggests that, for 5-year periods, use of the Willekens and Rogers (1976) probability estimation equation does not lead to much empirical bias in comparison with accounting-based estimates. So, it would appear that using the migrant data from the 1971 Census as if they were "moves" data is acceptable.

The problem is, however, that the probability matrices for multiregional life table analysis and for multiregional projection are based on "transitions" between exact ages 5 years apart (in life table analysis) or between 5-year age groups over 5-year periods. The rates for 1 year are multiplied by 5 to yield estimates of the 5-year rates in the probability estimation equation

$$\mathbf{P}(x) = [\mathbf{I} + \tfrac{5}{2}\,\bar{\mathbf{M}}(x)]^{-1}[\mathbf{I} - \tfrac{5}{2}\,\bar{\mathbf{M}}(x)], \qquad (22)$$

employed in the Willekens and Rogers (1976) program. Death rates (and fertility rates) can be treated in this fashion, but transition rates cannot (Ledent, 1978). The matrix of 1-year transition rates must be raised to the power 5 to yield a proper estimate of the 5-year matrix (Rees, 1977b), although the exact procedure still needs to be explored.* Alternatively

*This should involve the deconsolidation of the 5-year age group, 1-year time period data to single-year data; the estimation of a single-year matrix of probabilities; the running of a population model for 5 years and then the extraction from the results of the 5-year age group, of 5-year period matrix.

5-year transitions data must be employed from the start of the analysis as in Ledent (1978).

This point can be illustrated by drawing from the probability matrix generated using Equation (22), and from a probability matrix derived from a set of multiregional accounts (Rees, 1977a) using Equation (16.45), from Rees and Wilson (1977)

$$\mathbf{P}(x) = [\mathbf{H}(r_{x-T}) + \mathbf{H}(r_x)]^2, \tag{23}$$

for $0 < x < \omega - T$, with slightly different techniques used for the $x = 0$ and $x = \omega - T$, and $\omega$ cases. Life table survival rates are interpolated between corresponding accounting-based survivorship rates. Figure 22 shows the probabilities of migration and survival by age for the East Anglia to South East transitions. The shape of the profiles are similar, but the Equation (22) probabilities are clearly overestimates of the corresponding 5-year rates.

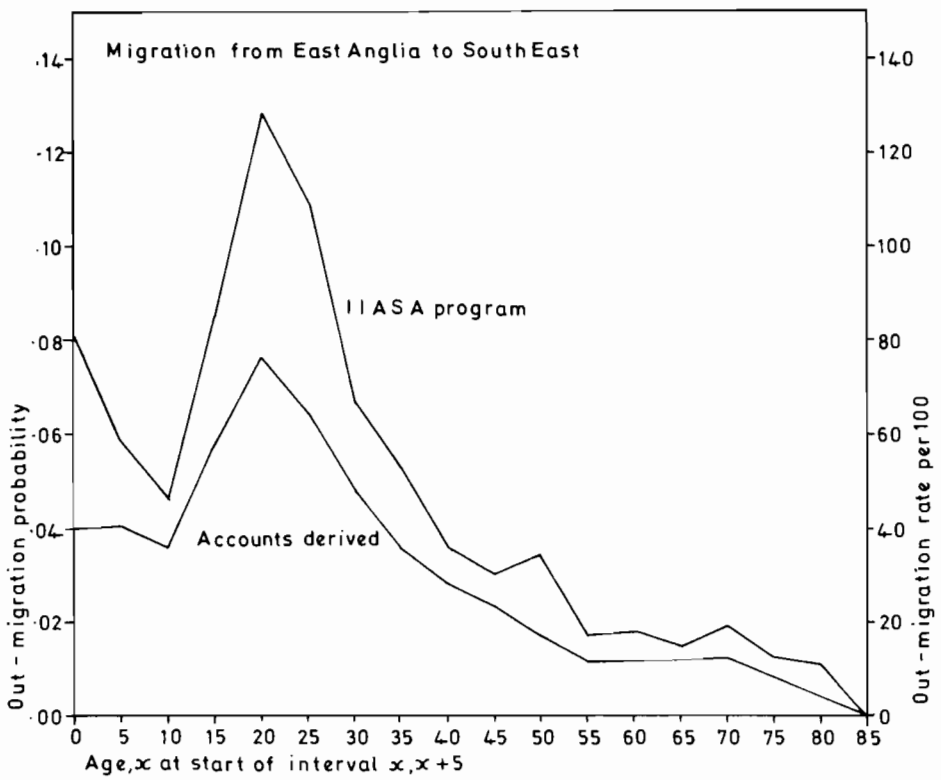


FIGURE 22 A comparsion of selected multiregional life table out-migration probabilities estimated by different methods.

The multiregional population analysis reported here uses 1-year data and Equation (22) to generate the probability matrix, and must therefore be regarded as a preliminary exploration only, justified as being the first attempt to answer the questions posed at the beginning of this section. The likely biases introduced will be suggested as each part of the analysis is considered.*

## 3.4 THE MULTIREGIONAL LIFE TABLE

### *3.4.1 Life History of the Initial Cohorts*

The recursive application of the age-specific probabilities of dying and out-migrating to regional radices generates the life histories of cohorts born in each region. The life history consists of 2 tables: the first specifies the location of the deaths of the initial cohort, the second the number of interregional transitions made between regions at the various ages by members of the initial cohort.

Since full specification of the life history of cohorts in a 10 region system requires 10 sets of 11 tables (1 for deaths, 10 for interregional transitions) with 18 rows and 10 columns, only a sample can be reproduced here. In Table 22 the life history of the initial cohort born in Yorkshire and Humberside is traced out in terms of the locations at which people die. Although the amount of migration recorded in the table is probably overestimated by about 60 percent, even the approximate adjusted totals for deaths suggest that 42 percent of the initial cohort will die outside the region in which they were born, some 12 percent of them in the South East and between 4 and 6 percent of them in adjacent regions. Note that no migrants are allowed to die within the period of migration – hence the zeros in the first row – although this would be fairly easy to add to the multiregional life table model.

If the totals of tables similar to Table 22 are gathered together, then a complete picture of the lifetime migration history of the initial cohorts in our 10 regions is obtained (Table 23). Table 23 is the multiregional equivalent to the $D(x)$ column in single-region life tables showing how deaths to a cohort are distributed by age at death. Table 23 resembles the right hand side of the accounts tables presented earlier (Tables 7 to 10) in showing migration and death flows, but over a lifetime rather than a period. It also serves to emphasize that any population model is a model

*The descriptions of the 1970 migration, fertility, and mortality rates still stand as these are based on the components of the $\mathbf{M}(x)$ matrices rather than the $\mathbf{P}(x)$ matrices.

of deaths as well as survivors perhaps funeral directors might benefit as well as planners from such analysis.

The second component of the life history of a regional cohort is the specification of the interregional transfers experienced over a lifetime. Table 24 extracts 1 of the 10 tables of interregional transitions for persons born in Yorkshire and Humberside, and records all the transitions out of the South East to other regions at each exact age $x$ to exact age $x + 5$ interval. Note that there are no entries in the first row as persons born in Yorkshire and Humberside have first to migrate out of Yorkshire and Humberside before they can subsequently migrate out of another region.

Given the earlier conclusion about the equation that generates the probabilities of migration, the results can be regarded only as illustrative. Rather than 192,000 transitions, it is more likely that 122,402 (that is, 192,000 x 0.637512, the ratio of 5-year to 1-year migrants given in footnote *c* of Table 22) probably take place.

The word "transitions" or "transfers" has been used instead of either "migrants" or "moves" here. The numbers do refer to persons in hypothetical regional cohorts, but when counted up columnwise persons are counted perhaps several times. Since there are only 100,000 persons in the initial radix, the 192,000 total in Table 24 must refer to their actions – the action of transferring from a location in the South East at age $x$ to another location in the South East or in another region at age $x + 5$. In fact, 181,000 out of the 192,000 are acts of staying put.

However, conversely the numbers in Table 24 are not migrations or moves. Several interregional moves may be made in an age interval $x$ to $x + 5$ by a migrant making only one transition. In fact, even stayers may make moves. So "transitions" are underestimates of "moves". This would be true even if single-year age intervals were used with a 1-year period, although the undercounting would be far less serious, particularly at the interregional level. In order to count moves made, it would be necessary to adopt a time interval within which it could be assumed that only 1 move took place. A year might be considered a reasonable period for interregion migration. One would then construct a 1-year-of-age, 1-year-of-time population model, and count transitions as moves. Otherwise it is very difficult to extract a mobility measure from a model incorporating transitions.

### *3.4.2 Expected Numbers of Survivors $\ell(x)$*

At each age $x$ the expected number of survivors is calculated. In the multiregional life table this involves subtracting the decrements of death

TABLE 22 Initial region of cohort, Yorkshire and Humberside: number of deaths in each region of residence.[a]

| Age | N | YH | NW | EM | WM | EA | SE | SW | W | S | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 2,332 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,332 |
| 5 | 3 | 150 | 3 | 3 | 2 | 1 | 4 | 1 | 1 | 1 | 169 |
| 10 | 4 | 123 | 5 | 4 | 2 | 2 | 6 | 2 | 1 | 1 | 150 |
| 15 | 11 | 247 | 11 | 11 | 5 | 5 | 19 | 5 | 2 | 4 | 320 |
| 20 | 15 | 240 | 16 | 14 | 9 | 7 | 33 | 7 | 4 | 6 | 351 |
| 25 | 21 | 188 | 23 | 21 | 13 | 6 | 50 | 10 | 6 | 9 | 347 |
| 30 | 29 | 206 | 35 | 30 | 20 | 9 | 73 | 16 | 9 | 17 | 444 |
| 35 | 50 | 293 | 62 | 47 | 33 | 17 | 106 | 24 | 19 | 29 | 677 |
| 40 | 96 | 504 | 122 | 89 | 66 | 34 | 207 | 47 | 31 | 49 | 1,245 |
| 45 | 170 | 788 | 216 | 149 | 116 | 55 | 355 | 89 | 60 | 91 | 2,089 |
| 50 | 272 | 1,207 | 345 | 239 | 188 | 90 | 570 | 150 | 100 | 145 | 3,306 |
| 55 | 404 | 1,861 | 544 | 379 | 298 | 144 | 932 | 257 | 154 | 222 | 5,195 |
| 60 | 601 | 2,738 | 806 | 580 | 453 | 229 | 1,415 | 408 | 239 | 341 | 7,810 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 65 | 863 | 3,867 | 1,115 | 865 | 643 | 375 | 2,050 | 639 | 347 | 462 | 11,231 |
| 70 | 1,113 | 4,707 | 1,406 | 1,085 | 821 | 503 | 2,622 | 881 | 454 | 591 | 14,183 |
| 75 | 1,263 | 5,024 | 1,510 | 1,216 | 925 | 588 | 3,033 | 1,092 | 514 | 657 | 15,822 |
| 80 | 1,205 | 4,740 | 1,452 | 1,208 | 922 | 610 | 3,172 | 1,117 | 496 | 622 | 15,544 |
| 85 | 1,307 | 5,307 | 1,607 | 1,486 | 1,118 | 865 | 4,392 | 1,458 | 559 | 689 | 18,788 |
| TOTAL | 7,432 | 34,522 | 9,278 | 7,426 | 5,634 | 3,540 | 19,039 | 6,203 | 2,993 | 3,936 | 100,003[b] |
| ADJUSTED TOTAL[c] | 4,738 | 58,258 | 5,915 | 4,734 | 3,592 | 2,257 | 12,138 | 3,954 | 1,908 | 2,509 | 100,003 |

[a] In the output of the Willekens and Rogers (1976) program, the variables ${}_{jo}\ell_{k\delta}$ (85) for $k \neq j$ are not calculated (as they should be), and they are inserted in the table above using the relationships:

$$ {}_{jo}\ell_{k}\ (85) = \sum_{i} {}_{jo}\ell_{ik}\ (80), \text{ all } k, k \neq j, $$

$$ {}_{jo}\ell_{k\delta}\ (85) = {}_{jo}\ell_{k}\ (85)\ q_{k}\ (85), $$

$$ q_{k}\ (85) = 1. $$

The ${}_{jo}\ell$ (85) values are, however, computed in the latest version of the program as described in Willekens and Rogers (1978) p.27.

[b] The total, 100,003, is 3 above the initial cohort radix due to rounding error.

[c] Adjusted totals are computed by multiplying all column totals, except that for Yorkshire and Humberside, by the ratio of the 5-year out-migration rate to 5 times the 1-year out-migration (for 1966–1971 and 1970–1971, respectively) given in Rees (1977): i.e., by (0.3382)/(5 x 0.1061) = 0.637512. "Stayers" were worked out as a residual.

TABLE 23 Lifetime migration and death matrix, Great Britain.

| Region of birth | Region of death | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | YH | NW | EM | WM | EA | SE | SW | W | S | Total |
| Original | | | | | | | | | | | |
| N | 37,314 | 8,190 | 8,302 | 4,871 | 5,134 | 3,078 | 18,800 | 6,006 | 2,565 | 5,739 | 100,000 |
| YH | 7,432 | 34,521 | 9,278 | 7,427 | 5,634 | 3,541 | 19,036 | 6,203 | 2,992 | 3,936 | 100,000 |
| NW | 4,093 | 5,781 | 43,319 | 4,278 | 5,943 | 2,652 | 18,240 | 6,361 | 5,231 | 3,922 | 100,000 |
| EM | 4,712 | 9,093 | 6,979 | 28,914 | 8,443 | 4,801 | 21,706 | 7,627 | 3,332 | 4,394 | 100,000 |
| WM | 3,255 | 4,719 | 7,294 | 6,782 | 38,880 | 3,040 | 19,817 | 8,169 | 4,440 | 3,604 | 100,000 |
| EA | 3,411 | 5,537 | 6,079 | 7,043 | 6,238 | 23,233 | 31,538 | 8,869 | 3,381 | 4,669 | 100,000 |
| SE | 3,371 | 4,580 | 6,141 | 5,484 | 5,691 | 5,535 | 50,434 | 10,742 | 3,360 | 4,661 | 100,000 |
| SW | 3,606 | 4,961 | 6,267 | 5,007 | 7,369 | 4,140 | 32,577 | 26,502 | 4,328 | 5,245 | 100,000 |
| W | 2,968 | 4,037 | 8,541 | 4,252 | 7,411 | 2,852 | 20,333 | 8,611 | 37,384 | 3,611 | 100,000 |
| S | 4,239 | 4,276 | 6,264 | 4,114 | 4,465 | 2,578 | 18,564 | 5,578 | 2,302 | 47,622 | 100,000 |
| Adjusted[a] | | | | | | | | | | | |
| N | 61,455 | 5,036 | 5,105 | 2,995 | 3,157 | 1,893 | 11,560 | 3,693 | 1,577 | 3,529 | 100,000 |
| YH | 4,738 | 58,257 | 5,915 | 4,735 | 3,592 | 2,257 | 12,136 | 3,954 | 1,907 | 2,509 | 100,000 |
| NW | 2,506 | 3,540 | 65,294 | 2,619 | 3,639 | 1,624 | 11,279 | 3,895 | 3,203 | 2,401 | 100,000 |
| EM | 2,839 | 5,479 | 4,205 | 57,164 | 5,088 | 2,893 | 13,080 | 4,596 | 2,008 | 2,648 | 100,000 |
| WM | 2,001 | 2,902 | 4,485 | 4,170 | 62,419 | 1,869 | 12,185 | 5,023 | 2,730 | 2,216 | 100,000 |
| EA | 1,876 | 3,044 | 3,343 | 3,873 | 3,430 | 57,790 | 17,341 | 4,877 | 1,859 | 2,567 | 100,000 |
| SE | 1,904 | 2,587 | 3,469 | 3,098 | 3,215 | 3,126 | 72,002 | 6,068 | 1,898 | 2,633 | 100,000 |
| SW | 2,052 | 2,823 | 3,566 | 2,849 | 4,193 | 2,356 | 18,537 | 58,176 | 2,463 | 2,985 | 100,000 |
| W | 1,843 | 2,507 | 5,305 | 2,641 | 4,603 | 1,771 | 12,629 | 5,348 | 61,110 | 2,243 | 100,000 |
| S | 2,503 | 2,525 | 3,698 | 2,429 | 2,636 | 1,522 | 10,960 | 3,293 | 1,359 | 69,073 | 100,000 |

[a]Adjustments were carried out as in Table 22. The ratios of 5-year migration rates to 5 times 1-year migration rates were used.

TABLE 24 Life history of initial cohort, Yorkshire and Humberside: migrants.

| Location at age $x$: SE | Location at age $x + 5$ | | | | | | | | | | Total migrants |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | YH | NW | EM | WM | EA | SE | SW | W | S | |
| $x = 0$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 8 | 11 | 16 | 18 | 14 | 23 | 2,346 | 41 | 7 | 12 | 2,496 |
| 10 | 11 | 15 | 22 | 26 | 20 | 32 | 4,185 | 59 | 10 | 17 | 4,397 |
| 15 | 26 | 34 | 44 | 50 | 49 | 59 | 5,380 | 131 | 30 | 39 | 5,842 |
| 20 | 79 | 113 | 158 | 167 | 150 | 160 | 7,947 | 290 | 74 | 111 | 9,249 |
| 25 | 101 | 138 | 186 | 221 | 165 | 226 | 12,674 | 391 | 93 | 142 | 14,337 |
| 30 | 80 | 100 | 132 | 147 | 141 | 192 | 14,876 | 347 | 66 | 113 | 16,194 |
| 35 | 47 | 70 | 112 | 109 | 98 | 152 | 16,253 | 268 | 53 | 77 | 17,239 |
| 40 | 35 | 53 | 84 | 82 | 73 | 119 | 17,138 | 215 | 40 | 58 | 17,897 |
| 45 | 31 | 42 | 61 | 56 | 63 | 110 | 17,398 | 235 | 40 | 49 | 18,085 |
| 50 | 29 | 39 | 57 | 53 | 52 | 103 | 17,051 | 222 | 38 | 46 | 17,690 |
| 55 | 25 | 33 | 48 | 45 | 35 | 97 | 16,372 | 206 | 33 | 39 | 16,933 |
| 60 | 24 | 22 | 42 | 44 | 26 | 123 | 14,898 | 253 | 30 | 26 | 15,488 |
| 65 | 23 | 27 | 37 | 49 | 33 | 93 | 12,705 | 239 | 29 | 30 | 13,265 |
| 70 | 12 | 14 | 19 | 25 | 17 | 47 | 10,234 | 122 | 15 | 15 | 10,520 |
| 75 | 7 | 10 | 13 | 17 | 12 | 31 | 7,326 | 82 | 10 | 10 | 7,518 |
| 80 | 4 | 6 | 8 | 10 | 7 | 18 | 4,260 | 49 | 6 | 6 | 4,374 |
| 85 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| TOTAL | 543 | 727 | 1,038 | 1,118 | 955 | 1,585 | 181,046 | 3,148 | 574 | 790 | 191,524 |

TABLE 25 Expected numbers of survivors: initial region of cohort, Yorkshire and Humberside.

| Region | 0 | 5 | 20 | 40 | 50 | 60 | 70 | 80 |
|---|---|---|---|---|---|---|---|---|
| N | 0 | 179 | 457 | 673 | 672 | 616 | 485 | 252 |
| YH | 10,000 | 8,673 | 6,542 | 3,704 | 3,292 | 2,824 | 2,046 | 1,017 |
| NW | 0 | 160 | 455 | 833 | 835 | 771 | 592 | 305 |
| EM | 0 | 177 | 420 | 695 | 687 | 636 | 496 | 269 |
| WM | 0 | 89 | 250 | 516 | 520 | 478 | 367 | 202 |
| EA | 0 | 71 | 176 | 300 | 308 | 296 | 255 | 147 |
| SE | 0 | 250 | 928 | 1,810 | 1,826 | 1,690 | 1,314 | 755 |
| SW | 0 | 79 | 222 | 444 | 475 | 474 | 431 | 254 |
| W | 0 | 34 | 104 | 231 | 244 | 239 | 198 | 105 |
| S | 0 | 55 | 149 | 316 | 330 | 315 | 249 | 130 |
| TOTAL | 10,000 | 9,767 | 9,703 | 9,521 | 9,188 | 8,338 | 6,433 | 3,433 |

and out-migrants in the interval $x - 5$ to $x$ from the expected number of survivors at age $x - 5$ and adding the increments through in-migration in the interval. Survivors from each regional cohort are now spread over all regions, and these form 10 sets of tables such as that for Yorkshire and Humberside (Table 25).

TABLE 26 Total expected numbers of survivors: initial region of cohort, all GB regions.

| Region | 0 | 5 | 20 | 40 | 50 | 60 | 70 | 80 |
|---|---|---|---|---|---|---|---|---|
| N | 10,000 | 9,789 | 9,727 | 9,545 | 9,199 | 8,329 | 6,421 | 3,410 |
| YH | 10,000 | 9,769 | 9,703 | 9,521 | 9,188 | 8,338 | 6,433 | 3,433 |
| NW | 10,000 | 9,767 | 9,701 | 9,517 | 9,169 | 8,283 | 6,354 | 3,365 |
| EM | 10,000 | 9,799 | 9,738 | 9,559 | 9,234 | 8,401 | 6,517 | 3,520 |
| WM | 10,000 | 9,787 | 9,721 | 9,543 | 9,216 | 8,376 | 6,485 | 3,489 |
| EA | 10,000 | 9,810 | 9,744 | 9,572 | 9,262 | 8,464 | 6,633 | 3,653 |
| SE | 10,000 | 9,814 | 9,754 | 9,580 | 9,269 | 8,463 | 6,627 | 3,653 |
| SW | 10,000 | 9,810 | 9,752 | 9,579 | 9,266 | 8,450 | 6,601 | 3,610 |
| W | 10,000 | 9,788 | 9,728 | 9,548 | 9,208 | 8,341 | 6,437 | 3,436 |
| S | 10,000 | 9,778 | 9,712 | 9,503 | 9,139 | 8,238 | 6,305 | 3,321 |
| Max–min | – | – | 51 | 77 | 130 | 226 | 328 | 332 |
| Max–min (Table 18) | – | – | 44 | 118 | 248 | 537 | 848 | 896 |

Again Table 25 carries forward the earlier overestimation of migration, and rather too many of the initial cohort find themselves in other regions. However, something quite useful can be learned from a comparison with Table 26, which contains the total survivors rows of all the regional tables equivalent to Table 25, with the single-region results presented earlier (Table 18). The variance of the single-region $\ell(x)$ values is over twice that of the multiregion $\ell(x)$ values. There is thus significant regression towards the mean when multiregion statistics are substituted for single-region statistics: the gap between the maximum and minimum survival proportions of regional populations under single-region assumptions widens to 896/10,000 by age 80 compared with only 332/10,000 for regional cohorts under multiregion assumptions. The effect of migration is to smooth out the spatial differences in survival chances within the United Kingdom. This conclusion should continue to hold even when reduced migration probabilities are substituted in the analysis, and it is, in effect, a consequence of the Markovian assumption inherent in the multiregional life table model that migrants experience the death rates of their current region of residence. Use of any alternative assumption or relation would require sophisticated life history data.

### *3.4.3 Numbers of Years Lived in Each Region*

From the life history of the initial cohorts (deaths and transitions), tables giving the number of years lived in each region in each age interval, the $\mathbf{L}(x)$ matrices, are generated for each initial region, and these numbers are then summed "backwards" cumulatively starting at age 85, to yield the $\mathbf{T}(x)$ matrices for each year of life lived beyond age $x$ in the region of origin.

### *3.4.4 Expectations of Life*

If the $\mathbf{T}(x)$ matrices are multiplied by $\ell^{-1}(x)$ matrices, then expectations of life are obtained. Again the statistics for the initial cohort born in Yorkshire and Humberside are produced in Table 27, and in Table 28 the expectations of life at age 0 for all regions are consolidated.

It should be emphasized that Table 27 is only a partial multiregional analogue of the single-region life expectation vector: given births in Yorkshire and Humberside these are the expectations of life in the 10 regions beyond the ages noted in the rows. Thus, at age 50, persons born

TABLE 27 Expectations of life in the regions beyond age $x$ for initial region of cohort, Yorkshire and Humberside.

| Age, $x$ | Region of residence | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | YH | NW | EM | WM | EA | SE | SW | W | S | |
| 0 | 4.1 | 36.7 | 4.9 | 4.2 | 3.0 | 1.9 | 10.6 | 2.9 | 1.4 | 1.9 | 71.6 |
| 5 | 4.2 | 32.8 | 5.0 | 4.3 | 3.0 | 1.9 | 10.8 | 2.9 | 1.4 | 1.9 | 68.3 |
| 10 | 4.1 | 28.6 | 4.9 | 4.2 | 3.0 | 1.9 | 10.7 | 2.9 | 1.4 | 1.9 | 63.4 |
| 15 | 3.9 | 24.7 | 4.7 | 4.0 | 2.9 | 1.8 | 10.4 | 2.8 | 1.4 | 1.8 | 58.5 |
| 20 | 3.7 | 21.2 | 4.5 | 3.8 | 2.8 | 1.8 | 10.1 | 2.7 | 1.3 | 1.8 | 53.7 |
| 25 | 3.5 | 18.2 | 4.3 | 3.6 | 2.6 | 1.7 | 9.5 | 2.6 | 1.3 | 1.7 | 48.9 |
| 30 | 3.2 | 15.8 | 3.9 | 3.3 | 2.4 | 1.5 | 8.7 | 2.4 | 1.2 | 1.6 | 44.0 |
| 35 | 2.9 | 13.6 | 3.5 | 3.0 | 2.2 | 1.4 | 7.9 | 2.2 | 1.1 | 1.4 | 39.2 |
| 40 | 2.5 | 11.7 | 3.1 | 2.6 | 2.0 | 1.3 | 7.0 | 2.0 | 1.0 | 1.3 | 34.5 |
| 45 | 2.2 | 10.0 | 2.7 | 2.3 | 1.7 | 1.1 | 6.1 | 1.8 | 0.9 | 1.1 | 29.9 |
| 50 | 1.9 | 8.4 | 2.3 | 2.0 | 1.5 | 1.0 | 5.3 | 1.6 | 0.7 | 1.0 | 25.5 |
| 55 | 1.6 | 6.9 | 1.9 | 1.6 | 1.2 | 0.8 | 4.5 | 1.4 | 0.6 | 0.8 | 21.4 |
| 60 | 1.3 | 5.5 | 1.6 | 1.4 | 1.0 | 0.7 | 3.7 | 1.2 | 0.5 | 0.6 | 17.6 |
| 65 | 1.0 | 4.4 | 1.3 | 1.1 | 0.8 | 0.6 | 3.0 | 1.0 | 0.4 | 0.5 | 14.1 |
| 70 | 0.8 | 3.4 | 1.0 | 0.9 | 0.6 | 0.5 | 2.4 | 0.8 | 0.3 | 0.4 | 11.1 |
| 75 | 0.6 | 2.5 | 0.7 | 0.7 | 0.5 | 0.4 | 1.9 | 0.6 | 0.3 | 0.3 | 8.6 |
| 80 | 0.4 | 1.8 | 0.5 | 0.5 | 0.4 | 0.3 | 1.5 | 0.5 | 0.2 | 0.2 | 6.4 |
| 85 | 0.3 | 1.3 | 0.4 | 0.4 | 0.3 | 0.2 | 1.2 | 0.4 | 0.1 | 0.2 | 4.6 |

in Yorkshire and Humberside can expect a further 25.5 years of life, 8.4 of them in Yorkshire and Humberside, 5.3 in the South East, and so on. It would also be interesting to know what would be the expectation of life beyond age $x$ in region $i$, given that a person was located there at age $x$.* The value of migration in life expectancy terms would then be revealed.

Table 28 gives a very convenient overview of the effects of migration on life expectancy (again with the caveat that the values of off-diagonal terms are overestimated). The table indicates that very large proportions of a person's life are likely to be spent outside his region of birth, and that for all regions of birth a great deal of the regional cohort's lives will be spent in the country's metropolitan region, the South East.

Figure 23 compares the row totals of Table 28 – the life expec-

*These expectations are computed in the Willekens and Rogers (1978) version of the program but are not yet available if the number of regions exceeds seven because of memory size problems.

TABLE 28 Expectations of life at birth by regions of birth and regions of residence, $_{i_0}e_j$, Great Britain.

| Region of birth | Region of residence | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | YH | NW | EM | WM | EA | SE | SW | W | S | |
| N | 38.6 | 4.5 | 4.3 | 2.5 | 2.7 | 1.6 | 10.4 | 2.8 | 1.2 | 2.9 | 71.7 |
| YH | 4.1 | 36.7 | 4.9 | 4.2 | 3.0 | 1.9 | 10.6 | 2.9 | 1.4 | 1.9 | 71.6 |
| NW | 2.1 | 3.0 | 42.3 | 2.2 | 3.1 | 1.3 | 10.1 | 3.0 | 2.6 | 1.9 | 71.4 |
| EM | 2.5 | 5.2 | 3.5 | 33.5 | 4.8 | 2.7 | 12.2 | 3.8 | 1.6 | 2.3 | 72.1 |
| WM | 1.6 | 2.4 | 3.8 | 3.9 | 40.1 | 1.5 | 10.9 | 3.9 | 2.1 | 1.7 | 71.9 |
| EA | 1.6 | 2.9 | 3.1 | 4.0 | 3.4 | 29.8 | 19.1 | 4.5 | 1.6 | 2.4 | 72.6 |
| SE | 1.7 | 2.3 | 3.0 | 3.0 | 2.9 | 3.0 | 47.4 | 5.4 | 1.6 | 2.8 | 72.6 |
| SW | 1.8 | 2.6 | 3.1 | 2.7 | 4.1 | 2.1 | 19.7 | 31.4 | 2.2 | 2.7 | 72.5 |
| W | 1.5 | 2.0 | 4.6 | 2.2 | 4.0 | 1.4 | 11.2 | 4.4 | 38.7 | 1.7 | 71.8 |
| S | 2.2 | 2.3 | 3.2 | 2.2 | 2.4 | 1.2 | 10.4 | 2.7 | 1.0 | 43.6 | 71.2 |

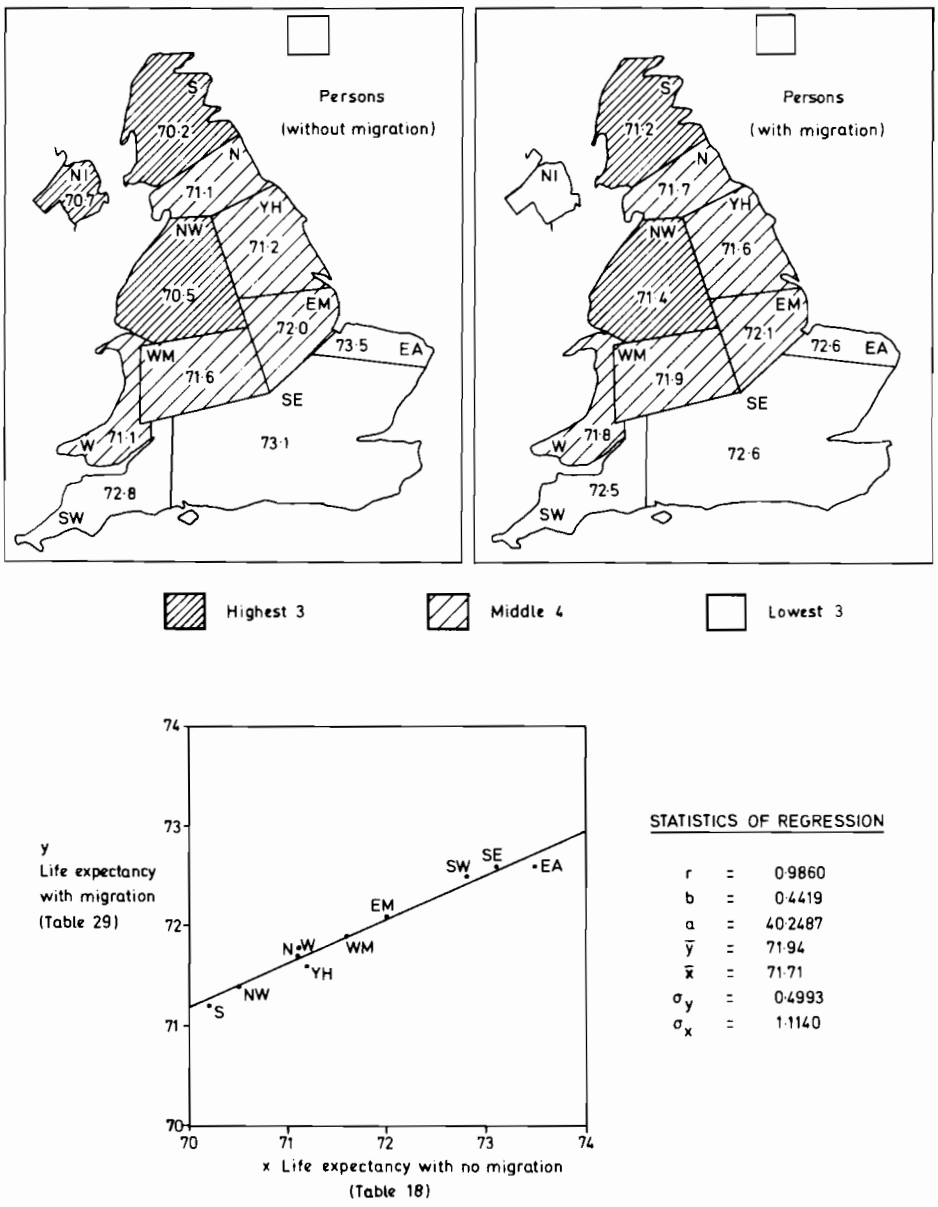


FIGURE 23 Life expectancy, persons, 1970: single-region and multiregion values.

tancies of the regional birth cohorts with the earlier single-region life expectancies. The latter can be regarded as measuring the "mortality environment" of the region, whereas the former measure the actual experience of the region's sons and daughters given that they migrate. The 2 measures have an almost identical pattern when mapped (Figure 23) and correlated ($r = 0.986$), but the variance of the multiregion measure is much lower than that of the single region. There is classic regression towards the mean with a regression coefficient of 0.4419 (less than one): those regions with high single-region expectations of life have lower multiregional values; those regions with low single-region expectations have higher multiregional values. Migration thus has the effect of reducing regional mortality differentials for birth cohorts.

Finally, to conclude the consideration of the multiregional life table, Table 29 summarizes succinctly the effect of migration on the distribution of life in a multiregional system by dividing each element in Table 28 by the relevant row total. Again with revised probabilities included in the analysis, the allocations in the diagonal would increase, and those in the off-diagonal would decrease.

## 3.5 MULTIREGIONAL FERTILITY ANALYSIS

In the same way as the multiregional life table generated tables of deaths and transitions (as illustrated by Tables 22, 23, and 24), so the equivalent tables of births can be calculated: these are births in all regions to mothers classified by region of origin. The assumption is made that the mothers who migrate to another region take on the fertility rates of that region. Then the results are consolidated to yield a matrix of spatial fertility expectancies. The theory underlying the calculation and the program used are described in Willekens and Rogers (1977, Section 2.1).

$$\phi(x) = \mathbf{F}(x)\mathbf{L}(x), \tag{23}$$

where $\phi(x)$ is the matrix of ${}_i\phi_j(x)$ values of the number of children expected to be born during a unit time $T$, in a region $j$, to a parent of age $x$ to $x + T$, who is part of the stationary life table population, $\mathbf{L}(x)$. The net reproduction values are summed over age

$$\mathbf{NRR} = \sum_x \Phi(x) \tag{24}$$

to yield the spatial fertility expectancy matrix or net rate of reproduction matrix.

TABLE 29 Net allocations of the expectations of life ${}_i\theta_j$, Great Britain.

| Region of birth | Region of residence | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | YH | NW | EM | WM | EA | SE | SW | W | S | Total |
| N | 0.5390 | 0.0631 | 0.0605 | 0.0353 | 0.0378 | 0.0221 | 0.1453 | 0.0395 | 0.0166 | 0.0408 | 1.0000 |
| YH | 0.0577 | 0.5127 | 0.0682 | 0.0591 | 0.0414 | 0.0266 | 0.1485 | 0.0401 | 0.0195 | 0.0262 | 1.0000 |
| NW | 0.0289 | 0.0415 | 0.5925 | 0.0304 | 0.0436 | 0.0179 | 0.1409 | 0.0415 | 0.0360 | 0.0268 | 1.0000 |
| EM | 0.0350 | 0.0723 | 0.0491 | 0.4645 | 0.0665 | 0.0379 | 0.1694 | 0.0521 | 0.0221 | 0.0312 | 1.0000 |
| WM | 0.0228 | 0.0334 | 0.0522 | 0.0543 | 0.5577 | 0.0209 | 0.1515 | 0.0542 | 0.0298 | 0.0233 | 1.0000 |
| EA | 0.0223 | 0.0406 | 0.0427 | 0.0556 | 0.0468 | 0.4108 | 0.2637 | 0.0619 | 0.0224 | 0.0332 | 1.0000 |
| SE | 0.0229 | 0.0318 | 0.0420 | 0.0408 | 0.0404 | 0.0418 | 0.6532 | 0.0741 | 0.0215 | 0.0313 | 1.0000 |
| SW | 0.0254 | 0.0362 | 0.0427 | 0.0368 | 0.0559 | 0.0289 | 0.2725 | 0.4340 | 0.0306 | 0.0371 | 1.0000 |
| W | 0.0209 | 0.0276 | 0.0637 | 0.0310 | 0.0556 | 0.0193 | 0.1567 | 0.0612 | 0.5397 | 0.0242 | 1.0000 |
| S | 0.0312 | 0.0316 | 0.0449 | 0.0311 | 0.0331 | 0.0174 | 0.1466 | 0.0373 | 0.0142 | 0.6125 | 1.0000 |

The results for Great Britain are shown in Table 30 and in Table 31 in net allocation form (in which the elements of Table 30 are divided by their row elements). Once again the caveat that the diagonal elements are underestimated and the off-diagonal elements are overestimated applies. The table gives some indication, however, of the likely genetic mixture across regions of a nation's population. For example, parents born in East Anglia will have, under the conditions of mortality and migration in the multiregional life table model described above, only 41 percent of their children in the region itself, just under 22 percent in the South East, and between about 2 and 6 percent in the other regions. These children will themselves migrate among regions resulting in even greater genetic mixture after two generations.

Another way of looking at the regional mixture of the parental origins of births is to generate an origin allocations matrix by premultiplying the net allocations matrix by a row vector containing the proportions of national births in the regions and then dividing each column by the relevant column total. The observed 1970 proportions were used to calculate Table 32, although the stable population proportions would be more general. The table shows how the offspring of those born in 1970 would be distributed in 50 years' time (at the end of the reproductive age span) in terms of the regional birth origins of their parents. The ranking of the regions in the diagonal elements in Tables 31 and 32 gives some indication of the degree of "endogamy" involved over a generation. The regions that retain their offspring to the greatest extent are the South East, Scotland, and the North West with values above 0.6 in the diagonal (Figure 24); the most open regions are East Anglia, the South West, and the East Midlands, with the other regions in between. The same classification applies to the admission proportions, with the exception of Scotland, which receives less migrants than the South East and so takes the first rank in "endogamy."

A comparison similar to that for life expectancy can be made between the total multiregional values (Table 30) and the single-region values (Table 13) for the regional net reproduction rates. The graph of the 2 sets of statistics (Figure 25) reveals the same "regression to the mean" effect with a regression coefficient of 0.5901 (less than one). Variance in the fertility of regional cohorts is reduced compared with the variance in regional fertility with no allowance for migration. The regression is not quite as pronounced in the fertility case as in the life expectancy instance ($b = 0.59$ as opposed to 0.44), and the correlation is lower ($r = 0.95$ as opposed to 0.99). The higher regression coefficient is the result of the lesser age span over which the fertility process takes place as compared

TABLE 30 Spatial fertility expectancies, GB regions, 1970.

| Region of birth of parent | Region of birth of child | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | YH | NW | EM | WM | EA | SE | SW | W | S | Total |
| N | 0.640 | 0.077 | 0.070 | 0.037 | 0.042 | 0.020 | 0.153 | 0.037 | 0.015 | 0.048 | 1.140 |
| YH | 0.065 | 0.659 | 0.080 | 0.069 | 0.046 | 0.025 | 0.157 | 0.037 | 0.019 | 0.028 | 1.185 |
| NW | 0.030 | 0.046 | 0.768 | 0.032 | 0.048 | 0.016 | 0.144 | 0.038 | 0.037 | 0.030 | 1.188 |
| EM | 0.038 | 0.089 | 0.055 | 0.571 | 0.078 | 0.039 | 0.181 | 0.052 | 0.022 | 0.037 | 1.161 |
| WM | 0.023 | 0.037 | 0.059 | 0.062 | 0.691 | 0.019 | 0.158 | 0.052 | 0.030 | 0.026 | 1.158 |
| EA | 0.022 | 0.046 | 0.047 | 0.065 | 0.054 | 0.459 | 0.296 | 0.064 | 0.022 | 0.039 | 1.113 |
| SE | 0.023 | 0.035 | 0.047 | 0.045 | 0.044 | 0.042 | 0.736 | 0.076 | 0.021 | 0.036 | 1.106 |
| SW | 0.026 | 0.041 | 0.047 | 0.040 | 0.065 | 0.027 | 0.310 | 0.495 | 0.033 | 0.045 | 1.128 |
| W | 0.021 | 0.029 | 0.076 | 0.033 | 0.064 | 0.017 | 0.167 | 0.063 | 0.654 | 0.027 | 1.150 |
| S | 0.031 | 0.035 | 0.048 | 0.032 | 0.036 | 0.015 | 0.152 | 0.035 | 0.013 | 0.786 | 1.182 |

TABLE 31 Net allocations of fertility expectancies, GB regions, 1970.

| Region of birth of parent | Region of birth of child | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | YH | NW | EM | WM | EA | SE | SW | W | S | Total |
| N | 0.5609 | 0.0678 | 0.0616 | 0.0326 | 0.0367 | 0.0179 | 0.1345 | 0.0325 | 0.0135 | 0.0422 | 1.0000 |
| YH | 0.0548 | 0.5564 | 0.0674 | 0.0580 | 0.0385 | 0.0215 | 0.1324 | 0.0310 | 0.0159 | 0.0240 | 1.0000 |
| NW | 0.0249 | 0.0388 | 0.6467 | 0.0266 | 0.0403 | 0.0134 | 0.1212 | 0.0324 | 0.0308 | 0.0249 | 1.0000 |
| EM | 0.0325 | 0.0764 | 0.0475 | 0.4914 | 0.0671 | 0.0339 | 0.1558 | 0.0447 | 0.0192 | 0.0316 | 1.0000 |
| WM | 0.0199 | 0.0317 | 0.0514 | 0.0590 | 0.5971 | 0.0165 | 0.1361 | 0.0452 | 0.0259 | 0.0221 | 1.0000 |
| EA | 0.0194 | 0.0417 | 0.0425 | 0.0583 | 0.0483 | 0.4124 | 0.2658 | 0.0571 | 0.0198 | 0.0350 | 1.0000 |
| SE | 0.0207 | 0.0316 | 0.0421 | 0.0411 | 0.0401 | 0.0379 | 0.6659 | 0.0685 | 0.0192 | 0.0329 | 1.0000 |
| SW | 0.0230 | 0.0364 | 0.0414 | 0.0353 | 0.0580 | 0.0238 | 0.2744 | 0.4389 | 0.0291 | 0.0396 | 1.0000 |
| W | 0.0181 | 0.0255 | 0.0658 | 0.0783 | 0.0560 | 0.0145 | 0.1453 | 0.0551 | 0.5683 | 0.0231 | 1.0000 |
| S | 0.0264 | 0.0293 | 0.0410 | 0.0274 | 0.0302 | 0.0125 | 0.1284 | 0.0294 | 0.0106 | 0.6658 | 1.0000 |

TABLE 32 Regional births by origin cohort, Great Britain.

| Region of birth of parent | Region of birth of child | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | N | YH | NW | EM | WM | EA | SE | SW | W | S |
| N | 0.5793 | 0.0473 | 0.0293 | 0.0292 | 0.0221 | 0.0324 | 0.0261 | 0.0259 | 0.0169 | 0.0267 |
| YH | 0.0879 | 0.6005 | 0.0499 | 0.0789 | 0.0361 | 0.0590 | 0.0400 | 0.0396 | 0.0316 | 0.0235 |
| NW | 0.0552 | 0.0577 | 0.6635 | 0.0497 | 0.0522 | 0.0501 | 0.0506 | 0.0573 | 0.0844 | 0.0342 |
| EM | 0.0362 | 0.0566 | 0.0238 | 0.4591 | 0.0431 | 0.0649 | 0.0322 | 0.0396 | 0.0253 | 0.0213 |
| WM | 0.0345 | 0.0370 | 0.0420 | 0.0804 | 0.6138 | 0.0501 | 0.0451 | 0.0587 | 0.0570 | 0.0245 |
| EA | 0.0103 | 0.0139 | 0.0103 | 0.0249 | 0.0140 | 0.3628 | 0.0255 | 0.0232 | 0.0127 | 0.0107 |
| SE | 0.1103 | 0.1120 | 0.1021 | 0.1842 | 0.1234 | 0.3422 | 0.6587 | 0.2865 | 0.1245 | 0.1078 |
| SW | 0.0259 | 0.0277 | 0.0214 | 0.0336 | 0.0381 | 0.0442 | 0.0574 | 0.3888 | 0.0401 | 0.0277 |
| W | 0.0155 | 0.0139 | 0.0253 | 0.0205 | 0.0271 | 0.0206 | 0.0229 | 0.0368 | 0.5844 | 0.0117 |
| S | 0.0448 | 0.0335 | 0.0325 | 0.0395 | 0.0301 | 0.0383 | 0.0416 | 0.0396 | 0.0232 | 0.7118 |
| TOTAL | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |

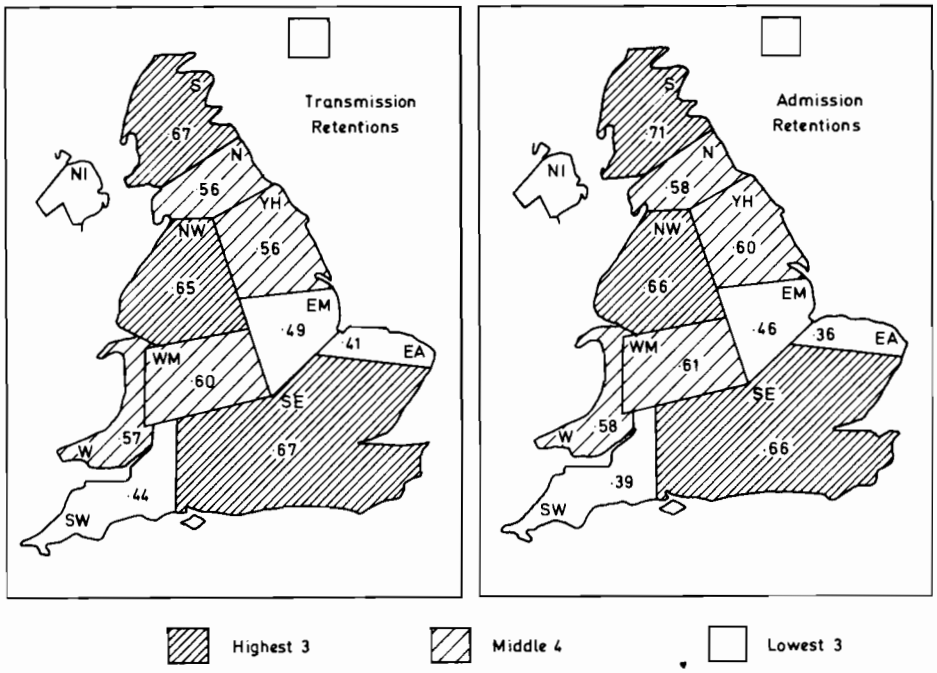


FIGURE 24 Net allocation of spatial fertility expectancies: retention probabilities.

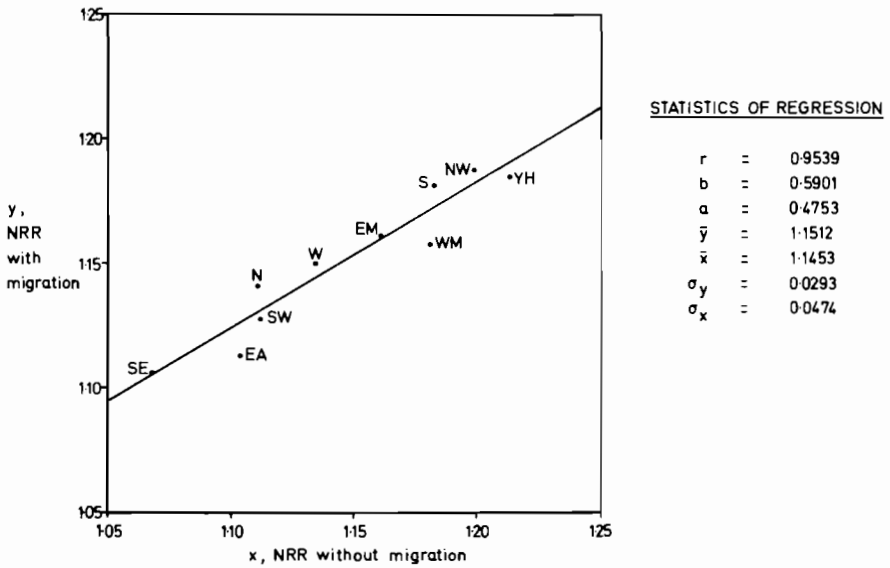


FIGURE 25 Spatial fertility expectancies: single-region and multiregion values.

with that of mortality; the lower correlation is probably due to the fact that the multiregional calculation involved both sexes, whereas only females are used in the single-region calculation.

This fertility expectancy finding is dependent on the assumption, in common with the similar life expectancy finding, that people adopt the mortality and migration behavior of their current residence. In the United Kingdom, data to test such an assumption are absent, although Long (1975) has analyzed the relevant U.S. data with respect to the probability of return migration. However, there is some evidence to support another assumption underlying the spatial fertility expectancy calculation, namely, that people adopt the fertility behavior of the population in the region to which they move. King (1974) reports fertility rates for immigrants to Leeds, and the Immigrant Statistics Unit (1978) reports fertility rates for the New Commonwealth and Pakistani immigrant population in England and Wales. The fertility rates fall between those of the country of origin and the host country and show fairly rapid convergence over time. The differences in fertility rates between regions are, of course, much lower, but it would be surprising if the same effect did not occur. It would be instructive in the spatial fertility expectancy calculation to substitute fertility rates interpolated between origin and destination region according to length of stay.

## 3.6 MULTIREGIONAL MOBILITY ANALYSIS

In the previous section the events under examination were births. The acts of migration or moves can be analyzed in a similar fashion (Willekens and Rogers, 1977) and a net migraproduction matrix, **NMR**, can be defined. This matrix contains the expected number of out-migrations that an individual makes during his lifetime:

$$\mathbf{NMR} = \sum_{x} \mathbf{Y}(x), \tag{25}$$

where

$$\mathbf{Y}(x) = \mathbf{M}^{0}(x)\mathbf{L}(x), \tag{26}$$

where $\mathbf{M}^{0}(x)$ is a diagonalized matrix of out-migration rates for the age interval $x$ to $x + 5$. In principle, this kind of calculation could be extended to cover interregional migrations.

The net migraproduction matrix for the regions of Great Britain is

shown in Table 33, and the corresponding net allocations matrix in Table 34. To what extent are the values in this matrix correct given our earlier comments on the probability matrix calculation? As estimates of the expected number of interregional transitions over 5-year periods, they are clearly overestimates, in the light of our earlier comments. As estimates of the expected number of interregional transitions over 1 year they may be better since the latter are closer to the definition of moves. Further analysis is undoubtedly indicated here (as suggested in Ledent, 1978).

Table 33 suggests that interregional migrations occur only slightly less frequently than births. The figures in the column totals in Table 33 range from 0.92 migrations per person for Scottish cohorts to 1.40 for East Anglia cohorts. The totals for fertility in Table 30 are just a little higher, although the earlier data in Table 13 indicate that births in recent years occur less frequently than interregional migration.

What is the single-region equivalent of the net migraproduction rate? The gross migraproduction rate (GMR) (Willekens and Rogers, 1977) is one equivalent

$$\mathbf{GMR} \doteq \sum_{x} \mathbf{M}^{0}(x), \tag{27}$$

where $\mathbf{M}^{0}(x)$ is a matrix with out-migration rates from the regions in the diagonal and zeros elsewhere. The **GMR**s are the mobility equivalents of the gross rate of reproduction. A true single-region equivalent would involve applying single-region stationary life table populations to the schedule of out-migration rates (as in Long and Boertlein, 1975). To approximate to this in a convenient manner the total out-migration rate is multiplied by the single-region life expectancy value. This enables us to compare mobility rates at a number of spatial scales quite easily; and a range of mobility measures for the British regions has been accumulated in Table 35. In addition column 10 of the table gives the single-region net migraproduction rate, very similar to the Long and Boertlein measure, derived from a run of the program described in Willekens and Rogers (1978, p. 13). Column 10 values are slightly lower in general than the cruder column 9 figures. On average 0.0230 less moves are measured by the more disaggregated measure, and this indicates the likely level of overestimation in the other columns.

Column 2 of Table 35 contains the total internal out-migration rate of residents of the 10 regions. This rate includes all intraregional as well as interregional transitions in the 1970–1971 1-year period. Column 3 gives the total numbers of "moves" (equated here with 1-year tran-

TABLE 33 Net migraproduction matrix, Great Britain.

| Region of birth | Region from which out-migration takes place | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | YH | NW | EM | WM | EA | SE | SW | W | S | Total |
| N | 0.6629 | 0.0678 | 0.0507 | 0.0414 | 0.0344 | 0.0297 | 0.1215 | 0.0532 | 0.0140 | 0.0277 | 1.1034 |
| YH | 0.0561 | 0.7084 | 0.0574 | 0.0739 | 0.0376 | 0.0367 | 0.1244 | 0.0531 | 0.0167 | 0.0167 | 1.1811 |
| NW | 0.0261 | 0.0420 | 0.6133 | 0.0350 | 0.0395 | 0.0231 | 0.1161 | 0.0552 | 0.0322 | 0.0173 | 0.9998 |
| EM | 0.0330 | 0.0794 | 0.0406 | 0.7719 | 0.0635 | 0.0549 | 0.1434 | 0.0731 | 0.0196 | 0.0213 | 1.3006 |
| WM | 0.0207 | 0.0337 | 0.0435 | 0.0678 | 0.6591 | 0.0276 | 0.1262 | 0.0744 | 0.0265 | 0.0148 | 1.0942 |
| EA | 0.0195 | 0.0427 | 0.0353 | 0.0705 | 0.0441 | 0.8259 | 0.2320 | 0.0891 | 0.0199 | 0.0228 | 1.4017 |
| SE | 0.0206 | 0.0323 | 0.0344 | 0.0499 | 0.0368 | 0.0599 | 0.6571 | 0.1061 | 0.0188 | 0.0208 | 1.0367 |
| SW | 0.0232 | 0.0377 | 0.0347 | 0.0442 | 0.0530 | 0.0390 | 0.2399 | 0.8430 | 0.0284 | 0.0254 | 1.3686 |
| W | 0.0188 | 0.0273 | 0.0544 | 0.0363 | 0.0520 | 0.0249 | 0.1314 | 0.0874 | 0.6587 | 0.0155 | 1.1065 |
| S | 0.0281 | 0.0322 | 0.0362 | 0.0367 | 0.0297 | 0.0220 | 0.1214 | 0.0499 | 0.0116 | 0.5493 | 0.9172 |

TABLE 34 Allocations matrix, migraproduction, Great Britain.

| Region of birth | Region from which out-migration takes place | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | YH | NW | EM | WM | EA | SE | SW | W | S | Total |
| N | 0.6008 | 0.0615 | 0.0460 | 0.0376 | 0.0311 | 0.0269 | 0.1101 | 0.0483 | 0.0127 | 0.0251 | 1.0000 |
| YH | 0.0475 | 0.5998 | 0.0486 | 0.0626 | 0.0318 | 0.0311 | 0.1053 | 0.0450 | 0.0142 | 0.0141 | 1.0000 |
| NW | 0.0261 | 0.0420 | 0.6135 | 0.0350 | 0.0395 | 0.0231 | 0.1161 | 0.0552 | 0.0322 | 0.0173 | 1.0000 |
| EM | 0.0254 | 0.0610 | 0.0312 | 0.5935 | 0.0488 | 0.0422 | 0.1103 | 0.0562 | 0.0151 | 0.0163 | 1.0000 |
| WM | 0.0189 | 0.0308 | 0.0397 | 0.0620 | 0.6024 | 0.0252 | 0.1154 | 0.0680 | 0.0242 | 0.0135 | 1.0000 |
| EA | 0.0139 | 0.0304 | 0.0252 | 0.0503 | 0.0314 | 0.5892 | 0.1655 | 0.0636 | 0.0142 | 0.0162 | 1.0000 |
| SE | 0.0198 | 0.0311 | 0.0332 | 0.0482 | 0.0355 | 0.0578 | 0.6338 | 0.1024 | 0.0181 | 0.0201 | 1.0000 |
| SW | 0.0170 | 0.0276 | 0.0254 | 0.0323 | 0.0387 | 0.0285 | 0.1753 | 0.6159 | 0.0208 | 0.0186 | 1.0000 |
| W | 0.0170 | 0.0247 | 0.0492 | 0.0328 | 0.0470 | 0.0225 | 0.1187 | 0.0790 | 0.5952 | 0.0140 | 1.0000 |
| S | 0.0307 | 0.0351 | 0.0395 | 0.0401 | 0.0324 | 0.0240 | 0.1324 | 0.0544 | 0.0126 | 0.5989 | 1.0000 |

TABLE 35 Various migraproduction calculations, Great Britain.

| Region | Life expectancy (Table 17) (1) | Total OMR (Rees, 1977) (2) | Total "moves" (3) | Regional OMR (Table 20) (4) | Regional "moves" (5) | GMR (6) | NMR (Table 33) (7) |
|---|---|---|---|---|---|---|---|
| N | 71.1 | 0.1101 | 7.2281 | 0.0155 | 1.1021 | 1.2143 | 1.1033 |
| YH | 71.2 | 0.1061 | 7.5543 | 0.0174 | 1.2389 | 1.3370 | 1.1811 |
| NW | 70.5 | 0.1056 | 7.4448 | 0.0134 | 0.9447 | 1.0599 | 0.9998 |
| EM | 72.0 | 0.1080 | 7.7760 | 0.0206 | 1.4832 | 1.5674 | 1.3007 |
| WM | 71.6 | 0.1074 | 7.6898 | 0.0151 | 1.0812 | 1.1561 | 1.0941 |
| EA | 73.5 | 0.1280 | 9.4080 | 0.0241 | 1.7714 | 1.8435 | 1.4018 |
| SE | 73.1 | 0.1269 | 9.2764 | 0.0135 | 0.9869 | 1.0590 | 1.0367 |
| SW | 72.8 | 0.1266 | 9.2165 | 0.0235 | 1.7108 | 1.8417 | 1.3687 |
| W | 71.1 | 0.0938 | 6.6692 | 0.0152 | 1.0807 | 1.2063 | 1.1065 |
| S | 70.2 | 0.1187 | 8.3327 | 0.0117 | 0.8213 | 0.8677 | 0.9172 |

| Region | Regional IOMR (Table 8) (8) | Regional internal "moves" (9) | Regional internal net migra-production rate (10) | Regional ER (Table 8) (11) | Emigrations (12) | Regional TOMR (Table 8) (13) | Regional total "moves" (14) | Grand total "moves" (15) |
|---|---|---|---|---|---|---|---|---|
| N | 0.0153 | 1.0878 | 1.0823 | 0.0075 | 0.5333 | 0.0228 | 1.6211 | 7.7614 |
| YH | 0.0172 | 1.2246 | 1.2080 | 0.0058 | 0.4130 | 0.0230 | 1.6376 | 7.9673 |
| NW | 0.0133 | 0.9377 | 0.9392 | 0.0065 | 0.4583 | 0.0198 | 1.3960 | 7.9031 |
| EM | 0.0204 | 1.4688 | 1.4269 | 0.0076 | 0.5472 | 0.0280 | 2.0160 | 8.3232 |
| WM | 0.0159 | 1.1384 | 1.0585 | 0.0054 | 0.3866 | 0.0213 | 1.5250 | 8.0764 |
| EA | 0.0238 | 1.7493 | 1.6900 | 0.0169 | 1.2422 | 0.0407 | 2.9915 | 10.6502 |
| SE | 0.0133 | 0.9722 | 0.9512 | 0.0112 | 0.8187 | 0.0245 | 1.7909 | 10.0951 |
| SW | 0.0232 | 1.6890 | 1.6838 | 0.0094 | 0.6843 | 0.0327 | 2.3733 | 9.9008 |
| W | 0.0150 | 1.0665 | 1.0749 | 0.0037 | 0.2631 | 0.0187 | 1.3296 | 6.9323 |
| S | 0.0115 | 0.8073 | 0.7970 | 0.0111 | 0.7792 | 0.0226 | 1.5865 | 9.1119 |

Column (3) = column (1) x column (2)
Column (5) = column (1) x column (4)
Column (6): GMR = gross migraproduction rate
Column (7): NMR = net migraproduction rate
Column (8): IOMR = internal out-migration rate
Column (9) = column (1) x column (8)
Column (10) = single-region migraproduction rate derived from Willekens and Rogers (1978) program.

Column (11): ER = emigration rate (external out-migration)
Column (12) = column (1) x column (11)
Column (13): TOMR = total out-migration rate
= column (8) + column (11)
Column (14) = column (9) + column (12)
= column (1) x column (13)
Column (5) = column (3) + column (12)

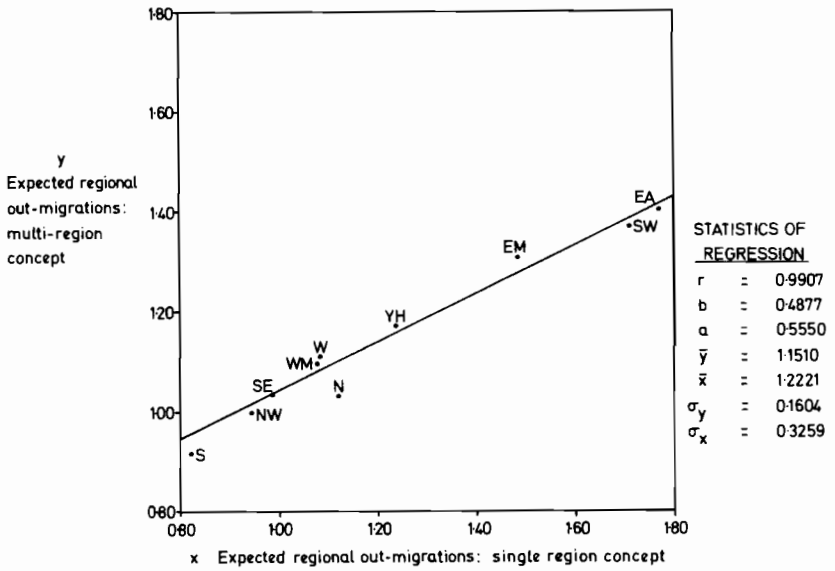


FIGURE 26 Migraproduction expectations: single-region vs. multiregional values.

sitions*) expected in a lifetime by this method. The Southern regions of the country – East Anglia, the South East, and South West – stand out as having the most mobile population, followed by Scotland, the Midlands regions, the Northern regions, and Wales exhibit the lowest mobility with the Welsh population likely to make almost 3 less moves in an average lifetime than the East Anglian.

If the same calculation is applied to regional out-migrants (to other British regions) then a single-region estimate of regional "moves" is obtained (column 5 of Table 35). This can be compared with the net migraproduction rates derived from the multiregional analysis (column 7 of Table 35) in Figure 26). Precisely the same kind of "regression to the mean" relationship shows up as in the life expectancy and fertility cases. The variance in the migratory behavior of birth cohorts is reduced by the very act of migration.

The bottom half of Table 35 shows similar calculations based on the accounting data of Table 8, which contains the multiregional population accounts for the mid-year 1970 to mid-year 1971 period. The regional

*Evidence from the General Household Survey of the Office of Population Censuses and Surveys (1973) suggests that persons who migrate in Britain make an average of 1.274 moves per year rather than the 1 move assumed here. This would shift the range in column 3 from 8.5 moves per lifetime for Wales to 11.99 moves per lifetime for East Anglia.

internal out-migration rate is computed by dividing the total of such migrants by the population of the initial period. This is a slightly different procedure from that for the column 4 rates, but the results (columns 8 and 9) are very little different. What the accounts table does add, however, is the possibility of calculating the lifetime number of emigrations expected in each regional population (columns 11 and 12), and these were found to be surprisingly high. In fact, one might suppose that such figures would lead to the disappearance of the British population. In reality, a very large proportion of emigrations are balanced by immigrations (as shown in Tables 11 and 12) and a very large proportion of immigrants are, in fact, returning British citizens.

The final columns of Table 35 record the sum of internal and external "moves" for the regions (column 15) and the grand total of residential mobility (column 15). The ranking of the regions remains fairly stable as the migration scale changes – compare columns 3, 7, 11, and 13 – with the exceptions of Scotland and the South East. The Scottish population and the Scottish birth cohort have the lowest interregional migraproduction rate, probably because Scotland is the region least accessible to the British population system. However, residential mobility in general and out-migration mobility are fairly high for Scotland, which ranks seventh in regional total "moves" and fourth in grand total "moves." Similarly, the South East has a low ranking on interregional mobility, in this case probably because of its large size, a second place in the "emigrations" column, a second place in the total "moves" category, and a second place overall in the grand total "moves." These differences emphasize the difficulty of explaining the patterns of interregional migration without adopting an appropriate spatial interaction perspective (Stillwell, 1977a, 1977b).

## 3.7 MULTIREGIONAL POPULATION PROJECTIONS

### *3.7.1 Theory and Caveats*

One of the most useful products of multiregional population analysis is the projection of regional populations using the survivorship matrix $\mathbf{S}(x)$, generated from the multiregional life table

$$\mathbf{S}(x) = \mathbf{L}(x + 5)\mathbf{L}^{-1}(x) \tag{28}$$

(Willekens and Rogers, 1976, p. 31) where $\mathbf{L}(x)$ refers to the stationary

multiregional life table population. The survivorship proportions are used to project the existing population

$$\{\mathbf{K}^{(t+5)}(x+5)\} = \mathbf{S}(x)\{\mathbf{K}^{(t)}(x)\} \text{ for } 5 \leqslant x \leqslant z-5, \tag{29}$$

where $\{\mathbf{K}^{(t)}(x)\}$ is a vector of regional populations aged $x$ to $x+5$ at time $t$, and $\{\mathbf{K}^{(t+5)}(x+5)\}$ is the equivalent vector at time $t+5$, now aged $x+5$ to $x+10$.

Births are computed by applying a fertility and survivorship matrix $\mathbf{B}(x)$ to the potentially fertile population

$$\{\mathbf{K}^{(t+5)}(0)\} = \sum_{\alpha-5}^{\beta-5} \mathbf{B}(x)\{\mathbf{K}^{(t)}(x)\} \tag{30}$$

(Willekens and Rogers, 1976, p. 41) where

$$\mathbf{B}(x) = \tfrac{1}{2}\mathbf{L}(0)\ell^{-1}(0)[\mathbf{F}(x) + \mathbf{F}(x+5)\mathbf{S}(x)], \tag{31}$$

where $\mathbf{F}(x)$ is a diagonal matrix of regional fertility rates for persons aged $x$ to $x+5$ at time $t$, $\ell(0)$ is the value of the life table radix, and $\mathbf{L}(0)\ell^{-1}(0) = \mathbf{S}(0)$, the survivorship matrix for persons born in the period.

This projection procedure follows, for a multiregional system, the same method of deriving survivorship rates as that used in connection with the conventional life table (Keyfitz, 1968; Keyfitz and Flieger, 1971), but contrasts with a more direct derivation, in other multiregional projection models, from migrant and death statistics (Rogers, 1968; Gilje and Campbell, 1973) or from spatial population accounts (Rees and Wilson, 1977; Rees, 1977a).

In this section, the results of applying the Equations (28)–(31) model to the 1970 British regions system described in Section 3.2, using the Willekens and Rogers 1976 program are described. A number of caveats apply to these projections which make them unsuitable as forecasts,* but they are worth examination as the one of the few multiregional population projections of the regional populations of Britain.† The caveats are listed below.

(a) The point made earlier about the likely overestimation of the multiregional migration and death probability matrix applies with equal

*The terms "projection" and "forecast" are used as follows. Projections of the population are explorations of the future development of various categories of the population using particular models and assumptions. Forecasts are judgmentally selected or adjusted projections that the author(s) of the projection consider to be as the best available view of the demographic situation in the future.

†See Joseph (1974, 1975) for earlier attempts, Rees (1976) for an aggregate projection, Rees (1977a) for a 3-region projection.

force to the multiregional survivorship matrix. Such an overestimation is likely to accelerate whatever redistribution of the population is taking place, other things being equal, though it is not of itself likely to affect the overall population system since the death probabilities and fertility rates are correctly determined.

(b) The effect of external migration, which was shown to be of such importance in Section 2.3, is unrepresented in the projections reported here.

(c) The situation with respect to fertility has changed dramatically since 1970 (as was shown in Section 2.4), and that of mortality has altered marginally since 1970, so that updating to a more recent year would be desirable.

(d) Similarly, the internal migration picture requires updating, since in Section 2.2 the net migration picture was shown to have changed substantially in a number of respects.

Caveat *a* requires the solution of a technical problem in multiregional population analysis that should soon be overcome. Caveat *b* requires the estimation of emigration vectors for the regions (the immigration vectors are readily available) and inclusion of net emigration rates, disaggregated by age in an unpublished simulation version of the Willekens and Rogers 1976 programs (Willekens, 1978, personal communication). The simulation version of the programs could readily accept updated fertility and mortality data (caveat *c*). Caveat *d* is more difficult to remove as migration data are available only at the periodic censuses (5 or 10 years apart). However, using a combination of official net migration estimates, external migration data (OPCS, 1978c), and accounting techniques, an estimate of the annual interregional migration matrices has been prepared as part of larger accounts matrices (the accounts table for 1975–1976 given in Table 10 is an example). These estimations could be easily disaggregated by age and sex using improved versions of the methods employed in Rees (1977a).

### *3.7.2 The Population Projection*

Selected results from the population projection are presented in Table 36: the total populations in the 10 regions, their shares of the national population and one measure of their age structure, the percentage of the population in the potentially active age groups 15 to 64. A second table, Table 37, gives details of the way the components of growth change over

TABLE 36 Multiregional population projection: GB regions, 1970 base.

| Region[a] | 1970 | 1975 | 1980 | 1985 | 1990 | 2000 | 2010 | 2020 |
|---|---|---|---|---|---|---|---|---|
| Population numbers (1000s) | | | | | | | | |
| N | 3,360 | 3,413 | 3,463 | 3,518 | 3,579 | 3,710 | 3,870 | 4,056 |
| YH | 4,812 | 4,850 | 4,884 | 4,925 | 4,981 | 5,123 | 5,320 | 5,568 |
| NW | 6,789 | 6,863 | 6,938 | 7,032 | 7,151 | 7,439 | 7,806 | 8,237 |
| EM | 3,363 | 3,499 | 3,628 | 3,757 | 3,894 | 4,173 | 4,469 | 4,783 |
| WM | 5,178 | 5,307 | 5,423 | 5,538 | 5,661 | 5,922 | 6,217 | 6,555 |
| EA | 1,674 | 1,811 | 1,937 | 2,058 | 2,177 | 2,404 | 2,628 | 2,852 |
| SE | 17,316 | 17,612 | 17,909 | 18,248 | 18,633 | 19,495 | 20,530 | 21,722 |
| SW | 3,764 | 3,968 | 4,158 | 4,340 | 4,519 | 4,867 | 5,233 | 5,618 |
| W | 2,734 | 2,777 | 2,818 | 2,860 | 2,909 | 3,020 | 3,161 | 3,327 |
| S | 5,199 | 5,250 | 5,306 | 5,371 | 5,448 | 5,616 | 5,836 | 6,096 |
| GB | 54,187 | 55,349 | 56,463 | 57,646 | 58,951 | 61,769 | 65,070 | 68,814 |
| Population shares (percentage of GB population) | | | | | | | | |
| N | 6.20 | 6.17 | 6.13 | 6.10 | 6.07 | 6.01 | 5.95 | 5.89 |
| YH | 8.88 | 8.76 | 8.65 | 8.54 | 8.45 | 8.29 | 8.18 | 8.09 |
| NW | 12.53 | 12.40 | 12.29 | 12.20 | 12.13 | 12.04 | 12.00 | 11.97 |
| EM | 6.21 | 6.32 | 6.42 | 6.52 | 6.61 | 6.76 | 6.87 | 6.95 |
| WM | 9.56 | 9.59 | 9.60 | 9.61 | 9.60 | 9.59 | 9.55 | 9.53 |
| EA | 3.09 | 3.27 | 3.43 | 3.57 | 3.69 | 3.89 | 4.04 | 4.14 |
| SE | 31.96 | 31.82 | 31.72 | 31.66 | 31.61 | 31.56 | 31.55 | 31.57 |
| SW | 6.95 | 7.17 | 7.36 | 7.53 | 7.67 | 7.88 | 8.04 | 8.16 |
| W | 5.05 | 5.02 | 4.99 | 4.96 | 4.93 | 4.89 | 4.86 | 4.83 |
| S | 9.59 | 9.48 | 9.40 | 9.32 | 9.24 | 9.09 | 8.97 | 8.86 |
| GB | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| Percentage of population active | | | | | | | | |
| N | 63.5 | 62.5 | 63.2 | 63.5 | 63.0 | 63.7 | 64.7 | 64.4 |
| YH | 63.1 | 61.8 | 61.9 | 62.2 | 61.8 | 62.6 | 63.6 | 63.4 |
| NW | 62.5 | 61.5 | 61.8 | 62.3 | 61.9 | 63.0 | 64.0 | 63.8 |
| EM | 63.2 | 62.4 | 62.6 | 63.1 | 62.8 | 63.6 | 64.6 | 64.1 |
| WM | 64.5 | 63.1 | 63.0 | 63.3 | 62.8 | 63.4 | 64.2 | 63.9 |
| EA | 63.4 | 62.2 | 62.3 | 62.9 | 62.8 | 63.9 | 64.6 | 63.8 |
| SE | 63.9 | 62.8 | 62.8 | 63.4 | 63.2 | 64.3 | 65.3 | 65.0 |
| SW | 62.0 | 61.0 | 61.3 | 61.8 | 61.5 | 62.6 | 63.7 | 63.1 |
| W | 63.1 | 62.0 | 62.5 | 62.8 | 62.3 | 63.3 | 64.4 | 64.0 |
| S | 61.7 | 61.5 | 61.9 | 62.1 | 61.7 | 63.0 | 64.2 | 63.6 |
| GB | 63.2 | 62.2 | 62.4 | 62.9 | 62.5 | 63.5 | 64.5 | 64.1 |

[a]The regions are the "old" regions (Figure 1.2).

TABLE 37 Aggregate components of growth rates, GB regions, 1970 base.

| Region | 1970 | 1975 | 1980 | 1985 | 1990 | 2000 | 2010 | 2020 |
|---|---|---|---|---|---|---|---|---|
| Natural increase rate (per 1000, annual equivalent) | | | | | | | | |
| N | 3.6 | 3.2 | 3.1 | 3.6 | 3.6 | 3.8 | 4.3 | 4.5 |
| YH | 4.8 | 4.1 | 3.9 | 4.4 | 4.6 | 5.2 | 6.0 | 6.4 |
| NW | 3.9 | 3.6 | 3.8 | 4.6 | 5.2 | 5.9 | 6.7 | 7.0 |
| EM | 5.3 | 5.2 | 4.9 | 5.4 | 5.7 | 5.9 | 6.3 | 6.4 |
| WM | 6.7 | 5.9 | 5.2 | 5.3 | 5.4 | 5.6 | 6.0 | 6.3 |
| EA | 4.2 | 4.0 | 3.6 | 3.8 | 3.9 | 3.9 | 4.1 | 3.9 |
| SE | 4.1 | 4.0 | 3.8 | 4.0 | 4.4 | 4.8 | 5.4 | 5.7 |
| SW | 2.5 | 2.4 | 2.1 | 2.3 | 2.5 | 2.7 | 3.2 | 3.3 |
| W | 2.7 | 2.4 | 2.1 | 2.5 | 2.6 | 3.1 | 3.7 | 4.0 |
| S | 4.6 | 4.7 | 5.0 | 5.4 | 5.5 | 5.7 | 6.4 | 6.5 |
| GB | 4.3 | 4.0 | 3.9 | 4.2 | 4.5 | 4.8 | 5.4 | 5.7 |
| Internal net migration rate (per 1000, annual equivalent) | | | | | | | | |
| N | −0.3 | −0.3 | −0.3 | −0.3 | −0.1 | 0.0 | 0.1 | 0.3 |
| YH | −3.1 | −2.8 | −2.6 | −2.4 | −2.2 | −2.0 | −1.8 | −1.6 |
| NW | −1.7 | −1.5 | −1.6 | −1.6 | −1.6 | −1.5 | −1.6 | −1.5 |
| EM | 2.9 | 2.4 | 1.9 | 1.7 | 1.4 | 0.9 | 0.6 | 0.3 |
| WM | −1.6 | −1.4 | −1.2 | −1.1 | −1.1 | −1.0 | −0.9 | −0.9 |
| EA | 12.6 | 10.4 | 8.9 | 7.8 | 6.8 | 5.2 | 4.5 | 3.8 |
| SE | −0.9 | −0.7 | −0.4 | −0.2 | −0.2 | −0.0 | 0.0 | 0.1 |
| SW | 8.7 | 7.6 | 6.7 | 5.9 | 5.3 | 4.5 | 4.1 | 3.7 |
| W | 0.5 | 0.6 | 0.6 | 0.6 | 0.8 | 1.0 | 1.1 | 1.3 |
| S | −2.7 | −2.8 | −2.8 | −2.8 | −2.6 | −2.4 | −2.2 | −2.0 |
| GB | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Growth rates (per 1000, annual equivalent) | | | | | | | | |
| N | 3.22 | 2.90 | 2.78 | 3.29 | 3.43 | 3.79 | 4.46 | 4.82 |
| YH | 1.69 | 1.35 | 1.31 | 1.92 | 2.41 | 3.23 | 4.22 | 4.81 |
| NW | 2.17 | 2.06 | 2.21 | 3.01 | 3.59 | 4.36 | 5.16 | 5.47 |
| EM | 8.17 | 7.53 | 6.82 | 7.01 | 7.11 | 6.77 | 6.82 | 6.71 |
| WM | 5.18 | 4.54 | 4.05 | 4.19 | 4.38 | 4.62 | 5.03 | 5.48 |
| EA | 16.77 | 14.42 | 12.49 | 11.53 | 10.66 | 9.17 | 8.51 | 7.72 |
| SE | 3.27 | 3.31 | 3.36 | 3.82 | 4.22 | 4.75 | 5.45 | 5.74 |
| SW | 11.18 | 9.91 | 8.73 | 8.21 | 7.78 | 7.18 | 7.26 | 6.97 |
| W | 3.20 | 2.98 | 2.72 | 3.08 | 3.41 | 4.12 | 4.86 | 5.27 |
| S | 1.79 | 1.99 | 2.15 | 2.64 | 2.85 | 3.34 | 4.22 | 4.42 |
| GB | 4.30 | 4.04 | 3.86 | 4.23 | 4.49 | 4.85 | 5.44 | 5.66 |

time under the regime of unchanging mortality, fertility, and migration rates.

The first point to make is that the absolute sizes of the populations are greater than those in the majority of other projections (discussed later). In 1970 fertility was high relative to overall post-1918 British experience (Figure 3.2), higher than subsequently in the 1970s, and higher than the long-term fertility rates assumed by the Office of Population Censuses and Surveys in recent projections. Generally, a total population fertility rate of 2.2 was assumed for England and Wales by the Office of Population Censuses and Surveys from 1971 through to 1975 with a reduction to 2.1 in 1976-based projections (OPCS, 1978d).

Of more interest are the projected relative shares of the GB population. Shares for the North, Yorkshire and Humberside, the North West, Wales, and Scotland are projected to fall throughout the projection time horizon to 2020. Shares for the East Midlands, East Anglia, and the South West grow continuously in this period. The West Midlands' share at first increases and then decreases; the South East's share declines through the remainder of the twentieth century, but recovers slightly in the twenty-first.

These share projections can be compared with projections (Table 38) based on input of the 1970–1971 accounts matrix (Table 9) into a simpler aggregate model

$$\{\mathbf{K}^{(t+1)}\} = \mathbf{G}^{(t,t+1)}\{\mathbf{K}^{(t)}\} + \{\mathbf{I}^{(t,t+1)}\}\,, \tag{32}$$

where the $\{\mathbf{K}\}$ are vectors of regional populations, $\mathbf{G}^{(t,t+1)}$ is a matrix of survivorship and birth and survivorship rates for a 1-year period and $\{\mathbf{I}^{(t,t+1)}\}$ is a vector of regional immigrants (not net immigrants, because emigration rates are implicitly included in the $\mathbf{G}$ matrix). The total numbers projected are, of course, rather different because of aggregation error in the simpler model, and because no emigration losses are allowed in the more complex model. The share trends (Table 40) are, however, quite similar.

Table 38 also reports the results of a growth matrix or components of growth model based on the 1975–1976 accounts (Table 10), and Table 39 gives details of the latest (1976-based) official national projections (OPCS, 1978d) prepared by the Government Actuary in collaboration with the Office of Population Censuses and Surveys, and the latest (1974-based) regional projections. Both sets of projections show that expectations of the future population have fallen dramatically from 1970-based levels. Whereas the 1970-based projection (Table 36) had a figure of 61.8 millions projected for Great Britain in 2000, the official projections

TABLE 38 Multiregional population projections, GB regions, aggregate growth matrix (GM) model based on 1970–1971 and 1975–1976 accounts.

| Region[c] | 1970 | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|---|---|
| Population shares (percentage) 1970–71 GM model[a] | | | | | | | |
| N | 5.82 | 5.75 | 5.70 | 5.65 | 5.61 | 5.58 | 5.54 |
| YH | 9.00 | 9.00 | 8.99 | 8.99 | 8.99 | 9.00 | 9.00 |
| NW | 12.23 | 12.15 | 12.09 | 12.03 | 11.98 | 11.94 | 11.91 |
| EM | 6.69 | 6.84 | 6.97 | 7.09 | 7.19 | 7.29 | 7.37 |
| WM | 9.45 | 9.55 | 9.64 | 9.73 | 9.81 | 9.89 | 9.97 |
| EA | 3.09 | 3.23 | 3.36 | 3.45 | 3.53 | 3.59 | 3.64 |
| SE | 31.48 | 31.24 | 31.03 | 30.85 | 30.69 | 30.55 | 30.43 |
| SW | 7.53 | 7.66 | 7.77 | 7.86 | 7.94 | 8.00 | 8.05 |
| W | 5.04 | 5.02 | 5.01 | 4.99 | 4.98 | 4.98 | 4.97 |
| S | 9.67 | 9.55 | 9.45 | 9.35 | 9.26 | 9.18 | 9.11 |
| GB | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| Popn GB | 54,072 | 54,777 | 55,643 | 56,493 | 57,327 | 58,145 | 58,949 |
| Population shares (percentage) 1975–76 GM model[b] | | | | | | | |
| N | 5.82 | 5.74 | 5.73 | 5.71 | 5.70 | 5.69 | 5.68 |
| YH | 9.00 | 9.00 | 8.95 | 8.91 | 8.87 | 8.84 | 8.81 |
| NW | 12.23 | 12.09 | 11.92 | 11.77 | 11.63 | 11.51 | 11.40 |
| EM | 6.69 | 6.85 | 6.91 | 6.96 | 7.00 | 7.04 | 7.08 |
| WM | 9.45 | 9.51 | 9.43 | 9.36 | 9.30 | 9.25 | 9.20 |
| EA | 3.09 | 3.27 | 3.46 | 3.62 | 3.75 | 3.86 | 3.95 |
| SE | 31.48 | 31.10 | 30.91 | 30.77 | 30.65 | 30.57 | 30.51 |
| SW | 7.53 | 7.77 | 7.99 | 8.18 | 8.34 | 8.47 | 8.58 |
| W | 5.04 | 5.08 | 5.11 | 5.14 | 5.16 | 5.18 | 5.20 |
| S | 9.67 | 9.57 | 9.57 | 9.58 | 9.59 | 9.59 | 9.60 |
| GB | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| Popn GB | 54,072 | 54,405 | 54,324 | 54,239 | 54,153 | 54,065 | 53,977 |

[a] The 1970–1971 GM (aggregate population) model is computed based on Table 9 accounts and used to project the population. See Rees and Wilson (1977) Chapter 6 for details of the method. The program used is described in Jenkins and Rees (1977).

[b] The 1975–1976 GM model is computed based on Table 10 accounts and used to project the population. The program used is described in Jenkins and Rees (1977).

[c] The regions are "new" regions (Figure 1.3).

TABLE 39 Official single-region population projections, regions (1974-based) and countries (1976-based).

| Region | 1974 | 1976 | 1981 | 1986 | 1991 | 1996 | 2001 | 2016 |
|---|---|---|---|---|---|---|---|---|
| Populations (1000s): home population of the English regions | | | | | | | | |
| N | 3,127 | 3,110 | 3,068 | 3,071 | 3,082 | | | |
| YH | 4,897 | 4,883 | 4,841 | 4,864 | 4,910 | | | |
| NW | 6,593 | 6,554 | 6,447 | 6,437 | 6,465 | | | |
| EM | 3,719 | 3,758 | 3,851 | 3,981 | 4,128 | | | |
| WM | 5,181 | 5,183 | 5,191 | 5,256 | 5,339 | | | |
| EA | 1,758 | 1,802 | 1,921 | 2,053 | 2,191 | | | |
| SE | 16,955 | 16,911 | 16,842 | 16,954 | 17,110 | | | |
| SW | 4,206 | 4,249 | 4,369 | 4,543 | 4,730 | | | |
| E | 46,436 | 46,448 | 46,528 | 47,159 | 47,956 | | | |
| Populations (1000s): total population of the UK countries | | | | | | | | |
| W | 2,765 | 2,773 | 2,790 | 2,832 | 2,893 | 2,945 | 2,979 | 3,090 |
| S | 5,242 | 5,225 | 5,188 | 5,223 | 5,304 | 5,362 | 5,378 | 5,427 |
| NI | 1,535 | 1,528 | 1,532 | 1,545 | 1,566 | 1,587 | 1,600 | 1,625 |
| UK | 56,053 | 56,002 | 55,697 | 55,962 | 56,712 | 57,325 | 57,535 | 58,201 |
| GB | 54,518 | 54,472 | 54,165 | 54,418 | 55,147 | 55,738 | 55,935 | 56,576 |
| EW | 49,276 | 49,247 | 48,977 | 49,195 | 49,844 | 50,376 | 50,557 | 51,148 |
| E | 46,511 | 46,474 | 46,187 | 46,363 | 46,951 | 47,431 | 47,578 | 48,058 |

| Population shares (of GB population) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| N | 5.74 | 5.72 | 5.62 | 5.55 | 5.47 | | | |
| YH | 9.00 | 8.97 | 8.87 | 8.78 | 8.72 | | | |
| NW | 12.11 | 12.04 | 11.82 | 11.63 | 11.48 | | | |
| EM | 6.83 | 6.90 | 7.06 | 7.19 | 7.33 | | | |
| WM | 9.52 | 9.52 | 9.52 | 9.50 | 9.48 | | | |
| EA | 3.23 | 3.31 | 3.52 | 3.71 | 3.89 | | | |
| SE | 31.15 | 31.06 | 30.87 | 30.63 | 30.38 | | | |
| SW | 7.73 | 7.81 | 8.01 | 8.20 | 8.39 | | | |
| W | 5.07 | 5.09 | 5.15 | 5.20 | 5.25 | 5.28 | 5.33 | 5.46 |
| S | 9.62 | 9.59 | 9.58 | 9.60 | 9.62 | 9.62 | 9.61 | 9.59 |
| NI | 2.82 | 2.81 | 2.83 | 2.84 | 2.84 | 2.85 | 2.86 | 2.87 |
| UK | 102.82 | 102.81 | 102.83 | 102.84 | 102.84 | 102.85 | 102.86 | 102.87 |
| GB | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| EW | 90.38 | 90.41 | 90.42 | 90.40 | 90.38 | 90.38 | 90.39 | 90.41 |
| E | 85.31 | 85.32 | 85.27 | 85.20 | 85.14 | 85.10 | 85.06 | 84.94 |

SOURCES: English region projections – OPCS (1977d). UK countries projections – OPCS (1978d).

based on 1976 show a figure of only 55.9 million in 2001, and the components of growth projection (in which fertility is not assumed to recover to replacement levels) gives a figure of 54.0 million only, slightly less than the figure in 1970.

The pattern of changes in regional shares does not appear to be very different from that of the 1970-based projections (Table 40), with the exception of Wales, which is projected to gain in share terms, and the West

TABLE 40 Shifts in population shares in the projections.

| | Projection model | | | |
|---|---|---|---|---|
| Region | Multiregional cohort survival 1970 base Table 36 | Growth matrix 1970–71 base Table 38 | Growth matrix 1975–76 base Table 38 | Cohort survival with net migration 1974–76 base Table 39 |
| Change in percentage share 1970–90 | | | | |
| N | −0.13 | −0.21 | −0.08 | −0.35 |
| YH | −0.33 | −0.01 | −0.13 | −0.28 |
| NW | −0.40 | −0.25 | −0.60 | −0.75 |
| EM | +0.40 | +0.50 | +0.31 | +0.64 |
| WM | +0.04 | +0.36 | −0.15 | +0.03 |
| EA | +0.60 | +0.42 | +0.66 | +0.80 |
| SE | −0.35 | −0.79 | −0.83 | −1.10 |
| SW | +0.72 | +0.41 | +0.81 | +0.86 |
| W | −0.08 | −0.06 | +0.12 | +0.21 |
| S | −0.35 | −0.41 | −0.08 | −0.05 |
| Change in percentage share 1970–2000 | | | | |
| N | −0.19 | −0.28 | −0.14 | |
| YH | −0.58 | 0.00 | −0.19 | |
| NW | −0.49 | −0.32 | −0.83 | |
| EM | +0.55 | +0.68 | +0.39 | |
| WM | +0.03 | +0.52 | −0.25 | |
| EA | +0.80 | +0.55 | +0.86 | |
| SE | −0.40 | −1.05 | −0.97 | |
| SW | +0.93 | +0.52 | +1.05 | |
| W | −0.16 | −0.07 | +0.16 | |
| S | −0.50 | −0.56 | −0.07 | |

Midlands, which is projected to lose, thus reversing the 1970-projected pattern.

These comparisons have not provided a precise evaluation of the influence of a multiregional approach as opposed to a single-region approach because there are many causes for the differences in projection – both in model and in data input and assumptions. Evaluation of the influence of model construction requires the kind of experimentation with same data base that Rogers (1976) has carried out so successfully, and evaluation of the influence of data input and assumptions requires systematic simulation of a variety of possible scenarios (as in Rees, 1977a).

This study of migration and population dynamics in UK regions concludes with a brief review of relevant policy.

# 4 POPULATION DISTRIBUTION POLICY

## 4.1 INTRODUCTION

In the first 3 sections of this paper, the aim has been to describe, in as thorough a fashion as possible, the population dynamics of UK regions. Clearly it would be satisfying to combine this descriptive account with an explanation of why regional populations have differed in their mortality experience, fertility behavior, and migration propensity. This explanation would attempt to determine the role, direct or indirect, that explicit public policy has played in influencing those differences. It is not possible to give a thorough exploration here, but the subject is important enough to warrant a short review of the findings of others, and some speculation. For more careful and detailed descriptions of various aspects of population distribution policy in the UK, reference should be made to McCrone (1969), the Department of the Environment (1971, Chapter 5), House (1973), Lawton (1973), and Lawton (1977).

The regions used in the analysis are not governmental units in the sense of having an elected governing council or equivalent body. They are statistical amalgamations of the upper tier of local governmental units: counties in England and Wales, and "regions and areas" in Scotland. These are the units that could be said to have population distribution policies, and they are responsible for preparing Structure Plans that incorporate population forecasts and distribution strategies. However, since there are some 68 of these local government units (Greater London, 7 Metropolitan counties, and 39 nonmetropolitan counties in England; 8 counties in Wales; 12 regions and areas in Scotland; and Northern Ireland), multiregional analysis of the kind carried out at the regional scale is too large a task at the local scale for the present, although use might be

made of the aggregated or decomposed models suggested by Rogers (1976). Similarly, multiregional analysis for the city regions, which represent the fundamental units of the spatial economy would require extensive resources and exploration. The Urban Change Project (Drewett, Spence, and Goddard, 1975) has measured population and employment trends, components of change, and migration patterns for about 360 city-region zones (circa 120 metropolitan labor markets divided into core, outer, and peripheral zones), but little model-based analysis has yet been attempted.

However, the standard regions or approximate equivalents do serve as units in the administrative structure of national government departments. The National Health Service, for example, is divided into 15 Regional Health Authorities, the boundaries of 6 of which coincide with standard regions while others aggregate to standard regions. There has always been a regional dimension to most national policies, particularly those concerned with employment. In some cases, for example, national policy concerned with the location of manufacturing employment, the regional element in policy has been explicit: attempts have been made to force or to lure jobs away from low unemployment regions (South East, West Midlands) to high unemployment regions (Northern Ireland, Scotland, the North); this has consequent effects on migration patterns. In other cases, policy has been indirect in its influence: the distribution of finance among the regional hospital authorities has been very uneven in the past and may have contributed to the mortality differences highlighted in Section 2.6.

Explanations for the regional patterns and policy influence on each of the elements in population dynamics are discussed in turn: stocks, births, deaths, internal migrants, and external migrants.

## 4.2 THE DIRECTION OF POPULATION

People are not told where they should live in the United Kingdom. Almost all of them choose, subject to various employment, income, and family constraints, where to live. The exceptions are those bound in some way to institutions: the Armed Forces and the prisons are the principal examples. The differences between total, home, and civilian population distributions, for example, are entirely a matter for the Ministry of Defence, since the differences are constituted by the Armed Forces.

## 4.3 EXPLANATIONS OF FERTILITY PATTERNS

National fertility trends have been analyzed in detail by official demographers (OPCS, 1978d) and academics (Simons, 1977). Principal explan-

ations for the declining trend since 1964 include the desire for smaller families stemming from a perception of worsened life chances for offspring, and from the more careerist orientation of women, the availability of legal abortions since 1968, and the use of safer contraceptives such as "the Pill."

Less attention has been paid to regional fertility variation. Jones (1975) has related birthrates in local areas in Scotland to the degree to which women in the childbearing age group participate in the labor force and to the proportion of Catholics, who have a higher fertility rate, in the population, once the effect of the age–sex structure of the population had been eliminated. Compton (1978) has analyzed the variation in fertility within Northern Ireland and has shown that the sectarian (Protestant/Catholic) composition of local populations is the main, though not exclusive, explanation. Lawton (1973) points to the correlation between migration and more fertile couples. Migrants in the fertile age ranges who move into "suburbanizing" areas do so in order to have children, whereas those who stay behind in the city are more likely to have decided to have smaller families or no children. Finally, given a fair degree of difference in family size between families headed by men in different social classes (Lawton, 1973; Pearce and Britton, 1977), it is likely that the social class composition of the regions, which given the differing industrial structures will vary considerably, contributes to an explanation of the fertility variations. Thus, female workforce participation, religious and social class composition, and life-cycle-related migration all combine to give a multivariate explanation of fertility patterns.

Policy on family planning, such as it is, aims to maximize people's freedom of choice in the number and spacing between the births of their children. Income supplementation for families with children (formerly through family allowances, currently through child benefit), although differentiating in a pronatalist fashion between the first and subsequent children. Income supplementation for families with children (formerly have been enacted for welfare reasons, and not in order to achieve particular population goals.

## 4.4 REASONS FOR MORTALITY VARIATION

Lawton (1973) and Coates and Rawstron (1971) suggest that the highest mortality rates are found in association with poor housing and urban environments and higher-than-average incidence of social and economic problems. The low rank for Scotland, Northern Ireland, and the North

West on the life expectancy maps supports this interpretation: these are the regions with the poorest housing and the worst urban environments (Glasgow, Belfast, Liverpool). In Scotland, particularly, there is the additional problem of higher-than-average incidence of alcoholism. The poor environment has a particular influence on the infant-mortality rate (see Coates and Rawstron, 1971, Figure 9.2) among and within the regions, with the inner city areas suffering most of all. The influence of social class (correlated with quality of environment) on infant mortality, child mortality, and adult mortality has been shown (Fox, 1977) to be quite marked, and thus if the regions differ in terms of occupations and industries (House, 1973, Figure 1.2), they will show variations in infant mortality. The South East, East Anglia, and the South West have much higher concentrations of worker in professional and managerial occupations, correlated to the lower mortality risk category. The West Midlands and Northern regions have a greater concentration of workers in the higher mortality risk industrial occupations, which undoubtedly affect mortality incidence from respiratory disease through air pollution. Happily, the pollution from coalburning has been reduced in recent years through the operation of Smoke Control orders.

Public policy has an effect on the variation in mortality among regions through the great per capita differences in National Health Service expenditure among the hospital regions, and in expenditure on general practice and the dental service (Coates and Rawstron, 1971, Chapters 7 and 8). These differences in public provision may account for part of the better-than-average life expectancy in the South East, where there is a concentration of teaching hospitals, hospital beds, medical practitioners, and dentists (particularly those with higher qualifications). Under the 1974–79 Labour administration the Department of Health and Social Security began to redistribute financial resources among the hospital regions.

## 4.5 THE FACTORS INFLUENCING INTERREGIONAL MIGRATION

Of the 7 to 11 migrations that a person is likely to make during a lifetime only 1 to 2 (see Table 35 for the precise statistics) are likely to be between the regions, while 5 to 10 will be within the regions. Migrations between regions will be primarily those for job-related reasons, whereas those within regions will be residence-related (Harris and Clausen, 1966; Stillwell, 1975, 1978; Hyman and Gleave, 1978), although the correlation is by no means perfect. Selected interregional migration streams (as was shown in Section 2.7) also involve migrants moving to retirement homes.

Local planning and housing policy will have the greatest effect on intraregional migrations, and this applies also to the planned migrations to the new towns in the United Kingdom. The purpose of these new towns and agreed town expansion schemes (see Department of the Environment, 1971, Figure 19) is to relocate industry and the population, taking them from the crowded inner zones of the major metropolises (London, Birmingham, Liverpool, Newcastle, and Glasgow) to the outer areas of the region. The only planned migrations that cross regional boundaries to any large extent are those into the East Midlands from the South East and Scotland (Corby and Northampton new towns; Daventry and Wellingborough town expansion schemes), into East Anglia from the South East (Peterborough new town; King's Lynn, Huntingdon, St. Neots, Mildenhall, Thetford, Bury St. Edmunds, Haverhill, Ipswich, and Sudbury-Melford town expansion schemes), and into Wales from the West Midlands (Newtown new town). Even in the South East to East Anglia case planned migrations are exceeded by voluntary moves, so that the direct effect of policy on interregional migration is small.

The influence of the gravity model variables – distance, size of origin population, and extent of destination opportunities, or some surrogate measure – has been extensively studied, as was mentioned in Section 2.3, together with variables such as the unemployment rate and regional per capita income. The gravity model variables account for 91 to 96 percent of the variation in intercounty migration in Stillwell's (1977a) study, leaving a relatively small role for socioeconomic indicators. However, these do play an important part in determining the opportunities and attractiveness of destination regions (Weeden, 1973). The clearest link that has been established between net migration and employment change is in the American situation (Lowry, 1966). In the British situation a similar relationship probably holds.

A regional policy concerning the distribution of manufacturing employment has existed since 1934 (McCrone, 1969). Through investment grants and loans, through tax incentives such as the Regional Employment Premium and Selective Employment Tax, and through controls such as the Industrial Development Certificates limiting expansion in low unemployment regions, manufacturing employment has been redirected to various categories of assisted areas. Most assistance has gone to Northern Ireland, Scotland, the North, and Wales. In the North West, the Liverpool area has received most of such redirected employment, and the remote western districts of the South West have also benefited. The North West and Yorkshire and Humberside were included as Intermediate Areas only from 1971 (House, 1973, Figure 1.4).

The national government has also acted to redistribute state-controlled office employment to peripheral regions, to limit office development in Central London at various times, and to encourage private office employment to move out of the metropolis (until very recently) through the Location of Offices Bureau – although most of the shifts were to locations in the outer South East.

The graphs of net migration trends in Figure 6 suggest that perhaps regional policy has, since 1970, begun to have the desired effects. Those regions benefiting most from regional policy – Wales, Scotland, and the North – have certainly shown much less net out-migration after 1970 than in the 1960s. Of course, Northern Ireland is an exception in that although the incentives for relocation of employment there were at a maximum, employees were reluctant to stay there or move there because of "the troubles." After 1969 the net migration rate declined sharply. Conversely, the net migration rate for the South East has become more negative.

## 4.6 THE FACTORS INFLUENCING INTERNATIONAL MIGRATION

Of all demographic flows, international migration is the one most closely regulated by legislation and government action. The effect of such legislation is to set ceilings on the flows generated by the demand for labor in the destination country and the need for employment in the country of origin.

Successive Immigration Acts (1962, 1968, 1973) have sought to limit the right of New Commonwealth citizens to migrate to the United Kingdom. Very small quotas of work permits are allowed now, and the migration stream is principally one of dependents. There has as a consequence been a fall in the total number of immigrants since the early 1960s. The flows from other destinations (the Old Commonwealth, foreign countries) have, however, remained at their earlier levels (OPCS, 1978c). One characteristic of immigration not commonly recognized is that the largest group by citizenship has always been UK citizens returning from sojourns abroad.

Similar legislative action has affected people emigrating from the United Kingdom to other countries – particularly Australia, New Zealand, Canada, and the United States. The 1970s saw reduced numbers of emigrants compared with earlier years, because of the greater restrictions imposed by those countries, worried by rising domestic unemployment (particularly after 1973).

Immigrants and emigrants have been very concentrated in their distribution within the United Kingdom with the South East being the destination of almost one-half of the GB immigrants in 1975–1976 and the origin of 40 percent of the emigrants (Table 12). New Commonwealth inmigrants tend to be concentrated in the inner areas of major metropolises and particularly in Greater London; other immigrants are more widely spread in the major cities and across the regions (see Coates and Rawstron, 1971, Chapter 6). The opportunities for employment in the service and industrial sectors in the jobs being vacated by the native population have determined the metropolitan concentration of New Commonwealth immigrants. Once established concentrations have tended to persist, although there has been some dispersion as socioeconomic improvement is achieved by immigrant families. Policy (on race relations, on discrimination, etc.) has been reactive to the facts of distribution in this area rather than a determining factor.

# 5 CONCLUSION

A number of tentative conclusions, empirical, conceptual, and technical, can be drawn from the analysis of the population dynamics of UK regions. The dominant pattern across the regions in terms of fertility and mortality, whether measured by single-region or multiregional methods, was one of a gradient of demographic development from a low mortality, low fertility south and east to a high mortality, high fertility north and west. At the start of the 1960s this was also a gradient from conditions of net in-migration to those of heavy net outflows.

In the recent past, fertility has declined steadily in all regions and life expectancy has improved uniformly, but only marginally. Dramatic reductions in the projected populations of regions resulted from the necessity to adopt ever lower fertility scenarios. The pattern of migration has shifted in kind from one of "drift to the South East" from the northern and western regions to one of loss from the nation's core, the South East. The margins of the core, the South West, East Anglia, East Midlands, and Wales have gained, and the northern, western, and West Midlands regions have had smaller losses. Some would see the shift in migration and population trends as the product of policy; others might view it as the natural course of decentralization from the national metropolis.

Detailed examination of the age pattern of those migration streams has revealed a regularity of behavior on a par with the more well-known fertility and mortality curves, which would make further model-based analysis worthwhile. The crude measures fitted, however, did reveal that the age pattern of migration varied systematically with the length of the move, and that for interregional migration at least the relationship be-

tween parent and child migration was of a form different from that reported for other countries.

The feasibility of multiregional population analysis with British population data was demonstrated through use of the set of models and computer programs developed by Andrei Rogers and his fellow workers at IIASA. A first multiregional life table was produced for British regions, together with linked spatial fertility expectancies and multiregional migraproduction expectancies. Comparison of single-region and multiregion life expectancy, net reproduction and migraproduction measures revealed that they were not alternative measures of the same concept, but related measures of different concepts. The single-region measures applied to a regional population unchanged by the flux of migrants through the population over time; the multiregion measures applied to regional cohorts moving through time and space. Since these regional cohorts were assumed to adopt instantaneously the behavior of the cohorts in their destination region, the multiregion measures were regressions of the single-region measures towards the national mean. There is probably a strong case for relaxing this assumption in order to allow cohorts to carry some information about their birthplace with them on their travels, although empirical calibration of any relationships would be very difficult.

Projections of multiregional age–sex disaggregated populations were carried out using the IIASA programs and compared with official single-region projections and multiregional all age and sex accounts based projections. Again the feasibility of their use with British data was demonstrated, although a number of technical and empirical drawbacks still have to be overcome before official demographers in the United Kingdom are likely to consider employing this methodology.

Finally, a rough attempt was made to speculate about the likely explanations for the regional demographic structure and dynamics described. Much knowledge and understanding of "migration and settlement in the United Kingdom" has been gained, but much has still to be discovered.

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HMSO is the abbreviation used for Her Majesty's Stationery Office. OPCS is the abbreviation used for the Office of Population Censuses and Surveys.


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# APPENDIXES

APPENDIX A Components of population change, UK regions, 1965–1976: stocks and flows, in 1000s.

| Period[b] | Final population[c] | Initial population[d] | Population change | Births | Deaths | Natural increase | Net migration[e] |
|---|---|---|---|---|---|---|---|
| North[a] | | | | | | | |
| 1965–66 | 3,125.0 | 3,126.0 | −1.0 | 56.2 | 38.3 | 17.9 | −18.9 |
| 1966–67 | 3,130.0 | 3,125.0 | 5.0 | 54.6 | 37.1 | 17.5 | −12.5 |
| 1967–68 | 3,133.0 | 3,130.0 | 3.0 | 53.1 | 37.0 | 16.0 | −13.0 |
| 1968–69 | 3,132.0 | 3,133.0 | −1.0 | 50.8 | 38.7 | 12.2 | −13.2 |
| 1969–70 | 3,134.0 | 3,132.0 | 2.0 | 49.6 | 38.8 | 10.9 | −8.9 |
| 1970–71 | 3,137.4 | 3,134.0 | 3.4 | 49.9 | 38.0 | 11.9 | −8.5 |
| 1971–72 | 3,137.8 | 3,137.4 | 0.4 | 47.7 | 38.7 | 9.0 | −8.6 |
| 1972–73 | 3,132.3 | 3,137.8 | −5.5 | 43.6 | 39.8 | 3.8 | −9.3 |
| 1973–74 | 3,128.7 | 3,132.3 | −3.6 | 40.8 | 39.4 | 1.4 | −5.0 |
| 1974–75 | 3,124.7 | 3,128.7 | −4.0 | 38.9 | 38.7 | 0.2 | −4.2 |
| 1975–76 | 3,121.6 | 3,124.7 | −2.6 | 37.4 | 39.4 | −2.0 | −0.6 |

APPENDIX A *Continued*.

| Period[b] | Final population[c] | Initial population[d] | Population change | Births | Deaths | Natural increase | Net migration[e] |
|---|---|---|---|---|---|---|---|
| Yorkshire and Humberside[a] | | | | | | | |
| 1965–66 | 4,809.0 | 4,790.0 | 19.0 | 85.5 | 58.2 | 27.3 | −8.3 |
| 1966–67 | 4,829.0 | 4,809.0 | 20.0 | 84.8 | 57.6 | 27.2 | −7.2 |
| 1967–68 | 4,847.0 | 4,829.0 | 18.0 | 84.3 | 57.7 | 26.6 | −8.6 |
| 1968–69 | 4,852.0 | 4,847.0 | 5.0 | 83.2 | 59.8 | 23.4 | −18.4 |
| 1969–70 | 4,853.0 | 4,852.0 | 1.0 | 82.6 | 59.8 | 22.8 | −21.8 |
| 1970–71 | 4,868.0 | 4,853.0 | 15.0 | 82.1 | 59.1 | 23.0 | −8.0 |
| 1971–72 | 4,882.1 | 4,868.0 | 14.1 | 77.7 | 60.5 | 17.3 | −3.2 |
| 1972–73 | 4,890.8 | 4,882.1 | 8.7 | 71.1 | 61.2 | 9.9 | −1.2 |
| 1973–74 | 4,897.4 | 4,890.8 | 6.6 | 65.8 | 59.9 | 5.9 | −0.7 |
| 1974–75 | 4,899.8 | 4,897.4 | 2.4 | 61.8 | 59.4 | 2.4 | −0.0 |
| 1975–76 | 4,891.9 | 4,899.8 | −7.9 | 59.1 | 59.9 | −0.8 | −6.6 |

| North West[a] | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1965–66 | 6,539.0 | 6,519.0 | 20.0 | 118.7 | 82.4 | 36.4 | −16.3 |
| 1966–67 | 6,561.0 | 6,539.0 | 22.0 | 116.7 | 82.5 | 34.2 | −12.2 |
| 1967–68 | 6,568.0 | 6,561.0 | 7.0 | 114.9 | 82.2 | 32.7 | −25.7 |
| 1968–69 | 6,579.0 | 6,568.0 | 11.0 | 112.5 | 83.7 | 28.8 | −17.8 |
| 1969–70 | 6,589.0 | 6,579.0 | 10.0 | 110.5 | 84.5 | 26.1 | −16.1 |
| 1970–71 | 6,602.3 | 6,589.0 | 13.3 | 109.6 | 83.4 | 26.2 | −12.9 |
| 1971–72 | 6,607.3 | 6,602.3 | 5.0 | 104.5 | 84.0 | 20.5 | −15.5 |
| 1972–73 | 6,609.2 | 6,607.3 | 1.9 | 95.7 | 84.7 | 11.0 | −9.1 |
| 1973–74 | 6,592.9 | 6,609.2 | −16.3 | 89.1 | 84.3 | 4.8 | −21.1 |
| 1974–75 | 6,574.7 | 6,592.9 | −18.2 | 84.4 | 83.8 | 0.6 | −18.8 |
| 1975–76 | 6,553.4 | 6,574.7 | −21.3 | 80.7 | 81.1 | −0.5 | −20.2 |
| East Midlands[a] | | | | | | | |
| 1965–66 | 3,497 | 3,468 | 29 | 64.3 | 39.0 | 25.2 | 3.8 |
| 1966–67 | 3,529 | 3,497 | 32 | 63.4 | 38.4 | 25.0 | 7.0 |
| 1967–68 | 3,557 | 3,529 | 28 | 62.9 | 38.9 | 24.0 | 4.0 |
| 1968–69 | 3,587 | 3,557 | 30 | 62.2 | 40.8 | 21.3 | 8.7 |
| 1969–70 | 3,606 | 3,587 | 19 | 60.7 | 41.0 | 19.7 | −0.7 |
| 1970–71 | 3,634.6 | 3,606 | 28.6 | 60.4 | 40.5 | 19.9 | 8.7 |
| 1971–72 | 3,663.1 | 3,634.6 | 28.5 | 58.5 | 41.2 | 17.3 | 11.2 |
| 1972–73 | 3,696.0 | 3,663.1 | 32.9 | 54.8 | 41.9 | 12.9 | 20.0 |
| 1973–74 | 3,714.7 | 3,696.0 | 18.7 | 51.6 | 42.1 | 9.6 | 9.1 |
| 1974–75 | 3,728.0 | 3,714.7 | 13.3 | 48.5 | 42.3 | 6.2 | 7.1 |
| 1975–76 | 3,734.5 | 3,728.0 | 6.5 | 46.3 | 41.6 | 4.7 | 0.7 |

APPENDIX A *Continued*.

| Period[b] | Final population[c] | Initial population[d] | Population change | Births | Deaths | Natural increase | Net migration[e] |
|---|---|---|---|---|---|---|---|
| West Midlands[a] | | | | | | | |
| 1965–66 | 4,946 | 4,910 | 36 | 94.7 | 52.5 | 42.2 | −6.2 |
| 1966–67 | 4,984 | 4,946 | 38 | 94.2 | 52.0 | 42.2 | −4.2 |
| 1967–68 | 5,022 | 4,984 | 38 | 93.6 | 52.6 | 40.9 | −2.9 |
| 1968–69 | 5,066 | 5,022 | 44 | 92.1 | 54.8 | 37.3 | 6.7 |
| 1969–70 | 5,094 | 5,066 | 28 | 90.2 | 54.9 | 35.3 | −7.3 |
| 1970–71 | 5,121.5 | 5,094 | 27.5 | 88.8 | 53.9 | 34.8 | −7.3 |
| 1971–72 | 5,152.1 | 5,121.5 | 30.6 | 84.5 | 55.0 | 29.5 | 1.1 |
| 1972–73 | 5,163.2 | 5,152.1 | 11.1 | 77.8 | 56.3 | 21.5 | −10.4 |
| 1973–74 | 5,179.4 | 5,163.2 | 16.2 | 72.4 | 56.0 | 16.4 | −0.2 |
| 1974–75 | 5,175.9 | 5,179.4 | −3.5 | 67.7 | 55.6 | 12.1 | −15.6 |
| 1975–76 | 5,164.5 | 5,175.9 | −11.4 | 64.4 | 58.2 | 6.2 | −17.0 |

East Anglia[a]

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1965–66 | 1,575 | 1,553 | 22 | 26.7 | 17.8 | 8.8 | 13.2 |
| 1966–67 | 1,602 | 1,575 | 27 | 26.7 | 17.6 | 9.0 | 18.0 |
| 1967–68 | 1,626 | 1,602 | 24 | 27.0 | 18.5 | 8.4 | 15.6 |
| 1968–69 | 1,645 | 1,626 | 19 | 26.6 | 19.1 | 7.5 | 11.5 |
| 1969–70 | 1,663 | 1,645 | 18 | 26.1 | 18.9 | 7.2 | 10.8 |
| 1970–71 | 1,686 | 1,663 | 23.0 | 26.4 | 18.9 | 7.4 | 15.6 |
| 1971–72 | 1,710.7 | 1,686 | 24.7 | 26.2 | 19.4 | 6.8 | 17.9 |
| 1972–73 | 1,739.0 | 1,710.7 | 28.3 | 25.4 | 20.0 | 5.5 | 22.8 |
| 1973–74 | 1,758.2 | 1,739.0 | 19.2 | 24.5 | 19.9 | 4.5 | 14.7 |
| 1974–75 | 1,781.4 | 1,758.2 | 23.2 | 23.2 | 20.0 | 3.2 | 20.0 |
| 1975–76 | 1,802.7 | 1,781.4 | 21.3 | 22.2 | 20.5 | 1.7 | 20.0 |

South East[a]

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1965–66 | 16,719.0 | 16,609.0 | 110.0 | 298.4 | 187.0 | 111.3 | −1.3 |
| 1966–67 | 16,820.0 | 16,719.0 | 101.0 | 291.6 | 186.0 | 105.6 | −4.6 |
| 1967–68 | 16,895.0 | 16,820.0 | 75.0 | 283.2 | 190.7 | 92.5 | −17.5 |
| 1968–69 | 16,943.0 | 16,895.0 | 48.0 | 274.7 | 195.6 | 79.1 | −31.1 |
| 1969–70 | 16,965.0 | 16,943.0 | 22.0 | 266.3 | 193.5 | 72.8 | −50.8 |
| 1970–71 | 16,993.3 | 16,965.0 | 28.3 | 262.3 | 191.6 | 70.7 | −42.4 |
| 1971–72 | 17,020.4 | 16,993.3 | 27.1 | 252.6 | 193.5 | 59.1 | −32.0 |
| 1972–73 | 17,018.5 | 17,020.4 | −1.9 | 235.3 | 195.5 | 39.9 | −41.8 |
| 1973–74 | 16,966.5 | 17,018.5 | −5.2 | 221.8 | 193.8 | 28.0 | −80.0 |
| 1974–75 | 16,921.2 | 16,966.5 | −45.3 | 210.9 | 193.0 | 17.9 | −63.2 |
| 1975–76 | 16,893.7 | 16,921.2 | −27.5 | 202.0 | 199.6 | 2.5 | −30.1 |

APPENDIX A *Continued*.

| Period[b] | Final population[c] | Initial population[d] | Population change | Births | Deaths | Natural increase | Net migration[e] |
|---|---|---|---|---|---|---|---|
| South West[a] | | | | | | | |
| 1965–66 | 3,920.0 | 3,879.0 | 41.0 | 66.3 | 47.7 | 18.7 | 22.3 |
| 1966–67 | 3,957.0 | 3,920.0 | 37.0 | 64.7 | 47.5 | 17.3 | 19.7 |
| 1967–68 | 3,992.0 | 3,957.0 | 35.0 | 63.2 | 48.5 | 14.6 | 20.4 |
| 1968–69 | 4,025.0 | 3,992.0 | 33.0 | 62.4 | 50.2 | 12.2 | 20.8 |
| 1969–70 | 4,059.0 | 4,025.0 | 34.0 | 61.7 | 50.4 | 11.3 | 22.7 |
| 1970–71 | 4,087.7 | 4,059.0 | 28.7 | 61.4 | 50.7 | 10.7 | 18.0 |
| 1971–72 | 4,130.2 | 4,087.7 | 42.5 | 59.9 | 51.6 | 8.3 | 34.2 |
| 1972–73 | 4,176.3 | 4,130.2 | 46.1 | 57.0 | 52.7 | 4.2 | 41.9 |
| 1973–74 | 4,206.2 | 4,176.3 | 29.9 | 53.8 | 53.4 | 0.4 | 29.5 |
| 1974–75 | 4,229.4 | 4,206.3 | 23.2 | 50.1 | 53.8 | −3.7 | 26.9 |
| 1975–76 | 4,256.4 | 4,229.4 | 27.0 | 47.5 | 55.1 | −7.6 | 32.1 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Wales[a] | | | | | | | |
| 1965–66 | 2,693.8 | 2,686.3 | 7.5 | 45.6 | 33.9 | 11.7 | −4.2 |
| 1966–67 | 2,701.2 | 2,693.8 | 7.4 | 44.3 | 33.9 | 10.4 | −3.0 |
| 1967–68 | 2,706.2 | 2,701.2 | 5.0 | 44.0 | 34.1 | 9.9 | −4.9 |
| 1968–69 | 2,711.4 | 2,706.2 | 5.2 | 43.6 | 35.5 | 8.2 | −3.0 |
| 1969–70 | 2,717.0 | 2,711.4 | 5.6 | 42.8 | 35.5 | 7.3 | −1.7 |
| 1970–71 | 2,723.6 | 2,717.0 | 6.6 | 42.8 | 34.9 | 8.0 | −1.4 |
| 1971–72 | 2,734.6 | 2,723.6 | 11.0 | 41.5 | 35.4 | 6.1 | 4.9 |
| 1972–73 | 2,749.3 | 2,734.6 | 14.7 | 38.8 | 35.9 | 2.9 | 11.8 |
| 1973–74 | 2,757.2 | 2,749.3 | 7.9 | 36.9 | 35.7 | 1.2 | 6.7 |
| 1974–75 | 2,764.3 | 2,757.2 | 7.1 | 35.1 | 35.6 | −0.5 | 7.6 |
| 1975–76 | 2,766.1 | 2,764.3 | 1.8 | 34.4 | 36.0 | −1.6 | 4.1 |
| Scotland[a] | | | | | | | |
| 1965–66 | 5,200.6 | 5,209.9 | −9.3 | 97.5 | 63.3 | 35.2 | −44.5 |
| 1966–67 | 5,198.3 | 5,200.6 | −2.3 | 98.1 | 61.5 | 34.8 | −37.1 |
| 1967–68 | 5,200.2 | 5,198.3 | 1.9 | 94.9 | 61.5 | 34.0 | −32.1 |
| 1968–69 | 5,208.5 | 5,200.2 | 6.3 | 92.9 | 63.6 | 28.9 | −20.6 |
| 1969–70 | 5,213.7 | 5,208.5 | 5.2 | 87.9 | 63.7 | 25.1 | −19.9 |
| 1970–71 | 5,217.4 | 5,213.7 | 3.7 | 87.0 | 62.6 | 24.4 | −20.7 |
| 1971–72 | 5,210.4 | 5,217.4 | −7.0 | 82.5 | 63.4 | 19.2 | −26.2 |
| 1972–73 | 5,211.7 | 5,210.4 | 1.3 | 76.4 | 64.7 | 11.7 | −10.4 |
| 1973–74 | 5,216.6 | 5,211.7 | 4.9 | 72.2 | 64.6 | 7.6 | −2.7 |
| 1974–75 | 5,206.2 | 5,216.6 | −10.4 | 69.0 | 63.8 | 5.1 | −15.5 |
| 1975–76 | 5,205.1 | 5,206.2 | −1.1 | 67.4 | 64.0 | 3.4 | −4.5 |

APPENDIX A *Continued*.

| Period[b] | Final Population[c] | Initial population[d] | Population change | Births | Deaths | Natural increase | Net migration[e] |
|---|---|---|---|---|---|---|---|
| Northern Ireland[a] | | | | | | | |
| 1965–66 | 1,475.6 | 1,468.2 | 7.4 | 34.0 | 16.0 | 18.0 | −10.6 |
| 1966–67 | 1,488.8 | 1,475.6 | 13.2 | 34.0 | 15.0 | 19.0 | −5.8 |
| 1967–68 | 1,502.6 | 1,488.8 | 13.8 | 33.0 | 15.0 | 18.0 | −4.2 |
| 1968–69 | 1,514.1 | 1,502.6 | 11.5 | 33.0 | 16.0 | 17.0 | −5.5 |
| 1969–70 | 1,527.4 | 1,514.1 | 13.3 | 32.0 | 17.0 | 15.0 | −1.7 |
| 1970–71 | 1,537.8 | 1,527.4 | 10.4 | 33.0 | 16.0 | 17.0 | −6.6 |
| 1971–72 | 1,544.7 | 1,537.8 | 6.9 | 30.7 | 16.8 | 13.9 | −7.0 |
| 1972–73 | 1,547.1 | 1,544.7 | 2.4 | 29.5 | 17.6 | 11.9 | −9.5 |
| 1973–74 | 1,546.8 | 1,547.1 | −0.3 | 28.2 | 17.1 | 11.1 | −11.4 |
| 1974–75 | 1,537.2 | 1,546.8 | −9.6 | 26.4 | 17.1 | 9.3 | −18.9 |
| 1975–76 | 1,538.1 | 1,537.2 | 0.9 | 26.4 | 16.8 | 9.6 | −8.7 |

United Kingdom[a]

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1965–66 | 54,500.0 | 54,218.4 | 281.6 | 987.0 | 648.0 | 339.0 | −57.4 |
| 1966–67 | 54,800.3 | 54,500.0 | 300.3 | 982.0 | 609.0 | 373.0 | −72.7 |
| 1967–68 | 55,049.0 | 54,800.3 | 248.7 | 948.0 | 658.0 | 289.0 | −40.3 |
| 1968–69 | 55,263.0 | 55,049.0 | 214.0 | 943.0 | 646.0 | 296.0 | −82.0 |
| 1969–70 | 55,421.1 | 55,263.0 | 158.1 | 899.0 | 667.0 | 232.0 | −73.9 |
| 1970–71 | 55,609.6 | 55,421.1 | 188.5 | 915.0 | 639.0 | 276.0 | −87.5 |
| 1971–72 | 55,793.4 | 55,609.6 | 183.8 | 862.3 | 660.8 | 201.5 | −17.7 |
| 1972–73 | 55,933.4 | 55,793.4 | 140.0 | 807.6 | 671.9 | 135.8 | 4.2 |
| 1973–74 | 55,964.6 | 55,933.4 | 31.2 | 751.7 | 664.0 | 87.7 | −56.5 |
| 1974–75 | 55,942.8 | 55,964.6 | −21.8 | 720.7 | 671.1 | 49.6 | −71.4 |
| 1975–76 | 55,928.0 | 55,942.8 | −14.8 | 688.6 | 681.0 | 7.6 | −22.4 |

England and Wales[a]

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1965–66 | 47,823.6 | 47,540.3 | 283.3 | 856.0 | 567.0 | 289.0 | −5.7 |
| 1966–67 | 48,113.2 | 47,823.6 | 289.6 | 850.0 | 534.0 | 316.0 | −26.4 |
| 1967–68 | 48,346.2 | 48,113.2 | 233.0 | 820.0 | 580.0 | 240.0 | −7.0 |
| 1968–69 | 48,540.4 | 48,346.2 | 194.2 | 817.0 | 568.0 | 249.0 | −54.8 |
| 1969–70 | 48,680.0 | 48,540.4 | 139.6 | 779.0 | 586.0 | 193.0 | −56.4 |
| 1970–71 | 48,854.4 | 48,680.0 | 174.4 | 795.0 | 562.0 | 233.0 | −58.6 |
| 1971–72 | 49,038.3 | 48,854.4 | 183.9 | 748.6 | 579.9 | 168.8 | 15.1 |
| 1972–73 | 49,174.6 | 49,038.3 | 136.3 | 701.8 | 590.4 | 111.4 | 24.9 |
| 1973–74 | 49,201.2 | 49,174.6 | 26.6 | 652.5 | 582.7 | 69.8 | −43.2 |
| 1974–75 | 49,199.4 | 49,201.2 | −1.8 | 625.0 | 589.2 | 35.8 | −37.6 |
| 1975–76 | 49,184.8 | 49,199.4 | −14.6 | 594.6 | 599.3 | −4.7 | −9.9 |

APPENDIX A *Continued*.

| Period[b] | Final population[c] | Initial population[d] | Population change | Births | Deaths | Natural increase | Net migration[e] |
|---|---|---|---|---|---|---|---|
| Great Britain[a] | | | | | | | |
| 1965–66 | 53,024.4 | 52,750.2 | 274.2 | 953.9 | 620.0 | 334.8 | −60.6 |
| 1966–67 | 53,311.5 | 53,024.4 | 287.1 | 939.1 | 614.0 | 323.3 | −36.2 |
| 1967–68 | 53,546.4 | 53,311.5 | 234.9 | 921.1 | 621.8 | 299.6 | −64.7 |
| 1968–69 | 53,748.9 | 53,546.4 | 202.5 | 901.0 | 641.7 | 259.0 | −56.5 |
| 1969–70 | 53,893.7 | 53,748.9 | 144.8 | 878.4 | 641.0 | 238.4 | −93.6 |
| 1970–71 | 54,071.8 | 53,893.7 | 178.1 | 870.6 | 633.7 | 237.0 | −58.9 |
| 1971–72 | 54,248.7 | 54,071.8 | 176.9 | 835.7 | 642.7 | 193.0 | −16.1 |
| 1972–73 | 54,386.3 | 54,248.7 | 137.6 | 775.9 | 652.6 | 123.3 | 14.3 |
| 1973–74 | 54,417.8 | 54,386.3 | 31.5 | 728.9 | 649.2 | 79.8 | −48.3 |
| 1974–75 | 54,405.6 | 54,417.8 | −12.2 | 689.5 | 646.0 | 43.5 | −55.7 |
| 1975–76 | 54,389.9 | 54,405.6 | −15.7 | 661.4 | 655.3 | 6.1 | −22.2 |
| Greater London[a] | | | | | | | |
| 1965–66 | 7,810.0 | 7,857.0 | −47.0 | 141.6 | 87.4 | 54.2 | −101.2 |
| 1966–67 | 7,761.0 | 7,810.0 | −49.0 | 136.0 | 86.0 | 50.0 | −99.0 |
| 1967–68 | 7,693.0 | 7,761.0 | −68.0 | 129.7 | 87.2 | 42.5 | −110.5 |
| 1968–69 | 7,619.0 | 7,693.0 | −74.0 | 123.5 | 88.4 | 35.1 | −109.1 |
| 1969–70 | 7,530.0 | 7,619.0 | −89.0 | 117.5 | 86.5 | 31.0 | −120.0 |
| 1970–71 | 7,441.3 | 7,530.0 | −88.7 | 114.5 | 85.5 | 29.0 | −117.7 |
| 1971–72 | 7,344.8 | 7,441.3 | −96.5 | 108.2 | 85.8 | 22.4 | −118.9 |
| 1972–73 | 7,281.1 | 7,344.8 | −63.7 | 99.1 | 85.2 | 13.9 | −77.6 |
| 1973–74 | 7,173.9 | 7,281.1 | −107.2 | 92.7 | 83.8 | 8.8 | −116.0 |
| 1974–75 | 7,102.8 | 7,173.9 | −71.1 | 88.1 | 83.6 | 4.5 | −75.6 |
| 1975–76 | 7,027.6 | 7,102.8 | −75.2 | 84.2 | 86.2 | −1.9 | −73.3 |

Rest of the South East[a]

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1965–66 | 8,909.0 | 8,752.0 | 157.0 | 156.7 | 99.6 | 57.1 | 99.9 |
| 1966–67 | 9,059.0 | 8,909.0 | 150.0 | 155.6 | 100.0 | 55.6 | 94.4 |
| 1967–68 | 9,202.0 | 9,059.0 | 143.0 | 153.5 | 103.5 | 50.0 | 93.0 |
| 1968–69 | 9,324.0 | 9,202.0 | 122.0 | 151.2 | 107.2 | 44.1 | 77.9 |
| 1969–70 | 9,435.0 | 9,324.0 | 111.0 | 148.9 | 107.0 | 41.8 | 69.2 |
| 1970–71 | 9,552.0 | 9,435.0 | 117.0 | 147.8 | 106.1 | 41.8 | 75.2 |
| 1971–72 | 9,675.6 | 9,552.0 | 123.6 | 144.5 | 107.7 | 36.7 | 86.9 |
| 1972–73 | 9,737.4 | 9,675.6 | 61.8 | 136.2 | 110.3 | 25.9 | 35.9 |
| 1973–74 | 9,792.6 | 9,737.4 | 55.2 | 129.1 | 109.9 | 19.2 | 36.0 |
| 1974–75 | 9,818.4 | 9,792.6 | 25.8 | 122.7 | 109.4 | 13.4 | 12.4 |
| 1975–76 | 9,866.1 | 9,818.4 | 47.7 | 117.8 | 113.4 | 4.4 | 43.3 |

[a] Regions: "new" regions (post 1 April 1974) as defined in Figure 1.3
[b] Periods: 1 July in year to 30 June in the next year
[c] Final population: home population estimate as of 30 June of next year
[d] Initial population: home population estimate of 30 June of year
[e] Net migration: population change less natural increase
SOURCES: Population, births, and deaths figures given in *Population Trends* (OPCS, 1978e) and in the revised population estimates for 1961–1971 (OPCS, 1975b), with some estimates made of missing data from "old" region data (for example, in OPCS, 1967)

APPENDIX B Components of population change, UK regions, 1965–1976, rates per 1000 population.

| Period | Population change rate[a] | Birth-rate[a] | Death rate[a] | Natural increase rate[a] | Net migration rate[a] |
|---|---|---|---|---|---|
| North | | | | | |
| 1965–66 | −0.32 | 17.98 | 12.24 | 5.74 | −6.06 |
| 1966–67 | 1.60 | 17.47 | 11.87 | 5.60 | −4.00 |
| 1967–68 | 0.96 | 16.95 | 11.83 | 5.12 | −4.16 |
| 1968–69 | −0.32 | 16.22 | 12.34 | 3.89 | −4.20 |
| 1969–70 | 0.64 | 15.85 | 12.38 | 3.47 | −2.83 |
| 1970–71 | 1.08 | 15.92 | 12.12 | 3.80 | −2.72 |
| 1971–72 | 0.13 | 15.21 | 12.34 | 2.88 | −2.75 |
| 1972–73 | −1.75 | 13.91 | 12.68 | 1.23 | −2.98 |
| 1973–74 | −1.15 | 13.03 | 12.59 | 0.44 | −1.59 |
| 1974–75 | −1.28 | 12.42 | 12.36 | 0.06 | −1.34 |
| 1975–76 | −0.83 | 11.96 | 12.61 | −0.65 | −0.18 |
| Yorkshire and Humberside | | | | | |
| 1965–66 | 3.97 | 17.85 | 12.15 | 5.70 | −1.73 |
| 1966–67 | 4.16 | 17.63 | 11.97 | 5.66 | −1.50 |
| 1967–68 | 3.73 | 17.46 | 11.95 | 5.51 | −1.78 |
| 1968–69 | 1.03 | 17.18 | 12.34 | 4.83 | −3.80 |
| 1969–70 | 0.21 | 17.03 | 12.33 | 4.70 | −4.49 |
| 1970–71 | 3.09 | 16.91 | 12.18 | 4.74 | −1.65 |
| 1971–72 | 2.90 | 15.97 | 12.42 | 3.55 | −0.65 |
| 1972–73 | 1.78 | 14.55 | 12.53 | 2.03 | −0.24 |
| 1973–74 | 1.35 | 13.46 | 12.25 | 1.21 | 0.14 |
| 1974–75 | 0.49 | 12.63 | 12.13 | 0.50 | −0.01 |
| 1975–76 | −1.51 | 12.06 | 12.22 | −0.16 | −1.35 |

| Period | Population change rate[a] | Birth-rate[a] | Death rate[a] | Natural increase rate[a] | Net migration rate[a] |
|---|---|---|---|---|---|
| North West | | | | | |
| 1965–66 | 3.07 | 18.21 | 12.64 | 5.57 | −2.51 |
| 1966–67 | 3.36 | 17.85 | 12.61 | 5.24 | −1.87 |
| 1967–68 | 1.07 | 17.52 | 12.53 | 4.98 | −3.91 |
| 1968–69 | 1.67 | 17.13 | 12.74 | 4.39 | −2.71 |
| 1969–70 | 1.52 | 16.80 | 12.84 | 3.96 | −2.44 |
| 1970–71 | 2.02 | 16.63 | 12.66 | 3.97 | −1.95 |
| 1971–72 | 0.76 | 15.83 | 12.72 | 3.11 | −2.35 |
| 1972–73 | 0.29 | 14.48 | 12.81 | 1.66 | −1.38 |
| 1973–74 | −2.47 | 13.48 | 12.75 | 0.73 | −3.19 |
| 1974–75 | −2.76 | 12.80 | 12.71 | 0.09 | −2.85 |
| 1975–76 | −3.15 | 12.27 | 12.34 | −0.07 | −3.08 |
| East Midlands | | | | | |
| 1965–66 | 8.36 | 18.53 | 11.25 | 7.28 | 1.09 |
| 1966–67 | 9.15 | 18.14 | 10.98 | 7.16 | 1.99 |
| 1967–68 | 7.93 | 17.82 | 11.01 | 6.81 | 1.13 |
| 1968–69 | 8.43 | 17.48 | 11.48 | 6.00 | 2.44 |
| 1969–70 | 5.30 | 16.91 | 11.43 | 5.48 | −0.19 |
| 1970–71 | 7.93 | 16.75 | 11.24 | 5.51 | 2.42 |
| 1971–72 | 7.84 | 16.10 | 11.35 | 4.76 | 3.09 |
| 1972–73 | 8.98 | 14.96 | 11.43 | 3.53 | 5.46 |
| 1973–74 | 5.06 | 13.97 | 11.38 | 2.59 | 2.47 |
| 1974–75 | 3.58 | 13.06 | 11.40 | 1.66 | 1.92 |
| 1975–76 | 1.45 | 12.43 | 11.17 | 1.26 | 0.19 |
| West Midlands | | | | | |
| 1965–66 | 7.33 | 19.29 | 10.70 | 8.59 | −1.26 |
| 1966–67 | 7.68 | 19.04 | 10.52 | 8.53 | −0.85 |
| 1967–68 | 7.62 | 18.77 | 10.56 | 8.21 | −0.59 |
| 1968–69 | 8.76 | 18.34 | 10.91 | 7.43 | 1.34 |
| 1969–70 | 5.53 | 17.81 | 10.83 | 6.97 | −1.45 |
| 1970–71 | 5.40 | 17.43 | 10.59 | 6.84 | −1.44 |
| 1971–72 | 5.97 | 16.50 | 10.73 | 5.76 | 0.21 |
| 1972–73 | 2.15 | 15.10 | 10.94 | 4.17 | −2.01 |
| 1973–74 | 3.14 | 14.03 | 10.85 | 3.17 | −0.04 |
| 1974–75 | −0.68 | 13.08 | 10.74 | 2.33 | −3.01 |
| 1975–76 | −2.09 | 12.45 | 11.24 | 1.21 | −3.29 |

| Period | Population change rate[a] | Birth-rate[a] | Death rate[a] | Natural increase rate[a] | Net migration rate[a] |
|---|---|---|---|---|---|
| East Anglia | | | | | |
| 1965–66 | 14.17 | 17.17 | 11.49 | 5.68 | 8.49 |
| 1966–67 | 17.14 | 16.93 | 11.19 | 5.74 | 11.40 |
| 1967–68 | 14.98 | 16.83 | 11.56 | 5.27 | 9.71 |
| 1968–69 | 11.69 | 16.35 | 11.74 | 4.61 | 7.07 |
| 1969–70 | 10.94 | 15.89 | 11.49 | 4.40 | 6.54 |
| 1970–71 | 13.83 | 15.85 | 11.39 | 4.45 | 9.38 |
| 1971–72 | 14.65 | 15.53 | 11.49 | 4.04 | 10.61 |
| 1972–73 | 16.54 | 14.87 | 11.67 | 3.21 | 13.34 |
| 1973–74 | 11.04 | 14.08 | 11.47 | 2.61 | 8.43 |
| 1974–75 | 13.20 | 13.18 | 11.38 | 1.80 | 11.39 |
| 1975–76 | 12.18 | 12.48 | 11.51 | 0.97 | 11.21 |
| South East | | | | | |
| 1965–66 | 6.62 | 17.96 | 11.26 | 6.70 | −0.08 |
| 1966–67 | 6.04 | 17.44 | 11.12 | 6.32 | −0.27 |
| 1967–68 | 4.46 | 16.84 | 11.34 | 5.50 | −1.04 |
| 1968–69 | 2.84 | 16.26 | 11.58 | 4.68 | −1.84 |
| 1969–70 | 1.30 | 15.72 | 11.42 | 4.30 | −3.00 |
| 1970–71 | 1.67 | 15.46 | 11.29 | 4.17 | −2.50 |
| 1971–72 | 1.59 | 14.87 | 11.39 | 3.48 | −1.88 |
| 1972–73 | −0.11 | 13.83 | 11.48 | 2.34 | −2.45 |
| 1973–74 | −3.06 | 13.03 | 11.38 | 1.65 | −4.70 |
| 1974–75 | −2.67 | 12.43 | 11.37 | 1.06 | −3.73 |
| 1975–76 | −1.63 | 11.94 | 11.79 | 0.15 | −1.78 |
| South West | | | | | |
| 1965–66 | 10.57 | 17.10 | 12.29 | 4.81 | 5.76 |
| 1966–67 | 9.44 | 16.51 | 12.11 | 4.41 | 5.03 |
| 1967–68 | 8.85 | 15.96 | 12.26 | 3.69 | 5.15 |
| 1968–69 | 8.27 | 15.64 | 12.58 | 3.06 | 5.20 |
| 1969–70 | 8.45 | 15.34 | 12.53 | 2.81 | 5.64 |
| 1970–71 | 7.07 | 15.14 | 12.50 | 2.64 | 4.44 |
| 1971–72 | 10.40 | 14.65 | 12.63 | 2.02 | 8.38 |
| 1972–73 | 11.16 | 13.79 | 12.76 | 1.03 | 10.13 |
| 1973–74 | 7.16 | 12.89 | 12.79 | 0.10 | 7.06 |
| 1974–75 | 5.52 | 11.91 | 12.79 | −0.88 | 6.40 |
| 1975–76 | 5.79 | 11.23 | 13.02 | −1.79 | 7.58 |

| Period | Population change rate[a] | Birth-rate[a] | Death rate[a] | Natural increase rate[a] | Net migration rate[a] |
|---|---|---|---|---|---|
| Wales | | | | | |
| 1965–66 | 2.79 | 16.96 | 12.62 | 4.34 | −1.55 |
| 1966–67 | 2.75 | 16.43 | 12.57 | 3.86 | −1.11 |
| 1967–68 | 1.85 | 16.27 | 12.61 | 3.66 | −1.81 |
| 1968–69 | 1.92 | 16.13 | 13.11 | 3.03 | −1.11 |
| 1969–70 | 2.07 | 15.78 | 13.08 | 2.69 | −0.63 |
| 1970–71 | 2.43 | 15.75 | 12.80 | 2.95 | −0.52 |
| 1971–72 | 4.04 | 15.24 | 13.01 | 2.23 | 1.81 |
| 1972–73 | 5.38 | 14.17 | 13.13 | 1.05 | 4.33 |
| 1973–74 | 2.87 | 13.41 | 12.98 | 0.43 | 2.44 |
| 1974–75 | 2.58 | 12.72 | 12.91 | −0.19 | 2.77 |
| 1975–76 | 0.90 | 12.44 | 13.01 | −0.57 | 1.47 |
| Scotland | | | | | |
| 1965–66 | −1.79 | 18.91 | 12.15 | 6.76 | −8.55 |
| 1966–67 | −0.44 | 18.53 | 11.83 | 6.70 | −7.14 |
| 1967–68 | 0.37 | 18.37 | 11.83 | 6.53 | −6.17 |
| 1968–69 | 1.60 | 17.78 | 12.23 | 5.55 | −3.96 |
| 1969–70 | 1.00 | 17.04 | 12.23 | 4.81 | −3.81 |
| 1970–71 | 0.71 | 16.68 | 12.00 | 4.68 | −3.97 |
| 1971–72 | −1.34 | 15.82 | 12.15 | 3.67 | −5.01 |
| 1972–73 | 0.25 | 14.67 | 12.42 | 2.24 | −1.99 |
| 1973–74 | 0.94 | 13.85 | 12.40 | 1.45 | −0.51 |
| 1974–75 | −1.99 | 13.22 | 12.23 | 0.99 | −2.98 |
| 1975–76 | −0.21 | 12.94 | 12.29 | 0.65 | −0.86 |
| Northern Ireland | | | | | |
| 1965–66 | 5.04 | 23.16 | 10.90 | 12.26 | −7.22 |
| 1966–67 | 8.95 | 23.04 | 10.17 | 12.88 | −3.93 |
| 1967–68 | 9.27 | 22.17 | 10.08 | 12.09 | −2.82 |
| 1968–69 | 7.65 | 21.96 | 10.65 | 11.31 | −3.66 |
| 1969–70 | 8.78 | 21.13 | 11.23 | 9.91 | −1.12 |
| 1970–71 | 6.81 | 21.61 | 10.48 | 11.13 | −4.32 |
| 1971–72 | 4.49 | 19.96 | 10.92 | 9.04 | −4.55 |
| 1972–73 | 1.55 | 19.10 | 11.39 | 7.70 | −6.15 |
| 1973–74 | −0.19 | 18.23 | 11.05 | 7.17 | −7.37 |
| 1974–75 | −6.21 | 17.07 | 11.06 | 6.01 | −12.22 |
| 1975–76 | 0.59 | 17.17 | 10.93 | 6.25 | −5.66 |

| Period | Population change rate[a] | Birth-rate[a] | Death rate[a] | Natural increase rate[a] | Net migration rate[a] |
|---|---|---|---|---|---|
| United Kingdom | | | | | |
| 1965–66 | 5.19 | 18.20 | 11.95 | 6.25 | −0.11 |
| 1966–67 | 5.51 | 18.02 | 11.17 | 6.84 | −1.33 |
| 1967–68 | 4.54 | 17.30 | 12.01 | 5.27 | −0.74 |
| 1968–69 | 3.89 | 17.13 | 11.73 | 5.38 | −1.49 |
| 1969–70 | 2.86 | 16.27 | 12.07 | 4.20 | −1.34 |
| 1970–71 | 3.40 | 16.51 | 11.53 | 4.98 | −1.58 |
| 1971–72 | 3.31 | 15.51 | 11.88 | 3.62 | −0.32 |
| 1972–73 | 2.51 | 14.47 | 12.04 | 2.43 | 0.08 |
| 1973–74 | 0.56 | 13.44 | 11.87 | 1.57 | −1.01 |
| 1974–75 | −0.38 | 12.88 | 11.99 | 0.89 | −1.28 |
| 1975–76 | −0.26 | 12.31 | 12.17 | 0.14 | −0.40 |
| England and Wales | | | | | |
| 1965–66 | 5.96 | 18.01 | 11.93 | 6.08 | −0.12 |
| 1966–67 | 6.06 | 17.77 | 11.17 | 6.61 | −0.55 |
| 1967–68 | 4.84 | 17.04 | 12.05 | 4.99 | −0.15 |
| 1968–69 | 4.02 | 16.90 | 11.75 | 5.15 | −1.13 |
| 1969–70 | 2.88 | 16.05 | 12.07 | 3.98 | −1.16 |
| 1970–71 | 3.58 | 16.33 | 11.54 | 4.79 | −1.20 |
| 1971–72 | 3.76 | 15.32 | 11.87 | 3.46 | 0.31 |
| 1972–73 | 2.78 | 14.31 | 12.04 | 2.27 | 0.51 |
| 1973–74 | 0.54 | 13.27 | 11.85 | 1.42 | −0.88 |
| 1974–75 | −0.04 | 12.70 | 11.98 | 0.73 | −0.76 |
| 1975–76 | −0.30 | 12.09 | 12.18 | −0.10 | −0.20 |
| Great Britain | | | | | |
| 1965–66 | 5.20 | 18.10 | 11.75 | 6.35 | −1.15 |
| 1966–67 | 5.41 | 17.68 | 11.58 | 6.10 | −0.68 |
| 1967–68 | 4.41 | 17.28 | 11.66 | 5.62 | −1.21 |
| 1968–69 | 3.78 | 16.82 | 11.98 | 4.84 | −1.05 |
| 1969–70 | 2.69 | 16.36 | 11.93 | 4.44 | −1.74 |
| 1970–71 | 3.30 | 16.15 | 11.76 | 4.40 | −1.09 |
| 1971–72 | 3.27 | 15.46 | 11.89 | 3.57 | −0.30 |
| 1972–73 | 2.54 | 14.30 | 12.03 | 2.27 | 0.26 |
| 1973–74 | 0.58 | 13.40 | 11.94 | 1.47 | −0.89 |
| 1974–75 | −0.22 | 12.67 | 11.87 | 0.80 | −1.02 |
| 1975–76 | −0.30 | 12.16 | 12.05 | 0.11 | −0.41 |

| Period | Population change rate[a] | Birth-rate[a] | Death rate[a] | Natural increase rate[a] | Net migration rate[a] |
|---|---|---|---|---|---|
| Greater London | | | | | |
| 1965–66 | −5.98 | 18.03 | 11.13 | 6.90 | −12.88 |
| 1966–67 | −6.27 | 17.41 | 11.01 | 6.40 | −12.67 |
| 1967–68 | −8.84 | 16.85 | 11.33 | 5.52 | −14.36 |
| 1968–69 | −9.71 | 16.21 | 11.60 | 4.60 | −14.32 |
| 1969–70 | −11.82 | 15.60 | 11.48 | 4.12 | −15.94 |
| 1970–71 | −11.92 | 15.39 | 11.49 | 3.89 | −15.81 |
| 1971–72 | −13.14 | 14.73 | 11.68 | 3.05 | −16.18 |
| 1972–73 | −8.75 | 13.61 | 11.70 | 1.91 | −10.66 |
| 1973–74 | −14.72 | 12.73 | 11.52 | 1.21 | −15.94 |
| 1974–75 | −9.91 | 12.28 | 11.65 | 0.63 | −10.54 |
| 1975–76 | −10.59 | 11.86 | 12.13 | −0.27 | −10.32 |
| Rest of the South East | | | | | |
| 1965–66 | 17.94 | 17.91 | 11.38 | 6.53 | 11.41 |
| 1966–67 | 16.84 | 17.47 | 11.22 | 6.24 | 10.59 |
| 1967–68 | 15.79 | 16.94 | 11.43 | 5.52 | 10.27 |
| 1968–69 | 13.26 | 16.43 | 11.65 | 4.79 | 8.47 |
| 1969–70 | 11.90 | 15.96 | 11.48 | 4.48 | 7.42 |
| 1970–71 | 12.40 | 15.67 | 11.24 | 4.43 | 7.97 |
| 1971–72 | 12.94 | 15.12 | 11.28 | 3.84 | 9.10 |
| 1972–73 | 6.39 | 14.08 | 11.40 | 2.68 | 3.71 |
| 1973–74 | 5.67 | 13.26 | 11.29 | 1.97 | 3.70 |
| 1974–75 | 2.64 | 12.57 | 11.20 | 1.37 | 1.27 |
| 1975–76 | 4.86 | 12.00 | 11.55 | 0.45 | 4.41 |

[a]All rates are defined as the flow term from Appendix A divided by the initial population.
SOURCE: Appendix A.

# APPENDIX C Observed population, births, deaths, and migrant numbers by age and region, Great Britain, 1970.

region north

| age | population | births | deaths | migration from north | north yorkshir | north to n.west | e.midl. | w.midl. | e.anglia | s.east | s.west | wales | scotland |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 263600. | 0. | 1125. | 0. | 945. | 803. | 451. | 387. | 294. | 1292. | 513. | 212. | 701. |
| 5 | 299600. | 0. | 104. | 0. | 757. | 667. | 318. | 366. | 224. | 1064. | 278. | 89. | 355. |
| 10 | 247500. | 0. | 77. | 0. | 542. | 457. | 216. | 256. | 149. | 827. | 211. | 58. | 247. |
| 15 | 237600. | 5693. | 142. | 0. | 1097. | 725. | 330. | 437. | 191. | 2199. | 503. | 81. | 449. |
| 20 | 244300. | 20203. | 162. | 0. | 2051. | 1352. | 754. | 750. | 378. | 3633. | 688. | 263. | 949. |
| 25 | 213000. | 14813. | 154. | 0. | 1108. | 967. | 501. | 454. | 343. | 1946. | 475. | 191. | 652. |
| 30 | 206300. | 7487. | 192. | 0. | 626. | 571. | 322. | 388. | 181. | 1067. | 324. | 105. | 467. |
| 35 | 208000. | 3149. | 320. | 0. | 485. | 471. | 247. | 180. | 104. | 747. | 175. | 56. | 254. |
| 40 | 211900. | 852. | 612. | 0. | 361. | 344. | 182. | 131. | 72. | 552. | 129. | 42. | 186. |
| 45 | 227800. | 49. | 1155. | 0. | 361. | 234. | 136. | 103. | 59. | 454. | 119. | 44. | 162. |
| 50 | 187300. | 0. | 1553. | 0. | 309. | 199. | 112. | 88. | 52. | 391. | 101. | 37. | 139. |
| 55 | 203900. | 0. | 2614. | 0. | 221. | 154. | 87. | 62. | 37. | 280. | 80. | 26. | 102. |
| 60 | 193000. | 0. | 3965. | 0. | 166. | 200. | 88. | 31. | 40. | 208. | 116. | 10. | 90. |
| 65 | 161200. | 0. | 5395. | 0. | 129. | 109. | 63. | 34. | 35. | 184. | 75. | 10. | 85. |
| 70 | 115500. | 0. | 5992. | 0. | 78. | 67. | 38. | 21. | 21. | 111. | 48. | 6. | 52. |
| 75 | 74260. | 0. | 5959. | 0. | 75. | 66. | 39. | 20. | 19. | 112. | 45. | 6. | 47. |
| 80 | 42068. | 0. | 5299. | 0. | 47. | 42. | 26. | 13. | 13. | 72. | 28. | 5. | 30. |
| 85 | 22872. | 0. | 5347. | 0. | 28. | 25. | 19. | 9. | 9. | 43. | 16. | 2. | 17. |
| total | 3359700. | 52246. | 40167. | 0. | 9386. | 7453. | 3929. | 3730. | 2221. | 15182. | 3924. | 1243. | 4984. |

region yorkshir

| age | population | births | deaths | migration from yorkshir | north yorkshir | yorkshir to n.west | e.midl. | w.midl. | e.anglia | s.east | s.west | wales | scotland |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 404000. | 0. | 1920. | 1619. | 0. | 1411. | 1614. | 762. | 645. | 2143. | 684. | 290. | 461. |
| 5 | 408500. | 0. | 142. | 1163. | 0. | 1125. | 1123. | 410. | 475. | 1782. | 410. | 184. | 320. |
| 10 | 353200. | 0. | 109. | 782. | 0. | 740. | 728. | 295. | 299. | 1252. | 273. | 132. | 202. |
| 15 | 331600. | 9391. | 221. | 1306. | 0. | 1183. | 1171. | 748. | 369. | 2838. | 518. | 280. | 279. |
| 20 | 358100. | 31340. | 264. | 2416. | 0. | 2563. | 2778. | 1371. | 714. | 5623. | 1100. | 532. | 531. |
| 25 | 309200. | 23140. | 226. | 1342. | 0. | 1713. | 1712. | 644. | 627. | 2415. | 793. | 356. | 433. |
| 30 | 288300. | 11104. | 268. | 896. | 0. | 1078. | 1136. | 494. | 323. | 1605. | 442. | 221. | 278. |
| 35 | 280400. | 4936. | 412. | 753. | 0. | 770. | 634. | 435. | 253. | 1165. | 281. | 135. | 259. |
| 40 | 294400. | 1384. | 808. | 555. | 0. | 571. | 474. | 304. | 184. | 845. | 208. | 98. | 189. |
| 45 | 319500. | 96. | 1464. | 450. | 0. | 489. | 428. | 125. | 128. | 498. | 172. | 74. | 140. |
| 50 | 279600. | 0. | 2089. | 385. | 0. | 422. | 367. | 107. | 110. | 431. | 144. | 63. | 121. |
| 55 | 297800. | 0. | 3720. | 299. | 0. | 318. | 281. | 82. | 85. | 308. | 125. | 53. | 95. |
| 60 | 276300. | 0. | 5633. | 294. | 0. | 292. | 290. | 72. | 59. | 185. | 179. | 69. | 96. |
| 65 | 232000. | 0. | 7814. | 312. | 0. | 306. | 276. | 88. | 51. | 304. | 164. | 53. | 53. |
| 70 | 168800. | 0. | 8782. | 178. | 0. | 181. | 160. | 51. | 30. | 187. | 88. | 29. | 29. |
| 75 | 111523. | 0. | 8696. | 110. | 0. | 113. | 99. | 32. | 19. | 115. | 55. | 16. | 16. |
| 80 | 63054. | 0. | 7671. | 63. | 0. | 64. | 56. | 19. | 10. | 67. | 30. | 10. | 10. |
| 85 | 35623. | 0. | 8032. | 34. | 0. | 35. | 30. | 11. | 5. | 35. | 16. | 6. | 6. |
| total | 4811900. | 81391. | 58271. | 12957. | 0. | 13374. | 13357. | 6050. | 4386. | 21798. | 5682. | 2601. | 3518. |

region n.west

| age | population | births | deaths | migration from north | yorkshir | n.west to n.west | e.midl. | w.midl. | e.anglia | s.east | s.west | wales | scotland |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 572800. | 0. | 2718. | 715. | 1004. | 0. | 637. | 1316. | 273. | 2752. | 829. | 1077. | 788. |
| 5 | 591300. | 0. | 221. | 489. | 891. | 0. | 494. | 641. | 249. | 2233. | 837. | 836. | 441. |
| 10 | 506900. | 0. | 171. | 350. | 607. | 0. | 342. | 453. | 184. | 1625. | 585. | 562. | 291. |
| 15 | 454100. | 12598. | 296. | 700. | 939. | 0. | 574. | 869. | 405. | 3422. | 949. | 765. | 353. |
| 20 | 500800. | 42037. | 360. | 1517. | 2106. | 0. | 1369. | 2198. | 608. | 6836. | 1518. | 1729. | 985. |
| 25 | 430000. | 32687. | 311. | 750. | 1320. | 0. | 864. | 1239. | 391. | 3278. | 1006. | 1068. | 741. |
| 30 | 399300. | 16255. | 372. | 546. | 1003. | 0. | 437. | 827. | 210. | 2307. | 600. | 836. | 536. |
| 35 | 387700. | 7322. | 610. | 323. | 564. | 0. | 312. | 425. | 127. | 1784. | 499. | 514. | 224. |
| 40 | 406800. | 1995. | 1202. | 264. | 456. | 0. | 252. | 352. | 102. | 1390. | 403. | 433. | 183. |
| 45 | 448000. | 136. | 2327. | 281. | 455. | 0. | 249. | 400. | 106. | 941. | 409. | 575. | 189. |
| 50 | 388700. | 0. | 3292. | 188. | 301. | 0. | 163. | 263. | 69. | 621. | 271. | 382. | 126. |
| 55 | 429800. | 0. | 5939. | 180. | 267. | 0. | 153. | 245. | 71. | 574. | 270. | 405. | 120. |
| 60 | 397300. | 0. | 8783. | 187. | 129. | 0. | 117. | 191. | 69. | 442. | 320. | 674. | 142. |
| 65 | 333500. | 0. | 11626. | 152. | 286. | 0. | 172. | 186. | 60. | 525. | 220. | 256. | 64. |
| 70 | 243200. | 0. | 13135. | 98. | 191. | 0. | 113. | 127. | 37. | 343. | 144. | 167. | 44. |
| 75 | 158469. | 0. | 12666. | 67. | 125. | 0. | 73. | 84. | 27. | 227. | 94. | 109. | 29. |
| 80 | 90917. | 0. | 11385. | 38. | 72. | 0. | 43. | 48. | 13. | 127. | 52. | 62. | 17. |
| 85 | 49114. | 0. | 11442. | 19. | 36. | 0. | 21. | 25. | 7. | 63. | 27. | 30. | 9. |
| total | 6788700. | 113030. | 86856. | 6864. | 10752. | 0. | 6385. | 9889. | 3008. | 29490. | 9033. | 10480. | 5282. |

region e.midl.

| age | population | births | deaths | migration from north | yorkshir | e.midl. to n.west | e.midl. | w.midl. | e.anglia | s.east | s.west | wales | scotland |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 284700. | 0. | 1152. | 571. | 1625. | 613. | 0. | 1208. | 721. | 1927. | 788. | 282. | 597. |
| 5 | 286300. | 0. | 93. | 393. | 1133. | 488. | 0. | 893. | 647. | 1543. | 647. | 224. | 327. |
| 10 | 248700. | 0. | 72. | 248. | 679. | 296. | 0. | 546. | 402. | 1025. | 407. | 132. | 191. |
| 15 | 226700. | 5982. | 141. | 477. | 1117. | 499. | 0. | 931. | 695. | 2524. | 759. | 219. | 257. |
| 20 | 263100. | 20942. | 180. | 865. | 2121. | 931. | 0. | 1786. | 896. | 4399. | 1080. | 458. | 575. |
| 25 | 217600. | 17111. | 160. | 533. | 1615. | 820. | 0. | 1264. | 662. | 2234. | 777. | 256. | 420. |
| 30 | 204500. | 7693. | 190. | 366. | 1001. | 524. | 0. | 915. | 489. | 1418. | 468. | 208. | 231. |
| 35 | 203300. | 3097. | 280. | 234. | 721. | 280. | 0. | 670. | 381. | 1005. | 349. | 96. | 142. |
| 40 | 210300. | 862. | 540. | 163. | 514. | 199. | 0. | 469. | 269. | 730. | 245. | 72. | 101. |
| 45 | 224600. | 68. | 975. | 101. | 379. | 172. | 0. | 276. | 185. | 675. | 204. | 76. | 77. |
| 50 | 191200. | 0. | 1356. | 80. | 303. | 139. | 0. | 217. | 149. | 543. | 167. | 62. | 61. |
| 55 | 199200. | 0. | 2321. | 66. | 244. | 111. | 0. | 167. | 122. | 416. | 142. | 49. | 51. |
| 60 | 185600. | 0. | 3549. | 76. | 255. | 99. | 0. | 85. | 151. | 237. | 222. | 54. | 66. |
| 65 | 156500. | 0. | 5037. | 39. | 293. | 87. | 0. | 129. | 154. | 284. | 235. | 78. | 30. |
| 70 | 115000. | 0. | 5650. | 22. | 169. | 50. | 0. | 83. | 88. | 168. | 133. | 45. | 17. |
| 75 | 75798. | 0. | 5624. | 12. | 93. | 27. | 0. | 47. | 48. | 93. | 72. | 24. | 9. |
| 80 | 43814. | 0. | 5081. | 7. | 54. | 17. | 0. | 30. | 28. | 57. | 42. | 15. | 6. |
| 85 | 25888. | 0. | 5556. | 6. | 31. | 10. | 0. | 18. | 16. | 28. | 23. | 10. | 5. |
| total | 3362800. | 55755. | 37957. | 4259. | 12347. | 5362. | 0. | 9734. | 6103. | 19306. | 6760. | 2360. | 3163. |

APPENDIX C *Continued.*

region w.midl.

| age | population | births | deaths | migration from north | yorkshir | w.midl. to n.west | e.midl. | w.midl. | e.anglia | s.east | s.west | wales | scotland |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 453100. | 0. | 1959. | 463. | 565. | 1225. | 1680. | 0. | 269. | 2112. | 1068. | 637. | 271. |
| 5 | 440200. | 0. | 167. | 339. | 456. | 755. | 1008. | 0. | 308. | 1931. | 973. | 493. | 328. |
| 10 | 376700. | 0. | 129. | 256. | 351. | 582. | 760. | 0. | 239. | 1555. | 748. | 367. | 248. |
| 15 | 358000. | 9462. | 230. | 334. | 594. | 933. | 1171. | 0. | 402. | 3178. | 1189. | 473. | 328. |
| 20 | 421800. | 31682. | 299. | 622. | 1036. | 1659. | 2456. | 0. | 495. | 5848. | 1836. | 1020. | 571. |
| 25 | 355000. | 27196. | 248. | 437. | 636. | 1393. | 1723. | 0. | 343. | 3174. | 1221. | 807. | 463. |
| 30 | 324500. | 13196. | 291. | 230. | 567. | 686. | 1079. | 0. | 187. | 1905. | 855. | 494. | 219. |
| 35 | 321300. | 6010. | 444. | 228. | 270. | 558. | 709. | 0. | 160. | 1482. | 710. | 348. | 213. |
| 40 | 327500. | 1656. | 843. | 187. | 231. | 473. | 598. | 0. | 135. | 1254. | 610. | 304. | 178. |
| 45 | 356400. | 138. | 1594. | 76. | 181. | 361. | 369. | 0. | 112. | 841. | 508. | 270. | 125. |
| 50 | 298700. | 0. | 2198. | 59. | 139. | 278. | 284. | 0. | 88. | 650. | 399. | 212. | 96. |
| 55 | 302800. | 0. | 3668. | 57. | 119. | 253. | 246. | 0. | 78. | 566. | 398. | 208. | 91. |
| 60 | 274700. | 0. | 5471. | 95. | 67. | 276. | 162. | 0. | 76. | 409. | 742. | 352. | 133. |
| 65 | 219200. | 0. | 7150. | 49. | 36. | 137. | 82. | 0. | 40. | 207. | 378. | 187. | 67. |
| 70 | 154500. | 0. | 7778. | 18. | 14. | 55. | 34. | 0. | 15. | 83. | 150. | 72. | 27. |
| 75 | 101518. | 0. | 7674. | 15. | 9. | 44. | 24. | 0. | 10. | 62. | 112. | 50. | 20. |
| 80 | 58390. | 0. | 6915. | 7. | 5. | 24. | 15. | 0. | 6. | 36. | 64. | 27. | 13. |
| 85 | 33692. | 0. | 7424. | 6. | 2. | 15. | 6. | 0. | 5. | 20. | 36. | 15. | 6. |
| total | 5178000. | 89340. | 54482. | 3478. | 5278. | 9707. | 12406. | 0. | 2968. | 25313. | 11997. | 6336. | 3397. |

region e.anglia

| age | population | births | deaths | migration from e.anglia to north | yorkshir | n.west | e.midl. | w.midl. | e.anglia | s.east | s.west | wales | scotland |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 128700. | 0. | 489. | 85. | 348. | 272. | 537. | 350. | 0. | 2361. | 464. | 187. | 311. |
| 5 | 134700. | 0. | 50. | 60. | 207. | 223. | 394. | 223. | 0. | 1710. | 449. | 72. | 174. |
| 10 | 113900. | 0. | 38. | 41. | 132. | 132. | 246. | 153. | 0. | 1121. | 290. | 49. | 105. |
| 15 | 114200. | 2695. | 83. | 92. | 230. | 119. | 372. | 319. | 0. | 2134. | 479. | 91. | 100. |
| 20 | 137700. | 10058. | 113. | 276. | 478. | 370. | 899. | 475. | 0. | 4185. | 620. | 185. | 279. |
| 25 | 108600. | 8029. | 57. | 143. | 277. | 276. | 595. | 333. | 0. | 2748. | 337. | 141. | 258. |
| 30 | 103100. | 3475. | 69. | 81. | 242. | 229. | 361. | 257. | 0. | 1524. | 220. | 141. | 144. |
| 35 | 101300. | 1400. | 123. | 81. | 167. | 125. | 266. | 130. | 0. | 1156. | 309. | 53. | 90. |
| 40 | 97800. | 337. | 221. | 55. | 104. | 78. | 173. | 80. | 0. | 744. | 189. | 37. | 55. |
| 45 | 109300. | 24. | 397. | 51. | 82. | 59. | 168. | 36. | 0. | 702. | 102. | 64. | 39. |
| 50 | 92400. | 0. | 545. | 49. | 80. | 57. | 164. | 34. | 0. | 683. | 99. | 63. | 38. |
| 55 | 100800. | 0. | 985. | 26. | 46. | 29. | 87. | 21. | 0. | 374. | 53. | 34. | 21. |
| 60 | 95800. | 0. | 1539. | 13. | 57. | 10. | 61. | 49. | 0. | 381. | 52. | 38. | 20. |
| 65 | 84700. | 0. | 2393. | 36. | 33. | 6. | 74. | 39. | 0. | 308. | 69. | 13. | 16. |
| 70 | 61400. | 0. | 2684. | 35. | 30. | 6. | 72. | 38. | 0. | 303. | 67. | 12. | 15. |
| 75 | 43795. | 0. | 2940. | 17. | 17. | 3. | 38. | 20. | 0. | 154. | 33. | 6. | 8. |
| 80 | 27672. | 0. | 2899. | 11. | 11. | 2. | 23. | 11. | 0. | 101. | 22. | 4. | 5. |
| 85 | 17633. | 0. | 3396. | 7. | 6. | 2. | 16. | 8. | 0. | 64. | 13. | 3. | 4. |
| total | 1673500. | 26018. | 19021. | 1159. | 2547. | 1998. | 4546. | 2576. | 0. | 20753. | 3867. | 1193. | 1682. |

region s.east

| age | population | births | deaths | migration from north | yorkshir | s.east to n.west | e.midl. | w.midl. | e.anglia | s.east | s.west | wales | scotland |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1392600. | 0. | 5192. | 1339. | 2051. | 2298. | 3247. | 2375. | 4603. | 0. | 6146. | 982. | 1840. |
| 5 | 1366500. | 0. | 417. | 866. | 1217. | 1756. | 2125. | 1529. | 2729. | 0. | 4796. | 778. | 1359. |
| 10 | 1197800. | 0. | 330. | 612. | 849. | 1198. | 1453. | 1089. | 1868. | 0. | 3408. | 580. | 956. |
| 15 | 1139500. | 24194. | 725. | 1058. | 1400. | 1774. | 2104. | 1995. | 2564. | 0. | 5690. | 1233. | 1597. |
| 20 | 1382200. | 94958. | 972. | 2573. | 3690. | 5197. | 5660. | 4797. | 5692. | 0. | 10496. | 2434. | 3610. |
| 25 | 1152200. | 85789. | 805. | 1725. | 2327. | 3135. | 3929. | 2790. | 4201. | 0. | 7342. | 1585. | 2438. |
| 30 | 1059800. | 41336. | 949. | 1084. | 1348. | 1787. | 2049. | 1905. | 2783. | 0. | 5034. | 885. | 1546. |
| 35 | 1027800. | 16793. | 1261. | 564. | 849. | 1366. | 1366. | 1192. | 1949. | 0. | 3433. | 654. | 945. |
| 40 | 1031000. | 4171. | 2363. | 409. | 618. | 995. | 977. | 858. | 1440. | 0. | 2601. | 473. | 683. |
| 45 | 1151100. | 281. | 4463. | 402. | 544. | 797. | 734. | 817. | 1465. | 0. | 3125. | 520. | 638. |
| 50 | 1019400. | 0. | 6455. | 338. | 458. | 671. | 618. | 610. | 1242. | 0. | 2664. | 441. | 541. |
| 55 | 1097800. | 0. | 11738. | 331. | 431. | 638. | 590. | 463. | 1292. | 0. | 2751. | 435. | 519. |
| 60 | 998300. | 0. | 17427. | 320. | 287. | 562. | 581. | 342. | 1628. | 0. | 3366. | 391. | 338. |
| 65 | 824600. | 0. | 23619. | 297. | 337. | 469. | 627. | 420. | 1191. | 0. | 3066. | 368. | 387. |
| 70 | 614500. | 0. | 27208. | 136. | 163. | 225. | 296. | 202. | 556. | 0. | 1453. | 177. | 181. |
| 75 | 410253. | 0. | 27512. | 79. | 105. | 141. | 184. | 130. | 336. | 0. | 905. | 107. | 110. |
| 80 | 268275. | 0. | 28533. | 49. | 68. | 90. | 117. | 84. | 213. | 0. | 573. | 67. | 69. |
| 85 | 181872. | 0. | 36202. | 27. | 42. | 56. | 69. | 59. | 128. | 0. | 349. | 41. | 42. |
| total | 17315502. | 267522. | 196171. | 12209. | 16784. | 23155. | 26726. | 21657. | 35880. | 0. | 67198. | 12151. | 17799. |

region s.west

| age | population | births | deaths | migration from north | yorkshir | s.west to n.west | e.midl. | w.midl. | e.anglia | s.east | s.west | wales | scotland |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 295400. | 0. | 1126. | 345. | 642. | 396. | 521. | 994. | 390. | 5132. | 0. | 567. | 546. |
| 5 | 309700. | 0. | 93. | 292. | 434. | 453. | 465. | 583. | 283. | 3647. | 0. | 357. | 476. |
| 10 | 265700. | 0. | 70. | 191. | 275. | 292. | 297. | 422. | 196. | 2598. | 0. | 247. | 311. |
| 15 | 254400. | 5967. | 155. | 266. | 318. | 393. | 426. | 963. | 332. | 5551. | 0. | 477. | 442. |
| 20 | 284400. | 21739. | 198. | 573. | 987. | 928. | 655. | 1888. | 678. | 10603. | 0. | 865. | 1053. |
| 25 | 228600. | 17291. | 150. | 410. | 661. | 708. | 588. | 1024. | 377. | 6283. | 0. | 620. | 695. |
| 30 | 217200. | 7729. | 183. | 309. | 387. | 486. | 376. | 683. | 254. | 3516. | 0. | 419. | 453. |
| 35 | 212100. | 3085. | 241. | 207. | 258. | 355. | 262. | 516. | 201. | 2594. | 0. | 219. | 292. |
| 40 | 220200. | 820. | 466. | 139. | 176. | 241. | 175. | 364. | 140. | 1826. | 0. | 168. | 197. |
| 45 | 242800. | 66. | 946. | 67. | 102. | 137. | 123. | 321. | 110. | 1649. | 0. | 197. | 94. |
| 50 | 213700. | 0. | 1365. | 59. | 89. | 122. | 107. | 284. | 97. | 1456. | 0. | 173. | 84. |
| 55 | 233500. | 0. | 2578. | 44. | 62. | 85. | 71. | 189. | 72. | 1040. | 0. | 123. | 59. |
| 60 | 226900. | 0. | 4081. | 64. | 46. | 72. | 34. | 82. | 98. | 1114. | 0. | 127. | 58. |
| 65 | 201800. | 0. | 5912. | 14. | 91. | 88. | 74. | 186. | 62. | 1010. | 0. | 92. | 38. |
| 70 | 151800. | 0. | 6302. | 10. | 57. | 59. | 45. | 117. | 50. | 642. | 0. | 58. | 28. |
| 75 | 103238. | 0. | 7496. | 7. | 42. | 41. | 33. | 85. | 36. | 453. | 0. | 40. | 19. |
| 80 | 62969. | 0. | 7117. | 5. | 24. | 26. | 20. | 53. | 22. | 278. | 0. | 24. | 13. |
| 85 | 39293. | 0. | 8196. | 3. | 16. | 17. | 11. | 30. | 12. | 163. | 0. | 15. | 7. |
| total | 3763700. | 56697. | 47271. | 3005. | 4667. | 4899. | 4283. | 8784. | 3430. | 49563. | 0. | 4789. | 4866. |

APPENDIX C *Continued.*

region wales

| age | population | births | deaths | migration from north | yorkshir | wales n.west | to e.midl. | w.midl. | e.anglia | s.east | s.west | wales | scotland |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 212900. | 0. | 912. | 176. | 292. | 935. | 302. | 599. | 178. | 1072. | 715. | 0. | 417. |
| 5 | 229300. | 0. | 69. | 175. | 104. | 450. | 195. | 459. | 85. | 869. | 565. | 0. | 145. |
| 10 | 195100. | 0. | 52. | 110. | 71. | 319. | 130. | 318. | 59. | 646. | 399. | 0. | 90. |
| 15 | 191300. | 4993. | 126. | 155. | 197. | 711. | 271. | 690. | 140. | 1824. | 823. | 0. | 103. |
| 20 | 200900. | 16250. | 147. | 275. | 498. | 1213. | 454. | 1100. | 227. | 3777. | 1330. | 0. | 318. |
| 25 | 166700. | 12172. | 120. | 143. | 204. | 757. | 380. | 700. | 190. | 1519. | 764. | 0. | 364. |
| 30 | 158300. | 5811. | 146. | 164. | 146. | 450. | 194. | 339. | 98. | 850. | 510. | 0. | 127. |
| 35 | 157200. | 2531. | 226. | 107. | 105. | 350. | 137. | 318. | 86. | 570. | 317. | 0. | 94. |
| 40 | 170500. | 679. | 460. | 84. | 91. | 295. | 117. | 263. | 68. | 483. | 276. | 0. | 80. |
| 45 | 187300. | 51. | 959. | 17. | 76. | 206. | 85. | 143. | 23. | 395. | 258. | 0. | 39. |
| 50 | 157600. | 0. | 1321. | 11. | 49. | 130. | 54. | 93. | 14. | 248. | 162. | 0. | 24. |
| 55 | 170100. | 0. | 2192. | 12. | 54. | 136. | 54. | 108. | 14. | 274. | 189. | 0. | 23. |
| 60 | 164700. | 0. | 3473. | 18. | 50. | 131. | 11. | 176. | 30. | 357. | 329. | 0. | 2. |
| 65 | 145000. | 0. | 4840. | 7. | 47. | 134. | 20. | 138. | 25. | 150. | 141. | 0. | 15. |
| 70 | 103000. | 0. | 5335. | 6. | 39. | 117. | 20. | 118. | 26. | 135. | 117. | 0. | 14. |
| 75 | 66174. | 0. | 5263. | 4. | 26. | 83. | 15. | 79. | 18. | 96. | 79. | 0. | 9. |
| 80 | 37188. | 0. | 4611. | 2. | 16. | 47. | 8. | 47. | 12. | 56. | 46. | 0. | 6. |
| 85 | 20638. | 0. | 4746. | 1. | 7. | 25. | 5. | 24. | 6. | 28. | 23. | 0. | 4. |
| total | 2733900. | 42487. | 34998. | 1467. | 2072. | 6489. | 2452. | 5712. | 1299. | 13369. | 7073. | 0. | 1674. |

region scotland

| age | population | births | deaths | migration from scotland to north | yorkshir | n.west | e.midl. | w.midl. | e.anglia | s.east | s.west | wales | scotland |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 449900. | 0. | 2029. | 791. | 773. | 932. | 780. | 703. | 212. | 2532. | 734. | 161. | 0. |
| 5 | 475400. | 0. | 207. | 556. | 606. | 730. | 676. | 471. | 203. | 1944. | 565. | 134. | 0. |
| 10 | 436300. | 0. | 140. | 334. | 370. | 437. | 395. | 299. | 133. | 1314. | 355. | 89. | 0. |
| 15 | 387500. | 9038. | 238. | 442. | 525. | 602. | 361. | 547. | 284. | 3132. | 643. | 191. | 0. |
| 20 | 404600. | 31492. | 324. | 918. | 734. | 1235. | 727. | 927. | 388. | 5756. | 1075. | 288. | 0. |
| 25 | 322600. | 25885. | 273. | 937. | 565. | 1069. | 672. | 535. | 188. | 3174. | 641. | 252. | 0. |
| 30 | 292600. | 13406. | 374. | 452. | 338. | 764. | 407. | 461. | 170. | 2043. | 370. | 91. | 0. |
| 35 | 289700. | 5875. | 573. | 371. | 314. | 517. | 286. | 197. | 163. | 1227. | 280. | 101. | 0. |
| 40 | 302000. | 1537. | 949. | 266. | 229. | 365. | 210. | 146. | 116. | 881. | 206. | 80. | 0. |
| 45 | 322900. | 102. | 1838. | 149. | 148. | 138. | 152. | 126. | 60. | 522. | 138. | 116. | 0. |
| 50 | 284100. | 0. | 2570. | 108. | 107. | 102. | 110. | 91. | 44. | 379. | 100. | 85. | 0. |
| 55 | 313400. | 0. | 4413. | 73. | 75. | 75. | 78. | 64. | 33. | 276. | 74. | 51. | 0. |
| 60 | 288800. | 0. | 6618. | 54. | 48. | 99. | 49. | 40. | 30. | 302. | 61. | 28. | 0. |
| 65 | 243300. | 0. | 8443. | 77. | 24. | 91. | 34. | 39. | 29. | 227. | 70. | 18. | 0. |
| 70 | 173800. | 1. | 9358. | 39. | 14. | 59. | 21. | 23. | 16. | 130. | 37. | 11. | 0. |
| 75 | 115000. | 0. | 9406. | 31. | 10. | 54. | 17. | 19. | 12. | 111. | 30. | 11. | 0. |
| 80 | 63600. | 0. | 8018. | 16. | 6. | 30. | 9. | 10. | 7. | 64. | 17. | 6. | 0. |
| 85 | 33600. | 0. | 7869. | 8. | 3. | 17. | 5. | 4. | 3. | 35. | 9. | 3. | 0. |
| total | 5199100. | 87335. | 63640. | 5622. | 4889. | 7316. | 4989. | 4702. | 2091. | 24049. | 5405. | 1716. | 0. |

# APPENDIX D Age-specific mortality, fertility, and migration rates, Great Britain, 1970.

observed rates
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death rates
**********

| age | north | yorkshir | n.west | e.midl. | w.midl. | e.anglia | s.east | s.west | wales | scotland |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.004268 | 0.004752 | 0.004745 | 0.004046 | 0.004324 | 0.003800 | 0.003728 | 0.003812 | 0.004284 | 0.004510 |
| 5 | 0.000347 | 0.000348 | 0.000374 | 0.000325 | 0.000379 | 0.000371 | 0.000305 | 0.000300 | 0.000301 | 0.000435 |
| 10 | 0.000311 | 0.000309 | 0.000337 | 0.000290 | 0.000342 | 0.000334 | 0.000276 | 0.000263 | 0.000267 | 0.000321 |
| 15 | 0.000598 | 0.000666 | 0.000652 | 0.000622 | 0.000642 | 0.000727 | 0.000636 | 0.000609 | 0.000659 | 0.000614 |
| 20 | 0.000663 | 0.000737 | 0.000719 | 0.000684 | 0.000709 | 0.000821 | 0.000703 | 0.000668 | 0.000732 | 0.000801 |
| 25 | 0.000723 | 0.000731 | 0.000723 | 0.000735 | 0.000699 | 0.000525 | 0.000699 | 0.000656 | 0.000720 | 0.000846 |
| 30 | 0.000931 | 0.000930 | 0.000932 | 0.000929 | 0.000897 | 0.000669 | 0.000895 | 0.000843 | 0.000922 | 0.001278 |
| 35 | 0.001538 | 0.001469 | 0.001573 | 0.001377 | 0.001382 | 0.001214 | 0.001227 | 0.001136 | 0.001438 | 0.001978 |
| 40 | 0.002888 | 0.002745 | 0.002955 | 0.002568 | 0.002574 | 0.002260 | 0.002292 | 0.002116 | 0.002698 | 0.003142 |
| 45 | 0.005070 | 0.004582 | 0.005194 | 0.004341 | 0.004473 | 0.003632 | 0.003877 | 0.003896 | 0.005120 | 0.005692 |
| 50 | 0.008292 | 0.007471 | 0.008469 | 0.007092 | 0.007359 | 0.005898 | 0.006332 | 0.006387 | 0.008382 | 0.009046 |
| 55 | 0.012820 | 0.012492 | 0.013818 | 0.011652 | 0.012114 | 0.009772 | 0.010692 | 0.011041 | 0.012887 | 0.014081 |
| 60 | 0.020544 | 0.020387 | 0.022107 | 0.019122 | 0.019916 | 0.016065 | 0.017457 | 0.017986 | 0.021087 | 0.022916 |
| 65 | 0.033468 | 0.033681 | 0.034861 | 0.032185 | 0.032619 | 0.028253 | 0.028643 | 0.029296 | 0.033379 | 0.034702 |
| 70 | 0.051879 | 0.052026 | 0.054009 | 0.049130 | 0.050343 | 0.043713 | 0.044277 | 0.045494 | 0.051796 | 0.053843 |
| 75 | 0.080245 | 0.077975 | 0.079927 | 0.074197 | 0.075593 | 0.067131 | 0.067061 | 0.072609 | 0.079533 | 0.081791 |
| 80 | 0.125963 | 0.121658 | 0.125224 | 0.115967 | 0.118428 | 0.104763 | 0.106357 | 0.113024 | 0.123992 | 0.126069 |
| 85 | 0.233779 | 0.225472 | 0.232968 | 0.214617 | 0.220349 | 0.192593 | 0.199052 | 0.208587 | 0.229964 | 0.234196 |
| gross | 2.921633 | 2.842156 | 2.947937 | 2.699400 | 2.765700 | 2.412701 | 2.472549 | 2.593622 | 2.890793 | 2.981316 |
| crude | 0.011956 | 0.012110 | 0.012794 | 0.011287 | 0.010522 | 0.011366 | 0.011329 | 0.012560 | 0.012801 | 0.012241 |
| m.age | 78.8212 | 78.6815 | 78.5763 | 78.7736 | 78.7425 | 78.8479 | 78.8426 | 78.9956 | 78.7467 | 78.4633 |

fertility rates
**********

| age | north | yorkshir | n.west | e.midl. | w.midl. | e.anglia | s.east | s.west | wales | scotland |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 5 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 10 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 15 | 0.023960 | 0.028320 | 0.027743 | 0.026387 | 0.026430 | 0.023599 | 0.021232 | 0.023455 | 0.026100 | 0.023324 |
| 20 | 0.082698 | 0.087517 | 0.083940 | 0.079597 | 0.075111 | 0.073043 | 0.068701 | 0.076438 | 0.080886 | 0.077835 |
| 25 | 0.069545 | 0.074838 | 0.076016 | 0.078635 | 0.076608 | 0.073932 | 0.074457 | 0.075639 | 0.073017 | 0.080239 |
| 30 | 0.036292 | 0.038515 | 0.040709 | 0.037619 | 0.040666 | 0.033705 | 0.039004 | 0.035585 | 0.036709 | 0.045817 |
| 35 | 0.015139 | 0.017603 | 0.018886 | 0.015234 | 0.018705 | 0.013820 | 0.016339 | 0.014545 | 0.016101 | 0.020280 |
| 40 | 0.004021 | 0.004701 | 0.004904 | 0.004099 | 0.005056 | 0.003446 | 0.004046 | 0.003724 | 0.003982 | 0.005089 |
| 45 | 0.000215 | 0.000300 | 0.000304 | 0.000303 | 0.000387 | 0.000220 | 0.000244 | 0.000272 | 0.000272 | 0.000316 |
| 50 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 55 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 60 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 65 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 70 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 75 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 80 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 85 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| gross | 1.159348 | 1.258982 | 1.262505 | 1.209367 | 1.214823 | 1.108823 | 1.120108 | 1.148287 | 1.185339 | 1.264496 |
| crude | 0.015551 | 0.016915 | 0.016650 | 0.016580 | 0.017254 | 0.015547 | 0.015450 | 0.015064 | 0.015541 | 0.016798 |
| m.age | 26.3975 | 26.4053 | 26.6086 | 26.4503 | 26.8172 | 26.4250 | 26.9114 | 26.4895 | 26.4214 | 27.0735 |

APPENDIX D *Continued.*

outmigration rates
**********

migration from north to

| age | total | north | yorkshir | n.west | e.midl. | w.midl. | e.anglia | s.east | s.west | wales | scotland |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.021237 | 0.000000 | 0.003585 | 0.003046 | 0.001711 | 0.001468 | 0.001115 | 0.004901 | 0.001946 | 0.000804 | 0.002659 |
| 5 | 0.013745 | 0.000000 | 0.002527 | 0.002226 | 0.001061 | 0.001222 | 0.000748 | 0.003551 | 0.000928 | 0.000297 | 0.001185 |
| 10 | 0.011972 | 0.000000 | 0.002190 | 0.001846 | 0.000873 | 0.001034 | 0.000602 | 0.003341 | 0.000853 | 0.000234 | 0.000998 |
| 15 | 0.025303 | 0.000000 | 0.004617 | 0.003051 | 0.001389 | 0.001839 | 0.000804 | 0.009255 | 0.002117 | 0.000341 | 0.001890 |
| 20 | 0.044282 | 0.000000 | 0.008395 | 0.005534 | 0.003086 | 0.003070 | 0.001547 | 0.014871 | 0.002816 | 0.001077 | 0.003885 |
| 25 | 0.031160 | 0.000000 | 0.005202 | 0.004540 | 0.002352 | 0.002131 | 0.001610 | 0.009136 | 0.002230 | 0.000897 | 0.003061 |
| 30 | 0.019636 | 0.000000 | 0.003034 | 0.002768 | 0.001561 | 0.001881 | 0.000877 | 0.005172 | 0.001571 | 0.000509 | 0.002264 |
| 35 | 0.013072 | 0.000000 | 0.002332 | 0.002264 | 0.001187 | 0.000865 | 0.000500 | 0.003591 | 0.000941 | 0.000269 | 0.001221 |
| 40 | 0.009434 | 0.000000 | 0.001704 | 0.001623 | 0.000859 | 0.000618 | 0.000340 | 0.002605 | 0.000609 | 0.000198 | 0.000878 |
| 45 | 0.007340 | 0.000000 | 0.001585 | 0.001027 | 0.000597 | 0.000452 | 0.000259 | 0.001993 | 0.000522 | 0.000193 | 0.000711 |
| 50 | 0.007624 | 0.000000 | 0.001650 | 0.001062 | 0.000598 | 0.000470 | 0.000278 | 0.002088 | 0.000539 | 0.000198 | 0.000742 |
| 55 | 0.005145 | 0.000000 | 0.001084 | 0.000755 | 0.000427 | 0.000304 | 0.000181 | 0.001373 | 0.000392 | 0.000128 | 0.000500 |
| 60 | 0.004917 | 0.000000 | 0.000860 | 0.001036 | 0.000456 | 0.000161 | 0.000207 | 0.001078 | 0.000601 | 0.000052 | 0.000466 |
| 65 | 0.004491 | 0.000000 | 0.000800 | 0.000676 | 0.000391 | 0.000211 | 0.000217 | 0.001141 | 0.000465 | 0.000062 | 0.000527 |
| 70 | 0.003827 | 0.000000 | 0.000675 | 0.000580 | 0.000329 | 0.000182 | 0.000182 | 0.000961 | 0.000416 | 0.000052 | 0.000450 |
| 75 | 0.005777 | 0.000000 | 0.001010 | 0.000889 | 0.000525 | 0.000269 | 0.000256 | 0.001508 | 0.000606 | 0.000081 | 0.000633 |
| 80 | 0.006561 | 0.000000 | 0.001117 | 0.000998 | 0.000618 | 0.000309 | 0.000309 | 0.001712 | 0.000666 | 0.000119 | 0.000713 |
| 85 | 0.007345 | 0.000000 | 0.001224 | 0.001093 | 0.000831 | 0.000393 | 0.000393 | 0.001880 | 0.000700 | 0.000087 | 0.000743 |
| gross | 1.214334 | 0.000000 | 0.217955 | 0.175089 | 0.094255 | 0.084402 | 0.052131 | 0.350793 | 0.094087 | 0.027987 | 0.117634 |
| crude | 0.015493 | 0.000000 | 0.002794 | 0.002218 | 0.001169 | 0.001110 | 0.000661 | 0.004519 | 0.001168 | 0.000370 | 0.001483 |
| m.age | 31.6862 | 0.0000 | 31.7726 | 32.5942 | 33.9893 | 28.8721 | 31.5211 | 30.8136 | 33.5090 | 28.3824 | 32.3517 |

migration from yorkshir to

| age | total | north | yorkshir | n.west | e.midl. | w.midl. | e.anglia | s.east | s.west | wales | scotland |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.023834 | 0.004007 | 0.000000 | 0.003493 | 0.003995 | 0.001886 | 0.001597 | 0.005304 | 0.001693 | 0.000718 | 0.001141 |
| 5 | 0.017116 | 0.002847 | 0.000000 | 0.002754 | 0.002749 | 0.001004 | 0.001163 | 0.004362 | 0.001004 | 0.000450 | 0.000783 |
| 10 | 0.013315 | 0.002214 | 0.000000 | 0.002095 | 0.002061 | 0.000835 | 0.000847 | 0.003545 | 0.000773 | 0.000374 | 0.000572 |
| 15 | 0.026212 | 0.003938 | 0.000000 | 0.003568 | 0.003531 | 0.002256 | 0.001113 | 0.008559 | 0.001562 | 0.000844 | 0.000841 |
| 20 | 0.049226 | 0.006747 | 0.000000 | 0.007157 | 0.007758 | 0.003829 | 0.001994 | 0.015702 | 0.003072 | 0.001486 | 0.001483 |
| 25 | 0.032455 | 0.004340 | 0.000000 | 0.005540 | 0.005537 | 0.002083 | 0.002028 | 0.007810 | 0.002565 | 0.001151 | 0.001400 |
| 30 | 0.022452 | 0.003108 | 0.000000 | 0.003739 | 0.003940 | 0.001713 | 0.001120 | 0.005567 | 0.001533 | 0.000767 | 0.000964 |
| 35 | 0.016708 | 0.002685 | 0.000000 | 0.002746 | 0.002261 | 0.001551 | 0.000902 | 0.004155 | 0.001002 | 0.000481 | 0.000924 |
| 40 | 0.011644 | 0.001885 | 0.000000 | 0.001940 | 0.001610 | 0.001033 | 0.000625 | 0.002870 | 0.000707 | 0.000333 | 0.000642 |
| 45 | 0.007837 | 0.001408 | 0.000000 | 0.001531 | 0.001340 | 0.000391 | 0.000401 | 0.001559 | 0.000538 | 0.000232 | 0.000438 |
| 50 | 0.007690 | 0.001377 | 0.000000 | 0.001509 | 0.001313 | 0.000383 | 0.000393 | 0.001541 | 0.000515 | 0.000225 | 0.000433 |
| 55 | 0.005527 | 0.001004 | 0.000000 | 0.001068 | 0.000944 | 0.000275 | 0.000285 | 0.001034 | 0.000420 | 0.000178 | 0.000319 |
| 60 | 0.005559 | 0.001064 | 0.000000 | 0.001057 | 0.001050 | 0.000261 | 0.000214 | 0.000670 | 0.000648 | 0.000250 | 0.000347 |
| 65 | 0.006927 | 0.001345 | 0.000000 | 0.001319 | 0.001190 | 0.000379 | 0.000220 | 0.001310 | 0.000707 | 0.000228 | 0.000228 |
| 70 | 0.005527 | 0.001055 | 0.000000 | 0.001072 | 0.000948 | 0.000302 | 0.000178 | 0.001108 | 0.000521 | 0.000172 | 0.000172 |
| 75 | 0.005156 | 0.000986 | 0.000000 | 0.001013 | 0.000888 | 0.000287 | 0.000170 | 0.001031 | 0.000493 | 0.000143 | 0.000143 |
| 80 | 0.005218 | 0.000999 | 0.000000 | 0.001015 | 0.000888 | 0.000301 | 0.000159 | 0.001063 | 0.000476 | 0.000159 | 0.000159 |
| 85 | 0.004997 | 0.000954 | 0.000000 | 0.000983 | 0.000842 | 0.000309 | 0.000140 | 0.000983 | 0.000449 | 0.000168 | 0.000168 |
| gross | 1.337008 | 0.209826 | 0.000000 | 0.217989 | 0.214217 | 0.095390 | 0.067739 | 0.340867 | 0.093387 | 0.041798 | 0.055795 |
| crude | 0.017399 | 0.002693 | 0.000000 | 0.002779 | 0.002776 | 0.001257 | 0.000911 | 0.004530 | 0.001181 | 0.000541 | 0.000731 |
| m.age | 30.8193 | 32.2648 | 0.0000 | 32.8623 | 31.3568 | 29.1304 | 27.7490 | 28.5371 | 33.4822 | 31.3787 | 31.0193 |

migration from n.west to

| age | total | north | yorkshir | n.west | e.midl. | w.midl. | e.anglia | s.east | s.west | wales | scotland |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.016395 | 0.001248 | 0.001753 | 0.000000 | 0.001112 | 0.002297 | 0.000477 | 0.004804 | 0.001447 | 0.001880 | 0.001376 |
| 5 | 0.012026 | 0.000827 | 0.001507 | 0.000000 | 0.000835 | 0.001084 | 0.000421 | 0.003776 | 0.001416 | 0.001414 | 0.000746 |
| 10 | 0.009862 | 0.000690 | 0.001197 | 0.000000 | 0.000675 | 0.000894 | 0.000363 | 0.003206 | 0.001154 | 0.001109 | 0.000574 |
| 15 | 0.019767 | 0.001542 | 0.002068 | 0.000000 | 0.001264 | 0.001914 | 0.000892 | 0.007536 | 0.002090 | 0.001685 | 0.000777 |
| 20 | 0.037672 | 0.003029 | 0.004205 | 0.000000 | 0.002734 | 0.004389 | 0.001214 | 0.013650 | 0.003031 | 0.003452 | 0.001967 |
| 25 | 0.024784 | 0.001744 | 0.003070 | 0.000000 | 0.002009 | 0.002881 | 0.000909 | 0.007623 | 0.002340 | 0.002484 | 0.001723 |
| 30 | 0.018287 | 0.001367 | 0.002512 | 0.000000 | 0.001094 | 0.002071 | 0.000526 | 0.005778 | 0.001503 | 0.002094 | 0.001342 |
| 35 | 0.012308 | 0.000833 | 0.001455 | 0.000000 | 0.000805 | 0.001096 | 0.000328 | 0.004601 | 0.001287 | 0.001326 | 0.000578 |
| 40 | 0.009427 | 0.000649 | 0.001121 | 0.000000 | 0.000619 | 0.000865 | 0.000251 | 0.003417 | 0.000991 | 0.001064 | 0.000450 |
| 45 | 0.008047 | 0.000627 | 0.001016 | 0.000000 | 0.000556 | 0.000893 | 0.000237 | 0.002100 | 0.000913 | 0.001283 | 0.000422 |
| 50 | 0.006133 | 0.000484 | 0.000774 | 0.000000 | 0.000419 | 0.000677 | 0.000178 | 0.001598 | 0.000697 | 0.000983 | 0.000324 |
| 55 | 0.005316 | 0.000419 | 0.000621 | 0.000000 | 0.000356 | 0.000570 | 0.000165 | 0.001336 | 0.000628 | 0.000942 | 0.000279 |
| 60 | 0.005716 | 0.000471 | 0.000325 | 0.000000 | 0.000294 | 0.000481 | 0.000174 | 0.001113 | 0.000805 | 0.001696 | 0.000357 |
| 65 | 0.005760 | 0.000456 | 0.000858 | 0.000000 | 0.000516 | 0.000558 | 0.000180 | 0.001574 | 0.000660 | 0.000768 | 0.000192 |
| 70 | 0.005197 | 0.000403 | 0.000785 | 0.000000 | 0.000465 | 0.000522 | 0.000152 | 0.001410 | 0.000592 | 0.000687 | 0.000181 |
| 75 | 0.005269 | 0.000423 | 0.000789 | 0.000000 | 0.000461 | 0.000530 | 0.000170 | 0.001432 | 0.000593 | 0.000688 | 0.000183 |
| 80 | 0.005192 | 0.000418 | 0.000792 | 0.000000 | 0.000473 | 0.000528 | 0.000143 | 0.001397 | 0.000572 | 0.000682 | 0.000187 |
| 85 | 0.004826 | 0.000387 | 0.000733 | 0.000000 | 0.000428 | 0.000509 | 0.000143 | 0.001283 | 0.000550 | 0.000611 | 0.000183 |
| gross | 1.059920 | 0.080084 | 0.127901 | 0.000000 | 0.075575 | 0.113795 | 0.034605 | 0.338173 | 0.106341 | 0.124237 | 0.059209 |
| crude | 0.013432 | 0.001011 | 0.001584 | 0.000000 | 0.000941 | 0.001457 | 0.000443 | 0.004344 | 0.001331 | 0.001544 | 0.000778 |
| m.age | 32.9165 | 33.3448 | 34.4034 | 0.0000 | 34.1620 | 31.9502 | 31.5567 | 31.2203 | 34.4232 | 36.4227 | 29.8124 |

migration from e.midl. to

| age | total | north | yorkshir | n.west | e.midl. | w.midl. | e.anglia | s.east | s.west | wales | scotland |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.029266 | 0.002006 | 0.005708 | 0.002153 | 0.000000 | 0.004243 | 0.002532 | 0.006769 | 0.002768 | 0.000991 | 0.002097 |
| 5 | 0.021987 | 0.001373 | 0.003957 | 0.001705 | 0.000000 | 0.003119 | 0.002260 | 0.005389 | 0.002260 | 0.000782 | 0.001142 |
| 10 | 0.015786 | 0.000997 | 0.002730 | 0.001190 | 0.000000 | 0.002195 | 0.001616 | 0.004121 | 0.001637 | 0.000531 | 0.000768 |
| 15 | 0.032986 | 0.002104 | 0.004927 | 0.002201 | 0.000000 | 0.004107 | 0.003066 | 0.011134 | 0.003348 | 0.000966 | 0.001134 |
| 20 | 0.049833 | 0.003288 | 0.008062 | 0.003539 | 0.000000 | 0.006788 | 0.003406 | 0.016720 | 0.004105 | 0.001741 | 0.002185 |
| 25 | 0.039435 | 0.002449 | 0.007422 | 0.003768 | 0.000000 | 0.005809 | 0.003042 | 0.010267 | 0.003571 | 0.001176 | 0.001930 |
| 30 | 0.027482 | 0.001790 | 0.004895 | 0.002562 | 0.000000 | 0.004474 | 0.002391 | 0.006934 | 0.002289 | 0.001017 | 0.001130 |
| 35 | 0.019075 | 0.001151 | 0.003546 | 0.001377 | 0.000000 | 0.003296 | 0.001874 | 0.004943 | 0.001717 | 0.000472 | 0.000698 |
| 40 | 0.013134 | 0.000775 | 0.002444 | 0.000946 | 0.000000 | 0.002230 | 0.001279 | 0.003471 | 0.001165 | 0.000342 | 0.000480 |
| 45 | 0.009550 | 0.000450 | 0.001687 | 0.000766 | 0.000000 | 0.001229 | 0.000824 | 0.003005 | 0.000908 | 0.000338 | 0.000343 |
| 50 | 0.009001 | 0.000418 | 0.001585 | 0.000727 | 0.000000 | 0.001135 | 0.000779 | 0.002840 | 0.000873 | 0.000324 | 0.000319 |
| 55 | 0.006867 | 0.000331 | 0.001225 | 0.000557 | 0.000000 | 0.000838 | 0.000612 | 0.002088 | 0.000713 | 0.000246 | 0.000256 |
| 60 | 0.006708 | 0.000409 | 0.001374 | 0.000533 | 0.000000 | 0.000458 | 0.000814 | 0.001277 | 0.001196 | 0.000291 | 0.000356 |
| 65 | 0.008492 | 0.000249 | 0.001872 | 0.000556 | 0.000000 | 0.000824 | 0.000984 | 0.001815 | 0.001502 | 0.000498 | 0.000192 |
| 70 | 0.006739 | 0.000191 | 0.001470 | 0.000435 | 0.000000 | 0.000722 | 0.000765 | 0.001461 | 0.001157 | 0.000391 | 0.000148 |
| 75 | 0.005607 | 0.000158 | 0.001227 | 0.000356 | 0.000000 | 0.000620 | 0.000633 | 0.001227 | 0.000950 | 0.000317 | 0.000119 |
| 80 | 0.005843 | 0.000160 | 0.001232 | 0.000388 | 0.000000 | 0.000685 | 0.000639 | 0.001301 | 0.000959 | 0.000342 | 0.000137 |
| 85 | 0.005678 | 0.000232 | 0.001197 | 0.000386 | 0.000000 | 0.000695 | 0.000618 | 0.001082 | 0.000888 | 0.000386 | 0.000193 |
| gross | 1.567350 | 0.092659 | 0.282806 | 0.120732 | 0.000000 | 0.217339 | 0.140677 | 0.429219 | 0.160019 | 0.055766 | 0.068133 |
| crude | 0.020636 | 0.001267 | 0.003672 | 0.001595 | 0.000000 | 0.002895 | 0.001815 | 0.005741 | 0.002010 | 0.000702 | 0.000941 |
| m.age | 30.6267 | 27.2283 | 31.8215 | 30.3289 | 0.0000 | 29.3943 | 32.1183 | 29.5617 | 34.4373 | 34.3166 | 26.4082 |

APPENDIX D *Continued.*

migration from w.midl. to

| age | total | north | yorkshir | n.west | e.midl. | w.midl. | e.anglia | s.east | s.west | wales | scotland |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.018296 | 0.001022 | 0.001247 | 0.002704 | 0.003708 | 0.000000 | 0.000594 | 0.004661 | 0.002357 | 0.001406 | 0.000598 |
| 5 | 0.014973 | 0.000770 | 0.001036 | 0.001715 | 0.002290 | 0.000000 | 0.000700 | 0.004387 | 0.002210 | 0.001120 | 0.000745 |
| 10 | 0.013555 | 0.000680 | 0.000932 | 0.001545 | 0.002018 | 0.000000 | 0.000634 | 0.004128 | 0.001986 | 0.000974 | 0.000658 |
| 15 | 0.024028 | 0.000933 | 0.001659 | 0.002606 | 0.003271 | 0.000000 | 0.001123 | 0.008877 | 0.003321 | 0.001321 | 0.000916 |
| 20 | 0.036849 | 0.001475 | 0.002456 | 0.003933 | 0.005823 | 0.000000 | 0.001174 | 0.013864 | 0.004353 | 0.002418 | 0.001354 |
| 25 | 0.028724 | 0.001231 | 0.001792 | 0.003924 | 0.004854 | 0.000000 | 0.000966 | 0.008941 | 0.003439 | 0.002273 | 0.001304 |
| 30 | 0.019174 | 0.000709 | 0.001747 | 0.002114 | 0.003325 | 0.000000 | 0.000576 | 0.005871 | 0.002635 | 0.001522 | 0.000675 |
| 35 | 0.014560 | 0.000710 | 0.000840 | 0.001737 | 0.002207 | 0.000000 | 0.000498 | 0.004613 | 0.002210 | 0.001083 | 0.000663 |
| 40 | 0.012122 | 0.000571 | 0.000705 | 0.001444 | 0.001826 | 0.000000 | 0.000412 | 0.003829 | 0.001863 | 0.000928 | 0.000544 |
| 45 | 0.007977 | 0.000213 | 0.000508 | 0.001013 | 0.001035 | 0.000000 | 0.000314 | 0.002360 | 0.001425 | 0.000758 | 0.000351 |
| 50 | 0.007382 | 0.000198 | 0.000465 | 0.000931 | 0.000951 | 0.000000 | 0.000295 | 0.002176 | 0.001336 | 0.000710 | 0.000321 |
| 55 | 0.006658 | 0.000188 | 0.000393 | 0.000836 | 0.000812 | 0.000000 | 0.000258 | 0.001869 | 0.001314 | 0.000687 | 0.000301 |
| 60 | 0.008416 | 0.000346 | 0.000244 | 0.001005 | 0.000590 | 0.000000 | 0.000277 | 0.001489 | 0.002701 | 0.001281 | 0.000484 |
| 65 | 0.005397 | 0.000224 | 0.000164 | 0.000625 | 0.000374 | 0.000000 | 0.000182 | 0.000944 | 0.001724 | 0.000853 | 0.000306 |
| 70 | 0.003029 | 0.000117 | 0.000091 | 0.000356 | 0.000220 | 0.000000 | 0.000097 | 0.000537 | 0.000971 | 0.000466 | 0.000175 |
| 75 | 0.003408 | 0.000148 | 0.000089 | 0.000433 | 0.000236 | 0.000000 | 0.000099 | 0.000611 | 0.001103 | 0.000493 | 0.000197 |
| 80 | 0.003374 | 0.000120 | 0.000086 | 0.000411 | 0.000257 | 0.000000 | 0.000103 | 0.000617 | 0.001096 | 0.000462 | 0.000223 |
| 85 | 0.003295 | 0.000178 | 0.000059 | 0.000445 | 0.000178 | 0.000000 | 0.000148 | 0.000594 | 0.001069 | 0.000445 | 0.000178 |
| gross | 1.156082 | 0.049151 | 0.072566 | 0.138882 | 0.169869 | 0.000000 | 0.042246 | 0.351833 | 0.185568 | 0.096007 | 0.049960 |
| crude | 0.015620 | 0.000672 | 0.001019 | 0.001875 | 0.002396 | 0.000000 | 0.000573 | 0.004889 | 0.002317 | 0.001224 | 0.000656 |
| m.age | 30.8857 | 29.2462 | 27.3930 | 30.9048 | 27.1025 | 0.0000 | 29.9624 | 28.6431 | 37.2919 | 36.0995 | 33.1423 |

migration from e.anglia to

| age | total | north | yorkshir | n.west | e.midl. | w.midl. | e.anglia | s.east | s.west | wales | scotland |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.038190 | 0.000660 | 0.002704 | 0.002113 | 0.004172 | 0.002720 | 0.000000 | 0.018345 | 0.003605 | 0.001453 | 0.002416 |
| 5 | 0.026073 | 0.000445 | 0.001537 | 0.001656 | 0.002925 | 0.001656 | 0.000000 | 0.012695 | 0.003333 | 0.000535 | 0.001292 |
| 10 | 0.019921 | 0.000360 | 0.001159 | 0.001159 | 0.002160 | 0.001343 | 0.000000 | 0.009842 | 0.002546 | 0.000430 | 0.000922 |
| 15 | 0.034466 | 0.000806 | 0.002014 | 0.001042 | 0.003257 | 0.002793 | 0.000000 | 0.018687 | 0.004194 | 0.000797 | 0.000876 |
| 20 | 0.056405 | 0.002004 | 0.003471 | 0.002687 | 0.006529 | 0.003450 | 0.000000 | 0.030392 | 0.004503 | 0.001344 | 0.002026 |
| 25 | 0.047035 | 0.001317 | 0.002551 | 0.002541 | 0.005479 | 0.003066 | 0.000000 | 0.025304 | 0.003103 | 0.001298 | 0.002376 |
| 30 | 0.031028 | 0.000786 | 0.002347 | 0.002221 | 0.003501 | 0.002493 | 0.000000 | 0.014782 | 0.002134 | 0.001368 | 0.001397 |
| 35 | 0.023465 | 0.000800 | 0.001649 | 0.001234 | 0.002626 | 0.001283 | 0.000000 | 0.011412 | 0.003050 | 0.000523 | 0.000888 |
| 40 | 0.015491 | 0.000562 | 0.001063 | 0.000798 | 0.001769 | 0.000818 | 0.000000 | 0.007607 | 0.001933 | 0.000378 | 0.000562 |
| 45 | 0.011921 | 0.000467 | 0.000750 | 0.000540 | 0.001537 | 0.000329 | 0.000000 | 0.006423 | 0.000933 | 0.000586 | 0.000357 |
| 50 | 0.013712 | 0.000530 | 0.000866 | 0.000617 | 0.001775 | 0.000368 | 0.000000 | 0.007392 | 0.001071 | 0.000682 | 0.000411 |
| 55 | 0.006855 | 0.000258 | 0.000456 | 0.000288 | 0.000863 | 0.000208 | 0.000000 | 0.003710 | 0.000526 | 0.000337 | 0.000208 |
| 60 | 0.007109 | 0.000136 | 0.000595 | 0.000104 | 0.000637 | 0.000511 | 0.000000 | 0.003977 | 0.000543 | 0.000397 | 0.000209 |
| 65 | 0.007013 | 0.000425 | 0.000390 | 0.000071 | 0.000874 | 0.000460 | 0.000000 | 0.003636 | 0.000815 | 0.000153 | 0.000189 |
| 70 | 0.009414 | 0.000570 | 0.000489 | 0.000098 | 0.001173 | 0.000619 | 0.000000 | 0.004935 | 0.001091 | 0.000195 | 0.000244 |
| 75 | 0.006759 | 0.000388 | 0.000388 | 0.000069 | 0.000868 | 0.000457 | 0.000000 | 0.003516 | 0.000754 | 0.000137 | 0.000183 |
| 80 | 0.006866 | 0.000398 | 0.000398 | 0.000072 | 0.000831 | 0.000398 | 0.000000 | 0.003650 | 0.000795 | 0.000145 | 0.000181 |
| 85 | 0.006976 | 0.000397 | 0.000340 | 0.000113 | 0.000907 | 0.000454 | 0.000000 | 0.003630 | 0.000737 | 0.000170 | 0.000227 |
| gross | 1.843488 | 0.056542 | 0.115832 | 0.087113 | 0.209414 | 0.117130 | 0.000000 | 0.949670 | 0.178332 | 0.054637 | 0.074818 |
| crude | 0.024094 | 0.000693 | 0.001522 | 0.001194 | 0.002716 | 0.001539 | 0.000000 | 0.012401 | 0.002311 | 0.000713 | 0.001005 |
| m.age | 30.4683 | 37.6060 | 30.1496 | 25.6726 | 31.4258 | 28.7492 | 0.0000 | 30.8105 | 30.2550 | 31.3702 | 26.6678 |

migration from s.east to

| age | total | north | yorkshir | n.west | e.midl. | w.midl. | e.anglia | s.east | s.west | wales | scotland |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.017867 | 0.000962 | 0.001473 | 0.001650 | 0.002332 | 0.001705 | 0.003305 | 0.000000 | 0.004413 | 0.000705 | 0.001321 |
| 5 | 0.012554 | 0.000634 | 0.000891 | 0.001285 | 0.001555 | 0.001119 | 0.001997 | 0.000000 | 0.003510 | 0.000569 | 0.000995 |
| 10 | 0.010029 | 0.000511 | 0.000709 | 0.001000 | 0.001213 | 0.000909 | 0.001560 | 0.000000 | 0.002845 | 0.000484 | 0.000798 |
| 15 | 0.017038 | 0.000928 | 0.001229 | 0.001557 | 0.001846 | 0.001751 | 0.002250 | 0.000000 | 0.004993 | 0.001082 | 0.001401 |
| 20 | 0.031941 | 0.001862 | 0.002670 | 0.003760 | 0.004095 | 0.003471 | 0.004118 | 0.000000 | 0.007594 | 0.001761 | 0.002612 |
| 25 | 0.025579 | 0.001497 | 0.002020 | 0.002721 | 0.003410 | 0.002421 | 0.003646 | 0.000000 | 0.006372 | 0.001376 | 0.002116 |
| 30 | 0.017382 | 0.001023 | 0.001272 | 0.001686 | 0.001933 | 0.001798 | 0.002626 | 0.000000 | 0.004750 | 0.000835 | 0.001459 |
| 35 | 0.011985 | 0.000549 | 0.000826 | 0.001329 | 0.001329 | 0.001160 | 0.001896 | 0.000000 | 0.003340 | 0.000636 | 0.000919 |
| 40 | 0.008782 | 0.000397 | 0.000599 | 0.000965 | 0.000948 | 0.000832 | 0.001397 | 0.000000 | 0.002523 | 0.000459 | 0.000662 |
| 45 | 0.007855 | 0.000349 | 0.000473 | 0.000692 | 0.000638 | 0.000710 | 0.001273 | 0.000000 | 0.002715 | 0.000452 | 0.000554 |
| 50 | 0.007439 | 0.000332 | 0.000449 | 0.000658 | 0.000606 | 0.000598 | 0.001218 | 0.000000 | 0.002613 | 0.000433 | 0.000531 |
| 55 | 0.006786 | 0.000302 | 0.000393 | 0.000581 | 0.000537 | 0.000422 | 0.001177 | 0.000000 | 0.002506 | 0.000396 | 0.000473 |
| 60 | 0.007828 | 0.000321 | 0.000287 | 0.000563 | 0.000582 | 0.000343 | 0.001631 | 0.000000 | 0.003372 | 0.000392 | 0.000339 |
| 65 | 0.008685 | 0.000368 | 0.000409 | 0.000569 | 0.000768 | 0.000509 | 0.001444 | 0.000000 | 0.003718 | 0.000446 | 0.000469 |
| 70 | 0.005515 | 0.000221 | 0.000265 | 0.000366 | 0.000482 | 0.000329 | 0.000905 | 0.000000 | 0.002365 | 0.000288 | 0.000295 |
| 75 | 0.005111 | 0.000193 | 0.000256 | 0.000344 | 0.000449 | 0.000317 | 0.000819 | 0.000000 | 0.002206 | 0.000261 | 0.000268 |
| 80 | 0.004958 | 0.000183 | 0.000253 | 0.000335 | 0.000436 | 0.000313 | 0.000794 | 0.000000 | 0.002136 | 0.000250 | 0.000257 |
| 85 | 0.004470 | 0.000148 | 0.000231 | 0.000308 | 0.000379 | 0.000324 | 0.000704 | 0.000000 | 0.001919 | 0.000225 | 0.000231 |
| gross | 1.059021 | 0.053848 | 0.073519 | 0.101850 | 0.117653 | 0.095154 | 0.163799 | 0.000000 | 0.319448 | 0.055250 | 0.078501 |
| crude | 0.013488 | 0.000705 | 0.000969 | 0.001337 | 0.001543 | 0.001251 | 0.002072 | 0.000000 | 0.003881 | 0.000702 | 0.001028 |
| m.age | 33.9820 | 31.4063 | 30.5003 | 31.4593 | 30.7432 | 30.7079 | 34.7533 | 0.0000 | 38.3741 | 34.5657 | 31.2120 |

migration from s.west to

| age | total | north | yorkshir | n.west | e.midl. | w.midl. | e.anglia | s.east | s.west | wales | scotland |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.032271 | 0.001168 | 0.002173 | 0.001341 | 0.001764 | 0.003365 | 0.001320 | 0.017373 | 0.000000 | 0.001919 | 0.001848 |
| 5 | 0.022570 | 0.000943 | 0.001401 | 0.001463 | 0.001501 | 0.001882 | 0.000914 | 0.011776 | 0.000000 | 0.001153 | 0.001537 |
| 10 | 0.018175 | 0.000719 | 0.001035 | 0.001099 | 0.001118 | 0.001588 | 0.000738 | 0.009778 | 0.000000 | 0.000930 | 0.001170 |
| 15 | 0.036038 | 0.001046 | 0.001250 | 0.001545 | 0.001675 | 0.003785 | 0.001305 | 0.021820 | 0.000000 | 0.001875 | 0.001737 |
| 20 | 0.064100 | 0.002015 | 0.003470 | 0.003263 | 0.002303 | 0.006639 | 0.002384 | 0.037282 | 0.000000 | 0.003041 | 0.003703 |
| 25 | 0.049720 | 0.001794 | 0.002892 | 0.003097 | 0.002572 | 0.004479 | 0.001649 | 0.027485 | 0.000000 | 0.002712 | 0.003040 |
| 30 | 0.031690 | 0.001423 | 0.001782 | 0.002238 | 0.001731 | 0.003145 | 0.001169 | 0.016188 | 0.000000 | 0.001929 | 0.002086 |
| 35 | 0.023121 | 0.000976 | 0.001216 | 0.001674 | 0.001235 | 0.002433 | 0.000948 | 0.012230 | 0.000000 | 0.001033 | 0.001377 |
| 40 | 0.015559 | 0.000631 | 0.000799 | 0.001094 | 0.000795 | 0.001653 | 0.000636 | 0.008292 | 0.000000 | 0.000763 | 0.000895 |
| 45 | 0.011532 | 0.000276 | 0.000420 | 0.000564 | 0.000507 | 0.001322 | 0.000453 | 0.006792 | 0.000000 | 0.000811 | 0.000387 |
| 50 | 0.011563 | 0.000276 | 0.000416 | 0.000571 | 0.000501 | 0.001329 | 0.000454 | 0.006813 | 0.000000 | 0.000810 | 0.000393 |
| 55 | 0.007473 | 0.000188 | 0.000266 | 0.000364 | 0.000304 | 0.000809 | 0.000308 | 0.004454 | 0.000000 | 0.000527 | 0.000253 |
| 60 | 0.007478 | 0.000282 | 0.000203 | 0.000317 | 0.000150 | 0.000361 | 0.000432 | 0.004910 | 0.000000 | 0.000560 | 0.000256 |
| 65 | 0.008345 | 0.000069 | 0.000451 | 0.000436 | 0.000367 | 0.000922 | 0.000406 | 0.005045 | 0.000000 | 0.000456 | 0.000193 |
| 70 | 0.007029 | 0.000066 | 0.000375 | 0.000389 | 0.000296 | 0.000771 | 0.000329 | 0.004229 | 0.000000 | 0.000389 | 0.000184 |
| 75 | 0.007323 | 0.000068 | 0.000407 | 0.000397 | 0.000320 | 0.000823 | 0.000349 | 0.004388 | 0.000000 | 0.000387 | 0.000184 |
| 80 | 0.007385 | 0.000079 | 0.000381 | 0.000413 | 0.000318 | 0.000842 | 0.000349 | 0.004415 | 0.000000 | 0.000381 | 0.000206 |
| 85 | 0.006973 | 0.000076 | 0.000407 | 0.000433 | 0.000280 | 0.000763 | 0.000305 | 0.004148 | 0.000000 | 0.000382 | 0.000178 |
| gross | 1.841683 | 0.060473 | 0.096728 | 0.103484 | 0.088677 | 0.184561 | 0.072246 | 1.037087 | 0.000000 | 0.100287 | 0.098139 |
| crude | 0.023457 | 0.000798 | 0.001240 | 0.001302 | 0.001138 | 0.002334 | 0.000911 | 0.013169 | 0.000000 | 0.001272 | 0.001293 |
| m.age | 30.9140 | 26.9211 | 29.5610 | 31.5764 | 29.1381 | 31.5534 | 32.2318 | 31.4598 | 0.0000 | 31.6530 | 26.9190 |

APPENDIX D *Continued.*

| | migration from wales to | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| age | total | north | yorkshir | n.west | e.midl. | w.midl. | e.anglia | s.east | s.west | wales | scotland |
| 0 | 0.021071 | 0.000827 | 0.001372 | 0.004392 | 0.001419 | 0.002814 | 0.000836 | 0.005035 | 0.003358 | 0.000000 | 0.001019 |
| 5 | 0.013506 | 0.000763 | 0.000454 | 0.001962 | 0.000850 | 0.002002 | 0.000371 | 0.003877 | 0.002595 | 0.000000 | 0.000632 |
| 10 | 0.010979 | 0.000564 | 0.000364 | 0.001635 | 0.000666 | 0.001630 | 0.000302 | 0.003311 | 0.002045 | 0.000000 | 0.000461 |
| 15 | 0.025687 | 0.000810 | 0.001030 | 0.003717 | 0.001417 | 0.003607 | 0.000732 | 0.009535 | 0.004302 | 0.000000 | 0.000538 |
| 20 | 0.045754 | 0.001369 | 0.002479 | 0.006038 | 0.002260 | 0.005475 | 0.001130 | 0.018800 | 0.006620 | 0.000000 | 0.001583 |
| 25 | 0.030120 | 0.000858 | 0.001224 | 0.004541 | 0.002280 | 0.004199 | 0.001140 | 0.009112 | 0.004583 | 0.000000 | 0.002184 |
| 30 | 0.018181 | 0.001036 | 0.000922 | 0.002843 | 0.001226 | 0.002142 | 0.000619 | 0.005370 | 0.003222 | 0.000000 | 0.000802 |
| 35 | 0.013257 | 0.000681 | 0.000668 | 0.002226 | 0.000872 | 0.002023 | 0.000547 | 0.003626 | 0.002017 | 0.000000 | 0.000598 |
| 40 | 0.010305 | 0.000493 | 0.000534 | 0.001730 | 0.000686 | 0.001543 | 0.000399 | 0.002833 | 0.001619 | 0.000000 | 0.000469 |
| 45 | 0.006631 | 0.000091 | 0.000406 | 0.001100 | 0.000454 | 0.000763 | 0.000123 | 0.002109 | 0.001377 | 0.000000 | 0.000208 |
| 50 | 0.004981 | 0.000070 | 0.000311 | 0.000825 | 0.000343 | 0.000590 | 0.000089 | 0.001574 | 0.001028 | 0.000000 | 0.000152 |
| 55 | 0.005079 | 0.000071 | 0.000317 | 0.000800 | 0.000317 | 0.000635 | 0.000082 | 0.001611 | 0.001111 | 0.000000 | 0.000135 |
| 60 | 0.006703 | 0.000109 | 0.000304 | 0.000795 | 0.000067 | 0.001069 | 0.000182 | 0.002168 | 0.001998 | 0.000000 | 0.000012 |
| 65 | 0.004669 | 0.000048 | 0.000324 | 0.000924 | 0.000138 | 0.000952 | 0.000172 | 0.001034 | 0.000972 | 0.000000 | 0.000103 |
| 70 | 0.005748 | 0.000058 | 0.000379 | 0.001136 | 0.000194 | 0.001146 | 0.000252 | 0.001311 | 0.001136 | 0.000000 | 0.000136 |
| 75 | 0.006181 | 0.000060 | 0.000393 | 0.001254 | 0.000227 | 0.001194 | 0.000272 | 0.001451 | 0.001194 | 0.000000 | 0.000136 |
| 80 | 0.006454 | 0.000054 | 0.000430 | 0.001264 | 0.000215 | 0.001264 | 0.000323 | 0.001506 | 0.001237 | 0.000000 | 0.000161 |
| 85 | 0.005960 | 0.000048 | 0.000339 | 0.001211 | 0.000242 | 0.001163 | 0.000291 | 0.001357 | 0.001114 | 0.000000 | 0.000194 |
| gross | 1.206328 | 0.040048 | 0.061241 | 0.191967 | 0.069357 | 0.171043 | 0.039310 | 0.378092 | 0.207642 | 0.000000 | 0.047628 |
| crude | 0.015219 | 0.000537 | 0.000758 | 0.002374 | 0.000897 | 0.002089 | 0.000475 | 0.004890 | 0.002587 | 0.000000 | 0.000612 |
| m.age | 31.8186 | 25.3755 | 33.8265 | 32.9420 | 28.8456 | 34.2491 | 33.7703 | 30.2241 | 33.7367 | 0.0000 | 28.4126 |

| | migration from scotland to | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| age | total | north | yorkshir | n.west | e.midl. | w.midl. | e.anglia | s.east | s.west | wales | scotland |
| 0 | 0.016933 | 0.001758 | 0.001718 | 0.002072 | 0.001734 | 0.001563 | 0.000471 | 0.005628 | 0.001631 | 0.000358 | 0.000000 |
| 5 | 0.012379 | 0.001170 | 0.001275 | 0.001536 | 0.001422 | 0.000991 | 0.000427 | 0.004089 | 0.001188 | 0.000282 | 0.000000 |
| 10 | 0.008540 | 0.000766 | 0.000848 | 0.001002 | 0.000905 | 0.000685 | 0.000305 | 0.003012 | 0.000814 | 0.000204 | 0.000000 |
| 15 | 0.017360 | 0.001141 | 0.001355 | 0.001554 | 0.000932 | 0.001412 | 0.000733 | 0.008083 | 0.101659 | 0.000493 | 0.000000 |
| 20 | 0.029778 | 0.002269 | 0.001814 | 0.003052 | 0.001797 | 0.002291 | 0.000959 | 0.014226 | 0.002657 | 0.000712 | 0.000000 |
| 25 | 0.024901 | 0.002905 | 0.001751 | 0.003314 | 0.002083 | 0.001658 | 0.000583 | 0.009839 | 0.001987 | 0.000781 | 0.000000 |
| 30 | 0.017416 | 0.001545 | 0.001155 | 0.002611 | 0.001391 | 0.001576 | 0.000581 | 0.006982 | 0.001265 | 0.000311 | 0.000000 |
| 35 | 0.011930 | 0.001281 | 0.001084 | 0.001785 | 0.000987 | 0.000680 | 0.000563 | 0.004235 | 0.000967 | 0.000349 | 0.000000 |
| 40 | 0.008275 | 0.000881 | 0.000758 | 0.001209 | 0.000695 | 0.000483 | 0.000384 | 0.002917 | 0.000682 | 0.000265 | 0.000000 |
| 45 | 0.004797 | 0.000461 | 0.000458 | 0.000427 | 0.000471 | 0.000390 | 0.000186 | 0.001617 | 0.000427 | 0.000359 | 0.000000 |
| 50 | 0.003963 | 0.000380 | 0.000377 | 0.000359 | 0.000387 | 0.000320 | 0.000155 | 0.001334 | 0.000352 | 0.000299 | 0.000000 |
| 55 | 0.002549 | 0.000233 | 0.000239 | 0.000239 | 0.000249 | 0.000204 | 0.000105 | 0.000881 | 0.000236 | 0.000163 | 0.000000 |
| 60 | 0.002462 | 0.000187 | 0.000166 | 0.000343 | 0.000170 | 0.000139 | 0.000104 | 0.001046 | 0.000211 | 0.000097 | 0.000000 |
| 65 | 0.002503 | 0.000316 | 0.000099 | 0.000374 | 0.000140 | 0.000160 | 0.000119 | 0.000933 | 0.000288 | 0.000074 | 0.000000 |
| 70 | 0.002014 | 0.000224 | 0.000081 | 0.000339 | 0.000121 | 0.000132 | 0.000092 | 0.000748 | 0.000213 | 0.000063 | 0.000000 |
| 75 | 0.002565 | 0.000270 | 0.000087 | 0.000470 | 0.000148 | 0.000165 | 0.000104 | 0.000965 | 0.000261 | 0.000096 | 0.000000 |
| 80 | 0.002594 | 0.000252 | 0.000094 | 0.000472 | 0.000142 | 0.000157 | 0.000110 | 0.001006 | 0.000267 | 0.000094 | 0.000000 |
| 85 | 0.002589 | 0.000238 | 0.000089 | 0.000506 | 0.000149 | 0.000119 | 0.000089 | 0.001042 | 0.000268 | 0.000089 | 0.000000 |
| gross | 0.867742 | 0.081376 | 0.067244 | 0.108309 | 0.069607 | 0.065631 | 0.030351 | 0.342913 | 0.076867 | 0.025444 | 0.000000 |
| crude | 0.011690 | 0.001081 | 0.000940 | 0.001407 | 0.000960 | 0.000904 | 0.000402 | 0.004626 | 0.001040 | 0.000330 | 0.000000 |
| m.age | 28.5588 | 29.2687 | 25.8823 | 30.6126 | 26.8696 | 26.7689 | 30.3330 | 28.4798 | 28.5608 | 32.7977 | 0.0000 |

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