The analysis of internal migration in the United Kingdom using Census and National Health Service Central Register data

by

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Abstract

The Census provides spatially detailed information on internal migration within the UK. It is only available decenially, however, so during inter-censal years it is necessary to rely on the NHSCR as an alternative measure of population movement. The value of the NHSCR in the analysis of migration and its suitability as an input to the procedure for projecting sub-national populations remains uncertain.

This thesis examines the relationship between NHSCR and Census-derived migration data for a common period (1980/81) and illustrates the conceptual and measurement differences and similarities between the two. Although a strong correlation between the respective patterns of migration is evidenced, significant spatial and age-sex discrepancies in the measured levels of population movement are observed. The presence of Armed Forces and student moves and the phenomenon of multiple/return migration, particularly amongst young adults, are cited as major reasons for the differences.

Given an understanding of the characteristics of each type of data, the thesis undertakes to illustrate spatio-temporal patterns and trends in migration since 1970 using both transition and movement information. A reduction in the level of migration throughout the seventies and early eighties has been followed by an increase in the general propensity to migrate, with increasing decentralisation processes moving people away from the most densely populated areas, but with an increasing attractiveness of the South East, particularly Greater London, to young, mobile adults and a net loss of migrants from North to South.

The illustration of contemporary trends in migration using time-series data highlights the potential shortcomings of a sub-national population projection model based primarily on 1981 Census information. The thesis critically examines a number of features of the migration component of the OPCS/DOE projection procedure using NHSCR migration data, and suggests possible improvements to the methodology.

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Abbreviations

AF	Armed Forces
ATP	Age-time plan
CSD	Computer-summary data
DOE	Department of the Environment
FUR	Functional Urban Region
GHS	General Household Survey
GIMMS	Geographic Information Management and Mapping System
GMR	Gross migra-production rate
HMSO	Her Majestys Stationary Office
IIASA	International Institute for Applied Systems Analysis
IGS	Information Gain Statistic
IH	Industrial Heartland
IOD	Index of Dissimilarity
LCL	Lower confidence limit
LFS	Labour Force Survey
LS	Longitudinal Study
MAD	Mean Absolute Deviation
MELA	Metropolitan Economic Labour Area
MML	Mean migration length
MNM	Metropolitan/non-metropolitan
NDHS	National Dwelling and Housing Survey
NHSCR	National Health Service Central Register
OMA	Outer Metropolitan Area
OPCS	Office of Population Censuses and Surveys
OSE	Outer South East
PUD	Primary Unit Data
ROS	Rest of the South
SED	Squared Euclidian distance
SER	South East remainder
SMLA	Standard Metropolitan Labour Area
SPSSX	Statistical Package for the Social Sciences
UCL	Upper confidence limit
UMRCC	University of Manchester Regional Computing Centre
UK	United Kingdom

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Chapter 1. INTRODUCTION

1.1 THE IMPORTANCE OF INTERNAL MIGRATION

Internal migration is currently the most important demographic component shaping the spatial pattern of population change in the United Kingdom (UK). Rates of natural change and of net migration between the UK and the rest of the world have been much less significant than rates of internal net migration in determining sub-national population changes, although it should be acknowledged that

> "there are instances in which fertility differences (such as the high fertility level in Northern Ireland) or mortality differences (the higher mortality rates for the elderly in Northern Britain) or the pattern of external migration (gains to London in particular) have an important influence on population change."
> (Rees and Stillwell, 1987, p.1)

The importance of internal migration is accentuated because the UK has experienced virtually zero population growth over the last two decades. In this context, spatial population dynamics have been determined primarily by patterns of migration behaviour, with resulting implications for the provision of housing, education and other public services.

This thesis aims to identify and analyse the trends and characteristics of migration flows in the UK at different spatial scales, ranging from those between standard regions to those between local authority administrative areas. Comprehensive studies of migration behaviour are limited by the relative paucity of data, and the research reported in this thesis compares and utilizes information from two specific sources - the Census of Population and the National Health Service Central Register (NHSCR).

At present the most reliable source of migration data is the

Census. Currently taken every ten years, it provides a count of all persons undertaking a change of usual residence during the year prior to enumeration. A migrant is identified by area of origin and destination, by age and sex, and by a number of socio-economic indicators. Despite providing comprehensive migration statistics at a fine level of spatial disaggregation, the decennial nature of the Census precludes the identification of inter-censal trends in population movement. The National Health Service Central Register (NHSCR) provides an alternative measure of internal migration. It records the re-registration of NHS patients with a new doctor upon transfer to a new Family Practitioner Committee Area (FPCA). Within England and Wales FPCAs correspond to metropolitan districts, non-metropolitan counties and combinations of London Boroughs. The NHSCR does not record transfers within FPCAs but it does provide a continuous measure of patient movement within the UK disaggregated by age and sex.

The nature of the research that has been undertaken has been influenced by the need to establish improved methods of forecasting inter-regional migration in the context of population projection. Accurate projections require a detailed understanding of historical patterns and trends in the movement of the population. The Census provides only a cross-sectional view of such trends so potentially the NHSCR, because it is an ongoing count, is a more valuable indicator of migration change over time. The current method of population projections for sub- national areas, undertaken jointly by the Office of Population Censuses and Surveys and the Department of the Environment (OPCS/DOE), incorporates a migration forecasting component which is based primarily on Census information and which makes relatively little use of the available time-series of NHSCR data in updating from 1981. This thesis identifies shortcomings in the OPCS/DOE projection model and suggests how improvements might be incorporated.

1.2 THE AIMS OF THE RESEARCH

The research undertaken has three distinct but inter-related objectives. Firstly, to carry out a comparison of the alternative sources of migration data provided by the Census and the NHSCR. Secondly, to construct a detailed picture of spatio-temporal patterns and trends in migration during the 1970s and 1980s using information from successive Censuses and from the NHSCR, and thirdly to evaluate the use of migration data in the OPCS/DOE sub-national population projection model.

Although the Census provides comprehensive and detailed information on the internal movement of the population, it is necessary to rely on alternative data sources, in particular the NHSCR, to provide some indicator of migration behaviour occurring in the years between the censuses. However, the value of NHSCR migration data as an alternative to that obtained from the Census is still uncertain. A major objective of the thesis, therefore, is to carry out a detailed comparison of the two alternative migration data sources for the year prior to the 1981 Census. This work expands upon that previously done by Ogilvy (1980a, 1980b), Thomson (1984) and Devis and Mills (1987). Important conceptual differences between the Census and NHSCR data, ignored by previous analyses, are elucidated and incorporated into the comparison, as are the recognised measurement differences between the two. Devis and Mills

(1987) have provided the most detailed account to date of the major differences that exist between the alternative measures but were concerned primarily with the downward adjustment of the NHSCR for consistency with the Census. Here the comparative research aims to establish the relationship between the respective levels of migration at a variety of spatial scales and levels of age and sex disaggregation. Where possible, adjustment and alignment techniques are used to ensure greater consistency between the data sets and the accuracy of measurement is improved through the reassignment of flows previously excluded from Census and NHSCR tabulations. Statistical methods are utilised to quantify the relationship between the alternative migration data sources. On the strength of these analyses it is possible to make a series of recommendations regarding the use of NHSCR and Census migration data in future population projection procedures and in the analysis of internal migration in general.

Given the understanding developed in the comparative work, subsequent objectives of the thesis may be tackled. With the co-operation of OPCS a large migration and population information system has been constructed containing a time-series of NHSCR movement data for the period mid-year 1975 to mid-year 1986, comprehensive files of migration data from the 1981 Census together with further 1971 Census information, and a variety of population datasets, in particular mid-year estimates from 1975 to 1986. Using this information system it is possible to undertake a detailed analysis of spatio-temporal patterns and trends in the UK's internal migration. These analyses are carried out not only to illustrate important changes in the migration processes shaping the pattern of population redistribution in the UK but also to evaluate the methodology and data inputs to the migration forecasting component of the current OPCS/DOE population projection methodology (Martin, Voorhees and Bates, 1981).

The migration data used in this forecasting process is derived almost entirely from the Census. For this reason spatial and age-sex patterns of population movement from the 1981 Census are examined to establish the underlying processes evident in the 'base-year' of current projections, 1980/81. Previous analyses of migration from the 1981 Census (Devis, 1983; Brant, 1984; Rees and Stillwell, 1987, for example) are complemented with an illustration of patterns at a more disaggregate scale, that of FPCAs, and an evaluation of decentralisation processes by age and sex category. As a precursor to the major time-series analysis, 1981 information is compared with data from the previous Census to give an indication of changes occurring during the 1970s. Previous studies (Ogilvy, 1982; Devis, 1983, 1984; and Stillwell, 1985) have illustrated a reduction in the level of migration and a deceleration in the process of counter-urbanization between 1971 and 1981. These changes are elucidated using a number of alternative spatial aggregations which attempt to illustrate the importance of movement away from the most densely populated areas of the UK and the evidence for a net North-South shift in the population.

The Census, however, gives only a 'snapshot', cross-sectional view of the migration process. By using NHSCR time-series data, a detailed analyis of temporal trends in the internal movement of the population is undertaken. The thesis is particularly concerned with the illustration of trends since 1981, to examine the processes currently shaping population redistribution and to evaluate the effect of these processes upon the accuracy of the OPCS/DOE population projection procedure. Using NHSCR data at its most disaggregate level, that of FPCAs, the changing pattern of movement is examined using a framework which deconsolidates flows into level, generation, attraction and distribution components. Particular attention is focussed on the South East 'system' which continues to dominate internal migration in the UK. To establish the importance of counter-urbanization and decentralization during the 1980s, and to assess the variation between the 'North' and the 'South' of the UK a population density variable and a broad regional classification are utilised. The variation in the pattern of movement by age and sex is also examined with particular reference to the stability and origin-destination patterns of the 'labour-force' and 'retirement' components of migration, to establish the relative importance of decentralization processes between age-groups over time and to identify the spatial preferences of migrants by age and sex. Age-specific NHSCR migration data is used to analyse changes in the shape of zone-specific in- and out-migration profiles and model migration schedules (Rogers et al, 1978) are utilised to summarise the dominant patterns of internal movement in the UK by single year of age. All these analyses contribute to a comprehensive illustration of spatio-temporal patterns and trends in migration since 1970/71.

The structure and data inputs to the migration component of the OPCS/DOE projection model are outlined in detail prior to an evaluation of a number of facets of the model. Spatially detailed and age and sex-disaggregated Census migration flows are utilised in the projection procedure. The pattern of inter-regional movement is generally assumed to remain constant over time so an illustration of change in the origin-destination patterns and the age-sex structure of migration since 1980/81 enables an evaluation of the accuracy of the projection procedure. The research aims to comment critically on the actual and potential use of alternative sources of migration data by OPCS/DOE given the understanding of Census-NHSCR differences and the examination of patterns and trends since 1980/81. The structural framework of the thesis is illustrated in Figure 1.1 with the following sub-section outlining the contents of individual chapters.

1.3 THE STRUCTURE OF THE THESIS

Given these aims, the research undertaken in this thesis is structured as follows. Chapter 2 provides a review of the literature relating to the analysis of migration. It outlines recent empirical studies at national and sub-national scales and by age and sex and identifies specific areas of study which require further research. Some of the more important migration modelling strategies are illustrated with particular reference to techniques utilised in the thesis. A comprehensive description is presented of the OPCS/DOE migration forecasting methodology with detailed discussion of its data inputs and possible shortcomings. The concluding section reviews research objectives in the light of previous work undertaken.

Chapter 3 outlines the variety of spatial scales utilised in the analyses, introduces the reader to the alternative data sources and describes in detail the problems and procedures associated with the acquisition and processing of the migration and population data sets. A considerable amount of time was required to obtain and construct

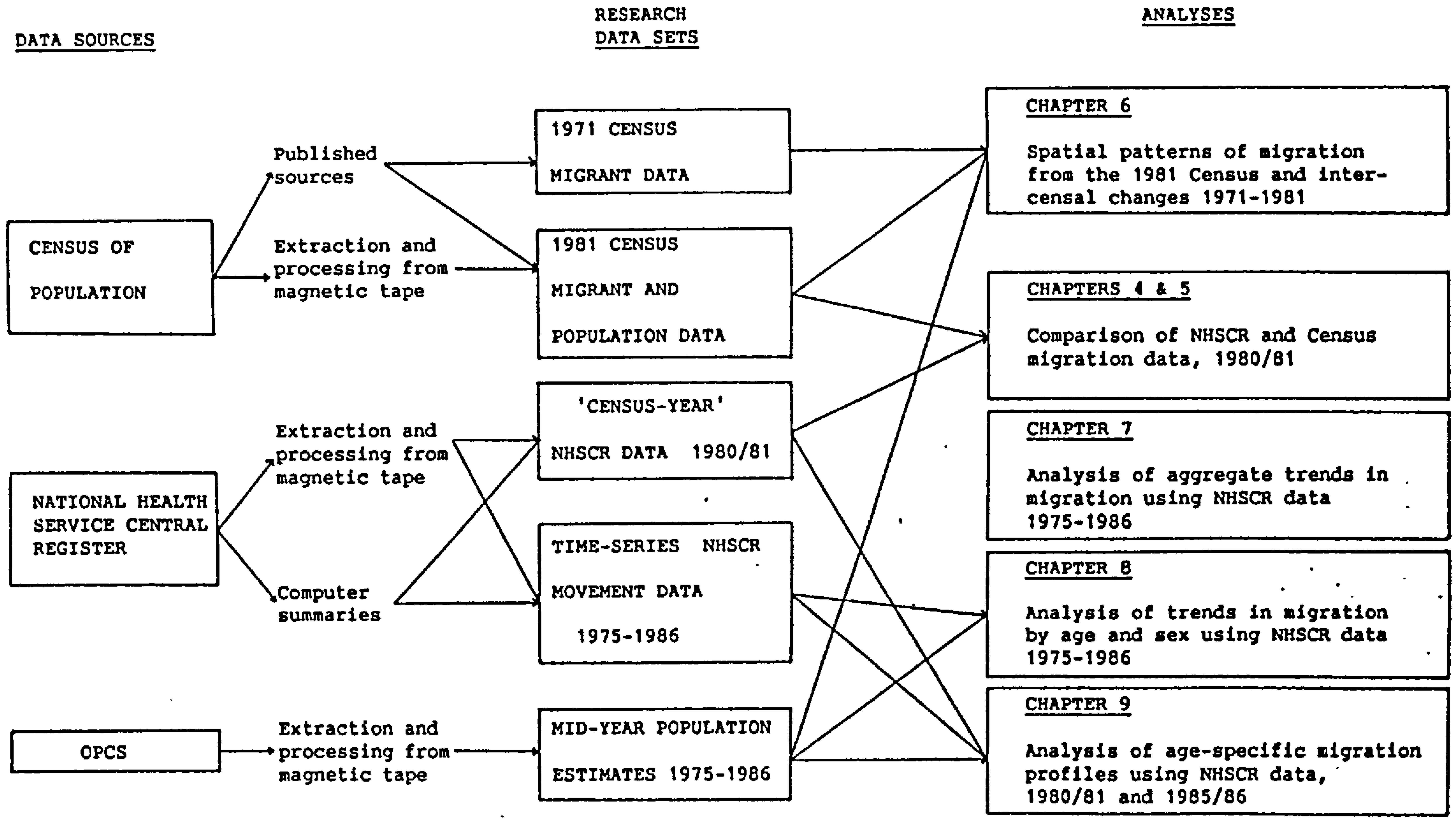


Figure 1.1 The structural framework of the thesis

the fully disaggregate data files. For this reason an initial comparison of the the Census and NHSCR data sources was undertaken in Chapter 4 using information already available. This chapter provides a review of previous comparative analyses and outlines preliminary observations from the comparison of NHSCR and Census flows and rates at a number of spatial scales and levels of age- and sex-disaggregation.

Chapter 5 was undertaken once the optimal sets of Census and NHSCR data for the period 1980-81 had been acquired. More precise techniques of alignment and adjustment are utilised to illustrate the spatial variation and the age-sex differences that exist between the alternative measures of migration. Further statistical and modelling methods are used to quantify the relationship between them. The chapter concludes with some recommendations regarding the handling of NHSCR data and the implications for its use in subsequent chapters of the thesis and in migration analyses in general.

The second part of the thesis is concerned primarily with an illustration of the patterns and trends evident in the migration information obtained from the two data sources. Chapter 6 contains a preliminary analysis of change over time using data from successive Censuses and outlines the spatial patterns of internal migration evident at sub-national levels in 1980/81.

Chapters 7, 8 and 9 are based on NHSCR data. A detailed picture of spatio-temporal patterns and trends in migration during the 1970s and 1980s is constructed and the potential effect of the variation in population movement upon the OPCS/DOE projection procedure is evaluated. Chapter 7 analyses aggregate trends in migration between 1975 and 1986 using a 'components' framework to illustrate temporal variation in the level of in- and out-migration. Measures of population density, a metropolitan/non-metropolitan classification and broad regional divisions are chosen to generate a picture of migration patterns between rural and urban areas, between the most densely populated and more remote areas of the UK and between the 'North' and the 'South'.

In Chapter 8 the analysis of the temporal variation in migration by broad age-group and sex at a variety of spatial scales is continued by examining the preferential movement of age-groups within the UK. Contained within the chapter is an examination of the age-group clustering and assignment procedures utilised within the OPCS/DOE forecasting process.

The analyses are concluded in Chapter 9 with an illustration of changes in the pattern of zonal in- and out-migration by single years of age between 1980/81 and 1985/86. The chapter draws on the work of Rogers et al (1978) to examine variations in age-specific migration profiles across the spatial spectrum and over time. It incorporates an examination of a further facet of the forecasting procedure which utilises a classification of FPCAs based on similarities between observed and modelled migration rate schedules.

Finally in the concluding chapter all the information and results are collated to: assess the relative merits of Census and NHSCR data in the field of migration analysis; review the dominant features of the migration process evident since 1971; reassess the OPCS/DOE projection procedure given the extensive analyses undertaken using NHSCR data; and finally to provide a number of recommendations and possible alternatives for the use of migration statistics in the projection of sub-national population change and in migration analysis in general.

Chapter 2. THE ANALYSIS OF INTERNAL MIGRATION: A REVIEW OF THE LITERATURE

2.1. INTRODUCTION

The spatial phenomenon of population migration has received much attention in recent decades by researchers in both the academic and the planning professions, with the result that a large volume of literature reporting the empirical and modelling analyses of the migration process has accumulated. Whilst this chapter contains a review of empirical results and modelling methodologies of most relevance to the thesis it was considered appropriate to postpone a review of literature on migration definition and measurement until Chapter 4 where it logically precedes a description of the methods to compare the two different types of migration data used in the thesis.

In order to provide some structure to the review which follows in this chapter the material has been divided into three inter-related sections. The first, Section 2.2 provides a summary of empirical analyses of migration in the UK in recent years. It is itself divided into three distinct sections. Section 2.2.1 outlines spatio-temporal variations in the overall level of migration over the last two decades. Section 2.2.2 reviews analyses of patterns and trends in aggregate migration behaviour at a number of spatial scales. This serves not only to identify the major features of movement from the national down to the district level and to contrast the analysis of administrative with functional regions, but also to identify those areas of study which have been neglected and which require further investigation. Finally, Section 2.2.3 reviews the work undertaken in relation to age-specific migration and identifies those areas which require further research and examination.

In Section 2.3 some of the important developments that have taken place in recent years in migration modelling research are outlined. This section is sub-divided into two parts. In Section 2.3.1 approaches to modelling schedules of standardized age-specific migration are reviewed in view of the application of these methods to data sets reported later in the thesis and the relevance of these methods to developing a migration projection methodology. Then in Section 2.3.2, alternative methods of modelling the distribution of migrants between origin and destination zones are outlined, focussing, in particular, on those which are utilised within subsequent analyses but giving some indication of alternative methodologies.

One of the general aims of the research contained in the thesis is to contribute towards the development of more effective, reliable and consistent methods of projecting the population of sub-national areas. This is achieved through greater understanding of pragmatic and conceptual problems associated with alternative data sets and methods of analysis as well as through improved understanding of the migration process itself. It is both necessary and appropriate to spell out the modelling methodology used by the DOE to prepare the current net migration assumptions which feed into the OPCS cohort survival model to generate population projections for sub-national areas in England. The review of the official migration forecasting methodology constitutes Section 2.4 of the chapter.

In the final section, conclusions are drawn and the structure of the research reported in the thesis is outlined in view of previous analyses that have been reviewed in the chapter.

2.2 INTER-REGIONAL MIGRATION IN THE UK: A REVIEW OF EMPIRICAL RESEARCH

2.2.1 The overall level of migration

The illustration of national trends in migration behaviour gives an indication of the general propensity of the population to migrate. This section outlines the variation in the overall level of migration from a number of sources since 1961. Comparison of data from the 1961 and 1971 Censuses of Population, although inadequate because of the ten-year gap between successive enumerations, indicates that the population of England and Wales became more mobile with an increase in the migration rate and the propensity to move over comparatively long distances (Ogilvy, 1979). Whilst 10.5% of persons were recorded as having changed usual residence in the year prior to the 1961 Census, the corresponding figure for the 1971 Census was 11.6%. This latter figure is equivalent to 6.25 million recorded changes of residence in the year preceding the 1971 Census. Stillwell (1985), analysing five-year migration flows from the 1971 Census for a set of metropolitan counties, region remainders and other regions in the UK showed that 4.1 million persons (aged over 5 in 1971) were involved in inter-zonal migration with a further 13.8 million migrating within the same zone. In other words, approximately 7.5% of the usually resident population moved residence between zones.

During the 1970's there was a reversal in the trend of the 1960's with a considerable reduction in the level of overall mobility. In attempting to explain this downturn, Ogilvy (1979) has emphasised the correlation between population movement and the general level of economic prosperity. She cites changes in the distribution and availability of housing and employment as major causes of the decline in overall mobility since 1973. Devis (1983) has illustrated the decline in the mobility rate (defined as the number of usual residents who moved within or into an area per 1000 population aged one and over in that area) from 118 per 1000 in 1971 (6.25 million persons) to 96 per 1000 in 1981 (5 million persons) - a drop of 19%. Using NHSCR patient re-registration data to analyse population movements between the regions of Great Britain, Ogilvy (1982) demonstrates that the total number of NHSCR flows decreased from 999,700 in 1971-73 to 889,300 in 1977-79, a drop of 11%. Devis (1984), also using NHSCR data to study inter-regional moves, further confirmed the general decrease in the mobility level illustrating an average annual decline of approximately 2.5% between 1971 and 1981. A decline in mobility of 16% over the 1976-82 period was noted by Stillwell (1985) using a more spatially disaggregated scale. Furthermore, the decline during the 1970's has been verified by Ogilvy (1979) using data from the Labour Force Survey (LFS) and General Household Survey (GHS). The LFS indicated a constant decline over the 1973-77 period in the number of inter-regional transfers and a total mobility rate of approximately 8.8% in 1977. The GHS, for the period 1971-77 revealed a steady increase in the number of persons who had made no moves in the previous five years and a corresponding decrease in the number who had made one or more moves.

Using more recent data, Rees and Stillwell (1987) have illustrated an upturn in the overall level of mobility since 1980/81. A total of 2.93 million moves were recorded by the NHSCR in 1980/81. By 1985/86 this figure had increased by approximately 10% to 3.23 million.

These national or overall levels of migration hide the considerable spatial variations that exist in the patterns of inter -zonal movement within the UK. Section 2.2.2 provides a review of empirical research relating to the analysis of internal migration at a number of administrative and functional levels of spatial disaggregation.

2.2.2. Spatial patterns and trends in aggregate migration

Sub-national patterns of internal migration have been analysed at a variety of spatial scales in the UK. This section includes a review of more recent studies undertaken with data from the last two Censuses and from the NHS Central Register for different administrative and functional systems of interest.

At the standard region scale, Ogilvy (1982) has examined the volume and direction of inter-regional migration using data from the NHSCR for the period 1971-79. She has indicated that over the period 1971/73, substantial net dispersal of population took place from the South East, with East Anglia, the South West, East Midlands and Wales all gaining considerably through net in-migration (Figure 2.1). The highest net gains expressed as rates per 1000 population were experienced by East Anglia (14.6 per 1000) and the South West (10.9 per 1000). Those regions losing in net terms through migration, in addition to the South East, were Yorkshire and Humberside, the North and North West, the West Midlands and Scotland, although Ogilvy showed the out-migration rates for these regions to be falling over the period. 1973 seems to have been the year in which the migration propensity peaked, and thereafter the situation altered sharply. The net figures for the period 1977/79 indicate a large decrease in the net loss through migration from the South East and a corresponding decrease in the net migration gains in all those regions which had gained (primarily from the South East) in the 1971/3 period. In

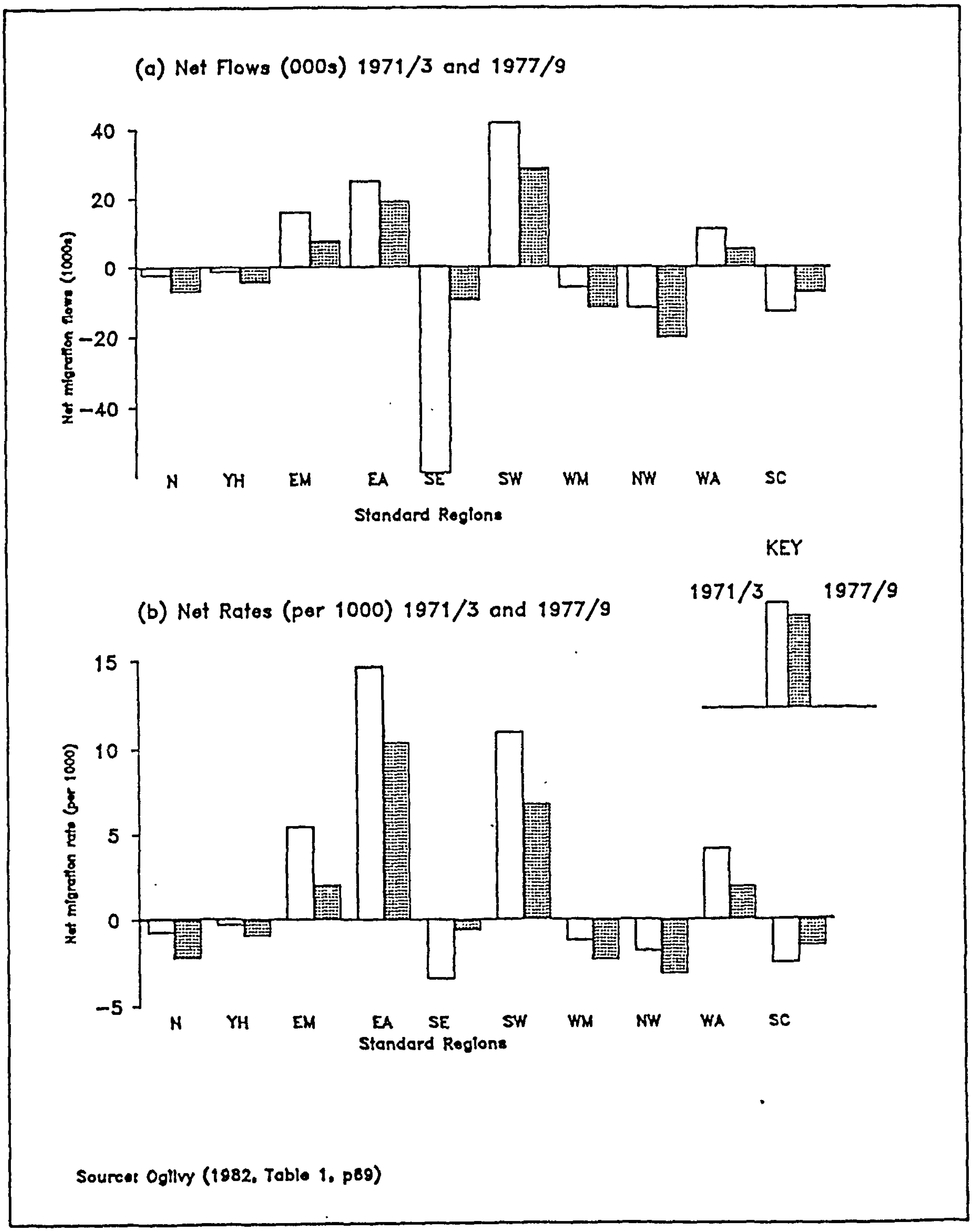


Figure 2.1 <u>Net migration flows and rates for the standard regions of Great Britain, 1971/3 and 1977/9</u>

areas where net migration losses had been diminishing, the net outward flow of migrants began to increase - apart from in Scotland where the net rate of migration declined over the period from -2.5 per 1000 in 1971/73 to -1.5 per 1000 in 1977/79. The North West and the West Midlands, in particular, experienced a considerable increase in the net loss through migration over the period.

Data on the rates of gross in- and out-migration for the same time period (Table 2.1) showed that the rate of inward transfer tended to fall more steeply than the rate of outward transfer, with the exception of the South East where the out-migration rate decline far exceeded the in-migration rate decline. The main reason for regions experiencing an increase in the net loss through migration was therefore the sharp decrease in the rate of in-migration, although Scotland, like the South East had a decline in the out-migration rate which exceeded the in-migration decline. When data for Scotland, the North, Yorkshire and Humberside, the North West and the West Midlands were aggregated the fall in the number of outflows from these regions was 11.6% between the 1971/3 and 1977/9 periods, whereas inflows fell by approximately 16.8%. Total inflow to those regions gaining through migration in 1971/3, decreased in 1977/9 by a total of 9.1% whereas total outflow remained much the same. It was the decline in inflows, therefore, that was principally responsible for changes in the net balances of provincial regions. The increased net losses and reduced net gains were mainly due to a drop in the number of people transferring from south east England, emphasising a north -south shift in the distribution of population.

Data from the 1981 Census was used by Brant (1984) to show that 12% of total migrants moved inter-regionally, with the highest rates

Table 2.1 Gross in- and out-rates of migration and percentage changes over the period 1971/3 - 1977/9

Region	1/10/71-30/9/73		1/10/77-30/9/79		1971/3 - 1977/9 %age change	
	Inrate	Outrate	Inrate	Outrate	Inrate	Outrate
North	17.6	18.3	9.1	10.6	-10.8	-16.5
Yorks.& Humbs.	18.5	18.8	15.6	16.5	-15.7	-12.2
East Midlands	28.2	23.6	23.3	21.3	-17.4	-9.8
East Anglia	41.3	26.7	34.9	24.6	-15.5	-7.9
South East	14.1	17.5	13.8	14.4	-2.1	-17.7
South West	36.0	25.1	29.5	22.8	-18.1	-9.2
West Midlands	17.6	18.8	14.7	17.0	-16.5	-9.6
North West	15.0	16.8	12.9	16.0	-14.0	-4.8
Wales	21.2	17.1	18.7	16.8	-11.8	-1.8
Scotland	10.2	12.7	9.1	10.6	-10.8	-16.5

Source : Adapted from Ogilvy (1982, Tables 1 and 2) of migration occurring between East Anglia and the South East (9.2 per 1000) and between the South West and the South East (9.1 per 1000). Inflow rates to Wales and Scotland were generally low as were inflow rates to the Northern region and to Yorkshire and Humberside, West Midlands and North West regions from non-contiguous areas.

Brant (1984) analysed regional net migration balances from the 1971 and 1981 Censuses to confirm the results of Ogilvy (1982). He noted a decrease in the net gain in the East Midlands, East Anglia and the South West and a reduction in the 1971 net outflow figure from the South East (1.0 per 1000) to produce a small net inflow in 1981 (0.2 per 1000). In the North and North West net out-migration increased (the only two regions to experience an increase in the net rate over the 1971-81 period) with all regions containing a metropolitan county, with the exception of the South East, having a negative balance of migration both in 1971 and 1981. Brant illustrated the variation in the distance travelled to the region of destination, distinguishing between metropolitan and non-metropolitan areas (Table 2.2). On average, 80% of in-migrants to metropolitan areas moved from origins within 10km of their destination with the percentage figure varying between 73 for Greater London and 85 for Tyne and Wear. Longer-distance in-migration to metropolitan areas made up 10% or less of the total. Non-metropolitan regions had a much smaller proportion of in-migrants from less than 10km (65%) with, on average, 15% in-migrating over a distance of more than 80km. East Anglia and the South West, in particular, received high proportions of longer-distance migrants.

Devis (1984) showed regional mobility rates to be lower in 1981 than 1971 in all regions, with the greatest decline of 26% occurring

Table 2.2 Distance travelled by migrants from the 1981 Census (percentage distribution)

Destination region	Percentage distribution Less than 10km	10 - 80km	More than 80km
Metropolitan			
Tyne & Wear	85	8	7
South Yorkshire	80	12	8
West Yorkshire	80	12	8
Gt London	73	17	10
West Midlands	82	16	10
Gt Manchester	82	12	6
Merseyside	82	11	7
Average	80	12	8
Non-metropolitan			
North Remainder	75	14	11
Yorks & Humbs Rem	66	19	15
East Midlands	68	18	14
East Anglia	56	22	22
Outer Metrop. Area	59	29	12
Outer South East	57	24	19
South West	59	17	24
West Midlands Rem	65	22	13
North West Rem	71	19	10
Wales	68	17	15
Scotland	70	17	13
Average	65	20	15

Source : Brant (1984)

in the South West, which had the highest mobility rate in 1971. Wales exhibited the lowest mobility rate both in 1971 and 1981. With the decline in mobility being greatest for those with the largest rates in 1971 the range of rates between regions reduced from 44 per 1000 in 1971 to 26 per 1000 in 1981.

More recent inter-regional trends in NHSCR migration have been identified by Rees and Stillwell (1987) who have noted a significant reduction in outflows from Greater London between 1975/76 and 1985/86 although a slight recovery in more recent years. The 'South' was observed to have experienced above average increases in in-migration since 1981/82 whereas the peripheral regions of Wales, Scotland and Northern Ireland showed greater decreases and smaller recoveries in in- migration than the rest of the UK.

A more disaggregated spatial system composed of metropolitan counties, region remainders and other regions was used by Stillwell (1983) to illustrate spatial variations in the balance of migration with Census data for the 1966-71 period and NHSCR data for the 1976-81 period. The pattern in 1966-71 was one of gains to all non-metropolitan zones and losses from all metropolitan zones emphasising the process of metropolitan decentralisation to more rural areas which has become known as counter-urbanization (Fielding, 1982; 1986). Net migration balances reveal that large gains were made in the Outer Metropolitan Area (OMA), the Outer South East (OSE), the South West and East Anglia with the latter three zones also gaining considerably from the OMA as well as from Greater London. The largest balance was a net loss of approximately 0.25 million from Greater London to the OMA. All metropolitan regions, except South Yorkshire, suffered losses to their region remainders during the 1966-71 period. Greater London and the OMA were obviously key zones of migration activity within the metropolitan/non-metropolitan system of interest. Stillwell's analysis of 1976-81 NHSCR data revealed a deceleration in the process of decentralization with metropolitan zones marginally increasing their proportion of in-migration and reducing their proportion of out-migration and non-metropolitan zones having a reduced in-migration share and an increased out-migration share. The process of decentralization was most evident for moves into the South East remainder from Greater London. The four fastest growing zones during 1976-81 were the OSE, East Anglia, OMA and the West Midlands remainder, whereas the fastest declining zones were Greater London, Central Clydeside, Merseyside and Tyne and Wear (Rees and Stillwell, 1984).

Rees and Stillwell (1987) noted that the largest migration streams in gross and net terms in 1980/81 occurred between metropolitan counties and their surrounding non- metropolitan areas. Importantly there was a net gain of approximately 50 thousand migrations from regions of the North to those of the South and a net gain of over 100 thousand from metropolitan to non-metropolitan zones.

There are fewer detailed analyses of aggregate migration at lower levels of spatial disaggregation, although two papers by Devis (1983; 1984) do give an insight into patterns at the administrative FPCA (shire county and metropolitan district) and district level respectively. Devis (1984) used NHSCR data for the period 1975-1982 to analyse migration trends at the FPCA level. In 1980/82, areas of net gain were all non-metropolitan FPCAs whilst net losses were generally experienced by metropolitan districts. This study confirms that the levels of net gain and net loss decreased between 1975/7 and 1980/2 with the greatest decline in net losses occurring in the West Midlands and Greater London and the greatest decline in net gains occurring in Wales, East Anglia and counties along the south coast. Merseyside was an exception to the rule with an increased net loss during the period. In both Greater London and the West Midlands the decline in out-movement exceeded the decline in in-movement. In areas adjacent to metropolitan zones net outflow was seen to increase. Devis identified several counties with consistently large net gains - West Sussex, Dorset, Buckinghamshire, Powys and the Isle of Wight - citing the importance of retirement migration and the presence of New Towns as reasons for the relatively high net balances in particular areas.

Previously, Devis (1983) had used 1981 Census data to illustrate the extent of variation in the mobility rate between districts. The highest mobility rates in 1981 were found in the districts of Inner London, those districts containing a New Town, and those with a large military population. Districts with the lowest mobility rates were those located in industrial South Wales or small town manufacturing areas. Table 2.3 illustrates 1971 and 1981 mobility rates for a Census classification of districts. All categories showed a decline in the level of mobility with districts of Inner London having the highest rates both in 1971 and 1981. Metropolitan districts had an overall rate less than that of non-metropolitan districts both in 1971 and 1981 with non-metropolitan areas showing a greater decline over the period (-20%). Smaller cities (105 per 1000) and resort and seaside retirement districts (102 per 1000) showed significantly high mobility rates in 1981, although the latter experienced a significant

Table 2.3 Mobility rates 1971 and 1981 and change 1971-81 by category of district

Category of district	Mobility rate 1971	Mobility rate 1981	%age change 1971-1981
England and Wales	117	94	-19
Gt.London Boroughs	126	105	-16
1 Inner London	146	129	-11
2 Outer London	113	91	-19
Metropolitan districts	105	87	-17
3 Principal cities	109	93	-15
4 Other districts	102	84	-18
Non-metropolitan districts	119	95	-20
5 Large cities	113	97	-14
6 Smaller cities	118	105	-10
7 Industrial districts	101	83	-18
8 New town districts	119	98	-17
9 Resort and seaside retirement districts	131	102	-22
10 Other urban/mixed urban-rural and more accessible rural districts	130	98	-24
11 Remoter, largely rural districts	121	95	-22

Note: Mobility rate = number of usual residents who moved within or into an area per 1000 population

Source : Devis (1983, Table 4, p19)

reduction in mobility (-22%) over the 1971-81 period. The lowest rates of mobility in 1981 were found in industrial districts and metropolitan areas on the periphery of large cities.

Alternative systems of interest have been adopted to analyse spatial patterns of migration between functional rather than administrative regions. Flowerdew and Salt (1979) and Johnson (1984), for example, used Standard Metropolitan Labour Areas (SMLAs) as their zones of study, whereas Kennett (1980) utilised Metropolitan Economic Labour Areas (MELAs). The SMLA/MELA classification was devised by Hall (1973) using the 1961 Census and was based on a spatial distinction between urban cores and their surrounding commuter rings. Inter-censal comparison of migration based on SMLAs or MELAs is impossible due to local government reorganisation in 1974/5 although CURDS (Centre for Urban and Regional Development Studies) at Newcastle have developed a system of Functional Urban Regions (FURs) based upon 1971 employment and journey to work data for use with 1971 and 1981 Census information. They define 280 urban-centred regions known as Local Labour Market Areas (LLMAs) which cover the whole of England, Wales and Scotland. Those LLMAs with a population of less than 50000 are termed 'rural areas' and have been assigned to individual urban regions on the basis of commuter flows thus producing a system of 228 FURs.

Flowerdew and Salt (1979) used 1961 and 1971 Census figures to examine migration between Labour Market areas (SMLAs) in Great Britain. SMLAs were net losers of population in 1970/71 although only 34 out of 126 actually experienced a net loss. The largest negative balances were associated with the major cities. Most of the top ten gaining SMLAs were retirement resorts or 'medium-sized growth centres' in south east England. Johnson (1984) has highlighted three major forms of movement in 1970/71. Firstly there were the large population flows to and from London which dominated the migration system. Secondly there were other large flows associated with the major cities and thirdly there was the emergence of a number of local sytems of migration emphasising the importance of local attraction and self-containment of some labour markets. These results are comparable to those obtained by Flowerdew and Salt (1979) who developed a 'migration-efficiency' measure based on the ratio between gross and net flows to give an indication of the importance of inflows and outflows (stream and counterstream). Coastal resorts and overspill/New towns had the highest positive ratios, indicating large inflows to these areas. The major cities and older industrial areas had the highest negative ratios. Flowerdew and Salt drew attention to the strong decentralisation evident from major cities which constituted 40.3% of outmigration but only 27.7% of inmigration, and stated that, in general, the large cities were attracting migrants from a wide area but losing migrants predominantly to nearby SMLAs.

Kennett (1980) has used the larger MELAs as his zones of study for an earlier period, 1966-71. He notes that in 1971, 85% of SMLAs were decentralizing with an overall net population loss of 750,000. In contrast, the rings experienced continuous growth with the majority of core- to-ring flows taking place within individual MELAs. Among the MELAs, it was the largest urban areas which were decentralizing most rapidly during the period. The seven largest MELAs or 'million-cities' (London, Birmingham, Manchester, Glasgow, Liverpool, Leeds and Newcastle) experienced declining rates of expansion and all suffered large losses due to inter-MELA transfers. London derived net inflows from each of the other million-cities. The London ring recorded a population decline from 1971 onwards with reduced rates of increase in outer rings reflecting falling migration propensities.

Champion <u>et al</u> (1987) have used the LLMA system to analyse population change over the 1971-81 period, stating that,

> "One of the most remarkable features of the period under study is the absence of significant overall population growth. ....This move towards zero growth by the national population has, however, by no means led to a drying up of internal shifts, though the residential mobility levels recorded by the 1981 Census were somewhat lower than at 1971"
>
> (p.17)

Although they do not utilise any migration data in their study there is some justification for illustrating certain trends in population change that they identify because of the importance of the migration component in a period when overall population growth by natural change was negligible.

The dominant features of the 1971-81 period were shown to be the decentralization from the cores to other zones, and the continuing expansion of the South East region. The movement away from cities and the most highly urbanized areas was confirmed, together with correspondingly high rates of population growth in the more rural areas of Britain. Those LLMAs in the South East region furthest from the capital experienced particularly high growth rates in contrast to the rapid decline of Greater London LLMA itself. The decrease in the growth rate of the West Midlands was also substantial. A general drift to the south was noticeable at the expense of the north with Liverpool, Glasgow and Manchester all experiencing significant decline in population size.

> "Centrifugal tendencies appear to constitute a major component of the geographical patterns of population change recorded between 1971 and 1981"
>
> (Champion et al, 1987 p22)

The core zones of the LLMAs experienced a 4% (1.5 million) decline in population between 1971 and 1981 with much of this loss being accounted for by the positive growth rates in the surrounding rings (9.1%) and also in the outer and rural areas. The population of the 20 major cities was shown to have decreased by some 6.2% (1.3 million) with a related increase of 3.9% in immediately surrounding metropolitan regions.

Champion and Congdon (1987, 1988) have illustrated something of a turnaround in recent years in the process of decentralisation in relation to Greater London. Between 1983 and 1986 the capital was gaining approximately 6000 p.a. in terms of population, contrasting with average annual losses of 88 thousand in the early 1970s. The major factor fuelling this turnaround was established as the reduction in the rate of net migration loss since the 1970s - from 110 thousand p.a. on average between 1966 and 1971 to 25 thousand p.a. between 1981 and 1986. As Rees and Stillwell (1987) have noted, out-migration from Greater London has declined steadily since the mid-1970s whereas in-migration has remained rather more stable.

> "The reduction in population decentralisation from London since the early 1970s ties in with the worsening of the national economic situation later in the decade particularly during 1979-81, and with the relative buoyancy of the London economy more recently"
>
> (Champion and Congdon, 1988)

This section has attempted to review patterns and trends in aggregate inter-area migration occurring at a number of spatial scales and to summarise the main features of the studies undertaken. From the review it is clear that there has been very little analysis of time-series NHSCR data below the standard region level and furthermore there has been little analysis of trends since 1981. With the availability of NHSCR information for the period 1976-86 a comprehensive analysis of spatio-temporal trends in migration at the FPCA scale is undertaken in Chapters 7, 8 and 9 to identify important features of movement that are hidden in studies using data at more aggregate spatial levels. Chapter 7 analyses individual level, generation, attraction and distribution components of migration - a technique used by a number of Dutch demographers to analyse historical patterns and reviewed in Section 2.3 of this chapter. There has been little examination also of the variation in the average distance travelled by migrants. Brant provided a comparison of 1971 and 1981 patterns at the regional level but little analysis has been undertaken of trends in the 1980s. It is possible, therefore, to undertake a more substantial illustration of the variation in the propensity to migrate by spatial zone and by age and sex using the techniques of spatial interaction modelling introduced in Section 2.3.2 of this review chapter.

2.2.3 Patterns of migration by age and sex

So far in this chapter levels and aggregate spatial patterns of migration have been reviewed. Much research attention has been focussed, however, on the characteristics of migrants disaggregated by demographic, household and socio-economic status. This section concentrates on the main demographic variables of age and sex.

The relationship between migration and age, investigated by numerous researchers in the UK and elsewhere, has been found to exhibit some general characteristics in common. In an analysis of inter-metropolitan/non-metropolitan region migration in the UK in the five years prior to the 1971 Census, Stillwell (1983) illustrated the variation in the percentage of age-group population who migrated during the period (Figure 2.2). 17.3% of total inter-zonal migration involved children aged 5-14 (16.4% of the total population). 36.4% involved young adults aged 15-29 (21.6% of the population). 34.6% involved adults aged 30-59 (37.7% of the population) and 11.6% involved the elderly in the 60+ age-group (24.4% of the population). The greatest mobility in the 1966-71 period was in evidence for those aged 25-29 on Census date, 1971. The 20-24 and 30-34 age-groups also had high mobility rates whereas those aged 70-74 were shown to be the least mobile. Stillwell showed that metropolitan zones experienced net losses in all age-groups (apart from Greater London in the 20-24 age-group), whereas non-metropolitan zones gained in all age-groups (apart from the Outer Metropolitan Area which suffered a net loss in the 60-69 age-group).

Kennett (1980) has also studied age-specific migration propensities during the 1966-71 period but based his analysis on MELAs. Urban cores were seen to suffer net outflows in each cohort whereas all rings and outer rings experienced net gains. Table 2.4 summarises the net balance of migrants in each of five broad age-groups as a percentage of the total gain or loss of each urban zone. Urban cores had particularly large net outflows in the 15-44 age range (-52%). The rings experienced their largest net inflows in the 15-19 age range (34.1%) whereas in the outer rings the highest

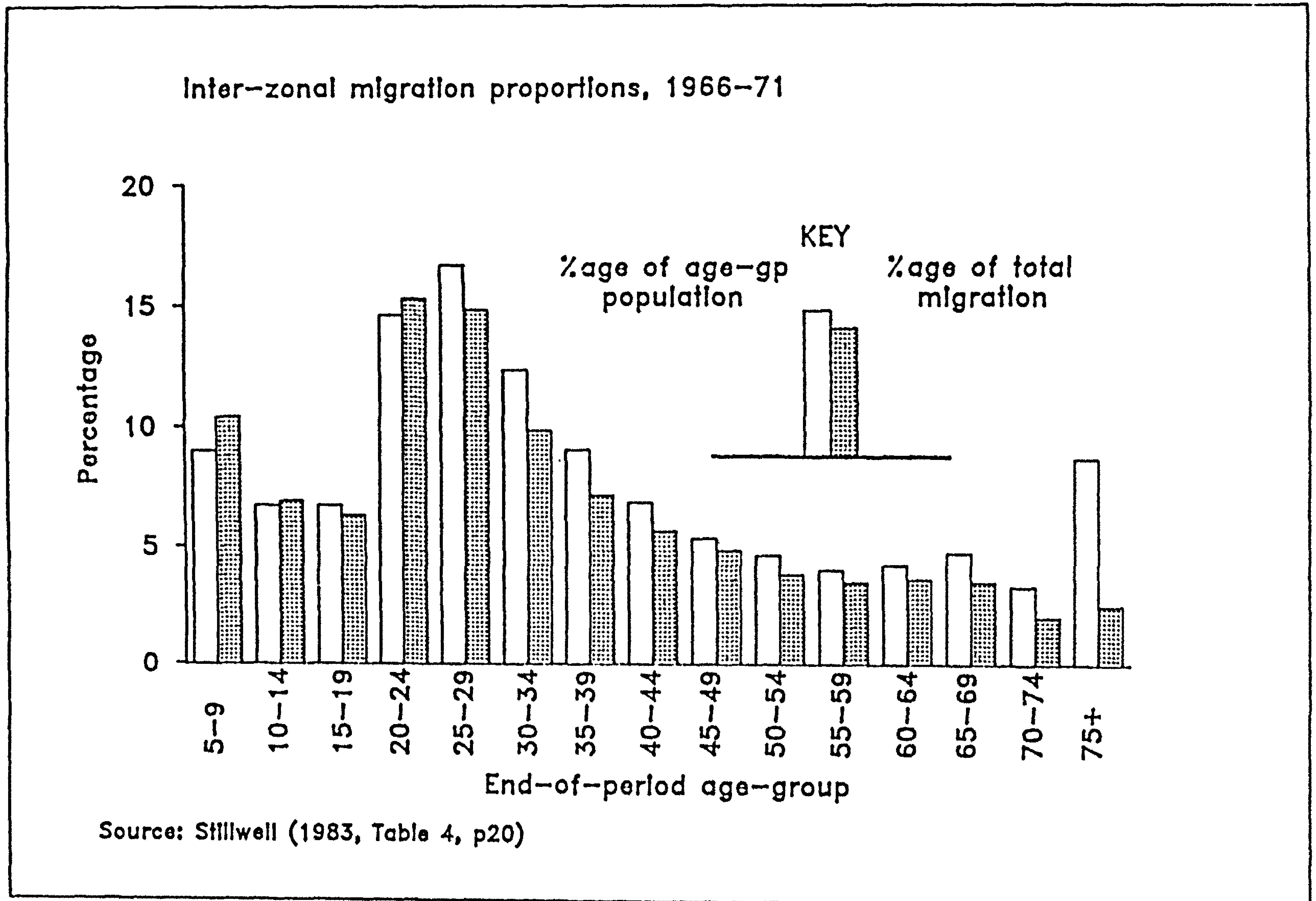


Figure 2.2 Age-specific inter-zonal migration proportions, 1966-71

proportion of in-migrants were aged over 45 (45.7%). The outer rings experienced a 25% increase in their pensioner populations. Those areas which remained outside of the MELA classification were becoming increasingly attractive to those of retirement age with substantial net inflows also recorded by the majority of resort MELAs in the retirement age-groups. Kennett identified the continuing net inflow of 15-29 year olds to London as a prominent feature of the inter-regional migration system. Spence et al (1982) attempted to relate these zonal differences to stages in the migration histories of individuals:

> "...a generalised schema of the process begins with a number of young, economically active entering the labour force or further education, centralising to the core when first leaving home in search of accessible and cheaper rented accommodation. On or about the age of marriage this group may decentralize to the rings and in later life decentralize further to the outer rings."
>
> (p.168)

As illustrated in the previous section, major net losses were experienced by the so-called 'million-cities' in the 1966-71 period. Table 2.5 indicates that they suffered considerable losses in each age-group due to migration, with the greatest decline being in the 15-29 age-group. New Town MELAs were seen to be greatly increasing their share of the population through migration in the 15-29 and 30-44 age-groups (14% and 7%) as were MELAs in the London periphery (8% and 6%). Resort MELAs showed considerable increases in the two older broad age categories (7.7% and 8.4%) (Spence et al, 1982).

Since the early seventies the level of mobility has declined with the decrease occurring across all age-groups. Stillwell (1983), showed that during the seven year period, 1976-82, the level of mobility fell by 28% in the 0-14 age range, by 14% in the 15-29

Table 2.4 Net gains and losses of migrants by age and urban zone 1966-71

MELA zone	Total net gain/loss (000s)	Age-group percentages 5-14	15-29	30-44	45-pen	pens.
Cores	-1128	-17	-28	-24	-18	-13
Rings	808	18	34	26	15	7
Outer rings	293	16	17	21	21	25

Source : Kennett (1980, Table 9.2, p226)

Table 2.5 Net migration losses from the 'Million-Cities' by broad age-group, 1966-71

Age-group	Net migration	Decline in %age of 1971 population
5-14	-106,010	-1.74
15-29	-151,290	-4.07
30-44	-136,390	-2.87
45-pen	-132,860	-2.05
pensioners	-145,480	-2.75

Source: Spence *et al* (1982, Tables 3.13 & 3.14) group, by 10% in the 30-59 and by 8% in the 60+ age range. Changes in the relative migration proportions were illustrated with the percentage in the 0-4, 5-9 and 10-14 age-groups and in the 25-29, 45-49 and 50-54 age-groups declining, while the other age-groups had either remained the same or increased.

Data from the 1981 Census shows that the most mobile migrants were those aged 16-24 and 25-34 (Brant,1984). Little difference was evident between male and female percentages (Table 2.6) although women were more mobile than men in the younger adult category (16-24). Devis (1983), however, analysing age-specific data from the 1971 and 1981 Censuses, showed the decline in mobility to be greatest for those aged 45-49 and least for those aged 1-4 and 25-34 (Table 2.7). Little difference was evident between the decline in mobility level for males and females.

Stillwell and Boden (1989) have examined changes between the 1971 and 1981 Censuses in the national age-schedules of migration between and within regions, counties and districts. The two most striking features were the more prominent retirement peak in the male schedules and the shape of the upward curve of the labour force component for males migrating between zones in 1980/81, which was shown to be kinked at the inter-regional scale in particular, so that migration rates rose for male teenagers aged 16 and 17, remained at about the same level for those aged 18 to 20 and then rose again to age 22. Since a high proportion of inter-regional migration tends to be longer distance and job-based it was hypothesized that migration rates may increase as school leavers secure their first job, remain stable for two to three years and then increase again as they move to jobs elsewhere.

Table 2.6 Age-specific migration percentages by age and sex from the 1981 Census

	Percentage of usually resident population						
	All ages	1-15	16-24	25-34	35-44	45-pen	pen +
Males	9	9	15	16	8	4	4
Females	9	9	18	14	7	4	5

Source : Brant (1984, Table 3, p28)

Table 2.7 Percentage change in mobility rates by age and sex between 1971 and 1981

Sex	Percentage change by age-group								
	1-4	5-14	15-24	25-34	35-44	45-59	60-64	65+	All ages
Males	-14	-22	-20	-13	-17	-25	-20	-22	-19
Females	-13	-21	-22	-14	-20	-26	-22	-16	-18

Source : Devis (1983, Table 1)

Warnes (1983) analysed migration in late working and early retirement age-groups and showed that 5.5% of the population aged 50 and over changed usual residence. Persons in this age range constituted approximately 16% of total migration and 14.4% of all inter-county migration in 1970/71. 30% of migration by males aged 50-74 in 1970/71 and 1980/81 was shown to be long distance. Peaks in the level of male migration were evident at age 65 in both years but more pronounced in 1970/71 (Rees and Warnes, 1986). Female schedules exhibited a 'flatter' rise in the 60-65 age-group. Overall migration in the 50-74 age range fell by 1.5% over the ten-year period. Rees and Warnes illustrated pronounced retirement peaks in migration from metropolitan regions especially those containing the largest cities of London, Glasgow, Birmingham, Manchester and Liverpool. The peaks coincided with concentrations of 60-69 year-olds in the major retirement areas of the South West, East Anglia and the Outer South East. A significant rise in mobility was highlighted for the last age-group (75+) both in 1970/71 and 1980/81.

In general, the literature contains a number of descriptive analyses which allow a picture of trends in migration by age and sex to be constructed. However, with the availability of a comprehensive time-series of NHSCR information described in Chapter 3 it is possible to examine in more detail the age and sex-specific characteristics of migration by five-year and single year of age at a number of spatial scales down to the metropolitan district/county level and to analyse time-series changes occurring in the late 1970s and 1980s.

This section has summarised some of the main features of age-specific migration in the UK. The existence of common characteristics in observed rate schedules has prompted researchers at the International Institute for Applied Systems Analysis (IIASA) to develop techniques to model age-specific migration schedules and these modelling methods, which are used by OPCS/DOE in their migration forecasting procedures, are introduced in the first part of the next section which is devoted to a review of relevant modelling techniques.

2.3 A REVIEW OF POTENTIAL MODELLING METHODS

2.3.1 Modelling age-specific migration rate schedules

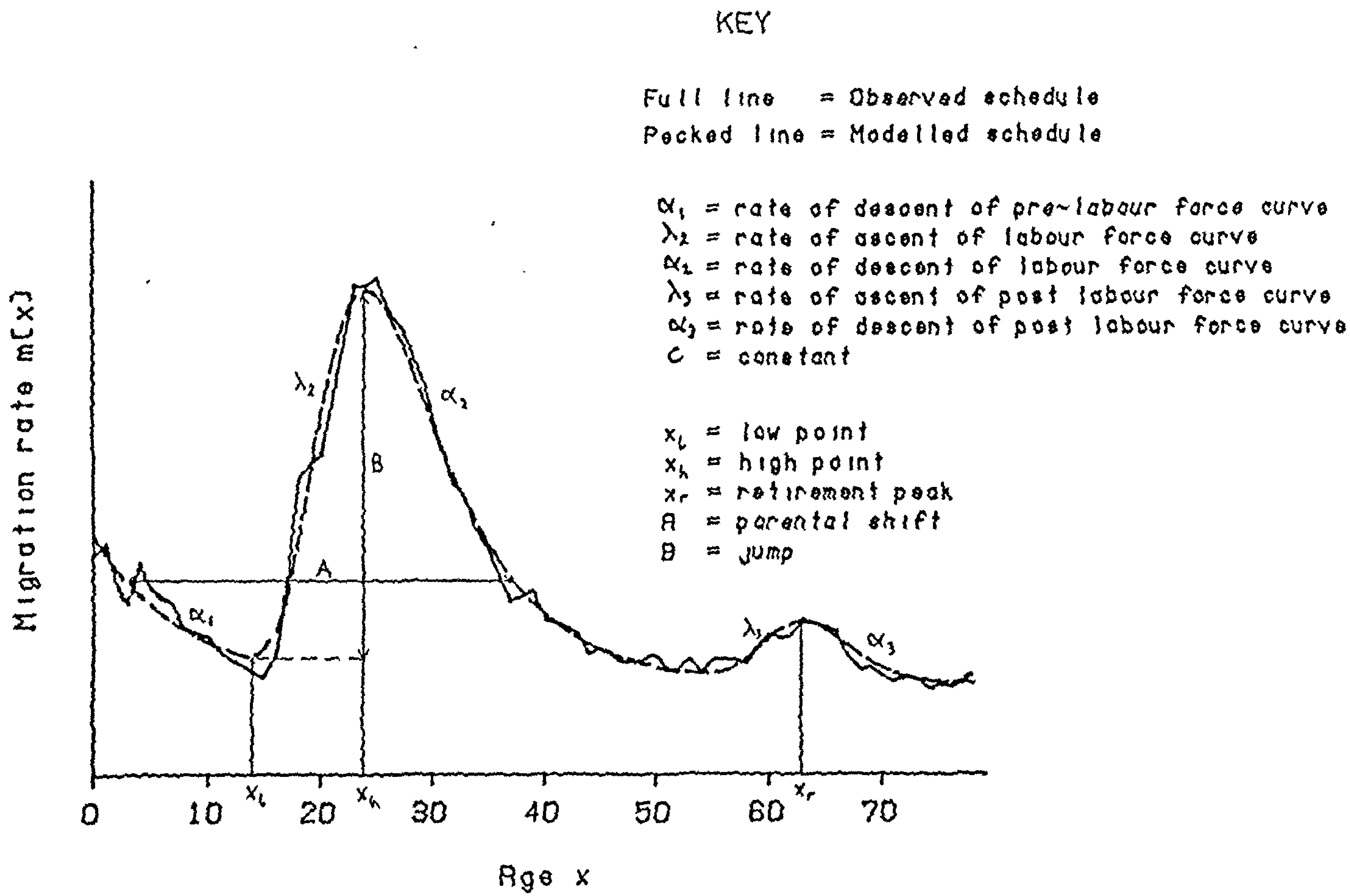
Research at IIASA has confirmed that regardless of spatial scale and level of economic and demographic development, the age distribution of internal migrants has a highly characteristic shape that lends itself to mathematical modelling. Rogers, Raquillet and Castro (1978) developed a mathematical function to fit to the observed schedule of standardized migration rates which has been successfully applied to data from a number of countries (Rogers and Castro, 1981).

The modelling of migration schedules utilises a technique common in demographic analysis whereby a mathematical function is used to 'smooth' a sequence of observed age-specific rates so as to remove fluctuations which may be due to sampling error, for example. The derived parameters describing the shape of the particular profile allow for easy comparison of schedules and furthermore allow single year of age migration rates to be inferred when only 5-year information is available. In the context of projection, model migration schedules, calibrated on historical data, have been used to deconsolidate gross migra-production rates, as in Martin, Voorhees and Bates (1981).

It is apparent that aggregate male and female migration streams between and within different countries, despite variations in their respective levels, exhibit similar age-specific profiles. In general terms, all have an initial decline in the rate of migration up until approximately 15 years of age, followed by a sharp rise till the early 20's and then a gradual decline. The movement of families is reflected in the migration rates of young adults which parallel those of the young age-groups. Certain schedules exhibit a peak in the migration rate at around age 60-65 reflecting the relative importance of retirement migration. A model of this migration schedule can be disaggregated into four components (Rogers and Castro 1981): a pre-labour force curve, a labour force curve, a retirement curve and a constant.

Figure 2.3 illustrates the fit of a model schedule to a hypothetical data set. The mathematical function defining the shape of the model schedule has four components describing: (1) a single negative exponential curve of the pre-labour force ages with its rate of descent, α_1 ; (2) a left-skewed uni-modal curve of the labour force ages positioned at mean age μ_2 on the age axis and exhibiting rates of ascent λ_2 and of descent α_2 ; (3) a bell shaped curve of the post-labour force (retirement) ages positioned at μ_3 on the age axis and exhibiting rates of ascent λ_3 and of descent α_3 , and (4) a constant curve, c, the inclusion of which improves the fit of the mathematical expression to the observed schedules and reflects the overall level of migration. The model equation has the form,

$$
\begin{aligned}
m(x) = \; & a_1 \exp(-\alpha_1 x) \\
& + a_2 \exp\{-\alpha_2 (x - \mu_2) - \exp(-\lambda_2 (x - \mu_2))\}
\end{aligned}
$$



Source: Rogers and Castro (1981)

Figure 2.3 Model migration schedule: components, parameters and characteristics

$$+ \ a_3 \exp \{-\alpha_3 (x - \mu_3) - \exp(-\lambda_3 (x - \mu_3))\}$$
$$+ \ c \qquad (2.1)$$

where m(x) is the rate of migration of those in age-group x and where the profile of the schedule is defined by seven of the eleven parameters (α_1, α_2, μ_2, λ_2, α_3, μ_3, λ_3) and the level of the schedule is determined by the remaining parameters (a_1, a_2, a_3, c,).

Rogers et al (1978) noted that although the migration profile may be similar for several regions the volume of migration may differ considerably. The gross migra- production rate (GMR), defined as the sum of the age- specific migration rates is therefore calculated as a measure of the level at which migration is occurring:

$$GMR_i = \sum_x m(x)_i \qquad (2.2)$$

Variations in the GMR will affect the values assumed by the 'level' parameters but not the values of the parameters depicting the shape of the profile. The GMR allows the standardization of migration rates and model schedules by setting the area under the generated curve to one and eliminating the variation in the level of migration. This allows for a standardized comparison of age-specific migration levels over time or between regions.

Rogers and Castro (1981) have devised a series of indicators to assist in profile classification some of which are based on the values of the calibrated parameters. They have also defined a further set of derived measures which have been used to assist in comparing migration characteristics between countries and regions throughout the world (Table 2.8, Figure 2.3). Furthermore, these variables have been used to develop a classification system for profiles in England and Wales (Bates and Bracken, 1982, 1987: Bracken and Bates 1983) for

Table 2.8 Important indicators used in model migration schedule analysis

Characteristic	Description
GMR_1	Gross migraproduction rate (sum of all age-specific rates)
x_m	Mean age of migration
%(0-14)	%age of migration in pre-labour force range
%(15-64)	%age of migration in labour force curve
%(65+)	%age of migration in post-labour force
$\delta_{1c} = a_1 / c$	Proportion of level allocated to constant component
$\delta_{12} = a_1 / a_2$	Degree of labour dominance (or index of child dependency)
$\delta_{32} = a_3 / a_2$	Degree of post labour force dominance
$\beta_{12} = \alpha_1 / \alpha_2$	Index of parental shift regularity
$\sigma_2 = \alpha_2 / \lambda_2$	Index of labour assymetry
$\sigma_3 = \alpha_3 / \lambda_3$	Index of retirement assymetry
x_l	Low point of schedule
x_h	High peak of schedule
x_r	Retirement peak
z	Labour force shift
A	Parental shift
B	Increase in migration rate between low-point and high peak

Source : Rogers and Castro (1981)

use in OPCS/DOE migration projection.

A comprehensive package (MODEL) for estimating parametrized model schedules of fertility, mortality, migration and marital and labour-force transitions has been developed by Rogers and Planck (1984). The migration routine allows the selection of one of three models to fit to an observed dataset depending upon the presence of a retirement peak, an upward retirement slope or neither in the migration schedule. Models with 11, 9 or 7 parameters can therefore be calibrated. The package is based on a Levenberg-Marquardt algorithm which fits the selected model to a set of observed data. The user simply provides the necessary data (age-specific migration and population data), chooses the appropriate model (11, 9 or 7 parameter) and selects from a number of options controlling calibration and output. Estimated model schedule parameters are output together with a goodness of fit statistic and a table of observed versus estimated rates. The MODEL package has been adapted for use on the Amdahl at Leeds (Stillwell, Boden and Rees, 1987) and is used in Chapter 9 to examine age-specific migration at a sub-national level using NHSCR movement data.

Bates and Bracken (1982), as part of a study to improve the official projection of sub-national migration in the context of a local area population forecasting model, have attempted to refine the IIASA approach by applying the principles of maximum likelihood to the estimation of the coefficients of the mathematical function. They have criticised the form of the retirement function suggested by Rogers <u>et al</u> for being too sophisticated and for providing difficulties in calibration. The primary objective of Bates and Bracken's work was an assessment of similarities between migration profiles for local authority areas in England and Wales. They used migration profile fitting and cluster analytic methods to develop an alternative classification of in and out-migration profiles from the 1971 Census (Bates and Bracken, 1983) and they concluded that spatial variations in the level of migration and the shift in the peak age of gross migration activity were the two outstanding features to be noted when considering schedule classification. In a more recent paper (Bates and Bracken, 1987) they compared 1971 Census profiles and their classification with those from the 1981 Census using migration schedule modelling methods. They noted that the onset of labour force migration in most areas had been delayed by about one year between 1971 and 1981, that retirement moves were less common and that there was less variation in the pattern across the country in 1981 between local authorities. The general reduction in the amount of migration activity was seen to be independent of flow direction, origin and destination.

The profile classifications produced by Bates and Bracken using 1981 Census information are an integral part of the migration forecasting procedure of the OPCS/DOE population projection model (Section 2.4). In Chapter 9 the methods developed by Rogers et al (1978) are used to examine the patterns of age-specific movement since 1981 using NHSCR data. The 'MODEL' package provides a convenient method of comparing FPCA profiles at a variety of spatial scales and in the development of a classification of areas based on migration schedule similarities.

2.3.2 Migration distribution modelling

The wide diversity of studies relating to the modelling of internal migration flows makes a succinct review of the relevant literature in this field a difficult task. Classifications of modelling strategies have, in the past, attempted to distinguish various approaches. Weeden (1973), for example, identifies a three-fold classification - ad-hoc models relating net migration to a series of independent economic variables, gravity models and models based on probability theory. Stillwell (1975), alternatively, outlined four main modelling options - gravity, intervening opportunities, econometric and probability models whereas Molho (1986) makes a simple distinction between the 'gravity school' and the 'economic school' of migration modelling. This section does not provide a comprehensive review of modelling strategies but attempts to extract from the literature some of the more important approaches to the subject of migration distribution modelling that have been undertaken, and that complement or provide alternatives to the techniques applied in this study. The review begins with an introduction to the basic gravity model and its subsequent evolution to the spatial interaction model. The importance of the distance measure is discussed along with the effectiveness of adding further explanatory variables to the log-linear transformed gravity models. Illustration of an 'econometric' approach to modelling is made together with a discussion of the use of probability-based models for historical analysis in the context of multi-regional forecasting. The structure of a number of the models is illustrated using equations where appropriate.

Gravity models of migration were used in the first half of this century (Reilly,1929; Zipf,1946; Stewart,1948) to measure the amount of interaction between two zones as a function of the size (mass) of the two zones and the distance between them. The basic gravity model has the form,

$$G_{ij} = k\, P_i P_j \;/\; D_{ij} \qquad (2.3)$$

where

G_{ij} = amount of interaction between zones i and j;

k = constant;

P_i, P_j = measure of zone size (e.g. population); and

D_{ij} = distance between zones i and j.

The amount of interaction was seen to be proportional to the size of the zone and inversely proportional to the distance between zones. With a variety of alternative measures of distance (such as time, cost or mileage) the exponent of the distance value has been defined as a variable parameter as have exponents attached to respective measures of zone size. This gives a more precise gravity formulation:

$$G_{ij} = k\, P_i^{a}\; P_j^{b}\; D_{ij}^{c} \qquad (2.4)$$

The functional relationship between the interaction flow and distance has been alternatively calibrated using an exponential rather than a power function and the 'mass' terms have been measured as origin and destination outflow and inflow totals. Such gravity models have usually been transformed to log-linear equations allowing calibration using multiple regression techniques. Equation (2.3) therefore becomes,

$$\ln G_{ij} = \ln k + a \ln P_i + b \ln P_j - c \ln D_{ij} \qquad (2.5)$$

In many cases additional explanatory variables have been added to the basic gravity model. Lowry (1966), using data from the 1960 US

Census, devised a model which incorporated economic as well as gravity variables with the following form,

$$M_{ij} = k.\ U_i/U_j\ .\ Y_j/Y_i\ .\ L_i L_j/D_{ij} \tag{2.6}$$

where

U_i and U_j refer to unemployment in zones i and j;

Y_i and Y_j refer to income in zones i and j; and

L_i and L_j refer to labour force in zones i and j

Through log transformation this becomes

$$\ln M_{ij} = \ln k + \ln U_i + \ln U_j + \ln Y_j - \ln Y_i + \ln L_i + \ln L_j - \ln D_{ij} \tag{2.7}$$

where the parameters are calibrated using linear least squares regression methods. Rogers (1967) used a similar model but found the unemployment variables to be less important than income and labour force variables. Masser (1970) tested these models on British data at the regional scale and highlighted the greater predictive significance of the gravity variables in relation to other explanatory variables.

The use of distance between zones in the gravity model has been criticised although few alternatives have been offered. The work of Stouffer (1940, 1960) has been much quoted as providing an alternative measure of distance based on intervening opportunities and competing migrants. Weeden (1973) has also attempted to handle distance more effectively within an inter-regional migration model by introducing a contiguity dummy variable to account for the important distinction between flows which involve a change of workplace and those which involve simply a change of address.

More recently, Flowerdew and Salt (1981) have tested alternative forms of the gravity model on inter-urban (SMLA) migration flows in Britain. The basic gravity formulation provided a reasonable fit to the data (R-squared=0.521) but underpredicted a number of small flows and produced large residuals for flows between contiguous zones and between zones containing naval bases. The introduction of contiguity and naval base dummy variables improved the model fit significantly and nine additional explanatory variables were included. The destination unemployment rate and percent unemployment growth were shown to be of most significance, although producing only a small increase in the goodness of fit of the model to the observed data. The use of Euclidian distance in the gravity model was questioned and variants of Stouffer's model were tested which produced only a small improvement upon the fit of the basic gravity model. Flowerdew and Salt concluded that 'population size and distance still account for the vast majority of inter-urban migration'. Flowerdew and Aitkin (1982) have argued that the Poisson form of regression analysis should be employed where the dependent variable (the count of migration) is based upon a discrete Poisson distribution rather than a normal distribution as used in ordinary least-squares regression. The Poisson model produced a less than adequate fit to the data however, although it gave an improved prediction of larger flows and the overall migration total.

The distinction between separate migration 'streams' within the regional sytstem has been identified by a number of authors. Creedy (1974) explored the relationship between regional mobility and economic incentives and attempted to explain the different motives underlying the decision to migrate by the employed and the unemployed. His model excludes the distance variable and cites differential income levels as the major incentive to migration. Gordon (1975) constructed a two-stream model based on the assumption that housing streams will have a higher distance elasticity than employment streams. The model had the form,

$$M_{ij} / P_i P_j = A_i^H B_j^H D_{ij}^{-b1} + A_i^E B_j^E D_{ij}^{-b2} \qquad (2.8)$$

where A and B are vectors of regional attributes and superscripts H and E relate to housing and employment streams respectively. The above model was reformulated in its exponential form (Gordon, 1982) and found to provide a more adequate representation of the separate streams. The separation of short-distance housing-related flows and long-distance employment-related flows proved difficult when a general cut-off point of 100 miles was selected, beyond which employment flows were assumed to be predominant.

Molho (1982a) also employed the exponential distance function in the development of a model based on gravity and economic variables which attempted to 'overcome the problems created by the existence of migrant housing streams across the borders of contiguous regions'. As an alternative to Gordon's model, Molho based the modelling of employment flows for the whole system on cells within the inter-regional array that could be identified as consisting mainly of employment streams. The remaining cells consisting of contiguous flows were modelled to provide a prediction of housing streams. Molho (1982b) employed an algorithm which allowed the data to select the appropriate cut-off point. He noted a strong distance deterence relationship in both employment and housing streams with unemployment rate, employment growth rate and per capita income identified as important additional explanatory variables.

The 'econometric' approach to migration modelling has been based primarily on regional differences in income and employment levels rather than the distance variable. Oliver (1964), for example, produced a set of models based on the prediction of net migration from regional unemployment rates and Hart (1973) devised a similar suite of net migration models using rates of change of income and employmant levels as his explanatory variables. Elias and Molho (1982) combine this approach with the ideas of Weeden and Gordon to develop the migration component of a larger model of regional labour supply as follows:

$$\begin{aligned}\ln(M_{ij} / P_i P_j) = {} & a_1 + a_2 \ln U_{it} + a_3 \ln U_{jt} + a_4 \ln W_{it} \\ & + a_5 \ln W_{jt} + a_6 \ln E_{it} + a_7 \ln E_{jt} \\ & + a_8 \ln ENV_i + a_9 \ln ENV_j + a_{10} \ln D_{ij} \\ & + a_{11} C_{ij} \ln D_{ij} + a_{12} SESWEA + e_{ijt} \qquad (2.9)\end{aligned}$$

where

- i, j, t are subscripts representing origin destination and time;
- U = zonal unemployment;
- W = zonal income;
- E = zonal employment growth/decline;
- ENV = zonal environmental preference;
- D = inter-zonal distance;
- C = zonal contiguity dummy;
- SESWEA = a dummy variable for SE, SW and EA flows which proved difficult to model; and
- e = error term.

The contiguity dummy variable isolates non-employment related movement between contiguous regions and was seen to have a positive effect upon migration reflecting the importance of flows to contiguous zones. The distance variable showed strong negative elasticity but the income and employment change variables produced little effect. Unemployment level in the destination zone had a negative effect upon migration. A similar model has been devised to predict inter-regional moves to and from Greater London (Mitchell, 1988). Relative income levels were shown to have had a positive effect upon in-migration to the capital whereas rises in house prices were shown to have been a deterrent to such movement. Distance was found not to be significant although variables were again incorporated to model flows to and from East Anglia and the South West more accurately.

The traditional gravity model has been redefined by Wilson (1974) to develop spatial interaction models. The models are designed to generate better predictions of inter-area flows through the incorporation of constraint equations. A family of four models have been distinguished depending upon constraints imposed. These are the unconstrained, production constrained, attraction constrained and production-attraction (doubly) constrained models. A doubly constrained spatial interaction model of migration takes the form

$$M_{ij} = A_i O_i B_j D_j f(d_{ij}) \quad (2.10)$$

where

O_i is the total outmigration from zone i;

D_j is the total inmigration to zone j; and

$f(d_{ij})$ is a distance function.

The A_i and B_j terms are balancing factors which ensure that the relevant interaction flows sum to the out-migration and in-migration totals. They are defined as:

$$A_i = 1 / \sum_j B_j D_j f(d_{ij}) \quad (2.11)$$

$$B_j = 1 / \sum_i A_i O_i f(d_{ij}) \quad (2.12)$$

and ensure that

$$O_i = \sum_j M_{ij} \quad (2.13)$$

$$D_j = \sum_i M_{ij} \quad (2.14)$$

The calibration procedure usually involves a Newton Raphson search routine to define the optimum decay parameter associated with a particular distance function - either negative power or negative exponential. The beta parameter is an index of the propensity to migrate over distance with higher beta values indicating greater friction of distance. The rise in the beta value over time illustrates a corresponding reduction in the mean length of migration. The model can be adapted to calibrate origin and destination- specific parameters to assess the friction of distance effect upon flows to and from individual zones (Stillwell, 1978). A package called IMP (Stillwell, 1984) has been developed for calibration of the set of alternative spatial interaction models defined above.

The techniques of spatial interaction modelling provide a very effective means of summarising large inter-zonal arrays of migration in terms of the frictional effect of distance upon movement. The 'IMP' package allows the examination of the variation in the beta parameters and mean migration lengths at a variety of spatial scales and levels of age and sex disaggregation using the time-series of NHSCR information.

Probability theory has provided the basis for a number of alternative migration models. Such models have previously been developed in the context of forecasting (Joseph,1975; Alonso,1978). Willekens and Baydar (1983) and Baydar (1983), in the context of developing a multi-regional forecasting model, emphasized the importance of identifying 'inertia' and 'stationarity' in historical migration flows. Such identification aids the formulation of hypotheses concerning the future patterns of migration. They use a conditional probability model to search for stability in migration flows. The model is split into three components - the overall level of migration, a generation component and a distribution component with the model having the following form

$$M_{ijt} = N_t \cdot W_{it} \cdot P_{ijt} \tag{2.15}$$

where

M_{ijt} is the number of migrants from region i to region j in year t;

N_t is the total number of migrants in year t;

W_{it} the generation of migration flows factor: the probability that a migration originates from i in year t

P_{ijt} the distribution factor: the probability that a migrant will migrate to zone j in year t given that his origin is region i.

The analysis of each component separately enables some insights into the stability of migration trends and patterns over time to be gained.

The above model has been used for an exploratory analysis of temporal trends in migration in the Netherlands (Baydar, 1983). In its log-linear form the model has provided the basis for a description of observed trends, and parameters with a 'direct demographic interpretation' have formed the input to a forecasting procedure. The log-linear model gives a simple representation of migration flows in the form of a contingency table and identifies individual components of the migration process (time, origin and destination). Although there are pragmatic difficulties associated with storage of data online when applying the model to large inter-zonal migration data sets, the importance of the 'effects' can be assessed individually, which allows a reduction in the size of the model used in forecasting through the exclusion of components that show stability over time.

The 'components' approach provides a very suitable framework for the systematic analysis of stability in migration which is undertaken in the thesis. The level, generation and distribution effects associated with inter-zonal movement within the UK measured by the NHSCR data over the period 1976-86 are examined. The analysis of migration stability in the 1980s is important in the evaluation of the migration component of the OPCS/DOE forecasting model which relies on data from the single year preceding the Census (Section 2.4).

2.4 THE OPCS/DOE MIGRATION PROJECTION METHODOLOGY

An integral part of the thesis is the examination of the migration component of the OPCS/DOE sub-national population projection procedure. At present, the forecasting of migration is based primarily on 1980/81 Census information with relatively little use being made of the NHSCR data available for subsequent years. In this section the projection methodology and the inputs that it requires are described in detail and a number of particular features of the process are highlighted and are investigated further in later sections of the thesis.

Martin and Voorhees Associates and John Bates Services, under contract to the Department of the Environment have developed a model for the generation of net migration flows for 108 local authority (LA) areas in England and Wales (metropolitan districts, shire counties and London Boroughs) by sex and single years of age (Martin, Voorhees and Bates, 1981). The procedure, using gross flow information for the LA areas, provides the net migration assumptions which are input directly to the OPCS population projection model. Prior to 1981 the net migration assumptions used within the projection procedure were derived in a hierarchical manner with initial totals for the standard regions used to constrain Local Authority estimates. The DOE, due to its close links with planning authorities, was responsible for the initial regional estimates. Lengthy consultation between the DOE and individual LAs was necessary to establish 'correct' net totals to account for the possible effect of local factors upon the migration estimates. Decision making was not made easier by the dearth of available migration statistics. Once agreement had been reached net figures were adjusted accordingly and an age and sex structure allocated to the migration flows. The process was deemed to be too costly in terms of time spent in consultation with the planning authorities and in the considerable effort required by OPCS to produce the age and sex breakdown of net migration flows by individual LA. OPCS/DOE sought to improve the migration forecasting so as to;

> "Make better use of existing data in order to produce a first estimate of net migration which could be input to the consultation process, hopefully at a level which would arouse relatively little controversy."
>
> and
>
> "To couple such an estimate with a methodology which would automatically disaggregate by age and sex for direct input to the cohort survival process."
>
> (Martin,Voorhees and Bates, 1981)

There are four main stages in the 'new' procedure for generating net migration assumptions:

(i) projection of migration flows out of each LA area by age and sex;

(ii) assignment of these outflows to individual destinations;

(iii) aggregation of these flows to provide zonal in-migration totals by age and sex; and

(iv) calculation of net-migration estimates from outflow and inflow totals.

Three sets of population projections have so far been undertaken using this procedure - in 1981, 1983 and 1985 (see OPCS, 1983, 1986 and 1988 respectively). The base populations or starting point of each round of projections are the mid-year population estimates prepared by the Registrar General (see OPCS, 1982, 1984 and 1986 respectively). The population totals for each individual LA area are disaggregated by sex and single year of age (<1 to 85+). The estimates include all persons usually resident in local government and health authority areas of England and Wales, with Armed Forces personnel stationed in an area taken to be usually resident and students counted as residents at their term-time address.

Stage one of the projection procedure involves estimating outflows from individual zones by age and sex for a given time-period as the product of the estimated population of a LA area by age and sex, the associated gross migra-production rate (GMR) and the proportion of the GMR accounted for by the particular age and sex group. Rees and Willekens (1989) have outlined the structure of the model in detail.

ie.

$$M_{i*}^{as}(t) = GMR_{i}(t) \,.\, om_{r}^{as}(r) \,.\, P_{i}^{as}(t) \qquad (2.16)$$

where

$M_{i*}^{as}(t)$ = total number of out-migrations from an area i by single year of age a and sex s for a future period t;

$GMR_i(t)$ = gross migra-production rate of outmigration from area i in time period t;

$om_I^{as}(r)$ = proportion of the outmigration GMR in single -year age-group a and sex s. Derived from modelled, standardized migration rates for area cluster I for a standard period r (1980/81); and

$P_i^{as}(t)$ = population of region i at single-year of age a and sex s beginning of period t.

The GMR is the sum of all age-specific rates of out-migration and reflects the variation in the level of migration across the spatial spectrum. Current projections use 1981 Census GMRs modified in the light of changes evident from NHSCR movement data since 1980/81. The Census GMR for a LA area is simply 'trended' parallel to that of the NHSCR. This procedure provides a base-period GMR for each LA area which remains constant unless altered explicitly. The model allows the user to, 'specify factors by which the GMRs will be changed either on a year-to-year basis, or at a compound rate for a chosen number of years'.

Out-migration proportions (oms) have been derived from the age-specific profiles of a series of LA area clusters (Bates and Bracken, 1982; Bracken and Bates, 1983; Bates and Bracken, 1987). To reduce the data requirements of the model (ie. to avoid having to calculate male and female age-specific migration rates for each LA area) a classification of LA out-migration and in-migration profiles has been derived based on similarities between individual migration schedules. Using the techniques developed by Rogers <u>et al</u> (1978)

model migration schedules were fitted to observed migration rates for each LA. The parameters describing the model schedule were then used to compare LAs and combine them into a classification based on profile similarities. The 'om' value for a particular area is therefore a fixed proportion of the GMR of a standardized migration profile (ie. GMR=1) for cluster I representing age a and sex s. This classification was designed to summarise the spatial variation in the propensity to migrate with age. The 1981-based projections used a classification derived from 1971 Census information. Subsequent rounds have utilised a similar classification based on 1981 Census data. In Chapter 9 changes since 1981 in the pattern of age-specific movement evident from the NHSCR data are investigated and a similar classification of FPCAs based on 1985/86 migration information is proposed.

The second stage of the forecasting procedure involves the assignment of these estimated out-migrations to individual destinations. To simplify the model, out-migrants are grouped into three broad age-bands (0-16/29-59, 17-28 and 60+) and assignment matrices are used to allocate out-migrants to destinations. The assignment stage of the model can be written as

$$M_{ij}^{As}(t) = M_{i*}^{As}(t) \, . \, k_{ij}^{As}(r) \qquad (2.17)$$

where

$M_{ij}^{As}(t)$ = migration flows from area i to area j in broad age-group A and sex s during period t;

$M_{i*}^{As}(t) = \sum_{a} M_{i*}^{as}$ where age a is contained within broad age-band A

= total out-migration from area i in broad age-group A and sex s during period t; and

$k_{ij}^{As}(r)$ = the proportion of outmigrants from area i in broad age-group A and sex s which have a destination area j in a standard period.

In the 1981 round of projections, NHSCR data for the standard period 1977-82 was merged to provide the necessary array of inter-zonal assignment proportions and 1971 Census data was used to estimate those flows where NHSCR information was unavailable. This method is rather unreliable given the conceptual and measurement differences between the two sources. Subsequent projection rounds have used 1981 Census information as the basis for assigning out-flows to destinations. No updating of the inter-zonal information has been undertaken using the available NHSCR data. Patterns of migration are assumed to remain constant over time. The suitability of using assignment proportions for a standard period (1980/81) is assessed in Chapter 8 where some analysis of the variation in the origin-destination pattern of movement observed from NHSCR data since 1980/81 is reported.

The broad age-groups which are used in the assignment process are deemed to encapsulate the major components of migration: family moves (0-16/29-59); moves at the time of entry to the labour force (17-28) and retirement moves (60+). Little justification is given by OPCS/DOE for adopting these age-group categories although the patterns of migration characterising each age-group are summarised as follows:

> "The 17-28 group, which is the most highly mobile, has the characteristic pattern dominated by movement to urban areas, particularly to Central London, while the 60+ age group demonstrates cetain specific movements to 'retirement areas' such as the South Coast. The remaining ages, which we refer to as 'family movers' show a characteristic pattern of movement from the highly

urbanized areas into the surrounding hinterland."

(Martin, Voorhees and Bates, 1981, p8)

In Chapter 8 of the thesis the validity of these broad age-groups is questioned by the derivation of an alternative classification based on patterns of age-specific inter-zonal movement evident from the NHSCR during the period 1983-86.

The product of stage two of the procedure is a series of inflows to individual LA areas disaggregated by broad age-group and sex. The third component of the forecasting model aggregates these flows to produce total in-migration and then disaggregates the totals to provide in-flows by single year of age and sex.

ie.

$$M^{as}_{*j}(t) = \sum_{A} \sum_{i} M^{As}_{ij}(t) \; . \; im^{as}_{J}(r) \qquad (2.18)$$

where

$M^{as}_{*j}(t)$ = total number of inmigrants to area j by age a and sex s in period t;

$\sum_{A} \sum_{i} M^{As}_{ij}(t)$ = aggregation of inter-zonal flows by broad age-group and sex to provide total in-migration to zone i by sex in period t;

$im^{as}_{J}(r)$ = proportion of in-migration GMR in age-group a and sex s. (Derived from modelled, standardized migration rates for area cluster J for the standard period, r).

The 'im' values are again derived from a series of clusters, this time based on in-migration data from the 1981 Census. Each LA area is assigned a particular profile type and zonal inflow totals are then disaggregated into single years of age based on proportions evident from the standardized profile.

At this stage of the forecasting procedure there exists, for each area, gross outflows and inflows disaggregated by single year of age and sex. From these it is possible to compute the net migration estimates as:

$$N_{j}^{as}(t) = M_{*j}^{as}(t) - M_{j*}^{as}(t) \tag{2.19}$$

where

$N_{j}^{as}(t)$ = net migration for area j, age a and sex s in period t;

$M_{*j}^{as}(t)$ = estimated gross in-migration to area j, age a and sex s in period t; and

$M_{j*}^{as}(t)$ = estimated gross out-migration from LA area j, age a and sex s in period t.

These net migration assumptions are then input directly to the population projection model. A constraint option is provided within the model which allows the user to input the actual or maximum and mimimum values of net-migration for specified areas.

A number of concerns have been expressed about various parts of the migration projection procedure. In particular the assignment stage where 1980/81 proportions are obviously out of date. Several of the analyses reported subsequently in the thesis endeavour to demonstrate existing inadequacies and to suggest alternative procedures.

2.5 CONCLUSIONS

This review has sought to identify empirical and modelling analyses of migration undertaken in recent years which relate directly to the general aims and objectives of the thesis. These aims and objectives need to be regarded in the light of previous research in the field. An important part of the thesis is the direct comparison of Census and NHSCR migration data for the 1980/81 period. However, a review of previous comparative work using these data types is withheld until Chapter 4, where it logically precedes analyses which are designed not only to establish the value of the NHSCR as an alternative source of migration data but also to identify the general problems associated with the use of alternative sources of migration information.

This chapter has therefore outlined a number of more recent studies of spatio-temporal patterns and trends in migration at a variety of different levels of age and sex disaggregation and reviewed a series of model-based studies. The majority of the former have used Census migration information with relatively little use made of NHSCR time-series data. Given an understanding of the conceptual and measurement differences between the data sources the intention is to undertake a more detailed and systematic analysis of spatio-temporal trends in migration than has so far been attempted. Little analysis of time-series NHSCR data has been undertaken below the standard region level and virtually no studies have looked at the pattern of movement evident since 1981. Subsequent analyses, therefore, examine trends in the pattern of NHSCR movement between 1976-86 at a number of sub-national scales and at both five and single-year age disaggregation. It becomes possible to evaluate the use of 1981 Census data in the OPCS/DOE forecasting procedure given the trends evident from the time-series. From the review of the sub-national migration forecasting methodology, it is clear that the accuracy of prediction depends upon the temporal stability of internal migration patterns within the UK with the NHSCR used solely as a means of extrapolating zone-specific GMR values. The illustration of post-1981 trends in NHSCR migration will, therefore, establish the suitability of using origin-destination 'allocation proportions' and LA age-profile classifications derived from the 1981 Census as the basis for forecasting migration flows.

The review of modelling strategies provided a summary of alternative methodologies available for the analysis of migration. The OPCS/DOE forecasting procedure utilises the techniques of migration schedule modelling initiated by Rogers et al (1978) to derive its FPCA classifications based on similarities between calibrated profile parameters. Modelling methods are applied to NHSCR age-specific data in Chapter 9 using the 'MODEL' package (Rogers and Planck, 1984) to describe and summarise age-profile differences across the spatial spectrum and to derive a Bates/Bracken type classification using more recent migration information.

Analysis of the variation in the spatial and temporal stability of migration patterns over time, reported in Chapter 7 of the thesis, utilises a 'components' framework, following that used by Dutch demographers, to illustrate fluctuations in the level, generation, attraction and distribution components of movement at a number of spatial scales, although no formal log-linear modelling has been attempted. However, spatial interaction models have been constructed and calibrated to examine the frictional effect of distance on migration, and to illustrate variations in mean migration lengths and parameter values between zones and age and sex categories.

It is apparent from this review of the literature that the NHSCR provides a valuable source of migration information which has not been fully utilised. A full understanding of its characteristics and limitations is still required and this exercise, reported in Chapters

3, 4 and 5 is an important pre-requisite for interpreting changes in patterns of movement which are evident from the NHSCR data time -series which has been assembled and which is introduced in the next chapter.

Chapter 3. SPATIAL FRAMEWORK AND DATA DESCRIPTION

3.1. INTRODUCTION

The aims of this chapter are twofold. Firstly, it is necessary to introduce the spatial scales selected for undertaking the comparative analyses of data from alternative sources and the analyses of spatio-temporal migration patterns and trends. Secondly, the chapter seeks to describe how the data upon which the analyses are based have been obtained from different sources and assembled for computer processing and subsequent interpretation. Whereas published Census volumes provide a source of information which can be collected manually, much of the information has been supplied by OPCS in coded form on magnetic tape. This chapter, therefore, indicates how migration and population data from the 1971 and 1981 Censuses of Population, annual migration data from the NHSCR from 1975 to 1986, and annual OPCS population estimates from mid-year 1975 to mid-year 1986 have been assembled in a computerised information system.

The following section describes and illustrates the spatial scales of analysis adopted in this study. Limitations on data availability and problems of management of large data files are very influential in determining the level of resolution. Section 3.3 describes in detail the alternative migration data sources utilised, outlining existing differences and similarities, the collection of data from published sources and provides a step by step illustration of the methodologies adopted for the processing of coded migration information from magnetic tapes. Section 3.4 provides a similar description of the processing of population data, both from published sources and magnetic tape, and finally Section 3.5 summarises the alternative sources of migration data that exist in Great Britain but which are not utilised in this study.

3.2 SCALES FOR SPATIAL ANALYSIS

3.2.1 The national scale

A variety of spatial scales are utilised in the research with the most aggregate being the national or UK level. This generally provides a measure of the number of NHSCR moves or Census migrants occurring between the counties and metropolitan districts of England and Wales and the three regions of Scotland, Northern Ireland and the Isle of Man. National level Census data excludes flows to Northern Ireland and the Isle of Man which are included in national-level NHSCR information. A brief description of the nature of the Census or NHSCR data used and the spatial levels adopted is given at the beginning of each chapter.

3.2.2 Standard region scale

The standard region scale consists of eight English regions, together with Scotland, Wales and Northern Ireland. The Isle of Man is also included as a separate region because it is included in the NHSCR zone set. However, outflows to Northern Ireland and the Isle of Man are not available from the Census and NHSCR moves to these zones are also excluded from the inter-regional matrix of flows in the comparative analysis. The system of interest consists of 12 origins and 10 destinations. The study zones at this spatial scale, excluding the Isle of Man, are illustrated in Figure 3.1 which has been generated using the GIMMS mapping package as described in Rees, Stillwell and Boden (1987). Standard regions give an indication of broad patterns of migration but miss the important patterns of movement between metropolitan and non-metropolitan areas. Other spatial scales are therefore adopted.

3.2.3 Metropolitan/non-metropolitan regions

This second spatial scale consists of metropolitan counties, their region remainders and regions without metropolitan counties in England, together with Wales, Scotland, Northern Ireland and the Isle of Man. This spatial system follows that presented in Rees and Stillwell (1984) except that no distinction is made between the Outer Metropolitan Area (OMA) and the Outer South East (OSE), or between Central Clydeside and the rest of Scotland. This is because no NHSCR data on moves within Scotland have been collected and because it is impossible to distinguish moves to or from the OMA and the OSE from the NHSCR data for England and Wales. Furthermore, the absence of census data for flows to Northern Ireland and the Isle of Man restricts the system of interest to 19 origins and 17 destinations. Figure 3.2 illustrates the metropolitan and non-metropolitan zones referred to as the MNM system in the thesis.

3.2.4 Family Practitioner Committee Area scale

The most disaggregate spatial level for which NHSCR data is available involves Family Practitioner Committee Areas (FPCAs) in England and Wales together with Scotland, Northern Ireland and the Isle of Man. There are 97 origin and 95 destination zones since flows to Northern Ireland and the Isle of Man are again excluded. FPCAs in England and Wales correspond to metropolitan districts and counties without metropolitan districts with several exceptions. Knowsley and St. Helens in Merseyside are combined to form one FPCA and 33 London

Figure 3.1 UK standard regions

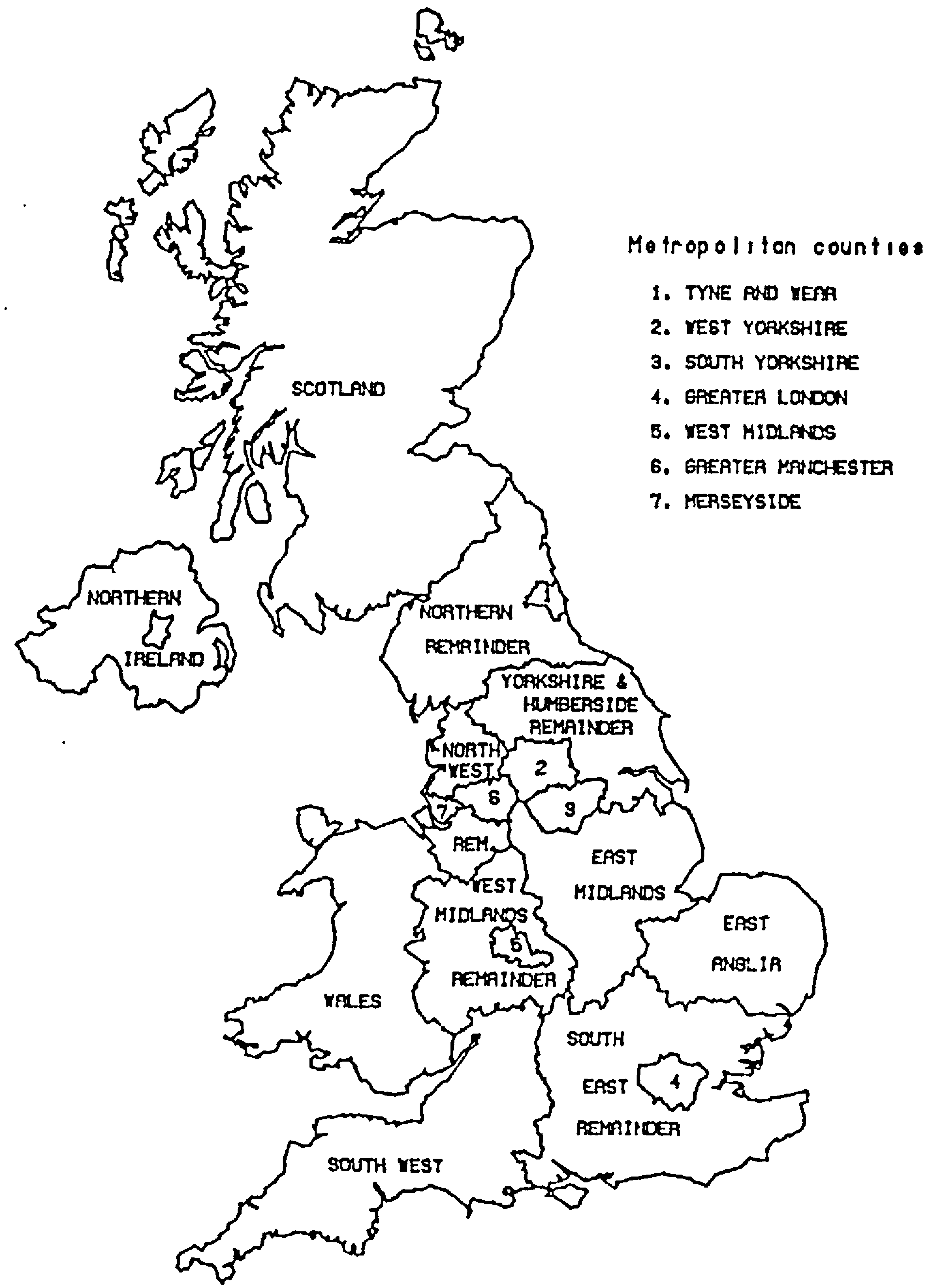


Figure 3.2 Metropolitan and non-metropolitan regions

Boroughs are combined to form a total of twelve FPCAs within Greater London. Figure 3.3 illustrates the FPCA system of interest and Table 3.1 indicates the names of the coded zones.

3.2.5 Other spatial systems

Two alternative categorisations of individual FPCAs are utilised in Chapters 6 through 9. The first is of the type used by Champion et al (1987) in their analysis of population change within Britain based on functional regions and involves the division of the country into 'North' and 'South' with the North consisting of the 'Industrial Heartland' and the 'Periphery' and the South consisting of Greater London and the 'Rest of South'. Table 3.2 lists the FPCAs within these four broad regional divisions and Figure 3.4 illustrates the spatial division of the regions.

The second alternative spatial system is based on the density of population observed in individual FPCAs. 1981 Census usually resident populations and area by hectare have been used to compute a measure of density as follows:

$$PD_i = P_i / A_i \qquad (3.1)$$

where

PD_i = population density (persons per hectare) for zone i;

P_i = usually resident population of zone i (1981 Census);

A_i = area of zone in hectares.

FPCAs have been categorised based on density of population into four equally sized groups (quartiles) and classed as either high, medium-high, medium-low or low density areas. The four groups may be further categorised into northern and southern sections using the

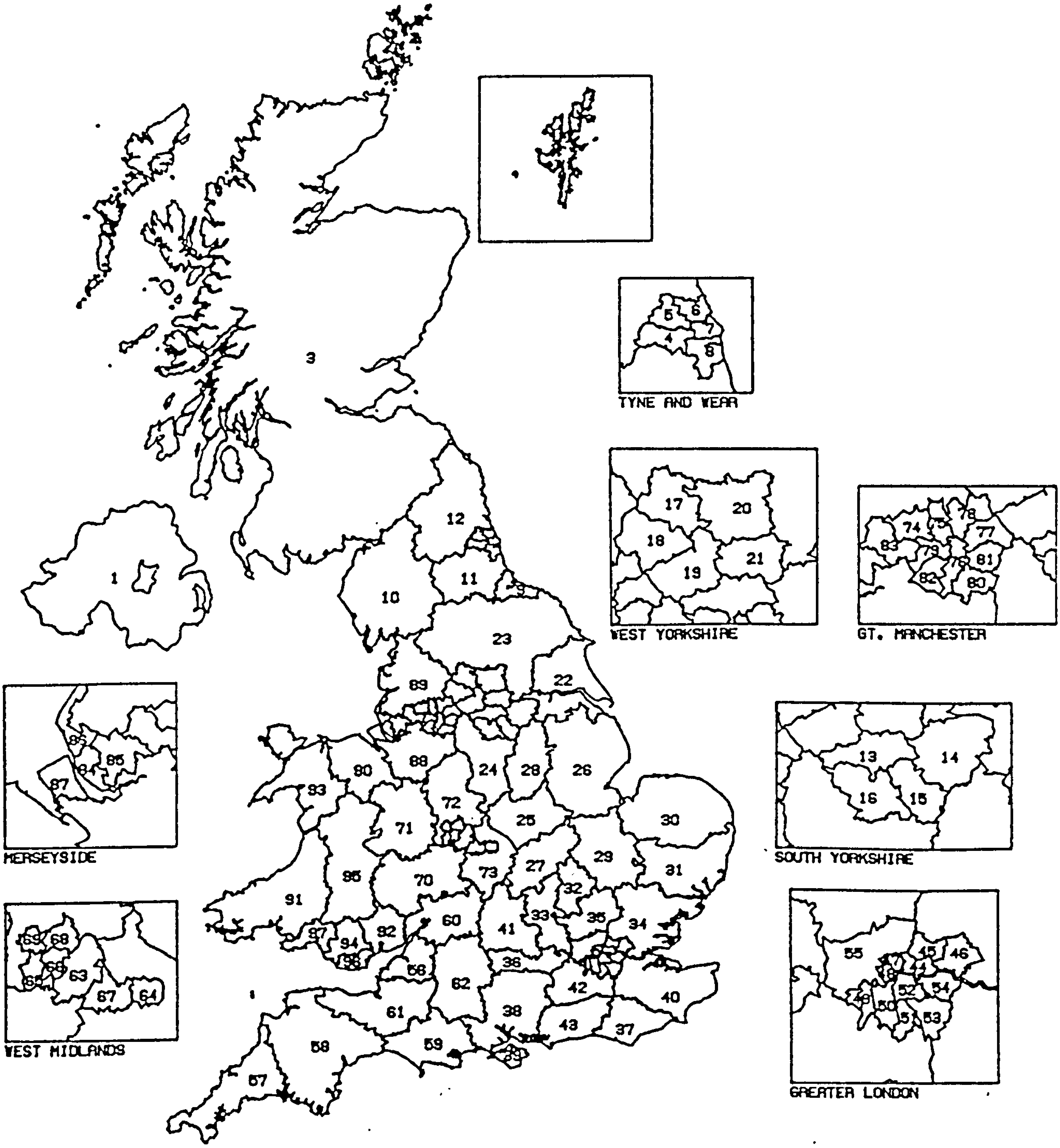


Figure 3.3 <u>Family Practitioner Committee Areas in England and Wales and other study zones</u>

Table 3.1 Names of the Family Practitioner Committee Areas in England and Wales plus other study zones

Code	FPCA name	Code	FPCA name	Code	FPCA name
1	Northern Ireland	37	East Sussex	63	Birmingham
2	Isle of Man	38	Hampshire	64	Coventry
3	Scotland	39	Isle of Wight	65	Dudley
4	Gateshead	40	Kent	66	Sandwell
5	Newcastle	41	Oxfordshire	67	Solihull
6	North-Tyneside	42	Surrey	68	Walsall
7	South-Tyneside	43	West Sussex	69	Wolverhampton
8	Sunderland	44	City, Hackney,	70	Hereford &
9	Cleveland		Newham & Tower		Worcestershire
10	Cumbria		Hamlets	71	Shropshire
11	Durham	45	Redbridge &	72	Staffordshire
12	Northumberland		Waltham Forest	73	Warwickshire
13	Barnsley	46	Barking &	74	Bolton
14	Doncaster		Havering	75	Bury
15	Rotherham	47	Camden &	76	Manchester
16	Sheffield		Islington	77	Oldham
17	Bradford	48	Kensington,	78	Rochdale
18	Calderdale		Chelsea &	79	Salford
19	Kirklees		Westminster	80	Stockport
20	Leeds	49	Richmond &	81	Tameside
21	Wakefield		Kingston	82	Trafford
22	Humberside	50	Merton,Sutton	83	Wigan
23	North-Yorkshire		& Wandsworth	84	Liverpool
24	Derbyshire	51	Croydon	85	St. Helens &
25	Leicestershire	52	Lambeth,Southwark		Knowsley
26	Lincolnshire		& Lewisham	86	Sefton
27	Northamptonshire	53	Bromley	87	Wirral
28	Nottinghamshire	54	Bexley & Greenwich	88	Chesire
29	Cambridgeshire	55	Middlesex	89	Lancashire
30	Norfolk	56	Avon	90	Clwyd
31	Suffolk	57	Cornwall	91	Dyfed
32	Bedfordshire	58	Devon	92	Gwent
33	Buckinghamshire	59	Dorset	93	Gwynedd
34	Essex	60	Gloucestershire	94	Mid-Glamorgan
35	Hertfordshire	61	Somerset	95	Powys
36	Berkshire	62	Wiltshire	96	South Glamorgan
				97	West Glamorgan

Note:
Middlesex consists of the London Boroughs of Barnet, Brent, Harrow, Ealing, Hammersmith, Hounslow, Enfield, Haringey and Hillingdon.

Abbreviated labels for the London borough combinations are illustrated in Table 3.2

Table 3.2 Classification of FPCAs within broad regional divisions

NORTH		SOUTH	
Periphery	Industrial Heartland	Greater London	Rest of the South
N.Ireland	Barnsley	(44) LON - CHNT	Derbyshire
Scotland	Doncaster	(45) LON - RWF	Leicestershire
Gateshead	Rotherham	(46) LON - BH	Lincolnshire
Newcastle	Sheffield	(47) LON - CI	Northamptonshire
N.Tyneside	Bradford	(48) LON - KCW	Nottinghamshire
S.Tyneside	Calderdale	(49) LON - RK	Cambridgeshire
Sunderland	Kirklees	(50) LON - MSW	Norfolk
Cleveland	Leeds	(51) LON - CROY	Suffolk
Cumbria	Wakefield	(52) LON - LSL	Bedfordshire
Durham	Humberside	(53) LON - BROM	Buckinghamshire
Northumberland	N.Yorkshire	(54) LON - BG	Essex
Clwyd	Birmingham	(55) LON - MIDD	Hertfordshire
Dyfed	Coventry		Berkshire
Gwent	Dudley		East Sussex
Gwynedd	Sandwell		Hampshire
Mid-Glamorgan	Solihull		Isle of Wight
Powys	Walsall		Kent
South Glamorgan	Wolverhampton		Oxfordshire
West Glamorgan	Hereford		Surrey
	Salop		West Sussex
	Staffordshire		Avon
	Warwickshire		Cornwall
	Bolton		Devon
	Bury		Dorset
	Manchester		Gloucestershire
	Oldham		Wiltshire
	Rochdale		
	Salford		
	Stockport		
	Tameside		
	Trafford		
	Wigan		
	Liverpool		
	St Helens		
	Sefton		
	Wirral		
	Chesire		
	Lancashire		

Note: The numbers allocated to the Greater London FPCAs correspond to those in Table 3.1

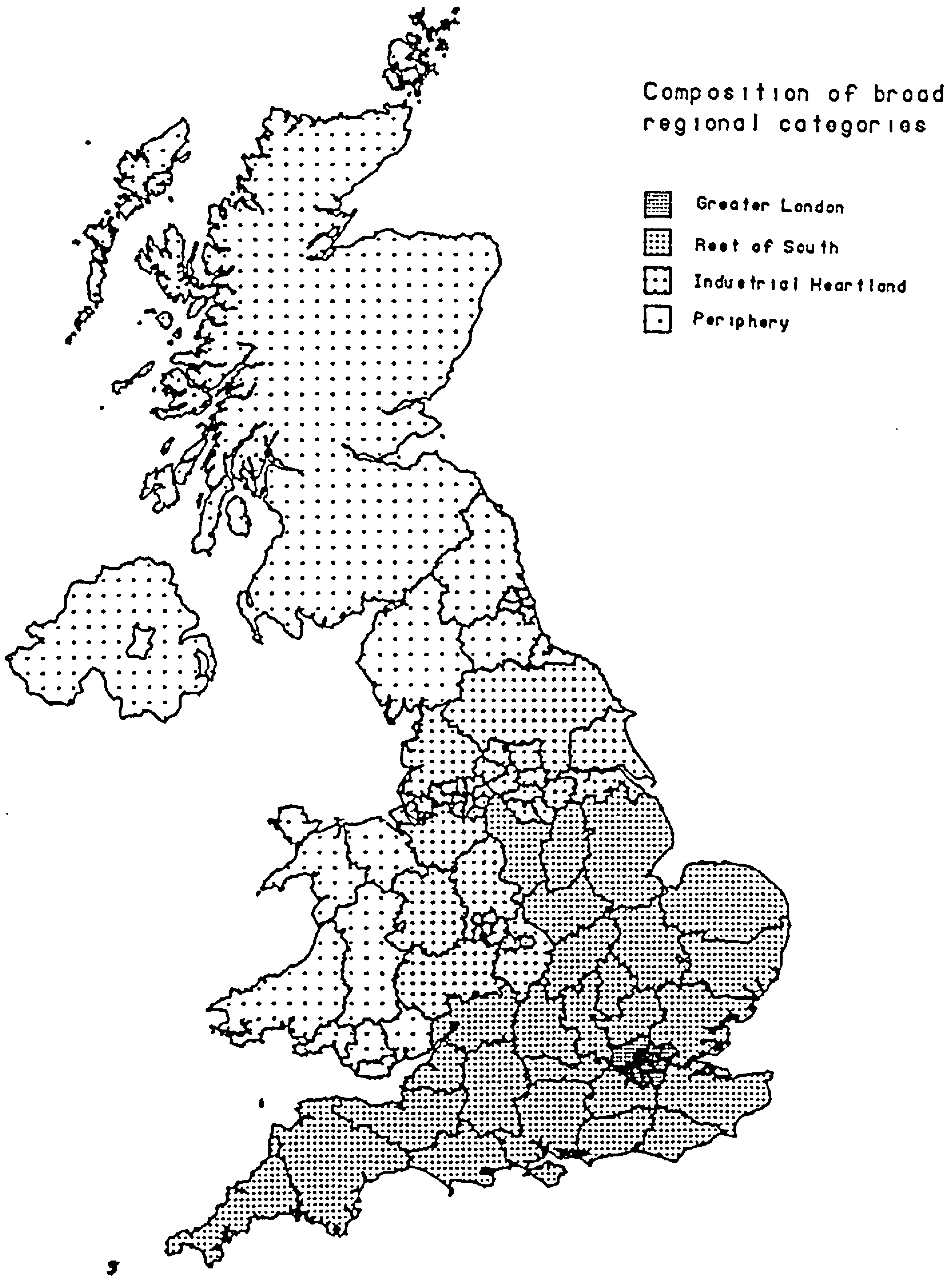


Figure 3.4 Composition of the broad regional divisions of the UK

previous division. The full classification of FPCAs into population density classes is listed in Table 3.3 and illustrated in Figure 3.5.

3.3 MIGRATION DATA SOURCES

3.3.1 Moves and transitions: conceptual differences

Prior to outlining in detail the form of the data to be utilised in this study it is necessary to give some insight into the conceptual differences that exist between alternative types of migration. These differences, although well documented by Courgeau (1980), Ledent (1980) and Rees (1984), for example, have been somewhat neglected within previous comparative analyses of migration information. Rogers and Castro (1986, p157) note that

> "Most information regarding migration is obtained from population censuses or registers that report migration data for a given time interval, in terms of counts of migrants or of moves respectively."

Subsequent analyses will involve the use of migration data from both types of source so it is necessary to understand the contrasting methods of migration measurement in the decennial Census of Population and the NHSCR which is a continually updated register.

A person undergoing a change of residence will be classified in a population register by age at the time of move. If the period of observation of events is limited to one year then all moves by persons of a given age will be counted in the age-time space illustrated in Figure 3.6 - the period age-time plan (ATP) of observation. A move recorded in this way is defined as

> "an event in which only the immediately anterior state and the immediately posterior state are known, not the states of the mover at the beginning or end of the time interval."
>
> (Rees,1986, p101)

Table 3.3 Classification of north/south FPCAs within population density categories

POPULATION DENSITY (persons/hectare) High 23-87 p/h	Medium/High 7-23 p/h	Medium/Low 2.5-7 p/h	Low 0.2-2.5 p/h
LON - CI	* Wirral	Surrey	* Warwickshire
LON - KCW	* Sunderland	Hertfordshire	Northamptonshire
LON - LSL	* Tameside	* Mid-Glamorgan	Dorset
LON - CHNT	* Trafford	* Calderdale	Oxfordshire
LON - MSW	* Sefton	Berkshire	Gloucestershire
LON - RWF	LON - BROM	* Doncaster	Cambridgeshire
* Liverpool	* Bolton	Nottinghamshire	* Hereford
LON - BG	* Bury	* W.Glamorgan	* Clwyd
LON - MIDD	* St Helens	* Lancashire	Suffolk
* Birmingham	* Oldham	Bedfordshire	Wiltshire
* Manchester	* Wigan	Essex	Devon
* Wolverhampton	* Gateshead	* Chesire	Norfolk
LON - CROY	* Sheffield	Kent	Somerset
* Sandwell	* Rochdale	Hampshire	Cornwall
* Coventry	* Leeds	* Staffordshire	* Salop
LON - RK	* Bradford	East Sussex	* N.Ireland
* Dudley	* Solihull	Derbyshire	Lincolnshire
LON -BH	* Cleveland	Buckinghamshire	* N.Yorkshire
* S.Tyneside	* Wakefield	Leicestershire	* Cumbria
* Walsall	* S.Glamorgan	W.Sussex	* Scotland
* Salford	* Kirklees	* Gwent	* Northumberland
* Newcastle	* Rotherham	Isle of Wight	* Gwynedd
* N.Tyneside	* Barnsley	* Durham	* Dyfed
* Stockport	Avon	* Humberside	* Powys

* indicates 'NORTH'

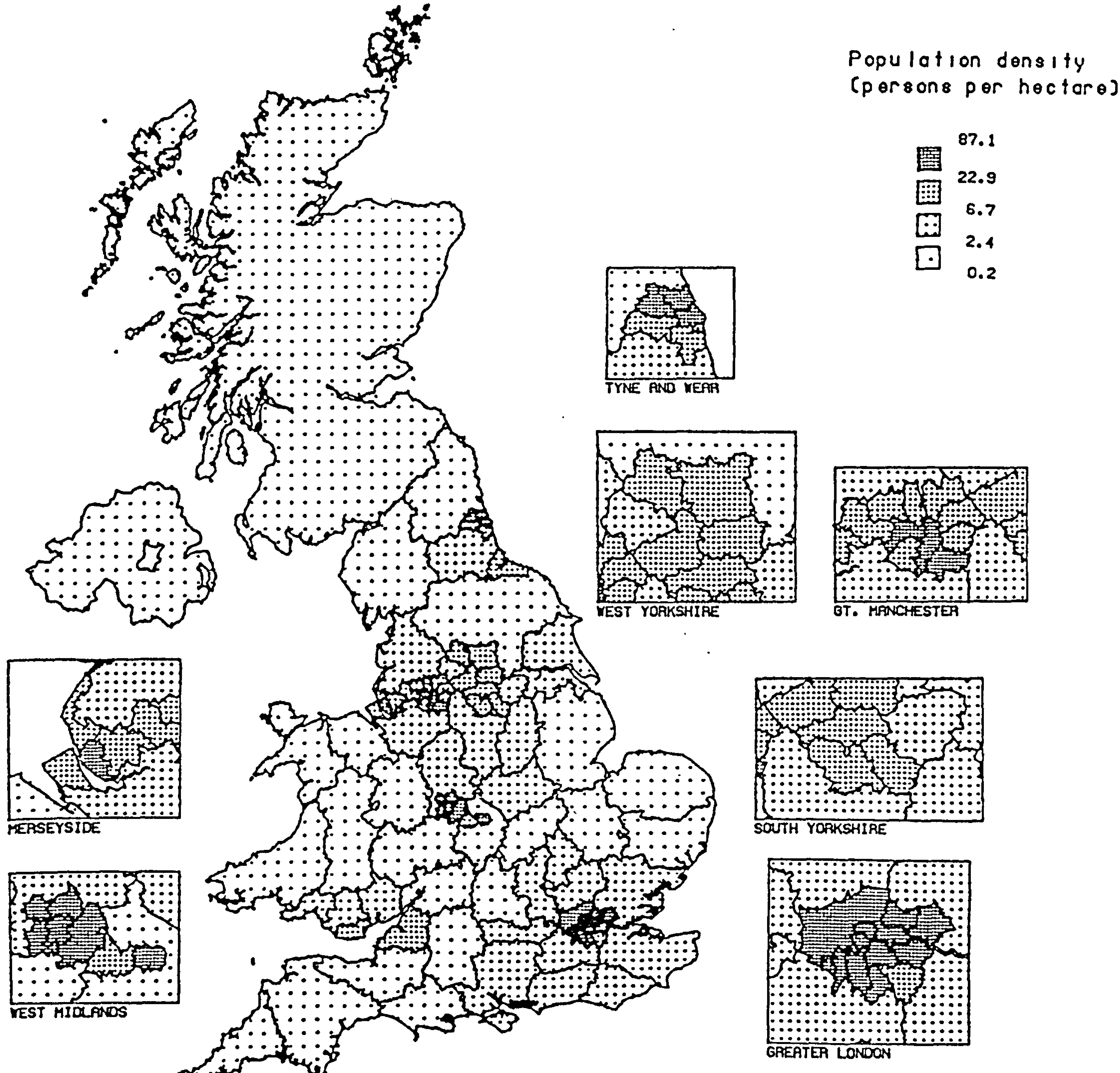


Figure 3.5 Composition of the four population density categories

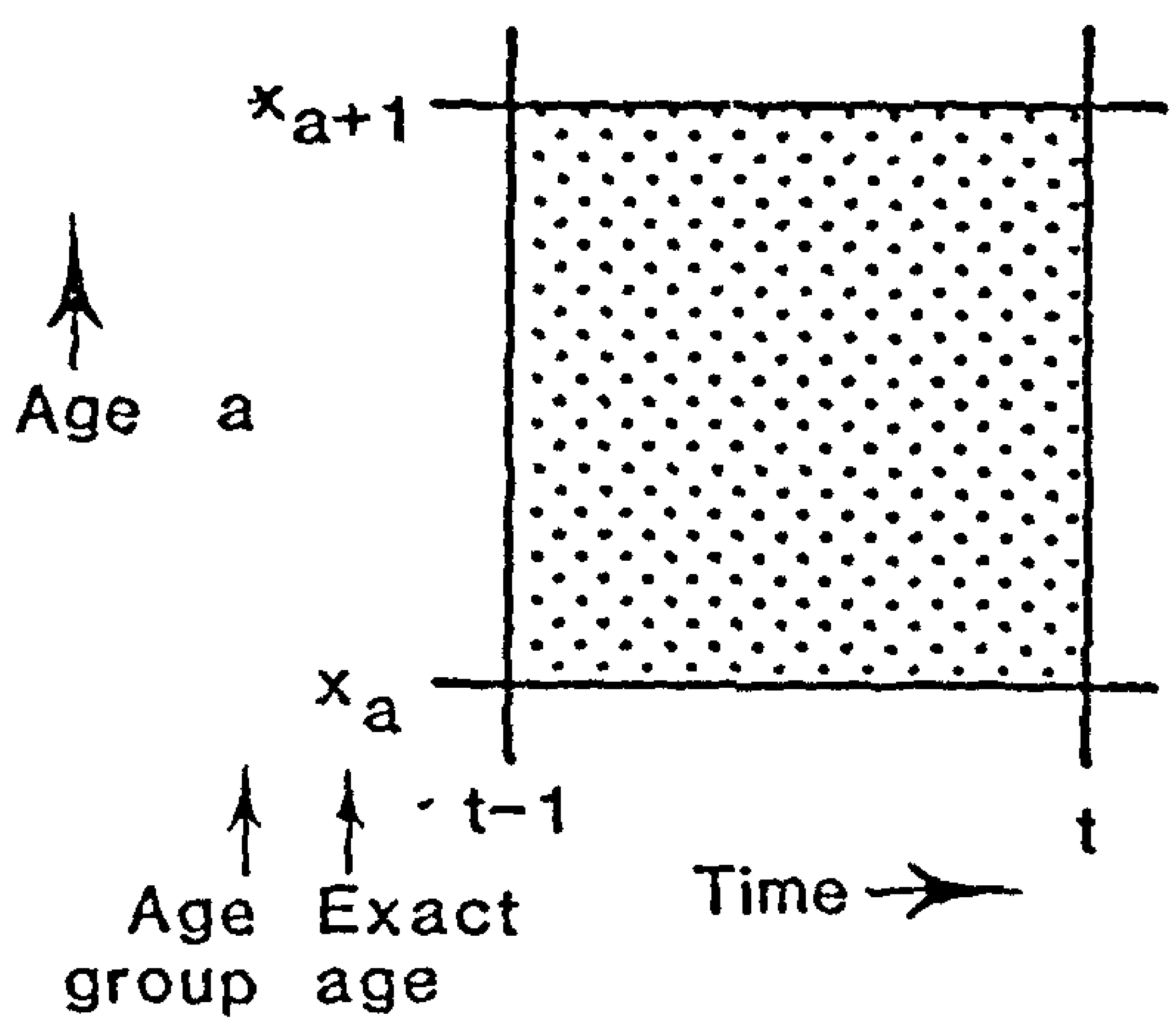


Figure 3.6 The age-time plan of observation for movement data

A register will record all such moves taking place within a given time-period and provides, therefore, a count of migration events rather than a count of the number of persons migrating.

Alternatively, population censuses provide a retrospective measure of migration. The age of a migrant is measured at the end of the period of observation and migrant transitions are counted for cohorts of the population who are aged between X_{a-1} and X_a at time t-1 and aged between X_a and X_{a+1} at time t, assuming a one-year period is observed. The transitions are measured as a period cohort (Figure 3.7). Transitions can subsequently be defined as

> "classifications of the populations by initial and final states in a time interval; the intermediate states through which a person may have passed are unknown."
>
> (Rees 1986, p101)

A census will record migrants as persons whose usual residence on census date was different one year or five years previously.

Population censuses and population registers, therefore, employ contrasting methods of migration classification which invariably produce contrasting levels of mobility if compared over a similar time-period. For example, an individual undertaking several changes of address within a given period of observation will have each move recorded in a population register, provided that a re-registration is made at each new destination, but will only be classed as a migrant in a census if the persons address at the beginning of the period is different to that at the time of enumeration. If an individual returns to his initial address before the end of the period of observation, after previous changes of address, he/she will be recorded in the census as a non-migrant as address at the beginning

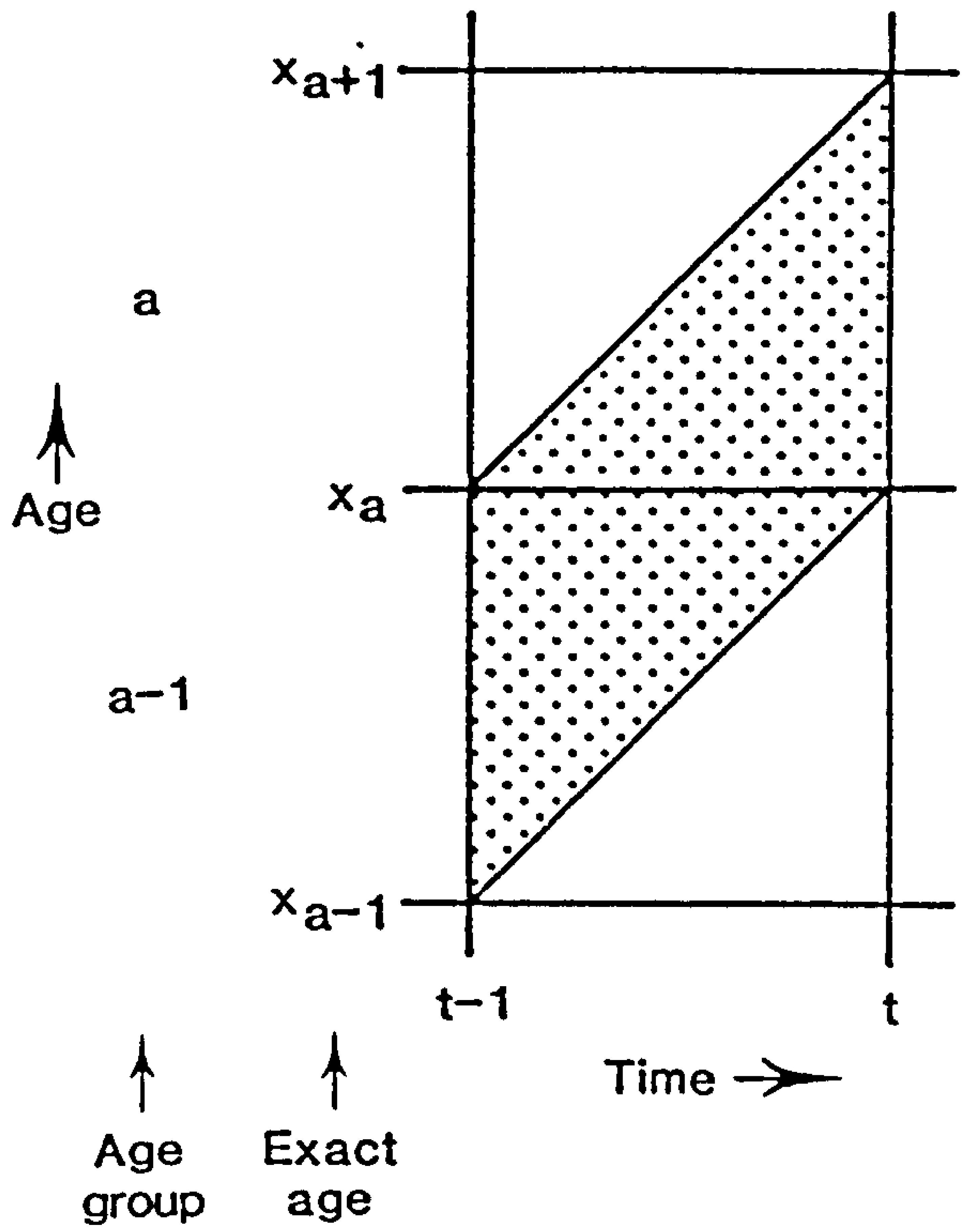


Figure 3.7 <u>The age-time plan of observation for transition data</u>

and end of the period are the same. In this instance a population register would record a return movement. Furthermore, a person who changes residence during the period in question yet dies before the end of the period will constitute one move in a population register but will be ignored by the retrospective census. Similarly moves by those who are born in the period and by those who are born and die in the period are excluded from the Census. The result of such discrepancies is that

> "since at least some migrants, by census definition, will have been involved, by registration definition, in more than one migratory event, counts from registers should normally exceed those from censuses."
>
> (Rogers and Castro,1986 p158)

From this explanation it appears that a population register would produce a more precise measure of mobility as it records all moves taking place within a given time-period. Unfortunately there is no such register in Great Britain specifically designed to record the internal movements of the population on a continuous basis. It is the Census, taken at ten-yearly intervals, which includes a question on usual residence at enumeration and one-year previously, that is accepted as the most reliable source of migration data in Britain. The nearest approximate to a population register is the National Health Service Central Register (NHSCR) which records the re-registration of doctors patients upon transfer to a new FPCA. The value of the NHSCR as a source of migration data can be assessed, therefore, through a direct comparison of transfer data with the Census transition data, taking into account the conceptual differences outlined in this section.

3.3.2 Diagnostic features of 1981 Census and NHSCR migration data

Section 3.3.1 outlined the conceptual differences that exist between movement and transition data which can result in different measures of the level of mobility. Cognisance of these concepts is of paramount importance if a correct interpretation and understanding of differences between NHSCR and census data is to be achieved.

In addition to conceptual differences between these two alternative types of migration data, there are also variations in the populations-at-risk covered by the NHSCR and the Census. Certain sub-groups of the population are handled differently in each data source. The movement of students, for example, tends to be omitted from the Census because persons completing census forms were instructed in 1981 to include

> "any persons who usually live with your household but who are absent on census night. For example, on holiday, in hospital at school or college."
>
> (OPCS,1981)

Students tend, therefore, to be recorded by the Census as living at the parental home and moves to places of education during the previous year are excluded from subsequent tabulations. In contrast the NHSCR will record student moves if re-registration takes place. The extent and timing of re-registration in a new FPCA varies between educational establishments with some having compulsory or block registrations with a GP upon arrival and others leaving the timing of registration to the individual.

The recording of moves made by Armed Forces (AF) personnel and their dependents provides another form of discrepancy between the NHSCR and the Census. Such moves are included in the Census yet excluded from the NHSCR. Table 3.4, adapted from Devis and Mills

Table 3.4 Classification of types of moves between FPCAs by Armed Forces personnel

Type of move	Identified in Census	Identified in NHSCR	Recorded as Census	Recorded as NHSCR	Census Orig	Census Dest	NHSCR Orig	NHSCR Dest
Recruitment	yes	yes	Move by member of AF	Move from FPCA to AF	FPCA	FPCA	FPCA	AF
Posting	yes	no	Move by member of AF	No record	FPCA	FPCA	-	-
Discharge	yes	yes	Move by civilian	Move from AF to FPCA	FPCA	FPCA	AF	FPCA

Adapted from Devis and Mills (1986, p.14)

(1986), illustrates how each source treats AF movement. The Census records recruitments, postings and discharges (although AF discharges are recorded as civilian migrants) provided that address at enumeration was different from one year previously. The NHSCR, however, records only recruitment and discharge moves by origin and destination respectively. No moves within the AF are captured by the NHSCR as personnel are recorded, on enlistment, as being members of the Forces and from then until discharge are excluded from any movement tabulations. The destination FPCA on recruitment and the origin FPCA at time of discharge are not distinguishable. These FPCAs are tabulated as 'Armed Forces' in the NHSCR. AF dependents are not distinguished from AF personnel in the NHSCR and recruitment and discharge totals therefore include all moves whether by personnel or dependent. Published tabulations and computer summaries of NHSCR data (1976-83) produced by OPCS do not include movement by AF personnel.

Moves by prisoners and long-term psychiatric patients are also included in the Census but excluded from the NHSCR. The 1981 Census specified the usual residence of an inmate as the institution concerned if the person had been in the institution for more than six months, or as the home address if less than six months. Again a person is classed as a migrant if address on Census night and one year previously differed. The NHSCR excludes all moves to such institutions and all moves between them but will include patient/prisoner discharges on the condition that the person re-registers in a different FPCA to that of the institution.

Another important difference between the NHSCR and the Census involves the recording of transfers made by infants - those aged less than one at the end of the period. The NHSCR, being a continuous register and observing events in a period age-time plan, records all registered moves regardless of age. The Census, on the other hand, recording information for cohorts defined by end-of-period ages, will omit all migrants aged less than one at the time of enumeration. Sections 4.3.2 and 5.2.2 outline the procedures adopted in this study for reconciling the recording of infant flows in Census and NHSCR datasets.

Other factors, apart from conceptual differences and differences between populations-at-risk require recognition when comparing NHSCR and Census data. For instance, the accuracy of information collected by a national survey such as the Census has been measured through a Post Enumeration Survey (PES) (Britton and Birch, 1981) which was carried out immediately after the Census. Devis and Mills (1986) estimate from the PES that the Census failed to record approximately 172,000 migrants in terms of origin not-stated, incorrect completion of forms and mis-representation of those usually resident on Census night. Migrants in the 20-29 age range were estimated as being those most affected by the deficiency of recording suggested by the PES. The extent of this unrecorded Census migration provides further discrepancy between data sources although it is possible to assign the origin not-stated migrants on the basis of known flows.

The quality of the NHSCR can be questioned on several counts. Firstly, the NHSCR does not record migrants who do not register with a doctor. Certain groups, especially young adults may not register with a new FPC until they require treatment and may even neglect registration totally. Devis (1984) emphasises the fact that household surveys have shown that over a year 28% of the population never consult a family doctor. Young adults are the most mobile members of the population so their failure to re-register upon moving to a new FPCA may falsify the true level of mobility. Other sub-groups, however, such as the elderly or mothers with young children, are likely to re-register as soon as a move is made, these groups being the most likely to require frequent medical treatment. The speed of re-registration varies, therefore, between age-groups and although it is impossible to measure accurately, the general assumption has been made that the average time-lag between a move and its accompanying re-registration is three months. The implication is that moves recorded in a certain period refer to moves made, on average, three months earlier. Devis and Mills (1986) explored the use of alternative lags in their comparison of NHSCR and Census data but found little variation in the results that were obtained. The three month lag has, therefore, been universally accepted.

Finally it is important to recognise that movement data from the NHSCR has been obtained by OPCS on a 10% sample basis, whereas the 1981 Census count of migration was 100%. In order to compare data from the two sources for a common time-period it is necessary to compute the sampling error and confidence interval associated with each NHSCR statistic.

3.3.3 Processing of 1981 Census data from magnetic tapes

At the onset of this research project it was agreed that OPCS would provide the 1981 Census data necessary for comparative analysis in the form of a district by district migration matrix for Great Britain. The data were supplied on ten magnetic tapes with each tape containing migration information for a standard region of England or

Wales or for Scotland.

Each tape contains a number of records (Table 3.5) with each record containing seven fields of coded information: the destination and origin area codes, age, sex, record type, type of move and a migrant count (Table 3.6). The destination area code refers to the district of usual residence of a person on Census day and the origin area code refers to the district of usual residence one year before Census date. The data includes an origin not-stated category but does not include a similar category for destinations. The migration information excludes all transfers involving persons aged less than one at the time of the Census so the age code ranges from 1 to 109 and there is no 'age not-stated' category. The sex code also does not contain a 'sex not-stated category'. The fifth field within each record contains the code 1 or 2 depending on whether the count refers to in-migrants or out-migrants. Each individual is recorded twice within the complete data set, once as an in-migrant and once as an out-migrant, for each transfer where the origin is in Great Britain. For migration between Great Britain and each external zone there are only records containing counts of in-migrants. The entire processing of the Census data can, therefore, be restricted to the in-migrant records with subsequent runs of the routine handling only out-migrants undertaken to act as a check on the accuracy of the procedures. Each record has a 'TYMO' field to indicate whether the transfer takes place within or between districts. This particular code facilitates the exclusion of intra-district flows from any analysis. The seventh field of information records a count of the number of persons with identical age and sex characteristics who undergo a particular transition during the Census period. The count,

Table 3.5 Number of records on each magnetic tape containing 1981 Census district migration data

Region code	OPCS identifier	Tape number	Number of records
Northern	1001	F36141	113856
Yorkshire & Humberside	1002	F36322	161035
East Midlands	1003	F36323	192171
East Anglia	1004	F36324	115880
West Midlands	1005	F36325	185948
South West	1006	F36329	269352
North West	1007	F36330	221725
Wales	1010	F36331	124070
Scotland	1011	F36332	214691
South East	1012	F36335	1025563

Notes:
Census code = OPCS-supplied tape identification.
Tape number = ULCS-supplied tape identification.

Table 3.6 1981 Census transition data: record layout for inmigrants

Start position	Max no of characs	Data type	Field description	Range of codes
5	4	character	Destination area code	0101 - 8145
9	4	character	Origin area code	0004 - 8145
13	3	character	Single year of age at Census date	001 - 109
16	1	character	Sex	1 = males 2 = females
17	1	character	Record type	1 (inmigrant)
18	1	character	TYMO	1 = intra-district 2 = inter-district
19	2		Filler	
21	4	binary	Migrant count	1 upwards

unlike the other six fields which are coded in character form, is recorded in binary form.

The problem involves the extraction of migration information from the magnetic tapes and the creation of files of data of manageable size for use in subsequent analyses. The degree of disaggregation of the processed data files was restricted by the limitations upon the storage capacity within the Leeds University CMS system. Initially three sets of Census migration information corresponding with available NHSCR computer summary data were required in separate files as follows:

(i) a matrix of migrant flows between the 97 origins and 95 destinations of the FPCA spatial level;

(ii) out-migrant totals for each zone (FPCA) disaggregated by five-year age-group and sex; and

(iii) in-migrant totals for each zone (FPCA) disaggregated by five-year age-group and sex.

These three files are labelled TRAN1 DATA, TRAN2 DATA and TRAN3 DATA repectively in Table 3.7 which is a summary of the data assembled in the information system.

The data processing was carried out using a Fortran program. Contained within the program was an assembler routine converting all fields of information within an individual record read from tape, from ICL 1900 code to EBCDIC code and the binary integer in the count field to an EBCDIC integer variable. The assembler sub-routine output each record as a character variable vector. It therefore required an internal 'READ' statement to distinguish each individual field of information in the character variable. The variables stored in the fields could then be used to increment the elements of the respective arrays.

Table 3.7 Description and structure of the migration and population data files created

Filename	Type of data	Source	Spatial scale	Age -groups	Sexes	Description
TRAN1 DATA	transition	1981 Census	FPCA	None	Persons	Inter-FPCA array of Census migrant flows
TRAN2 DATA	transition	1981 Census	FPCA	Five-year	M/F	Total migrant outflows from FPCAs by age and sex
TRAN3 DATA	transition	1981 Census	FPCA	Five-year	M/F	Total migrant inflows to FPCAs by age and sex
CEN7071 DATA	transition	1971 Census	MNM	Five-year	M/F	Inter-MNM migrant flows by age and sex, 1970/71
CEN8081 DATA	transition	1981 Census	MNM	Five-year	M/F	Inter-MNM migrant flows by age and sex, 1980/81
MOV1A DATA	movement	NHSCR CSD	FPCA	None	Persons	Inter-FPCA array of NHSCR moves, 1980/81
MOV2A DATA	movement	NHSCR CSD	FPCA	Five-year	M/F	Total NHSCR out-moves for FPCAs by age and sex, 1980/81
MOV3A DATA	movement	NHSCR CSD	FPCA	Five-year	M/F	Total NHSCR in-moves for FPCAs by age and sex, 1980/81
MOV1B DATA	movement	NHSCR PUD	FPCA	None	Persons	Inter-FPCA array of NHSCR moves, 1980/81
MOV2B DATA	movement	NHSCR PUD	FPCA	Five-year	M/F	Total NHSCR out-moves for FPCAs by age and sex, 1980/81
MOV3B DATA	movement	NHSCR PUD	FPCA	Five-year	M/F	Total NHSCR in-moves for FPCAs by age and sex, 1980/81
T17686 FPCDATA	movement	NHSCR CSD/PUD	FPCA	Five-year	M/F	11-year time-series of gross inflows and outflows at the FPCA level by age and sex, NHSCR, 1976-1986
T27686 FPCDATA	movement	NHSCR CSD/PUD	FPCA	None	Persons	11-year time-series of inter-FPCA NHSCR moves 1976-1986
T27686 MNMDATA	movement	NHSCR CSD/PUD	MNM	None	Persons	11-year time-series of inter-MNM NHSCR moves 1976-1986
MOV1 CEN8081	movement	NHSCR PUD	FPCA	Five-year	Persons	NHSCR inter-FPCA movement by age for 1980/81
MOV1 D8586	movement	NHSCR PUD	FPCA	Five-year	Persons	NHSCR inter-FPCA movement by age for 1985/86
C9MIG DATA	movement	NHSCR PUD	FPCA	Single yr	Persons	Gross NHSCR in and out moves by age and sex, 1980/81 & 1985/86
FPCDATA POPS	population	Mid-yr estim	FPCA	None	Persons	Mid-year population estimates by FPCA, 1975-1986
FPCDATA AGEPOPS	population	Mid-yr estim	FPCA	Five-year	M/F	Mid-year population estimates by FPCA, age and sex 1975-1986
MNMDATA POPS	population	Mid-yr estim	MNM	None	Persons	Mid-year population estimates by MNM region, 1975-1986
C9POP DATA	population	Mid-yr estim	FPCA	Single yr	Persons	Population estimates for FPCAs by age, 1980/81 and 1985/86
CEN7181 PDATA	population	Mid-yr estim	MNM	Five-year	M/F	Mid-year population estimates by MNM by age and sex, 1971 & 1981
CEN8081 POPS	population	1981 Census	FPCA	Five-year	M/F	Usually resident populations by FPCA, age and sex, 1980/81

Note: Refer to Abbreviations list

The first run of the processing program involved the input of three arrays of dimensions 97 by 95, 97 by 2 by 16 and 95 by 2 by 16, which contained only zero elements. These were the base files on which the subsequent incrementation of individual elements would take place. The required migration data files related to flows between zones rather than within zones so only inter-district migrants were processed by excluding all those records where 'TYMO' was equal to 1.

In the case of the two-dimensional array it was necessary to include all transitions between 97 origin FPCAs and 95 destination FPCAs. The coded origin and destination information output from the assembler routine referred to the local authority district level so it was therefore necessary to aggregate the data to the relevant FPCA scale. Approximately 460 districts were recoded to correspond to the 97 FPCAs in the system of interest. The conversion was performed using 'look-up' tables - a method whereby each district code is assigned an integer value corresponding to a particular study zone, which upon processing allows aggregation of those districts with similar study zone codes. A similar method of code conversion was used to reduce the 109 single-year age-groups to 16 five-year age-groups (1-4,...75+). Once the codes had been converted the count field of each individual record was used to increment array elements. The arrays excluded intra-district flows but also inter-district flows within a single FPCA, thus giving a true picture of inter-FPCA migration.

Each tape was loaded and processed separately. After each tape-run the three arrays were output to disk and then entered into the next run as the initial arrays. By this method, gradual incrementation of the elements of each array was performed with three complete files of information produced after the processing of all ten tapes. A selection of data from the output files was further aggregated and checked against published 1981 Census migration information. Figure 3.8 illustrates the overall structure of the processing procedure.

3.3.4 Further transition data files

The three data files created from the district migration tapes contain the Census transition data which is used in the comparative analysis reported in Chapters 4 and 5 and for the analysis of spatial patterns of migration in Chapter 6. Further Census migration data files were compiled to allow the results of the 1981 Census to be compared with those of the 1971 Census and thus enable investigation of the changes taking place between 1970/71 and 1980/81. Additional migration data for both single year periods was collated manually from published Census volumes (OPCS, 1974a; 1983). The spatial scale at which suitably disaggregated data is available for such analysis is the metropolitan/non-metropolitan (MNM) level, consisting of metropolitan counties, regions without metropolitan counties and region remainders. Thus the two files of data (CEN7071 DATA and CEN8081 DATA in Table 3.7) chosen for the analysis of change between 1970/71 and 1980/81 contain arrays of inter-zonal flows from successive Censuses disaggregated at the MNM level by five-year age-group (1-4,...75+) and by sex. A full checking program was devised to ensure perfect accuracy in the information which was punched in manually. The procedure was undertaken in two stages with Philip Rees responsible for the input and checking of 1980-81 information.

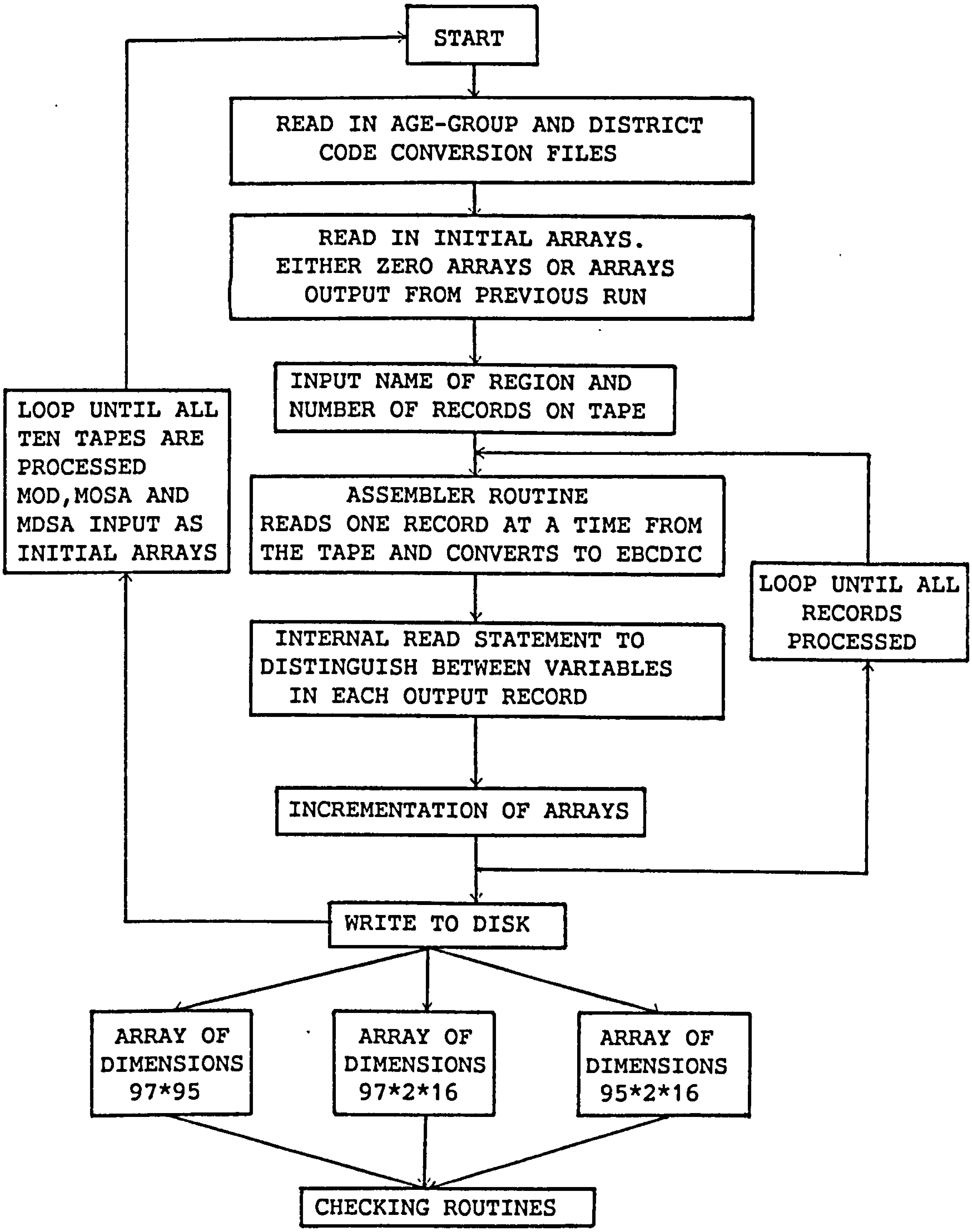


Figure 3.8 Flow-chart illustration of the tape processing program for Census data

3.3.5 NHSCR 'computer summaries'

The comparative analysis of NHSCR and Census data is split into two stages. The first stage reported in Chapter 4 utilises movement information for the relevant 1980/81 period aggregated by OPCS from Primary Unit data (PUD) files and supplied in the form of computer summaries on magnetic tape. The second stage of the comparison reported in Chapter 5 involves the direct creation of NHSCR data files from the PUD supplied by OPCS - an explanation of which is given in section 3.3.6. The computer summaries of NHSCR data read from tape using a FORTRAN program developed by John Stillwell consist of a matrix of transfers between FPCAs and gross in, out and net-movement totals for each FPCA disaggregated by five-year age-group for both males and females. Data is read into files MOV1A DATA, MOV2A DATA, MOV3A DATA (Table 3.7). The dimensions of these arrays correspond exactly to those created from 1981 Census district data: 97 origins, and 95 destinations, since inflows to Northern Ireland and the Isle of Man are excluded for the purpose of comparison, 16 age-groups and 2 sexes. There are no origin or destination not-stated moves included in the computer summaries of information which, furthermore, exclude all AF recruitments and discharges. The age and sex-disaggregated files of total out and in-transfers contain age not-stated and sex not-stated categories and moves in these categories are included in the aggregate inter-zonal matrix.

Analysis of temporal trends in NHSCR migration is undertaken using data supplied in equivalent computer summary form for twelve-month periods preceding each mid-year between 1976 and 1983. Similar inter-FPCA and age and sex-disaggregated data are available for each of these years. Since 1984 OPCS have changed the system of acquiring data from the NHSCR and consequently data in computer summary form has ceased to be available. The time-series of movement information has been continued with the acquisition of 100% Primary Unit Data (PUD) for subsequent years (1984-1986) from OPCS with each quarter-year of data being supplied on one magnetic tape. A full explanation of the processing of NHSCR PUD information from files is given in the following section.

3.3.6. Extraction of NHSCR Primary Unit Data

The previous section outlined how NHSCR data utilised in the preliminary comparative analysis has been assembled. The computer summary files were initially created from PUD at OPCS. In order to carry out a more accurate comparison of migration information it has been necessary to obtain the PUD directly and create further files of more disaggregated NHSCR data, conceptually consistent with the Census. PUD was supplied by OPCS for the year ending June 30 1981, which corresponds to the period April 1 1980 to March 31 1981, given the approximation of an average three month lag between a persons move and its accompanying re-registration. The data was split into four quarter-years and supplied on magnetic tapes, one for each quarter (Table 3.8). The number of records indicates that, unlike census data where each record contains a count of migrants between origin and destination, each PUD record refers to an individual move between origin and destination.

Each re-registration is represented in fact by two records: one as an in-migration and one as an out-migration. As with the 1981 Census coded data, processing was restricted to the in-migration

Table 3.8 Number of records on each magnetic tape containing NHSCR movement data for the period 1/4/80 to 31/3/81

Period	Period assuming a three-month lag	Number of records
Quarter ending 30/9/80	1/4/80 - 30/6/80	1,023,600
Quarter ending 31/12/80	1/7/80 - 30/9/80	1,285,200
Quarter ending 31/3/81	1/10/80 - 31/12/80	1,165,200
Quarter ending 30/6/81	1/1/81 - 31/3/81	956,400

records. Each record consists of nine fields of coded information relating to origin, destination, sex, year of birth, type of move, age, date of move, direction and an events field (Table 3.9). The origin and destination codes relate to non-aggregated FPCAs in England and Wales and Area Health Boards (AHBs) in Scotland with Northern Ireland and the Isle of Man as separate zones. AF recruitments and discharges are recorded separately with no distinction being made between FPCAs to which personnel are recruited to or discharged from. 'Armed Forces' is therefore classified as a single origin and a single destination. No moves within the AF (postings) are recorded in the PUD. An origin not-stated category is included in the data file but there is no similar category for destinations. The system of interest therefore relates to 97 origin FPCAs and 95 destination FPCAs. The AHBs were aggregated to form one Scottish FPCA and London Boroughs were combined to form a total of 12 FPCAs corresponding to those indicated in Figure 3.3. Sex is coded within each record as either 1, 2 or 9 - male, female and not-stated respectively. Year of birth is coded as the number of years since 1900, but with no distinction made between years of the 19th and 20th centuries, which means a person whose year of birth was 1974, for example, has a similar coding (74) to a person born in 1874. In cases such as this the year of birth code was compared with the age code to place the year of birth of the re-registrant in the correct century. The age at move code ranges from zero, for moves made by those aged under one year of age to 99 for those aged 99 at the time of re-registration. The type-of-move field is of little significance as it merely distinguishes between moves within and between regions of England, Wales and Scotland, whereas the direction code

Table 3.9 Quarterly NHSCR transfer data: record layout for in-moves

Start position	Max no of characs	Data type	Field description	Range of codes
1	5	character	New FPCA	06026 - 93510
6	5	character	Old FPCA	00000 - 93510
11	1	character	Sex	1, 2 or 9
12	3	character	Yr of birth	000 -099, 999
15	2	character	Type of move	01 - 11
17	3	character	Age	000 - 099, 999
20	3	character	Date	001 - 999
23	1	character	Direction	1 (inmigration)
24	1		Filler	
25	4	binary	Events	+1

distinguishes between in and out-migration (the latter being ignored during the processing procedure). The date code corresponds to the number of months that have elapsed since January 1970 to the time of re-registration. The data for these first eight fields is in character form but for the ninth variable, the events field, it is coded in binary. This field contains a +1 for an in-migration and a -1 for an out-migration and is used by OPCS to obtain signed net migration figures. Since the direction of move was identified by the previous variable it was possible for the processing program to ignore this field.

A FORTRAN program was written which processed each tape separately and gradually built up complete arrays. The arrays to be created were of an identical format to those described in Section 3.3.5. Aggregate inter-FPCA movement and gross in- and out-movement totals disaggregated by age and sex were assembled in files MOV1B DATA, MOV2B DATA and MOV3B DATA described in Table 3.7. The advantage of utilising the PUD, however, was that the age-time plan of observation for the NHSCR data could be directly adjusted so as to be consistent with migration information obtained from the 1981 Census. Section 3.3.1 has already introduced the conceptual problem and a full explanation of the adjustment procedures involved are given in Chapter 5.

The program was designed not to process single records, as in the Census-data routine, but individual blocks from each tape (292 records per block). A block was read from tape as a large character string with a loop breaking the block down into individual records and subsequently into a series of integer variables. 'Look-up' tables were again used to convert the PUD codes to study codes (origin, destination and age) and any intra-FPCA moves were excluded. The variables were used to increment the individual elements of the three files which, after all blocks had been processed, were output to disk and entered into the next run of the program as the initial arrays. Three complete files of information for the Census period were therefore created after all four tapes had been processed. Figure 3.9 gives an illustration of the general structure of the program.

A similar procedure was used to complete the full time-series of NHSCR data required for the analysis of migration trends during the period 1975-86. OPCS ceased to produce computer summaries from mid-year 1983 onwards so the time-series has been continued using information accessed directly from PUD, again supplied by OPCS on magnetic tape, for the period mid-year 1983 to mid-year 1986. Table 3.10 outlines the full list of PUD files obtained from OPCS, together with the appropriate number of records in each file.

The files of information were processed using the MOVES routine to generate arrays of NHSCR data consistent with those available from the computer summaries. A full time-series of information has been created therefore for an eleven-year period 1975/76 to 1985/86. The complete data files are referenced as T17586 FPCDATA and T27586 FPCDATA in Table 3.7. The latter defines the file of inter-FPCA moves and the former the file of gross in and out transfers disaggregated by five-year age-group and sex, for the eleven-year period.

3.4 POPULATION DATA

3.4.1 Introduction

The examination of spatio-temporal patterns and trends in migration

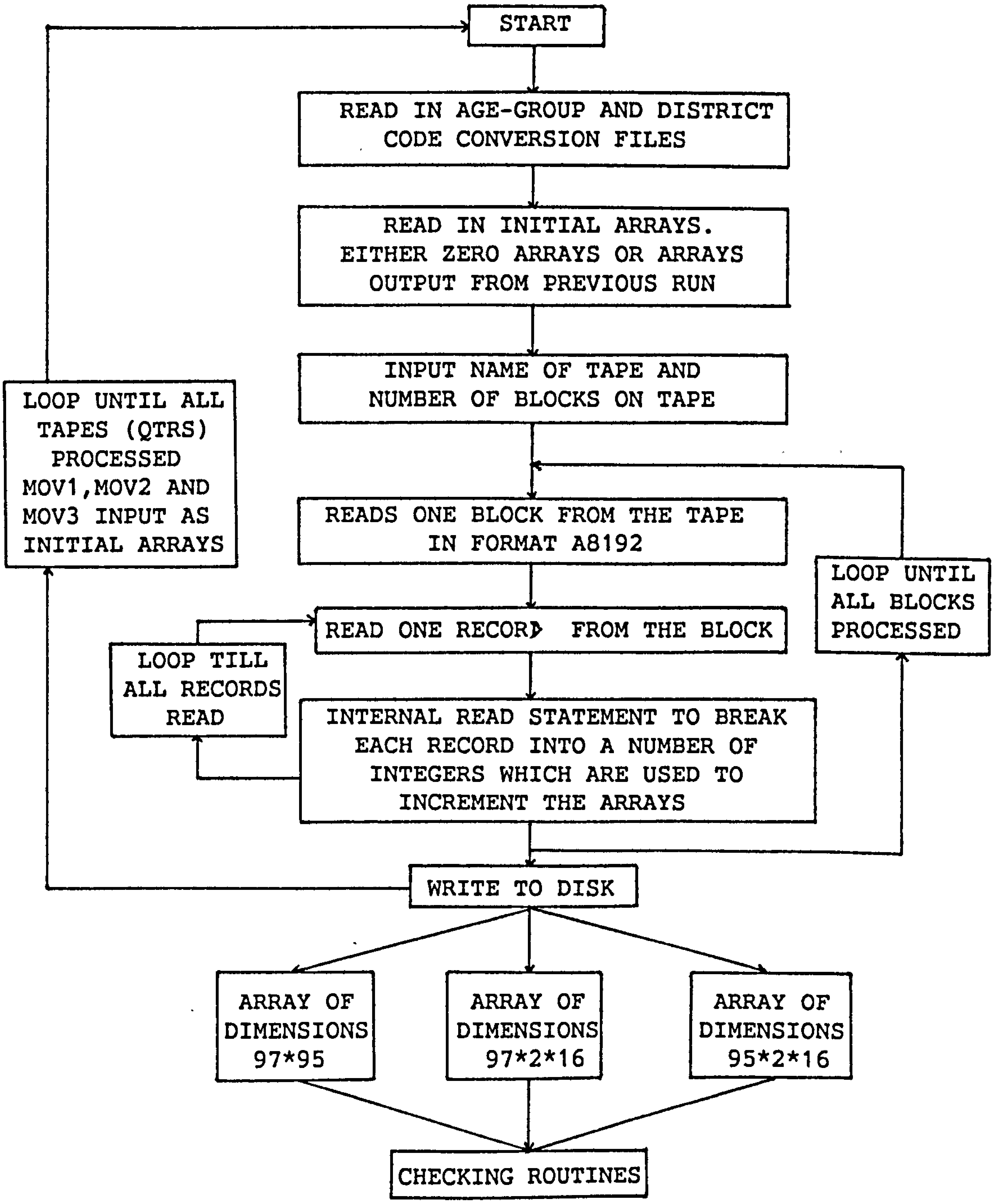


Figure 3.9 Flow-chart illustration of the tape processing program NHSCR data

Table 3.10 Quarterly NHSCR PUD: 1983-1986 information

Quarter (end month)	Number of records	Description (assuming 3 month lag)
December 1983	1,153,400	) Equivalent to NHSCR
March 1984	1,192,236	) transfers between
June 1984	990,829	) 1/7/83 and 31/6/84
September 1984	926,589	)
December 1984	1,219,319	) Equivalent to NHSCR
March 1985	1,106,169	) transfers between
June 1985	915,420	) 1/7/84 and 31/6/85
September 1985	1,061,274	)
December 1985	1,074,487	) Equivalent to NHSCR
March 1986	1,192,528	) transfers between
June 1986	1,190,630	) 1/7/85 and 31/6/86
September 1986	1,116,097	)

may be examined using actual numbers of moves or transitions. However, to give some idea of the relative importance of individual zones, age-groups or sexes it is necessary to compute rates of migration using appropriate populations-at-risk as the denominator. Population-at-risk is a term applied to all persons susceptible to migration and normally those resident in a zone or age-sex category at a certain point in time. The type of migration data being examined determines the nature of the population data used although it is not always possible to match the two exactly. The NHSCR records moves in a period age-time plan (Figure 3.6). In order to compute rates of NHSCR movement it is therefore necessary to derive a denominator which is equivalent to the population-at-risk at the mid-point of the appropriate time-period. NHSCR data is recorded in single-year periods from mid-year to mid-year and OPCS conveniently provide mid-year estimates of population by zone, age and sex. These estimates can be used therefore to derive populations for use in the computation of NHSCR movement rates. The procedure for accessing the OPCS population estimates from magnetic tape is outlined in Section 3.4.2.

The Census provides migration data in the form of transitions recorded in a period-cohort age-time plan (Figure 3.7). The true population-at-risk of migration in this instance is therefore the usually resident population for a particular zone at the beginning of the Census period. This information is not readily available so the population at the end of the Census period is used as an alternative denominator in the rate calculations.

A description of the type of population data used in subsequent analyses is given at the beginning of each chapter.

3.4.2 Mid-year population estimates, 1975-86

The analysis of annual NHSCR data over the period mid-year 1975 to mid-year 1986 requires the acquisition of population estimates with appropriate zone, age and sex disaggregation. OPCS have supplied the relevant information on magnetic tape. The data are held on two magnetic tapes and consist of mid-year population estimates for all years from 1971 to 1985, by age and sex for each individual district. There are eleven files on the first tape and four on the second. The files were copied directly to the mainframe computer at Leeds before processing of the data was undertaken. Table 3.11 indicates the composition of the two tapes and the corresponding files created on the Amdahl. Each file contains data records for 490 'building bricks' which correspond to local authority districts and district health authorities for which alternative estimates may be derived. Population estimates are available for each area disaggregated by nineteen age-groups, (i.e. <1,1-4,5-9,...80-84,85+) and for males and females.

Philip Rees has constructed a FORTRAN program which carries out the processing of these files into the required levels of aggregation. Population estimates for specified years and for a choice of aggregations may be accessed. Output from the routine is available in tabulated or matrix format. The analyses undertaken in subsequent chapters required mid-year estimates for the period 1975 to 1985, at both the FPCA level and the MNM level. Age and sex disaggregation was required for the FPCA data. The three files created are referenced in Table 3.7 as FPCDATA POPS, FPCDATA AGEPOPS and MNMDATA POPS.

Table 3.11 Mid-year estimates of population: file description

OPCS file on magnetic tape	Created file on Amdahl	Description of estimates
Tape 1		
HP71REVRD4	BPEWBB71 PDATA	Mid-1971
HP72REVRD4	BPEWBB72 PDATA	Mid-1972
HP73REVRD4	BPEWBB73 PDATA	Mid-1973
HP74REVRD4	BPEWBB74 PDATA	Mid-1974
HP75REVRD4	BPEWBB75 PDATA	Mid-1975
HP76REVRD4	BPEWBB76 PDATA	Mid-1976
HP77REVRD4	BPEWBB77 PDATA	Mid-1977
HP78REVRD4	BPEWBB78 PDATA	Mid-1978
HP79REVRD4	BPEWBB79 PDATA	Mid-1979
HP80REVRD4	BPEWBB80 PDATA	Mid-1980
HP81FRD4	BPEWBB81 PDATA	Mid-1981
Tape 2		
HP82RD4	BPEWBB82 PDATA	Mid-1982
HP83RD4	BPEWBB83 PDATA	Mid-1983
HP84RD4	BPEWBB84 PDATA	Mid-1984
HP85RD4	BPEWBB85 PDATA	Mid-1985

3.4.3 1981 Census populations from SASPAC

The 1981 Census data base at the University of Manchester Regional Computing Centre (UMRCC) consists of 100% and 10% small area statistics for enumeration districts (Great Britain), district electoral wards (England and Wales), post-code sectors (Scotland) and local government districts (Great Britain). The data set required was a 100% count of populations in each FPCA disaggregated by five-year age-group and sex.

The data were obtained as a matrix file (data are available alternatively in tabulated form) containing information for all districts of England and Wales disaggregated by sex five-year age-group and marital status. The SASPAC district codes were converted to the study zone codes and the data were aggregated and reorganised using FORTRAN routines. Equivalent population data for Northern Ireland, Scotland and the Isle of Man has been compiled from published Census volumes.

3.5. ALTERNATIVE SOURCES OF MIGRATION DATA

It is important to acknowledge the existence of sources of migration data alternative to the Census and NHSCR and to assess their availability and suitability for the type of analyses to be carried out in this research. Other than the two primary sources, it is sample surveys which provide data on internal migration. The Longitudinal Study (LS) provides a potentially valuable source of migration information. The LS is based on a cohort forming 1% of the 1971 Census population usually resident in England and Wales which is continuously updated by the inclusion of 1% of total births and immigrants, and which draws other vital event information from different registers (Brown and Fox, 1984). Transfers recorded by the NHSCR are only incorporated within the LS for the years 1971-74 and OPCS indicated that such a linkage for subsequent years is not available for use in this study.

Sample surveys are similar to censuses in that data is collected retrospectively - respondents are asked about past experiences. Their great advantage is that they allow the collection of much more detailed information than a national census. Recent sample surveys that contain a migration question are the General Household Survey (GHS), the Labour Force Survey (LFS) and the National Dwelling and Housing Survey (NDHS) and Devis and Southworth (1984) provide a summary of their main characteristics.

The GHS is a continuous survey based on a sample of the population resident in private (non-institutional) households in Great Britain. It has been running since 1971. Information for the GHS is collected week by week throughout the year by personal interview. Before 1984 the sample of addresses was selected from the Electoral Register but since 1984 a new sample design has been adopted based on selections from the Postcode Address File. Financial restraints imposed in 1982 reduced the size of the sample of selected addresses by approximately 14% from 14500 to 12500. Since 1971, the GHS has included questions on population, fertility, housing, employment, education and health. Between 1972 and 1977 the migration questions enquired as to the length of residence at present and previous address, the reasons for moving from previous address and the number of moves in the last five years. Since 1978, there has been a reduction in the migration information collected however, with only questions on length of residence at present address and number of moves in the last five years being included.

The Labour Force Survey is a survey of the population in private households carried out by the Social Survey division of OPCS on behalf of the Department of Employment. The first LFS was in 1973 and it has been carried out biennially between 1973 and 1983 to, 'assist in the framing and monitoring of economic and social policy' (OPCS, 1984). Since 1984, the LFS has been carried out annually. The survey is designed to provide reliable national and regional information in addition to more detailed information for particular sub-groups within the population. Questions are included in the LFS on behalf of OPCS population statistics division and include a question on address one year ago disaggregated by age, sex and marital status. Published LFS data is not appropriate for the analysis of migration below the regional level and OPCS have indicated that unpublished LFS information can not be made available.

The National Dwelling and Housing Survey (the main purpose of which was to provide information on the housing situation in England and Wales), conducted in 1977, is a further source of migration data. Questions on length of residence at present address and address 12 months ago provide the necessary measures of migration. The survey has not been repeated since 1977.

Devis and Southworth (1984) cite four major drawbacks to using sample-based data for migration analysis. First any retrospective transition question does not give a measure of the total number of migrants (this includes the Census). Second, any such data is subject to sampling error especially with as small a sample population size as in the GHS. Third, samples tend not to be random with a certain degree of clustering involved and fourth, there is a tendency of bias in surveys which exclude certain sections of the population. Although such samples may be useful for analysing certain characteristics of population sub-groups they have not been designed specifically to measure migration and thus do not provide a suitable source of information for such detailed spatial and temporal analyses that are undertaken in this study. Furthermore, the migration data held in these surveys is not readily available, in the unpublished form in which it could be most valuable.

Chapter 4. PRELIMINARY COMPARISON OF CENSUS AND NHSCR DATA

4.1. INTRODUCTION

Both short and long-term projections of sub-national population in Great Britain depend increasingly on the ability to predict inter-area migration, yet knowledge and understanding of current trends in migration levels and patterns continues to be limited by inadequate data. The Census of Population provides the most reliable and comprehensive migration information, but during inter-censal periods it is necessary to rely on migration data from other sources, in particular, on the FPCA re-registrations of the NHSCR. It therefore becomes essential to identify the characteristics of both types of data and to establish the relationship between them so that when census data are unavailable, NHSCR data can be used and interpreted with a better understanding of its shortcomings.

Section 3.3.1 has outlined the underlying conceptual differences between census-based 'transition' data and register-based 'movement' data. The basic difference is that the NHSCR provides a count of every NHS patient re-registration or move occurring in each quarterly or annual period, whereas the 1981 Census migrant count refers to those persons whose usual residence on census date was different from that one year previously, regardless of how many moves or migrations were made by any individual between the two dates. The identification of the major differences between these two migration data sources is essential if an accurate interpretation of migration patterns and trends is to be achieved and if methods and procedures for forecasting are to be devised which incorporate both types of data. The migration assumptions within the current official population forecasting methodology (Martin, Voorhees and Bates, 1981) are based primarily on census-derived information although some adjustments are made in response to trends inherent in NHSCR data.

Although research comparing NHSCR movement data and census transition data for 1970-71 (Ogilvy, 1980) and 1980-81 (Devis and Mills, 1986) has been undertaken at a subnational scale, conceptual differences between the two measures of migration have not been the focus of attention and adjustments required to achieve greater consistency between the two data sets used in the comparison might have been improved in this respect. The primary aim of this analysis therefore is to provide a rigorous comparison of Census and NHSCR migration data taking into account some of the omissions of previous studies. The comparative work is being undertaken in two stages. The first, reported in this chapter, involves a comparison of summary tables of census and register migration statistics. The second reported in Chapter 5, will involve a more precise comparison of the two sets of disaggregated migration data, made possible by the use of NHSCR Primary Unit Data which are records of individual patient transfers in Great Britain. The two-stage nature of the comparison reflects the evolution of the research and the availability of the necessary migration data. NHSCR information was initially only available in computer-summary form. The acquisition and processing of NHSCR PUD proved to be a lengthy process so the comparative research was initiated using already-available data and continued once the more disaggregate files of information had been compiled. The comparisons aim to highlight the major similarities and differences that exist between NHSCR and Census data at three alternative spatial scales using aggregate inter-zonal migration data sets together with gross out and inflow totals disaggregated by age and sex. The work seeks to confirm some of the findings of previous studies and also to extend the analysis of these two types of migration data.

This chapter reports on the preliminary comparison of the two migration data sources using inter-zonal and gross flow matrices derived from coded Census records (Section 3.1.3) and computer summaries of NHSCR information. Section 4.2 reviews previous comparative work undertaken, with particular emphasis on the research based on 1980-81 datasets reported by Devis and Mills (1986). Section 4.3 describes the characteristics of the respective data sets used in this preliminary comparison and outlines the various alignments and adjustments made to achieve greater consistency between the migration arrays. Ratio values and statistical methods are used in Section 4.4 to compare inter-zonal flow matrices at three spatial scales and Section 4.5 provides an introduction to the comparison of NHSCR and Census gross flows at the FPCA level disaggregated by age and sex. The concluding section summarises the major features highlighted in this chapter and introduces the further comparative work reported in Chapter 5.

4.2 REVIEW OF PREVIOUS COMPARATIVE WORK AND FEATURES OF THIS PRELIMINARY COMPARISON

4.2.1 Ogilvy's analyses

Ogilvy (1980a) has compared one-year transition data from the 1971 Census with NHSCR movement data for the closest period. Census migration was measured from 25/26 April, 1970 to 25/26 April, 1971, whereas the closest NHSCR dataset available was that associated with moves occurring between April 1, 1971 and March 31, 1972.

This dataset, on the assumption of an average three-month lag in re- registration, corresponds to the calendar year 1971 and therefore the two time-periods overlap by only three months (January 1 - March 31, 1971).

In her analysis, which is restricted to gross and net movement between the eight English regions and Wales, Ogilvy points out the difficulties involved in such a comparison of migrants versus migrations and states that multiple movement is the main reason of the differences between the two types of data. NHSCR gross flows were shown to be approximately 20% higher than those from the Census at this spatial scale although there was a strong correlation (r=0.997) between the two data sets. The correlation proved to be only slightly weaker when net flows were compared. The transformation of flows into rates again produced a significant positive correlation coefficient. In a subsequent paper, Ogilvy (1980b) summarised the differences by age and sex, highlighting in particular, a higher rate of NHSCR movement for children under 5 and people aged 15-19, a differentially higher recording of NHSCR moves by young women as compared to young men and a higher rate of NHSCR movement by persons aged 60 and over.

4.2.2. <u>Thomson's analysis</u>

Thomson (1984) undertook a comparative study based on age and sex-disaggregated 1981 Census data and NHSCR data for flows between metropolitan districts and shire counties in the West Midlands, and flows between these zones and the other standard regions. Thomson showed that there was a generally strong correlation between the two data sets but not for the 15-19 age-group. The possibility of student distortion was emphasised, with the application of a student correction factor producing a more satisfactory relationship for this 15-19 age-group. The overall computed NHSCR:Census ratio for net flows was 1.04 although ratios for individual areas showed wide variation. The gross flow comparison produced ratios which were higher overall but more stable across age-bands. Like Ogilvy, Thomson states that the presence of multiple moves is the major reason for differences between Census and NHSCR figures but argues that whilst significant variation is apparent at the small area level, the NHSCR is a reasonable guide to migration at more aggregate spatial scales.

4.2.3. The analysis of Devis and Mills

Devis and Mills (1986) have published a detailed comparison of NHSCR and 1981 Census information which analyses some of the differences that exist between the two alternative sources of migration data, and illustrates the effect of adjusting for these differences. The comparison is based on rates of movement between FPCAs in England and Wales. The respective time-periods of observation for the NHSCR and the Census are more closely matched than those used by Ogilvy (1980a). NHSCR data, when lagged by three months, are associated with the twelve months ending March 31, 1981, whilst the Census data refer to the year prior to April 5, 1981, the date of the 1981 Census.

The total NHSCR in- and out-transfers were shown to exceed the total census in- and out-flows by approximately 28%. When NHSCR moves by those with unstated age and sex were omitted, together with moves made by persons aged under one, the discrepancy fell to 24%. These crude discrepancies were greater for females than males and greater for moves between regions than for moves between FPCA's within regions. The difference was most significant for women aged 15-19 and boys aged 10-14.

Devis and Mills emphasize that there is no simple reason for these crude differences such as one source including multiple and return moves and the other not doing so, and they outline the main factors which require consideration when attempting to match the alternative data sets. The important types of move are those involving students, Armed Forces personnel and their dependants, non-survivors, prisoners and long-term psychiatric patients and those who move more than once. The quality of Census data is also an important factor. The effect of adjusting for these discrepancies is to reduce the total difference between the data sets to 3%.

The main aim of the analysis reported in Occasional Paper 35 (Devis and Mills, 1986) was to decompose NHSCR re-registrations and Census migrant figures into move or migrant types and to attempt a comparison of the lowest common denominator. Table 4.1 sets out the decompositions estimated by Devis and Mills although arranged differently from their tables on pages 1 and 54. Figure 4.1 illustrates these components in diagrammatic form. Essentially, component A.1 of the NHSCR re-registrations (1,301,306) is compared with component B.1 of the Census migrants plus component B.4, an estimate of missed migrants, which is 1,130,575 plus 172,000 = 1,302,575. The estimated numbers are thus in very close agreement.

The remaining components of both data sets can be divided into

Table 4.1. The decomposition of NHSCR re-registrations and Census migrants, 1980-81, estimated by Devis and Mills (1986): migration between FPCAs in England and Wales.

			Source in Devis & Mills (1986)
A.	Decomposition of NHSCR re-registrations between FPCAs		
A.1	First moves of non-student survivors who are one year of age or more and whose sex and age are stated.	1301306	Residual
A.2	Moves by migrants who die	4662	Table 3.8
A.3	Moves by students	100100	Table 3.2
A.4	Second and further moves (Multiple and return moves)	101672	Table 1.1 & p.16
A.5	Moves by persons under one year of age	17600	Table 2.2
A.6	Moves of persons with sex not-stated	25490	Table 2.2
A.7	Moves of persons with age not-stated	3300	Table 2.2
	Total NHSCR re-registrations	1554130	
	Additional components not measured directly		
A.8	Armed Forces moves between FPCAs	78600	Table 3.5
A.9	Moves between FPCAs by inmates of prisons or psychiatric establishments	7440	p.18
A.10	Sampling Error	+ or - 7330	Appendix C
A.11	Moves between FPCAs not resulting in a re-registration	unknown	
	Possible total NHSCR re-registrations	1647500 to 1632840	
B.	Decomposition of Census migrants between FPCAs		
B.1	Civilian, non-institutional surviving migrants, aged one or more	1130575	Residual
B.2	Armed Force migrants	78600	Table 3.5
B.3	Prisoners and psychiatric patients	7440	p.18
	Total Census migrants	1216615	
B.4	Migrants missed by the Census (origin not-stated, under-enumeration or mis-reporting as estimated by the Post Enumeration Survey)	172000	pp. 18-19
		1388615	

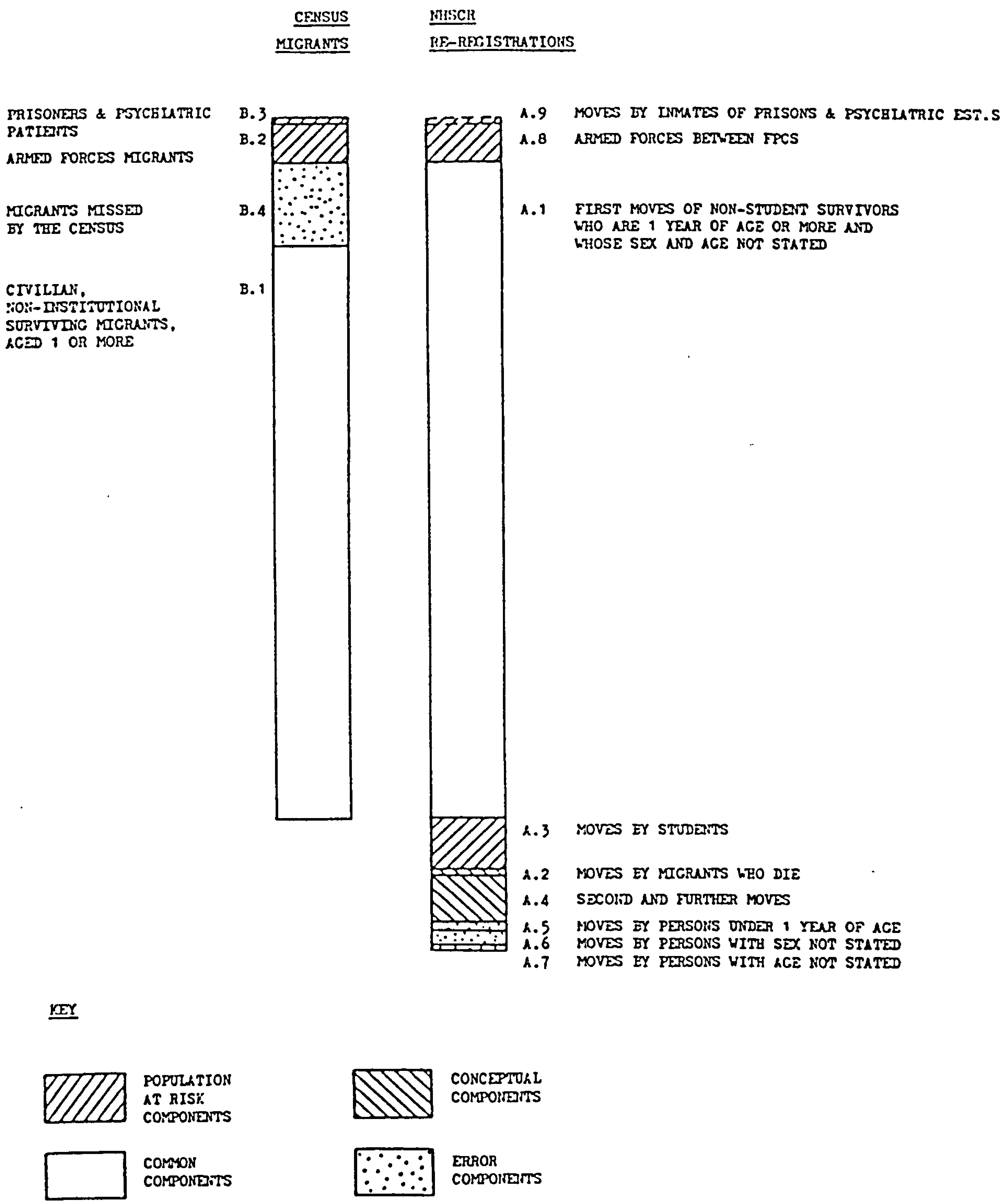


Figure 4.1 <u>The components of NHSCR re-registrations and Census migrants, 1980-81, estimated by Devis and Mills (1986)</u>

three groups:

(i) those that involve operational measurement problems in the two sources;

(ii) those that involve conceptual differences between the two sources; and

(iii) those that involve differences in the populations at risk captured in the two sources.

Under the first category, can be identified, in the NHSCR re-registration data, component A.6, moves of persons with sex not stated; component A.7, moves of persons with age not-stated; component A.10, sampling error; and component A.11, moves not resulting in a re-registration. For Census migration data, the corresponding component is B.4, migrants with origin not-stated, migrants with misreported migrations and migrants missed through underenumeration.

Under the second category fall components A.2, moves by migrants who die, and component A.4, second and further moves for NHSCR re-registrations.

The third category comprises component A.3, moves by students; component A.5, moves by persons under 1 year of age; component A.8, moves between FPCAs by Armed Forces; component A.9, moves between FPCAs by inmates of prisons or psychiatric establishments. The corresponding components in the Census data are B.2, Armed forces migrants, and B.3 prisoner and psychiatric migrants.

Much of the analysis by Devis and Mills (1986) focusses on whether at the FPCA scale the net migration estimates provided by the two sources were in agreement or not. This concern with net migration derives from its use in the final stage of current subnational population projections. The argument is that if the two sources are shown to be in agreement, then one can be confident in using NHSCR re-registration data for inter-censal years to provide data for trending the migration inputs to the sub-national projections. However, in its earlier stages, the sub-national population projection model utilizes gross migration by age and sex into and out of local authority areas, and gross migration for broad age-groups between local authority areas. Alternative projection models which might be explored also use gross migration stream data. Hence it is important to explore the goodness of fit between the NHSCR re-registrations data set and the Census migrant data set by looking initially at the matrix of inter-FPCA flows at various spatial scales.

The comparison reported in this chapter takes a slightly different view of the components that make up the two types of migration measure. It aims to provide the justification for the implementation of a multiregional population projection based primarily on movement data rather than census data, and so is concerned to use, not downwardly adjusted NHSCR re-registrations, component A.1, but upwardly adjusted NHSCR re-registrations - components A.1 to A.7 (total measured re-registrations), plus unmeasured components A.8, A.9 and A.11, adding to NHSCR re-registrations estimates of Armed Forces and institutional migration wherever possible. A study of the discrepancies between Census migration and NHSCR migration should help in this respect.

To summarize this review, it is clear that the analysis of Devis and Mills (1986) is crucial to an understanding of the differences between NHSCR re-registration data and Census migrant data at FPCA level. Devis and Mills emphasize the variety of reasons why differences occur between the two data sources, and adjust each data set successively in order to reduce the differences between them. However, they do conclude that

> "... although care should be taken in each area with the treatment of various sub-populations, NHSCR data can be an effective tool for the annual measurement of net population changes through migration."
> (Devis and Mills, 1986, p28)

4.2.4 Features of the preliminary comparison

In the remainder of this chapter an attempt is made to confirm earlier findings and to extend the comparative analysis. The clarification of the conceptual differences as well as the population differences between movement and transition data is essential. The problem has been introduced previously in Section 3.3.1 and Section 4.3.2 will explain in detail the crude adjustment techniques adopted for converting NHSCR movement data to a cohort basis consistent with Census transition data. These techniques will be improved upon in Chapter 5 using Primary Unit Data.

Devis and Mills (1986) based their study on a comparison of rates of migration. Results reported in Chapters 4 and 5 will attempt to confirm their findings using migration flows as well as rates. Furthermore, Devis and Mills' work will be extended by analysing, in detail, differences that exist between the two data sources at three alternative sub-national spatial scales, together with a more systematic breakdown of individual inter-area flows at each level to examine the influence of metropolitan status on the size of the ratio representing the relationship between NHSCR and Census migration data for each area. A statistical interpretation of the relationship between NHSCR and Census flows is introduced through the computation of 'goodness of fit' statistics and regression analysis.

The final set of results presented in Section 4.5 of this chapter is associated with the differences between age and sex disaggregated inflows into FPCAs. Statistical comparisons together with further breakdown of the data by metropolitan status isolate the age and sex groups responsible for the major differences highlighted in the analysis of aggregate inter-zonal flows. Comparable arrays of out-migration disaggregated by age and sex are not available for the preliminary analysis as outflows to Northern Ireland and the Isle of Man are excluded from the Census. Although Chapter 5 contains some replication of analyses reported in Chapter 4 using more comparable data sets, it also explores more deeply the NHSCR:Census relationship by zone, age and sex using different empirical, statistical and modelling methods.

4.3 DATA DESCRIPTION, ALIGNMENT AND ADJUSTMENT

4.3.1 NHSCR and Census data sets utilised

The preliminary comparison of NHSCR and Census migration data uses 1981 Census data aggregated from the district by district migration matrix supplied by OPCS on magnetic tape, and NHSCR data, also obtained from OPCS, in the form of computer summaries of information aggregated from the Primary Unit Data. A full explanation of the construction and form of these datasets has been given in Sections 3.3.3 and 3.3.5. This chapter examines corresponding matrices of NHSCR and Census flows between the 97 origin and 95 destination zones in the FPCA system. Aggregation of these arrays is required to provide inter-zonal migration information at the regional level and the MNM level. The NHSCR and Census files are referenced as MOV1A DATA and TRAN1 DATA respectively in Table 3.7.

An important discrepancy between the two data sets is the inclusion in the NHSCR data of moves made by infants aged less than one at the end of the period. For this reason the NHSCR inter-zonal flows are reduced in volume by a constant which corresponds to the proportion of infant moves within the system as a whole. Figures from Devis and Mills suggest a constant, c, defined as,

$$c = \frac{\text{Total moves by persons aged under 1}}{\text{Total moves by persons of all ages}} = 0.011 \qquad (4.1)$$

This adjustment which is applied both here and by Devis and Mills is slightly in error because the under 1 category in the NHSCR data refers to a period age-group whereas the missing under 1 category in the Census data refers to a period cohort. In the second stage of the comparison, Chapter 5, this error will be corrected for.

The results of Ogilvy's (1980a) previous analysis based on 1971 Census data are made suspect by the poor alignment of the respective time-periods of observation. This study will use data from the Census which refers to the one-year period prior to 5/6 April, 1981. This is matched most closely by the NHSCR movement data for the twelve-month period ending June 30 1981. This approximates to moves taking place between April 1, 1980 and March 31, 1981, assuming an average three-month lag between each move and re-registration.

4.3.2 Age-time plan (ATP) adjustment of NHSCR data

Section 3.3.1 described some of the conceptual differences that exist between Census and NHSCR data. To make the age disaggregated data sets more comparable it is necessary to convert NHSCR movement data for five-year age groups to Census five-year period-cohort data. The diagrams in Figure 4.2 illustrate the way estimation techniques are used to convert NHSCR data to a cohort basis consistent with Census flows in different age-groups.

(a) The first age group

The NHSCR records moves made by all persons in age groups 0 to 4 years during the one year period (Figure 4.2a). The Census records transitions made by persons in the period-cohort defined by the 1-4 age-group at the end of the period. The census therefore does not include migrants aged less than 1 year of age.

The NHSCR inmove data for the first five-year age group can be estimated, for both sexes, as:

$$M^{1}_{*j}(c) = 0.8\, M^{1}_{*j}(n) \qquad (4.2)$$

where

M = NHSCR re-registrations or moves;

$M^{1}_{*j}(c)$ = total number of NHSCR moves into zone j recorded in the period cohort defined by the end-of-period age-group 1;

$M^{1}_{*j}(n)$ = total number of NHSCR moves into zone j recorded in period age group 1.

(b) The final age-group

For the purposes of comparison the final age-group was defined as those aged 75 or over. The penultimate census period-cohort contains all transfers made by those in the 70-74 age-group at the end of the year (Figure 4.2b). So, to match the movement data, a proportion of the penultimate NHSCR age-group must be combined with the final NHSCR age-group, using the equation:

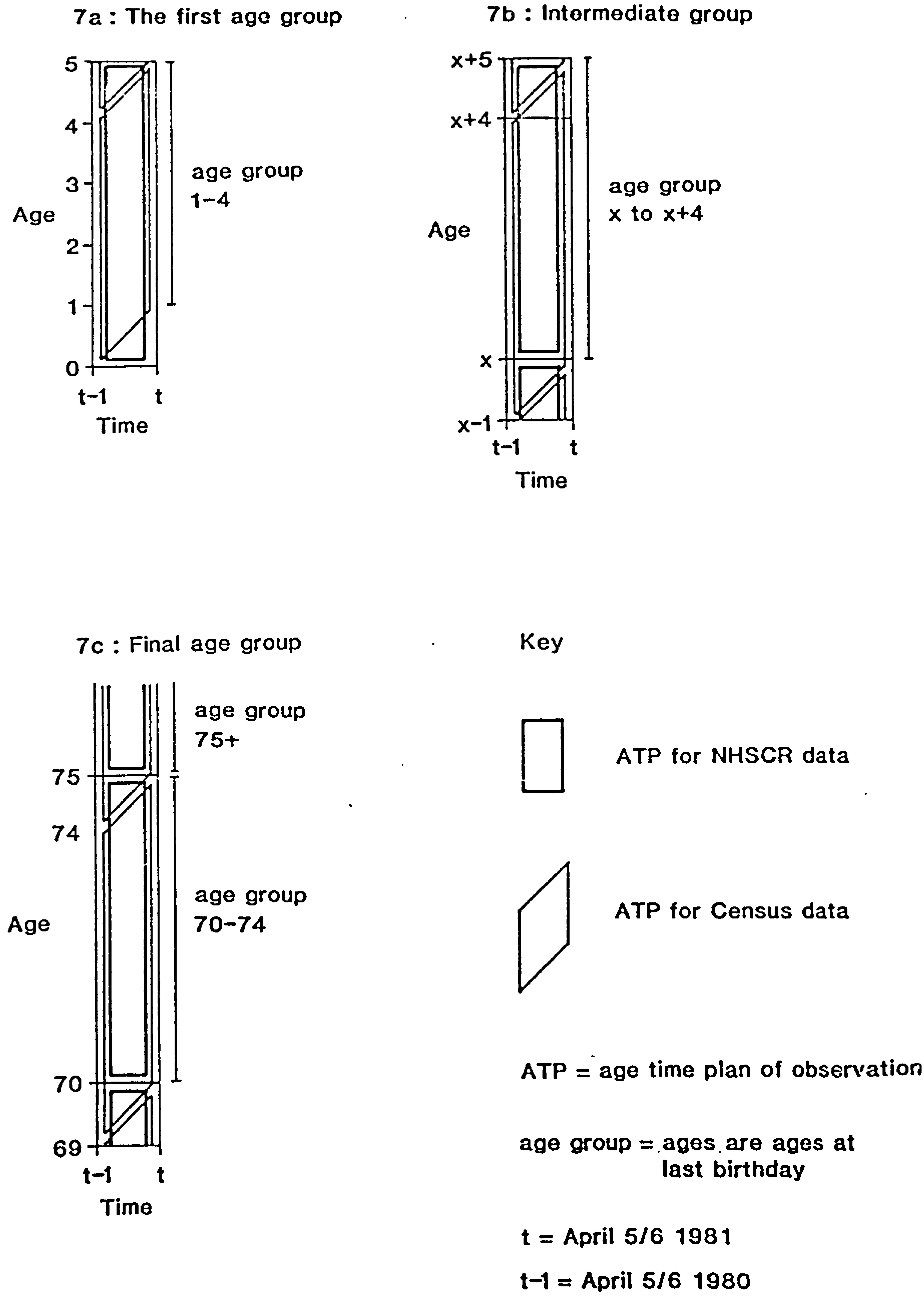


Figure 4.2 Age-time plan adjustments required to convert movement to transition data in first, intermediate and final age-groups

$$M^{16}_{*j}(c) = 0.1\, M^{15}_{*j}(n) + M^{16}_{*j}(n) \qquad (4.3)$$

where 0.1 is the proportion of the penultimate age-group total to be included. The 15th age group is 70-74 years of age and the 16th refers to 75 or more years of age.

(c) <u>The intermediate age-groups</u>

The inmove totals for intermediate age-groups (Figure 4.2c) can be adjusted as follows:

$$M^{a}_{*j}(c) = 0.1\, M^{a-1}_{*j}(n) + 0.9\, M^{a}_{*j}(n) \quad \text{for } 1<a<16 \qquad (4.4)$$

where a-1(n) and a(n) are consecutive age groups used in the NHSCR re-registration dataset.

4.3.3 <u>Assignment of not-stated categories</u>

This initial analysis is based upon comparisons of the inter-FPCA array of person migration and the arrays of inflow totals by age for males and females. The Census figures include only one not-stated category, that of origin not-stated. Therefore reassignment of these flows is important only for the inter-zonal matrix. Those Census flows with unknown origin were assigned as follows (age and sex subscripts omitted):

$$T_{ij}(2) = T_{ij}(1) + (T_{?j} \,.\, (T_{ij}(1)/(\sum_{j} T_{ij}(1))) \qquad (4.5)$$

where

T = Census migrant transitions;

$T_{ij}(2)$ = adjusted Census migrant flow between origin i and destination j;

$T_{ij}(1)$ = recorded Census migrant flow between origin i and destination j;

$T_{?j}$ = Census migrants to zone j with origin not stated.

Because the NHSCR inter-FPCA array used in this analysis includes no origin or destination not-stated categories, no reassignment is required.

The second NHSCR array used is that of flows to all destinations disaggregated by age and sex. Within this array appears not-stated age and not-stated sex categories. To make the array more comparable with that of the Census the not-stated flows were assigned as follows:

$$\begin{aligned} M_{*j}^{as}(2) = {} & M_{*j}^{as}(1) \\ & + M_{*j}^{?s} \cdot \left(M_{*j}^{as}(1) / \sum_{a} M_{*j}^{as}(1)\right) \\ & + M_{*j}^{a?} \cdot \left(M_{*j}^{as}(1) / \sum_{s} M_{*j}^{as}(1)\right) \\ & + M_{*j}^{??} \cdot \left(M_{*j}^{as}(1) / \sum_{as} M_{*j}^{as}(1)\right) \end{aligned} \qquad (4.6)$$

where

$M_{*j}^{as}(2)$ = adjusted NHSCR moves to destination j for age group a and sex s;

$M_{*j}^{as}(1)$ = recorded NHSCR moves to destination j for age group a and sex s;

$M_{*j}^{?s}$ = NHSCR moves to destination j for sex s of unknown age;

$M_{*j}^{a?}$ = NHSCR moves to destination j for age group a of unknown sex;

$M_{*j}^{??}$ = NHSCR moves to destination j for unknown age group and unknown sex.

The results of the initial comparison of the two types of aggregate inter-area data, with the adjustments made as indicated, are presented in the following section.

4.4 COMPARISON OF AGGREGATE INTER-ZONAL MIGRATION DATA FROM THE TWO SOURCES

4.4.1 Overall levels of migration

Differences exist between the total number of NHSCR and Census migration flows at different spatial scales. The first row in Table 4.2 includes only inter-FPCA flows that cross standard region boundaries. The second row includes all inter-FPCA flows that cross the boundaries of MNM level regions that fall within standard regions, the fourth row accounts for those inter-FPCA flows that remain within MNM regions, and the bottom row refers to all inter-FPCA migration flows. Overall, there are 24.5% more NHSCR re-registrations than Census migrants between all FPCAs. This figure compares with the 23.9% obtained by Devis and Mills (1986). The slight difference is because Devis and Mills omit all NHSCR re-registrations with unstated age and sex and consider only inter-FPCA flows within England and Wales. The figures in the final column of Table 4.2 show clearly that the ratio of NHSCR re-registration to Census migrants varies systematically with the spatial scale. The highest ratio is evident for migration flows over the longest distance and the ratio declines as the average distance over which migration is likely to occur decreases.

This observation may be explained by referring to differences in the components of each migration data set that are set out in Table 4.1 and Figure 4.1. The differences in populations at risk between the NHSCR and Census measurement systems might make some contribution. Students, for example, which appear in the NHSCR data are known to be heavily involved in inter-regional migration; on

Table 4.2. NHSCR and Census migration flows and ratios at various spatial scales.

Migration flows between FPCAs	Total moves (NHSCR)	Total transtns (Census)	Difference	Ratio
(1) Between standard regions	838,501	629,915	208,586	1.331
(2) Between MNM regions	1,148,990	881,826	267,164	1.303
(3) Between MNM regions,within standard regions	310,489	251,911	58,578	1.233
(4) Within MNM regions	499,757	442,918	56,839	1.128
(5) All flows	1,648,747	1,324,744	324,003	1.245

Source: unpublished NHSCR and Census data supplied by the Office of Population Census and Surveys.

Notes:
Relationship between row items:-
row(3) = row(2) - row(1)
row(4) = row(5) - row(2)
row(5) = row(1) + row(3) + row(4)

the other hand, migrants within the Armed Forces recorded by the Census also migrate over long distances. The 100,000 student movers per year are balanced by 86,000 migrants in the Armed Forces and institutional populations. Moreover, infant migrants (those under 1 year of age) do not contribute to an explanation of the ratio variations as they have been excluded from the NHSCR flow matrix.

It is unlikely that the error components of either data set differ in a systematic way related to spatial scale. Furthermore, the errors of age not-stated, sex not stated or origin not-stated cannot contribute to the effect observed in Table 4.2 because the relevant totals have been proportionally allocated over flows for which all characteristics are known.

The most likely culprits are therefore the conceptual components. However, non-surviving migrants, whose migrations are recorded in the NHSCR but not in the Census, are too few in number to produce such a substantial effect. What remains, therefore, is the component "multiple or return moves".

Devis and Mills (1986, Table 3.6, p16) report on the number of multiple and return moves by Longitudinal Study members between FPCAs recorded in the NHSCR over the years 1972-73. A return move was one with the same FPCA as origin of the first move and destination of the last. They report that 95.5% of movers made only 1 inter-FPCA move in a year; 4.5% made 2 or more moves (4.3% just 2 moves, 0.2% more). Of the 4.5%, some 1.8% made return moves.

Herein lies one possible explanation for the scale effect observed in Table 4.2. If moves were randomly distributed with respect to chances of returning to the origin area, then we should expect Census-recorded migration to consist of longer distance displacements than NHSCR-recorded migration, since the displacement in Census migration would be the average distance between origin 1 and destination 2 whereas in NHSCR migration the mean distance would be the average of the displacements of origin 1 and destination 1 and of origin 2 (alias destination 1) and destination 2. If Census-recorded migrations are longer distance on average than NHSCR migration, we should observe the reverse of the relation between scale and NHSCR:Census ratio shown in Table 4.2. However, if return moves are a very important phenomenon and the statistics quoted by Devis and Mills suggest that 40% of second or higher order moves in a year are return moves, then the Census migrations will tend to show much shorter displacements between origin and destination than NHSCR moves. If this is the case, then we should observe the kind of ratio gradient with scale observed in Table 4.2.

So, the hypothesis concerning the relationship between scale of migration and the size of the NHSCR:Census migration ratio is that part of it may be due to the inclusion of longer distance student migrants in the NHSCR but not in the Census, an effect not fully compensated for by the exclusion of large distance migrants from the Armed Forces. The greater part, however, is likely to be due to a combination of the conceptual differences between the two methods of measuring migration (NHSCR picking up multiple moves, the Census not) and the greater significance of return migration for multiple movers.

4.4.2. Outflow, inflow and netflow ratios: detailed patterns

The aggregate figures considered so far give an indication of the effect of scale upon the NHSCR:Census ratio, but they hide the considerable variations that exist at more disaggregate levels.

Examination of the zonal outflow, inflow and netflow totals at each spatial scale reveals a number of interesting characteristics. Table 4.3 illustrates in rank order the outflow, inflow and netflow ratios that exist at the UK standard region scale. The greatest outflow ratios are exhibited by the North West and Northern regions with the South East, West Midlands and the Isle of Man ratios also above the mean for all regions of 1.33. By far the lowest ratio between NHSCR and Census data is for Northern Ireland, with Scotland and the South West also having relatively low ratios. Wales, East Anglia and the East Midlands all have ratios below the UK average.

For the ten destinations at the regional level, the greatest inflow ratios are exhibited by those regions outside the South East containing a metropolitan county: the North West, the North, Yorkshire and Humberside, and the West Midlands. Scotland and the South West have the lowest inflow ratios at this spatial scale. The existence of metropolitan counties within a standard region appears to determine the value of both the inflow and outflow NHSCR:Census ratio relative to the mean. The importance of student movement in the NHSCR and Armed Forces flows in the Census have previously been cited as an important factor determining the relative levels of migration to metropolitan and non-metropolitan areas but the phenomenon requires examination at more disaggregate spatial scales before definite conclusions can be drawn.

The distribution of net flow ratios at the standard region scale indicates that whilst several regions have ratios close to

Table 4.3. Outflow,inflow and netflow totals,differences and ratios for NHSCR and Census migration for UK standard regions

Region	NHSCR	Census (1000's)	Difference	Ratio
		OUTFLOWS		
NORTHWEST	96.4	68.2	28.3	1.41
NORTH	49.3	35.1	14.2	1.40
ISLE OF MAN	1.3	1.0	0.4	1.37
WEST MIDLANDS	80.2	58.8	21.4	1.36
SOUTH EAST	222.0	165.2	56.8	1.34
YORKS. & HUMB.	76.4	57.0	19.3	1.34
WALES	43.5	33.5	10.1	1.30
EAST MIDLANDS	72.3	55.6	16.8	1.30
EAST ANGLIA	43.7	33.7	10.1	1.30
SOUTH WEST	89.7	69.9	19.8	1.28
SCOTLAND	52.8	41.9	10.9	1.26
NORTHERN IRELAND	10.7	10.0	0.7	1.07
		INFLOWS		
NORTHWEST	78.6	52.0	26.6	1.51
NORTH	40.8	27.7	13.1	1.47
YORKS. & HUMB.	73.2	51.3	22.0	1.43
WEST MIDLANDS	71.6	50.5	21.1	1.42
WALES	46.2	34.5	11.7	1.34
SOUTH EAST	227.6	172.5	55.0	1.32
EAST ANGLIA	56.9	45.0	11.9	1.26
EAST MIDLANDS	81.9	64.9	17.0	1.26
SCOTLAND	47.9	38.6	9.2	1.24
SOUTH WEST	113.8	92.9	21.0	1.23
ALL REGIONS	838.5	629.9	208.6	1.33
		NETFLOWS		
WALES	2.7	1.0	1.6	2.56
SCOTLAND	-5.0	-3.3	-1.7	1.50
ISLE OF MAN	-1.3	-1.0	-0.4	1.37
EAST ANGLIA	13.2	11.4	1.8	1.16
NORTH	-8.5	-7.4	-1.1	1.15
NORTHWEST	-17.8	-16.1	-1.6	1.10
NORTHERN IRELAND	-10.7	-10.0	-0.7	1.07
SOUTH WEST	24.1	23.0	1.2	1.05
WEST MIDLANDS	-8.6	-8.3	-0.3	1.03
EAST MIDLANDS	9.5	9.3	0.3	1.03
SOUTH EAST	5.5	7.3	-1.8	0.76
YORKS. & HUMB.	-3.1	-5.8	2.6	0.54

unity, the range of values is greater than with either the outflows or inflows. The NHSCR value of net inmigration to Wales is 150% higher than the Census figure, whereas NHSCR net outmigration from Yorkshire and Humberside is only about half that indicated by the Census data.

At the scale of metropolitan counties, region remainders and regions without metropolitan counties, outflow ratios vary around the mean figure of 1.303 (Table 4.4). West Yorkshire flows show the greatest discrepancy with the Northern region remainder, North West remainder, Greater Manchester and Merseyside also having relatively large ratios. The smallest ratios are found for outflows from the region remainders of the West Midlands and Yorkshire and Humberside.

The most striking feature of the inflow figures at this level is the size of the NHSCR:Census ratios for inflows to provincial metropolitan counties. Tyne and Wear, West Yorkshire, Greater Manchester, Merseyside, West Midlands and South Yorkshire all have ratios well above the mean and above the largest outflow ratio. Greater London also exhibits a relatively high ratio. The annual inflow of students to the Universities and Polytechnics within metropolitan zones is a major determinant of the large ratios. Multiple and return movement will also increase the ratio values. Short-term moves to metropolitan areas for employment reasons, for example, may result in an NHSCR re-registration but will not be picked up by the Census if the person returns to his/her original residence or moves on elsewhere. The phenomenon of multiple movement will obviously be of greatest importance in metropolitan areas where a large proportion of in-migration consists of movement by the

Table 4.4. Outflow, inflow and netflow totals, differences and ratios for NHSCR and Census migration for MNM regions

MNM Region	NHSCR	Census (1000's)	Difference	Ratio
		OUTFLOWS		
WEST YORKSHIRE	40.2	28.0	12.2	1.44
NORTH REM.	40.3	29.3	11.0	1.38
NORTH WEST REM.	57.2	41.9	15.3	1.36
GREATER MANCHESTER	51.2	37.8	13.4	1.35
MERSEYSIDE	34.4	25.4	9.0	1.35
WEST MIDLANDS C.	58.1	44.3	13.8	1.31
GREATER LONDON	193.6	148.5	45.1	1.30
EAST MIDLANDS	72.3	55.6	16.8	1.30
WALES	43.5	33.5	10.1	1.30
EAST ANGLIA	43.7	33.7	10.1	1.30
TYNE AND WEAR	24.8	19.1	5.7	1.30
SOUTH EAST REM	216.5	166.9	49.5	1.30
SOUTH WEST	89.7	69.9	19.8	1.28
SOUTH YORKSHIRE	22.4	17.7	4.7	1.27
SCOTLAND	52.8	41.9	10.9	1.26
YORKS. & HUMB. REM	36.3	28.9	7.4	1.25
WEST MIDLANDS REM	59.8	48.4	11.4	1.24
		INFLOWS		
TYNE & WEAR	20.2	12.8	7.4	1.58
WEST YORKSHIRE	35.8	23.1	12.6	1.55
GREATER MANCHESTER	40.2	26.2	14.0	1.53
MERSEYSIDE	23.7	15.7	8.0	1.51
WEST MIDLANDS C.	42.5	28.7	13.7	1.48
SOUTH YORKSHIRE	22.1	15.2	6.9	1.46
GREATER LONDON	155.5	111.5	44.0	1.39
WALES	46.2	34.5	11.7	1.34
NORTH WEST REM.	61.0	47.1	14.0	1.30
NORTH REM.	36.4	28.2	8.3	1.29
EAST ANGLIA	56.9	45.0	11.9	1.26
EAST MIDLANDS	81.9	64.9	17.0	1.26
YORKS. & HUMB. REM	37.9	30.5	7.4	1.24
SCOTLAND	47.9	38.6	9.2	1.24
SOUTH EAST REM	260.1	211.3	48.8	1.23
SOUTH WEST	113.8	92.9	21.0	1.23
WEST MIDLANDS REM	66.9	55.6	11.2	1.20
ALL REGIONS	1149.0	881.8	267.2	1.30
		NETFLOWS		
NORTH REM.	-3.9	-1.1	-2.8	3.51
WALES	2.7	1.0	1.6	2.56
SCOTLAND	-5.0	-3.3	-1.7	1.50
EAST ANGLIA	13.2	11.4	1.8	1.16
MERSEYSIDE	-10.7	-9.7	-0.9	1.10
SOUTH WEST	24.1	23.0	1.2	1.05
GREATER LONDON	-38.1	-37.0	-1.1	1.03
EAST MIDLANDS	9.5	9.3	0.3	1.03
WEST MIDLANDS C	-15.6	-15.6	-0.1	1.01
YORKS. & HUMB. REM	1.6	1.6	0.0	1.00
SOUTH EAST REM	43.6	44.3	-0.7	0.98
WEST MIDLANDS REM	7.1	7.3	-0.2	0.97
GREATER MANCHESTER	-10.9	-11.5	-0.6	0.95
WEST YORKSHIRE	-4.4	-4.8	-0.4	0.92
NORTH WEST REM	3.8	5.1	-1.3	0.75
TYNE & WEAR	-4.6	-6.3	1.7	0.73
SOUTH YORKSHIRE	-.3	-2.6	2.2	0.13

younger, more mobile sections of the population.

Once again the variation in the netflow ratios at the MNM scale is accentuated at the extremes, whilst 10 out of 17 regions have ratios which represent a difference of less than +10%. Another feature which emerges more clearly at this scale is that a significant proportion of zone netflow ratios are below unity, indicating that the absolute value of the NHSCR netflow is less than the corresponding Census figure. In the case of South Yorkshire, the NHSCR net outflow is only 13% of the Census net outflow. This situation arises simply as a result of differences in the NHSCR/Census ratios for the gross flows involved. The absolute differences between the NHSCR and Census data on net migration remain within + 3,000.

Further disaggregation of the data allows analysis of individual FPCAs to examine, in particular, whether the large inflow ratios are confined to certain metropolitan districts or are consistently high within metropolitan counties. Figures 4.3 and 4.4 illustrate the variation in inflow and outflow ratios for FPCAs in England and Wales. Ratio values are split into quartiles for illustration. Scotland is included as a separate zone but Northern Ireland and the Isle of Man are excluded. The majority of outflow ratios for FPCAs within metropolitan counties are below the national figure of 1.24 although West Yorkshire and Merseyside are exceptional in containing some FPCAs with relatively high ratios.

Ratios for flows from FPCAs within Greater London are all below the national figure with the one exception of the FPCA of Lambeth, Southwark and Lewisham.

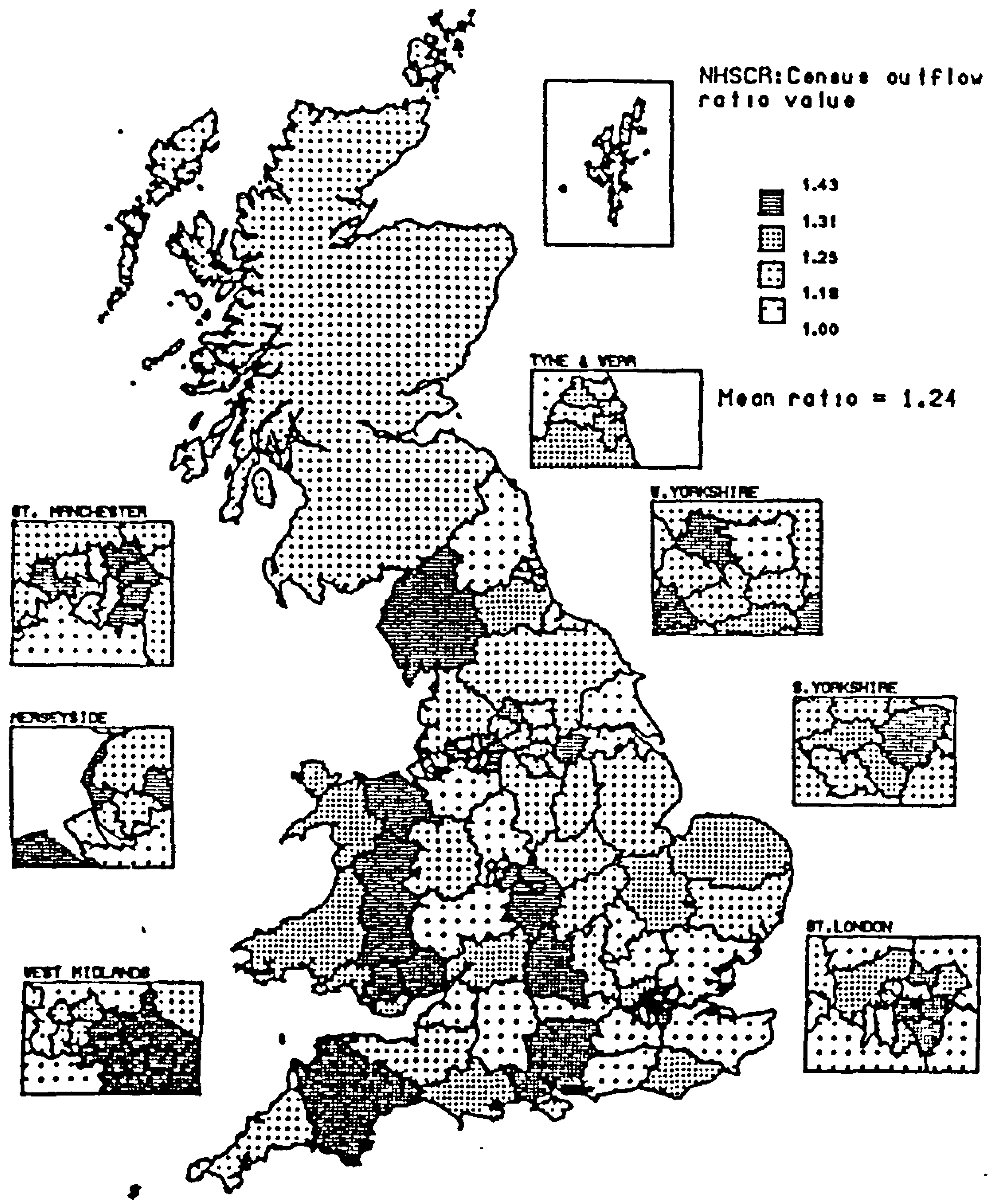


Figure 4.3 NHSCR:Census out-migration ratios for FPCAs

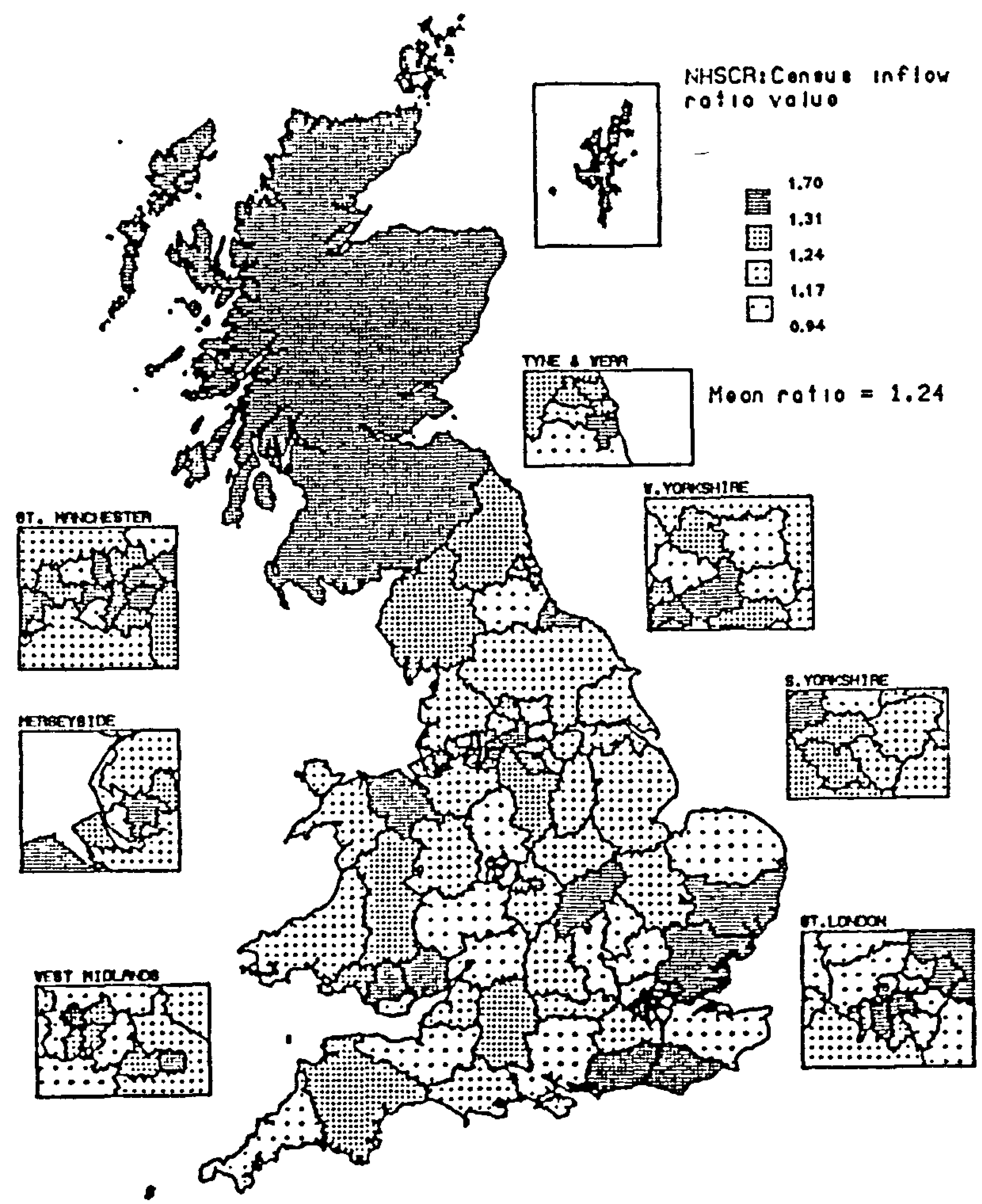


Figure 4.4 NHSCR:Census in-migration ratios for FPCAs

The inflow ratios at this scale emphasise the discrepancies that exist between data for inflows to metropolitan zones. Although the range of ratios within each metropolitan county is substantial, certain FPCAs do exhibit relatively high ratios, such as, Coventry (1.70), Sheffield (1.64), Newcastle (1.56), Leeds (1.52) and Manchester (1.51). The FPCAs of West Glamorgan (1.65) and Cleveland (1.58) also have high ratio values. The FPCAs of Greater London show relatively low ratio values compared to other metropolitan zones. Those FPCAs with the lowest inflow ratios include the non-metropolitan counties of Lincolnshire (0.94), Wiltshire (0.99), Hampshire (1.03) and Northumberland (1.06) together with the metropolitan FPCAs of Dudley (0.99) and Sandwell (1.05). The high inflow ratios for the provincial metropolitan districts will almost certainly be due to student inflows in particular and the disproportionate level of in-migration of young persons in general. The low ratios highlighted for a number of non-metropolitan FPCAs will be due to the dominance, again of young-person migration, but primarily of movement to the Armed Forces recorded only by the Census.

Although the overall NHSCR:Census migrant ratio has been shown to decrease as the scale becomes more refined (Table 4.2), the variation in the ratio between zones at any one scale is greatest at the FPCA level. At each spatial scale the deviation around the mean ratio for inflows generally exceeds that for outflows, with inflows to metropolitan zones (regions containing a metropolitan zone in the standard region case) showing the most significant discrepancies. The largest difference between NHSCR and

Census inflow increases as the number of zones increases.

The analysis of inflow ratios at the FPCA scale highlights certain metropolitan zones as having extreme ratio values. It is possible to hypothesize that the movement of students will have a significant influence on the NHSCR/Census ratio in those metropolitan FPCAs containing a major educational establishment as will the importance of multiple and return moves. The variation in the ratio according to metropolitan status is examined in the next section at different spatial scales and an explanation for the observed differences is offered.

4.4.3. Ratios for metropolitan and non-metropolitan areas

The preceding discussion suggests that the size of the flow ratio is related to degree of urbanization and consequently gross flows at the MNM and FPCA scales can be grouped according to whether they involve metropolitan or non-metropolitan zones (Table 4.5). At the MNM region level, aggregate ratios involving metropolitan zones are higher than ratios for non-metropolitan zones with NHSCR values exceeding census values for metropolitan inflows by 46% and for metropolitan outflows by 32%. However, at the FPCA level, the lowest aggregate ratio is 1.207 for metropolitan outflows and the highest is 1.272 for non-metropolitan outflows.

The change in the relative differences between ratios as the spatial scale becomes more refined is illustrated further in Table 4.6, which presents the ratios between the two data types for flows between the sets of metropolitan and non-metropolitan origins and destinations. At the MNM scale, the NHSCR:Census ratio is significantly high (1.654) for inter-metropolitan flows in comparison

Table 4.5. Aggregate ratios between NHSCR and Census inflows to and outflows from metropolitan and non-metropolitan zones

Type of flow	Spatial scale MNM regions	 FPCAs
Metropolitan inflows ratio	1.458	1.251
Metropolitan outflows ratio	1.324	1.207
Non-metropolitan inflows ratio	1.247	1.241
Non-metropolitan outflows ratio	1.291	1.272

Table 4.6. Aggregate ratios between NHSCR and Census data on flows between metropolitan and non-metropolitan zones.

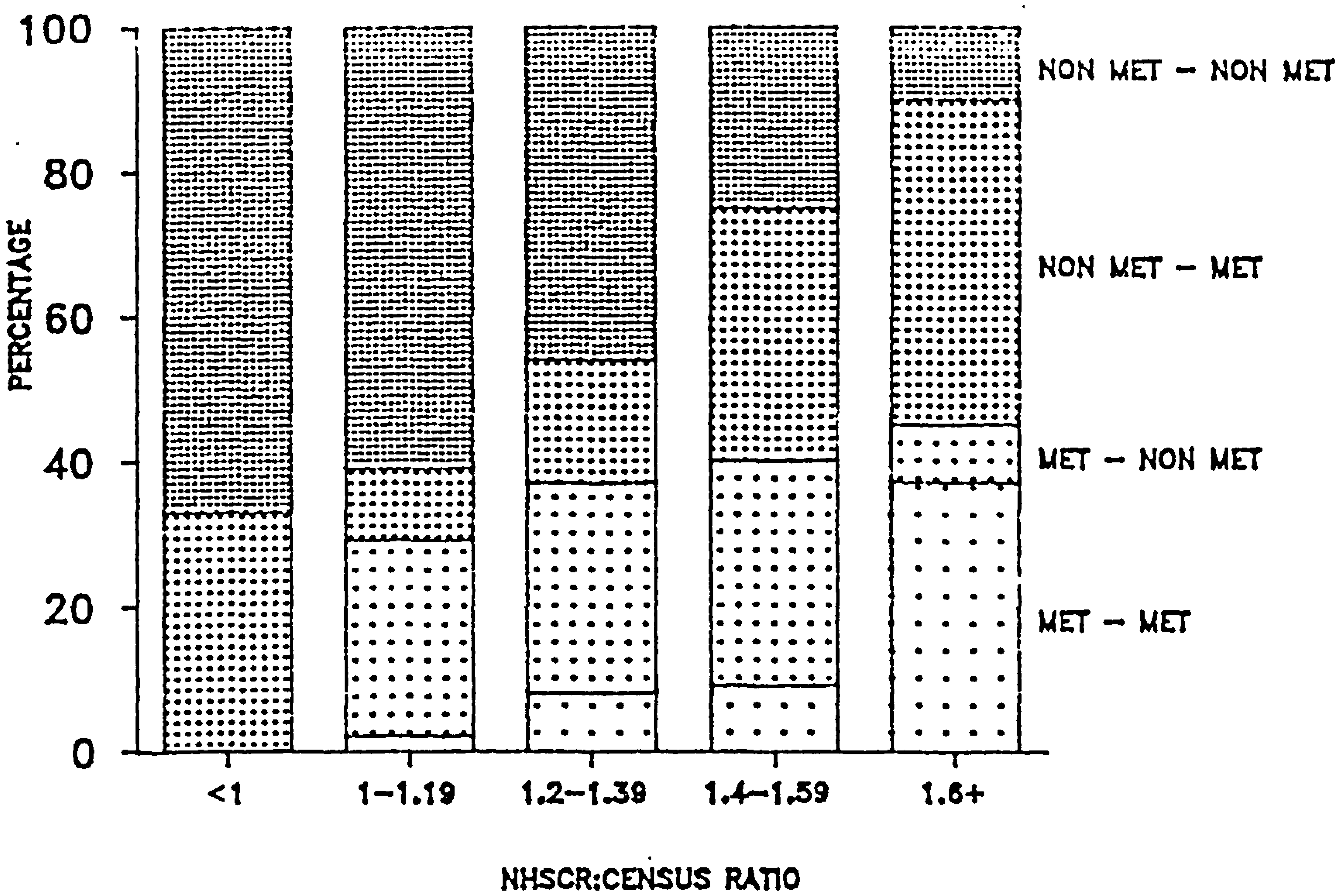
Origins	Destinations Metropolitan	 Non-metropolitan	 All
Metropolitan zones:			
MNM regions	1.654	1.272	1.324
FPCAs	1.144	1.272	1.207
Non-metropolitan zones:			
MNM regions	1.413	1.226	1.272
FPCAs	1.413	1.226	1.272
All zones:			
MNM regions	1.458	1.247	1.303
FPCAs	1.250	1.241	1.245

with the ratio for flows from non-metropolitan to metropolitan regions (1.413). However, at the FPCA scale, the inter-metropolitan ratio decreases considerably to 1.144. These variations contrast with much smaller variations at different spatial scales between ratios involving flows from metropolitan to non-metropolitan zones and flows between non-metropolitan zones.

The scale effect interpreted earlier is present in all ratios in Tables 4.5 which shows an interesting reversal when in and outflow ratios are compared. The metropolitan inflow ratios exceed the metropolitan outflow ratios at both scales; the non-metropolitan inflow ratios are, however, smaller than the non-metropolitan outflow ratios at both scales. These observations are consistent if we regard non-metropolitan zones as consistently more favoured by migrants than metropolitan. The inflow ratios for metropolitan zones are high because of the student factor and because more return migration out of these unattractive zones takes place and this depresses the Census count. Conversely, the outflow ratios for metropolitan zones are lower because more migrants stay out once they have left (i.e. there is less return migration); the Census count is thus less depressed vis a vis the Register count than in the inflow case. Exactly, the reverse arguments apply when inflow and outflow ratios for the more attractive non- metropolitan zones are considered.

Variations in the distributions of ratio values can be illustrated by using GIMMS to plot histograms of inter-zonal ratios by size category and zone type. Figure 4.5 indicates that, at the MNM scale, those ratios with a value of less than one relate entirely to flows from non-metropolitan zones. For the largest

(1) MNM Regions



(2) FPCAs

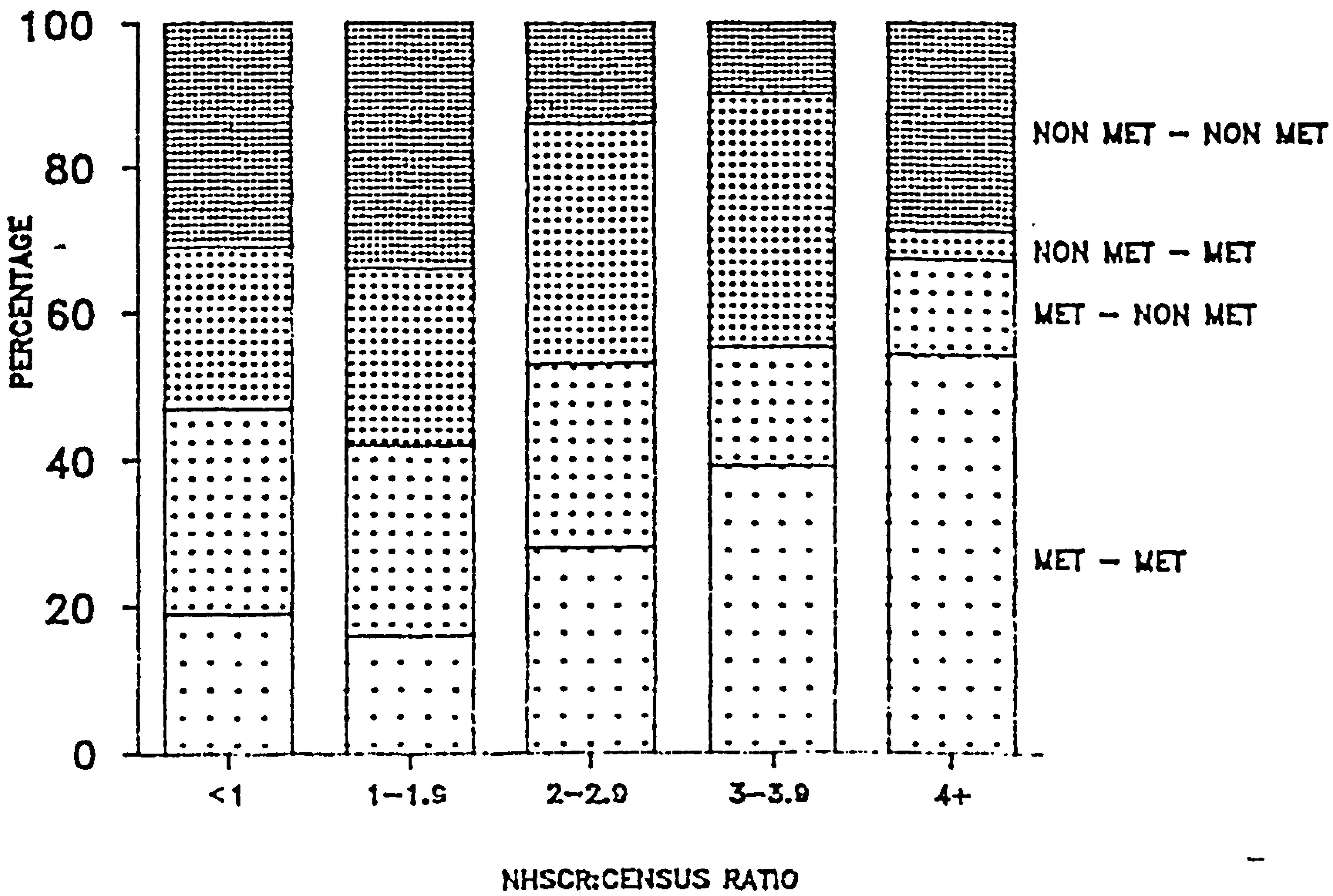


Figure 4.5 Inter-zonal flow ratios by size and zone type

ratio category (>1.6), the majority of ratios relate to flows to metropolitan zones with approximately 35% being between metropolitan zones and 45% from non-metropolitan to metropolitan zones. At the FPCA level, the first three ratio categories show fairly similar proportions in each status-group. In the 3-3.9 and 4+ ratio size categories, flows between metropolitan zones begin to assume greater importance with approximately 50% of the largest ratios being in this group. Flows from non-metropolitan to metropolitan zones have little significance in the highest category in this case.

4.4.4 Statistical relationship between NHSCR and Census migration data

The preceding sections have highlighted some of the major differences and similarities that exist in ratio terms and suggested reasons for variations in ratio values. The statistical relationship between NHSCR and Census data can be investigated more precisely by applying correlation and regression techniques to datasets at the standard region, MNM region and FPCA scales. Migration rates have been calculated with usually resident populations from the 1981 Census. Pearsons correlation coefficients computed for NHSCR and Census out-, in- and net-migration rates (Figure 4.6) are above 0.9 at each spatial scale although the coefficient decreases as the number of zones in the system increases. Correlation coefficients for outmigration are generally higher than those for inmigration at each spatial scale, with the least significant correlation found between net migration rates at the FPCA level (r=0.913). When linear least-squares regression parameters are computed for bivariate equations, intercept values appear to be largest at the smaller spatial scales although they are close to zero at all

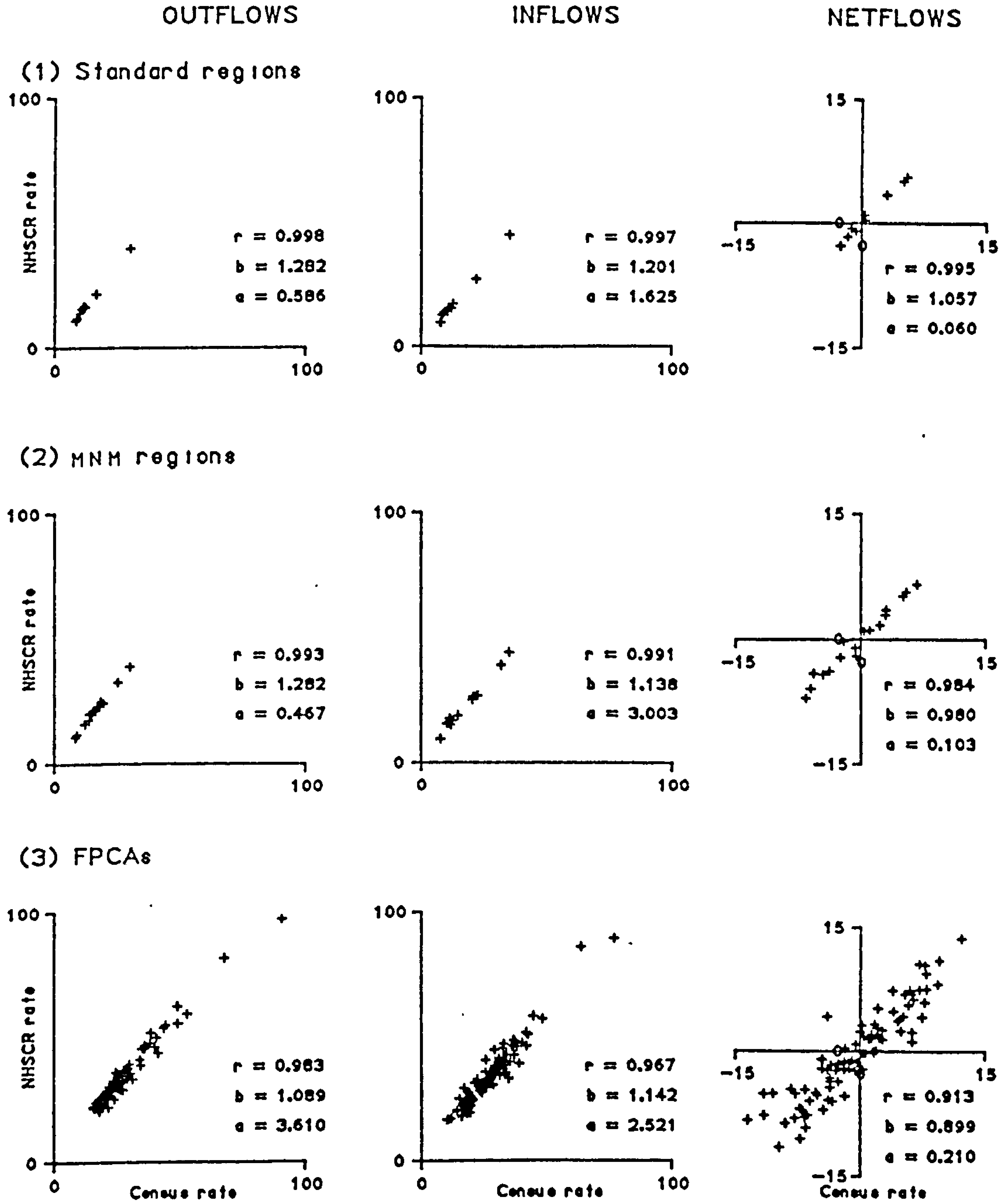


Figure 4.6 Scatterplots of NHSCR re-registration rates against Census migration rates at three spatial scales

scales. The regression coefficient should reflect the overall NHSCR:Census ratio as long as the intercept is close to zero. However, as the spatial scale becomes more refined the slope of the regression also reduces and the intercept increases. This is the case for outmigration and net migration rates but for inmigration rates, the slope value is lower at the MNM region scale than at the FPCA scale. The slope value is smallest for net rates and falls below one for NHSCR and Census net rates at the MNM and FPCA scales. The positive intercepts in all the regressions suggest that when Census-recorded migration is nil, there would still be NHSCR-registered migration, reflecting the additional population group, students, covered in part in NHSCR re-registrations, but not in the Census. Although the coefficients indicated in Figure 4.6 suggest that the correlation between the aggregate migration data sets from the two sources at all three spatial scales is strong, they are likely to conceal considerable variations which emerge when data is disaggregated further.

Summary statistics have also been computed which provide an indication of the overall relationship between the NHSCR and Census inter-zonal flow matrices at the three alternative spatial scales. Knudsen and Fotheringham (1986) have classified alternative 'goodness-of-fit' statistics into three categories: information based statistics, general distance statistics and traditional statistics; and four appropriate examples from these three categories are computed.

The information gain statistic (IGS) is the original information-based statistic from which subsequent measures have been derived. The formula for computation here is:

$$IGS = \sum_{i=1}^{m} \sum_{j=1}^{n} p_{ij} \ln (p_{ij}/q_{ij}) \qquad (4.7)$$

where

m,n are matrix dimensions or number of origin and destination zones respectively;

p_{ij}, q_{ij} are elements of discrete probability distributions P and Q

where

$$p_{ij} = M_{ij} / \sum_{i=1}^{m} \sum_{j=1}^{n} M_{ij} \qquad i \neq j \qquad (4.8)$$

$$q_{ij} = T_{ij} / \sum_{i=1}^{m} \sum_{j=1}^{n} T_{ij} \qquad i \neq j \qquad (4.9)$$

where M_{ij} is the observed count of NHSCR re-registrations between zone i and zone j and T_{ij} is the observed Census inter-zonal migration. The information gain statistic has a minimum of zero when P = Q and a maximum of positive infinity when $p_{ij}>0$ and $q_{ij} = 0$ for any i,j combination. The statistic is used here to analyse non-zero elements of the respective arrays. The information gain is low in all three cases in Table 4.7, showing a strong relationship between NHSCR and Census flows at each spatial scale, although the statistic increases as the scale becomes more disaggregate.

Two general distance statistics are computed: the mean absolute deviation (MAD) and the index of dissimilarity (IOD). The MAD statistic, represented in Table 4.7 as a percentage, has the following computational formula:

$$MAD = \frac{\sum_{i}^{n} \sum_{j}^{m} M_{ij} - T_{ij} \; 100}{\sum_{i}^{n} \sum_{j}^{m} M_{ij}} \qquad i \neq j \qquad (4.10)$$

Table 4.7. Summary statistics comparing NHSCR and Census inter-zonal flows

Statistic		Spatial Scale Standard regions	MNM regions	FPCAs
Information Gain	(IGS)	0.005	0.009	0.053
Mean Absolute Deviation	(MAD)	25.08	23.68	25.84
Index of Dissimilarity	(IOD)	3.7	4.7	11.1
Correlation Coefficient	(R)	0.996	0.995	0.980

where the sum of the absolute deviations is divided by the sum of the NHSCR inter-zonal transfers. The mean deviation is lowest at the MNM scale at 23.7% in contrast to the regional scale where it is 25.1% and the FPCA scale where it is highest.

The index of dissimilarity is an index which compares two distributions by calculating the sum of deviations between cell proportions in the two matrices. The IOD ranges from 0 to 100 with zero indicating perfect correspondence and 100 indicating complete dissimilarity. The formula for computation is:

$$IOD = \sum_{i}^{n}\sum_{j}^{m} (M_{ij}/\sum_{i}^{n}\sum_{j}^{m} M_{ij})-(T_{ij}/\sum_{i}^{n}\sum_{j}^{m} T_{ij}) \; 50 \qquad i \neq j \qquad (4.11)$$

The degree of dissimilarity is relatively low at all three spatial scales with the IOD value of 11.1 at the FPCA level being the greatest illustrating a greater distance between NHSCR and Census flows at this scale.

The correlation coefficient (R) is representative of what Knudsen and Fotheringham refer to as traditional statistics. R can have a value between zero, indicating no correspondence between the two arrays, and one, indicating perfect correlation. It is defined as,

$$R = \{\sum_{i}^{n}\sum_{j}^{m}(M_{ij}-M)(T_{ij}-\bar{T})/(\sum_{i}^{n}\sum_{j}^{m}(M_{ij}-\bar{M})^{2} - \sum_{i}^{n}\sum_{j}^{m}(T_{ij}-\bar{T})^{2}.\}0.5 \qquad (4.12)$$

The R coefficient indicates strong correlation between the Census and NHSCR arrays at all three spatial scales with the strength of correlation decreasing as the spatial scale becomes finer. The measures computed highlight a strong relationship between NHSCR and Census flows at all three levels with the strength of the statistical relationship decreasing as the level of spatial disaggregation increases.

4.5 THE COMPARISON OF AGE AND SEX-DISAGGREGATED MIGRATION DATA SETS AT THE FPCA SCALE

4.5.1 Total inflow ratios by age and sex

This section takes the comparative analysis a step further by examining differences between the NHSCR and Census inflows to all FPCAs for persons, males and females in age-groups 1-4, 5-9 to 70-74 and 75+. The conversion and estimation routines applied to the data have been discussed in Section 4.3.2.

Table 4.8 illustrates the breakdown of total flow ratios by five-year age-group for persons. The greatest ratio values are found in the 10-14 and 15-19 age-groups, particularly the latter, due to the student effect and multiple/return movement factors discussed earlier. The ratio value increases significantly in the last two age-groups indicating the importance of two factors. Firstly a move by a person in the 70+ age-range will invariably result in a re-registration with the NHSCR. However, if that person dies within the one-year period in question the move will not be counted in the Census. Secondly, a considerable amount of short-term or return migration is associated with moves by the elderly back to their original FPCA. Both of these factors will contribute to the increasing ratio values in the oldest age categories.

The overall NHSCR:Census ratio of 1.27 hides the considerable variation that exists between the sexes. The all-age ratio for female inflows (1.342) is far higher than the corresponding figure for males (1.192). Illustration of the ratio values for individual age and sex-groups indicates that the greatest ratio is found in the

Table 4.8 NHSCR:Census FPCA inflow ratios by age-group

Age-group	NHSCR moves	Census migrants	Ratio
1-4	98,960	83,484	1.185
5-9	100,806	78,846	1.279
10-14	96,176	64,598	1.489
15-19	188,931	113,589	1.663
20-24	306,303	266,647	1.149
25-29	241,353	206,603	1.168
30-34	176,776	145,786	1.213
35-39	100,275	79,911	1.255
40-44	64,304	52,761	1.219
45-49	48,994	37,647	1.301
50-54	41,377	32,750	1.263
55-59	40,669	31,642	1.285
60-64	40,245	31,764	1.267
65-69	37,878	29,756	1.273
70-74	27,093	20,515	1.321
75+	42,785	29,497	1.451
All ages	1,652,926	1,305,796	1.266

female 15-19 category (Figure 4.7). This suggests the importance of two phenomenon. Firstly young women are likely to be more prompt in their re-registration upon transfer to a new FPCA. Secondly the movement of these women is likely to include a considerable number of employment-related moves which may be only temporary posts within the service sector, for example. The combined effect of these two factors will be an inflated level of NHSCR movement and a relatively high NHSCR:Census ratio value.

Males aged 15-19 do not exhibit such a large discrepancy as females and it is the 10-14 ratio value which is the highest for males, suggesting a considerable under-recording of NHSCR moves due to the exclusion of Armed Forces flows. The NHSCR and Census flows are most similar in the 20-29 male age-range. This may be as a result of considerable non-registration within this 'healthy' section of the population giving rise to a deflated level of NHSCR movement or possibly the reduction in the importance of return/multiple moves. Movement by 25-29 year-old males in particular is likely to be more permanent and not to involve multiple moves within a one-year period. Census and NHSCR migration will, therefore, be more comparable.

The increase in the ratio value for the elderly is emphasised, particularly for males for whom the incidence of migrating and dying will be proportionately more significant.

4.5.2 Age and sex-disaggregated inflow ratios for FPCAs

The categorisation of individual male and female inflow ratios for FPCAs according to size reveals some interesting features (Table 4.9). The relatively large discrepancies in the female 15-19 age-group are emphasised with 33% of NHSCR flows in this age-range

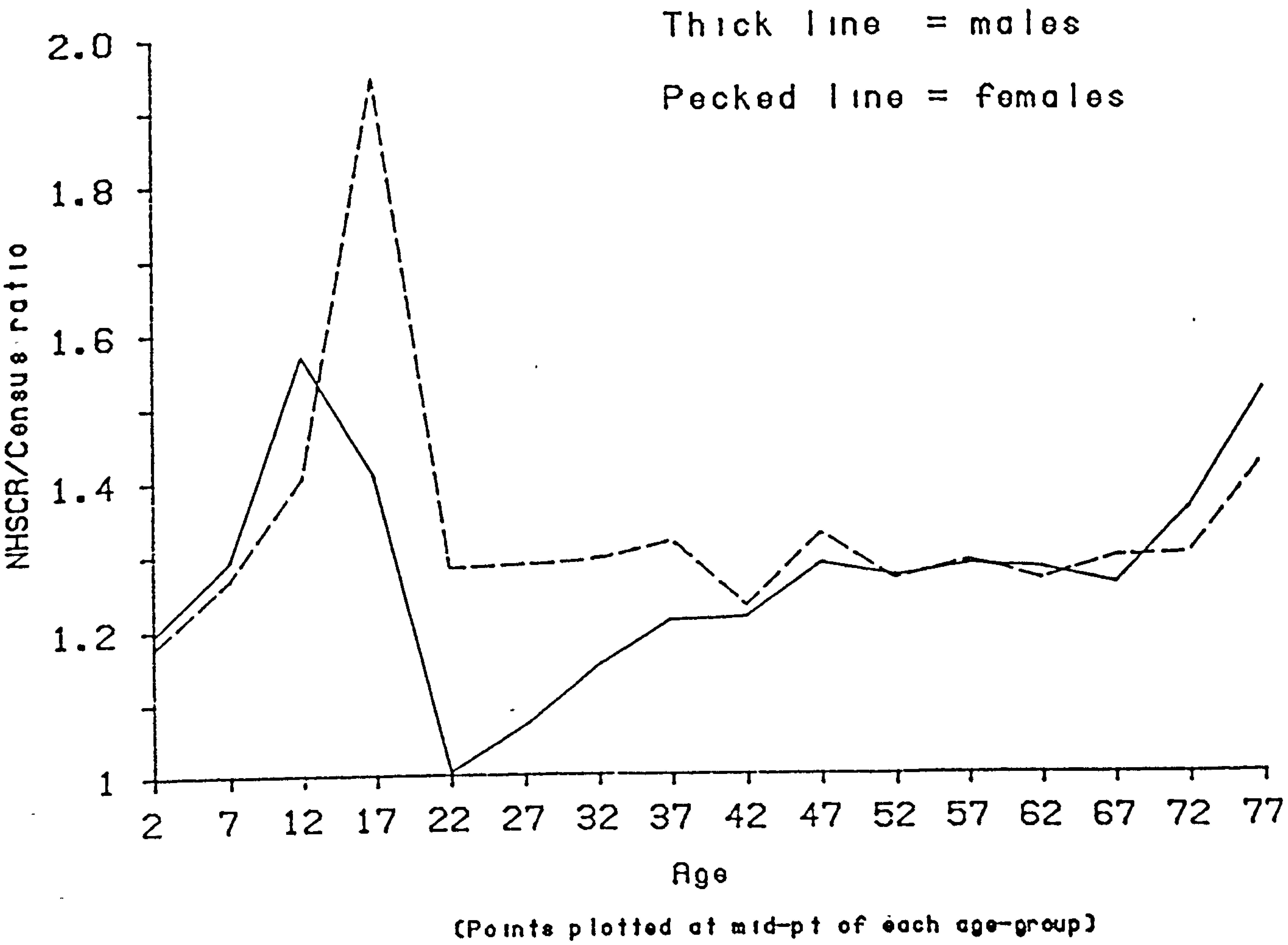


Figure 4.7 NHSCR:Census inflow ratios by age and sex

being more than twice the size of the corresponding Census figure, and 14% being more than three times larger. The corresponding figures for 15-19 year-old males are 27% and 11%.

The relatively low ratio values for males aged 20-29 contain a considerable number of cases in which the Census flow actually exceeds the NHSCR figure emphasising the phenomenon of considerable non-registration by this section of the population which reduces the NHSCR count quite considerably. Table 4.9 also illustrates the increase in the number of relatively large inflow ratio values in the older age-groups particularly for males.

A series of statistical indices computed to measure the similarity between NHSCR and Census inflows in relative and absolute terms are illustrated in Table 4.10. A full definition of the indices is given in Section 4.4.4. Correlation coefficients are generally high indicating considerable agreement in the pattern of age and sex-disaggregated NHSCR and Census flows, with the exception of the 15-19 age-group. Male 15-19 year-old inflow counts in particular are poorly correlated and the high MAD statistic of 49.6 suggests considerable under as well as over-counting of NHSCR flows. The large NHSCR flows relative to the Census will be in metropolitan areas particularly in University or Polytechnic districts where the annual inflow of students is considerable whereas the deflated NHSCR flows will be in non-metropolitan FPCAs where the non-recording of Armed Forces moves reduces the inflow ratio value. The high MAD statistic for female 15-19 year-olds reflects the importance of short-term, multiple movement to metropolitan areas which are not picked up by the Census.

Table 4.9. Age and sex-disaggregated NHSCR:Census FPCA inflow ratios by ratio size

Age-group	Males				Females			
	Ratio Value							
	<1	1<1.9	2<2.9	3+	<1	1<1.9	2<3.9	3+
1-4	18	77	0	0	18	76	1	0
5-9	7	87	1	0	15	80	0	0
10-14	4	85	6	0	8	81	6	0
15-19	16	53	16	10	2	62	18	13
20-24	40	55	0	0	2	93	0	0
25-29	29	66	0	0	4	91	0	0
30-34	19	76	0	0	10	85	0	0
35-39	14	79	2	0	7	88	0	0
40-44	13	82	0	0	17	77	1	0
45-49	12	83	0	0	15	77	3	0
50-54	13	78	4	0	20	72	3	0
55-59	21	69	5	0	17	73	5	0
60-64	18	73	4	0	16	76	3	0
65-69	22	67	6	0	20	70	5	0
70-74	15	69	10	1	14	74	6	1
75+	16	66	11	2	12	78	5	0

Table 4.10. Summary statistics comparing NHSCR and Census inflows by age-group for males and females

Age-group	Correlation coefficient R		Mean Absolute Deviation MAD		Index of Dissimilarity IOD		Information Gain IGS	
	male	female	male	female	male	female	male	female
1-4	0.970	0.958	18.0	17.7	6.76	7.19	0.014	0.017
5-9	0.978	0.974	23.6	22.9	5.56	6.10	0.011	0.013
10-14	0.946	0.964	36.5	29.3	8.66	7.49	0.022	0.018
15-19	0.672	0.897	49.6	48.7	23.97	12.74	0.189	0.049
20-24	0.969	0.989	15.5	22.0	7.74	4.77	0.018	0.007
25-29	0.990	0.991	10.3	22.3	4.39	4.31	0.007	0.006
30-34	0.986	0.984	14.7	23.1	4.87	5.41	0.008	0.009
35-39	0.975	0.980	18.7	24.3	6.29	5.74	0.014	0.010
40-44	0.975	0.971	20.2	21.1	5.74	6.20	0.013	0.015
45-49	0.965	0.966	24.0	26.9	7.67	7.59	0.019	0.022
50-54	0.967	0.959	23.0	23.4	6.95	8.26	0.019	0.023
55-59	0.959	0.977	24.8	24.4	8.72	7.03	0.027	0.021
60-64	0.976	0.971	25.7	22.4	8.28	7.77	0.027	0.020
65-69	0.976	0.970	23.1	24.8	8.05	8.11	0.025	0.020
70-74	0.966	0.956	28.1	25.2	8.58	9.20	0.030	0.029
75+	0.960	0.981	35.6	31.4	9.29	6.44	0.031	0.017
Totals	0.948	0.956	22.6	26.6	10.14	7.96	0.041	0.025

Note: Each statistic is computed for inflows to FPCAs

4.5.3 Disaggregate inflow ratios for metropolitan and non-metropolitan FPCAs

It has already been hypothesised that the NHSCR:Census ratio varies considerably between certain metropolitan and non-metropolitan FPCAs for a number of reasons. Table 4.11 illustrates male and female inflow ratio values by age-group for the two broad categories. The most striking feature is the difference in the male 15-19 age-group between the average metropolitan and the average non-metropolitan inflow ratio. The figure for metropolitan FPCAs is very high (1.975) reflecting student movement and short-term moves by this mobile section of the population. The corresponding non-metropolitan ratio (1.205) is relatively low, however, confirming the hypothesis of the previous section that the non-recording of AF recruitments, discharges and postings deflates the level of NHSCR movement in certain FPCAs. Women do not make up a very significant percentage of AF movement and the ratio values are not therefore affected to such an extent.

The extreme high and low ratio values for the male and female 15-19 age-groups are illustrated in Tables 4.12 and 4.13. The variation in the male ratio values illustrated by the statistics of Table 4.10 is clearly evident. The high NHSCR:Census ratio values occur in FPCAs containing large educational establishments whereas the low values are in non-metropolitan areas where a considerable amount of AF migration is recorded by the census but not the NHSCR. The female ratios do not exhibit such wide variation due to the lesser importance of AF migration but the student effect is of equal importance in producing high values in certain FPCAs.

Table 4.11. Metropolitan and non-metropolitan FPCA inflow ratios by age-group and sex

Age-group	Males Metrop.	Males Non-met.	Females Metrop.	Females Non-met.
1-4	1.281	1.155	1.286	1.126
5-9	1.358	1.264	1.333	1.239
10-14	1.408	1.634	1.392	1.409
15-19	1.975	1.205	1.849	2.018
20-24	0.984	1.018	1.217	1.337
25-29	1.040	1.085	1.280	1.288
30-34	1.160	1.141	1.365	1.252
35-39	1.250	1.188	1.368	1.291
40-44	1.320	1.158	1.295	1.196
45-49	1.326	1.261	1.301	1.334
50-54	1.335	1.233	1.334	1.231
55-59	1.353	1.255	1.361	1.264
60-64	1.346	1.256	1.378	1.228
65-69	1.395	1.220	1.336	1.277
70-74	1.471	1.319	1.339	1.280
75+	1.625	1.479	1.368	1.446
TOTAL	1.212	1.181	1.346	1.341

Table 4.12. Ten highest ratios for inflows to FPCAs in the 15-19 age-group, males and females

Males		Females	
Zone	Ratio	Zone	Ratio
Coventry	6.53	Sheffield	4.41
Newcastle	5.20	Leeds	3.94
Sheffield	4.97	Coventry	3.78
Leeds	4.65	Newcastle	3.39
W.Glamorgan	3.68	W.Glamorgan	3.24
Birmingham	3.60	Durham	3.21
Manchester	3.43	Dyfed	3.25
Liverpool	3.31	Nottinghams	3.14
Durham	3.37	Liverpool	3.08
Leicesters	3.35	Oxon	3.07

Table 4.13. Ten lowest ratios for inflows to FPCAs in the 15-19 age-group, males and females

Males		Females	
Zone	Ratio	Zone	Ratio
Cornwall	0.24	Powys	0.96
Lincolns	0.39	Lon-Croy	0.98
Northumb	0.41	Sandwell	1.02
Powys	0.52	Trafford	1.02
Wiltshire	0.56	Dudley	1.15
Hampshire	0.57	Wiltshire	1.19
Salop	0.59	Northumb	1.19
N.Yorks	0.64	Wigan	1.24
Northants	0.66	Salop	1.32
Somerset	0.76	Cheshire	1.33

4.6 PRELIMINARY CONCLUSIONS AND FURTHER RESEARCH

In the preceding sections of this chapter, preliminary comparative analyses have highlighted both the similarities and the dissimilarities between migration data collected from the NHSCR and the Census at several different aggregations and different spatial scales. A summary of the results is presented here together with their interpretation in relation to the components highlighted by Devis and Mills (1986).

Comparing the two datasets at the highest level of aggregation (standard region flow totals), correlation coefficients of over 0.99 are observed. The coefficients drop to 0.98 when the totals are disaggregated into zone to zone flows for FPCAs. It is only when the netflows are considered that the correlation coefficient is significantly lower. However, NHSCR and Census migration measures are not perfect replicas of each other by any means. The correlation of FPCA inflows for males in the 15-19 year old age group is only 0.672, and the mean absolute deviations of NHSCR and Census inter-zonal flows vary by age-group by between 10% and 50%.

Overall the NHSCR re-registration count is 24.5% greater than the Census migrant count. However, Devis and Mills (1986) have demonstrated that if non-comparable elements are excluded from the NHSCR and Census counts, the resultant 'lowest common denominators' are very close numerically. Recalling Table 4.1, component A.1 of the NHSCR count is 1.301 millions and components B.1 and B.4 of the Census count together sum to 1.303 millions. The difference is less than one tenth of one percent.

Substantial differences are evident when comparing NHSCR and

Census flows across spatial zones. These differences can be explained in terms of three factors: operational measurement problems; conceptual differences and differences in the populations captured in the two sources (Section 4.2.3). Taking the last set first, it is noted that the map of NHSCR:Census ratios for inflows to FPCAs (Figure 4.4) places in the lowest category (ratios just above or just below unity) those counties with substantial AF establishments (Cornwall, Wiltshire, Hampshire, Powys, Salop, Lincolnshire, Northumberland, North Yorkshire) and therefore systematic migration directed by the recruitment, promotion and tour of duty systems of the military. AF migrants are 'picked up' by the Census question but not by the NHSCR re-registration process. The computer summaries of NHSCR information utilised in this peliminary comparison exclude all movement of AF personnel. A record is kept of the amount of AF recruitment and discharge taking place from and to individual FPCAs but these moves are not included in the summaries. Furthermore, no record is made of movement between FPCAs within the AF. The NHSCR count will therefore be suppressed, and the ratio becomes small in those FPCAs named above, where there are considerable service personnel present. Conversely, the highest ratios in Figure 4.4 appear in metropolitan districts (Newcastle, Leeds, Manchester, Liverpool, Birmingham) and non-metropolitan counties (Durham, Leicester, Avon,) with large institutions of higher education that import and export substantial numbers of student migrants each year. The NHSCR will include all student moves given that a re-registration takes place whereas the Census records students as living at home and so will exclude all moves to places of education. The NHSCR:Census ratio will therefore be high in FPCAs with a considerable annual student inflow.

It was observed that the NHSCR:Census ratio increased with scale of migration considered and the hypothesis was proposed that the return migration element of additional NHSCR recorded moves was primarily responsible for such observations. Similarly, return migration was held to play some part in the higher NHSCR:Census ratios observed for inflows to metropolitan areas as a whole: areas unattractive to migrants were associated with returns to more attractive zones (non-metropolitan areas). Such return flows depressed the observed Census count while not affecting the NHSCR count. The relationship between multiple and return moves, the metropolitan/non-metropolitan classification of origin and destination and the average distance travelled needs to be examined further. These non-common components of the two migration measures clearly act together with the observed NHSCR:Census difference for any one area or any one inter-area flow being the net outcome of the various effects discussed above with the comments here merely selecting areas in which one effect was clearly dominant.

In the next chapter, the results of comparing census data with primary unit NHSCR data are reported. The PUD allows the construction of an NHSCR dataset that is conceptually more consistent with that of the Census in terms of the age-time plan of observation. Furthermore, the use of PUD allows the reassignment of flows not included in the summary information - moves with either origin, age or sex not-stated and moves involving recruitment and discharge of AF personnel. This provides more consistent datasets to compare at alternative scales. The new NHSCR dataset will be used in similar comparative analyses to confirm the findings of Chapter 4 and also to extend the work to encompass more complex modelling and statistical methods. A quantitative relationship between NHSCR and Census data and their non-common components is constructed using multiple regression techniques and spatial interaction models are utilised to assess the effect of friction of distance upon migration from the two sources at alternative spatial scales. The ATP consistency allows a more precise comparison of age and sex-disaggregated flows which, in Chapter 5, include gross inflows and gross outflows to and from individual FPCAs.

Chapter 5. COMPARISON OF CENSUS AND NHSCR MIGRATION DATA: STAGE TWO

5.1 INTRODUCTION

Chapter 4 has provided a preliminary comparison of NHSCR and Census data analysing differences and similarities between the two sources at a variety of spatial scales and levels of age and sex disaggregation. Hypotheses have been formulated to explain a number of the prominent features of the comparison highlighting the importance of student and Armed Forces flows and the presence of multiple and return moves in determining the NHSCR-Census differences.

This chapter reports on a second round of comparisons, undertaken using the primary unit data (PUD) which was unavailable at the outset of the study. PUD is superior to data obtained from NHSCR computer-summaries because it provides movement information that is more consistent with the Census data in terms of age-time plan of observation and includes those not-stated and Armed Forces moves previously excluded from the NHSCR arrays. The PUD-based data sets are used to validate the hypotheses formulated in Chapter 4 by repeating some of the previous analyses and also through a more extensive comparison utilising a number of statistical and modelling techniques and a more thorough examination of age and sex-disaggregated migration.

Section 5.2 outlines the new datasets used in this stage of the comparison, explains the age-time plan adjustments applied to the NHSCR data, describes the assignment of 'not-stated' flows and moves involving Armed Forces personnel and their dependants and describes the procedure adopted for the estimation of confidence limits for the

10% sample NHSCR data. Section 5.3 has a similar structure to Section 4.4 and compares inter-zonal migration datasets using flows and ratios highlighting differences that exist at alternative spatial scales and by metropolitan status and contiguity. Section 5.4 illustrates the strength of the NHSCR-Census relationship at alternative spatial scales using a number of statistical indices and uses multiple regression techniques to develop quantitative relationships between the NHSCR and the Census and a series of dependant variables. Spatial interaction models are also used to assess the variation in zone-specific mean migration lengths and the friction of distance effect upon standard region, MNM region and FPCA level flows. Section 5.5 undertakes the analysis of gross in and out migration disaggregated by age and sex, illustrating differences and similarities between the Census and the NHSCR using flow-ratios, and a number of goodness of fit statistics. Finally, Section 5.6 attempts to collate the results and provides a discussion of the findings of the analysis in relation to the future use of NHSCR data in migration analysis and projection.

5.2 DATA EXTRACTION, ADJUSTMENT AND ALIGNMENT

5.2.1 NHSCR and Census data utilised

Chapter 3 outlined the assembly and processing of Census and NHSCR migration data from the PUD held on magnetic tape (Section 3.3.6). The three arrays processed from each source of coded information which are compared in this chapter are:

(a) a matrix of flows between 97 origin zones and 95 destination zones;

(b) out-migration totals for each zone disaggregated by five-year age-group and sex; and

(c) in-migration totals for each zone disaggregated by five-year age-group and sex.

The time period of observation is as before with Census data relating to the one-year period prior to April 5/6 1981, which is matched most closely by NHSCR movement data for the twelve month period ending June 30th 1981 (moves taking place between April 1st 1980 and March 31st 1981, assuming an average three-month lag between each move and re-registration).

The analyses in this chapter are undertaken at a number of spatial scales (Section 3.2), although the comparison of age and sex-disaggregated data sets is limited to the FPCA scale. The out-migration and in-migration totals by age and sex contain a record of all inter-FPCA moves. Any aggregation of these data to the MNM or regional level would include intra-zonal flows implicitly and thus give an incorrect count of inter-zonal migration. A further point to note is that since all flows to Northern Ireland and the Isle of Man are not recorded in the 1981 Census, they are excluded from all analyses.

5.2.2 Age-time plan adjustment of NHSCR data

Chapter 4 outlined the initial estimation technique adopted to convert NHSCR movement data to a cohort basis consistent with Census flows. Although this method was adequate for the preliminary comparison the processing of PUD allows a more accurate conversion routine to be utilised and at the same time allows the estimation of the relevant proportion of infant moves not recorded by the Census to be excluded from the NHSCR inter-FPCA array of moves.

Figure 5.1 illustrates the age-time plan (ATP) of observation for

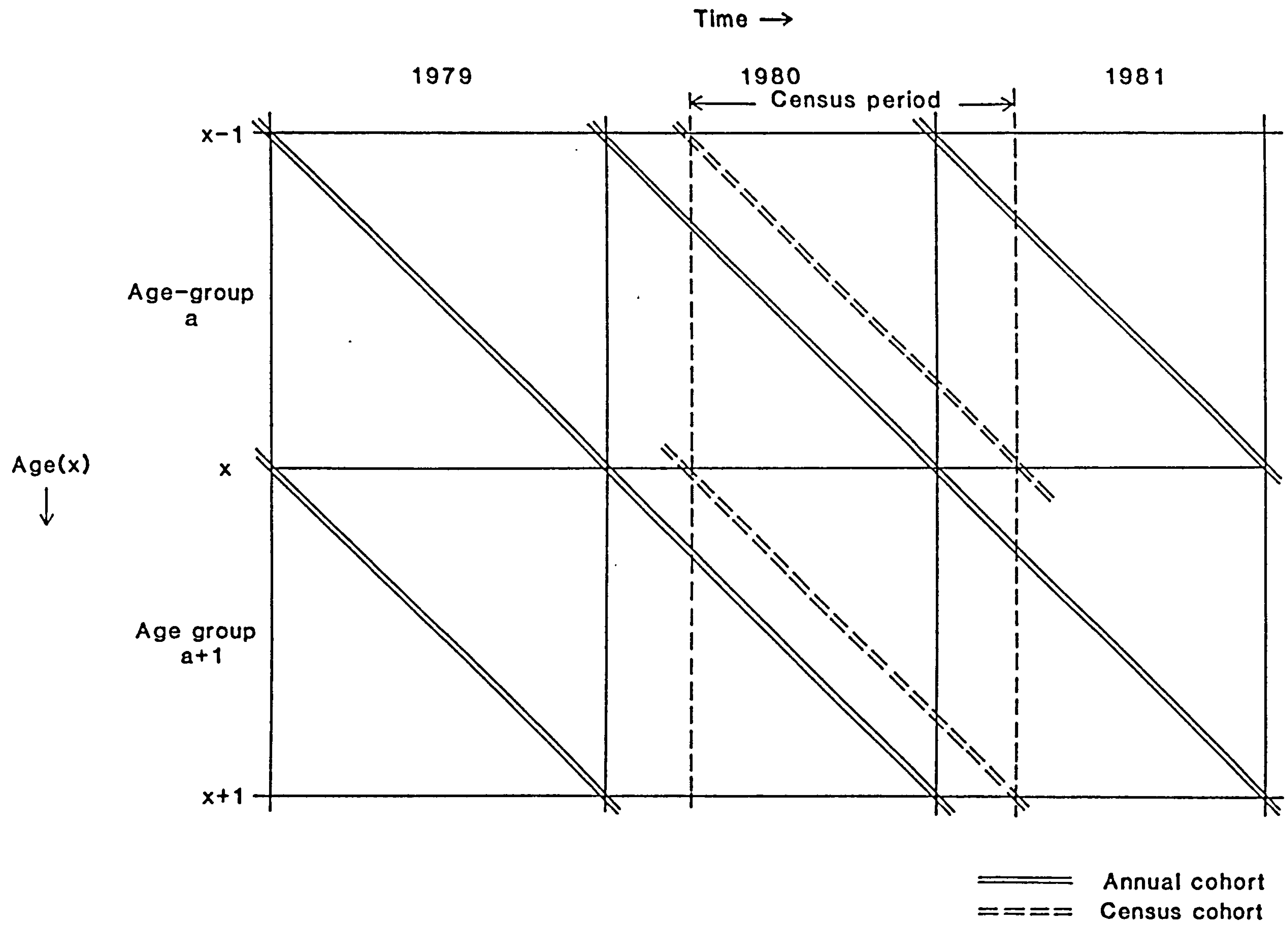
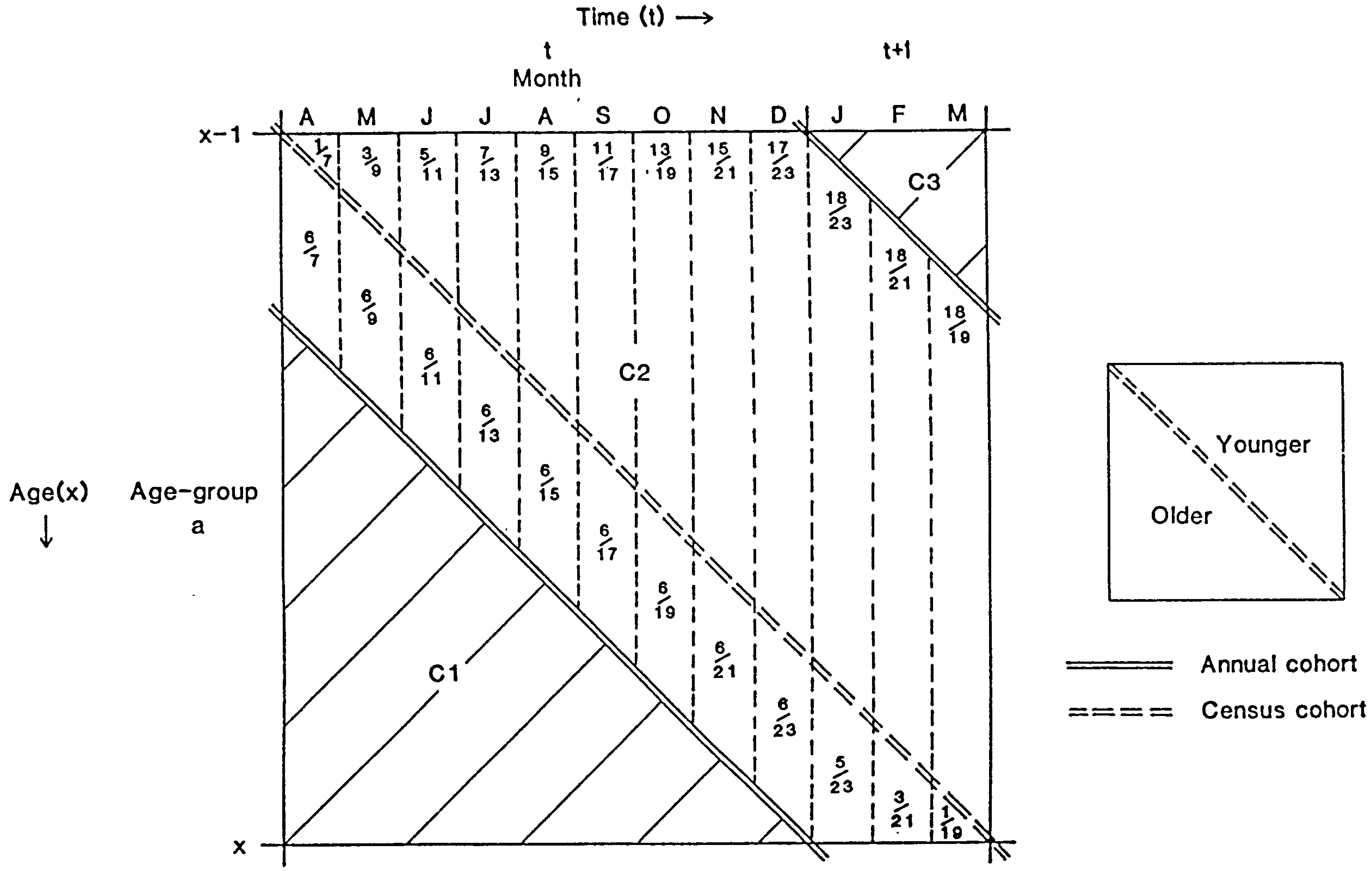


Figure 5.1 <u>Age-time plan of observation for Census cohorts in relation to annual cohorts</u>

Census cohorts in relation to annual cohorts. Census data relate to cohorts defined by end-of-period age-groups. The aim is to transform the NHSCR movement data so as to be consistent with the Census transition-type of age-time plan. The coded PUD gives the calendar year of birth for each move thus allowing the NHSCR data to be recorded in annual cohorts. The PUD relates to the period April 1st 1980 to March 31st 1981. The coincidence between annual cohorts and the required cohorts for the NHSCR data is illustrated in Figure 5.1. For each age-group it is necessary, therefore to convert the NHSCR data, recorded in annual cohorts, to census-period cohorts. Figure 5.2 illustrates in greater detail the nature of the estimation and conversion routine involved.

First, in order to compare NHSCR with Census data, one needs to estimate the number of moves made by those aged less than one at the end of March 1981 and subtract these from the aggregate NHSCR counts. If the value of t (year) in Figure 5.2 is taken to be 1980 then those moves to be excluded from the NHSCR inter-FPCA flows are those recorded in the 'younger' section of the Census-period age-time plan of observation (those aged less than one at enumeration). Year of birth is coded in the PUD as the number of years since 1900 (i.e. if year of birth is 1934 then the code assigned is 034). The age at move code ranges from zero, for moves made by those aged under one year of age, to 099 for those aged 99 at time of move. Finally a 'month-of-move' code is contained in the PUD which relates the time of move to the number of months since January 1970. A simple recoding procedure converts the month-of-move code to one relating to the twelve months of the period of interest (April 1980 = 1 and March 1981 = 12).



Probabilities : e.g. $\frac{1}{7}$ = probability that a move is recorded in the younger cohort given that the move was made in April and given the move was recorded in C2

Figure 5.2 <u>ATP of observation for the Census period illustrating its division by month of move and age of mover</u>

Figure 5.2 illustrates how the ATP for the first age-group can be broken down into a series of sections dependent upon year of birth, age at time of move and month of move. The 'older' section relates to the upper half of the first single-year census-period cohort (ie. those aged one at the end of the period). The superimposition of the NHSCR annual cohorts onto the census-period cohort divides the ATP into three sections - C1, C2 and C3. So, for example, if a move is made by an infant (aged 0) whose year of birth was 1979 then that move must be recorded in section C1. If, however a move is made by an infant whose year of birth was 1981 then that move must be included in setion C3. Any other moves by infants (ie. those born in 1980) must be recorded within the boundaries of section C2. All moves made by infants born in 1979 must be in the 'older' section of the age-group. All moves made by infants born in 1981 must be in the younger section of the age-group. It is necessary, therefore, to proportionally assign moves recorded in the C2 section to either the 'younger' or 'older' half. Knowledge of the month of move allows a series of conditional probabilities to be computed based on the probability that a move is recorded in the younger or older half of the Census cohort given that the month of move is known and given that the move was recorded in section C2. Individual records (one move per record) are processed from magnetic tape so that each move is assigned to its appropriate section (C1, C2 or C3). and, if in section C2, proportionally divided,on the basis of the probabilities computed, between the younger and older sections of the first age-group. Each time an infant move is encountered with year of birth 1980 the 'younger' and 'older' sections are incremented by a fraction. It is therefore important to retain the fractional part of each element of the matrices created when outputting arrays to disk and reading them in as the initial arrays of the subsequent tape run (Chapter 3). The output from a complete run of all coded PUD records for the relevant period is a count of all moves made by infants split into a younger and older section. As the corresponding Census data excludes all transfers made by persons aged less than one at the end of the period, those moves recorded in the younger section of the first age-group will be excluded from the NHSCR inter-FPCA array of flows. Those moves recorded in the 'older' section will be included.

The second estimation routine involves the conversion of all age-groups within the NHSCR data to the Census-type age-time plan of observation. As with the first age-group, each subsequent individual age-group can be split into a 'younger' and 'older' section which relate to a younger and older cohort. The annual cohorts superimposed on the census-period cohorts again divides the ATP into three sections C1, C2 and C3. As each record is processed it is the comparison of the age at time of move with the year of birth which places each individual move into the relevant section. To make the year of birth directly comparable with the age at move code, it is necessary to convert it to a figure representing the difference between 1980 and the year of birth. So, for example, if a persons year of birth was given as 1950 the new coding would be 30 (1980-1950). This effectively converts the year of birth figure to an alternative measure of a persons age at move. Comparing this 'age' with the age at the time of move places each individual move into either section C1, C2 or C3 of the ATP. For example, assuming that a coded record gives the age at move as 5, the year of birth of a person moving in the relevant period must, therefore, be either

1974, 1975 or 1976. If the year of birth was 1974 the move must be recorded in section C1 of the ATP. If the year of birth was 1976 the move must be recorded in section C3 of the ATP. Those with a year of 1975 must, therefore, be recorded in section C2. The procedure for comparison of converted year of birth (IYEAR) with age at move is as follows. Assuming age at move (IAGE) is 5 then:

```
if          year of birth         = 1974
then        IYEAR = 1980 -1974    = 6
so          IYEAR - IAGE = 6 - 5  = 1
and the move is recorded in section C1

if          year of birth         = 1975
then        IYEAR = 1980 -1975    = 5
so          IYEAR - IAGE = 5 - 5  = 0
and the move is recorded in section C2

if          year of birth         = 1976
then        IYEAR = 1980 - 1976   = 4
so          IYEAR - IAGE          = -1
and the move is recorded in section C3
```

Moves assigned to the C2 section can again be distributed proportionally between the younger and older halves of the age-group using conditional probabilities based upon month of move. After the complete processing of PUD for the 1980-81 period each single-year age-group will contain a younger and older half. It is then possible to aggregate these halves to create single-year cohorts consistent with those of the census data, and further to five-year cohorts which are used in the comparative analysis. The origin-age-sex and destination-age-sex arrays will therefore contain migration information with an age-time plan of observation that coincides with that of the Census transition data.

5.2.3. Assignment of not-stated flows

(a) Assignment of origin not-stated flows in the inter-FPCA array

The NHSCR inter-FPCA array of flows includes only one not-stated category - that of origin not-stated. Those NHSCR flows with unknown origin were assigned as follows:

$$M_{ij}(2) = M_{ij}(1) + M_{?j}\,(M_{ij}(1) \,/\, (\sum_{j} M_{ij}(1)) \qquad (5.1)$$

where

M = NHSCR move;

$M_{ij}(2)$ = adjusted NHSCR flow between origin i and destination j;

$M_{ij}(1)$ = recorded NHSCR flow between origin i and destination j;

$M_{?j}$ = NHSCR moves to zone j with origin not-stated.

The assignment of the origin not-stated flows for the the 1981 Census inter-FPCA array was performed in a similar way and is illustrated in Section 4.4.

(b) Assignment of all not-stated categories in the origin-age-sex and destination-age-sex arrays

The generation of age-disaggregated data sets from the PUD required the reassignment of three not-stated categories - age, sex and origin not-stated. There is no destination not-stated category. Those flows with origin and/or age and/or sex not-stated were assigned as follows.

$$M^{as}_{i*}(2) = M^{as}_{i*}(1)$$
$$+ \; M^{as}_{?*}\,(M^{as}_{i*}(1) \,/ \sum_{i} M^{as}_{i*}(1))$$

$$+ M_{i*}^{?s} \left(M_{i*}^{as}(1) \Big/ \sum_{a} M_{i*}^{as}(1) \right)$$

$$+ M_{i*}^{a?} \left(M_{i*}^{as}(1) \Big/ \sum_{s} M_{i*}^{as}(1) \right)$$

$$+ M_{?*}^{?s} \left(M_{i*}^{as}(1) \Big/ \sum_{ia} M_{i*}^{as}(1) \right)$$

$$+ M_{?*}^{a?} \left(M_{i*}^{as}(1) \Big/ \sum_{is} M_{i*}^{as}(1) \right)$$

$$+ M_{i*}^{??} \left(M_{i*}^{as}(1) \Big/ \sum_{as} M_{i*}^{as}(1) \right)$$

$$+ M_{?*}^{??} \left(M_{i*}^{as}(1) \Big/ \sum_{ias} M_{i*}^{as}(1) \right) \qquad (5.2)$$

where

$M_{i*}^{as}(2)$ = adjusted NHSCR moves from origin i for age-group a and sex s;

$M_{i*}^{as}(1)$ = recorded NHSCR moves from origin i for age-group a and sex s;

$M_{?*}^{as}$ = NHSCR moves from unknown origin for age-group a and sex s;

$M_{i*}^{?s}$ = NHSCR moves from origin i for unknown age-group and sex s;

$M_{i*}^{a?}$ = NHSCR moves from origin i for age-group a and unknown sex;

$M_{?*}^{?s}$ = NHSCR moves from unknown origin unknown age-group and sex s;

$M_{?*}^{a?}$ = NHSCR moves from unknown origin for age-group a and for unknown sex;

$M_{i*}^{??}$ = NHSCR moves from origin i for unknown age-group of unknown sex;

$M_{?*}^{??}$ = NHSCR moves from unknown origin for unknown age-group of unknown sex.

A similar procedure is adopted for the assignment of not-stated flows in the destination-age-sex array of NHSCR moves.

5.2.4 Assignment of Armed Forces recruitments and discharges

The NHSCR PUD records moves to and from the Armed Forces (AF) (i.e. recruitments and discharges) but not moves within the AF (i.e.

postings). The PUD codes the AF as a single origin and as a single destination with no information given on the FPCA to which a person is recruited or from which a person is discharged. The computer summaries of NHSCR information used in the initial comparison contained no data whatsoever on movement to or from the AF.

The Census array includes recruitments and discharges (together with flows within the AF) so it is necessary to assign these components within the NHSCR array to allow for a more accurate comparison of the data sources. The PUD includes AF personnel and their dependants within the same code so that both are assigned by the same process.

The assignment is undertaken using usually resident AF populations obtained from 1981 Census economic activity volumes (OPCS, 1984; GRO, 1984) as a measure of the 'attractiveness' of an FPCA. AF flows are proportionally assigned to individual FPCAs based upon the relative size of AF population at the origin or destination. The assumption is made that the level of recruitment and discharge to or from an individual FPCA is directly proportional to the size of AF population in the origin or destination. Such flows within the NHSCR inter-zonal array are therefore assigned in the following way:

$$M_{ij}(2) = M_{ij}(1) + (M_{iAF} \,.\, P_j^{AF} / P_*^{AF}) + (M_{AFj} \,.\, P_i^{AF} / P_*^{AF}) \qquad (5.3)$$

where

$M_{ij}(1)$ = original flow total;

$M_{ij}(2)$ = flow total with AF assigned;

M_{iAF} = total number of flows from zone i to AF;

M_{AFj} = total number of flows from AF to zone j;

P_{i}^{AF} = usually resident AF population in zone i;

P_{j}^{AF} = usually resident AF population in zone j;

P_{*}^{AF} = total AF population.

AF recruitments and discharges need to be assigned also to the age and sex-disaggregated gross out and inflow NHSCR totals. The reassignment process becomes a little cruder as no age and sex-disaggregation of the usually resident AF population is available and so flows for a particular age and sex group are distributed to individual FPCAs on the basis of the total AF population in each zone. So, for example, the total outflow from a particular zone i, of those in age-group a and of sex s is equal to the outflow total (excluding all AF flows) plus all those recruitments from zone i in age-group a and sex s, plus a proportion of all those AF discharges in age-group a and sex s. The proportion is equivalent to the number of AF personnel resident in an individual FPCA as a percentage of the total AF personnel. The assignment procedure for both outflows and inflows is as follows:

(a) Outflows

$$M_{i*}^{as}(2) = M_{i*}^{as}(1) + R_{iAF}^{as} + D_{AF*}^{as} . P_{i}^{AF} / P_{*}^{AF} \qquad (5.4)$$

where

$M_{i*}^{as}(1)$ and $M_{i*}^{as}(2)$ = original and new outflow totals for zone i, age-group a and sex s;

R_{iAF}^{as} = recruitments from zone i in age-group a and sex s;

D^{as}_{AF*} = total AF discharge in age a and sex s;

P^{AF}_{i} = usually resident AF population in zone i; and

P^{AF}_{*} = total AF population in the system.

(b) Inflows

$$M^{as}_{*j}(2) = M^{as}_{*j}(1) + D^{as}_{AFj} + R^{as}_{*AF} \; . \; P^{AF}_{j} \, / \, P^{AF}_{*} \qquad (5.5)$$

where

$M^{as}_{*j}(1)$ and $M^{as}_{*j}(2)$ = original and new inflow totals for zone i, age-group a and sex s;

D^{as}_{AFj} = discharges to zone i in age-group a and sex s;

R^{as}_{*AF} = total AF recruitment in age-group a and sex s.

5.2.5 Estimating sampling error for NHSCR data

Up to April 1984, all patient re-registration data were obtained by OPCS from the NHSCR as a 10% sample. Consequently all the figures used in this comparison are subject to sampling error. This analysis will incorporate a crude method of sampling error computation to assess the effect, at different spatial scales, of comparing 100% transition data with 10% sample data. Devis and Mills (1986, Appendix C) use a similar method. Confidence limits for NHSCR sample figures can be computed as follows:

$$CI = p \pm 1.96 \, SE(p) \qquad (5.6)$$

where

CI is the interval between the upper and lower confidence limits;

p is the probability of moving either:
(a) out of zone i;
(b) in to zone j; or
(c) from zone i to zone j; and

SE(p) is the standard error of the sample probability p:

$$SE(p) = (pq/n)^{0.5} \qquad (5.7)$$

where

$$q = 1 - p \qquad (5.8)$$

an

n = number in the sample or the population at risk

For example, the probability of moving out of zone i is defined as

$$p^{i*} = M_{i*} / M_{**} \qquad (5.9)$$

where * indicates aggregation across zones. Then

$$q^{i*} = 1 - p^{i*} \qquad (5.10)$$

and

$$SE(p^{i*}) = (p^{i*} q^{i*} / M_{**})^{0.5} \qquad (5.11)$$

hence, the upper confidence limit for p^{i*} is calculated as,

$$UCL(p^{i*}) = p^{i*} + 1.96\ SE\ (p^{i*}) \qquad (5.12)$$

and the lower limit is,

$$LCL(p^{i*}) = p^{i*} - 1.96\ SE\ (p^{i*}) \qquad (5.13)$$

The confidence limit for M (flow total) can be obtained by multiplying the confidence limit for p^{i*} by M_{**}. Similar limits can be computed for total inflows, aggregate inter-zonal flows and age and sex-disaggregated flows.

5.3 COMPARISON OF INTER-ZONAL MIGRATION DATA SETS USING FLOWS AND RATIOS

5.3.1 Overall levels of NHSCR and Census migration

Table 5.1 illustrates the differences and ratios that exist between NHSCR and Census flows at a variety of spatial scales and can be compared with Table 4.2. The scale effect remains but at a higher level with the difference between inter-regional flows increasing by approximately 62% to produce a ratio value of 1.54. The size of ratio decreases systematically as the average distance of migration declines so that again, the ratio between flows within MNM regions is the closest to unity (1.19). The reassignment of AF and not-stated flows will have the greatest effect upon the regional level ratio, reflecting the importance of longer-distance moves by AF personnel and their dependants, and the least effect upon flows between MNM regions within standard regions. The assignment of the origin not-stated category (50,860 moves) and the AF recruitments (69,409) and discharges (62,932) increases the overall inter-FPCA ratio between NHSCR and Census flows from 1.25 to 1.37. These AF flows have been ignored in previous analyses but have an important effect upon the NHSCR-Census relationship. The Census figures include all AF recruitments and discharges so the only remaining discrepancy regarding AF movement is that which involves postings or moves <u>within</u> the AF (included in the Census but not in the NHSCR). Assignment of such intra-AF moves would further increase the NHSCR:Census ratio as would the assignment of moves by prisoners and long-term psychiatric patients, were they available. Their effect upon the overall ratio would be counter-balanced somewhat by the allocation of an estimated 100 thousand student moves to the Census total (Devis and Mills, Table 3.2).

Table 5.1 NHSCR and Census migration flows and ratios at various spatial scales

Migration flows between FPCAs	Total moves (NHSCR)	Total transitions (Census)	Difference	Ratio
(1) Between standard regions	967,224	629,915	337,309	1.54
(2) Between MNM regions	1,289,451	881,826	407,625	1.46
(3) Between MNM regions, within standard regions	322,227	251,911	70,316	1.28
(4) Within MNM regions	524,917	442,918	81,999	1.19
(5) All flows	1,814,368	1,324,744	489,624	1.37

Source: unpublished NHSCR and Census data supplied by the Office of Population Census and Surveys.

Notes:
Relationship between row items:-

row(3) = row(2) - row(1)
row(4) = row(5) - row(2)
row(5) = row(1) + row(3) + row(4)

The adjustment procedures outlined previously ensure that the discrepancy between flows involving infants is eliminated with both sources recording only flows for those aged greater than one at the end of the 1980-81 period. Furthermore the allocation of not-stated flows is based on flow proportions so does not enhance or reduce the scale effect that is evident. The major discrepancies that exist at these aggregate levels may therefore be strongly influenced by the relative importance of multiple and return moves.

The greatest NHSCR:Census ratio value is found at the regional level, which indicates that it is longer-distance migration that produces the greatest discrepancy between NHSCR and Census figures and shorter-distance flows that have the greatest consistency. Gordon (1975, 1982) has highlighted the multi-stream nature of migration identifying the predominantly longer-distance employment related flows and predominantly shorter-distance housing related flows. Transfers that are related solely to a change of house are likely to be more permanent than transfers related to employment if analysed in aggregate terms and therefore the multiple/return move phenomenon will be of least importance at those spatial scales involving the greater proportions of shorter-distance flows - intra-MNM, intra-regional/inter-MNM and inter-FPCA. The NHSCR and the Census will show the greatest consistency for those flows which are most unlikely to involve more than one change of residence over the period in question. Employment-related flows are likely to be less permanent and will be the predominant component of long-distance migration. Multiple and return movement will therefore be of greatest importance where employment-related moves predominate ie. longer distance flows between the standard regions of Britain. The scale effect illustrated in Table 5.1 is consistent with this explanation.

A further hypothesis put forward in Chapter 4 was that NHSCR movers should move further than Census migrants if there is a significant proportion of persons making second moves who return to the zone from which they originated earlier in the year. This would only be the case if the return migration phenomenon was an important component of longer distance migration. If shorter distance flows were more affected by return migration then the average distance travelled by census migrants would be higher than if return flows were unimportant. Conversely, the greater importance of return migration in longer distance flows deflates the mean length travelled by a Census migrant and reduces the number of longer distance Census transfers. The NHSCR:Census ratio will therefore be high at those scales which include predominantly long-distance flows where return migration is important.

There is therefore a marked difference between ratios for these alternative spatial scales at the aggregate level that can be explained partly by the existence of multiple/return moves. It would be unreasonable to 'regard multiple moves as the major explanation of the differences' (Ogilvy,1979), although it is hypothesized that the return move phenomenon will be more important at those scales which involve predominantly long-distance migration. Disaggregation of the migration data should reveal the variation in the effect of the conceptual, population-at-risk and error components upon individual zones, age-groups and sexes. Discrepancies at a disaggregate level are likely to be explained more readily by one single component such as the presence of a large number of AF personnel or a large educational establishment with the importance of the conceptual components dependent upon the level of disaggregation adopted. The following sections examine some of the differences that exist at alternative spatial scales, disaggregating to total inflows and outflows and individual inter-zonal flows and by five-year age-group and sex.

5.3.2 <u>Outflow, inflow and netflow ratios: detailed patterns</u>

The ratio variation that exists between outflows and inflows at the standard region scale is illustrated in Table 5.2. The zones are ranked according to ratio size so as to be consistent with Table 4.3. Also included in the Table is an estimate of 95% confidence limits for the 10% sample NHSCR inflow and outflow data. The final column gives the confidence interval as a percentage of the NHSCR flow whereas columns 5 and 6 indicate the range of ratio values (lower confidence limit and upper confidence limit) within which one can be 95% certain the actual ratio value lies. The size of the confidence intervals is below one percentage point for the majority of inflows and outflows from individual regions but the smaller flows - ie. outflows from the Isle of Man, in particular, and Northern Ireland - have larger confidence intervals and thus less reliable estimates of the NHSCR:Census ratio.

The inflow and outflow ratios show a considerable increase upon those illustrated in Table 4.3. The large increases are due to the re-assignment of origin not-stated flows and AF recruitments and discharges. The AF recruitments and discharges will affect the ranking as they are assigned on the basis of the AF population usually resident in individual FPCAs. The effect upon the outflow

Table 5.2 NHSCR:Census outflow and inflow ratios at the standard region scale

Region	NHSCR	Census (1000's)	Diff.	Ratio	LCL	UCL	%CL
				Outflows			
East Anglia	53.8	33.7	20.2	1.60	1.59	1.61	0.82
North	55.3	35.1	20.2	1.58	1.56	1.59	0.81
North West	106.4	68.2	38.2	1.56	1.55	1.57	0.57
South West	108.4	69.9	38.5	1.55	1.54	1.56	0.56
Yorks & Humbs	88.1	57.0	31.0	1.54	1.53	1.55	0.63
Northern Ireland	15.5	10.0	5.5	1.54	1.52	1.57	1.56
South East	253.0	165.2	87.8	1.53	1.53	1.54	0.33
West Midlands	89.8	58.8	30.9	1.53	1.52	1.54	0.62
East Midlands	83.3	55.6	27.7	1.50	1.49	1.51	0.65
Scotland	62.8	41.9	20.9	1.50	1.49	1.51	0.76
Wales	49.5	33.5	16.0	1.48	1.47	1.49	0.86
Isle of Man	1.3	1.0	.4	1.40	1.33	1.48	5.34
				Inflows			
North	46.3	27.7	18.6	1.67	1.66	1.69	0.89
North West	86.8	52.0	34.7	1.67	1.66	1.68	0.64
Yorks & Humbs	84.2	51.3	32.9	1.64	1.63	1.65	0.65
West Midlands	81.1	50.5	30.5	1.60	1.59	1.61	0.66
South East	263.2	172.5	90.6	1.53	1.52	1.53	0.33
East Anglia	68.7	45.0	23.6	1.52	1.51	1.54	0.72
Wales	51.8	34.5	17.3	1.50	1.49	1.52	0.84
Scotland	56.5	38.6	17.9	1.46	1.45	1.48	0.80
South West	135.5	92.9	42.6	1.46	1.45	1.47	0.49
East Midlands	93.2	64.9	28.4	1.44	1.43	1.45	0.61
All Regions	967.2	630.0	337.2	1.54			

Notes:

Diff = NHSCR - Census
Ratio = NHSCR/Census
LCL = lower confidence limit of ratio value
UCL = upper confidence limit of ratio value
%CL = 95% confidence interval expressed as a percentage of the NHSCR flow

ratios is to greatly increase the ratio between NHSCR and Census flows from the East Anglia in particular. Total NHSCR outflows from East Anglia are 60% higher than corresponding Census outflows. The effect of AF flows is also strong upon outflows from the South West. Considerable recruitment takes place from East Anglia and the South West and these flows are supplemented by a number of discharges from the two regions based upon their relatively large AF usually resident populations. The other regions which exhibit higher than average ratio values are the North, the North West (which were ranked 1 and 2 in Table 4.3), Yorkshire and Humberside and Northern Ireland. The remaining regions have ratios below the mean of 1.54 with the Isle of Man (1.40) exhibiting the smallest figure.

The ranking of the inflow ratios changes little after the various adjustments and reassignments have been made. The level of the ratio values has increased, however, with the highest ratios evident for inflows to those regions containing a metropolitan county - namely the North (1.67), the North West (1.67), Yorkshire and Humberside (1.64) and the West Midlands (1.60). All other inflow ratios are below the mean figure with the South East (1.53) having the greatest ratio value of this group and East Midlands (1.44), the lowest. The top four ranked inflow ratios are all higher than the largest outflow ratio. Referring back to the previous section, it is likely that these top-four ranked regions are those most affected by the multiple/return moves phenomenon and the annual in-migration of students. These regional inflows are predominantly long-distance moves and it is hypothesized that they are mostly employment/ education related. They are therefore likely to contain a large number of temporary/multiple moves in the NHSCR total which will be missed by the Census. Any person moving to one of these four regions and returning to the original zone before the end of the period will not be recorded as a migrant in the Census.

These features can be investigated further by disaggregating the data to the MNM level (Table 5.3). The computed 95% confidence limits again rarely exceed one percentage point apart from the relatively small flows from and to some metropolitan counties and from Northern Ireland and the Isle of Man. The East Anglia outflow ratio remains the highest with the majority of above average outflow ratios relating to flows from non-metropolitan counties - the exception being West Yorkshire. This ranking contrasts to that illustrated in Table 4.4 where the metropolitan counties of Greater Manchester, Merseyside and the West Midlands all had outflow ratios above the mean figure. The reassignment of AF flows has the effect of increasing each ratio value but generally increases the value of non-metropolitan zone ratios to a greater degree due to the importance of the AF in these regions.

The ranking of inflow ratio values in Table 5.3 corresponds generally to those illustrated in Table 4.4 although at a higher level. The table further highlights the larger ratio values that exist for inflows to metropolitan zones. The re-assignment of AF flows increases the inflow ratios for non-metropolitan zones to a greater extent due to the greater importance of AF personnel in these zones but the metropolitan zones remain in the highest ranking positions. All those zones with an inflow ratio value below the mean figure (1.46) are non-metropolitan zones.

Appendix Tables 1a and 1b illustrate a similar ranking of outflow and inflow ratios but at the most disaggregate scale - that of FPCAs

Table 5.3 NHSCR/Census outflow and inflow ratios at the MNM region scale

MNM region	NHSCR	Census (1000's)	Diff.	Ratio	LCL	UCL	%CL
				Outflows			
East Anglia	53.8	33.7	20.2	1.60	1.59	1.61	0.83
West Yorkshire	43.5	28.0	15.5	1.56	1.54	1.57	0.92
South West	108.4	69.9	38.5	1.55	1.54	1.56	0.57
Northern Ireland	15.5	10.0	5.5	1.54	1.52	1.57	1.56
North Rem.	44.6	29.3	15.4	1.53	1.51	1.54	0.91
Yorks & Humb Rem.	43.7	28.9	14.8	1.51	1.50	1.53	0.92
East Midlands	83.3	55.6	27.7	1.50	1.49	1.51	0.66
Scotland	62.8	41.9	20.9	1.50	1.49	1.51	0.76
North West Rem.	62.1	41.9	20.1	1.48	1.47	1.49	0.77
Wales	49.5	33.5	16.0	1.48	1.47	1.49	0.86
South East Rem.	245.7	166.9	78.7	1.47	1.47	1.48	0.36
Greater Manchester	55.0	37.8	17.2	1.46	1.44	1.47	0.82
Merseyside	36.9	25.4	11.5	1.45	1.44	1.47	1.01
Tyne & Wear	27.0	19.1	7.9	1.41	1.40	1.43	1.18
Isle of Man	1.3	1.0	.4	1.40	1.33	1.48	5.35
West Midlands	61.5	44.3	17.3	1.39	1.38	1.40	0.77
West Midlands Rem	67.1	48.4	18.7	1.39	1.38	1.40	0.74
South Yorkshire	24.4	17.7	6.7	1.38	1.36	1.39	1.24
Greater London	203.4	148.5	54.8	1.37	1.36	1.38	0.40
				Inflows			
Tyne & Wear	22.2	12.8	9.4	1.74	1.71	1.76	1.30
West Yorkshire	39.0	23.1	15.8	1.68	1.67	1.70	0.98
Greater Manchester	43.4	26.2	17.2	1.66	1.64	1.67	0.92
Merseyside	25.6	15.7	10.0	1.64	1.62	1.66	1.21
West Midlands	46.3	28.7	17.5	1.61	1.60	1.63	0.90
South Yorkshire	24.2	15.2	9.0	1.59	1.57	1.61	1.25
East Anglia	68.7	45.0	23.6	1.53	1.51	1.54	0.73
Wales	51.8	34.5	17.3	1.50	1.49	1.52	0.84
Greater London	166.9	111.5	55.4	1.50	1.49	1.50	0.45
Scotland	56.5	38.6	17.9	1.46	1.45	1.48	0.81
Yorks & Humbs Rem	44.5	30.5	14.0	1.46	1.45	1.47	0.91
South West	135.5	92.9	42.6	1.46	1.45	1.47	0.50
East Midlands	93.2	64.9	28.4	1.44	1.43	1.45	0.62
North Rem.	40.4	28.2	12.3	1.44	1.42	1.45	0.95
North West Rem.	65.2	47.1	18.2	1.39	1.38	1.40	0.75
South East Rem.	292.3	211.3	81.0	1.38	1.38	1.39	0.32
West Midlands Rem	73.7	55.6	18.0	1.32	1.32	1.33	0.70
All Regions	129.0	881.8	407.6	1.46			

- and Figures 5.3 and 5.4 illustrate the spatial variation in the ratio values at this scale. Inflows and outflows are affected to a greater extent by sampling error at the FPCA level. Appendix Tables 1a and 1b illustrate how the size of the 95% confidence limit and thus the range of the expected ratio value increases at this scale. The percentage confidence limit for outflows ranges from 0.62% for Middlesex to 3.2% for Powys whereas the limit for inflows ranges from 0.67% again for Middlesex to 3% for Barnsley. The most unreliable observed NHSCR:Census ratio values will therefore be associated with the smaller flows.

Ratios between outflows from metropolitan counties are indicated by an asterisk in Appendix Table 1a. Of the 47 metropolitan FPCAs, 38 have a ratio value below the average figure of 1.37. Of the nine FPCAs with above average ratios, four are from the county of West Yorkshire (Kirklees, Calderdale, Leeds and Bradford). Of the 40 lowest ranked outflow ratios, 36 are for metropolitan counties. Of the ten non-metropolitan FPCAs with ratios below the national figure, five are in the South East region. The range of the ratio values increases considerably at this scale from 1.103 (Solihull) to 1.638 (Devon), which compares with 1.369 to 1.600 at the MNM level and 1.403 to 1.600 at the standard region level.

Figure 5.4 illustrates the variation in the inflow ratios at the FPCA scale. The largest ratios are exhibited by inflows to West Glamorgan (1.87), Coventry (1.78), Cleveland (1.75), Sheffield (1.74), Newcastle (1.67) and Leeds (1.62) (Appendix Table 1b). Although not classed as metropolitan zones, West Glamorgan and Cleveland could be identified as highly urbanised areas. Other major cities also exhibit high inflow ratios: Manchester (1.59), Birmingham

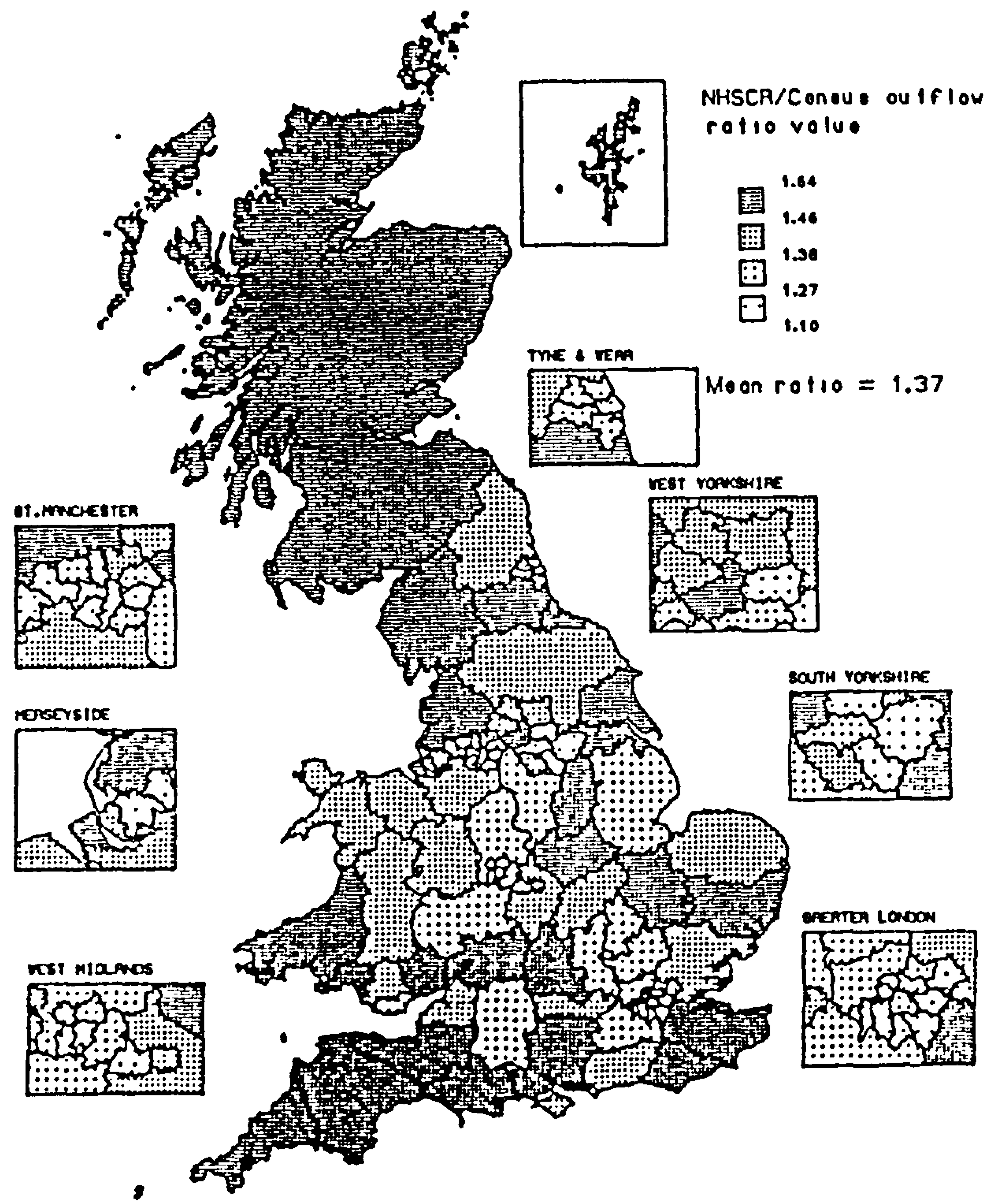


Figure 5.3 Outflow ratio values at the FPCA scale

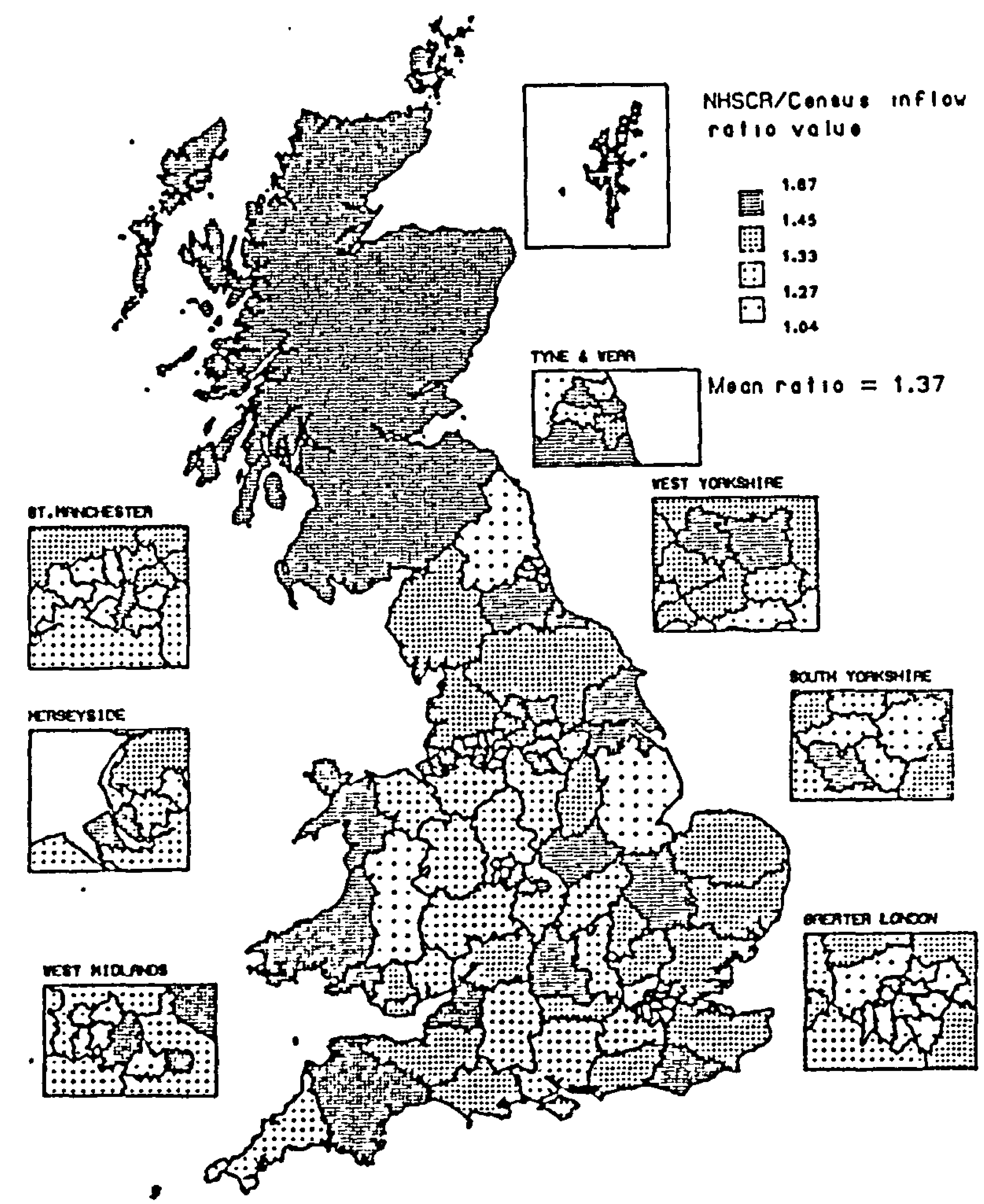


Figure 5.4 Inflow ratio values at the FPCA scale

(1.53) and Liverpool (1.46). Even for inflows, however, 32 out of 47 metropolitan inflow ratios are below the average figure. It is the big cities within the metropolitan counties that have the highest inflow ratios with other metropolitan FPCAs in the same county having much lower ratio values, although exceptions include South Tyneside, Bradford and Calderdale. The twelve individual FPCAs of Greater London exhibit considerable variation in their ratio values with only two having a value above the national figure - the FPCAs of City/Hackney/Newham/Tower Hamlets (1.46) and Camden/Islington (1.40). The remaining ten London FPCAs have inflow values below the mean figure. An important point to note is the increase in the ratio of outflows and inflows from and to FPCAs with large AF populations such as Hampshire, Lincolnshire and Wiltshire. All three were shown to have very low inflow and outflow ratios but the reassignment of the AF recruitments and discharges gives a truer picture of their actual ratio values.

5.3.3 Ratios for metropolitan and non-metropolitan areas

Before analysing metropolitan and non-metropolitan ratios, it is interesting to examine the percentage distribution of flows by status at the MNM and FPCA levels (Table 5.4). At the MNM level, the percentage distribution of both NHSCR and Census data is quite similar with the prominent feature in both being the relatively low proportion of inter-metropolitan flows (5.9% in the NHSCR and 4.9% in the Census). At the FPCA level metropolitan outflows represent a greater percentage of total flows in the Census (43%) than in the NHSCR (40%) whereas the reverse is true for non-metropolitan outflows - NHSCR (60%) and Census (57%). The Census data also contain a

Table 5.4 Percentage distribution of flows by status at the MNM and FPCA level for the NHSCR and the Census

(a) MNM level

Origin	Destination: Metropolitan NHSCR	Metropolitan Census	Non-metropolitan NHSCR	Non-metropolitan Census	Total NHSCR	Total Census
	(percentage)					
Metropolitan	6	5	29	31	35	36
Non-metropolitan	23	22	42	42	65	64
Total	29	27	71	73	100	100

(b) FPCA level

Origin	Destination: Metropolitan NHSCR	Metropolitan Census	Non-metropolitan NHSCR	Non-metropolitan Census	Total NHSCR	Total Census
	(percentage)					
Metropolitan	19	22	21	21	40	43
Non-metropolitan	16	14	44	43	60	57
Total	35	36	65	64	100	100

greater proportion of inter-metropolitan flows (22% compared to 19%) whereas the NHSCR records a greater proportion of non-metropolitan to metropolitan flows than the Census (16% to 14%). The identification of these percentage differences is important when attempting to explain the variation in metropolitan and non-metropolitan ratio values.

Table 5.5 illustrates total metropolitan and non-metropolitan outflow and inflow differences and ratios at the MNM and FPCA level. At the MNM level, ratios vary little around the average figure of 1.46, with metropolitan inflows exhibiting the greatest discrepancy of 1.58. At the FPCA level (overall ratio value of 1.37), a greater degree of variation is evident. The larger proportion of Census to NHSCR metropolitan outflows (Table 5.4) gives rise to a ratio value well below average (1.27) whereas the greater proportion of NHSCR to Census non-metropolitan outflows gives a ratio value well above average (1.45). Non-metropolitan inflows have a relatively high ratio (1.40) also, whereas metropolitan inflows exhibit a below average ratio value (1.33).

Table 5.6 illustrates a further disaggregation to give ratios and differences between inter-metropolitan/non- metropolitan flows. The dominant feature of the ratios at both scales is the ratio value for inter-metropolitan flows. At the MNM level the ratio is very high (1.69) whereas at the FPCA level the value drops considerably (1.18). An explanation of this phenomenon is possible by referring to the percentage distributions of flows given in Table 5.4 and the initial explanation of the scale effect given in Section 5.3.1. At the MNM level inter-metropolitan flows constitute only 6% and 5% respectively of NHSCR and Census flows. The nature of the spatial distribution of

Table 5.5 Metropolitan/non-metropolitan outflow and inflow differences and ratios at the MNM and FPCA level

(a) MNM level

	NHSCR	Census	Difference	Ratio
Metropolitan inflows	367,565	233,266	134,299	1.58
Metropolitan outflows	451,588	320,830	130,758	1.41
Non-metropolitan inflows	921,886	648,560	273,326	1.42
Non-metropolitan outflows	837,863	560,996	276,867	1.49
Total	1,289,451	881,826	407,625	1.46

(a) FPCA level

	NHSCR	Census	Difference	Ratio
Metropolitan inflows	629,493	475,127	154,366	1.33
Metropolitan outflows	713,516	562,691	150,825	1.27
Non-metropolitan inflows	1,184,875	849,617	335,258	1.40
Non-metropolitan outflows	1,100,852	762,053	338,799	1.45
Total	1,814,368	1,324,744	489,624	1.37

Table 5.6 Ratios and differences between inter metropolitan/non-metropolitan flows at the MNM and FPCA level

(a) MNM level

Type of flow	NHSCR	Census (1000's)	Difference	Ratio
Metropolitan to metropolitan	75,496	43,376	32,120	1.74
Metropolitan to non-metropolitan	376,092	277,454	98,638	1.36
Non-metropolitan to non-metropolitan	545,794	371,106	174,688	1.47
Non-metropolitan to metropolitan	292,069	189,890	102,179	1.54
Total	1,289,451	881,826	407,625	1.46

(a) FPCA level

Type of flow	NHSCR	Census (1000's)	Difference	Ratio
Metropolitan to metropolitan	337,424	285,237	52,187	1.18
Metropolitan to non-metropolitan	376,092	277,454	98,638	1.36
Non-metropolitan to non-metropolitan	808,783	572,163	236,620	1.41
Non-metropolitan to metropolitan	292,069	189,890	102,179	1.54
Total	1,814,368	1,324,744	489,624	1.37

MNM metropolitan zones ensures that inter-metropolitan flows at this level are predominantly inter-regional, longer-distance transfers. Excluded from the inter-metropolitan totals will be important short-distance flows for which the Census and NHSCR are most consistent - ie. those flows within MNM metropolitan regions which involve a more permanent change of residence and which are unlikely to be accompanied by further moves during the period of observation. Short-distance, predominantly housing related flows, are those which are likely to correspond most closely between datasets but are also those which make up only a very small proportion of inter-metropolitan flows at the MNM level. The predominance of longer-distance migration, a major component of which will be unstable, employment-related flows therefore gives the large ratio value exhibited by flows between metropolitan zones at this level.

At the FPCA scale, however, the corresponding ratio drops considerably to 1.18, with the proportion of inter-metropolitan flows increasing to 19% and 22% from the NHSCR and Census respectively. This level of spatial disaggregation will record short-distance flows between metropolitan FPCAs contained within the larger MNM metropolitan zones. Inter-metropolitan migration at the FPCA level will, therefore, be predominantly short distance flows. The magnitude of these flows due to their more permanent nature (ie. they are less likely to involve multiple or return moves in the single year of observation) will be similar in both the Census and the NHSCR. Furthermore, Table 5.4 illustrates that the Census contains a greater proportion of these mainly short-distance flows at the FPCA level than the NHSCR. The ratio between inter-metropolitan flows at this level will therefore be low.

A further significant feature at the FPCA level is the relatively large ratio value observed between the NHSCR and the Census for non-metropolitan to metropolitan flows (1.54). This is consistent with the previous explanation in that the ratio is high due to the importance of multiple and return moves for these predominantly employment related flows i.e. persons will be attracted to metropolitan areas as centres of employment.

The metropolitan and non-metropolitan disaggregation reveals a number of notable characteristics of the ratio values which appear to be consistent with the scale effect outlined in Section 5.3.1. The following section attempts to further validate the conclusions made so far by identifying contiguous and non-contiguous flows at the three spatial scales.

5.3.4 Ratios for contiguous and non-contiguous areas

The percentage shares of contiguous and non-contiguous flows at three spatial scales for both the NHSCR and the Census are illustrated in Table 5.7. At the regional scale, the proportions are not too dissimilar. At the MNM level the percentage of contiguous flows decreases in both the NHSCR and the Census case although the inter-MNM flows from the Census contain the greater proportion of contiguous flows whereas the NHSCR contains the greater proportion of non-contiguous flows. This characteristic is true also for flows at the FPCA scale with the difference between the respective proportions increasing so that the Census contains 6% more contiguous flows than the NHSCR and vice versa for non-contiguous flows.

The percentage distribution of flows from the two migration data sources helps to explain the differences that exist between

Table 5.7 Percentage distribution of contiguous and non-contiguous flows and the ratios between them at three spatial scales

Scale	Contiguous NHSCR	Contiguous Census (%age)	Contiguous Ratio	Non-contiguous NHSCR	Non-contiguous Census (%age)	Non-contiguous Ratio
Standard region	56	58	1.50	44	42	1.59
MNM region	52	56	1.36	48	44	1.59
FPCA	36	42	1.15	64	58	1.54

contiguous and non-contiguous flow ratios at the regional, MNM and FPCA scales also illustrated in Table 5.7. At the relatively coarse standard region level, with similar proportions of contiguous and non-contiguous flows from both the NHSCR and the Census, there is little variation between the ratios. At the MNM level, however, the contiguous ratio (1.35) is well below that for non-contiguous flows (1.54). The discrepancy increases further at the FPCA scale where a fair degree of consistency between NHSCR and Census data is indicated for contiguous flows (1.15). The ratio between contiguous flows decreases, therefore, as the spatial scale becomes finer, i.e. as more shorter-distance migration is included in the datasets. These results confirm the findings of the previous sections emphasising the greater consistency between the NHSCR and the Census for relatively short-distance flows ie. those flows which are assumed here to be least affected by multiple and return moves. The longer distance non-contiguous flows are less well recorded in the Census due to the influence of multiple moves and therefore produce much higher ratios between NHSCR and Census figures.

In concluding this analysis of all-age migration, it is interesting to look more closely at the distribution of inflow ratios by individual FPCA. The ratios for each zone can be disaggregated by contiguity and metropolitan status. Table 5.8 ranks the inflow ratios according to total ratio size with metropolitan zones indicated by an asterisk.

The table shows that for each FPCA, the contiguous ratio is lower than the non-contiguous ratio (with the exception of the Isle of Wight). For inflows to metropolitan FPCAs, the discrepancy between the contiguous and non-contiguos ratio is particularly great,

Table 5.8 Contiguous, non-contiguous, metropolitan, non-metropolitan and total inflow ratios for individual FPCAs

FPCA	Ratio values: Contig	Non-contig	Met	Non-met	Total
W-GLAM	1.46	2.08	1.65	1.92	1.87
* COVENTRY	1.05	2.20	1.87	1.76	1.78
CLEVELND	1.37	1.93	1.93	1.69	1.76
* SHEFFELD	1.08	2.08	1.69	1.79	1.74
* NEWCSTLE	1.07	2.22	1.38	1.95	1.67
* LEEDS	1.11	1.94	1.41	1.82	1.62
LEICS	1.30	1.74	1.75	1.56	1.61
HUMBERSD	1.24	1.77	1.60	1.61	1.60
* S-TYNESD	1.24	1.91	1.38	1.89	1.59
AVON	1.36	1.64	1.74	1.55	1.59
* MANCHSTR	1.14	2.21	1.33	2.15	1.59
DYFED	1.48	1.59	1.77	1.53	1.58
DEVON	1.34	1.56	1.60	1.51	1.53
* BIRMINGH	1.16	2.04	1.31	1.75	1.53
DURHAM	1.28	1.70	1.30	1.67	1.50
* WIRRAL	1.33	1.59	1.52	1.48	1.50
OXFORDSH	1.13	1.65	1.66	1.45	1.49
GWYNEDD	1.38	1.51	1.66	1.42	1.49
CAMBS	1.25	1.61	1.55	1.46	1.48
SCOTLAND	1.50	1.46	1.55	1.43	1.46
* LON-CHNT	1.27	1.67	1.34	1.72	1.46
* LVERPOOL	0.93	2.31	1.12	2.08	1.46
* BRADFORD	1.15	1.76	1.38	1.54	1.45
SUFFOLK	1.06	1.68	1.58	1.41	1.45
E-SUSSEX	1.33	1.52	1.40	1.48	1.45
LANCS	1.27	1.53	1.38	1.52	1.45
* CALDERDL	1.11	1.77	1.34	1.65	1.44
NORFOLK	1.17	1.52	1.45	1.43	1.44
MID-GLAM	1.10	1.79	1.91	1.38	1.44
DORSET	1.29	1.48	1.41	1.43	1.43
GLOUCS	1.22	1.52	1.43	1.43	1.43
BEDFORDS	1.18	1.56	1.49	1.38	1.41
IOWIGHT	1.58	1.39	1.34	1.45	1.41
KENT	1.28	1.47	1.32	1.50	1.41
S-GLAM	1.14	1.51	1.53	1.39	1.41
NOTTS	1.08	1.61	1.51	1.37	1.40
BERKS	1.27	1.47	1.37	1.41	1.40
* LON-CI	1.13	1.71	1.19	1.83	1.40
* SUNDRLND	1.05	1.79	1.22	1.56	1.39
ESSEX	1.22	1.53	1.26	1.52	1.38
* KIRKLEES	1.07	1.70	1.18	1.76	1.37
CUMBRIA	1.18	1.46	1.40	1.35	1.36
N-YORKS	1.23	1.45	1.30	1.39	1.36
* OLDHAM	1.09	1.69	1.18	1.84	1.35
HERTS	1.19	1.47	1.23	1.43	1.34
SOMERSET	1.24	1.39	1.36	1.33	1.34
* WAKEFELD	1.18	1.50	1.26	1.44	1.33
DERBYSHR	1.11	1.59	1.32	1.34	1.33
NTHANTS	1.19	1.40	1.33	1.33	1.33
HANTS	1.23	1.37	1.33	1.33	1.33
W-SUSSEX	1.23	1.39	1.35	1.33	1.33
STAFFS	1.14	1.59	1.16	1.53	1.33
GWENT	1.13	1.44	1.39	1.32	1.33
SURREY	1.20	1.50	1.20	1.43	1.32
* LON-RWF	1.13	1.70	1.25	1.46	1.32
CORNWALL	1.22	1.34	1.33	1.31	1.32
CHESIRE	1.19	1.46	1.23	1.43	1.32
HEREFORD	1.18	1.43	1.19	1.40	1.31
WARWICKS	1.12	1.53	1.15	1.44	1.31
CLWYD	1.11	1.42	1.39	1.27	1.31
BUCKS	1.25	1.34	1.35	1.27	1.30
* ROCHDALE	1.07	1.63	1.15	1.64	1.30
WILTS	1.16	1.36	1.31	1.29	1.29
SALOP	1.16	1.33	1.36	1.26	1.29
* ST-HELEN	1.17	1.62	1.13	1.60	1.29
* GATESHED	1.17	1.51	1.16	1.43	1.28
* LON-KCW	1.02	1.49	1.12	1.49	1.28
* LON-LSL	1.01	1.55	1.12	1.60	1.28
* WOLVERHN	0.99	1.63	1.28	1.28	1.28
* STOCKPRT	1.15	1.43	1.17	1.45	1.28
* LON-MIDD	1.07	1.48	1.16	1.39	1.27
* BOLTON	1.05	1.49	1.20	1.37	1.27
* TAMESIDE	1.06	1.60	1.14	1.59	1.27
* SEFTON	1.10	1.46	1.21	1.34	1.27
* POWYS	1.13	1.35	1.49	1.21	1.26
* LON-BG	1.11	1.42	1.18	1.35	1.25
* SALFORD	0.88	1.64	1.05	1.80	1.24
* DONCASTR	1.13	1.30	1.20	1.25	1.23
* BARNSLEY	1.05	1.43	1.14	1.39	1.22
* ROTHERHM	1.00	1.65	1.05	1.57	1.22
* N-TYNESD	0.89	1.62	1.04	1.42	1.21
LINCS	1.04	1.31	1.20	1.22	1.21
* LON-RK	1.00	1.42	1.09	1.35	1.21
* LON-MSW	1.04	1.47	1.10	1.43	1.21
* TRAFFORD	1.02	1.40	1.15	1.33	1.21
* LON-BH	1.11	1.42	1.08	1.39	1.20
* LON-CROY	1.01	1.44	1.11	1.36	1.20
* SOLIHULL	1.11	1.31	1.12	1.28	1.18
* WALSALL	0.94	1.76	1.04	1.37	1.18
* BURY	0.95	1.55	1.07	1.43	1.18
* WIGAN	1.10	1.25	1.05	1.39	1.18
NTHMBLND	1.09	1.29	1.11	1.26	1.17
* LON-BROM	1.01	1.32	1.03	1.32	1.13
* SANDWELL	0.90	1.56	0.99	1.44	1.10
* DUDLEY	0.90	1.37	0.95	1.18	1.04

* Indicates metropolitan FPCA

emphasising the importance of short-distance flows in the Census. The greatest consistency between the Census and the NHSCR is found for flows between metropolitan FPCAs within the same metropolitan county. These are likely to be predominantly house-related moves as opposed to moves relating to a change of employment and are thus likely to be more permanent. The big cities all have very high non-contiguous inflow ratio values. This illustrates the relatively poor recording of longer-distance moves in the Census compared to the NHSCR. It has been hypothesised that this discrepancy in the core FPCAs is due to two factors. First, the large number of students moving to Universities and Polytechnics within these cities which are recorded by the NHSCR but not the Census, and secondly the importance of multiple/return migration as a component of the longer-distance non-contiguous flows. The big cities will attract migrants from a wide area, moving for reasons of employment. It is these moves which are most likely to be subject to a subsequent return move within a relatively short time-period.

A number of important characteristics of the patterns of NHSCR and Census migration have therefore been discerned through the analysis of aggregate information. Section 5.5 attempts to validate the hypotheses forwarded in preceding sections through an examination of age-sex differences in the alternative data sources. Prior to this, however, a number of statistical and modelling methods are used to quantify the relationship between aggregate NHSCR and Census migration and to examine further the variation in the effect of distance upon the level of movement.

5.4 STATISTICAL AND MODEL-BASED COMPARISONS OF INTER-ZONAL MIGRATION

5.4.1 Statistical relationship between NHSCR and Censusflows at various spatial scales

The relationship between NHSCR and Census outflows, inflows and netflows can be quantified at three spatial scales as in Section 4.4.2. Usually resident end-of-period populations are used to generate rates of migration for each data source which are used to obtain correlation coefficients and least squares regression parameters for NHSCR re-registrations against Census migrants. Figure 5.5 illustrates the scatterplots produced at the standard region, MNM and FPCA levels. The correlation is generally good with the strongest relationship in evidence for inflow rates at the standard region level (0.997) and the weakest for netflows at the FPCA level (0.896). The correlation between netflow rates is, at each scale, the weakest. At the standard region and MNM scales inflow rates exhibit a stronger relationship than outflow rates although this is not the case at the FPCA level. It is difficult to establish a pattern in the regression parameters although intercept values are larger at the more disaggregate spatial scale. Regression coefficients, when the intercept approaches zero, do reflect the overall ratio between the NHSCR and the Census.

Table 5.9 provides a number of summary statistics assessing the relationship between individual inter-zonal flows from the NHSCR and the Census at three spatial levels. The information gain statistic (IGS) has the major drawback of only comparing non-zero values (the number of zero elements being quite substantial in an array containing 97 origins and 95 destinations). It is included here, however, to indicate the increase in information gain as the scale becomes more disaggregate but with a strong relationship between

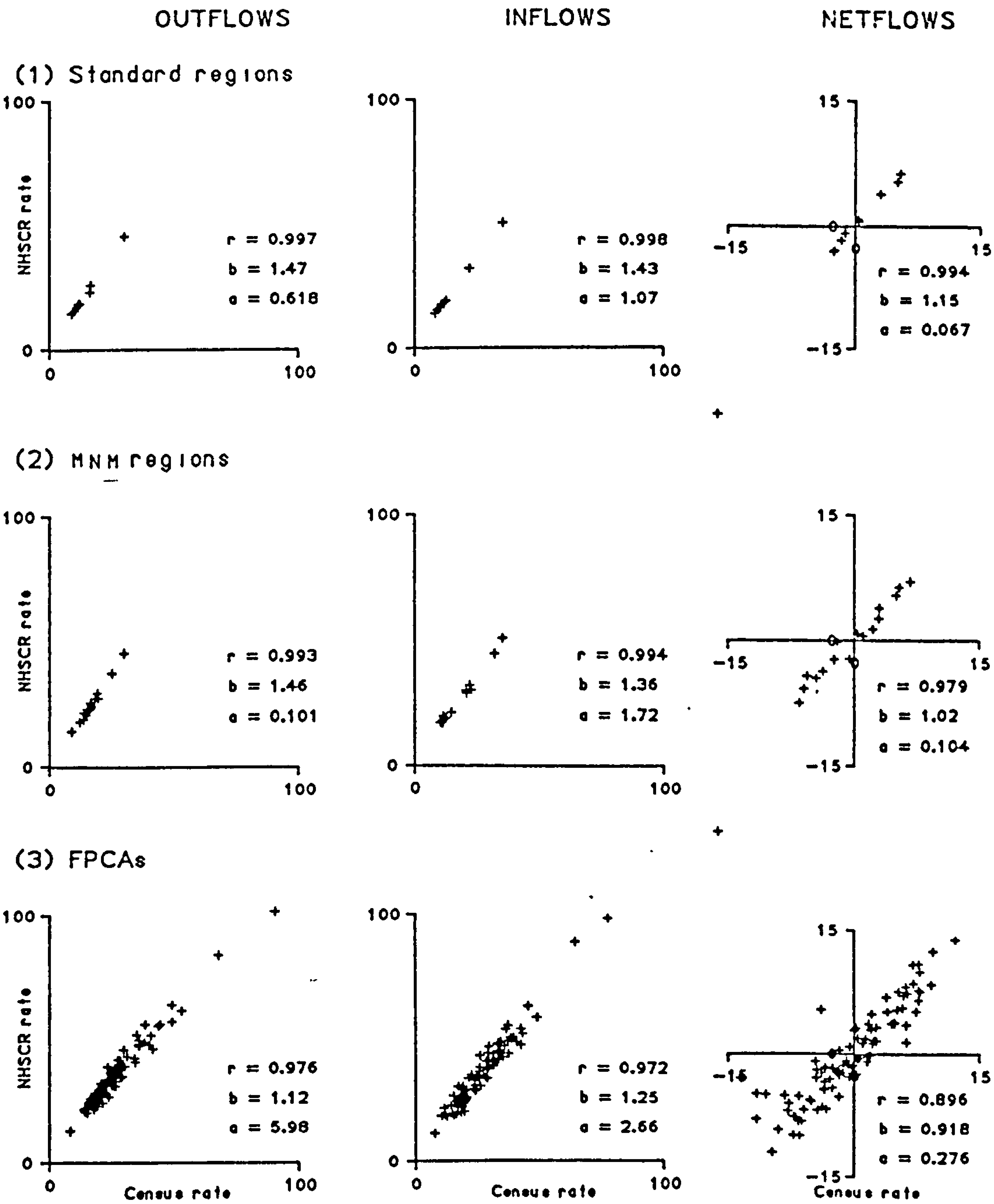


Figure 5.5 Scatterplots for NHSCR and Census outflow, inflow and netflow rates at three spatial scales illustrating correlation coefficients and regression parameters

Table 5.9 Statistics comparing NHSCR and Census inter-zonal flows

Statistic	Spatial Scale Regions	MNMs	FPCAs
Information Gain	0.004	0.009	0.047
Mean Absolute Deviation	34.89	31.37	29.95
Index of Dissimilarity	3.3	5.1	11.4
Correlation Coefficient	0.997	0.997	0.982

flows at all three levels. The MAD statistic gives a measure of the 'distance' between the two arrays in terms of absolute numbers. The MAD decreases as the scale becomes finer - from 35% at the standard region level, to 31% at the MNM level to 30% at the FPCA level. This contrasts to the corresponding statistics computed in section 4.4.4 where the value was lowest at the MNM level (24%) followed by standard regions (25%) and FPCAs (26%). The increase in the level of the MAD statistic is related to the assignment of AF and not-stated flows in the NHSCR array.

The index of dissimilarity (IOD) measures the degree to which the spatial distibution of the two arrays are dissimilar. The value of the IOD ranges from 100, indicating complete dissimilarity to zero, indicating perfect correspondence. The statistic compares the two arrays by computing the sum of deviations between cell proportions. The value increases as the scale becomes finer indicating that although the MAD statistic computes a relatively small absolute difference at the FPCA scale the IOD value shows that the arrays at this level are least similar in relative terms. The IOD values are relatively low, however, at all three spatial scales indicating a fair degree of similarity between the inter-zonal flow matrices of the NHSCR and the Census. The IODs are of a similar value to those computed in Section 4.4.4.

The final statistic computed is the correlation coefficient (R) ranging from zero to one with one indicating perfect correlation. The R value is high in each case with the correlation decreasing with scale. The values are at a slightly higher level to those computed in Section 4.4.4.

5.4.2. Multiple regression models to predict NHSCR outflows and inflows

A major drawback of the OPCS/DOE migration forecasting is that it does not effectively incorporate NHSCR data into the methodology for non-Census years. The problem encountered by OPCS is the derivation of a method for updating migration information given that the NHSCR and the Census are conceptually quite different and produce levels of migration that are spatially dissimilar.

In this section multiple regression techniques are used to construct linear equations relating NHSCR inflow and outflow totals for males and females to a number of independent variables - the corresponding Census flow total, the AF usually resident population and an estimate of the number of inward and outward student re-registrations. AF populations are used in the absence of an accurate estimate of inter-FPCA AF movement and are obtained from 1981 Census Economic Activity volumes based on 10% processing (OPCS, 1984). The estimates of student moves are taken from Devis and Mills (1986, Appendix Table 2). No estimate is available of student re-registrations to and from the FPCAs of Greater London as the non-correspondence of FPCAs and LEAs provides particular problems for estimating student movement. Furthermore, no estimates of student re-registration are available for Scotland. The multiple regression analysis is, therefore, restricted to non-London FPCAs in England and Wales.

Table 5.10 presents Pearsons correlation coefficients for male and female outflow and inflow figures. The correlation between NHSCR flows and the AF population variable is relatively strong. Coefficients for the student variable range from 0.44 with NHSCR female inflows to 0.78 with male NHSCR outflows. It is interesting,

Table 5.10 Correlation matrix for all variables, male and female outflows

(a) Outflows

	NOUTM	COUTM	AFPOPM	STRGOM
NOUTM	1.000	0.992	0.632	0.780
COUTM	-	1.000	0.607	0.780
AFPOPM	-	-	1.000	0.331
STRGOM	-	-	-	1.000
	NOUTF	COUTF	AFPOPF	STRGOF
NOUTF	1.000	0.970	0.628	0.677
CIOUTF	-	1.000	0.573	0.631
AFPOPF	-	-	1.000	0.278
STRGOF	-	-	-	1.000

NOUTM (NOUTF) = NHSCR male (female) outflow
COUTM (COUTF) = Census male (female) outflow
AFPOPM (AFPOPF) = Armed Forces male (female) population
STRGOM (STRGOF) = Student male (female) outflow

(b) Inflows

	NINM	CINM	AFPOPM	STRGIM
NINM	1.000	0.988	0.679	0.626
CINM	-	1.000	0.718	0.545
AFPOPM	-	-	1.000	0.343
STRGIM	-	-	-	1.000
	NINF	CINF	AFPOPF	STRGIF
NINF	1.000	0.993	0.661	0.436
CINF	-	1.000	0.646	0.370
AFPOPF	-	-	1.000	0.272
STRGIF	-	-	-	1.000

NINM (NINF) = NHSCR male (female) inflow
CINM (CINF) = Census male (female) inflow
AFPOPM (AFPOPF) = Armed Forces male (female) population
STRGIM (STRGIF) = Student male (female) inflow

however, to assess the correlation between NHSCR:Census ratios and the AF and student variables rather than the actual migration flows (Table 5.11). It can be assumed that any AF variable should have a negative effect upon the ratio value. This is the case for the ratio between male non-metropolitan inflows but is not true for other relationships between the NHSCR/Census ratio and the AF population. A negative coefficient indicates that, due to the fact that AF movement is excluded from the NHSCR but included in the Census, the ratio will decrease as the size of the AF population increases. For all metropolitan flows, however, the correlation is strongly positive indicating an increase in the ratio value as the size of the AF population increases. The problem here is the relatively small numbers of AF personnel present in metropolitan areas (4%) compared to non-metropolitan areas (96%). For the student variables all correlations are positive. The Census records students as living at home and does not register any move to place of education. The NHSCR, however, will record all such moves, assuming the student re-registers in a new FPCA. The greater the number of estimated student inward and outward re-registrations, therefore, the greater the NHSCR:Census ratio.

Multiple regression analyses have been undertaken to establish linear relationships between NHSCR outflows and inflows and the corresponding Census flows, AF populations and estimated student re-registrations. Table 5.12 illustrates the derived regression equations which predict male or female NHSCR inflows from the independent variables. R is a measure of the correlation between the dependent and the independent variables and R-squared measures the goodness of fit of the linear model to the observed data. The

Table 5.11 Pearson correlation coefficients between NHSCR:Census ratio and the Armed Forces and student variables, male and female, outflows and inflows

(a) Outflows

Correlation	All FPCAs	Metropolitan FPCAs	Non-metrop FPCAs
RATIOUTM with :			
(a) AFPOPM	0.274	0.385	0.085
(b) STRGOM	0.343	0.353	0.065
RATIOUTF with :			
(a) AFPOPF	0.343	0.148	0.192
(b) STRGIF	0.381	0.385	0.153

RATIOUTM = NHSCR male outflow total / Census male outflow total
RATIOUTF = NHSCR female outflow total / Census female outflow total

(b) Inflows

Correlation	All FPCAs	Metropolitan FPCAs	Non-metrop FPCAs
RATIOINM with :			
(a) AFPOPM	-0.082	0.602	-0.207
(b) STRGIM	0.458	0.675	0.308
RATIOINF with :			
(a) AFPOPF	0.160	0.359	0.028
(b) STINF	0.570	0.781	0.275

RATIONM = NHSCR male inflow total / Census male inflow total
RATIOINF = NHSCR female inflow total / Census female inflow total

Table 5.12 <u>Multiple regression equations to predict NHSCR inflows to non-London FPCAs.</u>

<u>All non-London FPCAs</u>

(a) PNINM = 91.3 + 1.28(CINM) + 1.29(STRGIM) - 0.07(AFPOPM)

Step	Enter	R	R-squared	R-squared change
1	CINM	0.989	0.977	0.977
2	STRGIM	0.994	0.988	0.011
3	AFPOPM	0.995	0.989	0.001

(b) PNINF = -92.8 + 1.38(CINF) + 1.04(STRGIF) + 0.78(AFPOPF)

Step	Enter	R	R-squared	R-squared change
1	CINF	0.993	0.986	0.986
2	STINF	0.996	0.992	0.006
3	AFPOPF	0.997	0.992	0.001

<u>Non-metropolitan FPCAs</u>

(c) PNINM = 385 + 1.26(CINM) +1.17(STRGIM) -0.06(AFPOPM)

Step	Enter	R	R-squared	R-squared change
1	CINM	0.987	0.974	0.974
2	AFPOPM	0.992	0.984	0.010
3	STRGIM	0.993	0.986	0.002

(d) PNINF = 189 + 1.36(CINF) + 1.03(STRGIF) + 0.76(AFPOPF)

Step	Enter	R	R-squared	R-squared change
1	CINF	0.991	0.982	0.982
2	STRGIF	0.994	0.988	0.006
3	AFPOPF	0.995	0.989	0.001

<u>Metropolitan FPCAs</u>

(e) PNINM = -575 + 1.29(CINM) + 1.12(STRGIM) + 1.80(AFPOPM)

Step	Enter	R	R-squared	R-squared change
1	CINM	0.977	0.955	0.955
2	STRGIM	0.990	0.980	0.024
3	AFPOPM	0.993	0.986	0.007

(f) PNINF = -258 + 1.40(CINF) + 1.05(STRGIF)

Step	Enter	R	R-squared	R-squared change
1	CINF	0.981	0.962	0.962
2	STRGIF	0.993	0.987	0.025

PNINM (PNINF) = Predicted NHSCR inflow males (females)
CINM (CINF) = Census inflow males (females)
AFPOPM (AFPOPF) = Armed forces population males (females)
STRGIM (STRGIF) = Estimated student inflow re-registrations males (females)

R-squared change figure gives an indication of the increase in the goodness of fit as successive independent variables are added to the model. In the case of in-migration the regression model best fits the data for female inflows to all non-London FPCAs although the effect of the student and AF variables upon this model is negligible (R-squared change = 0.006 and 0.001). For male inflows to all non-London FPCAs the AF variable again has little effect upon the fit of the model although the estimate of student inward re-registrations produces an R-squared change of 0.011. The ten worst outliers obtained from multiple regression models (a) and (b) in Table 5.12 are non-metropolitan FPCAs (Table 5.13) emphasising the inadequacy of the three variable model in predicting male and female inflows. Devon has a particularly high residual value in both the male and female inflow models. Models (c) to (f) in Table 5.12 illustrate the generally poor effect of the AF variable on the predictive equation with the exception of model (c) where the variable produces an R-squared change of 0.01 for non-metropolitan male inflows. Non-metropolitan male flows are likely to be those most influenced by the AF variable as the large majority of AF personnel are male and contained in non-metropolitan areas. In general, however, the proxy variable of usually resident AF population appears to be a poor substitute for the estimation of the level of movement between FPCAs within the AF. The student variable appears to be of greatest value in the prediction of metropolitan inflows for both males and females (R-squared change = 0.024 and 0.025). With the importance of the AF variable in the prediction of non-metropolitan inflows the effect of the student variable upon the fit of the model to observed data is negligible.

Table 5.13 Top ten worst outliers for multiple regression of inflows for all non-London FPCAs by sex

Males		Females	
FPCA	ZRESID	FPCA	ZRESID
Suffolk	2.87	Devon	3.06
Devon	2.75	Kent	2.73
Linconshire	-2.16	Dorset	2.64
Surrey	-2.03	Chesire	-2.63
Cleveland	1.96	Cleveland	2.49
Warwickshire	-1.74	Cornwall	2.41
Bedfordshire	1.64	Avon	2.13
West Sussex	1.61	Surrey	-1.91
Staffordshire	-1.57	Oxfordshire	-1.83
Avon	1.45	Staffordshire	-1.70

Note :
ZRESID = standardized residual
= actual residual / s.d. of the residuals
Standardized residuals have a mean of zero and a standard deviation of one.

Table 5.14 illustrates similar multiple regression equations for the prediction of NHSCR male and female outflows. For all non-London FPCAs the fit of the model (b) for female outflows is relatively poor, whereas model (a), male outflows, excludes the student variable and includes the AF variable but with only a negligible effect upon the goodness of fit of the model to the observed data. Tabulation of the top ten outliers (Table 5.15) illustrates the very high standardized residual value for South Glamorgan female outflows. The majority of these outliers are again non-metropolitan FPCAs with the exception of Manchester and Solihull.

At the non-metropolitan outflow level the AF and student variable are excluded from the male predictive equation. The female model includes all the variables but the fit is the poorest in both Table 5.12 and Table 5.14, although the AF and student variables do improve the fit quite considerably (R-squared change = 0.011 and 0.016 respectively). At the metropolitan outflow level the overall fit of the models (e) and (f) is relatively good but independent variables other than the Census variable have little effect upon the predictive capacity of the model and the AF variable is excluded from the equation which predicts female metropolitan outflows.

These analyses demonstrate that although the fit of the models to the observed data is generally good the importance of the independent variables varies. The AF variable is of questionable value as a substitute for the estimation of inter-FPCA movement, although it does have a considerable importance within the model for predicting non-metropolitan inflows. The student variable appears to have the greatest effect upon the prediction of metropolitan inflows and it is the model to predict female outflows from non-metropolitan zones

Table 5.14 Multiple regression equations to predict NHSCR outflows to non-London FPCAs.

All non-London FPCAs

(a) PNOUTM = -236 + 1.40(COUTM) - 0.06(AFPOPM)

Step	Enter	R	R-squared	R-squared change
1	COUTM	0.992	0.984	0.984
2	AFPOPM	0.993	0.985	0.001

(b) PNOUTF = -95 + 1.28(COUTF) + 2.16(AFPOPF) + 1.62(STRGOF)

Step	Enter	R	R-squared	R-squared change
1	COUTF	0.970	0.942	0.942
2	AFPOPF	0.974	0.950	0.008
3	STRGOF	0.979	0.959	0.009

Non-metropolitan FPCAs

(c) PNOUTM = -10.2 + 1.42(COUTM)

Step	Enter	R	R-squared	R-squared change
1	COUTM	0.991	0.982	0.982

(d) PNOUTF = 124 + 1.20(COUTF) + 2.55(AFPOPF) + 2.08(STRGOF)

Step	Enter	R	R-squared	R-squared change
1	COUTF	0.955	0.912	0.912
2	AFPOPF	0.961	0.923	0.011
3	STRGOF	0.969	0.939	0.016

Metropolitan FPCAs

(e) PNOUTM = -309 + 1.2(COUTM) + 1.57(AFPOPM) + 0.78(STRGOM)

Step	Enter	R	R-squared	R-squared change
1	COUTM	0.988	0.977	0.977
2	AFPOPM	0.991	0.983	0.006
3	STRGOM	0.992	0.985	0.002

(f) PNOUTF = -482 + 1.44(COUTF) + 0.93(STRGOF)

Step	Enter	R	R-squared	R-squared change
1	COUTF	0.991	0.981	0.981
2	STRGOF	0.993	0.985	0.004

PNOUTM (PNOUTF) = Predicted NHSCR outflow males (females)
COUTM (COUTF) = Census outflow males (females)
AFPOPM (AFPOPF) = Armed forces population males (females)
STOUTM (STOUTF) = Estimated student outflow re-registrations males (females)

Table 5.15 Top ten worst outliers for multiple regression of outlows for non-London FPCAs by sex

Males		Females	
FPCA	ZRESID	FPCA	ZRESID
Manchester	-2.85	S.Glamorgan	-6.78
Lancashire	2.73	Devon	2.10
Buckinghamshire	-2.73	Kent	1.62
Lincolnshire	-2.19	Cambridgeshire	-1.44
Solihull	-1.94	Suffolk	-1.38
East Sussex	1.82	Manchester	1.23
Kent	1.79	Hampshire	1.19
S.Glamorgan	1.75	W.Glamorgan	-1.06
Wiltshire	-1.59	Nottinghamshire	1.05
Hertfordshire	-1.58	Dorset	0.99

which gives the poorest fit to the data. Improvements to this basic model could be made with the addition of further independent variables such as a more accurate measure of inter-FPCA movement within the AF, a count of moves involving prisoners and long-term psychiatric patients or, more importantly, a measure of the spatial variation in the effect of multiple and return migration.

5.4.3 Comparison of zone-specific mean migration lengths and distance decay parameters at alternative spatial scales

This section is concerned with the differences that exist between average distances travelled by Census migrants and NHSCR movers and with the spatial variation in the frictional effects of distance on migration. The results reported here refer to NHSCR and Census inter-zonal migration at three alternative scales (standard region, MNM and FPCA). Inter-zonal, straight-line distances have been measured, in kilometres, between population centroids of individual FPCAs (OPCS, 1984). The distance arrays for the standard region and MNM level have been computed as weighted averages of the FPCA values. Glasgow was chosen as the zone centroid for Scotland whereas Northern Ireland and the Isle of Man were excluded from the analysis - partly because only Census inmigration data from these two zones is available, and partly because of difficulties involved in measuring distances between these zones and other zones in the system.

Using the IMP package (Stillwell, 1984) origin and destination-specific mean out- and in-migration lengths are computed together with an estimation of the frictional effect of distance on migration through the calibration of the distance decay parameter of a doubly constrained spatial interaction model defined for migration between origin i and destination j as:

$$M_{ij} = A_i O_i B_j D_j d_{ij}^{-b} \tag{5.14}$$

where

O_i = the total out-migration from origin i;

D_j = the total in-migration to destination j;

d_{ij}^{-b} = the negative power distance decay function with its generalized beta parameter;

and where balancing factors

$$A_i = 1 / \sum_j B_j D_j d_{ij}^{-b} \tag{5.15}$$

and $$B_j = 1 / \sum_i A_i O_i d_{ij}^{-b} \tag{5.16}$$

are used to ensure the out-migration and in-migration constraints are satisfied.

At the standard region level (Table 5.16), the mean migration lengths of Census migrants and NHSCR moves are similar. The overall friction of distance effect is shown to be greater upon migrants than moves (0.672 to 0.639). Origin and destination-specific mean migration lengths for the NHSCR and the Census are also similar but variation exists in the zone-specific parameters. A ratio of greater than one in Table 5.16 indicates the friction of distance effect to be greater upon NHSCR moves than Census migrants. Outflows from the North are most affected by distance in both sources with migrants and moves from the East Midlands being least affected. It is only for Welsh outflows that the NHSCR origin-specific parameter exceeds the Census value indicating a greater friction of distance effect upon movers. The destination-specific parameters reveal the friction of distance effect to be greater upon inflows to all zones for both sources - with the exception of the South East where beta parameters are relatively low. The ratio value is again below unity for all

Table 5.16 Origin and destination-specific NHSCR and Census mean migration lengths and distance decay parameters and their ratios at the standard region scale

Standard region	Mean migration lengths			Distance decay parameters		
	NHSCR	Census	Ratio	NHSCR	Census	Ratio
(a) Origin-specific						
SCTLAND	445.6	449.2	0.99	0.502	0.541	0.93
NORTH	268.8	269.5	1.00	0.955	1.017	0.94
E.ANGL	206.6	204.2	1.01	0.359	0.446	0.81
E.MIDS	172.8	173.1	1.00	0.344	0.414	0.83
S.EAST	232.4	230.3	1.01	0.618	0.640	0.96
S.WEST	229.8	229.7	1.00	0.905	0.910	0.99
W.MIDS	170.7	171.1	1.00	0.503	0.550	0.91
N.WEST	210.7	213.0	0.99	0.642	0.659	0.97
WALES	206.5	206.9	1.00	0.803	0.794	1.01
(b) Destination-specific						
SCTLAND	423.0	428.7	0.99	0.710	0.605	1.17
NORTH	258.7	250.1	1.03	0.955	1.137	0.84
YKS/HUM	197.8	197.5	1.00	0.709	0.748	0.95
E.ANGL	205.0	203.6	1.01	0.491	0.554	0.89
E.MIDS	171.5	169.6	1.01	0.346	0.439	0.79
S.EAST	250.2	251.6	0.99	0.462	0.462	1.00
S.WEST	232.4	230.8	1.01	0.962	1.023	0.94
W.MIDS	170.8	171.8	0.99	0.600	0.607	0.99
N.WEST	204.8	203.6	1.01	0.708	0.762	0.93
WALES	205.2	202.8	1.01	0.983	1.085	0.91
Totals	231.0	230.0	1.00	0.639	0.672	0.95

zones, apart from Scotland and the South East.

At the MNM level (Table 5.17), the overall mean migration length is shown to be higher for NHSCR flows than Census flows (178km to 171km) which is consistent with the previous hypothesis put forward concerning the influence of return migration. All other things being equal, NHSCR migrants move further than Census migrants if there is a significant proportion of persons making second or further moves who return to the FPCAs from which they originated earlier in the year. It is also consistent with section 5.3.4 which highlighted NHSCR flows at the MNM level as containing 3% more non-contiguous, longer distance flows than the Census. The NHSCR mean migration length exceeds the corresponding Census figure by the greatest percentage for outflows from the West Midlands (14%) and the South East Remainder (12%) and for inflows to the West Midlands (16%) and Tyne and Wear (15%). Origin-specific parameter ratios are all below unity with the exception of Scotland and Wales. The greatest ratio values between out-migration parameters are exhibited by East Anglia and the East Midlands. Destination specific parameter ratios are again predominantly below one although there is greater variation. In-migration distance decay parameters are lowest for Scotland and the East Midlands whereas inflows to Tyne and Wear, the Northern Remainder, Yorkshire and Humberside Remainder and the South West are most affected by the friction of distance.

At the FPCA level (Appendix Tables 2a and 2b), average length of move from the NHSCR exceeds the Census figure by 12km (137km to 125km), emphasising the greater importance of longer distance moves in the NHSCR inter-zonal array. The origin-specific mean migration length ratios exhibit considerable variation. The largest ratio

Table 5.17 Origin and destination-specific NHSCR and Census mean migration lengths and distance decay parameters and their ratios at the MNM region level

	Mean migration lengths			Distance decay parameters		
	NHSCR	Census	Ratio	NHSCR	Census	Ratio
(a) Origin-specific						
SCTLAND	445.1	448.7	0.99	0.112	0.073	1.54
TYNE/WR	205.0	192.5	1.07	1.100	1.192	0.92
NOR-REM	220.0	211.6	1.04	0.975	1.131	0.86
S.YORKS	157.6	159.3	0.99	0.721	0.747	0.97
W.YORKS	163.4	158.6	1.03	0.835	0.949	0.88
YH-REM	193.2	190.4	1.01	0.875	1.014	0.86
E.ANGL	204.7	202.0	1.01	0.538	0.667	0.81
E.MIDS	172.4	172.7	1.00	0.275	0.341	0.81
G.LOND	165.6	160.0	1.04	0.528	0.608	0.87
SE-REM	106.0	94.3	1.12	0.617	0.701	0.88
S.WEST	232.6	232.7	1.00	1.037	1.076	0.96
W.MIDS	110.0	96.9	1.14	0.995	1.123	0.89
WM-REM	137.6	131.6	1.05	0.840	0.989	0.85
GT.MAN	150.8	142.7	1.06	0.756	0.870	0.87
MERS.	148.3	138.9	1.07	0.938	1.056	0.89
NW-REM	160.3	156.6	1.02	0.837	0.943	0.89
WALES	207.3	207.8	1.00	0.693	0.676	1.02
(b) Destination-specific						
SCTLAND	422.5	428.1	0.99	0.371	0.200	1.86
TYNE/WR	201.3	175.1	1.15	1.030	1.240	0.83
NOR-REM	197.0	179.1	1.10	1.085	1.251	0.87
S.YORKS	155.2	154.2	1.01	0.686	0.723	0.95
W.YORKS	160.4	151.8	1.06	0.781	0.907	0.86
YH-REM	179.7	172.9	1.04	1.041	1.193	0.87
E.ANGL	202.7	201.1	1.01	0.690	0.799	0.86
E.MIDS	171.2	169.2	1.01	0.288	0.380	0.76
G.LOND	150.3	142.2	1.06	0.617	0.696	0.89
SE-REM	148.9	139.4	1.07	0.425	0.497	0.85
S.WEST	235.1	233.6	1.01	1.078	1.164	0.93
W.MIDS	120.6	104.3	1.16	0.901	1.073	0.84
WM-REM	121.0	112.2	1.08	0.972	1.081	0.90
GT.MAN	147.0	136.6	1.08	0.732	0.853	0.86
MERS.	144.8	131.6	1.10	0.911	1.055	0.86
NW-REM	134.2	122.6	1.09	0.961	1.082	0.89
WALES	206.0	203.6	1.01	0.856	0.943	0.91
Totals	178.0	171.0	1.04	0.668	0.763	0.88

values are found in metropolitan FPCAs. Mean out-migration lengths are generally lower in metropolitan areas, emphasising the importance of short-distance flows between adjacent zones, and lower for migrants than movers illustrating the greater importance of such flows in the Census. Origin-specific distance decay parameters are all below unity with the exception of Wiltshire where the importance of AF inter-regional moves in the Census will reduce the distance effect.

For inflows the greatest mean migration length ratios are again found in metropolitan FPCAs. The NHSCR-Census difference is particularly high in the metropolitan FPCAs of the Northern and North West regions. Distance decay parameter ratios are again predominantly less than one - exceptions being Scotland and the Isle of Wight.

The results from the analysis illustrate therefore that NHSCR movers are less affected by the friction of distance than Census migrants. Origin- and destination-specific mean migration lengths are greater for NHSCR flows than Census with the difference between the two being greatest at the metropolitan zone level, indicating the greater importance of longer distance migration flows in the NHSCR data, and validating the arguments forwarded in previous sections.

5.5 COMPARISON OF AGE AND SEX-DISAGGREGATED OUTFLOWS AND INFLOWS

5.5.1 Total flow ratios by age and sex

The results illustrated so far in this chapter give no indication of the variation in the NHSCR:Census ratio between age-groups and between the sexes. The characteristic age-specific migration profile that exists at all spatial scales will have a considerable effect upon the ratio values. NHSCR and Census migration data will exhibit similar national and sub-national profiles but at different levels and it is this variation in the level of migration by age and sex group at the FPCA scale that we are interested to observe. The adjustment procedures outlined in Section 5.2.2 ensure that migration data from the NHSCR are matched as accurately as possible to the Census data in terms of age-time plan of observation. We are thus comparing cohorts defined by end-of-period age-groups. A more accurate count of the level of migration from both sources is obtained through the assignment of AF recruitments and discharges and not-stated flows.

Table 5.18 indicates the overall variation in the NHSCR:Census ratio by age, and Figure 5.6 illustrates the variation that exists between gross flows disaggregated by age and sex. The effect of sampling error upon the ratio values has been estimated through the computation of confidence limits for the NHSCR data (Section 5.2.5) to give a range of ratio values within which one can be 95% certain the actual ratio value lies. The final column of Table 5.18 gives the confidence interval as a percentage of the NHSCR flow. The percentage interval ranges from 5.68% for the 15-19 age-group to 19.63% for the 75+ age-group. These intervals are averages of individual zone-age flows. Those age-groups with a large number of small flows have larger confidence intervals. The figures reveal that the NHSCR sample information is less reliable as the data becomes more disaggregate ie. when flows are distributed by individual zones, age-groups and sexes.

The overall ratio of 1.40 varies between 1.34 for males and 1.46 for females. Considerable variation is evident between male and

Table 5.18 Overall NHSCR/Census ratio by age and sex

Age-group	Total flows NHSCR (000s)	Total flows Census (000s)	Ratio	95% Confidence levels LCL	UCL	%CL
1-4	113.6	83.5	1.36	1.23	1.49	9.65
5-9	116.3	78.9	1.47	1.33	1.62	9.74
10-14	106.9	64.6	1.65	1.48	1.82	10.38
15-19	203.3	113.6	1.78	1.64	1.92	7.88
20-24	353.4	266.7	1.32	1.25	1.40	5.68
25-29	267.0	206.6	1.29	1.21	1.37	6.44
30-34	188.0	145.8	1.29	1.19	1.39	7.73
35-39	110.1	79.9	1.38	1.25	1.51	9.69
40-44	68.7	52.8	1.30	1.12	1.49	14.10
45-49	51.9	37.7	1.38	1.17	1.59	15.15
50-54	43.9	32.8	1.34	1.13	1.56	15.95
55-59	41.8	31.6	1.32	1.09	1.56	17.80
60-64	42.1	31.8	1.33	1.09	1.57	17.92
65-69	40.2	29.8	1.35	1.11	1.60	18.03
70-74	28.1	20.5	1.37	1.18	1.63	18.49
75+	50.0	29.5	1.70	1.36	2.03	19.63
TOTALS	1825.3	1306.1	1.40			

Notes :
- LCL = lower confidence limit of NHSCR/Census ratio
- UCL = upper confidence limit of NHSCR/Census ratio
- %CL = 95% confidence intervals expressed as a percentage of the NHSCR flow

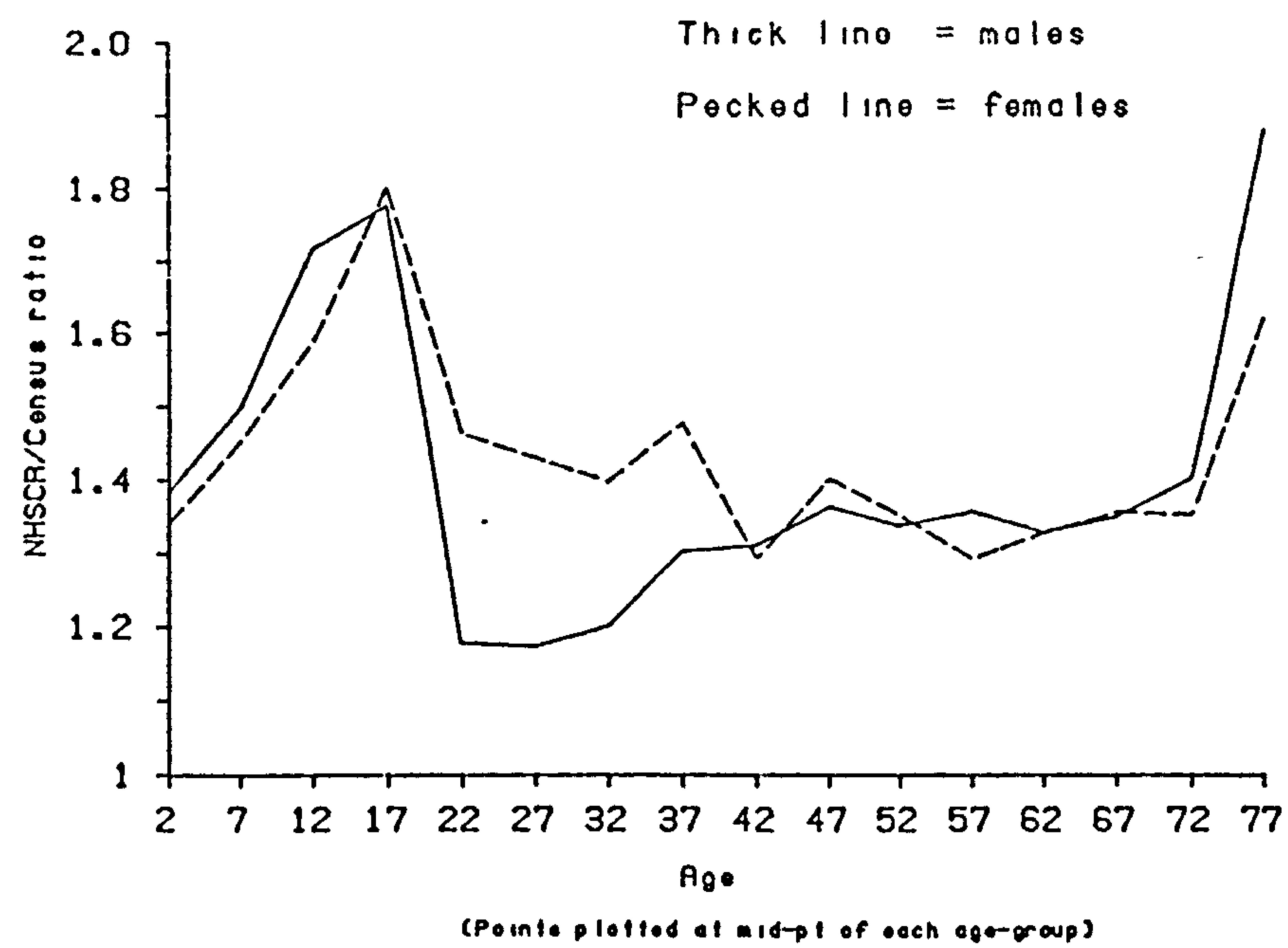


Figure 5.6 Overall NHSCR:Census ratios by age and sex

female age-groups. Males and females both have high ratio values at ages 15-19 and 75+. The inclusion of student flows in the NHSCR data will accentuate the 15-19 peak as will the incidence of moves for reasons of short-term employment, by females in particular.

Multiple moves and return moves are likely to be of greatest importance for migrants with the highest mobility levels, ie. the 15-29 age range. Devis and Mills (Table 3.7, p.16) estimate that multiple moves are most prevalent in the 15-19 and 20-24 female age-groups particularly in the former. In the male ratio profile the early peak includes the 10-14 age-group and this is hypothesised by Devis and Mills to be due to the considerable migration of young boys to boarding schools which will be recorded by the NHSCR but not the Census. The female ratio value is higher than the male in the 15-19 age-group but not in the 75+. Sampling error has already been shown to be more important in the older age-groups and may explain to a certain degree the high ratios evident in the 75+ age-range. Sampling error is, however, just as likely to be responsible for an unusually small flow as it is for a large flow thus making a definite assessment of its effect upon ratio values difficult. Non-surviving migrants, ie. those persons making a move but not surviving to the end of the period, will be particularly important in the older age-groups. Devis and Mills (Table 3.8, p17) estimate that approximately 5% of migrants in the 75+ age category do not survive to the end of the period. This component will be particularly important for flows to (and from) 'retirement' areas on the south coast of England.

The greatest discrepancy between the sexes exists in the 20-39 age-range with the male ratio being much lower than the female particularly in the 20-24 age-group. Young male adults are more likely to neglect re-registration with the NHS upon moving to a new FPCA. They are only likely to re-register when medical treatment is required, which may not be until subsequent moves have been made. Females, it is hypothesized are likely to be more prompt in their re-registration with the NHS. The outcome of this is that the NHSCR count for males is suppressed and the ratio value is relatively low.

These results can be compared with those illustrated in Table 4.8 and Figure 4.8 of Chapter 4. The ratio profiles are at a higher level in Figure 5.6 but the most noticeable difference is the increase in the ratio value for males aged 15-19. In the previous NHSCR dataset used, the number of 15-19 year-old moves involving the recruitment and discharge of Armed Forces personnel and their dependants were considerably undercounted and therefore the ratio value in this age category was suppressed. The increase in the 20-24 age-group for males is also considerable.

These ratio patterns and the explanations put forward can be investigated further by analysing individual inflows and outflows and by subdividing the zones into metropolitan and non-metropolitan categories.

5.5.2 Influence of metropolitan status upon age-sex disaggregated outflows and inflows for FPCAs

The variation between metropolitan and non-metropolitan outflow and inflow ratios by age and sex is illustrated in Figure 5.7. The all-age female ratios are higher than the male and overall metropolitan outflow ratios are lower than the corresponding non-metropolitan figures. All male non-metropolitan outflow ratios are higher than the corresponding metropolitan figure with the

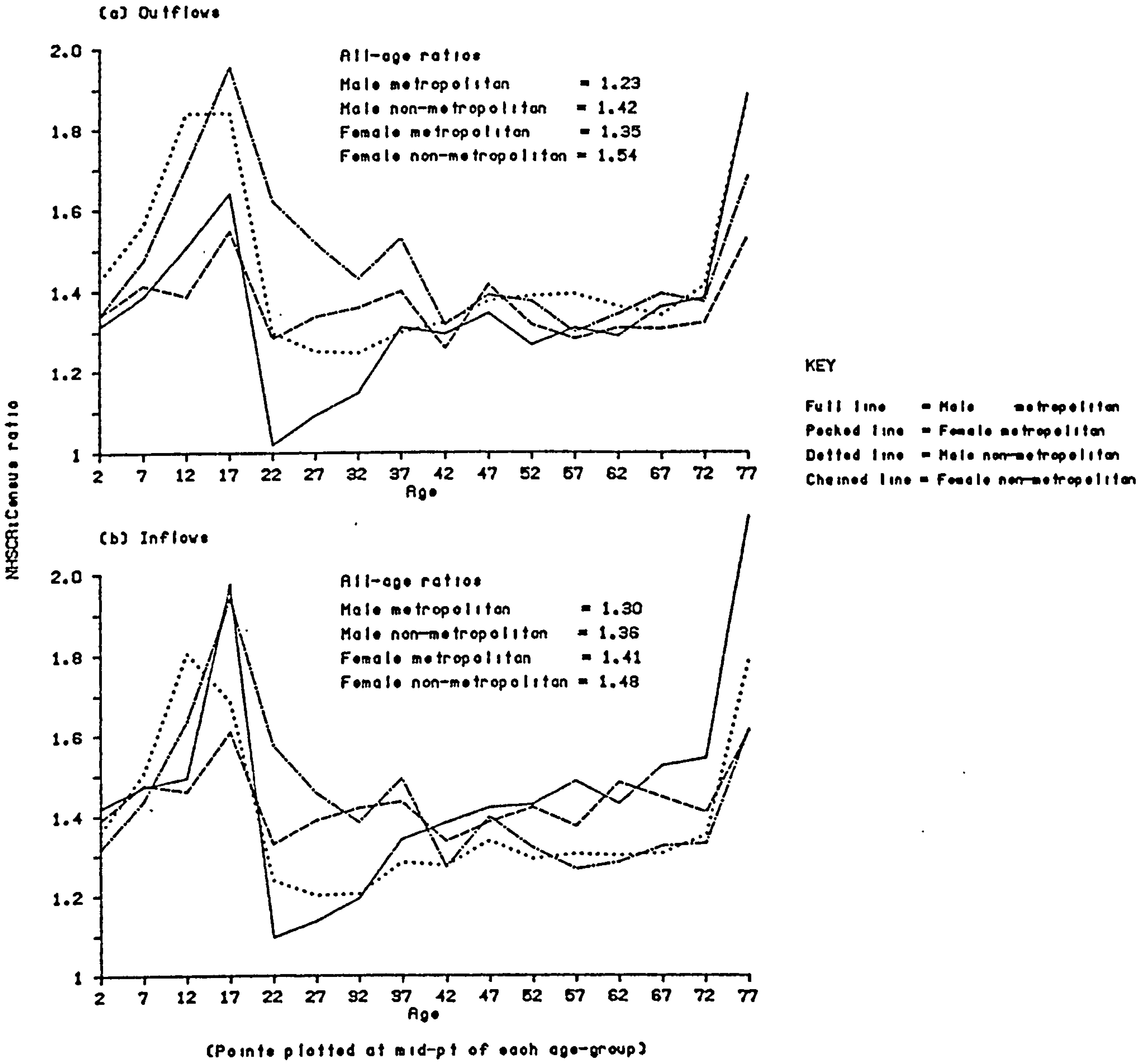


Figure 5.7 <u>Metropolitan and non-metropolitan outflow and inflow ratios by age and sex</u>

exception of the 65-69 and 75+ age-group. In the female case only 45-49 year olds have higher metropolitan ratios. The male non-metropolitan ratio value peaks in the 10-19 age-range whereas the female peak, which is higher than the male, is limited to the 15-19 age-group. All schedules have a high outflow ratio value in the 75+ age-range with the male values exceeding the female. Between the ages of 45-69 all outflow schedules have similar ratio values which range between approximately 1.28 and 1.4. The lowest ratio value is observed for male metropolitan outflows in the 20-24 age-group with low ratios also in the 25-34 age-range. Male non-metropolitan outflow ratios are also relatively low within this age-range. The 20-34 ages experience the greatest discrepancy between male and female outflow ratios.

Examination of the inflow ratio values reveals the discrepancy between male and female metropolitan and non-metropolitan ratios to be not as great with the metropolitan ratio increasing and the non-metropolitan ratio decreasing for both sexes. The dominant features of the inflow ratio schedules are the high values observed in the 15-19 and 75+ age-groups. The largest ratio values are found for male metropolitan inflows (1.98) and female non-metropolitan inflows (1.81) in the 15-19 age-group. The male metropolitan inflow ratio for the final age-group is also high (2.14). Between the ages of 45-69 male and female non-metropolitan ratios appear lower than corresponding metropolitan ratios. The greatest discrepancy between male and female inflow ratios is again found in the 20-34 age-range for both metropolitan and non-metropolitan flows. Male non-metropolitan inflows have a high value in the 10-14 age-group and also relatively high in the subsequent age-group.

These figures confirm the hypotheses previously forwarded with student moves and the importance of multiple and return migration producing high ratio values in the 15-19 age-group. The low ratio value for males aged 20-34 are reproduced at all spatial scales as is the sharp rise in ratio value at age 75+ for which non-surviving migrants are of the greatest importance.

5.5.3 Age and sex disaggregated outflow and inflow ratios for individual FPCAS

The total outflow and inflow ratios for each FPCA disaggregated by age and sex can be categorised on the basis of ratio size (Table 5.19). Male outflows have a large number of ratios in the lowest category (<1) for the 20-24 age-group. The 15-19 age-group has no ratios less than unity for males and only one for females with a large number of the NHSCR flows being over twice those of the Census. Males aged 10-14 and 75+ also have a relatively high number of outflow ratios in the 2-2.9 category. Male and female outflows in the 45-69 age groups have a similar range of ratios although female outflows in the 65-69 group have a relatively large number of ratios with a value of less than one. Males aged 20-24 have a far greater number of ratios less than one than females in the same age-range.

Inspection of the inflow ratio categorisation reveals that the greatest range of values is found for males aged 15-19 and 75+ and for females aged 15-19. The greatest number of ratios in the higher categories (2+) are found in the male 15-19, male 75+ and female 75+ in that order. Males aged 20-24 also have a large number of low ratio values. Ratios for males aged 10-14 are relatively high. Male and female profiles are again similar in the 45-69 age-group although males aged 55-59 do have a considerable range of ratio values.

Table 5.19 Categorisation of outflow and inflow ratios by age and sex

(a) Outflows

Age-group	Males <1	Males 1-1.9	Males 2-2.9	Males 3+	Females <1	Females 1-1.9	Females 2-2.9	Females 3+
1-4	7	89	1	0	5	91	1	0
5-9	3	92	2	0	5	88	4	0
10-14	2	77	18	0	9	81	7	0
15-19	0	70	27	0	1	68	28	0
20-24	26	71	0	0	3	92	2	0
25-29	15	82	0	0	1	95	1	0
30-34	12	85	0	0	2	93	2	0
35-39	11	86	0	0	6	89	2	0
40-44	11	85	1	0	16	79	2	0
45-49	12	83	2	0	15	80	1	1
50-54	15	80	2	0	14	77	6	0
55-59	11	83	3	0	13	82	2	0
60-64	14	78	4	1	17	77	3	0
65-69	15	76	6	0	22	72	3	0
70-74	17	68	10	2	19	72	5	1
75+	7	55	28	7	4	82	11	0

(b) Inflows

Age-group	Males <1	Males 1-1.9	Males 2-2.9	Males 3+	Females <1	Females 1-1.9	Females 2-2.9	Females 3+
1-4	6	87	2	0	7	86	2	0
5-9	5	86	4	0	7	85	3	0
10-14	3	78	14	0	5	81	9	0
15-19	7	47	31	10	5	63	22	5
20-24	20	72	3	0	2	89	4	0
25-29	9	86	0	0	2	93	0	0
30-34	11	84	0	0	5	90	0	0
35-39	12	80	3	0	7	88	0	0
40-44	8	86	1	0	17	76	2	0
45-49	15	76	4	0	14	74	7	0
50-54	10	79	6	0	12	77	5	1
55-59	21	64	9	1	18	71	5	1
60-64	14	70	11	0	13	75	6	1
65-69	14	71	9	1	10	78	7	0
70-74	14	68	12	1	7	78	10	0
75+	6	52	29	8	7	76	12	0

The variation in the size of the ratio value for each age and sex group is further investigated through the computation of a number of goodness of fit statistics, a description of which is given in Section 4.4.4. Table 5.20 illustrates correlation coefficients (R), mean absolute percentage deviations (MAD) and indices of dissimilarity (IOD) for outflows and inflows disaggregated by age and sex. The correlation is stronger between female (R=0.978) than male (R=0.968) outflows. The R value for males varies between 0.919 (75+) and 0.986 (1-4) with the 20-24 and 50-54 age-groups also having relatively low values. Correlation for female outflows varies between 0.955 (50-54) and 0.987 (30-34) with the 25-29 and 60-64 age-groups exhibiting relatively high values and the 15-19 age-group relatively low. The MAD statistic, higher overall for females varies from 17.1 (20-24) to 47.8 (75+) for males and from 25.3 (40-44) to 44.7 (15-19) for females. The male MAD values illustrate further the discrepancy that exists between male outflows in the 10-19 range and the greater consistency between outflows in the 25-34 age-group. The range of IOD values is fairly small with the highest value - greatest dissimilarity - evident for males aged 75+. The greatest similarity is found in the male 1-4 and 35-39 age-groups and the female 25-29 age-group.

The dominant feature of the inflow correlation coefficients, which again is larger overall for females, is the poor correlation between male and female inflows in the 15-19 age-range. This is confirmed by very high MAD and IOD statistics for this age-group. The strongest correlation is in evidence for male and female inflows in the 25-29 age-group with relatively low figures found between male inflows in the 75+ and 55-59 age-groups and female inflows in the

Table 5.20 Goodness of fit statistics for individual age and sex groups, outflows and inflows

(a) Outflows

Age-group	Correlation coefficient male	Correlation coefficient female	Mean Absolute Deviation male	Mean Absolute Deviation female	Index of Dissimilarity male	Index of Dissimilarity female
1-4	0.986	0.979	27.9	25.9	5.07	5.77
5-9	0.982	0.979	33.4	31.5	5.63	5.66
10-14	0.967	0.964	41.8	37.9	7.94	8.18
15-19	0.962	0.956	43.7	44.7	7.66	7.49
20-24	0.950	0.963	20.9	31.7	8.45	7.73
25-29	0.979	0.984	17.1	30.0	6.19	5.06
30-34	0.985	0.987	17.3	28.5	5.15	4.69
35-39	0.986	0.981	24.2	32.8	4.93	5.80
40-44	0.971	0.972	25.2	25.3	7.10	7.10
45-49	0.962	0.969	28.2	30.7	8.15	8.11
50-54	0.955	0.955	27.8	28.5	9.36	8.83
55-59	0.965	0.975	27.9	25.5	8.43	7.71
60-64	0.966	0.983	27.1	26.3	9.03	7.58
65-69	0.979	0.974	29.3	30.0	8.57	8.09
70-74	0.968	0.967	31.9	30.5	9.50	9.14
75+	0.919	0.980	47.8	38.7	12.01	7.15
Totals	0.968	0.978	27.5	32.3	9.40	7.95

(b) Inflows

Age-group	Correlation Coefficient male	Correlation Coefficient female	Mean Absolute Deviation male	Mean Absolute Deviation female	Index of Dissimilarity male	Index of Dissimilarity female
1-4	0.977	0.969	28.1	25.6	6.00	6.51
5-9	0.983	0.977	33.4	31.4	5.69	6.37
10-14	0.960	0.970	41.8	37.4	8.08	7.38
15-19	0.876	0.888	45.8	44.9	16.87	12.41
20-24	0.961	0.977	19.0	31.5	8.58	6.43
25-29	0.991	0.989	15.7	30.0	4.27	4.68
30-34	0.985	0.986	17.7	28.6	4.91	4.82
35-39	0.979	0.982	23.8	33.0	5.86	6.38
40-44	0.977	0.962	24.6	25.4	5.94	7.44
45-49	0.951	0.952	28.3	30.2	8.87	8.86
50-54	0.963	0.953	26.5	27.9	7.48	8.49
55-59	0.942	0.968	28.8	26.0	9.77	8.10
60-64	0.971	0.966	27.9	26.3	8.67	8.34
65-69	0.975	0.967	27.6	27.7	8.14	8.14
70-74	0.955	0.956	31.0	27.2	9.59	9.63
75+	0.943	0.978	47.5	38.7	10.68	6.79
Totals	0.963	0.978	27.0	32.2	10.10	8.00

45-49 age-group. The MAD statistic indicates a low average deviation between NHSCR and Census male inflows in the 20-34 age-range although the lowest MAD values are exhibited by male and female inflows in the 40-44 age-group. The IOD, apart from high values in the 15-19 age-group, is high for males aged 75+ and lowest in the 25-34 age-range for males and females.

5.6 SUMMARY AND CONCLUSIONS

This chapter has reported on the second stage of the comparison of alternative migration data sets obtained from the Census and the NHSCR. The analyses of Chapter 4 have been supplemented and improved upon in a number of ways. The use of NHSCR PUD has enabled an estimate of the number of AF recruitments and discharges from individual FPCAs to be made thus producing a more accurate indication of actual levels of NHSCR movement. Secondly, the use of PUD has allowed the proportional assignment of further not-stated flows in the NHSCR again producing a more accurate etimate of the level of movement but not in fact affecting the spatial pattern of NHSCR: Census ratios. Conceptually Census and NHSCR data are quite dissimilar and so the individual movement records were adjusted directly to be consistent with the period-cohort information provided by the Census. Furthermore, the processing of PUD enables the exclusion of infant moves from the NHSCR again ensuring greater consistency between the datasets. Finally a crude computation of confidence limits for the 10% sample data emphasised the discrepancies that are likely to exist due to sampling error particularly when small numbers are involved such as in the case of inflows to minor metropolitan areas.

A number of explanations have been put forward in preceding sections to describe the differences that exist between Census and NHSCR migration data at a number of spatial scales and levels of aggregation. The actual correlation between inter-zonal flows was shown to be high (Table 5.9) although the MAD statistic emphasised the significant differences evident in the respective levels of measurement. A scale effect was noted in the pattern of NHSCR:Census ratios. The predominance of longer-distance migration is reflected by discrepancies between NHSCR and Census counts. Census counts have been shown to be more reliable for shorter-distance migration due to the reduced effect of multiple moves which tend to be of greatest importance for the longer-distance predominantly employment-related migration. This was further illustrated by the contiguity effect with contiguous flows generally having the lowest ratio values particularly for moves between adjacent metropolitan areas, emphasising greater NHSCR-Census consistency associated with shorter-distance migration. The mean migration length for NHSCR moves was seen to be generally higher than the corresponding Census figure with the friction of distance effect exerting greatest influence upon Census migrants.

A number of metropolitan districts had very high inflow ratios, primarily due to the annual influx of students to higher education but also because of the importance of the multiple movement phenomenon in these less attractive FPCAs. Females in particular may be attracted to a big city for temporary employment, for example, and may return to original residence within a relatively short space of time. The Census will miss the multiple moves and thus will be deflated relative to the NHSCR. AF moves were shown to be of considerable importance in certain non-metropolitan FPCAs with the assignment procedures increasing the ratio value in these areas. Multiple regression analyses illustrated the importance of the AF variable in the prediction of male non-metropolitan flows and showed the student re-registration variable to be of significance in the estimation of metropolitan inflows. Significant differences by age and sex were observed. The male and female 15-19 age-range had particularly high ratio values for migration into metropolitan areas. This emphasises the important effect of student moves and the high incidence of multiple migrations in this mobile age-group. The high ratio values in the oldest age-group were explained by the increase in the number of non-surviving migrants and the possible importance of return migration of the elderly. Finally non-registration was cited as the main reason for the greater consistency between NHSCR and Census flows in the male 20-29 age-range.

The comparisons reported in these two Chapters have, therefore, established a number of possible guidelines regarding the use of migration data in population analysis. Firstly, a record of AF recruitment and discharge moves is available from the PUD and this Chapter has illustrated a method for re-assigning the flows to individual origins and destinations. However, further information is required in FPCAs with large AF populations to account for the internal transfers of service personnel within the AF (postings). Secondly, the NHSCR has the advantage of locating students at their places of education in contrast to the Census which records the usual residence of students as their home address and thus excludes moves to University or College from its tabulations. Large ratio values for inflows to metropolitan districts have been illustrated thus supporting the argument for using NHSCR figures. Thirdly, there are a considerable number of 'not-stated' flows in both the Census and the NHSCR which require re-distribution in order to establish the correct level of migration. Methods for re-assigning these flows to individual FPCAs, age-groups and sexes have been outlined. Fourthly, the conceptual differences between the two sources of migration data have been outlined emphasising the need to match the population model utilised to the type of migration data available. Methods have been illustrated for the conversion of movement-type data to the appropriate census-type period-cohort age-time plan of observation. Fifthly, infant moves require inclusion in any population model again favouring the use of NHSCR migration data in preference to the Census. Finally it is probable that the undercounting of moves by the NHSCR is not as serious as the considerable under-enumeration evident from the 1981 Census data, again supporting the use of the re-registration information instead of the Census.

Little has been said so far about the patterns of migration which are evident from the Census and NHSCR data. The chapters which now follow analyse both Census and NHSCR data outlining spatio-temporal patterns and trends in both which can be evaluated given the understanding of differences between the data sources. Furthermore, analyses are undertaken to evaluate the current use of Census data in the OPCS/DOE population projection model given the availability of and trends evident in NHSCR information.

Chapter 6. SPATIAL PATTERNS OF MIGRATION FROM THE 1981 CENSUS AND INTER-CENSAL CHANGES 1971-1981

6.1 INTRODUCTION

This chapter outlines the spatial patterns of internal migration evident at sub-national levels in 1980/81 and examines what changes in migration have taken place between the two most recent single-year periods for which migrant transition data is available, 1970/71 and 1980/81.

The limitations of Census transition data have been outlined in Chapter 3. The major drawbacks include the failure of the Census to record infant migrants and the movement of students to places of education, its inability to distinguish between single and multiple moves, and the quite considerable under-enumeration and mis-classification of migrants estimated at approximately 172 thousand for 1980/81 (Britton and Birch, 1985). However, unlike the NHSCR, the Census does include important Armed Forces migrants within its tabulations, and although the data is only available at ten-yearly intervals it provides migration information at a relatively fine level of spatial disaggregation.

The large number of empirical analyses of Census migration data, most of which adopt a fairly aggregate spatial scale, have been reviewed in Section 2.2.2. Brant (1984), for example, used 1981 Census data to show that 12% of total migrants moved inter-regionally with the highest rates of migration occurring between East Anglia and the South West (9.2 per 1000) and between the South West and the South East (9.1 per 1000). Comparing 1971 and 1981 Census data, Brant noted a decrease in the net gain in the East Midlands, East Anglia and the South West over the ten-year period and a reduction in the 1971 net outflow figure from the South East to produce a small net inflow in 1981. In the North West and North, net out-migration increased, and all regions containing a metropolitan county, with the exception of the South East, maintained a negative balance of migration both in 1971 and 1981. Variations in the distance of migration were illustrated with the North, Yorkshire and Humberside, West Midlands and the North West all receiving over 70% of migrants from within 10km, and East Anglia and the South West, in contrast, receiving less than 60% of migrants from within 10km and 22% and 24% of in-migrants respectively moving over 80km.

Regional mobility rates were lower in 1981 than 1971 in all regions, with the greatest decline (-26%) occurring in the South West (Devis, 1984). Devis also analysed variations in district-level migration from the 1981 Census (Devis, 1983), illustrating that the highest mobility rates were found in districts of inner London, those districts containing a New Town and those with large military populations. Districts with the lowest rates of mobility were those located in industrial South Wales or 'small-town manufacturing areas'. Devis showed that non-metropolitan districts experienced the greatest decline in mobility rates between 1970/71 and 1980/81.

It is the specific aim of this chapter to examine the spatial patterns of migration evident from the 1981 Census at the FPCA scale and to illustrate, with the aid of the density classification (Section 3.2.5), the importance of decentralisation processes in 1980/81 in the redistribution of population through migration. Important age and sex differences are illustrated using gross in- and out-migration data. Since migration information from the 1971 Census is not available at the FPCA scale, inter-censal comparisons are undertaken using MNM-level data disaggregated by five-year age-group and sex.

It is important to outline and understand the spatial patterns of migration from the 1981 Census as 1980/81 is the base year in the assignment procedure within the OPCS/DOE migration projection methodology. Patterns evident from Census data for 1980/81 can be compared with patterns evident for NHSCR statistics for more recent years, given an understanding of the discrepancies between the data sources as outlined in Chapters 4 and 5. The results illustrated here are used in conjunction with those produced from the analysis of 1980/81 and 1985/86 NHSCR inter-zonal migration (Section 8.6) to assess the effect of changes in the distribution of migration flows upon the accuracy of the migration forecasting procedure.

The analysis of 1971 and 1981 Census data at the MNM level provides a useful illustration of changes in migration over the ten-year period. Inter-censal changes require careful interpretation as they exclude any possible fluctuations in the level and pattern of migration in intervening years. The Census, however, provides a reliable and detailed record of the movement of the population and the spatio-temporal changes apparent from the Census information can be interpreted alongside changes in patterns based on NHSCR data given the understanding of differences between the two sources.

The remainder of this chapter is structured as follows. Section 6.2 describes the format of the relevant migration and population data files used in the analysis. Section 6.3 illustrates patterns of migration at a number of spatial scales highlighting important age and sex differences in population movement. The analysis of change over time is undertaken in Section 6.4 with an illustration of the spatial and temporal variations in the level and rate of movement supplemented by the analysis of the changing effect of distance upon migration using a doubly-constrained spatial interaction model. Section 6.5 provides the concluding comments linking to the further empirical and modelling analyses of subsequent chapters.

6.2 DATA SOURCES AND SPATIAL FRAMEWORK

6.2.1 Census migration data

The analyses undertaken in this chapter utilise census data obtained from both published sources and from coded records of information stored on magnetic tape. The analysis of spatial patterns of migration in 1980/81 is based on Census data at the FPCA level (see Figure 3.3 and Table 3.1) disaggregated by sex and five-year age-group. Outflows to Northern Ireland and the Isle of Man are excluded. The three data files are similar to those used in the previous two chapters and are referenced as TRAN1 DATA, TRAN2 DATA and TRAN3 DATA in Table 3.7.

The inter-censal comparison uses migration information collected from published sources for 17 metropolitan or non-metropolitan study zones (see Figure 3.2). Data is disaggregated at the MNM level by origin, destination, five-year age-group and sex. Files containing the migration data for successive Censuses are referenced as CEN7071 DATA and CEN8081 DATA in Table 3.7.

6.2.2 Population data

For the purpose of rate calculation usually resident populations are used in the analysis of 1980/81 Census migration patterns (CEN8081 POPS in Table 3.7). To avoid further data collection (of 1971 Census populations) the comparison of 1970/71 and 1980/81 information utilises mid-year population estimates for 1971 and 1981. Access to the population data is described in Section 3.2 and the relevant file is referenced as CEN7181 PDATA in Table 3.7.

6.3 GEOGRAPHICAL PATTERNS OF AGGREGATE INTERNAL MIGRATION, 1980/81

6.3.1 Gross and net patterns of migration

Approximately 4.75 million migrants were recorded in the 1981 Census (Table 6.1). In other words, almost 9% of the 1981 population moved residence at least once during the year prior to April 5/6, 1981. The majority of migrants moved to a new address within the same FPCA (3.46 million or 6.5% of the 1981 population). 73% of migrants moved within the boundaries of an FPCA. Inter-FPCA migrants comprised approximately 27% of total migation or 2.42% of the total population in 1981, whereas inter-MNM and inter-regional migrants comprised 18.1% and 12.9% respectively of the total internal migration figure. Net and gross migration flows by Standard Region in 1980/81 are presented in Table 6.2. The South East was dominant to the extent that approximately 27% of the total of 611 thousand inter-regional migrants were involved in migration to and from this region. The South West was particularly important as a destination with a net inflow of some 22 thousand persons although East Anglia also had a relatively high net inflow figure (11 thousand). The largest net losses were experienced by the North West (-17.7 thousand), the West Midlands (-8.8 thousand) and the North (-7.6 thousand).

The highest inflow and outflow rates (Table 6.3) were experienced in East Anglia (24 and 18 per 1000) and the South West (21 and 16 per 1000). The East Midlands also had high inflow (17 per 1000) and high

Table 6.1 Aggregate levels of migration,1980/81

Scale	Migrants	%age of total mig	Rate (/1000)
Between standard regions	611,123	12.9	11.4
Between MNM regions	859,408	18.1	16.1
Between FPCAs	1,294,933	27.2	24.2
Within FPCA	3,458,337	72.8	64.6
Total migrants	4,753,270	100.0	88.8

Table 6.2 Aggregate migration flows and percentages at the standard Region level, 1980/81

Standard region	In-flow	Outflow	Netflow	In-flow %age	Out-flow %age
Scotland	36,955	41,363	-4,408	6.1	6.8
North	27,079	34,671	-7,592	4.4	5.7
Yks & Humbs	50,031	56,353	-6,322	8.2	9.2
E.Midlands	63,669	54,840	8,829	10.4	9.0
E.Anglia	44,236	33,197	11,039	7.2	5.4
South East	165,801	163,295	2,506	27.1	26.7
South West	90,685	68,963	21,722	14.8	11.3
W.Midlands	49,264	58,099	-8,835	8.1	9.5
North West	49,629	67,297	-17,668	8.1	11.0
Wales	33,774	33,045	729	5.5	5.4
All regions	611,123	611,123	0	100.0	100.0

Table 6.3 In, out and net migration rates at the Standard Region level, 1980/81

Standard Region	In	Out	Net
	(migration rate per 1000)		
Scotland	7.3	8.2	-0.9
North	8.8	11.3	-2.5
Yks & Humbs	10.4	11.7	-1.3
E.Midlands	16.8	14.5	2.3
E.Anglia	24.0	18.0	6.0
South East	10.0	9.9	0.2
South West	21.3	16.2	5.1
W.Midlands	9.7	11.4	-1.7
North West	7.8	10.6	-2.8
Wales	12.3	12.0	0.3
All regions	11.4	11.4	0.0

outflow rates (14.5 per 1000) rates. It is these three regions which recorded the largest absolute net gains during the period with East Anglia gaining at a net rate of 6 persons per 1000 population. Negative net rates were found in Scotland, North, Yorkshire and Humberside, West Midlands and the North West with the largest rate of net loss of -2.8 per 1000 occurring in the North West.

Disaggregation of the flows into MNM regions uncovers significant patterns hidden at the Standard Region level (Table 6.4). The South East Remainder (SER) and Greater London together comprised over 36% of in-migration and 35% of out-migration at the MNM level during 1980/81. The net gain through migration by the SER was approximately 42 thousand, in contrast to the net loss of 39 thousand from Greater London. The disaggregation of provincial regions into metropolitan counties and their region remainders also produces important differences. All metropolitan counties experienced net losses through migration whereas all remainders experienced net gains. The largest net losers were the West Midlands (-15.8 thousand), Tyne and Wear (-14.7 thousand) and Greater Manchester (-11.8 thousand). The conversion of these figures to rates per 1000 (Table 6.5) reveals that Tyne and Wear experienced a negative net rate of -13 per 1000 in 1980/81, a figure considerably higher than other metropolitan counties, with Merseyside and West Midlands having net rates of -6.6 and -6.0 per 1000 respectively. The large rate of out-migration from Greater London in relation to its in-migration rate gave rise to a net rate of approximately -6 per 1000 with a consequent net gain in the SER of 4.2 per 1000.

In and out-migration rates at the FPCA level are illustrated in Figure 6.1. The highest rates both for in and out-migration were

Table 6.4 Aggregate migration flows and percentages at the MNM level, 1980/81

MNM region	Inflow	Outflow	Netflow	Inflow %age	Out-flow %age
Scotland	36,955	41,363	-4,408	4.3	4.8
Tyne & Wear	12,549	27,258	-14,709	1.5	3.1
N.Remainder	35,999	28,882	7,117	4.1	3.3
S.Yorkshire	14,946	17,546	-2,600	1.7	2.0
W.Yorkshire	22,647	27,652	-5,005	2.6	3.2
YH Remainder	29,829	28,546	1,283	3.4	3.3
E.Midlands	63,669	54,840	8,829	7.3	6.3
E.Anglia	44,236	33,197	11,039	5.1	3.8
SE Remnder	206,156	164,310	41,846	23.8	18.9
Gt London	107,457	146,797	-39,340	12.4	16.9
South West	90,685	68,963	21,722	10.5	8.0
W.Midlands	27,992	43,771	-15,779	3.2	5.0
WM Remainder	54,651	47,707	6,944	6.3	5.5
Gt Manch.	25,505	37,372	-11,867	3.0	4.3
Merseyside	15,246	25,123	-9,877	1.8	2.9
NW Remainder	45,442	41,366	4,076	5.2	4.8
Wales	33,774	33,045	729	3.9	3.8
All regions	867,738	867,738	0	100.0	100.0

Table 6.5 In,out and net migration rates at the MNM level, 1980/81

MNM region	In (Migration rate per 1000)	Out	Net
Scotland	7.3	8.2	-0.9
Tyne & Wear	11.1	24.0	-13.0
N Remainder	18.6	15.0	3.7
S.Yorkshire	11.6	13.6	-2.0
W.Yorkshire	11.2	13.7	-2.5
YH Remainder	19.9	19.1	0.9
E.Midlands	16.8	14.5	2.3
E.Anglia	24.0	18.0	6.0
SE Remainder	20.7	16.5	4.2
Gt London	16.3	22.2	-6.0
South West	21.3	16.2	5.1
W.Midlands	10.7	16.7	-6.0
WM Remainder	22.1	19.3	2.8
Gt Manch.	9.9	14.5	-4.6
Merseyside	10.1	16.7	-6.6
NW Remainder	19.9	18.1	1.8
Wales	12.3	12.0	0.3
All regions	16.2	16.2	0.0

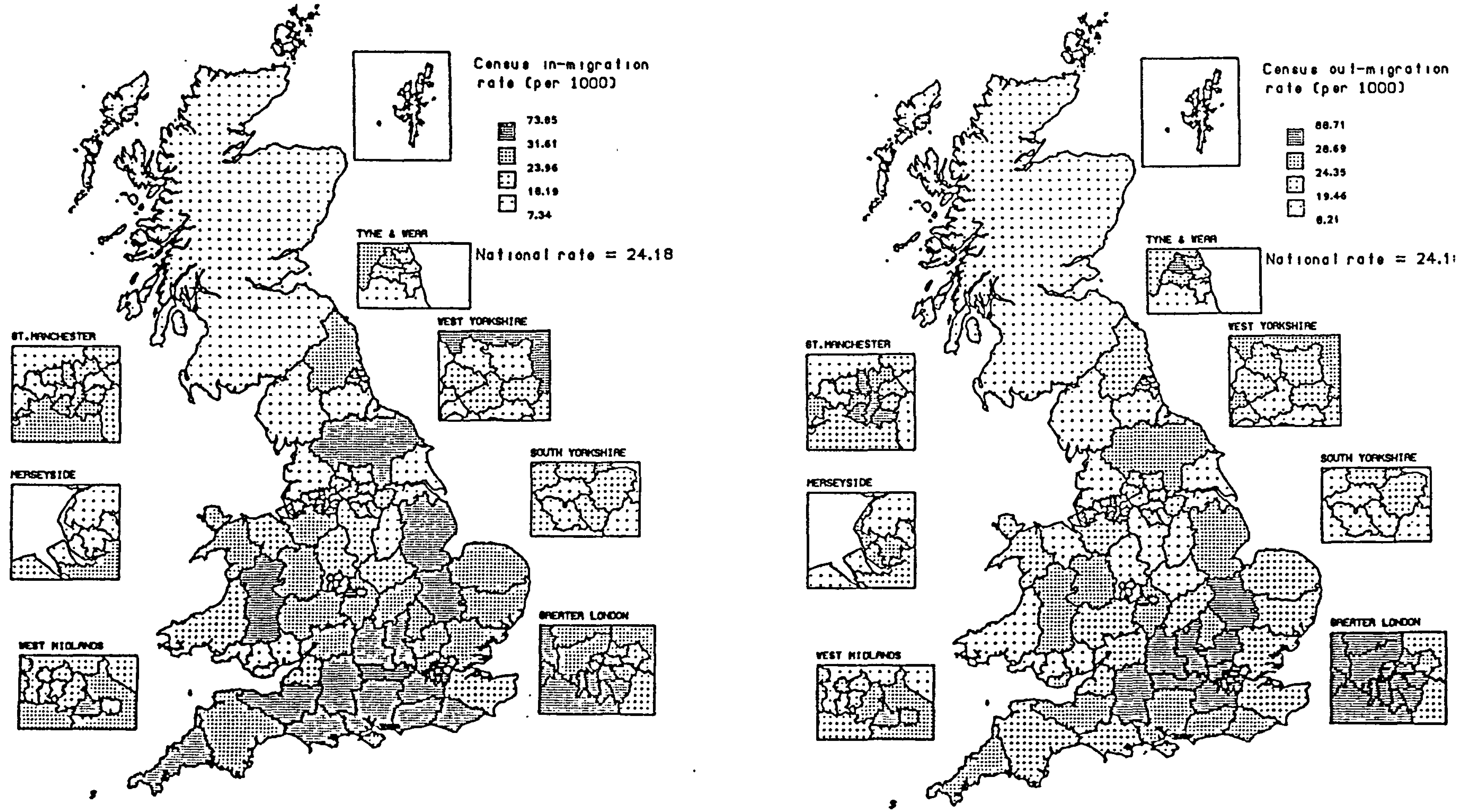


Figure 6.1 In- and out-migration rates for FPCAs, 1980/81 Census

experienced by FPCAs within Greater London. The FPCA of Kensington, Chelsea and Westminster, for example had an inflow rate of 74 per 1000 exceeded by an out-rate of 89 per 1000. Corresponding rates for Camden and Islington FPCA were 61 and 66 per 1000. With the exception of Bromley, all FPCAs within Greater London had out-migration rates which exceeded the in-migration figure. Outside the capital substantial inflow rates were evident for the south-coast counties of West Sussex (37 per 1000), Wiltshire (38 per 1000), Cornwall (34 per 1000) and Dorset (33 per 1000). Elsewhere the largest in-migration rates were found in the south-eastern counties of Buckinghamshire, Berkshire, Oxfordshire and Surrey, the metropolitan district of Solihull and the shire counties of Cambridgeshire and Lincolnshire. In-migration of the Armed Forces personnel has in the previous chapter been shown to be of considerable importance in counties such as Wiltshire, Lincolnshire and Hampshire, whereas the importance of retirement migration will have contributed to the relatively high figures for the south coast FPCAs of West Sussex, Cornwall and Dorset. The lowest in-migration figure was evident for Scotland (7 per 1000) with Cleveland, South Tyneside and the Welsh FPCAs of Mid- and South Glamorgan also relatively low.

Out-migration rates outside Greater London were particularly high in the metropolitan districts of Newcastle (36 per 1000), Manchester (40 per 1000) and also Solihull (41 per 1000). The high in-migration rates of Berkshire, Oxfordshire and Surrey were matched by equally high out- migration figures. Again the lowest rates were experienced in Scotland and in the Welsh FPCAs.

The pattern of net rates is one of negative balances in metropolitan districts and London Boroughs and positive balances in the non-metropolitan counties (Figure 6.2). The largest rates of net loss were evident in the Greater London FPCAs of Kensington, Chelsea and Westminster (-15 per 1000) and City-Hackney-Newham-Tower Hamlets (-12 per 1000) and in the metropolitan districts of Manchester (-12 per 1000) and Newcastle (-10.5 per 1000), although substantial negative rates were experienced by the majority of metropolitan FPCAs. Only Rotherham, Bromley and Dudley of the London borough/ metropolitan district group had positive rates of net-migration in 1980/81.

The highest net gains during the period were experienced by the south-coast FPCAs of West Sussex (12 per 1000), Dorset (9 per 1000), Cornwall (8.9 per 1000) and East Sussex (7.7 per 1000) and all the counties of the South West, East Midlands and East Anglia, with the exception of Leicestershire which had a small negative rate, had positive net migration rates in 1980/81.

These overall differences between metropolitan FPCAs (including Greater London) and non-metropolitan FPCAs are summarised in Table 6.6. A net loss of almost 18 thousand from metropolitan areas at the MNM level increases to over 90 thousand at the more disaggregate FPCA scale. Non- metropolitan areas were gaining population through migration at the FPCA level at a rate of 2.5 per 1000 in 1980/81 whereas metropolitan areas were losing at a rate of 5.1 per 1000. Further insights into this differentiation can be gained by utilising the density classification of FPCAs outlined in Section 3.5 to analyse important decentralisation processes evident from the 1981 Census migration figures.

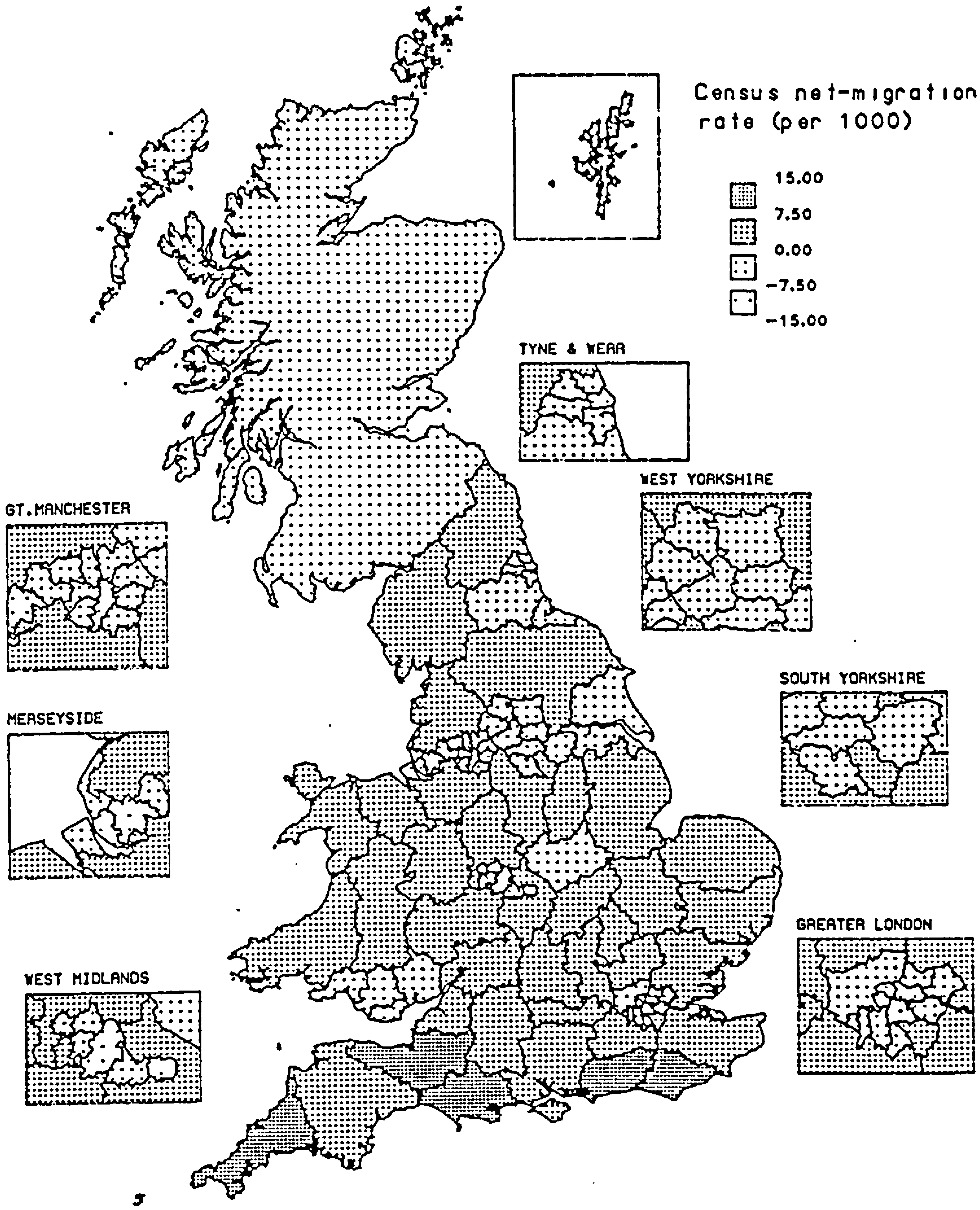


Figure 6.2 Net migration rates for FPCAs, 1980/81 Census

Table 6.6 Metropolitan and non-metropolitan migration patterns for inter-MNM and inter FPCA flows, 1980/81

(a) Inter-MNM

Zone	Inflow	Outflow	Netflow	In	Out	Net
				(migration rate / 1000)		
Metropolitan	409,265	427,231	-17,966	9.3	9.7	-0.41
Non-metropol	458,473	440,507	17,966	7.3	7.0	0.29
All areas	867,738	867,738	0	16.2	16.2	0.00

(b) Inter-FPCA

Zone	Inflow	Outflow	Netflow	In	Out	Net
				(migration rate / 1000)		
Metropolitan	463,271	562,448	-99,177	26.1	31.7	-5.68
Non-metropol	839,992	740,815	99,177	23.5	20.7	2.77
All areas	1,303,263	1,303,263	0	24.3	24.3	0.00

6.3.2 The effect of population density upon migrants

The total number of migrants into and out of FPCAs grouped within the four population density categories are presented in Table 6.7. Inflow and outflow figures include inter-zonal migrants who move between FPCAs in the same density class so it is the netflow figures which give an indication of the general direction of movement. Both high and medium-high density areas lost considerably during 1980/81 with the former losing over 71 thousand persons through migration. The two lower-density categories made large gains of over 43 and 51 thousand for medium-low and low density areas respectively. Translating these figures into rates per 1000 (Table 6.8) indicates that the highest net rate was found in the high density category where 6.6 per 1000 population were lost through migration during the census year, with low density FPCAs experiencing the largest gain during the period (3.3 per 1000).

The extent of migrant movement between the density categories can be expressed as percentage figures. In Table 6.9, inter-category migration as a percentage of the total out-migration from each density classification is presented in section (a). For example, 41% of all migrants whose origin was recorded as an FPCA within the high density category moved to an FPCA within the same category. This illustrates the importance of short-distance migration activity within Greater London in particular. For each origin category, approximately one third of all out-migrants chose a medium-low density FPCA as a destination. FPCAs of medium-high density were the least attractive to out-migrants, receiving only 11% of the total out-migration from each of the other three density categories. Section (b) illustrates migration flows as a percentage of total

Table 6.7 Gross and net migration flows for population density categories, 1980/81

Density category	Inflow	Outflow	Netflow
High	325,358	397,281	-71,923
Medium-high	161,551	183,997	-22,446
Medium-low	456,212	413,208	43,004
Low	351,812	300,447	51,365
All FPCAs	1,294,933	1,294,933	0

Table 6.8 Gross and net migration rates for population density categories, 1980/81

Density category	Inrate	Outrate (per 1000 population)	Netrate
High	30.0	36.6	-6.6
Medium-high	19.5	22.2	-2.7
Medium-low	24.4	22.1	2.3
Low	22.4	19.1	3.3
All FPCAs	24.2	24.2	0.0

Table 6.9 <u>Migration in, out and distribution percentages for flows between population density categories</u>

(a) Out-migration

Origin	Destination: High	Med-high	Med-low	Low	All FPCAs
	(Percentage of total out-migration)				
High	41	11	32	16	100
Med-high	21	22	33	24	100
Med-low	19	11	39	31	100
Low	15	11	35	39	100

(b) In-migration

Destination	Origin: High	Med-high	Med-low	Low	All FPCAs
	(Percentage of total inter-FPCA migration)				
High	50	12	24	14	100
Med-high	27	25	28	20	100
Med-low	28	13	36	23	100
Low	18	13	36	33	100

(c) Distribution proportions

Origin	Destination: High	Med-high	Med-low	Low	All FPCAs
	(Percentage of total inter-FPCA migration)				
High	12.6	3.4	9.8	4.9	30.7
Med-high	3.0	3.1	4.7	3.4	14.2
Med-low	6.0	3.5	12.5	9.9	31.9
Low	3.5	2.5	8.2	8.9	23.2
All FPCAs	25.1	12.5	35.2	27.2	100.0

in-migration. One half of all migrants entering high density FPCAs moved from an FPCA within the same density category. Significantly 24% of in-migrants to high density areas originated from medium-low density FPCAs whereas only 14% originated from the low density category. The medium-low density FPCAs appear to have been important generators as well as attractors of migrants during the 1980/81 period.

In terms of total outflows and inflows, the high density areas were relatively more important as generators of migration with 31% of total in-migration originating in these FPCAs compared to only 25% of migrants choosing them as a destination (section (c) of Table 6.9). The medium-low and low density FPCAs were more important as attractors than generators of migration. The pattern of net movement away from the most highly urbanised areas is confirmed, therefore, with consequent net increases in the FPCAs of the least urbanized areas of Britain.

Table 6.9 (section (c)) also illustrates migrant flows as a percentage of total inter-FPCA migration and emphasises the importance of movement within high density and medium-low density areas (12.6% and 12.5% of total figure respectively). Significant migration flows were also evident between high and medium low density FPCAs (9.8%) and between the latter and low density areas (9.9%).

The rates in Table 6.10 represent disaggregations of the out and in-migration rates of Table 6.8 into individual inter-category figures. Section (a) uses origin population as the denominator in the rate calculation whereas Section (b) uses population at the destination. The highest rates of migration were found within high density areas where 15 per 1000 persons moved between FPCAs. The

Table 6.10 Out, in and net migration rates for inter-zonal flows between population density categories, 1980/81

(a) Out-migration

Origin	Destination High	Med-high	Med-low	Low	All FPCAs
	(Migration rate - origin based)				
High	15.0	4.1	11.7	5.9	36.6
Med-high	4.7	4.8	7.4	5.4	22.2
Med-low	4.2	2.4	8.7	6.8	22.1
Low	2.9	2.1	6.8	7.4	19.1

(b) In-migration

Origin	Destination High	Med-high	Med-low	Low	All FPCAs
	(Migration rate - destination based)				
High	15.0	3.6	7.2	4.2	30.0
Med-high	5.3	4.8	5.5	3.9	19.5
Med-low	6.8	3.3	8.7	5.7	24.4
Low	4.0	2.8	8.1	7.4	22.4

(c) Net migration

Origin	Destination High	Med-high	Med-low	Low	All FPCAs
	(Percentage of total inter-FPCA migration)				
High	-	-0.5	-4.5	-1.7	-6.6
Med-high	0.6	-	-1.9	-1.5	-2.7
Med-low	2.6	0.9	-	-1.1	2.3
Low	1.1	0.7	1.3	-	3.3

out-migration rate from these high density FPCAs to medium low areas was also significantly high (11.7 per 1000). Out-migration rates from other areas to high density areas were relatively low as were the rates of out-migration to medium-high density FPCAs from elsewhere. If these out-migration figures are compared with the in-migration rates in section (b) quite significant net rates result. The figures in Section (c) indicate, for example, that high density FPCAs lost in net migration terms to medium low density areas at a rate of 4.5 per 1000. High density areas also suffered a loss in net terms to medium-high and low density areas. Medium-high density FPCAs gained migrants from higher density areas but lost to the lower density classes. Medium-low density FPCAs lost migrants in net terms only to the low density category which itself gained from all three higher density classes.

The dominant patterns highlighted are therefore significant movement within high density areas with net migration losses evident for flows between this and other density categories. The net loss from high density to medium low density FPCAs was particularly significant, suggesting substantial movement away from Greater London into the counties of the South East, South West and East Midlands. A further disaggregation of FPCAs by density category in the North and South of the country enables the extent of such movement in the internal migration system to be identified.

Table 6.11 illustrates gross and net flows and rates for population density categories in both North and South. The general pattern is one of net loss from the North to the South. Of the FPCAs in the North, only those of low density gained through migration in 1980/81. The high and medium-high density categories of the North

Table 6.11 Gross and net flows and rates for Northern and Southern density categories, 1980/81

(a) Flows

Category	Inflow	Outflow	Netflow
N High	91,048	123,076	-32,028
N Medium-high	130,728	153,843	-23,115
N Medium-low	113,985	113,997	-12
N Low	141,751	130,692	11,059
NORTH	477,512	521,608	-44,096
S High	234,310	274,205	-39,895
S Medium-high	30,823	30,154	669
S Medium-low	342,227	299,211	43,016
S Low	210,061	169,755	40,306
SOUTH	817,421	773,325	44,906
All FPCAs	1,294,933	1,294,933	0

(b) Rates

Category	Inrate	Outrate	Netrate
N High	20.1	27.2	-7.1
N Medium-high	18.4	21.7	-3.3
N Medium-low	17.4	17.4	0.0
N Low	15.8	14.6	1.2
NORTH	17.6	19.2	-1.6
S High	37.1	43.4	-6.3
S Medium-high	25.8	25.2	0.6
S Medium-low	28.2	24.6	3.5
S Low	31.0	25.1	6.0
SOUTH	30.9	29.2	1.7
All FPCAs	24.2	24.2	0.0

lost in net terms at rates of -7.1 and -3.3 per 1000 respectively. This negative net rate for high density FPCAs of the North was higher than corresponding areas in the South although gross flows in the highly urbanized areas of the South were considerably larger. Each of the three lower density categories of the South gained through migration in 1980/81 with low-density FPCAs gaining at a rate of 6 per 1000 population. In terms of actual numbers the medium-low and low density FPCAs of the Southern half of Britain gained approximately 83 thousand migrants at the expense of more highly urbanised areas of the North and South.

Figure 6.3 illustrates the discrepancies between out and in-migration rates (using origin and destination populations respectively as the denominator) for migrant flows between all density categories in the North and South. By far the highest rate of migration was evident for moves within the high density FPCAs of Greater London (20 per 1000). Apart from this, movement between Greater London's high density areas and from these areas to the medium-low density FPCAs of the South East and the East Midlands was the most substantial. Also of importance was the flow of migrants between the medium-low density areas and the more rural areas of the southern half of Britain. The patterns of net migration produced from these gross rate figures (Table 6.12) indicate that high density FPCAs of the North lost in net migration terms to FPCAs in all other density classifications. The most substantial rates of net loss were suffered with respect to other FPCAs in the North particularly those of medium-low and low density. A quite substantial net loss was also made to those southern FPCAs in the medium-low category. All the Northern categories suffered net losses through migration to the

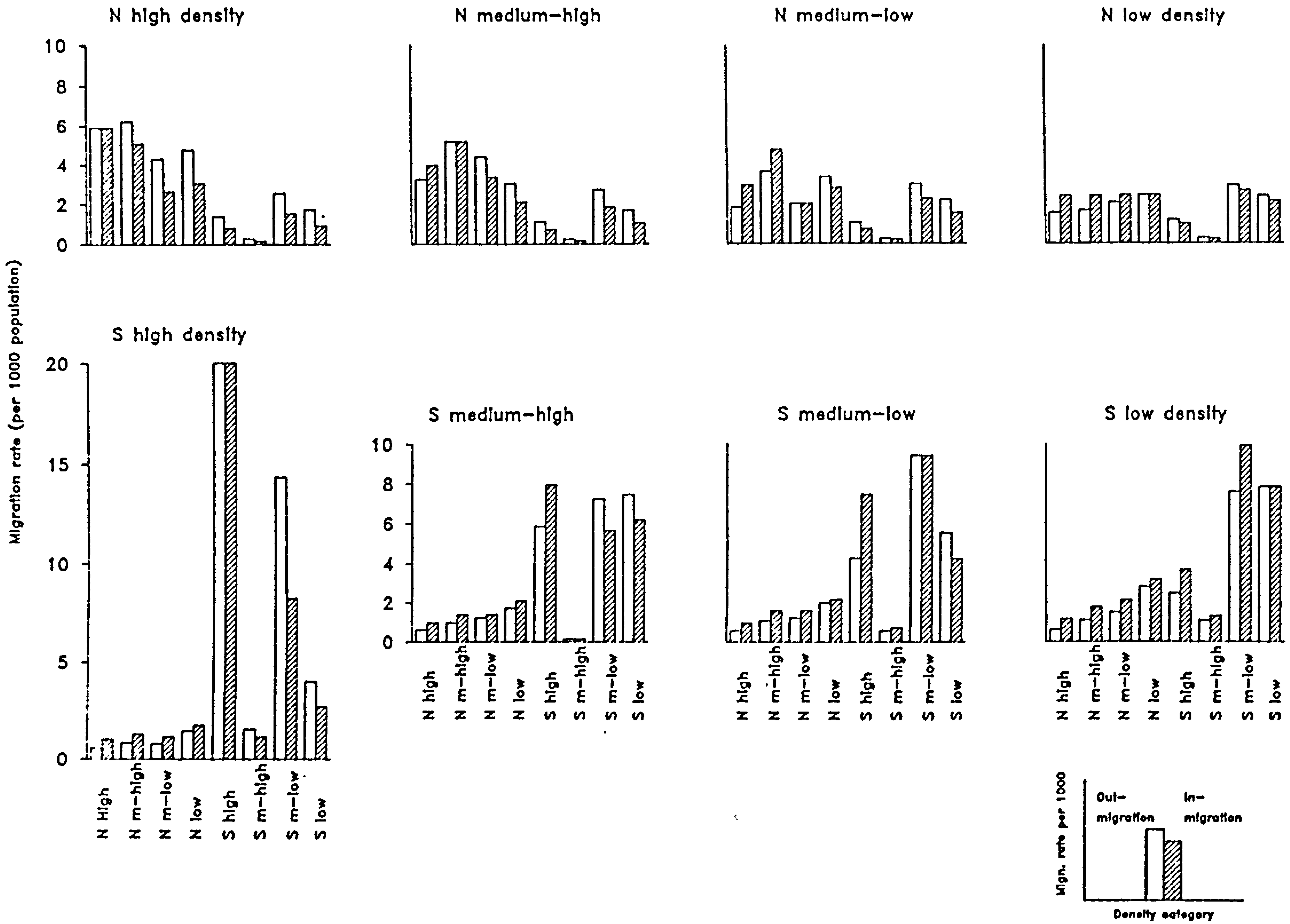


Figure 6.3 In and out-migration rates for migrant flows between density categories in the North and South, 1980/81

Table 6.12 Net migration rates for individual inter-category flows

	Destination								
	NORTH				SOUTH				
Origin	high	med/h	med/l	low	high	med/h	med/l	low	All
N high	-	-1.14	-1.67	-1.73	-0.60	-0.09	-1.02	-0.81	-7.07
N med/h	0.73	-	-1.05	-0.94	-0.39	-0.07	-0.89	-0.64	-3.26
N med/l	1.15	1.13	-	-0.54	-0.33	-0.03	-0.75	-0.65	0.00
N low	0.87	0.75	0.39	-	-0.20	-0.05	-0.24	-0.28	1.23
S high	0.43	0.44	0.34	0.29	-	-0.40	-6.13	-1.30	-6.32
S med/h	0.36	0.42	0.16	0.37	2.10	-	-1.58	-1.27	0.56
S med/l	0.38	0.52	0.40	0.18	3.19	0.16	-	-1.28	3.54
S low	0.54	0.67	0.63	0.37	1.21	0.22	2.30	-	5.95
ALL	0.60	0.43	0.00	-0.21	0.74	-0.01	-0.80	-0.75	-

southern FPCAs. Northern FPCAs gained only at the expense of other areas of the North.

In the South the most striking feature was the loss of over 6 migrants per 1000 population from high to medium-low density FPCAs. The corresponding net gain figure for the latter is approximately 3.2 per 1000. Greater London FPCAs gained from areas in the North but lost to all lower density categories of the South. The low density areas exhibited significant net gains from all other areas. Further examination of these spatial patterns of migration can now be undertaken using data sets which are age and sex- disaggregated. Section 6.3.3 uses gross in and out-migrant flows at the FPCA level to illustrate the differences between urban and more rural areas by five-year age-group and sex.

6.3.3 <u>Patterns of age and sex-disaggregated migration</u>

The total number of male internal migrants exceeded the number of females migrating in 1980/81 and rates of migration were approximately 25 and 23 per 1000 for males and females respectively (Table 6.13). The most mobile age-group was that of the 20-24 year-olds, particularly females (71 per 1000) with high rates also evident for both sexes in the 25-29 age-range (60 and 54 per 1000). The rate of migration declined steadily from age-group 20-24 onwards but increased significantly in the female 60-64 age-group and male 60-69 age-range, reflecting the importance of retirement movement.

The geographical pattern of migration in 1980/81 was generally one of gains to non-metropolitan areas in almost all age-groups at the expense of losses from metropolitan zones (Figure 6.4). Only female 15-19 year-olds and male 20-24 year-olds showed positive net migration rates in metropolitan areas. The variation between sexes

Table 6.13 National age and sex-disaggregated inter-FPCA migration flows and rates, 1980/81

(a) Migration flows

Age-group	Males	Females	Persons
1-4	42,483	40,148	82,631
5-9	40,069	37,931	78,000
10-14	32,822	31,160	63,982
15-19	58,808	53,593	112,401
20-24	125,279	138,571	263,850
25-29	109,163	95,951	205,114
30-34	79,408	65,333	144,741
35-39	45,955	35,474	81,429
40-44	28,490	21,785	50,275
45-49	20,582	16,855	37,437
50-54	16,936	15,651	32,587
55-59	14,596	16,902	31,498
60-64	14,038	17,568	31,606
65-69	14,625	14,994	29,619
70-74	8,615	11,775	20,390
75+	8,401	20,972	29,373
TOTAL	660,270	634,663	1,294,933

(b) Migration rates (per 1000)

Age-group	Males	Females	Persons
1-4	25.7	25.6	25.7
5-9	22.0	22.0	22.0
10-14	15.0	15.0	15.0
15-19	25.8	24.5	25.2
20-24	62.5	70.9	66.7
25-29	60.0	53.4	56.7
30-34	39.4	32.7	36.1
35-39	27.0	21.0	24.0
40-44	18.4	14.2	16.3
45-49	13.8	11.4	12.6
50-54	11.1	10.1	10.6
55-59	9.5	10.4	9.9
60-64	10.7	11.9	11.4
65-69	12.1	10.3	11.1
70-74	9.0	9.0	9.0
75+	8.5	10.2	9.6
TOTAL	25.3	23.1	24.2

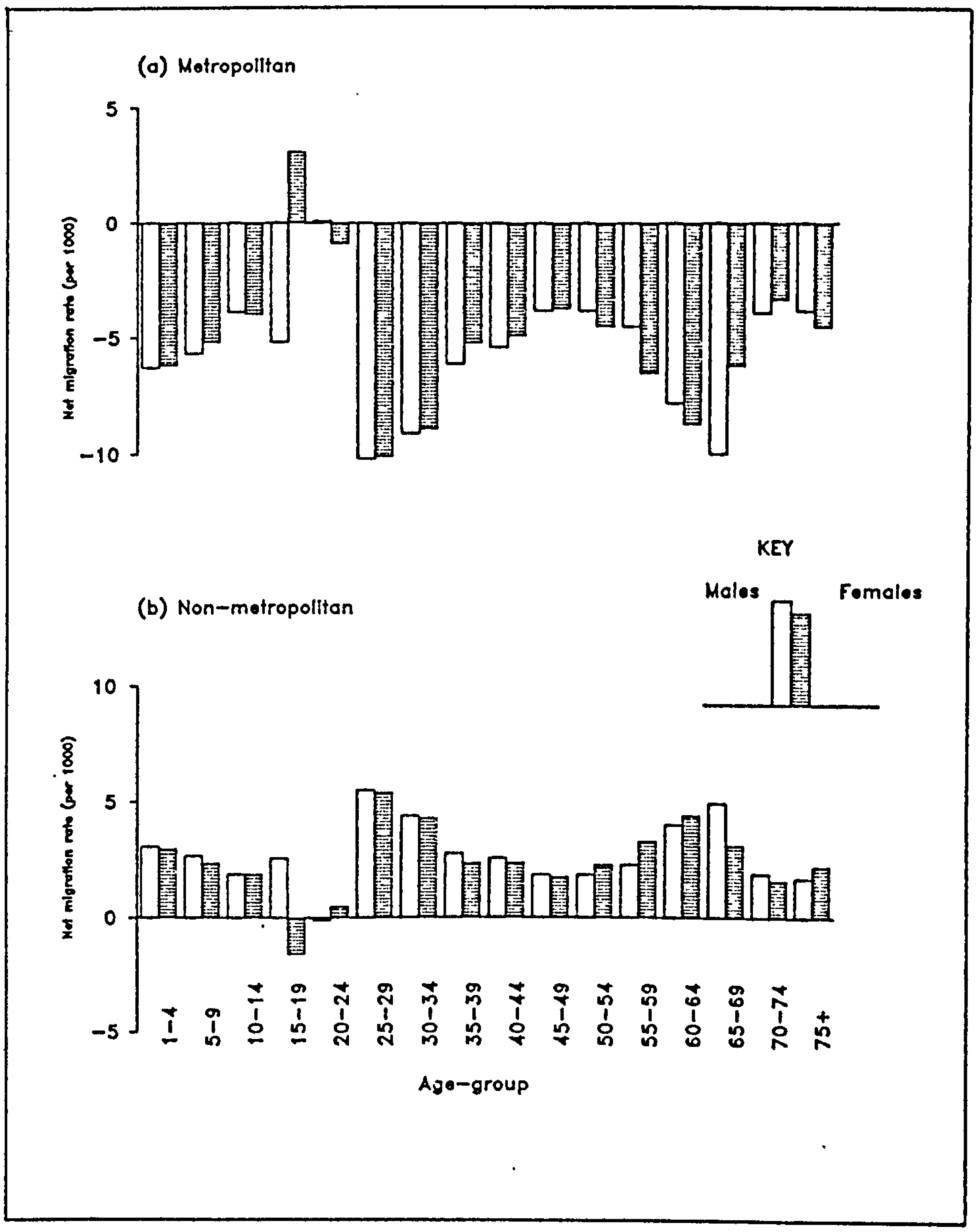


Figure 6.4 Net migration rates for metropolitan and non-metropolitan zones by five-year age-group and sex, 1980/81

for different age-groups was relatively minor with the exception of the aforementioned age-groups. Male 15-19 year-olds experienced a substantially negative net rate of migration in metropolitan areas (-5.2 per 1000) compared to a net gain of over 3 per 1000 for females. The pattern was reversed in the 20-24 age-group but with much smaller net rate figures evident.

The highest rates of net loss from metropolitan zones, and highest rates of net gain to non-metropolitan zones, were found in the 25-34 and 60-69 age ranges for both sexes. Negative net rates of over 10 per 1000 were found in the 25-29 male and female age category for metropolitan zones with only slightly lower figures in the 30-34 age-group. The rate of net gain in non-metropolitan areas was approximately 5.5 and 4.4 per 1000 (both sexes) for the 25-29 and 30-34 age-group respectively. The rate of net loss from metropolitan zones in the 65-69 age-group was -10 per 1000 for males compared to -6.2 per 1000 for females. In the 60-64 age-range the female figure exceeded that of males (-8.7 compared to -7.8 per 1000). These net rate patterns were reflected in the positive net rates exhibited by non-metropolitan areas in the respective age-groups.

The metropolitan/non-metropolitan split is sufficiently crude to conceal variations that exist, particularly between Greater London and other metropolitan zones. However the density classification can be used to examine the effect of degree of urbanisation upon the net movement of migrants by five-year age-group and sex. Figure 6.5 illustrates the pattern of net rates evident for classifications of FPCAs in the North during 1980/81. All age-groups in the high and medium-high density categories experienced negative net rates in 1980/81. These two categories include all metropolitan districts

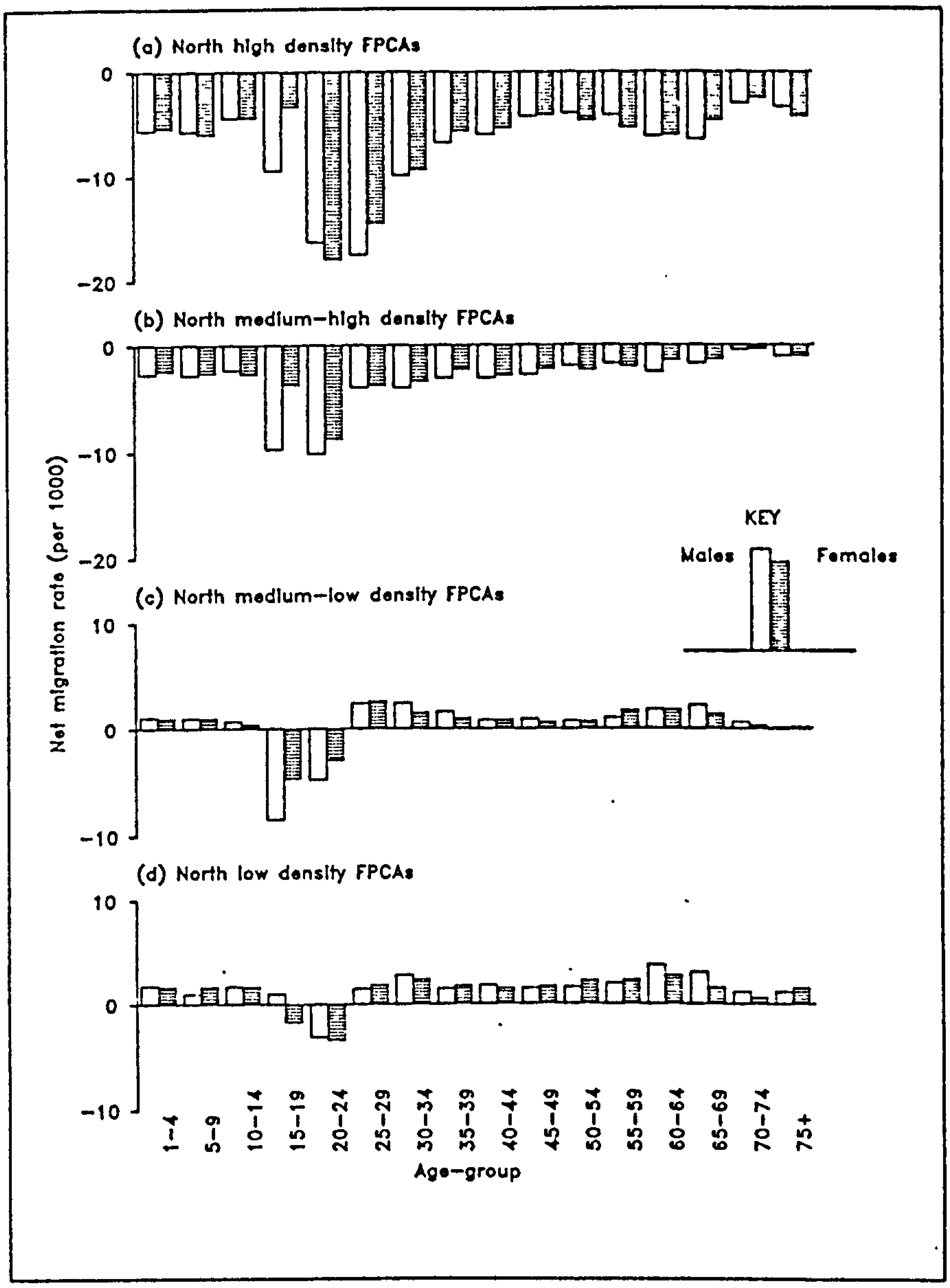


Figure 6.5 Net migration rates for density-classified FPCAs of the North by five-year age-group and sex, 1980/81

outside Greater London. The high density category includes the 'big-city' FPCAs of Birmingham, Manchester, Liverpool and Newcastle and experienced the largest net losses during the period, particularly in the 20-24 and 25-29 age-groups where between 14 and 20 per 1000 migrants were lost in net terms by both sexes. Important decentralising processes were therefore in operation in the North during 1980/81 with considerable net losses from the most highly urbanised areas but the net gain in the less dense areas of the North did not occur at the same rates as the losses from the more densely populated areas. In the medium-low density areas of the North, all age-groups of both sexes gained in net terms through migration with the exception of those aged 15-19 and 20-24. The net loss was greatest for 15-19 year-olds, particularly males (-8.5 per 1000). The pattern was similar in the lowest density areas although males aged 15-19 experienced a small positive net migration rate in 1980/81. Positive net rates in the medium-low and low density FPCAs were not significantly high, suggesting important net losses from the high density areas of the North to the South. This is emphasised in Table 6.14 which indicates that when all FPCAs in the North are grouped together, only male 65-69 year-olds gained in net migration terms during 1980/81. The largest net gains per 1000 in the South were found in the 20-24 and 15-19 age-groups with male gains being greater than female particularly for 15-19 year-olds. In the older age-groups net rate figures were relatively small but all positive with the exception of the 65-69 male age-group.

High density FPCAs in the South (Figure 6.6), which are equivalent to all London Boroughs with the exception of Bromley, suffered negative net rates of migration for all but the 15-19 and

Table 6.14 Net migration rates for both sexes in North/South categories by five-year age-group, 1980/81

Age-group	North males	North females	South males	South females
	(net migration rate per 1000)			
0-4	-0.81	-0.72	0.85	0.76
5-9	-1.08	-0.87	1.17	0.94
10-14	-0.61	-0.81	0.69	0.90
15-19	-5.90	-3.22	6.36	3.49
20-24	-7.73	-7.30	7.97	7.49
25-29	-2.94	-2.13	2.94	2.09
30-34	-1.07	-1.14	1.05	1.10
35-39	-0.92	-0.58	0.90	0.56
40-44	-0.97	-0.89	0.99	0.91
45-49	-0.67	-0.53	0.69	0.57
50-54	-0.47	-0.46	0.50	0.49
55-59	-0.28	-0.26	0.30	0.27
60-64	-0.10	-0.07	0.11	0.09
65-69	0.05	-0.19	-0.03	0.20
70-74	-0.06	-0.19	0.08	0.20
75+	-0.35	-0.43	0.36	0.46
TOTAL	-1.81	-1.37	1.86	1.41

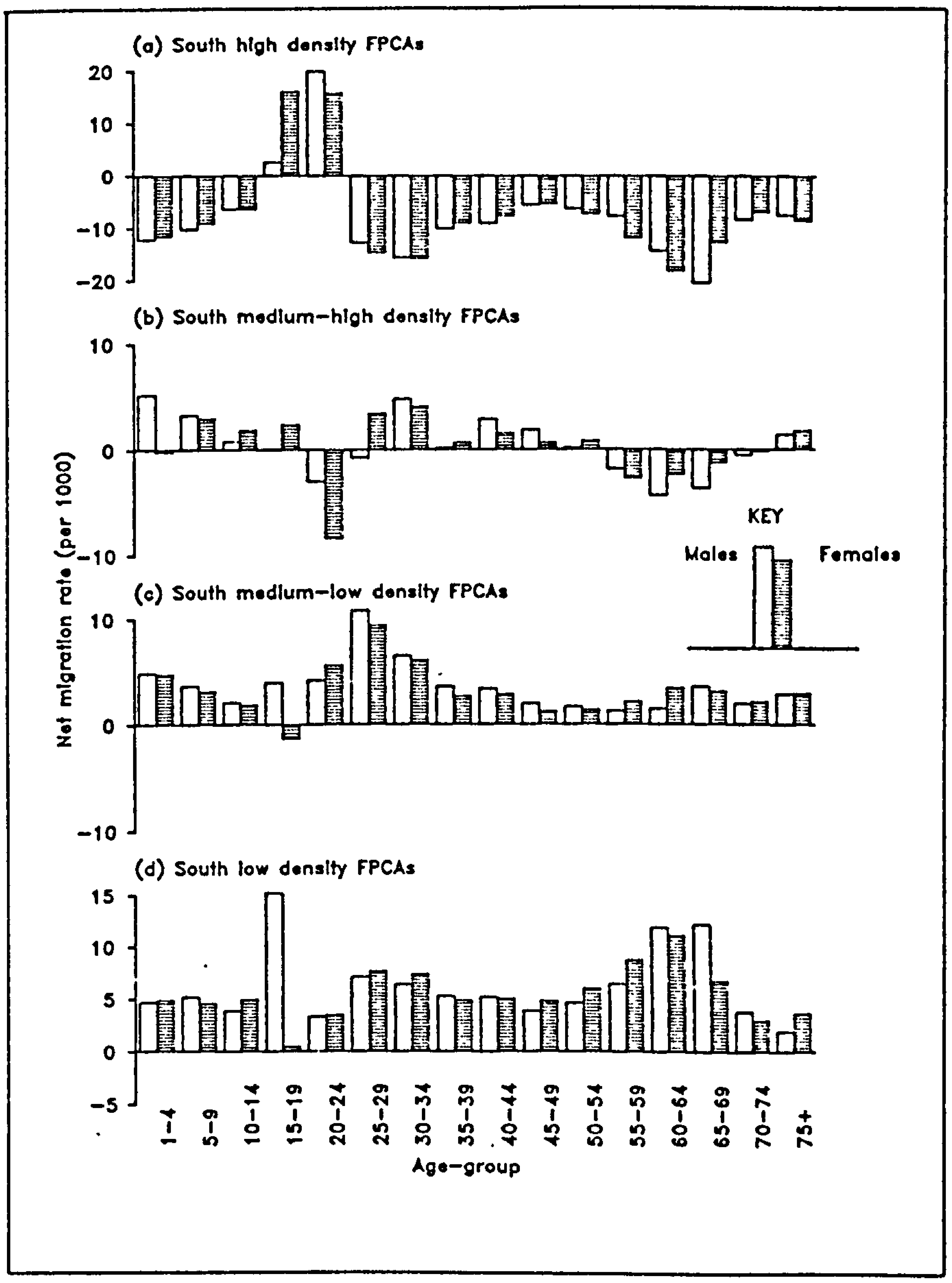


Figure 6.6 Net migration rates for density-classified FPCAs of the South by five-year age-group and sex, 1980/81

20-24 age-groups. Rate values were considerably higher for all age-groups relative to other density categories emphasising the importance of Greater London as a generator and attractor of migrants within Britain. The highest rates of net loss per 1000 population in these high-density FPCAs were exhibited by the retirement age-groups, particularly males aged 65-69 and females aged 60-64, whilst persons aged between 25 and 34 also experienced rates of net loss in 1980/81 from Greater London in excess of 15 per thousand.

The losses from the more urbanised areas were mirrored by positive net rates for almost all age-groups in the lower density categories of the South. Exceptionally high rates of net gain were experienced by low density areas of the South West and East Anglia in the 60-69 age-range. The highest rates for the medium-low density areas of the South East and East Midlands were found in the 25-34 age-range. This reflects the importance of family migration into the commuter belt of Greater London and the attraction of the most rural areas of Southern England to those persons of retirement age.

A further notable feature was the very large positive net rate experienced by 15-19 year-old males in low density FPCAs. This is very likely to be related to the recruitment, discharge and posting of Armed Forces personnel to counties such as Devon, Cornwall, Wiltshire, Norfolk and Lincolnshire.

6.4 VARIATION IN THE PATTERN OF MIGRATION BETWEEN SUCCESSIVE CENSUSES

6.4.1 Introduction

Although recent Censuses have collected detailed information on migration within the UK, they only provide a cross-sectional view of the patterns of migration during a single year period. Temporal trends are difficult to discern when linking censuses due to the ten-year gap between successive enumerations. It is important, however, to outline differences between 1970/71 and 1980/81 Census information at a fairly disaggregate level to provide a context for the time-series analyses of NHSCR data. Almost 11% of the population of Great Britain changed usual residence at least once during the year prior to the 1971 Census. The majority (79%) of these migrants moved within an MNM region whereas only 21% crossed an MNM boundary. By 1980/81 the total number of migrants measured only 8.8% of the total population with 7.2% moving within and 1.6% between MNM regions (Table 6.15). The overall fall in the level of migration was approximately 19% although the decrease in the amount of longer-distance movement was much more substantial. The number of migrants moving between MNM regions fell by approximately 29% over the ten-year period compared to a drop of only 16.5% for intra-MNM flows. Subsequent sections will examine these overall trends at a more disaggregate level, outlining spatial variations and differences by age-group and sex. A doubly constrained spatial interaction model is used to examine the changing effect of distance upon the level of movement by zone, age and sex between 1970/71 and 1980/81.

6.4.2 Inter-censal trends in migration at a sub-national level

The spatial scale used for the inter-censal comparison distinguishes between non-metropolitan and metropolitan (including Greater London) zones. Table 6.16 outlines the aggregate level and rate of movement to and from these zone categories in 1970/71 and 1980/81. The net loss from metropolitan zones decreased considerably over the period from 178 to 91 thousand with a corresponding decrease in the net gain

Table 6.15 Aggregate migration flows and rates at the MNM level 1970/71 and 1980/81

	1970/71	1980/81	%age change
(a) Flows			
Intra-MNM	4,655,310	3,885,527	-16.54
Inter-MNM	1,214,240	859,408	-29.22
Total	5,869,550	4,744,935	-19.16
(b) Rates (per 1000)			
Intra-MNM	87.0	71.6	-17.64
Inter-MNM	22.7	15.8	-30.40
Total	109.7	87.5	-20.23

Note: rate values differ from Table 6.1 due to the different population-at-risk used as the denominator (mid-year estimates as opposed to usually resident)

Table 6.16 Aggregate inter-MNM migration flows and rates for metropolitan and non-metropolitan zones, 1970/71 and 1980/81

(a) Flows (000s)

	1971			1981			1971-1981 %age change	
	In	Out	Net	In	Out	Net	In	Out
Metropolitan	316	494	-178	226	317	-91	-28.4	-35.8
Non-metropol	898	720	178	633	542	91	-29.5	-24.7
All areas	1214	1214	0	859	859	0	-29.2	-29.2

(b) Rates (per 1000)

	1971			1981			1971-1981 %age change	
	In	Out	Net	In	Out	Net	In	Out
Metropolitan	16.6	25.9	-9.3	12.6	17.7	-5.1	-23.8	-31.7
Non-metropol	26.1	20.9	5.2	17.4	14.9	2.5	-33.2	-28.6
All areas	22.7	22.7	0.0	15.8	15.8	0.0	-30.2	-30.2

to non-metropolitan areas. The largest percentage decrease was observed in the level of out-migration from metropolitan zones (-36%) and the smallest change involved migrants from non- metropolitan areas (-25%).

The reduction in the rate of out-migration from metropolitan regions was matched by a similar reduction in the rate of in-migration to non-metropolitan zones, with both values falling to below 18 per 1000 from approximately 26 per 1000 in 1970/71. The rate of in-migration to metropolitan zones showed the smallest decrease with a value of 12.6 per 1000 in 1980/81 reflecting a 24% decline over the ten-year period. The rate of out-migration from non-metropolitan areas decreased by a more considerable margin (-29%). Net rates of migration decreased as a result with a net loss of over 5 per 1000 from metropolitan areas in 1980/81 compared to a figure of -9.3 per 1000 in 1970/71. Corresponding net rate values for non-metropolitan areas were 2.5 and 5.2 per 1000 for 1980/81 and 1970/71 respectively.

Table 6.17 disaggregates the migrant flows into individual MNM zones distinguishing between the seven metropolitan counties and the remaining non-metropolitan regions. Of the former, the largest reduction over the period was evident for out-migration from Greater London with a 41% decrease in the number of persons leaving the capital between 1970/71 and 1980/81. The level of out-migration from metropolitan areas of the North West was also significantly curtailed with declines of 39% and 38% from Merseyside and Greater Manchester respectively. The decline in persons leaving Merseyside was matched also by a substantial drop in the level of in-migration (-36%). The outmigration variations were reflected in the large decreases in the

Table 6.17 Gross migration flows for MNM regions in 1970/71 and 1980/81 and percentage change over the period

Region	1970/71 In	1970/71 Out	1980/81 In	1980/81 Out	%age change In	%age change Out
(a) Metropolitan zones						
TYNE/WR	19,030	26,250	12,549	18,928	-34.1	-27.9
W.YORKS	31,160	38,390	22,647	27,652	-27.3	-28.0
S.YORKS	19,020	25,690	14,946	17,546	-21.4	-31.7
G-LOND	140,330	247,050	107,457	146,797	-23.4	-40.6
W.MIDS	41,550	61,190	27,992	43,771	-32.6	-28.5
GT.MAN	41,170	54,420	25,505	37,372	-38.0	-31.3
MERS.	23,980	41,270	15,246	25,123	-36.4	-39.1
SUB-TOTAL	316,240	494,260	226,342	317,189	-28.4	-35.8
(b) Non-metropolitan zones						
SCTLAND	45,660	60,000	36,955	41,363	-19.1	-31.1
NOR-REM	41,220	39,290	27,669	28,882	-32.9	-26.5
YH-REM	42,750	40,230	29,829	28,546	-30.2	-29.0
E.MIDS	84,400	72,880	63,669	54,840	-24.6	-24.8
E.ANGL	60,710	39,760	44,236	33,197	-27.1	-16.5
SE-REM	309,930	219,980	206,156	164,310	-33.5	-25.3
S.WEST	126,600	90,700	90,685	68,963	-28.4	-24.0
WM-REM	71,810	62,390	54,651	47,707	-23.9	-23.5
NW-REM	72,430	53,710	45,442	41,366	-37.3	-23.0
WALES	42,490	41,040	33,774	33,045	-20.5	-19.5
SUB-TOTAL	898,000	719,980	633,066	542,219	-29.5	-24.7
TOTAL	1,214,240	1,214,240	859,408	859,408	-29.2	-29.2

amount of in-migration to the South-East remainder and the North West remainder (-34% and -37% respectively) illustrating the importance of migration from these urban areas to their surrounding non-metropolitan counties. The reduction in the level of out-migration from the non-metropolitan zones was generally less severe with the exception of Scotland which experienced a relatively small fall in the number of in-migrants but a large decrease in the counter-flow.

Illustration of the gross migration rate figures (Table 6.18) indicates that, with respect to in-movement to metropolitan zones, migrants to Greater London showed the least variation with a fall of only 15% over the ten-year priod, from 19 to 16 per 1000. This was in contrast to the metropolitan regions of Merseyside, Greater Manchester, Tyne and Wear and the West Midlands which experienced considerable reductions (between 29 and 35%) in their rates of in-migration between 1970/71 and 1980/81. The drop in the rate of out-migration from Greater London was considerable with a figure of 33 per 1000 in 1970/71 falling to approximately 22 per 1000 in 1980/81. With the capital being such an important source of migrants, a reduction of 34% in the level of out-migration affected in-migration rates throughout Britain but particularly those directed to the remainder of the South-East where the rate of in-movement fell from 33 per 1000 to just over 20 per 1000 during the ten-year period. East Anglia and the North West remainder also suffered particularly large reductions in their rates of in-migration.

The net figures produced from these gross rates are illustrated in Figure 6.7. In 1970/71 there was considerable variation in the rates of net migration. Although all metropolitan zones experienced negative net rates, Greater London and Merseyside experienced

Table 6.18 Gross migration rates for MNM regions in 1970/71 and 1980/81 and percentage change over the period

Region	1970/71 In	1970/71 Out	1980/81 In	1980/81 Out	%age change In	%age change Out
(a) Metropolitan zones						
TYNE/WR	15.9	21.9	11.0	16.6	-30.7	-24.2
W.YORKS	15.2	18.7	11.1	13.6	-26.8	-27.4
S.YORKS	14.5	19.6	11.5	13.5	-20.9	-31.2
G-LOND	18.9	33.3	16.0	21.9	-15.4	-34.4
W.MIDS	15.0	22.1	10.6	16.6	-29.4	-25.1
GT.MAN	15.2	20.1	9.9	14.5	-35.2	-28.2
MERS.	14.7	25.2	10.2	16.7	-30.8	-33.7
SUB-TOTAL	16.6	25.9	12.6	17.7	-23.8	-31.7
(b) Non-metropolitan zones						
SCTLAND	8.9	11.7	7.1	7.9	-20.4	-32.2
NOR-REM	21.7	20.6	14.3	14.9	-34.1	-27.8
YH-REM	29.3	27.6	19.7	18.8	-32.9	-31.8
E.MIDS	23.5	20.3	16.7	14.4	-28.8	-28.9
E.ANGL	36.5	23.9	23.6	17.7	-35.3	-25.8
SE-REM	32.8	23.3	20.5	16.3	-37.6	-30.0
S.WEST	31.3	22.4	20.9	15.9	-33.0	-28.9
WM-REM	31.3	27.2	22.0	19.2	-29.6	-29.3
NW-REM	33.1	24.6	19.9	18.1	-40.1	-26.4
WALES	15.7	15.2	12.2	11.9	-22.8	-21.8
SUB-TOTAL	26.1	20.9	17.4	14.9	-33.2	-28.6
TOTAL	22.7	22.7	15.8	15.8	-30.2	-30.2

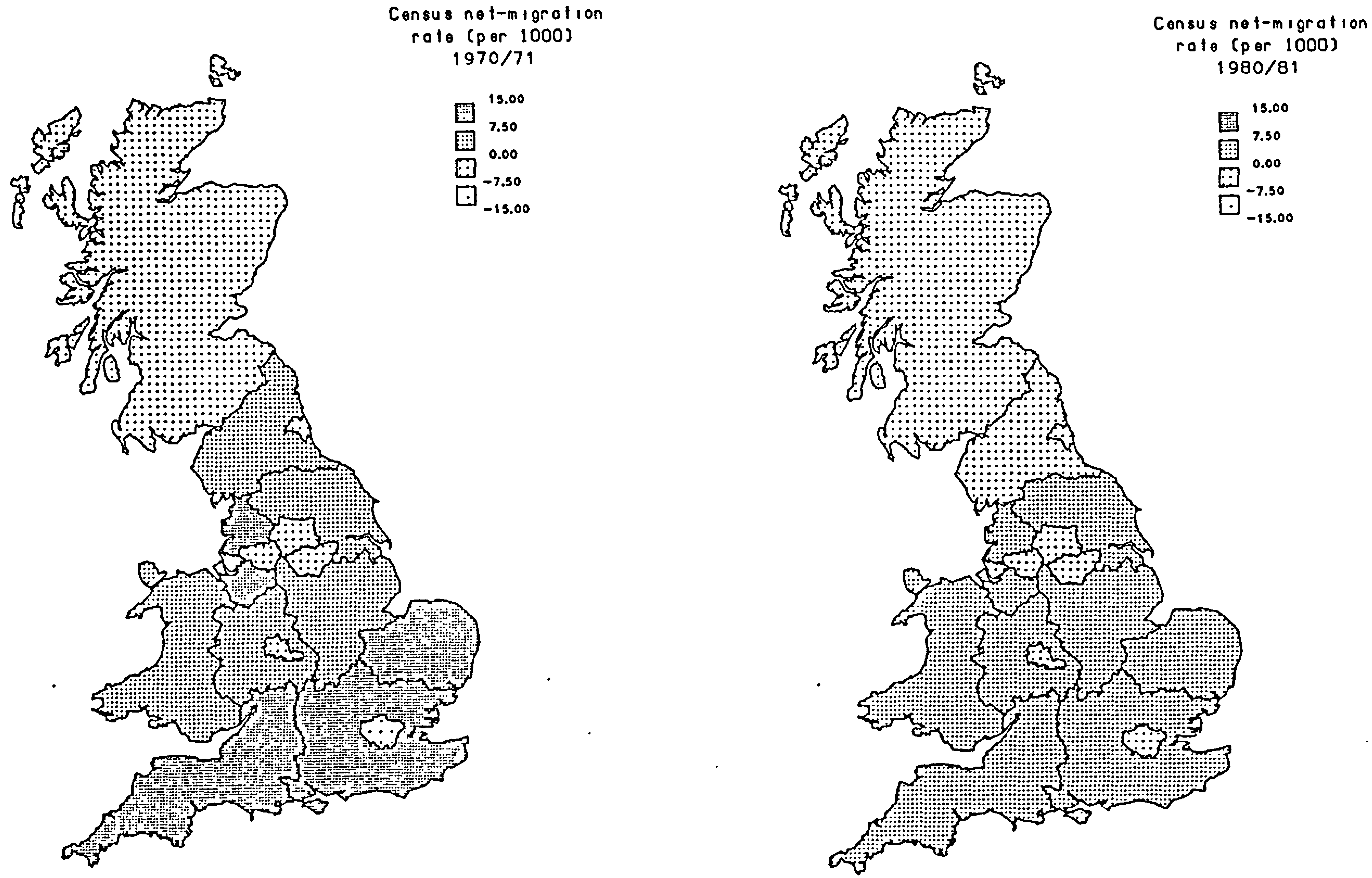


Figure 6.7 Net migration rates for MNM regions in 1970/71 and 1980/81

particularly high net losses per 1000 population (-14.4 and -10.6). Of the non-metropolitan regions only Scotland suffered a net loss in 1970/71 with the greatest gains per 1000 population made in East Anglia (12.6), South-East remainder (9.5), South-West (8.9) and the North-West remainder (8.6).

By 1980/81 the variation in the pattern of net rates had become much less pronounced. The negative net rate for Greater London fell considerably, to -5.9 per 1000, with the figures for Merseyside (-6.6) and West Midlands (-6.0) exceeding that of the capital. Of the non-metropolitan zones, both Scotland and the Northern remainder experienced net losses in 1980/81 whereas other regions reduced their rates of net gain quite considerably. The rate of net in-migration to East Anglia (5.9) and North West remainder (1.8) were significantly reduced over the ten-year period.

6.4.3 Inter-censal trends in migration by age and sex

The characteristic age-specific pattern of migration between MNM regions is evident with the peaks in mobility in 1970/71 and 1980/81 occurring in the 20-24 age-range with a significant upturn in the rate of migration in the 60-69 retirement age-groups (Table 6.19). The level of migration in 1970/71 and 1980/81 differed, however, with an average decrease in the rate of migrant movement of over 30%. The 45-54 age-range experienced the greatest percentage decline in the rate of migration over the ten-year period although the fall in the rate value was much greater in the more mobile age-groups. The migration rate for 20-24 year-olds, for example, fell from 61.5 per 1000 in 1970/71 to 41.7 per 1000 in 1980/81.

The overall drop in the rate of migration was greater for females

Table 6.19 Total inter-MNM migration rates 1970/71 and 1980/81 and percentage change 1971-1981 by five-year age-group

Age-group	Migration rate 1970/71 (per 1000)	Migration rate 1980/81 (per 1000)	%age change
1-4	31.0	20.6	-33.5
5-9	21.5	15.1	-29.7
10-14	14.6	10.3	-29.4
15-19	26.6	17.5	-34.1
20-24	61.5	41.7	-32.2
25-29	45.6	33.6	-26.2
30-34	30.3	23.2	-23.4
35-39	21.4	15.3	-28.5
40-44	15.3	10.7	-29.8
45-49	12.7	8.1	-36.4
50-54	11.1	7.0	-37.5
55-59	9.7	6.8	-29.7
60-64	10.8	7.9	-26.7
65-69	11.7	7.9	-32.4
70-74	8.5	5.9	-30.3
75+	9.0	6.3	-29.2
Total	22.7	15.8	-30.2

(31.2%) than males (29%). Decreases in rate values between 1970/71 and 1980/81 (Figure 6.8) were most notable for males and females aged 45-49 and 50-54 (between 34 and 39%) and for females aged 15-19 (39%). The largest drop during the period was in the rate of migration of the 20-24 female age-range (64.6 to 43.3 per 1000). The equivalent age-group for males also suffered a considerable decline in its migration rate value.

Total migration rates by age and sex can be disaggregated to produce in- and out-migration rate figures for metropolitan and non-metropolitan regions. Figure 6.9 illustrates 1980/81 rates as time-series indices of the 1970/71 figures, thus illustrating the substantial decline in migration evident for all age-groups. It has already been established that the rates of out-migration from metropolitan regions and in-migration to non-metropolitan regions suffered the largest decreases over the period and Figure 6.9 shows that the most significant declines were evident for the more mobile 15-19 and 20-24 age-groups in these directions. The rate of female migration fell by the most substantial amount in each case with the rate of out-migration from metropolitan zones in 1980/81 being less than 60% of that experienced ten years earlier in the 15-19 and 20-24 age-groups. Substantial decreases were also evident in the 45-54 age-range for both metropolitan out-migration and non- metropolitan in-migration. The least significant fall in the rate of migrant movement was experienced by persons, particularly males, aged between 60-74 moving into metropolitan areas. These graphs include inter-metropolitan and inter-non-metropolitan migrants in the rate figures so the extent of the changes in loss and gain by age and sex from the two regional categories can be examined. Figure 6.10

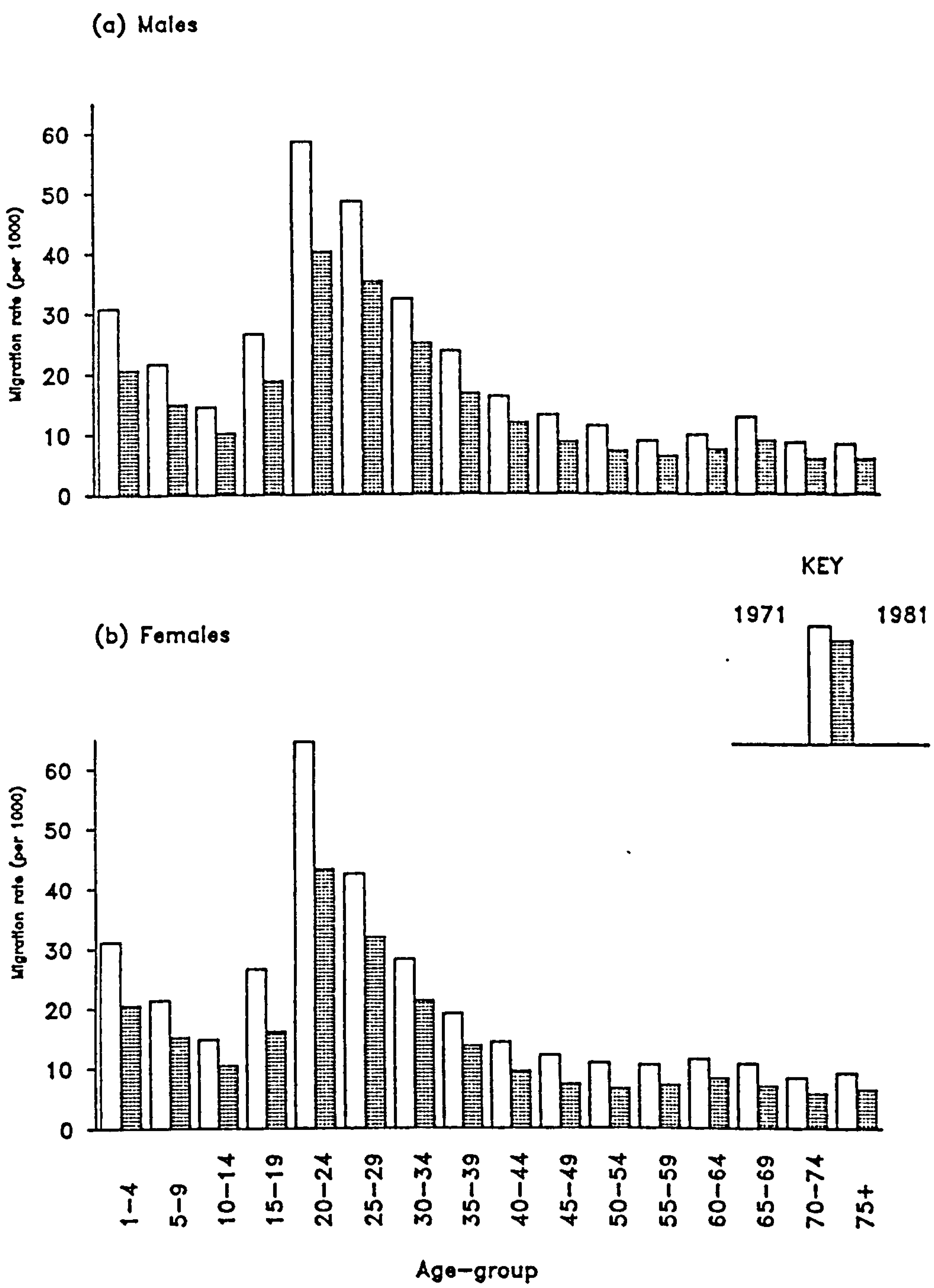


Figure 6.8 National migration rates by five-year age-group and sex, 1970/71 and 1980/81

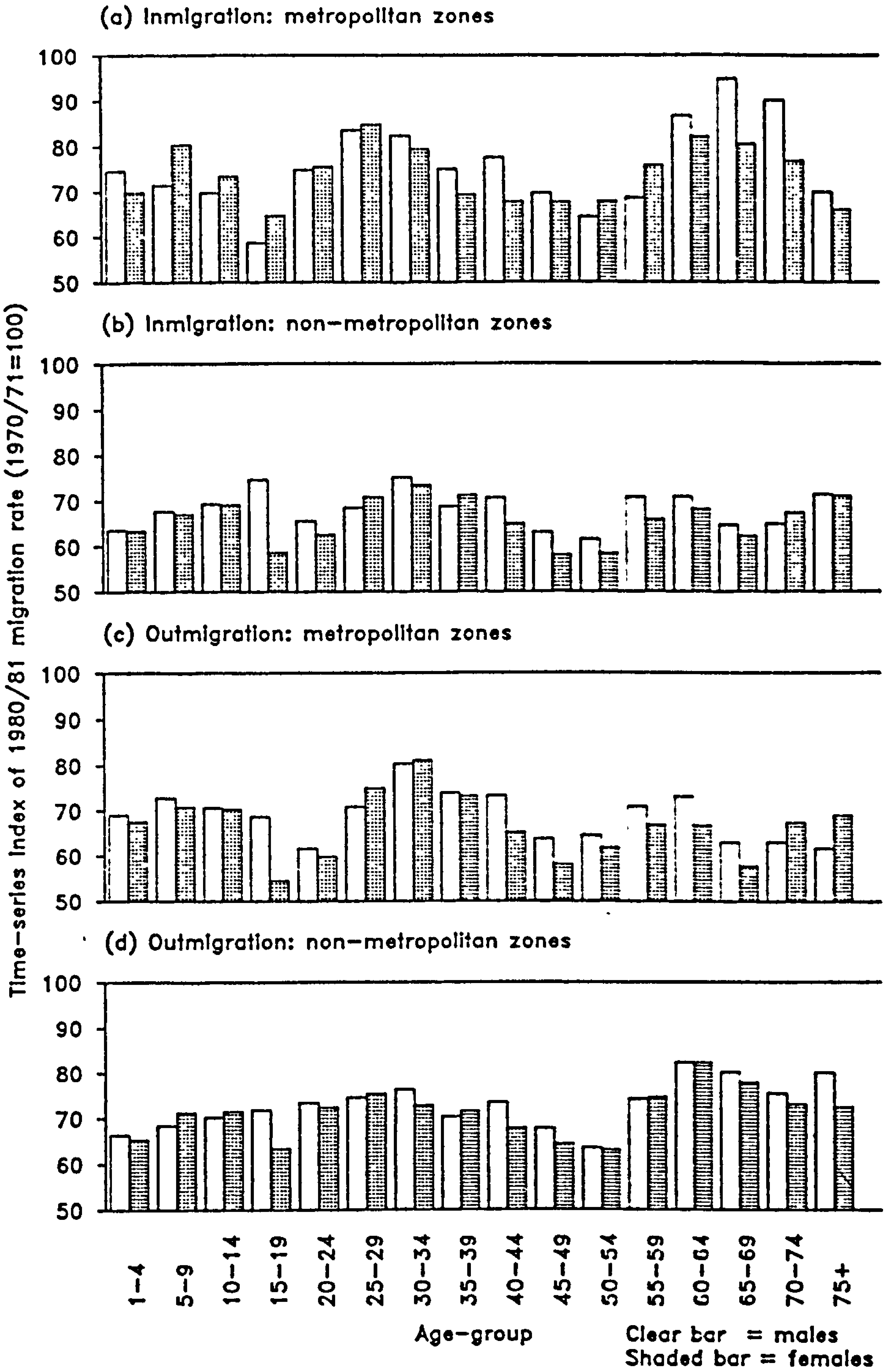


Figure 6.9 <u>1980/81 in and out-migration rates for metropolitan and non- metropolitan zones by age-group and sex expressed as time- series indices of 1970/71 values</u>

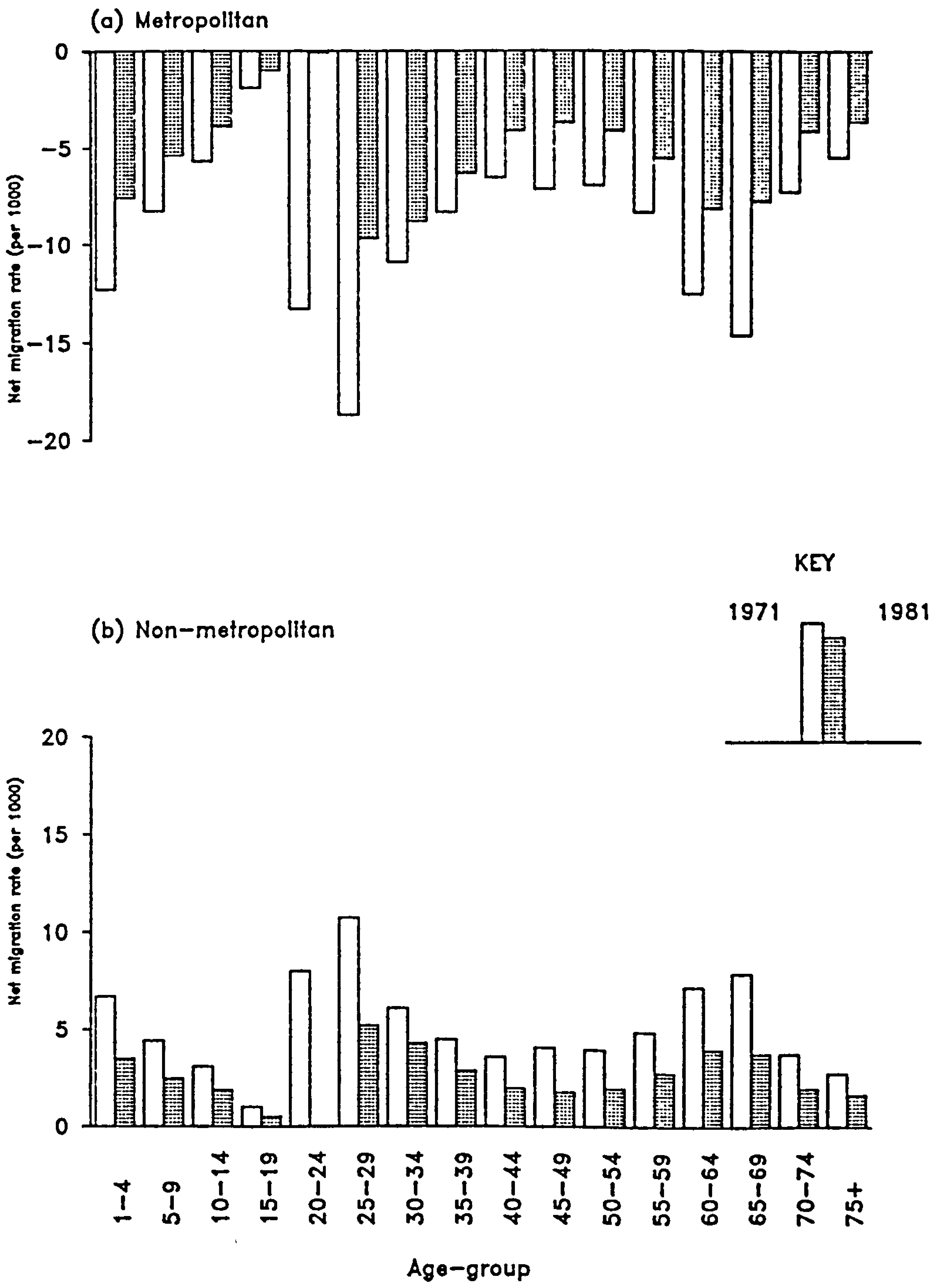


Figure 6.10 Inter-censal differences in the rate of net migration by five year age-group

indicates inter-censal differences in the rate of net migration for metropolitan and non-metropolitan zones by five-year age-groups. The most striking characteristic is the change evident for the 20-24 age-group. In 1970/71, the net rate of migration for metropolitan zones for this most mobile age-range was -13.3 per 1000. By 1980/81 this had fallen to only -0.1 per 1000. Consequently the net rate in non-metropolitan areas had fallen from 8.0 to zero in 1980/81. This indicates a radical change in the directional flow of young adult migrants in a relatively short space of time. In 1970/71 considerable decentralisation from urban areas was evident in this age-group but by 1980/81, the pattern had been completely changed with the most mobile persons in the population prefering, in net terms, to move to the metropolitan areas of Britain. The 25-29 age-range also experienced large falls in the rate of net loss from metropolitan areas but, unlike 20-24 year-olds, still maintained a substantial negative rate in 1980/81.

These metropolitan/non-metropolitan differences hide the variation that exists between individual MNM regions, particularly between Greater London and the remaining metropolitan zones and between non-metropolitan areas of the North and those of the South. Figure 6.11 illustrates net rate schedules for MNM zones by five-year age-group and sex in both 1970/71 and 1980/81. The most outstanding features of the metropolitan zones are the male and female schedules for Greater London. In the case of males, 1970/71 saw a negative net migration rate in all but the 15-19 age-group with a particularly large loss of 20-24 year-olds. In 1980/81, the 15-19 age-group figure remained much the same but a much larger positive rate was evident for the 20-24 age-range. The pattern for females was similar although the 15-19 and 20-24 age-groups experienced similar gains per 1000 in 1980/81. The peak in the rate of net loss from Greater London experienced by the male 25-29 and 65-69 age-groups and the female 25-29 and 60-64 age-groups were substantially reduced over the ten-year period with all age-groups suffering smaller net losses from the capital in 1980/81.

Outside the capital, the most pronounced peak in net loss in the retirement age-groups was experienced by the West Midlands in 1970/71 but this was reduced by 1980/81. Merseyside, West Midlands and Tyne and Wear all suffered particularly large losses per 1000 population in the 20-24 age-range in both census years but a lower level in 1980/81. The schedules for Tyne and Wear, West Yorkshire and Greater Manchester maintained similar net-rate profiles over the ten-year period.

For non-metropolitan zones important retirement peaks were evident in 1970/71 for the South East remainder and for East Anglia and the South West in particular. In 1980/81, the positive net rate of migration in the male 65-69 and female 60-64 age-groups remained at much the same level in East Anglia but was quite substantially reduced in the other two zones, particularly in the South East remainder. The large positive net rates experienced in 1970/71 for the 20-29 age-range were again much reduced with a similar pattern evident in the East Midlands and the West Midlands remainder. The South West and East Anglia maintained considerable rates of net gain in the 15-19 age-group over the period reflecting the continual importance of Armed Forces migrants to these areas. The Yorkshire and Humberside schedule reveals a similar pattern.

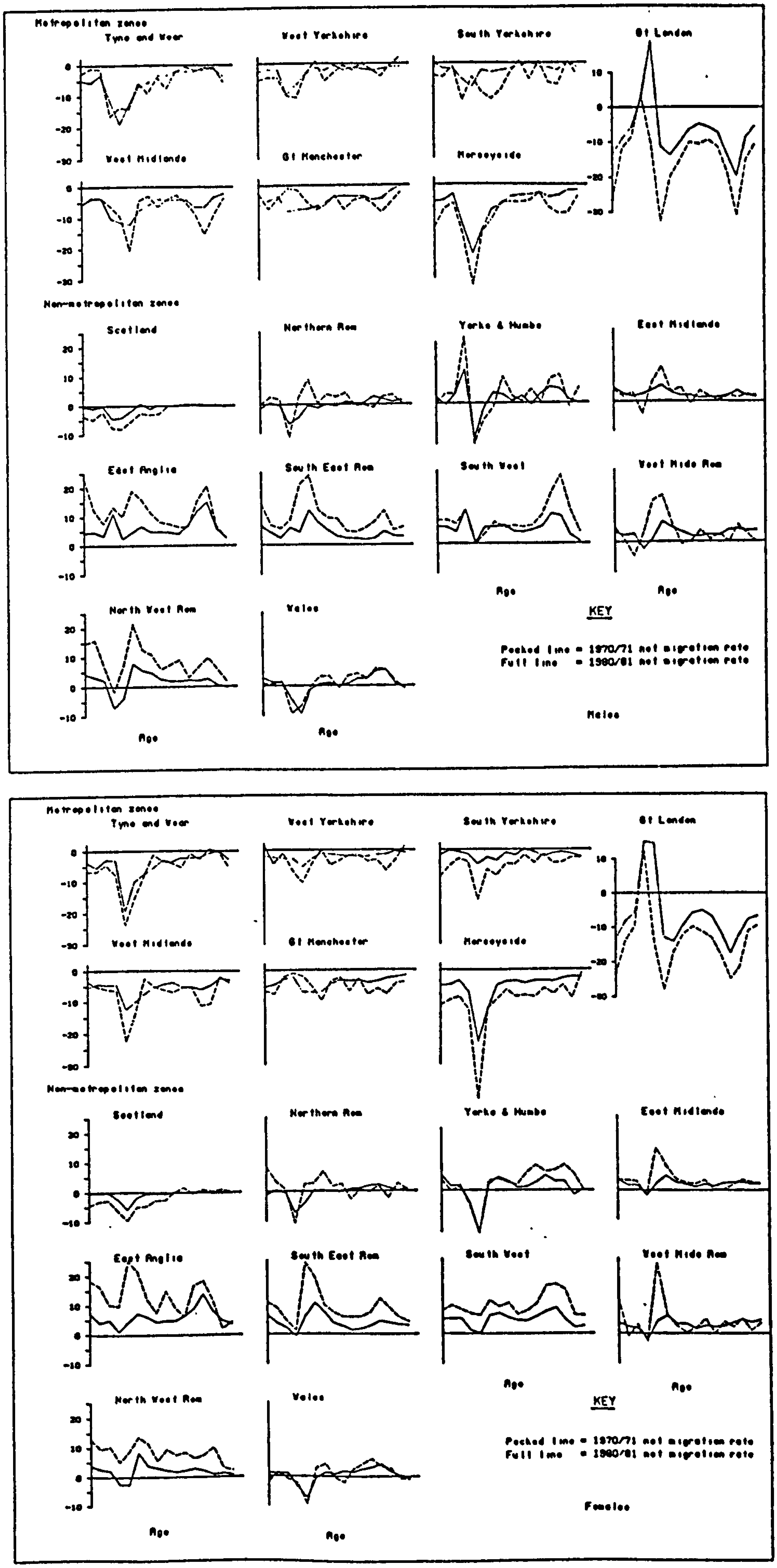


Figure 6.11 Net migration rate schedules for five-year age-groups, males and females, 1970/71 and 1980/81

6.4.4 <u>The changing effect of distance upon migration</u>

This section analyses differences in the average distance travelled by migrants between MNM regions in 1970/71 and 1980/81 and the temporal variation in the frictional effect of distance upon migration. A doubly-constrained spatial interaction model is used to calibrate generalised and age-specific distance-decay parameters and mean migration lengths (MMLs). The model has the form

$$M_{ij}^{as} = A_i^{as} O_i^{as} B_j^{as} D_j^{as} d_{ij}^{-b} \qquad (6.1)$$

where

O_i^{as} = total outmigration from origin i, age a, sex s;

D_j^{as} = total inmigration to destination j, age a, sex s;

d_{ij}^{-b} = negative power distance decay function with generalised parameter beta;

and balancing factors

$$A_i^{as} = 1 / \sum_j B_j^{as} D_j^{as} d_{ij}^{-b} \qquad (6.2)$$

$$B_j^{as} = 1 / \sum_i A_i^{as} O_i^{as} d_{ij}^{-b} \qquad (6.3)$$

ensure that in- and out-migration constraints are satisfied. The model uses an array of inter-MNM migration in calibration. Straight-line distances have been computed as weighted averages of the population centres of individual FPCAs within each MNM region. Glasgow was taken to be the population centre of Scotland.

Table 6.20 contains generalised beta parameters and MMLs for both sexes in 1970/71 and 1980/81. The friction of distance effect was slightly greater upon females than males with the parameter values decreasing only slightly over the ten-year period. Females moved, on

Table 6.20 Generalized beta parameters and mean migration lengths for MNM sytstem, males and females, 1970/71 and 1980/81

Sex	1970/71		1980/81	
	mml	beta	mml	beta
Males	163	0.812	168	0.805
Females	157	0.862	162	0.844
Persons	160	0.837	165	0.824

Table 6.21 Age-specific beta parameters and mean migration lengths for MNM system, 1970/71 and 1980/81

Age-group	1970/71		1980/81	
	mml	beta	mml	beta
1-4	162	0.951	170	0.891
5-9	170	0.915	177	0.886
10-14	171	0.837	173	0.915
15-19	175	0.725	181	0.725
20-24	161	0.728	166	0.714
25-29	158	0.835	160	0.812
30-34	165	0.822	163	0.858
35-39	165	0.837	166	0.887
40-44	161	0.859	167	0.883
45-49	154	0.866	162	0.923
50-54	150	0.972	155	0.970
55-59	137	1.071	152	1.032
60-64	135	1.096	150	1.036
65-69	137	1.090	147	1.025
70-74	142	1.113	149	1.018
75+	135	1.100	147	1.030
All ages	160	0.837	165	0.824

average, six kilometres less than males both in 1970/71 and 1980/81, with the MML increasing in each case by 5km between the censuses.

The variation in the friction of distance effect by age-group is illustrated in Table 6.21. 15-19 year-olds had the largest MML in both 1970/71 and 1980/81 and together with the 20-24 age-group were the least affected by distance in both census years. All age-groups with the exception of those aged 30-34 experienced an increase in MML between 1970/71 and 1980/81. The most significant increases in the mean length of migration were experienced by the older age-groups, particularly the 55-59 and 60-64 year-olds (+15km in each case).

Origin and destination-specific MMLs and beta parameters are illustrated in Table 6.22 and indicate the variation in the frictional effect of distance upon migrants moving between individual MNM regions in both 1970/71 and 1980/81. Of the metropolitan regions, Greater London stands out for its low friction of distance parameters. The variation between the origin and destination-specific MMLs for the capital reflect its attractiveness to longer-distance migrants, both in 1970/71 and 1980/81. The average distance travelled by a migrant moving to Greater London in 1980/81 was 139km. The MML of migrants moving away from the capital was approximately 93km. The respective friction of distance parameters were 0.51 and 0.71, with very little variation over the ten-year period. Greater London, therefore, remained a great attraction to migrants from all over Britain with movement away from the capital being concentrated in a much smaller area. These patterns reflect firstly the in-migration of the more mobile 15-19 and 20-24 age-groups from the rest of Britain and secondly the important family and retirement moves from Greater London into the remaining counties

Table 6.22 Origin and destination-specific MMLs and beta parameters for individual MNM zones, 1970/71 and 1980/81

MNM region	Origin-specific MML (km)		Origin-specific Beta		Destination-specific MML (km)		Destination-specific Beta	
	71	81	71	81	71	81	71	81
(a) Metropolitan zones								
Tyne & Wear	182	190	1.21	1.20	181	173	1.19	1.25
W.Yorkshire	147	152	1.03	1.01	144	146	1.02	0.97
S.Yorkshire	131	132	1.16	1.17	134	133	1.05	1.03
Gt.London	89	93	0.74	0.71	141	139	0.52	0.51
W.Midlands	95	91	1.15	1.78	116	98	0.97	1.13
Gt.Manchester	134	135	0.89	0.95	134	129	0.89	0.92
Merseyside	114	136	1.25	1.08	140	129	0.99	1.08
(b) Non-metropolitan zones								
Scotland	440	446	0.14	0.08	440	426	0.12	0.17
North rem	205	209	1.13	1.14	180	177	1.23	1.25
Yorks & Humb	179	184	1.18	1.12	168	168	1.28	1.25
E.Midlands	158	159	0.90	0.90	157	154	0.88	0.94
E.Anglia	186	187	1.27	1.19	173	180	1.68	1.50
S.East rem	161	160	0.66	0.66	127	143	0.78	0.74
South West	231	228	1.08	1.11	227	229	1.36	1.24
W.Mids rem	125	122	1.01	1.10	107	104	1.13	1.17
N.West rem	147	152	0.96	0.98	109	119	1.21	1.12
Wales	201	204	0.75	0.72	202	201	0.98	0.98
All areas	160	165	0.84	0.82	160	165	0.84	0.82

of the South East.

Important changes in the effect of distance upon migration were evident for Merseyside and the West Midlands. The origin-specific beta value for Merseyside decreased considerably between 1970/71 and 1980/81 indicating that outmigrants from this county became less constrained by distance. The West Midlands, on the other hand, suffered a greatly increased origin-specific beta value with fewer out-migrants travelling longer distances in 1980/81. The destination-specific parameters for both regions increased over the period with subsequent decreases in their respective MMLs. Tyne and Wear and Greater Manchester showed similar destination-specific decay parameter characteristics.

With the exception of Scotland, the lowest distance decay parameters for non-metropolitan zones were exhibited by the South East remainder. Both origin and destination-specific values remained fairly stable between 1970/71 and 1980/81 with the MML being greatest for migrants moving away from the South Eastern counties reflecting the importance of longer distance retirement migration to the South West and East Anglia. Relatively low destination-specific beta values were also evident in the East Midlands. The corresponding value for East Anglia, although high in comparison, decreased considerably over the ten-year period with a substantial increase in the MML. This pattern was evident also for the North West remainder.

6.5 SUMMARY AND CONCLUSIONS

The results outlined in this chapter have highlighted a number of the major features of the spatial patterns of inter-zonal migration in 1980/81 and the changes that have taken place in the pattern at a more aggregate scale between 1970/71 and 1980/81. The difficulty of establishing 'trends' over time using ten-yearly census data has already been made clear. However, over the period, a substantial reduction in the level of migration activity took place. People were far less mobile in 1980/81 than they were in 1970/71. Economic factors will have had a strong effect on the variation in movement between the censuses, with the decline of British industry during the late seventies and early eighties producing huge numbers of unemployed. The low-point in the economic decline of the nation occurred during the early eighties with the level of migration consequently at a considerably lower level than in 1970/71. Longer-distance movement was shown to have undergone the greatest decrease during the decade, with a 30% reduction in what are predominantly employment-related moves. Limited employment opportunities throughout Britain will have curtailed the movement between regions by those more mobile sections of the population seeking new employment, illustrated by a significant reduction in the rate of migration of the 15-24 age-range out of metropolitan MNMs over the ten-year period.

Although the reduced level of migration in 1980/81 has been established, a number of very significant patterns were maintained over the inter-censal period. The decentralisation process was seen to continue with almost all metropolitan FPCAs losing in net migration terms during 1980/81. Those areas of highest population density were losing through migration at a rate of approximately 7 per 1000 in 1980/81. The largest net gains were generally found in medium-low and low-density areas of the South and in south-coast FPCAs in particular. In 1970/71 and 1980/81, all metropolitan MNMs, with the exception of Greater London, experienced negative net migration rates for all age-groups, with 20-24 year-olds suffering the greatest net losses. The situation in Greater London was slightly different, however, with considerable net gains occurring in the 20-24 male and female age-groups and the 15-19 female age-group in 1980/81. This was in contrast to net rate patterns for the capital in 1970/71 when significant net losses of 20-24 year-old migrants were made. Over a ten-year period, therefore, Greater London experienced a drastic reversal in the net directional flow of the most mobile section of the population due mainly to a substantial reduction in the rate of out-migration and the increasing attraction of life in the capital to 20-24 year-olds.

Although at a lower level in 1980/81, the greatest net losses from Greater London in both Censuses were experienced by males aged 25-29 and 65-69 and females aged 25-29 and 60-64. Consequently, the most significant net gains in 1980/81 were evident for the 25-34 age-range in medium-low and low density areas of the South and for the 60-69 age-range in the lowest population density areas of the South. Retirement peaks were evident in 1970/71 in the net migration schedules of the South East remainder, South-West and East Anglia. In 1980/81 the peaks were maintained but only East Anglia continued to gain older-age migrants at a level similar to that of the early 1970s. Important patterns of migration within Britain in both 1970/71 and 1980/81 therefore involved the movement of families away from the highest density areas of Greater London into the lower density FPCAs surrounding the capital and the more expansive retirement migration from Greater London and the remainder of the South East to the more remote, least densely populated areas of the

South West and East Anglia.

In the North the pattern of migration in 1980/81 was not simply one of net losses from metropolitan areas and gains to non-metropolitan areas. The net rate of migration was negative for movement between density categories of the North and those of the South. In 1980/81 the North was losing more population through migration to the South. All age-groups in the North, with the exception of 65-69 year-old males, suffered a negative net rate of migration during the year prior to the last Census.

A number of significant spatio-temporal patterns and trends in migration have therefore been highlighted using transition data from successive Censuses. The major advantage of the Census is that it provides detailed and comprehensive information on migration within the UK for a single-year period. Chapters 4 and 5 have outlined some of the main drawbacks of using such information. In particular the temporal changes illustrated in this chapter are based on cross-sectional information and thus do not allow the identification of annual fluctuations in migration behaviour. In addition, the nature of the migration question in the Census ensures that only migrants are recorded and not the number of moves made by these migrants.

Data from the NHSCR is used in subsequent chapters to analyse in greater detail the spatio-temporal patterns and trends evident in internal migration not only to confirm the findings of this chapter, but also to establish what changes have taken place since 1980/81.

Chapter 7. CHANGE OVER TIME: AGGREGATE PATTERNS AND TRENDS IN NHSCR MOVEMENT DATA, 1975/76 TO 1985/86

7.1 INTRODUCTION

Chapter 6 has drawn on data from the last two censuses to illustrate some of the spatial patterns that existed in 1980/81 and the changes in patterns of migration between 1970/71 and 1980/81. The ten-year gap between censuses means that any detailed analysis of temporal trends in migration in the intervening years must utilise alternative data. Furthermore with the next Census not due until 1991 and transition data for 1990/91 not likely to be available until 1992/93, data from an alternative source is required to monitor migration behaviour in the 1980s. The NHSCR is, at present, the only viable source of alternative information for intervening years in both decades, and most previous time-series analyses have been based on NHSCR data. Ogilvy (1979; 1982) used NHSCR data for the period 1971/73 to 1977/79 to outline trends in regional migration and to assess their relationship with variations in the levels of employment and unemployment and the availability of housing. Stillwell (1983) used relative measures to compare NHSCR data for 1976-81 with Census information for 1966-71, Devis (1984) provided a brief outline of NHSCR migration trends between 1975 and 1982 at the FPCA level, and Rees and Stillwell (1987) compiled a movement data set to outline important temporal trends at the Standard Region level between 1975 and 1986. It has been argued that the processes of decentralisation and counter-urbanisation, which have been identified as dominant trends in the early 1970s, have decelerated during recent years and there is evidence of a 'migration turnaround' in London and the South East (Champion and Congdon, 1988) with population increases again being experienced in the capital. More detailed analysis of aggregate and disaggregate NHSCR migration data for the second half of the 1970s and first half of the 1980s will provide further insights into the stability of zone-specific in and out-migration migration components and their relationship to the pattern of decentralisation.

With the co-operation of OPCS, a continuous time-series of NHSCR re-registration data has been constructed (Chapter 3) which, with prior knowledge of its drawbacks and limitations (Chapters 4 and 5), can be used to provide a detailed picture of spatio-temporal trends in mid-year to mid-year migration, illustrating both zonal and age and sex-disaggregated patterns. This analysis will thus provide a detailed description of internal migration processes in the U.K. which can subsequently be updated as further NHSCR data becomes available.

It is not only of academic interest to analyse historical trends in migration but also of importance to understand the potential use of NHSCR data in the migration forecasting component of the official population projection model. Section 2.4 outlined the migration forecasting methodology and illustrated the importance of 1981 Census data within the OPCS/DOE model. The current round of projections (1985-based) still relied heavily on the Census to provide age-specific migration information and inter-zonal assignment probabilities. The NHSCR is used solely as a means of updating the zone-specific GMRs utilised in the procedure, but no account is taken of changes in the distribution of migration flows since the 1981 Census.

Subsequent analyses will attempt to assess the value of relying so heavily on the Census by evaluating the changes that have taken place in the patterns of NHSCR migration by zone, age and sex since 1980/81. By drawing together the conclusions of Chapters 4 and 5 with the results of the time-series analyses reported in Chapters 7, 8 and 9 it is hoped that a series of recommendations may be forwarded regarding the use of alternative migration data within the official projection model and in the analysis of migration in general.

This chapter therefore concentrates on the analysis of aggregate trends in NHSCR migration at a number of alternative spatial scales. Section 7.2 briefly describes the nature of the data used in this chapter and supplies appropriate references to the file assembly procedures outlined in Chapter 3. Section 7.3 provides an introduction to the sub-national analysis with a discussion and illustration of the temporal variation in the overall level of inter-MNM and inter-FPCA migration. Sections 7.4 and 7.5 build on these basic results to provide a detailed picture of trends in the movement data at the alternative spatial scales using a variety of measures of migration and a number of alternative spatial aggregations. The final section collates all the information illustrated and provides a summary of the major trends in age-sex aggregate data that are identified in the chapter.

7.2 DATA DESCRIPTION

7.2.1 NHSCR data

This initial analysis of migration patterns and trends over time utilises NHSCR information obtained in two different ways. Movement data for the first eight years of the period (mid-1975 to mid-1983) has been obtained from computer summaries of Primary Unit Data (PUD) produced by OPCS, whereas data for the three years, mid-1983 to mid-1986, has been compiled directly from the PUD.

Two files of movement data are used in this chapter and referenced as T27686 FPCDATA and T27686 MNMDATA in Table 3.7. These files contain eleven inter-FPCA and inter-MNM movement matrices respectively. A full explanation of the content and method of construction of these two data files has been given in Sections 3.3.5 and 3.3.6. Between 1976 and April 1984, OPCS extracted a 10% sample of moves from the NHSCR. Since April 1984, however, a 100% count has been obtained. Thus the mid-year 1983 to mid-year 1984 portion of the time-series contains a mixture of 10% and 100% count data.

Each inter-zonal array consists of a count of all registered moves during a given mid-year to mid-year time-period aggregated over all age-groups (<1 to 99 and age not-stated) and sexes (males, females and sex not-stated). Moves by infants (ie. those aged less than one at time of move) are included in the arrays. The FPCA system of interest consists of 97 origin and destination zones as illustrated in Figure 3.3 and listed in Table 3.1. Migration flows from all other zones to Northern Ireland and the Isle of Man are recorded by the NHSCR and therefore included in the analyses. Scotland, like Northern Ireland is included as a single FPCA. The FPCA array has been aggregated to provide movement between the 19 origin and destination zones (illustrated in Figure 3.2), which constitute the MNM spatial units.

Two further spatial aggregations are also used to illustrate patterns of movement. The first is of the type used by Champion et al (1987) and involves the amalgamation of FPCAs into four broad regional divisions, two in the North and two in the South (see Figure

3.3 and Table 3.2). Secondly the population density classification (Figure 3.4 and Table 3.3) is used to examine the temporal variation in the importance of decentralising movement from urban areas to the least densely populated FPCAs of the UK.

7.2.2 Population data

Section 3.4.1 outlined in detail the processing of population data supplied by OPCS on magnetic tapes, to produce a sequence of mid-year population estimates by zone, sex and five-year age-group for the 1975 to 1986 period. These mid-year estimates will be used extensively in this, and subsequent chapters, to calculate various rates of movement based on NHSCR data. The movement information is recorded as a count of all changes of residence between two points in time (mid-years) as opposed to a count of the number of persons whose residence at one mid-year was different to that at the previous (transition-type data). In order to calculate rates of movement for a particular year, the population at risk has been estimated as the average of the initial and final mid-year populations. The population data files used in this chapter, which contain mid-year estimates for each year in the 1975-86 period at both the FPCA and MNM scale, are referenced in Table 3.7 as FPCDATA POPS and MNMDATA POPS.

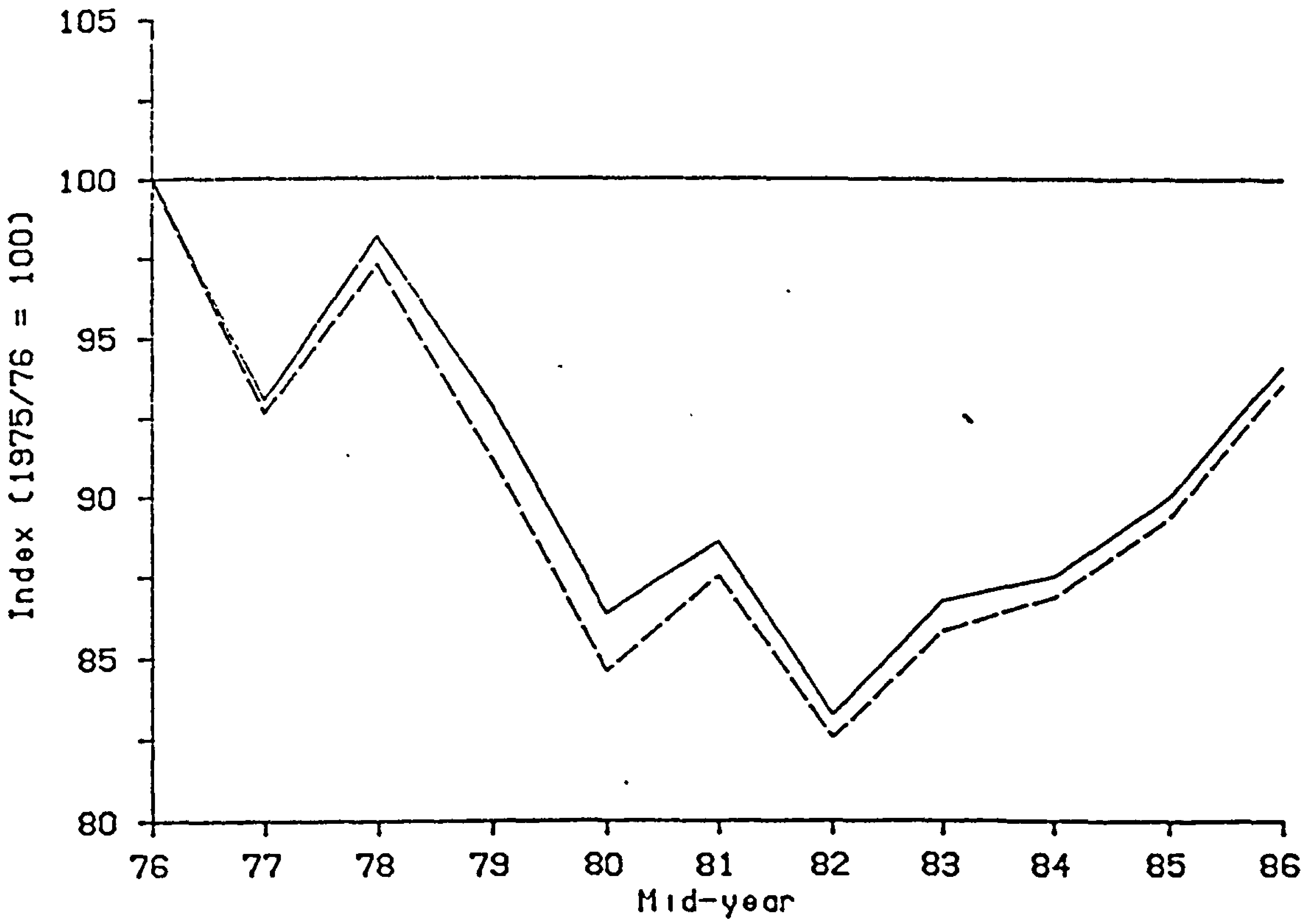
7.3 TEMPORAL VARIATION IN THE OVERALL LEVEL OF INTER-MNM AND INTER-FPCA MIGRATION

The review presented in Section 2.2.1 of the thesis highlighted an increase in mobility during the 1960s with 10.5% of persons recorded as changing usual residence in the year prior to the 1961 Census in comparison with 11.6% in the year before the 1971 Census (Ogilvy, 1979). A reversal in this trend during the 1970s has been illustrated by several authors using Census information (Devis, 1983; Stillwell and Boden, 1986) and NHSCR data (Ogilvy, 1979; 1982: Devis, 1984; Stillwell, 1985; and Rees and Stillwell, 1987). In his analysis of 1971 and 1981 Census migration data, Devis (1983) revealed a 19% reduction in the overall mobility rate, whereas NHSCR data for a similar period showed an average annual decline of 2.5% in the rate of inter-FPCA movement (Devis, 1984). Rees and Stillwell (1987), using NHSCR data derived from OPCS monitors, have extended the available time-series to include 1985/86 and highlighted a definite upturn in the level of migration activity from approximately 1981/82 onwards. This section will attempt to confirm and extend these overall trends by analysing total inter-MNM and inter-FPCA movement over the 1975/76 to 1985/86 period, and thus provide an introduction to the more disaggregate analyses undertaken in Sections 7.4 and 7.5.

Table 7.1 indicates the temporal changes in the total number of recorded NHSCR inter-MNM and inter-FPCA moves together with their corresponding rates of movement. The total number of moves per annum can be expressed as a percentage of the base-year total (time-series index) and are presented graphically in Figure 7.1. In 1975/76, over 1.3 million moves were made between MNM regions and over 1.9 million moves were made between FPCAs. These figures correspond to movement rates of 23.6 and 34.4 per 1000 repectively. Since this time there has been significant fluctuation in the level of movement between the zones defined in these systems of interest. An approximate 7% decrease in the number of moves between 1975/76 and 1976/77 was followed by a slightly less substantial increase in 1977/78. From 1977/78 onwards, however, a strong downward trend in the number and

Table 7.1 Total inter-MNM region and inter-FPCA movement measured by the NHSCR, 1975/76 to 1985/86

Year	Inter-MNM region Moves (000s)	Inter-MNM region %age change	Inter-MNM region Rate (/1000)	Inter-FPCA Moves (000s)	Inter-FPCA %age change	Inter-FPCA Rate (/1000)
1975/76	1326		23.6	1931		34.4
1976/77	1233	-7.0	22.0	1789	-7.4	31.8
1977/78	1302	5.6	23.2	1879	5.1	33.4
1978/79	1232	-5.4	21.9	1762	-6.3	31.3
1979/80	1146	-7.0	20.4	1633	-7.2	29.0
1980/81	1175	2.6	20.9	1691	3.4	30.0
1981/82	1105	-6.0	19.6	1595	-5.6	28.3
1982/83	1151	4.2	20.4	1658	3.9	29.4
1983/84	1161	0.8	20.6	1677	1.2	29.7
1984/85	1194	2.9	21.1	1725	2.9	30.5
1985/86	1248	4.6	22.0	1806	4.7	31.9



Full line = inter-MNM movement

Pecked line = inter-FPCA movement

Figure 7.1 Time-series index of total inter-MNM and inter-FPCA movement, 1975/76 to 1985/86 rate of movement was in evidence with a low point being reached in 1981/82 after a slight recovery in the level in 1980/81. The level of movement between MNMs in 1981/82 represented only 83.3% of that experienced in 1975/76. The inter-FPCA total represented only 82.6%. The rate of inter-zonal transfer fell to below 20 per 1000 for MNMs and to 28.3 per 1000 for FPCAs. Approximately 222 thousand fewer moves were made between MNMs in 1981/82 than in 1975/76. The figure is roughly 337 thousand for corresponding FPCA moves. Ogilvy (1979) has previously cited worsening economic conditions with regard to housing and employment opportunities as the chief determinants of the declining level of movement during the late 1970s. It is clear that this decline continued into the early 1980s as the recession deepened and unemployment reached record levels. Since the low-point of 1981/82 total inter-zonal migration at both spatial scales has steadily increased and reached levels that were fractionally over 93% of the respective 1975/76 totals. The final year in the time-series saw a 4.6% and 4.7% increase in the level of inter-MNM and inter-FPCA migration respectively over the previous twelve months. The rate of movement in 1985/86 was equal to that of 1976/77 when 22 per 1000 and 32 per 1000 moves were made between MNMs and between FPCAs. This represents total inter-MNM movement of approximately 1.25 million and total inter-FPCA movement of 1.81 million.

These temporal fluctuations in the level of migration can be examined in greater detail by further disaggregation of the data to examine characteristics of migration to and from individual MNM regions and FPCAs. Subsequent sections provide an insight into variations in the sub-national patterns of migration over time at both spatial scales, identifying metropolitan and non-metropolitan differences and assessing the stability of the components of migration over time. Has there been a turnaround in decentralization in recent years to the effect that metropolitan areas are again 'urbanising' or are counter-urbanization processes still attracting people into the more rural areas of the U.K.?

7.4 TEMPORAL VARIATION IN SUB-NATIONAL MIGRATION FLOWS: MNM REGION LEVEL

7.4.1 Out, in and net-migration trends

Figure 7.2 illustrates the temporal fluctuation in the level of out and in-migration at the MNM region scale using time-series indices. The out-migration profiles of certain regions followed the trend illustrated by the U.K. profile but the magnitude of in- and out-migration fluctuated considerably from the norm in other regions. Gross out-migration from Northern Ireland, for example, declined sharply until 1981/82, when the level was only 60% of that experienced in the base year. There has been a recovery in the final year of the time-series yet still only to a level that is approximately 83% of the the total out-migration of 1975/76. Northern Ireland, particularly Belfast, suffered badly during the worst years of the economic slump and with opportunities lacking throughout the U.K. during the early 1980s, out-migration from such an isolated region was significantly curtailed. Out-migration from Scotland appears to have decreased sharply in 1981/82, reaching a point 20% lower than the level of 1975/76, but this was in contrast to all other years during the period in which the out-migration level did not fall below 94% of the base-year total. The out-migration profile for South Yorkshire is unusual in that after fluctuating marginally around the base total until 1981/82, the level increased

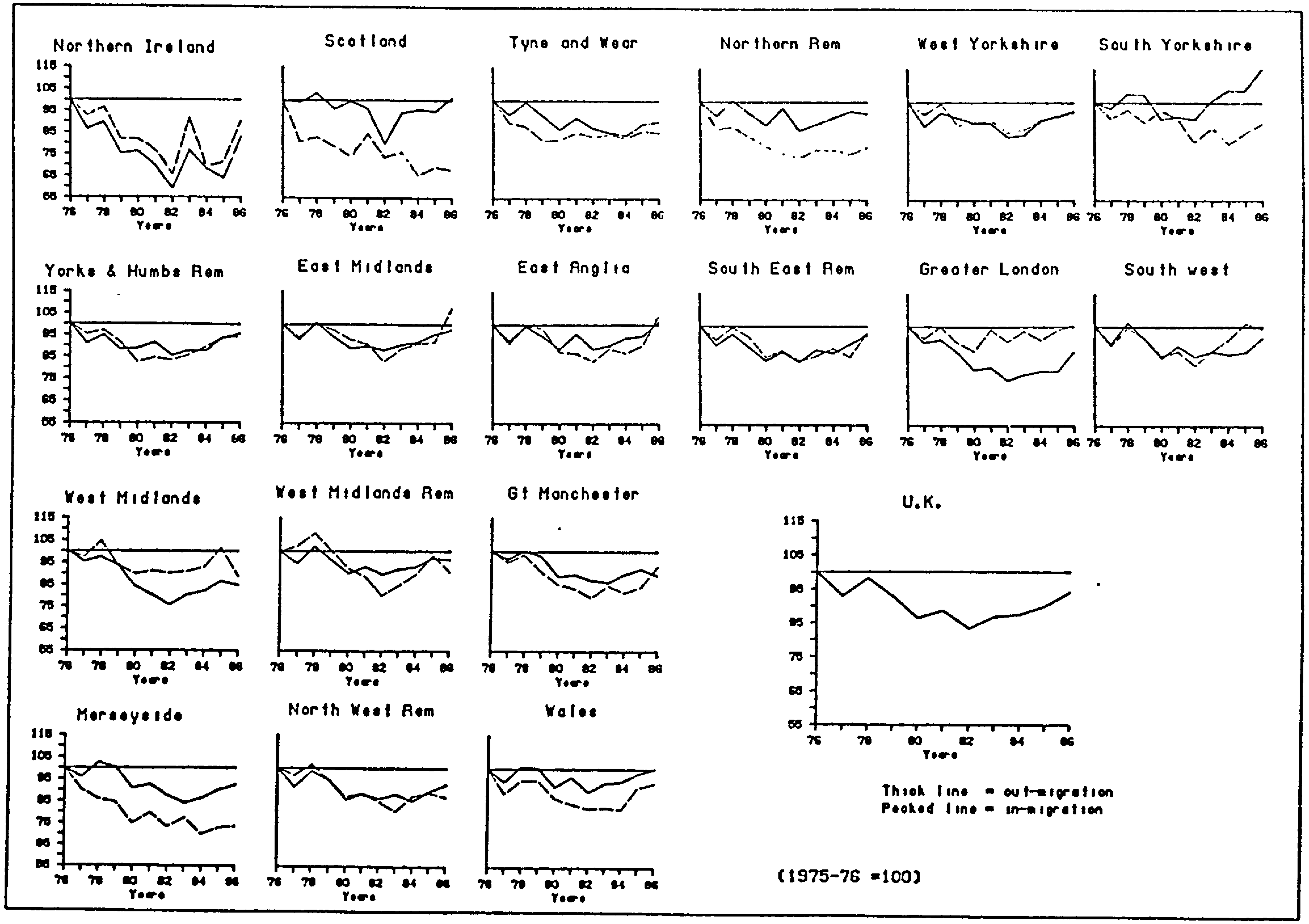


Figure 7.2 <u>In and out-migration flows at the MNM level: time-series indices</u>

considerably until in 1985/86, total out-migration from the region was over 15% higher than in the initial year of the time-series. An explanation for this substantial increase may well lie in the effect of the Miners' Strike and the considerable cutbacks and closures implemented by British Steel in the 1970s and more recently by British Coal. South Yorkshire has suffered badly as British Coal has strived to rid itself of unprofitable mines with the consequence of considerable out-migration from an area providing limited alternative employment opportunities.

Two further out-migration profiles which are significantly different from that of the U.K. in total are Greater London and the West Midlands metropolitan county. The major difference being that total out-migration from these two regions fell to levels considerably lower than other MNM regions in England and Wales. Total movement out of both in 1981/82 was only 75% of that experienced in 1975/76 but, with an increase in the level of out-migration in recent years, flows from Greater London in 1985/86 measured 88% of the base-year total and flows from the West Midlands 85%. This upturn in the level of out-movement from Greater London is significant given the importance of the capital as a generator of migration. One final trend of note is the decline in the level of out-migration from Merseyside and Greater Manchester which continued into 1982/83 and from Tyne and Wear into 1983/84. All other MNM region out-migration profiles reached a low-point in 1981/82 which was followed by a definite increase in the number of outflows. The decline appears to have been prolonged in these northern metropolitan regions where the effects of the recession have been more strongly felt.

Examination of the time-series in-migration profiles in Figure 7.2 again reveals a number of significant trends. In-migration to Northern Ireland fluctuated considerably during the 1980s with the 1982/83 and 1985/86 levels over 90% of that experienced at the beginning of the time-series, in contrast to a total in-movement in 1981/82 that was only 65% of that in 1975/76. Variations in the level of in-migration to Northern Ireland mirrored the changes in out-migration In-migration to Scotland generally appears to have been on a downward trend throughout the period although some annual increases were experienced (in particular in 1980/81 and 1982/83). The 1985/86 level of in-migration was only 68% of that recorded by the NHSCR ten years earlier. This was in contrast to the level of out-migration which was shown to have exceeded the 1975/76 level in the final year of the time-series. The level of in-migration to Tyne and Wear and the Northern Remainder also remained at a relatively low level in comparison with the 1975/76 figure, with the 1985/86 total for the latter being only 79% of that in the base year. The metropolitan county of Merseyside has also experienced a general decline in the level of in-migration reaching a low-point in 1983/84, some 30% less than the 1975/76 figure and only recovering fractionally to 73% of the base flow in 1985/86. In-migration to Greater London has remained fairly stable during the 1980s and increased in 1985/86 to a figure which slightly exceeded the 1975/76 total. A significant trend is the very sharp increase in the level of in-migration to East Anglia, East Midlands and the South-East Remainder in 1985/86 (to 104%, 107% and 97% respectively of the 1975/76 total), possibly a result of the corresponding upturn in the level of out-migration from Greater London in the final year.

In-migration to the South-West began to increase from 1981/82 but experienced a slight decrease in the final year of the time-series. The level of in-migration to the West Midlands Remainder appears to fluctuate in parallel with the level of out-migration from its metropolitan county, clearly illustrating the importance of out-flows from this metropolitan area to to its surrounding shire counties.

Net migration figures give a clearer indication of the importance of counter-urbanisation processes in recent years. Figures 7.3a and 7.3b illustrate the level of net migration for metropolitan and non-metropolitan zones respectively and Figure 7.4 presents a series of graphs for individual MNM regions illustrating the temporal fluctuation in the rate of net migration recorded by the NHSCR between 1975/76 and 1985/86. A dominant feature of internal migration in the late 1970s and early 1980s was the very sharp reduction in the net loss from Greater London, particularly between 1978/79 and 1980/81 when the net loss in volume terms fell from approximately -60.5 thousand to just below -30.8 thousand (Figure 7.3a). This is consistent with the general reduction in the level of movement within the U.K. and illustrates the importance of Greater London to the rest of the migration system. The decline in the net loss from Greater London was accounted for predominantly by a significant decrease in the level of out-migration which reached a low-point in 1981/82 (Figure 7.2). This decrease was mirrored by a reduction in the level of gain through migration experienced by the South East Remainder, South West, East Anglia and to a lesser extent, the East Midlands between 1978/79 and 1981/82. The highest net gains per 1000 population throughout the period were experienced in East Anglia and the South West with a slightly lower rate in the South

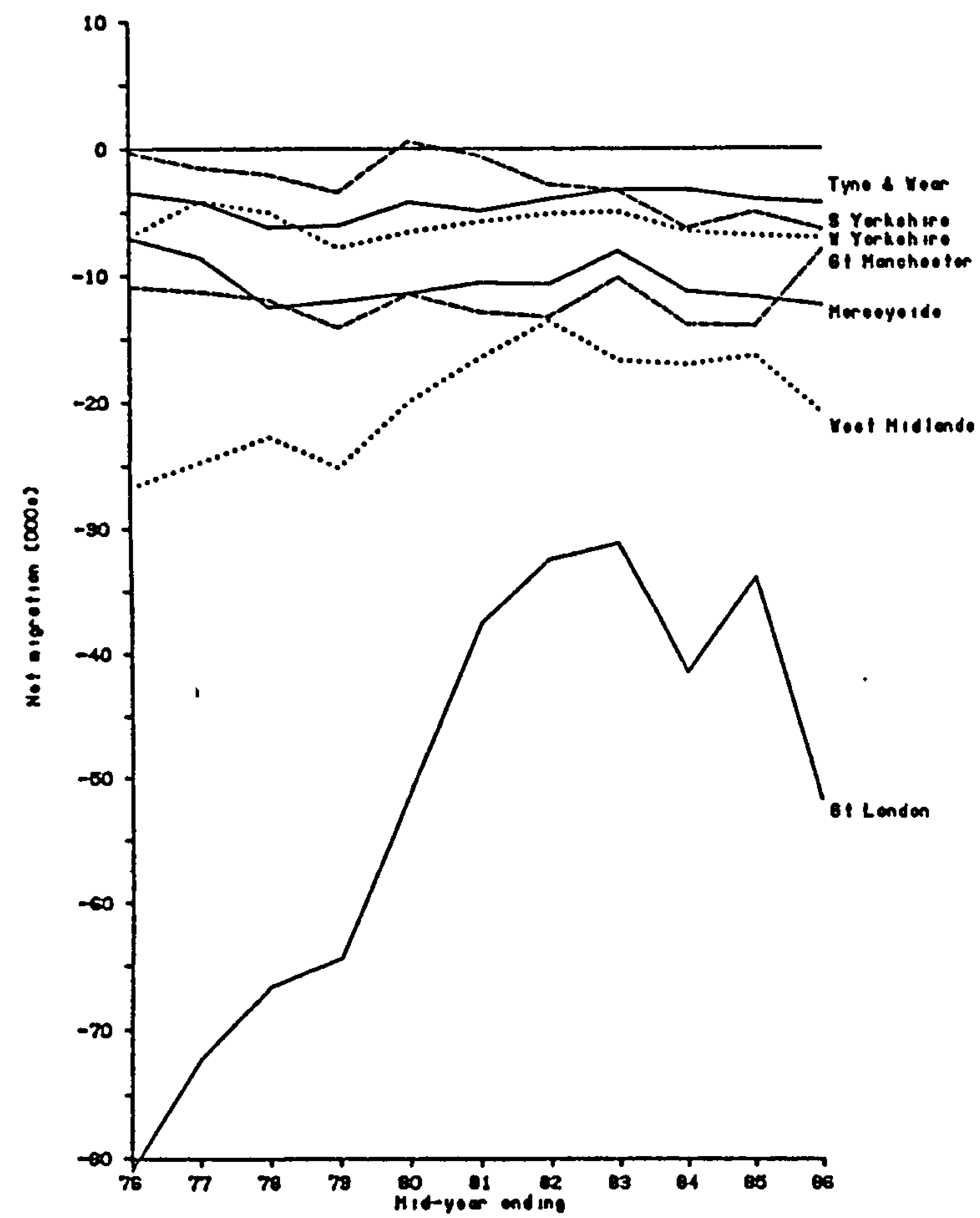


Figure 7.3a Net migration to metropolitan regions

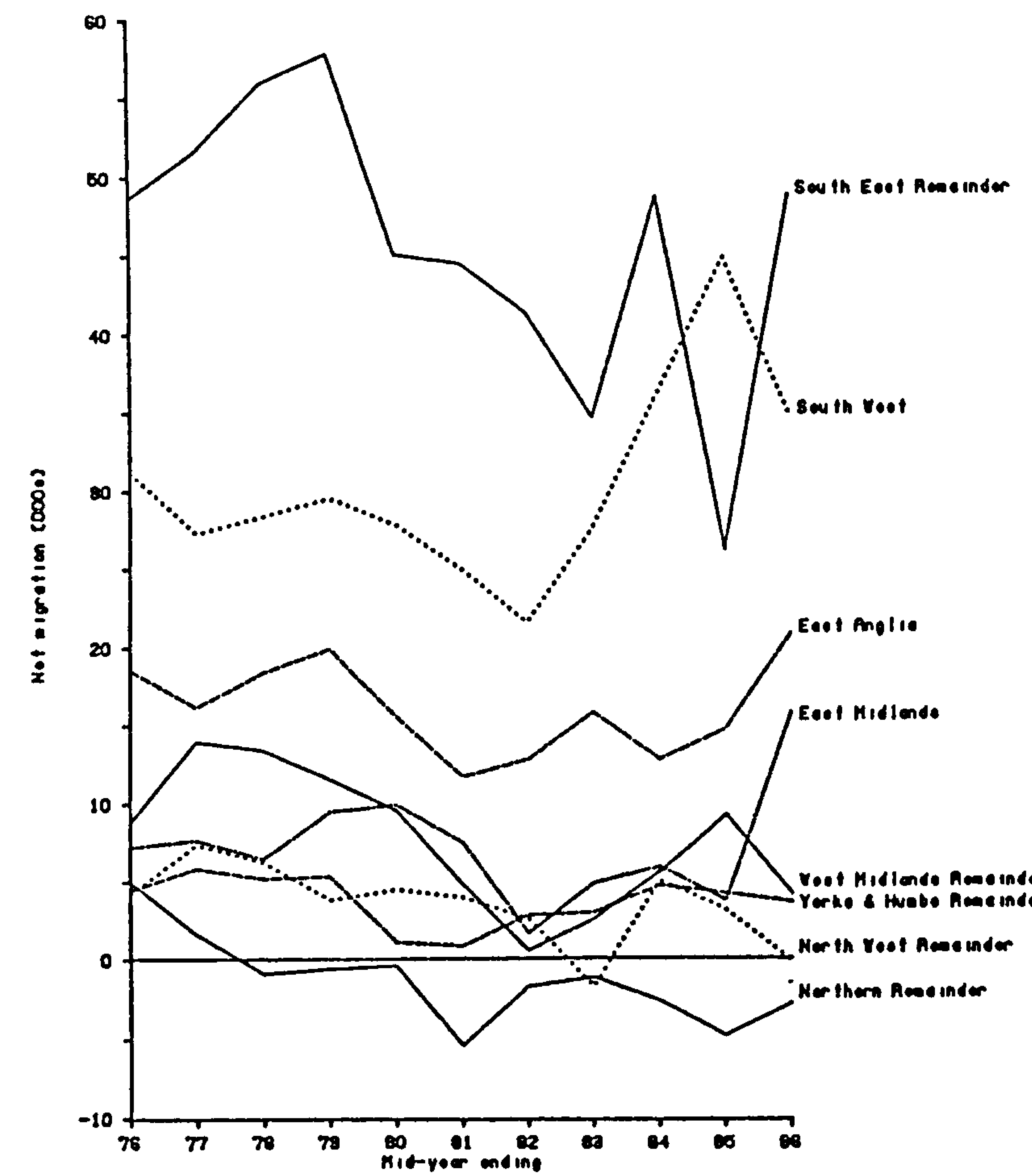


Figure 7.3b Net migration to non-metropolitan regions

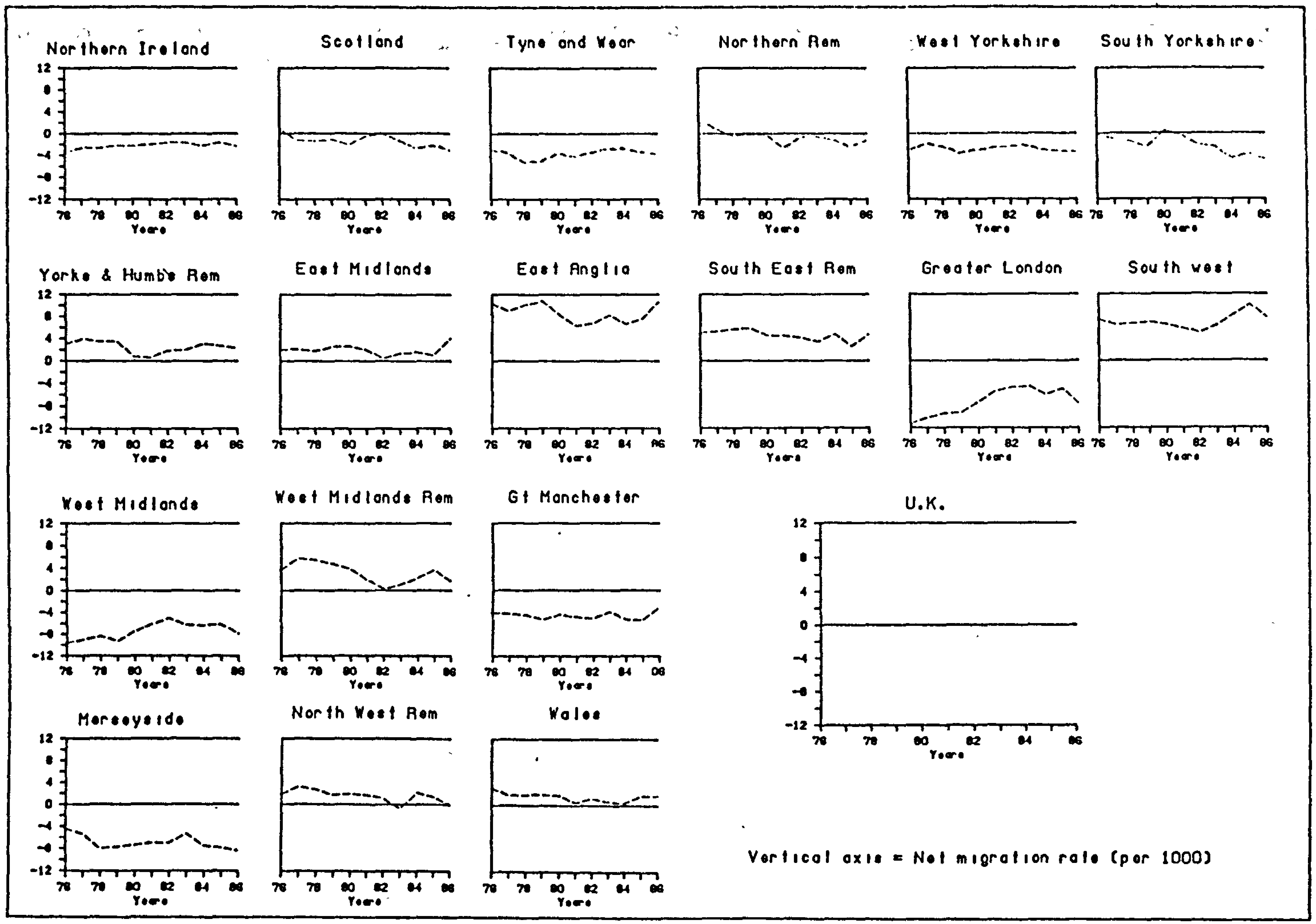


Figure 7.4 Net migration rates at the MNM level

East Remainder.

The West Midlands metropolitan county also suffered a considerable reduction in its net loss through migration up to 1981/82 and was matched by a reduction in the net gain to its remainder. The rate of net gain to the West Midlands Remainder was only 0.2 per 1000 in 1981/82 compared to 5.72 per 1000 in 1976/77. The other metropolitan MNMs did not undergo such large reductions in their net losses during the period, thus indicating that the deceleration of decentralization processes, evident up until 1982/83, was predominantly centred on Greater London and to a lesser extent on the West Midlands metropolitan county.

The net loss from Greater London increased, however, during 1983/84 and after decreasing in 1984/85 rose substantially to over -50 thousand in 1985/86. These fluctuations were matched by subsequent increases and decreases in the net gain through migration experienced by the South East Remainder and sharp increases in 1985/86 to the net gains of the East Midlands and East Anglia. The South West, after reaching a net gain of almost 45 thousand in 1985 (10 per 1000), suffered a slight decrease. The relationship between these four MNMs and Greater London needs to be examined in more detail to establish the importance of movement between them in establishing their characteristic time-series profiles. The net loss from Greater London appears to be on the increase again, fuelling the process of counter-urbanization. The West Midlands metropolitan county also increased its net loss after the 'high' point in 1981/82 although its remainder, like the South West region suffered a reduction in its net gain during 1985/86 after increasing considerably between 1982 and 1985, implying that decentralizing moves out of the West Midlands did not involve destinations located entirely in the surrounding non-metropolitan area but in more distant regions of the U.K. The Northern Remainder and the North West Remainder suffered net losses through migration in recent years which, together with the previous evidence suggests a definite distinction between the metropolitan/non-metropolitan migration processes in the north of the U.K. and those in the south with some evidence of a southerly shift in the population. It requires a more detailed analysis of individual inter-zonal flows to substantiate this claim. Section 7.4.2 attempts this through an analysis of the distribution component of migration. The remainder of this section adds weight to the arguments already put forward by examining aggregate metropolitan and non-metropolitan differences in the level and rate of in, out and net-migration during the period in question.

Figure 7.5 illustrates differences in the level of movement to and from all metropolitan and non-metropolitan regions (aggregated from MNM regions) expressed as a time-series index (1975/76=100). Table 7.2 gives corresponding levels and rates of movement in addition to annual percentage fluctuations. Aggregate metropolitan out-migration declined considerably during the late 1970s and early 1980s until in 1981/82, the total number of moves originating in metropolitan MNMs was 20% lower than in 1975/76. This rapid fall was mirrored by a decrease in non-metropolitan in-migration - reaching a low-point in 1981/82, 18% below the base-year total. The metropolitan out-migration rate fell from 27.2 per 1000 in 1975/76 to 22.6 per 1000 in 1981/82, whereas the rate of in-migration to non-metropolitan zones decreased from 25.4 to 20.4 per 1000. Since this low point both have increased steadily until in 1985/86 they

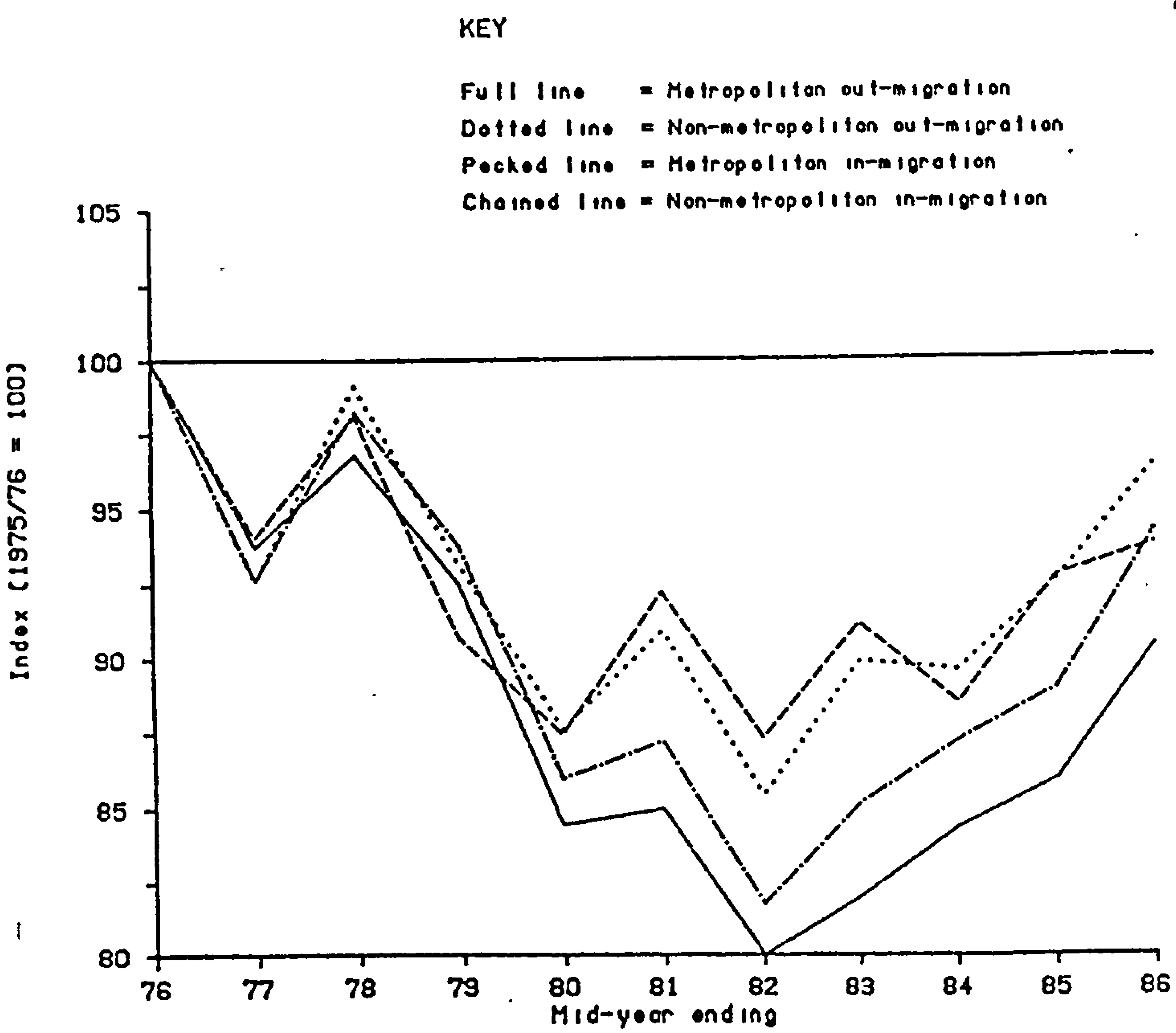


Figure 7.5 Time-series graphs of metropolitan and non-metropolitan in- and out-migration at the MNM level

Table 7.2 Total metropolitan and non-metropolitan inter-MNM movement

Year	Non-metropolitan			Metropolitan		
	Moves (000s)	%age change	Rate (/1000)	Moves (000s)	%age change	Rate (/1000)
(a) Out-migration						
1975/76	815		21.8	511		27.2
1976/77	755	-7.4	20.1	479	-6.3	25.7
1977/78	808	7.0	21.4	495	3.2	26.7
1978/79	759	-6.0	20.1	473	-4.4	25.7
1979/80	714	-6.0	18.8	432	-8.7	23.6
1980/81	741	3.8	19.4	434	0.6	23.9
1981/82	696	-6.1	18.2	409	-5.9	22.6
1982/83	732	5.2	19.1	419	2.5	23.2
1983/84	730	-0.4	19.0	431	2.9	23.9
1984/85	754	3.4	19.6	439	1.9	24.4
1985/86	786	4.2	20.3	462	5.2	25.7
(b) In-migration						
1975/76	952		25.4	375		27.2
1976/77	881	-7.4	23.5	352	-6.0	25.7
1977/78	935	6.1	24.8	368	4.3	26.7
1978/79	892	-4.5	23.6	340	-7.6	25.7
1979/80	818	-8.3	21.5	327	-3.6	23.6
1980/81	830	1.4	21.8	346	5.5	23.9
1981/82	778	-6.3	20.4	327	-5.4	22.6
1982/83	810	4.1	21.2	342	4.4	23.2
1983/84	829	2.4	21.6	331	-3.0	23.9
1984/85	846	2.0	21.9	347	4.9	24.4
1985/86	896	5.9	23.2	351	1.2	25.7

were 90% (metropolitan out-migration) and 94% (non-metropolitan in-migration) of the 1975/76 level. Decentralization or counter-urbanization processes appear to have been of declining importance during the early 1980s. This is emphasised by the net migration rate figures illustrated in Table 7.3. These show that the rate of net loss from metropolitan zones and net gain to non-metropolitan zones reached a low-point in 1982/83 (-4.3 and 2.0 per 1000 respectively). Net out-migration from metroplitan MNM regions has since increased

resulting in an increase in the level of net in-migration to non-metropolitan MNMs. It is evident from the graphs in Figure 7.5 that non-metropolitan outflows and metropolitan inflows did not suffer such large decreases during the period although both reached low-points in 1981/82. The out-migration rate from non-metropolitan MNMs reached a low of 18.2 per 1000 in this year which compares with the 1975/76 figure of 21.8 per 1000. The rate of in-migration to metropolitan zones was at its lowest in 1979/80 and 1981/82 (approximately 18 per 1000) in contrast to the base-year figure of 20 per 1000.

The important differentiation between metropolitan and non-metropolitan zones will be examined more fully in Section 7.5, where MNM regions are disaggregated into their individual metropolitan districts and non-metropolitan counties, thereby incorporating inter-FPCA flows so far excluded from the analysis, and introducing the concept of urban density to analyse the importance of movement to more rural regions from areas of greatest population density. This section has illustrated some of the major temporal trends in NHSCR inter-regional levels of movement and net migration gains and losses. The following section approaches the analysis from

Table 7.3 Net migration rates to metropolitan and non-metropolitan MNM regions

Year	Net migration rate (per 1000) Non-metropolitan	Metropolitan
1975/76	3.6	-7.3
1976/77	3.4	-6.8
1977/78	3.4	-6.9
1978/79	3.5	-7.3
1979/80	2.7	-5.7
1980/81	2.3	-4.9
1981/82	2.1	-4.5
1982/83	2.0	-4.3
1983/84	2.6	-5.5
1984/85	2.4	-5.1
1985/86	2.9	-6.2

a different angle by examining the stability of migration 'components' over time. Section 7.3 has already introduced the 'level' component of migration and the following section will analyse temporal variation in the 'generation', 'attraction' and the 'distribution' components.

7.4.2 Temporal variation in the generation, attraction and distribution components of migration

The generation and attraction components give a measure of the changing relative importance of an individual region as either a source of migration (generator) or as a destination (attractor). Each zonal out-migration or in-migration total can be expressed as a proportion of the total 'level' of movement in the migration system for a particular year - in this case the number of inter-MNM moves - to give an alternative interpretation of the temporal variation or stability in zone-specific in and out-migration totals. The generation component for one time-period (year t) is defined as:

$$g_{it} = \sum_j m_{ijt} \Big/ \sum_{ij} m_{ijt} \qquad (7.1)$$

and the attraction component as,

$$a_{jt} = \sum_i m_{ijt} \Big/ \sum_{ij} m_{ijt} \qquad (7.2)$$

where

$\sum_j m_{ijt}$ = total out-migration from zone i in year t;

$\sum_i m_{ijt}$ = total in-migration to zone j in year t; and

$\sum_{ij} m_{ijt}$ = total number of moves between MNM regions in year t.

Figure 7.6 illustrates the fluctuation in the out-migration (generation) and in-migration (attraction) components expressed as time-series indices. Out-migration components remained relatively

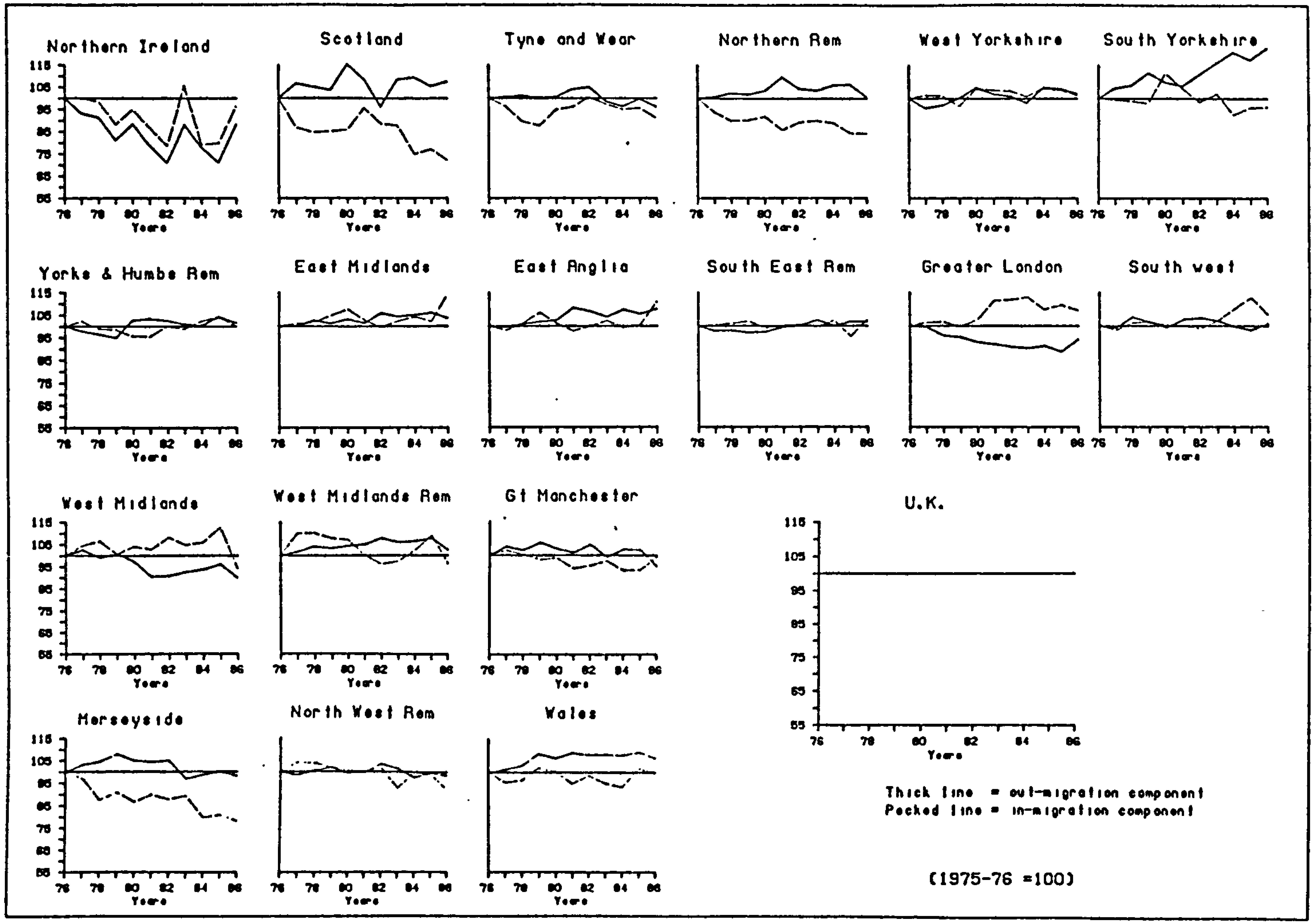


Figure 7.6 In- and out-migration components: time-series indices

stable during the 11-year period with certain exceptions. The two main sources of out-migration in absolute terms during the period were the South East Remainder and Greater London, but whereas the generation component of the former remained fairly stable, the proportion of all moves originating from Greater London declined during the late 1970s and early 1980s to be only 90% (16.5% of total movement) of the 1975/76 figure in 1981/82 and only 88.5% (16.3% of total movement) in 1983/84. In 1985/86, however, there was a significant increase in the proportion of moves originating from Greater London - a factor noted in the previous section and assumed to account for the increase in the proportion of moves destined for the South East Remainder, East Anglia and the East Midlands. Examination of the distribution component will confirm or refute this assumption. The out-migration component profile for the West Midlands follows a similar trend to that of Greater London although the final year of the time-series saw a decrease in the proportion of moves originating from the metropolitan county.

The importance of South Yorkshire as a source of movement increased considerably over the period with some possible explanations discussed in Section 7.4.1. In 1985/86 the proportion of moves originating from this MNM was 23% higher than ten years earlier. The in-migration components showed a greater degree of instability over the period. Scotland, Merseyside and the Northern Remainder stand out as areas which have undergone sharp reductions in their relative attractiveness as destination zones. In-movement to Scotland in 1985/86, for example, was only 72% of the 1975/76 total. Corresponding figures for Merseyside and the Northern Remainder were 78% and 84% respectively. East Anglia, the South East Remainder and the East Midlands all had relatively stable in-migration proportions over the period 1975/76 to 1984/85 followed by a sharp increase in 1985/86. The South West, in contrast, suffered a sharp decline in the final year of the period and further analysis of the respective distribution components should indicate which origins generated less moves to the South West in this year. In 1985/86, these four regions accounted for approximately 47% of total in-migration and if Greater London is included, this figure increases to 60%, thus illustrating the importance of the 'south' in the internal migration system of the U.K. It is interesting, therefore, to analyse the temporal changes in the distribution components of migration to assess the dominance of these MNM regions (the South East Remainder and Greater London in particular) as generators and attractors of migration movement and to establish any north/south divisions that may exist.

Two alternative formulations of the component are possible. First, taking an individual i-j flow as a proportion of the total <u>outflow</u> from origin i,

$$dg_{ijt} = m_{ijt} / \sum_{j} m_{ijt} \qquad (7.3)$$

and second as a proportion of the total <u>inflow</u> to destination j

$$da_{ijt} = m_{ijt} / \sum_{i} m_{ijt} \qquad (7.4)$$

For each individual cell of the inter-MNM, 11-year array there is, therefore, a corresponding distribution 'proportion' measuring either the importance of the flow in the level of out-migration from the origin or in the level of in-migration to the destination. Previous illustrations have highlighted a number of patterns requiring further investigation and explanation so the remainder of this section focuses on the distribution components for Greater

London and the South East Remainder to elucidate these trends.

Figures 7.7 and 7.8 illustrate the proportion of outflows from each MNM region which are destined for Greater London and the South East Remainder respectively. The graphs are represented as time-series indices. The dominant feature of both illustrations is the increasing attractiveness of Greater London, in particular, and the South East Remainder to moves originating in both the metropolitan and non-metropolitan regions of the 'North'. All metropolitan MNM regions experienced a considerable increase over the period in the proportion of their total outflows which were destined for Greater London. A particularly significant increase was apparent for the proportion of outflows leaving Merseyside for the capital after 1979/80. In 1985/86 12% of moves originating from the West Midlands were to Greater London. Corresponding figures of between 8 and 11% were evident for the metropolitan counties of Merseyside, Greater Manchester, Tyne and Wear, West Yorkshire and South Yorkshire respectively. The proportion of outflows from non-metropolitan MNM regions in the 'north' to Greater London also rose significantly during the period - the Northern and North West Remainders showing the largest increases.

In contrast the proportion of outflows leaving the East Midlands, East Anglia and the South West for the capital remained fairly stable during the period. The proportion of out-flows from the South East Remainder to Greater London has actually decreased since 1981/82, although still accounted for approximately 30% of total out-movement from the Remainder. The counter-stream of migration from Greater London to the South East Remainder (Figure 7.8) has also remained fairly stable throughout the period with 60% of moves originating in

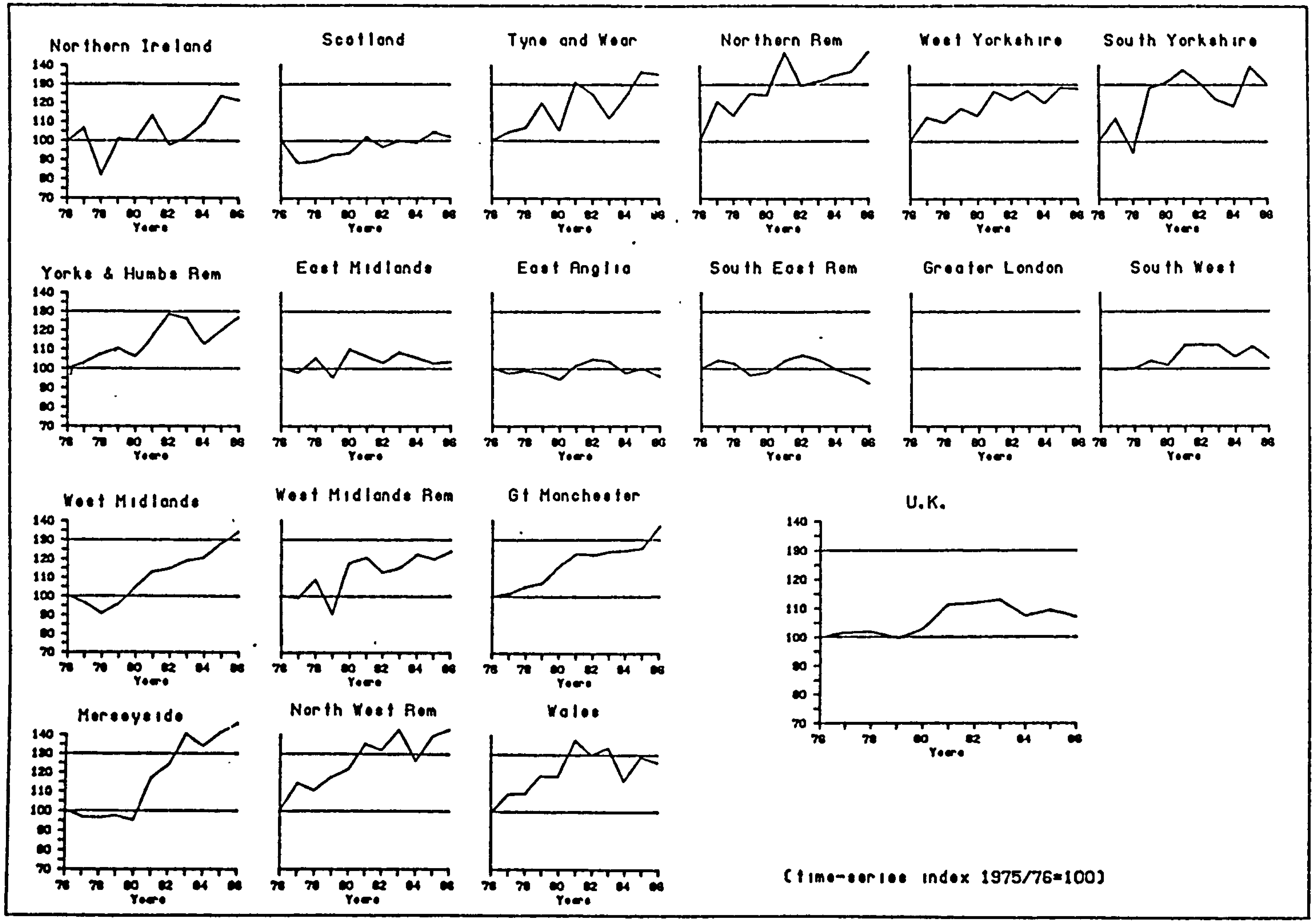


Figure 7.7 <u>Proportion of total outflows from each MNM region destined for Greater London</u>

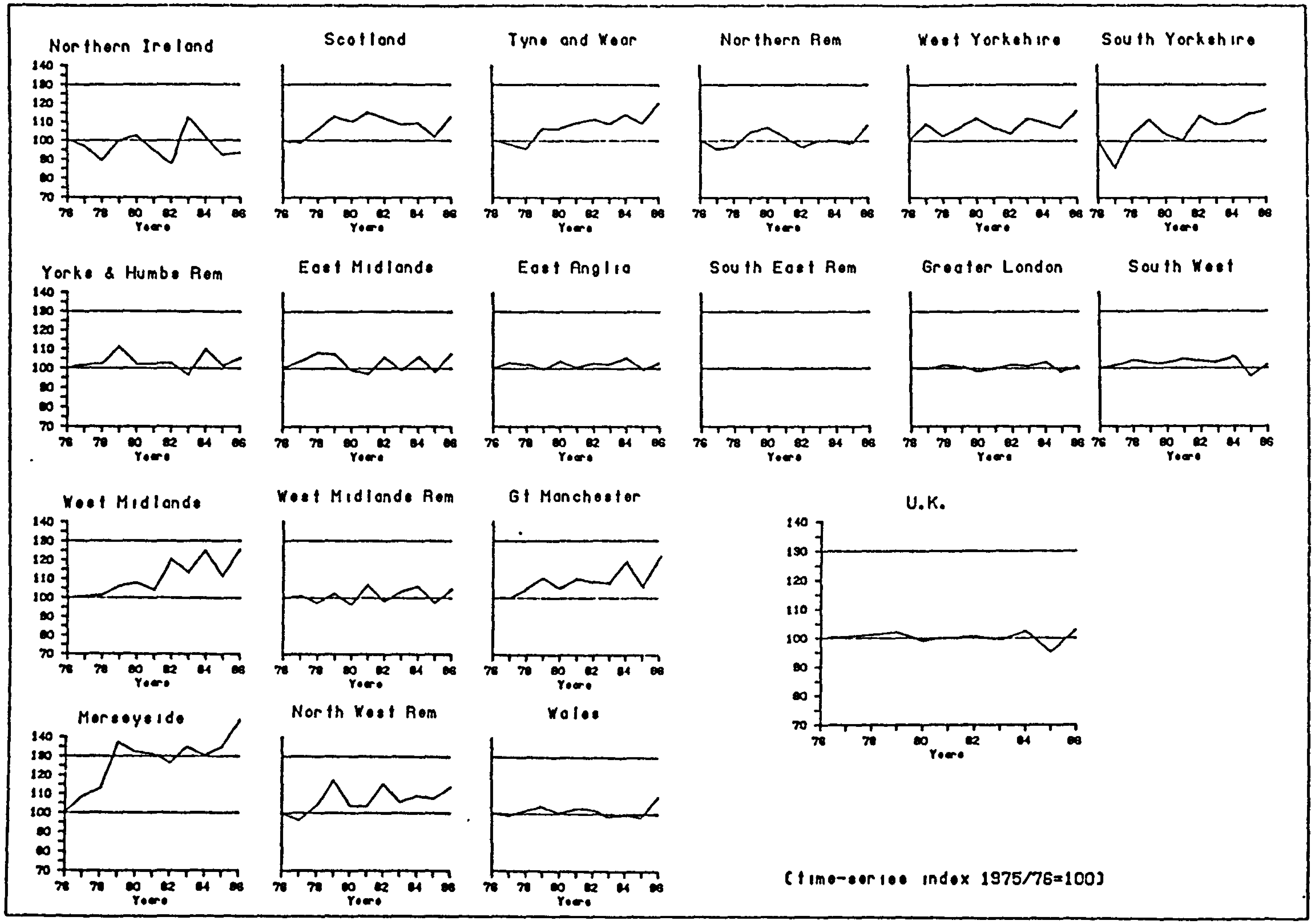


Figure 7.8 Proportion of total outflows from each MNM region destined for the South East Remainder

the London Boroughs directed at the surrounding non-metropolitan counties. Outflows from the East Midlands, East Anglia and the South West to the South East Remainder showed a similar stability with the three non-metropolitan regions directing approximately 22%, 35% and 38% of their outflows to the region in 1985/86. The increase in the out-migration proportion of metropolitan MNM regions to the South East Remainder is not quite as striking as for Greater London although there is evidence of a definite upward trend in each. The exception is Merseyside which experienced a substantial increase in the proportion of moves directed at the South East Remainder during the period. Of the non-metropolitan regions of the 'north' only the North West Remainder showed evidence of such an increase.

With Greater London and the South East Remainder playing such a dominant role in the internal migration system of the U.K. it is interesting to analyse the variation in the distribution of outflows from each to the remaining zones of the MNM region system. Figures 7.9 and 7.10 illustrate, as time-series indices, the proportion of outflows to each individual MNM region from Greater London and the South East Remainder respectively expressed as a percentage of the 1975/76 figure. As mentioned before movement between Greater London and the South East Remainder remained stable but of considerable magnitude during the period. The proportion of outflows from Greater London to the East Midlands decreased during the early 1980s but from 1982/83 onwards has steadily increased again. Similarly the proportion of outflows to East Anglia from the capital also decreased from 1979/80, but in this case until 1984/85. Only in the final year of the time-series has there been any substantial increase in this proportion. Flows to the South West have constituted a fluctuating

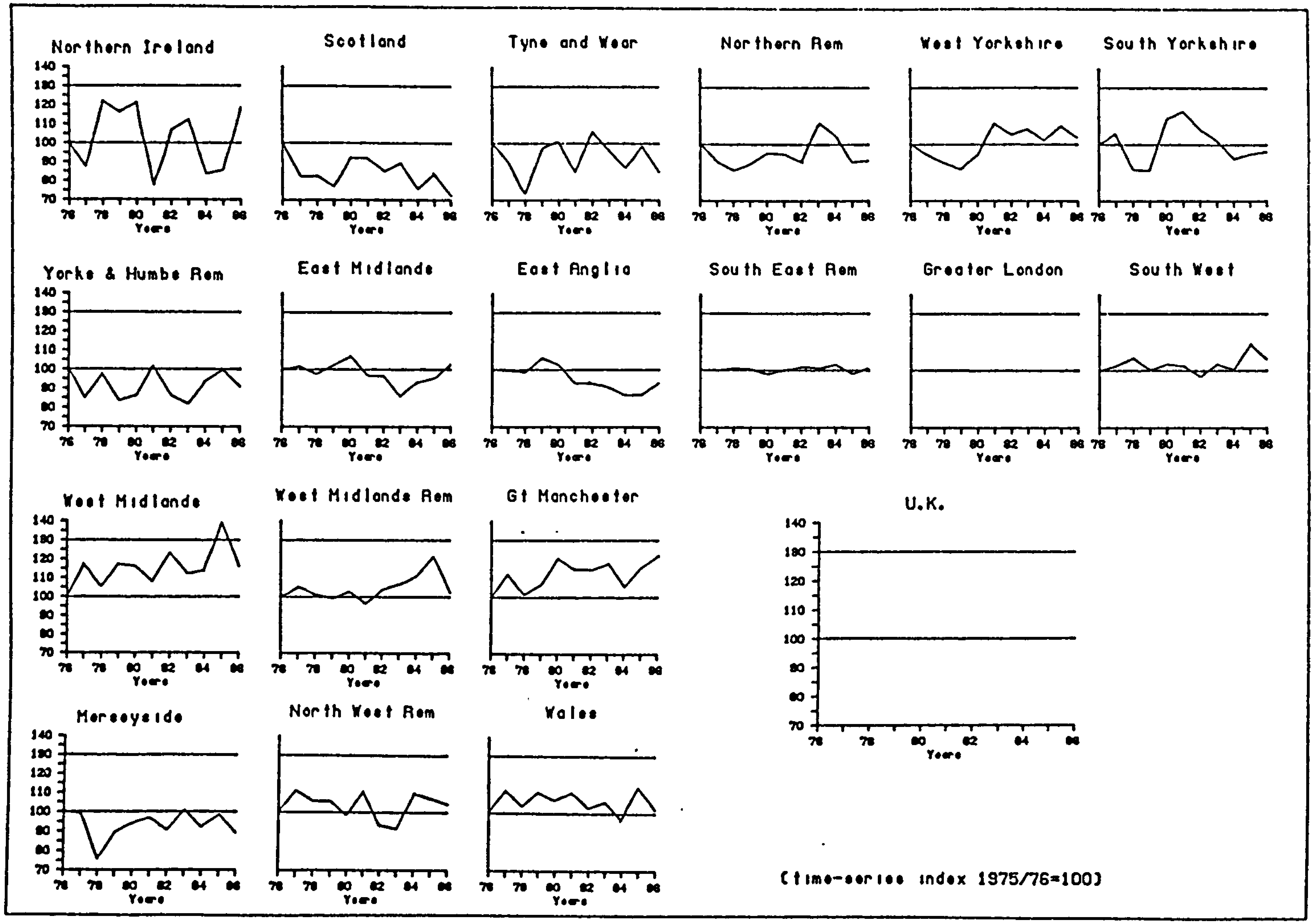


Figure 7.9 <u>Proportion of total outflows from Greater London destined for other MNM regions</u>

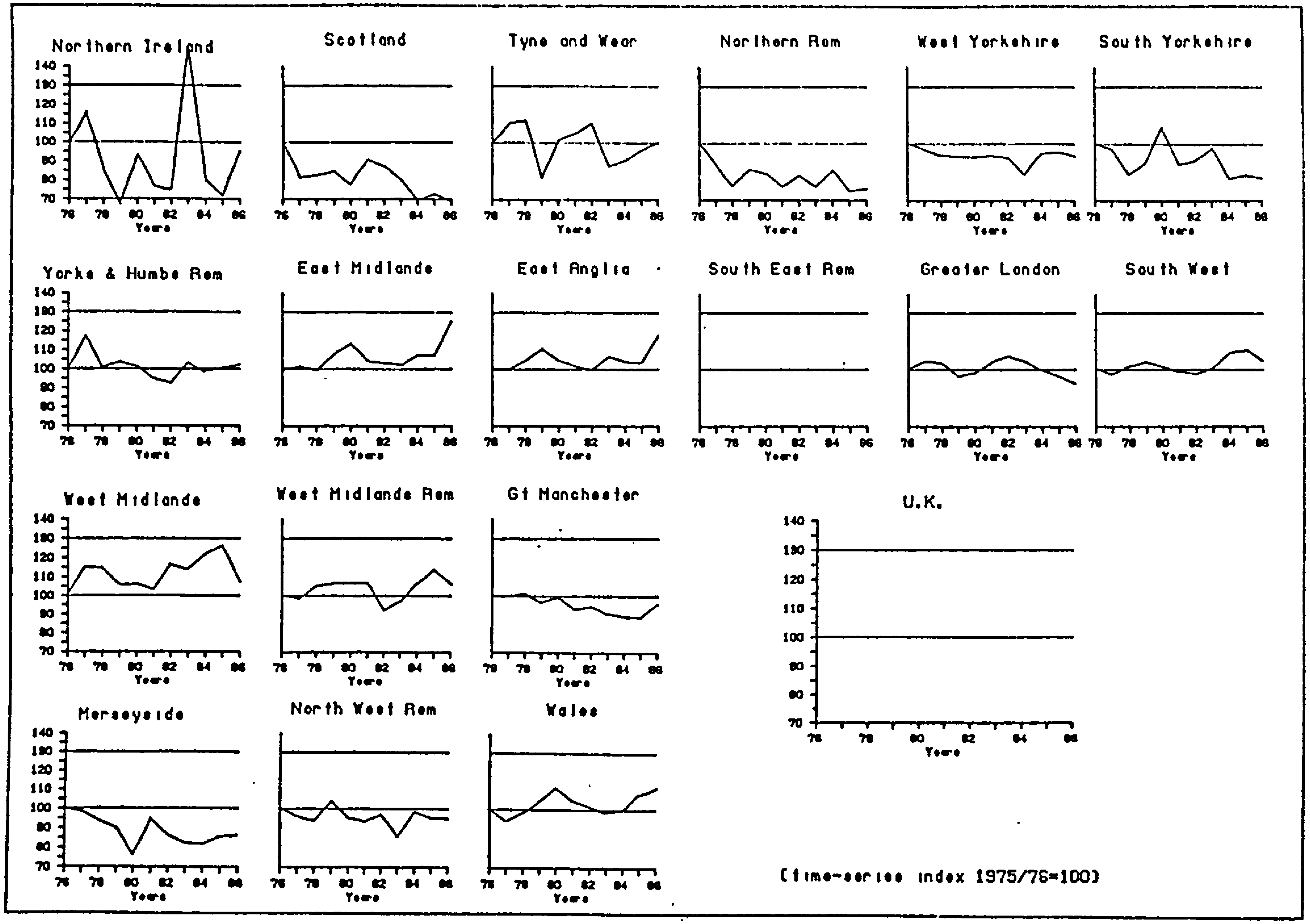


Figure 7.10 Proportion of total outflows from South East Remainder destined for other MNM regions

but important percentage of Greater London outflows in recent years. Also of significance is the apparently increasing attractiveness of the West Midlands and Greater Manchester to migrants from Greater London, illustrating important inter-metropolitan movement within the system. No other MNM region of the 'North' showed evidence of an increase in its attractiveness to out-migration from the London Boroughs.

The previous section highlighted major increases in the levels of in-migration to the East Midlands and East Anglia. Figure 7.10 presents an explanation for this with the proportion of moves to these two regions from the South East Remainder increasing considerably during 1985/86. These increases together with the upturn in the proportion of moves from Greater London has increased the importance of East Anglia and the East Midlands as attractors of migration. A significant increase in the proportion of flows from the South East Remainder to the South West was also evident during the later years of the period, illustrating the regions' attractiveness to migrants from both Greater London and the South East Remainder. The West Midlands metropolitan county has also benefited from increased in-migration from the South East although the proportion declined somewhat during 1985/86.

Significant trends in the patterns of migration have therefore been highlighted at the MNM level. The sharp reduction in the level of metropolitan out-migration and non-metropolitan in-migration up until 1981/82 was due predominantly to the substantial reduction in the number of moves originating from the capital. An upturn in the level of out-migration from Greater London in recent years and a rise in the distribution proportion of the South East Remainder has seen significant increases in the level of in-migration to East Anglia, the East Midlands and to a lesser extent the South West. Metropolitan and non-metropolitan regions of the 'north' appear to be providing an increasing number of in-flows to Greater London, in particular, but also to the South East Remainder. This suggests a definite north/south division in the nature of migration processes within the U.K. with only the West Midlands and Greater Manchester increasing their importance as attractors of migration from the capital.

7.5 TEMPORAL VARIATION IN SUB-NATIONAL MIGRATION FLOWS AT THE FPCA LEVEL

This section analyses inter-zonal movement at a much finer spatial scale allowing important intra-MNM region moves to be included. Subsequent sections complement the results outlined in Sections 7.3 and 7.4 through a general discussion of net, in and out-migration patterns at the FPCA level. A breakdown of flows into broad North/South divisions is investigated to assess the strength of the apparent shift in population, and the classification of FPCAs into categories based upon population density is used to illustrate important changes that have been taking place in the pattern of movement between the most highly urbanised areas and other more rural FPCAs.

7.5.1 Out, in and net-migration patterns

As in Section 7.4.1, the inter-FPCA flows can be sub-divided into metropolitan and non-metropolitan categories. Figure 7.11 illustrates the temporal change in the respective in and out migration totals as time-series indices and Table 7.4 outlines the

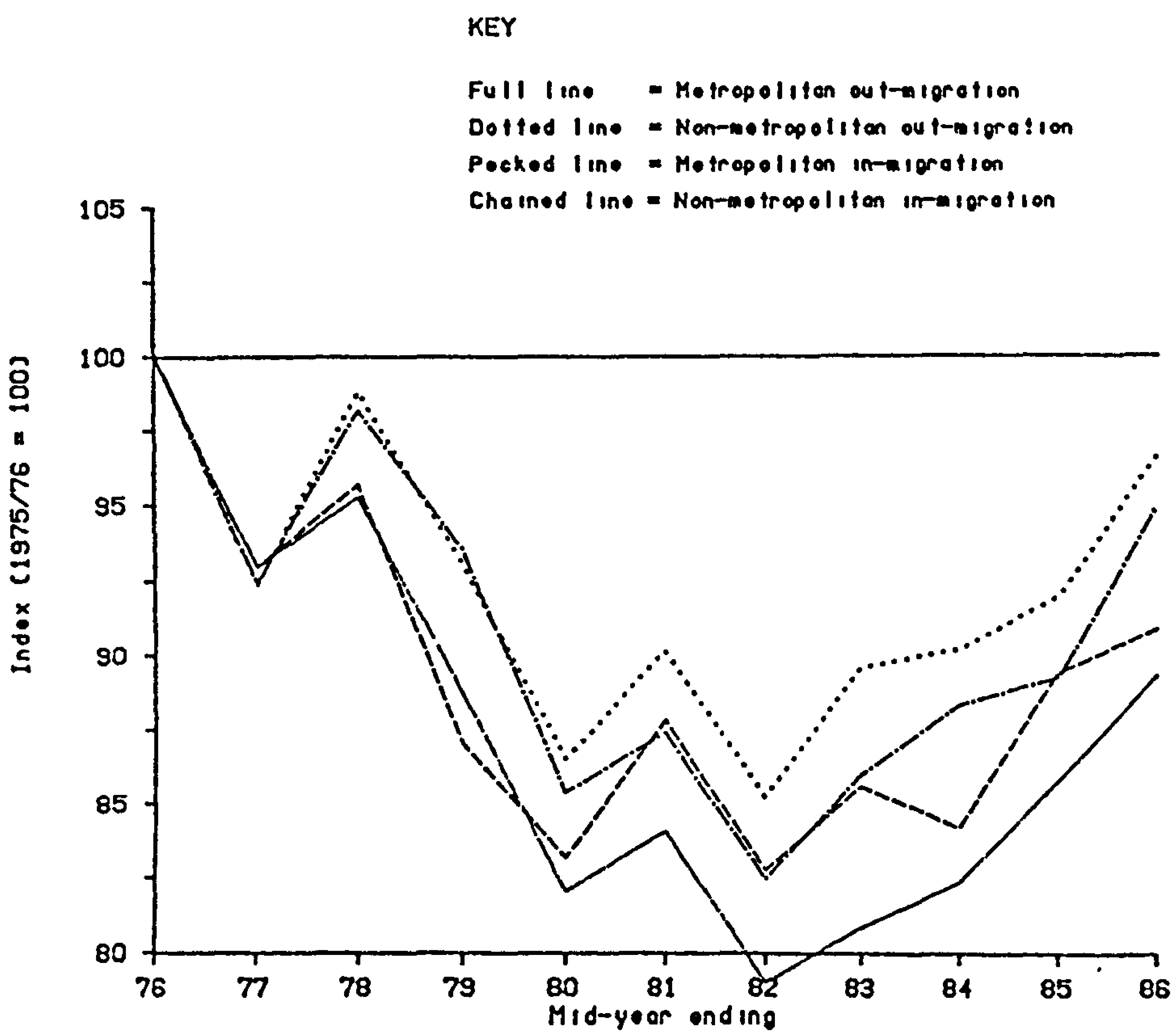


Figure 7.11 Time-series graphs of metropolitan and non-metropolitan in and out migration at the FPCA level

Table 7.4 Total metropolitan and non-metropolitan inter-FPCA movement

Year	Non-metropolitan Moves (000s)	Non-metropolitan Rate (per 1000)	Metropolitan Moves (000s)	Metropolitan Rate (per 1000)
(a) Out-migration				
1975/76	1101	29.4	830	44.2
1976/77	1017	27.1	771	41.4
1977/78	1088	28.9	791	42.8
1978/79	1025	27.1	736	40.1
1979/80	953	25.1	681	37.2
1980/81	993	26.0	698	38.3
1981/82	939	24.6	656	36.2
1982/83	987	25.8	671	37.2
1983/84	994	25.9	684	38.0
1984/85	1013	26.3	712	39.6
1985/86	1065	27.6	741	41.2
(b) In-migration				
1975/76	1238	33.1	694	37.0
1976/77	1144	30.4	645	34.6
1977/78	1215	32.2	664	35.9
1978/79	1158	30.6	603	32.8
1979/80	1057	27.8	577	31.6
1980/81	1082	28.4	609	33.5
1981/82	1021	26.7	574	31.7
1982/83	1064	27.8	594	32.9
1983/84	1093	28.5	584	32.4
1984/85	1105	28.7	620	34.5
1985/86	1175	30.4	630	35.1

actual number of moves together with the corresponding rates of movement. The sharp reduction in the level of metropolitan out-migration illustrated at the MNM level is even more pronounced at this finer spatial scale, with the level in 1981/82 being only 79% of the 1975/76 total. The rate of inter-FPCA metropolitan out-migration decreased over the same period from 44.2 per 1000 to just over 36 per 1000 - a decline in actual numbers from 830 thousand to 666 thousand. This emphasises the fact that the economic recession greatly reduced the level of movement from metropolitan areas with a lack of employment opportunities in a resident FPCA matched by limited vacancies throughout the U.K. The effect upon metropolitan in-migration was also much more pronounced at this scale than at the MNM level, with approximately 217 thousand fewer moves made into metropolitan FPCAs in 1981/82 than in 1975/76. These more substantial declines at the FPCA scale are due to the importance of shorter-distance <u>intra</u>-metropolitan flows within the system. This indicates that shorter-distance predominantly housing-related moves were affected to a greater extent than the generally longer-distance employment-related moves. Figure 7.11 illustrates that non-metropolitan in-migration declined considerably up to 1981/82 but its recovery after that date was much sharper than for corresponding metropolitan flows. All four types of flow have shown considerable increases in their levels of movement between 1981/82 and 1985/86 although metropolitan out-migration had only recovered to 89% of the 1975/76 total by the end of the period.

Figures 7.12 and 7.13 provide an illustration of the fluctuation in the level of out-migration and in-migration for individual metropolitan and non-metropolitan FPCAs repectively. The distinct

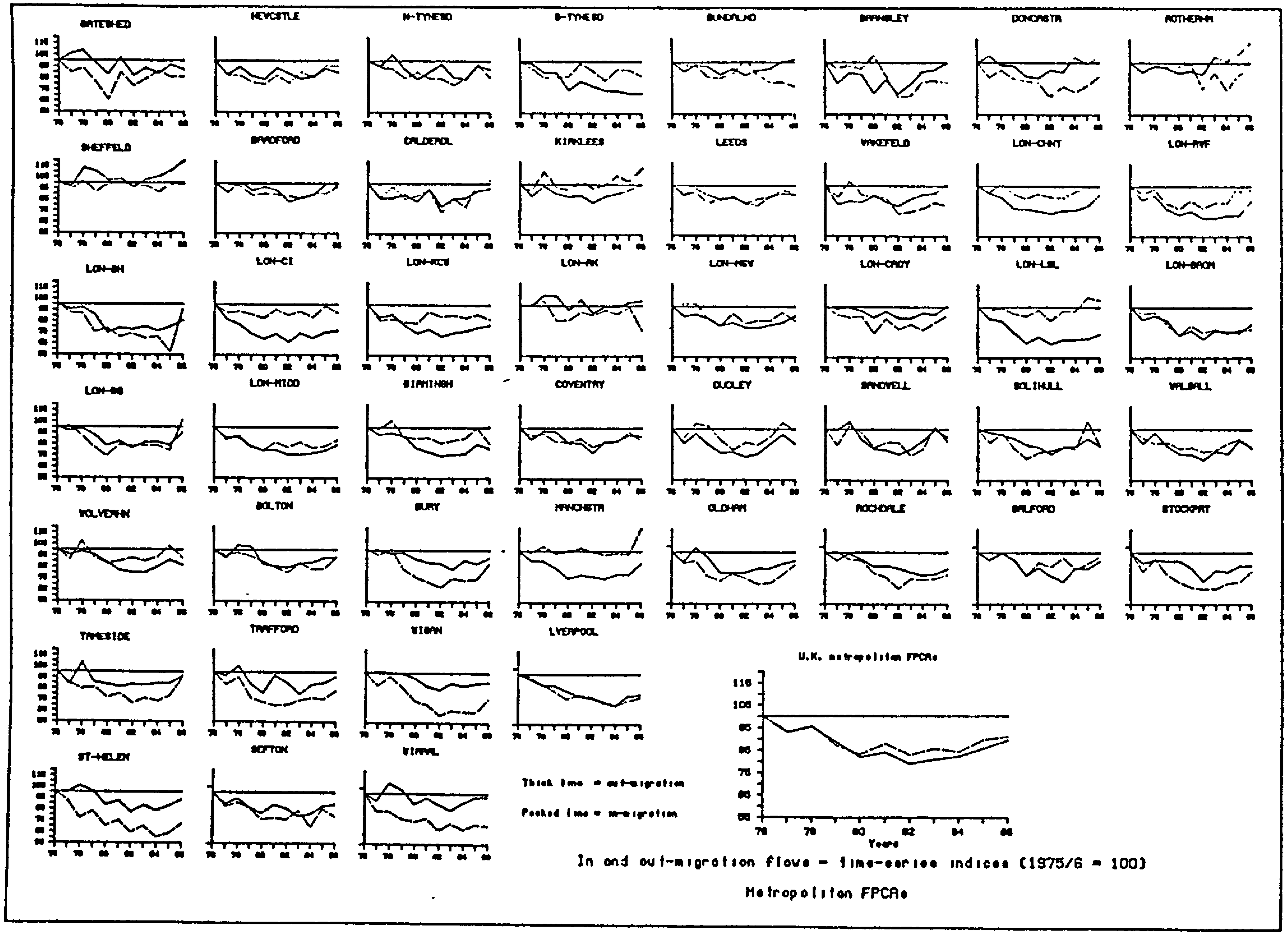


Figure 7.12 In- and out-migration flows for individual metropolitan FPCAs: time-series indices

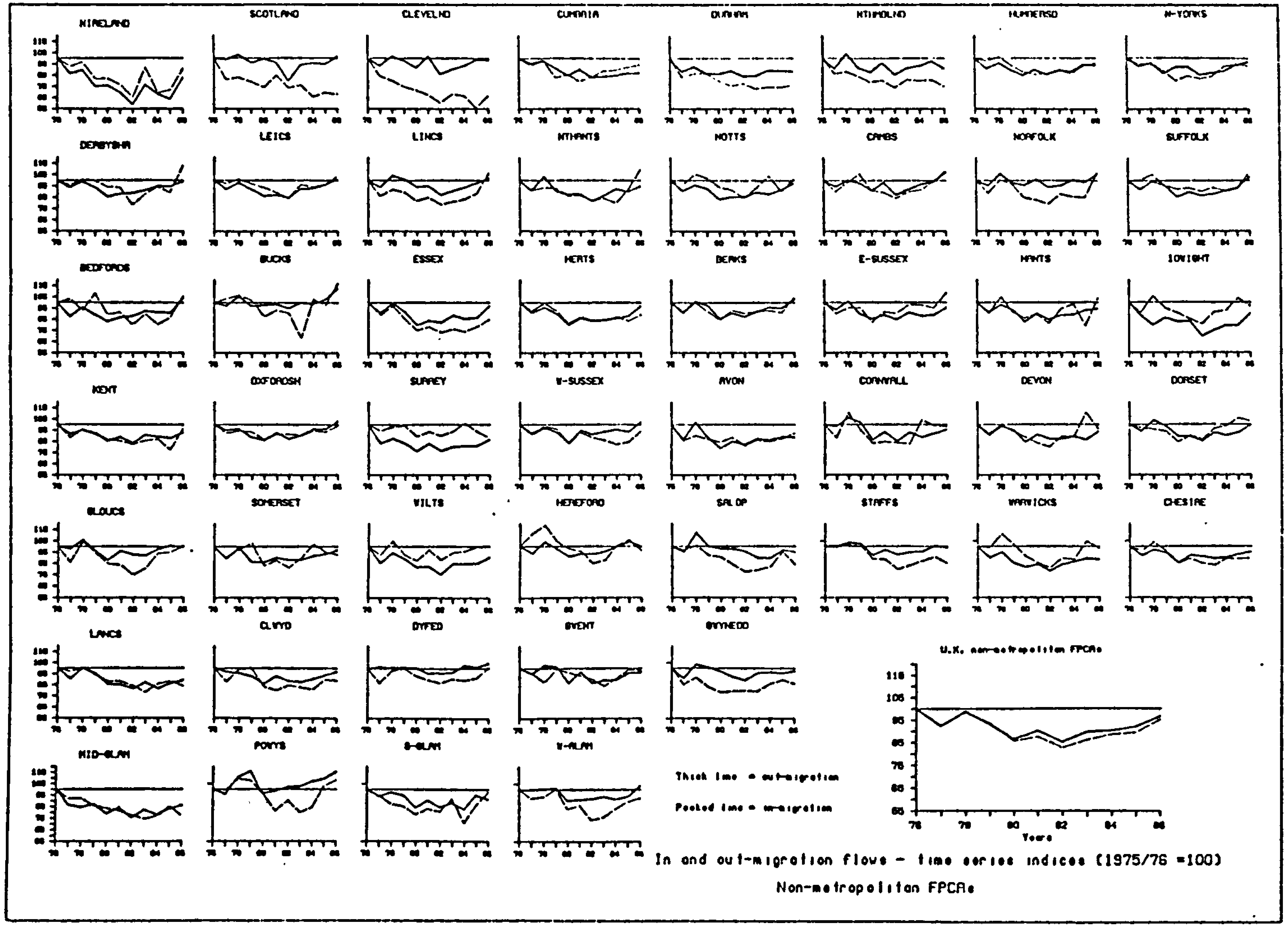


Figure 7.13 <u>In- and out-migration flows for individual non-metropolitan FPCAs: time-series indices</u>

increase in the level of out-migration from South Yorkshire, outlined in Section 7.4.1, was due to a significant increase in all four metropolitan districts. Each experienced levels of out-migration in 1985/86 greater than those of 1975/76 with Rotherham and Sheffield approaching levels 20% greater than ten years earlier. The majority of London-Borough FPCAs suffered significant reductions in their levels of out-migration up until the early 1980s with Lambeth/ Southwark/Lewisham, Camden/Islington, Kensington/Chelsea/Westminster and Redbridge/Waltham Forest experiencing the largest declines. All London FPCAs, however, showed a recovery in the level of out-migration in the later years of the time-series and it is these increases which suggest the continuing importance of decentralization processes in the South East. In-migration profiles for London FPCAs were fairly similar although Bromley was shown to experience steadily declining in-migration in recent years whereas Barking/Havering, which had an out-migration level 40% below 1975/76, and Bexley/ Greenwich had very large in-flow increases during 1985/86.

The elongated 'U' shape of the out-migration profiles was also in evidence in the districts of the West Midlands. The most significant falls in the out-flow level were experienced by Birmingham, Dudley and Wallsall. A significant downturn in the level of out-migration was found in all West Midlands metropolitan districts in 1985/86. This is matched by a similar downturn in the respective levels of in-migration. In the metropolitan districts of the North-West, Manchester stands out for maintaining a relatively stable high level of in-migration which increases sharply in 1985/86. The decline in the level of in-migration elsewhere, however, has been pretty severe, particularly in the Merseyside districts of Liverpool, St Helens/

Knowsley and the Wirral and the Greater Manchester district of Wigan. All the districts of Greater Manchester have experienced an upturn in the level of in-migration in recent years. Out-migration from the cities of Manchester and Liverpool showed substantial declines during the period with only the last two years of the time-series producing any significant upturn in the trend.

These fluctuations in the level of out and in-migration for metropolitan FPCAs can be matched with changes experienced by non-metropolitan zones (Figure 7.13). Initial increases in the level of in-migration were in evidence for all FPCAs in the East Midlands and East Anglia - all attaining levels above those of 1975/76. All FPCAs in the South East Remainder also experienced a steady increase in in-migration in the latter years of the time-series, with the exception of the Isle of Wight and Surrey. The most significant increases were apparent in Bedfordshire, Buckinghamshire and East Sussex. The importance of the South East Remainder as a generator of movement also increased after a low-point in the early 1980s with all FPCAs increasing their level of out-migration in the last few years of the 1975-86 period. The recent downturn in migration to the South West region illustrated in Section 7.4 is emphasised here with particularly significant declines in the level of in-migration to Devon and Somerset in later years of the time-period. One notably significant profile in Figure 7.13 is that of Cleveland which has the largest percentage decrease of all non-metropolitan FPCAs. It is probably more correct to class this FPCA as a 'metropolitan' area since Teeside is the site of much heavy industry and has suffered economic decline to the same extent as other metropolitan areas in the North and Midlands.

These in and out-migration variations can be translated into net-migration rates for the period. Figures 7.14 and 7.15 illustrate changes in the net rate of migration between 1975 and 1986 for metropolitan and non-metropolitan zones respectively. A notable decline in the rate of net loss from certain Greater London FPCAs was observed up until 1981/82. Particularly sharp declines were in evidence for Camden/Islington, which actually had a positive net-migration rate between 1979/80 and 1984/85, Kensington/Chelsea/ Westminster, especially between 1975/76 and 1981/82, and Lambeth/ Southwark/Lewisham. Slightly smaller decreases in the rate of net loss through migration were experienced by City/Hackney/Newham/Tower Hamlets and Redbridge/Waltham Forest. The majority of London FPCAs have, since 1981/82, had increasingly negative net rates of migration, with the exception of Barking/ Havering and Bexley/Greenwich which, due to a rapidly increasing in-migration component, had a positive net-migration rate in 1985/86, suggesting a preferential shift to the eastern FPCAs of Greater London in recent years. In the West Midlands, Birmingham has suffered the largest rate of net loss in contrast to Solihull which experienced a positive net rate of migration between 1980/81 and 1985/86. In the North West high negative rates were in evidence in Manchester although they decreased somewhat during the period, with particularly large and consistent negative rates also in the FPCAs of Liverpool and St Helens/Knowsley.

At the non-metropolitan level (Figure 7.15), the increase in the level of in-migration to FPCAs of the East Midlands was not matched by high rates of net in-migration in Derbyshire, Leicestershire or Nottinghamshire. Only Lincolnshire and Northamptonshire showed

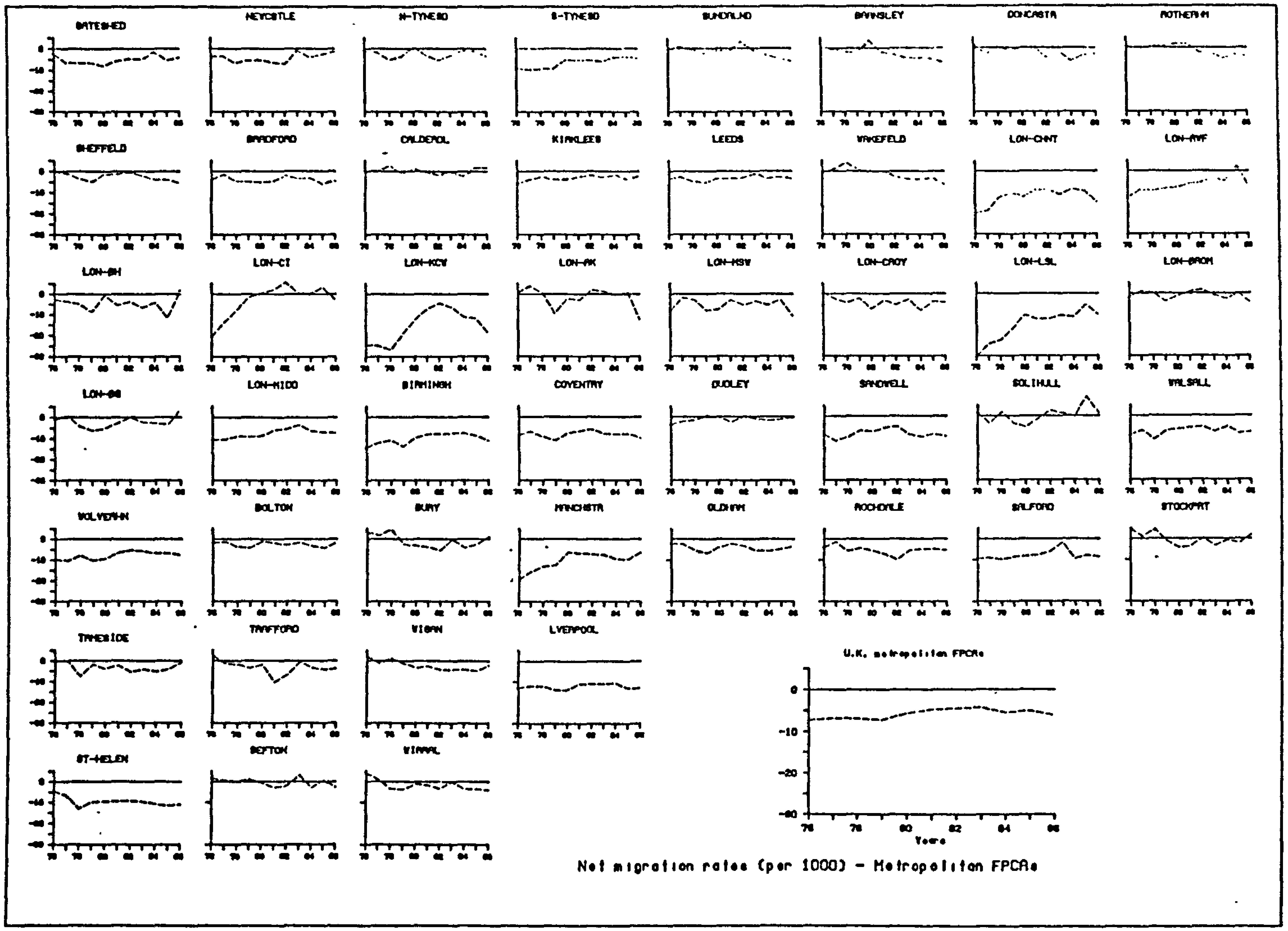


Figure 7.14 Net migration rates for metropolitan FPCAs

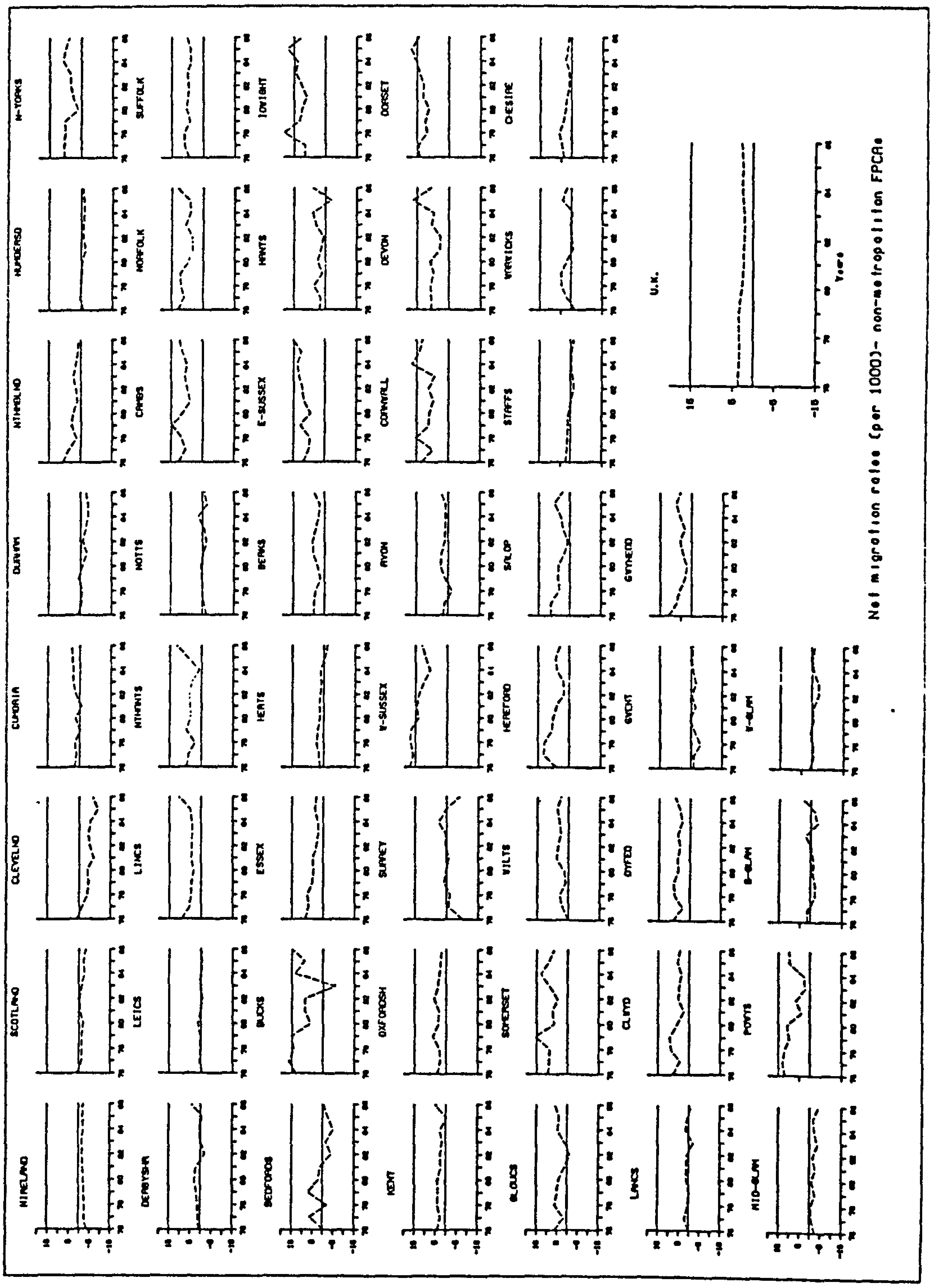


Figure 7.15 Net migration rates for non-metropolitan FPCAs

significantly high net in-migration rates during the period, particularly in the last two years in the case of the latter. All three FPCAs in East Anglia had large positive net in-migration rates throughout the period with some increase from 1983/84 onwards.

The net rate patterns in evidence for FPCAs of the South East region are not quite so clearly defined. The fluctuating importance of in-migration to Milton Keynes probably accounts for the sharp increases and decreases in the net migration rate for Buckinghamshire during the period. The net rate reached a low-point in 1982/83 when the FPCA was actually losing population through migration but has increased rapidly since to a high of almost 15 per 1000. Whereas Berkshire, Essex, Kent and Oxfordshire experienced fairly stable positive net in-migration rates, Bedfordshire, for the period 1980/81 to 1984/85, and Surrey and Hampshire at various times during the period, suffered net losses. Surrey has been increasing its negative rate of net in-migration since 1983/84. Those FPCAs with the highest net in-migration rates during the period, apart from Buckinghamshire, were the counties of East and West Sussex and also the Isle of Wight. Retirement migration is likely to be of importance in maintaining the net inflow at such a high level in these FPCAs, and in the coastal FPCAs of the South West region. Devon, Cornwall and Dorset all experienced very high net in-migration rates throughout the eleven-year period despite a downturn in 1985/86. The importance of these FPCAs as destinations is examined more closely in Chapter 8. Within the West Midlands 'system', Hereford and Worcester and Shropshire have had the highest net rates during the period whereas Staffordshire has maintained a negative rate in recent years. In Wales, Mid-, South- and West Glamorgan all had negative rates in the later years of the time-series whereas Powys, Dyfed and Clwyd appeared to be increasing their net-migration gain.

This section has outlined trends at the FPCA level and highlighted patterns overlooked by the inter-MNM region analysis. The differences between processes affecting FPCAs of the East Midlands, East Anglia, the South East and the South West and those affecting the rest of the country can be further investigated using two alternative forms of aggregation. The following section attempts to confirm the trends outlined in previous sections by analysing North/South differences and the effect of population density upon migration.

7.5.2 The North/South divide and the influence of population density upon net migration patterns

This section examines further the trends in migration during the 1975/76 to 1985/86 period by introducing categorisations of individual FPCAs based on population density and broad regional divisions which allow temporal trends in the differences between North and South and between the highly urbanised and more rural areas to be clarified and for the prior evidence of continued counter-urbanization to be confirmed. A full description of the derivation of these alternative spatial divisions is given in Section 3.2.5.

Figure 7.16 illustrates the variation in the levels of out and in-migration for the broad regional divisions, and Figure 7.17 translates these fluctuations into net figures. The dominant feature is the growth of the Rest of the South (ROS) at the expense of the other three regions. Even during the slump of the early 1980s, the ROS still maintained a positive net-migration balance of almost 80

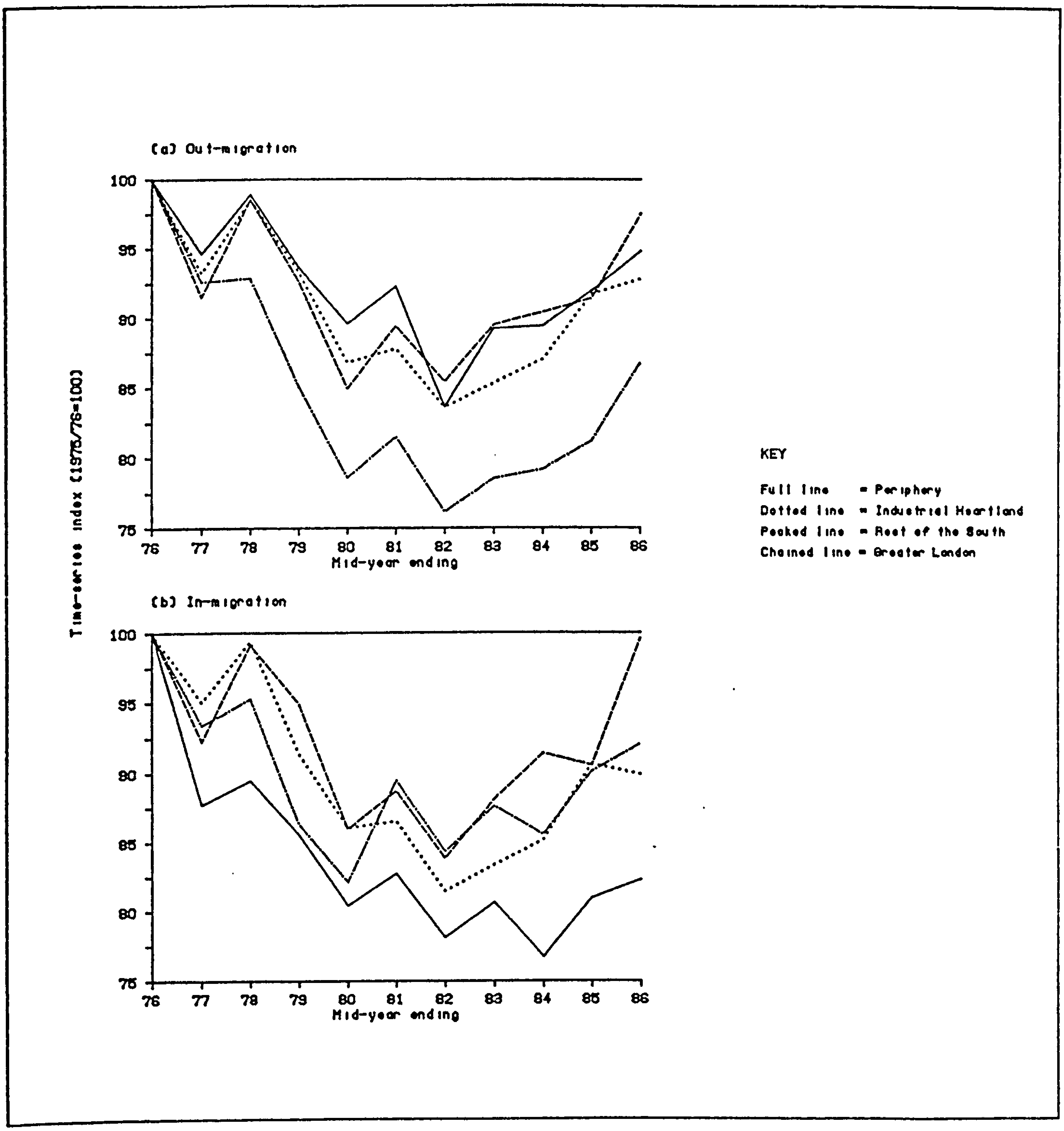


Figure 7.16 Out- and in-migration flows for broad regional divisions of the U.K.

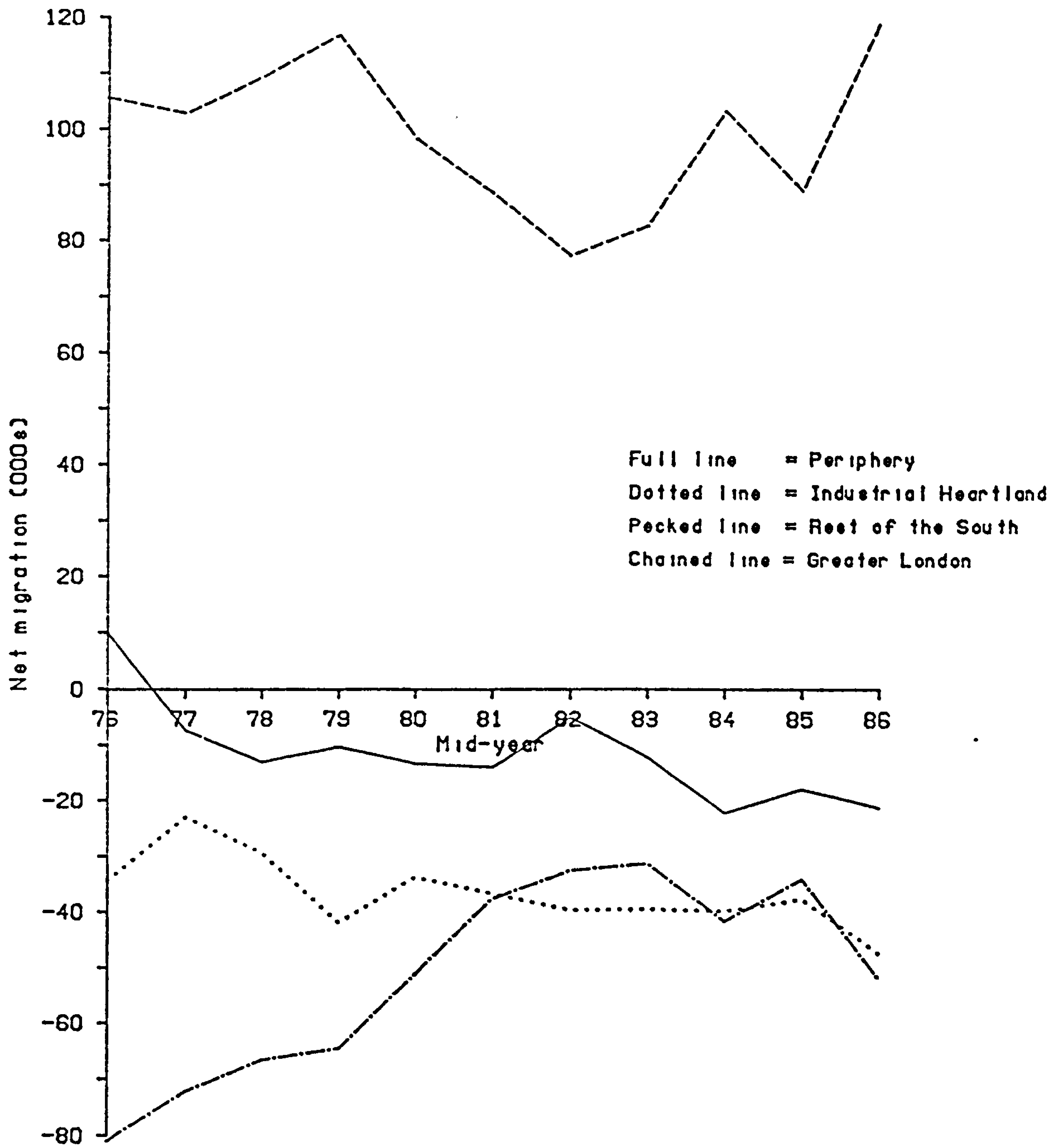


Figure 7.17 <u>Net migration flows for broad regional divisions of the U.K.</u>

thousand. With a sharp increase in the level of in-migration in 1985/86, the ROS recorded a net in-migration of approximately 120 thousand. Variations in the level of net in-migration to the ROS are very much reflected in the net migration schedule of Greater London, reaching a peak in the early 1980s and fluctuating thereafter but with a definite upward trend in evidence: ie. greater net migration loss from the capital and an increased net gain to the ROS. The two northern zones suffered a steady increase in the level of net-migration loss during the period. In the case of the Periphery, whereas the level of out-migration increased considerably from 1981/82 onwards, the level of in-migration recovered only marginally to approximately 82% of the 1975/76 total in 1985/86, thus producing a continually increasing migration deficit. The levels of out and in-migration associated with the Industrial Heartland fluctuated almost in parallel during the period leading to a sustained migration deficit of approximately 40 thousand. A significant feature of the net migration balances during the late 1970s was the rapidly declining net-migration loss to Greater London and the contrasting, steadily increasing net migration losses of the Periphery and of the Industrial Heartland in particular. The second FPCA classification, based upon population density, further highlights these North/South differences.

Population density is used here as a proxy for degree of urbanisation and is useful in this context to analyse the importance of decentralising migration within the inter-FPCA system and to assess any differences that may exist between such processes in the North and in the South. Figure 7.18 illustrates the net-migration balances for the four density categories over the eleven year period.

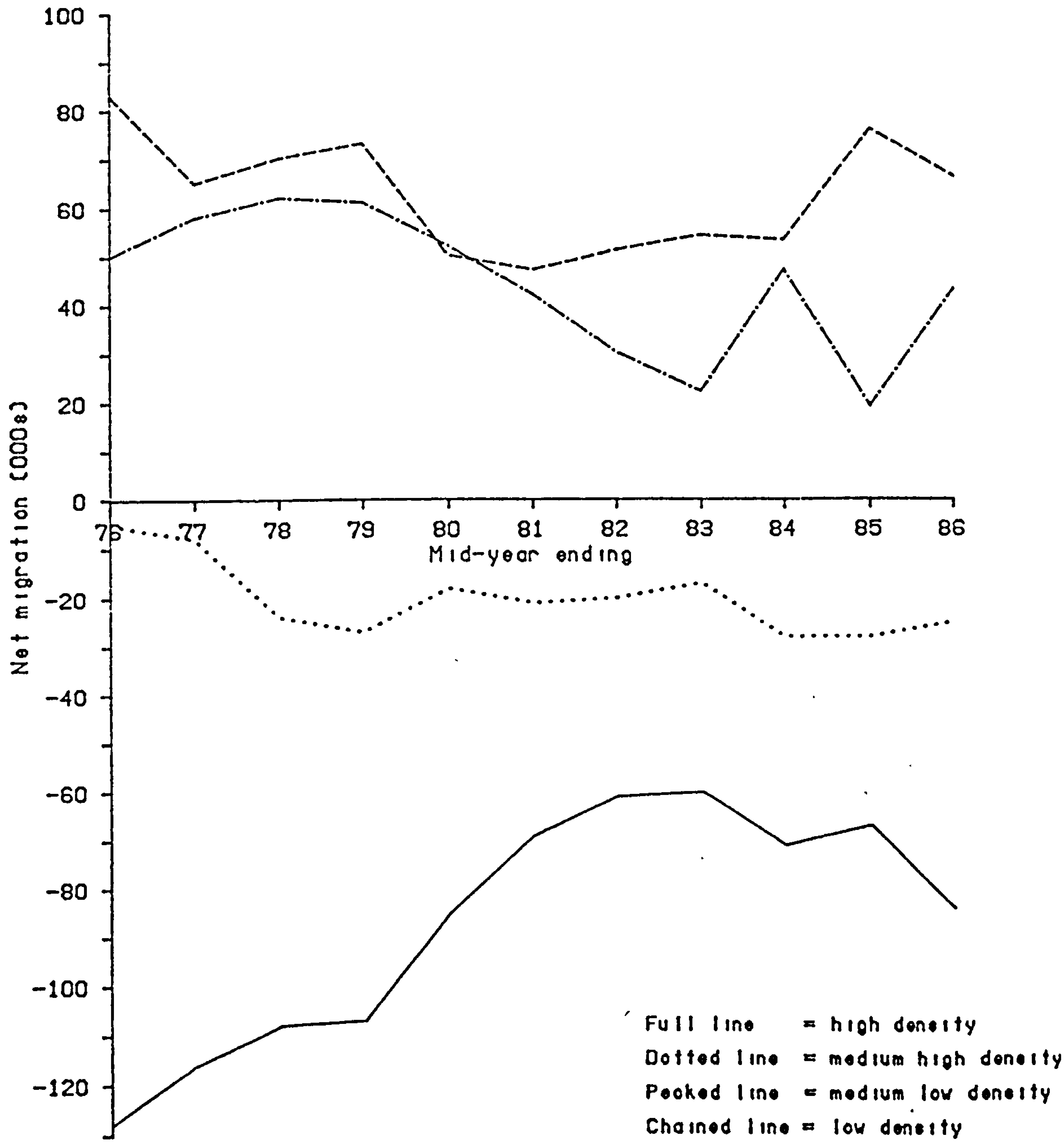


Figure 7.18 <u>Net migration flows for broad FPCA classes based on population density</u>

The high density class underwent a considerable reduction in its net loss through migration between 1975/76 and 1982/83 (-128 thousand to -60 thousand) but has since seen a definite downward trend with the level of net in-migration in 1985/86 being approximately -84 thousand. The medium/high density class fluctuated least during the period but maintained a negative net in-migration balance which varied little around -30 thousand between 1983/84 and 1985/86. The two lower density classifications of FPCA have both experienced positive net migration levels during the period. The medium/low category decreased its level up until 1982/83 in parallel with the decline in the negative balance of the high density class. Since 1982/83, the net figure has varied considerably with a balance of over 42 thousand evident in 1985/86. The low density class, influenced strongly by the negative balance of Scotland, experienced the largest net gains during the 1980/81 to 1985/86 period with an increase of 66 thousand through migration in 1985/86. The use of a crude population density classification emphasises, therefore, the decline in the level of decentralisation from the major urban areas up until the early 1980s. The process of counter-urbanization appears to have gained further momentum in recent years however with particularly significant gains to the low density areas which include the East Anglian FPCAs and the coastal counties of the South West region.

A clear difference exists between decentralization processes in the North and those in the South (Figure 7.19). The general trend in the level of net in-migration to the North is of sustained increases in net loss. The South is a reverse of this trend. In 1985/86, the North suffered a negative net migration balance of approximately 68

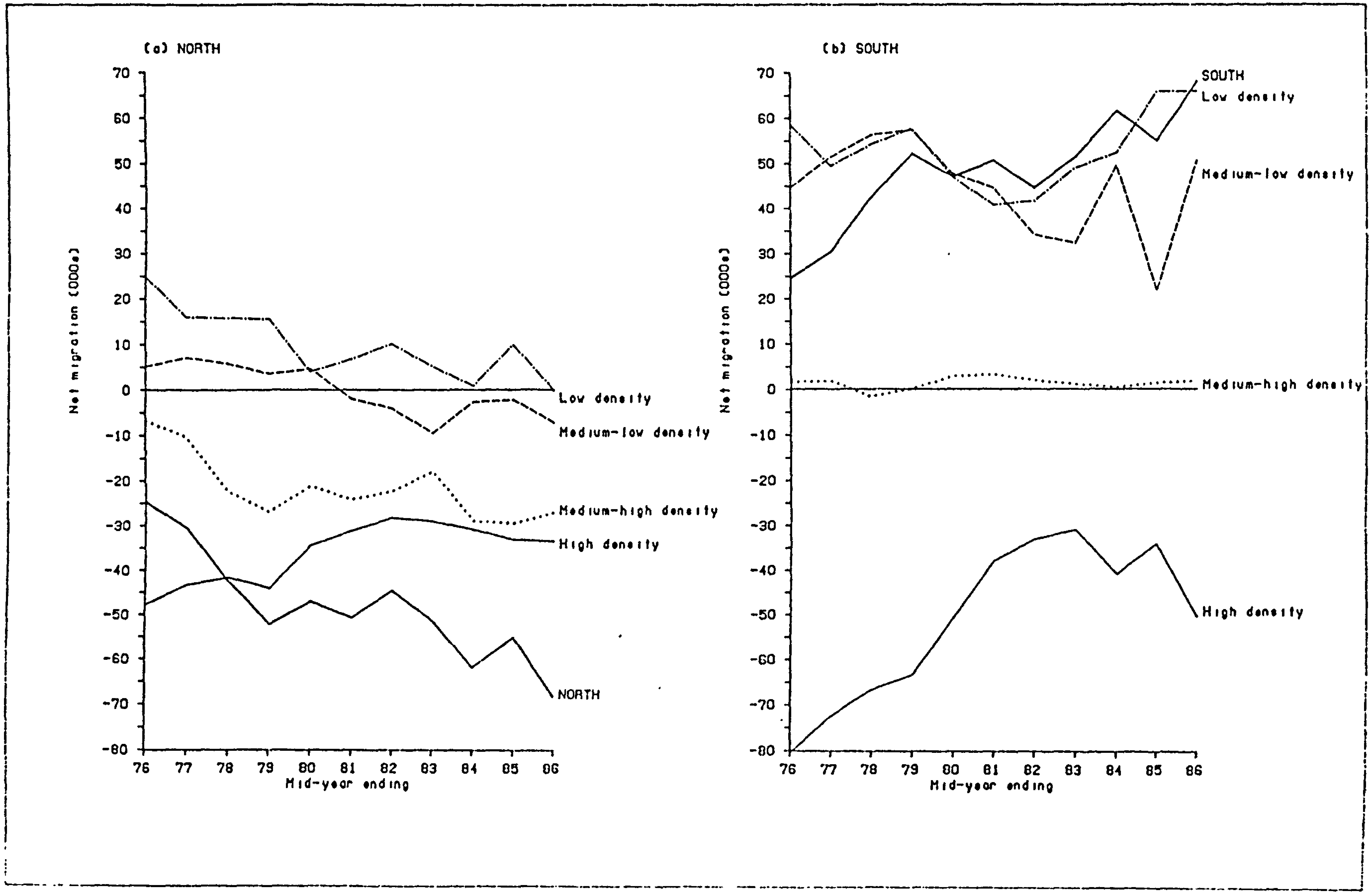


Figure 7.19 Net migration flows for north/south divisions of population density classes

thousand. The important characteristic of the net balances for the density classifications of the North is that although significant net losses are experienced by the two higher-density categories, there is no corresponding gain in the medium/low and low density classifications. The medium/low category has actually suffered a net migration loss since 1980/81, and the figure for the low density class, which remained below +10 thousand throughout the period, dipped below zero in 1985/86. The urban areas of the North have, therefore, experienced considerable net losses during the period but the consequent outflow does not appear to have been directed at the less urbanised areas of the North. Counter-urbanization processes are not a strong feature of the northern system. The loss to the southern half of the country is a much more important phenomenon. In the South the net migration schedule for the high-density London FPCAs indicates a deceleration in the level of decentralisation up until 1982/83, which is mirrored in the schedules of the medium/low and low density classes. The medium/low category has shown considerable fluctuation in recent years although the gain through migration was over 50 thousand in 1985/86. The low density areas have undergone a more sustained increase in the level of net in-migration since 1981/82, reaching a figure of +68 thousand in the final year of the time-series. This indicates clearly that decentralization processes appear to have extended to the 'most rural' areas in the southern half of Britain, namely East Anglia, the South West and parts of the East Midlands. Movement out to the FPCAs immediately surrounding Greater London (medium/low density) is still important but has fluctuated considerably in recent years.

7.6 SUMMARY AND CONCLUSIONS

The analyses undertaken in this chapter have revealed a number of significant characteristics of the changing pattern of internal migration within the UK. The general level of movement reached a low point in 1981/82 but has since increased considerably. Throughout the period the ROS gained through migration at the expense of the other three macro regions with Greater London being the major supplier of migrants to the less densely populated areas of the South East, South West, East Anglia and the East Midlands. The net outflow from the capital decreased substantially between 1975/76 and 1982/83, but has since experienced a considerable rise in the level of out-migration with a consequent increase in in-migration to the ROS in particular. The North experienced an increasing net loss to the South, and in 1985/86, all population density classes of the North suffered net out-migration, with the low-density FPCAs of East Anglia and the South West having particularly large net gains. The proportion of flows from provincial metropolitan areas to Greater London rose considerably as did the corresponding movement to the SE Remainder. The capital and its surrounding counties were therefore becoming increasingly attractive to migrants from the most densely populated areas of the West Midlands, Merseyside, Greater Manchester, Tyne and Wear and West and South Yorkshire. The importance of decentralisation processes from Greater London decreased as the general propensity to migrate decreased but the proportion of moves from the capital to the SE Remainder remained stable throughout the period. The counterflow of moves into the most densely populated areas of the country from the surrounding counties of the South East declined in importance up to 1985/86. Decentralisation or counter-urbanisation appears to be continuing from Greater London, therefore, despite evidence to suggest small population increases in the capital (Champion and Congdon, 1988). Migrants are continuing to be attracted to the less densely populated areas of the country with the expansion of the South East transport system continually increasing the commuter field around the capital. This ensures that family migrations out of Greater London do not necessarily involve a change of employment for the head of household although, with the increasing diffusion of industrial enterprises to lower cost locations and the loosening of locational ties of many businesses, the non-metropolitan areas of the SE Remainder are themselves becoming important centres of employment. This is further emphasised by an increasing level of movement to this region from the urban areas of the North, which constitutes an important component of the visible drift to the South.

The increasing attraction of the least urban, most remote areas of East Anglia and the South West reflects environmental preferences of persons in the South East upon retirement. The same is not true of the least densely populated areas of the North which are now also loosing population through migration.

These trends are obviously significant but may be easier to interpret given an understanding of the age-sex structure of the migration processes. Which groups are moving from North to South and what is the age-structure of the considerable number of migrants moving into Greater London? Furthermore is the process of counter-urbanization evident for all age-groups and is it only the young more mobile sections of the population migrating between the major urban areas. These questions are examined in Chapter 8.

Chapter 8. CHANGE OVER TIME: AGE AND SEX DISAGGREGATED PATTERNS AND TRENDS IN NHSCR MOVEMENT DATA, 1975/76 TO 1985/86

8.1 INTRODUCTION

This chapter continues the analysis of trends in internal migration in the UK but utilises NHSCR data at a number of spatial scales which is disaggregated by age and sex. Following on from the previous chapter, temporal trends in age and sex-disaggregated movement are examined for metropolitan and non-metropolitan areas, and for broad regional divisions and derived population density categories (Section 3.2.5). In addition, the chapter aims to investigate two facets of the migration component of the current OPCS/DOE sub-national projection methodology, namely the use of certain broad age-groups in the assignment stage of the forecasting procedure, and secondly, the use of 1981 Census inter-zonal migration information as a basis for assigning estimated out-flows in these broad age-groups to individual destinations in more recent years.

To minimise the internal storage requirements of the assignment process in the official methodology, OPCS/DOE utilise assignment matrices for only three broad age-bands which are assumed to represent the important components of age-specific movement: family moves (0-16 and 29-59); moves around the time of entry to the labour force (17-28) and moves by the elderly (60+) which involve retirement. In this chapter the suitability of these age-groups will be assessed in the light of results produced from a cluster analysis of five-year age-groups on the basis of similarities between their patterns of inter-zonal movement. The assignment probabilities used in the most recent round of population projections are based on 1981 Census migration data with no updating of the inter-zonal information using data from the NHSCR for subsequent years. Patterns of age-group migration by origin and destination are assumed to remain constant over time. This chapter, using inter-FPCA movement data for 1980/81 and 1985/86, examines changes in the spatial pattern of movement using a broad age-group classification to assess the justification for basing the 1985 and subsequent rounds of projections on migration data obtained from the 1980/81 period.

The remainder of the chapter has the following structure. Section 8.2 provides a brief description of the data utilised in the analyses undertaken in this chapter, whilst Section 8.3 introduces the description of temporal trends with an illustration of age and sex-disaggregated migration at the national level for the 1975/76 to 1985/86 period. Clustering methods are utilised in Section 8.4 to derive an age-group classification which is used firstly for comparison with the OPCS/DOE categorisation and secondly to examine temporal trends in age and sex-disaggregated migration at a sub-national level (Section 8.5). Section 8.6 concludes the analysis with an illustration of changes in the pattern of inter-zonal movement between 1980/81 and 1985/86 by broad age-group and Section 8.7 provides a summary of the major temporal trends and an assessment of the projection methodology in the light of the results produced.

8.2 DATA DESCRIPTION

8.2.1 NHSCR migration data

As in Chapter 7, the analyses which follow utilise NHSCR information obtained in two ways. Movement data for the first eight years of the time-series (mid-year 1975 to mid-year 1983) have been obtained from computer summaries of NHSCR primary unit data (PUD) produced by OPCS, whereas for the remaining period (mid-year 1983 to mid-year 1986), files of data have been generated directly from the PUD. The full movement data file is referenced as T17686 FPCDATA in Table 3.7 and consists of gross in- and out-movement totals for FPCAs disaggregated by 16 five-year age-groups (0-4,...75+) and two sexes for the eleven year period, 1975/76 to 1985/86. For the comparison of 1980/81 and 1985/86 movement patterns, NHSCR migration information has been accessed from the PUD in the form of inter-FPCA arrays by five-year age-group. The arrays are for persons with no sex disaggregation. The respective files are referenced in Table 3.7 as MOV1 CEN8081 and MOV1 D8586. Age not-stated moves are recorded by the NHSCR but are not incorporated into the analyses. Similarly, origin not-stated moves are captured by the PUD but are excluded from the analyses. Sex not-stated moves are excluded from T17686 FPCDATA but included within the inter-zonal arrays. In and out-moves are recorded for all 97 FPCAs illustrated in Figure 3.3 and listed in Table 3.1. Alternative movement arrays are generated through the aggregation of individual FPCAs into the population density and North/South categories (Section 3.2.5).

8.2.2 Population data

Mid-year population estimates are used in this chapter to compute zone-specific rates of movement. Using the methodology described in Section 3.4.1, a file of populations has been constructed for individual FPCAs disaggregated by five-year age-group (0-4,...75+) and sex. This is referenced as FPCDATA AGEPOPS in Table 3.7.

8.3 AGE AND SEX-DISAGGREGATED MIGRATION TRENDS AT THE NATIONAL LEVEL

Section 7.3.2 discussed the temporal variation in the level of both total inter-MNM region and inter-FPCA migration, indicating a decrease of approximately 17% in the repective levels of mobility over the 1975/76 to 1981/82 period, followed by a continual increase in the amount of inter-zonal movement until 1985/86 when both inter-MNM region and inter-FPCA migration had reached a level some 7% below the 1975/76 figure. This section disaggregates the total inter-FPCA movement to illustrate variation in the national level of migration by five-year age-group and sex. Annual movement totals are not consistent with those in Table 7.1 because flows with age and sex not-stated are excluded from the 'T17686 FPCDATA' array.

The variation in the level of movement by persons in five-year age-groups can be represented as a time-series index (Table 8.1). The greatest percentage increases over the whole period were experienced by the 75+, 35-39, 40-44 and 70-74 age-groups (35%, 29%, 22% and 13% respectively). With the exception of the 20-24 and 30-34 ages all other groups experienced a level of movement in 1985/86 which was below that recorded in 1975/76. In the case of the 35-39, 40-44 and 75+ age-groups the greatest increase in mobility has occured since 1982/83. The most severe declines in movement levels were experienced by the younger age-groups particularly in the 0-9 age-range. The levels of migration sustained in the 0-4 and 5-9 categories fell to 67% and 62% respectively of the 1975/76 total in 1981/82 and recovered only slightly to 72% in each case by 1985/86. The level of movement within the 10-14 and 15-19 age-groups was also less than 80% of that recorded in 1975/76. Figure 8.1 further

Table 8.1 Time-series indices of total movement 1975/76 to 1985/86 for persons in five-year age-groups

Age-group	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
0-4	100.0	87.4	89.6	79.8	72.3	74.5
5-9	100.0	90.6	95.6	85.3	74.7	71.4
10-14	100.0	93.9	98.1	93.0	84.6	83.3
15-19	100.0	95.4	98.0	96.0	90.6	95.0
20-24	100.0	91.1	92.4	90.3	87.1	92.1
25-29	100.0	88.0	89.9	85.6	78.1	80.5
30-34	100.0	102.3	114.3	112.0	102.5	105.7
35-39	100.0	92.2	100.0	96.8	91.5	94.1
40-44	100.0	94.7	105.1	93.9	83.1	88.0
45-49	100.0	93.1	99.8	89.3	79.3	82.9
50-54	100.0	88.5	97.7	83.1	74.4	73.7
55-59	100.0	95.6	113.3	102.8	89.0	88.3
60-64	100.0	96.5	99.6	81.6	75.3	85.6
65-69	100.0	95.4	106.2	91.6	82.5	85.9
70-74	100.0	100.2	107.4	99.5	91.5	100.3
75+	100.0	96.4	103.8	94.9	90.5	98.5
Total	100.0	92.6	97.5	91.5	84.4	87.3

Age-group	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
0-4	74.5	69.7	74.3	68.7	68.0	72.3
5-9	71.4	62.9	63.9	64.9	67.4	72.5
10-14	83.3	77.7	79.4	79.0	76.5	76.5
15-19	95.0	92.2	94.0	79.7	81.2	77.9
20-24	92.1	86.2	88.0	89.3	95.4	100.2
25-29	80.5	74.1	76.4	81.2	86.4	92.1
30-34	105.7	93.7	94.7	98.5	102.9	107.6
35-39	94.1	97.2	111.7	121.1	126.0	129.0
40-44	88.0	84.9	91.2	103.4	108.5	121.5
45-49	82.9	78.7	83.5	90.8	92.7	98.9
50-54	73.7	73.5	75.9	80.3	81.4	86.6
55-59	88.3	83.0	89.2	92.1	90.3	94.5
60-64	85.6	85.9	94.1	101.2	96.3	98.0
65-69	85.9	81.6	82.0	80.6	83.6	92.8
70-74	100.3	98.5	104.3	109.2	106.1	113.3
75+	98.5	98.3	106.4	124.8	122.0	134.7
Total	87.3	82.2	85.5	86.8	89.5	93.7

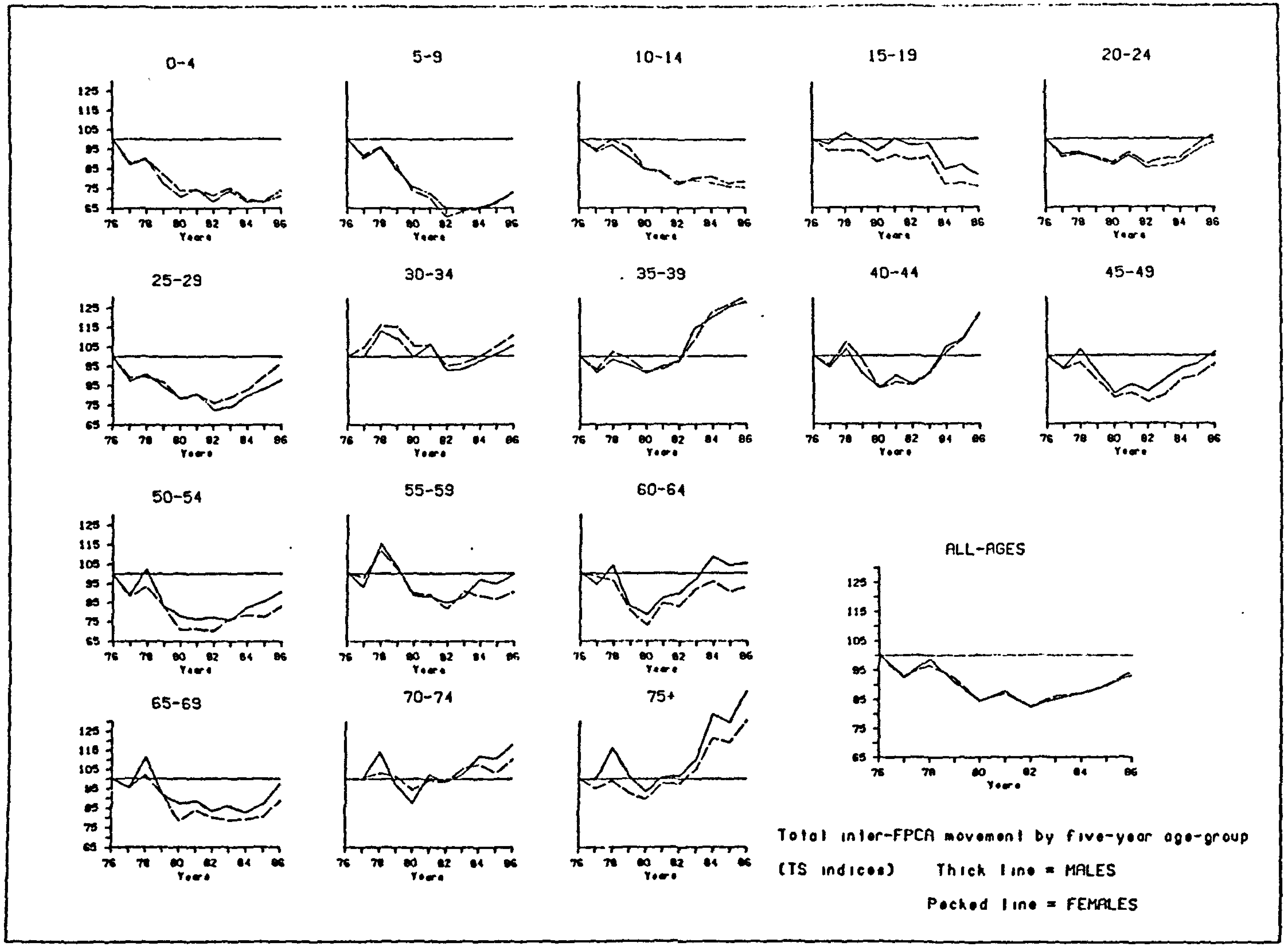


Figure 8.1 <u>Time-series graphs of total inter-FPCA movement by five-year age-group and sex, 1975/76 to 1985/86</u>

highlights these trends illustrating temporal fluctuation in the level of movement by age and sex. Again the actual flow total is represented as a time-series index. The dramatic increase in the migration levels of the 35-39, 40-44 and 75+ age-groups are emphasised with both males and females experiencing the gain. Males appear to have maintained a higher level of movement than females in the two highest age-groups. The considerable decline in migration in the younger age-groups is emphasised for both sexes with the 15-19 age-range showing particularly large reductions since 1982/83. The remaining age-groups generally experienced a reduction in the overall level of movement between 1975/76 and 1980/81 followed by a continual increase up until 1985/86. The 30-34 age-group is an exception in that male and female levels remained above the 1975/76 figure until 1981/82. Table 8.2 illustrates the disaggregation of annual movement totals for persons into age-group percentages. Throughout the period, moves by persons aged 20-24 comprised the largest percentage share, fluctuating between 17% and just over 19%, with the 15-29 age-range as a whole constituting between 42-45% of the total level of movement in each year of the time-series. The 20-24 age-group increased its share by approximately 1.2% over the period. Other significant increases in percentage shares were observed for the 35-39, 40-44 and 75+ age-groups (approximately 1.6%, 1% and 0.5% respectively). The three youngest age-groups, 0-4, 5-9 and 10-14 experienced the largest reductions of 2%, 1.6% and 1.1% respectively.

These trends are significant but they need to be re-examined in the light of temporal changes in the age-structure of the population. The movement of successive birth cohorts through the population will have an important effect upon the level of movement occurring within

Table 8.2 Total movement by five-year age-group as a percentage of total annual movement, 1975/76 to 1985/86

Age-group	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
0-4	8.7	8.2	8.0	7.5	7.4	7.4
5-9	7.2	7.1	7.1	6.8	6.4	5.9
10-14	5.9	6.0	6.0	6.0	6.0	5.7
15-19	10.9	11.3	11.0	11.5	11.7	11.9
20-24	18.0	17.7	17.0	17.7	18.6	19.0
25-29	15.2	14.5	14.0	14.2	14.1	14.0
30-34	8.5	9.3	9.9	10.3	10.3	10.2
35-39	5.2	5.2	5.3	5.5	5.6	5.6
40-44	3.6	3.7	3.9	3.7	3.5	3.6
45-49	3.0	3.0	3.1	2.9	2.8	2.9
50-54	2.8	2.7	2.8	2.6	2.5	2.4
55-59	2.4	2.5	2.8	2.7	2.6	2.5
60-64	2.6	2.7	2.6	2.3	2.3	2.5
65-69	2.3	2.4	2.6	2.3	2.3	2.3
70-74	1.4	1.5	1.5	1.5	1.5	1.6
75+	2.2	2.3	2.3	2.3	2.4	2.5
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

Age-group	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
0-4	7.4	7.3	7.5	6.9	6.6	6.7
5-9	5.9	5.5	5.4	5.4	5.5	5.6
10-14	5.7	5.6	5.5	5.4	5.1	4.9
15-19	11.9	12.3	12.0	10.1	9.9	9.1
20-24	19.0	18.8	18.5	18.5	19.2	19.2
25-29	14.0	13.7	13.6	14.3	14.7	15.0
30-34	10.2	9.6	9.4	9.6	9.7	9.7
35-39	5.6	6.1	6.8	7.2	7.3	7.1
40-44	3.6	3.7	3.8	4.3	4.4	4.7
45-49	2.9	2.9	2.9	3.1	3.1	3.2
50-54	2.4	2.5	2.5	2.6	2.6	2.6
55-59	2.5	2.5	2.5	2.6	2.5	2.5
60-64	2.5	2.7	2.8	3.0	2.8	2.7
65-69	2.3	2.3	2.2	2.2	2.2	2.3
70-74	1.6	1.7	1.7	1.8	1.7	1.7
75+	2.5	2.6	2.7	3.1	2.9	3.1
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

each individual age-group. Figure 8.2 gives an illustration of the fluctuations in the live birth rate (per 1000 women aged 15-44) this century. The relatively high rate during the early part of the century decreased sharply during the First World War but reached a peak in 1920. The low observed rate in the late 1920s and 1930s preceded an increase during the Second World War with a high-point reached in 1947. A more sustained 'baby-boom' is evident for the mid-1960s prior to a continuous decline in the live birth rate into the late 1970s and early 1980s. These variations are clearly visible in a cross-sectional view of the population. Figure 8.3 illustrates the estimated usually resident population of Great Britain by single years of age at Census date 1981, for example. Craig (1983) summarises the schedule as follows:

> "Peaks and troughs from as long ago as 1915 can be discerned in the age-distribution of the population in 1981. Admittedly after about 40 years the number of births and the actual population diverge; but the original fluctuations in number of births are still apparent, though they are attenuated by mortality. Only for those aged 65 and over are the effects of mortality strong enough to mask the original pattern of births."
> (p28)

With such large differences between the size of certain birth cohorts, the level of migration within a particular five-year age-group will be influenced by the movement of these cohorts through the population during the eleven-year time-period. Figure 8.4 illustrates the variation in the level of the population-at-risk by five-year age-group, expressed as a time-series index. Population-at-risk is defined as the average of two successive mid-year population estimates and is used to compute zone-specific rates of movement. The high birth rates in the early years of this century coupled with an increase in the average life-expectancy have

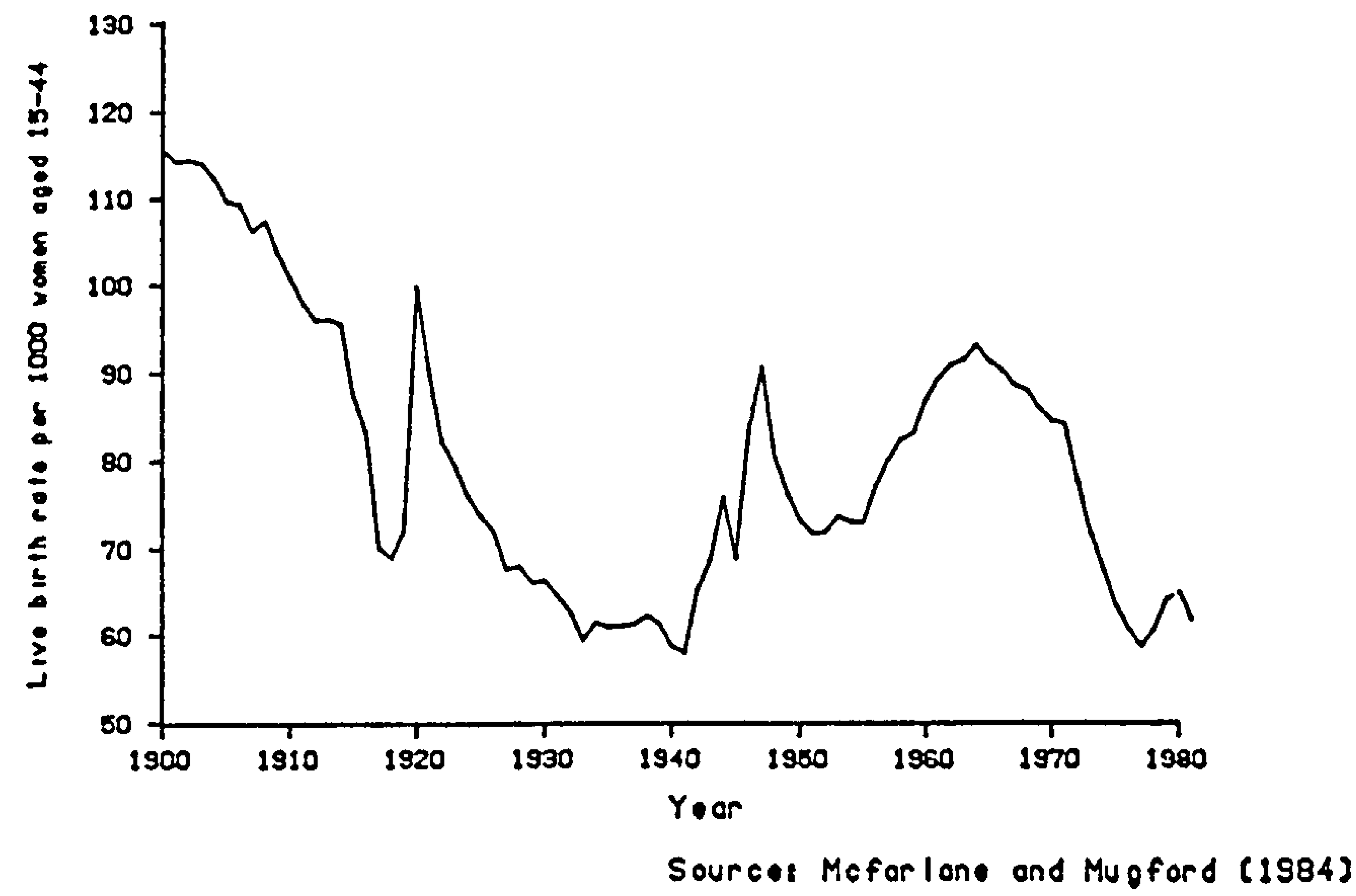


Figure 8.2 Live birth-rates per 1000 women aged 15-44, 1900-1981

Figure 8.3 Usually resident population by single years of age, 1981 Census

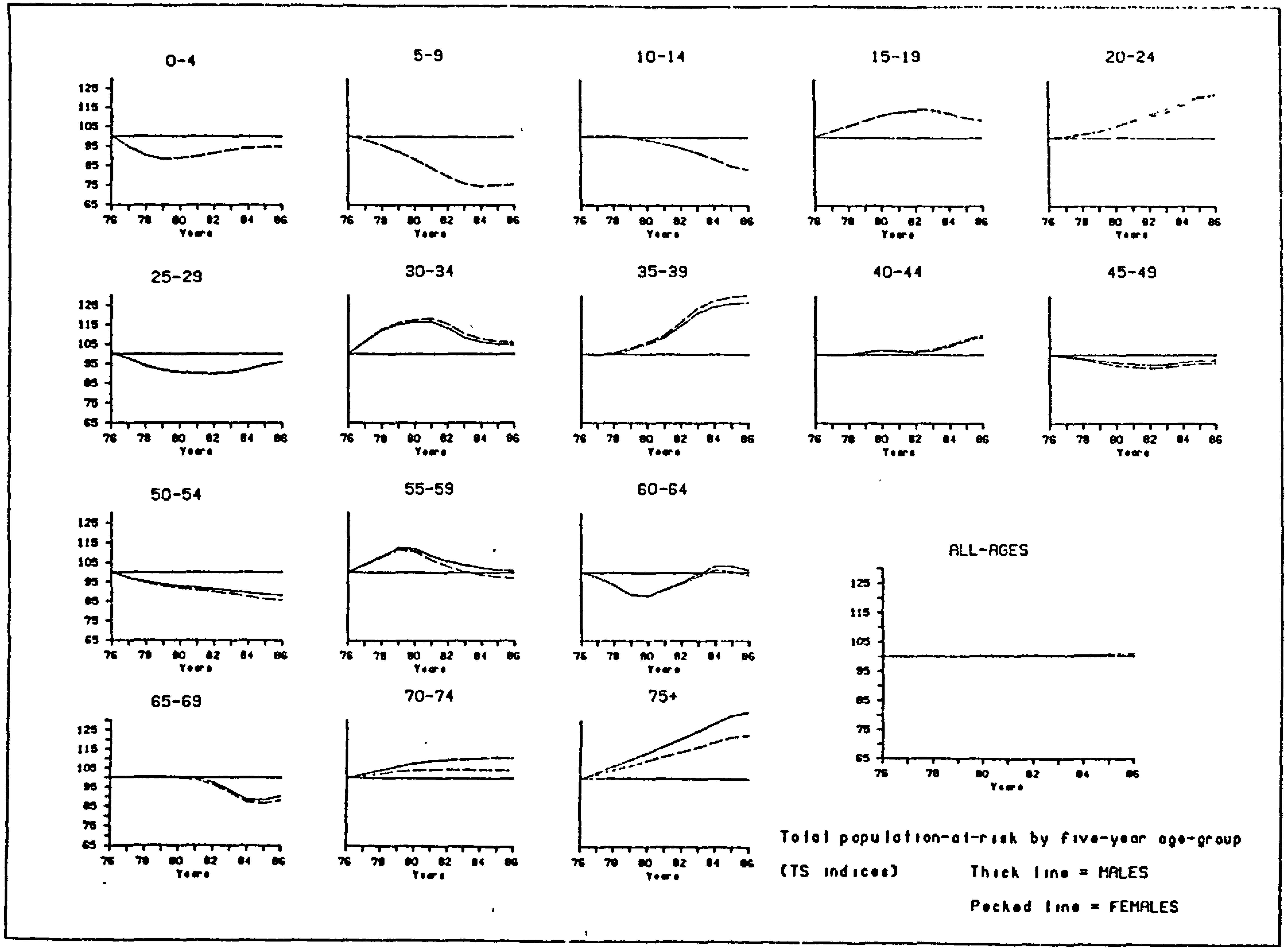


Figure 8.4 <u>Variations in the level of the population-at-risk by five-year age-group, 1975/76 to 1985/86</u>

led to a continuous increase in the size of the 75+ age category. Similarly, the 1947 peak in births is reflected in the increase in the size of the population-at-risk in the 30-34 age-range during the late 1970s and the subsequent increase in the 35-39 total from 1978 onwards. The baby boom of the 1960s has led to the increase in the population of the 15-19 and 20-24 age-groups during the period. Significant declines have been experienced by the three youngest age-groups although the 0-4 category shows evidence of a recovery since 1981 indicating an increase in the number of births in recent years.

Using population-at-risk estimates for the 1975/76 to 1985/86 period, inter-FPCA movement rates for 5-year age-groups can be computed (Table 8.3). The average rate of movement in 1975/76 was approximately 33.8 per 1000 persons falling to a low of 27.7 per 1000 in 1981/82 and rising to 31.5 per 1000 in 1985/86. The highest rates of movement throughout the period were experienced by the 20-24 age-group with the 25-29 and 15-19 ages also having significantly high figures. The 20-24 group experienced a low point in 1983/84 (67 per 1000 compared to 89 per 1000 in 1975/76) as did the 15-19 age-group (56 and 36 per 1000 in 1975/76 and 1983/84 respectively). The rate of movement in the 25-29 age-group dropped to its lowest level of 56 per 1000 in 1981/82 (compared to 68 per 1000 in 1975/76). From 1983/84 onwards the rate of movement in the 30-34 age-range exceeded that experienced by the 15-19 year olds. The rate of movement of those persons aged 40 or more (with the exception of the 55-59 age-group) declined from 1975/76 to a low point in 1979/80. This contrasts with the remaining, younger ages where the low-point comes significantly later. Besides the 15-24 and the 0-4 year olds,

Table 8.3 Total movement rates per 1000 persons by five-year age-group, 1975/76 to 1985/86

Age-group	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
0-4	43.5	40.3	43.3	39.4	35.6	36.2
5-9	30.9	28.5	30.9	28.6	26.2	26.3
10-14	24.5	22.9	23.9	22.9	21.1	21.2
15-19	50.4	46.8	46.8	44.6	41.0	42.3
20-24	88.6	80.2	80.4	77.4	73.1	75.1
25-29	67.8	61.1	65.1	63.3	58.6	60.8
30-34	44.8	43.1	45.5	43.4	39.2	40.3
35-39	30.3	28.1	30.2	28.6	26.3	26.1
40-44	21.7	20.6	22.8	20.1	17.7	18.8
45-49	17.4	16.4	17.7	16.1	14.5	15.3
50-54	15.4	14.1	15.9	13.7	12.4	12.4
55-59	14.9	13.7	15.6	13.7	11.9	12.2
60-64	15.4	15.2	16.4	14.2	13.2	14.4
65-69	15.5	14.8	16.5	14.2	12.8	13.4
70-74	11.7	11.6	12.2	11.2	10.2	11.1
75+	14.4	13.5	14.2	12.7	11.8	12.5
TOTAL	33.8	31.3	33.0	30.9	28.5	29.4

Age-group	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
0-4	36.2	33.3	34.8	31.9	31.4	33.3
5-9	26.3	24.5	26.0	27.0	27.9	29.7
10-14	21.2	20.1	21.1	21.8	22.0	22.5
15-19	42.3	40.8	41.6	35.7	37.1	36.0
20-24	75.1	68.5	68.3	67.2	69.8	72.5
25-29	60.8	56.0	57.4	60.0	62.1	65.3
30-34	40.3	36.7	38.8	41.3	43.6	45.8
35-39	26.1	25.5	27.6	29.1	29.9	30.4
40-44	18.8	18.2	19.4	21.4	21.9	24.2
45-49	15.3	14.7	15.4	16.5	16.7	17.8
50-54	12.4	12.5	13.1	14.0	14.4	15.4
55-59	12.2	11.8	13.0	13.6	13.5	14.2
60-64	14.4	13.9	14.7	15.2	14.5	15.1
65-69	13.4	13.1	13.7	14.2	14.9	16.2
70-74	11.1	10.8	11.5	12.0	11.6	12.4
75+	12.5	12.2	12.8	14.6	14.0	15.3
TOTAL	29.4	27.7	28.9	29.3	30.1	31.5

all other age-groups reach a low in their respective rates of movement in 1981/82. The 0-4 age-group has experienced a continual decrease in its rate up until 1984/85.

Expressing the temporal variation in the rate of movement by age for males and females as time-series indices (Figure 8.5), the considerable decline in the 0-4 ages is emphasised for both sexes with a similar pattern evident in the 15-19 year age-group, although males maintained a consistently higher rate of movement than females in this age-group. The rate of movement of females in the 25-29 age-group, and to a lesser extent the 30-34 ages, have been increasing to a greater degree than for males in the later years of the time-series. This is not the case for the majority of age-groups where the rate of male movement exceeds that of females. The most significant increases in the rate of movement in more recent years are found in the 40-44 age range (males and females) and in the retirement and post-retirement ages (60-64, 65-69, 70-74 and 75+). By standardising the levels of movement using population as a denominator, a true picture of the temoral variation in migration by age and sex is given. Discrepancies between the age-groups due to the movement of irregularly sized birth cohorts through the population are removed. This section has highlighted national trends in age and sex-disaggregated migration. At a more disaggregate spatial level an age-group classification is utilised for ease of illustration. The following section describes the clustering methods used to derive such a classification.

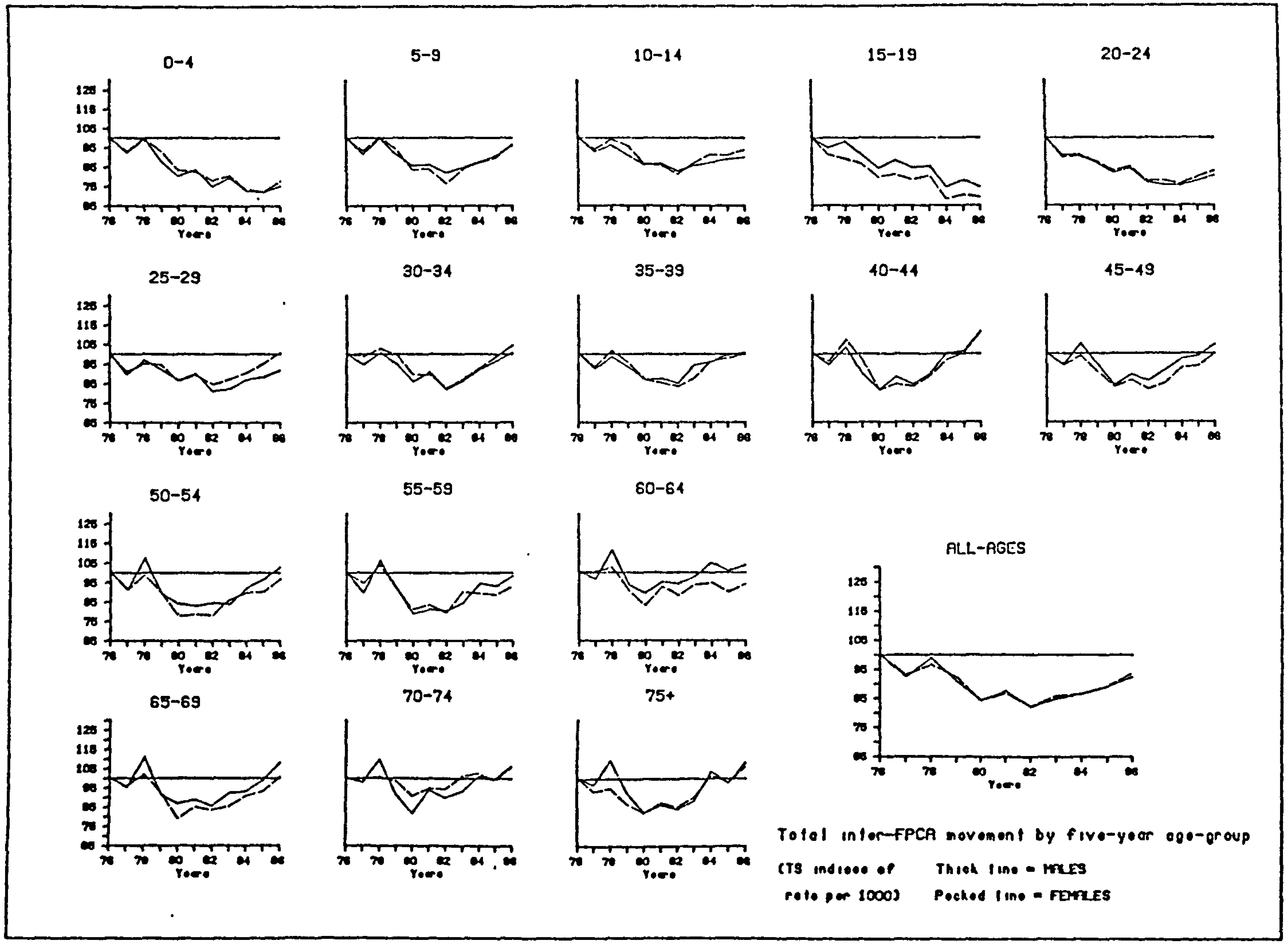


Figure 8.5 <u>Time-series graphs of total inter-FPCA movement rates by five-year age-group and sex, 1975/76 to 1985/86</u>

8.4 GENERATION OF AN AGE-GROUP CLASSIFICATION USING CLUSTERING METHODS

8.4.1 Introduction

This section has two objectives. Firstly, to assess the value of the broad age-group clusters adopted by OPCS/DOE in their population projection model through the derivation of an alternative age-group classification; and secondly, to generate age-group clusters for use in the illustration of temporal trends in NHSCR movement data.

The migration component of the current sub-national population projection procedure involves the estimation of outflows from individual origins by single years of age and their assignment to destinations on the basis of known distibution patterns (from the 1981 Census). To simplify the assignment process migrants in single ages are grouped into broad age-bands representing family moves (0-16/29-59), moves at the time of entry to the labour force (17-28) and retirement moves (60+). Little justification is given by Martin, Voorhees and Bates (1981) for adopting these age-group categories although the patterns of migration characterising each age-group were summarised as follows,

> "The 17-28 group, which is the most highly mobile, has the characteristic pattern dominated by movement to urban areas, paticularly to Central London, while the 60+ age group demonstrates cetain specific movements to 'retirement areas' such as the South Coast. The remaining ages, which we refer to as 'family movers' show a characteristic pattern of movement from the highly urbanized areas into the surrounding hinterland."
>
> (p.8)

In this section an alternative age classification has been derived through the clustering of 5-year age-group data on the basis of similarities in the pattern of inter-FPCA movement. Clusters have been created for each of two years (1984/85 and 1985/86) using individual cells of the respective inter-zonal arrays as the descriptive variables.

The second aim of the section is to develop an optimum age-group classification to aid in the illustration of temporal trends in gross in and out movement by age and sex. The movement arrays used in Section 8.5 consist of in and out-flows for 97 FPCAs disaggregated by five-year age-group and sex. To ease the problem of handling large matrices and to highlight already established trends the FPCAs are grouped into population density categories. A suitable classification of individual age-groups is required to enable an effective analysis of trends by age to be undertaken. This is also achieved through the clustering of five-year age-groups on the basis of similarities evident in the pattern of movement during the 1975/76 to 1985/86 period. Individual variables for each of the 16 age-groups are taken as gross out or inflows by sex for each mid-year to mid-year period. Age-group classifications are derived independently for both inflows and outflows for males, females and persons.

The following section outlines the SPSSX clustering procedure utilised and Section 8.4.3 illustrates the results of the analyses, whilst Section 8.4.4 provides a number of concluding comments.

8.4.2 Outline of the clustering methodology

The clustering procedure adopted is outlined in the SPSSX Advanced Statistics Guide (Norusis, 1985). The initial step in the process is to compute 'distances' between the equivalent cell entries for different age-groups. Cell entries are standardized to remove the effect of the level of migration upon the clustering process, expressing each value as a proportion of total movement by age-group. The measure used was that of Euclidian distance where the distance between two cases is the sum of the squared differences in values for each cell of the matrix of migration proportions. So, for example, the computation of SEDs for the 1984/85 and 1985/86 inter-zonal arrays is undertaken as follows:

$$SED^{ab} = \sum_{y} \sum_{i} \sum_{j} (M_{ij}^{ay} / M_{ij}^{*y} - M_{ij}^{by} / M_{ij}^{*y})^{2} \qquad (8.1)$$

where

SED^{ab} = squared Euclidian distance between age-group a and age-group b;

M_{ij}^{ay}, M_{ij}^{by} = number of moves between origin i and destination j in age-group a or b in year y;

M_{ij}^{*y} = total number of moves between origin i and destination j in year y.

In the second analysis gross in and outflows are used in the clustering procedure with SEDs computed as follows:

$$SED_{d}^{abs} = \sum_{y} \sum_{i} (M_{id}^{ays} / M_{id}^{*ys} - M_{id}^{bys} / M_{id}^{*ys})^{2} \qquad (8.2)$$

where

SED_{d}^{abs} = squared Euclidian distance between age-group a and age-group b for sex s and direction d;

M_{id}^{ays}, M_{id}^{bys} = number of moves between origin i, direction d in age-group a or b in year y; and

M_{id}^{*ys} = total number of moves between origin i, direction d for sex s and year y.

The computation of the distance array is a precursor to the clustering procedure. The method used for clustering was based on the 'average linkage between groups method' where the distance between two clusters is the average of the distances between all pairs of age-groups in which one member of the pair is from each of the clusters. For example, using inter-zonal proportions as the clustering variable, the average linkage value would be defined as:

$$D_{AB} = \sum_{a \in A} \sum_{b \in B} SED^{ab} / n_A n_B \qquad (8.3)$$

where

D_{AB} = distance between clusters A and B (distance coefficient);

SED^{ab} = squared Euclidian distance between age-groups a and b;

n_A and n_B = number of age-groups in cluster A and B.

The method is agglomerative in that the process starts with the maximum number of clusters and then combines those cases with the smallest distance coefficient. The procedure iterates until all cases are classified into one cluster.

8.4.3 Generating an age-group classification from inter-zonal movement data

The first stage of the cluster analysis aimed to produce a classification of five-year age-groups, based on similarities in patterns of inter-zonal movement, for comparison with the broad age bands used in the OPCS/DOE projection model. Age-groups were clustered using arrays of inter-FPCA migration for two periods - 1984/85 and 1985/86. Table 8.4 illustrates the agglomeration schedules produced from the clustering procedure using average distance between groups to successively combine cases. For example, the first stage of the 1984/85 clustering produced the combination of age-group 35-39 with age-group 40-44 - the age-groups with the smallest value within the array of squared euclidean dissimilarity coefficients (2699). The distance coefficient increases as the

Table 8.4 Agglomeration schedules for the clustering of five-year age-groups using inter-zonal movement 1984/85 and 1985/86

(a) 1984/85

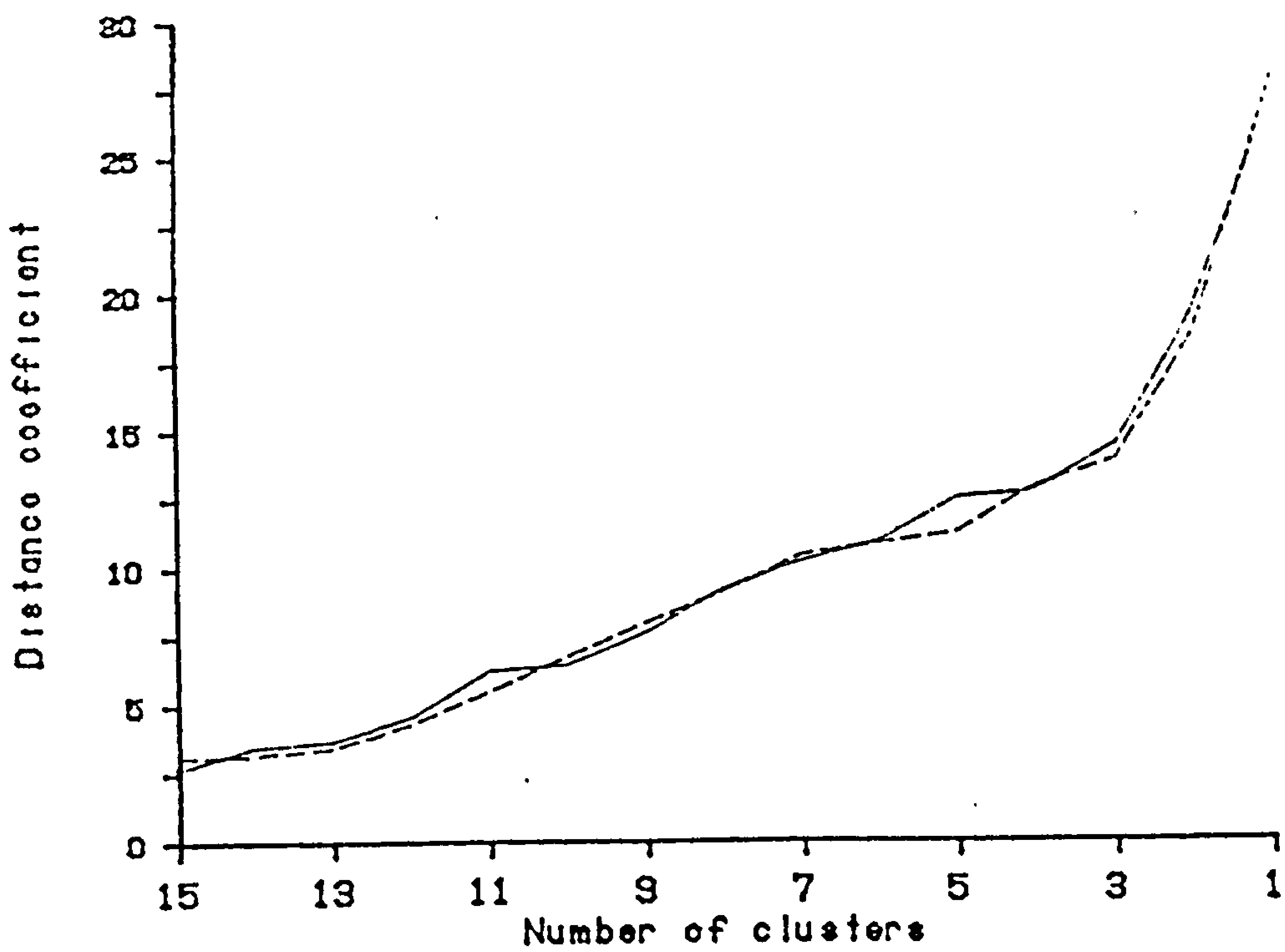
Stage	Clusters Combined Cluster 1	Cluster 2	New cluster	Coefficient
1	35-39	40-44	35-44	2699
2	25-29	30-34	25-34	3435
3	0-4	5-9	0-9	3654
4	35-44	45-49	35-49	4534
5	60-64	65-69	60-69	6213
6	35-49	50-54	35-54	6446
7	0-9	10-14	0-14	7616
8	25-34	35-54	25-54	9229
9	55-59	60-69	55-69	10207
10	70-74	75+	70+	10924
11	15-19	20-24	15-24	12476
12	0-14	25-54	0-14/25-54	12772
13	55-69	70+	55+	14429
14	0-14/25-54	15-24	0-54	19357
15	0-54	55+	All	27029

(b) 1985/86

Stage	Clusters Combined Cluster 1	Cluster 2	New cluster	Coefficient
1	35-39	40-44	35-44	3076
2	25-29	30-34	25-34	3125
3	0-4	5-9	0-9	3390
4	35-44	45-49	35-49	4267
5	60-64	65-69	60-69	5458
6	35-49	50-54	35-54	6740
7	0-9	10-14	0-14	7975
8	0-14	35-54	0-14/35-54	9108
9	70-74	75+	70+	10445
10	55-59	60-69	55-69	10819
11	15-19	20-24	15-24	11218
12	0-14/35-54	25-34	0-14/25-54	12901
13	55-69	70+	55+	13863
14	0-14/25-54	15-24	0-54	18575
15	0-54	55+	All	27879

number of clusters decreases. The sequence in which clusters are formed varies slightly between 1984/85 and 1985/86. The major difference is that at stage 8 of the process in Table 8.4a the 35-54 age-range combines with the 25-34 which then combines with the 0-14 ages at stage 12. In Table 8.4b, however, the 0-14 cluster combines with the 35-54 cluster at stage 8 and then combines with the 25-34 group in stage 12. The 0-14 and 25-54 age ranges will have relatively similar movement patterns due to the relationship between the movement of children with their parents, although there is slight discrepancy between 1984/85 and 1985/86 in the strength of similarity between these younger and older age-groups. Significantly the 55-59 age-group combines most readily with the 60-69 age-range and then further with the 70+ ages. This indicates that early retirement/pre-retirement moves are an important phenomenon, closely linked to the patterns of retirement migration in the 60-69 age-group, in particular. This is in contrast to the OPCS/DOE age-grouping which matches moves of 55-59 year olds with those of the 29-55 age-range. Also important to note is the link between the 25-29 age-group and the 30-54 age-range. Moves in this younger age-group are linked most closely with those of the 30-34 year-olds and not with the 20-24 year-olds as the OPCS/DOE classifications imply. Figure 8.6 gives a clearer indication of the increase in the distance coefficient as the number of clusters decreases. The value of the distance measure increases steadily until the point at which six clusters become five. Subsequent increases become more irregular suggesting a greater degree of dissimilarity between the movement patterns of the age-groups being combined.

OPCS/DOE derived three broad age categories for use in their



Thick line = 1984/85

Pecked line = 1985/86

Figure 8.6 Agglomeration schedules for the clustering of five-year age-groups based on NHSCR inter-zonal migration data forecasting methodology. These can be compared with those generated through the cluster analysis (Table 8.5). The results indicate that the assignment of inter-zonal moves by persons in their late 20s with those of the late teens-early 20s is not an optimal solution Furthermore, including moves by persons in their late 50s with retirement moves and post-retirement moves is more appropriate to combining them with the 'family' moves of the 25-54 age-range.

8.4.4 Generating an age-group classification for the illustration of temporal trends in age and sex-disaggregated migration

Cluster analysis has also been used to derive an age-group classification for the eleven-year time-series of gross outflows and inflows. The aim here was to reduce the 16 five-year age-groups to a small number of clusters which represented the major components of migration by age between 1975/76 and 1985/86. The problem was to decide on an optimum categorization given the results produced from the clustering of age-groups based on inflows and outflows for males, females and persons. Before embarking on the analyses it was considered that six clusters would be ideal to combine with the eight-fold density classification of FPCAs for the illustration of temporal trends in migration (Section 8.5). It was with this in mind that the results were analysed.

Figure 8.7 illustrates the agglomeration schedules produced for all six runs of the cluster procedure. The distance coefficients are similar for inflows and outflows until stage 11 (5-cluster solution) of the respective analyses, after which the coefficient for subsequent inflow clusters increases at a greater rate than for outflow clusters. This suggests that inflow patterns are difficult to classify into fewer than five clusters. With less than five

Table 8.5 OPCS/DOE broad age-bands compared with classifications derived from clustering of five-year age-groups

OPCS/DOE groups	4-cluster solution	3-cluster solution
1. 0-16/29-59	1. 0-14/25-54	1. 0-14/25-54
2. 17-28	2. 15-24	2. 15-24
3. 60+	3. 55-69	3. 55+
	4. 70+	

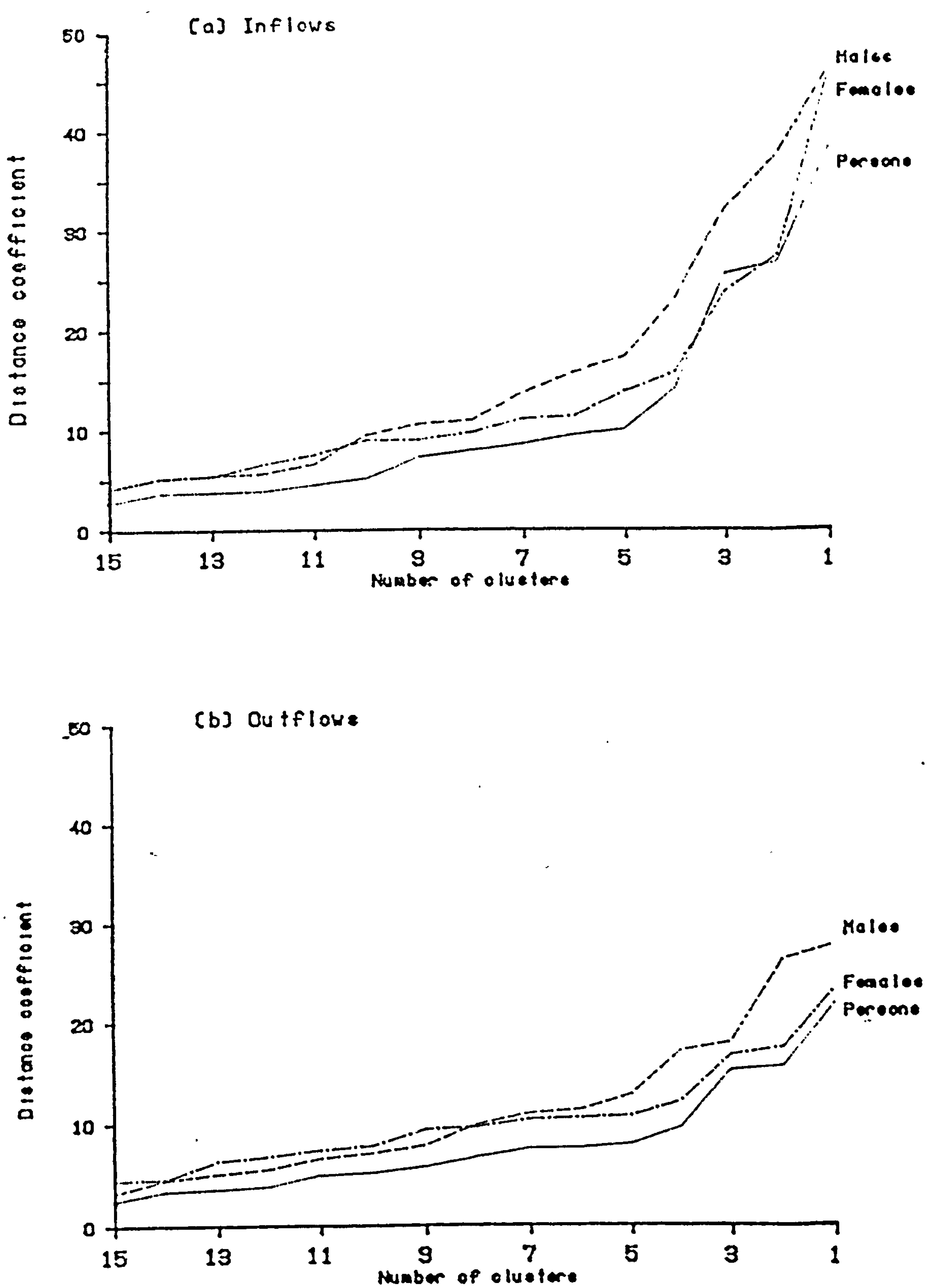


Figure 8.7 Agglomeration schedules for the clustering of five-year age-groups based on NHSCR inflow and outflow data

clusters the level of dissimilarity between combined clusters rises rapidly and an increasing amount of information differentiating spatial patterns of age-group migration is lost. The difference between the five and four cluster solution is evident from the outflow agglomeration schedules but is not quite as pronounced. These results suggest that at least five clusters are required in the optimum solution if an adequate differentiation between the main components of age-disaggregated migration is to be maintained. Tables 8.6 and 8.7 illustrate the cluster membership evident for persons, males and females from the inflow and outflow analyses respectively. The clustering sequence for inflows is fairly regular across the sexes with the 15-19 age-group exhibiting the least similar pattern of movement over the period. Interestingly the 25-29 age-group combines with the 20-24 age-group in preference to the 30-34 age-group for both sexes. The three youngest age-groups combine readily with the 30-54 age-range illustrating the importance of family moves in the pattern of in-migration. Of the older age-groups it is those aged 75 and over which have the most unique inflow patterns for males and persons, although this age-group does combine with the 70-74 year-olds in the female case.

The sequence of clusters produced from the analysis of outflows is slightly different. The uniqueness of the migration patterns of the 15-19 year-olds is not apparent. For both males and females this age-group combines readily with the three youngest age-groups. There is again a reasonable degree of similarity between male and female outflows in the 25-54 age-range and males aged 20-24 exhibit a rather different pattern of outflows to the remaining age-groups. The major differences occur in the clustering of the older age-groups in

Table 8.6 Cluster membership at the later stages of the clustering procedure: inflows

Age-group	Number of clusters 10	9	8	7	6	5	4	3	2
(a) Person inflows									
0-4	1	1	1	1	1	1	1	1	1
5-9	1	1	1	1	1	1	1	1	1
10-14	2	1	1	1	1	1	1	1	1
15-19	3	2	2	2	2	2	2	2	1
20-24	4	3	3	3	3	3	3	2	1
25-29	4	3	3	3	3	3	3	2	1
30-34	5	4	4	4	4	1	1	1	1
35-39	5	4	4	4	4	1	1	1	1
40-44	5	4	4	4	4	1	1	1	1
45-49	5	4	4	4	4	1	1	1	1
50-54	6	5	4	4	4	1	1	1	1
55-59	7	6	5	5	5	4	4	3	2
60-64	8	7	6	6	5	4	4	3	2
65-69	8	7	6	6	5	4	4	3	2
70-74	9	8	7	5	5	4	4	3	2
75+	10	9	8	7	6	5	4	3	2
(b) Male inflows									
0-4	1	1	1	1	1	1	1	1	1
5-9	1	1	1	1	1	1	1	1	1
10-14	2	2	1	1	1	1	1	1	1
15-19	3	3	2	2	2	2	2	2	1
20-24	4	4	3	3	3	3	3	2	1
25-29	4	4	3	3	3	3	3	2	1
30-34	5	5	4	1	1	1	1	1	1
35-39	5	5	4	1	1	1	1	1	1
40-44	5	5	4	1	1	1	1	1	1
45-49	5	5	4	1	1	1	1	1	1
50-54	5	5	4	1	1	1	1	1	1
55-59	6	6	5	4	4	4	4	3	2
60-64	7	7	6	5	5	5	4	3	2
65-69	8	7	6	5	5	5	4	3	2
70-74	9	8	7	6	5	5	4	3	2
75+	10	9	8	7	6	4	4	3	2
(c) Female inflows									
0-4	1	1	1	1	1	1	1	1	1
5-9	1	1	1	1	1	1	1	1	1
10-14	1	1	1	1	1	1	1	1	1
15-19	2	2	2	2	2	2	2	2	2
20-24	3	3	3	3	3	3	3	2	2
25-29	3	3	3	3	3	3	3	2	2
30-34	4	4	4	1	1	1	1	1	1
35-39	4	4	4	1	1	1	1	1	1
40-44	4	4	4	1	1	1	1	1	1
45-49	4	4	4	1	1	1	1	1	1
50-54	5	5	5	4	4	4	4	3	1
55-59	6	6	6	5	5	5	4	3	1
60-64	7	7	6	5	5	5	4	3	1
65-69	8	6	6	5	5	5	4	3	1
70-74	9	8	7	6	6	4	4	3	1
75+	10	9	8	7	6	4	4	3	1

Table 8.7 Cluster membership at the later stages of the clustering procedure: outflows

Age-group	Number of clusters 10	9	8	7	6	5	4	3	2
(a) Person outflows									
0-4	1	1	1	1	1	1	1	1	1
5-9	1	1	1	1	1	1	1	1	1
10-14	2	2	2	2	2	1	1	1	1
15-19	2	2	2	2	2	1	1	1	1
20-24	3	3	3	3	3	2	2	2	1
25-29	4	4	4	4	4	3	2	2	1
30-34	5	5	4	4	4	3	2	2	1
35-39	5	5	4	4	4	3	2	2	1
40-44	5	5	4	4	4	3	2	2	1
45-49	5	5	4	4	4	3	2	2	1
50-54	6	6	5	5	4	3	2	2	1
55-59	6	6	5	5	4	3	2	2	1
60-64	7	7	6	6	5	4	3	3	2
65-69	8	7	6	6	5	4	3	3	2
70-74	9	8	7	7	6	5	4	3	2
75+	10	9	8	7	6	5	4	3	2
(b) Male outflows									
0-4	1	1	1	1	1	1	1	1	1
5-9	1	1	1	1	1	1	1	1	1
10-14	2	2	2	1	1	1	1	1	1
15-19	2	2	2	1	1	1	1	1	1
20-24	3	3	3	2	2	2	1	1	1
25-29	4	4	4	3	3	2	1	1	1
30-34	4	4	4	3	3	2	1	1	1
35-39	4	4	4	3	3	2	1	1	1
40-44	4	4	4	3	3	2	1	1	1
45-49	4	4	4	3	3	2	1	1	1
50-54	5	4	4	3	3	2	1	1	1
55-59	6	5	4	3	3	2	1	1	1
60-64	7	6	5	4	4	3	2	2	2
65-69	8	7	6	5	4	3	2	2	2
70-74	9	8	7	6	5	4	3	3	2
75+	10	9	8	7	6	5	4	3	2
(c) Female outflows									
0-4	1	1	1	1	1	1	1	1	1
5-9	1	1	1	1	1	1	1	1	1
10-14	1	1	1	1	1	1	1	1	1
15-19	2	1	1	1	1	1	1	1	1
20-24	3	2	2	2	2	2	2	1	1
25-29	3	2	2	2	2	2	2	1	1
30-34	4	3	3	2	2	2	2	1	1
35-39	4	3	3	2	2	2	2	1	1
40-44	4	3	3	2	2	2	2	1	1
45-49	4	3	3	2	2	2	2	1	1
50-54	5	4	4	3	3	3	3	2	2
55-59	6	5	4	3	3	3	3	2	2
60-64	7	6	5	4	4	4	3	2	2
65-69	8	7	6	5	5	4	3	2	2
70-74	9	8	7	6	6	5	4	3	2
75+	10	9	8	7	6	5	4	3	2

particular those of persons aged 70 and above. It is clear that important trends are evident in retirement and post-retirement out-migration that are significantly different from each other and from other age-groups to merit their inclusion in an exclusive cluster. The problem is how to derive an optimum solution from all the cluster analyses illustrated here. With a six cluster solution favoured for illustrative purposes it is possible to collate the results into one table. Table 8.8 illustrates the derivation of the required classification from the results of the outflow, inflow and inter-zonal analyses. The classification of the three youngest age-groups into one cluster is an obvious first step. Although in a number of cluster analyses these younger ages were combined with the 25-54 age-range it was thought feasible to differentiate between the two given the fact that six clusters were desired. For this reason the 25-54 age-range was classed as a single cluster. The importance of retirement and post-retirement migration has been emphasised and so two clusters were created, firstly to cater for the 55-69 year olds and secondly for those aged 70 and over. It is important to note the inclusion of the 55-59 year-olds in the 'retirement' category. The most mobile age-groups, 15-19 and 20-24, were those which produced a variety of results within the repective analyses. It was therefore decided that due to the importance of migration in the late teens and early 20s these should each be treated as single clusters so as not to exclude any important trends from the age-disaggregated analysis. The final solution is outlined in Table 8.9 with appropriate labels.

Table 8.8 Derivation of an optimum 6-cluster classification of five-year age-groups based on NHSCR movement patterns

Age-group	Cluster membership								
	Outflows			Inflows			Inter-zonal 84/85	Inter-zonal 85/86	Consensus
	m	f	p	m	f	p	p	p	
0-4	1	1	1	1	1	1	1	1	1
5-9	1	1	1	1	1	1	1	1	1
10-14	1	1	2	1	1	1	1	1	1
15-19	1	1	2	2	2	2	2	2	2
20-24	2	2	3	3	3	3	3	3	3
25-29	3	2	4	3	3	4	4	4	4
30-34	3	2	4	1	4	4	4	4	4
35-39	3	2	4	1	4	4	4	1	4
40-44	3	2	4	1	4	4	4	1	4
45-49	3	2	4	1	4	4	4	1	4
50-54	3	3	4	4	4	4	4	1	4
55-59	3	3	4	5	5	5	5	5	5
60-64	4	4	5	5	5	5	5	5	5
65-69	4	5	5	5	5	5	5	5	5
70-74	5	6	6	6	5	5	6	6	6
75+	6	6	6	6	6	6	6	6	6

Table 8.9 Derived age-group clusters and their labels

Age-group cluster	Label
1. 0-14	Childhood
2. 15-19	Entry to labour force and higher education
3. 20-24	Leaving higher education
4. 25-54	Workforce and family
5. 55-69	Retirement
6. 70+	Post-retirement

8.4.5 Conclusion

The purpose of Section 8.4 has been firstly to develop an age-group classification comparable to that used in the official projection methodology and secondly to develop an age-group classification for use in the illustration of temporal trends in NHSCR age and sex-disaggregated migration. With reference to the former it has been illustrated that when assigning estimated moves to individual destinations it is unwise to group moves by 25-29 year-olds with those by persons aged 15-24 and more appropriate to combine them with moves by the 30-54 age-range. Secondly it has been made clear that retirement moves are now becoming increasingly important in the 55-59 age-group and so require classification with the 60+ age-range in preference to the 25-54 year olds. The derivation of an age-group classification for use in Section 8.5 has been achieved through the somewhat subjective assessment of results produced from a number of clustering analyses. This age-group classification is used in subsequent sections to illustrate temporal trends in age and sex-disaggregated migration at different spatial scales.

8.5 ANALYSIS OF GROSS OUT AND IN-MIGRATION FLOWS BY BROAD AGE-GROUP AND SEX AT VARYING SPATIAL LEVELS

8.5.1 Group-specific differences between metropolitan and non-metropolitan areas

Aggregate patterns of movement at the MNM region level were described in Section 7.5.1. These trends can be examined further using the broad age-groups generated in Section 8.4. Table 8.10 illustrates person inflow and outflow rates of migration for metropolitan FPCAs. The overall rate of inflow to metropolitan areas declined from 36 per 1000 in 1975/76 to approximately 31 per 1000 in the early 1980s before rising steadily to just over 34 per 1000 in 1985/86 (Table 8.10a). The highest age-group rates throughout the period were experienced by the 20-24 year-olds, although a significant decrease between 1975/76 and 1983/84 (111 to 85 per 1000) was only followed by a modest increase in more recent years (92 per 1000 in 1985/86). The two older age-groups experienced declining rates of migration until the end of the 1970s but had, by 1985/86, reached levels similar to those at the beginning of the period (between 10 and 12 per 1000). The rate of in-movement to metropolitan zones in the 70+ age-group was generally higher than that of the 55-69 year-olds. The large age-group comprising 'workforce and family' migrants has shown considerable increase in its rate of migration to metropolitan zones in recent years with the figure of over 39 per 1000 in 1985/86 exceeding that of 1975/76. The 0-14 year olds have also experienced increases since 1981/82, although not as great as in the 25-54 age-group. Significantly the rate of in-migration to metropolitan zones by the 15-19 year-olds has decreased continually during the period with a rate less than 41 per 1000 in 1985/86 compared to 58

Table 8.10 Inflow and outflow rates for all metropolitan FPCAs by age-group (persons), 1975/76 to 1985/86

(a) Inflow rates (per 1000)

AGE-GROUP	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
0-14	30.0	27.7	28.9	25.8	24.6	25.4
15-19	58.2	54.1	55.0	50.9	48.5	51.4
20-24	111.2	102.0	101.0	94.8	90.0	94.4
25-54	38.0	36.0	38.1	34.9	32.9	34.8
55-69	11.1	10.6	11.7	9.8	9.1	9.9
70+	11.7	11.3	11.4	10.1	9.6	10.4
ALL AGES	36.1	33.8	35.2	32.2	30.7	32.6

AGE-GROUP	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
0-14	25.4	24.2	25.1	24.3	25.1	26.2
15-19	51.4	49.2	51.1	42.3	44.0	41.5
20-24	94.4	86.4	88.1	84.8	90.9	92.1
25-54	34.8	32.9	34.3	35.6	38.5	39.3
55-69	9.9	9.4	9.8	10.1	10.6	10.8
70+	10.4	9.7	10.1	11.0	11.0	11.7
ALL AGES	32.6	30.8	32.0	31.6	33.7	34.3

(b) Outflow rates (per 1000)

AGE-GROUP	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
0-14	38.0	35.9	37.3	34.9	31.7	31.8
15-19	52.7	48.6	48.8	46.4	42.8	43.6
20-24	118.5	107.1	104.3	98.7	92.4	92.6
25-54	46.9	44.0	46.6	44.0	40.3	41.6
55-69	20.8	20.3	21.7	18.6	17.2	18.1
70+	16.2	16.1	16.3	14.9	14.0	14.9
ALL AGES	43.4	40.6	42.1	39.4	36.4	37.4

AGE-GROUP	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
0-14	31.8	30.2	31.2	31.1	32.2	34.3
15-19	43.6	41.7	41.8	36.4	38.4	37.5
20-24	92.6	83.9	84.6	82.6	85.8	86.7
25-54	41.6	39.1	40.3	43.1	45.6	47.6
55-69	18.1	17.4	18.3	18.8	19.2	20.5
70+	14.9	14.8	15.5	16.5	16.7	18.2
ALL AGES	37.4	35.3	36.3	37.0	38.8	40.4

per 1000 in 1975/76.

The overall rate for metropolitan outflows (Table 8.10b) is higher than that for inflows although the trend is similar with a low-point of 35 per 1000 in 1981/82 increasing to over 40 per 1000 in 1985/86. The 20-24 year-olds have the highest rate of out-movement which importantly is higher than corresponding metropolitan inflows between 1975/76 and 1979/80 but lower between 1980/81 and 1985/86 - a significant reversal in the net directional movement of these young adults over a relatively short period of time. The rate of out-movement from metropolitan areas by the 20-24 age-group decreased steadily up until 1983/84 with only a slight recovery in 1984/85 and 1985/86 (87 per 1000 in 1985/86 compared to 119 per 1000 in 1975/76). The rate of out-migration from metropolitan zones in the 55-69 age-range was significantly higher than that for those aged 70 and over although the rate of post-retirement movement has increased considerably since 1979/80 to a figure well above that of 1975/76 and approaching the level of the 55-69 year olds. The family and workforce ages again reached a level in 1985/86 that was greater than that of 1975/76 (approximately 48 per 1000) with the rate of outflow from metropolitan zones consistently higher than the rate of inflow. The trend in the rate of out-movement by 0-14 year-olds mirrored that of in-movement although at a higher level. The 15-19 year-olds rate of out-movement from metropolitan zones, as in the case of in-movement declined up until 1983/84 with only a slight recovery in later years. The rate of inflow was higher than the rate of outflow throughout the period. Table 8.11 illustrates corresponding rate values for non-metropolitan FPCAs. The overall rate of in-migration to non-metropolitan zones is lower than that for metropolitan zones

Table 8.11 Inflow and outflow rates for non-metropolitan FPCAs by age-group (persons), 1975/76 to 1985/86

(a) Inflow rates (per 1000)

AGE-GROUP	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
0-14	33.5	30.8	33.0	31.1	28.0	28.1
15-19	46.5	43.0	42.7	41.5	37.4	38.1
20-24	76.6	68.7	69.4	68.2	64.1	64.8
25-54	32.9	30.3	32.7	31.3	28.0	28.4
55-69	17.4	16.6	18.3	16.1	14.3	15.0
70+	13.9	13.3	14.3	12.9	11.8	12.6
ALL AGES	32.7	30.1	31.9	30.3	27.4	27.9

AGE-GROUP	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
0-14	28.1	26.1	27.8	27.7	27.7	29.3
15-19	38.1	36.9	37.2	32.7	34.0	33.5
20-24	64.8	58.9	58.0	58.2	59.2	62.7
25-54	28.4	26.5	27.8	29.9	30.3	32.5
55-69	15.0	14.6	15.7	16.4	16.0	17.1
70+	12.6	12.5	13.3	14.7	13.9	15.2
ALL AGES	27.9	26.3	27.4	28.1	28.4	30.2

(b) Outflow rates (per 1000)

AGE-GROUP	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
0-14	29.5	26.8	29.0	26.8	24.7	25.1
15-19	49.3	45.8	45.8	43.7	40.2	41.7
20-24	72.8	66.0	67.7	66.2	62.8	65.7
25-54	28.4	26.3	28.5	26.9	24.4	25.1
55-69	12.4	11.6	13.3	11.7	10.3	11.0
70+	11.8	11.1	12.0	10.7	9.8	10.5
ALL AGES	29.0	26.7	28.5	26.8	24.7	25.6

AGE-GROUP	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
0-14	25.1	23.3	25.0	24.6	24.5	25.6
15-19	41.7	40.4	41.4	35.4	36.6	35.3
20-24	65.7	60.3	59.8	59.5	61.8	65.4
25-54	25.1	23.5	25.0	26.4	27.0	28.7
55-69	11.0	10.8	11.7	12.3	12.0	12.6
70+	10.5	10.2	10.8	11.9	11.3	12.2
ALL AGES	25.6	24.2	25.4	25.6	26.0	27.3

with a rate of 33 per 1000 in 1975/76, falling to 26 per 1000 in 1981/82 and recovering to 30 per 1000 in 1985/86. The inflow rate to non-metropolitan areas for 20-24 year olds was considerably lower than the inflow rate for this group to metropolitan areas. Substantial decreases occurred up until 1982/83 (77 to 58 per 1000) followed by an increase in recent years (63 per 1000 in 1985/86). The 15-19 year-olds experienced a downward trend in the rate of movement up until 1983/84 with the rate of in-migration to non-metropolitan FPCAs being lower than corresponding figures for metropolitan in-movement and rising to only 34 per 1000 by the end of the period from 32.7 per thousand in 1982/83. The 55-69 and 70+ age-groups had higher rates of out-migration from non-metropolitan than from metropolitan zones. The former was higher than the latter but important increases in the rate of in-movement by those of post-retirement age were observed in the second half of the period, resulting in a final rate well above that observed at the start of the period. The 0-14 age-group also experienced in-migration rates for non-metropolitan areas above those for metropolitan zones but with similar fluctuations in the level of movement. The 25-54 year-olds, in contrast, had inflow rates below those of metropolitan zones but with a similarly fluctuating trend.

The overall rate of out-migration from non-metropolitan FPCAs is the lowest, relative to the other three aggregate gross rates (Table 8.11b) at 29 per 1000 in 1975/76 reaching a low of 24 per 1000 in 1981/82 and increasing to over 27 per 1000 in 1985/86. The 20-24 year-olds experienced a rate of migration of only 73 per 1000 in 1975/76 which after a drop during the early 1980s increased to only 65 per 1000 in 1985/86. The difference between out-migration rates from metropolitan and non-metropolitan for this age-group is significant. The rate of out-migration from non-metropolitan zones was higher than in-migration between 1975/76 and 1980/81 but lower in subsequent years resulting in a turnaround in the net migration balance. The rate of out-movement for 15-19 year-olds, which was higher than that for in-movement to non-metropolitan areas, experienced a continual decline during the period (from 49 to 35 per 1000). In contrast the 55-69 and 70+ age-groups both had rates in 1985/86 above those of 1975/76 after reaching a low-point in 1979/80. The 0-14 rate values follow a similar trend but at a lower level, whereas the rate of out-migration from non-metropolitan areas by 25-54 year-olds follows a similar trend to out-migration of those in this age-group from metropolitan areas but at a significantly lower level. The graphs comprising the first two rows of Figure 8.8 illustrate more clearly the temporal fluctuations in the rate of in and out-migration for metropolitan and non-metropolitan zones. The graphs are drawn as time-series indices to illustrate variation of the rate values from the base-year (1975/76=100). The continual decline throughout the period in the rate of in and out-movement in the 15-19 age-group is emphasised for both metropolitan and non-metropolitan flows. The most significant difference between metropolitan and non-metropolitan FPCAs was in the 20-24 out-migration category where the fall and recovery in the out-migration rate from non-metropolitan areas has not been matched by a similar trend in movement away from metropolitan areas. The 70+ age-range also exhibited marked differences in that the rate of non-metropolitan in-migration increased at a greater rate than metropolitan with the reverse being true for outflows. The third row

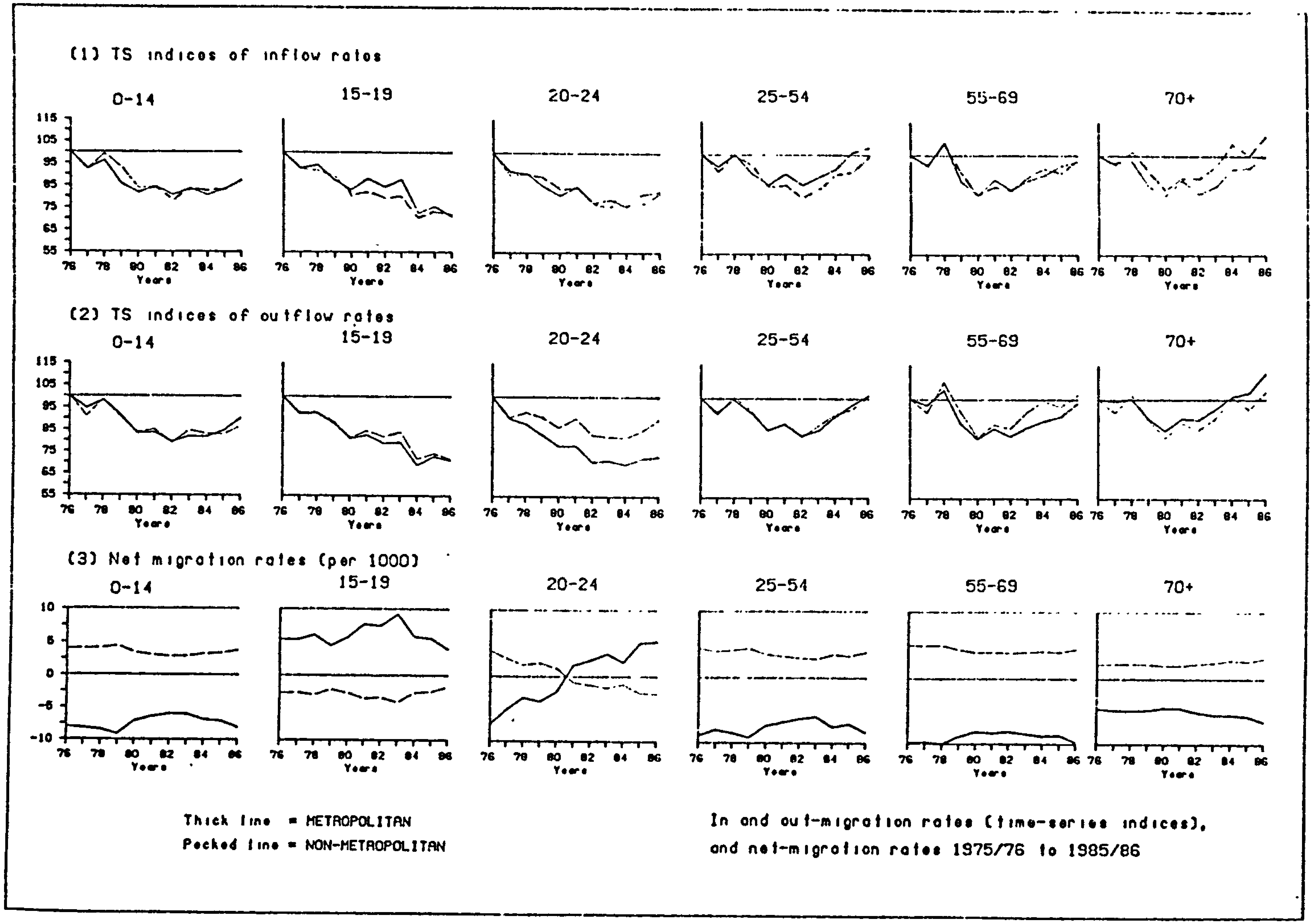


Figure 8.8 <u>In and out-migration rate time-series graphs and net-migration rate graphs for metropolitan and non-metropolitan FPCAs, 1975/76 to 1985/86</u>

of Figure 8.8 demonstrates the consequences of changing in and out-migration by illustrating net-migration rates for metropolitan and non-metropolitan zones. In the 0-14, 25-54, 55-69 and 70+ age-ranges the pattern throughout the period is of a relatively stable positive net-migration rate in non-metropolitan areas and a relatively stable negative rate in metropolitan areas. The situation in the remaining two age-groups is significantly different. A large positive rate of net migration was experienced in the 15-19 age-group in metropolitan areas. The rate reached a peak of over 9 per 1000 in 1982/83 and has declined since with a consequent reduction in the rate of net loss in non-metropolitan areas. The 20-24 age-group produced the most significant trends over the eleven year period. From 1975/76 onwards the negative rate of net migration in metropolitan areas decreased until in 1980/81 when the rate became positive. At the same time the rate of non-metropolitan net migration has become progressively more negative. The rate of metropolitan net migration in the 20-24 age-range increased from -7.3 per 1000 in 1975/76 to 5.3 in 1985/86. The rate of net migration for non-metropolitan FPCAs has decreased from 3.9 to -2.7 per 1000 - a significant shift in the directional flow of young adults.

It is important to analyse these metropolitan and non-metropolitan differences by sex as well as age. Figure 8.9 illustrates in, out and net-migration rates by age-group for males and females at the metropolitan level. The pattern of net-migration for children (0-14) and the workforce and family ages (25-54) are matched quite closely for both sexes with increased net losses from metropolitan areas in recent years. Male and female rates are matched very closely in the two older age categories with the net

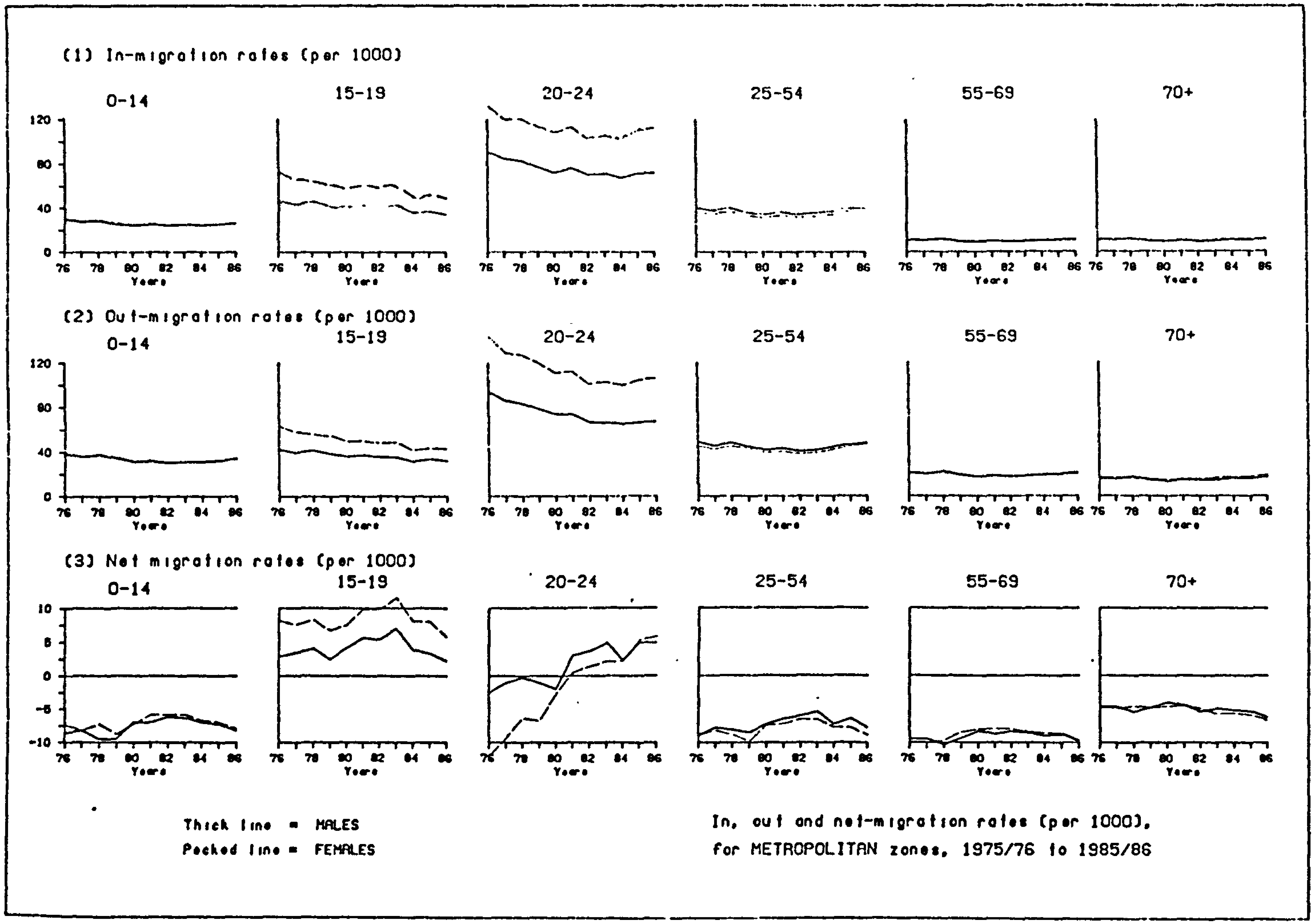


Figure 8.9 In-, out- and net-migration rates for males and females, metropolitan zones, 1975/76 to 1985/86

rate of retirement and post-retirement movement becoming increasingly negative since 1982/83 in the case of both sexes. In the more mobile 15-19 and 20-24 year age-groups the discrepancy between the rates of male and female movement in metropolitan areas is much greater. In the younger of the two groups the in- and out-migration rates for males and females fluctuated in parallel, with the female rate being substantially higher throughout the period. In the case of the net rate of movement in metropolitan FPCAs the 1982/83 peak in net gain in the 15-19 age-group varies between 11.5 per 1000 for females to 7 per 1000 for males. The rate of net gain in this age-range has remained positive but has fallen in more recent years for both sexes. The 20-24 age-group exhibits the greatest differences between the sexes at this metropolitan level. Both male and female inflow and outflow rates have been on a downward trend during the period with only slight recovery, particularly for females, in the final three years of the time-series. Female rates have been significantly higher than male rates. In 1985/86 the rate of in-migration to metropolitan zones for females was 112 per 1000 compared to 72 per 1000 for males. The rate of out-migration ranged from 106 per 1000 for females to 87 per 1000 for males. The net rate graph for the 20-24 year-olds illustrates that fluctuations in the rate of in and out-migration have had a varied effect upon the sexes. At the beginning of the period males suffered a net loss through migration in metropolitan zones at a rate of 2.6 per 1000. This rate has become progressively more positive throughout the period until in 1985/86 a net gain was experienced at a rate of approximately 5 per 1000. In contrast, females experienced a much larger rate of net loss in 1975/76 (-12 per 1000) which had by 1985/86 become a net gain of almost 6 per 1000 - exceeding the male figure. Figure 8.10 illustrates how these net trends are reversed for non-metropolitan areas as a whole although the decreases in the rates of net gain in the 20-24 age-range for both sexes are not as dramatic as the increases illustrated in Figure 8.9. The rate of net loss in the 15-19 age-group from the non-metropolitan FPCAs was less negative for males than females with both becoming increasingly less negative towards the end of the period. Significantly, temporal fluctuations in the net rates for the remaining age-groups (0-14, 25-54, 55-69 and 70+) are less apparent at the non-metropolitan level.

This section has identified some significant trends in age-specific movement over the eleven-year period, with important changes occurring in the directional movement of the more mobile sections of the population (15-24). The division of the UK into metropolitan/non-metropolitan categories is rather crude, and Section 8.5.3 improves on this by utilising the population density classes to examine these trends more closely and to elucidate trends missed at this aggregate level. In the following section, however, trends at the broad regional level are illustrated and North/South discrepancies by broad age cluster are examined.

8.5.2 Temporal trends in NHSCR migration by age and sex at a broad regional scale

In Chapter 7 it was shown that the ROS was growing at the expense of the other three macro regions, with the Industrial Heartland and the Periphery increasing their net losses during the period. Figure 8.11 groups the Periphery and the Industrial Heartland to form the North and the ROS and Greater London to form the South. The graphs illustrate fluctuations in the rate of age-specific net migration

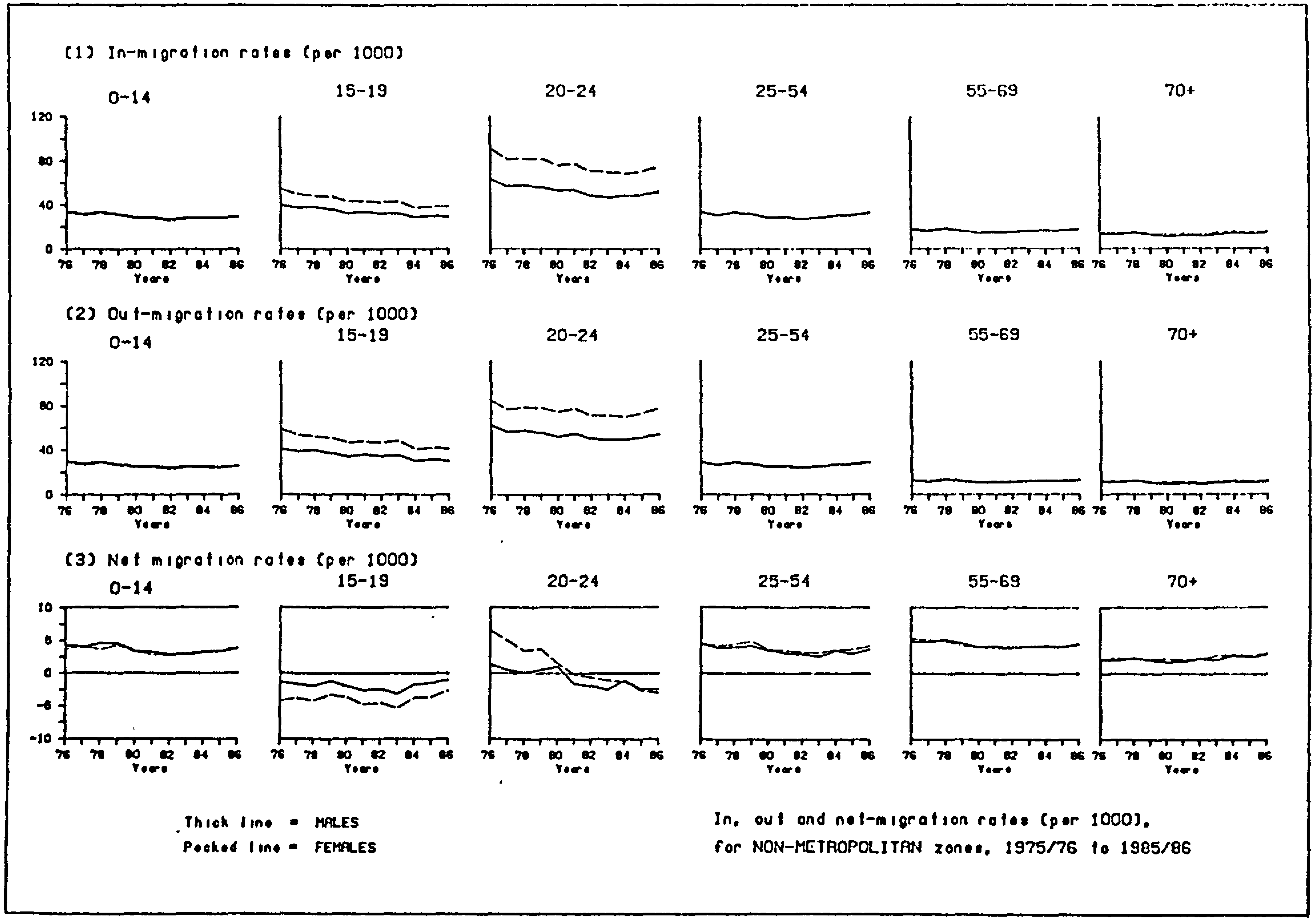


Figure 8.10 <u>In-, out- and net-migration rates for males and females, non-metropolitan zones, 1975/76 to 1985/86</u>

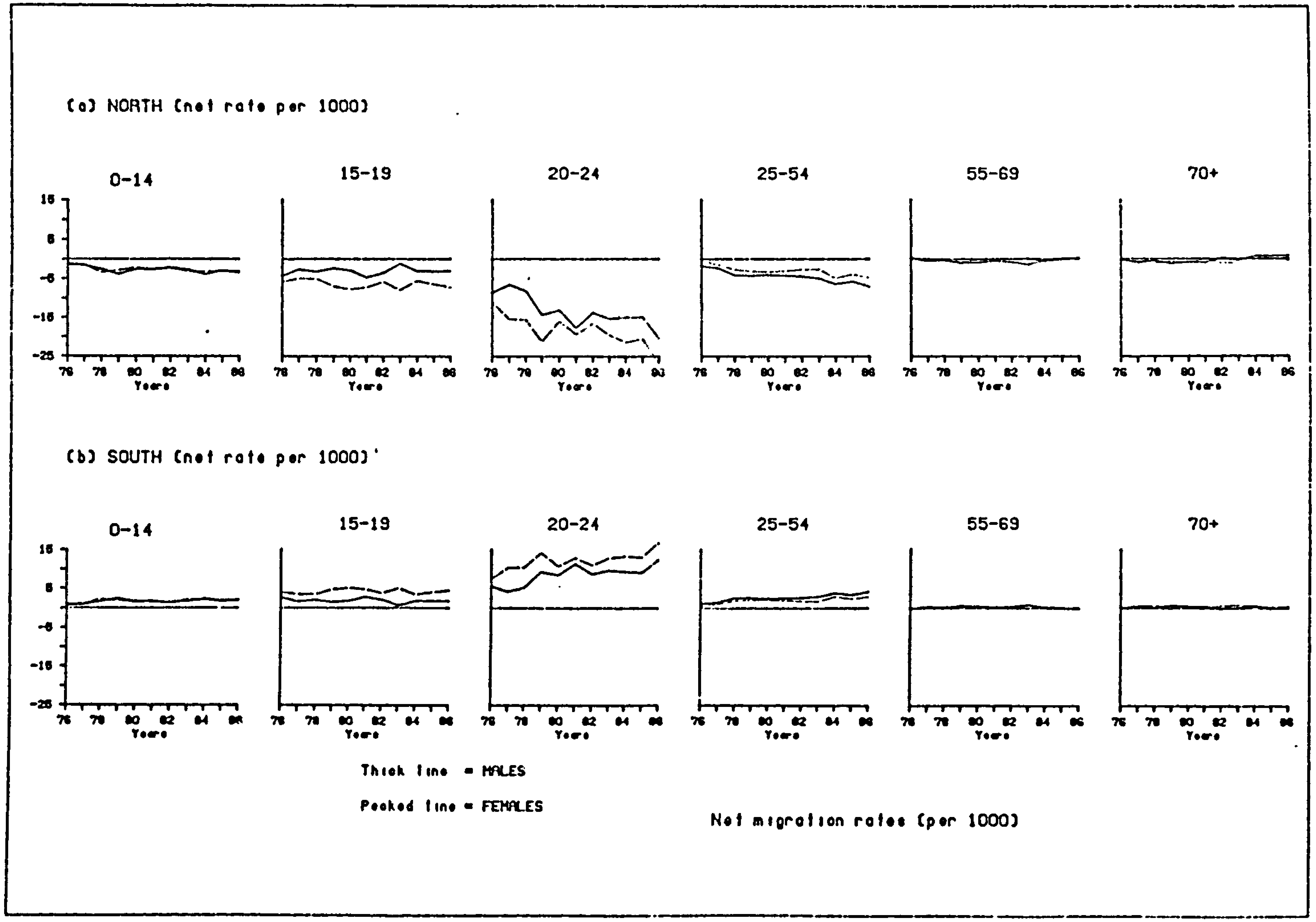


Figure 8.11 <u>Net migration rates for North and South divisions by broad age-group</u>

over the eleven-year period for this crude division of the country. Little discrepancy is evident between the North and the South in the two oldest age-groups. For both males and females in the 55-69 and 70+ ages the net rate of migration varied only fractionally around zero in both the North and the South. The North lost slightly to the South in each case with the exception of male moves between 1983/84 and 1985/86. The rates of net migration for young children and persons aged 25 to 54 follow similar trends. In the North the net rate for the 0-14 year-olds was negative throughout the period as was the net rate for those aged 25-54. The net rate for the latter in both the male and female case has become increasingly negative since 1975/76. In 1985/86, the net rates for those living in the North in the workforce and family ages were approximately -7 and -5 per 1000 for males and females respectively. The 0-14 net rate varied between -1 and -4 per 1000 for both sexes. In the South, consistent net gains have been made in the 0-14 and 25-54 age-groups at the expense of the North, with the rate of net gain increasing marginally over the eleven-year period. The 15-19 and 20-24 age-groups both exhibit patterns of negative rates in the North and positive rates in the South although differences are significant. The rate of net loss of 15-19 year olds in the North has been greater for females than males with the reverse true of gain in the South. The most significant changes in the net rates of migration are found in the 20-24 age-group. At the beginning of the period the rate of net loss from the North was approximately -9 and -11 per 1000 for males and females respectively. By 1985/86 these rates of net loss had increased to -20 and -27 per 1000. Females have maintained a larger negative rate than males throughout the period. The South, as a consequence, has experienced increasing net gains in the 20-24 age-range for both males and females. In 1985/86, the rate of net gain through migration in this most mobile of age-groups was over 12 per 1000 for males and approximately 17 per 1000 for females.

The rate of net migration varies between the four broad regional divisions of the UK (Figure 8.12). Significant variations appear in the patterns of net migration for the six age groupings. In the 55-69 and 70+ ages, the pattern was of minimal rates of net migration gain and loss for the Periphery and Industrial Heartland, quite sizeable positive rates of net migration for the ROS and considerable negative rates for Greater London. The rate of net loss for 55-69 year olds in Greater London, for example, was approximately -20 per 1000 for males and females in 1985/86. The corresponding figure for those of post-retirement age was -13 per 1000. Retirement and post-retirement movement away from Greater London was therefore substantial with the majority of gains being made in FPCAs within the ROS. The 0-14 and 25-54 groups exhibited similar patterns to the two older age-groups. Small but negative net rates have been experienced by both 0-14 and 25-54 year-olds in the Periphery and the Industrial Heartland throughout the period. Significant net gains in the ROS have been matched by the large negative net rates found for young children and the family and workforce ages in Greater London. The rate of net loss from Greater London in the 0-14 and 25-54 age-groups increased in 1985/86, particularly for females in the latter. The 15-19 year-olds showed important differences from other age-groups in that negative rates of net migration were experienced not only in the Periphery and the Industrial Heartland but also in the ROS - particularly in the case of females. These net losses have given

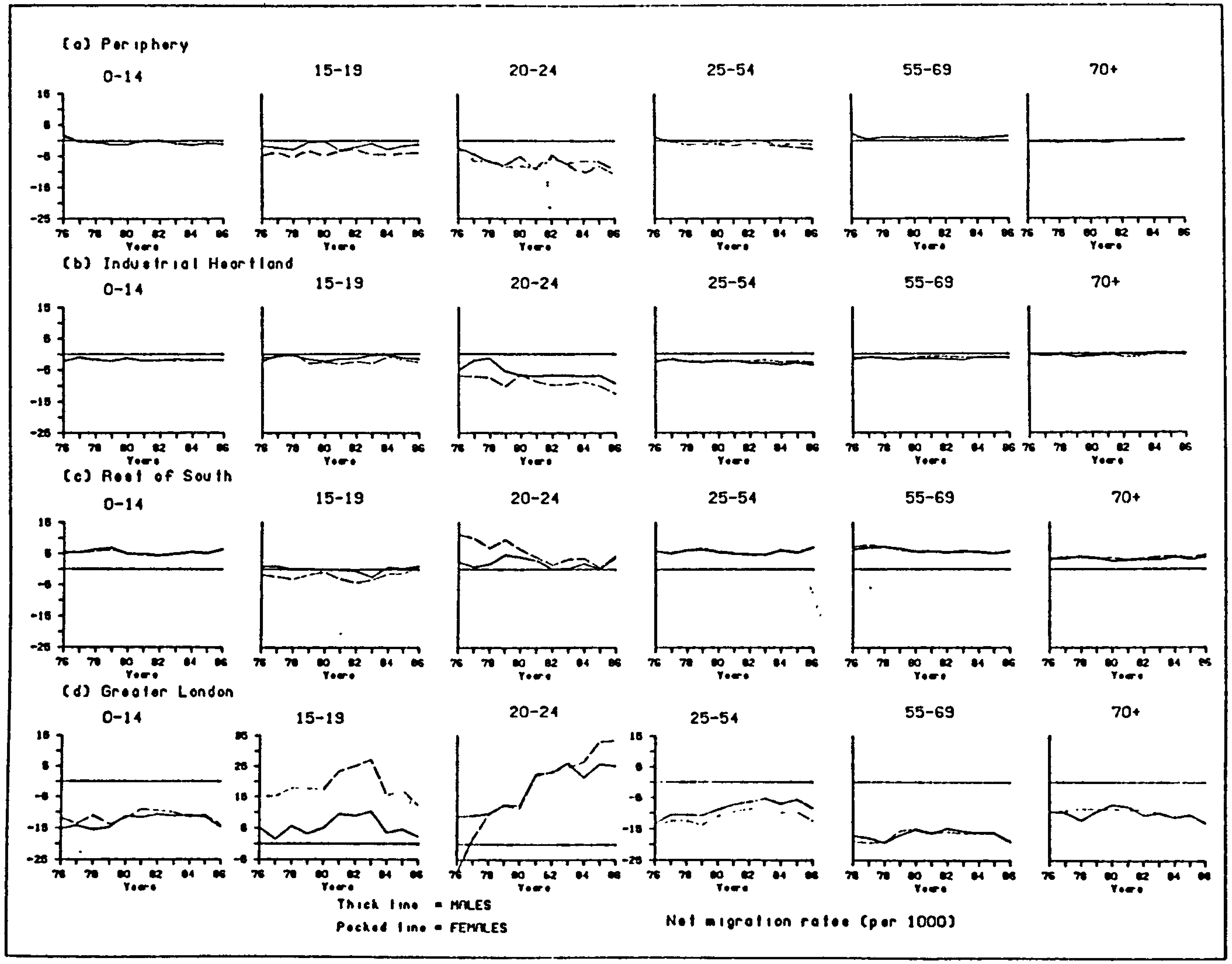


Figure 8.12 Net migration rates for regional divisions by broad age-group

rise to large net gains in Greater London. The rate of net gain for females aged 15-19 was especially large throughout the period. The peak in the rate of net migration occurred in 1982/83 when the gain was 27 per 1000 for females and 10 per 1000 for males. The attraction of the capital to those of young school-leaving age has been great although the rate of net gain has decreased quite sharply since 1982/83. The 20-24 age-group shows the greatest variation in the pattern of net gains and losses across the broad regional divisions. In the Periphery and the Industrial Heartland the rate of net loss through migration of this mobile age-group increased. In 1985/86, the net rate for males in the Periphery and the Industrial Heartland was -9 per 1000. For females the figure was approximately -11 per 1000. Unlike the 15-19 age-range, 20-24 year-olds have experienced a consistently positive net rate of migration in the ROS for both males and females. Although the respective net rates declined during the period, a recovery in the rate of net gain is evident in 1985/86 for this age-group in the ROS. The effect of these trends in net migration loss in the Periphery and the Industrial Heartland has been to dramatically increase the rate of net gain through migration of 20-24 year-olds by Greater London. At the beginning of the period the net rate of migration for females of this age-group in Greater London was -9 per 1000. For males the figure was 9 per 1000. By the end of 1985/86, however, these rates had increased to approximately 34 and 25 per 1000 respectively. The rise in the rate of female net in-migration has been particularly spectacular.

This section has highlighted some important trends in the net movement of the population between the North and the South and between broad regional groups of FPCAs. The following section continues the analysis of movement trends by age and sex by examining the effect of population density upon the net rate of migration, developing further the discussion of counter-urbanisation processes introduced in Chapter 7.

8.5.3 The effect of population density upon the movement of males and females by broad age-group

The derivation of the population density classification has been outlined in Section 7.5.2, and Figure 8.13 illustrates net migration rates for the four density categories by age-group. Throughout the period, high density areas experienced a negative rate of net migration in the 0-14, 25-54, 55-69 and 70+ age-groups. The largest rates were those for persons of retirement age (55-69). In contrast, the 15-19 age-group and the 20-24 age-group (since the early 1980s) have had positive rates of net migration. In the 15-19 range female net rates have been quite considerably higher than males throughout the period. In 1985/86 the rate of net gain through migration for 15-19 year-olds in high density areas was approximately 6 and 13 per 1000 for males and females respectively. These rates are a significant reduction from the early 1980's when male and female rates of net gains in this age-range were approaching 13 and 22 per 1000. The large net gains in high density areas in the 15-19 age-group will be considerably influenced by the inclusion within the NHSCR of the movement of students to places of education both in Greater London and in the big cities of Birmingham, Manchester, Liverpool and Newcastle in the North.

At the beginning of the period negative net rates of migration were experienced by 20-24 year-olds in high density areas. The rate,

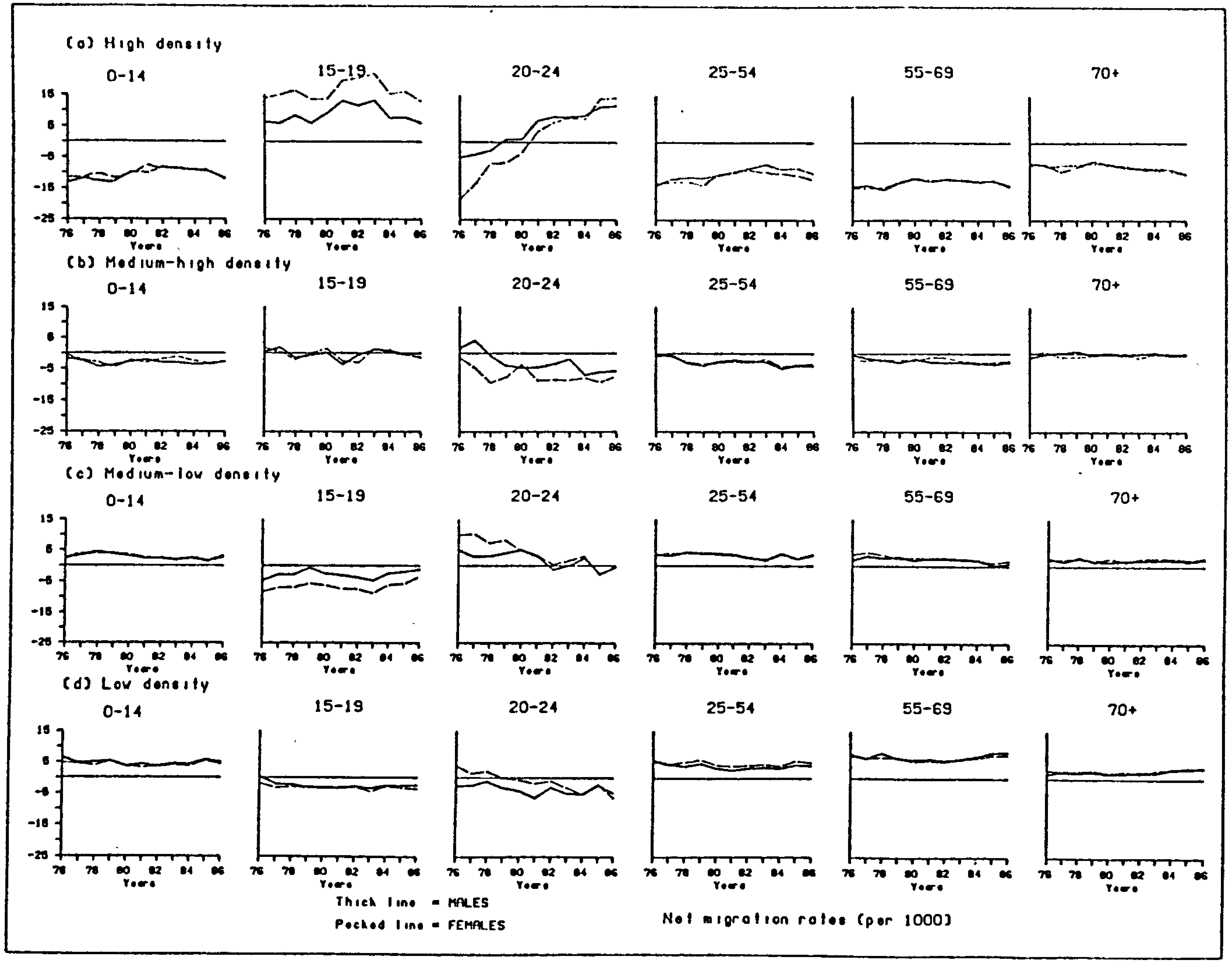


Figure 8.13 Net migration rates for density categories by broad age-group

however, became increasingly positive for both sexes - females in particular - with net rates at the end of the period of 12 and 14 per 1000 for males and females respectively. These net rate figures illustrate the dominance of Greater London in the migration system with the trends illustrated in Figure 8.12 very much reflected in the high density graphs of Figure 8.13. Counter-urbanization processes are evident, therefore, for the majority of age-groups in the system. Persons of retirement and post-retirement age have consistently moved away from high-density areas in net terms. The net loss of children in these areas is very much reflected in the net-rate schedule of family and workforce moves. It is the most mobile 15-19 and 20-24 age-groups which have continued to favour highly urbanized areas as destinations for employment and higher education.

Subsequent discussion will examine whether it is only movement to Greater London in these mobile ages which is increasing in net terms or whether the net gains are being experienced also in highly urbanized areas of the North. The remainder of Figure 8.13, however, illustrates age-group variation in the rate of net migration for the three other density categories. The medium-high density graphs indicate that throughout the period it has been net losses that have predominated for all age-groups. The rates of net loss were generally quite small indicating less important decentralisation trends for these medium-high density areas which were, in the main, metropolitan FPCAs of the North. The larger rates of net loss in the 20-24 age-group reflect the increasing net gains to high density FPCAs. The two lower density categories in Figure 8.13 had similar net rate patterns for each age-group. Net gains per 1000 were higher in the low-density category for the 0-14, 25-54, 55-69 and 70+

age-groups with the largest positive rate being in the retirement ages. The net rate schedules for 15-19 year-olds reflect their preference in net terms for the more urban areas with consistent net losses throughout the period in both medium-low and low density categories.

A most significant trend was the positive net rates experienced by 20-24 year-olds during much of the period in the medium-low density FPCAs. This can be put down to the attractiveness in employment terms of the less dense FPCAs of the South which include the majority of counties surrounding Greater London. This phenomenon and the others highlighted above can be further examined by disaggregating the density groups into North and South categories. The net rate schedules for Northern FPCAs by density class (Figure 8.14) are generally similar to those illustrated in Figure 8.13, although there are a number of significant differences. In the 15-19 age-range the importance of student inflows to high density areas was again evident with net gains throughout the period. Negative migration balances in the high density FPCAs of the North are again experienced in the 0-14 and the three oldest age-groups although at a slightly reduced level to those illustrated previously indicating less extensive decentralisation. The net rate graph for 20-24 year-olds follows a similar schedule to that of Figure 8.13 except that net losses through migration, although declining, were maintained throughout the period. In 1975/76, the rates of net loss of 20-24 year-olds from high density areas of the North were -24 and -33 per 1000 for males and females respectively. By 1985/86 these figures had decreased to -9 and -17 per 1000, but it is clear that high density FPCAs of the West Midlands, Merseyside, Greater

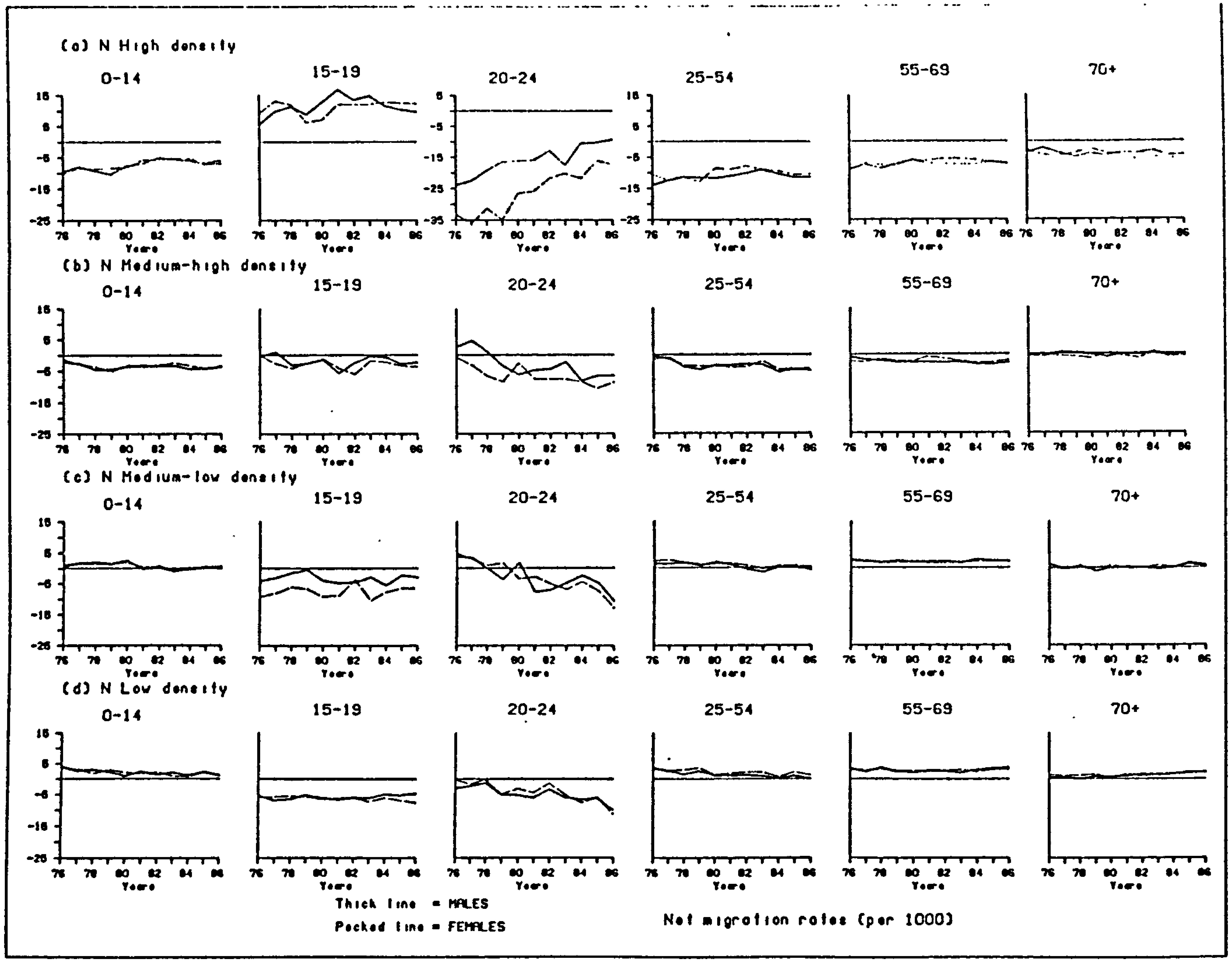


Figure 8.14 Net migration rates for Northern density categories by broad age-group

Manchester and Tyne and Wear continued to lose 20-24 year olds in net migration terms to the capital, although at a reduced rate. In the three remaining density categories of the North, increasingly negative rates of net migration were evident for those aged 20-24. The attraction of the South East and of Greater London in particular is strong to people in these mobile ages. Net migration gains of 55-69 year-olds and persons aged 70 and over were relatively small in the lower density FPCAs of the North as were the positive net rates in the 0-14 and 25-54 age-groups. The higher density areas of the North were losing population in these age-groups but with no significant net gains in the less urbanised areas of Scotland, Northern England and Wales. The positive net rates in high density areas for 15-19 year-olds were matched by negative rates throughout the period in the remaining three density categories.

Figure 8.15 illustrates net rate schedules for the density categories of FPCAs in the South. The graphs emphasise the importance of the inflow of persons in their late teens and early 20s to the capital. Rates of net increase through migration of 15-19 year-olds have decreased quite considerably in recent years but the net gains in the 20-24 age-range have increased continually. In 1985/86 the rate of net gain of 20-24 year-olds in the capital was 27 and 34 per 1000 for males and females respectively. Females have undergone the most significant increases over the eleven-year period. Importantly the rate of net migration has remained positive for 20-24 year-olds in the medium-low density FPCAs of the South and also, more recently, in the low density category. This is in contrast to the trends illustrated in the North and reflects somewhat the national distribution of employment opportunities and the dispersion of

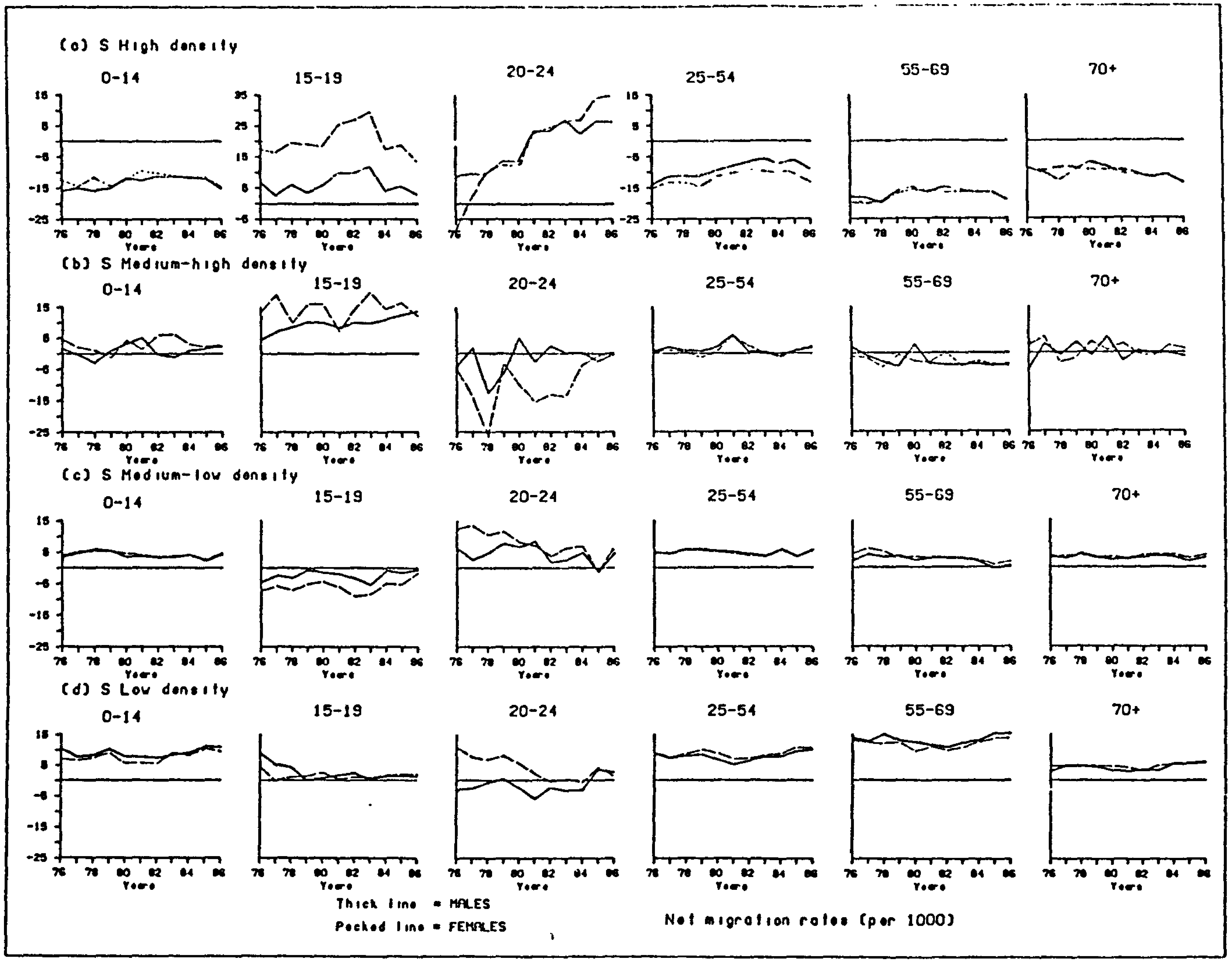


Figure 8.15 Net migration rates for Southern density categories by broad age-group

predominantly service sector industries into the counties surrounding Greater London.

The rate of net migration loss from Greater London for the remaining age-groups (0-14, 29-54, 55-69 and 70+) was considerably higher than for corresponding high-density FPCAs of the North. The net loss of persons through retirement migration was particularly pronounced and was matched by quite substantial rates of net migration gain in the low-density areas of the South reflecting the preference of the South West, East Anglia and parts of the East Midlands as destinations for migrants in the 55-69 age-range. Post-retirement movement followed a similar trend with an equal rate of net migration gain in medium-low density FPCAs but slightly lower rates in the lowest density areas. The considerable net migration losses of 0-14 and 25-54 year olds in high density areas of the South were matched again by net gains in the lower density categories.

A substantial number of results have been illustrated in the last three sections and a number of major and important characteristics of age-group migration highlighted. The following section concludes the analyses with a brief summary of the trends.

8.5.4 Summary

A number of major trends have emerged from the analyses of Section 8.5. Firstly, there is evidence of a continued net loss of migrants of retirement and post-retirement age from the higher density London boroughs and other metropolitan areas. Net migration gains have been made in the less dense areas of the North but the favoured destinations for migrants aged 55 and over appear to have been FPCAs within East Anglia and the South West, in particular, but also in the shire counties of the South East and parts of the East Midlands. The importance of the migration of the elderly has continued throughout the period, therefore, with the traditional preferences for movement to the south coast and more rural areas remaining. Early retirement migration appears to be becoming increasingly significant as illustrated by the cluster analysis of Section 8.4. Secondly, the movement of families has followed a similar trend with considerable net losses through migration from all higher density areas of both North and South in the 0-14 and 25-54 age-groups. Less urbanised areas have again been the preferred destinations. Thirdly, for those persons of school leaving age (15-19) there is evidence of fluctuating trends in in-migration during the period. In the North, the rate of net gain in high density areas has been considerable with corresponding net losses from other less urbanized areas. There has been a net loss of 15-19 year olds throughout the period from North to South, with the peak in the net gain to boroughs of Greater London in 1982/83 preceding a decline in recent years. The positive net rate of migration for high density FPCAs in the South has been substantially higher for females than males although fluctuations have been in parallel.

Many of the more significant changes in the patterns of migration have occurred in the 20-24 age-group. The negative rate of net migration for metropolitan FPCAs in 1975/76 had, by 1985/86, become significantly positive with the reverse being true for non-metropolitan areas. All areas of the North lost in net migration terms in this age-range. In the South the increase in the net gain of 20-24 year-olds has been considerable particularly in the case of females. Importantly the less urbanised areas of the South East and the East Midlands have also maintained positive net rates throughout the period.

8.6 AN ANALYSIS OF CHANGES IN THE PATTERN OF INTER-ZONAL MIGRATION BY BROAD AGE-GROUP BETWEEN 1980/81 AND 1985/86

8.6.1 Introduction

This section utilises inter-zonal NHSCR movement data for the 12-month period which most closely approximates to the year before the 1981 Census (1 April 1980 to 31 March 1981) and for mid-year 1985 to mid-year 1986 to analyse changes in the spatial distribution of moves by broad age-group. The respective migration arrays consist of moves between 97 origins and destinations by age-group (defined in Section 8.4) but with no sex disaggregation.

The reasons for undertaking this analysis are twofold. Firstly it was felt appropriate to examine changes in the directional flow of age-specific moves over time given the analyses reported in Chapter 7 which illustrated temporal variation in selected distribution components of migration. The second reason relates to the nature of the assignment procedure adopted in the official sub-national projection methodology. The method of assignment adopted in the most recent round of population projections involves using 1981 Census migration data, the assumption being made that the spatial pattern of movement by age-group varies little over time. No attempt has been made in the assignment stage of the methodology to update Census information using NHSCR data for subsequent years. This section aims to deduce, therefore, whether patterns of age-group migration have in fact altered between 1980/81 and 1985/86 and whether there is justification for basing the 1987 projections on spatial patterns of migration observed in 1980/81.

In Section 8.6.2 a brief indication of variation in the distribution patterns of migration is given through the computation of goodness of fit statistics. Aggregation of individual FPCAs into population density categories allows changes in the rate of inter-zonal movement to be illustrated with particular attention to migration flows into and out of the high and medium-low density areas of the 'Southern' half of Britain which are acknowledged as the major centres of migration activity in the UK. The section also illustrates important differences in the spatial pattern of migration for the two years in question, outlining gross and net rate changes for selected age-groups at the finest spatial scale. Section 8.6.4 uses a doubly-constrained spatial interaction model to examine the temporal and spatial variation in the friction of distance effect upon migration by age-group and Section 8.6.5 summarises the results of this particular sub-section.

8.6.2 Changes in the distribution patterns of migration between 1980/81 and 1985/86

One approach to the assessment of temporal stability involves a comparison of the distribution patterns evident in 1980/81 and 1985/86 using goodness of fit statistics. Two measures are chosen to illustrate the 'distance' and correlation between the patterns of inter-FPCA migration for individual age-groups in the two periods. These are the index of dissimilarity (IOD) and the correlation coefficient (R). Table 8.12 illustrates the values computed. The IOD statistic for all ages indicates a fair degree of similarity between the years in question with a reasonably strong correlation coefficient to match, yet individual age-groups show considerable variation. The greatest dissimilarity and the poorest correlation

Table 8.12 Goodness of fit statistics for the comparison of inter-zonal movement by age-group, 1980/81 to 1985/86

Age-group	Index of dissimilarity	Correlation coefficient
0-14	20.1	0.950
15-19	24.7	0.908
20-24	19.1	0.953
25-54	14.0	0.977
55-69	27.2	0.926
70+	33.5	0.891
All ages	10.5	0.982

are evident for the post-retirement age-group indicating a quite substantial alteration in the pattern of movement by those persons aged 70 and above over the five-year period. The level and pattern of migration by those aged 15-19 also appears to have undergone fundamental changes between 1980/81 and 1985/86. Those age-groups exhibiting the greatest consistency are the more mobile 20-24 year-olds and the 25-54 age-group. These figures can be borne in mind when examining the inter-zonal patterns of movement evident in 1980/81 and 1985/86.

Changes have occurred in out-migration rates between 1980/81 and 1985/86 by age-group for the four broad density categories (Figure 8.16). The 1980/81 figure is taken to be 100 and the 1985/86 rates computed as time-series indices. The general pattern is one of increased out-migration rates for age-groups 0-14, 25-54, 55-69 and 70+ over the five-year period but generally lower rates of movement for the 15-19 and 20-24 year-olds with a number of important exceptions. The highest rates in 1980/81 and 1985/86 were evident for 20-24 year-olds moving between high-density areas (44.3 and 43.5 per 1000) with a 2% decline over the period. The greatest decline for this age-group was evident for moves between high and medium-high density areas with a 9% decline between 1980/81 and 1985/86, and between high and low density areas with an 8.6% decrease. The decline in the rate of out-migration appears to have been more substantial for 15-19 year-old migrants, particularly for those moving to high density areas from medium-low and low density FPCAs (-16% and -14% respectively). In general, there was quite a reduction in the rate of migration to high density areas from the two lowest density classes in all age-groups with the exception of those

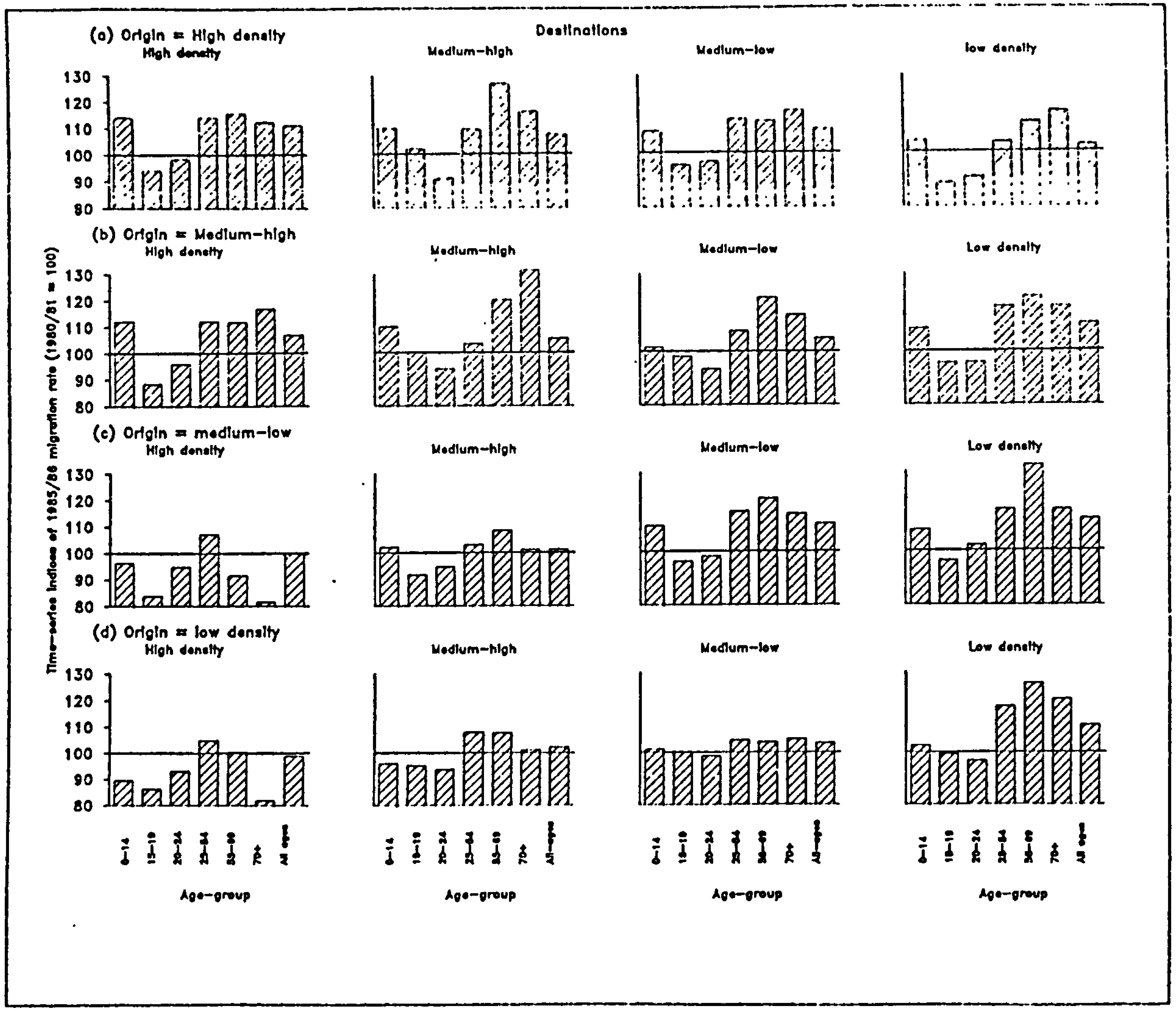


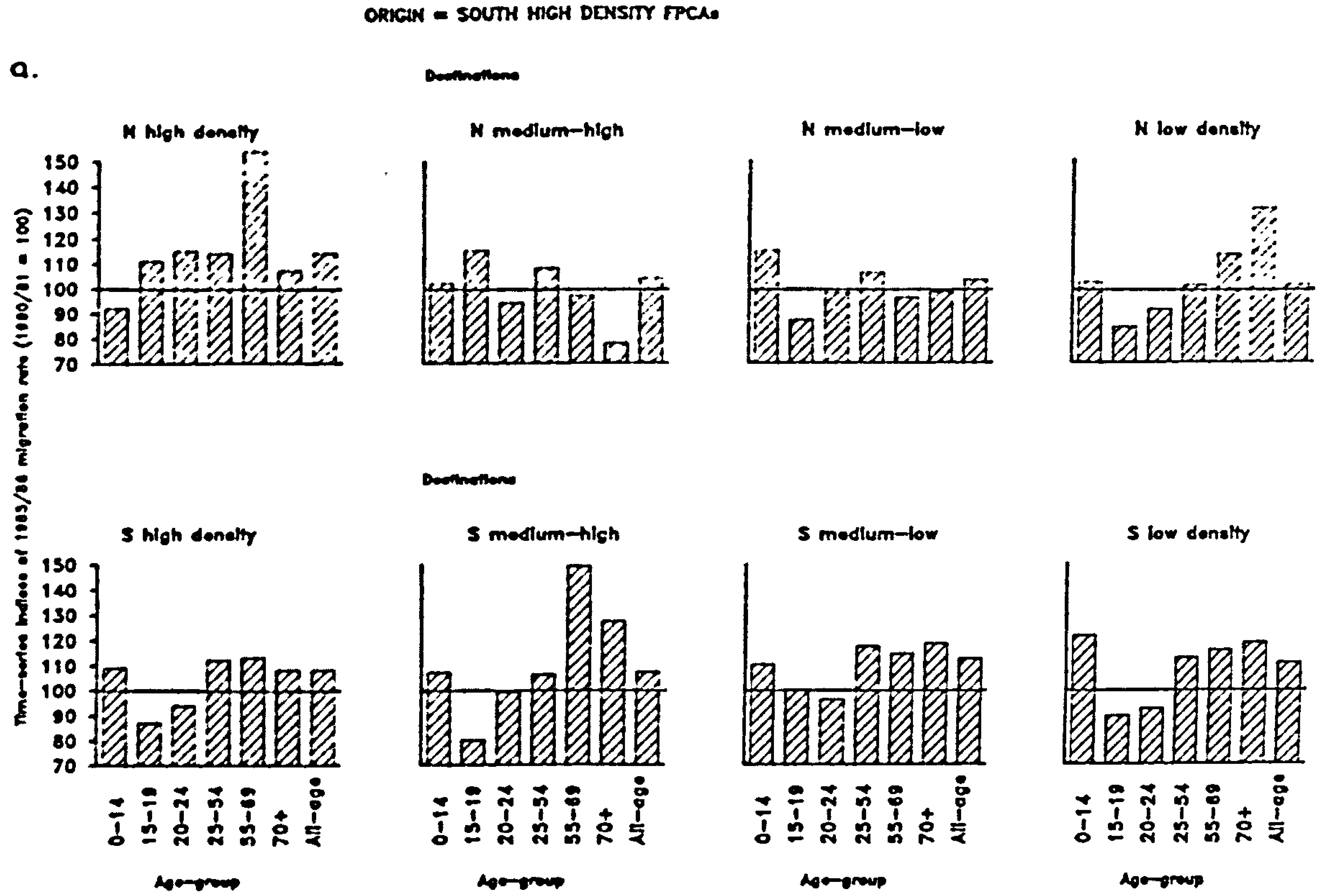
Figure 8.16 Graphs of out-migration rate change for density categories, 1980/81 to 1985/86

aged 25-54. The post-retirement age-group in particular, although having relatively small out-migration rates, suffered large decreases over the five-year period (18% in each case). The same is not true for medium-high density areas where the rate of movement to high density FPCAs increased in all but the 15-19 and 20-24 age-groups. The most distinctive pattern over the 1980/81 to 1985/86 period was the increase in the level of movement to lower density areas in the older age-groups. The rate of migration from medium-low density areas to those of a lower density in the retirement ages increased by over 32% from 5.1 per 1000 in 1980/81 to 6.8 per 1000 in 1985/86. The corresponding rate for post-retirement moves showed a considerable increase of 16%. Movement of these older age-groups showed similarly high increases over the period for moves between FPCAs within low density and within medium-low density areas. Retirement and post-retirement migration away from the higher density areas also increased substantially particularly to low density FPCAs from the medium-high density FPCAs of the major metropolitan areas of the North.

The most significant trends to emerge from Figure 8.16 are, therefore, the reduction in the rate of movement of the 15-19 and 20-24 year-olds over the five-year period particularly from lower to high density FPCAs, and the increase in the importance of retirement and post-retirement movement to low density areas from all other density categories. Greater London and the medium-low density areas of the South East and East Midlands have been identified as the major generators and attractors of migrants within the migration system of the UK. It is interesting, therefore, to examine changes in the flow of moves into and out of these areas over the 1980/81 to 1985/86 period.

Changes in the age-specific rate of out-migration from high density London boroughs to all other density categories of the North and South are illustrated in Figure 8.17a. The rate of movement to high density areas of the North increased in all but the 0-14 age-group. The most substantial increase was in the 55-69 age-range owing to the very small out-migration rate in 1980/81 (0.17 per 1000). In contrast the rate of retirement and post-retirement movement to medium-high and medium-low areas of the North decreased during the period. Northern low-density areas became more attractive to migrants from Greater London in the 55-69 and 70+ age-groups. The largest rates of out-migration were found, both in 1980/81 and 1985/86, within high density areas of Greater London. Only the 15-19 and 20-24 age-groups showed evidence of a decline in the rate of movement between Southern high density areas over the five years (13% and 6% respectively). Other age-groups increased their rates of movement within Greater London by between 8 and 13%. The importance of family moves and retirement and post-retirement moves out of Greater London to the more rural areas of the South East, East Anglia, South West and the East Midlands increased, emphasising the general preference of these age-groups for residence away from high density FPCAs. This contrasts to the 15-19 and 20-24 age-groups whose rate of movement out of high density to lower density FPCAs decreased significantly up to 1985/86.

Figure 8.17b illustrates the rate of out-migration from all other density categories to high density FPCAs of Greater London. Movement rates from high density areas of the North increased over the period in all age-groups indicating the growing importance of movement



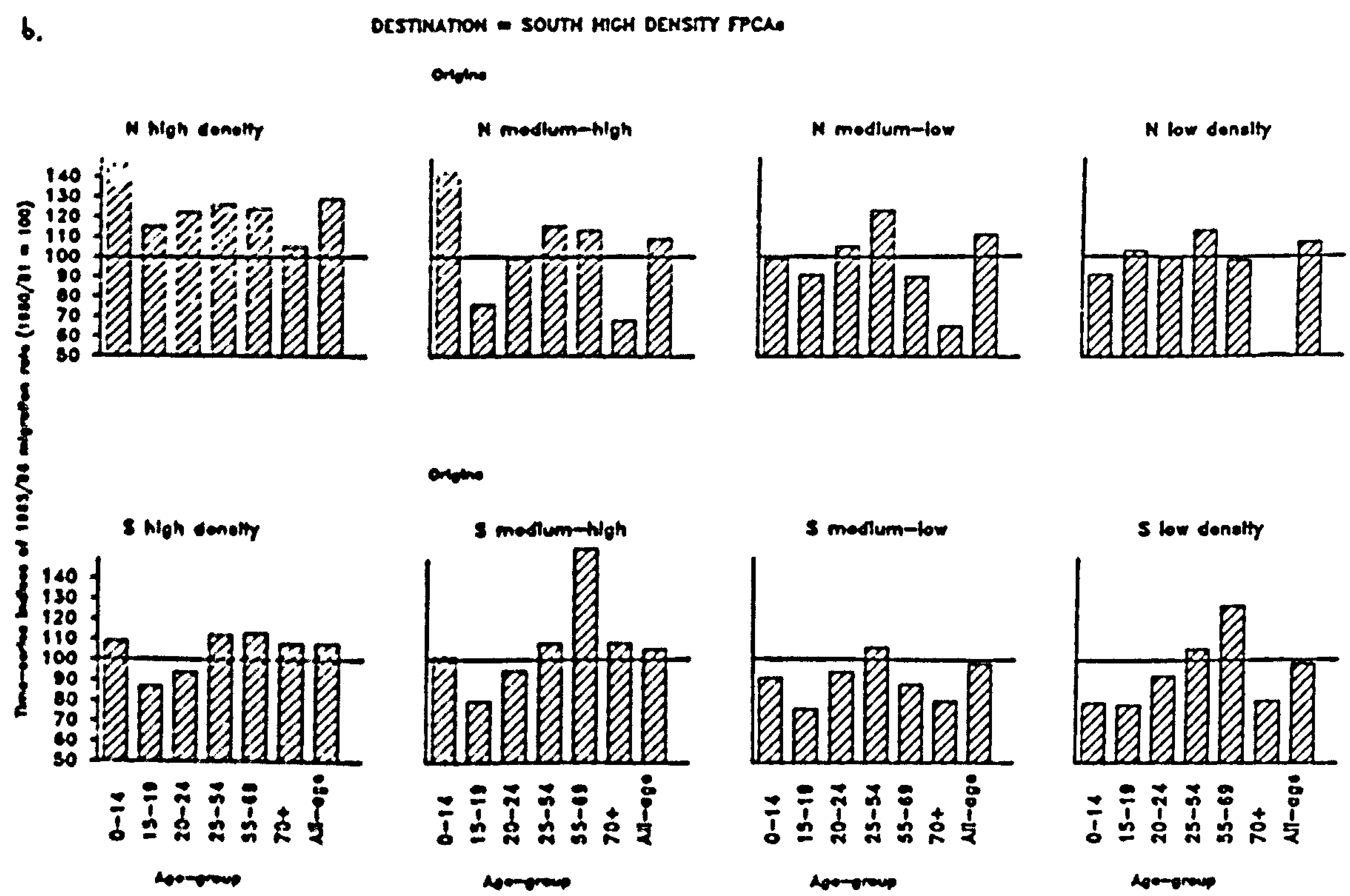


Figure 8.17 <u>In and out-migration rate change to and from high density FPCAs of the South, 1980/81 to 1985/86</u>

between the major metropolitan areas and Greater London. One significant characteristic of movement from the North to Southern high-density FPCAs is the large reduction in the rate of movement of those aged 70 and above. Although the values are small the decrease between 1980/81 and 1985/86 was almost 50% in the case of moves from low-density areas. A substantial reduction was also evident in the rate of movement of 15-19 year-olds to high density FPCAs in Greater London from the medium-high density FPCAs of the metropolitan counties of the North. In the South the rate of movement into high density areas from lower density FPCAs generally reduced, again with a considerable reduction in the rates of migration by those of post-retirement age and by those aged 15-19. In-movement by 55-69 year-olds from low density areas was the only category which showed significant increase during the period.

The medium-low density areas of the South have also been identified as major areas of attraction and generation within the migration system, so fluctuations in the rate of movement from and to these FPCAs will have an important effect upon the distribution of flows throughout the UK. Figure 8.18a illustrates the variation in the rate of out-migration from these medium-low density areas of the South to all other density categories. Again, as in the case of the high density areas, the rate of movement of 15-19 year-olds has decreased in each density category. The 20-24 age-group also showed evidence of a reduced rate of movement to all other density categories. The most significant increases in the rate of out-migration relate to persons of the older age-groups moving from these medium-low density areas of the South East and East Midlands to the least urbanised areas of the South West and East Anglia. The

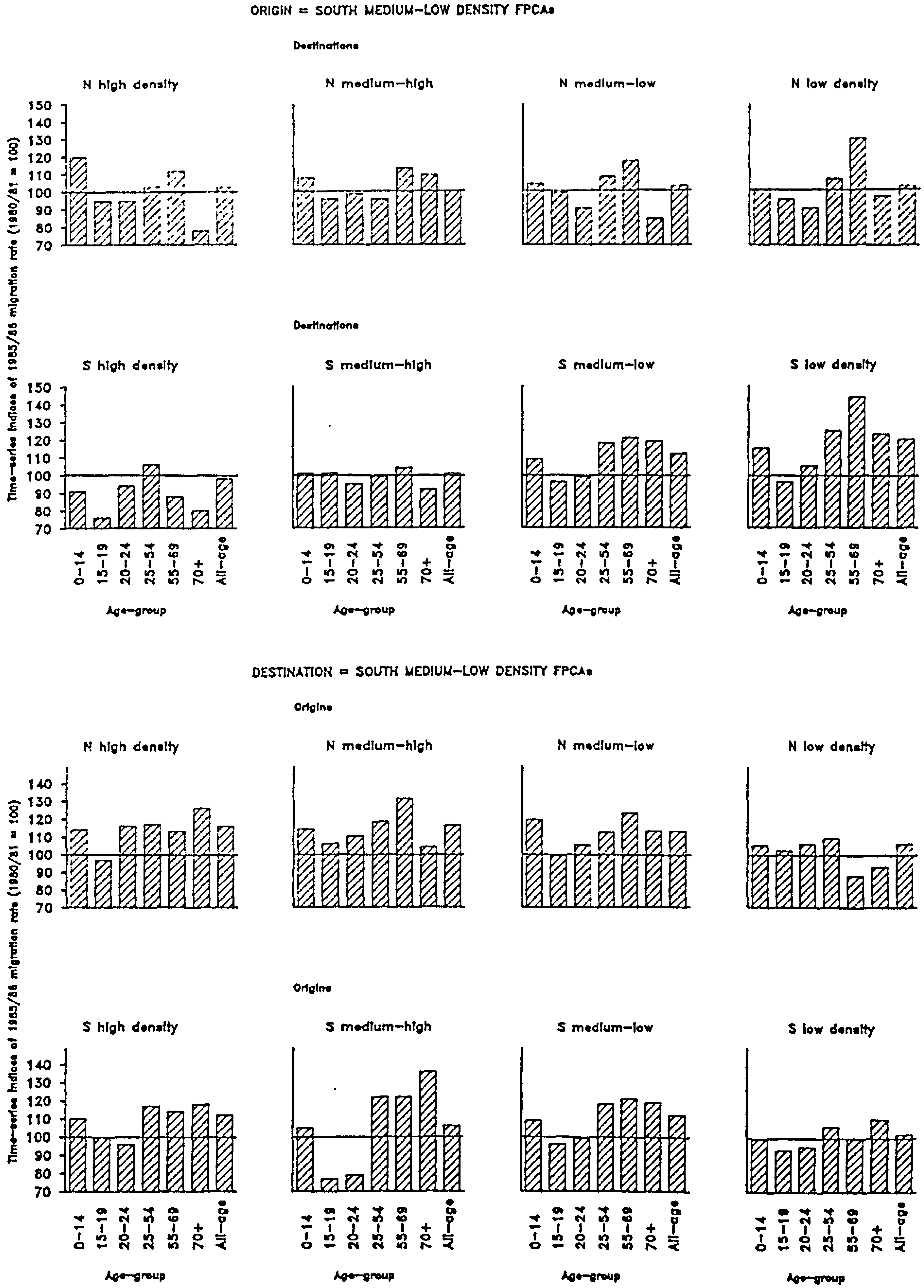


Figure 8.18 <u>In and out-migration rate change to and from medium-low density FPCAs of the South, 1980/81 to 1985/86</u>

rate of movement of 55-69 year-olds in 1985/86 was almost 50% higher than the corresponding figure for 1980/81. This contrasts to the rate of out-migration of the older age-groups from medium-low density areas of the South to highly urbanised areas of Greater London. The decrease over the five-year period was approximately 15% and 20% for the 55-69 and 70+ age-groups respectively. Figure 8.18b illustrates changes in the rate of out-migration to medium-low density areas of the South. The major feature is the increase in the rate of movement to these FPCAs from almost all age-groups for density categories of the North. Only 15-19 year-olds in high density areas and the 55-69 and 70+ age-groups in the lower density FPCAs show evidence of a declining out-migration rate during the period. The counties surrounding Greater London appear to be increasing in their importance as destinations for migrants from the North, emphasising further the net loss through migration from North to South.

Some of the most striking differences in the patterns of migration between 1980/81 and 1985/86 are evident for the 15-19 year-old age-group which appears to have decreased its rate of movement throughout the UK. Figure 8.19 illustrates the percentage change in the in- and out-migration rates over the five-year period across FPCAs. The overall rate of inter-FPCA migration for 15-19 year-olds was 39 per 1000 in 1980/81 decreasing by 6% to 36 per 1000 in 1985/86. The largest increases in rates of in-migration (Figure 8.19a) were experienced by the northern FPCAs of Cleveland, Cumbria and Gateshead, a number of metropolitan FPCAs in Greater Manchester and West Midlands and the non-metropolitan counties of Leicestershire, Powys and West Sussex. Significantly, the largest decreases were observed in Greater London FPCAs, particularly in

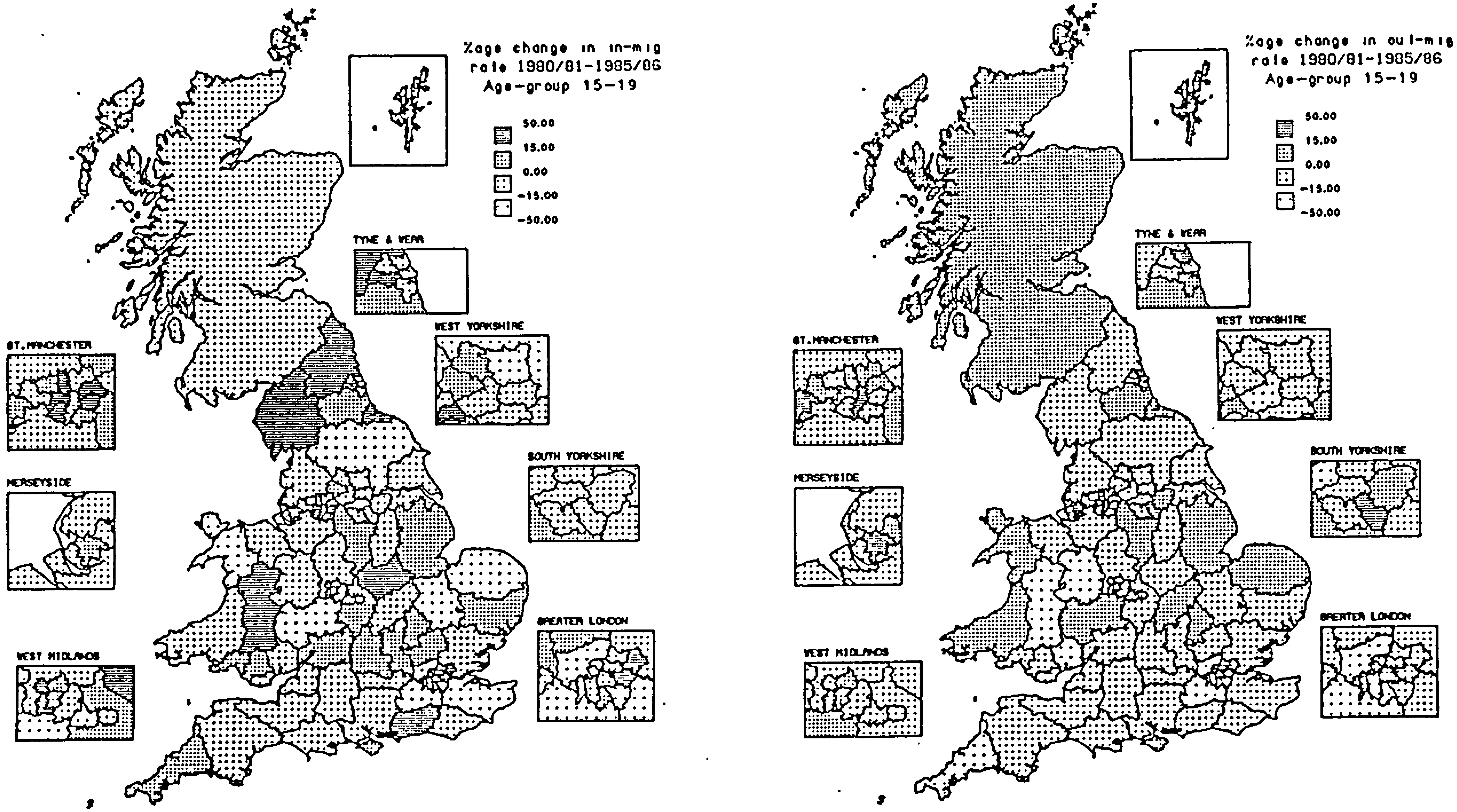
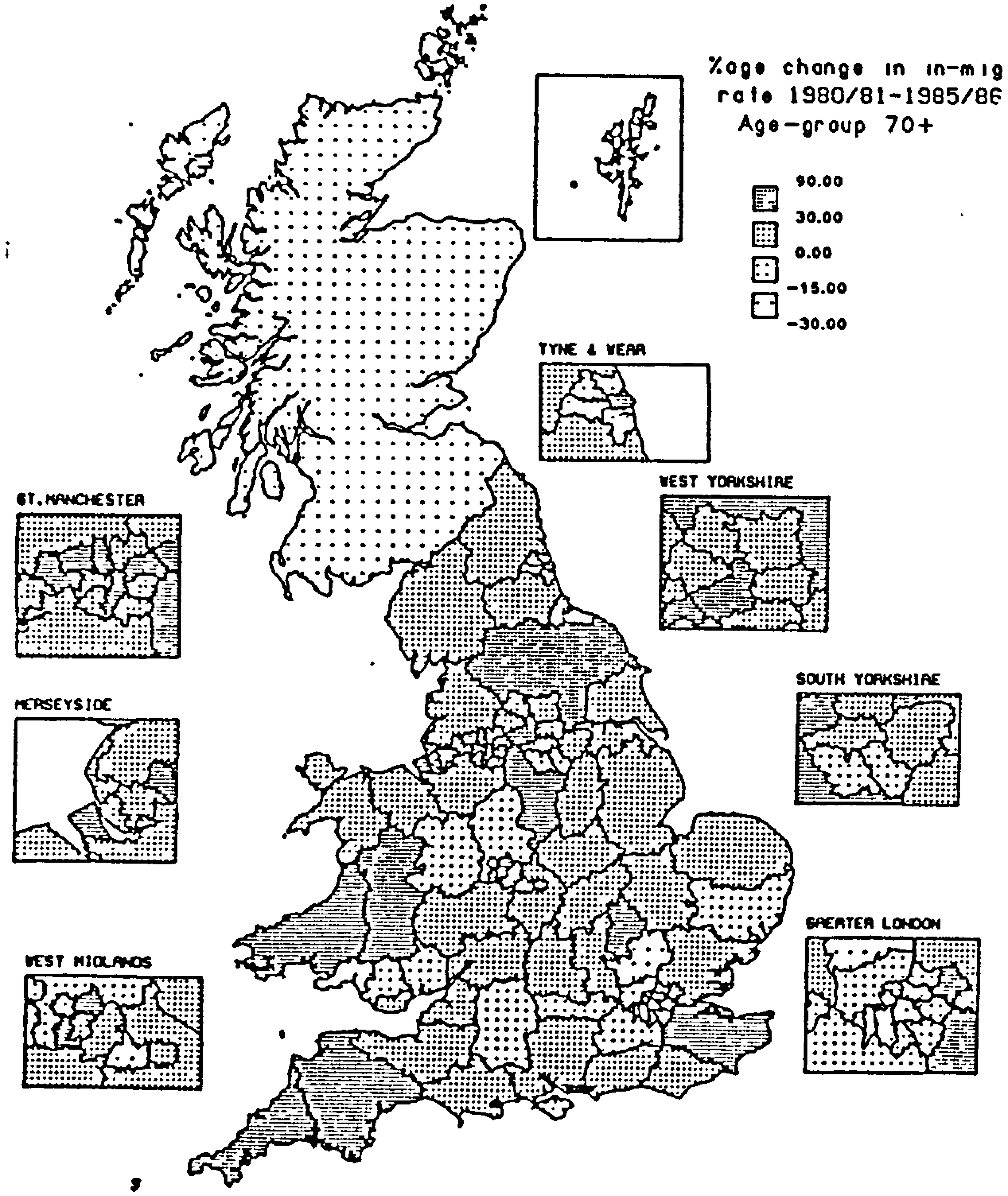


Figure 8.19 Percentage change in the in- and out-migration rate of the 15-19 age-group, 1980/81 to 1985/86

Camden/Islington, Kensington/Chelsea/Westminster, Richmond/Kingston and Middlesex. Other FPCAs of the capital, namely Croydon and the two East London FPCAs of Barking/Havering and Bexley/Greenwich, increased their rate of in-migration. Outside the capital substantial decreases were experienced by Surrey and Kent and the East Anglian FPCAs of Norfolk and Cambridgeshire.

The majority of out-migration rates in the 15-19 age-group (Figure 8.19b) decreased over the 1980/81 to 1985/86 period. The largest rate increases were observed in a number of metropolitan FPCAs, particularly in the North West. The most significant decreases were evident for non-metropolitan FPCAs of the South East and South West and other less urbanised areas such as Powys and Salop. Of the Greater London FPCAs only Merton/Sutton/Wandsworth, Croydon and Middlesex showed substantial reductions. The reduction in the level of migration by those aged 15-19 is reflected in sharp reductions in in-migration to certain areas of Greater London and equally large percentage reductions in the rate of out-movement from the lower density FPCAs of the non-metropolitan South East and South West. The post-retirement age-group has undergone equally significant changes in its pattern of migration between 1980/81 and 1985/86. The highest in-movement rates were observed in both years in FPCAs of the South East, South West and East Anglia with the outflow rates being greatest from the high-density FPCAs of Greater London. Figure 8.20 gives an illustration of percentage change in migration rates at the FPCA level for those aged 70 and over. The observed rates are relatively small in comparison with other age-groups so the percentage change is more marked. The majority of in-migration rates for the 70+ age-group (Figure 8.20a) increased over the period.



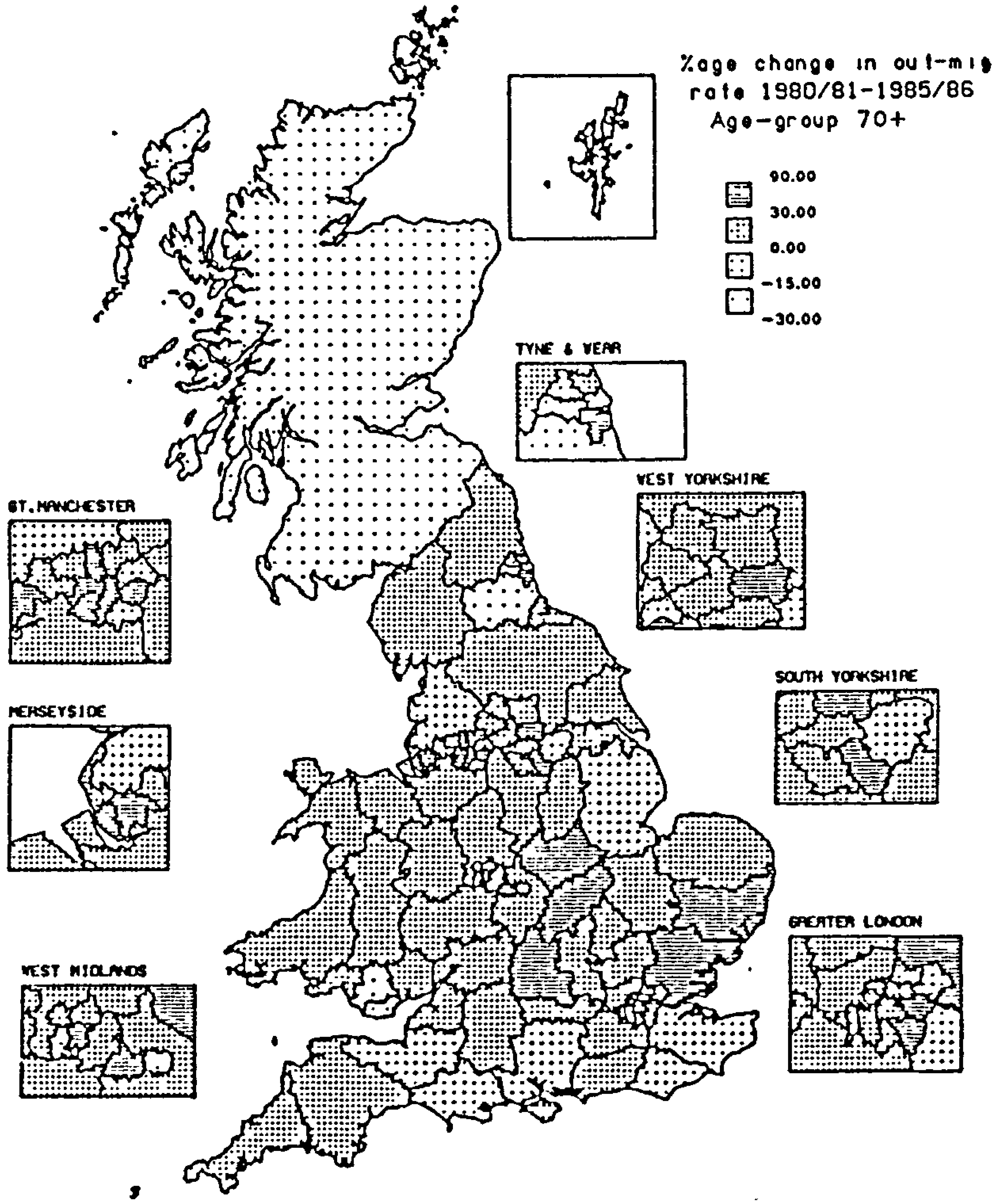


Figure 8.20 Percentage change in the in and out-migration rate of the 70+ age-group, 1980/81 to 1985/86

Those FPCAs with a declining rate were found in Scotland, a number of metropolitan areas of the North and in the Greater London areas (especially Richmond/Kingston, Merton/Sutton/Wandsworth, Lambeth/ Southwark/Lewisham and City/Hackney/Newham/Tower Hamlets). A number of metropolitan FPCAs of Greater Manchester, Merseyside and the West Midlands showed a significantly increasing in-migration rate over the period but with the more important increases evident for non-metropolitan counties such as Devon, Cornwall, Bedfordshire, Kent, Dyfed and Powys. Figure 8.20b illustrates increases occurring in the rate of out-migration of those of post-retirement age from the majority of metropolitan FPCAs and London Boroughs. The most significant decreases in out-migration rate were observed in the more rural areas of Hampshire, East Sussex, Kent, Lincolnshire, Lancashire, Durham and Scotland and the two welsh FPCAs of Mid- and South Glamorgan.

Some instability of the distribution patterns of the 15-19 and 70+ age-groups is therefore evident and the goodness of fit statistics of Table 8.12 have indicated that it is these two age-groups relative to others which have undergone the most important changes in their patterns of migration since 1980/81. It is, however, important to acknowledge that throughout the five-year period, movement by the 20-24 age-group comprised almost 20% of total inter-FPCA migration. Figure 8.21 illustrates net rates of migration for persons aged 20-24 in 1980/81 and 1985/86. Previous sections have already indicated that movement to high density areas of the South by such persons has increased considerably between 1975/76 and 1985/86. In 1980/81 the major cities outside London all experienced large negative rates of net migration in the 20-24 age-group as did

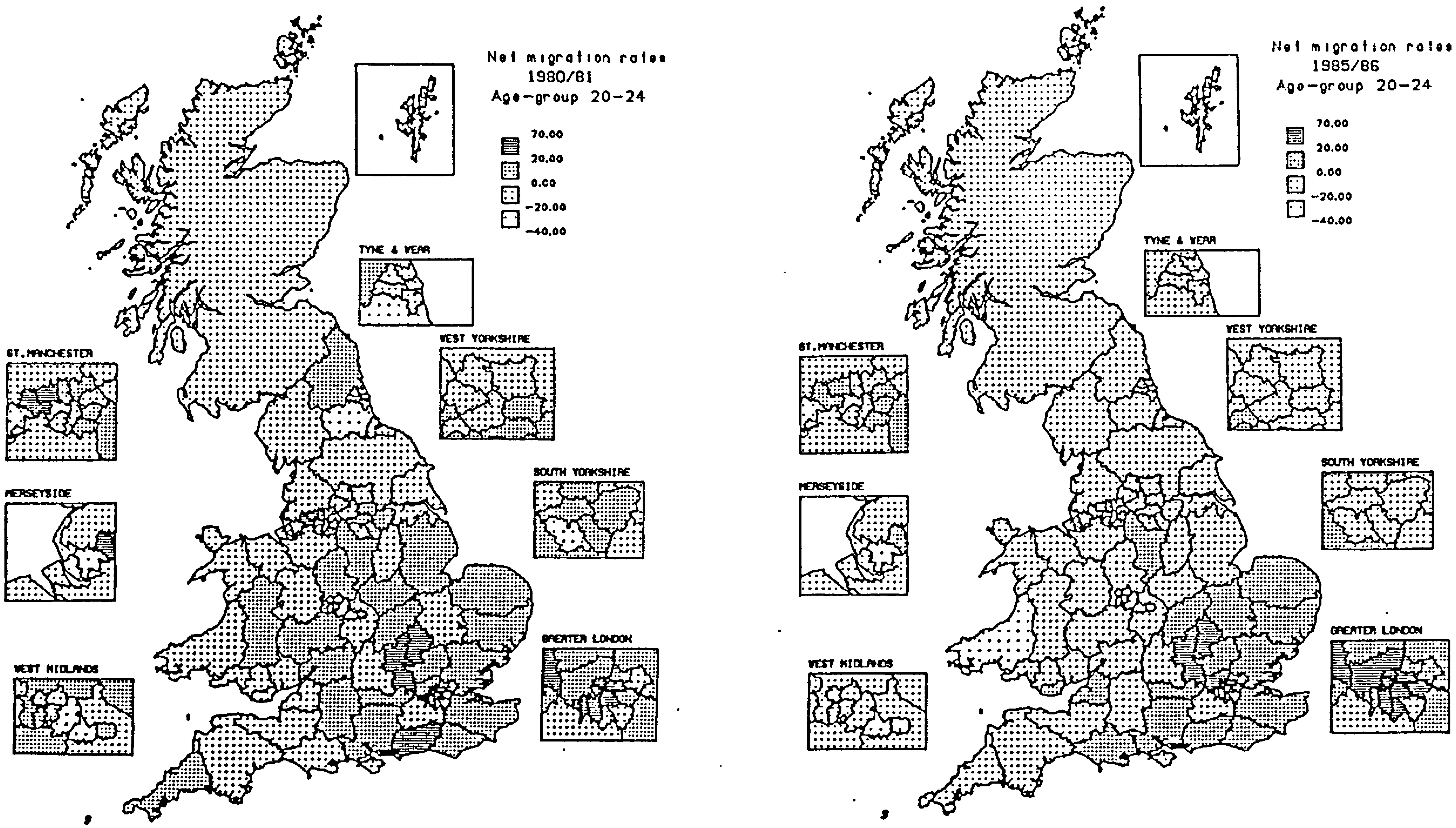


Figure 8.21 Net migration rates for the 20-24 age-group, 1980/81 and 1985/86

other metropolitan areas of the North although at a slightly lower level. Of the London FPCAs, Bromley and Barking/Havering alone had negative rates in 1980/81. Non-metropolitan FPCAs losing in net migration terms in the 20-24 age-group were Cambridgeshire, Humberside, Oxfordshire, Surrey, Devon and a number of the Welsh FPCAs. The largest positive net rates in 1980/81 were found in Greater London particularly Kensington/Chelsea/Westminster, Camden/ Islington, City/Hackney/Newham/Tower Hamlets and Lambeth/Southwark/ Lewisham and in the counties of Bedforshire and Buckinghamshire.

In 1985/86 the North-South split becomes more apparent (Figure 8.21b). Almost all FPCAs of the North had a negative rate of net migration in this year for persons aged 20-24. Only a number of areas in Greater Manchester, Dudley and South Glamorgan provide exceptions. As in 1980/81 the majority of counties in the South West experienced negative rates but the pattern elsewhere in the South was of positive net-migration rates in this age-group. The largest were apparent in Greater London and counties of the South East with substantial gains in much of the South East and East Anglia. These results indicate an intensification of net gains in the South East, partcularly Greater London, for the 20-24 age-group. The general flow of movement for this most mobile age-group has become increasingly directed towards high and medium-low density areas of the South at the expense of the remainder of the UK. The following section attempts a further elucidation of differences between age-group movement over the 1980/81 to 1985/86 period by examining the changing effect of distance upon migration with the aid of a doubly-constrained spatial-interaction model.

8.6.3 The changing effect of distance upon migration

This section uses a doubly constrained spatial interaction model to examine the relationship between distance and migration in 1980/81 and 1985/86 for individual age-groups. Generalised and zone-specific beta parameters and mean migration lengths (MMLs) are computed to illustrate the spatial variation in the effect of distance upon movement. The beta parameter in this case can be interpreted as a measure of the general propensity to migrate over distance with higher parameter values indicating distance to have a more pronounced effect on migration. Zone-specific parameters and MMLs are aggregated to produce a comparison of variation between the density categories of the North and South.

In 1980/81 those of retirement age were most affected by distance (Table 8.13) with the 20-24 year-olds showing the greatest propensity to migrate over longer distances. In 1985/86, a decrease in the mean length of migration is observed for the post-retirement age-group with the 15-19 and 20-24 year-olds being the only two groups to increase their average migration length over the period. The calibration of zone-specific doubly constrained models using IMP (Stillwell, 1984) produces MMLs and beta values for individual origin and destination FPCAs. Grouping these FPCAs into population density categories gives an indication of the effect of degree of urbanisation upon average MMLs and beta parameters for individual age-groups.

Table 8.14 illustrates origin-specific average MMLs and average beta values for FPCA density categories of the North. The major features are the increases in MML for the 20-24 year-olds particularly in high density areas (103 to 118km) with

Table 8.13 Generalised beta parameters and mean migration lengths for inter-FPCA movement, 1980/81 and 1985/86

Age-group	Mean mig length (km) 80/81	85/86	Average beta value 80/81	85/86
0-14	132	129	1.316	1.312
15-19	137	138	1.096	1.089
20-24	133	137	1.044	0.994
25-54	125	122	1.219	1.246
55-69	127	126	1.370	1.412
70+	129	119	1.274	1.439
All ages	130	128	1.196	1.204

Table 8.14 Origin-specific mean migration lengths and average beta values for density categories of the North

Age-group	Mean mig length (km) 80/81	Mean mig length (km) 85/86	Average beta value 80/81	Average beta value 85/86
(a) North high density				
0-14	90	87	1.44	1.45
15-19	108	109	1.19	1.16
20-24	103	118	1.22	1.13
25-54	94	94	1.37	1.40
55-69	97	86	1.47	1.56
70+	85	82	1.47	1.55
All ages	97	98	1.33	1.34
(b) North medium-high				
0-14	100	102	1.42	1.38
15-19	121	117	1.08	1.11
20-24	117	124	1.16	1.11
25-54	103	106	1.36	1.35
55-69	101	99	1.51	1.51
70+	112	92	1.36	1.54
All ages	107	109	1.30	1.30
(c) North medium-low				
0-14	155	150	1.63	1.68
15-19	149	155	1.58	1.48
20-24	166	170	1.39	1.35
25-54	159	156	1.54	1.61
55-69	154	146	1.70	1.79
70+	150	137	1.71	1.91
All ages	157	156	1.55	1.58
(d) North low density				
0-14	166	162	1.27	1.37
15-19	165	165	1.23	1.20
20-24	169	177	1.22	1.10
25-54	168	166	1.27	1.34
55-69	165	161	1.47	1.49
70+	159	158	1.44	1.50
All ages	167	167	1.27	1.30

Table 8.15 Origin-specific mean migration lengths and average beta values for density categories of the South

Age-group	Mean migration length 80/81	Mean migration length 85/86	Average beta value 80/81	Average beta value 85/86
(a) South high density				
0-14	70	70	1.29	1.30
15-19	86	85	0.90	0.95
20-24	72	72	0.90	0.86
25-54	66	64	1.16	1.19
55-69	87	85	1.33	1.43
70+	72	76	1.28	1.40
All ages	71	70	1.11	1.13
(b) South medium-High				
0-14	115	116	1.22	1.21
15-19	124	127	1.03	0.98
20-24	112	113	1.05	0.97
25-54	109	110	1.21	1.17
55-69	125	118	1.20	1.33
70+	113	106	1.27	1.39
All ages	114	114	1.15	1.12
(c) South medium-high				
0-14	131	128	1.22	1.22
15-19	126	130	1.11	1.05
20-24	120	121	1.07	1.00
25-54	126	122	1.16	1.18
55-69	131	137	1.35	1.30
70+	133	124	1.11	1.34
All ages	126	125	1.15	1.14
(d) South low density				
0-14	163	160	1.42	1.43
15-19	161	161	1.36	1.34
20-24	166	163	1.24	1.26
25-54	166	158	1.32	1.42
55-69	162	162	1.42	1.41
70+	161	157	1.44	1.47
All ages	164	160	1.33	1.37

correspondingly low beta values indicating a relatively low frictional effect of distance. A major decrease in MML was evident for those of retirement age leaving high density FPCAs with increases in beta value for both the 55-69 and 70+ age-groups. Out-migration by those of post-retirement age appears to be increasingly affected by distance with a considerable reduction in MML from medium-high density metropolitan areas and medium-low density FPCAs of the North. The lowest beta values in Table 8.14 were evident for 15-19 year-olds leaving medium-high density areas reflecting the importance of student flows which are mainly inter-regional longer-distance migrations. Those persons most affected by distance were those of retirement and post-retirement age leaving the medium-low density areas of the North.

Corresponding origin-specific values for the South are illustrated in Table 8.15. Fairly stable patterns of mobility for flows originating in high density FPCAs of Greater London are evident with relatively low MMLs and beta parameters changing little over time although the friction of distance effect upon retirement and post-retirement out-migration did increase during the five-year period. Beta values were particularly low for out-flows involving 20-24 year-olds. For the medium-low density FPCAs of the South East and the East Midlands, the major change in the effect of distance over time upon out-migration was evident for the 70+ age-group with a reduction in the MML (133 to 124km) and a considerable increase in the beta parameter (1.11 to 1.34).

Destination-specific MMLs and friction of distance parameters reveal further differences between the age-groups in their migration behaviour. Table 8.16 indicates that the pattern of movement for high density areas of the North in terms of average distance travelled remained fairly stable over time with the exception of migrations made by the 70+ age-group. The destination-specific MML for persons of post-retirement age decreased by almost 30km over the five-year period with a consequent increase in the beta parameter reflecting the frictional effect of distance. The medium-low density FPCAs of the North showed a similar trend for those aged 70 and over as did the other density categories although at a reduced level. For the younger age-groups the major feature of Table 8.16 is the reduction in the effect of distance upon 20-24 year-old migrants moving into the medium-high density FPCAs of the metropolitan areas of the North. The destination-specific MML for this category increased quite substantially over the period (95 to 103km). In the South, destination-specific MMLs for 15-19 and 20-24 year-olds moving to Greater London were considerably higher than the corresponding origin-specific values and with slightly lower beta values (Table 8.17). This again indicates the importance of in-migration to high-density London FPCAs by those of their late teens and early twenties. Friction of distance parameters were generally lower for moves to the high density areas of the South emphasising the dominance of Greater London and the South East in the migration system of the UK. The medium-low density areas also exhibited relatively low beta values which were fairly stable over time with the exception of the 70+ age-group which again, in each density category, suffered a reduction in its MML between 1980/81 and 1985/86, and a substantial increase in the respective beta values.

Table 8.16 Destination-specific mean migration lengths and average beta values for density categories of the North

Age-group	Mean migration length 80/81	Mean migration length 85/86	Average beta value 80/81	Average beta value 85/86
(a) North high density				
0-14	83	78	1.42	1.46
15-19	106	104	1.19	1.18
20-24	100	103	1.18	1.13
25-54	86	81	1.32	1.40
55-69	84	80	1.45	1.49
70+	105	78	1.27	1.51
All ages	93	89	1.29	1.33
(b) North medium-high				
0-14	92	92	1.41	1.41
15-19	92	96	1.36	1.31
20-24	95	103	1.25	1.17
25-54	92	90	1.35	1.39
55-69	92	85	1.49	1.54
70+	89	83	1.52	1.57
All ages	93	93	1.35	1.35
(c) North medium-low				
0-14	141	146	1.79	1.70
15-19	145	150	1.58	1.51
20-24	145	154	1.53	1.41
25-54	143	143	1.68	1.69
55-69	148	144	1.77	1.85
70+	151	136	1.68	1.91
All ages	144	146	1.66	1.64
(d) North low density				
0-14	156	156	1.36	1.38
15-19	149	151	1.44	1.37
20-24	153	155	1.25	1.22
25-54	152	156	1.37	1.32
55-69	154	158	1.48	1.45
70+	161	154	1.40	1.52
All ages	154	156	1.35	1.32

Table 8.17 Destination-specific mean migration lengths and average beta values for density categoies of the South

Age-group	Mean migration length 80/81	Mean migration length 85/86	Average beta value 80/81	Average beta value 85/86
(a) South high density				
0-14	74	73	1.13	1.11
15-19	103	109	0.92	0.87
20-24	100	106	0.89	0.85
25-54	73	74	1.05	1.04
55-69	55	61	1.10	0.98
70+	72	58	1.03	1.13
All ages	82	84	1.00	0.97
(b) South medium high				
0-14	114	107	1.21	1.27
15-19	114	119	1.15	1.10
20-24	126	130	1.09	1.01
25-54	115	109	1.14	1.22
55-69	119	100	1.01	1.25
70+	107	98	1.21	1.32
All ages	116	112	1.14	1.18
(c) South medium low				
0-14	124	121	1.28	1.28
15-19	131	131	1.13	1.14
20-24	131	134	1.15	1.10
25-54	122	118	1.23	1.28
55-69	108	103	1.26	1.32
70+	118	109	1.22	1.34
All ages	123	120	1.22	1.25
(d) South low density				
0-14	167	166	1.47	1.45
15-19	164	166	1.37	1.38
20-24	173	170	1.30	1.31
25-54	169	166	1.41	1.45
55-69	164	161	1.43	1.46
70+	172	161	1.30	1.47
All ages	169	166	1.39	1.41

8.7 SUMMARY AND CONCLUSIONS

The broad age-groups used in the OPCS/DOE forecasting model are deemed to encapsulate the three major components of age-specific migration - family moves, moves at the time of entry to the labour force and retirement moves, with each assumed to have distinct patterns of migration that are common to all the single-years of age included in the group. In this chapter clustering methods have been used to derive an age classification alternative to that used by OPCS/DOE. The results indicate firstly that it is incorrect to group moves by 25-29 year-olds with those by persons aged 15-24. The patterns of inter-zonal migration evident for persons in their late twenties are of a greater similarity to those of the 'family-moves' category than to the young mobile age-groups. The 17-24 age-group, as used in the projection procedure, clearly has a distinct pattern of movement which is not evident for persons aged 25-29, who will have reduced levels of migration relative to the younger more mobile age-groups, and patterns of movement that reflect the general trends of family migration. Secondly, it was evident from the clustering analysis that the pattern of movement by those aged 55-59 reflected more the migration of those of retirement age than that of the family age-groups. Pre-retirement or early retirement moves are therefore an important phenomenon with migrants aged 55-59 selecting similar destinations to those of the older age-groups. It is concluded that it would be more appropriate to include the assignment of moves made by persons aged 55-59 with the 60+ category given the similarity of inter-FPCA migration patterns.

The assignment process in the projection model assumes that patterns of inter-zonal migration remain constant over time. However, in this chapter Census-period NHSCR data has been compared with 1985/86 data to assess the stability of migration patterns by broad age-group since 1980/81. The 15-19 and 70+ age-groups were seen to have particularly unstable patterns of movement. The rate of movement of 15-19 year-olds showed a general decline between 1980/81 and 1985/86 particularly for moves into high density areas of Greater London and into and out of the medium-low density areas of the South East. The 70+ age-group, however, showed evidence of generally increased rates of movement particularly out of Greater London and between counties of the South East and more remote areas of the South West and East Anglia. Post-retirement migration into the capital was greatly reduced over the five-year period. Retirement and family moves maintained similar patterns with a general net movement away from high density areas to more rural FPCAs, whereas persons aged 20-24 continued to migrate in large numbers to the capital with a consequent net loss in this age-group to the majority of FPCAs outside the South East.

It is unwise, therefore, to assume that the pattern of inter-zonal movement of persons within the UK remains constant with important changes taking place in particular in the distribution of young school leavers and those of post-retirement age, and an intensification of movement of the most mobile age-group towards the South East. The problem encountered by OPCS/DOE is to decide how changes in the pattern of inter-zonal migration may be incorporated into the forecasting procedure. How can trends evident in NHSCR movement data be allied to Census transition information? The problem is, therefore, one of providing a method for updating census data using the NHSCR, which has in Chapters 4 and 5 been shown to be particularly difficult due mainly to the problem of estimating the effect of multiple and return movement.

This chapter has also provided an indication of the major characteristics of age-specific NHSCR movement between 1975/76 and 1985/86. Throughout the eleven-year period Greater London and the non-metropolitan counties of the South East maintained their status as the major attractors and generators of migration with the South as a whole, gaining through migration from the North. Important differences between areas of higher and lower population density were observed with significant fluctuations in the directional flow of age-group movement throughout the period. Some of the most significant changes in the pattern of migration have occurred in the 20-24 age-group. The negative net rate of movement in the 20-24 age-range for metropolitan FPCAs in 1975/76 had, by 1985/86, become strongly positive with the reverse being true for non-metropolitan areas. The increase was particularly significant for females. The large net gains in this age-group appear to have been concentrated in the South East and Greater London in particular at the expense of FPCAs elsewhere in the UK. Movement of this most mobile section of the population has been especially significant from all areas of the North particularly high and medium-high density metropolitan FPCAs. The City continues to attract young adults seeking high-salaried employment unavailable elsewhere in the UK. With the demise of Britain's manufacturing base in the North the South East is becoming more and more attractive with its expanding service-sector economy. The distribution of suitable employment opportunities for graduates in particular will ensure that the attraction of the City remains great to the more mobile sections of the population. The only brake to the disproportionate movement of young adults to Greater London could be provided by the escalating property prices and relatively high cost of living in the capital although it appears that the rest of the South East is proving to be equally attractive with the expansion of the service sector into the FPCAs surrounding Greater London.

The 15-19 age-group has undergone equally significant changes in its pattern of migration over the 1980/81 to 1985/86 period. In the North, the rate of net gain in high density areas was considerable with corresponding net losses from other less urbanised areas. This trend has been accentuated in recent years. There has been a net loss of 15-19 year-olds throughout the period from North to South, with the peak in the net gain to Greater London in 1982/83. The rate of inter-FPCA movement of the 15-19 age-group has showed a general decline in recent years particularly for moves into high density areas of Greater London and into and out of medium-low density FPCAs of the South East. Throughout the period the positive net rate of migration for high density FPCAs in the South has been substantially higher for females than males.

The early 1980s saw Britain at the lowest point of its economic slump. At the same time the size of the 15-19 age-group was at its greatest for some considerable time owing to the progression of the 'baby boom' birth cohort from the mid 1960s, through the age structure of the population. Job opportunities for the young were generally depressed and the disproportionate size of the cohort of persons seeking first time employment accentuated the problem. Lack of employment in a particular area of usual residence will have created a climate encouraging out-migration particularly for the young mobile age-groups explaining, to some extent, the large net migration gains experienced in the 15-19 age-group in Greater London and the remainder of the South East during the early 1980s. The movement of students to places of education will have remained an important phenomenon throughout the period so their generally longer-distance moves coupled with the increased mobility of the young school leavers at the time of the recession will have increased net migration gains in metropolitan areas. The fact that net gains to Greater London were so much larger reflects the disproportionate effect of the economic conditions upon the North and the importance of the service sector in the South. Female participation in the labour force has increased considerably during the last two decades in line with the expansion of the service economy. The larger net migration gains of females aged 15-19 in the South East reflect their importance as full and part-time employees to the industry.

In recent years, as the size of the 15-19 cohort has decreased, the rate of movement of this age-group to and within Greater London and the rest of the South East has declined with important increases in the rate of movement to metropolitan areas of the North. It may be hypothesized that with fewer school leavers entering the labour force the problem of supplying sufficient employment opportunities has been lessened. In fact the low birth rates of the late 1960s and early 1970s may lead to a surplus of jobs in certain sectors. School leavers provide an important input to low paid and part-time employment, for example, as well as to crucial public service occupations such as nursing. Any significant reduction in their numbers could create shortfalls in such employment, unable to be filled by other age-groups. In the late 1980s the pattern of movement of the 15-19 year-old age-group is, therefore, likely to be one of sustained inter-regional movement by students but a reduced rate of longer-distance employment-related migration due to the improved ratio of job opportunities to population size.

The general movement towards higher density areas by the 15-19 and 20-24 age-groups has been in sharp contrast to the spatio-temporal patterns of migration evident for the remaining age-groups. Between 1975/76 and 1985/86, the family age-groups (0-14 and 25-54) maintained fairly stable rates of movement with net migration losses from higher density FPCAs and gains to the less urbanised areas of the UK. Important increases in recent years have been evident in the rate of family in-migration to low-density areas from all higher density categories. Similarly the retirement and post-retirement age-groups have become increasingly attracted away from high density areas of Greater London and other metropolitan areas. Net migration gains have been made in the less dense areas of the North but the favoured destinations for migrants aged 55 and over appear to have been medium-low and low density FPCAs of the South East, parts of the East Midlands, East Anglia and the South West. In recent years the rate of in-migration of the older age-groups to high density areas particularly Greater London has declined sharply with a similar increase in the rate of out-migration. The South East appears to be the preferred destination of retirement migrants from Greater London whereas increasingly important movement is directed at the lowest density FPCAs of the South West and East Anglia from the counties surrounding the capital. The less urbanised areas, therefore, continue to be an attraction to the family and older age-groups with the net loss from Greater London being maintained over the period. The size of the public transport network in the South East ensures that place of residence is becoming increasingly distanced from place of work encouraging out-migration from the areas of highest population density.

Chapter 9. THE ANALYSIS OF CHANGE IN AGE-SPECIFIC MIGRATION USING NHSCR DATA, 1980/81 AND 1985/86

9.1 INTRODUCTION

This chapter completes the analysis of NHSCR migration data with an examination of the variation in the pattern of migration by single year of age between the year prior to the last Census (1980/81) and 1985/86, the most recent year for which NHSCR data is available. Age-migration profiles are examined at a number of spatial scales with attention being focussed on the investigation of patterns evident at the FPCA level. The last census provided a detailed breakdown of the pattern of migration by single year of age and sex. There has, however, been no analysis of change in age-specific rates since 1980/81 using available NHSCR data. Previous chapters have indicated a general increase in the level of migration over the period 1980/81 to 1985/86. This chapter assesses the variations in zone-specific in- and out-migration profiles which have resulted in this increase.

The OPCS/DOE population projection model (Section 2.4) currently utilises age-specific profiles derived from the 1981 Census within its migration forecasting component (Bates and Bracken, 1987). Local Authority (LA) profiles are grouped on the basis of the similarity between zone-specific parameter sets describing the shape of the migration schedule. The parameters are derived through the fitting of model migration schedules to observed migration rate data after Rogers et al (1978) (see Section 2.3). Classifications have been developed for both in and out-migration profiles. The use of profile clusters greatly reduces the on-line storage requirements of the model by assigning similar standardized age-specific rates of in- and out-migration to all zones within a particular cluster. The most recent sub-national population projections have been undertaken using these 1981 Census-based groupings. No account is taken of any changes in the pattern of age-specific migration that may have occurred since 1980/81. Using NHSCR data for the two twelve month periods 1980/81 and 1985/86 a detailed examination may be made of the variation in the zone-specific profiles of in- and out-migration. Changes in the level of migration can be illustrated using the GMR whereas changes in the shape of specific migration schedules can be examined through the calibration of profile parameters using the MODEL package (Rogers and Planck, 1984).

An alternative method of FPCA classification based on schedule similarities has also been developed. The 1980/81 categories suggested by Bates and Bracken (1987) are derived from Census data and so are not directly comparable with any NHSCR-derived groupings. However, the use of NHSCR data enables the spatial similarities between profiles in 1985/86 to be examined. It is important to recognise the main characteristics of profile categories, such as the presence of an early peak in labour-force migration or a prominent retirement component so as to understand the processes currently shaping the pattern of internal migration in the UK.

The chapter is structured as follows. Section 9.2 outlines the nature of the migration and population data utilised and introduces the MODEL package. Section 9.3 provides the analyses of change in the pattern of age-specific migration between 1980/81 and 1985/86 at a number of spatial scales from the national down to the FPCA level. GMRs are used to examine variations in the level of migration since 1980/81 across the spatial spectrum and a full illustration is given of the observed migration schedules evident for individual FPCAs in both 1980/81 and 1985/86. The MODEL package is used in Section 9.4 to calibrate in- and out-migration schedule parameters for individual FPCAs to allow a more quantifiable assessment of change between 1980/81 and 1985/86. The more significant characteristics of age-specific migration are highlighted. Section 9.5 attempts to derive a classification of FPCAs based on similarities between observed age-specific migration rates. A clustering routine is used to derive FPCA groupings and the MODEL package is again used to provide descriptive parameters characterising the respective profile groupings. The concluding section reviews the evidence of change between 1980/81 and 1985/86 in the pattern of age-specific migration and assesses its possible effect upon the accuracy of the migration forecasting procedure within the OPCS/DOE population projection model.

9.2 DATA AND SOFTWARE DESCRIPTION

9.2.1 Migration data

The analyses undertaken in this chapter are based upon the use of NHSCR information obtained from PUD supplied by OPCS. The procedure for accessing data from magnetic tapes is described in Chapter 3. The migration data file produced for use in subsequent sections of this chapter consist of gross in and out movement totals for individual FPCAs disaggregated by single year of age (from age 1 to age 79) for the twelve month period which corresponds closely with the Census year 1980/81 and for 1985/86. Beyond age 79 the relatively small number of migrations observed in each age-group gives rise to considerable fluctuation in the level and rate of migration. It was decided, therefore, to limit the analyses to an examination of the 1-79 age-range and to avoid the use of an open-ended final age category (80+). Both Northern Ireland and the Isle of Man are excluded from the analyses so the system of interest includes all metropolitan districts of England, non-metropolitan counties of England and Wales and Scotland as a distinct region (Figure 3.3). The full migration data file is referenced in Table 3.7 as C9MIG DATA.

9.2.2 Population data

Age-specific populations used for rate calculations have been obtained from mid-year population estimates (OPCS). The estimates are only available for individual FPCAs in five-year age-groups. Single-year of age figures have been produced by disaggregating five-year age-groups using the national population age breakdown as a guideline. The assumption has been made that the age composition of individual FPCAs will vary little from the national pattern within any one five-year age-group. Estimates were produced for the mid-years of 1980, 1981, 1985 and 1986. The denominator in the rate calculations for each one-year period was taken as the average of two mid-year estimates. The procedure for computing population estimates by single year of age can be formally stated as follows:

$$P_i^a = P_i^A * \sum_i P_i^a / \sum_i P_i^A \qquad (9.1)$$

where

A = Five-year age-group (1-4, 5-9,...);
a = Single year of age (1,2,3...);
i = FPCA;

P_i^a = Population of area i for single age a;

P_i^A = Population of area i for five-year age-group A;

$\sum_i P_i^a$ = Population of <u>all</u> FPCAs by single year a;

$\sum_i P_i^A$ = Population of <u>all</u> FPCAs by five-year age-group A;

The full population data file is referenced as C9POP DATA in Table 3.7.

9.2.3 <u>Model migration schedules and the MODEL package</u>

Studies in different countries have shown that the age distribution of migrants exhibits a characteristic shape which can be described by a mathematical function. The function, which has a number of separate elements, was described initially by Rogers, Raquillet and Castro (1978) and illustrated schematically by Rogers and Castro (1981). A general program for estimating parametrized model schedules of migration has been developed by Rogers and Planck (1983), a version of which has been operationalized on the CMS system at Leeds (Stillwell, Boden and Rees, 1987). Chapter 2 described in detail the components of the model migration schedule and illustrated its associated mathematical function. Those details are not repeated here. This section provides an outline of the MODEL package which is used in Sections 9.4 and 9.5 to derive summary statistics for the comparison of individual FPCA profiles and generated cluster schedules.

Gross rates of age-specific migration out of and in to individual zones are usually calculated using the appropriate population-at-risk denominator (Section 9.2.2). The problem that arises when comparing observed sets of age-specific migration rates for different zones is that whilst the shape of the observed profile might be similar, variation may occur in the volume or level of migration taking place. It is therefore necessary to standardize the observed rates to facilitate comparison. The process of standardization is achieved by calculating the zonal gross migra-production rate (GMR) as the sum of the observed age-specific rates:

$$GMR_{i} = \sum_{a=1}^{n} om_{i}^{a} \qquad (9.2)$$

and then expressing each age-specific rate as a proportion of the GMR to give a normalized migration rate:

$$nom_{i}^{a} = om_{i}^{a} / GMR_{i} \qquad (9.3)$$

such that

$$\sum_{a=1}^{n} nom_{i}^{a} = 1.0 \qquad (9.4)$$

Which means that the area under the 'nom' profile is unity. The GMR itself can be interpreted as a measure of the propensity to migrate throughout the age-range specified and Section 9.3 illustrates the range of GMR values evident in 1980/81 and 1985/86 within the FPCA in and out-migration system.

The MODEL package itself is a general program for estimating parametrized model schedules of fertility, mortality, migration and marital status and labour-force transitions. It was developed at the International Institute for Applied Systems Analysis (IIASA) in Austria over a number of years by Richard Raquillet, Luis Castro and Walter Kogler and formally documented by Andrei Rogers and Friedrich Planck (1984). The heart of the program is an iterative non-linear algorithm which is used to estimate the parameters of a series of mathematical functions to produce an optimal fit of model to data.

The migration routine allows the user to fit one of three alternative models - with a retirement peak, with a retirement slope or with neither. It is necessary, therefore, to establish the shape of the observed profile of a particular zone prior to calibration. The options available within the MODEL package are explained in Stillwell, Boden and Rees (1987) and in the IIASA manual (Rogers and Planck, 1983). In its most basic form the model requires the user to provide input data in the form of age-specific migration rates or migration flows and populations, to select the appropriate model schedule, set-up normalization of the data and control the flow of output from the fitting procedure. The output produced by the package includes a table of the estimated model schedule parameters and a goodness of fit statistic E, calculated as:

$$E = 100 \sum_a | \hat{m}(mod) - \hat{m}(obs) | / \sum_a \hat{m}(obs) \qquad (9.5)$$

where

$\hat{m}(mod)$ = predicted migration rate for age a; and

$\hat{m}(obs)$ = observed migration rate for age a.

When using standardized rates the value of the denominator in equation 9.5 will always be one. Therefore the E statistic is simply a summation of the absolute differences between modelled and observed age-specific rates expressed on the scale zero to 100. Low values of the statistic (eg <10) indicate a good fit; high values (eg >25) reflect a poor fit.

In Section 9.4 the MODEL package is used to generate parameter sets for individual FPCA in- and out-migration schedules in both 1980/81 and 1985/86 to evaluate important changes over time and in Section 9.5, provides a convenient means of summarising derived FPCA cluster profiles to enable the identification of the major characteristics of age-specific internal migration in the UK using the most recent NHSCR data.

9.3 CHANGES IN THE PATTERN OF AGE-SPECIFIC MIGRATION BETWEEN 1980/81 AND 1985/86

9.3.1 Introduction

Section 8.6 examined some of the changes taking place in the pattern of NHSCR migration between 1980/81 and 1985/86 by broad age-group. This section illustrates the variation by single years of age. Section 9.3.2 provides an introduction to the analyses with an illustration of age-specific schedules at the national level. It is important to recognise that NHSCR migration data is recorded as moves between FPCAs. The aggregation of age-specific schedules to other, coarser, sub-national levels allows, therefore, only an examination of net rather than gross in and out flows. Section 9.3.3 illustrates age-specific net migration profiles for a number of alternative aggregations. Sections 9.3.4 and 9.3.5 examine changes in the pattern of age-specific migration at the FPCA level illustrating zone-specific GMR values and observed profile schedules for rates of in and out-migration.

9.3.2 Observed national migration levels and rates by single year of age, 1980/81 and 1985/86

In 1980/81, a total of 1.65 million moves between FPCAs were recorded by the NHSCR for persons aged between 1 and 79. By 1985/86, this had risen to 1.74 million. The distribution of these moves by single year of age is illustrated in Figure 9.1a. The striking feature of both schedules is the shape of the labour-force curve since there

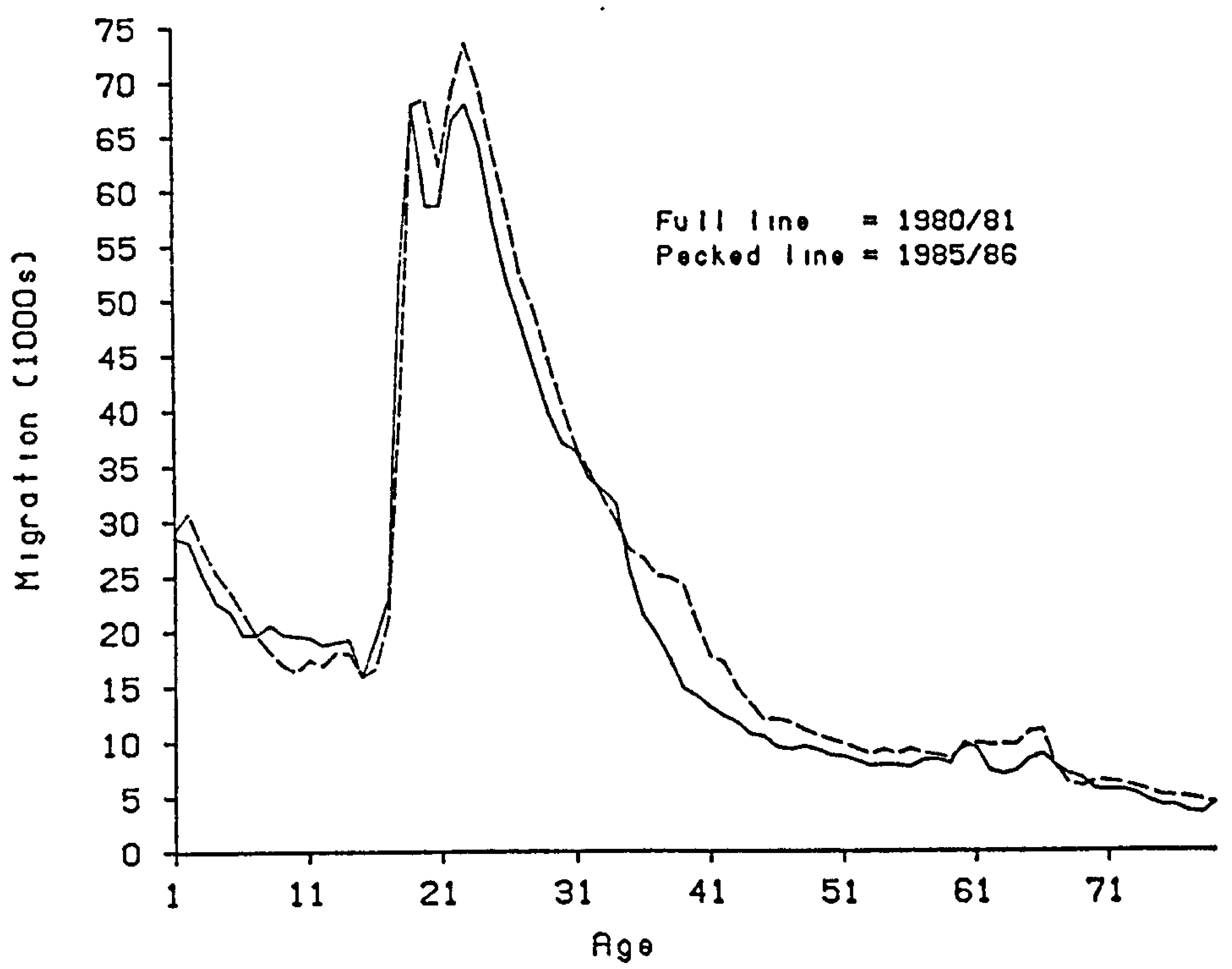


Figure 9.1a Observed age-specific migration 1980/81 and 1985/86

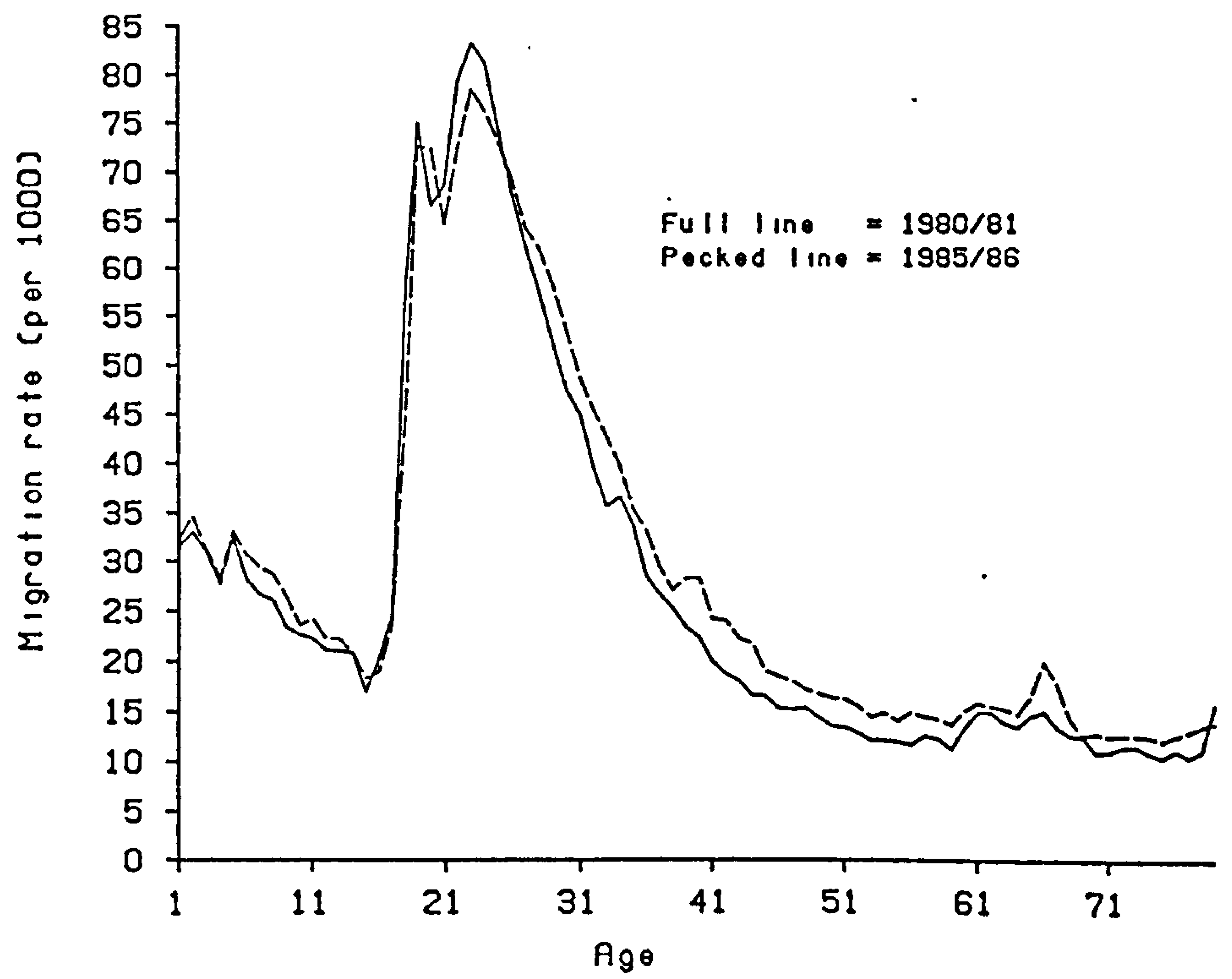


Figure 9.1b Observed age-specific migration rates 1980/81 and 1985/86

appears to be double peaking. Stillwell and Boden (1986) showed, using 1981 Census migration data, that the upward slope of the labour-force component, for males in particular, was kinked. The level of migration rose for teenagers aged 16 and 17, remained at about the same for those aged 18 to 20 and then rose again to a peak at age 22. It was argued that the causes of this kink related to the considerable inter-zonal migration undertaken by school leavers as they seek employment for the first time, and the substantial recruitment by the Armed Forces of persons in the 16-19 age-range.

The kink in the NHSCR schedule shown in Figure 9.1 is likely to occur for rather different reasons. NHSCR migration does not include Armed Forces moves but, unlike the Census, does record student transfers. For this reason the kink in the upward curve is accentuated in the late teens. This student factor and the effect of the time-lag involved in recording NHSCR moves produced, in 1980/81, a local peak in the level of movement at age 19 followed by a drop for ages 20 and 21 and a further peak at age 23, reflecting the movement of students away from higher education to first-time employment in their early twenties. In 1985/86 the relatively high level of movement experienced by 19-year olds was matched by those aged 20 with the significant drop occurring at age 21. The movement of students is not solely responsible for the high level of movement in the late teens and early twenties although such migration flows at certain ages do enhance peaks evident in Figure 9.1a. In terms of actual numbers the level of movement for this most mobile age-range was higher in 1985/86 than in 1980/81 reflecting the movement through the population profile of the disproportionately large birth cohort of the mid-sixties.

A truer picture of the relative levels of migration in 1980/81 and 1985/86 is given in Figure 9.1b which illustrates the respective age-specific migration rate schedules. The variation in the level of migration is indicated by a 6% rise in the GMR value over the period - from 2.10 in 1980/81 to 2.23 in 1985/86. The distinctive double-peaking of the labour-force curve is still apparent in both schedules although the 1980/81 rate of migration is generally higher in these most mobile ages. The remainder of the profile shows 1985/86 rates to be slightly higher than those observed in 1980/81. Retirement peaks were evident in both years between ages 60 and 66 with the 1985/86 schedule revealing considerable inter-FPCA migration activity at age 66.

9.3.3 Age-specific net migration rates, 1980/81 and 1985/86

Previous chapters have illustrated variations in the pattern of migration at several spatial scales. Figure 9.2 summarises the age-specific net-migration profiles at a number of these scales in both 1980/81 and 1985/86. The North-South split is dominated by the large net loss from the North of persons in the most mobile age-groups. A peak in the loss at age 23 emphasises the importance of the movement of graduates to employment in the South East and to Greater London in particular. The rate of net loss appears to have increased between 1980/81 and 1985/86 indicating the growing attraction of the 'South' to this younger section of the population.

The metropolitan/non-metropolitan dichotomy produces two interesting net migration schedules. Metropolitan FPCAs experienced positive net rates (in both 1980/81 and 1985/86) in only the 17-23 age-range with, as expected, the net gain being greatest for 19

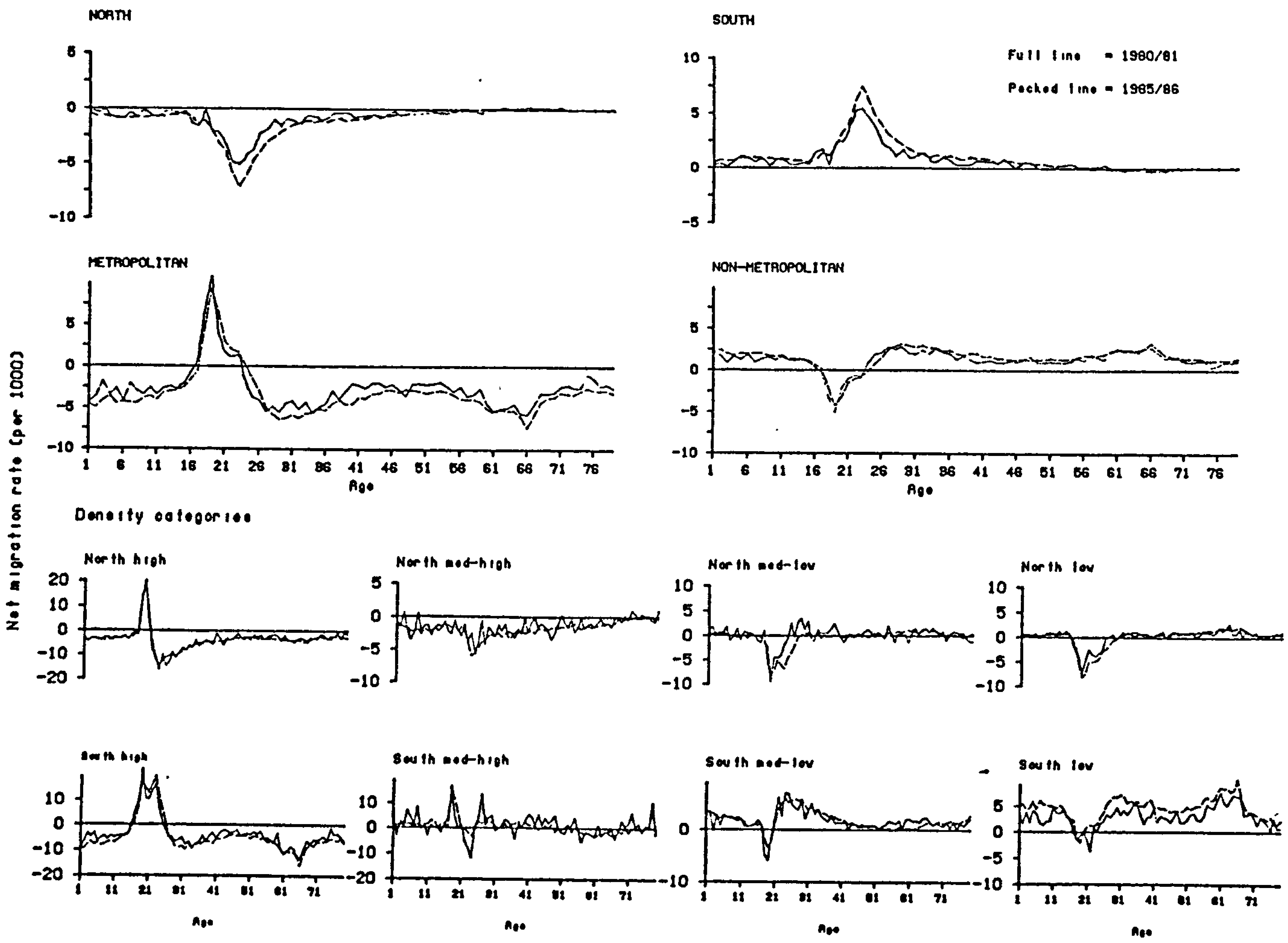
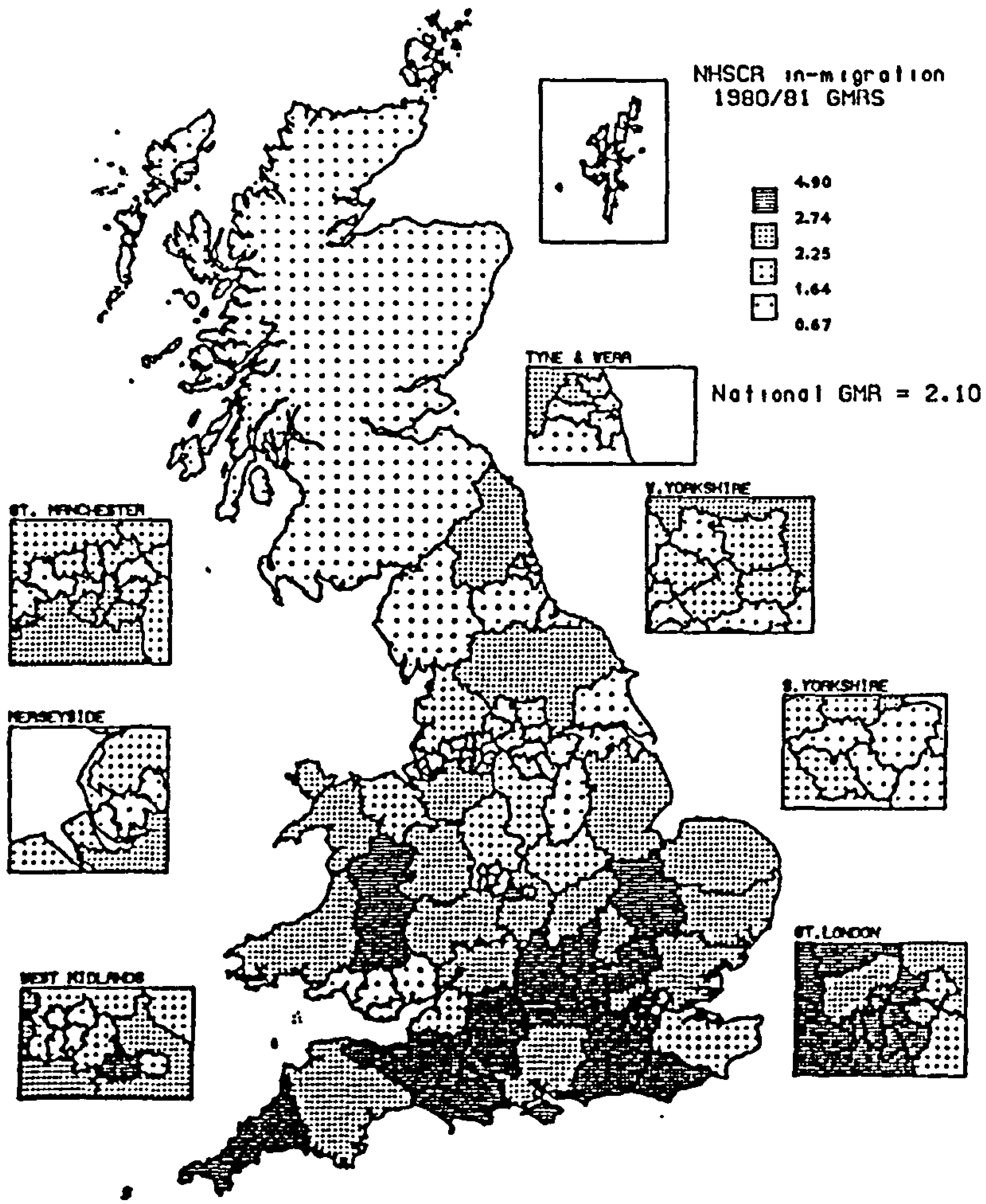


Figure 9.2 Summary of age-specific migration by broad North/South, metropolitan/non-metropolitan and population density divisions

year-olds reflecting the importance of the in-movement of students to places of higher education. Movement away from metropolitan areas at or around the retirement age was evident in both years. These patterns are mirrored in the non-metropolitan profile although at a slightly lower rate. The net migration schedules of FPCAs grouped into the eight population density categories show little variation between 1980/81 and 1985/86 although significant characteristics are maintained. In high density areas of the North the student in-movement factor produces a highly positive net migration rate at ages 18 and 19 but negative net rates for all other ages. FPCAs of Greater London show evidence of a similar peak which is coupled with a second at age 23. The low density FPCAs of the South continued to attract migrants particularly in the retirement age-range with the net gains in 1985/86 generally exceeding those of the Census year.

9.3.4 Gross migra-production rates by FPCA, 1980/81 and 1985/86

The NHSCR provides migration data in its most disaggregate form as moves to and from FPCAs in England and Wales. Since little variation between male and female classifications was evident in previous studies (Bates and Bracken, 1982; 1987: Bracken and Bates, 1983: Stillwell and Boden, 1986), analysis will therefore focus on the movement of persons within the migration system. The standardization of age-specific migration rates removes the effect of the level of migration and allows a direct comparison of all FPCA profiles in relative terms. Standardization is achieved by dividing individual age-specific rates by zonal GMR values. Figures 9.3 and 9.4 give an indication of the variation in the in- and out-migration GMR values for FPCAs in 1980/81 and 1985/86, and Figure 9.5 illustrates



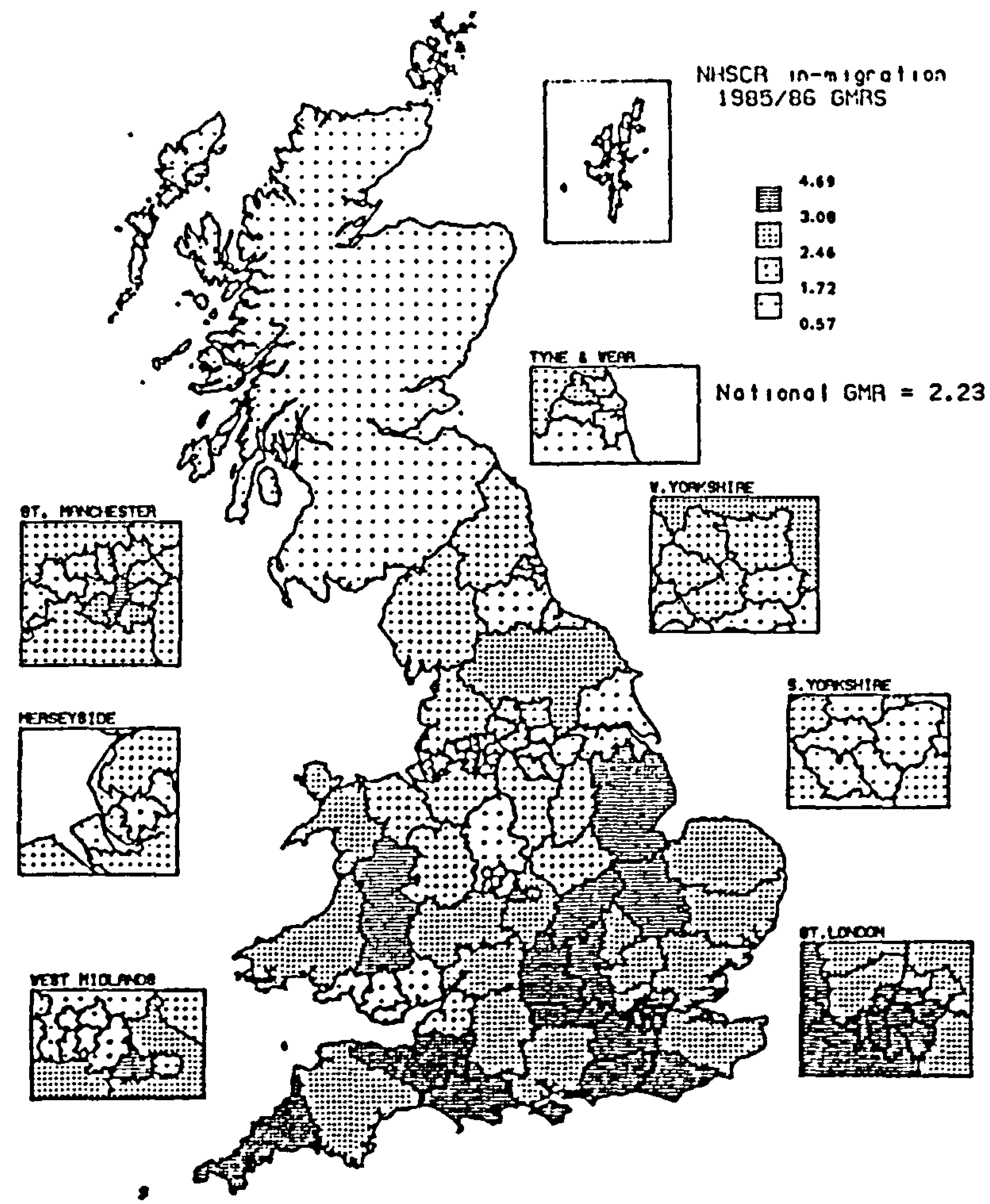


Figure 9.3 In-migration GMRs, 1980/81 and 1985/86

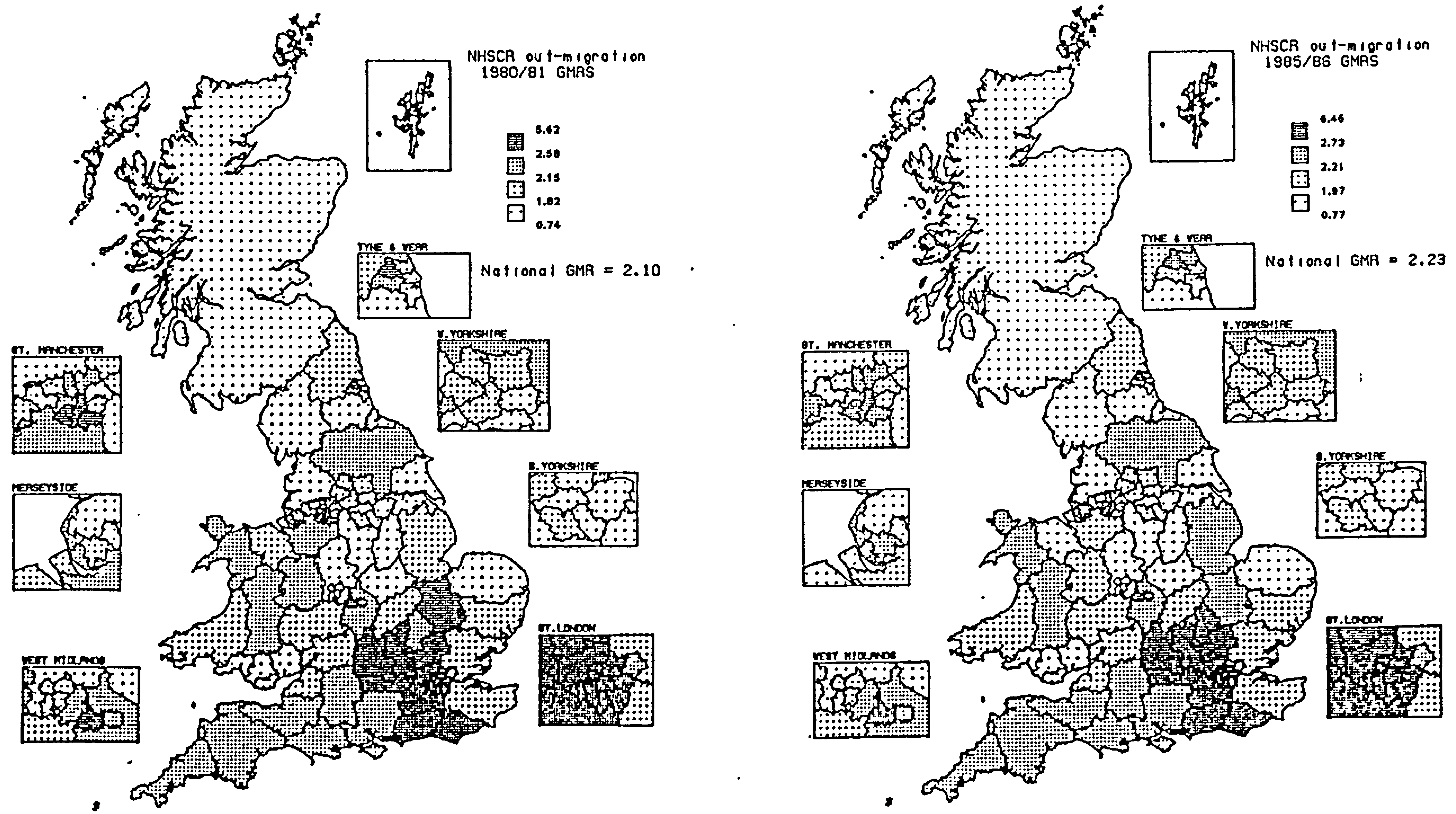


Figure 9.4 Out-migration GMRs, 1980/81 and 1985/86

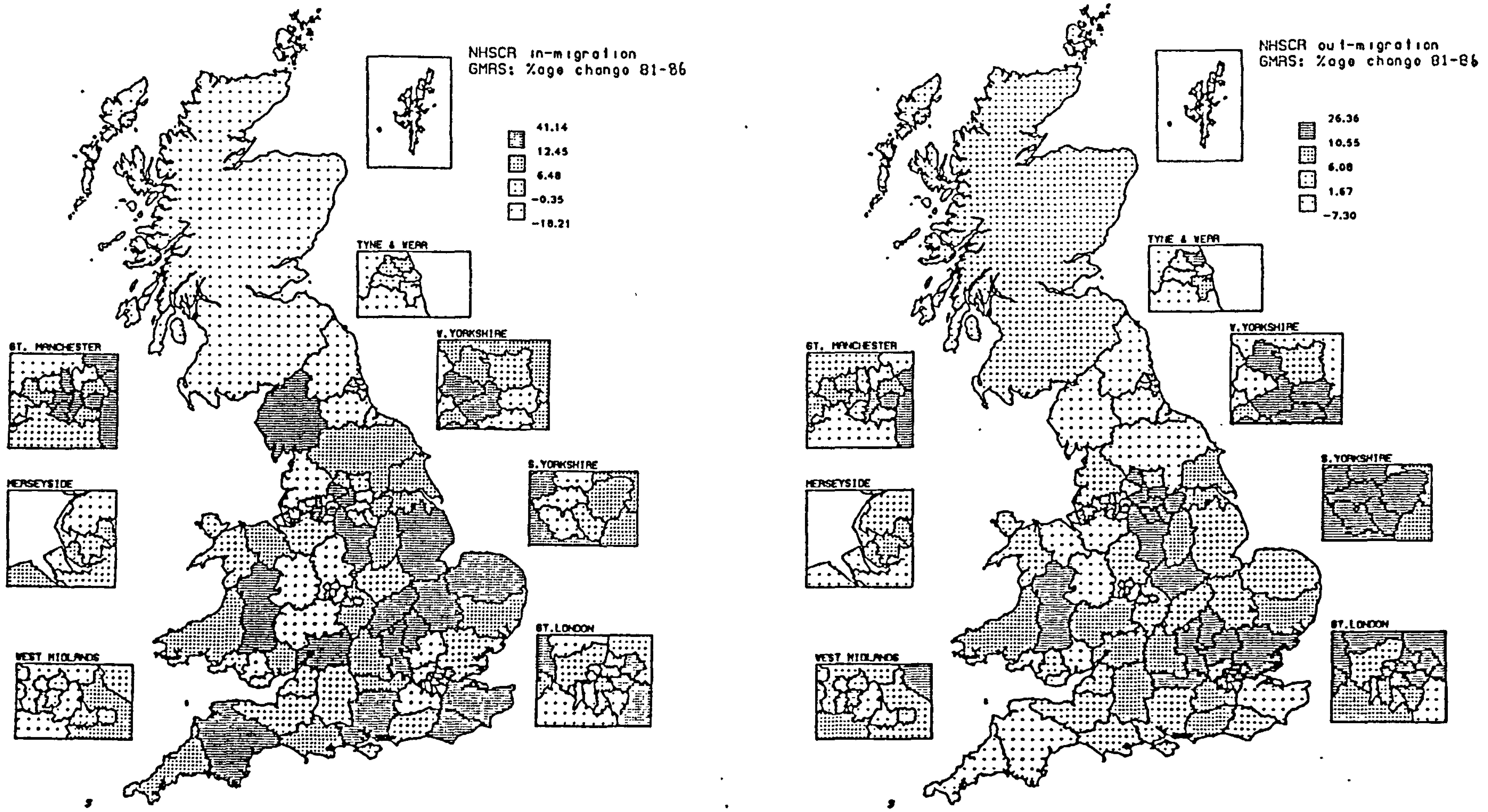


Figure 9.5 Percentage change in in- and out-migration GMRs, 1980/81-1985/86

percentage change over the five-year period.

In-migration GMRs for metropolitan areas in 1980/81 ranged from 1.21 in South Tyneside to 4.90 in Camden and Islington. In 1985/86, Barnsley had the lowest value (1.12) with Kensington/Chelsea/Westminster and Camden and Islington reaching 4.69 and 4.67 respectively. In general the highest GMRs in both years were experienced by the London Boroughs although Solihull (3.22 and 3.26) and Manchester (2.73 and 3.29) had significantly high values in 1980/81 and 1985/86. The greatest percentage change over the period was the 41% and 26% increases in the levels of inter-FPCA movement to Barking and Havering and to Bexley and Greenwich respectively. This is a possible indication of the increase in movement to East London as a consequence of house-price rises which have generally been less severe than elsewhere in this part of the capital. Several London FPCAs, particularly Richmond and Kingston (82%) suffered a reduction in their GMR values over the period. The majority of metropolitan FPCAs experienced an increase in their in-migration GMRs between 1980/81 and 1985/86. The same was true of out-migration figures with only 6 metropolitan zones having a lower value in 1985/86 than in 1980/81. Out-migration GMRs were generally higher than those for in-migration reflecting the movement away from urban areas. Greater London FPCAs had the highest values particularly Kensington/Chelsea/Westminster and Camden/Islington. The lowest values were again found in the medium-high population density metropolitan FPCAs of the North. High density areas outside Greater London had relatively high GMR values.

Increases over the period in non-metropolitan in-migration GMRs were particularly significant in Lincolnshire, Powys, Norfolk and

Northants (between 22 and 26%), although the highest values were found in Buckinghamshire, East and West Sussex and Dorset. These last four FPCAs all experienced significant in-migration - the first due mainly to the flow of migrants to the 'New Towns' and the other three due predominantly to the inflow of migrants in the older age-range (55+). Buckinghamshire also had a high out- migration GMR reflecting the generally high mobility associated with the youthful population of the New Towns. Surrey experienced a high GMR in both years and on the evidence of previous chapters appears as a net loser of population in contrast to other non-metropolitan FPCAs surrounding the capital. The overall rise in the level of migration ensured that only a handful of non-metropolitan GMRs were lower in 1985/86 than in 1980/81.

9.3.5 <u>Age-specific in- and out-migration rates, 1980/81 and 1985/86</u>

With the effect of the level of migration removed and the area under the migration curve reduced to unity, it is possible to compare the shape of FPCA migration profiles in relative terms. NHSCR information used here consists of 10% sample data in 1980/81 but a total count of registered inter-FPCA moves in 1985/86. The consequent differences in profile shape are evident in the following analyses.

Figures 9.6 and 9.7 illustrate out-migration rate profiles for all FPCAs in 1980/81 and 1985/86 respectively. The nature of the sample data in 1980/81 leads to considerable fluctuations in the age-specific rates in comparison with the 1985/86 schedules. It is difficult to adequately summarise the schedules but it is important at this point to illustrate the relative importance of the retirement

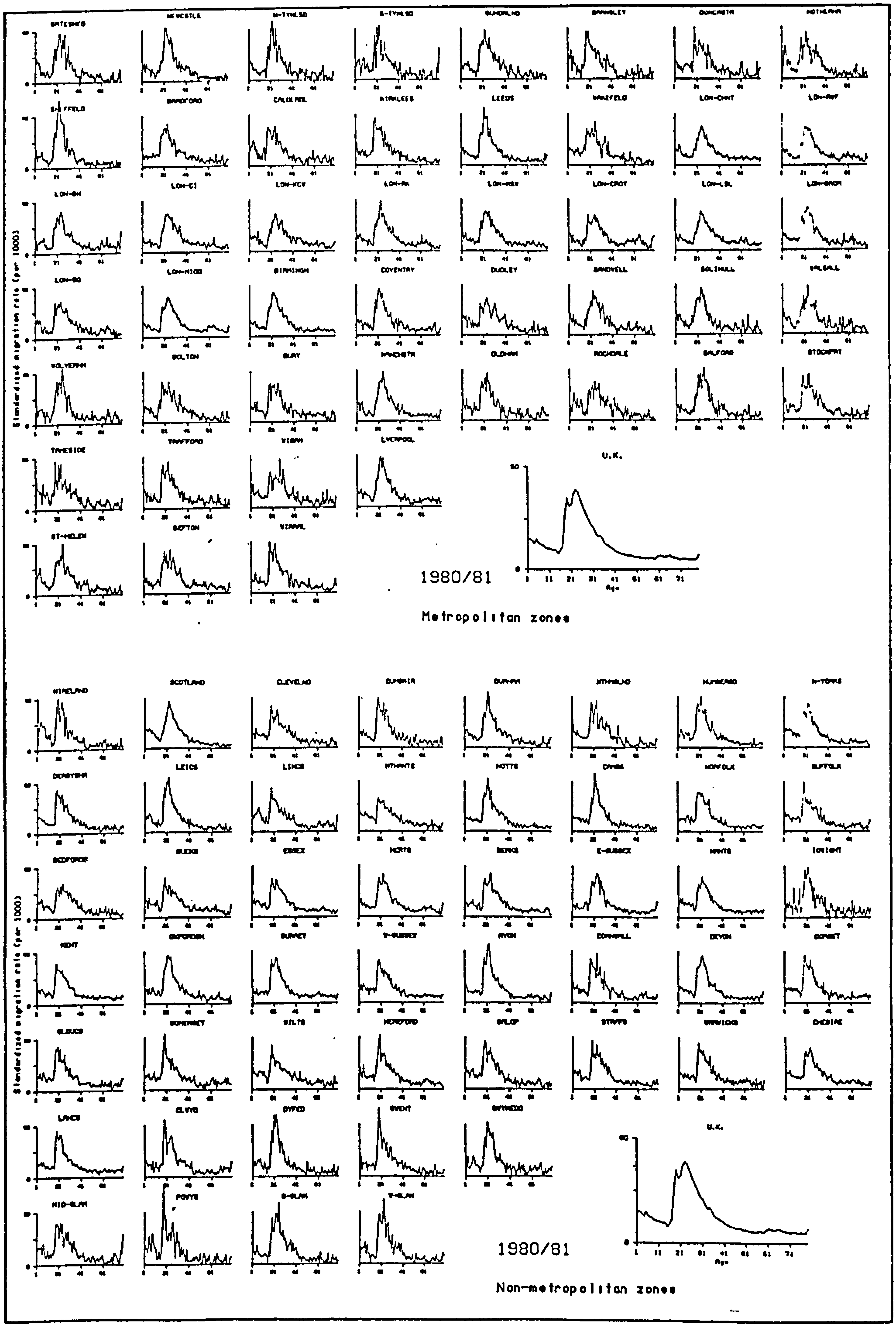


Figure 9.6 Out-migration profiles for all FPCAs 1980/81

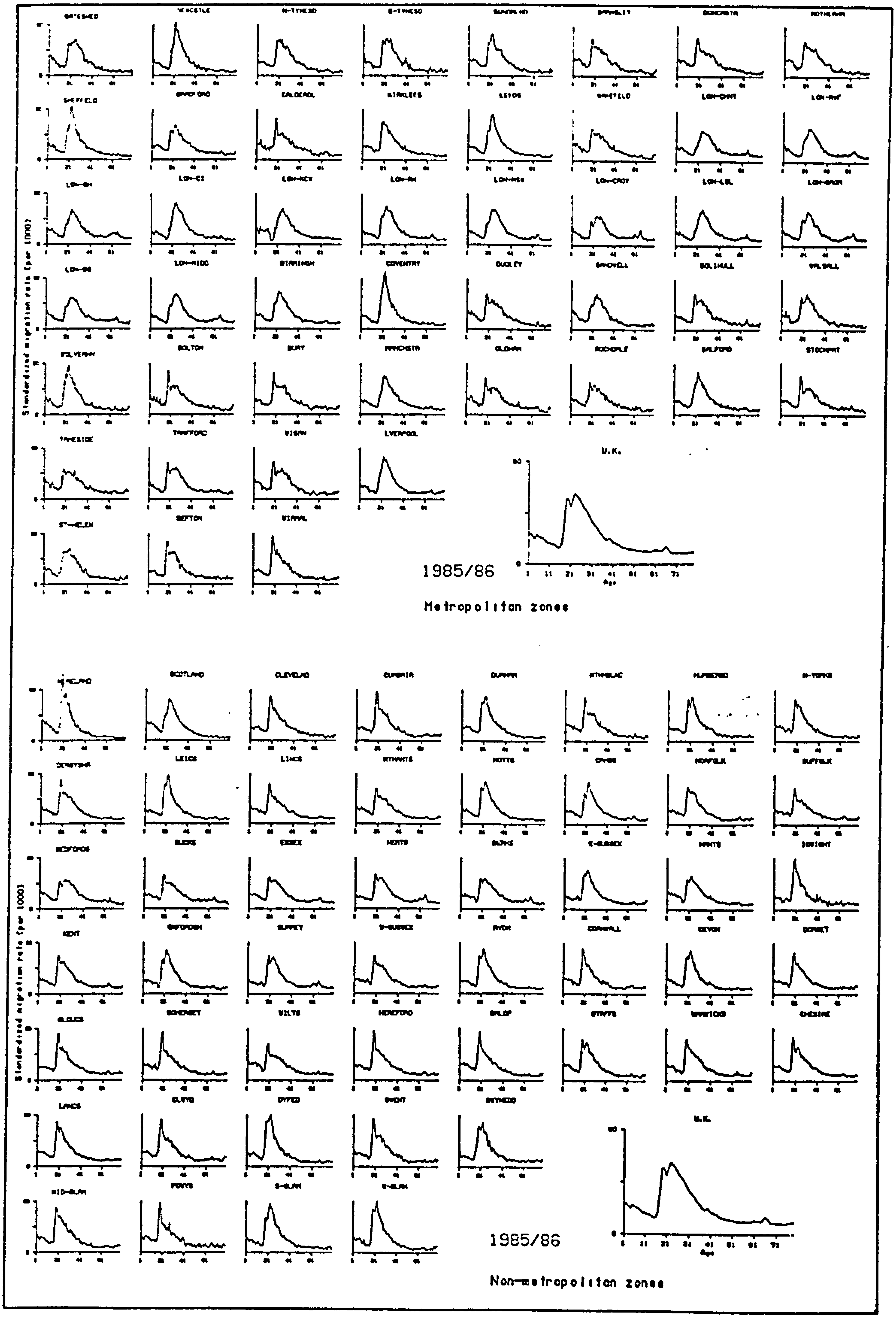


Figure 9.7 Out-migration profiles for all FPCAs 1985/86

components of migration. From previous chapters it would be expected that prominent retirement migration would be apparent in the schedules of London Boroughs in particular but also in those of South East counties and other high population density metropolitan FPCAs. In 1980/81 it is difficult to distinguish a definite peak due to the variation in the 10% sample data, although out-migration from the majority of London-Borough FPCAs does show evidence of a sustained peak around the retirement age-range. Many of the FPCAs experienced a sharp rise in the rate of movement at age 65 reflecting the importance of migration at the time of male retirement. However, this peak is seldom sustained in the 60-65 or 65+ age-range. In 1985/86, the retirement peak in out-migration from London Boroughs was much more pronounced. Other major metropolitan FPCAs showed little evidence of a prominent retirement peak in either 1980/81 or 1985/86 although again 1980/81 fluctuations make identification exceedingly difficult. Of the non-metropolitan FPCAs, those immediately surrounding Greater London showed evidence of a sustained retirement peak in 1985/86. Essex, Bedfordshire, Buckinghamshire, Hertfordshire, Berkshire and Surrey all experienced significant out-migration around age 65, reflecting the important movement to the least densely populated areas of the country on exit from the labour force.

The in-migration schedules for all metropolitan and non-metropolitan FPCAs in 1980/81 (Figure 9.8) and 1985/86 (Figure 9.9) respectively suggest that there is little evidence of a retirement component for the majority of metropolitan FPCAs, although Sefton and Wirral appear to have experienced, in 1985/86, an increase in migration activity from age 65 onwards. An upward retirement

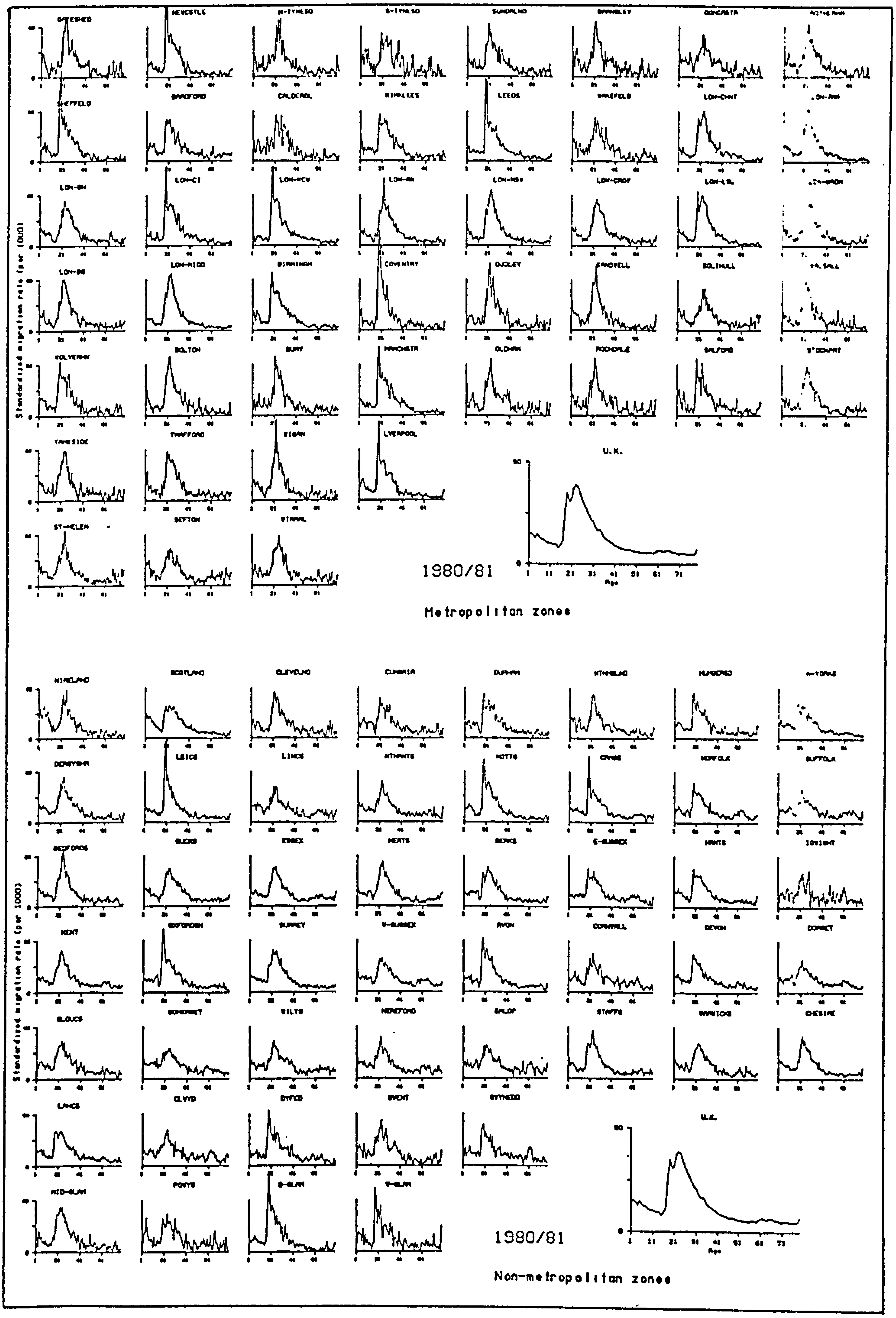


Figure 9.8 In-migration profiles for all FPCAs 1980/81

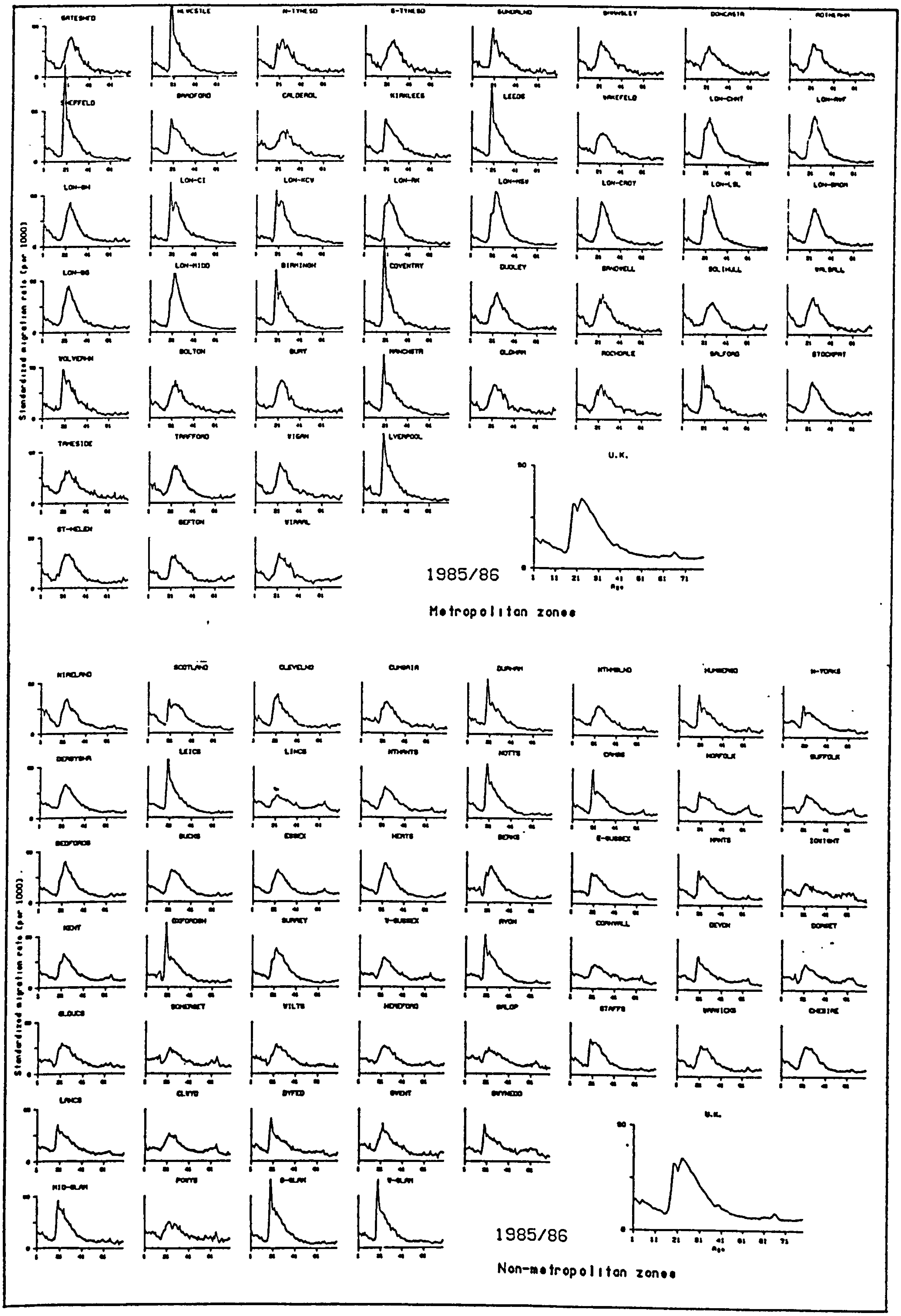


Figure 9.9 In-migration profiles for all FPCAs 1985/86

slope seems to be in evidence here, reflecting the movement to these less densely populated metropolitan FPCAs of the North West away from the major metropolitan areas of Liverpool and Greater Manchester. Significant retirement migration was clearly evident from a number of the in-migration schedules for non-metropolitan FPCAs. The importance of movement to the more remote FPCAs was emphasised with important retirement components visible in the schedules of Lincolnshire, Norfolk and Suffolk and in those of the South West - Cornwall, Devon, Dorset and Somerset. South coast FPCAs of East and West Sussex and Kent, also had a prominent retirement peak. Elsewhere in Britain non-metropolitan FPCAs surrounding the West Midlands ie. Hereford and Worcester, Salop and Warwickshire, experienced relatively high rates of retirement in-migration as did the Welsh FPCAs of Clwyd and Gwynedd. The South-East counties of Bedfordshire, Buckinghamshire, Hertfordshire and Berkshire did not experience retirement peaks in 1985/86 but a slight upward slope was evident in the rate of in-migration beyond age 65.

The most outstanding feature of the series of schedules in Figures 9.6 through 9.9 is the height of the peak in the labour-force curve in a number of the in-migration profiles for certain metropolitan and non-metropolitan FPCAs. This is undoubtedly a result of the inclusion of student moves in the NHSCR migration data which accentuates the peak at age 18-19. Newcastle, Sheffield, Leeds, Coventry, Manchester, Salford and Liverpool all experienced significant rates of movement at age 19 and all contain major establishments of higher education. Similarly the non-metropolitan FPCAs of Durham, Leicestershire, Nottinghamshire, Cambridgeshire, Oxfordshire and Avon, containing major Universities all had sharp peaks in the rate of in-migration at age 18-19. All FPCAs experienced a peak in the rate of in- and out-migration at or around the age of 18-20 but it is the existence of a considerable influx of students which produces the more pronounced peaks outlined here.

To allow a more precise comparison of 1980/81 and 1985/86 age-specific migration profiles it is possible to use the MODEL package to fit model schedules to observed data to derive a series of parameters unique to each FPCA. The following section undertakes to generate zone-specific parameters for each FPCA for both in-migration and out-migration schedules highlighting some of the potentially more important features of change over the period 1980/81 to 1985/86.

9.4 MODELLING AGE-SPECIFIC MIGRATION

9.4.1 Introduction

Section 9.2.3 has outlined the format of the MODEL package. It is possible to calibrate, for each FPCA, a series of parameters which describe the shape of the age-specific profiles of in- and out-migration. Reducing each schedule to a list of parameters allows a much clearer comparison of patterns evident in 1980/81 and 1985/86.

The first step in the fitting of a model schedule to observed data is the selection of the appropriate model type: either with a retirement peak, with a retirement slope or with neither (11, 9 or 7 parameters respectively). Section 9.3 emphasised the difficulty in the identification of a definite retirement component from the 1980/81 schedules. It was decided to undertake the comparison using the 7-parameter model, therefore eliminating the older ages from the calibration procedure. This is in effect an analysis of three components of each schedule: the pre-labour force curve; the labour force curve and the constant component. A summary of the parameters is given in Table 9.1. Each fit of the 7-parameter model to an observed age-specific profile produces an associated 'level-of-error' statistic (E) (see Section 9.2.3). The greater the value of E the poorer the fit of the model to the observed data. This provides an indication of the variation in the accuracy of model fits between FPCAs and between 1980/81 and 1985/86. In addition to the seven calibrated parameters, three further statistics may be derived which aid interpretation and comparison of migration profiles.

'DELTA' is a child-dependency index which measures the pace at which children migrate with their parents, comparing the level parameter of the pre-labour force component (A.1) with that of the labour-force component (A.2)

$$DELTA_i = A.1_i / A.2_i \quad \text{where } i = \text{FPCA} \qquad (9.6)$$

'BETA' is defined here as an indicator of 'parental-shift regularity' and measures the ratio between the rate of descent of the pre-labour force curve and that of the labour force curve:

$$BETA_i = ALPHA.1_i / ALPHA.2_i \qquad (9.7)$$

Do the migration rates of children mirror those of their parents? A value of one can be seen as correspondence between child/parent migration rates. The final statistic is 'SIGMA' which is a measure of labour asymmetry, measuring the relationship between the rate of descent (ALPHA.2) and the rate of ascent (LAMBDA.2) of the labour-force curve.

$$SIGMA_i = LAMBDA.2_i / ALPHA.2_i \qquad (9.8)$$

A high value indicates a sharper rate of ascent than descent - a

Table 9.1 Breakdown of 7-parameter model schedule

Parameter	Description
A.1	Level parameter for pre-labour force curve
ALPHA.1	Rate of descent of pre-labour force curve
A.2	Level parameter for labour force component
MU.2	Mean age of labour force component
ALPHA.2	Rate of descent of labour force curve
LAMBDA.2	Rate of ascent of labour force curve
C	Constant

Note: See Section 2.3.1 for detailed illustration of the model migration schedule left-skewed curve.

9.4.2 Model parameters, 1980/81 and 1985/86

A 7-parameter model schedule was fitted to the in- and out-migration profile of each of the FPCAs of England and Wales and Scotland. The extensive results of this procedure are illustrated in Appendix Tables 3a, 3b, 3c and 3d. The most striking feature is the marked difference between the goodness-of-fits in 1980/81 and 1985/86. At the FPCA level, the number of moves into minor metropolitan areas, for example, will be relatively small. Drawing a 10% sample of such data may produce rather large fluctuations in the migration profile between successive age-groups. The high E statistic for the 1980/81 profiles are therefore a result of the model trying to smooth out migration schedules with considerable between-age variation. The problem is clearly evident from the schedules illustrated in Figures 9.6 to 9.9. The 100% count of NHSCR moves provided by OPCS for the 1985/86 period is much more suitable for the accurate modelling of age-specific profiles. The comparison of 1980/81 and 1985/86 parameter sets becomes rather difficult, therefore, and the identification of definite change over time rather uncertain. However, it is possible to illustrate and highlight some of the more important characteristics of the modelled schedules in both 1980/81 and 1985/86.

The derived in-migration parameters have been summarised in Table 9.2 through the averaging out of selected parameters at a number of spatial scales. The parameters selected neatly describe the main features of the modelled migration schedules. The difference between the E values is very noticeable with the error levels being greatest

Table 9.2 Average values for selected parameters at a number of spatial scales, in-migration 1980/81 and 1985/86

	MU.2	LAMBDA.2	E	DELTA	BETA	SIGMA
A. North						
1980/81	21.4	3.09	25.2	0.35	0.70	27.92
1985/86	20.8	1.78	10.5	0.30	0.73	19.99
South						
1980/81	20.9	1.38	17.7	0.21	0.51	11.58
1985/86	20.8	1.85	9.4	0.29	0.62	20.63
B. Metropolitan						
1980/81	21.7	3.19	25.1	0.34	0.75	28.82
1985/86	21.0	0.91	10.3	0.24	0.74	8.97
Non-metropolitan						
1980/81	20.7	1.60	19.2	0.24	0.49	13.76
1985/86	20.6	2.69	9.8	0.34	0.63	31.30
C. Periphery						
1980/81	20.6	2.11	26.3	0.28	0.65	18.57
1985/86	20.4	3.27	11.0	0.31	0.74	36.91
Ind Heartland						
1980/81	21.8	3.56	24.7	0.39	0.72	32.34
1985/86	21.0	1.08	10.2	0.29	0.72	11.98
Rest of South						
1980/81	21.0	1.69	17.6	0.22	0.39	14.02
1985/86	20.7	2.19	9.7	0.34	0.59	24.81
Greater London						
1980/81	20.7	0.67	17.8	0.18	0.78	6.10
1985/86	20.9	1.08	8.9	0.16	0.69	11.22
D. High density						
1980/81	20.3	2.21	22.4	0.24	0.85	21.35
1985/86	20.5	1.18	10.2	0.21	0.73	11.93
Med-high density						
1980/81	21.8	4.25	26.5	0.27	0.69	36.90
1985/86	21.1	1.60	10.5	0.27	0.79	15.63
Med-low density						
1980/81	21.7	1.51	19.8	0.39	0.54	13.31
1985/86	20.6	1.72	9.2	0.33	0.65	20.40
Low density						
1980/81	21.1	1.56	19.7	0.27	0.39	12.94
1985/86	21.1	2.78	10.4	0.36	0.56	33.62

Notes: MU.2 = Mean age of labour force component
LAMBDA.2 = Rate of ascent of labour force component
E = Goodness of fit statistic
DELTA = Child dependency index
BETA = Parental shift regularity index
SIGMA = Labour assymetry index

for higher density, metropolitan areas of the North in particular where the numbers involved are small and the fluctuations much greater. The SIGMA statistics are generally high, being influenced by the extreme values which are evident for those FPCAs with a very sharp rise in the upward curve of the labour force component. These FPCAs contain the major educational establishments and have schedules dominated by the peak in the in-migration of students at around age 18-19. The average MU.2 parameter varies little between the spatial scales but shows a decrease over the five-year period in all but the Greater London and high density categories. The importance of in-migration of young, single persons to the capital is emphasised with a low DELTA parameter in both 1980/81 and 1985/86 indicating a large difference between the level of child and parent movement.

Table 9.3 illustrates similar parameter averages for out-migration schedules. SIGMA values are significantly lower particularly those relating to FPCAs of Greater London. The mean age of the labour force component (MU.2) shows considerably more variation. Non-metropolitan areas had a MU.2 value of less than 19 years in both 1980/81 and 1985/86 and this is mirrored by low values for FPCAs of the 'Rest of South' region and for those of medium-low and low density areas. The movement of young persons either to education or first-time employment in metropolitan areas is obviously of continuing importance. The mean age value for medium-low density FPCAs (many of the counties surrounding Greater London) has actually decreased quite considerably over the period. Relatively high LAMBDA.2 values for low density FPCAs in both 1980/81 and 1985/86 emphasise the importance of young-person out-movement from these areas. The average MU.2 parameter for high density FPCAs, in

Table 9.3 Average values for selected parameters at a number of spatial scales, out-migration 1980/81 and 1985/86

	MU.2	LAMBDA.2	E	DELTA	BETA	SIGMA
A. North						
1980/81	20.1	1.41	24.2	0.27	0.73	12.70
1985/86	19.1	1.14	10.2	0.31	0.74	14.14
South						
1980/81	20.1	0.82	17.7	0.25	0.70	7.70
1985/86	20.8	1.50	9.3	0.26	0.69	15.07
B. Metropolitan						
1980/81	21.5	0.56	23.5	0.26	0.87	5.43
1985/86	20.8	0.86	10.3	0.30	0.85	11.46
Non-metropolitan						
1980/81	18.8	1.77	19.5	0.26	0.57	15.75
1985/86	18.8	1.71	9.3	0.28	0.59	17.53
C. Periphery						
1980/81	19.2	2.82	26.1	0.24	0.75	24.18
1985/86	19.0	1.01	10.3	0.27	0.66	10.32
Ind Heartland						
1980/81	20.6	0.74	23.2	0.28	0.72	7.26
1985/86	19.1	1.21	10.1	0.33	0.79	15.95
Rest of South						
1980/81	18.9	1.05	17.7	0.26	0.53	10.04
1985/86	18.9	2.06	9.2	0.28	0.61	21.07
Greater London						
1980/81	22.7	0.31	17.6	0.23	1.07	2.42
1985/86	24.9	0.24	9.4	0.21	0.86	1.59
D. High density						
1980/81	21.8	0.35	21.4	0.23	0.98	2.72
1985/86	22.4	0.78	9.2	0.25	0.86	10.35
Med-high density						
1980/81	20.4	0.84	24.7	0.29	0.74	8.91
1985/86	19.2	0.87	11.0	0.33	0.84	11.00
Med-low density						
1980/81	19.6	0.88	19.9	0.24	0.62	8.14
1985/86	18.8	1.09	9.6	0.28	0.63	12.31
Low density						
1980/81	18.7	2.68	19.9	0.27	0.52	23.35
1985/86	18.6	2.47	9.4	0.30	0.55	24.89

Notes: MU.2 = Mean age of labour force component
LAMBDA.2 = Rate of ascent of labour-force component
E = Goodness of fit statistic
DELTA = Child dependency index
BETA = Parental shift regularity index
SIGMA = Labour assymetry index

contrast, has increased over the period and by over 2 years in the case of Greater London. This indicates that a growing percentage of movement away from major urban areas is predominantly family-orientated. This is emphasised by the average parental shift regularity statistics (BETAs) for FPCAs of Greater London and high density areas in general. They are very close to unity in both 1980/81 and 1985/86, highlighting the correspondence between the migration rates of children and their parents.

With movement to and from Greater London being of such importance to the UK migration system it is useful to illustrate similar parameter sets for the individual FPCAs of the capital. This gives an indication not only of changes over the period but also an insight into spatial differences between the most densely populated areas of the country. The large numbers involved in such movement also ensure that random variations in the 1980/81 schedules are not as severe and the 'fits' are generally better than average. This allows for a rather more confident assessment of parameter change over the five-year period. In both 1980/81 and 1985/86 the in-migration schedule of Kensington /Chelsea/Westminster (KCW) and Camden/Islington (CI) were characterised by having a relatively high LAMBDA.2 parameter and a large SIGMA statistic (Table 9.4). The sharp gradient of the labour force curve increased in the case of KCW with a consequent increase in the degree of skew of this component. KCW and CI recorded the lowest MU.2 values in both years with the values increasing slightly over the period. These FPCAs are obviously the most attractive to young migrants moving to the city and entering the labour force or higher education for the first time. A sharp contrast is evident in other FPCAs of the capital with much

Table 9.4 Selected in-migration parameters for FPCAs of Greater London

(a) In-migration, 1980/81

FPCA	MU.2	LAMBDA.2	E	DELTA	BETA	SIGMA
LON-CHNT	18.8	0.59	18.7	0.22	1.22	6.80
LON-RWF	20.1	0.39	16.4	0.22	0.72	3.35
LON-BH	24.1	0.24	19.2	0.18	0.68	1.17
LON-CI	17.9	2.18	20.6	0.16	0.46	24.43
LON-KCW	18.0	2.05	16.9	0.09	0.16	18.51
LON-RK	20.3	0.42	18.2	0.15	0.63	3.24
LON-MSW	20.9	0.36	16.4	0.17	1.02	2.40
LON-CROY	22.1	0.32	17.5	0.21	1.00	2.19
LON-LSL	19.0	0.58	15.2	0.23	1.02	5.60
LON-BROM	25.6	0.18	22.1	0.22	0.90	0.96
LON-BG	21.5	0.32	21.0	0.19	0.98	1.92
LON-MIDD	20.3	0.37	11.8	0.11	0.60	2.68
Average	20.7	0.67	17.8	0.18	0.78	6.10

(b) In-migration, 1985/86

FPCA	MU.2	LAMBDA.2	E	DELTA	BETA	SIGMA
LON-CHNT	19.1	0.53	8.6	0.21	0.80	6.54
LON-RWF	21.5	0.30	8.3	0.17	0.75	2.22
LON-BH	23.2	0.30	7.8	0.25	0.82	1.80
LON-CI	18.2	1.57	12.3	0.13	0.58	18.06
LON-KCW	18.5	7.71	12.6	0.19	0.17	87.06
LON-RK	19.7	0.51	8.6	0.13	0.76	4.46
LON-MSW	21.6	0.31	8.4	0.10	0.86	2.12
LON-CROY	23.0	0.28	7.7	0.13	0.70	1.63
LON-LSL	20.0	0.42	10.8	0.14	0.75	3.79
LON-BROM	23.1	0.27	7.9	0.20	0.79	1.86
LON-BG	21.8	0.30	7.2	0.16	0.67	2.07
LON-MIDD	20.8	0.41	7.2	0.10	0.66	2.99
Average	20.9	1.08	8.9	0.16	0.69	11.22

higher MU.2 values. Barking/Havering (BH), Croydon (CROY) and Bromley (BROM) had significantly high mean age values in both 1980/81 and 1985/86, although only in the case of Croydon did the figure show an increase over the five-year period. LAMBDA.2 and SIGMA values are much lower for the majority of London FPCAs indicating a more symmetrical labour force curve. The correspondence between adult and child moves is particularly low for KCW in both 1980/81 and 1985/86. The DELTA values indicate that the pace at which children migrate with their parents into the capital varies little across space and over time although again generally decreasing slightly over the period.

The corresponding out-migration parameters are illustrated in Table 9.5. The most important feature is the very large MU.2 value evident for Croydon in 1980/81 (28.4) which increases still further in 1985/86 (34.2). Referring back to Figure 9.9 the observed 1985/86 schedule does have a very late peak in its labour force component. The importance of child-parent out-migration from Croydon is emphasised by a high DELTA value in 1985/86 and a strong correspondence between child and adult migration rates in both 1980/81 and 1985/86. Each of the Greater London FPCAs, with the exception of Richmond/Kingston, showed an increase in their MU.2 parameters over the five-year period. Out-migration from the capital is becoming increasingly dominated by the 'family' age-groups. The relatively low SIGMA statistics and LAMBDA.2 parameters in both 1980/81 and 1985/86 indicate more symmetrical labour force curves which are not dominated by the movement of young adults. With the exception of KCW, the rate of out-migration of children in 1985/86 from London FPCAs is strongly associated with the movement of their

Table 9.5 Selected out-migration parameters for FPCAs of Greater London

(a) Out-migration, 1980/81

FPCA	MU.2	LAMBDA.2	E	DELTA	BETA	SIGMA
LON-CHNT	23.7	0.25	12.9	0.22	0.85	1.63
LON-RWF	22.8	0.27	16.2	0.24	1.24	1.51
LON-BH	21.4	0.32	23.7	0.12	0.93	1.81
LON-CI	21.3	0.38	15.2	0.17	1.14	3.42
LON-KCW	21.2	0.42	18.8	0.41	1.40	5.14
LON-RK	21.4	0.35	19.2	0.16	0.77	2.49
LON-MSW	22.1	0.27	16.7	0.19	0.80	1.78
LON-CROY	28.4	0.15	21.8	0.39	1.38	0.55
LON-LSL	22.6	0.31	13.9	0.17	1.02	2.39
LON-BROM	24.4	0.21	18.5	0.12	0.58	0.94
LON-BG	19.2	0.59	21.2	0.42	1.64	6.31
LON-MIDD	24.1	0.22	13.1	0.15	1.06	1.07
Average	22.7	0.31	17.6	0.23	1.07	2.42

(b) Out-migration, 1985/86

FPCA	MU.2	LAMBDA.2	E	DELTA	BETA	SIGMA
LON-CHNT	24.8	0.24	8.1	0.18	0.78	1.52
LON-RWF	24.9	0.21	9.6	0.21	1.04	1.15
LON-BH	25.3	0.20	10.3	0.17	0.73	1.00
LON-CI	22.1	0.36	7.9	0.15	0.86	3.09
LON-KCW	22.9	0.33	9.4	0.22	0.53	2.77
LON-RK	21.3	0.34	9.1	0.15	0.84	2.62
LON-MSW	25.9	0.19	7.8	0.17	0.82	1.00
LON-CROY	34.2	0.12	10.9	0.60	0.84	0.39
LON-LSL	23.9	0.27	8.2	0.16	0.95	1.74
LON-BROM	24.6	0.20	13.0	0.16	0.92	1.03
LON-BG	22.5	0.27	9.5	0.25	1.11	1.94
LON-MIDD	26.5	0.19	9.0	0.14	0.90	0.85
Average	24.9	0.24	9.4	0.21	0.86	1.59

parents.

There is evidence, therefore, for a considerable amount of change over the period 1980/81 to 1985/86 in the pattern of age-specific migration. The following section attempts to summarise the main features of migration by single year of age through the derivation of a classification of FPCAs based on similarities between observed migration rate schedules using 1985/86 NHSCR data.

9.5 DEVELOPING A CLASSIFICATION OF MIGRATION PROFILES

9.5.1 Introduction

Previous sections have illustrated some of the changes that have taken place since 1980/81 in the pattern of age-specific migration. This section attempts to summarise the main features of movement by age in 1985/86 through the derivation of a classification of FPCAs based on similarities between observed, standardized age-specific rates. Bates and Bracken (1987) appear to derive a classification of LAs based on migration profile similarities using 1981 Census data. They fitted model schedules to individual local authority in- and out-migration profiles to derive zone-specific parameter sets. LA areas were combined on the basis of the similarity between their parameters. A direct comparison of the 1980/81 Census classification with that derived from 1985/86 NHSCR data is not viable due to the different cluster methodologies adopted and the recognised differences between the data sources. Furthermore, the random fluctuations in 1980/81 10% sample data precludes the development of a Census-period NHSCR classification. Cluster analyses were carried out using observed 1980/81 rates but the results proved rather difficult to interpret. The sharp variation between rates for successive ages was particularly noticeable in the case of in-migration to many metropolitan FPCAs where numbers were relatively small. A possible alternative would have been to cluster FPCA profiles using the calibrated parameter sets of Section 9.4. The level of error, however, between observed and modelled schedules was generally much higher in 1980/81 than 1985/86. Moreover, the 7-parameter model only described a portion of the observed migration schedule and did not take into account any variation around the ages of retirement. Finally, to obtain the most accurate classification of age-specific migration by FPCA it is more appropriate to use observed rather than modelled statistics to pick up actual variations between areas, and avoid any errors due to poor prediction.

Observed, standardized age-specific rates of migration obtained from 1985/86 NHSCR data are used, therefore, to derive, using clustering methods, a classification of FPCAs based on profile similarities. The analysis is important for a number of reasons. The major patterns of age-specific gross in- and out-migration can be summarised in the form of a series of aggregate schedules. The clustering routine combines FPCAs with similar profile characteristics. The age-specific rates of the FPCAs within each cluster can be aggregated to form a cluster-profile and the major features of these new profiles quantified using the MODEL package to derive comparable statistics as in Section 9.4. This provides a description of the dominant patterns shaping internal migration in the UK using the most recent data available.

9.5.2 The clustering methodolgy

The clustering methodology used to classify migration profiles is similar to that adopted in Section 8.4. Standardized out and in-migration rates for persons aged 1 to 79 for individual FPCAs provide the input to the clustering procedure with the combination of FPCAs dependent upon the similarity between their observed age-specific rates. The initial step in the process is the computation of 'distances' between the rates of migration for equivalent ages for different FPCAs with distance measured in squared euclidian space. The squared euclidian distance (SED) between two FPCAs is the sum of the squared differences between the equivalent age-specific standardized migration rates; ie.

SED_{ij}^{d} = squared euclidian distance between FPCA i and FPCA j for direction d

$$SED_{ij}^{d} = \sum_{a} (m_{i}^{ad} - m_{j}^{ad})^{2} \qquad (9.9)$$

where

- m = migration rate (stanardized);
- a = age;
- d = direction (in or out-migration); and
- i,j = FPCAs.

The computation of the distance array is a precursor to the main clustering procedure. The method used for clustering was based on the 'average linkage between groups' where the distance between two clusters is the average of the distance between all pairs of FPCAs in which one member of the pair is from each of the clusters; ie.

$$D_{IJ} = \sum_{i \in I} \sum_{j \in J} SED_{ij} \; / \; n_{I} n_{J} \qquad (9.10)$$

where

- D_{IJ} = distance between clusters I and J (distance coefficient);
- SED_{ij} = squared euclidian distance between FPCAs i and j; and
- n_{I} and n_{J} = number of FPCAs in clusters I and J respectively.

The method is agglomerative in that the process starts with the maximum number of clusters, in this case individual FPCAs, and then combines those cases with the smallest distance coefficient. The procedure iterates until all cases are classified into one cluster.

9.5.3 Derivation of an FPCA classification

The agglomeration schedules produced in the clustering of in and out-migration age-specific profiles are illustrated in Figure 9.10. The distance coefficient increases as the number of clusters decreases. It is necessary to decide on an optimum number of clusters and the justification for this decision is derived from the pattern of increase in the distance coefficient illustrated by the agglomeration schedule. It appears that the increase in the coefficient is fairly constant until around stage 75-80 of the clustering procedure (15-20 clusters). At this point increases become larger and less uniform indicating the association of FPCAs becoming more irregular. Large increases in the coefficient are associated with the clustering of FPCAs which have less similar age-specific migration rate schedules. This 'break' in the curve can therefore be seen as the point at which the optimum number of clusters has been reached. From Figure 9.10 this appears to be at approximately the 15-cluster solution. It is therefore appropriate to illustrate the in and out-migration cluster compositions at this stage. Tables 9.6 and 9.7 outline the FPCA composition of the in and out-migration profile categories at the 15-cluster stage. To illustrate and describe the characteristics of each of these groups the observed age-specific migration rates for FPCAs within each cluster are aggregated to provide a 'cluster profile'. To derive

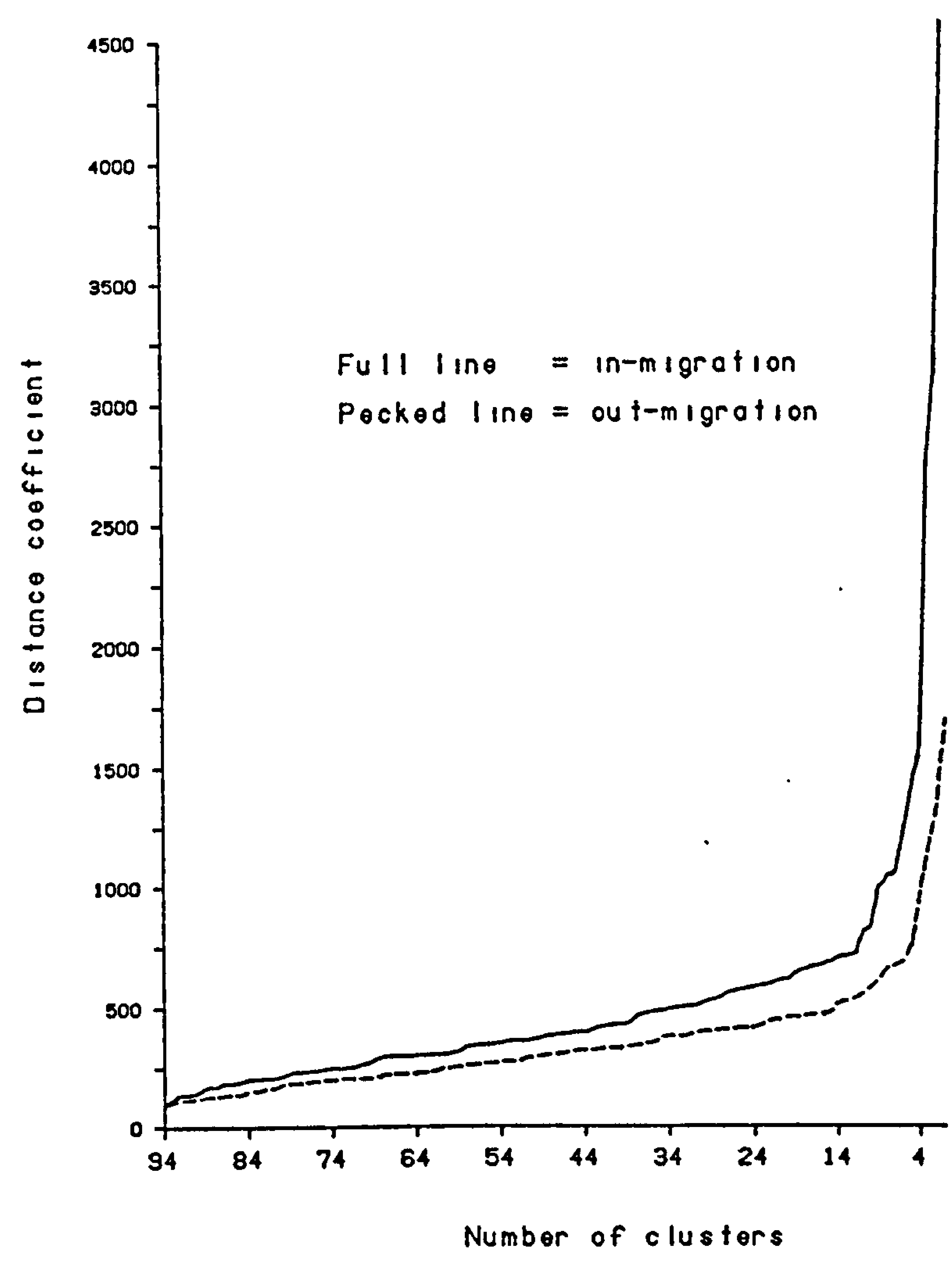


Figure 9.10 Agglomeration schedules for in and out-migration clustering procedures, 1985/86

Table 9.6 15-cluster stage of FPCA classification process for 1986 in-migration

1. LON-CI, LON-KCW
2. LON-RWF, LON-CROY, LON-BG
3. LON-CHNT, LON-RK, LON-MSW, LON-LSL, LON-MIDD
4. Lincolnshire, Suffolk, IOW, W.Sussex, Cornwall, Dorset, Somerset, Hereford, Salop, Clwyd, Powys
5. Humberside, Norfolk, E.Sussex, Devon, Lancashire, Dyfed, Gwynedd
6. Cumbria, Northumberland, Rotherham, Calderdale, Wakefield, Derbyshire, Northamptonshire, Buckinghamshire, Essex, Kent, Gloucestershire, Wiltshire, Warwickshire, Bolton, Oldham, Rochdale, Tameside, Sefton, Wirral, Chesire, Gwent
7. Gateshead, N.Tyneside, Barnsley, Bedfordshire, Hertfordshire, Berkshire, LON-BH, LON-BROM, Dudley, Sandwell, Walsall, Bury, Stockport, Trafford, Wigan, St Helens
8. Durham, Leicestershire, Nottinghamshire, Oxfordshire, Avon, Birmingham, Wolverhampton, Manchester, Salford, S,Glamorgan
9. Newcastle, Sheffield, Coventry
10. Leeds, Liverpool
11. Sunderland, Cleveland, Bradford, Kirklees, Cambridgeshire, Staffordshire, Mid-Glamorgan
12. Scotland, Doncaster, N.Yorkshire, Hampshire
13. S.Tyneside
14. Solihull
15. W.Glamorgan

Table 9.7 15-cluster stage of FPCA classification process for 1986 out-migration

1. LON-CHNT, LON-RWF, LON-BH, LONMSW, LON-CROY, LON-LSL LON-BROM, LON-BG, LON-MIDD
2. Newcastle, Sheffield, Leeds, Coventry, Wolverhampton, S.Glamorgan
3. Cambridgeshire, Oxfordshire, Surrey, LON-RK, Birmingham, Manchester, Salford, Liverpool, E.Sussex
4. Bradford, Bedfordshire, Buckinghamshire, Essex, Hertfordshire, Berkshire, Hampshire, Rochdale, Tameside
5. Durham, Leicestershire, Nottinghamshire, Avon, Devon, Dyfed, W.Glamorgan
6. Northumberland, Barnsley, Doncaster, Rotherham, Calderdale, Wakefield, Lincolnshire, Northants, Suffolk, W.Sussex, Dudley, Solihull, Warwickshire, Bolton, Bury, Oldham, Stockport, Trafford, Wigan, Wiltshire
7. Cleveland, Cumbria, Kirklees, N.Yorkshire, Derbyshire, Norfolk, Cornwall, Dorset, Gloucestershire, Somerset, Hereford, Salop, Staffordshire, Sefton, Wirral, Chesire, Lancashire, Clwyd, Gwent, Mid-Glamorgan
8. N.Tyneside, Walsall, St Helens, Sunderland
9. Scotland, Gateshead
10. LON-CI, LON-KCW
11. S.Tyneside
12. IOW
13. Sandwell
14. Gwynedd

15 Powys

descriptive statistics for each of these new profiles it is again possible to fit model migration schedules to observed data.

Prior to the calibration of the parameters in each run of MODEL it was necessary to determine which type of migration schedule should be fitted to the observed data ie. either with a retirement peak, with a retirement slope or with neither. Deciding which clusters had a retirement peak etc proved difficult as some schedules showed evidence of a peak only at age 65. A model schedule with a retirement peak was only fitted, therefore, to profiles with a sustained increase in the rate of migration around the ages of retirement. Where no peak or slope was evident the post labour-force component parameters were fixed at zero and a 7-parameter model schedule was utilised. The aggregate oberved rate schedules for each of the derived clusters were therefore modelled using the appropriate method and a set of descriptive parameters produced for each cluster. The observed and estimated migration schedules for each of the in and out-migration clusters are illustrated in Figure 9.11(a) and (b). The goodness-of-fit of the model schedule to observed data was measured using the E statistic. The E values for in and out-migration clusters are illustrated in Figure 9.11(a) and (b). In the case of in-migration the double peak in the labour-force component of the cluster 1 schedule gives a relatively high level of error as does the very high peak in the same component of the cluster 9 schedule. Fits are otherwise good for both in and out- migration clusters (ie. less than 10).

Table 9.8 gives a summary of the derived parameters for in-migration clusters together with the three further descriptive statistics introduced in Section 9.4. Three distinct London clusters

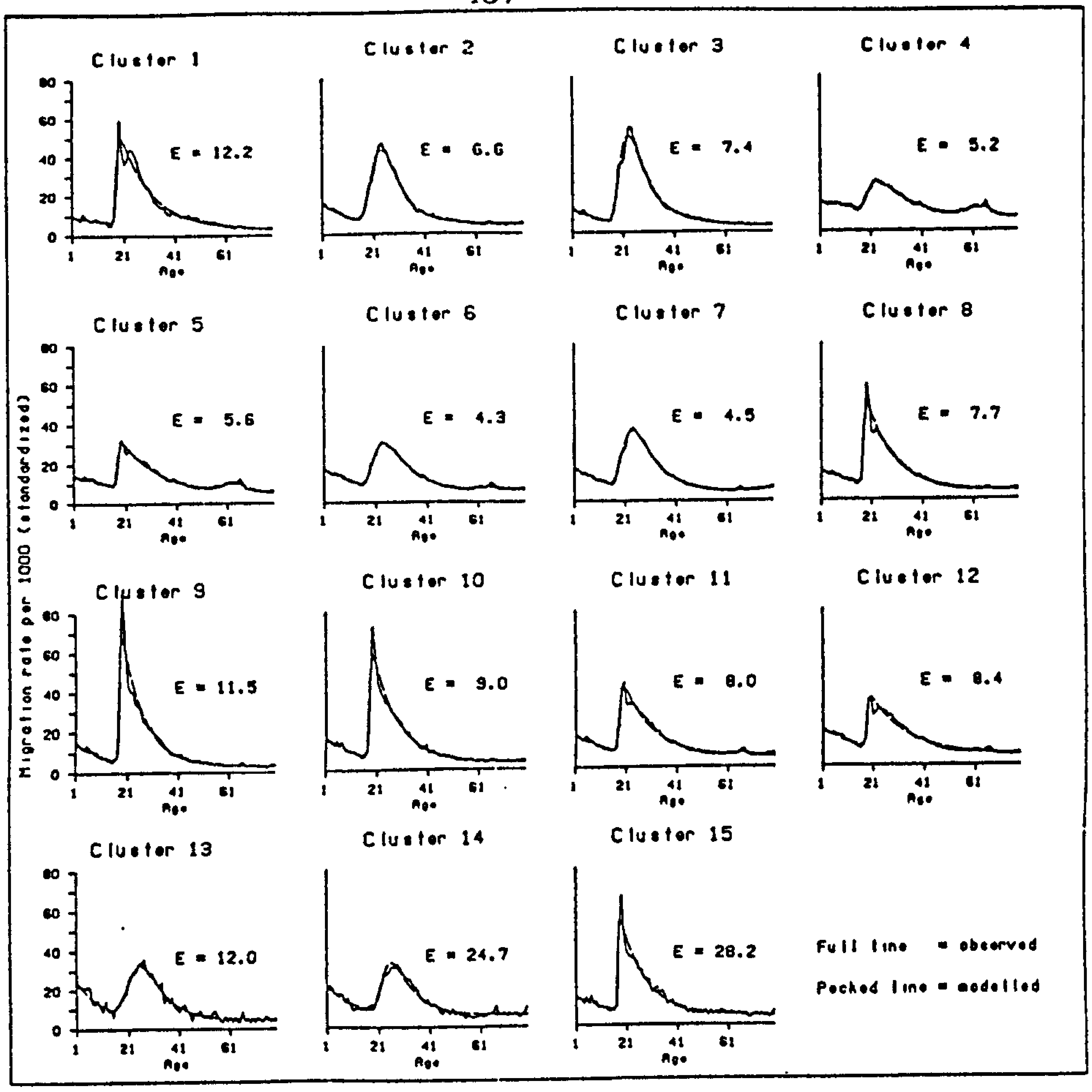


Figure 9.11a Observed and estimated schedules for in-migration clusters, 1985/86

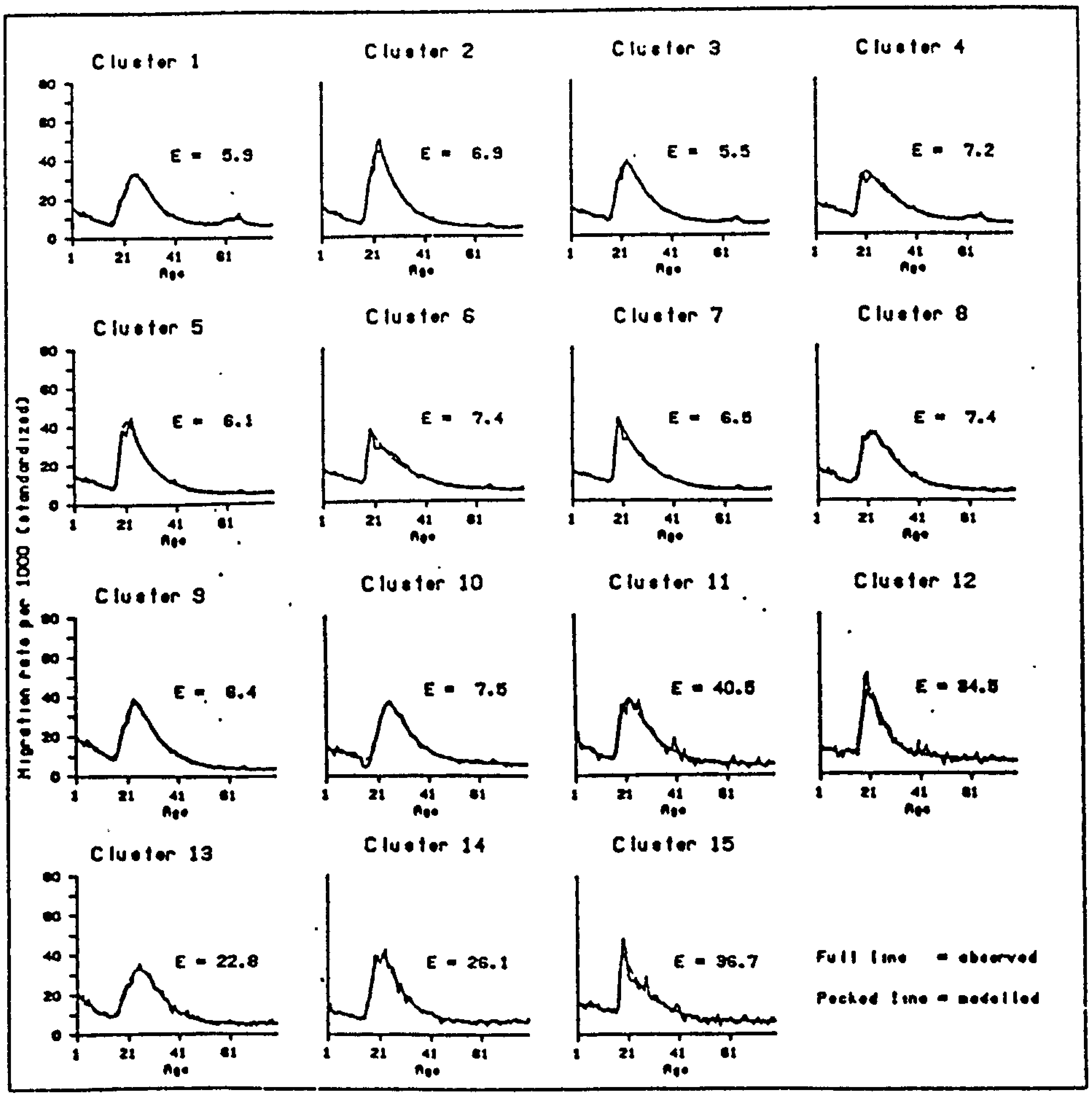


Figure 9.11b Observed and estimated schedules for out-migration clusters, 1985/86

Table 9.8 Parameters and parameter ratios for in-migration clusters

	CLUSTER 1	2	3	4	5	6	7	8
A.1	0.007	0.013	0.010	0.010	0.010	0.014	0.016	0.012
ALPHA.1	0.039	0.108	0.091	0.031	0.046	0.066	0.058	0.059
A.2	0.055	0.087	0.088	0.026	0.027	0.043	0.058	0.050
MU.2	18.319	22.028	20.434	20.899	18.186	20.949	21.024	18.129
ALPHA.2	0.087	0.148	0.123	0.096	0.071	0.096	0.104	0.098
LAMBDA.2	1.514	0.289	0.404	0.403	1.580	0.352	0.335	1.978
A.3	.	.	.	0.000	0.000	0.004	0.002	.
MU.3	.	.	.	81.157	80.985	60.257	0.000	.
ALPHA.3	.	.	.	0.545	0.557	0.047	0.051	.
LAMBDA.3	.	.	.	0.099	0.101	0.384	0.000	.
C	0.003	0.005	0.003	0.005	0.005	0.004	0.002	0.004
DELTA	0.132	0.155	0.119	0.383	0.389	0.332	0.280	0.246
BETA	0.447	0.729	0.735	0.325	0.650	0.686	0.553	0.610
SIGMA	17.492	1.960	3.275	4.195	22.114	3.655	3.214	20.280

	CLUSTER 9	10	11	12	13	14	15
A.1	0.014	0.014	0.013	0.015	0.024	0.018	0.011
ALPHA.1	0.091	0.081	0.077	0.064	0.105	0.095	0.078
A.2	0.076	0.064	0.042	0.029	0.067	0.050	0.054
MU.2	17.949	18.081	18.539	18.771	24.210	23.300	17.900
ALPHA.2	0.121	0.107	0.089	0.070	0.137	0.121	0.105
LAMBDA.2	2.745	2.159	1.304	2.512	0.210	0.400	3.060
A.3	.	.	0.003	0.005	.	.	.
MU.3	.	.	70.000	86.825	.	.	.
ALPHA.3	.	.	0.500	0.500	.	.	.
LAMBDA.3	.	.	0.227	0.623	.	.	.
C	0.003	0.003	0.005	0.005	0.004	0.006	0.005
DELTA	0.181	0.224	0.306	0.523	0.358	0.360	0.204
BETA	0.752	0.756	0.863	0.917	0.766	0.785	0.743
SIGMA	22.747	20.106	14.594	36.123	1.533	3.306	29.143

were formed (Table 9.6). CI and KCW with the characteristic double peaking in the observed labour force curve formed a single group. The fitted model schedule smooths the curve and produced a very low MU.2 parameter (18.3) illustrating the importance of in-migration of persons in their late teens. The high LAMBDA.2 value for this cluster emphasises the sharp increase in the rate of migration at age 18 with a relatively high SIGMA statistic (17.5) indicating the difference between the rate of ascent and descent of the labour force curve. The remaining two London borough groups contain FPCAs with a high but later peak in the observed labour force curve with MU.2 values of 22.0 and 20.4 for clusters 2 and 3 respectively. The curves are rather more symmetrical with a less emphatic jump in the rate of migration on the upward slope. Clusters 4 to 7 all showed evidence of considerable retirement migration. An 11-parameter 'retirement-peak' model was fitted to schedules of clusters 4, 5 and 6 whereas a 9-parameter 'retirement -slope' model was fitted to cluster 7. The labour force peaks for these clusters were generally at a lower level than for the previous London clusters. The average age of labour force migration was, with the exception of cluster 5, experienced at age 21. The predominantly non-metropolitan FPCAs of cluster 5 experienced a relatively early but sharp peak at around age 19. Significantly these clusters, with the exception of the mainly metropolitan cluster 7, exhibited a considerably higher child dependency index than the London borough clusters. In-migration to the less densely populated areas of clusters 4, 5 and 6 involved a considerable amount of family migration. In cluster 7 a number of the constituent FPCAs showed clear evidence of an upward retirement slope particularly, Bedfordshire, Hertfordshire, Berkshire, Surrey, St Helens, Trafford and Barking/Havering.

The schedules of clusters 8, 9 and 10 are dominated by a very high peak in the labour-force curve at an early age and no retirement component. The sharp increase in the rate of movement at approximately age 18 is emphasised by relatively high LAMBDA.2 values giving significant asymmetry statistics (SIGMA = 20-23). The student factor has already been cited as the main determinant of schedule shape for these three clusters. DELTA values are relatively low but the index of parental shift regularity is, in each case quite high, indicating the correspondence between child and adult in-migration to these FPCAs. The remaining clusters, 11 and 12, produced quite strange combinations. Cambridgeshire stands out by having a unique profile which contains a labour-force curve with a sharp peak at age 19 (student factor again) and a quite significant retirement component. It most probably combines with other members of the group due to the dominance of the early peak. FPCAs of group 12 show evidence of a relatively flat labour-force curve but Scotland, North Yorkshire and Hampshire had a localised peak at age 19 reflecting the important in-migration of Armed Forces recruits. The only three FPCAs which failed to combine were: South Tyneside, which had a very late peak indeed (age 27); Solihull, a unique profile shape for a metropolitan area with a rounded labour-force curve and a retirement peak; and West Glamorgan which upon examination of Figure 9.6 appears to have similar characteristics to South Glamorgan and would therefore seem most similar to cluster 8.

At the 15-cluster stage of the out-migration classification procedure 10 distinct groups were formed with 5 individual FPCAs failing to combine (Table 9.7). The parameters corresponding to the

10 modelled profiles in Figure 9.11b are illustrated in Table 9.9. The majority of London-Borough FPCAs make up cluster 1 with a very different parameter set to that of clusters 1, 2 and 3 in Table 9.8. The peak in out-migration is much lower and at a much later age (23 years) and there is a significant retirement component. The labour force curve is far more symmetrical and the correspondence between child and parent migration is high. The highest density FPCAs of LON-CI and LON-KCW make up cluster 10 with again a later peak in the labour-force component (22.4), a much less skewed curve but an absence of any significant migration activity around the age of retirement. Clusters 2 and 3 in Table 9.9 contain the major high-density metropolitan areas outside Greater London together with, in cluster 3, the non-metropolitan FPCAs of Oxfordshire Cambridgeshire, Surrey and Essex (Table 9.7). Both cluster schedules have a peak at age 20 with that of cluster 2 at a higher level. Only cluster 3 has a significant retirement component. The BETA value is greatest for the metropolitan FPCAs in cluster 2 indicating the importance of family movement away from these high-density areas.

The pattern of out-migration from non-metropolitan FPCAs surrounding the capital has been outlined in previous chapters and the modelled schedule for cluster 4, containing Bedfordshire, Buckinghamshire, Hertfordshire, Berkshire, Essex and Hampshire, emphasises these patterns. The observed schedule actually has a double peak in the labour force curve indicating considerable out-migration in the late teens predominantly to Greater London. The retirement component has been cited previously as movement to the least densely populated areas of the South, particularly in East Anglia and the South West. Cluster 5 is also non-metropolitan in

Table 9.9 Parameters and parameter ratios for out-migration clusters

	CLUSTER 1	2	3	4	5	6	7	8
A.1	0.012	0.013	0.010	0.012	0.011	0.012	0.011	0.014
ALPHA.1	0.125	0.096	0.074	0.059	0.066	0.058	0.055	0.074
A.2	0.063	0.069	0.054	0.033	0.056	0.032	0.041	0.052
MU.2	23.254	20.055	20.227	18.804	19.046	18.219	18.227	19.524
ALPHA.2	0.142	0.119	0.114	0.078	0.113	0.077	0.096	0.099
LAMBDA.2	0.247	0.497	0.438	0.781	0.715	1.457	1.353	0.398
A.3	0.000	.	0.000	0.000	.	.	.	.
MU.3	79.905	.	76.001	77.829	.	.	.	.
ALPHA.3	0.638	.	0.821	0.640	.	.	.	.
LAMBDA.3	0.113	.	0.157	0.126	.	.	.	.
C	0.006	0.004	0.005	0.005	0.005	0.005	0.005	0.004
DELTA	0.192	0.196	0.178	0.368	0.205	0.389	0.282	0.272
BETA	0.882	0.805	0.647	0.755	0.581	0.749	0.572	0.743
SIGMA	1.748	4.166	3.839	10.047	6.316	18.875	14.052	4.010

	CLUSTER 9	10	11	12	13	14	15
A.1	0.019	0.011	0.016	0.012	0.019	0.008	0.011
ALPHA.1	0.070	0.083	0.105	0.008	0.111	0.104	0.045
A.2	0.059	0.058	0.053	0.076	0.070	0.067	0.036
MU.2	20.893	22.386	19.200	19.800	24.010	19.100	17.900
ALPHA.2	0.108	0.116	0.099	0.215	0.142	0.134	0.102
LAMBDA.2	0.331	0.351	0.500	0.400	0.190	0.410	2.340
A.3	.	.	.	.	.	.	.
MU.3	.	.	.	.	.	.	.
ALPHA.3	.	.	.	.	.	.	.
LAMBDA.3	.	.	.	.	.	.	.
C	0.003	0.006	0.005	0.005	0.005	0.006	0.005
DELTA	0.316	0.183	0.302	0.158	0.271	0.119	0.306
BETA	0.650	0.717	1.061	0.037	0.782	0.776	0.441
SIGMA	3.063	3.038	5.051	1.861	1.338	3.060	22.941

composition but has no retirement component and a slightly later modelled peak in labour force migration, although the peak is significantly higher than that of cluster 4. Again the observed schedule has a double peak indicating disproportionately high levels of out-migration around the age of leaving school when movement to University and to first-time employment is dominant. The second peak will be accentuated by the movement of graduates away from place of education. Clusters 6 and 7 are two much larger groups and their model schedules stand out in Figure 9.11b for having the greatest degree of labour asymmetry with SIGMA values of 19 and 14 respectively (Table 9.9). The peak in labour force migration occurs at around age 18 and although observed rates do rise at age 65 in each case the cluster schedules were modelled without a retirement component. Cluster 8 contains four metropolitan areas whose schedules are characterised by a flat labour-force curve with a relatively late peak whereas cluster 9 is a rather strange combination of Scotland with the metropolitan FPCA of Gateshead. Those FPCAs failing to combine at this 15-cluster stage were: Gwynedd; Sandwell; South Tyneside with a multi-peaked labour-force component; Isle of Wight with a high labour-force peak but large fluctuations in rate in the 40+ age-range; and Powys with a very strange labour-force curve dominated by a peak at age 19 and a further minor peak at age 30.

The major distinguishing characteristics of both the in-migration and out-migration cluster schedules appear to be, therefore, the height of the peak in the labour force curve, the age at which this peak occurs, the increase in the migration rate up to this peak and the presence or absence of a retirement component.

9.6 SUMMARY AND CONCLUSIONS

This final chapter of analysis has attempted to examine some of the changes taking place in the pattern of age-specific migration since 1980/81. Current sub-national population projections utilise a classification of LA profiles based on 1981 Census data. It is therefore important to establish the degree of variation in the pattern of migration by single year of age in more recent years and to assess the potential effect of this variation upon the accuracy of OPCS/DOE migration forecasting.

A 6% increase in the overall level of migration was observed between 1980/81 and 1985/86 with rates of retirement and family movement in particular increasing over the five-year period. A labour-force curve with a double peak was maintained although at a slightly lower level in 1985/86. An increase in the level of movement to FPCAs in East London was noted whereas significant percentage increases to in-migration GMRs were evident for low density areas such as Lincolnshire, Norfolk, Northamptonshire, Powys, East and West Sussex and Dorset. Continued out-migration from Greater London was experienced with a similar trend in a number of non-metropolitan FPCAs surrounding the capital. The mean ages of labour force in-migration were seen to decrease except in Greater London and other high density areas. An increase of 2 years in the MU.2 value for movement out of the capital was evident, emphasising the increased importance of family moves out of Greater London and high density areas in general. The mean age of labour force out-migration increased for all Greater London FPCAs over the five-year period particularly in Croydon. The pattern of migration to and from the capital was seen to be increasingly dominated by considerable in-migration at around school leaving age and entrance to University or Polytechnic but with decentralisation occurring at an increasing rate in the form of family and retirement migration.

The most important trends relevant to the process of migration projection can be listed as: a definite rise in the rate of migration away from metropolitan areas in general, and the majority of London FPCAs in particular, in the 'family' and 'retirement' age-groups; an intensification of the rate of movement of persons in their late teens to the capital; an increase in the rate of in-migration to the least densely populated areas of East Anglia and the South West; and from Figure 9.2, the evidence of an increasing rate of net loss of young persons from the North to the South.

Bates and Bracken captured the dominant trends in age-specific gross in and out-migration during 1980/81 within a classification of LAs. Data was obtained from the 1981 Census which was taken at a time when the general propensity to migrate was very low relative to previous years. In their comparison of 1971 and 1981 age-specific migration they concluded that,

> 'the greater part of the reduction in migration flow is independent of flow direction, origin and destination'
>
> (p531)

They stated that using the GMR as a measure of standardization the pattern of age-specific migration can be seen to be reasonably stable over time. The use of 1981 profile groupings in subsequent projections is justified, therefore, on the basis of this stability.

This chapter has shown evidence of increasing rates of movement directed at specific areas of the UK as a result of the general increase in migration since 1980/81. An alternative classification of migration profiles has therefore been derived based on more recent information. A direct comparison of the alternative classifications is not viable because of methodological and data differences. It is clear, however, that important changes have taken place in the directional rate of movement since 1980/81. The problem, therefore, is the integration of an alternative clustering procedure into the already established migration forecasting methodology. The benefits of the NHSCR profile classification developed in this chapter are that: it can be updated annually using the time-series data; it produces clusters based on similarities between observed rates of age-specific movement and thus accounts for variations in all four 'components' of the migration schedule and it includes implicitly the important, mainly long-distance migrations of students to places of education. However, it does not include moves to and from the Armed Forces, which are picked up by the Census, and suffers from the deficiencies of non-registration outlined in Chapters 4 and 5.

Ideally a classification derived from NHSCR data would be directly applicable to the current forecasting methodology. However, the presence of student moves in the NHSCR appears to greatly influence the clustering procedure due to the accentuated early peak in the labour force curve evident in many FPCA profiles. As student flows are not recorded by the Census they are handled explicitly by the procedure (estimated by individual LAs). Consequently the in-migration categories derived by Bates and Bracken produced rather convenient groupings of Inner and Outer London boroughs and Other Metropolitan Areas.

If an NHSCR-derived classification is to be utilised within the current forecasting methodology the NHSCR data needs to be used more fully in relation to all aspects of the procedure such as in the computation of GMRs and the assignment of out-migrations to destinations. The concluding chapter provides an indication of some possible future developments in forecasting using NHSCR information.

Chapter 10. SUMMARY, CONCLUSIONS AND FURTHER RESEARCH

10.1 INTRODUCTION

The research reported in this thesis has been undertaken with three main objectives: to formulate a detailed comparison of migration data provided by the Census and the NHSCR; to construct a detailed picture of spatio-temporal patterns and trends in migration during the 1970s and 1980s based on information from successive Censuses and from the NHSCR; and to assess the migration component of the OPCS/DOE sub-national population projection model. This concluding chapter summarises the major results and conclusions for each of these distinct but inter-related analyses, and provides some pointers for the use of NHSCR data in future research.

10.2 SUMMARISING NHSCR-CENSUS SIMILARITIES AND DIFFERENCES

During the acquisition and processing of the NHSCR Primary Unit Data, a comparison was carried out between Census migration data and already-available 'computer-summary' NHSCR data and some preliminary conclusions were drawn regarding the relationship and differences between the alternative data sources. The use of PUD allowed a much more consistent comparison to be carried out for a number of reasons. Firstly, given the understanding of the conceptual differences developed in Chapter 3, it was possible to derive NHSCR data with a period-cohort age-time plan (ATP) of observation similar to that of the Census. Secondly, and using a similar methodology, an estimate of the number of infant migrations, not recorded by the Census, was made to enable their exclusion from the NHSCR data set. Thirdly, the PUD provided a count of previously unknown 'not-stated' flows which were subsequently re-assigned on the basis of known distribution patterns. Finally, the processing of PUD established the fact that no Armed Forces (AF) moves, which are included in the Census, had been included in the computer summaries of NHSCR information. The PUD records origin zone upon recruitment to the AF and destination zone upon discharge but makes no distinction between specific AF areas. Furthermore PUD does not record moves within the AF. The recruitment and discharge flows constitute a considerable proportion of the total annual NHSCR movement so their re-assignment, based on zone-specific AF populations, had a significant effect upon NHSCR:Census ratio values.

A number of important characteristics of the NHSCR:Census relationship were discerned from the comparative analyses. The overall correlation between Census and NHSCR flows was high indicating similar patterns of migration, although the actual level of movement differed quite substantially. A scale effect was evident with the largest NHSCR:Census ratio values observed for flows between standard regions of the UK. The greater the percentage of longer-distance flows, the higher the observed ratio value. Census counts were shown to be more consistent with NHSCR figures for shorter distance migration due to the reduced effect of multiple and return movement which, it was hypothesised, becomes more important in the longer-distance predominantly employment related migration. Persons moving house but not employment are unlikely to do so more than once in a single year. Therefore, at spatial scales where these short-distance housing-related moves predominate, the multiple move phenomenon will be less important and the NHSCR:Census ratio will be lower. Relatively low ratio values for flows between contiguous areas, particularly between metropolitan FPCAs, confirmed this hypothesis. Certain metropolitan areas had very high ratio values. This was explained by a combination of two effects. Firstly, the considerable annual influx of students to Universities and Polytechnics, which are captured by the NHSCR but not the Census, and secondly the importance of multiple/return moves to these 'unattractive' urban areas particularly by young females seeking temporary employment. These features were emphasised by the age-sex comparison which illustrated significantly high ratio values for 15-19 year olds. The re-assignment of previously 'unknown' AF moves increases the level of movement, particularly in the 15-19 age-range, in a number of non-metropolitan zones. The method of re-assignment was rather crude but with the Census recording AF migrants the inclusion of recruitments and discharges in the NHSCR produces a more accurate comparison of actual levels of zone-specific movement. AF recruitments and discharges are obviously an important component of inter-zonal migration and their exclusion is a major drawback of the NHSCR data. If the register is to be used extensively as an alternative migration measure estimation of these AF moves is required. Without them the level of movement in the male, 15-19 age-group, in particular, is severely under-counted.

Flows for persons aged 75+ were also observed to have high ratio values, due in this instance to the prevalence of 'non-surviving' migrants in the older age-groups. The elderly are almost certain to register with the NHS upon transfer to a new FPCA. If they move, re-register but then die during the Census period they will be recorded as a move in the NHSCR but not as a migrant in the Census. In those FPCAs where the in-migration of the elderly is important the NHSCR:Census ratio value will, therefore, be inflated. Another significant characteristic of the NHSCR is the under-recording of moves by males aged 20-29. This was illustrated by the low ratio values observed in this age-range. This sub-group has been identified as the most likely to neglect re-registration upon transfer to a new FPCA, thus deflating the actual level of NHSCR movement relative to the Census. This deficiency will have an important effect upon the temporal trends evident in the NHSCR movement data.

The comparative analyses provided an invaluable insight into the relationship between Census and NHSCR migration data at a number of spatial scales and between age and sex groups, and showed the NHSCR to be a valuable source of migration data with a number of advantages over the Census. Firstly, it includes the re-registration of students at places of education whereas the census records students as usually resident at their 'permanent' address. Secondly, the NHSCR includes a count of moves made by infants. Thirdly, the NHSCR does include some measure of AF movement, albeit in the form of aggregate recruitments and discharges. A possible methodology for the deconsolidation of such flows was outlined in Chapter 5. Similarly, counts of those flows with either origin, age or sex 'not-stated' are available and can also be re-assigned to the known movement arrays. Finally, the NHSCR does provide a continuously updated record of internal migration in the UK at a relatively fine spatial scale with an age and sex breakdown. The Census, although detailed and comprehensive provides only a 'snapshot' view of internal migration processes at the beginning of each decade.

However, the NHSCR does have its disadvantages as a measure of migration. It has been shown, for example, that there is considerable under-recording of moves by males aged 20-29. They constitute a highly mobile section of the population so it is important to recognise this deficiency when interpreting patterns and trends in NHSCR movement data. Also the NHSCR does not record moves within individual FPCAs: ie. within metropolitan districts, non-metropolitan counties and London boroughs. Finally, the accuracy of the NHSCR is limited by not recording the actual time of move. Re-registration with the NHS is invariably not immediate upon transfer to a new FPCA. The timing of re-registration varies between age-groups so an estimated average three-month lag between move and re-registration has been adopted as a guideline.

In general, however, the NHSCR does appear to be an invaluable source of information on the internal movement of the population during inter-censal periods. Section 10.4 suggests some possible applications of the NHSCR data to an alternative population projection procedure in the context of future research projects.

10.3 CHANGE OVER TIME: A SUMMARY OF THE PATTERNS AND TRENDS IN MIGRATION, 1971-1986

A considerable amount of research time has been devoted to the collection and processing of migration and population data, both from published sources and from magnetic tapes supplied by OPCS. The result is a comprehensive system of information containing files of Census transition and NHSCR movement data, together with population data, at a variety of spatial scales and levels of aggregation. Using this information it has been possible to undertake a detailed analysis of the internal redistribution of the population of the UK during the period 1971-1986.

Using transition data from successive Censuses it was shown that the overall level of internal migration decreased by approximately

19% between 1970/71 and 1980/81 with the rate of longer-distance, inter-MNM movement falling by almost 30%. The process of counter-urbanization or decentralisation continued but at a reduced level with the most urbanised areas of the UK losing population through migration at a rate of -7 per 1000 in 1980/81. In both 1970/71 and 1980/81, all provincial metropolitan counties had negative net rates of migration for each age-group. The pattern for Greater London was significantly different. In 1980/81 considerable net gains were made in both the 20-24 male and female and 15-19 female age-groups. This was in contrast to 1970/71 when a substantial net loss of 20-24 year-olds from the capital was experienced. During the decade there was a reversal in the preferred direction of the net migration balances of these mobile age-groups towards Greater London at the expense of losses to other areas. In 1980/81 the greatest net losses from Greater London were observed for the 25-29 age-group and for females aged 60-64 and males aged 65-69. The importance of continuing decentralisation processes amongst young families and the retired is evident. The medium-low density areas of the South received substantial numbers of migrants in the 25-34 and 60-69 age-ranges with the movement of the latter to the least densely populated areas also significant. The levels of in-migration did fall considerably over the ten-year period, however, reflecting the importance of the capital as a generator of migrants. Only East Anglia maintained its 1970/71 level of 'retirement' in-migration over the period. The reduced but continuing decentralisation of the population in the South in 1980/81 was also evident in provincial metropolitan areas of the North but net losses were experienced from North to South. In the North all age-groups, except males aged

65-69, suffered net losses through migration with the South.

NHSCR data can be used to examine changes occurring in migration patterns on an annual basis. The level of inter-FPCA movement reached a low-point one year after the Census was taken, in 1981/82, with a total of approximately 1.6 million NHSCR moves (28.3 per 1000), compared with 1.9 million (34.4 per 1000) in 1975/76. The falling level of out-migration from Greater London observed in the inter-censal analysis was confirmed with the net outflow from the capital decreasing up until 1982/83, and the general propensity to migrate decreasing throughout the seventies and early eighties. Although the level of movement out of Greater London fell considerably, the proportion of these moves directed at the South East Remainder remained relatively stable. Decentralisation processes persisted even when the the general level of circulation was lower. Furthermore, the Rest of the South (ROS) gained in net terms throughout the eleven-year period at the expense of the other three macro-regions (Periphery, Industrial Heartland and Greater London). Since 1982/83, the general level and rate of movement have increased with greater net losses from the capital again fuelling the migration process. Increased movement from provincial metropolitan areas to Greater London has been observed with substantial increases in migration also occurring from these areas to FPCAs of the SE Remainder. Counter-urbanisation processes appear to be continuing not only in the South East but also in the West Midlands where the Remainder has increased its net gain since the early 1980s.

The significant patterns of age-sex migration illustrated by successive Censuses are reflected in the NHSCR trends. The time-series analysis emphasised the major reversal in the pattern of migration by those aged 20-24. In 1975/76, and indeed up until 1979/80, the pattern of net migration for metropolitan zones was one of net loss of males and females aged 20-24. In 1980/81 the situation changed, however, with high density, metropolitan areas beginning to experience substantial gains in this age-range. The process was particularly evident in the case of in-migration of females aged 20-24 to Greater London over the period. The large net gains appear to be concentrated in the capital and the Rest of the South East with a drift from North to South also evident. The expansion of the service sector economy in the capital and the necessary increased participation of women in the labour force has therefore had a dramatic effect upon the pattern of in-migration of females aged 20-24 into Greater London. With the diffusion of businesses away from the urban core the South East Remainder has also been attracting more people in this most mobile age-group. The dominance of the South East in the British economy during the 1980s, with its promise of high-salaried employment, has attracted migrants from throughout the UK with important long-distance movement from provincial metropolitan areas, particularly of those aged 20-24.

The trends in the pattern of movement are slightly different for the 15-19 age-group. In the North, a significant net gain of 15-19 year-olds has been observed in metropolitan areas throughout the period 1975-86, although in aggregate terms there has again been a net loss from North to South. A peak in the net gain of this age-group to Greater London occurred in 1982/83 with small decreases since then in the net inflow. Females have maintained generally higher rates of movement in this age-group. The annual movement of students to higher education will maintain a certain level of in-migration to areas containing major educational establishments. The migration profiles of a number of FPCAs, both metropolitan and non-metropolitan, were shown to be dominated by the peak in the rate of migration at around the time of entry to University. These areas will therefore continue to gain 15-19 year-old migrants each year but subsequently lose them when considerable out-migration to Greater London and the South East Remainder occurs in the 20-24 age-range. With a significant reduction in the size of the cohort of persons aged 15-19 imminent, the pattern of movement is likely to alter during the next decade with the continuing importance of student in-migration but a reduction in longer-distance employment-related moves with job surpluses likely to occur in public sector occupations such as nursing, for example, which require considerable annual recruitment of teenagers into the Health Service to maintain staff levels. One important feature of internal migration absent from the NHSCR data on which the analysis of trends have been based is the movement of young males to the Armed Forces. The level of recruitment and discharge has been shown to be significant in terms of affecting the level of in and out-migration to FPCAs such as Devon, Cornwall, Wiltshire, Hampshire, Lincolnshire etc., where large numbers of service personnel are present. These moves are, however, excluded from observed NHSCR totals due to the non-recording of destination upon recruitment and origin upon discharge. The number of males aged 15-19, in particular, moving into non-metropolitan FPCAs with large AF populations is under-counted by the NHSCR.

A greater degree of stability was exhibited by the migration patterns of the 'family' age-groups (0-14/25-54) during the period 1975/76 to 1985/86. The patterns were significant however in that net losses from the higher density areas were experienced each year throughout the period. The evidence from the 1981 Census suggested the continued importance of migration into the SE Remainder from Greater London. This trend has been observed since 1980/81 with the extension of the commuter field, the rapidly increasing property prices in the capital and the preferential relocation of businesses in the SE Remainder encouraging families to move away from more densely populated areas of Greater London. Those of retirement age exhibited similar tendencies over the eleven-year period with an even more significant trend towards migration to the least densely populated areas of the South.

With the capital continuing to dominate the migration system, the net pattern is currently one of decentralisation in all but the 15-19 and 20-24 age-groups. Young adults are moving to Greater London for education or employment. Probably living initially in private rented accommodation, they may choose, upon marriage or starting a family, or be forced for financial reasons, to live away from the most urbanised areas. Without changing employment, migrants are able to move out of the city into surrounding shire counties and still commute daily into work. High property prices in the capital will continue to force first-time buyers and young families into the surrounding non-metropolitan areas thus intensifying the process of counter-urbanisation. Furthermore, older migrants, of pre- or post-retirement age are continuing to choose to move from the city to more rural locations with the preferred destinations now stretching throughout the South West, East Anglia and Wales, with important retirement movement also evident from the medium-low density areas of the South to the more remote FPCAs in these regions.

10.4 AN EVALUATION OF THE CURRENT OPCS/DOE MIGRATION PROJECTION METHODOLOGY

The third aim of the thesis was to evaluate the methodology and data inputs to the current OPCS/DOE procedure for forecasting migration in the context of sub-national population projection, as outlined in detail in Section 2.5. Three particular features of the process have been examined in the thesis: the clustering of age-groups into broad age bands for the assignment of estimated outflows to destinations: the use of 1981 Census data in the assignment procedure; and the clustering of zone-specific migration profiles to simplify the estimation of in- and out-migration flows by single year of age and sex.

There appears to be little statistical justification for the way in which the OPCS/DOE model assigns estimated outflows to destinations using three broad age-bands deemed to represent the main components of age-specific movement: family moves (0-16 and 29-59); moves around the time of entry to the labour force (17-28) and moves by the elderly (60+). Section 8.4 derived an alternative age classification through the clustering of 5-year age-group data on the basis of similarities between patterns of inter-FPCA movement in 1984/85 and 1985/86. The result was three different age-bands: 0-14/25-54; 15-24 and 55+. The 25-29 age-group does not exhibit patterns of migration similar to the 15-24 age-range. The OPCS/DOE 17-28 category is described as:

> "...the most highly mobile, has the characteristic pattern dominated by movement to urban areas, particularly central London."
>
> (Martin, Voorhees & Bates, 1981, p8)

It has been illustrated within the analysis of NHSCR trends that it is only the 15-19 and 20-24 age-groups which are being continuously attracted to the capital. Those aged 25 and over are part of the decentralising migration process moving families and first-time buyers away from the most highly urbanised areas into non-metropolitan FPCAs. The 25-29 age-group, therefore, has patterns of inter-zonal movement more similar to those of the 'family' age-band than to those of 'moves at time of entry to the labour force'. It was also discovered that the pattern of movement by persons aged 55-59 reflected more the migration of those of retirement age than that of the family age-groups. Pre-retirement or early retirement migration was observed to be directed at the least densely populated areas of the UK, away from Greater London in particular and into the South West and East Anglia. The assignment of moves made by persons aged 55-59 should be combined, therefore, with the 60+ age-range rather than with the 25-54.

The broad age classifications are used within the assignment procedure of the projection model which is currently based on patterns of inter-zonal migration evident from the 1981 Census. These patterns are, in effect, assumed to remain constant over time. No updating of the inter-zonal array is undertaken using information from the NHSCR. In Section 8.6, NHSCR data for 1980/81 was compared with data for 1985/86 to establish the changes in age-specific migration which may affect the accuracy of the forecasting procedure. Goodness of fit statistics revealed that patterns of migration remained least stable for those aged 70+ and 15-19 with moves by persons aged 25-54 and 20-24 having more consistent distributions in 1980/81 and 1985/86. The rate of movement of 15-19 year-olds showed a general decline over the period particularly for moves into high density areas of Greater London and into and out of the medium-low density FPCAs of the South East. The level of in-migration to other metropolitan areas by the 15-19 year-olds showed a general increase with distance having a relatively minor effect reflecting the importance of student moves within this age-group. Movement of persons in the 20-24 age-group continued to be the most important component of the migration system although at a reduced rate. Increasingly the pattern for this age-group was of net gains in Greater London and the rest of the South East and net losses in the majority of other FPCAs, particularly in the North. Persons aged 20-24 were understandably those least affected by distance. Family migration, reflected in the movement of the 0-14 and 25-54 age-groups, maintained a pattern of net loss from high density FPCAs and net gain to the less urbanised areas of the UK particularly the South. The retirement (55-69) and post-retirement (70+) age-groups showed similar preferences with the major changes over the five-year period occurring in the latter. A general increase in the rate of post-retirement moves included a very significant reduction in the rate of movement to high density FPCAs between 1980/81 and 1985/86, with a corresponding increase, especially in Greater London, in the rate of out-movement. The mean length of post-retirement migration decreased considerably reflecting an increasing friction of distance effect. The increase in the rate of migration of those aged 55-69 and 70+ was particularly significant from non-metropolitan areas of the South East to more remote FPCAs of the South West and East Anglia.

The OPCS/DOE methodology is deficient, therefore, in its assumption that patterns of inter-zonal migration will remain stable over time. Important changes have been occurring ince 1980/81 which will affect the accurate assignment of out-flows to individual destinations. With the next Census not due until 1991 the projection procedure is likely to continue to utilise the 1981 Census as a base without the incorporation of trends evident in time-series NHSCR data.

The third aspect of the methodology which underwent investigation was the clustering of local authority areas based on similarities between observed, standardised, in- and out-migration profiles. A direct assessment of the 1981 Census-based procedure was not possible but an alternative methodology for cluster generation was illustrated. This methodology based on NHSCR data was seen to have a number of advantages. For example: it can be updated annually using the time-series data; it produces clusters based on similarities between observed rates of age-specific movement rather than calibrated parameter sets and thus accounts for variations in all four 'components' of the migration schedule, and it includes a measure of student flows to places of education. It does not, however, include Armed Forces moves and suffers from the deficiencies of non- registration in certain age-groups.

The great advantage of the NHSCR over the Census is that it provides a continuous record of migration. However, movement data is currently only used in the migration forecasting procedure as a method of updating zone-specific GMR values. The problem is clearly one of matching the data sources so that NHSCR information can be used as a direct alternative to the Census. The NHSCR has great potential as a means of continuously updating the assignment arrays and the migration profile clusters but there are a number of drawbacks. OPCS currently make projections for a total of 108 local authority (LA) areas: 36 metropolitan districts, 39 non-metropolitan counties and 33 London boroughs. The array of moves required for the assignment of estimated out-flows to destinations is, therefore, one of inter-zonal moves between 108 LA areas. In its most disaggregate form, the NHSCR records moves between FPCAs in England and Wales. FPCAs correspond to metropolitan districts (with the exception of Knowsley and St Helens which are combined to form a single FPCA) and non-metropolitan counties, but London boroughs are aggregated to form a total of 12 individual FPCAs. A certain degree of estimation of movement data is therefore required if complete assignment arrays are to be derived from the NHSCR. The deconsolidation of NHSCR flows could be undertaken using Census patterns as a guideline, incorporating 'bias' components to account for the NHSCR:Census differences by area age and sex (Chapter 5), together with a temporal component which accounted for the variation in the level of migration at the FPCA scale (Chapter 8). Once a full array has been derived the Census-based assignment proportions within the projection procedure could simply be trended, as in the case of the GMR values, in line with temporal changes in the distribution of inter-zonal NHSCR moves. However, the period ATP of observation for NHSCR age-groups would require conversion to the period-cohort ATP necessary for projection. Such complex adjustments are unlikely to be taken on board by OPCS in an effort to improve the forecasting procedure.

The incorporation of NHSCR based migration profile clusters would inevitably encounter similar problems of estimation. Age-specific in- and out-migration data would be required for the full set of

London boroughs, unless all boroughs within an FPCA were incorrectly assumed to have similar profiles. The measurement differences between the Census and the NHSCR assume greater importance in the clustering of profiles. The in-migration of students has been shown to dominate a number of the zone-specific profiles with the sharp peak in the labour-force curve having an important effect on the clustering procedure. Student moves are not incorporated directly into the migration forecasting process so the estimation of flows using NHSCR profile clusters would generate spurious results. Furthermore, the NHSCR does not include any AF moves, which will affect the shape of the migration profile for a number of non-metropolitan FPCAs, and which are included within the Census figures.

The incorporation of the NHSCR into the current projection procedure, therefore, not only requires a considerable amount of estimation but also produces important measurement differences between the two data sources which are difficult to reconcile. Taking these factors into account, and given the availability of the NHSCR time-series and the understanding of its limitations, it appears better to use NHSCR data streams directly for inter-censal years and use Census data to fill the spatial gaps than to use Census data directly and NHSCR indirectly to fill the temporal gaps. This entails adopting a movement model for projection in favour of a transition model.

10.5 THE USE OF NHSCR DATA IN FURTHER RESEARCH

The research undertaken in the thesis has produced a detailed understanding of the conceptual and measurement differences between the Census and the NHSCR and an appreciation of their use and disadvantages in migration analysis and population projection. Furthermore, using both data sources an investigation of trends in migration behaviour over an extended period has been reported. From the results produced it is evident that future research should be targeted on a number of areas.

Rather than attempting to use NHSCR as an update facility in the current migration forecasting methodology, an alternative procedure, based primarily on NHSCR movement data, requires development. This model would ideally produce similar data outputs to the official model and thus allow a direct comparison of results. The trends in the internal movement of the population illustrated using NHSCR data would be incorporated directly into the procedure using observed Census patterns to estimate missing flows at the local authority level. The spatial system would include English metropolitan districts, non-metropolitan counties and London boroughs together with Wales, Scotland and Northern Ireland. Annual projection figures would be required for both sexes by single years of age up to age 85+. The recommended strategy would be to adapt the OPCS/DOE model methodology to be used with data from the NHSCR, incorporating the alternative procedures developed in this thesis. The movement data would be processed directly from magnetic tape thus allowing the conversion, where necessary, of the ATP of observation to a projection-cohort type. The alternative classification of migration profiles to develop in- and out-migration clusters would be used and updated annually for successive base years. The assignment arrays could be improved by adopting the alternative age classification developed here, with a possible increase in the level of age-disaggregation. Again, they could be updated annually.

Given the detailed understanding of the limitations of the NHSCR in terms of under-recording and non- classification, the measurement problems can be overcome using the results of Chapters 4 and 5 to handle the biases evident in the movement data. Armed Forces moves, in particular, would require careful handling. A re-assignment procedure has been illustrated but this needs to be refined in order to derive a more accurate representation of the spatial pattern of recruitment and discharge and to establish the movement of persons within the Armed Forces. Age-sex biases would need to be accounted for particularly for males aged 20-24 where under-recording by the NHSCR is most severe.

The basis of an alternative model structure has been described in Rees (1984), which outlines procedures for population projection based on movement data and accounting methods. The problem in this instance would involve the expansion of the existing system to cater for a fully multi-regional model incorporating inter-zonal migration between 108 LA areas by age. Again a certain degree of aggregation by age would be required to maintain acceptable dimensions to the procedure. The development of an alternative projection methodology requires the continuous updating of the available migration and population information system. Thus NHSCR data in its most disaggregate form (PUD) needs to be collected annually to maintain the time-series. At the same time the patterns and trends in migration evidenced in previous chapters can be updated each year to maintain the detailed understanding required for the effective forecasting of migration. The results of the 1991 Census would enable another round of checking and comparison to be undertaken.

With the availability of such a large migration data base at

Leeds the scope for further empirical research is considerable. The research reported here has attempted to present a comprehensive illustration of spatio-temporal patterns and trends in migration with the South East receiving particular attention given its dominance within the internal migration system of the UK. Future research may be targeted, for example, on the linkages between demographic trends and socio-economic variables such as employment levels, public and private sector house building and marital status. This type of analysis would enable a wider interpretation of the dominant trends in migration and provide possible explanations for the increasing levels of decentralisation occurring from the most densely populated areas of the UK.

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APPENDIX TABLE 1A
NHSCR:Census outflow ratios at the FPCA scale

	FPCA	NHSCR	Census	Diff	Ratio	LCL	UCL	%CL
	DEVON	35.9	21.9	14.0	1.64	1.62	1.65	1.02
	LANCS	35.2	22.5	12.7	1.56	1.55	1.58	1.03
	HUMBERSD	20.7	13.4	7.3	1.54	1.52	1.56	1.36
	DYFED	9.1	5.9	3.2	1.54	1.50	1.57	2.05
	SUFFOLK	18.9	12.4	6.5	1.53	1.51	1.55	1.42
	CLEVELND	13.5	8.9	4.7	1.53	1.50	1.55	1.68
	KENT	46.0	30.2	15.8	1.52	1.51	1.54	0.90
	CUMBRIA	11.2	7.4	3.8	1.52	1.49	1.55	1.85
	W-GLAM	7.8	5.1	2.7	1.52	1.49	1.55	2.22
	DURHAM	15.9	10.5	5.4	1.52	1.49	1.54	1.55
	E-SUSSEX	24.0	15.8	8.2	1.52	1.50	1.54	1.26
	CAMBS	25.9	17.1	8.8	1.51	1.50	1.53	1.21
	HANTS	59.7	39.8	19.9	1.50	1.49	1.51	0.79
	SCOTLAND	62.8	41.9	20.9	1.50	1.49	1.51	0.77
*	WIRRAL	9.4	6.3	3.1	1.49	1.46	1.52	2.01
	GWENT	9.6	6.4	3.2	1.49	1.46	1.52	2.00
*	KIRKLEES	10.4	7.1	3.3	1.47	1.45	1.50	1.92
	DORSET	20.9	14.2	6.7	1.47	1.45	1.49	1.35
	NOTTS	24.9	16.9	8.0	1.47	1.45	1.49	1.23
	CORNWALL	16.1	11.0	5.1	1.47	1.44	1.49	1.54
	OXFORDSH	26.1	17.8	8.3	1.46	1.45	1.48	1.20
	SOMERSET	15.2	10.4	4.8	1.46	1.44	1.49	1.58
	LEICS	22.9	15.7	7.2	1.46	1.44	1.48	1.29
	GLOUCS	15.6	10.7	4.9	1.46	1.44	1.48	1.56
	AVON	27.4	18.8	8.6	1.46	1.44	1.47	1.18
	N-YORKS	26.9	18.5	8.4	1.45	1.43	1.47	1.19
	BERKS	31.1	21.5	9.6	1.45	1.43	1.46	1.10
	NORFOLK	19.8	13.7	6.0	1.44	1.42	1.46	1.39
	NTHMBLND	9.5	6.6	2.9	1.44	1.41	1.47	2.00
*	LEEDS	22.0	15.3	6.7	1.44	1.42	1.46	1.31
	MID-GLAM	10.9	7.6	3.3	1.43	1.41	1.46	1.87
	CLWYD	10.4	7.3	3.1	1.43	1.40	1.46	1.91
	W-SUSSEX	23.6	16.5	7.1	1.43	1.41	1.45	1.27
	NTHANTS	17.1	12.0	5.1	1.42	1.40	1.44	1.49
	WARWICKS	17.9	12.6	5.3	1.42	1.40	1.44	1.46
	GWYNEDD	7.4	5.2	2.2	1.42	1.39	1.45	2.27
*	CALDERDL	5.6	3.9	1.6	1.42	1.38	1.45	2.62
*	BRADFORD	13.5	9.6	4.0	1.42	1.39	1.44	1.68
*	ROCHDALE	7.4	5.3	2.2	1.41	1.38	1.44	2.27
*	COVENTRY	10.9	7.8	3.2	1.41	1.38	1.43	1.87
	ESSEX	42.3	30.2	12.1	1.40	1.39	1.41	0.94
*	SHEFFELD	14.5	10.4	4.1	1.39	1.37	1.41	1.62
	SALOP	13.6	9.8	3.8	1.39	1.36	1.41	1.67
	POWYS	3.8	2.7	1.0	1.39	1.34	1.43	3.19
	CHESIRE	29.3	21.2	8.1	1.38	1.37	1.40	1.14
*	LVERPOOL	19.2	13.9	5.3	1.38	1.36	1.40	1.41
	IOWIGHT	3.8	2.7	1.0	1.38	1.34	1.42	3.19
*	SUNDRLND	7.3	5.3	2.0	1.37	1.34	1.40	2.29
	SURREY	49.0	35.8	13.1	1.37	1.35	1.38	0.87
	BEDFORDS	19.7	14.4	5.3	1.37	1.35	1.38	1.39

	FPCA	NHSCR	Census	Diff	Ratio	LCL	UCL	%CL
	WILTS	21.9	16.0	5.8	1.36	1.34	1.38	1.32
	LINCS	20.2	14.9	5.3	1.36	1.34	1.38	1.37
*	BIRMINGH	35.9	26.7	9.2	1.34	1.33	1.36	1.02
	STAFFS	25.0	18.7	6.3	1.34	1.32	1.35	1.23
	HEREFORD	19.3	14.4	4.9	1.34	1.32	1.36	1.40
	HERTS	36.9	27.7	9.3	1.33	1.32	1.35	1.01
*	BOLTON	6.8	5.1	1.7	1.33	1.30	1.36	2.37
*	NEWCSTLE	13.0	9.8	3.2	1.32	1.30	1.35	1.71
	DERBYSHR	20.5	15.5	5.0	1.32	1.31	1.34	1.36
*	SALFORD	8.5	6.4	2.1	1.32	1.29	1.35	2.12
*	OLDHAM	5.8	4.4	1.4	1.31	1.28	1.35	2.56
*	BARNSLEY	4.5	3.4	1.1	1.31	1.27	1.35	2.93
*	STOCKPRT	11.2	8.6	2.6	1.31	1.28	1.33	1.85
*	LON-MIDD	96.2	73.8	22.4	1.30	1.30	1.31	0.62
*	LON-LSL	43.6	33.6	10.0	1.30	1.28	1.31	0.93
	S-GLAM	12.9	10.0	2.9	1.29	1.27	1.31	1.72
*	S-TYNESD	4.0	3.1	.9	1.27	1.23	1.31	3.11
*	LON-RWF	21.3	16.8	4.6	1.27	1.25	1.29	1.33
*	GATESHED	6.8	5.3	1.4	1.27	1.24	1.30	2.38
	BUCKS	26.1	20.6	5.5	1.27	1.25	1.28	1.20
*	WALSALL	7.6	6.0	1.6	1.27	1.24	1.30	2.25
*	LON-CROY	17.4	13.8	3.6	1.26	1.24	1.28	1.48
*	LON-CHNT	29.8	23.7	6.1	1.26	1.24	1.27	1.13
*	MANCHSTR	22.4	17.8	4.6	1.26	1.24	1.27	1.30
*	WAKEFELD	7.8	6.2	1.6	1.26	1.23	1.28	2.22
*	LON-CI	26.7	21.6	5.2	1.24	1.23	1.26	1.19
*	WOLVERHN	7.8	6.3	1.5	1.24	1.21	1.26	2.21
*	SEFTON	9.7	7.9	1.8	1.23	1.21	1.26	1.98
*	TRAFFORD	9.3	7.6	1.7	1.23	1.21	1.25	2.03
*	ROTHERHM	5.4	4.5	1.0	1.21	1.18	1.25	2.65
*	ST-HELEN	11.2	9.3	1.9	1.21	1.18	1.23	1.85
*	TAMESIDE	6.0	5.0	1.0	1.20	1.17	1.23	2.52
*	LON-BH	13.3	11.2	2.1	1.19	1.17	1.21	1.69
*	WIGAN	6.6	5.5	1.0	1.19	1.16	1.22	2.41
*	DUDLEY	6.8	5.7	1.1	1.19	1.16	1.22	2.38
*	LON-BROM	14.0	11.8	2.2	1.19	1.17	1.21	1.65
*	BURY	6.1	5.1	.9	1.18	1.15	1.21	2.51
*	LON-BG	17.2	14.6	2.5	1.17	1.15	1.19	1.49
*	N-TYNESD	6.1	5.2	.8	1.16	1.13	1.19	2.51
*	LON-MSW	33.3	28.7	4.6	1.16	1.15	1.17	1.06
*	LON-RK	17.7	15.3	2.4	1.16	1.14	1.18	1.47
*	LON-KCW	29.5	26.3	3.2	1.12	1.11	1.13	1.13
*	DONCASTR	6.9	6.2	.7	1.11	1.08	1.14	2.36
*	SANDWELL	8.1	7.3	.8	1.11	1.08	1.13	2.17
*	SOLIHULL	9.0	8.2	.8	1.10	1.08	1.13	2.06

* Indicates metropolitan FPCA

APPENDIX TABLE 1B
NHSCR:Census inflow ratios at the FPCA scale

	FPCA	NHSCR	Census	Diff	Ratio	LCL	UCL	%CL
	W-GLAM	7.8	4.2	3.6	1.87	1.83	1.92	2.22
*	COVENTRY	9.4	5.3	4.1	1.78	1.75	1.82	2.02
	CLEVELND	10.4	5.9	4.5	1.76	1.72	1.79	1.92
*	SHEFFELD	14.0	8.0	6.0	1.74	1.72	1.77	1.65
*	NEWCSTLE	11.7	7.0	4.7	1.67	1.64	1.70	1.81
*	LEEDS	20.4	12.6	7.8	1.62	1.60	1.64	1.36
	LEICS	25.3	15.8	9.5	1.61	1.59	1.63	1.22
	HUMBERSD	19.0	11.9	7.2	1.60	1.58	1.63	1.41
*	S-TYNESD	3.0	1.9	1.1	1.59	1.54	1.65	3.58
*	MANCHSTR	20.3	12.8	7.5	1.59	1.57	1.61	1.37
	AVON	30.2	19.0	11.2	1.59	1.57	1.61	1.12
	DYFED	11.3	7.2	4.1	1.58	1.55	1.61	1.84
*	BIRMINGH	29.0	19.0	10.1	1.53	1.51	1.55	1.14
	DEVON	40.8	26.7	14.1	1.53	1.51	1.54	0.96
	DURHAM	14.6	9.7	4.8	1.50	1.47	1.52	1.62
	WIRRAL	8.5	5.7	2.8	1.50	1.46	1.53	2.12
	OXFORDSH	27.9	18.7	9.2	1.49	1.47	1.51	1.16
	GWYNEDD	8.5	5.7	2.8	1.49	1.46	1.52	2.12
	CAMBS	30.5	20.6	9.9	1.48	1.46	1.50	1.11
	SCOTLAND	56.5	38.6	17.9	1.46	1.45	1.47	0.81
*	LVERPOOL	13.2	9.0	4.2	1.46	1.44	1.49	1.70
*	LON-CHNT	25.5	17.5	8.0	1.46	1.44	1.47	1.22
*	BRADFORD	11.6	8.0	3.6	1.45	1.43	1.48	1.82
	E-SUSSEX	30.4	20.9	9.5	1.45	1.44	1.47	1.12
	LANCS	36.9	25.5	11.4	1.45	1.43	1.46	1.01
	SUFFOLK	23.9	16.5	7.4	1.45	1.43	1.46	1.26
	MID-GLAM	9.6	6.7	3.0	1.44	1.41	1.47	1.99
*	CALDERDL	5.4	3.8	1.7	1.44	1.40	1.48	2.66
	NORFOLK	24.9	17.4	7.6	1.44	1.42	1.45	1.23
	GLOUCS	17.2	12.0	5.2	1.43	1.41	1.45	1.49
	DORSET	28.0	19.7	8.4	1.43	1.41	1.44	1.16
	KENT	48.2	34.1	14.1	1.41	1.40	1.43	0.88
	IOWIGHT	5.0	3.5	1.5	1.41	1.38	1.45	2.77
	S-GLAM	12.3	8.7	3.6	1.41	1.39	1.44	1.76
	BEDFORDS	20.6	14.6	6.0	1.41	1.39	1.43	1.36
	NOTTS	24.3	17.3	7.0	1.40	1.39	1.42	1.25
	BERKS	35.1	25.1	10.1	1.40	1.39	1.42	1.04
*	LON-CI	28.4	20.3	8.1	1.40	1.38	1.42	1.15
*	SUNDRLND	6.9	5.0	1.9	1.39	1.36	1.42	2.35
	ESSEX	49.7	36.1	13.7	1.38	1.37	1.39	0.87
*	KIRKLEES	9.4	6.9	2.5	1.37	1.34	1.39	2.02
	CUMBRIA	11.1	8.1	3.0	1.36	1.34	1.39	1.86
	N-YORKS	29.4	21.7	7.7	1.36	1.34	1.37	1.13
*	OLDHAM	5.2	3.8	1.3	1.35	1.32	1.39	2.73
	SOMERSET	18.3	13.7	4.6	1.34	1.32	1.36	1.44
	HERTS	38.7	29.0	9.7	1.34	1.32	1.35	0.99
	W-SUSSEX	32.6	24.5	8.2	1.33	1.32	1.35	1.08
	DERBYSHR	23.1	17.3	5.8	1.33	1.32	1.35	1.28
	STAFFS	26.3	19.8	6.6	1.33	1.32	1.35	1.20
*	WAKEFELD	8.0	6.0	2.0	1.33	1.30	1.36	2.18

* Indicates metropolitan FPCA

	FPCA	NHSCR	Census	Diff	Ratio	LCL	UCL	%CL
	HANTS	64.7	48.7	16.0	1.33	1.32	1.34	0.76
	NTHANTS	20.0	15.0	4.9	1.33	1.31	1.35	1.38
	GWENT	8.4	6.4	2.1	1.33	1.30	1.35	2.13
	SURREY	48.4	36.5	11.9	1.32	1.31	1.34	0.88
	CHESIRE	30.8	23.3	7.5	1.32	1.31	1.34	1.11
*	LON-RWF	18.0	13.7	4.3	1.32	1.30	1.34	1.45
	CORNWALL	19.6	14.9	4.7	1.32	1.30	1.34	1.39
	CLWYD	11.8	9.0	2.8	1.31	1.29	1.33	1.80
	WARWICKS	17.5	13.3	4.1	1.31	1.29	1.33	1.48
	HEREFORD	23.7	18.1	5.5	1.31	1.29	1.32	1.27
	BUCKS	33.5	25.8	7.7	1.30	1.28	1.31	1.06
*	ROCHDALE	6.3	4.9	1.5	1.30	1.26	1.33	2.46
*	ST-HELEN	7.9	6.1	1.8	1.29	1.27	1.32	2.21
	WILTS	25.8	20.0	5.8	1.29	1.28	1.31	1.21
	SALOP	14.9	11.6	3.3	1.29	1.27	1.31	1.60
*	LON-LSL	36.8	28.7	8.1	1.28	1.27	1.29	1.01
*	LON-KCW	28.6	22.4	6.3	1.28	1.27	1.30	1.15
*	STOCKPRT	10.0	7.8	2.2	1.28	1.25	1.30	1.96
*	WOLVERHN	5.9	4.6	1.3	1.28	1.25	1.31	2.54
*	GATESHED	5.0	3.9	1.1	1.28	1.24	1.31	2.76
*	SEFTON	8.7	6.9	1.9	1.27	1.25	1.30	2.09
*	TAMESIDE	5.6	4.4	1.2	1.27	1.24	1.30	2.60
*	LON-MIDD	82.2	64.9	17.3	1.27	1.26	1.28	0.67
*	BOLTON	6.4	5.0	1.3	1.27	1.24	1.30	2.45
	POWYS	4.5	3.5	.9	1.26	1.22	1.29	2.93
*	LON-BG	16.4	13.2	3.2	1.25	1.23	1.26	1.52
*	SALFORD	6.1	4.9	1.2	1.24	1.21	1.27	2.51
*	DONCASTR	7.0	5.7	1.3	1.23	1.20	1.26	2.34
*	BARNSLEY	4.1	3.4	.8	1.22	1.19	1.26	3.04
*	ROTHERHM	5.9	4.8	1.1	1.22	1.19	1.25	2.55
*	LON-MSW	30.3	24.9	5.4	1.21	1.20	1.23	1.12
	LINCS	22.9	18.9	4.0	1.21	1.20	1.23	1.29
*	N-TYNESD	5.7	4.7	1.0	1.21	1.18	1.24	2.58
*	TRAFFORD	7.5	6.2	1.3	1.21	1.18	1.24	2.26
*	LON-RK	16.8	14.0	2.9	1.21	1.19	1.22	1.50
*	LON-BH	11.1	9.2	1.8	1.20	1.18	1.22	1.86
*	LON-CROY	15.3	12.8	2.5	1.20	1.18	1.22	1.58
*	WIGAN	5.9	5.0	.9	1.18	1.15	1.21	2.55
*	SOLIHULL	8.7	7.3	1.3	1.18	1.16	1.21	2.10
*	BURY	5.4	4.5	.8	1.18	1.15	1.21	2.67
*	WALSALL	5.9	5.0	.9	1.18	1.15	1.21	2.56
	NTHMBLND	9.9	8.5	1.5	1.17	1.15	1.20	1.96
*	LON-BROM	13.9	12.4	1.6	1.13	1.11	1.15	1.65
*	SANDWELL	6.0	5.5	.5	1.10	1.07	1.12	2.52
*	DUDLEY	6.0	5.8	.2	1.04	1.02	1.07	2.52

APPENDIX TABLE 2A

Origin-specific NHSCR and Census MMLs and beta values and their ratios at the FPCA scale

FPCA	Mean migration length NHSCR	Mean migration length Census	Mean migration length Ratio	Beta parameter NHSCR	Beta parameter Census	Beta parameter Ratio
SCOTLAND	443.6	446.3	0.99	0.38	0.40	0.94
GATESHED	118.5	101.8	1.16	1.17	1.32	0.89
NEWCSTLE	158.6	132.5	1.20	1.11	1.26	0.88
N-TYNESD	148.0	121.3	1.22	1.14	1.34	0.85
S-TYNESD	151.3	134.6	1.12	1.10	1.22	0.90
SUNDRLND	165.7	152.3	1.09	1.11	1.24	0.89
CLEVELND	196.6	190.2	1.03	1.06	1.17	0.90
CUMBRIA	229.2	220.3	1.04	1.05	1.24	0.85
DURHAM	181.1	169.7	1.07	1.16	1.32	0.88
NTHMBLND	196.3	175.4	1.12	1.24	1.46	0.85
BARNSLEY	99.2	85.6	1.16	1.38	1.59	0.86
DONCASTR	123.7	120.8	1.02	1.30	1.40	0.94
ROTHERHM	86.8	75.2	1.15	1.52	1.72	0.88
SHEFFELD	110.1	98.8	1.11	1.35	1.52	0.89
BRADFORD	127.0	113.2	1.12	1.13	1.32	0.85
CALDERDL	110.7	99.2	1.12	1.21	1.38	0.87
KIRKLEES	126.5	113.0	1.12	1.06	1.26	0.84
LEEDS	122.9	111.0	1.11	1.25	1.42	0.88
WAKEFELD	104.3	88.6	1.18	1.37	1.61	0.85
HUMBERSD	179.1	171.4	1.05	1.27	1.45	0.87
N-YORKS	178.5	170.3	1.05	1.09	1.30	0.84
DERBYSHR	114.3	104.8	1.09	1.36	1.57	0.87
LEICS	129.5	125.3	1.03	1.19	1.33	0.89
LINCS	156.6	152.2	1.03	1.34	1.53	0.88
NTHANTS	137.9	130.1	1.06	0.92	1.17	0.79
NOTTS	129.3	116.2	1.11	1.21	1.47	0.82
CAMBS	142.8	134.6	1.06	1.20	1.44	0.83
NORFOLK	193.4	181.1	1.07	1.24	1.49	0.83
SUFFOLK	167.6	155.9	1.07	1.26	1.47	0.85
BEDFORDS	110.4	107.2	1.03	1.15	1.25	0.92
BUCKS	112.6	111.3	1.01	1.03	1.11	0.94
ESSEX	138.6	127.4	1.09	1.01	1.20	0.84
HERTS	111.1	99.2	1.12	0.94	1.15	0.82
BERKS	120.0	111.5	1.08	0.96	1.12	0.85
E-SUSSEX	147.4	134.8	1.09	1.17	1.36	0.86
HANTS	164.1	161.9	1.01	0.87	.93	0.93
IOWIGHT	153.7	145.3	1.06	1.00	1.09	0.92
KENT	162.9	155.4	1.05	0.95	1.08	0.88
OXFORDSH	128.2	124.2	1.03	1.03	1.15	0.89
SURREY	111.0	97.5	1.14	0.96	1.16	0.83
W-SUSSEX	126.1	118.7	1.06	1.20	1.33	0.90
LON-CHNT	62.5	49.6	1.26	1.14	1.34	0.85
LON-RWF	68.8	58.9	1.17	1.16	1.32	0.87
LON-BH	68.8	60.0	1.15	1.31	1.49	0.88
LON-CI	62.3	47.6	1.31	1.07	1.27	0.84
LON-KCW	67.1	52.5	1.28	1.00	1.19	0.84
LON-RK	84.6	66.5	1.27	0.96	1.19	0.81
LON-MSW	72.6	61.8	1.17	1.06	1.22	0.87
LON-CROY	79.0	67.8	1.17	1.05	1.20	0.87
LON-LSL	69.4	57.5	1.21	1.08	1.25	0.86

FPCA	Mean migration length NHSCR	Mean migration length Census	Mean migration length Ratio	Beta parameter NHSCR	Beta parameter Census	Beta parameter Ratio
LON-BROM	83.2	72.4	1.15	1.05	1.21	0.87
LON-BG	81.3	71.2	1.14	1.07	1.22	0.88
LON-MIDD	87.2	77.7	1.12	1.02	1.17	0.87
AVON	149.7	145.5	1.03	1.15	1.21	0.95
CORNWALL	299.0	292.2	1.02	1.16	1.24	0.94
DEVON	244.4	232.6	1.05	1.09	1.23	0.89
DORSET	166.2	161.0	1.03	1.25	1.33	0.94
GLOUCS	139.2	131.8	1.06	1.14	1.33	0.85
SOMERSET	155.8	146.4	1.06	1.27	1.43	0.89
WILTS	142.9	144.9	0.99	1.05	1.04	0.01
BIRMINGH	90.3	76.9	1.17	1.42	1.58	0.90
COVENTRY	105.6	91.9	1.15	1.04	1.20	0.87
DUDLEY	74.7	66.9	1.12	1.55	1.67	0.93
SANDWELL	61.2	46.1	1.33	1.50	1.73	0.87
SOLIHULL	70.6	59.9	1.18	1.46	1.65	0.88
WALSALL	76.2	61.8	1.23	1.50	1.71	0.87
WOLVERHN	85.7	68.3	1.26	1.44	1.67	0.86
HEREFORD	122.0	112.7	1.08	1.52	1.77	0.86
SALOP	136.4	134.2	1.02	1.36	1.44	0.94
STAFFS	119.4	110.7	1.08	1.41	1.63	0.86
WARWICKS	112.0	100.9	1.11	1.10	1.32	0.83
BOLTON	105.1	94.8	1.11	1.17	1.31	0.89
BURY	89.1	73.4	1.21	1.27	1.47	0.86
MANCHSTR	87.1	66.7	1.31	1.28	1.52	0.85
OLDHAM	105.1	85.4	1.23	1.11	1.34	0.83
ROCHDALE	91.2	78.8	1.16	1.30	1.48	0.88
SALFORD	82.3	61.8	1.33	1.27	1.53	0.83
STOCKPRT	103.0	92.3	1.12	1.14	1.30	0.87
TAMESIDE	86.0	75.7	1.14	1.29	1.46	0.89
TRAFFORD	87.0	77.3	1.12	1.24	1.38	0.89
WIGAN	92.0	81.4	1.13	1.35	1.51	0.89
LVERPOOL	101.3	86.6	1.17	1.33	1.50	0.89
ST-HELEN	83.9	66.4	1.26	1.43	1.67	0.86
SEFTON	126.2	112.1	1.13	1.21	1.40	0.86
WIRRAL	138.1	129.3	1.07	1.06	1.18	0.90
CHESIRE	130.5	127.4	1.02	1.17	1.27	0.92
LANCS	163.7	156.5	1.05	1.05	1.20	0.88
CLWYD	138.8	133.6	1.04	1.44	1.57	0.92
DYFED	205.6	203.3	1.01	1.57	1.66	0.94
GWENT	134.4	132.7	1.01	1.34	1.38	0.97
GWYNEDD	195.1	192.5	1.01	1.79	1.89	0.94
MID-GLAM	130.8	118.8	1.10	1.49	1.64	0.91
POWYS	145.4	140.2	1.04	2.07	2.25	0.92
S-GLAM	146.5	141.8	1.03	1.23	1.30	0.95
W-GLAM	172.5	164.1	1.05	1.37	1.49	0.92

APPENDIX TABLE 2B

Destination-specific NHSCR and Census MMLs and beta values and their ratios at the FPCA scale

FPCA	Mean migration length NHSCR	Census	Ratio	Beta parameter NHSCR	Census	Ratio
SCOTLAND	421.0	427.6	0.98	0.51	0.34	1.51
GATESHED	99.5	74.5	1.34	1.18	1.32	0.89
NEWCSTLE	162.1	119.4	1.36	0.99	1.19	0.83
N-TYNESD	125.4	91.0	1.38	1.15	1.35	0.86
S-TYNESD	149.6	118.8	1.26	1.01	1.16	0.87
SUNDRLND	137.3	98.6	1.39	1.15	1.40	0.83
CLEVELND	181.8	162.3	1.12	1.07	1.28	0.84
CUMBRIA	210.3	201.3	1.04	1.14	1.28	0.89
DURHAM	159.6	134.4	1.19	1.20	1.41	0.85
NTHMBLND	153.3	143.9	1.06	1.40	1.46	0.96
BARNSLEY	88.2	77.3	1.14	1.45	1.60	0.91
DONCASTR	120.1	115.6	1.04	1.29	1.35	0.95
ROTHERHM	83.3	64.6	1.29	1.51	1.76	0.86
SHEFFELD	121.9	106.1	1.15	1.12	1.33	0.84
BRADFORD	115.6	101.5	1.14	1.15	1.32	0.87
CALDERDL	97.8	77.9	1.26	1.24	1.50	0.83
KIRKLEES	101.9	83.2	1.23	1.24	1.48	0.84
LEEDS	129.9	111.8	1.16	1.08	1.29	0.84
WAKEFELD	94.6	83.8	1.13	1.40	1.55	0.90
HUMBERSD	167.7	155.1	1.08	1.41	1.67	0.85
N-YORKS	164.3	155.9	1.05	1.14	1.27	0.89
DERBYSHR	107.2	95.5	1.12	1.42	1.65	0.86
LEICS	131.3	125.3	1.05	1.13	1.28	0.88
LINCS	155.8	146.5	1.06	1.34	1.62	0.83
NTHANTS	124.7	117.2	1.06	1.27	1.49	0.85
NOTTS	132.0	119.8	1.10	1.14	1.35	0.84
CAMBS	147.2	138.5	1.06	1.17	1.42	0.83
NORFOLK	188.0	177.3	1.06	1.46	1.71	0.85
SUFFOLK	167.9	146.6	1.15	1.35	1.75	0.77
BEDFORDS	114.0	101.6	1.12	1.14	1.39	0.82
BUCKS	108.7	106.5	1.02	1.13	1.21	0.94
ESSEX	118.7	108.2	1.10	1.29	1.47	0.87
HERTS	104.5	95.6	1.09	1.04	1.18	0.88
BERKS	121.6	115.1	1.06	0.99	1.12	0.88
E-SUSSEX	142.0	132.7	1.07	1.31	1.47	0.89
HANTS	171.7	168.2	1.02	0.90	1.00	0.90
IOWIGHT	153.7	157.7	0.97	1.12	1.12	1.00
KENT	154.1	147.1	1.05	1.10	1.22	0.91
OXFORDSH	134.3	127.3	1.06	1.00	1.18	0.85
SURREY	108.8	99.0	1.10	1.01	1.15	0.88
W-SUSSEX	119.5	113.6	1.05	1.35	1.49	0.91
LON-CHNT	87.3	70.5	1.24	0.90	1.06	0.85
LON-RWF	73.3	57.2	1.28	1.08	1.27	0.85
LON-BH	55.8	47.9	1.17	1.46	1.62	0.90
LON-CI	93.0	74.1	1.25	0.79	0.95	0.83
LON-KCW	113.1	92.1	1.23	0.65	0.81	0.80
LON-RK	82.0	68.6	1.19	0.98	1.13	0.87
LON-MSW	80.4	65.5	1.23	0.97	1.13	0.86
LON-CROY	77.5	60.9	1.27	1.04	1.23	0.85
LON-LSL	88.5	71.1	1.24	0.89	1.06	0.85

FPCA	Mean migration length NHSCR	Census	Ratio	Beta parameter NHSCR	Census	Ratio
LON-BROM	76.4	62.2	1.23	1.10	1.27	0.86
LON-BG	74.8	65.7	1.14	1.11	1.23	0.90
LON-MIDD	103.6	89.4	1.16	0.87	1.02	0.86
AVON	159.8	158.4	1.01	1.10	1.16	0.95
CORNWALL	311.7	308.8	1.01	1.18	1.28	0.92
DEVON	255.7	246.1	1.04	1.12	1.29	0.87
DORSET	179.1	171.4	1.04	1.19	1.38	0.87
GLOUCS	138.8	133.1	1.04	1.24	1.39	0.89
SOMERSET	163.0	156.1	1.04	1.29	1.43	0.90
WILTS	152.2	145.3	1.05	1.01	1.20	0.85
BIRMINGH	94.6	74.7	1.27	1.31	1.52	0.86
COVENTRY	109.7	88.4	1.24	0.98	1.20	0.82
DUDLEY	67.6	52.0	1.30	1.54	1.75	0.88
SANDWELL	54.7	36.2	1.51	1.49	1.76	0.85
SOLIHULL	60.3	54.8	1.10	1.50	1.58	0.95
WALSALL	66.4	46.0	1.45	1.53	1.83	0.84
WOLVERHN	74.7	61.5	1.21	1.50	1.66	0.90
HEREFORD	111.1	103.9	1.07	1.70	1.86	0.91
SALOP	127.3	124.6	1.02	1.46	1.51	0.97
STAFFS	102.3	90.2	1.13	1.67	1.95	0.85
WARWICKS	101.7	88.3	1.15	1.18	1.35	0.87
BOLTON	80.2	70.4	1.14	1.32	1.43	0.92
BURY	77.4	59.2	1.31	1.28	1.50	0.85
MANCHSTR	100.1	70.3	1.42	1.06	1.35	0.79
OLDHAM	78.2	59.4	1.32	1.27	1.49	0.85
ROCHDALE	76.2	58.2	1.31	1.36	1.59	0.86
SALFORD	78.3	50.1	1.56	1.21	1.53	0.79
STOCKPRT	77.0	68.5	1.12	1.30	1.39	0.93
TAMESIDE	68.0	52.2	1.30	1.39	1.59	0.87
TRAFFORD	69.1	60.0	1.15	1.32	1.42	0.92
WIGAN	79.0	59.9	1.32	1.38	1.66	0.84
LVERPOOL	105.8	69.6	1.52	1.18	1.54	0.77
ST-HELEN	69.9	54.5	1.28	1.46	1.68	0.87
SEFTON	100.3	85.9	1.17	1.34	1.51	0.88
WIRRAL	105.6	97.5	1.08	1.22	1.30	0.94
CHESIRE	109.1	100.1	1.09	1.31	1.43	0.91
LANCS	139.2	126.8	1.10	1.20	1.36	0.88
CLWYD	123.9	114.4	1.08	1.51	1.67	0.91
DYFED	205.0	199.8	1.03	1.64	1.76	0.93
GWENT	134.1	125.0	1.07	1.39	1.52	0.92
GWYNEDD	183.0	179.3	1.02	1.92	2.02	0.95
MID-GLAM	133.0	110.4	1.21	1.50	1.75	0.86
POWYS	149.3	139.2	1.07	1.96	2.28	0.86
S-GLAM	146.5	148.1	.99	1.29	1.30	0.99
W-GLAM	157.9	146.9	1.08	1.63	1.78	0.91

APPENDIX TABLE 3A

MODEL parameters: 1980/81 out-migration

FPCA	A.1	ALPHA.1	A.2	MU.2	ALPHA.2	LAMBDA.2	C	E
SCOTLAND	0.020	0.069	0.061	20.6	0.117	0.39	0.003	10.8
GATESHED	0.023	0.168	0.076	21.0	0.133	0.30	0.005	29.7
NEWCSTLE	0.013	0.059	0.066	20.5	0.108	0.45	0.003	22.3
N-TYNESD	0.023	0.231	0.085	21.1	0.160	0.35	0.006	31.7
S-TYNESD	0.011	0.084	0.057	19.7	0.151	0.53	0.007	40.5
SUNDRLND	0.014	0.081	0.052	19.1	0.086	0.55	0.004	23.7
CLEVELND	0.013	0.039	0.034	18.2	0.082	1.51	0.004	17.7
CUMBRIA	0.012	0.094	0.052	18.0	0.104	1.09	0.005	23.9
DURHAM	0.015	0.104	0.063	19.1	0.116	0.51	0.005	19.9
NTHMBLND	0.017	0.083	0.046	18.2	0.082	0.66	0.004	26.1
BARNSLEY	0.018	0.090	0.038	17.6	0.084	4.18	0.005	31.0
DONCASTR	0.011	0.130	0.033	32.4	0.247	0.10	0.007	32.6
ROTHERHM	0.022	0.112	0.063	20.4	0.116	0.27	0.004	32.2
SHEFFELD	0.012	0.095	0.097	20.5	0.158	0.41	0.004	25.1
BRADFORD	0.010	0.012	0.052	19.2	0.123	0.49	0.002	18.8
CALDERDL	0.016	0.094	0.068	21.4	0.175	0.23	0.006	28.8
KIRKLEES	0.014	0.044	0.041	17.9	0.085	2.29	0.003	21.4
LEEDS	0.012	0.107	0.084	20.8	0.157	0.36	0.005	19.5
WAKEFELD	0.015	0.019	0.044	18.9	0.098	0.33	0.000	25.0
HUMBERSD	0.013	0.041	0.054	18.2	0.108	0.65	0.003	17.8
N-YORKS	0.015	0.049	0.060	19.4	0.147	0.42	0.004	16.1
DERBYSHR	0.014	0.082	0.046	18.0	0.097	2.10	0.005	16.5
LEICS	0.015	0.087	0.068	18.9	0.126	0.75	0.004	17.6
LINCS	0.016	0.072	0.038	18.0	0.115	1.21	0.006	21.1
NTHANTS	0.016	0.053	0.027	18.3	0.073	2.53	0.005	14.1
NOTTS	0.011	0.051	0.058	18.8	0.115	0.68	0.004	15.7
CAMBS	0.012	0.031	0.082	20.8	0.183	0.42	0.003	17.1
NORFOLK	0.011	0.038	0.054	18.7	0.127	0.69	0.004	15.9
SUFFOLK	0.013	0.049	0.039	17.9	0.108	1.63	0.005	20.6
BEDFORDS	0.017	0.085	0.039	18.8	0.079	0.56	0.005	19.5
BUCKS	0.012	0.061	0.030	18.1	0.084	2.21	0.006	17.9
ESSEX	0.012	0.063	0.039	18.3	0.095	1.13	0.005	14.9
HERTS	0.011	0.141	0.063	19.6	0.139	0.41	0.007	16.5
BERKS	0.010	0.061	0.045	18.4	0.100	0.93	0.005	17.8
E-SUSSEX	0.006	0.053	0.081	23.7	0.214	0.20	0.006	18.7
HANTS	0.013	0.060	0.055	19.9	0.140	0.44	0.006	13.6
IOWIGHT	0.010	0.028	0.050	18.5	0.150	0.78	0.005	34.5
KENT	0.010	0.068	0.048	18.5	0.123	0.70	0.006	12.5
OXFORDSH	0.011	0.018	0.071	20.3	0.161	0.46	0.002	16.0
SURREY	0.006	0.054	0.079	20.3	0.180	0.38	0.006	14.8
W-SUSSEX	0.011	0.042	0.039	18.3	0.108	1.70	0.005	15.9
LON-CHNT	0.015	0.131	0.066	23.7	0.154	0.25	0.007	12.9
LON-RWF	0.017	0.225	0.073	22.8	0.181	0.27	0.007	16.2
LON-BH	0.008	0.166	0.068	21.4	0.179	0.32	0.008	23.7
LON-CI	0.010	0.128	0.057	21.3	0.112	0.38	0.006	15.2
LON-KCW	0.017	0.115	0.041	21.2	0.082	0.42	0.005	18.8
LON-RK	0.011	0.106	0.067	21.4	0.139	0.35	0.006	19.2
LON-MSW	0.014	0.120	0.071	22.1	0.149	0.27	0.006	16.7
LON-CROY	0.019	0.368	0.049	28.4	0.265	0.15	0.008	21.8
LON-LSL	0.010	0.132	0.057	22.6	0.130	0.31	0.007	13.9

FPCA	A.1	ALPHA.1	A.2	MU.2	ALPHA.2	LAMBDA.2	C	E
LON-BROM	0.010	0.127	0.084	24.4	0.221	0.21	0.007	18.5
LON-BG	0.018	0.154	0.044	19.2	0.094	0.59	0.006	21.2
LON-MIDD	0.012	0.218	0.081	24.1	0.205	0.22	0.007	13.1
AVON	0.011	0.072	0.078	19.4	0.147	0.53	0.005	18.7
CORNWALL	0.014	0.085	0.044	17.8	0.099	1.87	0.005	21.4
DEVON	0.014	0.092	0.070	19.3	0.139	0.47	0.005	13.8
DORSET	0.010	0.049	0.051	18.5	0.127	1.04	0.005	18.0
GLOUCS	0.012	0.056	0.047	17.9	0.121	1.04	0.005	18.9
SOMERSET	0.009	0.049	0.044	17.9	0.127	1.71	0.006	19.3
WILTS	0.014	0.045	0.027	17.8	0.080	1.66	0.005	16.1
BIRMINGH	0.012	0.110	0.073	21.0	0.134	0.32	0.005	12.7
COVENTRY	0.010	0.084	0.057	19.4	0.117	0.62	0.006	21.4
DUDLEY	0.018	0.099	0.046	19.8	0.092	0.31	0.005	25.0
SANDWELL	0.019	0.142	0.073	22.4	0.144	0.23	0.005	22.8
SOLIHULL	0.020	0.170	0.043	30.1	0.336	0.14	0.007	24.7
WALSALL	0.017	0.164	0.066	21.2	0.145	0.26	0.006	27.2
WOLVERHN	0.010	0.110	0.079	26.8	0.300	0.18	0.006	29.1
HEREFORD	0.014	0.073	0.048	17.9	0.112	0.93	0.005	18.4
SALOP	0.015	0.053	0.048	17.9	0.115	1.02	0.004	19.2
STAFFS	0.015	0.079	0.049	18.4	0.102	0.84	0.005	18.3
WARWICKS	0.010	0.055	0.045	18.1	0.113	1.45	0.006	18.0
BOLTON	0.015	0.108	0.050	17.7	0.085	0.39	0.004	25.0
BURY	0.013	0.100	0.047	18.6	0.103	0.60	0.006	25.4
MANCHSTR	0.019	0.166	0.070	21.3	0.126	0.37	0.005	17.0
OLDHAM	0.016	0.102	0.064	19.6	0.147	0.44	0.006	29.5
ROCHDALE	0.017	0.040	0.030	18.7	0.058	0.73	0.002	31.5
SALFORD	0.011	0.121	0.084	22.2	0.150	0.27	0.005	27.3
STOCKPRT	0.013	0.093	0.052	18.7	0.105	0.55	0.005	25.6
TAMESIDE	0.019	0.072	0.042	18.9	0.100	0.52	0.005	31.8
TRAFFORD	0.013	0.120	0.046	18.2	0.097	1.21	0.006	23.8
WIGAN	0.013	0.112	0.053	29.6	0.207	0.12	0.006	28.6
LVERPOOL	0.013	0.105	0.083	21.6	0.161	0.34	0.005	17.7
ST-HELEN	0.022	0.118	0.052	19.3	0.094	0.46	0.004	20.9
SEFTON	0.010	0.137	0.078	23.7	0.185	0.18	0.006	22.6
WIRRAL	0.009	0.053	0.045	17.7	0.093	3.44	0.005	21.7
CHESIRE	0.013	0.067	0.045	18.4	0.104	0.78	0.005	16.5
LANCS	0.010	0.068	0.050	18.2	0.131	1.81	0.006	12.8
CLWYD	0.008	0.065	0.053	18.1	0.123	1.81	0.006	24.7
DYFED	0.010	0.059	0.088	19.7	0.175	0.54	0.005	26.2
GWENT	0.013	0.074	0.050	17.8	0.100	1.88	0.004	23.7
GWYNEDD	0.009	0.087	0.087	20.3	0.206	0.41	0.007	26.1
MID-GLAM	0.011	0.115	0.058	18.9	0.145	0.47	0.007	31.9
POWYS	0.018	0.065	0.049	17.5	0.119	38.06	0.004	36.7
S-GLAM	0.011	0.087	0.073	19.7	0.117	0.41	0.004	25.6
W-GLAM	0.014	0.090	0.062	18.3	0.107	0.89	0.004	28.2

APPENDIX TABLE 3B

MODEL parameters: 1980/81 in-migration

FPCA	A.1	ALPHA.1	A.2	MU.2	ALPHA.2	LAMBDA.2	C	E
SCOTLAND	0.024	0.093	0.041	19.3	0.078	0.53	0.004	12.8
GATESHED	0.012	0.095	0.062	21.0	0.140	1.03	0.006	36.0
NEWCSTLE	0.013	0.081	0.076	17.6	0.117	11.47	0.003	23.9
N-TYNESD	0.012	0.100	0.031	32.7	0.337	0.12	0.006	33.1
S-TYNESD	0.017	0.088	0.036	19.7	0.084	0.78	0.005	43.6
SUNDRLND	0.013	0.087	0.055	18.9	0.113	0.65	0.005	27.1
CLEVELND	0.013	0.137	0.058	20.9	0.140	0.57	0.007	23.5
CUMBRIA	0.011	0.047	0.046	20.7	0.140	0.47	0.006	23.7
DURHAM	0.013	0.057	0.039	17.8	0.084	2.35	0.004	21.4
NTHMBLND	0.015	0.063	0.042	20.6	0.119	0.79	0.006	23.8
BARNSLEY	0.018	0.126	0.057	19.8	0.125	0.46	0.006	38.4
DONCASTR	0.015	0.022	0.046	21.8	0.171	0.30	0.003	29.4
ROTHERHM	0.017	0.093	0.071	21.5	0.142	0.30	0.005	27.6
SHEFFELD	0.014	0.071	0.070	17.6	0.113	7.93	0.003	24.6
BRADFORD	0.011	0.076	0.045	18.3	0.105	1.66	0.006	20.8
CALDERDL	0.012	0.039	0.003	45.8	0.338	0.08	0.004	36.0
KIRKLEES	0.012	0.063	0.048	18.1	0.094	2.06	0.004	22.9
LEEDS	0.009	0.045	0.061	18.3	0.115	78.25	0.003	18.1
WAKEFELD	0.016	0.087	0.063	21.8	0.136	0.25	0.005	31.6
HUMBERSD	0.011	0.083	0.040	17.8	0.098	2.99	0.006	19.5
N-YORKS	0.014	0.034	0.032	18.0	0.088	1.81	0.004	15.0
DERBYSHR	0.014	0.066	0.060	20.7	0.127	0.38	0.005	16.2
LEICS	0.010	0.017	0.108	20.1	0.229	0.40	0.002	24.0
LINCS	0.010	0.053	0.044	21.7	0.180	0.34	0.008	23.0
NTHANTS	0.011	0.093	0.064	24.6	0.235	0.22	0.008	18.5
NOTTS	0.013	0.064	0.055	17.6	0.105	9.86	0.004	18.0
CAMBS	0.009	0.072	0.045	18.4	0.119	12.43	0.006	17.7
NORFOLK	0.007	0.078	0.043	18.3	0.136	0.64	0.008	19.3
SUFFOLK	0.007	0.069	0.039	21.3	0.167	0.42	0.009	18.7
BEDFORDS	0.013	0.083	0.095	22.7	0.212	0.30	0.006	18.2
BUCKS	0.016	0.124	0.064	22.4	0.140	0.28	0.006	13.3
ESSEX	0.009	0.114	0.075	23.3	0.221	0.26	0.008	13.5
HERTS	0.010	0.072	0.075	22.7	0.185	0.31	0.006	15.2
BERKS	0.011	0.044	0.068	21.8	0.169	0.25	0.005	17.2
E-SUSSEX	0.011	0.006	0.055	20.1	0.174	0.34	0.000	18.9
HANTS	0.014	0.098	0.043	18.6	0.102	0.76	0.006	14.4
IOWIGHT	0.014	0.006	0.035	21.3	0.216	0.56	0.000	31.0
KENT	0.009	0.079	0.071	22.6	0.205	0.25	0.007	14.9
OXFORDSH	0.012	0.025	0.048	18.4	0.126	11.36	0.003	17.9
SURREY	0.012	0.057	0.071	21.4	0.144	0.29	0.005	12.1
W-SUSSEX	0.008	0.073	0.046	21.8	0.156	0.41	0.008	15.9
LON-CHNT	0.014	0.105	0.063	18.8	0.087	0.59	0.003	18.7
LON-RWF	0.016	0.085	0.075	20.1	0.118	0.39	0.003	16.4
LON-BH	0.016	0.141	0.088	24.1	0.207	0.24	0.006	19.2
LON-CI	0.009	0.041	0.057	17.9	0.089	2.18	0.002	20.6
LON-KCW	0.006	0.017	0.066	18.0	0.111	2.05	0.002	16.9
LON-RK	0.011	0.080	0.077	20.3	0.128	0.42	0.004	18.2
LON-MSW	0.016	0.151	0.095	20.9	0.148	0.36	0.004	16.4
LON-CROY	0.016	0.145	0.078	22.1	0.145	0.32	0.005	17.5
LON-LSL	0.017	0.105	0.075	19.0	0.104	0.58	0.002	15.2

FPCA	A.1	ALPHA.1	A.2	MU.2	ALPHA.2	LAMBDA.2	C	E
LON-BROM	0.018	0.171	0.084	25.6	0.190	0.18	0.006	22.1
LON-BG	0.016	0.167	0.088	21.5	0.169	0.32	0.006	21.0
LON-MIDD	0.010	0.083	0.093	20.3	0.138	0.37	0.004	11.8
AVON	0.011	0.059	0.049	17.9	0.106	2.65	0.005	15.4
CORNWALL	0.013	0.008	0.035	20.4	0.127	0.40	0.000	21.7
DEVON	0.010	0.047	0.033	18.1	0.104	1.39	0.006	14.1
DORSET	0.013	0.011	0.038	21.5	0.184	0.37	0.002	15.1
GLOUCS	0.011	0.052	0.047	20.5	0.123	0.38	0.006	17.9
SOMERSET	0.016	0.012	0.039	26.4	0.255	0.19	0.000	15.6
WILTS	0.009	0.072	0.047	22.1	0.146	0.31	0.007	17.5
BIRMINGH	0.017	0.087	0.052	17.9	0.086	1.93	0.003	15.7
COVENTRY	0.013	0.142	0.094	17.9	0.161	2.90	0.004	26.7
DUDLEY	0.008	0.086	0.077	20.6	0.149	0.59	0.006	32.5
SANDWELL	0.021	0.116	0.081	20.9	0.154	0.48	0.005	23.4
SOLIHULL	0.019	0.187	0.016	35.8	0.361	0.12	0.008	24.8
WALSALL	0.023	0.251	0.069	20.6	0.148	0.43	0.006	28.1
WOLVERHN	0.016	0.119	0.066	19.1	0.132	0.61	0.005	29.3
HEREFORD	0.011	0.090	0.057	25.7	0.253	0.20	0.008	17.3
SALOP	0.008	0.075	0.049	22.5	0.215	0.27	0.009	22.4
STAFFS	0.016	0.166	0.087	21.7	0.183	0.27	0.006	16.5
WARWICKS	0.011	0.068	0.055	21.5	0.142	0.32	0.006	17.4
BOLTON	0.016	0.135	0.065	19.8	0.111	0.69	0.004	25.3
BURY	0.009	0.032	0.075	21.7	0.184	0.54	0.005	27.4
MANCHSTR	0.014	0.063	0.052	17.7	0.083	6.64	0.002	18.8
OLDHAM	0.017	0.144	0.046	19.5	0.095	0.68	0.006	36.6
ROCHDALE	0.013	0.117	0.057	19.9	0.133	0.46	0.006	35.6
SALFORD	0.023	0.163	0.046	18.5	0.096	16.22	0.005	29.5
STOCKPRT	0.013	0.113	0.089	22.9	0.192	0.32	0.006	22.4
TAMESIDE	0.017	0.163	0.092	24.3	0.258	0.25	0.007	28.3
TRAFFORD	0.017	0.143	0.091	22.8	0.186	0.27	0.006	23.4
WIGAN	0.014	0.090	0.110	22.1	0.227	0.40	0.005	27.4
LVERPOOL	0.020	0.102	0.058	17.8	0.104	2.70	0.004	20.0
ST-HELEN	0.014	0.116	0.070	21.5	0.185	0.40	0.007	29.2
SEFTON	0.020	0.169	0.033	31.0	0.324	0.14	0.008	25.5
WIRRAL	0.010	0.069	0.081	26.9	0.273	0.20	0.006	24.4
CHESIRE	0.017	0.085	0.066	22.2	0.152	0.34	0.005	11.9
LANCS	0.015	0.094	0.039	17.9	0.087	0.86	0.005	14.3
CLWYD	0.007	0.047	0.045	23.6	0.214	0.23	0.008	22.6
DYFED	0.009	0.021	0.039	17.8	0.092	2.04	0.003	22.5
GWENT	0.013	0.078	0.056	21.2	0.129	0.28	0.006	27.2
GWYNEDD	0.013	0.007	0.054	19.7	0.206	0.40	0.000	24.9
MID-GLAM	0.015	0.141	0.067	20.6	0.128	0.36	0.006	21.7
POWYS	0.016	0.137	0.053	23.2	0.174	0.26	0.008	32.9
S-GLAM	0.012	0.061	0.064	17.9	0.113	1.90	0.004	20.0
W-GLAM	0.011	0.123	0.046	17.6	0.119	13.78	0.007	33.3

APPENDIX TABLE 3C
MODEL parameters: 1985/86 out-migration

FPCA	A.1	ALPHA.1	A.2	MU.2	ALPHA.2	LAMBDA.2	C	E
SCOTLAND	0.019	0.063	0.059	20.8	0.108	0.35	0.003	7.1
GATESHED	0.020	0.101	0.059	20.2	0.100	0.33	0.004	11.0
NEWCSTLE	0.014	0.101	0.073	20.6	0.121	0.48	0.004	9.3
N-TYNESD	0.013	0.052	0.043	18.9	0.080	0.70	0.003	8.9
S-TYNESD	0.016	0.105	0.053	19.2	0.099	0.50	0.005	12.0
SUNDRLND	0.015	0.068	0.050	19.4	0.099	0.57	0.004	10.9
CLEVELND	0.012	0.035	0.037	18.1	0.082	1.62	0.003	8.3
CUMBRIA	0.011	0.053	0.045	18.0	0.102	1.57	0.005	11.2
DURHAM	0.012	0.048	0.051	18.8	0.104	0.81	0.004	8.6
NTHMBLND	0.015	0.048	0.035	18.2	0.083	1.58	0.004	11.5
BARNSLEY	0.017	0.052	0.033	18.2	0.069	1.21	0.003	12.4
DONCASTR	0.016	0.038	0.028	18.0	0.064	1.88	0.003	10.2
ROTHERHM	0.017	0.063	0.035	18.1	0.068	0.90	0.003	11.7
SHEFFELD	0.015	0.094	0.066	19.9	0.114	0.55	0.004	10.4
BRADFORD	0.011	0.050	0.039	19.1	0.089	0.55	0.005	9.3
CALDERDL	0.014	0.037	0.027	18.0	0.069	1.84	0.004	12.5
KIRKLEES	0.012	0.052	0.039	18.4	0.083	1.12	0.004	6.7
LEEDS	0.013	0.085	0.065	20.2	0.121	0.45	0.005	8.1
WAKEFELD	0.017	0.059	0.031	18.1	0.060	0.93	0.003	10.7
HUMBERSD	0.010	0.045	0.049	18.6	0.107	0.96	0.004	9.7
N-YORKS	0.013	0.045	0.044	18.4	0.104	1.02	0.004	6.9
DERBYSHR	0.014	0.053	0.039	18.2	0.082	1.47	0.004	9.1
LEICS	0.010	0.052	0.058	19.2	0.120	0.74	0.004	8.7
LINCS	0.013	0.050	0.031	18.0	0.084	1.77	0.005	8.2
NTHANTS	0.013	0.054	0.031	18.2	0.077	1.52	0.005	9.4
NOTTS	0.013	0.073	0.055	19.2	0.105	0.66	0.004	7.2
CAMBS	0.011	0.070	0.055	19.9	0.115	0.47	0.005	9.1
NORFOLK	0.012	0.059	0.047	18.6	0.111	0.70	0.005	9.2
SUFFOLK	0.010	0.041	0.028	18.0	0.084	1.81	0.006	9.3
BEDFORDS	0.015	0.099	0.041	20.2	0.088	0.33	0.006	9.7
BUCKS	0.009	0.060	0.026	18.5	0.074	3.19	0.006	9.3
ESSEX	0.010	0.079	0.034	18.9	0.093	0.75	0.007	10.5
HERTS	0.006	0.091	0.043	19.2	0.112	0.55	0.007	11.7
BERKS	0.009	0.062	0.032	18.9	0.084	0.80	0.006	10.6
E-SUSSEX	0.008	0.043	0.051	19.4	0.125	0.58	0.006	6.9
HANTS	0.014	0.062	0.035	19.2	0.089	0.70	0.005	7.8
IOWIGHT	0.012	0.008	0.076	19.8	0.215	0.40	0.000	13.7
KENT	0.011	0.077	0.038	18.4	0.094	1.19	0.006	8.3
OXFORDSH	0.009	0.065	0.059	20.0	0.124	0.47	0.005	9.3
SURREY	0.006	0.089	0.054	19.9	0.133	0.50	0.007	10.3
W-SUSSEX	0.010	0.048	0.035	18.4	0.092	1.09	0.006	9.2
LON-CHNT	0.010	0.121	0.055	24.8	0.156	0.24	0.008	8.1
LON-RWF	0.014	0.191	0.068	24.9	0.184	0.21	0.007	9.6
LON-BH	0.011	0.150	0.065	25.3	0.204	0.20	0.008	10.3
LON-CI	0.010	0.100	0.064	22.1	0.116	0.36	0.005	7.9
LON-KCW	0.012	0.064	0.052	22.9	0.121	0.33	0.006	9.4
LON-RK	0.010	0.108	0.064	21.3	0.129	0.34	0.006	9.1
LON-MSW	0.012	0.157	0.075	25.9	0.191	0.19	0.007	7.8
LON-CROY	0.015	0.248	0.024	34.2	0.297	0.12	0.008	10.9
LON-LSL	0.010	0.146	0.064	23.9	0.153	0.27	0.007	8.2

FPCA	A.1	ALPHA.1	A.2	MU.2	ALPHA.2	LAMBDA.2	C	E
LON-BROM	0.011	0.179	0.067	24.6	0.195	0.20	0.008	13.0
LON-BG	0.014	0.153	0.055	22.5	0.138	0.27	0.007	9.5
LON-MIDD	0.010	0.198	0.070	26.5	0.221	0.19	0.008	9.0
AVON	0.010	0.072	0.057	19.3	0.112	0.63	0.005	7.9
CORNWALL	0.011	0.069	0.039	18.5	0.110	14.25	0.006	9.2
DEVON	0.013	0.086	0.055	19.1	0.122	0.67	0.006	7.4
DORSET	0.009	0.061	0.040	18.4	0.108	1.20	0.006	7.9
GLOUCS	0.009	0.041	0.038	18.5	0.105	14.41	0.006	8.0
SOMERSET	0.011	0.038	0.036	18.1	0.100	1.45	0.005	10.0
WILTS	0.014	0.045	0.024	18.5	0.071	3.27	0.005	10.4
BIRMINGH	0.011	0.097	0.057	21.0	0.118	0.35	0.006	6.8
COVENTRY	0.013	0.115	0.073	19.8	0.127	0.60	0.005	9.2
DUDLEY	0.017	0.065	0.032	18.3	0.062	1.37	0.003	11.3
SANDWELL	0.019	0.111	0.070	24.0	0.142	0.19	0.005	8.9
SOLIHULL	0.012	0.075	0.034	18.4	0.073	1.38	0.005	10.4
WALSALL	0.014	0.082	0.053	19.8	0.101	0.32	0.005	10.8
WOLVERHN	0.015	0.113	0.066	19.8	0.120	0.53	0.005	9.6
HEREFORD	0.011	0.043	0.038	18.0	0.097	1.61	0.005	9.5
SALOP	0.014	0.047	0.039	18.1	0.100	1.34	0.004	8.9
STAFFS	0.014	0.066	0.046	18.6	0.097	0.76	0.005	8.8
WARWICKS	0.012	0.064	0.036	18.5	0.085	2.27	0.005	8.1
BOLTON	0.014	0.060	0.031	18.1	0.068	1.77	0.004	13.3
BURY	0.010	0.060	0.034	18.3	0.074	1.16	0.005	12.7
MANCHSTR	0.011	0.083	0.050	20.8	0.100	0.45	0.005	7.6
OLDHAM	0.015	0.058	0.027	18.0	0.058	1.78	0.004	14.4
ROCHDALE	0.014	0.066	0.034	18.5	0.069	0.46	0.004	11.0
SALFORD	0.011	0.069	0.052	20.2	0.106	0.44	0.005	7.7
STOCKPRT	0.012	0.057	0.028	18.5	0.060	9.77	0.004	12.3
TAMESIDE	0.014	0.088	0.035	19.2	0.088	0.41	0.006	11.3
TRAFFORD	0.013	0.141	0.047	19.2	0.095	0.41	0.006	12.7
WIGAN	0.017	0.094	0.049	19.6	0.097	0.32	0.005	15.7
LVERPOOL	0.010	0.138	0.076	22.1	0.163	0.33	0.007	7.6
ST-HELEN	0.014	0.096	0.061	20.4	0.119	0.29	0.005	11.0
SEFTON	0.009	0.069	0.041	18.3	0.091	1.70	0.005	11.0
WIRRAL	0.011	0.056	0.041	18.2	0.091	1.65	0.005	10.7
CHESIRE	0.012	0.051	0.036	18.2	0.084	1.54	0.005	7.3
LANCS	0.012	0.065	0.045	18.4	0.104	1.24	0.005	7.0
CLWYD	0.009	0.054	0.041	18.0	0.105	1.61	0.006	12.2
DYFED	0.011	0.058	0.067	19.0	0.127	0.72	0.004	9.3
GWENT	0.011	0.054	0.041	18.3	0.092	1.77	0.005	11.8
GWYNEDD	0.008	0.104	0.067	19.1	0.134	0.41	0.006	9.8
MID-GLAM	0.014	0.070	0.044	18.3	0.092	1.59	0.004	10.1
POWYS	0.011	0.045	0.036	17.9	0.102	2.34	0.005	13.8
S-GLAM	0.012	0.086	0.069	19.9	0.117	0.46	0.004	9.8
W-GLAM	0.013	0.077	0.066	19.1	0.116	0.72	0.004	10.5

APPENDIX TABLE 3D
MODEL parameters: 1985/86 in-migration

FPCA	A.1	ALPHA.1	A.2	MU.2	ALPHA.2	LAMBDA.2	C	E
SCOTLAND	0.021	0.069	0.031	18.8	0.056	1.94	0.002	10.8
GATESHED	0.019	0.103	0.073	22.0	0.132	0.25	0.004	10.9
NEWCSTLE	0.014	0.092	0.071	17.9	0.114	3.21	0.003	12.5
N-TYNESD	0.016	0.095	0.057	20.2	0.107	0.33	0.005	12.3
S-TYNESD	0.024	0.105	0.067	24.2	0.137	0.21	0.004	12.0
SUNDRLND	0.013	0.075	0.042	18.2	0.090	1.17	0.005	13.0
CLEVELND	0.015	0.132	0.055	19.4	0.124	0.51	0.006	10.5
CUMBRIA	0.013	0.014	0.048	21.8	0.152	0.32	0.001	8.6
DURHAM	0.014	0.051	0.040	18.5	0.092	11.39	0.004	10.2
NTHMBLND	0.014	0.057	0.039	21.9	0.102	0.30	0.005	7.6
BARNSLEY	0.017	0.093	0.048	19.8	0.095	0.40	0.005	10.4
DONCASTR	0.015	0.047	0.035	19.7	0.093	0.37	0.004	10.4
ROTHERHM	0.015	0.101	0.057	21.1	0.118	0.29	0.005	10.3
SHEFFELD	0.016	0.092	0.078	18.0	0.120	2.81	0.003	13.8
BRADFORD	0.010	0.088	0.044	18.2	0.092	1.17	0.006	9.5
CALDERDL	0.015	0.040	0.050	24.8	0.132	0.19	0.004	9.9
KIRKLEES	0.012	0.066	0.043	18.5	0.090	1.54	0.005	9.4
LEEDS	0.014	0.087	0.064	18.0	0.110	2.48	0.004	10.7
WAKEFELD	0.014	0.055	0.044	20.6	0.108	0.34	0.005	8.4
HUMBERSD	0.014	0.077	0.033	17.9	0.079	2.43	0.005	9.9
N-YORKS	0.014	0.028	0.021	18.5	0.069	10.08	0.004	8.8
DERBYSHR	0.013	0.065	0.050	21.0	0.114	0.34	0.005	5.4
LEICS	0.011	0.052	0.051	18.5	0.112	9.48	0.004	8.1
LINCS	0.009	0.092	0.019	20.0	0.097	0.40	0.009	11.4
NTHANTS	0.016	0.102	0.043	21.5	0.110	0.33	0.006	7.3
NOTTS	0.015	0.084	0.051	18.0	0.097	1.87	0.004	9.2
CAMBS	0.012	0.088	0.037	18.5	0.087	8.72	0.006	11.7
NORFOLK	0.007	0.082	0.023	19.0	0.084	1.72	0.008	14.3
SUFFOLK	0.008	0.020	0.038	24.4	0.190	0.25	0.006	11.1
BEDFORDS	0.012	0.109	0.070	22.2	0.148	0.31	0.006	8.6
BUCKS	0.013	0.096	0.060	23.6	0.140	0.24	0.006	7.8
ESSEX	0.012	0.155	0.060	24.6	0.198	0.22	0.008	7.9
HERTS	0.012	0.088	0.075	22.9	0.152	0.26	0.005	7.7
BERKS	0.012	0.050	0.055	20.7	0.121	0.35	0.005	10.3
E-SUSSEX	0.009	0.011	0.031	18.7	0.101	0.95	0.003	11.0
HANTS	0.013	0.092	0.031	18.9	0.082	2.88	0.006	9.4
IOWIGHT	0.016	0.018	0.009	19.2	0.018	1.53	0.000	14.5
KENT	0.011	0.112	0.052	21.9	0.147	0.32	0.008	8.3
OXFORDSH	0.010	0.034	0.044	18.4	0.114	10.92	0.004	13.2
SURREY	0.013	0.065	0.063	21.4	0.121	0.30	0.004	7.3
W-SUSSEX	0.006	0.053	0.043	22.6	0.159	0.31	0.008	8.3
LON-CHNT	0.012	0.065	0.059	19.1	0.081	0.53	0.002	8.6
LON-RWF	0.015	0.102	0.089	21.5	0.136	0.30	0.004	8.3
LON-BH	0.020	0.139	0.081	23.2	0.168	0.30	0.006	7.8
LON-CI	0.007	0.050	0.056	18.2	0.087	1.57	0.003	12.3
LON-KCW	0.009	0.015	0.051	18.5	0.089	7.71	0.000	12.6
LON-RK	0.010	0.087	0.079	19.7	0.114	0.51	0.003	8.6
LON-MSW	0.010	0.127	0.105	21.6	0.148	0.31	0.004	8.4
LON-CROY	0.012	0.119	0.091	23.0	0.170	0.28	0.005	7.7
LON-LSL	0.011	0.084	0.084	20.0	0.112	0.42	0.002	10.8

FPCA	A.1	ALPHA.1	A.2	MU.2	ALPHA.2	LAMBDA.2	C	E
LON-BROM	0.015	0.116	0.076	23.1	0.146	0.27	0.005	7.9
LON-BG	0.013	0.099	0.083	21.8	0.146	0.30	0.005	7.2
LON-MIDD	0.010	0.089	0.095	20.8	0.136	0.41	0.004	7.2
AVON	0.011	0.047	0.043	18.4	0.095	9.98	0.004	9.1
CORNWALL	0.008	0.035	0.016	19.3	0.054	0.75	0.006	9.2
DEVON	0.008	0.055	0.024	18.5	0.083	5.06	0.007	9.1
DORSET	0.013	0.007	0.021	20.2	0.106	0.68	0.000	12.0
GLOUCS	0.008	0.051	0.039	20.7	0.116	0.37	0.007	9.4
SOMERSET	0.010	0.011	0.029	23.4	0.195	0.34	0.004	11.2
WILTS	0.011	0.058	0.039	22.8	0.119	0.27	0.007	8.2
BIRMINGH	0.014	0.069	0.053	18.1	0.091	1.74	0.003	9.5
COVENTRY	0.009	0.070	0.081	18.0	0.136	2.30	0.004	13.3
DUDLEY	0.016	0.103	0.078	24.2	0.162	0.20	0.005	9.8
SANDWELL	0.019	0.090	0.057	20.7	0.097	0.32	0.004	9.5
SOLIHULL	0.018	0.095	0.050	23.3	0.121	0.40	0.006	11.4
WALSALL	0.023	0.142	0.074	23.8	0.159	0.22	0.005	11.2
WOLVERHN	0.013	0.055	0.049	18.4	0.090	1.58	0.003	11.7
HEREFORD	0.007	0.072	0.046	25.8	0.191	0.19	0.008	8.0
SALOP	0.012	0.021	0.026	22.0	0.129	0.29	0.005	11.0
STAFFS	0.014	0.078	0.044	18.9	0.099	0.67	0.005	9.6
WARWICKS	0.014	0.094	0.050	22.0	0.127	0.28	0.006	8.7
BOLTON	0.013	0.080	0.045	20.6	0.098	0.37	0.005	10.1
BURY	0.009	0.062	0.073	23.6	0.183	0.24	0.006	8.6
MANCHSTR	0.015	0.065	0.047	17.9	0.079	2.31	0.003	10.0
OLDHAM	0.013	0.139	0.061	22.6	0.148	0.23	0.007	11.7
ROCHDALE	0.014	0.086	0.040	19.3	0.081	0.39	0.005	10.2
SALFORD	0.014	0.097	0.049	18.3	0.089	1.24	0.004	14.3
STOCKPRT	0.012	0.100	0.072	23.9	0.164	0.26	0.006	8.4
TAMESIDE	0.016	0.072	0.043	20.7	0.096	0.31	0.005	10.4
TRAFFORD	0.017	0.094	0.071	23.7	0.152	0.24	0.005	8.6
WIGAN	0.018	0.109	0.054	21.2	0.115	0.39	0.005	11.2
LVERPOOL	0.015	0.072	0.063	18.2	0.106	1.77	0.003	10.2
ST-HELEN	0.017	0.155	0.060	29.2	0.223	0.13	0.006	9.1
SEFTON	0.013	0.117	0.048	21.9	0.137	0.41	0.007	13.0
WIRRAL	0.014	0.145	0.063	25.2	0.187	0.19	0.007	12.9
CHESIRE	0.015	0.097	0.059	23.8	0.143	0.21	0.006	7.2
LANCS	0.010	0.051	0.028	17.9	0.077	1.95	0.006	7.3
CLWYD	0.012	0.005	0.029	29.3	0.287	0.15	0.001	10.8
DYFED	0.011	0.073	0.029	17.9	0.079	2.24	0.006	10.6
GWENT	0.012	0.060	0.043	21.0	0.112	0.34	0.006	10.3
GWYNEDD	0.005	0.091	0.023	18.5	0.076	18.00	0.008	13.5
MID-GLAM	0.013	0.107	0.051	19.0	0.107	1.30	0.005	10.2
POWYS	0.008	0.072	0.030	21.8	0.118	0.30	0.008	12.0
S-GLAM	0.011	0.076	0.057	18.5	0.102	13.85	0.004	11.3
W-GLAM	0.011	0.078	0.054	17.9	0.105	3.06	0.005	11.1