WORKING PAPER 512

A TALE OF TWO CITIES:

THE PROSPECTS FOR FUTURE AGING OF THE POPULATIONS OF LONDON AND HARARE

PHILIP REES

School of Geography
University of Leeds
Leeds LS2 9JT

June 1988

A TALE OF TWO CITIES:

THE PROSPECTS FOR FUTURE AGING

OF THE POPULATIONS OF LONDON AND HARARE

Philip Rees

School of Geography
University of Leeds
Leeds LS2 9JT
United Kingdom

Paper prepared for presentation at the International Conference on Aging of Populations in the Context of Urbanization, Sendai, Japan, 12-16 September, 1988.

CONTENTS

ABSTRACT

The paper explores the phenomenon of population aging in two national populations, those of the United Kingdom and of Zimbabwe. Each national population is divided into two parts: those living in the national capital (London, Harare) and those living in the rest of the country. Using a bi-regional, cohort-component model, projections of those four subnational populations are carried out under scenarios of no change, of mortality decline and fertility movement to replacement, of alternative migration assumptions, and of the spread of AIDS.

In the United Kingdom, after a hiatus in population aging to the end of the century, renewed aging will take place in the next. This will be most vigorous outside London and the capital will lose elderly population share. In Zimbabwe absolute growth in the elderly population will be spectacular, particularly in the nation's capital. Relative aging is postponed until after 2026 but comes earlier than in the Zimbabwe projections of the United Nations because faster fertility decline is anticipated. Population aging occurs earlier and proceeds further in Harare which gains total and elderly population share under current migration conditions. AIDS reduces the size of all four subnational populations, but, under the assumptions adopted in the paper, less than might have been expected.

ACKNOWLEDGMENTS

The author would like to thank the Nuffield Foundation for financial support in 1987-88 in developing the United Kingdom projections in connection with a project on "Britain's population: a geographical analysis". My thanks are also due to Lazarus Zanamwe for providing substantial assistance with the Zimbabwe demographic statistics. Computational facilities were kindly provided by the School of Geography and the Computing Service of the University of Leeds.

LIST OF TABLES

LIST OF FIGURES

1. AGING AND URBANIZATION: TRENDS AND ISSUES

Studies of stable populations have shown that the fertility decline experienced in the demographic transition leads later to most of the demographic aging of the population (Woods, 1979, pp.215-218; United Nations, 1985a, pp.14-16), with mortality decline making a lesser contribution. By demographic aging here is meant the rise in the relative importance of the elderly in the population. The elderly are defined to be those persons aged 60 and over.

At first fertility decline leads merely to falls in the relative size of younger age groups and increases in the sizes of working age groups. After 60 years, however, these larger cohorts move into the elderly age range and rapid increase in the numbers and relative size of the elderly population occurs. Eventually this burst of aging ceases as the population stabilizes at low fertility and mortality rates, although fertility rises followed by falls may be reflected in renewed increase in the size of the elderly population.

The countries of Northern Europe, for example, will experience virtually no increase in their elderly population between 1980 and 2000 (Table 1) but renewed aging to 2025 as the birth cohorts of the 1950s and 1960s become elderly. On the other hand the countries of Eastern Africa will experience rapid growth in elderly numbers but very little change in the relative weight of the elderly in their populations. Between these two groups of countries, which lie at extremes of the growth ladder, lie the other More Developed and Less Developed Regions (MDRs and LDRs) which show rises in the percentages of the population aged 60 and over in both 1980-2000 and 2000-2025, though the trend is stronger in the latter period. Elderly percentages are given in Table 1 for two individual countries, the United Kingdom of Great Britain and Northern Ireland (UK) and Zimbabwe, whose populations will be studied in detail later in the paper.

How do the elderly distribute themselves within countries between urban and rural areas, and what contrasts are there between the sexes in the degree of aging and urbanization of the aged? Table 2 rearranges and extends statistics given in United Nations (1985a), and helps answer these questions. The rural population in both More and Less Developed Regions is estimated to be more elderly in 1980 and is projected to be more elderly in 2000 than its urban counterpart (with the small exception of the LDR population in 1980). The difference between the sexes in the elderly percentage is greatest in MDRs, where 4 to 5% more females are elderly than males, compared with less than 2% in LDRs.

The growth of the elderly is also substantially higher in urban areas than in rural, in both LDRs and MDRs (Panel 2 of Table 2). On average it is higher in MDR urban areas than in LDR rural areas, despite the much more rapid population growth in LDRs. That growth of the elderly is increasing their degree of urbanization in both LDRs and MDRs, with a faster pace in the former (Panel 3 of Table 2).

What the projections of the United Nations represented in Table 2 do not tell us is the source of the difference between urban and

TABLE 1. **<u>Percentage of the population aged 60 and over in selected regions</u>**

Region	Year		
	1980	2000	2025
World	8.33	9.72	13.89
More Developed Regions	15.21	18.32	23.59
Northern Europe	19.60	19.74	25.75
United Kingdom	19.82	19.89	25.38
Less Developed Regions	5.92	7.45	11.89
Eastern Africa	4.31	4.20	5.06
Zimbabwe	4.39	4.24	5.02

Source: Computed from projected populations in United Nations (1985b).

TABLE 2. Urban-rural contrasts in aging

Region	Urban/ Rural	Sex	Year 1980	Year 2000
			% aged 60 and over	
Less Developed Regions	Urban	Male	5.26	6.24
		Female	6.59	7.65
	Rural	Male	6.20	7.72
		Female	6.51	7.91
More Developed	Urban	Male	11.65	14.74
		Female	17.13	20.07
	Rural	Male	14.09	18.35
		Female	18.80	22.74
			Time series index (1980=100)	
Less Developed Regions	Urban	Male	100	247
		Female	100	243
	Rural	Male	100	147
		Female	100	146
More Developed Regions	Urban	Male	100	160
		Female	100	145
	Rural	Male	100	106
		Female	100	96
			% of 60+ living in urban areas	
Less Developed Regions		Male	27.89	39.36
		Female	30.52	42.17
More Developed Regions		Male	66.98	75.37
		Female	69.53	77.58

Source: United Nations (1985b), Table 9.

rural are populations in elderly change. There has been considerable investigation of the sources of urban growth in LDRs (Rogers, 1982; Ledent, 1982) though this has not focussed on the elderly. Rogers (1982, p.504) says:

> "The major conclusion ... is that ... the question whether urban populations are growing mostly from their own natural increase or from net inmigration from rural area ... does not have a simple unequivocal answer. At different periods during a nation's urbanization transition, its urban population may grow primarily as a consequence of net urban inmigration; at other times the main contributor may be urban natural increase."

However, matters are even more complex than Rogers suggests.

Firstly, fertility, mortality and migration rates ar all changing rapidly in LDRs, and in MDRs the net balance of migration flows has swung against the largest and oldest cities in the 1970s and 1980s (a process labelled as "counterurbanization").

Secondly, when attention is focussed on the elderly in subnational areas, changes in the population aged 60 and over has several possible sources. Affecting the elderly before they attain age 60 are the fluctuations in numbers born by subnational area, 60 years or more in the past, and the subsequent evolution of those cohorts as a result of migration and differential mortality. These influences determine the size of cohorts that will attain age 60 in particular subnational area - the input to the elderly population. Further inputs may result from in-migration after retirement. These inputs are balanced by losses thorugh migration and through mortality.

So, how can we investigate the future aging of the population of cities in the face of these complexities? The only way is to carry out population projections with demographic models that enable the researher to specifiy all of the components of change in a "multiregional" framework and to change in realistic ways the inputs to those model to reflect anticipated changes in mortality, fertility and migration.

This paper outlines a simple version of such a model that can be applied in countries with rather little data and with restricted computuaional facilities. The model is then used to generate a variety of projections for two national case studies - for the UK as an example of a developed country population that has passed through the demographic transition, where urbanizarion has ceased, and for Zimbabwe as an example of a developing country part way through the demographic trnasition and in the throes of rapid urbanization. In each case the populations of the capital cities (London and Harare) are projected simultaneously with those of the rest of the country.

Section 2 of the paper describes the methods available for projection, and gives details of the model selected. The third section of the paper speculates on what processes are likely to occur to urban populations, and thus should be incorporated in the projections. Section 4 provides a brief resume of the data estimation needed to prepare projection inputs. The fifth section describes the results of the alternative projections carried out for the population as a whole, while section 6 focusses specifically on the evolution of elderly populations in the two case studies.

2. METHODS FOR PROJECTING THE POPULATION OF CITIES

In the Manual on Subnational Population Projections currently being prepared for the Population Division of the United Nations, a family of demographic projection models is described (Table 3). The classification involves four dimensions: space, age, components and accounting perspectives. Populations may be projected a single unit at a time, or for many units simultaneously, with no age detail or broken down by age (and sex). The components incorporated in the projection model may be just total change, or natural change (births and deaths) together with net migration, or natural change plus gross migration streams (both internal to a country and between it and other countries). The final dimension distinguishes between projection models for handling migration data based on register counts (movements) and those used with migration data based on fixed-period, retrospective census questions (transition data).

Which of these models should be used to investigate the issues raised in the first section of the paper? Since the issues concern a population defined by its age, Models 1 through 3 and 6 are of no use. Since the key feature of cities is that they exchange populations with their rural regions and other cities, the multi-unit model is the only viable candidate (see Rogers 1986, pp.222-227 for the arguments for a multiregional versus a uniregional approach).

Although Model 7 is the model that must be used, computer programs for its implementation in the past have suffered from inflexibility of inputs (e.g. Willekens and Rogers, 1978), restictions to mainframes and poorly presented outputs (Rees 1981, 1984). More recently, user-friendly versions have become available: among these are the IMPP program of the Research Triangle Institute, North Carolina, USA (quoted in Strong 1987), the DIALOG program of the International Institute for Applied Systems Analysis, Laxenburg, Austria described in Wolf, 1988, and the MUDEA program of the Netherlands Inter-university Demographic Institute described by Willekens 1988.

For present purposes a simplified version of Model 7M (for use with movement data) was prepared and implemented on a small microcomputer (so that it could be used in both the UK and Zimbabwe). The simplification consisted of restricting the number of subnational units considered to two - the unit of interest and the rest of the national population. Rogers (1976, evaluated further in Rees, 1986, pp.130-132) showed that a set of bi-regional projections gave results close to the equivalent multi-regional projection. They have the advantage that age disaggregated data for total migration into and out of a sunational unit are published much more frequently than are data for inter-unit flows.

TABLE 3. A family of subnational population projection models

Spatial dimension	Age dimension	Component dimension			
		Total change	Natural change and net migration	Natural change and gross migration	
			Accounting dimension		
			Movement	Movement	Transition
Single unit	All ages	MODEL 1	MODEL 2	MODEL 3M	MODEL 3T
	Age detail		MODEL 4	MODEL 5M	MODEL 5T
Multi-unit	All ages			MODEL 6M	MODEL 6T
	Age detail			MODEL 7M	Model 7T

Source: United Nations (1988), Table II.12.

The bi-regional version developed for this paper contains two innovative features. The first is that the projections are controlled to and fit the national projection. In effect, the rest of the national population is computed as a residual. However, the key dependence of gross migration flows into the subnational unit of interest on the rest of the nation's population is retained. This enables the user to incorporate the assumptions and estimates of the national demographic office about national population development directly into the subnational projections.

The second innovative feature is that the projection model allows the user a variety of choices about each of the projection components so that the model can be precisely tailored to the data available. Table 4 set out the options for the stocks and flows concerned. This feature enables a fixed model specification to be replaced by a model building kit which the projection analyst can use to design an appropriate model. Of course, not all combinations of options produce a vaild model (e.g. consider what happens when the parameters governing start and end population stocks are both set to zero). Unfortunately, in the past such model building kits (Rees 1981, 1984) have not proved popular because too much knowledge is needed by the user of the accounting equations that underlie subnational population change. It is hoped to construct an expert system to help in the model building process when all the Table 3 models are implemented on a microcomputer.

Because components can be entered into the model in a large number of different ways, it is more convenient to use an iterative model than to define separate population change multipliers for each model combination. All variables are either input using the period-cohort age-time plan or converted to it prior to use in the projection model. This is always done projection models built on the cohort-survival principle, but doing it separately and early in the process simplifies all the model equations and computational algorithms.

3. PROTOTYPES OF POPULATION DEVELOPMENT

Before discussing the two cases, it is useful to speculate on the likely structure and behaviour of the demographic components for four prototypical populations:

(1) an MDR metropolitan population
(2) an MDR hinterland population
(3) an LDR metropolitan population
(4) an LDR hinterland population.

By metropolis is meant a large urban area and by hinterland is meant the surrounding territory (including urban and rural areas) dependent on the metropolis. One operational definition, adopted in the two case studies described later in the paper, might be the national capital and the rest of the national area. Table 5 sets out both the levels and expected changes in mortality, fertility, external and internal migration for the four populations.

For mortality the levels are low in developed regions, both in the metropolis and in the hinterland. Among 17 developed nations

TABLE 4. Options in modelling projection components

Component	Option number	Meaning
Start populations	0	Set equal to old end populations
	1	Input fresh populations
	2	Use accounting equation
	3	Input mid-period population
Deaths, Births, Emigration, Immigration, Internal migration	0	Input fresh rates and multiply by population at risk to compute flows
	1	Input fresh flows and divide by population at risk to compute rates
	2	Input fresh change factors, compute new rates and hence flows
	3	Use old rates and multiply by population at risk to compute flows
	4	Use old flows and divide by population at risk to compute rates
	5	Use old change factors, compute new rates and hence flows
Emigration, Immigration	6	Use accounting equation
	7	Set to zero
End populations	0	Use accounting equation
	1	Input fresh populations

Notes:
1. "old" = values of variables for the immediately previous time interval.

the regional population dynamics of which were closely studied (Rogers and Willekens, 1986, pp.99-102), in 11 life expectancy in the capital region was higher than in the rest of the country, but in 6 (5 in Eastern Europe) the reverse was true. However, in none of the 17 case studies did the capital region experience the highest life expectancy. For less developed countries there is not a comparable study but it would be very surprising if most did not follow Brazil's pattern of highest life expectancy in the core region (South East) revealed in Carvalho's (1974) study. The extreme concentration of medical personnel and facilities in Zimbabwe's capital, Harare, recorded by Zanamwe (1988a) is probably typical.

Decreases in mortality are expected in all four populations, but these will probably be fastest in less developed regions not subject to environmental or political crises. Rates of decrease have, however, picked up a little of late in some developed regions, particularly for the elderly (see Rees, 1988, Chapter 5).

In terms of fertility the four types of population order themselves from right to left in Table 5. Urban living depresses fertility in both MDRs and LDRs. There is, however, a major difference in expectations about future developments. In current national projections in developed nations which are experiencing below-replacement fertility, official forecasts predict rises to replacement. However, these rises have had to be postponed in the national projections as below-replacement fertility has persisted. Some expert opinion (Davies, Bernstam and Ricardo-Campbell, 1987) sees no prospect of the situation changing. In LDRs the evidence is of recent fertility decline in most countries: what varies very greatly is the pace at which this is taking place. The capital region of the less developed country is usually where fertility decline has begun the earliest and proceeded furthest.

The contribution of external migration to subnational population change is often ignored, because of data deficiencies, but it does have importance for metropolitan-hinterland relations. The national metropolis and other large cities serve as ports of entry to immigrants and ports of exit for emigrants. Thus, even when the nation is losing on balance through external migration, the national metropolis may be gaining.

When patterns of internal migration are considered, there are now great contrasts. In many MDRs the growth rate of large cities has slowed down and may even have reversed. The hinterland may be gaining from the metropolis. In other MDRs and virtually all LDRs, the process of net transfer of population from rural areas to urban continues at varying paces.

In constructing population projections for our two cases, cognizance must be taken of different regimes of population development discussed here.

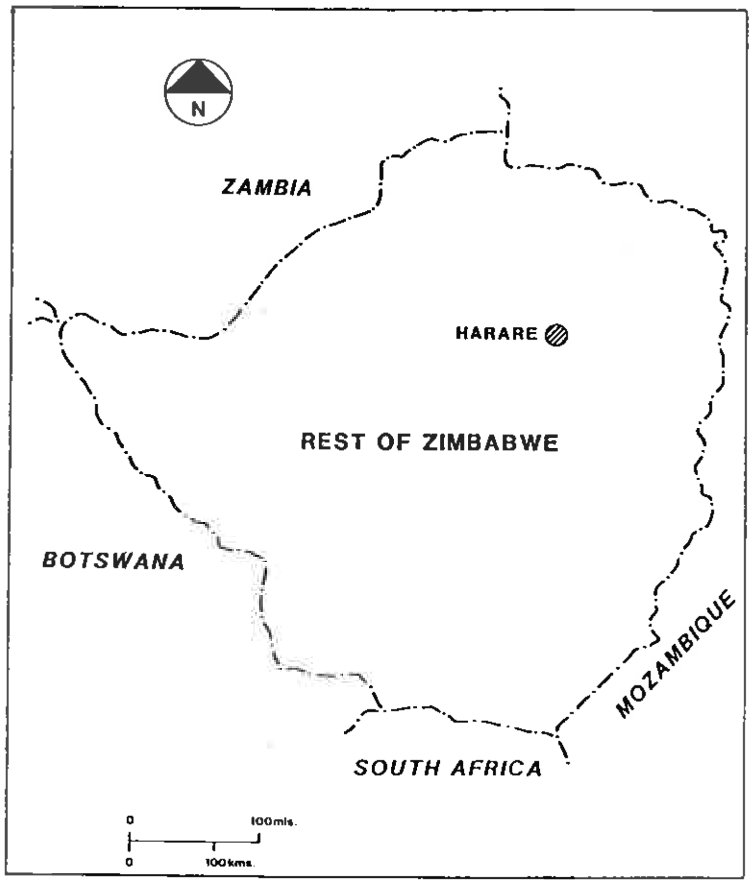
4. THE TWO CASE STUDIES: DATA ESTIMATION

Two contrasting case studies were chosen for detailed examination from opposite ends of the demographic spectrum (Figure 1): a more

TABLE 5. Prototypes of population development

Component	Level and change	More Developed Region		Less Developed Region	
		Metropolis	Hinterland	Metropolis	Hinterland
Mortality	Present	Low	Low	Medium	High
	Future	Slow Decrease	Slow Decrease	Fast Decrease	Fast Decrease
Fertility	Present	Low	Low	High	High
	Future	Rise to replacement	Rise to replacement	Fall to replacement	Fall to replacement
External Migration	Present	High	Low	High	Low
	Future	Losses up international hierarchy Gains from down hierarchy			
Internal Migration	Present	Net loss to hinterland	Net gain from metropolis	Rapid gain from hinterland	Rapid loss to metropolis
	Future	Slowing rate of loss	Slowing rate of gain	Slowing rate of gain	Slowing rate of loss

UNITED KINGDOM



ZIMBABWE

FIGURE 1. Capitals and countries: United Kingdom and Zimbabwe

developed country, the United Kingdom and a less developed country, together with their respective capitals, London (the former Greater London administrative area) and Harare (the district which was formerly called Salisbury). Brief notes are provided here on the estimation of benchmark period variables. The estimated data are reproduced in the Appendix.

4.1 Benchmark periods

4.1.1 Benchmark period for the United Kingdom

For the UK the benchmark period runs from mid-1981 to mid-1986 (June 30/July 1 in each year).

4.1.2 Benchmark period for Zimbabwe

For Zimbabwe most statistics derive from the Census of 1982, held in August of that year, and the various indirect estimates of demographic components apply to the year prior to the census or to a longer period stretching back into the 1970s. For the sake of neatness rather than precision and in order to fix the target time interval when interpolating between the 1969 and 1982 Zimbabwe censuses, the benchmark period was designated as August 1977 to August 1982.

4.2 Population estimates

4.2.1 Populations for the United Kingdom

Mid-year estimate populations for 1981 and 1986 were used for Greater London and the Rest of the United Kingdom derived from OPCS (1983, 1987 and 1988) for five year age groups 0-4 through 85+ for 1981 and 0-4 through 90+ for 1986. The 1981 estimates were closely based on the results of the April 1981 Census. The 1986 figures are estimates built forward from the 1981 figures using conventional accounting plus adjustments for Armed Forces transfers and some underenumeration of young male migrants. The projection model was run in "unconstrained, forecast" mode for the benchmark period 1981-86 with the component inputs described below and close agreement obtained with official estimates (with differences of less than one quarter of one percent in most age groups).

4.2.2 Populations for Zimbabwe

For Zimbabwe populations from the 1982 Census (CSO, 1985) were adjusted for age heaping by Zanamwe (1988b) using the method described in Annex V of United Nations (1983) up to age 75; older age groups were estimated using the stationary populations in the Zimbabwe life table based on the 1982 Census (derived from orphanhood data). These estimates differ a little from the adjusted figures given in CSO (1985), but were used because the same techniques were applied to Harare's 1982 Census population.

4.3 Mortality estimates

4.3.1 Mortality in the United Kingdom

Deaths for five year age groups (period-age plan) were assembled for the years 1981 to 1986 for the constituent countries of the UK (demographically these are England-and-Wales, Scotland and Northern Ireland), and by ten year age groups (period-age plan) for Greater London. The estimation of model variables involved two steps. Firstly, the Greater London ten year age group deaths were broken down into five year ages by applying national death rates for five year age groups for each year to populations in Greater London by five year age group, and these estimates were constrained to the known ten year figures. The second step involved conversion of the data to a period-cohort age-time plan through deconsolidating each period-age group into the two constituent cohorts using geometric factors based on the relevant Lexis diagram, and then the re-aggregation of the period-cohort-age estimates to period-cohorts (see Rees and Woods, 1986 for a detailed account of these techniques). In the process the calendar year 1981 and 1986 were accorded a weight of a half. The deaths counts were input to the projection model in the benchmark period (option 1 in Table 4) but rates were used thereafter either directly (options 0 or 3) or via change factors (options 2 or 5).

4.3.2 Mortality in Zimbabwe

For the Zimbabwe national population mortality rates by period-cohort were derived from the life table published in CSO (1985). Survivorship rates, $s(x)$, for period-cohort age group x to x+4 becoming age group x+5 to x+9, were computed from the stationary populations, $L(x)$, using the equations

$$s(x) = L(x+5) / L(x) \qquad (1)$$

and mortality rates, $d(x)$, computed as residuals

$$d(x) = 1 - s(x) \qquad (2).$$

These mortality rates assume that the population at risk is the starting population in a time interval whereas the projection model and the nature of the deaths statistics demand use of an average population at risk. So the mortality rates were adjusted thus to yield period-cohort death rates, $d1(x)$, for entry into the projection model

$$d1(x) = d(x)\ (1/\ 0.5(1 + s(x))) \qquad (3).$$

For Harare the detailed census tabulations required to estimate a life table were unavailable, so that the arbitrary assumption was made that the life expectancies for males and females in the Zimbabwean capital were ten years in advance of those for Zimbabwe as a whole (i.e. 66 and 69 respectively). The low rates of current infant mortality reported for Harare (Zanamwe, 1988b) and the extreme concentration of medical personnel in Harare (Zanamwe, 1988a) lend support to this assumption. The United Nations Model Life Tables for Developing Countries (United Nations, 1982) were used to derive survivorship rates, mortality rates by period-cohort and adjusted death rates, as above. For both Zimbabwe as a whole and for Harare recourse was made to the UK life table (Rees, 1988) to estimate death rates for the 80-84 to 85-89 and 85+ to 90+ period cohorts.

4.4 Fertility estimates

4.4.1 Fertiity in the United Kingdom

Livebirths (given in OPCS 1988b, GRO(S) 1987, DHSS(NI), 1987) by five year age group of mother (under 20, 20-24, ... ,35-39, 40 and over) for the calendar years 1981 to 1986 for the constituent countries of the UK and for Greater London were aggregated, applying a weight of a half to 1981 and 1986 figures. The period-age figures were deconsolidated by cohort and then reaggregated to period-cohorts for entry into the projection model.

4.4.2 Fertility in Zimbabwe

For Zimbabwe fertility rates were estimated for the year prior to the Census of 1969 and that prior to the Census of 1982 by CSO (1985) from the data supplied by women about babies born in the year previous to the Census. For 1968-69 the total fertility rate estimated by this method was 6.6 and the corresponding figure for 1982-83 was 5.611. These estimates are over one child per woman lower than estimates based on children ever born to women aged 15 to 50, but these latter estimates refer to the women's previous reproductive history stretching back up to 35 years in the case of the oldest women. Interpolation between the 1969 and 1982 based total fertility rates yielded an estimate of 5.802 for the 1977-82 benchmark period. The age-specific fertility rates wre converted from period-age to period-cohort plan before use in the projection model.

4.5 External migration estimates

4.5.1 External migration in the UK

The UK carries out a sample survey of arriving and departing international passengers, and from this survey statistics (OPCS 1987b) are estimated for the number of immigrants and emigrants intending to stay in or depart from the country for at least a year. The data are provided by sex and by five broad age groups for the UK and for regions (including Greater London). These figures for the years 1981 to 1986 were aggregated for the benchmark period, with 1981 and 1986 being weighted by a half as before.

The second stage was to use estimates of immigrations and emigrations by the period-cohorts needed in the model but for persons prepared for a prior analysis of 20 region populations in the UK for the 1976-81 period (see Rees and Woods 1986 for a detailed account of the estimation procedure) and to constrain them to the broad period-age by sex estimates for 1981-86. The resulting figures (Appendix) show the vital role played by Greater London in the international exchange of populations. Whereas the population of Greater London constituted 12 percent of the UK total in 1986, the metropolis received 30 percent of UK immigrants and contributed 23 of UK emigrants in the benchmark period.

4.5.2 External migration in Zimbabwe

Reliable statistics on external migration were not available for

Zimbabwe although a survey of visitors and migrants entering and leaving the country is carried out and might prove a useful future source. Zimabwe experienced substantial international migration flows between the 1969 and 1982 Censuses. CSO (1986) estimates the flows as a net gain of 276,000 Africans and a net loss of 81,000 Europeans, but assumed nil flows in the national projections. This same course is adopted here but is a defect in the Zimabwe projections that should be remedied in the future.

4.6 Internal migration estimates

4.6.1 Internal migration in the United Kingdom

Internal migration data are available in the UK from the National Health Service Central Register which counts patient re-registrations across the boundaries of Family Practitioner Committee areas, virtually coterminous in England and Wales with shire counties and ex-metropolitan districts. These data were assembled for the mid-year to mid-year periods 1981-82 to 1985-86 for the all-age flows out of and into Greater London, and aggregated to give figures for the benchmark period 1981-86. An equivalent age-disaggregated time series was not immediately available (though it could be estimated from partial data), and therefore the age-disaggregated flows for 1976-81 previously estimated (Rees 1986) were constrained to the 1981-86 totals. Sex disaggregation was achieved by applying all-sex migration rates to the population at risk for each age-sex group and adjusting to the totals for each sex. Further details of the data used are given in Stillwell, Boden and Rees (1988) and Boden (1988). Although these estimates can undoubtedly be improved, they represent a reasonable first approximation to the migration flows to and from Greater London in the benchmark period needed in the projection analysis.

4.6.2 Internal migration in Zimbabwe

The Zimbabwe Census of 1982 asked two migration questions: place of birth and place of residence one year previous (CSO, 1985). The latter statistics have not, however, been tabulated, and no age breakdown is available in tables of the former measure. Place of birth versus place of residence tables were produced from the Census of 1969, but again without age disaggregation. An attempt was made to estimate "net" intercensal migration flows using these two sources, but a conceptual analysis suggested that methods proposed in the literature were not reliable. Therefore, a very simple technique was adopted to generate estimates of the two sets of migration rates needed (to and from Harare). Rates of transfer of birthplace population to areas of residence in 1982 were computed from the 1982 place-of-birth by place-of-residence table and divided by the average age of the populations concerned in 1982 for each birthplace. Thus, the 44.72% rate at which persons born in Harare and surviving at the time of the 1982 Census are relocated in the Rest of Zimbabwe was divided by 26.4 (the average age of Harare's population in 1982) to yield a 1.69% annual migration rate. This was multiplied by 5 to produce a guestimate of 8.47% for the Harare to Rest of Zimbabwe migration rates for the 1977-82 benchmark period. For the counterstream from the Rest of Zimbabwe to Harare the equivalent figures were 5.9% divided by 20.8 years multiplied by 5 to yield a quinquennial migration rate of

1.43%.

To disaggregate these rates by age, use was made of the general parameters of the migration schedule proposed by Rogers and Castro (1981, Table 17, p.42). The migration rate at age x is given by

$$m(x) = 0.02 \exp(-0.10\, x) + 0.06 \exp(-0.10(x - 20) - \exp(-0.40(x - 20))) + 0.003 \qquad (4).$$

Migration rates at 5 year age intervals were computed and assumed to apply to five year period-cohorts "x-5,x-1 to x,x+4" (e.g. the migration rate for age 30 applies to the period-cohort in which persons start the time interval aged 25-29 and end it aged 30-34, with 30 being the assumed average age at migration).

Theses model migration rates must then be adjusted to reproduce the estimated average migration rate. The model rates are applied to average populations in the benchmark period, estimated by back-surviving the 1982 Census populations in each age-sex group, and then adjusted to agree with the estimated average migration rate

$$m1(x) = m0(x) \times [\, m(u) \,/\, (\, \sum_{c} m0(c)\, PAR(u,s,c) / \sum_{c} PAR(u,s,c)\,] \qquad (5)$$

where m0(c) is the model migration rate for period-cohort c (m(x) in equation (4)), m(u) is the average rate for both sexes for subnational unit u (Harare or the Rest of Zimbabwe) and PAR(u,s,c) is the population at risk for subnational unit u, sex s and period-cohort c defined as

$$PAR(u,s,c) = 0.5 \times (P1982(u,s,c) \times (1 + (\, 1 \,/\, s(u,s,c)))) \qquad (6)$$

where P1982 is the adjusted 1982 Census population and s(u,s,c) is the estimated survival rate for subnational unit u, sex s and period-cohort c. The resulting migration rates are given in the Appendix.

4.7 Data estimation: concluding remarks

All of the estimates for the benchmark period described above could be improved through further work, but for present purposes they represent a good working approximation on which projections can be based.

Table 6 provides a summary of key indicators associated with the four subnational populations. The indicators are for the first projection period (1986-91 for the UK and 1982-87 for Zimbabwe), assuming no change in rates from the benchmark period. This is done to make the two sets of rates strictly comparable and to avoid some minor accounting inconsistencies in the benchmark period. The following interesting contrasts are apparent.

TABLE 6. Key indicators for the 1980s for the United Kingdom and Zimbabwe

Indicator	United Kingdom 1986-91		Zimbabwe 1982-87	
	Greater London	Rest of UK	Harare	Rest of Zimbabwe
Populations				
Start	6,806	49,536	604	6,883
End	6,775	49,989	765	7,987
Change	-31	453	161	1,104
% aged 60+ (start)	20.3	20.7	3.9	4.7
Crude rates				
Birth	13.72	13.37	37.02	42.41
Death	11.55	12.28	5.88	11.24
Natural increase	2.17	1.08	31.14	31.17
Net migration	-2.80	0.49	16.03	-1.48
Change	-0.63	1.57	47.18	29.69
In-migration	23.86	3.92	34.82	1.73
Out-migration	29.11	3.22	18.78	3.20
Immigration	9.44	2.95	-	-
Emigration	6.99	3.17	-	-
Refined indicators				
Life exp.	74.50	74.15	67.40	56.50
TFR	1.73	1.78	4.48	5.93
GOMR	2.21	0.24	1.00	0.19
GEMR	0.49	0.24	-	-
GIMR	0.66	0.22	-	-

Source: computed from the projected population accounts for the first projection period in a constant rates projection.

Notes:

1. The populations are in 1000s.
2. The rates are per 1000 population at risk.
3. The refined indicators are averages of male and female values in the projected accounts.
4. Life exp.= life expectancy at birth in years. The Harare figure is a guestimate.
5. GOMR = gross out-migration rate GEMR = gross emigration rate GIMR = gross immigration rate. Gross rates = sum of age specific rates.

(1) Rates of growth, natural increase and net migration are much higher in Zimbabwe than in the UK, although the rate of gross out-migration (GOMR) is much lower.
(2) Comparison of the rates of growth of metropolis and hinterland indicate that counter-urbanization is occurring in the UK, whereas urbanization is occurring in Zimbabwe.
(3) Natural increase makes a small positive contribution to growth in Greater London and the Rest of the UK but a massive contribution in Zimbabwe.
(4) Natural increase in Harare is estimated as approximately the same as in the Rest of Zimbabwe: fertility is lower, but so is mortality.
(5) However, the crude death rate in Harare is unlikely to fall any further (and may well increase because of aging), and so natural increase will fall with fertility decline. This may not happen in the Rest of Zimbabwe for a while.
(6) Net migration contributes about a third to growth in Harare. This relative contribution may increase as natural increase shrinks, but may fall if the rates of migration from the Rest of Zimbabwe fall.
(7) The contribution of external migration to Greater London's population change is positive, whereas for the Rest of the UK it is negative.

5. ALTERNATIVE PROJECTIONS

To explore the future development of these two metropolis-hinterland population systems, projections were carried out, using the methods of section 2, the scenarios of section 3 and the data of section 4. Here a small subsample of possible assumptions are used, and these are set out in Table 7.

5.1 The set A projections - constant rates

In the set A projections all rates are kept constant. This projection provides a benchmark against which the effects of alternative assumptions can be gauged. The migration rates used are graphed in Figure 2.

5.2 The set B projections - trended mortality and fertility rates

In the set B projections, mortality rate trends are introduced. Table 8 sets out the factors used to decrease mortality over the projection period, based on recent experience in the two countries. Decrease percentages are greater at younger ages, and generally higher in Zimbabwe than in the UK. At retirement ages the decreases are higher in the UK, though the estimates of change rates for Zimbabwe at these ages are not very certain. By the middle of the next century life expectancies at birth will, under these assumptions, have improved to nearly 83 years (for persons) in the UK (not much beyond the current experience of the most favoured areas of southern counties) and to nearly 72 years in Zimbabwe.

The fertility scenarios adopted in the B set of projections are set out in Table 9. In both cases, the total fertility rates are trended to replacement, following the guidelines given in both

TABLE 7. The alternative assumptions used in the projections

Component	United Kingdom Projections			
	A	B	C	D
Mortality	Constant rates at 81-86 level	Trended rates to LE=82.6 in 2046-51	Trended rates to LE=82.6 in 2046-51	Trended rates with AIDS rates added
Fertility	Constant rates at 81-86 level	Trended rates to TFR=2.09 in 2006-11	Trended rates to TFR=2.09 in 2006-11	Trended rates to TFR=2.09 in 2006-11
Migration	Constant rates at 81-86 levels	Constant rates at 81-86 levels	Constant rates at 85-86 levels	Constant rates at 85-86 levels

Component	Zimbabwe Projections		
	A	B	D
Mortality	Constant rates at 77-82 level	Trended rates to LE=71.5 in 2047-52	Trended rates with AIDS rates added
Fertility	Constant rates at 77-82 level	Trended rates to TFR=2.10 in 2032-37	Trended rates to TFR=2.10 in 2032-37
Migration	Constant rates at 77-82 level	Constant rates at 77-82 level	Constant rates at 77-82 level

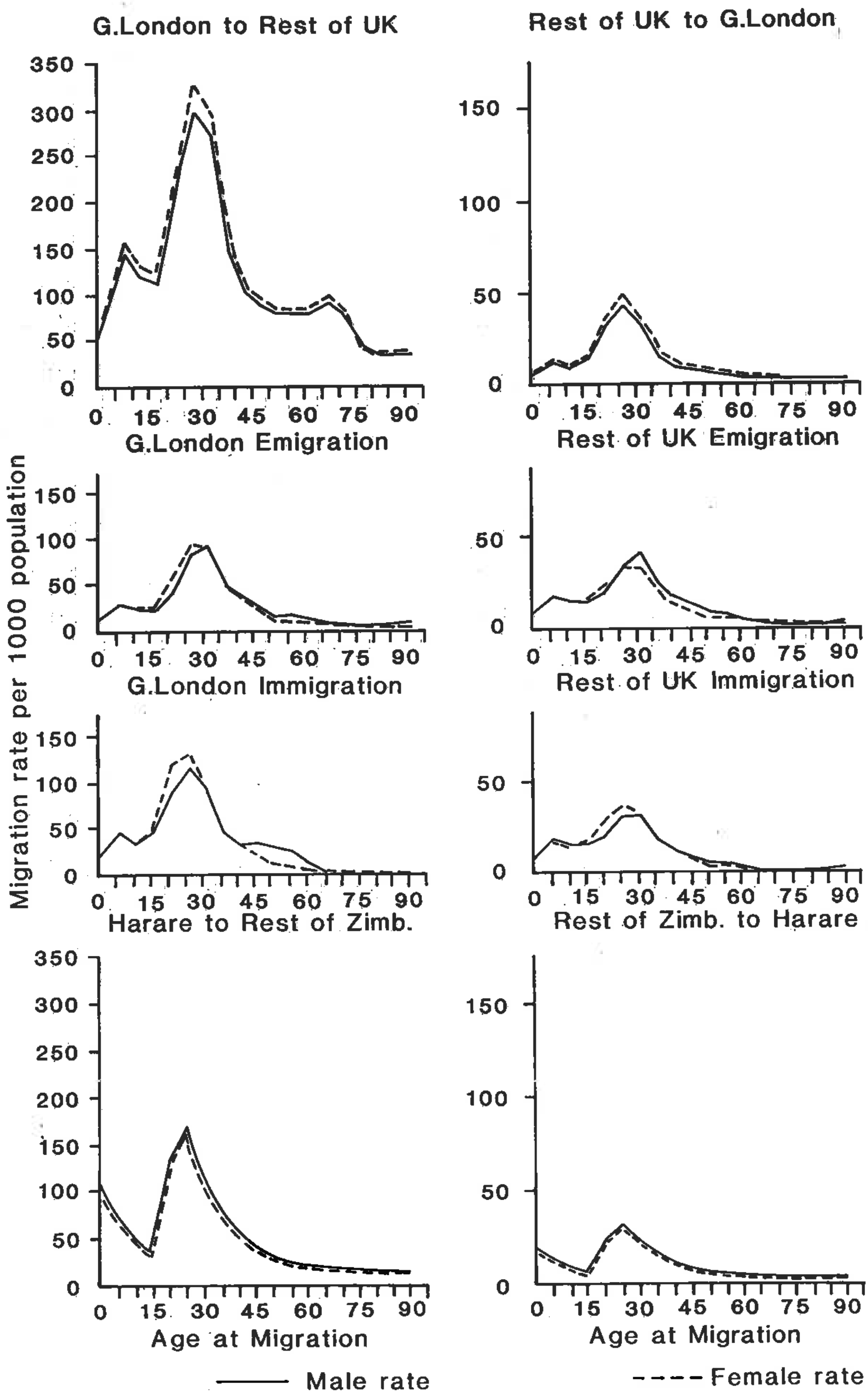


FIGURE 2. Migration rate profiles for the UK and Zimbabwe

TABLE 8. Percentage decreases in mortality rates assumed per quinquennium

Initial age group	United Kingdom Males	United Kingdom Females	Zimbabwe Males	Zimbabwe Females	Final age
Birth	-15	-14	-12	-14	0-4
0-4	-14	-10	-19	-24	5-9
5-9	-11	-6	-17	-18	10-14
10-14	-7	-8	-11	-11	15-19
15-19	-7	-11	-16	-17	20-24
20-24	-6	-8	-16	-17	25-29
25-29	-4	-5	-12	-14	30-34
30-34	-7	-5	-9	-11	35-39
35-39	-10	-11	-9	-7	40-44
40-44	-10	-10	-9	-4	45-49
45-49	-10	-9	-9	-3	50-54
50-54	-8	-6	-10	-4	55-59
55-59	-7	-3	-9	-5	60-64
60-64	-6	-4	-7	-4	65-69
65-69	-6	-4	-5	-3	70-74
70-74	-6	-5	-2	-1	75-79
75-79	-5	-7	0	0	80-84
80-84	-5	-6	0	0	85-89
85+	-4	-5	0	0	90+

Notes:

1. The United Kingdom percentages based on a comparison of England and Wales death rates in 1971-75 compared with those in 1981-85.
2. The Zimbabwe percentages are based on a comparison of the 1969 and 1982 Zimbabwe life tables (the 1969 rates are taken from the UN model life tables for life expectancies, 66 for men and 69 for women).
3. The percentage reductions are used as follows: new death rate = old death rate x (1.0+decrease factor/100).

TABLE 9. The total fertility rates assumed in the trended projections

Period	United Kingdom	Greater London	Period	Zimbabwe	Harare
			1977-82	5.80	4.48
1981-86	1.78	1.76	1982-87	5.19	4.01
1986-91	1.86	1.84	1987-92	4.57	3.53
1991-96	1.94	1.92	1992-97	3.87	2.99
1996-01	2.02	2.00	1997-02	3.37	2.61
2001-06	2.09	2.08	2002-07	3.03	2.34
2006-11	2.09	2.09	2007-12	2.76	2.10
2011-16	2.09	2.09	2012-17	2.54	2.10
2016-21	2.09	2.09	2017-22	2.41	2.10
2021-26	2.09	2.09	2022-27	2.29	2.10
2026-31	2.09	2.09	2027-32	2.16	2.10
2031-36	2.09	2.09	2032-37	2.10	2.10
to			to		
2046-51	2.09	2.09	2047-52	2.10	2.10

Notes:
1. The United Kingdom assumptions follow those of OPCS (1987c) to 1996-01 but then continue until replacement TFR is achieved. This is 2.09 rather than the conventional 2.10 under current mortality conditions.
2. The Zimbabwe assumptions follow those of CSO(1986)'s low assumption.

countries' official projections. There is little evidence of an upturn in UK fertility rates as yet (although numbers of births will rise in the 1990s because of larger parental cohorts). However, a rise of fertility to replacement level is the only scenario that will guarantee the survival of Britain's population, and so this is incorporated in the set B (and C and D) projections. The Zimbabwe scenario follows the "low scenario" of CSO (1986) although this still represents a fairly slow decline in fertility (50 years to replacement).

5.3 The set C projections - alternative migration rates

Migration rates have been observed to fluctuate considerably in terms of level and direction in developed countries over the past couple of decades. Major shifts have occurred in response to rates of economic activity both over time and across space (Rees and Stillwell, 1988; Stillwell, Boden and Rees, 1988). In the C projections the migration rates for the latest year available (1985-86 multiplied by 5) were used instead of rates for the full five year period. Table 10 compares the resulting migration flows for the first projection period.

When 1985-86 rates are adopted, Greater London shows an increased loss to the Rest of the UK, compensated for by increased gains from the Rest of the World. The Rest of the UK gains from Greater London and from the Rest of the World (losses in 1981-86 becoming gains in 1985-86). The C projection explores the impact of these changes.

5.4 The D projections - the impact of AIDS

One very serious development affecting populations world-wide, which to date has not been incorporated into official projections, is the spread of the Acquired Immune Deficiency Syndrome or Aids. The Human Immunodeficiency Virus (HIV) is spreading through the population through exchange of seminal, vaginal and blood fluids, principally through sexual intercourse and through the sharing of needles by intra-venous drug abusers. Persons infected by the HIV virus go on to develop AIDS (a complex of infectious diseases) after a latent period. The current prediction (by Dr.James Curran, Director of the AIDS program of the U.S. Center of Infectious Diseases quoted in Ballantyne, 1988) is that 90% of HIV positive people would develop AIDS within 15 years. The mortality risk to those with AIDS is estimated at 50% per year, and a majority die within two years.

Knox (1986) has constructed an epidemiological model for the transmission of HIV and AIDS in the United Kingdom population. The model attempts to predict equilibrium levels for the prevalence (spread in the population) and incidence (rate of new cases) of the AIDS virus using estimates of contact rates between the susceptible population and the infectious, the risk of transmission on establishing a contact and the annual decay rate of the infectious state (mortality principally). The population is broken down into 12 classes (9 male, 3 female) on the basis of sexual behaviour(s). Knox predicts 20,000 to 40,000 deaths from AIDS per year in the UK (total deaths from other causes in 1981-86 were circa 660,000 per year), and that equilibrium for the promiscuous

TABLE 10. <u>Migration flows for the 1986-91 period using 1981-86 and 1985-86 migration rates, United Kingdom</u>

Migration streams	Greater London		Rest of the UK	
	Males	Females	Males	Females
		1981-86 rates		
Internal				
Out-migration	464.4	520.1	379.0	428.1
In-migration	379.0	428.1	464.4	520.1
Net migration	-85.4	-92.0	+85.4	+92.0
External				
Emigration	114.8	121.6	416.8	377.7
Immigration	157.8	161.5	363.4	376.3
Net migration	+43.0	+39.9	-53.4	-1.4
Total net migration	-43.4	-52.1	32.0	90.6
		1985-86 rates		
Internal				
Out-migration	513.2	574.4	395.7	447.1
In-migration	395.7	447.1	513.2	574.4
Net migration	-117.5	-127.3	117.5	127.3
External				
Emigration	113.8	120.4	400.1	362.4
Immigration	184.7	189.1	423.3	438.2
Net migration	+70.9	+68.7	+23.2	+75.8
Total net migration	-46.6	-58.6	140.7	203.1

classes will be attained within 10 years, although it will take up to 40 years for equilibrium to be achieved among the non-promiscuous.

These equilibrium estimates appear to be consistent with the trajectory of new AIDS cases in the UK (Table 11). The extrapolated numbers of cases were computed by continuing the downward trend in the rate of increase of new AIDS cases from 1987 over 13 years to the year 2000. The final column in the table shows the number of AIDS deaths expected per quinquennium. In order to add these deaths into the projection model it was necessary to distribute them across the sexes (males, females), subnational units (Greater London, Rest of the UK), and ages. This distribution could only proceed through a series of guesses. Although 90% of HIV positives currently recorded in the UK (Wells, 1988) are male and only 10% female (mainly drug abusers), at equilibrium the virus is evenly distributed (Knox, 1986). The first panel of Table 12 shows the assumed proportions moving from the current situation to the equilibrium.

AIDS is unevenly distributed across the country. It is highly concentrated in the national capital, but is spreading from there outwards via the national urban hierarchy in the classic manner of geographic diffusions. An equilibrium spread of 50% in the national capital, and 50% in the hinterland is assumed, reflecting the distribution of susceptibles.

AIDS deaths have occurred predominantly to young adults to date, and are assumed to concentrate in the 15-19 to 50-54 age groups, following the fertility rate distribution as a surrogate for degree of sexual activity but displaced by 5 years to allow for the latency period between HIV infection and full blown AIDS. The probabilities in Table 12 are chained together to distribute AIDS deaths:

AIDS deaths in a sex, area, age group

= total AIDS deaths x sex proportion
x area proportion
x age proportion.

These deaths are then divided by the populations at risk in the 1981-86 period.

Table 13 shows the death rates that this procedure projects for 2001-06 and thereafter. Trended mortality rates and AIDS death rates are summed for entry to the projection model. From these guestimates it is clear that AIDS will soon become the most important cause of death between ages 15 and 50, that death rates in the 20s and 30s will increase dramatically (from 2 to 10 times their current level, depending on sex and area). The consequences are a reduction in life expectancy of from 1 to 6 years (depending on sex and area). These serious developments can only be ameliorated by drastic changes in sexual behaviour and by the development of a vaccine. There are difficult obstacles to both changes.

For Zimbabwe, the same additional death rates due to AIDS have

TABLE 11. Observed and extrapolated AIDS cases United Kingdom

Year	Number of new cases	Ratio of successive years	Estimated deaths from AIDS in five year periods	
Observed				
1982	3		1981-86	438
1983	28	9.33		
1984	77	2.75		
1985	165	2.14		
1986	330	2.00	1986-91	8,646
1987	597	1.81		
Extrapolated				
1988	1,043	1.75		
1989	1,759	1.69		
1990	2,854	1.62		
1991	4,455	1.56	1991-96	59,729
1992	6,676	1.49		
1993	9,588	1.44		
1994	13,172	1.37		
1995	17,275	1.31		
1996	21,580	1.25	1996-01	141,705
1997	25,613	1.19		
1998	28,804	1.12		
1999	30,599	1.06		
2000	30,599	1.00		
2001	30,599	1.00	2001-06	152,995

Sources:
1. Observed AIDS cases given in Wells (1986, 1988).
2. Extrapolated AIDS cases computed by trending the ratio of successive years from 1.81 (1986-87 value) to 1.00 by the year 2000.

TABLE 12. Assumptions used in distributing AIDS deaths

Population categories	Period 1986-91	1991-96	1996-01	2001-06
Sex proportion				
Male	.90	.77	.64	.50
Female	.10	.23	.36	.50
Region proportion				
Greater London	.7615	.6519	.5423	.50
Rest of the UK	.2385	.3481	.4577	.50
Age proportions (period-cohorts)				
15-19 to 20-24	.0413	.0413	.0413	.0413
20-24 to 25-29	.1724	.1724	.1724	.1724
25-29 to 30-34	.3158	.3158	.3158	.3158
30-34 to 35-39	.2916	.2916	.2916	.2916
35-39 to 40-44	.1275	.1275	.1275	.1275
40-44 to 45-49	.0441	.0441	.0441	.0441
45-49 to 50-54	.0073	.0073	.0073	.0073

TABLE 13. Death rates assumed in 2001-06

Period-cohort	Male		Female	
	Trended mortality rates	AIDS death rates	Trended mortality rates	AIDS death rates
		Greater London		
15-19 to 20-24	.003038	.005673	.001102	.005607
20-24 to 25-29	.003574	.023917	.001499	.022960
25-29 to 30-34	.004334	.047593	.002238	.047762
30-34 to 35-39	.005101	.042512	.002941	.042658
35-39 to 40-44	.007269	.022600	.003680	.022594
40-44 to 45-49	.012348	.009007	.007123	.009085
45-49 to 50-54	.018132	.001539	.011967	.001549
		United Kingdom		
15-19 to 20-24	.002970	.001302	.000956	.001355
20-24 to 25-29	.003327	.006145	.001331	.006271
25-29 to 30-34	.003905	.012597	.002033	.012799
30-34 to 35-39	.004186	.010658	.002943	.010733
35-39 to 40-44	.005908	.005426	.003791	.005496
40-44 to 45-49	.010670	.002124	.006806	.002139
45-49 to 50-54	.019030	.000365	.012317	.000365

been assumed. AIDS cases have been reported from the country, and rapid spread of the condition has been recorded in other East African countries. It is unlikely that Zimbabwe will avoid the disease.

Having assembled the benchmark data for the two case studies, having developed several alternative scenarios for future change in the demographic components in the two countries, we are now in a position to examine the future prospects for aging in our two sets of metropolis and hinterland populations.

6. EVOLUTION OF THE ELDERLY

6.1 Projected total populations

Table 14 sets out the evolution of the four case study populations under the alternative scenarios set out in the previous section. Continued application of benchmark period rates results population decrease in the long term in both UK areas, although the population of the hinterland continues to grow to 2001. In Zimbabwe such a scenario leads to a population explosion in the twenty first century.

Assuming rapid mortality decline, and trending fertility rates towards replacement ensures growth in the populations of both the Rest of the UK and Greater London, whereas in Zimbabwe fertility decline reduces the projected population by at least 11 millions by 2026 and 40 millions by 2051.

Adopting the migration rates of the latest year leads to greater growth in the Rest of the UK population compared with using benchmark period rates. Although the net migration flows implied by the 1985-86 rates were initially more negative for Greater London than in the benchmark period, the C projection yields higher populations later on as growth is transmitted from the Rest of the UK.

The influence of AIDS deaths is surprisingly small on all populations - by 2026 (after a quarter of a century at AIDS equilibrium) Greater London has lost only 371 thousand people, the Rest of the UK only 733 thousand (the AIDS deaths plus missing births), and Harare has lost 135 thousand and the Rest of Zimbabwe 239 thousand people, comparing successive projections. Let us pray that the consequences are no worse.

The distribution of the populations between metropolis and hinterland is set out in Table 15. "Counter-metropolitanization" continues in the UK, and "metropolitanization" continues in Zimbabwe, but rather slowly in both cases. AIDS deaths (assumed concentrated in the metropolis) reduce the national capital's shares.

6.2 Projected elderly populations: absolute aging

Most of the elderly population in the projections are already alive in the current population, and thus their future numbers are unaffected by prospective fertility except in the very last

TABLE 14. Projected total populations, selected years

Projection	1981	2001	2026	2051
	Greater London			
A Constant rates	6,806	6,651	6,250	5,546
B Trended rates	6,806	6,891	7,221	7,566
C Latest migration rates	6,806	6,882	7,282	7,766
D Plus AIDS rates	6,806	6,767	6,911	7,222
	Rest of the United Kingdom			
A Constant rates	49,536	50,687	49,019	43,789
B Trended rates	49,536	52,299	56,170	59,194
C Latest migration rates	49,536	53,014	58,280	62,898
D Plus AIDS rates	49,536	52,889	57,547	61,428

Projection	1982	2002	2027	2052
	Harare			
A Constant rates	604	1,453	3,625	8,372
B Trended rates	604	1,269	2,232	3,103
D Plus AIDS rates	604	1,247	2,097	2,833
	Rest of Zimbabwe			
A Constant rates	6,883	12,900	28,078	60,453
B Trended rates	6,883	11,237	16,628	20,227
D Plus AIDS rates	6,883	11,208	16,389	19,678

Notes:
1. The populations are in 1000s.

TABLE 15. Percentage shares of the projected population, selected years

Projection	Year			
	1981	2001	2026	2051
	Metropolitan % - United Kingdom			
A Constant rates	12.1	11.6	11.3	11.2
B Trended rates	12.1	11.6	11.4	11.3
C Latest migration rates	12.1	11.5	11.1	11.0
D Plus AIDS rates	12.1	11.3	10.7	10.5

Projection	Year			
	1982	2002	2027	2052
	Metropolitan % - Zimbabwe			
A Constant rates	8.1	10.1	11.4	12.2
B Trended rates	8.1	10.1	11.8	13.3
D Plus AIDS rates	8.1	10.0	11.3	12.6

projection quinquennium (2046-51 or 2047-52). Moving from a constant rates to a trended rates scenario therefore reflects only the influence of mortality decline and quite substantial increases in the numbers of the elderly results (see Table 16). AIDS deaths do not affect elderly numbers until the second decade of the next century.

For the Rest of the UK improvements in mortality rates add 5 millions to the elderly population by 2051, only half a million of whom will be "taken away" by AIDS. In fact, increased in-migration in projection C more than restores AIDS losses, contributing nearly 0.8 millions by 2051.

Improved survival chances change a situation of future decreases in persons aged 60 and over in Greater London into future gains when the renewed aging of the British population takes place from 2006 onwards.

The growth of Zimbabwe's elderly population will be spectacular as today's youthful cohorts attain their 60th birthdays. Table 17 converts the absolute population numbers into time series indices (1981 or 1982 = 100). The relative growth in Harare's elderly population by the middle of the next century is likely to be by a factor of 22, while the comparable figure for the Rest of Zimbabwe is 10 (projection D). The greater growth of the elderly population in Zimbabwe's metropolis contrasts with the lesser growth in the UK capital. This, of course, assumes that the migration schedule continues without the retirement peak (bottom left hand graph in Figure 2) which is characteristic of the migration stream out of the capitals of developed countries (top left hand graph in Figure 2).

6.3 Projected elderly population: relative aging

The relative shares of the elderly population are set out in Table 18 for the four subnational units. In the UK the share decreases in the 1990s from just over one fifth to just under, increasing again after 2001 to one quarter by 2026. In all projections the metropolitan elderly percentage remains below that of the rest of the country.

In Zimbabwe relative aging clearly takes place as a result of fertility decline but not until this has advnced far towards replacement. By 2027 some 8.5% of Zimbabwe's population will be aged 60 and over. Note that the corresponding United Nation's projection (quoted in Table 1) suggests that only 5.0% of the population will be aged 60 or over in 2025. The difference is attributable to the faster fertility decline assumed here, following the low scenario of CSO (1986).

Although the capital starts off with a less aged population than the hinterland (because the city is very "young"), by 2026 Harare's population is more elderly both as a result of better survival of existing cohorts and because of the aging of cohorts swollen by net in-migration. By 2052 Harare will have reached the elderly age structure characteristic of Greater London in 2001.

6.4 Projected dependency

TABLE 16. Projected population aged 60 and over, selected years

Projection	1981	2001	2026	2051
		Greater London		
A Constant rates	1,406	1,197	1,393	1,273
B Trended rates	1,406	1,267	1,661	1,815
C Latest migration rates	1,406	1,251	1,634	1,812
D Plus AIDS rates	1,406	1,251	1,581	1,661
		Rest of the United Kingdom		
A Constant rates	9,992	9,990	12,276	11,338
B Trended rates	9,992	10,582	14,728	16,388
C Latest migration rates	9,992	10,627	15,055	17,176
D Plus AIDS rates	9,992	10,627	14,947	16,700

Projection	1982	2002	2027	2052
		Harare		
A Constant rates	24	62	217	493
B Trended rates	24	66	256	580
D Plus AIDS rates	24	66	240	519
		Rest of Zimbabwe		
A Constant rates	324	487	1,084	2,495
B Trended rates	324	497	1,355	3,349
D Plus AIDS rates	324	497	1,345	3,263

TABLE 17. Projected population aged 60 and over: time series indices

Projection	1981	2001	2026	2051
		Greater London		
A Constant rates	100	85	99	91
B Trended rates	100	90	118	129
C Latest migration rates	100	89	116	129
D Plus AIDS rates	100	89	112	118
		Rest of the United Kingdom		
A Constant rates	100	100	123	113
B Trended rates	100	106	147	164
C Latest migration rates	100	106	151	172
D Plus AIDS rates	100	106	150	167

Projection	1982	2002	2027	2052
		Harare		
A Constant rates	100	263	918	2092
B Trended rates	100	278	1066	2458
D Plus AIDS rates	100	278	1018	2199
		Rest of Zimbabwe		
A Constant rates	100	150	335	770
B Trended rates	100	153	418	1033
D Plus AIDS rates	100	153	415	1007

Notes:
1. 1981 or 1982 = 100

TABLE 18. Projected percentages aged 60 and over, selected years

Projection	Year			
	1981	2001	2026	2051
	Greater London			
A Constant rates	20.7	18.0	22.3	23.0
B Trended rates	20.7	18.4	23.0	24.0
C Latest migration rates	20.7	18.2	22.4	23.3
D Plus AIDS rates	20.7	18.5	22.9	23.0
	Rest of the United Kingdom			
A Constant rates	20.2	19.7	25.0	25.9
B Trended rates	20.2	20.2	26.2	27.7
C Latest migration rates	20.2	20.1	25.8	27.3
D Plus AIDS rates	20.2	20.1	26.0	27.2

Projection	Year			
	1982	2002	2027	2052
	Harare			
A Constant rates	3.9	4.3	6.0	5.9
B Trended rates	3.9	5.2	11.3	18.7
D Plus AIDS rates	3.9	5.3	11.5	18.3
	Rest of Zimbabwe			
A Constant rates	4.7	3.4	3.9	4.1
B Trended rates	4.7	4.4	8.2	16.6
D Plus AIDS rates	4.7	4.4	8.2	16.6

Critical to the ability of either families or society to care for those of the elderly that require help is the ratio of the elderly to those in the working ages. The demographic ratio of those aged 60+ to those aged 15-59 is used as a dependency indicator. Table 19 sets out the figures for two of the projections.

Between 1981 and 2001 in the UK, the high ratios fall a little, but after 2001 they rise, particularly in the Rest of the UK. For every 2 persons in the working ages there will be 1 person aged 60 or more.

Currently, dependency ratios in Zimbabwe are very low, and lowest in Harare. With fertility decline these ratios will rise, earlier in the capital, to levels in the mid-21st century just below those in the UK currently. There is little difference between the sexes principally because the gap in life expectancies between the sexes is assumed to remain narrow at 2 to 3 years compared with 5 to 6 years in the UK.

6.5 Aging of the elderly

Within the elderly population, aging is expected, both as a result of increased survival chances into the most elderly ages, and, for a while, because large cohorts move into the oldest age groups. Table 20 shows what happens to the percentage of the population aged 80 and over, which increases proportionally more in both the UK and Zimbabwe than the 60 and over age group as a whole.

6.6 Metropolitan concentration or deconcentration?

The final issue that the projections enable us to address here is whether the elderly will become more concentrated in the nation's capital or less under the forecast mortality and fertility conditions, and under current mobility patterns. Table 21 reports the metropolitan share of the 60+ population in each country.

Under all scenarios the UK elderly population deconcentrates. Greater London loses 2 to 3% of the national elderly population over the projection period. Trending mortality rates makes little difference (because the same trends are applied to both capital and hinterland); adopting the most recent migration pattern shifts a further half of one percent out of London; accounting for AIDS removes another half of one percent by 2051 (because of the higher death rates from AIDS assumed for the capital).

In Zimbabwe the Harare share of the elderly population increases into the first quarter of the 21st century but shrinks back after that as fertility decline in the Rest of Zimbabwe catches up with that in Harare and as AIDS deaths remove more of the capital's population than the hinterland's.

7. CONCLUDING REMARKS

In the lifetime of babies currently being born, there are likely to be profound changes in the age and spatial structure of populations in both more and less developed regions of the world. This paper

TABLE 19. Dependency ratios, selected ratios

Projection	Sex	1981	2001	2026	2051
			Greater London		
B Trended rates	Male	32	29	41	43
	Female	46	38	49	52
D Plus AIDS rates	Male	32	30	41	41
	Female	46	38	50	50
			Rest of the United Kingdom		
B Trended rates	Male	33	32	48	52
	Female	47	44	60	64
D Plus AIDS rates	Male	33	32	48	51
	Female	47	43	59	63

Projection	Sex	1982	2002	2027	2052
			Harare		
B Trended rates	Male	7	12	20	35
	Female	9	9	20	35
D Plus AIDS rates	Male	7	12	21	35
	Female	9	9	21	35
			Rest of Zimbabwe		
B Trended rates	Male	14	10	14	32
	Female	13	9	15	30
D Plus AIDS rates	Male	14	10	14	32
	Female	13	9	16	30

Notes:
1. The dependency ratio is defined as the population 60 and over as a percentage of the population aged 15-59.

TABLE 20. Percentages aged 80 and over, selected years

Projection		Sex	Year 1981	2001	2026	2051
			Greater London			
B	Trended rates	Male	1.56	2.56	3.45	6.03
		Female	3.92	5.68	6.10	9.81
D	Plus AIDS rates	Male	1.56	2.59	3.49	6.00
		Female	3.92	5.76	6.17	9.76
			Rest of the United Kingdom			
B	Trended rates	Male	1.57	2.57	3.80	6.97
		Female	4.23	5.52	6.79	11.28
D	Plus AIDS rates	Male	1.56	2.57	3.79	6.97
		Female	3.92	5.51	6.78	11.27

Projection		Sex	Year 1982	2002	2027	2052
			Harare			
B	Trended rates	Male	0.28	0.36	0.84	1.87
		Female	0.42	0.38	0.76	2.22
D	Plus AIDS rates	Male	0.28	0.36	0.90	1.86
		Female	0.42	0.38	0.81	2.26
			Rest of Zimbabwe			
B	Trended rates	Male	0.41	0.25	0.34	1.06
		Female	0.46	0.27	0.43	1.12
D	Plus AIDS rates	Male	0.41	0.25	0.34	1.07
		Female	0.46	0.27	0.44	1.13

TABLE 21. Percentage shares of the projected elderly population, selected years

Projection	Year			
	1981	2001	2026	2051
	Metropolitan % - United Kingdom			
A Constant rates	12.3	10.7	10.2	10.1
B Trended rates	12.3	10.7	10.1	10.0
C Latest migration rates	12.3	10.5	9.8	9.5
D Plus AIDS rates	12.3	10.5	9.6	9.0

Projection	Year			
	1982	2002	2027	2052
	Metropolitan % - Zimbabwe			
A Constant rates	6.9	11.3	16.7	16.5
B Trended rates	6.9	11.7	15.9	14.8
D Plus AIDS rates	6.9	11.7	15.1	13.7

has contributed to an investigation of those changes in several ways.

Multiregional methods of projecting the population of subnational areas which represent properly the migration flows between them have been adapted in simplified biregional form for application in information and technology poor situations. It has been shown that reasonable estimates of the input variables can be made for both a more and a less developed nation.

Alternative scenarios of population development have been translated into population projections using the biregional method for two case studies consisting of the national capital and the rest of the nation. In the more developed nation, the UK, the greatest population aging will take place outside the national capital; in the less developed nation (Zimbabwe) the greatest population aging takes place inside the national capital. In all situations, however, the twenty-first century will bring with it a "greyer" population.

REFERENCES

Abbreviations

CSO = Central Statistical Office (Zimbabwe)
HMSO = Her Majesty's Stationery Office (United Kingdom)
OPCS = Office of Population Censuses and Surveys (United Kingdom)

Ballantyne, A. (1988) Europe warned of 50,000 AIDS cases by 1990. The Guardian, Tuesday, 14 June, p.3.

Boden, P. (1988) The analysis of internal migration in the United Kingdom using Census and NHSCR data. Ph.D. thesis in preparation, School of Geography, University of Leeds.

Carvalho, J.A.M. (1974) Regional trends in fertility and mortality in Brazil. Population Studies, 28, 401-421.

CSO (1985) Main demographic features of the population of Zimbabwe: an advance report based on a ten percent sample. 1982 Population Census Zimbabwe, CSO, Harare.

CSO (1986) Population projections of Zimbabwe: 1982 to 2032. CSO, Harare.

Davis, K., Bernstam, M.S. and Ricardo-Campbell, R. (eds.) Below-replacement fertility in industrial societies. Cambridge University Press, Cambridge.

DHSS(NI) (Department of Health and Social Security, Northern Ireland) (1987) Annual report, 1985. No.64. HMSO, Belfast.

GRO(S) (General Register Office, Scotland) (1987) Annual report, 1986. HMSO, Edinburgh.

Knox, E.G. (1986) A transmission model for AIDS. European Journal of Epidemiology, 2, 165-177.

Ledent, J. (1982) The limits to urban growth: suggestions for macromodelling Third World economies. Economic Development and Cultural Change, 30, 595-623.

OPCS (1983) Population estimates, 1981. Series PP1. HMSO, London.

OPCS (1987a) Mid-year population estimates, 1971-85 for local building blocks, England and Wales. OPCS Customer Services Division, Titchfield, Hampshire.

OPCS (1987b) International migration. Series MN, no.12. HMSO, London.

OPCS (1987c) Population projections. 1985-2025. Series PP2, no.15. HMSO, London.

OPCS (1988a) Key population and vital statistics: local and health authority areas, 1986. Series VS, no.13/PP1, no.9. HMSO, London.

OPCS (1988b) Birth statistics, 1986. Series FM, no.15. HMSO, London.

Rees, P.H. (1981) Accounts based models for multiregional population analysis: methods, program and user's manual. Working Paper 295, School of Geography, University of Leeds.

Rees, P.H. (1984) Spatial population analysis using movement data and accounting methods: theory, models, the 'MOVE' program and examples. Working Paper 404, School of Geography, University of Leeds/Working Paper no.50, Netherlands Interuniversity Demographic Institute, the Hague.

Rees, P.H. (1986) Choices in the construction of regional population projections. Chapter 7 in Woods, R.I. and Rees, P.H. (eds.) Population structures and models. George Allen and Unwin, London. Pp.126-159.

Rees, P.H. (1988) Britain's population: a geographical analysis. In preparation.

Rees, P.H. and Stillwell, J.C.H. (1988) Internal migration in the United Kingdom. In Nam, C.B., Serow, W.J. and Sly, D.F. (eds.) International handbook on internal migration. Greenwood Press, Westport, Connecticutt. In press.

Rees, P.H. and Woods, R.I. (1986) Demographic estimation: problems, methods and examples. In Woods, R.I. and Rees, P.H. (eds.) Population structures and models. George Allen and Unwin, London. Pp.301-343.

Rogers, A. (1976) Shrinking large-scale population projection models by aggregation and decomposition. Environment and Planning A, 8, 515-541.

Rogers, A. (1982) Rural-urban migration, urbanization and economic development. Economic Development and Cultural Change, 30, 507-538.

Rogers, A. (1986) Population projections. Chapter 6 in Rogers, A. and Willekens, F. (eds.) Migration and settlement: a multiregional comparative study. Reidel, Dordrecht. Pp.211-263.

Rogers, A. and Castro, L.J. (1981) Model migration schedules. Research Report RR-81-30, International Institute for Applied Systems Analysis, Laxenburg, Austria.

Rogers, A. and Willekens, F. (ed.) (1986) Migration and settlement: a multiregional comparative study. Reidel, Dordrecht.

Stillwell, J.C.H., Boden, P. and Rees, P.H. (1988) Internal migration change in the UK: trends based on NHSCR movement data, 1975-76 to 1985-86. Working Paper 510, School of Geography, University of Leeds.

Strong, M.A. (1987) Software for demographic research. Population Index, 53, 183-199.

United Nations (1982) Model life tables for developing countries. Department of International Economic and Social Affairs. Population Studies, No.77. United Nations, New York.

United Nations (1983) Manual X. Indirect techniques for demographic estimation. Department of International Economic and Social Affairs, Population Studies, No.81. United Nations, New York.

United Nations (1985a) The world aging situation: strategies and policies. Department of International Economic and Social Affairs, ST/ESA/150. United Nations, New York.

United Nations (1985b) World population prospects: estimates and projections as assessed in 1982. Department of International Economic Affairs, Population Studies, No.86. United Nations, New York.

United Nations (1988) Manual for subnational population projections. Department of International Economic and Social Affairs, Population Division. In preparation.

Wells, N. (1986) The AIDS virus: forecasting its impact. Office of Health Economics, London.

Wells, N. (1988) HIV and AIDS in the United Kingdom. Briefing No.23, January, 1988. Office of Health Economics, London.

Willekens, F. (1988) Personal communication.

Willekens, F. and Rogers, A. (1978) Spatial population analysis: methods and computer programs. Research Report RR-78-18, International Institute for Applied Systems Analysis, Laxenburg, Austria.

Wolf, D. (1988) Interpreting demographic trends. Options, 1988, 1, 5-7.

Woods, R.I. (1979) Population analysis in geography. Longman, London.

Zanamwe, L. (1988a) Regional variation in the provision of educational and health services in Zimbabwe. Working Paper 507, School of Geography, University of Leeds.

Zanamwe, L. (1988b) Personal communication.

APPENDIX: BENCHMARK DATA FOR THE UNITED KINGDOM AND ZIMBABWE

Table of population stocks and component flows for:-
United Kingdom 1981 to 1986

MALES

Start age group	Start populations	Deaths	Emigrations	Internal out-migrations	Internal in-migrations	Immigrations	End populations	End age group
Birth	1879741	20274	19360	27044	27044	22076	1866900	0-4
0-4	1770200	5619	33150	48509	48509	39611	1779300	5-9
5-9	1890500	2537	29339	38468	38468	34461	1900800	10-14
10-14	2295000	5825	34486	58028	58028	43805	2297200	15-19
15-19	2424000	9634	53178	130014	130014	70539	2429500	20-24
20-24	2158000	9144	87270	161644	161644	89604	2134200	25-29
25-29	1929200	8817	94083	121900	121900	75456	1906400	30-34
30-34	2104600	11712	58744	67443	67443	45544	2081000	35-39
35-39	1806500	16187	34498	38102	38102	26641	1789000	40-44
40-44	1603500	25832	22206	27853	27853	18855	1573400	45-59
45-59	1550500	44334	14625	23621	23621	13513	1506500	50-54
50-54	1574000	79371	13921	22040	22040	12479	1496500	55-59
55-59	1592800	134995	9279	20428	20428	7723	1459000	60-64
60-64	1376600	183721	4310	18678	18678	3520	1197700	65-69
65-69	1261400	249446	3129	13858	13858	2496	1003100	70-74
70-74	1002400	294650	2196	6463	6463	1788	697800	75-79
75-79	629600	261458	1496	3164	3164	1246	362000	80-84
80-84	289800	173292	767	1343	1343	649	126000	85-89
85+	140200	101595	463	620	620	394	40200	90+
Total	27398800	1638443	516500	829220	829220	510400	27646500	Total

FEMALES

Start age group	Start populations	Deaths	Emigrations	Internal out-migrations	Internal in-migrations	Immigrations	End populations	End age group
Birth	1784142	15064	19150	28715	28715	19455	1775400	0-4
0-4	1681000	4143	32791	51530	51530	34908	1686000	5-9
5-9	1790500	1637	29021	40804	40804	30370	1797800	10-14
10-14	2176200	2598	37337	62429	62429	47557	2184200	15-19
15-19	2311000	3555	64163	143141	143141	96019	2353900	20-24
20-24	2109000	3908	86638	182211	182211	104464	2097100	25-29
25-29	1896200	4711	77533	134921	134921	75419	1878800	30-34
30-34	2078600	7508	48410	74911	74911	45522	2077800	35-39
35-39	1781700	10722	28429	42291	42291	26628	1767800	40-44
40-44	1585300	16360	16765	30853	30853	14977	1568900	45-59
45-59	1542600	27479	10120	26270	26270	8275	1517300	50-54
50-54	1610000	48214	9633	25304	25304	7642	1559400	55-59
55-59	1683000	80395	9350	24096	24096	5891	1599300	60-64
60-64	1558500	114941	6249	23937	23937	3640	1441700	65-69
65-69	1540500	173168	5017	19691	19691	2975	1362300	70-74
70-74	1388200	247635	3522	10802	10802	2131	1137600	75-79
75-79	1075300	299629	2400	6704	6704	1485	769500	80-84
80-84	675600	294592	1230	3975	3975	773	381700	85-89
85+	460100	300177	742	2516	2516	469	161100	90+
Total	28943300	1656436	488500	935101	935101	528600	29117600	Total

Table of population stocks and component flows for:-
Greater London 1981 to 1986

MALES

Start age group	Start popul-ations	Deaths	Emig-rations	Internal out-mig-rations	Internal in-mig-rations	Immig-rations	End popul-ations	End age group
Birth	239932	2584	3520	15783	11261	5518	228000	0-4
0-4	203400	654	5637	28848	19661	9198	191300	5-9
5-9	194500	261	4628	23583	14885	6983	203300	10-14
10-14	240300	626	5458	29101	28927	11895	277200	15-19
15-19	262000	1131	11742	60896	69118	25762	295000	20-24
20-24	290900	1262	22630	81916	79728	32509	260500	25-29
25-29	272900	1295	23431	67760	54140	23484	234700	30-34
30-34	266900	1789	13510	39388	28055	12237	257800	35-39
35-39	209900	2391	7600	21998	16104	6959	221700	40-44
40-44	190600	3525	4469	16229	11624	6613	184000	45-59
45-59	186500	5009	2809	14234	9387	5587	176000	50-54
50-54	190200	10301	2855	14273	7767	4691	175200	55-59
55-59	195200	14564	2020	14582	5846	2575	169700	60-64
60-64	169700	20869	1016	13907	4771	700	136800	65-69
65-69	154900	28960	711	10012	3846	274	114800	70-74
70-74	123100	31741	436	4279	2184	219	83500	75-79
75-79	75700	29678	285	2005	1159	159	43500	80-84
80-84	34000	20203	149	849	494	84	15100	85-89
85+	17000	11467	94	393	227	53	4800	90+
Total	3277700	188310	113000	460036	369184	155500	3272900	Total

FEMALES

Start age group	Start popul-ations	Deaths	Emig-rations	Internal out-mig-rations	Internal in-mig-rations	Immig-rations	End popul-ations	End age group
Birth	227729	1883	3446	16440	12275	5042	217700	0-4
0-4	194200	504	5518	30144	21386	8405	182700	5-9
5-9	186300	174	4531	24653	16151	6380	193700	10-14
10-14	227700	304	6491	31007	31422	12950	276200	15-19
15-19	263100	495	16687	67426	75715	33866	300500	20-24
20-24	305500	601	26828	93377	88834	37720	268900	25-29
25-29	271400	695	22813	73885	61036	23694	234400	30-34
30-34	262100	944	13154	42953	31958	12346	260800	35-39
35-39	210400	1266	7400	24078	18213	7021	221300	40-44
40-44	189400	2016	3731	17606	13247	4103	182000	45-59
45-59	184900	3143	1915	15477	10793	2306	175300	50-54
50-54	196100	5749	1947	16101	9203	1936	180600	55-59
55-59	205400	8874	1799	16863	7233	1326	180200	60-64
60-64	188000	12705	1190	17547	6390	667	165400	65-69
65-69	188600	19971	891	14031	5660	569	156800	70-74
70-74	171300	29223	547	7087	3715	454	141400	75-79
75-79	134500	35127	358	4244	2460	330	96000	80-84
80-84	86900	31379	187	2551	1424	175	47900	85-89
85+	62200	37299	117	1631	885	110	20400	90+
Total	3528000	192352	119550	517101	418000	159400	3502200	Total

Table of fertility rates and births for United Kingdom 1981 to 1986

Start age group	Population at risk	Fertility rates	Births	End age group
10-14	2180200	0.073479	160199	15-19
15-19	2332450	0.306387	714632	20-24
20-24	2103050	0.561307	1180457	25-29
25-29	1887500	0.518232	978163	30-34
30-34	2078200	0.226597	470914	35-39
35-39	1774750	0.078403	139146	40-44
40-44	1577100	0.012917	20372	45-59
Total	13933250	1.777323	3663883	Total

Table of fertility rates and births for Greater London 1981 to 1986

Start age group	Population at risk	Fertility rates	Births	End age group
10-14	251950	0.070708	17815	15-19
15-19	281800	0.284244	80100	20-24
20-24	287200	0.489582	140608	25-29
25-29	252900	0.516505	130624	30-34
30-34	261450	0.275426	72010	35-39
35-39	215850	0.107051	23107	40-44
40-44	185700	0.018293	3397	45-59
Total	1736850	1.761809	467661	Total

Table of rates for components for:-
Zimbabwe 1977 to 1982

Start age group	Population at risk	Deaths	Emigrations	Internal out-migrations	Internal in-migrations	Immigrations	End populations	End age group
MALES								
Birth	692863	0.107750	0.000000	0.025144	0.025144	0.000000	684858	0-4
0-4	597085	0.029375	0.000000	0.015873	0.015873	0.000000	588315	5-9
5-9	506988	0.010132	0.000000	0.010912	0.010912	0.000000	504420	10-14
10-14	395245	0.011309	0.000000	0.008945	0.008945	0.000000	393010	15-19
15-19	306244	0.014289	0.000000	0.037406	0.037406	0.000000	304056	20-24
20-24	240681	0.018189	0.000000	0.053960	0.053960	0.000000	238492	25-29
25-29	193321	0.023528	0.000000	0.037084	0.037084	0.000000	191047	30-34
30-34	158029	0.030536	0.000000	0.023005	0.023005	0.000000	155616	35-39
35-39	136565	0.039310	0.000000	0.015069	0.015069	0.000000	133881	40-44
40-44	121388	0.051223	0.000000	0.010537	0.010537	0.000000	118279	45-59
45-59	103560	0.067358	0.000000	0.007745	0.007745	0.000000	100072	50-54
50-54	83285	0.089027	0.000000	0.005972	0.005972	0.000000	79578	55-59
55-59	61341	0.128888	0.000000	0.004860	0.004860	0.000000	57388	60-64
60-64	51328	0.194673	0.000000	0.004007	0.004007	0.000000	46332	65-69
65-69	40317	0.298394	0.000000	0.003699	0.003699	0.000000	34302	70-74
70-74	27897	0.458977	0.000000	0.003494	0.003494	0.000000	21497	75-79
75-79	15931	0.695536	0.000000	0.003342	0.003342	0.000000	10403	80-84
80-84	6546	1.012295	0.000000	0.003133	0.003133	0.000000	3274	85-89
85+	2386	1.290291	0.000000	0.003416	0.003416	0.000000	900	90+
Total	3770323	4.571080	0.000000	0.277604	0.277604	0.000000	3665720	Total

Start age group	Population at risk	Deaths	Emigrations	Internal out-migrations	Internal in-migrations	Immigrations	End populations	End age group
FEMALES								
Birth	685925	0.084395	0.000000	0.024670	0.024670	0.000000	684723	0-4
0-4	602439	0.022961	0.000000	0.015848	0.015848	0.000000	595523	5-9
5-9	513596	0.009035	0.000000	0.011001	0.011001	0.000000	511276	10-14
10-14	432278	0.010195	0.000000	0.008680	0.008680	0.000000	430074	15-19
15-19	357125	0.012637	0.000000	0.033592	0.033592	0.000000	354869	20-24
20-24	285663	0.015877	0.000000	0.044374	0.044374	0.000000	283395	25-29
25-29	220610	0.020174	0.000000	0.030047	0.030047	0.000000	218385	30-34
30-34	172248	0.026033	0.000000	0.019177	0.019177	0.000000	170006	35-39
35-39	138420	0.033625	0.000000	0.012837	0.012837	0.000000	136093	40-44
40-44	111670	0.043957	0.000000	0.009002	0.009002	0.000000	109216	45-59
45-59	88796	0.058534	0.000000	0.006700	0.006700	0.000000	86197	50-54
50-54	70578	0.078969	0.000000	0.005340	0.005340	0.000000	67791	55-59
55-59	53944	0.111448	0.000000	0.004456	0.004456	0.000000	50938	60-64
60-64	50179	0.166028	0.000000	0.004004	0.004004	0.000000	46013	65-69
65-69	40754	0.258053	0.000000	0.003694	0.003694	0.000000	35496	70-74
70-74	29540	0.403224	0.000000	0.003489	0.003489	0.000000	23585	75-79
75-79	17887	0.635351	0.000000	0.003334	0.003334	0.000000	12213	80-84
80-84	7624	0.919896	0.000000	0.003130	0.003130	0.000000	4146	85-89
85+	3138	1.254266	0.000000	0.003436	0.003436	0.000000	1231	90+
Total	3910156	4.164658	0.000000	0.246812	0.246812	0.000000	3821170	Total

Table of rates for components for:-
Harare 1977 to 1982

MALES

Start age group	Population at risk	Deaths	Emigrations	Internal out-migrations	Internal in-migrations	Immigrations	End populations	End age group
Birth	42691	0.054379	0.000000	0.105015	0.019899	0.000000	36950	0-4
0-4	29679	0.011429	0.000000	0.069084	0.013090	0.000000	32198	5-9
5-9	25804	0.004142	0.000000	0.047291	0.008961	0.000000	27296	10-14
10-14	34580	0.004237	0.000000	0.034352	0.006509	0.000000	35087	15-19
15-19	39834	0.006611	0.000000	0.126837	0.024034	0.000000	40378	20-24
20-24	40072	0.008479	0.000000	0.166321	0.031516	0.000000	39731	25-29
25-29	30277	0.009869	0.000000	0.117196	0.022207	0.000000	30164	30-34
30-34	20983	0.012552	0.000000	0.077431	0.014672	0.000000	21044	35-39
35-39	16498	0.017574	0.000000	0.052433	0.009935	0.000000	16517	40-44
40-44	14045	0.025849	0.000000	0.037198	0.007049	0.000000	13981	45-59
45-59	11191	0.039594	0.000000	0.027952	0.005297	0.000000	11058	50-54
50-54	7993	0.061429	0.000000	0.022343	0.004234	0.000000	7818	55-59
55-59	5079	0.095784	0.000000	0.018942	0.003589	0.000000	4889	60-64
60-64	3036	0.148899	0.000000	0.016878	0.003198	0.000000	2862	65-69
65-69	2348	0.227245	0.000000	0.015627	0.002961	0.000000	2119	70-74
70-74	1568	0.338753	0.000000	0.014868	0.002817	0.000000	1328	75-79
75-79	835	0.494871	0.000000	0.014407	0.002730	0.000000	643	80-84
80-84	260	0.698187	0.000000	0.014128	0.002677	0.000000	176	85-89
85+	163	1.036307	0.000000	0.013959	0.002645	0.000000	81	90+
Total	318131	3.296190	0.000000	0.992262	0.188020	0.000000	324320	Total

FEMALES

Start age group	Population at risk	Deaths	Emigrations	Internal out-migrations	Internal in-migrations	Immigrations	End populations	End age group
Birth	41990	0.052301	0.000000	0.107260	0.019284	0.000000	36497	0-4
0-4	32913	0.011916	0.000000	0.070561	0.012686	0.000000	35168	5-9
5-9	30038	0.003726	0.000000	0.048302	0.008684	0.000000	31356	10-14
10-14	35630	0.003358	0.000000	0.035087	0.006308	0.000000	36196	15-19
15-19	34622	0.004842	0.000000	0.129549	0.023291	0.000000	36051	20-24
20-24	28360	0.006326	0.000000	0.169877	0.030541	0.000000	29791	25-29
25-29	19160	0.007979	0.000000	0.119702	0.021520	0.000000	20104	30-34
30-34	13169	0.010347	0.000000	0.079086	0.014218	0.000000	13711	35-39
35-39	10111	0.013969	0.000000	0.053554	0.009628	0.000000	10387	40-44
40-44	7781	0.019608	0.000000	0.037994	0.006831	0.000000	7912	45-59
45-59	5943	0.030145	0.000000	0.028550	0.005133	0.000000	5981	50-54
50-54	4665	0.044445	0.000000	0.022821	0.004103	0.000000	4643	55-59
55-59	3324	0.067516	0.000000	0.019347	0.003478	0.000000	3268	60-64
60-64	3212	0.107677	0.000000	0.017239	0.003099	0.000000	3084	65-69
65-69	2567	0.173058	0.000000	0.015961	0.002869	0.000000	2379	70-74
70-74	1801	0.271152	0.000000	0.015186	0.002730	0.000000	1581	75-79
75-79	1020	0.423665	0.000000	0.014715	0.002646	0.000000	819	80-84
80-84	345	0.625973	0.000000	0.014430	0.002594	0.000000	244	85-89
85+	234	1.020819	0.000000	0.014257	0.002563	0.000000	118	90+
Total	268533	2.898822	0.000000	1.013478	0.182206	0.000000	279290	Total

Table of fertility rates and births for Zimbabwe 1977 to 1982

Start age group	Population at risk	Fertility rates	Births	End age group
10-14	432278	0.235000	101585	15-19
15-19	357125	0.902000	322127	20-24
20-24	285663	1.321500	377503	25-29
25-29	220610	1.235500	272564	30-34
30-34	172248	1.006750	173411	35-39
35-39	138420	0.666500	92257	40-44
40-44	111670	0.434750	48549	45-59
Total	1718015	5.802000	1387996	Total

Table of fertility rates and births for Harare 1977 to 1982

Start age group	Population at risk	Fertility rates	Births	End age group
10-14	35630	0.181580	6470	15-19
15-19	34622	0.696980	24131	20-24
20-24	28360	1.021120	28959	25-29
25-29	19160	0.954670	18291	30-34
30-34	13169	0.777920	10244	35-39
35-39	10111	0.515000	5207	40-44
40-44	7781	0.335930	2614	45-59
Total	148833	4.483200	95916	Total