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PREFACE

The *Population Bulletin of the United Nations* presents brief articles relating to population which, by their nature, do not require separate publication. Material for the *Bulletin* is selected in the light of the interests and needs of Governments, international organizations, research institutions and individuals engaged in social and economic research, as well as the public interested in population.

The first seven issues of the *Population Bulletin* were prepared by the Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat between 1951 and 1963. In accordance with the endorsement and recommendation of the Population Commission at its eighteenth session, the *Bulletin* was reinstated as a United Nations publication, beginning with the publication of *Bulletin* No. 8 in 1977. As in the past, the *Bulletin* is prepared by the Population Division.

Most of the articles published in the *Bulletin* are prepared by the United Nations Secretariat in pursuance of the programme of work recommended by the Economic and Social Council and the Population Commission. Studies by consultants and reports of meetings organized by the United Nations, or excerpts from such studies and reports, may also be included. In addition, contributions are solicited from the specialized agencies of the United Nations, the secretariats of the regional commissions and scholars.

Explanatory notes

The following symbols have been used in the tables throughout the report:

Three dots (. . .) indicate that data are not available or are not separately reported.

A dash (—) indicates that the amount is nil or negligible.

A blank in a table indicates that the item is not applicable.

A minus sign (—) indicates a deficit or decrease, except as indicated.

A full stop (.) is used to indicate decimals.

A slash (/) indicates a crop year or financial year, e.g., 1970/71.

Use of a hyphen (-) between dates representing years, e.g., 1971-1973, signifies the full period involved, including the beginning and end years.

Reference to "tons" indicates metric tons, and to "dollars" (\$), United States dollars, unless otherwise stated.

Annual rates of growth or change, unless otherwise stated, refer to annual compound rates.

Details and percentages in tables do not necessarily add to totals, because of rounding.

CONTENTS

	<i>Page</i>
Recent trends and conditions of fertility United Nations Secretariat	1
Fertility and family structure Norman B. Ryder	15
Population distribution policies Harry W. Richardson	35
Metropolitan migration and population growth in selected developing countries, 1960-1970 United Nations Secretariat	50
What the age composition of migrants can tell us Luis J. Castro and Andrei Rogers	63
The long-term impact of war on mortality: old-age mortality of the First World War survivors in the Federal Republic of Germany Shiro Horiuchi	80

RECENT TRENDS AND CONDITIONS OF FERTILITY

*United Nations Secretariat**

SUMMARY

This assessment provides some concise information on levels and trends of fertility and on ways in which demographic and selected economic, social and health factors stressed in the World Population Plan of Action have influenced fertility in recent years, mainly during the decade of the 1970s.

The rate at which children are born alive in the world as a whole declined during the 1970s, spurred mainly by the downward course of fertility in China. Crude birth rates continue to vary widely among countries and even within the developing regions. The rates reached an all-time low in many developed countries but, near the end of the decade, a number of them experienced a recovery from this nadir. There are several developing countries in which birth rates have descended below those posted in many developed countries, but at the same time, some of the less advanced nations are experiencing a rise in fertility, thanks to a variety of modernization influences. Among the factors affecting these trends are changes in age at first marriage or first union, mating patterns and marital status, conditions of infant and early childhood mortality, urbanization, levels of education, breastfeeding and abstinence, especially in sub-Saharan Africa, and other social, economic and health factors.

The past decade has witnessed increased research efforts to find empirical links between social and economic conditions and fertility, thanks mainly to statistics gathered in the World Fertility Survey (WFS). Data from these surveys that may yield some information about the effect of culture and tradition upon fertility in the more traditional societies of some developing countries, mainly in sub-Saharan Africa, are just becoming available. But there remain many gaps in knowledge about ways in which conditions of life as affected by socio-economic development influence reproduction and reproductive behaviour. Hopefully, data and resources will become available that will enable research leading to further enlightenment with respect to human reproductive behaviour.

INTRODUCTION

The International Conference on Population in 1984 will have as a central task a revision of the World Population Plan of Action in light of population conditions, trends and policies during the decade 1974 to 1984 and requirements of the International Development Strategy for the Third United Nations Development Decade. The United Nations World Population Conference, 1974, through the World Population Plan of Action, recommended a number of actions relative to reproduction and family formation which constituted a strategy for enhancing the quality of individual and family life and the condition of women and for fostering humanitarian alternative policies with respect to population growth. This Plan of Action pays special attention to possible linkages between social and economic factors and fertility, noting that certain "development goals generally have an effect on the

socio-economic context of reproductive decisions that tends to moderate fertility levels",¹ and that countries wishing to affect fertility levels should give priority to implementing "development programmes and educational and health strategies which, while contributing to economic growth and higher standards of living, have a decisive impact upon demographic trends, including fertility".²

Taking into account the concerns of the International Conference on Population, and "Recommendations concerning priority areas for action within the World Population Plan of Action",³ this paper provides an assessment of levels and trends of fertility throughout the world during the decade of the 1970s and shows how certain factors, the modification of which is directly or indirectly specified in the World Population Plan of Action as development goals, were affecting fertility and conditions of the family during the past decade. The demographic factors considered include age structure, age at marriage, marital status, types of marital unions and infant and early childhood mortality. The social, economic and other factors include rural-urban residence, level of education, women's work, familial roles and family struc-

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ture, social development, and health and contraceptive practice.⁴

I. FERTILITY LEVELS AND TRENDS⁵

The World Population Conference recommended that the monitoring of population trends and policies, discussed in the Plan of Action, be undertaken periodically. Recent data indicate that the rate at which children are born into the world as a whole has continued its decline. During 1975-1980, there were estimated to be in the world as a whole, on the average, 29 live births annually per 1,000 of the mid-year population. During the preceding quinquennium, there occurred annually about 32 live births per 1,000 population. While this change represents a drop of only about three births annually per 1,000 population world-wide, it actually amounted to approximately 14 million fewer births over a period of five years. Undoubtedly, this change in the global picture largely reflects the precipitous downward course that appears to have characterized the crude birth rate of China which, by 1975-1980, had reached an estimated 21 live births annually per 1,000 population.⁶

There are marked differences in levels of fertility between developing and developed regions. In the former, births occurred on average at the rate of 33 per 1,000 population during 1975-1980, compared with only about 16 in the more developed nations.⁷ Levels of the crude birth rate varied even more among individual countries. Although there is a wide gap between the highest and lowest rates recorded in developed countries, a rate of around 21 per 1,000 in Ireland being roughly double the measure for the Federal Republic of Germany (around 10), the disparity is even more marked among the developing countries. Indeed, the range in levels of birth rates among the latter is almost as great as that for the world as a whole, that is, from 50 to 54 per 1,000 in some sub-Saharan African countries to about 15 in Cuba.

The variation in levels of crude birth rates within the developing and developed regions reflects the phenomenal changes that have taken place over the past two decades. At the beginning of the 1960s, developed and developing countries were readily distinguished by the level of their birth rate; no developed country recorded a measure in excess of 30 and for no developing country was a measure estimated to be that low.⁸ Around 1980, according to the best available data, birth rates were higher in 14 developed countries than in Cuba (14.7) and in four of them than in Singapore (17.3).

The most obvious conclusion is that levels of fertility are now considerably less closely related to development than was the case 20 years ago, due in part to the introduction of national family planning programmes, which appear to have accelerated the fertility decline in many developing countries.

The spread in elective childbearing is but one component of the divergent patterns of reproductive behaviour that are seen in both the developed and developing regions. Fertility is declining in some developing countries and, due to modernization, is rising in others; counter-trends also characterize birth rates in the more developed regions.

A. DEVELOPING COUNTRIES

Because vital statistics registration in most of the developing countries is lacking or of doubtful quality, there are only a relatively few for which the course of the birth rate can be documented with firm confidence and, unfortunately, the countries for which data are unreliable include those with the largest populations. From 1970 onward, crude birth rates declined in all but a few of the 27 developing countries with data reasonably adequate to assess trends.

The picture for Asia is dominated by the precipitous decline of fertility in China, which was noted above. Measures for other countries of east Asia are estimated to have decreased, but less impressively, from an average of 30 during 1970-1975 to 27 per 1,000 during the succeeding five years. Over the same period, crude birth rates for south Asia declined from an estimated 40 to 37 per 1,000 with the most modest changes occurring in western south Asia.⁹

The average trend in Latin America over the decade under consideration was also downward, although there were some variations: throughout the 1970s, rates remained relatively constant at around 22 live births annually per 1,000 population in temperate South America, while in the tropical region, they dropped from 37 to 35 during the two quinquennia and, during the same periods, decreased from about 42 to 39 in middle America. The regional average for the Caribbean masks the fact that in several countries births remained relatively high or stable in recent years while, in one or two, they seemed to have moved upward somewhat.¹⁰ Results of WFS for a series of countries show that for five to 10 years prior to the surveys (taken between 1974 and 1978), a number of Asian and Latin American countries experienced significant decreases in total fertility rates. An intensive evaluative analysis documented declines in 12 of 20 countries that participated in WFS.¹¹ The decreases from the period 10-14 to 5-9 years prior to the survey ranged from 5 per cent in Peru and the Philippines to 23 per cent in Costa Rica; in the succeeding period from 5-9 to 0-4 years before the interviews, the decrease varied from 14 per cent in Peru and Malaysia to 31 per cent in Costa Rica.¹² Data for the other eight countries were not adequate to assess trends, or did not indicate a fertility decline. The rather remarkable decreases occurred during the late 1960s and early 1970s and, in some cases, were sharper than had been thought.¹³

The crude birth rates for the African regions, with the possible exception of northern Africa, are estimated to be relatively stable or rising. There is little evidence of downward trends. Measures for the region as a whole are thought to have dropped only from 48 to 46 per 1,000 over a 25-year period. Eastern, western and middle Africa have experienced virtually no evident changes.¹⁴ The stable rates probably mask strong counter-trends both among sub-populations within these countries, and among the different countries. While unchanging levels and modest declines are thought to characterize birth rates in some African countries, others may be experiencing at least a temporary increase in crude birth rates due to a rise in fertility. Such was the case in several of the Caribbean countries and of those in middle America either during the late 1950s or early 1960s before fertility rates turned downward in the middle to late 1960s.¹⁵

Similar evidence exists for states of India¹⁶ and some other countries of south Asia.¹⁷ Certainly, the literature contains many references to such occurrences in some countries of Africa below the Sahara.¹⁸ The pervasiveness of this phenomenon of rising fertility in response to development and the great variety of modernization elements that have been found capable of bringing about such change warrants notice. Changes in the incidence and duration of breastfeeding, in traditional abstinence following childbearing, in the prevalence of polygamy, in the quality of health and nutrition, advances in age at marriage and the consequent decrease in sub-fecundity associated with early marriages are likely to affect higher fertility at least in the short run. Lower adult mortality and a decrease in the prevalence of widowhood among women of reproductive age may also be contributing factors.

The World Population Plan of Action anticipates both in spirit and in fact the verisimilitude that some government goals and policies may conflict with others and also with individual rights, stating that the latter should be given priority consideration. The foregoing discussion corroborates the efficaciousness of that position. Indeed, in nearly all of Africa south of the Sahara, several countries of middle America and the Caribbean, and in some parts of Asia, especially the south-western region, birth rates are estimated to have been relatively high and stable, if not to have risen or, at best, to have undergone only a very modest decline in the recent past.¹⁹ Circumstances such as those noted above as being likely to cause fertility to rise, may, in many cases, be in conflict with forces and conditions tending to lower fertility, such as family planning programmes, increasing education and employment of women outside the home, changes in family structure, and so on.

B. MORE DEVELOPED COUNTRIES

Around 1980, the range in level of crude birth rates and total fertility rates among developed countries was from 21.5 births per 1,000 population and 3.3 births per woman in Ireland to 10.0 births per 1,000 population and 1.4 births per woman in the Federal Republic of Germany.²⁰ Fertility declined steadily and markedly in the more developed countries from the early to mid-1960s until the end of the 1970s. With few exceptions, this general trend is depicted both by the crude birth rates and the total fertility rates.²¹ The principal exceptions are the Union of Soviet Socialist Republics and countries of eastern Europe, where (apart from the German Democratic Republic whose crude birth rates followed the course documented for western European countries) an upswing in crude birth rates and in total fertility rates appears to have commenced in the early 1970s, but to have begun to drop or stabilize by the end of the decade.

The picture with respect to present trends is also varied: declining, stable and increasing crude birth rates and fertility rates are found among these countries. The downturn of fertility that began around 1960-1965 persists in Norway, Denmark, the southernmost developed countries of Europe, Oceania and Japan. In all other developed countries the

downward trend has ceased; further, since the late 1970s, eight European countries and the United States of America have been experiencing a rise in fertility, as measured by the total fertility rates. Among these countries, the values for the year 1980 were from 2 to 13 per cent higher than the figures at the nadir of the post-1965 trend.²² The result of these changes is that since 1970 fertility is, on the average, lower in the developed regions, although the range among those countries in levels of crude birth rates and total fertility rates has hardly been altered.

II. SOME FACTORS AFFECTING FERTILITY

The changes noted above in levels and trends of fertility and the apparent lack of change, where this is observed, may be attributed to many of the factors noted in the World Population Plan of Action as requiring national and international efforts at improvement.

The Plan of Action identified approximately 30 steps in the demographic, social and economic spheres as appropriate to ensuring choice in matters of reproduction and enhancing the status of the family, not all of which can be adequately measured with available data and methodology. Due to diverse past levels and trends of fertility, as well as of mortality, and to dissimilarities in patterns of nuptiality, there are important distinctions among countries in aspects of population structure that influence crude birth rates and total fertility rates. Further, the countries are at varying levels of development, inhabitants are distributed differently according to rural-urban residence, socio-economic status and level of education, and the quality of life associated with these differences varies among countries. Some cultures encourage early marriage, others tolerate or promote late marriages and economic activity of females. Some developing countries have viable national family planning programmes; others do not. Among the conditions that influence fertility, the demographic factors will be considered first.

A. DEMOGRAPHIC FACTORS

Since the number of births in a country depends not only on the fertility of women but also on their numbers in the reproductive ages, the trends of the crude birth rate also reflect the changes in the proportion of women in the childbearing ages. In many developing countries where fertility has been high over a long period of time, swelling the proportion of young people and, consequently, lowering the ratio of females of reproductive age to the remainder of the population, the crude birth rate is relatively low in comparison with fertility as measured by the total fertility rate. But when fertility begins to decline, this is not necessarily reflected by the crude birth rate, since the entrance into the childbearing age of the successively larger cohorts of young females born during periods of past high fertility (surviving in ever greater numbers thanks to declining mortality) will tend to "inflate" the birth rate and to mask the fertility

decline, just as the entrance of successively smaller cohorts tends to "deflate" the birth rate and to mask a fertility increase.

Because there are still many countries in which the practice of intentional fertility regulation is exceptional rather than commonplace,²³ the age at which women marry in these countries is one of the important determinants of their completed family size. As the range among countries in level of contraceptive use is enormous and age at first marriage varies considerably, the latter contributes significantly to the differences among countries in crude birth rates and total fertility rates. There is also evidence that other nuptiality characteristics, such as marital status or the type of marital union, as well as another demographic factor, infant and child mortality, may have a sizeable effect on fertility.

1. Age structure

The populations of the less developed and more developed regions as a whole aged somewhat during the decade of the 1970s.²⁴ In both regions, the number of women in the reproductive ages increased relative to the size of the total population, although the change was more pronounced in the less developed regions than in the more advanced countries. In the latter, the number of women aged 15 to 49 years increased by about 9 per cent during the interval 1970 to 1980 compared with a rise of around 32 per cent in the developing regions.²⁵ Furthermore, the number of females in the peak reproductive ages, 20 to 29 years, relative to all women aged 15 to 49, also increased, on average, both in the developed and the developing regions.²⁶ The paucity of reliable age data precludes a systematic comparison of the extent to which the declines in the average crude birth rates for the developing and developed regions have been influenced by these changes in age composition of the populations, and some examples must suffice.

An analysis of the influence of age structure on birth rates in 21 of the developing countries that participated in the World Fertility Survey²⁷ disclosed that countries with very high crude birth rates, such as Bangladesh, Pakistan, Mexico and Kenya, also had young populations and that, if the age structure of those countries had been the average of the 21 countries, their birth rates would have been considerably higher. Conversely, for the comparatively older populations of countries in which a fertility decline had been under way for some time, as in Sri Lanka or Costa Rica, the age structure had inflated the crude birth rates. Indeed, the range in birth rates after standardization was from 56.6 per 1,000 population (Kenya) to 25.0 (Sri Lanka) compared with a variation in crude rates from 48.7 (Kenya) to 28.3 (Sri Lanka). Thus, the extremes in regional and national levels of birth rates reported in this text are no doubt moderated among other things by the differences in age structure among the populations. Moreover, as mentioned above, trends in the birth rates may mask or temper trends depicted by other fertility measures.

Although in many developed countries marital fertility and postponed marriages, among other things, were the factors primarily responsible for the fertility trends during this period, the small cohorts of women born during the Second

World War contributed to the recent declines in crude birth rates, just as the larger cohorts born after the War were a factor in the upswing.²⁸

Thus, trends in crude birth rates, while appropriate indicators of the positive component of population growth trends, are insufficient as a gauge of the course of fertility since they may camouflage the movement of a complex pattern of other factors that should be considered from a policy perspective, just as other fertility measures alone are insufficient as indicators of the positive component of population growth.

2. Nuptiality

The World Population Plan of Action makes a number of recommendations with respect to marriage and the family, which were intended to enhance the quality of family life and to promote improved social, economic and other conditions for individuals.²⁹ The recommendations, if effected, might also have a bearing on fertility.

(a) Age at marriage

Age at marriage influences the lives of women in a variety of ways. In what follows, only the effect upon fertility is considered. The nuptiality data that are available for a majority of the developing countries are of dubious quality and insufficient for an assessment of trends. From such statistics as are at hand, however, it appears that women enter a marital union earliest in regions of Africa, south of the Sahara, and on the Indian sub-continent. At varying dates during the 1970s, the singulate mean age of women at marriage ranged from 16.6 to 20.1 in countries of continental sub-Saharan Africa and from 17.5 to 19.6 years in countries of the latter region.³⁰ Among developing countries as a whole, the range is estimated at from about 16.6 in the United Republic of Tanzania (1967) to 23.5 in Sri Lanka (1971). This excludes China for which there is no available information as to nuptiality conditions. It is reported that women are not considered to be of marriageable age until they reach age 23.³¹

The World Fertility Survey obtained statistics on the age at which women first married, or in some countries where it is especially relevant, the age at which women first entered any kind of sexual union or partnership. Data for 21 countries showed a range in the mean age at marriage for women who first entered into a marital union under the age of 25 as being from 19.4 in the Republic of Korea and the Philippines to 13.5 in Bangladesh.³² Analyses of the data³³ revealed that, within countries, the completed family size of the individual woman at age 40 and over was inversely related to her age at marriage.

This general finding reflects the connection between age at marriage and the duration of marriage at a woman's given age; the younger her age at marriage, the longer the time she would have spent in a marital union by age 40. However, the relationship between age at first marriage or first union and fertility seems to depend not only on the length of marital duration or on such factors as the incidence of contraceptive use, family size motivation and preferences, birth-spacing traditions and practices, etc., but also on the deviations of the

age at marriage from the socially accepted norms relative to marriageable age or on the physiologically optimal age for commencing reproductive activities. The analysis of the data from the World Fertility Survey, for example, showed that except in some, mainly Latin American, countries women who entered into their first marital union under age 15 had a slightly smaller completed family size than did those who married at ages 15 to 17. Also, those who married so young as under age 15 had their first child considerably later after the marriage than those who married at a more mature age. This difference in the interval between marriage and first birth may be due to age-related differences in average fecundability, for there are few among the developing nations for which empirical evidence implies a notable incidence of contraceptive use prior to the first birth.

Yet these data tend not to support the view that early marriage (under 15 or so) leads to serious lasting fecundity impairments, which would suppress lifetime fertility. On the other hand, raising the minimum age to or establishing it at the range of 15 to 17 years should not be considered a development goal that would tend to moderate the level of fertility. In nine countries that participated in the World Fertility Survey, the completed family size of women who married at ages 15 to 17 was higher than that of women who married at age 22 and over by more than three children per woman; in 13 countries the difference ranged between 1.2 and 2.9 children per woman. At the same time, women who marry later tend to have higher fertility at the same duration or at the same age than those who marry at a younger age, especially during the earlier years of marriage, but they do not "catch up" as far as lifetime fertility is concerned. As regards the higher duration and age-specific fertility of women who marry later, higher coital frequency early in marriage, age notwithstanding, and a lesser likelihood of fertility impairments among women who married at a more mature but not too advanced age are plausible explanations. However, in WFS data, differences among age-at-marriage groups in age-specific fertility tended to be influenced by the national incidence of contraceptive use. Systematic errors in the reporting of live birth intervals may also have influenced the observed patterns.

It is of interest that the effect upon fertility of recent increases in age at first marriage estimated for many countries, presumably enhanced by modernizing elements within the societies, do not appear to be strongly associated with levels of development. Using levels of literacy as a proxy for development, correlation coefficients of 0.04, 0.03 and 0.02, respectively, were obtained for low, middle and high literacy countries when age at first marriage was regressed upon fertility in the five years preceding the surveys in 22 countries. A negative association of age at first marriage with number of children ever born was only slightly more evident in the high than in the low literacy countries. (For the categories of countries mentioned above, the coefficients of correlations were, respectively, -0.21 , -0.26 and -0.26 .)³⁴

Recommendations in the World Population Plan of Action as to establishment of an appropriate minimum age at first marriage subsume existence of too low an age at first marriage mainly in certain developing countries. But due to the changing patterns and timing of entrance into union now occurring in a number of the more developed countries, the

concern about age and conditions of marriage that is expressed in the Plan of Action appears increasingly relevant to these countries as well.

Historically, in the now developed countries, women generally married older than was common until recently, and larger proportions of them remained unmarried. From the turn of this century onward, the first marriage of females occurred at increasingly earlier ages, and fewer and fewer women remained single. A reversal of this secular trend is clearly under way in a number of countries: since the mid-1970s, except in parts of southern and eastern Europe, Japan and a few other developed countries, the age at which most women entered their first marriage first stabilized and then began to advance. However, the change has been occurring slowly, a few months yearly and, in a minority of cases, the measures of change may not be significant.³⁵

Along with the rising age at legal marriage in a number of developed countries, there has been a compensating tendency towards early formation of consensual unions. Indeed, whereas in some countries, age at marriage has ceased to decline, age at cohabitation in a formal union has not.³⁶ Though the trend to early entrance into non-legal unions cannot be attributed to it, the spread of acceptable and dependable means of preventing unwanted births may have supported such developments. Indeed, the current advances in the age of women at legal marriage, where it is occurring, is explicable, because consensual unions are becoming more acceptable, unwanted pregnancies generally pose little threat and increasingly are tolerated by societies and because desired family size is small and easily attainable within a few years even in the case of a late marriage. It may be noted that age at first union, therefore, does not, on the whole, have an important bearing on fertility in the economically more advanced countries.

(b) *Marital status*

The distribution of women by marital status influences aggregate fertility levels and patterns. This distribution results from trends in age at marriage and the age-specific incidence of marriage, divorce, separation and widowhood, conditions which, along with levels of remarriage, determine the number of her reproductive years that a woman spends within marriage. An intensive analysis of data for 21 developing countries³⁷ disclosed a moderate correlation ($r = 0.6$) between time spent married and the total fertility rate. Divorce, separation and widowhood together accounted for less than 10 per cent of the reproductive span in nine of 11 Asian countries and three of eight Latin American nations. If women were not widowed before age 50, total fertility rates would be higher by 1 or 2 per cent in most countries and by as much as 5 per cent in Bangladesh. Where marital status composition is concerned, the main sources of variation in national levels of fertility appear to be the amount of time that a woman spends single, that is, prior to first union, which is, on average, greater than the time lost to marital disruption. This was evident despite the finding that extramarital fertility is of important magnitude especially in African and Latin American countries, and that childbearing is more frequent among formerly married than among single women. It may

be noted, however, that among the 21 countries studied, evidence of marital status distribution as a determinant of aggregate levels of fertility became less obvious as indications of fertility control increased.

Along with the rise in proportion of single women witnessed in many developed countries, particularly in western Europe and the United States of America, there has been a sharp upturn in the incidence of divorce.³⁸ In the United States, for example, the annual rate of divorce per 1,000 women aged 14 to 44 years more than doubled, rising from 15 to 37 in the periods 1954-1956 to 1975-1977. In 1970, 5 per cent of females aged 25 to 34 years were divorced; at the end of the decade the comparable figure was 10.5.³⁹ It has been reported that, in the United States and some of the European countries, divorce is tending to occur at increasingly shorter duration of marriage, although towards the end of the 1970s a rise in divorce was notable among cohorts in which couples were of middle age or older.⁴⁰

(c) *Mating patterns*

The World Population Plan of Action characterizes the family as the basic unit of society and recommends to Governments a variety of steps calculated to support and strengthen the family as an institution and to enhance the welfare of its members. Recent demographic studies have either confirmed or revealed a wide assortment of conditions and changes with respect to the formation and dissolution of unions (including divorce) which portends the weakening of the family and the alteration of its structure and functions as these have evolved until the present in the now developed countries or were sanctioned by major world religions, societies and laws, and have confirmed aspects of the family in many developed and developing countries that may be considered to undermine many of the goals and principles of the Plan of Action. In the discussion that follows, only implications for fertility are indicated. However, it is readily apparent that the mating patterns have considerable relevance for the status and condition of women and their children and because, among other things, educational attainment may be affected by these patterns, particularly in the developing countries, they affect development potential in general.

Both polygamous and monogamous marriages are found in most countries of Africa and the Middle East. Some earlier studies have indicated higher fertility of women in monogamous than in polygynous marriage,⁴¹ but one analysis of recent surveys in Kenya and Senegal suggests that, in those cultures, polygyny does not depress aggregate fertility and attributes this to the fact that men take a second, frequently very young, wife primarily because the first does not bear children.⁴²

However, the relationship between fertility and polygyny is a highly complex one. First of all most polygynous marriages begin as monogamous ones, and a polygynous unit may be reduced to a monogamous one. A polygynous woman's own fertility may be lower, among several other things, because of lower coital frequency and a more extended period of nursing than her monogamous counterpart. But

aggregate fertility may be higher in some polygynous societies, because polygyny permits the highest proportion of women to be married and exposed to pregnancy risks.

In many societies, especially in sub-Saharan Africa and in Latin America, childbearing is not confined to "legal unions". The influence of type of marital union (visiting and consensual or common-law unions and legal marriages) upon the level of individual fertility has been examined for several countries of the West Indies and for Guyana,⁴³ for all of which relevant statistics were obtained in the World Fertility Survey. The fertility of women in common-law unions, where couples live together in conditions of varying stability, is generally higher than that of the legally married. Common-law women are, on average, generally younger than married women and thus, as a group, have higher age-specific fertility, but as they become older with large families they tend to legitimize their relationships, so that their completed fertility is weighted with that of women who began cohabitation in a legal union, inflating the average fertility of the married category of women. Women in visiting unions, that is, having a more or less steady partner with whom they do not reside, had fewer children than women in legal marriages or consensual unions, both because many are younger than either married or common-law women (a large proportion of women begin sexual congress in a visiting union) and because they experience lower coital frequency. Most of them eventually switch to another type of union. Within each marital union category, the number of children is positively associated with the total number of partners. In summary, among these countries, the woman's completed fertility depends, *inter alia*, upon the number and types of unions that she experienced, her age while in specific union types and the number of her partners, which may not be synonymous with number of unions or union types.

If educational attainment is used as the best available proxy for socio-economic status, it would appear that women in consensual or common-law unions have lower status than have women in other union types. This may be reflected in the greater tendency for educated women who are not married to form a visiting union rather than a consensual union,⁴⁴ as the former has greater social acceptance.⁴⁵ The type of marital union also seems to be more closely associated with ethnic group than with rural-urban residence.⁴⁶ The apparent association of union type with social status and completed family size represents a life-style configuration susceptible to policy measures in the interest of family welfare and improved condition of women.

In many developed countries today, the formation of a more or less stable marital union is no longer necessarily signalled by a legal marriage and, where marriage occurs, it frequently takes place after a period of cohabitation. Moreover, illegitimacy is on the rise among both very young and mature women; cohabiting couples do not feel impelled to legitimize their children and societies exhibit increasing tolerance for or acceptance of it. Further, separations and divorces disrupt legal marriages with ever increasing frequency. Given this picture in much of the developed world, it has been observed that the family in these countries is undergoing radical changes,⁴⁷ and some scholars have questioned the stability of its sociological foundation.⁴⁸ These trends,

weak except in Sweden and Denmark until the late 1960s, were very much in evidence elsewhere in northern and western Europe and the United States of America in the early 1970s and became more accelerated around the middle of the decade.⁴⁹ Surveys conducted during the late 1970s in Denmark, Sweden, France, and among Swiss citizens in Geneva revealed that very large proportions of couples lived together before marriage. Indeed, a larger percentage of Swedish women aged 20 to 24 years was living in a consensual union than was married — 28.6 and 21.5 per cent, respectively.⁵⁰ In Iceland, too, the prevalence of consensual marriage, always of important magnitude, was on the rise and 5 per cent of all Norwegian women aged 18 to 45 years and 12 per cent of those aged 20 to 24 were cohabiting without legal sanction.⁵¹ In the United States, there were 20 per cent more couples living together without legal marriage in 1970 than in 1960 and 83 per cent more in 1977 than in 1970.⁵²

The increased tendency for couples to live together while forgoing legal marriage is, of course, complementary to the decline in first marriage rates recorded not only in the countries mentioned above, but also in other European countries outside of eastern Europe, where the pattern is mixed: Canada, Japan, Australia and New Zealand.⁵³

It is not certain how these trends were related to the course of the birth rate during the decade of the 1970s. It is reported that extramarital fertility increased in Sweden and Denmark, but declined elsewhere in western Europe, where single women in or outside of unions preferred to remain childless.⁵⁴ More recently, the rate of births to unmarried women has generally increased in western Europe and the United States.⁵⁵ However, since in most of these countries the course of marital fertility generally paralleled that of the crude birth rates and the total fertility rate and continued to account for the bulk of births, the impact of the changing attitudes and behaviour with respect to marriage and the family apparently had not played a decisive role either in the nadir achieved by the rates or, where it occurred, in their seeming recovery at the end of the decade.

3. *Infant and child mortality*

The World Population Plan of Action calls for the reduction of infant and child mortality as a goal in itself by a variety of means.⁵⁶ Achievement of this goal might also affect fertility, especially in populations characterized by high rates of both fertility and infant and early childhood mortality. It has been observed that these mortality conditions influence fertility where couples replace a child who died and where they have large numbers of children in anticipation of such losses in order to ensure the survival of a certain number, especially of a given sex.⁵⁷ When women ordinarily breast-feed their babies and abstinence is observed concurrently with lactation, as in many high-fertility developing countries, especially in sub-Saharan Africa, death of an infant curtails lactation, hastens the advent of risk exposure and shortens birth intervals.

In a relevant study of conditions in Latin America, it was disclosed that couples who experienced child mortality were less likely than others to use contraceptives. The link was not

strong, because fertility regulation was not widespread. It was postulated that, as knowledge and use of contraceptives become more common in the region, direct experience of child mortality might begin to have a greater effect on fertility levels.⁵⁸

Results of studies carried out by the United Nations suggest that higher infant and child mortality support higher fertility. An analysis of 17 KAP (knowledge, attitude and practice) surveys in 12 countries of Asia, Africa and Latin America, for example, disclosed that "... the differences between women who have experienced a child death and those who have not, though relatively small, generally fit the hypothesized pattern of lower levels of contraceptive use among women reporting a child death".⁵⁹ Another study found that, at certain parities, women with child mortality experience showed substantially less readiness than other women to cease childbearing.⁶⁰

Thus, from one perspective, that of the child replacement/child insurance hypothesis, declining child mortality should, eventually, have a depressing effect upon fertility. From another, the weakening of traditions that support breastfeeding and post-partum abstinence, decreasing child mortality should cause fertility to rise, barring a compensating, pervasive spread of effective contraceptive use. On the other hand, it should be noted that high fertility is one of the factors of high infant and early childhood mortality.

B. SOCIAL, ECONOMIC AND HEALTH FACTORS

In addition to the demographic factors discussed above, the importance of a number of socio-economic factors has been emphasized in the considerable amount of investigative work in differential fertility carried out over the last few decades. The succeeding paragraphs summarize recent findings regarding the influence of social, economic and other factors upon fertility levels and change, in particular focusing on certain topics highlighted in the World Population Plan of Action.

1. *Rural-urban residence*

Differences in levels of fertility between rural and urban components of national populations are not stable. It is conceivable that in a homogeneous culture the traditions that regulate fertility are weakened first in urban areas while they continue to be observed by the rural population, causing higher urban than rural fertility. However, as the urban people recognize earlier than their rural counterparts the advantages of a smaller family and with the influence of urban facilities and life style, the fertility of urban inhabitants may drop below that of rural folk. The gap in fertility between urban and rural residence may increase for a time but subsequently narrow or disappear as rural and urban life become increasingly similar.

Recent findings generally point to higher fertility in rural than in urban places although there are causes in both developing and developed regions in which little or no difference in fertility between rural and urban residents can be observed

or in which the fertility of urban dwellers is higher than that of their rural counterparts. Not surprisingly, urban fertility is higher than the rural in several developing countries. For instance, latest estimates in Liberia show an urban general fertility rate of 218 per 1,000, about 10 per cent above the corresponding rural rate.⁶¹ Average cumulative fertility in three Asian countries, Indonesia, Nepal and Pakistan, is also higher in urban than in rural centres according to results of WFS surveys.⁶²

However, analysis of WFS data for 20 developing countries documents the generally negative influence of urban living upon fertility after the effects of such factors as age of women at marriage, marital duration and education of mothers have been eliminated. As far as the "net" fertility differences are concerned, rural fertility is consistently higher in all countries (except Indonesia) even though the difference is not always significant.⁶³ The data from Indonesia display a contrary pattern, while in Bangladesh and Pakistan no significant rural-urban differentials in fertility emerge. Using level of literacy as the measure of development, a fairly clear progression is evident: among the least developed countries in this group, urban fertility is only 6 per cent less than rural fertility on average, while among countries further advanced developmentally the difference grows to 29 per cent.

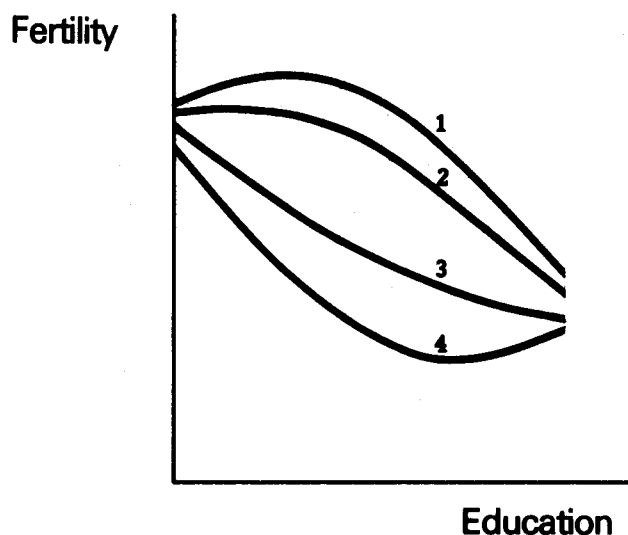
Use of a threefold residence classification, rural, minor urban and major urban, reinforces this developmental pattern. The minor urban-major urban differential accounts for almost the entire rural-urban difference in fertility among low-literacy countries; among high-literacy developing countries, however, about two thirds of the total gap in fertility corresponds to the rural-minor urban differential. Thus, fertility reduction may be associated either with towns or with metropolitan cities: current evidence suggests that the spread of industrialization to urban concentrations is more important than the size of the concentrations themselves. It may also be pointed out that this finding links a recommendation of the World Population Plan of Action concerning the strengthening of "... small and medium-size cities ..."⁶⁴ to others in the same document regarding measures to lower the level of fertility.

Recent findings from a number of WFS surveys carried out in developed countries show that the level of fertility in rural areas has remained somewhat above urban levels.⁶⁵ In terms of children ever born, the difference amounts to less than half a child in Poland and between a quarter and a half in Finland, France, Norway and Yugoslavia. Insignificant differences were observed in Belgium, the Netherlands, Italy and Spain.

2. Level of education

The educational attainment of parents has consistently been shown to be an important factor in explaining variations in levels of fertility. The relationship generally noted, in surveys covering all regions of the world, has been a negative one in which groups with high educational attainment (of either husband or wife) have lower fertility than low-education groups. Within this overall tendency, however, many variations and even counter-trends have been recorded. The main types of the education-fertility relationship which has

emerged as a result of recent comparative studies⁶⁶ can best be illustrated graphically:



where the four lines represent the relationship at four stages of development (from 1 = least developed to 4 = most developed).

An important question raised by comparative analysis of the education-fertility relationship concerns the causal mechanism behind the observed differentials. On the one hand, it is often assumed that the education process itself, involving the possibility of psycho-social changes in values and outlook, is responsible for fertility decline. Some evidence, however, suggests that educational attainment is largely an indicator of other attributes, such as socio-economic status. In developed countries, for instance, where a U-shaped pattern between education and fertility is often found, the positive relationship at the upper end of the educational spectrum is frequently interpreted as an income effect, not due to education *per se*.

Results from a comparative study of recent WFS data for 22 developing countries have shown that the various patterns illustrated above do indeed succinctly summarize the education-fertility relationship found.⁶⁷ Countries at a low level of literacy and per capita income, such as Bangladesh, Indonesia, Kenya and Nepal, show either increasing fertility with education or slight overall declines and a hump-shaped pattern. On the average, women with 10 or more years of schooling had had only 0.56 children less than women with no schooling in these countries.⁶⁸ On the other hand, Costa Rica, Guyana, Jamaica and Panama, four high-literacy countries, demonstrate monotonic negative patterns of fertility by educational level and large differentials (on average, 1.76 children less for women with 10 or more years of schooling).

Similarly, desired family size is also generally negatively related to educational level in the 22 developing countries studied. The relationship, however, tends to be monotonic and no change by level of development is apparent. Overall, women in the highest educational category desired about one child less than did completely uneducated women.⁶⁹

Recent analysis of WFS data for 13 developed countries revealed three patterns of relationship between education and fertility.⁷⁰ The first pattern, a generally inverse relationship, is found in Czechoslovakia, the Netherlands, Norway, Poland, the United States of America and Yugoslavia. On average, in terms of achieved fertility, there is a differential of about 0.18 children between educational groups. The second education-fertility pattern, including Finland, France, Great Britain, Hungary and Italy, is U-shaped or at least L-shaped but the average inter-category differences are about the same (0.17 children). Finally, Belgium and Spain, the two remaining countries included in the study, display no clear pattern between education and achieved fertility (average inter-category difference: 0.10 children).

3. *Women's work*

The World Population Plan of Action places great stress upon the importance of enabling women to participate in development, among other things, through gainful employment. Participation by women in the labour force is hypothesized to have a negative influence on fertility in all regions of the world regardless of level of development, with a principal condition for the relationship being a change in location of work, from within or near the household to locales distant from the home or working conditions otherwise unsuitable for child-rearing. Another factor conditioning the impact of women's work on fertility is the presence of older children, grandparents or other persons in the household or generally available help in the rearing of children once they are no longer physically dependent on the mother.⁷¹ This, of course, is more relevant in developing societies where fertility is at a high level and where customs make such help possible.

In light of the above, it can be hypothesized that the strength of the women's work-fertility relationship ought to increase as socio-economic development proceeds. Results of a recent study⁷² confirm this expectation. In almost all of the 20 developing countries in which WFS surveys were conducted, statistically significant and often substantial relationships were found between current fertility and women's work even after controlling several other socio-economic factors. Women employed outside the household had the lowest fertility, family-employed or self-employed women were intermediate and women who had never worked generally had the highest current fertility. The causative direction of the association, however, remains unclear since a similar analysis focusing on contraceptive use finds little evidence of a significant relationship with women's work.⁷³

Another study concentrating on women's work in 10 developing countries, again using WFS data, found significant differences in the mean number of children ever born to women by different measures of women's work.⁷⁴ In particular, women in non-agricultural industries, working away from home and/or in non-family employment in general have lower cumulative fertility than women in the converse categories or than non-working women. This is especially evident in the three Latin American countries studied (Colombia, Panama and Peru) where, for example, the aver-

age number of children ever born to women working away from home, working at home and not working were 3.73, 4.21 and 4.33, respectively. Bangladesh and Indonesia, on the other hand, do not follow this pattern. In some other countries, the fertility of housewives lies between that of women engaged in agricultural work at home and those employed in non-agricultural occupations away from home. The possibility cannot be ruled out that these divergent patterns reflect differences of work concepts across countries.

In contrast to the somewhat ambiguous results noted above, in developed countries, women's work is strongly associated with lower fertility. Analysis of WFS data⁷⁵ showed differences in cumulative fertility between currently working women and women who had not worked since marriage, even after controlling several other factors, of between 0.6 and 0.8 children in Belgium, France, Great Britain, Hungary, the Netherlands and the United States of America. On the other hand, in Poland, Italy, Spain and Yugoslavia, only moderate differences were found in fertility according to women's work history. There appears to be some evidence that women's work and childbearing tend to be relatively less compatible activities in economically highly developed countries.

4. *Familial roles*

The World Population Plan of Action places considerable stress upon the importance of the family as the essential medium in which individuals attain well-being, and it specifies that the roles of individuals within the family should be compatible with the full realization of individual rights and their social, cultural, political and economic potential.

The full integration of women into the development process, health and educational opportunities for children, the health and well-being of the aged can all be impeded by roles and responsibilities imposed by the family if those roles and duties are not compatible with the internationally recognized human rights of individual freedom and justice.

It has been theorized that traditional family structures and the concomitant roles played by individual family members in such families have a positive effect on fertility, since children contribute net benefits to the family; young offspring working in household enterprises (and remittances from non-resident sons) and the old age security provided to parents later on by adult children make high fertility preferable for individual parents. Others have extended these ideas to family structure,⁷⁶ claiming that joint and polygynous families with widespread kinship obligations (common in many of the less developed regions of the world) are supportive of high fertility, while nuclear families, lacking the possibilities for children to play these economically beneficial roles, tend towards low fertility. While it is true that joint family systems are prevalent only in less developed regions where the level of fertility is high, the few data available on this subject do not, in general, confirm a link between family structure and fertility.⁷⁷ Cross-sectional surveys demonstrate a lower fertility for women living in joint households, but also show that women in joint families are often younger than

their nuclear-family counterparts, and if age is controlled, differences in cumulative fertility by family type tend to disappear.

The view that joint households based on polygynous relations would tend to encourage high fertility is not supported by recently available WFS data. Analysis of such data⁷⁸ from two African countries (Kenya and Senegal) where polygyny is prevalent shows, for example, the wives aged 35 to 44 had borne, on the average, 6.4 to 6.5 children whether their husbands had one, two, three or more wives.

As noted earlier, the World Population Plan of Action offers a number of recommendations aimed to protect the family, including the strengthening of family ties and the promotion of respect within the family. These aims, desirable in themselves, can, if attained, also influence fertility. The extent of husband-wife communication may be taken as a proxy for the wife's status within the family (which in many countries is not such as to command respect), the rationale being that the more nearly equal in status the wife is with the husband, the more likely it is that decisions affecting reproduction and other aspects of family life will be made jointly by the spouses rather than by the husband alone. Results of field studies carried out in four Asian countries lead to the conclusion that communication between husband and wife was mediated by the freedom of the wife, level of family income, family size and, particularly, the respective levels of the spouses' education attainment.⁷⁹ Thus, communication did not of itself influence fertility. However, research conducted in another region revealed that failure of the husbands and wives to communicate might have explained their failure to adopt family planning.⁸⁰ It has also been reported that "... in their early stages, family planning programmes advocated methods removed from coitus, which tended to minimize [the need for] changes in relationships between husbands and wives",⁸¹ that in developing societies women are less likely than their husbands to favour high fertility,⁸² and that "a greater role in female fertility decision-making would itself imply an important transition in the superstructure".⁸³ Such reports argue vigorously for the enhancement of the wife's role in decisions on family matters and emphasize the efficaciousness of the relevant recommendations in the Plan of Action.

5. Social development

The World Population Plan of Action identified a specific group of developmental goals relevant to social development that generally have an effect on the socio-economic context of fertility. These goals include the "promotion of social justice, social mobility, and social development particularly by means of a wide participation of the population in development and a more equitable distribution of income, land, social services and amenities".⁸⁴ With respect to these concerns, the effect of urban-rural disparity on the distribution of social services and amenities and of the wider participation of females in the work force were discussed in previous sections. As for the other developmental goals in this group, some information is provided below on the effects of social mobility and income inequality on fertility.

Research undertaken in the early 1950s permitted the conclusion that social mobility can, if it is upward, depress fertility.⁸⁵ More recent studies of these relationships in some developed countries have yielded contradictory findings: one claiming strong interrelations between fertility and social mobility,⁸⁶ and the other finding no relationship.⁸⁷ However, social mobility may influence fertility indirectly in developing countries through the effect upon infant and early childhood mortality and the differential in propensity towards breastfeeding, lengthy post-partum abstinence, employment of women outside of the home and so on, between upwardly mobile and non-mobile individuals.

Earlier studies of differential fertility according to income and the size of landholding revealed sizeable fertility differences among income and landholding categories.⁸⁸ Thus, it is plausible to theorize that changes in income and land distribution should affect fertility. However, these studies also showed that the differentials are not uniform in space and time, that they undergo substantial changes, and that they also depend on other variables (for example, the association between fertility and income differs at various levels or between fertility and landholding among religious groups etc.).

In the developed countries, census returns usually demonstrate considerable differences in marital fertility between landless farm workers and farmers at the same duration of marriage or age of women.⁸⁹ According to observations made at different times in a number of countries, wives of agricultural farm workers had more live births (for example, France: 1911, 1946; Great Britain: 1946; England and Wales: 1961; Irish Catholics: 1961) in contrast with other findings that showed more children in the farmer families (for example, Hungary: 1930, 1949; the Netherlands: 1960; Czechoslovakia: 1961; Irish non-Catholics: 1961; Federal Republic of Germany: 1962). It should be considered, too, that the cumulative fertility of the landholding group also reflects the fertility of agricultural worker families that later obtained land. Thus, while in Hungary the family size of agricultural workers was smaller than that of the farmers, the general fertility rate of the former surpassed that of the latter at each census between 1900 and 1960.⁹⁰ The differentials are also changing in time; in Norway, for instance, the families of agricultural workers had more children after 18 years of marriage than that of the farmers in 1920 and 1930 but less in 1950.⁹¹

Apart from the above, only few observations are available on fertility differences by the size of landholding. A study of 20 Polish villages in 1948 concluded that the larger the landholding the greater the family size.⁹² On the other hand, an analysis of the fertility of the Hungarian agricultural population by landholding showed that the standardized number of children ever born increased from the landless group only to the group of small-to-medium size landholders (5.7 to 14.4 hectares) but decreased above this category.⁹³ Interestingly, somewhat similar findings were reported from a Bangladesh survey, where the size of the household increased sharply from the landless households only to those who owned about three acres of land; above this size the increase in the size of the household was much slower and did not keep pace with the increase in landholding.⁹⁴ There have

also been earlier reports of a positive relationship between rural family size and economic status in some developing countries.⁹⁵

Findings with respect to differentials in fertility by income, as mentioned earlier, are seemingly as inconclusive as the differentials by landholding. Obviously, the observations do not unanimously support the theory that income and land equality are associated with low fertility. Yet some cross-sectional multivariate statistical analyses⁹⁶ of data from several countries seem to suggest that declining inequality, while increasing fertility in the short-run, may depress it later in less developed countries. A recent study also concluded that factors reflecting economic inequality are more important in explaining provincial variations in fertility than some other factors used in the equations.⁹⁷ However, the effects of these factors on fertility do not appear to be very strong and, as is well known, cross-sectional studies are not suitable bases for inference with any statistical probability with respect to the future trend in fertility, provided there is a given change in one of the variables (for example, economic inequality).

6. Health factors

Although not well studied in demographic terms, many health factors have been linked to fertility lowering fecundability, either temporarily or permanently.⁹⁸ Because several problems make research into the demographic consequences of such factors inherently difficult, no precise answers are available as to either the extent to which health factors depress current fertility levels or the probable effect of removing these medically related causes of sub-fecundity and infertility. It is, nevertheless, evident that the World Population Conference's call for the "elimination of involuntary sterility and sub-fecundity in order that all couples may be permitted to achieve their desired number of children"⁹⁹ is relevant in developing and developed regions alike.

Given the widely cited estimate of maximum population fecundity of about 15 children per woman, the fact that in most developing countries fertility under "natural" conditions rarely exceeds six to eight births per woman has led many researchers to believe that, in addition to customs that regulate fertility and "natural" child-spacing practices, physiological sub-fecundity may also be an important, if little documented, part of the explanation of this large gap. Disease and malnutrition are among the principal causes cited as reducing fecundity (the latter has recently been questioned¹⁰⁰), but certain psychopathological factors, including psychoses, drug abuse (alcoholism, cigarette smoking, *inter alia*) and psychic stress, may be particularly relevant in societies undergoing rapid transition, modernization and urbanization.¹⁰¹ Diseases which likely depress fecundity and hence fertility include gonorrhea, tuberculosis, smallpox, malaria, sleeping sickness, filariasis, Chagas' disease, syphilis, German measles, toxoplasmosis, anaemia (often associated with malaria) and genital infections, especially those resulting from female circumcision, abortion and childbirth.¹⁰² Although the effect on fertility is

unknown, these diseases, taken together, claim hundreds of millions of victims, malaria alone infecting an estimated 600 million persons.

Malnourishment probably also contributes to reduce fertility in several developing countries. Different causal paths have been identified: by direct impairment of genitalia, by lactational changes and by infant mortality (the latter being a contrary effect). Although starvation and famine produce well-documented temporary declines in fertility, the more general condition prevailing in some regions is one of chronic malnutrition. Most experts now agree, however, that the direct biological effect of nutrition on fertility is minor.¹⁰³ A shorter reproductive time-span has also been convincingly related to poor nutrition, but since this involves the beginning and end of the reproductive period, the reduction of total fertility is probably insignificant. A perhaps more serious, but inadequately studied complication of chronic malnutrition is the development of contracted pelvis which complicates parturition, increasing the chance of subsequent infection.¹⁰⁴ Adolescent sub-fecundity and health complications at pregnancy and childbearing occurs where girls are exposed too early to pregnancy risks.¹⁰⁵

In the more advanced countries, health-related sub-fecundity is a less important determinant of fertility levels, partially because fertility desires are already so low. A number of trends suggest, however, that sub-fecundity may become an increasingly important factor in achieving even these low targets. Psychopathological causes and disease, especially gonorrhea, genital herpes and other infectious genital diseases may be increasing the level of sub-fecundity. Health impairments linked to IUD use and abortion may also become more prevalent in developed countries, given existing trends in contraception and abortion. The threat from a polluted environment may also be mentioned as a possible source of increasing sub-fecundity; the deleterious effects of radiation, certain pesticides and other toxic chemicals have already been documented.

7. Contraceptive use

The World Population Plan of Action has as one of its principles the tenet that "all couples and individuals have the basic right to decide freely and responsibly the number and spacing of their children and to have the information, education and means to do so".¹⁰⁶ The vast majority of countries directly support access of their inhabitants to modern means of fertility regulation. As of July 1980, this was the case with 81 out of 126 developing and 25 developed countries, with the numbers giving indirect support being 8 and 13, respectively.¹⁰⁷

A striking feature of world-wide contraceptive practice is that, although the use varies in proportion to the level of national development, there exists a substantial similarity between regions in the "mix" of contraceptive methods used. That is, the spread of the so-called modern methods of contraception (principally sterilization, pills and IUD) has taken place in developing countries almost at the same time as it has in developed countries, that is, during the last two to three decades. Much variation in the relative prevalence of

particular methods is observed, but this seems to be related more to differences in culture and historical experience among countries than to regional or developmental differences.

A recent study of current contraceptive use¹⁰⁸ covering 20 developing countries for which WFS data are available found that it varies widely, from 64 per cent of currently married women in the reproductive ages in Costa Rica to as little as 2 per cent in Nepal. Regionally, Latin American countries reported the highest range of current contraceptive use (30 to 64 per cent of currently married women), Asian and Oceanic countries fall into the range of 2 to 40 per cent, and three African countries (Senegal, Lesotho and Kenya) reported levels of current use of from 4 to 10 per cent. Trends in contraceptive use are more difficult to gauge because of methodological differences between surveys, but during the first half of the decade of the 1970s there appear to have been large increases in the percentage using contraception in Colombia, Costa Rica, Indonesia, Malaysia, Mexico, the Philippines, the Republic of Korea and Thailand. In Jordan, Pakistan and Peru, on the other hand, little change has been reported.

As noted above, modern methods are now widely applied by users of contraceptives in developing countries. In the study of 20 developing countries, only in Peru and the Philippines were modern methods used by less than 50 per cent of all users. In general, oral contraceptives were the most frequently used, and sterilization had also become widely spread in several countries.

Contraceptive use differs according to socio-economic factors in patterns similar to those noted for fertility, discussed above. A recent comparative analysis of ever-use of contraception in 22 developing countries, however, shows that the strength of effort of national family planning programmes explains much of the variation in the relationship between ever-use and educational level.¹⁰⁹ While a higher developmental level tends to enhance the positive association of education and contraceptive use, family planning programme effort significantly diminishes it. Thus, there is some evidence that contraceptive use, given a strong family planning programme, may transcend socio-economic barriers.

A report covering developed countries¹¹⁰ showed that,

about 1975-1977 in eight countries out of nine for which WFS data were available, 75 to 89 per cent of the married women of reproductive ages used contraception or were sterilized, sub-fecund or infecund; in one country (Spain), the percentage was only 50. The United States (28 per cent), Denmark and Great Britain (19 per cent each) had the highest proportions of married women of childbearing ages who were sterilized while, in other European countries, particularly in Hungary, Spain and the Netherlands, contraceptive sterilization was virtually non-existent.

Changes in contraceptive use during the 10 years prior to the round of surveys of WFS are highlighted by replacements of one method by another, although overall level of use also crept upwards. The trend of changes in contraceptive practices moved from the traditional folk methods (of mainly withdrawal and periodic abstinence or rhythm) first towards the so-called "drugstore" methods (such as diaphragm, spermicides and, first of all, condom) and later to the "modern" contraceptives (that is, pill and IUD) and sterilization. These changes explain the main patterns of current contraceptive use in developing countries. In one group of developed countries, folk methods still prevail, but either the condom (Poland¹¹¹) or the pill (Spain) gained in popularity. In others (Belgium, France and Hungary), the use of folk methods persists: the drugstore methods were never popular or lost their attractiveness and, recently, the use of modern methods, primarily oral contraceptives, registered dramatic increase. In the third group, the use of folk methods lost significance, and modern methods became dominant (first of all the pill, as in the Netherlands), but in many countries the use of the drugstore methods (mainly that of the condom) is still popular, as in Great Britain and Norway (where, as an exception, the use of the IUD is more widespread than that of the pill); in some countries sterilization attained growing importance (the United States, Denmark and Great Britain).

Clearly, information about contraceptive use cannot provide the full picture of birth regulation. The patterns of contraceptive use can only be evaluated in light of abortion conditions about which reliable information is relatively meagre even where abortion is legal. For some countries, an accounting of the incidences and conditions of sterilization would be among the requisite information for a proper assessment of birth regulation.

NOTES

¹ *Report of the United Nations World Population Conference, 1974, Bucharest, 19-30 August 1974* (United Nations publication, Sales No. E.75.XIII.3), p. 12.

² *Ibid.*

³ Economic and Social Council Resolution 1979/32 of 9 May 1979; *Review and Appraisal of the World Population Plan of Action* (United Nations publication, Sales No. E.79.XIII.7), pp. 58-59.

⁴ Although other sources are also utilized, this text is essentially based on reports prepared by the Population Division of the United Nations Secretariat, the regional economic commissions, the International Labour Organisation and the World Health Organization, as members of the United Nations Working Group on Comparative Analysis of World Fertility Survey Data. The Working Group's project is an effort to carry out research on 17 items of a minimum research plan extracted from George T. Acsádi, "Research plan for comparative analysis of WFS data of the Population Division of the United Nations", *The United Nations Programme for*

Comparative Analysis of World Fertility Survey Data (United Nations Fund for Population Activities, 1980), pp. 3-26.

⁵ Based on *World Population Prospects as Assessed in 1980* (United Nations publication, Sales No. E.81.XIII.8), table A-6; *World Population Trends and Policies; 1981 Monitoring Report*, Vol. 1, *Population Trends* (United Nations publication, Sales No. E.82.XIII.2); *World Population Trends and Policies; 1983 Monitoring Report* (in preparation).

⁶ *Ibid.* A figure of 18.3 has been quoted for the year 1978. See also Chen Muhua, "Birth planning in China", *International Family Planning Perspectives*, vol. 5, No. 3 (New York, September 1979), p. 92.

⁷ *World Population Prospects as Assessed in 1980* (United Nations publication, Sales No. E.81.XIII.8), table A-6.

⁸ *Population Bulletin of the United Nations No. 7-1963* (United Nations publication, Sales No. 64.XIII.2).

⁹ *World Population Prospects as Assessed in 1980*, *op. cit.*, table A-6.

¹⁰ *Ibid.*

¹¹ "Comparative analysis of fertility levels and trends as assessed from twenty World Fertility Surveys" (IESA/P/ICP.1984/EG.I/11). Publication of full text is forthcoming. When the project was undertaken, standard recode tapes were available for only 20 countries.

¹² *Ibid.* The countries examined that have World Fertility Survey data adequate to assess trends are Fiji, Malaysia, the Philippines, the Republic of Korea, Sri Lanka, Thailand, Colombia, Costa Rica, Guyana, Jamaica, Mexico, Panama and Peru.

¹³ The crude birth rate trends described in the preceding paragraphs for these two regions do not relate to the same period. However, they suggest more modest decreases. The differences may reflect the timing, the quality of the data or the influence of structural changes on the crude birth rates. Some aspects of these questions are discussed below.

¹⁴ *World Population Prospects as Assessed in 1980*, *op. cit.*, table A-6.

¹⁵ Rising birth rates attributable to higher fertility have been estimated, among other countries, for Kenya, Niger and Senegal. *Ibid.*; see also, *World Population Trends and Policies; 1977 Monitoring Report*, vol. I, *Population Trends* (United Nations publication, Sales No. E.78.XIII.3), pp. 62-64.

¹⁶ K. Srinivasan, P. H. Reddy and K. N. M. Raju, "From one generation to the next: changes in fertility, family size preference, and family planning in an Indian state between 1951 and 1975", *Studies in Family Planning*, vol. 9, Nos. 10 and 11 (October-November 1978); K. Srinivasan and Shireen Jejeeboy, "Changes in natural fertility in India, 1959-1972", paper presented to the IUSSP seminar on Determinants of Fertility Trends: Major Theories and New Directions for Research, Bad Homburg, 14-17 April 1980.

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¹⁹ *World Population Trends and Policies; 1977 Monitoring Report*, *op. cit.*, pp. 62-64; *World Population Prospects as Assessed in 1980*, *op. cit.*, table A-6.

²⁰ Excluding Albania, Cyprus, Israel and Turkey, which are sometimes included with developed countries. Council of Europe, *Recent Demographic Developments in the Member States of the Council of Europe* (Strasbourg, 1981); *World Population Trends and Policies; 1983 Monitoring Report*, *op. cit.*; *Demographic Yearbook 1980*, *op. cit.*

²¹ *Levels and Trends of Fertility Throughout the World, 1950-1970* (United Nations publication, Sales No. E.77.XIII.2), chap. VI; *World Population Trends and Policies; 1983 Monitoring Report*, *op. cit.*; Council of Europe, *Recent Demographic Developments in the Member States of the Council of Europe*, *op. cit.*

²² Council of Europe, *op. cit.*, pp. 5-8; G. Calot and C. Blayo, "Recent course of fertility in non-Communist European countries", paper presented to the Conference on Recent Developments in the Population of Europe, University of Exeter, 16-18 September 1981, table 16; *World Population Trends and Policies; 1983 Monitoring Report*, *op. cit.*

²³ See, for example, *Variations in the Incidence of Knowledge and Use of Contraception: A comparative analysis of World Fertility Survey results for twenty developing countries* (ST/ESA/SER.R/40).

²⁴ *World Population Trends and Policies; 1981 Monitoring Report*, *op. cit.*, vol. I, chap. 5.

²⁵ Files of the Population Division of the United Nations Secretariat.

²⁶ *Ibid.* For the more developed countries, the percentages are 28.9 and 32.1 for 1970 and 1980, respectively, and 32.9 and 36.0 for the less developed group.

²⁷ *The Impact of Population Structure on Crude Fertility Measures: A comparative analysis of World Fertility Survey results for twenty-one developing countries* (ST/ESA/SER.R/49).

²⁸ *Levels and Trends of Fertility Throughout the World, 1950-1970* (United Nations publication, Sales No. E.77.XIII.2), pp. 229-230; *World Population Trends and Policies; 1981 Monitoring Report*, *op. cit.*, chap. 3.

²⁹ *Report of the United Nations World Population Conference, 1974*, *op. cit.*

³⁰ *World Population Trends and Policies; 1981 Monitoring Report*, *op. cit.*, chap. 3; Economic Commission for Africa, "Marriage and fertility in Africa" (IESA/P/ICP.1984/EG.I/7). Singulate mean age at marriage is calculated from the proportion of women enumerated as single at different ages in a population census or survey.

³¹ *World Population Trends and Policies; 1981 Monitoring Report*, *op. cit.*

³² In most developing countries, only a few women marry at ages above 25. In countries where late marriages are not unusual, some women in the age-group 15 to 49 who were not married at the time of the surveys will eventually marry, so that, in those countries, the mean age at marriage should be higher.

³³ United Nations, *Marital Status and Fertility* (forthcoming).

³⁴ United Nations, *Relationships Between Fertility and Education* (in publication).

³⁵ *World Population Trends and Policies; 1981 Monitoring Report*, *op. cit.*

³⁶ *World Population Trends and Policies; 1981 Monitoring Report*, *op. cit.*, chap. 3; see also, P. Festy, "On the new context of marriage in Western Europe", *Population and Development Review*, vol. 6, No. 2 (June 1980), pp. 311-315.

³⁷ United Nations, *Marital Status and Fertility*, *op. cit.*

³⁸ R. Chester, ed., *Divorce in Europe* (Leiden, Martinus Nijhoff Social Sciences Division, 1977).

³⁹ United States, Bureau of the Census, *Statistical Abstract of the United States, 1980* (Washington, D.C., 1980), pp. 84-85.

⁴⁰ L. Roussel and P. Festy, *Recent Trends in Attitudes and Behaviour Affecting the Family in Council of Europe Member States* (Council of Europe, Strasbourg, 1979), pp. 5-19.

⁴¹ *The Determinants and Consequences of Population Trends*, vol. I, *Population Studies No. 50* (United Nations publication, Sales No. E.71/XIII.5), p. 81.

⁴² Economic Commission for Africa, *Marriage and Fertility in Africa* (IESA/P/ICP.1984/EG.I/7).

⁴³ United Nations, *Some Relationships Between Nuptiality and Fertility in Countries of the West Indies* (in publication).

⁴⁴ *Ibid.*

⁴⁵ Draft report of the Caribbean workshop on the Analysis of Data on Unions and Partners, convened by the World Fertility Survey in Bridgetown, 24-26 October 1978.

⁴⁶ United Nations, *Some Relationships Between Nuptiality and Fertility in Countries of the West Indies*, *op. cit.*

⁴⁷ *World Population Trends and Policies; 1981 Monitoring Report*, *op. cit.*, chap. 3; P. Festy, *op. cit.*; G. Wunsch, "Effect of changes in nuptiality on natality in Western Europe", L. T. Ruzicka, ed., *Nuptiality and Fertility* (Liège, International Union for the Scientific Study of Population, 1982), pp. 155-174.

⁴⁸ C. F. Westoff, "Some speculations on the future of marriage and fertility", *Family Planning Perspectives*, vol. 10, No. 2, 1978, pp. 78-83.

⁴⁹ P. Festy, *op. cit.*

⁵⁰ *World Population Trends and Policies; 1981 Monitoring Report*, *op. cit.*, chap. 3.

⁵¹ *Ibid.*, see also L. Roussel and P. Festy, *Recent Trends in Attitudes and Behaviour Affecting the Family in Council of Europe Member States*, *op. cit.*, pp. 20-27.

⁵² "Marrying, divorcing and living together in the United States today", *Population Bulletin*, Population Reference Bureau, vol. 32, No. 5 (Washington, D.C., 1977), pp. 4-5.

⁵³ *World Population Trends and Policies; 1981 Monitoring Report*, *op. cit.*, chap. 3.

⁵⁴ P. Festy, *op. cit.*, p. 314.

⁵⁵ *Ibid.*, "Marrying, divorcing and living together in the United States today", *op. cit.*

⁵⁶ *Report of the United Nations World Population Conference . . .*, *op. cit.*, p. 17.

⁵⁷ For a thorough treatment of this topic, see *The Effects of Infant and Child Mortality on Fertility*, S. H. Preston, ed. (New York, 1978), note especially the introductory chapter.

⁵⁸ S. Rutstein and V. Medica, "The Latin American experience", S. Preston, ed., *op. cit.*, pp. 93-112.

⁵⁹ *Factors Affecting the Use and Non-Use of Contraception: Findings from a Comparative Analysis of Selected KAP Surveys* (United Nations publication, Sales No. E.79.XIII.6), pp. 43-44.

⁶⁰ *Selected Factors Affecting Fertility and Fertility Preferences in Developing Countries* (ST/ESA/SER.R/37), pp. 54-55.

⁶¹ *Demographic Yearbook, 1979* (United Nations publication, Sales No. E/F.80.XIII.1), p. 327.

⁶² Economic and Social Commission for Asia and the Pacific, "Differen-

tials in urban-rural fertility in the countries of the ESCAP region", paper presented to the United Nations Working Group on Comparative Analysis of World Fertility Survey Data, 5th Meeting, Geneva, 26-29 January 1982, p. 8. In discussing rural-urban differential fertility, a distinction must be made between the "crude" or real fertility differential and the effect of rural and urban residence, that is, the "net" fertility difference that would be observed if the characteristics of the urban and rural populations were the same. "Crude" rural-urban differentials, while of little use in examining the effect of residential pattern upon fertility, nevertheless indicate overall differences in reproductive performance between rural and urban sub-populations.

⁶⁵ *Relationships Between Fertility and Education: A Comparative Analysis of World Fertility Survey Data for Twenty-two Developing Countries* (ST/ESA/SER.R/48).

⁶⁴ *Report of the United Nations World Population Conference . . . op. cit.*, p. 15.

⁶⁵ Economic Commission for Europe, "Socio-economic determinants of achieved fertility in some developed countries: a multivariate analysis based on WFS data" (IESA/P/ICP.1984/EG.1/6).

⁶⁶ *Relationships Between Fertility and Education*, *op. cit.*, and S. Cochrane, *Fertility and Education: What Do We Really Know?* (World Bank, Washington, D.C., 1979).

⁶⁷ *Relationships Between Fertility and Education*, *op. cit.* (with the exception of the fourth pattern which represents developed countries).

⁶⁸ With demographic factors standardized as well as rural-urban residence.

⁶⁹ Again, these findings are standardized for major demographic factors.

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FERTILITY AND FAMILY STRUCTURE

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SUMMARY

The argument of the present article begins with the proposition that we have been less than successful to date in our considerable efforts to understand the determinants of fertility decline because we have disproportionately emphasized, in concepts and surveys, the problem of explanation at the individual level, and consigned to residual neglect the institutional setting which always and everywhere conditions individual decisions and behaviour.

The last half of the article contains an account of those aspects of modernization which seem to have the most direct implications for family structure. The account begins with a description of the intergenerational contract, and the way in which mortality decline affects the parties to that contract. The conclusion is that mortality decline is disruptive of both the quantitative and the temporal equilibrium within the traditional family, simply speaking because of an increase in the ratio of sons to fathers and a delay in the time of transfer of statuses and rights from the senior to the junior generation. Because of our belief that the assumptions about family relationships, as conveyed by the nature of the intergenerational contract, as the primary determinants of fertility, our account of modernization as a force for demographic change is focused not so much on fertility itself, but on those assumptions, that is, on the system of family morality. The discussion is strongly derivative, in somewhat amended and abbreviated form, from Caldwell's theory of fertility decline.

Concerning policy aspects, the position of the author is that the need for policy arises from the circumstances that the pursuit of family interests yields consequences which are unsatisfactory for society in the aggregate because some of the costs incurred by the senior generation are displaced onto the junior generation. Several policy suggestions are developed in relation to the potential effect on fertility of certain socio-economic strategies.

In conclusion, the author maintained that an acceptable theory of fertility decline is probably inaccessible within the confines of mechanistic micro-analytic models; the admission is required that we are only beginning to define the macro-analytic problem in such a way as to suggest what the appropriate research concepts and instruments should be. The basis for firm recommendations for scientific investigations and for policy is likely to be a theory of social change.

In the past several decades there has been a large expenditure of professional and material resources on the problem of the determinants of fertility decline. Notwithstanding this effort, which has indeed led to a substantial increase in information, there has been little advance in understanding. Of the many diagnoses which might be proffered to explain our lack of success, the one we find most cogent is that a disproportionate share of our time has been allocated to one style of research. The centre-piece of most of our attention has been the individual decision-maker, and the socio-cultural context of reproduction has tended to be relegated to a residual environmental limbo. Our failure to provide the base of responsible knowledge required to inform social policy

may be attributable to the fact that we ask questions at the wrong analytic level.

In our view, a theory of fertility decline is but one element in a theory of social change. The conceptualization required for that differs categorically from the design of most current demographic inquiry. A theory of social change is concerned with the transformation of institutional structures. Metaphorically, the kind of thinking is much more like that employed by anthropologists and biologists than like the mechanistic formulations (borrowed from physics) from which most social and economic research is derivative. No claim is made to provide the necessary alternative conceptualization here. At best, the manuscript provides a set of suggestions for ways in which we may learn something important by pointing our investigations in other directions. Nor can there be much pride of originality. In recent years, similar positions have been expressed by many contributors

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to the literature. The most evident intellectual debt is to the work of Jack Caldwell. Beyond the shameless borrowing from his prodigious output, it will be evident to Geoffrey McNicoll and Ron Lesthaeghe, among many others, how influential their writings have been.

The complexity of the structural context within which reproduction is embedded is such that a comprehensive treatment would have exceeded reasonable bounds for the essay as well as the competence of the author. Instead, one particular theme has been pursued with some persistence. Intrinsic to the study of social change is the passage of time. In our view, the most promising link between family structure and social change (and accordingly fertility change) is the time dimension of the family, its generational structure, as it changes through time.

DISTINCTIONS BETWEEN ANALYTIC LEVELS

Thinking about fertility has proceeded along two distinct lines, one focused on characteristics of individuals, and the other on characteristics of the groups of which individuals are members. Research of the former kind, called micro-analytic inquiry, has tended to emphasize measurement of the relationship between a dependent variable and each of various independent variables, whereas research of the latter kind, called macro-analytic inquiry, is more inclined to ask questions about structure and interdependence, although this distinction is not a sharp one. Family structure, the particular emphasis of the present contribution, is clearly a macro-analytic subject. Nevertheless, because the dominant style of empirical inquiry has been oriented to the individual, it is important to consider how amenable the subject of fertility is to micro-analytic research.

Demographers study the characteristics of populations on the basis of observations about individual members, and particularly events occurring to those members which change the size of populations. It is accordingly not surprising to find two polar types of model constructed to organize the evidence, one centred on the individual and the other on the aggregate. The significance of the orientation selected is the distinctive recipe for research that emerges.

The question which justifies governmental support of fertility research is the set of determinants of the birth rates of successive cohorts in successive periods for populations variously characterized. The shape of fertility as a function of age and time is the critical input into projections of the size and age distribution of the population. The manifold consequences of the indicated changes provoke consideration of interventions which may modify the outcome in directions contributing to the attainment of societal goals.

Notwithstanding the policy priority of aggregate outcomes, most research has in fact been directed to the characteristics of individuals. Although a defensible case may be made for assigning theoretical priority to that line of inquiry, rather than to examination of the social arrangements within which individuals find themselves, we suggest that the predominance of this style has arisen less from reasoned debate on the issues than from intrinsic characteristics of the discipline of demography. In a strict sense, demographers are atheoretical. Their objects of study are concrete entities and

events rather than some particular class of analytic elements abstracted from those entities and events. The resultant pragmatic and empiricist bias has pulled demographers toward the study of available data sets, often produced for non-scientific (administrative) purposes, and typically multidisciplinary if not nondisciplinary in design. Demographers are much less comfortable with concepts than with data.

A typical account of fertility (for example, the chapter on the subject in United Nations, 1973) begins with the total fertility rate, and employs an accounting scheme to distinguish the analytically separated directions of influence on that rate, based on a typology of the so-called intermediate variables. This typology (Davis and Blake, 1956) has been very influential in research design and in conceptualization. It provides a comprehensive checklist of the pathways along which influences on fertility must flow, keyed to the phases of the physiological process. The measurement of fertility has developed impressively by progressive quantification of the separate components, essentially as a specialized branch of biometry, relatively independent of social science considerations (Bongaarts, 1982).

For present purposes, the crucial step in the process, from the standpoint of a research agenda, is the distinction drawn, in the discussion of the components of fertility, between intentional and unintentional behaviour, or between voluntary and involuntary determinants. The choice of terms specifies that the individual decision is central, and the rest is residual. Now this may be thought of as convenient shorthand for distinguishing the analytic assignments of the behavioural scientist and the biologist respectively. A comparable role has been played by the concept of natural fertility (Bongaarts, 1982). The idea behind that concept is the distinction between reproductive behaviour which is parity-dependent, that is, based on the intention to terminate fertility by appropriate means upon attainment of a particular parity, and all other behaviour, considered as "natural". Yet the latter does not accord in content with the distinction, say, between the natural and the social sciences. Included in the category of natural fertility are variations in fertility over space and time dependent on patterns of marriage, divorce and remarriage, customs of institutionalized abstinence in particular circumstances, lactation behaviour, and the conditional tolerance of fertility regulation in extreme situations not explicitly associated with parity. In the same way, the residual category of involuntary or unintentional behaviour is the repository not only of physiological differences but also of whatever sources of influence on individual behaviour result from the circumstance that the individual is affected by membership in one or another kind of social group.

The involuntary residual category may be thought of as a relatively invariant set of conditions, providing the setting within which voluntary acts, the manifestations of individual decisions, are carried out. Whether these conditions are biological or socio-cultural, the research implication is that they provide the background before which the individual actor stands. This is standard research strategy. One engages in a conceptual experiment, pretending that some variables are in fact constants, in order to focus on the role played by other variables, and deal with them more efficiently. There may also be empirical support for such a view, because of the time frame of the analysis. It would not be implausible, for

example, to characterize the physiological elements in the reproductive process as being of secondary significance in those inter-societal and inter-temporal variations in the fertility pattern that are of prime interest. Such would not be the case, however, for that part of the residual reflecting marriage, for example, since that shows substantial variation over space and time.

As so often happens with analytic distinctions, the conceptual tidiness is deceptive. For example, a fertility difference between two populations may be attributed to the physiological difference in the probability of conception during a single unprotected act of coitus without commitment to the position that such a difference is innate. The analytic question may be compared with that of a classification of deaths by cause, from a medical standpoint, which may be only a preliminary to an investigation of causes on other levels, such as the socio-economic level.

A comparable problem, more directly related to the present topic, is what is involved in identifying a particular behaviour pattern as intentional or as customary. If, for example, a respondent reports two years of lactation, the reason for that behaviour may be given as custom, without further specification. On the other hand, the respondent may be sufficiently introspective to volunteer the further opinion that the custom of extended breastfeeding contributes to the infant's health. After all, customs ordinarily make sense, at least in the double negative sense that, if they were harmful, there would have been selection against their continuation. The question is whether the recognition by the informant of some sense behind the custom transforms the act from the customary to the intentional side of the ledger.

The conventional practice has been to make the distinction between intentional and unintentional behaviour by type of activity rather than by whatever reasons may be given for it, so that contraception and abortion fall into the former and lactation and marriage into the latter category. The principal consequence of the intermediate variable typology has been the development of data and theory focused on explanation of the intentional behaviour of individuals to the neglect of those macro-analytic elements falling into the "unintentional" class. For example there is now substantial evidence concerning cultural variations in nuptiality, and in lactation practices, but the development of an explanatory scheme for either, in terms of other characteristics of the culture, has scarcely been addressed.

Parenthetically, there is more than a little irony to the intellectual history of the intermediate variable typology. Davis and Blake, who developed the framework, are prominent representatives of a socio-cultural orientation to fertility analysis. They used the typology originally to pose questions about the alternative strategies which may be followed by different kinds of society with respect to the range of values of each of the instrumental variable sets, and the macro-analytic correlates of those strategies. The profession has used their contribution to move in another direction.

A major reason for this outcome has been the dominant position in research, over the past generation, of the fertility survey. The objective of a typical survey is to interview a set of female respondents, selected for reasons of economy and discretion from the universe of those who are presumed to have been exposed to risk, and ask questions about their

reproductive behaviour, and especially about whatever actions they may have taken to interfere in the outcome of that behaviour. Such surveys have provided rich descriptions of the complex process of reproduction in various socio-cultural contexts; their yield of data is indispensable to the task of fertility analysis. But the question here is how the variations are to be explained. The form of the survey promotes a micro-analytic approach to explanation. Typically the individual's environment is treated as a set of conditions. The observation that completed parity differs for rural or urban populations, for various ethnic subcultures, and the like, is not so much a solution as the rephrasing of a problem. But the availability of many bits of information for each individual, one subset of which may be called the dependent variable (at least in the sense that it represents the rationale for the research endeavour), provides ample opportunity, on the other hand, for the exercise of analytic skills at the individual level, as by the social psychologist, the micro-economist, as well as the statistician (not otherwise specified).

A MICRO-ANALYTIC MODEL

A model of consumer choice has the characteristic form most often employed in the analysis of decision-making. The individual is the unit of analysis. The objective of actions by the individual is to maximize his or her utility. Individuals engage in a rational and systematic effort to achieve goals, subject to certain finite constraints such as income and time. (Economists do not concern themselves with the sources of ends or the availability of means, but rather with the calculus of decision implicit in their confrontation. Ends represent data in the same sense as other givens like technological feasibility.) The child may be thought of as a durable good yielding utility over an extended period, at the cost of parental time and other resources (Jones, 1982). The decision-maker assesses the costs and benefits of having an additional child. The costs are conventional expenses and foregone opportunities. The benefits may be restricted to the child as a consumer good or extended to the child as a producer good as well, that is, a source of family income either on a sustained basis during the child's early adulthood and the parents' old age, or on an emergency basis in times of special need (Robinson and Harbison, 1980). The outcome is completely determined by a sufficiently comprehensive view of the costs and benefits of the act to the individual decision-maker.

Some aspects of the intellectual approach may be exemplified by using the device of the regression equation:

$$y = c_0 + c_1x_1 + c_2x_2 + \dots$$

The dependent variable, y , on the left-hand side of the equation, is the reproductive decision. On the right-hand side, some particular independent variables (" x 's") are specified, while the values of the coefficients (" c 's") are the outcome of the statistical procedure. The independent variables selected are operationalized elements of the situation, such as the prices of goods and services associated with child-rearing and with other activities; the values of the coefficients stand for all other conditions of consequence in the observational situation. The independent variables are

selected not so much because they are considered primary in importance as because they are measurable aspects of those elements which are the disciplinary preoccupation of the model-builder, permitting a focus on the implications of some kinds and sources of variation in abstraction from others.

The conditions underlying the coefficients of the regression equation are not unlikely to change over time, and differ from one culture to another. In order to adapt the model so that it can address the question of the consequences of such variations explicitly, attempts have been made to incorporate some subjects in which demographers and sociologists have expressed considerable interest, in a sense to transfer them from the status of contributions to the values of the coefficients into the status of independent variables with an explicit role in the regression. One such effort (Easterlin, 1978) deserves particular attention because it has provided the conceptual basis for a major work currently being undertaken under the aegis of the United States National Academy of Sciences to summarize the determinants of fertility in developing countries.

The system of variables in that adaptation of the Easterlin model is as follows. Fertility is determined by the combination of the practice of fertility regulation and the "supply" of children. The latter term signifies the number of children which would be physiologically feasible for a couple, in the context of cultural practices (provided they are not parity-specific) which affect that number. The effect of the definition is to produce an approximation of what was identified above as "natural" fertility. The practice of fertility regulation in turn is based on a weighing of the motivation to regulate against the costs of fertility regulation. The motivation to regulate derives from a comparison of desired and actual parity. Finally, desired parity is the outcome of a subjective weighing of tastes and constraints by the couple, where tastes are the preferences for children relative to other goods and services and constraints are the prices of children relative to those of other goods and services, within the budgetary constraints of income and wealth.

The external elements which go into the fertility decision are the demand for children (tastes), the supply of children (natural fertility) and the costs of fertility regulation. These elements are conceptually formulated so that each is defined with the other two held constant. While this precaution does make the theoretical system tidy, some scepticism is warranted about whether the decision-maker can perform the same conceptual experiment when asked questions about the separate elements in this way.

The principal non-behavioural question in the model is desired family size. This is a most attractive and convenient variable for an analysis in which the information is to be algebraicized. It simplifies research because it appears to permit one to collapse the entire complex of institutional considerations bearing on the decision-maker into a single summary number. One is enabled to ascertain the priority accorded to parenthood in the respondent's life plan in abstraction from the particularities of the moment. Most respondents provide an answer to the question without apparent difficulty. And the outcome has immediate policy relevance. If desired parity is lower than actual parity, one is prompted to propose programmes to reduce the costs of

fertility regulation; if desired parity is higher than actual parity, the preferred direction of action is motivational. The parity norm for a couple is a policy target in the same sense that the nation has a target in terms of population size.

Yet a family, like a nation, may not think of population size as a goal, but rather as a means (among various others) to achieve goals. There may be no such quantitative dimension to the life strategy of the respondent, or it may be one aspect of a complex design. To interpret the response, one needs to know what assumptions were made about other aspects of the respondent's life, all of which are means to achieving unspecified goals. Presumably the number reported is conditional on unspecified assumptions about the rights and responsibilities of many relevant others, within and beyond the family, together with perceptions of opportunities for education, for employment, and the like. The parity norm has a kind of unreality because it can scarcely exist in disembodied form apart from those perceived conditions. The respondent has the challenging task of evaluating the number of children in abstraction from the stuff of her life; the analyst has the challenging task of divining what the question may have signified to the particular respondent.

In the typical survey, the respondent to the question about desired family size is a married woman. Little information has been collected concerning what responses her spouse might make. Most analysis appears to proceed on the assumption that the respondent is a neutral representative of a pair who always think and act in harmony. Little is known about the nature of the bargaining process by which some resolution is achieved if the couple disagree (Arthur, 1982). Clearly the respective discretionary powers of husband and wife differ from one culture to another (to the extent that the desires of the wife may be nearly irrelevant to the decision), and the power of the kinship group may be sufficient to reduce substantially the discretionary role of the couple even when they agree (Hawthorn, 1978). In brief, the link between desire and action may be tenuous if the respondent is not the responsible party.

Nor is the problem simply one of conflict of interest among the affected parties. In formulating a response, the informant may be putting her personal interests to the forefront, she may give heavy weight to the perceived interests of her husband, or she may think that the interests of the prospective children deserve priority. The respondent is a representative of a system of role relationships. It may be beyond her capabilities to articulate that system, given the way in which the internalization of norm yields a commingling of individual purpose and group design, but even if not, the reliability of the report would be questionable because of the particular position she occupies within that system.

Underlying the parity norm, if one assumes that it is more than a convenient artifact in the mind of the analyst, is an assessment of the costs and benefits of children. There are many complexities to that assessment. Thus the time spent on child-rearing is from one viewpoint a cost because it represents forgone opportunities, but from another viewpoint it is a benefit, since it is the vehicle through which many of the satisfactions of child-rearing are derived. Also, the characteristics which make it possible for the child to be a source of pleasure are the same as those which make it possible for the child to be a source of pain. As a third example, acceptance

of the burdens of child-rearing is a way to achieve the important pleasure of success in fulfilment of a strong moral obligation.

At the most mundane level of criticism, the particular wording of the question used to obtain the desired parity response is biased in favour of marriage rather than non-marriage, and biased in favour of a family (including children) rather than a childless couple, and finally biased in favour of children in the plural relative to a response of one child. Such considerations doubtless constitute part of the explanation for response distributions in every survey which have an effective floor of two children. Beyond this, there is the perplexing problem of reliability of any response to a question with a normative overlay, because of the tendency to misstate in the direction of what the respondent perceives the interviewer (and the powers he or she represents) to regard as proper.

In the conceptual system employed by the National Academy of Sciences project, norms are ubiquitous but implicit. With respect to desired parity, norms appear as a component of "tastes". Although strange to the uninitiated, the term has long standing in micro-economic models of consumer choice. It serves to indicate the direction of research required to give it content, presumably a psychological inquiry into the characteristics of the individual. If so, the term is peculiarly inappropriate for a normatively oriented facet of the response, since norms are not individual characteristics but properties of groups. Norms are shared expectations about how persons should behave in relationship systems. To ascertain group properties the level of inquiry is not the socio-psychological but the socio-cultural.

Norms also are introduced into the conceptual scheme as elements in the costs of regulation. Analytically, one may think of norms as standing for particular kinds of cost and benefit, in the sense that they are given force by positive and negative sanctions (Robinson and Harbison, 1980). Now the question of fertility regulation is logically prior to that of the reproductive goal. The responsiveness to a question about the parity norm implies acceptance of the legitimacy of modifying parity by intentional use of some mode of fertility regulation. In some cultures, the reproductive policy is not so much an injunction to bear a particular number of children as an injunction not to interfere at all in the process. Yet if the acts which would be appropriate given the specification of a parity goal are immoral, the question about that parity goal is inappropriate if not improper, and the response is misleading if not meaningless. More likely is a continuum of orientations to the appropriateness of fertility regulation by one or another means, raising the complex problem that the means considered legitimate may be those with a high cost relative to their perceived efficacy.

The reason for emphasizing the difficulty of ascertaining from the individual the weight of the norms bearing on responses to particular questions such as tastes, and the psychic costs of regulation, is that, if those elements cannot be measured, they tend to be given whatever values are necessary to explain the observed behaviour, in effect collapsing the conceptual scheme into a tautology on those dimensions, or they are considered to be constant for the purposes at hand, effectively eliminating them from the system of variables except as verbal window-dressing.

The final problem concerning the conceptual scheme adopted by the National Academy of Sciences is the extent to which, quite aside from the foregoing objections, the scheme suffices to provide a comprehensive answer to the question of fertility as a function of age and time. The approach is oriented to the explanation of marital parity. This neglects the necessary and interdependent question of the time pattern of fertility, and particularly its most important component, the nuptiality function. While some interesting questions may be raised concerning marriage in modernized societies, from an individualistic standpoint, the extent of the impress of custom on the pattern of marriage is substantial in the cultures of developing populations.

The centre-piece of reproductive strategy may in fact not be the parity norm at all, but rather a set of time pattern norms. Lesthaeghe (1980) has drawn attention to three questions which cultures answer in different ways: when do people start reproduction, how do they space reproduction and when do they stop reproduction? Acceptance of norms with respect to these temporal dimensions of reproduction would itself have the by-product of a particular parity, as an average outcome, not in direct response to any quantitative orientation but as the indirect consequence of the time constraints themselves. It is not far-fetched to propose that the time pattern of reproduction, relative to the respondent's age and stage in the family life cycle, may be weighted more heavily than a particular population size for the family, especially if the plan is sequentially formulated.

Finally, an analytic scheme which focuses on decisions made by individuals may provide an explanation of variation among individuals in the number of children borne, as responses to particular sets of conditions, but this leaves one a long way from explanation of the aggregate outcome. Precise predictions of individual fertility from a regression equation would leave in problematic status the question of the distributions of individuals in the population concerned with respect to the variables which yield those predictions (the distribution of the population between rural and urban areas, the wage rate for women in the labour force, the level of schooling and so forth). At the individual level, these elements in the decision process must be accepted as given, but they cannot be taken for granted by the analyst with the assignment of explaining why one culture has a different pattern of fertility by age and time than another.

A MACRO-ANALYTIC MODEL OF A TRADITIONAL SOCIETY

The centre of the micro-analytic model is occupied by the individual, pursuing his or her own interests within an environment constituted of organized groups, such as the family, the community and the nation, in which costs and benefits are administered by agents of those groups to constrain the individual's actions. In the macro-analytic model, to the contrary, the group is the focus, and the requirements for survival of the group are paramount. The individual is viewed less as a decision-maker than as a servant of the society, charged with responsibilities to the group, such as the responsibility for producing replacements (in a socio-cultural as well as biological sense) for a population structure

continually depleted by mortality. The individual is programmed by group processes to fill a role in the societal blueprint. Those processes to ensure that the "will" of the group will be served are socialization (the imprinting of the individual with the societal design to the point that the individual cannot perceive a distinction between selfish interests and group purposes) and social control (employment of positive and negative sanctions by group members to cope with the consequences of incomplete or imperfect socialization). The problem is to make individuals responsive to group interests even when they conflict with individual interests. Particularly at the subsistence level, the needs of the individual must be subordinate to those of the group as a whole; the weakling or the rebel cannot be tolerated.

The model may be most realistic as a depiction of life in a small homogeneous group, characterized by face-to-face interaction, and with little contact with alternative blueprints, but that admission should not be taken to imply its irrelevance for the understanding of larger and more complex societies. In a broader sense, there is something at least incomplete if not wrong with a model which denies free will just as there is with a model in which free will is the guiding principle. A major element in the complexity of the problem of devising a satisfactory theory of social change consists of finding complementary roles to be played by these contrasting orientations.

The central feature of a traditional society is its organization by kinship on the principle of descent. Kinship is a system of categories, and associated rights and duties, enabling persons to co-operate in an orderly social life (Eggan, 1968). Through descent, the individual becomes associated with a reservoir of relatives from whom he can expect certain kinds of conduct and vice versa. Every society defines for every individual the particular others with whom he has privileges and obligations. When he needs assistance, he turns to kin rather than non-kin.

The kinship system may be considered as a solution to problems posed by the passage of time, and individual mortality. The emphasis of its functions is the identity and solidarity of the group over time, in competition with other groups similarly constituted, and the survival of the system itself. Vital events provoke modification of population composition. In particular, death produces a gap which demands to be filled. Kinship institutions are designed to cope with the implications of such modifications (Fox, 1967).

The evolution of the kinship system may be regarded in part as an adaptation to high and variable mortality. The individual life cycle begins and ends with phases of dependency. No social system would be viable without regularized arrangements by which productive adults are committed to the care of young and old dependants (as well as those temporarily dependent because of morbidity). The nuclear family is just such an arrangement. Yet the nuclear family does not ordinarily suffice. It has a disproportionate burden of pre-mature dependants in its early stages and a disproportionate burden of post-mature dependants in its late stages. The two-generational design of the nuclear family, although more viable over time than the individual, still fails to balance the resources available with the resources required, over time. A further step in institutional innovation is the extended

family, a residential design which yields an overlapping of individual life cycles, potentially perpetual, more closely resembling the age distribution of the population as a whole, and coming closer to being a systematization of the flow of resources from those who have more to those who need more. The extended family is a social arrangement to ensure transactions over time by preventing the departure of the junior generation when it becomes productive. The larger principle of descent, by analogy, provides a still more comprehensive supply of replacements when members die who were necessary for the care of others; on the elementary insurance principle of spreading risk, the descent group has greater viability than any of its constituent extended families.

The kinship system is closely linked with the question of property, that is, of resources which persist over time. Descent groups are more likely to be found if there is property, perhaps in the form of land, or a house, or a grazing or fishing site, and therefore an advantage to the kind of continuity provided by an extended family system (Goody, 1968). Descent groups control all values which persist over time, all productive and reproductive resources, including succession to titles of rank. The role of the kinship system with respect to valuables which endure is closely linked with its function as a savings bank and insurance system, institutions which transfer resources through time, and thus from those in one life cycle stage to those in another.

Associated with the centrality of time as the problem the kinship system is designed to solve is a continuing emphasis on the evaluation of behaviour in terms of its implications for persistence of the kinship system itself (Levy, 1966). This is a principal justification for the epithet "traditional". The word tends to be used to signify the absence of change (Davis, 1963). The characteristic response of a traditional society, when faced with changes in its environment, is to limit its adaptations to those which do not risk a change in the institutional structure.

Every system has a conservative potential of this kind; it is part of what is meant by "system". There is an extensive array of requisites for survival, economic, political and integrative, as well as reproductive. The societal blueprint which charts a way through the rapids is characterized by high interdependence of elements. The emphasis is on the inhibition of deviance, and on survival strategy, as distinct from maximization of success in one particular direction. The analogy is with living things, where life can be extinguished by failure in any one of many constituent parts, or processes (Farber, 1973). A subsistence society with high fertility counterbalancing high mortality is fragile, and the range of discretion is very limited. Security is sought by establishing a network of personal relations, the size of which depends on the net reproductivity of the group, extensions of the network through marriage alliances, and success in inter-group competition. In a society with a history of survival despite many disasters, the system that has persisted under such testing accumulates respect (Caldwell, 1982). Although the natural inclination of the demographer is to emphasize the reproductive aspect of survival, the highest priority should properly go to the system itself, and its capacity to reproduce itself.

The axes of family structure are generation and gender. These are categorically different in the sense that one is fixed in gender for life, whereas, given survival, one passes from

one generation to the next. (Stone, 1977, captures this point by comparing them to caste and class.) Biological characteristics of the individual life cycle, specifically a long stage of prematurity, necessitate commitment, over an extended period, of a flow of resources, energy and attention from mature persons toward the child. The biological substratum of symbiosis between mother and infant is adapted and enlarged to encompass the transformation of the raw material socially as well as biologically. The dependence of the infant implies the preoccupation of the mother and therefore her need for protection from abandonment. The root of the marriage contract is the protection of women, specialized for child-bearing and child-rearing, from abandonment (Fox, 1967). Consequent upon this primary specialization is a focus of women's activities inside and men's activities outside the household, and so forth.

With no implication of denigrating the importance of gender differentiation for family structure and fertility, the topic is set aside in this manuscript. (There are highly competent reviews, for example, Dixon, 1975, and Oppong and Haavio-Mannila, 1979; see also Tilly and Scott, 1978, for a fine treatment of changes in England and France accompanying industrialization.) On the grounds of economy of presentation, we have chosen to pursue exclusively the generational axis of the family (and thus emphasize the time dimension of the family) and leave the important questions of gender for others. One cost of this decision is neglect of the interesting ways in which the topics merge.

A society can be defined by its institutionalization of particular cultural patterns. The necessity of internalizing those patterns in the oncoming generation is second in importance only to maintenance of adult levels of participation (Parsons, 1968). The family is the conduit by which culture is kept alive. Through socialization, individuals come to want to do what must be done if the society is to persist, acquiring the skills and attitudes requisite to performance of future adult roles. Because so much of the capital of the society is its culture, the possession of the adult members of the society with which the children become endowed as they become adults, the seniority system prevails.

There is clear demarcation between successive generations. The elders are the physical progenitors of the young, they protect and nurture them during their childhood, and provide their training in the crafts, customs and morals of the group (Fox, 1967). The participation of the father in the human family rests partly on economic specialization and complementarity, but partly on the body of lore to be transmitted to the junior generation. Parents socialize children, serve as models for them, ascribe parental status to the child, and exercise control through the panoply of sanctions they command. Parental control is authoritarian and oriented to the common good as the parents perceive it. The household is the centre of strictest inequality. The training of the younger by the older generation for adult roles reinforces the structure of authority more generally (Levy, 1966). Intergenerational authority and obedience are generalized by age. Where one sees one's contemporaries as individuals with whom a friendship relation can exist, the elders are representatives of the system being imposed from above. The emphasis on discipline and supervision is further justified by the formidable task of control in a society in which the age distribution is

disproportionately young. The equity and reciprocity which leavens the system is the expectation of rising from the bottom to the top of the authority system with the passage of personal time.

A traditional society has a low level of technology and a low level of productivity. Beyond the content of the culture, capital consists of land and, in a sense, women (since they represent not only labour but also the means to produce future labour). The scarce factor of production and the main source of energy is human labour. The only way to increase production is to increase numbers. Accordingly, no restriction of fertility is to be expected under normal circumstances.

Those responsible for the care of their children before they become productive may be more impressed with the costs than the benefits during that phase of the nuclear family life cycle. On the other hand, a child costs little in a poor family, and there are many helping kinfolk. Children are raised frugally and put to work early. Caldwell (1982) depicts such a family system as exploitative in the sense that the benefits of fertility accrue disproportionately to those who make the reproductive decisions, whereas the costs are displaced on those without decision-making power, the women and the children. Accordingly, he infers that it is economically rational to aim for fertility without limit. The validity of the inference depends on whether the patriarch is viewed as acting in his own interests or in the interests of the group for which he is responsible. Moreover, what is economically rational depends on whether there are resource limitations other than the size of the labour force, whether there are production costs associated with the size of the enterprise, and whether there may be problems of internal conflict and feasibility of social control associated with the size of the ratio of the junior to the senior generation. Perhaps a more defensible proposition would be that a bias against limiting fertility derives from the ability of the decision-maker to secure many of the advantages and avoid many of the burdens of high fertility.

If one regards each society as manifested in a particular cultural design, then those systems which have survived (and are accordingly available for investigation) must have been sufficiently fertile, whatever the reason, to match the forces of mortality to which they were exposed. Institutional structures compete for survival. Those with a higher intrinsic rate of natural increase are selected relative to those with a lower rate. Cultural selection parallels genetic selection: the element in each is a unit in the form of an instruction (the gene and the norm). The evolution of cultural forms obeys rules which are analogous to those governing the evolution of the genotype, although the potential pace of the former substantially attenuates the fruitfulness of the analogy. Demographic generalization contributes to the most fundamental aspect of sociological thought: the basis of survival or extinction of types of institution and society (Davis, 1959).

The demographic transition is described as a movement from an equilibrium of high mortality and fertility to one of low mortality and fertility, with an intervening episode of disequilibrium characterized by growth, because mortality decline tends to precede fertility decline. Yet the confident description of the high equilibrium remains out of empirical reach because the context is contrary to the requirements for data collection. Its empirical plausibility rests on the insight

that the average rate of population growth for the species since the beginning of time must have been approximately zero. That could follow logically from a model in which positive growth rates for some populations matched negative growth rates for others, or from a model in which positive rates for some periods were matched by negative rates for others. A general proposition is that, if the characteristics responsible for natural increase, within any subdivisions of a population, are transmitted familiarly (whether genetic or socio-cultural), the rate of natural increase for the total will tend to converge toward that of the subdivision for which it is highest. That would suggest a population growing under normal circumstances, but checked periodically by outbursts of high mortality, as population size exceeds the limits of its ecological niche. Yet we know so little about population history in detail that it is only discreet to keep our minds open to other possibilities (such as an institutional response in the form of preventive checks, where fertility as well as mortality plays an equilibrating role, as proposed by Wrigley and Schofield, 1981).

The kinship system has so large a stake in the maintenance of its numbers that there are strong pressures to fulfil parental obligations even if those assuming the burdens of the bearing and rearing of children would otherwise regard them as outweighing the prospective benefits. The family has a contract with the kinship group to produce new members, a most important contract because it serves the continuity of the group. The obligation to produce others, to whom one owes extensive and often burdensome obligations, requires considerable social reinforcement (Goode, 1968). Given the energy and attention devoted to teaching the joys of parenthood and the blessings of giving birth, it seems appropriate to regard this less as a celebration of the obvious than as evidence that, in the absence of such social pressure, fertility is at risk of becoming inadequate to the interests of the group.

Although adequate reproduction is evidently necessary to group survival, it is clearly insufficient. The success of one cultural form in competition with others requires that the system be viable in many other respects. The competitive position of a particular institutional structure depends on its economic and political vitality. If productivity is low, the relative strength of two systems depends heavily on their respective aggregate numbers. In this sense there is selection for those factors associated with larger population size. Power helps to determine the resources over which a particular social system has domain. Prior to the emergence of more embracing political forms, numbers were the principal guarantee of security from attack. Yet the effective strength of a society depends on solidarity and order as well as numbers. In an uncertain world, fragile systems stress order and continuity.

A larger population size can be achieved not only through fertility but also through alliances, and military success. Probably all societies use additional modes of entry, beyond fertility, to increase the size of the group—by marriage, capture, recruitment, and absorption (Goody, 1968). Just as the exigencies of fertility and mortality may lead to population decline and group extinction, so they may lead to population expansion. The larger the group, the greater the organizational requirements. Internal strains may become more of a threat than competition from outside, particularly

given the likely circumstance that effective leadership is rare (Goode, 1968). Large memberships are hard to hold together and hard to administer.

Within a general context of strong pressure on the members of the society to reproduce, there may be more or less tolerance of exceptions, safety valves in the face of short-term emergencies. For example, child neglect, if not infanticide, may be a reluctantly accepted response in worsening conditions. From the standpoint of group survival, dependants are the most expendable since they can be replaced. In contrast with contraception and abortion, infanticide permits selection of children on some quality criterion, it is not harmful to the mother, and it requires no foresight. If one were to characterize "population policy" for a traditional society, it might take the following form: each group attempts to maximize its size, perhaps more on political than on economic grounds, as a general principle; the form of policy effort is sanctions against those attempting to limit fertility in normal circumstances, with tolerance of fertility regulation when resources become over-extended. Should the fertility which is the outcome of the system of reproductive norms turn out to be higher than mortality, and the resource base permits, the group may grow and expand its area through warfare. Increase in mortality would follow from growing pressure on resources or from defeat in war. Should fertility, for whatever reason, be lower than mortality, the group is extinguished (Caldwell, 1982).

THE DEMOGRAPHIC TRANSITION

The demographic transition began as a description of the modern history of Western populations in stylized form, but became elaborated into a theory, predominantly of the correlates of fertility decline. In the latter guise, it is an application of a theory of modernization, and thus a prediction of the demographic consequences of modernization for any society. In the rest of this essay, the question is pursued for societies currently classified as developing.

Modernization theory is at its strongest as a description of two polar equilibria. On the one hand, there is an agricultural economy with a strong kinship system and a weakly developed political state, at a low level of productivity, and with constricted spatial and temporal horizons; on the other hand, there is an urban industrial economy with a nuclear family and a well-developed nation-state, at a high level of productivity, and broad horizons. It is only to be expected that a style of thought oriented to an integrated system would be at its best describing the compatibility of various structural features of a system in equilibrium; the many accounts are rich in their portrayals of interdependence (Cohen, 1967).

Modernization theory explains a process of temporal change in a particular society. But coexisting societies, each providing part of the environment for the other, may be at different stages in the process, and it is unlikely that the transition for either is unaffected by that circumstance. Those in the vanguard work out new solutions to new problems, increase their economic and political power, and have the opportunity to impose their will on the late-comers. Without further specification, it seems clear that at least two models are required, one appropriate to those societies in which

modernization was invented, and the other appropriate to those on which modernization was to some extent imposed. The conceptual difficulty is that, until recently, almost all of the documented experience on which one could draw for the currently developing societies was that of societies which were in the vanguard of modernization.

The problem is more than that of the consequences of living in a world characterized by massive differences in economic and political power. The position is plausible that modernization was not a chance invention, but rather depended on peculiar characteristics of the vanguard societies. Consider England as the pioneer, apparently not a society showing gradual progress from a peasant form towards industrialism, but one that, as far back as worthwhile records go, was based on individual rather than corporate ownership (Macfarlane, 1978), with a system of fertility regulation keyed to nuptiality and a bilateral kinship system, with substantial emphasis on individual autonomy, and a reasonably effective nation-state (Wrigley, 1978; Lesthaeghe, 1980).

Most accounts of modernization pay special attention to what happens to family relationships during the passage from one equilibrium context to the other. The transformation of the character of the family in the course of economic development has been well delineated verbally. Economic development is achieved by specialization, by structural differentiation. Particular organizations, designed to do one thing well, compete successfully with the all-purpose kinship system. Activities once carried on inside the home are relocated outside. The family is replaced by specialized units of production and finance. It becomes stripped down to an organization itself specialized in the residuum of child-rearing, the sole activity for which some kind of family design (in the sense of a generational structure persisting over time) is probably indispensable. Adults acquire extra-familial roles which compete for their attention with parental roles. Child labour laws and compulsory education reduce the value of children as cheap manpower. Some of the family responsibilities for political and financial security are assumed by the State.

In explaining the transition from a traditional to a modern society, much effort has been expended on measuring particular facets of the two polar systems, and locating particular populations at one or another point along the continuum, for example, with respect to urbanization or education, for the purpose of attempting to explain the movements of demographic indices. These empirical exercises typically adopt a multiple regression format. The customary outcome is clear congruence at the extremes, but little success in linking change in one or another demographic index over a particular time interval with change in one or another quantified socio-economic variable over the same interval. While there are immanent explanations for statistical failure, such as the cross-sectional character of most of the exercises, and the necessity for resort to crude and unreliable measures, perhaps there is a problem in principle: how can one devise a mechanistic test for a structural/functional theory?

A pervasive difficulty has been the general tendency to keep in separate compartments the demographic processes, on the one hand, and the social and economic processes, on the other. In consequence there is continuing confusion

between theories which posit a sweep of social change, to which demographic variables respond, and those which treat demographic change as an external force to which the society responds. Much of the discussion of the urgency of achieving fertility decline as a condition for economic development falls in the latter category. Two polar positions have been characterized: population growth is an independent variable which determines economic growth; population growth is a dependent variable responding to change in material conditions (Gregory and Piché, 1982).

An important subset of research on the link between modernization and fertility decline, if only because of its sheer bulk, is what is known as differential fertility analysis. Aggregate considerations of the degree to which a society is modernized are translated to the individual level, so that one attempts to ascertain whether an individual is located in a traditional or in a modern situation. When a society undergoes a process of modernization, one facet of that change is the movement of individuals from less to more modern locations. On the premise that modernization promotes lower fertility, one expects that those in the more modern locations should show lower fertility. Probably the most important indices of modernization at the individual level are those associated with modes of production (education, occupation and rural and urban residence) and their associated rewards. The rural life is symbiotic with a kin monopoly on the range of social activities; children form part of the family labour force. Urban contexts are associated with more expensive education and fewer employment opportunities for children. The role of the family is tapped by various attempts to determine the extent to which the individual interacts with unrelated others, but primarily by inference rather than by studying systems of interrelationship. To date, differential fertility analysis has, in our judgement, contributed little to the study of the relationship between fertility and modernization because it is resolutely individual-oriented, and focused on variables which are primarily labels for black boxes within which the reasons for their predictive power remain hidden.

STYLES OF RESEARCH

In the foregoing, two contrasting styles of theorizing have been depicted. The micro-analytic model was oriented to individual behaviour. This style of research is often called elementaristic, because its characteristic approach is to look at the separate elements in a situation, and the relationships among the various dimensions. It is essentially a mechanistic view, in the tradition of Comte's positivism. (Comte's first name for sociology was social physics.) For the macro-analytic model, the theory corresponded more to an organismic view that the basic social reality consists of interrelated wholes which are at a higher level than the individual and his acts in the sense that the social structure must be explained in its own terms, and cannot be reduced to the actions of individuals (Martindale, 1965). The implicit assumption is that the appropriate research strategy is not to ask the individual about his or her motivations, in order to understand behaviour, but rather to determine the purposes of the group of which the individual is a member. Foremost among these

is the maintenance of those institutionalized characteristics that constitute the identity of the group.

The brief sketch of modernization in the preceding section can be considered an organismic approach. Modernization is a structural/functional theory. It concerns the transformation of institutions, that is, of those normative complexes which provide the "rules of the game" for the conduct of classes of activity. The central research question becomes the feasibility of observing those rules and changes in them.

The conditions for applicability of the micro-analytic orientation are differentiation, individualization and quantification (as with monetization). Monetized calculations are made feasible by the analytic separation of ends. The individual's acts can be measured with respect to functionally specific aspects or elements. This is a characteristic of a highly differentiated (modernized) society. Economics arose as a consequence of institutional change: the increasing tendency for atomistic units in an impersonal exchange system to acquire a livelihood through market sale (Frankenberg, 1967). The process of secularization is associated with a progressive extension of the domain of economic rationality and the sphere of individual choice. The model places the individual ideologically at the centre of the universe. Survey research is a product of modern society, especially adapted to this style of thinking because individuals with the experience of life in a differentiated monetized market economy know how to respond to questions which call for answers abstracted from their conceptual environment.

In the macro-analytic (organismic) tradition, the unit of analysis is not the individual act but the normative instruction. Norms constitute the charters of groups. The criterion for membership is acceptance of their implications. Their violation elicits response from other members of the group. The argument and the explanation shifts to the group level because norms are group properties. Norms are standardized solutions to decision problems, directing individual behaviour away from what is perceived to be prejudicial to group interests (however attractive to the individual in the abstract) and toward what is perceived to contribute to group interests. The very notion of membership in a group implies receptivity to normative pressure, that is, the willingness to incorporate group interests in individual decisions. One pays dues for the privileges of group membership. When individuals come together as a group, each surrenders certain rights and resources for collective use, in return for whatever the group has to offer (Namboodiri, 1980). The costs of deviations are sanctions administered in part by other members of the group, but also by oneself, to the extent that group interests have become internalized. When an individual confronts objective reality, the response is conditioned by the norms; they are in this sense part of that objective reality.

In a traditional society, relationships among individuals are multifaceted. One does not interact with another on a single dimension, but on all dimensions simultaneously. The interrelationship of aspects of the system provides a special kind of constraint, captured in terms like the "web of relationships" and the "cake of custom". Norms play their primary role in adjudicating among directions of action which have more than one outcome for more than one person. Every act in a traditional society is a socio-cultural act, embracing all aspects of the system of relationships among

the parties concerned. Although an investigator may be able to perform the analytic task of abstraction of one facet of an act from the rest, it cannot be inferred that the parties involved are capable of so doing. The interpenetration of facets of each act is accompanied by acceptance of the cultural design *in toto* (Jones, 1982). Primitive economic systems lack impersonal relations. Labour is a social service with its reward calculated in terms of the total social situation rather than its immediate economic elements (Nash, 1968). The problems of understanding such a system have their analogue in biology: a common contention is that the development of biology has been impeded by attempts to extend to the complex and integrated biological systems the reductionism that has served physics so well. The systems are living: many requirements must be met minimally rather than one goal achieved maximally.

The conceptual conundrum at the heart of the problem of devising a theory of modernization derives from the extent to which the various facets of the modernization process represent transformations of socio-economic reality in the direction of amenability to treatment by means of a mechanistic model. They include monetization (the attachment of numerical values to goods and services as they pass through a marketplace), functional specificity and universalism (permitting one aspect of an object or a person's services to be considered independently of other aspects) and the growing tendency to regard the interests of the individual as a more significant test of the quality of a social system than any collective interest. Economics, and the model which epitomizes an economic style of thinking, has gradually been made feasible by modernization. McNicoll (1978) comments that "the structure of society that formerly held people in suspension receded, leaving individuals to struggle in a harsh neoclassical world".

If one takes the position that a mechanistic model is insufficient for the task of explaining a process of structural transformation, then the question must be confronted of the formidable problems involved in observing and identifying the norms which constitute the units of structural analysis. Having averred that actions depend in part on the presence of norms, either internalized in the actor or otherwise given effective force by the actor's recognition of those positive and negative sanctions available to interested others in response to the act, one must address the question of how to detect those norms. Hawthorn (1970) takes the position that, since norms exist only in the minds of individuals, we must get at them by asking people questions; only in that way can we infer that an activity is governed by a rule. Thus one observes the act, and achieves an understanding of it by evoking the actor's description of his mental state. While the argument seems unexceptionable, the problems of practical research following its guide are substantial.

Inference of the presence and character of a norm from an actor's explanation may be simply naïve. If the individual is reporting the acts he or she has engaged in, that account is suspect because of the presence of norms: the tendency is either to deny an act which may be judged as improper, or to misreport its character and circumstances in such a way that it appears to have been proper. Similarly, the actor is likely to present a moral image, in providing a reason for any act, which is bent in the direction of the normatively acceptable.

Quite aside from such misstatement, it is the very nature of norms that they are so woven into the fabric of life that the actor is unlikely to feel the need to mention those things that are understood because they are self-evident, and tend to omit reference to knowledge which is shared by everyone within his acquaintance (Bourdieu, 1976). Inference must hurdle a barrier of silences and elliptical statements. The actor may be literally unable to articulate a sense of the system of which he is a part. Norms are at their most effective as directors of individual behaviour when the individual cannot perceive the distinction between self-interest and group interest.

If the actor is not asked what norms constituted conditions for his acts, because of the expectation of incoherence or bias in the response, it is still possible to observe what people do and what they refrain from doing, inferring from uniformities of behaviour the presence of norms which would make them explicable (Levy, 1952). Yet if norms are inferred rather than observed, they may permit a more compelling account of the situation but they are not really part of the analysis, unless one is prepared to reason circuitously. Where the evidence for an explanatory variable is the behaviour it is invoked to explain, the relationship is scientifically impotent because it is irrefutable.

Sociologists are convinced that there is a level of social reality, not directly observable, which affects the behaviour of the individual. In this sense, sociologists are normative determinists (Hawthorn, 1970). Rather than trusting individuals to perceive and report the norms which constitute their social selves, or falling into the tautological trap of inferring norms from behaviour, the researcher would seem obliged to investigate the properties of the system of relationships in which the actor is a participant. If, as we believe, the principal source of fertility change over time and fertility differences among cultures is variations in the institutional context, then we must learn to study institutions, as normative complexes. The first step in that task is recognition that the appropriate source of evidence is at the level of the group, not the individual.

The difficulty of establishing canons of verifiability in the identification of norms, as group properties, from other properties of groups, leads to a familiar outcome. Those variables in a situation requiring explanation that are amenable to measurement by straightforward procedures seem for that reason to be more real than those for which the conceptualization and methodology are primitive; cultural variables tend in the circumstances to be either ignored or treated as illusion or rationalization. Like other empiricist disciplines, demography has the characteristic of permitting the feasibility and availability of data to dominate the process of conceptualization. We suffer from a tyranny of the quantifiable.

The preceding account is not at all intended to lead to the conclusion that a choice must be made between one or the other style of research (so that the issue is which one). Nor would it be satisfactory to conclude that one approach serves best in the traditional context and the other in the modern context, since such an outcome would defeat the purpose of studying the continuum of transformation from one into the other. Neither approach is sufficient in either context. In a traditional society, it may be broadly true as a first approx-

imation that individuals follow the norms set for them by the society in which they live, but their actions are nevertheless influenced also by their appreciation of their personal interests (Wrigley, 1978). Likewise in a modern society analysis would be impoverished were mechanistic arguments to remain uncomplemented by the consideration of structure: of agreements and rules (Arthur, 1982). The present writer is far from being able to present a coherent statement of a strategy for resolving the dilemma, beyond the strong conviction that we will find it much less productive to try to enrich micro-analytic models by providing normative footnotes than to begin with a structural framework, in which the processes of individual decision-making are embedded.

MORTALITY DECLINE AND FAMILY STRUCTURE

In the rest of this account, we propose to consider some aspects of modernization with direct implications for family structure (and particularly for intergenerational relations) and thus for fertility. In this section, we discuss some consequences of mortality decline for family structure, treating mortality decline as an initial dimension of the modernization process, exogenous to family structure and behaviour. In following sections, we examine the effects of the creation of various specialized institutions competitive with the family in performance of its traditional functions, first with respect to the adaptability to external change within the constraints of traditional family morality, and then with respect to change in the norms themselves in response to growing strains on role relationships in the family system. The final section contains a sketch of some policy directions suggested by the line of analysis.

The focus of the account is what we have called the intergenerational contract (Ryder, 1976). This contract specifies the flows of goods and services, broadly conceived, between the senior and the junior generations in a family, over the course of their respective overlapping individual life cycles. Throughout the life cycle, the individual who survives moves through phases of being a net consumer, then a net producer, and finally a net consumer again, with interspersed episodes of dependency associated with illness and unemployment, for example. The family design can be considered as a solution to this problem of the consequences for the individual of the passage of time. The intergenerational contract serves the purpose of achieving resource transfers from those who are net producers to those who are net consumers. As a first approximation to its justification, a norm of equality prevails, so that those who have more help those who need more, together with a norm of generational reciprocity, necessarily asymmetrical because of the ever-changing personnel over time (Hill, 1970).

The intergenerational contract has several idiosyncratic aspects. In the first place, the newborn are parties to a contract the terms of which they are unable to bargain about. The contract is drawn up by the senior generation, on the basis of legitimate expectations, but the fulfilment of the contract by the junior generation is conditional on the success of efforts at socialization and social control of them by the senior generation. In the second place, each individual's lifetime is encompassed by two such contracts, one with the

senior generation in his family of orientation and the other with the junior generation in his family of procreation. Long-term justice from the standpoint of the individual is achieved by writing the contract he initiates in the same terms as the contract written for him by his father, provided of course that there is the same relationship between expectation and fulfillment in the two cases.

Consider a highly simplified model based on the following assumptions: the individual is a net consumer up to age 15 and beyond age 60, and a net producer in the intervening years; the length of generation is 30 years. Any particular nuclear family incurs a debt during its earlier durations, when the junior generation are predominantly net consumers, and acquires the resources to pay off the debt during its later durations, when the junior generation has advanced into its net producer phase. The earlier durations for the nuclear family are also the time of movement of the parents of the senior generation into dependency. The obligation to provide a flow of resources in their direction may be considered as equivalent to payments for the property they transfer at their death.

In a subsistence economy, the flow of resources from net producers to net consumers must balance period by period. Since any particular nuclear family has a debit phase preceding its credit phase, the implication is that a flow of resources is required from older families to younger families. This is a primary purpose of membership in a descent group. Note that the argument is not appreciably changed if the family has a vertical extended rather than nuclear form. The pattern may be described as one of older families lending to younger families in the same sense that parents within each family lend to their children. The complement of the direction of resource flow is the age-hierarchized authority structure. Note, however, that there is an asymmetrical quality to the lending pattern: the debt is repaid not to the source of the loan (the preceding half-generation) but by lending in due course to the next half-generation.

If this is a plausible model, what can be said about the direction of net resource flow between the generations? From a familial standpoint, the direction is from earlier older families to later younger families. Within each family, on the other hand, consider the stage of the family life cycle in which both the senior and the junior generation are in the net producer ages. Cross-sectionally, the direction of net resource flow is from the junior to the senior generation. It would seem unreasonable to describe this as exploitation based on seniority, since the family, of whom the senior generation are the agents, needs help in repaying an obligation incurred when the junior generation were dependants.

This asymmetrical intergenerational equilibrium is disturbed by mortality decline. For families in the earlier marital durations, mortality decline means a higher ratio of net consumers to net producers than formerly, and thus the incurring of a larger debt. But mortality decline also means that there are more families in the earlier than in the later marital durations than formerly, and thus a smaller source of borrowing. This is a familial version of the well-known proposition that an increase in the growth rate produces a younger age distribution. One structural implication may be a weakening of kinship bonds.

Now consider the consequences of mortality decline for the net balance of consumer and producer person-years during the course of the life cycle of a particular family. If one takes the view that children in the second 15 years of life contribute to the family their net product in repayment of the family debt incurred when they were in their first 15 years of life, mortality decline has the consequence of increasing the person-years of the junior generation in the net producer ages relative to their person-years in the net consumer ages (since the slope of the survival curve varies inversely with the level of mortality). Moreover, the increase in parental survival defers the time when control of the family property is passed to the junior generation. This may increase the length of the period during which the junior generation contribute to the needs of their families of orientation.

With the proviso that the traditional intergenerational contract remains in force, specifically that the junior generation contribute to the needs of their families of orientation during their initial producer ages, the effect of mortality decline from the viewpoint of the senior generation is to make each child a better investment, and thus to imply no motivation to reduce fertility. From the standpoint of the junior generation, the situation looks very different. In preface, note that there is equilibrium in a dual sense when mortality is high and fertility is at the replacement level. The net reproduction rate of unity can be thought of as ensuring, on average, that each role in the preceding generation will be filled in turn by a member of the succeeding generation. The less obvious kind of equilibrium is temporal: the age of the father at death is in close correspondence with the age of the son at marriage (Wrigley, 1978). Both kinds of equilibrium are disturbed by a decline in mortality unaccompanied by a decline in fertility: the numerical representation of the generations, and the time table of overlapping life cycles. To get a sense of the numerical magnitudes involved, we exploited a model presented elsewhere (Ryder, 1975(ii)). A comparison was made between an equilibrium situation in which high mortality was matched by replacement fertility, and a disequilibrium situation with the same fertility but substantially lower mortality. In the equilibrium situation, there would be 1.2 surviving sons of average age 23 at the father's death; in the disequilibrium situation there would be 2.5 surviving sons of average age 33 at the father's death. The strain on the system of respective rights and responsibilities from these two changes is evident.

The obligations of sons to fathers can be generously met, because there are more of them, and the father's control through ownership of the family property lasts longer. On the other hand, the ability of the father to meet his obligations to his sons is sharply attenuated (barring a substantial improvement in resources). The essential reason there is no stimulus for the father to reduce fertility in anticipation of such a situation is the assumption that the costs can be shifted to the sons. If the inheritance takes the form of land, there is either subdivision so that each son starts out with less than his father did, or some of the junior generation is disinherited. Moreover, the delay of the time of the inheritance means that the transfer does not occur until after the junior generation have accumulated a substantial debt position in their families of procreation.

Although the size of the family of procreation of the senior generation is enlarged by mortality decline, its dimensions from the standpoint of relationship between person-years of net consumers and net producers are little affected so long as the intergenerational contract remains intact. The principal manifestation of population growth in any event is not the size of a family so much as the number of families. Moreover, the increase in the number of families is disproportionately of those in their earlier debtor phase relative to those in their later more productive phase. The focus of the strain on family structure caused by mortality decline is the inability of the father to provide the same beginning for the families of procreation of his sons as he was provided, and therefore the tenuousness of his hold on his sons and on their product as young adults.

Two directions of demographic response by the junior generation are plausible. On the one hand, there may be migration. Fulfilment of the traditional intergenerational contract is prejudiced not only by the inability of the senior generation to justify their authority by fulfilling their part of the bargain but also by the attenuation of bonds as a function of distance. On the other hand, there may be a delay of marriage. This is a further cost imposed on the junior generation, and has the significant corollary of coinciding with a life cycle stage when the productivity and power of the junior generation is increasing and that of the senior generation is decreasing.

In summary, mortality decline sets the stage for generational confrontation. By way of footnote to this section, we believe it would be highly worthwhile to develop models of family structure, employing alternative assumptions about mortality decline, production and consumption as functions of age, and particularly alternative forms of intergenerational contract to replace the sketchy suggestions of our verbal account. Some interesting work of this kind is now being pursued by Willis (1982).

INSTITUTIONAL COMPETITION

Because we believe that the assumptions about family relationships conveyed by the sense of the intergenerational contract are the primary determinants of fertility, our account of modernization is focused not so much on fertility itself as on those assumptions, that is, on the system of family morality. As institutions competitive with the family arise, and economic and political markets become more effective, the traditional system is capable for the time being of adaptation without modification of its premises. Nevertheless, the points of structural strain within the traditional family experience progressive pressure, the alternatives outside the family become more attractive to those members who are feeling increasingly disadvantaged, and the system itself is confronted with a new morality focused on the individual.

Granting the effectiveness of socialization and social control in maintaining the traditional family relationship system, the structure must always have been subject to strain. For example, this would be associated with intergenerational conflict, a ubiquitous problem derivative from the asymmetry of relationships implicit in the overlapping life cycles of

individual members, and particularly the shifting of power from the father in his declining years to the son progressing into full maturity. As described in Caldwell (1982), the system is one in which the older generation is in a position to exploit the younger one, given the lack of alternatives for the latter; exploitative systems carry the potential for conflict. The disintegration of the family of orientation with the death of the parents provokes a struggle for succession and property allocation among brothers, reflecting the competing demands of the families of procreation of each.

In the process of modernization, specialized institutions are created which compete with the family in the sense that each performs more efficiently a particular function previously performed by the family or the kin group. These institutions arise in many spheres: the economic functions of production, finance and distribution, the political functions of governance and provision of security from external threats and internal threats, the education of children, the care of the sick and elderly, and so forth. Industrialism is essentially a system for enhancing productivity by exploitation of the division of labour. Units with specific tasks are highly differentiated. Furthermore, firms are more efficient than families because they have much more flexibility with respect to both the number of members and their selection.

As the family is progressively displaced by more specialized institutions, the individual is in a position to compare the relative attractiveness of family and non-family opportunities and assistance. The father is progressively less likely to be the employer of the labour of his sons as a labour market develops (Smelser and Halpern, 1978). The shift from father/son to employer/employee relationships in production transforms authority relations within the family. Parental authority is eroded by the separation of family and workplace. The sanctions available to the father to maintain the authority structure are reduced. The individual shares allegiance between the family and other organizations; he has less need for membership in the family. The marketplaces created with respect to particular functions are based on exchanges with individuals. The employer makes a contract with the individual, emphasizing initiative and self-reliance, themes contradictory to the way the family works (Caldwell, 1982). Role relationships are established and conducted on principles of efficiency, with individuals rewarded for specific contributions. These new role relationships infiltrate the family and are generalized to the conduct of relationships within the family.

The new opportunities provided by the presence of a labour market may for a time be exploited by the family within the framework of the traditional family morality, as a more efficient way to produce part of the needs of the family. The key question is whether the father can claim the wages for the son's labour for family purposes. There are various alternative situations. In the first place, the father may be the employer. When the family farm creates produce for sale, the patriarch is the owner and employer, and the income from this activity is under his control. If the son works for a wage, part-time or full-time, for a non-family employer, the stage is set for a struggle between son and father for control of the son's income. The son may work for wages with an outside employer but continue to live at home. In this case the

income at least passes through the son's hands, and he may be reluctant to relinquish all of it to be disposed of by the father in the interests of the family (as the father perceives those interests), but the son is in a weak position because he remains a recipient of domestic services. Income helps to determine the relative resources over which each family member has some immediate control, and thus the relative power of family members. Finally, the son may work for wages with a non-family employer and also live in another household. In this case the question would be the extent to which familial obligations still carry some weight, and the extent to which the son continues to regard the family as a potential source of future help in an emergency situation.

What is the strength of the claim that the father has on the income of the son? In the first place, there is the son's stake in the inheritance. The patriarch is the steward of the land, the ancestral family property. The question may be particularly acute if there are brothers. Brothers are socialized to rivalry with each other rather than with their father. Sons will be less likely to rebel if there are rivals for the inheritance. In the second place, the threat of disinheritance may be reinforced by the threat of ostracism. The question in this case concerns the availability of alternative opportunities for the son, that is, whether the son has continuing need for the family connection. In a society dominated by kinship considerations, the individual without family support may be hard placed to locate an economic niche. In the third place, the agreement to hand over control of one's income to the head of the family is a congenial custom because of the *quid pro quo* when the son becomes head. The son expects his children to treat him the way he treats his father (Caldwell, 1982). Underlying all these considerations of personal interest is the effectiveness with which the son has been socialized to regard parental control over income as right and proper, and obedience as the mark of a good son.

One justification for the form of the intergenerational contract is that the older generation owns the sources of production: land, knowledge, skills and contacts. The contribution of labour by the junior generation until their father's death is a way of buying that property. The basis of respect for authority is that the older generation has what the younger generation needs; it is undermined when the younger generation is exposed to alternatives which are more attractive or less demanding. Although the father initiating the contract may want to make it equitable in relation to the contract visited upon him by his father, times change, and the social support for the earlier kind of relationship may have evaporated. Moreover, the enforceability of the contract depends on the options available to the junior generation, and they are likely to be broadening substantially over time.

The reproductive strategy, and the risks associated with that strategy, depend on the economic level of the family. For the poor, economic survival is the issue, and the emphasis is necessarily on the minimization of losses from day to day. Poverty forces households to disinvest in their future, and thus in the future of the children. Children are insurance against various kinds of misadventure. With high risk, and ineffective alternative institutions for assistance in coping with risk, the insurance value of children may be an overriding incentive for unrestrained fertility (Cain, 1982). Those denied access to the rewards of the modern sector are forced

to view the family as a survival mechanism in which children are essential assets (Ratcliffe, 1978). Family relationships may represent the only source of help in periods of ill health or unemployment; the family with no or few children is perceived to be vulnerable. Only with the development of alternative institutions of employment and social security, and the growth of confidence in them, will the poor exchange the fertility strategy for alternative options (Schnaiberg and Reed, 1974). Nevertheless, the risk of that strategy for the poor is evident: sons in the lower social strata have little to lose if they choose to rebel against their elders.

If, on the other hand, there is sufficient productive surplus in the family to permit the option, the father may attempt to increase the returns from the junior generation by investing in their education. The capital market for formation of human capital in the child is the family. The strategy implies not only larger expenditures but also maintenance of the child in a non-producer status for a longer time. Children are worthwhile investments from the parental standpoint if they remain responsive to the contractual obligation to contribute at least part of their income, once they begin working, to the parents. The likelihood of that depends in part on the extent to which the fathers are viewed as having a substantial role in making the new opportunities available. The evident risk is that the one-sided contract may be abrogated by mobility and individualism.

In the process of modernization, there is increased demand in the labour market for children in human capital. Since the educated are rewarded more than the uneducated, it is tempting for parents to educate their children in order to tap this new resource for the benefit of the family. Yet it is more likely that the pressure for education of the younger generation comes from outside rather than from inside the family. From a societal viewpoint, education provides an upward ladder for the gifted, and a key to national economic growth, it has a redistributive function to further social justice and it provides an electorate with education in responsible choice. Schools make citizens out of family members, teaching individuals how to act for the good of society. Moreover, if the young are kept out of the labour market, either from considerations of humanity or because they are perceived to be competing with their elders for wages, the social problem of idle youth must be coped with. In every society, those in the gap between childhood and adulthood pose special problems (Gulliver, 1968). The school provides a reasonably effective agency of social control (Smelser and Halpern, 1978).

The literature on the relationship between education and fertility is extensive and rich. Education broadens horizons spatially and lengthens them temporally; it reduces uncertainty, and brings a larger array of costs and benefits into the personal calculus; it provides one with the possibility of enjoying a wider range of pleasures, in particular causing non-familial goods to be evaluated more highly. For the prospective parents, this increases the attractiveness of non-parental relative to parental pursuits, or, otherwise said, raises the opportunity cost of child-bearing. Parenthetically, too little attention is paid, in the statistical analyses of the relationship between fertility and education, to its distinctive significance for the two generations involved. Most analyses stress that education makes the individual receiving it a

different person with respect to his or her reproductive decisions, but omit from the account the implications for fertility of the parent who pays for that education.

Education of the junior generation is a subversive influence within the family. Boys who go to school distinguish between what they learn there and what their father can teach them. The structure of control in the traditional family is legitimized in part by the fact that the father possesses the knowledge the son needs for his future. The reinforcement of the control structure is undermined when the young are trained outside the family for specialized roles in which the father has no competence (Levy, 1966). The young become spoiled in the sense that they do not want to do unskilled work, and their parents are apprehensive about asking them to do it. Education makes children superior to parents: they have greater access than their parents to the new key to social status. Social change differentiates generational milieux. History pulls parents and children apart.

Discussion of employment opportunities for the junior generation outside the home casts the argument in terms of a struggle between the father and the son. But there is another struggle going on, that between the family and the State for the allegiance of the individual. The society has interests in the rational allocation of human resources to serve aggregate economic and political ends, and expresses those interests by substituting individualistic for familistic principles in role assignment. Political organizations, like economic organizations, demand loyalty and attempt to neutralize family particularism (Kanter, 1978). There is a struggle between the family and the State for the minds of the young. Parents who may want their children to work are forced to send them to school, and they are prevented from neglecting and abusing their children. The school is the chief instrument for teaching citizenship, in direct appeal to the children over the heads of their parents. The school serves as the medium for communicating State morality, State legal tradition, and national cultural and historical myths. The attainment of universal schooling, according to Caldwell (1982), is the principal force for change in intergenerational attitudes. Compulsory education itself is tantamount to a rewriting by the State of crucial elements of the intergenerational contract.

In discussion of the competition among institutional forms for commitment by the individual, a general theme is the distinction between association based on the principle of descent, and association based on the principle of residence. In broadest terms, the descent principle is responsive to the problems of time, ensuring the continuity of the socio-cultural design for survival from generation to generation, whereas the residence principle is responsive to the problems of space, ensuring optimal adaptation to the environment. The strength of the descent system is preservation of structure over time, through control of collective property, through warfare and through performance of collective ritual. To a member of a primitive family, its property is the source of livelihood, its elders the high government, its ancestors its gods and its young men the defence and the source of support in old age. The individual becomes a member of the descent group by virtue of birth, is socialized to accept obligations to that group and receives from it the resources needed for individual survival.

As societies evolve, a new definition of social membership

becomes ever more prominent, informed by the advantages of contiguity. The descent group declines in importance when membership no longer provides rights in the means of production, when the function of defence is served by a centralized political system, and when mobility impairs the relational system (Goody, 1968). Political development is associated with the development of the residential community. Community is the generic designation for groups organized on a predominantly localized basis. Community organization provides individuals with opportunities for social intercourse, more abundant subsistence through co-operation in productive activities, insurance against temporary adversity through mutual aid and protection through numbers. The community, as a network of face-to-face relations, is the primary seat of social control. The ultimate inducement to social conformity is the threat of ostracism from the community. The residence principle is continually open to empirical verification, receptivity to innovation, and the allocation of resources on economic principles. Immediate survival on a day-to-day basis is achieved by coping with the environment through joint utilization of resources in response to the array of opportunities and threats from the shared environment. The descent principle, to the contrary, admits of no test of efficacy other than the outcome of total confrontation with other groups similarly constituted.

One of the most frequently encountered antinomies in accounts of social change is that between the traditional and the rational, but that labeling misplaces the key distinction. The focus of the traditional society is no less rational, but the rationality is directed toward the overarching purpose of preservation of the group constitution. The reaction to an opportunity for adaptation is customarily negative because priority is given to concern for the implications of novelty for organizational persistence. In the so-called rational society, to the contrary, primacy is given to individual ends, and material advantage takes precedence over risks to the prevailing institutional structure.

In the subsequent evolution of socio-cultural aggregations, the heirs of the residence principle have been the community and the State, both territorially organized and responsive to the requirements of organic solidarity (in Durkheim's terminology), whereas the heirs of the descent principle have been the ethnic group and the nation, putatively eternal and responsive to the requirements of mechanical solidarity. The kinship system survives in a different guise.

IDEOLOGICAL COMPETITION

An important source of strain on the traditional intergenerational contract, at another level, is the presence of an alternative family model, associated with the material success and economic and political power of the West. Less developed societies have been invaded not only economically and politically but also ideologically. People in the developing countries want to learn the Western secret of power, and perceive it to lie in education, and in the Western type of family (Caldwell, 1982). The overwhelming strength of the West makes this an exportable commodity as well. The West provides a model for social as well as economic

change, presenting an alternative view of the family in which the individual is the focus of attention and concern. Some part of the attractiveness of the Western family model may be logical, a sense that one key to the increase in productivity is an individualistic orientation, but some part of it may be magical.

The thesis that the Western model of the family is imported into developing countries, and plays a supportive if not determinative role in social change, has a convincing ring to it. But granting the premise that normative constructions may be disseminated, it is not clear whether the structure *in toto* is imported (cf. Freedman, 1982) nor exactly which form of the Western model has the most attraction. The predominant ideal for the Western family may still be the bread-winner model. The family of procreation is completely independent of the family of orientation, but there is a sharp division of labour by gender and an authoritarian allocation of power within the family. To the outside world, the husband/father is responsible for the care of his wife and children, and he is ideally the only one to participate in the labour market (a position supported by systematic discrimination in his favour in that market). Yet there is now evolving a much different form of family, particularly one which is egalitarian with respect to the division of labour by gender, and it would be premature to characterize any terminal equilibrium position. (One of the unfortunate consequences of adoption of terms like "developing" and "developed" societies is the implication that the former are in the process of changing whereas the latter have stopped.)

Caldwell (1982) has used the term "emotional nucleation" to characterize the principal familial change attributable to Westernization. The term points to a change of balance within the nuclear family with respect to which ends have priority. Conjugal relationships take precedence over consanguineal relationships; the influence of the wife increases relative to that of the husband; the interests of the children increase in allocation decisions relative to those of the parents; authority is tempered by egalitarianism. The increase in sentiment is not unassociated with another dimension to the Western invasion: the allure of household consumption goods. If sentiment is to be allowed to play a more important role within the family, it must be affordable. In a poor society, the individual end of delight in sentimental relationships must take second place to self-abnegation and personal sacrifice in the face of necessity. Sentiment is a pair bonding that can prove prejudicial to other responsibilities in other relationships. The increase in emotionality between the generations may reduce respect for authority because it implies a non-hierarchical relationship.

The increase in sentiment within the family is an accompaniment of the specialization of family functions. As the family is stripped of its responsibilities for education, employment, protection, credit and social security, it becomes progressively more specialized in non-marketable services, in particular the development and maintenance of the individual self, and the exchange of affection and emotional support among its members. The test of the effectiveness of the family comes to be how it serves its members as individuals, rather than how its members serve the family group.

Stone (1977), writing of early modern England, charac-

terized the new kind of family by the term "affective individualism". The market economy is important to the growth of individualism, and the development of the concepts of individual liberties and property rights. One requisite for the growing sense of individual autonomy is independence of the individual's family of procreation from his family of orientation. Yet it may not be quite correct to identify the distinction between the traditional and the modern family as one of growth of individual freedom. Rather there is a shift of allegiance of the individual from the family to the society. After all, the patriarch may be the archetypical tyrant, but there are many societies in which the interests of the collectivity take precedence over the interests of the individual.

The traditional morality of the family is threatened by any institution which competes for the hearts and minds of family members by offering services in exchange for commitment. Although some religions, like Hinduism, are family-centred, or, like Islam, are directed primarily to heads of households, others, like Buddhism, Judaism and Christianity, address their moral messages to the individual and are in that sense subversive of traditional family morality (Caldwell, 1982). The emphasis is sufficiently pronounced in Protestantism that it is generally credited with a crucial causal role in the beginning of the process of modernization.

Previously we drew a contrast between two models of the social system: the elementarist model which focused on individuals as decision-makers, and the organicist model which focused on the normative structure. A comparable distinction can be made in considering how to study social change. There are two ways to explain the solidarity of a family structure, distinguished by their relative emphasis on the twin processes which provide that structure: socialization and social control. Where socialization is emphasized, the occupants of different positions internalize the group design and come to regard it as good and just and proper. Satisfaction is derived from fulfilment of responsibilities in those terms. The good of the individual member is subordinate to, and in the long run best served by, attention to the ends of the collectivity, in particular the survival of the group (persistence of the group design).

In such a model, the nature of the contracts binding individual members is not subject to the test of satisfaction achieved by individual members, and is accordingly not questioned should a change in external conditions produce unfavourable outcomes for some of the group. If a theory of social change is to be developed from this base, it may take the form of some immanent process of progressive differentiation and reintegration, as with vanguard societies, or the test of survival in competition with other societies which follow different precepts. The Caldwell (1982) view of Westernization as a corrosive influence on traditional family morality falls into the latter category. Yet the key role he assigns to the patriarch as decision-maker leaves him open to the charge that his theory of social change is less than institutional in spirit; it can be read as implying that social change is at root a consequence of change in the individual decision-maker (Thadani, 1978). The model of solidarity through consensus, achieved by effective socialization, has proven useful in the study of simple societies in which almost all functions are familial, but it becomes progressively more difficult to adapt to a context of institutional competition, in

which individuals are members of many groups and have many alternative directions of possible commitment.

The alternative model for explanation of the solidarity of a social structure focuses on the process of social control. From this viewpoint, the group is a set of members whose actions have consequences from one another. Each member of the group has some degree of control over sanctions, rewards and punishments, which can be used to increase the probability that the behaviour of any other member is favourable to their interests. The individual is conceptualized as oriented to self-interest, and thus potentially rebellious in the sense that membership in the group is regarded as conditional on the rewards the individual receives as a consequence of that membership, relative to the costs of membership to the individual, in comparison with a like cost/benefit analysis for affiliation with alternative groups. The key to order in such a system is the differential control of rewards and punishments by those who are senior in the group hierarchy, in short by power. Socialization in such a model plays the subsidiary role of supporting the prevalent power structure by instilling in the young and inexperienced the myth that their own interests are best served by furthering the interests of the group (and its leaders).

From this perspective, the group is continually being tested for its ability to yield satisfactions to its senior members, with control maintained through sanctions imposed on its junior members, in competition with alternative membership groups. Modernization is a process of development of alternatives which permit contracts in extra-familial markets which are more advantageous to individual interests than those within the family. The family is sensitive to changing conditions because they may affect the perceived costs and benefits of continued allegiance to the family, and therefore influence the choice of commitments by the individuals whose interests are at the centre of the analysis.

In our judgement, it would be a strategic error to give undue emphasis in research design to either the model of solidarity based on socialization or the model based on social control. The key distinction between them is the criterion of effectiveness: for the former the interests of the group, for the latter the interests of the individual. Yet a point made previously deserves to be repeated. The process of social change should not be misread as a progressive augmentation of the interests of the individual relative to those of the group, because the structural transformations associated with modernization are more accurately characterized as the transfer of individual allegiance from one kind of group to others. From the standpoint of the study of fertility, the key significance of this transfer is not the direct and unequivocal interest the family has and can enforce in regulation of the forces which may change its dimensions, but the indirect and equivocal interests of the more remote collectivities with which the individual becomes progressively more closely affiliated during the process of modernization.

EXTERNALITIES

Any consideration of policy is concerned with actions by governments with the intent of making the future more attractive or less unattractive to those whose interests the govern-

ment serves than would be expected in the absence of such actions. For present purposes, we make the broad assumption that the aim of the government is to increase the pace of economic development. We also take as given that the pace of economic development is negatively affected by the rate of population growth. The basis for that position, in brief, is as follows. The key to economic development is rising productivity. That is achieved by an increase in the ratio of (human and physical) capital to labour. In the short term, population growth decreases the supply of capital by diverting resources into increasing consumption which might otherwise be invested. In the medium term, population increases the supply of labour as population growth advances into the labour force ages. In the long term, population growth reduces the yield from additional increments of capital, as a reflection of ultimately diminishing returns to scale. Finally, of the logical alternatives for reducing the rate of population growth, fertility reduction is the least unattractive.

If the argument at the aggregate level applied with equal force at the individual level, the level at which decisions are made about fertility, one could rely on rationality to reduce fertility. In short, there would be no need for a national population policy. The justification for a government programme arises from a discrepancy between the costs and benefits at the micro-analytic level and the costs and benefits at the macro-analytic level. This is the problem of what economists call negative externalities: the individual decision-maker is able to displace some of his or her costs onto others (Birdsall, 1982). High fertility is costly to a poor society, but not to the families responsible, relative to the perceived costs of fertility regulation.

One application of the externality concept is the argument (McNicoll, 1975) that population growth occurs at the village level, but the problem of employment of the increased number of entrants into the labour force is not solved at that level. Rather the surplus migrates to the city; in this way the village displaces its population costs to the city. The policy prompted by this line of argument would be a restriction on migration from the village to the city, in effect confining the problem to the location where it can be solved. On the other hand, restrictions on individual mobility would be politically unacceptable for many populations, and might be counter-productive to the process of spatial redistribution of labour required in the process of modernization.

The concept of externalities is directly applicable to the form of the intergenerational contract. If the senior generation, in making decisions about fertility, perceives that the benefits exceed the costs, from their standpoint, because of an intergenerational contract which obliges the junior generation to contribute to family income when they are young adults, this is tantamount to a displacement of costs from the senior to the junior generation. The negative externalities associated with fertility, from the standpoint of the society, and thus provoking the need for a population policy, are experienced by the junior generation, viewed from the standpoint of the family. Just as the costs of population growth are displaced from the village to the city, so are they displaced from the senior to the junior generation. From an aggregate standpoint, economic development means that the level of per capita income is higher at a later than at an earlier time. In terms of the sequence of generations which constitute the

population as a function of time, economic development means a higher level of income for junior than for senior generations. The familial counterpart of societal development is investment made by the parents with returns accruing to children, in short a new flow of resources from parents to children and thus a new intergenerational contract.

The general policy orientation that is derived from the foregoing account is to spur the process of modernization by accelerating the shift of individual allegiance from the family to the society and systematically discriminating by age, through various kinds of resource transfer, in favour of the new cohorts. The most direct approach is education. Economic development at its simplest is measured by an increase in the income of sons relative to that of fathers. Education is a form of forced saving and investment by the senior generation for the benefit of the junior generation. The process makes the young person a child of the society as well as of the family. Education transforms the time pattern of production and consumption as a function of the life cycle and disrupts the previous set of relationships between the generations.

The second policy direction, closely related to the first, is to attempt to achieve a delay in the time of entry into parenthood. The demographic case for this is straightforward. The later a birth occurs in a person's life, the smaller its discounted contribution to annual growth. Just as velocity is a question of time elapsed as well as distance covered, so is reproductivity keyed to the interval between generations as well as to their respective sizes. Moreover, during the transition from earlier to later entry into parenthood, fertility from period to period is distorted downward. The ultimate size of a population is modified by the ratio of the initial to the terminal mean age of reproduction (Ryder, 1975(ii)).

"Beyond such purely demographic arguments, the force of the case for delay is sociologically strong, particularly with respect to the initial steps in the reproductive sequence. The time of entry into marriage is a crucial point of structural strain in the traditional domination of one's family of procreation by one's family of orientation. Such domination is incompatible with sustained economic advance, whether it be that of the individual or of the social system as a whole. Early arranged marriage is a symptom of and mode of preservation of familism. The early imposition of family obligations traps the man, and especially the woman, within the traditional social structure. Temporary freedom from procreation is necessary to provide the young woman with the opportunity to enlarge her personal horizon and acquire sources of satisfaction alternative to motherhood. The future of developing societies may be much more bound up with the future of their young women than with that of their young men.

"Later marriage gives the young person a few adult years in which to become committed to personal or societal rather than familial goals. The later the marriage, the more likely will the couple form their own household, rather than sharing that of the family of orientation. The obligation to support the children is more likely under such circumstances to fall directly on the shoulders of the couple rather than be shared and absorbed by surrounding kinfolk. Basic to the growth of

individualism and to the growth of the economy is the principle that one must not marry until a living is assured. Delayed gratification and prudential restraint are essential to the achievement of a higher scale of living; they permit personal capital formation. In particular, the assumption of family responsibilities almost prohibits the continuation of formal education and technical training for personal advance, and, collectively, for social modernization. Education is society's agent in the release of the individual from kinship bondage. Education raises social aspirations, increases the anxiety for new goods, and makes children more costly in their own right and in relation to alternative opportunities which must be foregone by the parents. Education can provide a societal alternative to the family as a source of normative orientations, and an enhancement of vision beyond the limited boundaries of the local community—which has always been the ally of the kinship system in the maintenance of ascriptive criteria for placement.

"Marriage delay permits the postponement of cohort commitment to the existing system and thereby encourages or at least facilitates social change. Every society is a functioning collectivity with inputs of birth and outputs of death, which persists independently of the lives of its ever-changing membership. To reproduce itself, society must implant its precepts in the minds of each new cohort. Yet this continual threat to stability is also a continual opportunity for society to exploit the new cohorts as the vehicles for initiating change." (Ryder, 1976, pp. 10-11.)

The third proposal may seem perverse at first glance. Since population growth is regarded to be an impediment to economic development, and since mortality decline is the immediate source of population growth, it may seem contrary to societal interests to advocate aggressive efforts to reduce mortality still further, as an element in a policy for fertility reduction. Yet it has been argued above that the intergenerational contract at the core of traditional family morality, the underpinning for high fertility, is strongly challenged by mortality decline. In a stationary population based on high mortality and replacement fertility, there is both quantitative and temporal intergenerational equity. When mortality declines, the contract between father and son becomes untenable because of an increase in the ratio of sons to fathers and a lengthening of the time when the father passes the patrimony to his sons. Although the implicit strain on the family structure is probably insufficient without the concomitant development of institutions competitive with the family for the allegiance of the disadvantaged junior generation, the impetus provided by mortality decline is undoubtedly a powerful spur to the demise of the traditional system. It is likely to be more than statistical happenstance that there is no major population with low mortality which is not either already low in fertility or experiencing rapid fertility decline.

The final policy suggestion is that the poor be provided a reliable system of social insurance against risk. The simple case for lower fertility as a national policy is that high fertility is a deterrent to the reduction of poverty. On the level of the

family, the reverse proposition would seem equally valid: poverty is a deterrent to the reduction of fertility. The point is not at all that the poor have children out of ignorance or fatalistic apathy, but rather that children represent for them, on rational grounds, the best available insurance policy in a world of high insecurity. To the outside observer, taking the long view, this may look like a policy of desperation, but it is unlikely to be discontinued until there are institutionalized alternatives to children in which the poor may have confidence for protection during unemployment, illness and old age. An uncertain environment is an unpropitious context for the planning of families as well as for the planning of any other aspect of life.

CONCLUSION

Throughout this essay, the assertion has been made in various ways that an acceptable theory of fertility decline is inaccessible by way of the kind of mechanistic micro-analytic concepts and instruments which have characterized our research to date. Although some attempt has been made to

exemplify an alternative style of inquiry, the case is admittedly speculative and rhetorical, and embarrassingly weak in empirical support. We are only beginning to define the problem in such a way that we can contemplate the appropriate form of research procedures to move us toward verification. The investigation of fertility determinants from the perspective of institutional structures is a demanding enterprise. Reproduction is only one of a complex of institutions in intimate interdependence, and cross-sectional analyses are inherently inappropriate to capture the change in relationships between the generations over the passage of time.

The process of modernization that has been sweeping the world over the past several centuries is the major challenge for research in the social sciences. In that process, fertility decline may be a subsidiary by-product rather than the focus of analytic strategy. The fundamental inquiries to remedy our substantial ignorance will require major investments of professional commitment and financial support, as well as continuing patience and understanding from sponsors. The sole yet sufficient justification for that is the centrality of the question for the future of the world's populations.

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POPULATION DISTRIBUTION POLICIES

*Harry W. Richardson**

SUMMARY

The present article provides an overview of population distribution policies with special but not total reference to developing countries. Population distribution goals are analysed and the argument that rural-metropolitan migration is excessive is critically discussed. Policy instruments to influence the location of both households and firms are evaluated. It is argued that strategies to control primate city growth, to promote small towns and secondary cities and to implement rural development programmes are complementary rather than alternatives. Partial strategies, such as relocation of the national capital, countermagnets, new towns, border region policies and land colonization schemes, should be adopted only in rare cases because of their high cost and minimal impact. Success in population distribution policies has been hampered by implementation problems as well as poorly designed strategies. Nevertheless, policy-makers should persevere, especially in countries that combine modest urbanization levels with high rates of aggregate population growth, since improvements in the distribution of population may generate a variety of social benefits, such as efficiency, equity, environmental quality and national security.

INTRODUCTION: ARE POPULATION DISTRIBUTION POLICIES IMPORTANT?

Many countries have adopted population distribution policies in recent years, but they have varied greatly in the degree to which they have been implemented; clear failures have been very common and there have been almost no undiluted successes. Yet this indifferent performance should not be used as an argument that population distribution policies are unimportant. On the contrary, they can be critically important, especially in developing countries with two or more of the following characteristics: high rates of aggregate population growth, low levels of urbanization, fast rates of economic growth, a strongly interventionist system (with the State accounting for a substantial proportion of economic activity), intermediate levels of economic development, sizeable interregional gaps in incomes and welfare, and large geographical area. In these countries the distribution of population is going to change dramatically in any event. The question is whether these changes should be left to market forces or whether they can be guided in ways consistent with societal welfare. Population distribution policies are much less important, perhaps of little more than marginal value, in advanced, mature industrial and post-industrial economies, where the economy is highly urbanized, population growth rates have fallen to zero net reproduction levels, and spatial differences in income and public service levels are small.

Why are population distribution policies issues important over a wide range of countries? One reason is that, especially in heavily primate developing countries, the spatial distribution of population (and economic activity) has generated conditions that conflict with important societal goals, such as interpersonal and interregional equity, national security, political stability and integration, improvement in the quality of life, optimal resource exploitation and, perhaps, long-run economic efficiency. Moreover, in many cases, the overall development strategy, as reflected in macro and sectoral policies, has strong implicit spatial impacts that have, more often than not, reinforced an "unfavorable" population distribution, that is, one that conflicts with national goals and priorities.¹ The only ways to correct for this are to modify the overall development strategy (for example, replacing import substitution in the manufacturing sector by export promotion of resource-based products) or to implement offsetting explicit population distribution policies. There is a widely held, though not fully substantiated, hypothesis that time will remedy maldistributions of national population as market forces eventually lead to a reversal in the forces of spatial concentration and result in a secular process of spatial dispersion. Although polarization reversal² has occurred in most developed countries, its frequency in developing countries is very spotty (Brazil and the Republic of Korea may be the only two fully authenticated cases, and both are "transitional" rather than developing economies). Even if polarization reversal were inevitable, it may take decades in those countries in the early phases of economic development and modernization. However, the polarization reversal hypothesis does not imply that population distribution policies are unnecessary, but rather that the timing of intervention may be

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critical to their success. Furthermore, although it has been argued that there is a relationship between polarization reversal and the bell-shaped curve of regional inequality,³ population distribution policies may be a useful approach to improving equity long before the process of polarization reversal begins to show itself.

From the point of view of population policy, there are grounds for suggesting that population distribution is the current and future population issue. There is a substantial degree of consensus about what should be done to reduce fertility and mortality, and there have been some notable successes. With respect to population distribution policy, however, there is no consensus and no unambiguous successes. The field is riddled with extreme value judgements, ideological stances, and unsubstantiated assertions, many of them myths. The challenge of population distribution issues is that it is not known how to deal with them. Should all countries be moving in the direction of population dispersion? If not, at what level of development are attempts to disperse population likely to be effective? How to assess whether one distribution of population over national space is superior to another or not? Which strategies and instruments work, and which fail? What are the conditions increasing the probability of success? How replicable are strategies and how transferable are policies from one institutional environment to another? There are no clear-cut answers to these and other related questions.

An illustration of the lack of consensus is that ideas are changing so fast that yesterday's truism becomes today's misdiagnosis. An example of these shifting currents can be taken from the 1974 World Population Plan of Action itself.⁴ Paragraph 44 refers to the "adverse factors" of urbanization and to the link between these adverse consequences and the "dependent situation" of many developing countries. Furthermore, paragraph 45 discusses the "undesirable consequences of excessive migration". These ideas would not be generally accepted as the population distribution problem of the 1980s. The relationship between dependency and hyperurbanization has been widely rejected. The key question today would not be regarded as "excessive" urbanization and migration but rather the question of which population distribution would most improve the welfare of the population as a whole. The answer to this question could vary widely from one country to another; in some cases, it might imply more urbanization rather than less.

COUNTRY TYPE, LEVEL OF DEVELOPMENT AND INSTITUTIONAL STRUCTURE

Countries differ widely in their patterns of population distribution, levels of urbanization, degrees of primacy, rates of urban growth, urban settlement pattern and rural population growth rates. They also vary in their level of development and in their economic and political systems. Hence, it is hardly surprising that there are major differences in the content and design of the population distribution policies implemented by particular countries. Merely a few of these differences will be illustrated here. The present paper uses a threefold classification of countries: developed countries, developing countries and centrally planned economies.

Obviously, this is a very crude classification.⁵ The taxonomy is too aggregated. For examples, within centrally planned economies the population distribution policies adopted by the industrializing countries of eastern Europe are very different from the rural-oriented population distribution policies of China and Cuba. The city-state countries (for example, Singapore, Hong Kong and Bahrain) face unique population distribution problems. Island countries have an entirely different core-periphery geography from land-locked countries, while archipelagos (the Philippines and Indonesia) have very unusual population distribution problems, with efficient sea lanes linking port cities, many of which have severely underdeveloped hinterlands. Large geographical size (China, the United States of America, Brazil, the Union of Soviet Socialist Republics, India, Mexico and Canada) creates similarities in population distribution problems that transcend differences in levels of development and politico-economic systems. In some countries, overt (South Africa) or subcutaneous (Malaysia) ethnic conflict is so potentially severe that population distribution policies cannot be divorced from racial policy (*apartheid* and new economic policy, respectively). In many regions of the world, especially in Africa, the special problem of tribalism makes it difficult for Governments concerned with promoting national integration to adopt the decentralized planning approaches that might increase the success rate of population distribution policies.⁶

The effectiveness of population distribution policies undoubtedly changes with the level of development. In the early phases of development, there are few alternatives to the combination of a dispersed rural population and strong spatial concentration in one or two major cities. Regional markets are too small in terms of population and especially income to justify the development of viable secondary cities. In advanced, mature economies, on the other hand, where population pressures are negligible and infrastructure and public services are highly dispersed, the spatial distribution of population (and economic activity) becomes relatively fossilized, and there is very little for population distribution policies to do. In almost all developed countries, net migration to overbounded core regions declined in the 1970s so that market forces, reinforced in some cases by regional development policies to aid lagging areas, are gradually increasing the degree of population dispersal without comprehensive population distribution policies.⁷ Interestingly, in these very two types of country (developed countries and low-income developing countries emphasizing rural development) the population distribution policies that are implemented are negative in the sense that they are directed towards keeping population where it is (that is, discouraging migration) rather than in redistributing it. Hence, population distribution policies focus on redistributing jobs (economic activity) to the prevailing population distribution pattern. Nevertheless, promoting no change is still a policy. This important point will be even clearer when policy instruments are discussed in detail below. Population distribution policies are most effective when countries are in an intermediate stage of development, near the time when polarization forces begin to weaken spontaneously and while there remains considerable scope for guiding the pattern of urbanization.⁸ This view, that policies work much better when they anticipate or are consistent with market forces than when they fight

against them, is very close to the policy-relevant implications of the polarization reversal concept discussed above.

Another dimension of country differentiation is the population distribution policies pursued by centrally planned economies. For instance, the centrally planned economies of eastern Europe adopted a strategy of "economizing on urbanization", involving the shift of investment resources from housing and urban infrastructure to industrial capacity.⁹ Manning problems were alleviated by choosing capital-intensive technologies and by promoting commuting from nearby rural areas to factory jobs and the growth of a peasant-factory worker class who lived in villages rather than in cities. More obviously, centrally planned economies rely more heavily on direct controls than the developed countries mixed economies which prefer fiscal incentives.¹⁰ Nevertheless, incentives are increasingly deployed in some centrally planned economies, such as Yugoslavia, Hungary and even China.

A small subset of countries has critical population distribution problems that cannot be resolved in a way compatible with an overall increase in per capita incomes. These countries typically combine a high rate of aggregate population growth with a very limited agricultural and other resource base so that land-labour ratios are deplorably low and population grows much faster than the resource base. Placing a population "cap" on the primate city only makes matters worse because absorbing the rural population surplus in other urban centres often implies infeasibly high growth rates for the smaller cities. Encouraging the population to remain in rural areas does not work either, since it implies permanently depressed rural welfare levels. These countries, fortunately relatively few, are "overpopulated" in the true sense; Peru and Egypt are merely two members of this group. Probably, the only cost-effective population distribution policy for such countries is stronger actions to reduce fertility and bring down the aggregate population growth rate, thereby easing urban absorption problems (and the associated high investment cost) and reducing land-labour scarcity. In spite of the continued prevalence of cultural and institutional obstacles in many countries, such a strategy would be much more cost-effective than attempting to accommodate a significantly larger urban population. It would also be much more economical in terms of investment requirements, though it would require a very different investment mix with much more emphasis on human resource investments and less on physical structures and equipment.

Finally, changes in the international economic environment may affect the scope for population distribution policies in the large majority of countries. For example, the last decade has been a period of significantly slower world economic growth and there have been severe public capital investment constraints, with the notable exception of the oil-exporting economies. The attention of most national Governments has been concentrated on macro and sectoral issues. Population distribution policies have been downplayed, and the resources available for interregional, intraregional and urban infrastructure have been cut back. Particularly in developing countries, this focus is myopic since a soundly chosen and effectively implemented population distribution policy may promote both macroeconomic and sectoral goals. Also, there are palliatives to overcome shortages in the

availability of public capital. These include the substitution of institutional changes for large-scale investment programmes (for example, traffic management for new highways and subways, technical assistance for small-scale irrigation works instead of mammoth irrigation projects) and a more effective mobilization of private sector investment and community self-help projects (for example, in infrastructure provision).

GOALS

It is quite common for policy-makers to express population distribution goals in very specific terms, such as a desired rural-urban split, population caps or maximum growth rates for the primate city, and targets for small towns and intermediate cities. This contrasts sharply with goal specification in other policy areas where the goals are frequently very general and vague. However, the use of targets in population distribution goals is by no means an unmixed blessing. First, and most important, it gives the impression that these goals are ends in themselves. In fact, there is no particular virtue in, say, a primate city being constrained to a particular population size (or growth rate) unless this is as a means to another goal.¹¹ In other words, population distribution goals have no intrinsic merit unless they serve the broader goals of society at large, such as efficiency, equity, political stability, quality of life, and the optimal use of a nation's resources. Second, the use of physical targets may discredit population distribution policies in general if the numbers aimed for are infeasible. Imposing unrealistic population caps on the primate city, assuming that small towns and intermediate cities can grow much faster than the rate of growth of job creation and service provision, and overestimating the population absorptive capacity of rural areas are common recurrences. Too often, policy-makers rely on ideology and value judgements to pluck their numbers out of the air rather than on hard analysis. Ideology has created a set of myths (or at best half-truths) of population distribution policy: that big cities are too big, that migrants fare badly in the primate city, that the optimal solution is to maximize the share of population living in rural areas, that it is easy to provide off-farm employment opportunities in rural areas and in villages, and so on. These assumptions are widely held across countries (particularly the developing countries) regardless of the specific conditions prevailing in each country. Thus, policy-makers in, say, Kenya may lament the intolerable size-related problems of Nairobi as much as policy-makers in Mexico and Brazil express concern about the size of the Federal District and São Paulo, respectively.

Much of the discussion about spatial distribution goals focuses on the efficiency as opposed to equity issue. However, the neat hypothesis that population concentration equals efficiency, while population dispersion equals equity, and hence that the appropriate population distribution depends upon the efficiency-equity trade-off, is much too simplistic. The argument collapses if equity is defined in interpersonal rather than geographical (for example, interregional, rural-urban) terms. For instance, in many countries the distribution of income is much more equal in large cities than in the rural areas, while migration to the primate city and its core region

remains for many poor people the only available means of individual betterment.

Paradoxically, in spite of the fact that the macrospatial distribution of population and economic activity changes relatively slowly, population distribution goals can easily be overtaken by events. For example, in the United States of America in the late 1960s there was a flurry of interest in the idea of a national urban growth policy, the goals of which were to slow down the growth of the largest metropolitan centres and shift the population distribution in favour of rural areas, despite the facts that some of the major cities, especially in the north-east and the mid-west, were beginning to decline and the non-metropolitan areas had already started to grow faster than the metropolitan areas. Similarly, in the United Kingdom of Great Britain and Northern Ireland, about 1970, the goal of the national Government to decentralize economic activities from greater London continued to be promoted although many areas of inner London had begun to suffer from severe economic and social distress. Countless other illustrations of the same mismatch between population distribution goals and experience can be found in other countries, both developed and developing. The lags in population distribution data provision are compounded by the lags in policy-makers' perception of problems.

A sensible population distribution goal might be to aim for that distribution of population that maximized current and prospective real incomes and welfare levels for the mass of a nation's population regardless of where they live, in rural areas, small towns and intermediate cities or large cities, and regardless of whether they are migrants or non-migrants. In formal terms, this would imply finding the optimal distribution of population that maximized some equity-oriented social welfare function. In practice, this approach has two major problems. First, it may not be possible to identify such a population distribution. Alternative population distributions might generate a similar per capita income level and income distribution. Discrimination between superior and inferior population distributions may be feasible only in a very gross sense (for instance, the macro rural/urban split), and little can be said about the welfare implications of different national urban hierarchies (that is, the distribution of population among settlements of different sizes). Second, the theoretical notion of a spatial equilibrium in the national economy where real welfare levels of households are equalized does not occur in reality.¹² Some people will be made worse off as a result of any population distribution policy adopted. Thus, there is no way of avoiding the messy problems associated with interpersonal utility comparisons of welfare economics and the compensation principles (taxes and subsidies) needed to transfer income from those benefited by the population distribution policy to those made worse off.

IS RURAL MIGRATION TO THE PRIMATE CITY NON-OPTIMAL?

Stark suggested that population distribution policies, at least in a developing country context, were merely a codephrase for slowing down the growth of the primate city.¹³ Although in many countries natural increase accounts for

more than one half of urban growth,¹⁴ the population distribution component of slowing metropolitan growth obviously deals with reducing immigration, especially from rural areas. Hence, many population distribution policies imply the hypothesis that rural migration to the primate city is excessive. But can it be concluded that such migration is excessive, optimal or too low? Certainly, as a generalization, and despite individual disappointments, net private returns to migration tend to be positive. Most rural migrants are better off in the primate city even if they do not obtain formal sector employment. They earn more in the informal sector than in the area of origin (even after accounting for goods and services in kind), they have access to at least some public services, and they quickly adjust to big city life. The problem arises because of the externalities associated with such migration, namely the impacts they impose on society at large in both the sending and receiving areas. There is no clear consensus on whether the net social benefits are positive or negative either in the primate city or in the rural area of origin. Also, of course, they may differ according to circumstances, both across countries and (within countries) over time.

Figure I illustrates the alternatives for evaluation of net social benefits (costs) in both the rural areas and the primate city. Only if net effects are beneficial in both the origin and destination (quadrant A) can it be argued that rural-metropolitan migration is optimal (or insufficient), and only if both effects are negative (quadrant D) can it be concluded that migration is excessive. It is possible for net externalities to be positive at the origin and negative at the destination (quadrant B) or negative at the origin and positive at the destination (quadrant C). In these cases the outcome is ambiguous, unless each externality can be quantified exactly and hence aggregated.

Figure I. Net social benefits and costs of migration

		Primate city	
		Positive A(++)	Negative B(+--)
Rural areas	Positive		
	Negative	C(--+)	D(--)

Optimists stress benefits in both the rural areas and the primate city. In rural areas out-migration may reduce the rural labour surplus, boost agricultural output per capita and raise rural incomes as a result of remittances from the urban areas.¹⁵ In the primate city the migrant's marginal product may be higher than in the area of origin, the household's fertility rate may drop after migration,¹⁶ per capita public services costs may be lower than in the rural areas, urban agglomeration economies may persist even in the largest cities, and in-migration may dampen inflationary tendencies. The pessimists see the situation differently. Out-migration is selective in age and skill, migrants take capital with them, remittances are small relative to village income, public service provision suffers from losses of economies of scale, and rural out-migration worsens the rural income distribution because the migrants come from the better-off families and these benefit most from remittances.¹⁷ In-migration into the

primate city generates substantial social costs: higher unemployment, congestion costs, a heavier burden in housing and social service provision, a dampening of resident incomes, and the risks of political instability and mass unrest. These are extreme positions. In practice, the effects are likely to be mixed. Since many of them cannot be measured, at least in ways permitting aggregation, it is difficult, perhaps impossible, to draw a firm conclusion about whether or not rural-metropolitan migration is optimal (excessive, sub-optimal) in any concrete case. Almost all population distribution policies, at least in developing countries, assume that migration is excessive. Obviously, this is a value judgement, not the result of a comprehensive evaluation of social costs and benefits.

MIGRATION POLICY

The major focus of population distribution policies is migration policy, because the scope for spatially differentiated fertility and mortality policies is limited. Mortality policy in particular is unlikely to be spatially discriminatory. Typical goals might be to aim for equivalent reductions in mortality in all areas, to equalize average life expectancy everywhere, or to set specific standards for desired mortality rates. Of course, these goals might have to be modified in light of investment and human resource constraints or because of uncontrollable environmental influences at particular locations. Fertility policies may be more discriminatory since population distribution problems may develop from excessively high fertility rates in certain areas, possibly justifying stronger policy actions. It is undoubtedly easier to implement fertility reduction measures more effectively in densely populated large cities where attitudes to modernization are more prevalent, most of the population is accessible to health centres, mass media channels are more developed, and information diffuses faster. Ironically, the marginal cost of birth rate reductions is likely to be much higher in the areas where fertility decline is most needed (that is, in high-fertility rural areas). Hence, population distribution policies rely heavily on measures that either induce or inhibit migration, and save in exceptional circumstances (for example, the "overpopulated" countries with low land-labour ratios and insufficient urban absorptive capacity) policies to influence natural increase play only a marginal role.

It may be useful to draw a distinction between direct and indirect migration policies. Direct policies focus on measures to influence migrant behaviour directly, such as migration relocation allowances, transport subsidies, and the provision of information. Indirect policies, on the other hand, influence the determinants of migration, which in developing countries at least are predominantly economic. Typical examples might be industrial location policies or actions to discriminate in favour of some areas in the provision of infrastructure.

Migration policies may attempt either to promote migration or to deter it. Since available evidence strongly supports the hypothesis that most migrants benefit from moving, policies to promote migration can be rationalized in terms of helping individuals (or households) to better themselves. However, as suggested above, policies to deter migration

have to be based on an assessment of social, not private, costs and benefits. More specifically, the hypothesis that migration is excessive depends on the argument that it imposes net social costs on society as a whole. The evidence for this proposition is much more mixed.

There has been much more research on migration behaviour and on migratory processes than on migration policy itself. Nevertheless, recent research on migration behaviour suggests several factors that might be policy-relevant:

(a) Jobs are the dominant determinant of migration, especially in developing countries. Hence, changing the geographical distribution of jobs, particularly new jobs, may be the most effective way of changing migration patterns;

(b) Job search models are useful in explaining the behaviour of individual migrants. If so, the provision of better information about the number of vacant jobs, wage dispersion and labour supply at different locations may be a useful but neglected policy instrument;

(c) The "friends and relatives" effect and "beaten path" migration flow continue to be important. Again, this reinforces the importance of policies that improve information flows. Also, it suggests that focusing migration policy on groups and communities, and thereby reducing the psychic cost burden of migration, may be more effective than policies directed at individuals;

(d) The well-known Todaro model stresses the importance of expected wages (the wage \times the probability of getting a job) rather than actual wages.¹⁸ This suggests that policies to diffuse information to would-be migrants might profitably emphasize unemployment (and other negative factors), as well as jobs and wages;

(e) The Todaro model also implies that policies to deal with metropolitan unemployment by expanding jobs there will be self-defeating because the creation of formal sector jobs induces many more migrants than the number of jobs available;

(f) The costs of migration may be substantial relative to the individual migrant's income. As a result, the better-off rural dwellers may be disproportionately represented among rural-urban migrants. This suggests the potential importance of migration assistance to the very poor as an equity measure;

(g) Circular migration is an important type of migration stream overlooked in standard migration data. Policies to stimulate circular migration may be used as a mechanism for strengthening urban-rural linkages, especially with respect to information flows.

A distinction may be drawn between policies to promote migration in general and policies to promote migration to specific locations. Policies to promote migration do not necessarily imply an endorsement of rapid metropolitan growth. For example, measures to stimulate rural-rural migration may be very helpful in raising rural incomes, reducing population pressure in densely populated rural areas, and in opening up new agricultural regions for cultivation. Moreover, within an urbanization strategy, there has been too little attention given to policies to promote migration to small towns and intermediate cities. The strategies of small towns and intermediate cities typically emphasize labour demand (that is, the growth of jobs) by attempting to decentralize industry to smaller urban centres or by stimulating indigenous employment growth. Perhaps the strategies of

small towns and intermediate cities might be more effective if they also stressed labour supply, more specifically, how to guide migrants from rural areas to small towns and intermediate cities rather than to the primate city. There are several possible methods. Where step-by-step (chain) migration takes place, measures may be designed that block the final step (from the intermediate to the primate city). Such a strategy might involve the implementation of accommodationist policies in the intermediate cities (for example, help with housing, the provision of public services) to make adjustment to permanent life easier there. Second, relocation assistance may be offered to migrants from labour-surplus rural areas, but only if they move to small towns and intermediate cities. Third, intraregional road improvements and the provision of intraregional transport facilities may be given priority to make commuting from nearly rural areas a viable alternative to migrating out of the region. Finally, migration assistance might be focused on groups and communities to keep kinship networks intact and thereby to reduce the likelihood of moving on to the primate city.

EVALUATION OF POLICY INSTRUMENTS: A THUMBNAIL SKETCH

Given that population distribution policies rely more on indirect than on direct measures to influence the distribution of population, and also that they may be as concerned with keeping people where they are as with redistributing population dramatically, it is hardly surprising that there is a wide range of policy instruments available. Since each instrument may be found in slightly different shades (for example, with respect to intensity of intervention) and under several different names, it is virtually impossible to classify them in a comprehensive and clearly divisible manner. Table 1 presents a fairly compressed taxonomy, listing instruments according to whether they are aimed at firms or public enterprises or at individuals. The table also shows the use of instruments in three different types of country, mixed developed countries, developing countries and centrally planned economies. A check (✓) implies that the instrument is almost universally used, while a blank implies that it is rarely used. "Few", "some" and "many" are crude categories, but are self-explanatory. The table shows that most instruments are adopted in all types of country, though to a different extent. A few instruments are bound to certain types of political and institutional environment; for instance, residential controls and land colonization schemes are not found in the developed countries, while grants and loans to firms are not given, for obvious reasons, in centrally planned economies. Nevertheless, the general impression left by table 1 is that the use of population distribution instruments is not restricted to any particular level of economic development or to any one politico-economic system.

Space permits only the most general of observations on the effectiveness of each type of policy instrument. Public infrastructure subsidies and provision are used to influence the population distribution in almost all countries. Observed problems include: insufficient redistribution in favour of equal per capita allocations or primate city bias; resource misallocation from provision in advance of effective demand

TABLE 1. TAXONOMY OF POPULATION DISTRIBUTION POLICY INSTRUMENTS

Instrument	Type of country		
	Developed countries	Centrally planned economies	Developing countries
A. Enterprise-oriented			
1. Public infrastructure subsidies and/or development	✓	✓	✓
2. Grants, loans and tax incentives to new industries and relocatees	✓		✓
3. Direct restrictions and controls on industrial location	Many	✓	Few
4. Labour and employment subsidies	Some	✓	Many
5. Direct state investment	Some	✓	Some
6. Transport rate (and other inter-regional cost) adjustments ..	Some	✓	Many
7. Growth centre strategies	Some	Some	Many
B. Individual-oriented			
1. Migration subsidies and worker relocation assistance	Some	Many	Few
2. Housing and social services ..	✓	✓	✓
3. Human resource investments and job training	✓	✓	✓
4. Residential controls		✓	Few
5. Rural development programmes	Some	Many	✓
6. Land colonization schemes ..		Some	Many

Source: Freely adapted and condensed from R. J. Fuchs and G. J. Demko, "Population distribution measures and the redistribution mechanism", *Population Distribution Policies in Development Planning* (United Nations publication, Sales No. E.81.XIII.5), tables 3, 4 and 6.

(for example, the simultaneous development of too many, decentralized industrial estates); standards that are too high relative to scarce capital resources and household ability to pay; and an overemphasis on industrial infrastructure and neglect of social infrastructure, especially in the developing countries and centrally planned economies. Grants, loans and tax incentives are sometimes used more to support industry in general than for purposes of population distribution policy. Also, they frequently have a capital-intensive bias, with the results of small employment-creation impacts and minimal influence on migration. The scale of assistance may be too small to offset the attractions of the primate city. Better prospects are offered by combining locational incentives with a tax on industrial development in the core region, preferably in a self-financing tax-subsidy scheme. Such taxes are preferable to direct controls on industrial location, especially in developing countries where controls are easily evaded. Also, the impacts of direct controls are difficult to measure since firms may be deterred from starting up rather than being forced to choose an inferior location. Labour subsidies have received considerable attention from economic theorists, particularly in a developing country context,¹⁹ but most of the real-world applications have been in developed countries. They have considerable scope in developing countries, but they have to be handled carefully. It is unrealistic to expect urban wage subsidies to eliminate urban unemployment (the problem addressed in the theoretical models). Instead, they could be used very effectively as an instrument to change the spatial distribution of jobs if offered

only in small towns and intermediate cities and not in the prime and other large cities.

The degree of State involvement in directly productive activities varies widely among countries according to their political system, level of development and ideology. *A priori*, one might expect countries with a large government industrial sector to implement population distribution policies more effectively since profits should have less influence on location decisions. Experience has been different. The inefficiencies of weak market signals have been compounded by a lack of interest of Ministries of Industry (and Boards of Investment) in industrial location issues. Also, the small-scale private industrial sector, often more dynamic than the large-scale public sector, is the more critical for population distribution policies because it figures more prominently in the economic structure of small towns and intermediate cities. Subsidized transport rates from isolated regions have little impact, because for most commodities transport costs are only a small proportion of total costs. Finally, growth centres are now a discredited strategy of population distribution policy, despite widespread support in the 1960s and early 1970s. They concentrated on capital-intensive industry; spatial diffusion effects into their hinterlands were very weak; and they took off too slowly so that policy-makers became disillusioned about their effectiveness.²⁰ However, the principle of urban selectivity implied by growth centres may be resurrected in a strategy to promote small towns and intermediate cities (see below).

Turning to policy instruments aimed at individuals, migration subsidies and worker relocation assistance are an old population distribution policy measure, used for several decades in many developed countries, if only on a modest scale. They have rarely been tried in developing countries (except in the very specific context of land colonization schemes), presumably on the ground that migration rates in developing countries are already too high. But the case for migration assistance rests not on the need to boost migration in general but to guide migrants to specific locations, such as small towns and intermediate cities. There are two major reasons to support this idea: the underdeveloped transport system in developing countries may be a major obstacle to migration; and resources available to potential migrants may be small, because of low incomes and limited savings.

In many developed countries and centrally planned economies (especially in Europe), housing constraints and the shortage of good accommodation means that the provision of public housing, particularly when subsidized, can have a major impact on the population distribution. In developing countries, on the other hand, housing supply adjusts to rather than moulds the population distribution. Direct public investment in housing in developing countries is an expensive, wasteful policy that aids only the better-off. A better approach is to mobilize private initiative by stimulating self-help in the housing sector. Social service provision may have a strong influence on the population distribution. For example, an emphasis on primary schools and primary health care rather than higher education and specialist hospitals will help support a dispersed rural population rather than one densely concentrated in large cities. Scarce public investment resources make it difficult to bring all basic public services (water, power, sanitation, social services etc.) to all the

population, especially households in small towns and rural areas, within a reasonable time frame. The problem is exacerbated by providing such services well below cost. Implementation of cost-recovery schemes will generate resources for further investment, improve equity (since the rich benefit most from artificially cheap public services in the big cities), and reduce the implicit subsidies to big city living. Since people in rural areas and small urban centres are demanding accessibility to better public services, a more rational social service policy may be a key instrument to hold people in the rural areas, that is, a strategy of rural retention.

The effects of human resource investments and job training on the population distribution are difficult to predict. The first-order effect of such investments in lagging regions may be to accelerate out-migration, and it is difficult to determine how much additional spending is needed to swamp this first-order effect. Probably, human resource investments in small towns and intermediate cities will pay off only if combined with policies that stimulate labour demand. Even in developed countries, education and retraining programmes have often been ineffective because of a failure to address institutional obstacles (for example, trade union opposition to "dilution") and the problem of local economic growth.

Residential controls have been largely confined to centrally planned economies, apart from a few unsuccessful experiments in developing countries (for example, Indonesia). South Africa is clearly a special case of a non-centrally planned economy developed country where controls are maintained by tight laws and police repression. Since they are difficult to enforce outside a collectivist society (China and Cuba) or a police state, residential controls have little to recommend them. They are inequitable, and they conflict with human rights provisions (the freedom to travel within national borders). It is much better to use the price mechanism (full-cost pricing for metropolitan services), the tax system (differential residential taxes in cities of different size classes, as in the Republic of Korea) and controls on metropolitan employment growth.

Rural development programmes represent a comprehensive package of instruments. They can be defined in several different ways, and may sometimes be enterprise- rather than individual-oriented. For instance, agricultural development programmes have mainly benefited large firms, and led to an acceleration in rural-urban migration and adverse distributional changes in rural income. Similarly, land reform has not been the solution in practice, since it has had perverse effects, once again stimulating rural-urban migration.²¹ A more comprehensive approach is integrated rural development, usually defined as a broad, multisectoral approach within a delimited geographical area, embracing not only traditional agricultural development but also infrastructure provision, community development, organization of markets and supervised credit, public services, and the generation of off-farm jobs. Evaluation of experiments of integrated rural development is incomplete, but they do not uniformly reduce rural-urban migration. Even where permanent rural-urban migration is reduced, other migration options may be opened up, such as short-distance rural-rural migration, commuting to nearby towns and other forms of circular migration. Agropolitan development planning is yet another approach, implying a degree of rural population concentration into

agropolitan centres.²² The strategy involves treating agriculture as the propulsive sector, promoting small-scale industry and the informal sector, and mobilizing community resources and local participation. It is close to what has been tried in Cuba and a few other countries, but there is insufficient experience to evaluate the approach. It implies radical institutional and political changes and is clearly not replicable everywhere. If effective, however, the strategy would keep the rural population larger than it would be otherwise and would also involve some reshuffling of the rural population at the micro level. Finally, land colonization schemes also imply a mix of instruments, such as migration assistance, infrastructure and the provision of agricultural inputs. The goals of these schemes are not primarily related to population redistribution, their per capita cost has been very high, and since the numbers helped have been very small their impact on the population distribution has been negligible.

TOWARDS A COMPREHENSIVE STRATEGY

The debate on population distribution policy is often reduced to a squabble among fierce protagonists of alternative approaches: strategies for the primate city and other large metropolises (whether accommodationist or controlling); rural development strategies and policies for the retention of rural population; and policies to promote small towns and intermediate cities (growth centres, secondary cities, counter-magnets and other components of the urban settlement pattern). This squabble is totally unnecessary, since the only viable population distribution strategy for a country with a high rate of population growth and a moderate degree of urbanization is a comprehensive strategy stressing the complementarities among these so-called alternatives. Metropolitan, "other urban" and rural development strategies are all complementary, and any population distribution policy that limits itself to one of these spatial components is bound to fail. The aim here is to outline some elements of such a comprehensive strategy. It is believed that this approach has a wide degree of, though not universal, applicability, at least in those countries (predominantly developing countries) where population distribution policies remain critical.

A. *Slowing primate city (metropolitan) growth*

Although some analysts have argued that increases in primacy are favourable to economic development,²³ most population distribution policy-makers are preoccupied with attempts to slow down the growth of the primate city and other large metropolitan areas. But most attempts to slow down primacy have been ineffective, even though in almost all developed countries and in some developing countries spontaneous forces have reduced the growth rate of the primate city to below the growth rates of some secondary cities. The failures are the result of adopting inappropriate policies, such as difficult-to-enforce control strategies,²⁴ or the belief that half-hearted attempts to promote secondary cities would in themselves divert migrants from their

intended primate city destination.²⁵ However, it is possible to outline a strategy that should slow down primate city growth without resource misallocation and major losses in efficiency.

This strategy has several components:

(a) Modification of implicit spatial policies reinforcing primacy. It is well known that most sectoral policies have unintended spatial impacts, and many of those adopted favour continued growth of the primate city and its core region. For example, the most common overall development strategy in developing countries, promoting industrialization via import substitution, encourages the location of industry near the national market (the primate city). In many developing countries, an alternative strategy of export promotion favouring agricultural products and natural resources would encourage population dispersion because these economic activities are often located in the periphery rather than the core. Pricing policies, especially controls on the price of food and tariffs and other forms of protection for urban-industrial goods, shift the internal terms of trade in favour of urban and against rural areas. The underpricing (sometimes zero pricing) of urban services (water, electricity, transport, sewerage, garbage collection etc.) keeps metropolitan living costs far below their true level, especially if the deficits of utility companies are covered by general national revenues rather than out of local taxes. To eliminate all these adverse implicit spatial policies at a stroke may be difficult because it would make a huge difference to metropolitan real incomes. To be politically acceptable, the policy reforms would have to be phased.

(b) Controls on employment growth. In developed countries, measures to control industrial development, usually via licensing schemes, have been reasonably successful. In developing countries, on the other hand, they have been implemented only rarely and usually weakly. A pretext for this inaction is that job creation in the primate city is important to reduce urban unemployment. However, the implication of the Todaro model is that formal sector job growth induces many more migrants than the jobs created, thereby either increasing urban unemployment or intensifying labour supply pressures on the informal sector. Effective control of the growth of primate city employment is a key means of weakening the polarization of population in the primate city and its core region. Whether this is achieved more successfully by direct controls (for example, prohibition of new factories) or taxation may depend on institutional factors in each country. Incentives for industrial decentralization do not work without a parallel policy of disincentives in the primate city and its core region.

(c) Redistribution of the national urban infrastructure investment pool. The primate city usually absorbs an excessive proportion (perhaps more than one half) of the public investment resources available for urban infrastructure and public service provision. This is the result of the influence of the metropolitan elites, the desire to promote the primate city as a symbol of international prestige, and ignorance of deficiencies in secondary cities. Although difficult to implement, a major redistribution of urban infrastructure investment resources in favour of small towns and intermediate cities is critical if the absorptive capacity of these other

urban centres is to increase. However, the problem would be eased substantially if full-cost-pricing principles were adopted for urban services in order to generate the resources needed to relieve the squeeze on the urban investment pool.

(d) Higher taxes on metropolitan living. These might take the form of taxes on urban wages, higher property taxes, or metropolitan residential taxes. In the case of property taxes, major advances would be made merely by improving the assessment and collection of existing taxes.

(e) Appropriate decentralized planning. Intraregional decentralization out of the primate city into the core region typically occurs at an earlier phase of national economic development than interregional decentralization. This decentralization into the region surrounding the primate city is usually supported by a metropolitan region plan. In this plan it is important to ensure that any satellite urban centres that are developed are located at a far enough distance that they do not reinforce primacy. There may be a conflict here between national population distribution policy goals and economic efficiency, since the reinforced primacy pattern of a ring of close-in satellites may be the most efficient. However, it is not consistent with slowing down metropolitan growth.

All of the above components (with the possible exception of (e)) have the effect that they reduce the real income gap between metropolitan and rural areas. In those countries where the primary determinant of migration is income differentials (certainly developing countries and possibly others), the urban-rural income gap can become a critical lever for changing the rural-metropolitan population distribution. All the instruments discussed above operate to reduce metropolitan real incomes (or to slow their growth). The other side of the coin, of course, consists of measures to raise real incomes in the rural areas. Rural development strategies are analysed below, but it is worth stressing the importance of improving the quantity, quality and delivery of public services in rural areas in order to narrow the severe gaps in service provision between the city and the countryside.

B. *Promoting small towns and intermediate cities*

The parallel strategies to direct attempts to slow down primate city growth are the promotion of small towns and intermediate cities and of rural development. However, whereas efficient rural development strategies will raise rural incomes it is not clear that they would have much impact on slowing down rural-urban migration. From this point of view, strategies of small towns and intermediate cities are the most critical for reducing the flow of migrants into the primate city and other very large metropolitan regions.²⁶ Small towns and intermediate cities are defined here very broadly, ranging from small urban centres located in rural regions to large regional metropolises and secondary cities. In countries emphasizing rural development most attention will be given to the small towns, while in countries with an ambitious national urbanization strategy the large secondary cities will be given priority. However, strategies involving the promotion of a single large metropolis to compete with the primate city (the counter magnet approach), the construction of new urban centres (the new towns approach), or the

relocation of the national capital are considered partial strategies and are discussed separately below.

A strategy of small towns and intermediate cities of the kind suggested here should not be confused with a growth centre strategy. It has at least three distinctive characteristics: a strategy of small towns and intermediate cities stresses indigenous development rather than relying on outside growth stimuli, and this implies a very different economic structure from that found in growth centres; the growth of small towns and intermediate cities depends upon strengthening urban-rural linkages; and there is as much attention given to social as to industrial infrastructure.

Some of the literature has suggested that small towns and intermediate cities have performed weakly in urban settlement patterns, largely on the evidence that the share of urban population found in some specified size class of small towns and intermediate cities has declined over time.²⁷ Closer examination of this evidence shows that the argument is faulty, because it does not take account of the most successful small towns and intermediate cities which have grown so rapidly that they move upwards out of the size class. Unless the data are corrected for this "size-class jumping" phenomenon, incorrect conclusions will be drawn.

The scope for implementing a strategy of small towns and intermediate cities is limited in most countries by the scarcity of public investment resources. Capital scarcity means that all small towns and intermediate cities cannot be promoted simultaneously. Hence, a strategy of small towns and intermediate cities has to come to terms with the principle of selectivity. Probably, the most sensible approach is to begin with those urban centres that appear to have the highest economic potential. Beginning with a few centres may enable policy-makers to find out which measures work best and which can be replicated elsewhere. Selectivity has its cost—the political repercussions of a highly discriminatory strategy. Political acceptability requires the development of and publicity for a long-term programme in which centres excluded in the first and early phases are subsequently given priority as the spatial scope of the strategy is extended. The principle of phasing is a necessary counterpart to the principle of selectivity.

A reasonable aim of a strategy of small towns and intermediate cities is "regional containment". This implies that migrants should be induced to remain in their home region by migrating to its urban centres rather than to the primate city or to large cities in other regions. It also implies an emphasis on circular migration and on commuting from rural areas. Stressing policies to redistribute population within regions provides a viable alternative to the primate city versus rural areas dichotomy that too often dominates national population distribution policies. It is also a much more feasible approach than "rural retention" strategies. Nevertheless, a beneficial by-product of a strategy of small towns and intermediate cities may be a higher rate of rural retention. The explanation of this is that improving accessibility to urban public service is very important for the long-run viability of rural populations, and a strategy of small towns and intermediate cities almost always involves an expansion in the scale and quality of public services in the urban centres selected for promotion.

A successful strategy of small towns and intermediate cities requires the simultaneous implementation of several key elements. These include:

(a) Implicit spatial policies discriminating against small towns and intermediate cities should be eliminated or reviewed. This is the obverse of the policies that reinforce primacy. Typical adverse policies are price and energy subsidies to large cities and an industrial development policy favouring large-scale industry;

(b) As suggested above, migration policies should be redesigned to induce migration to small towns and intermediate cities. This implies destination-specific relocation assistance, better provision of information about opportunities in small towns and intermediate cities, and a focus upon groups, communities and kinfolk in migration assistance;

(c) Industrial incentives should be offered only in small towns and intermediate cities. Wage subsidies are the preferred instrument, though they have rarely been used in practice. However, the decentralization of large-scale industry cannot be the salvation of small towns and intermediate cities, except in rare cases (for example, satellites close to the primate city);

(d) Economic development assistance should be geared to the economic structure prevailing in small towns and intermediate cities. This implies an emphasis on agro-processing industries, small-scale industry and informal sector activities. The most relevant type of aid is increasing the supply of credit and the provision of technical assistance, measures that are costly in terms of human resources. A more specific industrial development policy is assistance to industries that provide domestic import substitutes for goods formerly imported from the primate city (for example, household utensils and agricultural tools);

(e) Policies to strengthen the support of urban centres to rural areas, such as improving marketing facilities for agricultural produce and the provision of agricultural extension services, should be developed;

(f) Relief of infrastructure bottlenecks and expansion of public services. Since it is naïve to expect metropolitan elites to accept a major shift in infrastructure resources in favour of small towns and intermediate cities, these efforts would need to be supplemented with efficient cost-recovery schemes²⁸ and policies to give local governments their own sources of revenue;

(g) Investment in intraregional transport and communication. In particular, improving the hinterland road network is critical for speeding up the supply of agricultural produce, promoting commuting and circular migration, and increasing rural accessibility to urban services;

(h) Decentralization of public facilities (such as universities, technical colleges, and routine divisions of government departments) may be useful in strengthening the social structure of certain small towns and intermediate cities and in broadening their economic base. Obviously, however, the number of small towns and intermediate cities that could be helped in this way is very small;

(i) Strengthening local autonomy and self-reliance via the decentralization of administrative functions to local governments, increasing the supply of technicians and planners to improve local planning and managerial capacity, and fiscal reforms to give local governments greater freedom to spend

revenues and to broaden the revenue sources available to them. It is impossible to orchestrate a successful strategy of small towns and intermediate cities from the centre.

C. Rural development strategies

In the last decade or more, rural development planning has received high priority in development policy and in the funding activities of international donors. It has begun to correct a long-term "urban bias" in the allocation of budgetary resources for development.²⁹ It has also received a substantial degree of intellectual support because of its consistency with concepts such as "bottom-up" planning, *agropolitan development* and *basic needs strategies*.³⁰ Since comprehensive rural development strategies involve attention to small urban centres in order to promote off-farm jobs and to provide public services to the rural population, they blur into strategies of small towns and intermediate cities. Although rural development strategies usually aim at rural population retention, a preferable strategy would be to design policies to maximize the increase in rural per capita incomes. In many cases this might require more migration, both rural-rural and perhaps some rural-urban, rather than less.

A rural development strategy focusing on raising incomes rather than maximizing the rural population share might include the following elements:

(a) Effective land reform and other institutional changes that radically redistribute the ownership of land and other rural assets, such as irrigation systems;

(b) The adoption of efficient labour-intensive technologies and organizational methods (for example, multiple cropping);

(c) Provision of technical assistance to small farmers;

(d) Strengthening rural-urban linkages by investing in farm-to-market roads, policies to promote off-farm jobs in nearby small towns, more investment in quasi-urban services in the small urban centres to serve the rural as well as the urban population, improvements in agricultural marketing facilities and services in the market centres, and rationalization of the lower levels of the urban hierarchy in rural regions (a version of *agropolitan development planning*);

(e) Replication of successful "integrated rural development" plans, that is, multisectoral strategies encompassing agricultural development, community development activities and promotion of agro-processing activities.

From the perspective of population distribution policies, the most important aspect of a successful rural development strategy is that it must be built on its complementarities with small-scale urban strategies because of the critical importance of improving rural accessibility to public services and of strengthening rural-urban linkages. This implies that any use of population targets should be applied to the region as a whole (including its urban centres), not to the rural population alone. The increasing importance of circular migration and commuting for off-farm jobs reinforces this key principle. A regional development strategy for rural regions requires policy-makers to combine agricultural development policies, rural development planning and a lower-order strategy of small towns and intermediate cities.

PARTIAL STRATEGIES

This section briefly describes "partial" strategies that fall short of a national population distribution policy, though one or more of them might be included as components of a comprehensive strategy.

A. *Relocation of the national capital*

There are several examples where relocation of the national capital has been implemented (for example, Islamabad and Brasilia), is under way (for example, Abuja) or is being considered (for example, in the central region of the Republic of Korea). Its drawback is that it is a "one-shot" strategy that cannot be replicated. Its impact on the population distribution may be small if the new capital grows slowly (for example, Islamabad). Brasilia successfully changed the regional population distribution in Brazil, but a major contributory factor was the rapid growth of the neighbouring industrial city of Belo Horizonte. The resource costs of building a new capital from scratch are huge, and there may be communication diseconomies resulting from the geographical separation of the administrative capital from the national economic commercial centre. A better idea than this high-cost option is to decentralize some government functions either by the regional devolution of personnel and functions or by the geographical relocation of routine branches of government departments.

B. *Counter magnets*

A counter magnet strategy aims to reduce the polarization of population and economic activity to the primate city by creating a second (and perhaps a third) core region in some other part of the country. This requires choosing an existing large city located far from the primate city. The approach often involves a contradiction. To break the stranglehold of primacy a counter magnet must be large, but the more primate the city size distribution the less likelihood that a suitable counter magnet can be found. Thus, the strategy might work best where the urban distribution already has some degree of balance, for example, in the Philippines (Cebu and Davao), Colombia (Cali) or the Republic of Korea (Busan). It would be bound to fail in extreme cases of primacy, for example, Thailand. Also, the approach incurs the risk of replicating primacy's pathological symptoms, such as agglomeration diseconomies, congestion costs and spatial polarization in the counter magnet itself.

C. *New towns*

New towns are a population distribution policies option that has been widely applied in developed countries, centrally planned economies and developing countries. Building new towns on greenfield sites is usually much more expensive than expanding existing towns. Where unavoidable (for

example, when a sparsely populated region is opened up for industrial development), a new towns policy has to be implemented carefully: modest population targets and phasing of construction in line with effective demand; minimum infrastructure and public service standards; simple and utilitarian buildings rather than award-winning extravaganzas; encouraging industrial corporations to build housing for their workforce; a "sites and services approach" encouraging self-construction of housing, and a sound cost-recovery scheme so that new town construction does not become a major drain on public revenues. Even so, the impact of a new towns programme on the population distribution is usually small.

D. *Regional development policies for lagging regions*

Regional development policies for lagging regions are a favoured population distribution policy in developed countries, based on the aim of "moving work to the workers" rather than "workers to the work". Hence, they substitute for migration flows. Their main impact is to fossilize the existing population distribution, and they could not succeed in those developing countries still experiencing high population growth rates. They are less likely to be successful in an environment of slower economic growth, because the populations of rich regions are reluctant to acquiesce if inter-regional redistribution means an absolute decline in their public investment allocations rather than a shrinking share of an expanding base. In these circumstances, there is likely to be a shift from regional development policies to migration and relocation assistance.³¹

E. *Border region strategies*

A particular type of population distribution policy is where resources are pumped into geographically isolated regions, not primarily because of their lower incomes but because they are border regions. A concern with border regions may stem from national security reasons, rival claims to disputed territory (for example, the Amazon region in South America), or the need to keep the support of the indigenous population (for example, where ethnic groups straddle national boundaries, such as the Kurds in Iran and Iraq or the Baluchis in Iran and Pakistan). Models of spatial price discrimination provide an economic rationale for border region strategies. The monopolist (the State) discriminates in favour of those citizens with more elastic demands for national allegiance (border residents) and against those with more inelastic demands (those living closer to the geographical centre of the country). By making more public investment in the border regions and by charging a lower tax-price per unit of public investment, the State maximizes the size of its market (that is, the number of loyal and committed population). Because Governments take steps to encourage the existing population to stay and attempt to increase the numbers living in border regions (for example, by colonization programmes), the populations of border regions are often

larger than if determined solely by economic efficiency considerations.

F. Land colonization schemes

Land colonization schemes are common in both developing countries and centrally planned economies with undeveloped frontier regions. However, they are usually motivated by the desire to expand the area of cultivation rather than by population distribution goals, though they may improve the spatial match of population and resources by relocating people out of densely populated, low-fertility areas.³² Most analysts agree that government-sponsored projects have been very expensive, and yet still fail because of insufficient government support, and the numbers affected have been small.³³ High-cost, low-impact programmes are obviously not very cost-effective. There may be more benefits from support to "spontaneous" colonization where individuals take the initiative (such as the two million people who migrated to land opened up by construction of the Belem-Brasilia highway).

G. Ethnic population distribution policies

In a few cases, ethnic considerations become the dominant focus of a population distribution policy. The policy of *apartheid* in South Africa is the most extreme example, where populations are separated by race and tribe ("nations") into "homelands" and where rural-urban migration for non-whites is strictly controlled by pass laws. A much more modified version of an ethnic population distribution policy is found in Malaysia where the spatial component of the new economic policy aims to achieve target rates of participation, income and education levels for native Malays. The new economic policy gives a high priority to rural development because the Malays are heavily concentrated in rural areas. Similarly, urban-industrial development efforts (for example, growth centres) have been focused on areas where the Malays account for most of the local population. Although they may be rationalized on equity grounds if the favoured race is the poorest and most deprived (as in Malaysia), there is little justification for ethnic population distribution policies. Migration encourages ethnic mixing, so that the more mobile a society and the more government assistance to migration the less likely that conditions will lead to an ethnic population distribution policy.

IMPLEMENTATION PROBLEMS

Successful experiences with population distribution policies have been rare. Although this fact reflects a variety of considerations, from misconceived goals to poorly designed policies, a major failing has been difficulties of implementation. These difficulties stem from several sources:

(a) There is an irreconcilable gap between the long-run character of population distribution policies and the short-run preoccupations of Governments and policy-makers. The macrospatial distribution of population changes so slowly that a 20-year time horizon is appropriate, but policy-makers and politicians frequently expect results within three to four

years. The results are inevitable: overambitious expectations, the lack of political will, and rapid shifts and reversals in goals and instruments.

(b) Policy-makers frequently misunderstand the determinants of population distribution. In particular, there is a myopic focus on the effects of explicit population distribution policies, ignoring the much more powerful spatial impacts of national development strategies and other implicit population distribution policies. Unless policy-makers can get the implicit spatial impacts that conflict with population distribution policy goals under control, explicit population distribution policies are almost certain to fail.

(c) In many countries, there are serious conflicts of interest among regions and cities, minority groups (for example, the Moslems in southern Philippines) and ethnic groups that prevent the emergence of a national consensus on the aims and content of population distribution policy. These conflicts hamper implementation because they impose tight constraints of political acceptability on population distribution policies.

(d) The prevalence of highly centralized régimes and administrations makes it very difficult to implement population distribution policies efficiently, because they lack the detailed knowledge and understanding of local conditions and the operational flexibility to pursue what are usually dispersed strategies. Administrative decentralization schemes have been common in recent years, but they are usually diluted in the transfer from paper reforms into practice.

(e) If effective population distribution policies imply a heavy emphasis on the spatial redistribution of infrastructure (both industrial and social) and of economic activity, public investment resource constraints become a major limitation on their implementation rate. Palliatives to make these constraints less binding include: reductions in infrastructure standards, cost-recovery plans to generate additional resources for public service provision, the substitution of institutional changes for investment solutions, spreading risks by choosing many, small projects rather than a few, large projects, the use of self-balancing tax-subsidy schemes, and gaining the support of international and bilateral donors for population distribution policies. However, political considerations may inhibit the adoption of these remedies.

EVALUATION

There are at least five different methods of evaluating spatial policies such as population distribution policies. These are: *ad hoc* methods using whatever indicators of policy performance are available; comparing actual changes in the population distribution with expected changes in the absence of policy, and defining the difference as the policy impact; social cost-benefit analysis; evaluating policies according to the extent to which they meet predetermined goals (goal achievement criteria); and international comparisons.³⁴ None of these is entirely satisfactory.

Ad hoc methods rely on whatever data are available, and this is a severe problem with population distribution policies since the data base varies widely among countries. Many developing countries have either inaccurate population censuses or no censuses at all. Migration data, the key source of

information, are imperfect and infrequent in all countries. The combination of an arbitrary data base and the subjective judgement of the analyst on the relative importance of alternative evaluation criteria makes this approach too unsystematic and unreliable.

Comparing actual changes with no policy scenarios is an attractive approach in theory, but the practical difficulties of obtaining a no policy forecast are immense, especially in the population distribution policy field. It is necessary to be able to separate out not only the influence of autonomous market forces but also the population distribution impacts of macro and sectoral policies (the implicit spatial policies) which may reinforce (or more often offset) the effects of the explicit population distribution policies. Moreover, population distribution policies work very slowly, the lags of impacts behind implementation may be very long and uneven from one policy instrument to another, and long-run impacts may be very different from short-run impacts.³⁵

Cost-benefit analysis is an obvious approach, but the discussion above on the social costs and benefits of rural-metropolitan migration suggests how difficult it is to come to a firm conclusion. The major problem is that many of the important population distribution policy impacts are social and non-economic (even political), and these are much harder to quantify than the income, employment, output and population change effects that are the traditional variables of economic analysis. The externalities of population distribution policies are ubiquitous. By definition, these externalities have no market price, so that quantification in terms that might be aggregated (that is, in monetary terms) is difficult if not impossible. Of course, there are variants of cost-benefit analysis that restrict themselves to listing rather than precise quantification of impacts, but these are far from satisfactory.

Goal achievement evaluations are also an attractive idea, since policies are supposed to be implemented to attain specific goals. But, as was shown in the earlier discussion of population distribution goals, the relationship between population distribution targets and the broader societal goals that population distribution policies are intended to serve is murky and unclear. Also, this approach is restrictive since population distribution policies have unforeseen and unanticipated effects that might be excluded from a goal-achievement evaluation. Moreover, although goals are supposed to reflect the preferences of society, in practice they are formulated via a political process and quantified by a handful of policy-makers who may be tempted to trim goals to what is easily attainable (to guarantee success) or, alternatively, to express goals in such vague terms that any movement in the desired direction could be described as a success for policy. There are more objective goal-achievement methodologies. One is to compare the policies in operation with alternative mixes of policy instruments not chosen in terms of their relative cost-effectiveness in meeting stated goals. However, this approach is time-consuming and costly, and incurs the danger of diverting evaluation efforts from assessing actual policies to examining hypothetical policies that might be infeasible on other grounds (for example, political acceptability). An even more sophisticated approach is to compare the actual degree to which a goal has been met with the optimal result obtained by maximizing the goal in an objective function of a linear programme, subject to budget and other policy constraints. But there are usually multiple goals

in population distribution policies, and even if the required data were available there is little experience in solving multiple objective linear programmes in a policy context.

International comparisons of experiences with population distribution policies is the implicit evaluation method adopted in the present paper. Such comparisons have a certain value in suggesting the possible adoption in one country of a neglected policy instrument that has been successful in another or in shedding light on universal characteristics of population distribution problems. But the approach has serious drawbacks. The lack of consensus, even among experts, about what policy-makers should be doing and how they should be doing it means that there is no generally accepted reference frame against which practical experiences can be evaluated (unlike in the fertility policy field, where there is more agreement about what works, where there have been some notable successes, and where the major problems are not policy design but their implementation). Moreover, there is such an extreme diversity of experience (intercountry differences in the settlement pattern, different policy mixes, nuances in the design of particular instruments and how they are implemented) that it is especially difficult in the population distribution policy field to derive generalizable conclusions. In particular, policy-makers should be cautious in transferring policy instruments from one political, social and institutional environment to another.

CONCLUSIONS

Population distribution policies should not be assigned the same priority in all countries. In developed countries (including the more industrialized centrally planned economies) there is not much scope for population distribution policies. The high level of urbanization and the low rates of population growth mean that the distribution of population is unlikely to change very much. There is some movement, offsetting migration exchanges among urban areas and perhaps some dispersion of population down the urban hierarchy, but it is doubtful whether these more or less spontaneous changes are in any way pathological. Hence, there is not a clear case for intervention. Moreover, spatial policies are now being given much lower priority compared with macroeconomic and sectoral policies in an era of slower economic growth. The little scope for population distribution policies that exists in developed countries is probably on the following lines:

(a) Migration relocation assistance to individuals and households who wish to move out of areas of poor economic opportunity;

(b) Income supplements for immobile population in lagging regions with low economic potential;

(c) The planning of orderly (that is, avoiding boom-bust) development in new areas of resource exploitation (for example, mining areas, oil and gas fields).

The situation is very different in most developing countries. Especially in large countries with high rates of aggregate population growth and low or moderate levels of urbanization, there is substantial scope for population distribution policies, and indeed the implementation of such policies may play a critical role in their economic, social and political development. However, badly designed and poorly

implemented population distribution policies may be worse than no policy at all. There are certain general principles that can help in ensuring that population distribution policies at least work in the right direction, even though success cannot be guaranteed. These include:

(a) The development of a long-term population distribution policy and strategy that is agreed upon by the vast majority of those involved and which is consistently followed from one Government to another;

(b) Recognition that population distribution policies are less likely to work if they are strongly in opposition to counteracting market forces. Since early phases of economic development are associated with spatial polarization, population distribution policies aimed at dispersion are unlikely to succeed in low-income market economies;

(c) Realistic expectations about what a population distribution policy can do. Policy impacts are likely to be marginal and modest, at least in the short run;

(d) Appreciation that an effective population distribution policy must involve simultaneous action in both urban and rural areas, preferably with the goal of raising incomes and welfare for all households, regardless of where they live;

(e) A comprehensive strategy is likely to combine measures to slow down the growth of the primate city, the promotion of development in other urban areas (especially small towns and intermediate cities), and rural development strategies;

(f) Direct controls on primate city growth are undesirable. A preferable strategy would involve modification of adverse implicit spatial policies, elimination of price distortions, including charging primate city residents the full cost of urban services, and measures (particularly tax disincentives) to restrict job growth in the formal sector;

(g) A sensible strategy of small towns and intermediate cities would give attention to all levels of the urban hierarchy, but priority to especially small towns and intermediate cities (say, those with population of less than 100,000) or to large secondary cities (for example, regional metropolises) would vary according to the level of development and the spatial distribution characteristics of each country. The policies adopted should emphasize those sectors in which small towns and intermediate cities already have strength, such as small-scale industry, agro-processing activities and the informal sector, rather than attempting to attract capital-intensive large-scale industry. There is scope for new initiatives, especially in designing migration incentives to induce rural migrants to move to small towns and intermediate cities rather than to the primate city; these could be a major element in a 'regional containment' strategy, built upon a strengthening of urban-rural linkages. A redistribution of urban infrastructure investment resources, effective administrative decentralization and a degree of local fiscal autonomy are also important elements in a strategy of small towns and

intermediate cities. However, resource constraints will in most cases make it impossible to develop all small towns and intermediate cities at the same time, so selectivity and phasing are needed to ensure that the policy is both feasible and potentially acceptable;

(h) Rural development programmes should be directed towards increasing incomes and rural welfare rather than at population retention itself. Whether this would involve less migration or more will vary from case to case. Rural development policies should be framed in the broader context of regional development strategy, emphasizing rural-urban linkages;

(i) Other components of population distribution policies, such as relocation of the capital, countermagnets, new towns, border region strategies, and land colonization schemes, are only to be recommended in very special cases. Most applications of these partial strategies have been too costly, with negligible impacts on the overall distribution of population;

(j) A national population distribution policy based on urban and rural complementarities and dealing with all levels of the urban hierarchy will need to give some attention to investment in transport and communications. There is no general guideline as to whether intraregional or interregional infrastructure should receive priority. It depends upon the content and emphasis of the selected strategy. For example, a population distribution policy stressing regional containment would give priority to intraregional road networks, while one emphasizing the decentralization of national industries (and employment) would probably give priority to interurban communications (for example, the telephone system).

Population distribution policies have received increasing attention in recent years, especially in developing countries. Nevertheless, there remains a surprising lack of agreement about what population distribution policies should be trying to do, what strategies and instruments should be deployed, and how population distribution policies should be evaluated. Population distribution policies have become the key issue of population policy, and are likely to remain so throughout the 1980s. In countries where the population continues to expand at more than negligible rates and where the distribution of population is still in the process of transformation, a sound population distribution policy is an important aspect of overall development strategy. Attempts to change the distribution of population in a desirable direction can be productive in improving both efficiency and equity and in the pursuit of other societal goals, from political stability to national security. Consequently, it is very important to evaluate the variety of experiences, to improve the effectiveness of population distribution policies and to discover what strategies and instruments can be replicated from one environment to another. The present paper is a modest step in such an assessment.

NOTES

¹ For more country illustrations, see the companion paper, "Strategies of population distribution policies: comparative experiences in developing countries" (IESA/P/ICP.1984/EG.II/21).

² H. W. Richardson, "Polarization reversal in developing countries", *Regional Science Association. Papers*, vol. 45 (1980), pp. 67-85.

³ W. Alonso, "Five bell shapes in development", *Regional Science Association. Papers* 45 (1980), pp. 5-16.

⁴ *Report of the United Nations World Population Conference, 1974, Bucharest, 19-30 August 1974* (United Nations publication, Sales No. E.75.XIII.3).

⁵ The World Bank, *World Development Report*, 1982 (Washington, D.C., 1982) uses a fivefold taxonomy (low-income economies, middle-income economies, high-income oil exporters, industrial market economies, nonmarket industrial economies), while B. Renaud, *National Urbanization Policies in Developing Countries* (New York, Oxford University Press, 1981), p. 40, adopts a sixfold scheme (small countries, countries with limited domestic markets, large low-income countries, middle-income countries, advanced market economies, centrally planned economies).

⁶ D. R. F. Taylor, "The role and functions of lower order centres in rural development" (Nagoya, Japan, United Nations Centre for Regional Development, WP79-07, 1979).

⁷ D. R. Vining, R. Pallone and D. Plane, "Recent migration patterns in the developed world: a clarification of some differences between our and IIASA's findings", *Environment and Planning A*, vol. 13 (1981), pp. 243-250.

⁸ Renaud suggested the interesting hypothesis that the rate of urban population growth is fastest near the point when the level of urbanization is about 50 per cent of the national population (B. Renaud, "Economic fluctuations and speed of urbanization: a case study of Korea, 1955-75", *World Bank Staff Working Paper*, No. 270, 1977). This hypothesis has not been tested over a wide range of countries.

⁹ G. Ofer, "Economizing on urbanization in socialist countries: historical necessity or socialist strategy", *Internal Migration: A Comparative Perspective*, A. A. Brown and E. Neuberger, eds. (New York, Academic Press, 1977), pp. 277-303.

¹⁰ The developing countries are more varied in their choice of population distribution policy instruments, partly because of a wider spectrum of political systems, partly because of the frequent coexistence of a government sector more involved in productive activity and, paradoxically, a less regulated business sector.

¹¹ H. W. Richardson, "Defining urban population distribution goals in development planning", *Population Distribution Policies in Development Planning* (United Nations publication, Sales No. E.81.XIII.5), pp. 7-18.

¹² This idea has been explored in the so-called open-city models of an optimum geography, see H. W. Richardson, *The New Urban Economics: and Alternatives* (London, Pion, 1977), chap. 10.

¹³ O. Stark, "On slowing metropolitan city growth", *Population and Development Review*, vol. 6 (1980), pp. 95-102.

¹⁴ Renaud (1981), *op. cit.*, table D-2.

¹⁵ K. Davis, "The effects of outmigration on regions of origin", in Brown and Neuberger, *op. cit.*, pp. 147-166.

¹⁶ This argument is very controversial, since those with a high propensity to move may be inherently low-fertility households regardless of location.

¹⁷ See the papers by G. E. Schuh and M. Lipton in *Migration and the Labor Market in Developing Countries*, R. H. Sabot, ed. (Boulder, Westview Press, 1982).

¹⁸ M. P. Todaro, "A model of labor migration and urban unemployment in less developed countries", *American Economic Review*, vol. 59 (1969), pp. 139-148; J. R. Harris and M. P. Todaro, "Migration, unemployment and development: a two-sector analysis", *American Economic Review*, vol. 60 (1970), pp. 126-142.

¹⁹ For example, see J. E. Stiglitz, "The structure of labour markets and shadow prices in LDCs", in Sabot, *op. cit.*, pp. 13-63.

²⁰ For the case that the pendulum against growth centres has swung too far see H. W. Richardson, "Growth centers, rural development, and national urban policy: a defense", *International Regional Science Review*, vol. 3 (1978), pp. 133-152, and S. Boisier, "Growth poles: are they dead?" (Santiago, Latin American Institute for Economic and Social Planning, 1980).

²¹ P. Peek and G. Standing, eds., *State Policies and Migration: Studies in Latin America and the Caribbean* (London, Croom and Helm, 1982).

²² J. Friedmann and M. Douglas, "Agropolitan development: towards a new strategy for regional planning in Asia", F. Lo and K. Salih, eds., *Growth Pole Strategy and Regional Development Policy: Asian Experiences and Alternative Approaches* (Oxford, Pergamon Press, 1978), pp. 163-193; J. Friedmann and C. Weaver, *Territory and Function* (London, Edward Arnold, 1979), pp. 193-207.

²³ K. Mera, "On the urban agglomeration and economic efficiency", *Economic Development and Cultural Change*, vol. 21 (1973), pp. 309-324. More recently, Mera has demonstrated a strong positive relationship between the growth of large metropolitan areas and indices of social development, such as educational enrolments, literacy, life expectancy, declining

infant mortality, and reductions in both birth and death rates (K. Mera, "The pattern and pace of urbanization and socio-economic development: a cross-sectional analysis of development since 1960", Institute of Socio-Economic Planning, University of Tsukuba, Japan, DP 70, 1980).

²⁴ A. B. Simmons, "A review and evaluation of attempts to constrain migration to selected urban centres and regions", *Population Distribution Policies in Development Planning*, *op. cit.*, pp. 87-100.

²⁵ Accommodationist policies do not aim to slow down primacy but to accommodate the migrants already there by providing them with services and helping them to adjust to big-city life through informal sector employment programmes (A. A. Laquian, "Review and evaluation of urban accommodationist policies in population redistribution", *Population Distribution Policies in Development Planning*, *op. cit.*, pp. 101-112. Since there is a risk that such policies might accelerate migration, a critical policy challenge is to design and implement them in ways that do not attract additional migrants.

²⁶ D. A. Rondinelli, *Developing and Managing Middle-Sized Cities in Less Developed Countries* (Washington, D.C., Office of Urban Development, United States Agency for International Development, 1981); H. W. Richardson, "Policies for strengthening small cities in developing countries", paper presented at the Expert Group Meeting on the Role of Small and Intermediate Size Cities in National Development, United Nations Centre for Regional Development, Nagoya, Japan, 26 January-2 February, 1982.

²⁷ United Nations Centre for Regional Development, 1982, *op. cit.*, appendix 4; D. A. Rondinelli, "A comparative analysis of demographic, social and economic characteristics of intermediate cities in developing countries" (Nagoya, United Nations Centre for Regional Development, Expert Group Meeting on the Role of Small and Intermediate Size Cities in National Development, 26 January-2 February, 1982).

²⁸ Surveys have shown that the urban poor lacking essential services are willing to pay for them. Usually, the private sector substitutes (for example, water from carriers) are much more expensive.

²⁹ M. Lipton, *Why People Stay Poor: Urban Bias in World Development* (Cambridge, Massachusetts, Harvard University Press, 1977); J. Friedmann, "Urban bias in regional development policy", *Humanizing Development: Essays on People, Space and Development in Honor of Masahiko Honjo*, R. P. Misra, ed. (Singapore, Maruzen Asia), pp. 143-159.

³⁰ W. B. Stöhr and D. R. F. Taylor, eds., *Development from Above or Below? The Dialectics of Regional Planning in Developing Countries* (New York, Wiley, 1981).

³¹ H. W. Richardson, "Regional policy in a slow economy" (paper presented at the North American Regional Science Association meeting, Pittsburgh, November 1982).

³² S. I. Abumere, "Population distribution policies and measures in Africa south of the Sahara: a review", *Population and Development Review*, vol. 7 (1981), pp. 421-433.

³³ T. S. Bharin, "Review and evaluation of attempts to direct migrants to frontier areas through land colonization schemes", *Population Distribution Policies in Development Planning*, *op. cit.*, pp. 131-143; G. Martine, "Colonization in Rondonia: continuities and perspectives", in Peek and Standing, *op. cit.*, pp. 147-172.

³⁴ H. W. Richardson, *Regional and Urban Economics* (Harmondsworth, Middlesex, Penguin, 1978), pp. 253-256. For other approaches to spatial policy evaluation, see H. Folmer, "Some methodological aspects of measuring effects of regional economic policy", and W. Stöhr and F. Tödtling, "Quantitative, qualitative and structural variables in the evaluation of regional development policies in Western Europe", papers presented at the Conference on Regional Problems and Policies in Western and Eastern Europe, Bellagio, Italy, 7 to 11 June, 1982.

³⁵ This last point requires a few illustrations. Industrial growth in rural areas may suffer from labour absenteeism at harvest and other peak times in the short run, but this problem may evaporate in the longer run as the rural labour force adjusts to industrial work habits. The short-run effects of industrial decentralization efforts in intermediate cities may be very weak, but in the longer run industrial growth may shoot ahead after a critical mass of industrialization builds up. Entrepreneurs may be attracted to small towns and intermediate cities or rural areas by low wages and an elastic supply of labour, but these conditions may disappear in the longer run as the demand for labour rises. Migrants to the primate city may have short-term adjustment problems, but in the long run they usually adapt very well to metropolitan life.

METROPOLITAN MIGRATION AND POPULATION GROWTH IN SELECTED DEVELOPING COUNTRIES, 1960-1970

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SUMMARY

The purpose of the present paper is to estimate the components of metropolitan population growth in selected developing countries during the 1960-1970 period. The results of the analysis show that net migration (including reclassification) contributed about 37 per cent to total metropolitan population growth, with the remainder of the growth attributable to natural increase. But the paper points out that migration, in many ways, has a much stronger impact on metropolitan growth than suggested by that proportion: (a) the study includes several metropolitan areas which, for various reasons, are unlikely to receive many migrants; without those cities, the share of metropolitan growth from net migration is 44 per cent; (b) the study also provides estimates of the natural increase of migrants after their arrival in the metropolitan areas; when the natural increase of migrants is added to migration itself, the total contribution of net migration to metropolitan population growth increases to 41 per cent (and to 49 per cent for the more limited number of metropolitan areas); (c) even where net migration contributes a smaller proportion to metropolitan growth than natural increase, the rates of net migration are generally high and should be viewed in the context of rapid metropolitan population growth from natural increase alone. Finally, the paper also compares the components of metropolitan growth with the components of growth in the remaining urban areas. The results show that the metropolitan areas, in general, grow faster than the remaining urban areas, and that this more rapid growth is mostly due to a higher rate of net migration.

INTRODUCTION

During the past decade, more than 70 cities doubled their population size, and several of those cities are projected to double again during the 1980s.¹ Some cities, mostly in Africa, are certain to quadruple before the end of the present century. Many other cities grew by rates exceeding 50 per cent per decade, and this pace translated into additions of hundreds of thousands of people during one decade in the case of large cities. Moreover, city populations, and urban population in general, are growing substantially faster than total populations, and this differential is widening in several countries. As a result, urbanization continues at a rapid and sometimes accelerating pace, and there are likely to be 25 cities with over 10 million people in the world by the year 2000.²

Population figures by themselves cannot, of course, tell the entire story. The continuing debate over the relationship between population growth and development has made it clear that rates of population growth must be interpreted within the specific social, economic and environmental context of each population, and this applies to cities no less than to countries. In some countries, the growth of a large city is

seen as desirable, given the existing circumstances, for it relieves the pressure on valuable farm land; such is the case for Jakarta in Indonesia.³ Other cities, for example, Mexico City, are clearly suffering the costs of their virtually unprecedented magnitude of growth. Yet it is difficult to imagine any city doubling in population size within the time span of only one decade that would not experience growth-related problems. Population change of such magnitude undoubtedly exerts enormous demographic pressures on the resources of most cities in terms of necessary financial expenditures on housing, transportation, sanitation, fire protection and employment. The demographic magnitude of metropolitan population growth is well illustrated by the case of Mexico City, which grew within a mere 30 years from 3 million inhabitants in 1950 to 15 million in 1980. During the 1970-1980 decade alone, Mexico City added over 500,000 persons annually to its population.

But the effects of population growth of such volume, tempo and persistence as can be observed in many parts of the world go beyond the physical and fiscal resources of a city. Such growth, particularly when a large part of it consists of immigrants, poses serious questions about a city's social organization itself. How can a city hold together while having to absorb tens of thousands and, sometimes, hundreds of thousands of additional persons every year? Are any new forms of social control required to avoid disintegration of the

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city? How can large streams of migrants, often with different cultures, be incorporated into city life? It is in the face of these problems that national Governments and policy-makers are increasingly pointing to population redistribution and the growth of large metropolitan centres as one of their major demographic concerns; and the likely continuation of high levels of urban and metropolitan population growth makes its analysis ever more pressing today.

It is the purpose of the present article to analyse the components of population growth in large metropolitan areas⁴ in developing countries that are located in Africa, Asia and Latin America. The analysis has the following objectives: (a) to estimate the relative contributions of natural increase and net migration to the growth of metropolitan areas, (b) to compare the components of growth for metropolitan areas with those for urban areas in general and (c) to assess the natural increase of migrants after their arrival in metropolitan areas.

Although the present study addresses mainly the demographic aspect of population growth and employment in metropolitan areas, the distinction between natural increase and migration is crucial for policy planning because policies aimed at migration require very different planning instruments than family-planning policies. Knowledge about the relative contributions of the two components thus is essential for the formulation of successful development plans.

THE PROCESS OF URBAN AND METROPOLITAN POPULATION GROWTH

Previous findings have shown that urban population growth in a number of developing countries was mostly due to rural-to-urban migration.

During the 1930-1950 period, for example, migration was found to have accounted for one half and more of urban population growth in several Latin American countries (Venezuela, Colombia, the Dominican Republic, Nicaragua, Paraguay and El Salvador).⁵ This role of migration in the urban growth process of developing countries was viewed as being consistent with the situation that existed in nineteenth-century European cities where migration was often even more eminent. Many cities then experienced a natural decrease due to low levels of fertility (which partly resulted from heavy in-migration of single adult males) and relatively high mortality. Net in-migration thus was the major, and sometimes only, source of urban population growth in Europe at that time.⁶

But the relative contributions of natural increase and net migration seem to have changed after 1950 in most developing countries. Mortality began to drop substantially while fertility continued at fairly high levels, thus leading to increased rates of natural increase in both urban and rural areas. During the same time, developing countries became increasingly urbanized which reduced the pool of potential rural-urban migrants. As a result, net migration was replaced by natural increase as the leading source of urban population growth. This new situation was shown by Arriaga for selected Latin American countries,⁷ and similar findings were obtained for developing countries in other regions.⁸ These selected findings are confirmed by the most compre-

hensive study to date of urban population growth after 1950 in developed and developing countries, carried out in the Population Division of the United Nations Secretariat.⁹ That study found that, on average, about 60 per cent of urban growth in developing countries was contributed by natural increase, with net migration¹⁰ and reclassification accounting for the remaining 40 per cent. These proportions were the reverse for developed countries.

Despite the growing empirical information about the relative contributions of migration and natural increase to urban population growth, little is yet known about the relationships between these components in the course of urbanization and the demographic transition. Preston, for example, noted that the single most important determinant of urban population growth is the rate of growth of the total population.¹¹ But it remains unclear through which mechanism the total rate of growth affects urban growth. It is possible, for example, that the urban natural increase varies systematically with total natural increase. Another possibility is suggested by the theory of demographic response according to which rural areas can respond to population pressure by lowering fertility, by out-migration or by a combination of both.¹² If migration is chosen as the response to population pressure, the relationship between total and urban population growth would be mediated by rural-urban migration. This possibility is also suggested by Keyfitz and Philipov¹³ who note that rural population growth is the most significant factor influencing urban growth, since it is likely to lead to greater rural-urban migration.

Assuming various hypothetical conditions, Keyfitz¹⁴ examined the relationship between urbanization, urban population growth and its components in a formal way. His model starts out with the following notions:

"... when there is no city population there can be no natural increase, and during the time after a city is established but still small, its births cannot be numerous. At the other extreme, when the country is mostly urbanized there is little rural population left to migrate to cities. Between these two extremes there must be a moment in the course of urban evolution when natural increase begins to exceed in-migration."¹⁵

Using a hypothetical population for which the rate of natural increase is set at 3 per cent in both rural and urban areas, and the rate of rural-urban migration at 2 per cent, Keyfitz estimates that the cross-over point at which natural increase exceeds migration occurs when approximately 40 per cent of the population is urbanized. His results show further that higher rates of migration lead to an earlier occurrence of the cross-over point.

But the constant rates for the two components are unrealistic, as readily acknowledged by Keyfitz, for the process of urbanization in any country is the result of fluctuating rates of natural increase and migration. He therefore goes on to construct a more realistic model permitting rates to fluctuate, and he discusses various hypothetical outcomes on the basis of assumed changes in the rates of natural increase and migration, without actually testing these models with real data. But his discussion nevertheless permits an identification of various situations that appear to be realistic representations of actual outcomes of the urbanization process. First,

at low levels of urbanization, one can expect net rural-urban migration to exceed natural increase as a source of urban population growth. Secondly, at moderate levels of urbanization, urban population growth will likely result primarily from natural increase; this situation appears to characterize many of the currently developing countries. And thirdly, at advanced levels of urbanization, migration again becomes the larger component of urban population growth, as demonstrated by the experience of the more developed countries.¹⁶ But it should be stressed that although the relative contributions of the components of urban population growth are related to the level of urbanization, they are mostly a function of the rates of natural increase and migration.¹⁷ Thus, if the rate of natural increase in the developing countries continues at the current high levels, or if it declines only slightly, one should expect that migration remains the smaller factor in urban population growth even at higher levels of urbanization.¹⁸

In contrast to the growing understanding of the way in which natural increase and net migration contribute to urban population growth, the dynamics of these components remain less clear in the case of metropolitan growth. This situation is partly the result of the difficulties in obtaining reliable and detailed age-sex data for individual metropolitan areas as opposed to all urban areas combined. It is also due to the greater complexity of population growth in an individual locality, because aside from rural-urban migration, an individual metropolitan area can also benefit from migration originating in other urban places.¹⁹

A recent study of metropolitan areas in Arab countries showed that migration, on average, accounted for about 42 per cent of population growth in 49 metropolitan areas located in nine countries.²⁰ Components of urban population growth are available from the earlier United Nations study²¹ for three of the nine countries, and a comparison of the results shows that, in all three cases, net migration is a more significant factor in the growth of a country's capital than in total urban growth. The greater role played by migration in metropolitan growth is not entirely unexpected, particularly in the case of political capitals, for these areas are often the centre of regions where economic growth is concentrated.²² These cities are likely to offer greater opportunities for migrants than urban places in general.

On the other hand, as a city grows beyond a certain size, the relative contribution by migration should be expected to decline, for the increasing population base of the city would require an ever-growing volume of migration just to maintain its relative size. But it is not clear at what population size the contribution of migration is surpassed by natural increase. It must also be noted that if natural increase falls to low levels, migration could continue to provide the major share of metropolitan growth even for very large metropolitan areas.

Given the lack of a clear understanding of the process by which metropolitan populations grow in developing countries, the present analysis by necessity is largely exploratory. But for several reasons, it is expected that net migration constitutes a larger share of metropolitan population growth than of urban population growth. First, the specific metropolitan areas selected for this study are largely capital cities and occupy a dominant role in their countries in economic, social and political terms. This position makes them particu-

larly attractive to migrants in search of work, and these cities are thus likely to receive a disproportionately large share of total net migration. Second, while increasing urbanization diminishes the potential for rural-urban migration to be the major source of urban population growth, this is not the case for metropolitan areas, because their growth can benefit from urban-to-metropolitan migration as well. And third, the large size of several of the selected metropolitan areas has to be seen in the context of the size of the total population. Since large cities such as Mexico City or Sao Paulo are located in large countries, migration to these metropolitan areas can still constitute a substantial share of their population growth.

METHODS OF PROCEDURE AND SELECTION OF METROPOLITAN AREAS

A. *Estimating components of metropolitan population growth*

Population in metropolitan areas with fixed boundaries can change through two sources: natural increase (the difference between births and deaths) and net internal migration (the difference between in-migration and out-migration), provided that the country can be assumed to be a closed population. If the population is not closed, immigration and emigration would be a third source of population change, and when the metropolitan boundaries are not fixed, changes in boundaries become a fourth source. The decomposition of population change has long been an important concern among demographers, for it can reveal important differences in the processes by which change occurs. If one knows, for example, that a certain locality grows mostly from migration rather than from natural increase, the causes for this migration can be further examined; and if there is concern about this growth, policies will be more effective if they address these migrations rather than fertility.

Despite the importance of distinguishing among the various sources of population change, little information exists for cities (or other geographical units, for that matter) permitting such distinctions. Vital statistics systems often have incomplete coverage and national censuses frequently contain migration questions that are not comparable, so that components of population growth in cities of developing countries are not readily identifiable. For that reason the present analysis applies the decomposition procedure used in the earlier study of *Patterns of Urban and Rural Population Growth*.²³ Although that method is indirect, it has yielded very satisfactory results.

The procedure starts with an application of national census survival ratios to metropolitan age cohorts during the 1960-1970 period. Differences between the actual number of persons in a specific age group in the metropolitan area and the number of persons expected from the application of the census survival ratios were then attributed to net migration and reclassification of metropolitan boundaries. The sum of those changes across cohorts resulted in an estimate of how much change in population was attributable to net migration and reclassification. The difference between this number and the total growth in a metropolitan area is then assumed to be due to natural increase in that locality.

The *Patterns of Urban and Rural Population Growth* study made a number of refinements in the method which are followed here as well. First, since this method yields only surviving migrants, they were survived backwards to the middle of the period in order to obtain the total amount of migration during the period. For this purpose, it was assumed that total migration in a cohort as well as migrants' deaths are equally distributed throughout the intercensal period. This means that migrants on average were in the city for five years, and the net surviving migrants thus were survived backwards by the same number of years. Second, in order to estimate the number of migrant children aged 0-4, the observed child-woman ratio of the city population at the end of the period (the second census) was applied to migrant women. For further refinement, this ratio was standardized by age by applying a fertility age-schedule that has been found to be characteristic of populations with high fertility. With the level of the fertility function set at the number of children aged 0-4 in each metropolitan area at the end of the intercensal period, the cumulative fertility rates were apportioned according to the standard age-schedule. Finally, it was assumed that mortality in the city was lower than in the country as a whole; specifically, city cohorts were expected to have 25 per cent fewer decrements per initial member in the cohort size. This procedure assumes, giving the existing mortality conditions in developing countries, an addition of five years in the life expectancy of city residents. It should be noted that this assumption reduces the estimates of population growth attributable to net migration and reclassification, compared to the assumption of no rural-urban mortality differentials.²⁴

An evaluation of this decomposition method reveals two major shortcomings: first, it does not distinguish between net migration and reclassification of metropolitan boundaries and, second, it does not make explicit the role of international migration in the process of urban population growth. Concerning the reclassification of boundaries, it should be noted that the present study employs the concept of metropolitan areas rather than city proper. It has been argued that metropolitan areas in developing countries are less frequently changed than those in developed countries, because their generally lower density makes it easier to accommodate population growth without boundary changes.²⁵ Population growth of metropolitan areas should also be less affected by reclassification than urban growth, for reclassification in the latter case also includes, besides boundary changes, reclassification of previously rural localities as urban. But it is impossible to say exactly by how much boundary changes affected population growth in the metropolitan areas that are subject of the present analysis. Gatica²⁶ reports that for all of Latin America, reclassification of urban areas accounted for 14 per cent of urban population growth during the 1960s. According to one estimate for Seoul,²⁷ reclassification of metropolitan boundaries contributed 5.6 per cent to the population growth of this city during the 1960-1970 decade. While this proportion differs from one metropolitan area to the next, it can be assumed that net migration in general is more important for metropolitan population growth than is reclassification of metropolitan boundaries.

As regards international migration, the extent to which the decomposition method will allocate its effects on population

growth to net migration depends on the geographical distribution of international migration as well as on the direction of the net flow. For either net immigration or emigration, its effects on metropolitan population growth will be correctly allocated to the migration component as long as most of that international migration originates in, or is destined for, the metropolitan area. But where international migration is either equally distributed in the country or concentrated outside the metropolitan area, the decomposition method will underestimate net migration to the metropolitan area in the case of net immigration and overestimate it in the case of net emigration. Information on international migration for the metropolitan areas is not available in sufficient detail that would permit an examination of these various situations, and it is therefore difficult to say how much the results of the analysis are affected by international migration.

B. Selection of metropolitan areas

The selection of the cities²⁸ was guided by several criteria and constraints. The initial plan was to choose the largest city from each of the developing countries that were included in the *Patterns of Urban and Rural Population Growth* study in order to examine if and to what extent the process of growth of the largest city differs from the general urban patterns in the same country. The technique estimating components of growth requires, as noted above, population data for cities by age and sex. Unfortunately, several countries publish this disaggregated information for urban areas in general but not for cities, and vice-versa. For these reasons, a complete congruence between the countries of the urban areas in the *Patterns of Urban and Rural Population Growth* study and the countries of the cities included in the present analysis could not be achieved. But there is enough of an overlap to assess the urban-city differential of the sources of population growth for 13 countries.²⁹

The present study examines population growth in 26 cities, of which 5 are in Africa, 8 in Asia and 13 in Latin America (see table 1).³⁰ The population data for these cities, as well as for their countries, were obtained from national census publications. These cities, in general, are the political capitals of their countries, but some additional large cities were selected in Brazil, Mexico and South Africa. Brazil is the only country for which the capital, Brasilia, was left out.³¹ A new city in the interior of Brazil, Brasilia was specifically built as the new capital which it became in 1961. The pattern of population growth in Brasilia during the 1960s therefore represents such a special case that it was decided not to include this city in the analysis.

All cities that were selected are large cities: at the beginning of the 1960-1970 decade they had over 500,000 population (except for Accra, which reached that level during the 1960s) and in 1970 only four cities were below 1 million inhabitants. The group of cities also includes some of the largest cities of the world, with over 4 million residents in 1970: Jakarta, Seoul, Teheran, Rio de Janeiro, Sao Paulo, Buenos Aires and Mexico City. The four Latin American cities are well over 10 million inhabitants in 1980, and Mexico City and Sao Paulo are projected to grow to over 20 million by the year 2000.³²

TABLE 1. POPULATION GROWTH OF 26 CITIES IN SELECTED DEVELOPING COUNTRIES, 1950-1980

Region and city (country)	Inhabitants (thousands)				Average annual rate of growth (per 100 population)			
	1950	1960	1970	1980	1950-1960	1960-1970	1970-1980	1950-1980
Africa								
Algiers (Algeria)	445	638 ^a	943 ^d	1 321	6.0	3.9	2.4	3.6
Accra (Ghana)	241	388	738	1 447	4.8	6.2	6.7	6.0
Cape Town (South Africa)	691	805	1 106	1 517	1.5	3.2	3.2	2.6
East Rand (South Africa)	610	718	890	1 196	1.6	2.1	3.0	2.2
Johannesburg (South Africa)	1 006	1 148	1 400	1 821	1.3	2.0	2.6	2.0
Asia								
Bangkok (Thailand)	1 482	2 135	3 077	4 688	3.7	3.7	4.2	3.8
Damascus (Syrian Arab Republic) ...	389	530	836	1 475	3.1	4.6	5.7	4.4
Hong Kong (Hong Kong)	1 747	2 667 ^b	3 462 ^e	4 613	3.8	2.6	3.2	3.2
Jakarta (Indonesia)	1 829	2 905 ^b	4 546 ^e	7 038	4.2	4.5	4.9	4.5
Manila (Philippines)	1 588	2 236	3 495	5 335	3.4	4.5	4.2	4.0
Seoul (Republic of Korea)	1 113	2 445	5 425	8 558	7.9	8.0	4.6	6.8
Singapore (Singapore)	815	1 230	1 562	1 770	4.1	2.4	1.2	2.6
Teheran (Islamic Republic of Iran) ...	1 126	2 827 ^d	4 691 ^e	5 394	5.8	5.1	3.5	5.2
Latin America								
Belo Horizonte (Brazil)	374	884	1 638	2 921	8.6	6.2	5.8	6.9
Bogota (Colombia)	628	1 697 ^c	2 934 ^f	4 254	7.1	5.5	6.2	6.4
Buenos Aires (Argentina)	5 251	6 739	8 289	10 075	2.5	2.1	2.0	2.2
Caracas (Venezuela)	701	1 336 ^b	2 283 ^e	3 423	5.9	5.4	4.0	5.3
Guadalajara (Mexico)	419	851	1 455	2 767	7.1	5.4	6.4	6.3
Lima (Peru)	1 101	1 965 ^b	3 176 ^e	4 656	5.3	4.8	4.2	4.8
Mexico City (Mexico)	2 999	5 245	8 615	15 056	5.6	5.0	5.6	5.4
Monterrey (Mexico)	370	716	1 242	2 113	6.6	5.5	5.3	5.8
Porto Alegre (Brazil)	435	1 026	1 530	2 447	8.6	4.0	4.7	5.8
Recife (Brazil)	659	1 149	1 692	2 460	5.6	3.9	3.7	4.4
Rio de Janeiro (Brazil)	2 934	4 982	7 061	10 417	5.3	3.5	3.9	4.2
Santiago (Chile)	1 348	1 984	2 819	3 931	3.9	3.5	3.3	3.6
Sao Paulo (Brazil)	2 480	4 664	8 011	13 240	6.3	5.4	5.0	5.6

Source: 1950 and 1980, *Estimates and Projections of Urban, Rural and City Populations, 1950-2025: The 1980 Assessment* (ST/ESA/SER.R/45); 1960 and 1970, national censuses.

^a1956.

^b1961.

^c1964.

^d1966.

^e1971.

^f1974.

^g1976.

SELECTED ECONOMIC AND DEMOGRAPHIC INDICATORS

Before presenting the results of the component analysis of population growth in the selected developing cities, a brief description will be given of the economic and demographic structure of the countries in which the cities are situated. This background information will help to place the cities in the context of the national economic and demographic development of which they are an integral part. Selected indicators are presented in table 2. These data show that around 1960, agriculture accounted for over one half of the labour force in 12 of the 18 countries. The share of the labour force in agriculture declined during the 1960s in all countries considered here, but agriculture remained the source of over 20 per cent of total employment in 15 countries throughout the period, and it continued to be the single largest industrial employment sector in 11 countries.

Using the level of agricultural employment as an indicator of economic development, the countries were divided into four broad groups, and they are listed in ascending order of level of agricultural employment.³³ Accordingly, countries with the smallest share of agricultural employment are considered to be the most developed.

Higher levels of development are usually accompanied by lower fertility and lower mortality, and the situation in the

countries of the present study is no exception: countries with low proportions of employment in agriculture tend to have low birth rates and low death rates. These relationships, in fact, were even more pronounced in 1970 than in 1960. The positive association between birth and death rates, moreover, implies that countries might not differ substantially with respect to their natural increase, and that therefore no relationship between levels of development and natural increase would be observed. This was indeed the case for the countries in 1960 when there was no relationship between development level and natural increase (Spearman's $r = -.070$). But the situation had changed by 1970, when the more developed countries tended to have lower natural increase than the less developed countries ($r = -.702$). One possible explanation for this change, following the theory of the demographic transition, is that the less developed countries are still in an earlier phase of the demographic transition where mortality falls more rapidly than fertility, thus resulting in higher natural increase.

A country with a large agricultural employment sector generally has also a large rural population, and this relationship is clearly exhibited by the 18 countries in the present study: among countries, the higher the per cent of employment in agriculture, the lower the per cent urban (the rank-order correlation coefficients are $-.930$ and $-.969$ in 1960 and 1970, respectively).

TABLE 2. SELECTED ECONOMIC AND DEMOGRAPHIC INDICATORS, 1960 AND 1970
1960

Per cent of employment in agriculture	Country	Population (in thousands)	Per cent of employment in agriculture	Crude birth rate (per thousand population)	Crude death rate (per thousand population)	Rate of natural increase	Per cent urban	Per cent of total population in largest city	Per cent of urban population in largest city	Index of urban primacy	Rural density ^a
20 or less	Singapore	1 591	7.5	38.0	8.0	30.0	77.6	77.6	100.0	—	n.a.
	Hong Kong	3 133	7.8	35.0	7.0	28.0	89.1	89.1	100.0	—	n.a.
	Argentina	19 962	20.0	24.0	9.0	15.0	73.6	33.8	45.7	10.20	6.9
	Average		11.8	32.3	8.0	24.3	80.1	66.8	81.9	10.20	6.9
21 to 40	Chile	7 374	30.0	37.0	12.0	25.0	67.8	26.9	37.9	7.47	19.5
	South Africa	15 974	32.2	41.8	17.0	24.8	46.6	7.2	15.5	1.43	13.0
	Venezuela	7 524	34.9	46.0	10.0	36.0	66.6	17.8	26.6	3.15	26.7
	Average		32.4	41.6	13.0	28.6	60.3	17.3	26.7	4.02	19.7
41 to 60	Colombia	17 484	51.4	46.0	14.0	32.0	48.2	9.7	17.1	1.57	40.9
	Brazil	70 008	51.9	40.0	11.0	29.0	46.1	7.1	15.1	1.07	33.2
	Peru	9 902	52.5	47.0	19.0	28.0	46.3	19.9	38.0	13.43	34.4
	Islamic Republic of Iran	25 075	53.9	47.0	21.0	26.0	33.6	11.3	26.3	6.13	31.2
	Syrian Arab Republic	4 563	54.2	47.0	18.0	29.0	36.8	11.6	34.8	1.38	7.1
	Mexico	34 810	55.1	45.0	12.0	33.0	50.6	15.1	27.7	6.05	21.9
	Average		53.2	45.3	15.8	29.5	43.6	12.4	26.5	4.94	28.1
61 or more	Ghana	6 727	63.8	49.0	24.0	25.0	23.3	5.8	25.1	1.78	17.2
	Republic of Korea	24 974	66.4	41.0	13.0	28.0	27.7	9.8	34.5	2.05	168.8
	Algeria	9 624	66.8	51.0	20.0	31.0	30.4	6.6	26.6	2.25	22.8
	Indonesia	96 202	74.8	47.0	23.0	24.0	14.6	3.0	20.0	2.87	121.1
	Thailand	26 212	83.7	46.0	17.0	29.0	12.5	8.2	65.1	25.90	52.4
	Average		69.4	46.5	18.7	27.8	23.1	7.0	33.1	7.30	74.0

1970

Per cent of employment in agriculture	Country	Population (in thousands)	Per cent of employment in agriculture	Crude birth rate (per thousand population)	Crude death rate (per thousand population)	Rate of natural increase	Per cent urban	Per cent of total population in largest city	Per cent of urban population in largest city	Index of urban primacy	Average annual growth rate of total population 1960-1970
20 or less	Singapore	2 075	3.4	23.0	5.0	18.0	75.3	75.3	100.0	—	2.4
	Hong Kong	3 937	4.3	22.0	5.0	17.0	89.7	89.7	100.0	—	2.5
	Argentina	23 390	15.0	22.5	8.6	13.9	78.4	35.4	45.5	10.35	1.4
	Average		7.6	22.5	6.2	16.3	81.1	66.8	81.8	10.35	2.1
21 to 40	Chile	8 885	23.8	28.0	9.0	17.0	75.2	31.7	41.0	10.99	2.1
	Venezuela	10 722	25.6	38.0	8.0	30.0	76.2	20.4	26.2	3.32	3.4
	South Africa	21 794	30.9	38.0	12.0	26.0	47.8	6.4	14.0	1.30	2.6
	Colombia	23 442	37.9	36.0	11.0	25.0	59.8	12.5	21.0	1.88	2.9
	Mexico	48 225	39.4	42.0	9.0	33.0	59.0	17.9	30.3	5.75	3.3
	Average		31.5	36.4	9.8	26.2	63.6	17.8	26.5	4.65	2.9
41 to 60	Peru	13 262	44.8	42.9	14.7	28.2	57.4	24.0	38.6	10.80	2.8
	Brazil	92 953	45.6	38.0	9.0	29.0	56.9	8.7	15.3	1.15	2.8
	Islamic Republic of Iran	33 662	46.0	45.0	16.0	29.0	40.9	13.9	28.1	6.51	2.9
	Algeria	12 075	50.0	49.0	16.0	33.0	45.6	7.8	16.5	3.48	2.3
	Republic of Korea	31 435	51.0	30.0	10.0	20.0	40.7	17.6	41.7	2.93	2.4
	Syrian Arab Republic	6 304	51.1	47.0	15.0	32.0	43.3	13.3	33.7	1.44	3.2
	Philippines	36 655	55.0	43.0	11.0	32.0	32.9	9.5	29.0	8.89	3.1
	Ghana	8 559	58.4	49.0	20.0	29.0	29.1	8.6	30.0	2.15	2.4
	Average		50.2	43.0	14.0	29.0	43.4	12.9	29.1	4.67	2.7
61 or more	Indonesia	118 353	66.3	43.0	18.0	25.0	17.1	3.8	21.8	2.93	2.5
	Thailand	34 354	79.9	42.0	12.0	30.0	13.2	9.0	67.8	33.40	3.0
	Average		73.1	42.5	15.0	27.5	15.1	6.4	44.8	18.16	2.8

Source: See table 1.

^aMeasured by the number of male agricultural workers per square kilometer of arable land.

The next three indicators in table 2 relate to the relative size of the largest city. Column 3 refers to the proportion of a country's total population living in the largest city. This proportion is a product of various forces: it can be expected that more urbanized countries have larger cities and therefore a larger proportion residing in the largest city. Similarly, countries with a primate urban structure, that is, a concentration of development in and around the main city, also are likely to have a higher share of total population in the largest city than countries without a primate pattern. On the other hand, the proportion should be less for large countries than for small countries, for it would require a very large city in a populous country in order to account for a similar proportion that can be reached by a much smaller city in a less populous country. Consider the case of India: if it were to equal the proportion found in, say, Venezuela, where Caracas accounted for 20.4 per cent of total population in 1970, Calcutta would have required a population of 113 million (compared with the actual 7 million).

The data in table 2 show that the proportion of total population in the largest city is positively associated with both the per cent urban and the level of development; these relationships existed in 1960 and 1970. But it could be argued that since both Singapore and Hong Kong are almost city states, their cities account for an "artificially" high proportion of total population. Yet even when these two countries are excluded from the analysis, the positive associations persist, with only a modest drop in the rank-order correlations. These correlations, moreover, would be substantially higher without South Africa. Although South Africa has one of the smallest proportions of agricultural employment and one of the highest levels of urbanization among the 18 countries of the study, Johannesburg accounts for a relatively small share of total population (rank 14).

The next two indicators, the share of the total urban population residing in the largest city and the index of urban primacy, speak more directly to the urban hierarchy, particularly with respect to the relative concentration of urbanization in the largest city. In most of these countries, at least one fourth of all urban residents lived in the largest city, and the proportions generally increased slightly during the 1960-1970 decade, thus indicating that the largest city grew faster than the total urban population.

Urban primacy is more directly measured by an index comparing the ratio of the largest city to the next largest city (two-city index) or to the next three largest cities (four-city index).³⁴ Column 5 presents the two-city index according to which a city would qualify, from the demographic perspective, for a primate designation if the index is over two. By this measure, 11 countries had a primate city in 1960, and 12 countries in 1970. Yet any value of this index below three would indicate only a slight primate pattern, and this applies to the Republic of Korea, Algeria, Indonesia, Venezuela and Ghana (the latter qualified only in 1970). This leaves the following countries with a truly primate urban structure: Thailand, Peru, Argentina, the Philippines, Chile, the Islamic Republic of Iran and Mexico.³⁵ Perhaps the most astounding incidence of primacy is Thailand where besides Bangkok with 3 million inhabitants in 1970 no other city even reached 100,000.

All countries in the present study except Argentina had relatively high rates of population growth exceeding 2.0 per cent annually during the 1960s. Population growth was particularly rapid in Venezuela, Mexico, the Syrian Arab Republic, the Philippines and Thailand where it was 3 per cent and more annually. But no relationship is found between levels of development and the average annual intercensal rate of population growth; this is consistent with the earlier finding that at the beginning of the 1960s the development level of a country was unrelated to its rate of natural increase.

But despite the relatively high rates of population growth in these countries, there exists a wide variation in the degree of rural density (as measured by the number of male agricultural workers per square kilometre of arable land), ranging from 7 in Argentina and the Syrian Arab Republic to over 100 in Indonesia and the Republic of Korea. These differences in terms of rural population pressure are another reminder that population growth should not be evaluated in isolation but rather in terms of the specific conditions that exist in a given country.

In sum, this discussion has shown that although all metropolitan areas in the study are located in developing countries, these countries nevertheless are characterized by substantial differences in levels of development, urbanization and urban structure, as well as by different stages of the demographic transition. With this background information in mind, we now turn to the discussion of the components of metropolitan population growth.

COMPONENTS OF METROPOLITAN AND URBAN POPULATION GROWTH

A. Metropolitan population growth

The results of the decomposition procedure to estimate the relative contribution of net migration³⁶ and natural increase to population growth in metropolitan areas are presented in table 3. They show that on average these cities grew by 4.5 per cent annually during the 1960-1970 period. The contribution of migration to city growth is given in columns 3 and 4. During the 1960s, on average, migration accounted for 37 per cent of total population growth in these cities.

But the results show substantial differences among cities in both the rate of migration and the contribution of migration to total city growth. This variation contrasts with the more similar rates of natural increase among the cities. This difference is not surprising, for the possible range of the rate of natural increase is more limited than the differences in the net migration rate.

In spite of the variety of different forces that are operating in the 26 cities, the two components (cols. 2 and 3), as well as the proportionate contribution of migration to growth (col. 4), are positively related to the average annual growth rate (col. 1). Thus, among these cities, the higher the annual rate of population growth, the higher the rate of natural increase, the rate of net migration and the contribution of migration to growth. (The respective rank-order correlation coefficients are .614, .927 and .715). But the relationship between the annual rate of natural increase and the annual rate of growth

TABLE 3. SOURCES OF GROWTH OF CITY POPULATIONS IN DEVELOPING REGIONS

TABLE 3. SOURCES OF GROWTH OF CITY POPULATIONS IN DEVELOPING REGIONS					
City	Period	Estimated annual growth rate of city	Estimated annual rate of growth from natural increase of city	Estimated annual rate of city growth from net migration and reclassification	Estimated percentage of growth from net migration and reclassification
		(1)	(2) (per hundred population)	(3)	(4) = (3)/(2) × 100
<i>Africa</i>					
Accra	1960-1970	6.4	2.7	3.7	57.8
Algiers	1956-1966	3.9	2.7	1.2	31.1
Cape Town	1960-1970	3.2	2.5	0.6	20.6
East Rand	1960-1970	2.1	2.1	0.1	2.6
Johannesburg	1960-1970	2.0	2.0	0.0	0.4
<i>Asia</i>					
Bangkok	1960-1970	3.6	2.1	1.6	42.9
Damascus	1960-1970	4.6	3.2	1.4	31.1
Hong Kong	1961-1971	2.6	2.2	0.4	14.8
Jakarta	1961-1971	4.5	2.9	1.6	35.4
Manila	1960-1970	4.5	2.8	1.6	36.9
Seoul	1960-1970	8.2	2.6	5.6	68.1
Singapore	1960-1970	2.3	2.6	- 0.1	- 4.0
Teheran	1966-1976	5.1	2.4	2.6	51.7
<i>Latin America</i>					
Belo Horizonte ...	1960-1970	6.2	3.0	3.2	51.9
Bogota	1964-1974	5.8	2.7	3.1	52.9
Buenos Aires	1960-1970	2.1	1.2	0.9	43.8
Caracas	1961-1971	4.9	2.9	2.0	40.2
Guadalajara	1960-1970	5.4	3.4	2.0	36.6
Lima	1961-1971	4.8	2.7	2.1	44.0
Mexico City	1960-1970	5.0	3.2	1.8	35.6
Monterrey	1960-1970	5.5	3.4	2.1	38.6
Porto Alegre	1960-1970	4.0	2.1	1.9	48.4
Recife	1960-1970	3.9	3.0	0.8	21.6
Rio de Janeiro ...	1960-1970	3.5	2.0	1.5	42.2
Santiago	1960-1970	3.5	1.9	1.6	47.0
Sao Paulo	1960-1970	5.5	2.2	3.3	59.6
Average		4.3	2.6	1.8	36.6
Average (excluding South African cities, Hongkong and Singapore)		4.8	2.6	2.2	44.0

Source: See table 1.

from migration is very weak; essentially these two rates vary independently from each other among cities in developing countries.

The data in table 3 call for further discussion for a number of cities. First, the six cities with the lowest rates of population growth are Johannesburg, Buenos Aires, East Rand, Singapore, Hong Kong and Cape Town. All these cities, except Cape Town, had annual growth rates below 3 per cent, and Cape Town's rate was only slightly above 3 per cent. But these relatively low city growth rates exist in very different contexts. In the case of Buenos Aires, both the rate of natural increase and the rate of net migration are low. Argentina is one of the most developed countries included in this analysis, and it has the lowest rate of total population growth among these countries (see table 2). Almost 75 per cent of the population of Argentina live in urban areas, and close to one half of all urban residents live in Buenos Aires; this makes it unlikely that migration rates for Buenos Aires would be very high.

But with regard to the other five cities, it is only the relatively low amount of growth from migration that results

in the moderate overall growth of these cities. Yet the reasons for the low migration rates in these cities differ. Metropolitan Hong Kong and Singapore are almost city states: these cities in 1970 accounted for 90 and 75 per cent of their national populations and for 100 per cent of their urban populations (see table 2). Such high levels of population concentration in a single city indicate a low potential for further migration. Considering, furthermore, the geographical restrictions of both Singapore and Hong Kong, one should expect relatively low rates of migration.

Explanations for the low level of migration into the three South African cities must be found on different grounds. Internal migration, with some exceptions, such as refugees from wars, forced settlements, or persons displaced through natural disasters, can basically be viewed as the movement of free persons seeking to improve their living conditions. But blacks, who make up the majority of the South African population, are not free to move to cities as are white South Africans. The pervasive network of *apartheid* policies, specifically through the urban migration policy of "influx control" for Bantu, severely restricts the residential choices of

blacks.³⁷ The policies of homeland settlement have led to the deportation of blacks from many cities.³⁸ A recent study of Cape Town has shown how the policies were not only aimed at segregating whites and blacks but at establishing a residential structure that in turn maintains the social structure in which the white minority dominates the black majority. These policies have turned Cape Town from a once integrated city to one of the most segregated cities of South Africa.³⁹ It is therefore not surprising to find that in 1970 only 33 per cent of blacks lived in urban areas compared to 87 per cent for whites.

Because of the special situation of the three South African cities, Hong Kong and Singapore, average values for population growth and its components have been computed separately for the remaining 21 cities (see table 3) and the results show migration to be a much larger source of metropolitan growth than when the five special cities were included. Also, there are now virtually no regional differentials in the relative contribution of migration to metropolitan growth.

While six cities had below average rates of population growth, seven cities grew at rates well exceeding 5.0 per cent annually: Seoul, Accra, Belo Horizonte, Sao Paulo, Bogota, Monterrey and Guadalajara. Similar to the case of the cities with below-average growth, which largely resulted from low rates of migration, these cities, except for Monterrey and Guadalajara, are largely growing so rapidly because of their high rates of migration. The growth of Seoul, in particular, is truly astounding, and two thirds of it came from migration during the 1960s. As a result, Seoul more than doubled its population during that decade. This growth is likely to reflect the large amount of foreign capital that has been invested in the Republic of Korea to make it one of the most rapidly growing economies of Asia, with many new employment opportunities; and Seoul is the focus of this development.

The growth of Sao Paulo and Belo Horizonte and their high levels of migration are similarly related to industrialization. The south-east of Brazil, and within it the triangle that is formed by Rio de Janeiro, Belo Horizonte and Sao Paulo, has been the centre of Brazil's industrial development and the recipient of large numbers of migrants. The north-east, in contrast, has been a net supplier of migrants, and north-eastern cities, such as Recife, are less attractive to migrants than their counterparts further south.⁴⁰ Rio de Janeiro grew less than either Sao Paulo or Belo Horizonte, partly because it ceased to be the capital of Brazil in 1961 and many government functions were transferred to the new capital of Brasilia. This transfer reduced the employment opportunities in Rio de Janeiro's main industry, which was public administration.

Bogota's high rate of population growth is interesting because Colombia, in contrast to most other Latin American countries, is not characterized by urban primacy but has a rather well-balanced urban system. National industrial growth is not concentrated in the Bogota region, and the relatively high rate of migration to Bogota is more a reflection of the generally rapid urbanization of Colombia than the result of particularly superior economic opportunities in Bogota. Although metropolitan Bogota has grown slightly faster than other cities, including Cali, Medellin and Barranquilla, its per capita share of national product relative to the national per capita product actually decreased after 1960.⁴¹

Accra's growth rate exceeded that of Ghana's urban population (see table 2) and its rate of growth from migration was the second highest of the 26 cities of the present study. While the Accra-Tema metropolitan region is not very primate in the strict demographic sense, its role as capital and centre of industry has made it particularly attractive to migrants.⁴² It should also be noted, however, that Accra is the smallest city in the study and, as was pointed out earlier, migration could be expected to constitute a relatively large share of growth in smaller metropolitan areas.

In contrast to the five cities that grew particularly fast because of high rates of net in-migration, the above-average rate of population growth in the Mexican cities is largely the result of their high rates of natural increase which exceed that of any other metropolitan area. Migration to the Mexican cities, on the other hand, was below the average for the metropolitan areas, with the exception of Hong Kong, Singapore and the South African cities.

B. *A comparison of metropolitan and urban population growth*

This section compares the sources of population growth in the selected metropolitan areas and in the remaining urban areas in its countries. To that end, the age-sex specific metropolitan population was subtracted from the age-sex specific total urban population in each country. These areas are termed non-metropolitan urban. The findings show that the average annual growth rate of the largest city in each country, on average, exceeds the growth rate of all non-metropolitan urban areas by 0.7 percentage points (see table 4). In only four of the 13 countries—Argentina, South Africa, Peru and Syria—does the largest city grow more slowly than the remaining urban areas, and in one case—Venezuela—Caracas and the other urban areas grow at the same rate.

The source of the greater rate of metropolitan population growth clearly is net migration and reclassification (since the largest city, on average, actually had slightly lower rates of natural increase than non-metropolitan urban areas): the rates of metropolitan population growth from net migration and reclassification exceed the corresponding non-metropolitan urban rates by 0.9 percentage points (or 64 per cent). This difference widens to 1.1 percentage point (or 79 per cent) when South Africa is excluded from the analysis, for Johannesburg—for reasons explained earlier—virtually had no net migration during the 1960s. Besides South Africa, the Syrian Arab Republic is the only other country in which the rate of metropolitan population growth from net migration fell short of the corresponding non-metropolitan urban rate, and the difference between Damascus and the other urban areas is quite small. In some of the remaining countries, the migration component of metropolitan population growth is particularly large in comparison with non-metropolitan urban areas. The rate of growth from migration in Bogota, Seoul and Accra, for example, exceeds the corresponding rate in the remaining urban areas of their respective countries by over 100 per cent, and it is four times as high in Santiago as in the other urban areas of Chile.

In sum, these findings clearly indicate that for most of the

TABLE 4. COMPONENTS OF NON-METROPOLITAN URBAN^a AND METROPOLITAN POPULATION GROWTH IN DEVELOPING COUNTRIES, 1960-1970

Non-metropolitan urban areas and metropolitan areas	Annual intercensal growth rate	Estimated annual growth rate of natural increase	Estimated annual rate of growth from internal migration and reclassification	Estimated percentage of growth attributable to internal migration and reclassification
	(1)	(2)	(3)	(4)
Argentina	2.6	1.7	0.9	35.5
Buenos Aires	2.1	1.2	0.9	43.8
Chile	2.4	2.0	0.4	15.7
Santiago	3.5	1.9	1.6	47.0
Venezuela	4.9	3.7	1.2	23.9
Caracas	4.9	2.9	2.0	40.2
South Africa	3.5	2.5	1.0	28.3
Johannesburg	2.0	2.0	0.0	0.4
Colombia	4.2	2.9	1.3	30.9
Bogota	5.8	2.7	3.1	52.9
Mexico	4.6	3.3	1.4	29.5
Mexico City	5.0	3.2	1.8	35.6
Peru	5.1	3.2	2.0	39.1
Lima	4.8	2.7	2.1	44.0
Brazil	4.6	2.7	1.9	41.3
Sao Paulo	5.5	2.2	3.3	59.6
Islamic Republic of Iran	4.7	2.8	1.8	39.2
Teheran	5.1	2.4	2.6	51.7
Republic of Korea	4.9	2.4	2.5	50.7
Seoul	8.2	2.6	5.6	68.1
Syrian Arab Republic ..	5.0	3.5	1.6	31.8
Damascus	4.6	3.2	1.4	31.1
Ghana	4.0	2.7	1.3	31.6
Accra	6.4	2.7	3.7	57.8
Indonesia	3.3	2.3	1.0	31.2
Jakarta	4.5	2.9	1.6	35.4
Average non-metropolitan	4.1	2.7	1.4	32.9
Average metropolitan ..	4.8	2.5	2.3	43.7
<i>Without South Africa</i>				
Average non-metropolitan	4.2	2.8	1.4	33.3
Average metropolitan	5.0	2.6	2.5	47.3

Source: See table 1.

Note: Countries and cities are listed according to the order given for 1970 in table 2.

^aNon-metropolitan urban refers to all urban minus the largest city.

countries in the study, net migration is a much more important factor for the growth of the largest city in a country than for the remaining urban areas in general. Furthermore, it seems likely that non-metropolitan urban population growth benefited more from reclassification, mostly from the graduation of formerly rural places to towns,⁴³ than the capital

cities. Thus, the real difference in the contribution of migration to population growth between the capital and the remaining urban areas may well be a good part larger than indicated.

C. The natural increase of migrants

The findings presented so far showed migration to account for a substantial part of total metropolitan growth, even though it was exceeded by the contribution of national increase. But it could be argued that the role of migration in total metropolitan growth is actually larger than reported here, for the decomposition method that was followed tends to underestimate migration due to its disregard of the natural increase of migrants after they arrived in the city. One could contend that the natural increase of migrants after arrival in the city should be attributed to migration itself rather than to the natural increase of the native city population. For that reason, the natural increase of migrants after arrival in the metropolitan areas was estimated for the intercensal period.⁴⁴ For this purpose it was assumed that migrants had the same rates of natural increase as the native city population. That assumption has two main biases: first, it is likely to underestimate the natural increase of migrants because of the concentration of migrants in the prime ages of family formation that would favour natural increase. On the other hand, the sex ratio of migration is more unbalanced than the sex ratio of the native population in most metropolitan areas and this would suggest that, everything else being equal, migrants tend to be more single (or, if married, alone in the city) than city natives. If this is correct, it would tend to lower the natural increase of migrants.⁴⁵ It is hoped that these two biases more or less neutralize each other, and for that reason standardizations of the rates of natural increase were not performed. The estimates of the natural increase of migrants are thus based on the rates of natural increase of the metropolitan population from table 3, and the results of this procedure are presented in table 5.

These estimates (col. 1) show that migration, on average, accounted for about 10 per cent of natural increase in metropolitan areas, but in cities with high volumes of net migration, migrants contribute up to 33 per cent of total natural increase, as in the case of Seoul. The extent to which metropolitan areas grow from the natural increase of migrants is a combined function of the rates of natural increase and migration. The results indicate that around 5 per cent of total metropolitan population growth is due to the natural increase of migrants (col. 3). Again, the metropolitan areas with the highest rates of migration, such as Seoul, Accra, Sao Paulo, Belo Horizonte and Bogota, also experience the highest proportion of population growth from the natural increase of migrants. These findings are consistent with the observation made above that the variation in the growth rates of metropolitan populations is more strongly affected by migration than by natural increase.

The addition of the proportions of population growth from migration (col. 2) and the natural increase of migrants (col. 3) yields the total share of metropolitan population growth that can be attributed, directly and indirectly, to migration. Accordingly, metropolitan areas in developing countries (with the exceptions of South African cities, Hong Kong and

TABLE 5. MIGRATION AND POPULATION CHANGE IN LARGE CITIES IN DEVELOPING COUNTRIES, 1960-1970

Region and city	Per cent of natural increase attributable to migration (1)	Per cent of population growth directly attributable to migration (2)	Per cent of population growth indirectly attributable to migration (3)	Total per cent of population growth from migration (4) = (2) + (3)	Migration as per cent of 1960 population (5)
<i>Africa</i>					
Accra	20.2	57.8	8.0	65.8	53.9
Algiers	6.2	31.2	4.1	35.3	15.1
Cape Town	3.3	20.6	2.6	23.2	7.7
East Rand	0.3	2.6	0.3	2.9	0.6
Johannesburg	0.0	0.4	0.0	0.5	0.1
<i>Asia</i>					
Bangkok	8.0	42.9	4.5	47.4	19.1
Damascus	7.3	31.1	4.9	36.0	18.3
Hong Kong	1.9	14.8	1.7	16.5	4.4
Jakarta	8.1	35.4	5.1	40.5	20.3
Manila	8.5	36.9	5.3	42.2	21.2
Seoul	33.1	68.1	9.3	77.4	90.4
Singapore	- 0.5	- 4.0	- 0.5	- 4.5	- 1.1
Teheran	13.7	51.7	6.4	58.1	34.8
<i>Latin America</i>					
Belo Horizonte ...	17.1	51.9	7.9	59.8	45.6
Bogota	16.3	52.9	7.4	60.3	42.8
Buenos Aires	4.6	43.8	2.5	46.3	10.1
Caracas	10.2	40.2	6.0	46.2	26.0
Guadalajara	10.2	36.6	6.4	43.0	26.6
Lima	10.9	44.0	6.0	50.0	27.7
Mexico City	9.1	35.6	5.8	41.4	23.3
Monterrey	10.5	38.6	6.7	45.3	29.0
Porto Alegre	9.9	48.4	5.0	53.4	24.1
Recife	4.2	21.6	3.3	24.9	10.3
Rio de Janeiro ...	7.5	42.2	4.3	46.5	17.8
Santiago	8.4	47.0	4.4	51.4	20.0
Sao Paulo	17.6	59.6	6.8	66.4	45.1
Average	9.5	36.6	4.8	41.4	24.4
Average ^a	11.5	44.0	5.7	49.4	29.6

Source: See table 1.

^aExcluding South African cities and city states.

Singapore) on average grow by virtually equal parts from migration and natural increase, and the total contribution of migration is at least 25 per cent in each metropolitan area.

But the relative proportion of metropolitan growth from migration is only part of the story. A small share of growth could nevertheless translate into a substantial addition in relation to the size of the metropolitan population at the beginning of the intercensal period. Conversely, a large proportion may not be that significant if the total growth is relatively small. For that reason, the amount of intercensal migration has been computed as the proportion of the metropolitan population at the beginning of that period for each city. The results (see col. 5) further underscore the importance of net migration for metropolitan areas. Migration during the 1960s amounted to one fourth of the population that lived in metropolitan areas at the beginning of that decade, and this proportion is significantly higher in several cities. For example, almost as many migrants arrived in Seoul during the 1960s as that city had inhabitants in 1960. Migrants to Accra were over one half of its 1960 population, and they were over 40 per cent in Sao Paulo and Belo Horizonte. While the proportions are less in other cities, they nevertheless indicate the tremendous additional demand that

these migrants represent in terms of housing, employment and urban services.

DISCUSSION

The present study has shown that net migration to political capitals and other large metropolitan areas in developing countries is an important factor in their process of growth, and the impact of migration on large metropolitan areas is of greater magnitude than in the case of urban areas in general. Although the contribution by natural increase to metropolitan population growth exceeds the growth from migration, it was found that natural increase and migration contribute equal parts to metropolitan growth when the natural increase of migrants is taken into consideration. Moreover, variations in the growth rates of metropolitan populations are more the result of differences in the rate of migration than in the rate of natural increase among metropolitan areas. But migration not only constitutes an ample part of population growth, its volume is also quite substantial in relation to the initial city size. Excluding South African cities, Hong Kong and Singapore (all of which have specific reasons for low rates of

migration), the total number of migrants during the 1960s, on average, added 30 per cent to the number of persons who lived in metropolitan areas at the beginning of that decade. In some cities, these proportions are even larger: the metropolitan population of Seoul, for example, almost doubled during the 1960s due to migration alone, and migrants to Sao Paulo, which already had 5 million inhabitants in 1960, added another 45 per cent by 1970.

Because of its concentration in the group 15-29 years of age, migration has a differential impact on the various age groups in metropolitan areas. Compared to total population growth, migrants constitute an even larger part—almost two thirds—of the growth of this age group in which many persons enter the labour market for the first time.⁴⁶ Migration thus increases the labour supply in these cities in proportions far greater than with respect to total population growth. The result is an ever greater necessity to create employment opportunities that few of the cities have been able to meet.

It must also be kept in mind that the results reported in the present study refer to net migration. These rates do not speak to the actual volume of in-migration and out-migration; both streams can be substantial without necessarily resulting in high levels of net migration. Bangkok, for example, had a ratio of in-migration to out-migration of 3 : 1, so that the total number of in-migrants was about one third higher than net in-migration.⁴⁷ And in Seoul during the 1972-1978 period, there were 789,000 in-migrants as compared to 510,000 out-migrants.⁴⁸ But since in-migrants to cities are often of different ages than out-migrants (who frequently are pre-

vious in-migrants returning to their places of origin), these two streams, while possibly offsetting each other numerically, put different demands on urban services, employment, education and health systems.

The data that were available for the study are far too general to evaluate the full impact of migration on such sectors as health, housing or urban services. In many cases, migration may benefit city economies, and those cities in the present study that had the highest rates of migration are frequently experiencing rapid industrial growth, such as Seoul, Belo Horizonte and Sao Paulo. But high volumes of net migration also impose many strains, particularly when their topography is unfavourable, as is the case in Mexico City and Seoul, which suffer from increasing levels of pollution and ecological deterioration. Furthermore, an evaluation of the costs and benefits of migration would also have to include the social situation of migrants themselves, and the overwhelming evidence points to improvements in their standard of living as a result of migration.

But the results clearly demonstrated that migration plays a very important function in the demographic process of population growth of metropolitan areas in developing countries. Given this significance of migration for metropolitan growth, further investigations of the effects of these migration streams, particularly with respect to in-migration and out-migration, would greatly benefit our understanding of the detailed and interconnected processes of population growth, migration, employment and the social welfare of city residents.

NOTES

¹ Cities are defined as localities with at least 100,000 population. Although more than one half of these fast growing cities were relatively small (100,000 to 250,000), 10 cities that increased two-fold had a base of over 500,000 inhabitants, and one city, Dacca, had over 2 million.

² *Estimates and Projections of Urban, Rural and City Populations, 1950-2025: The 1980 Assessment* (ST/ESA/SER.R/45, 1982).

³ "Indonesia: a delicate balance between people and land", Draper Fund Report, No. 10, Washington, D. C., 1981, pp. 26-27. But Jakarta is also an example of an attempt (that ultimately failed) to reduce migration through very restrictive residency requirements; see Aprodicio A. Laquian and Alan B. Simmons, "Public policy and migratory behaviours in selected cities", *The Urban Impact of Internal Migration*, J. E. White, ed. (Chapel Hill, University of North Carolina, Institute for Research in Social Science, 1979), pp. 110-111.

⁴ Attempts have been made in the present paper to use a comparable definition of locality. The data in the paper refer to urban agglomerations and metropolitan areas rather than cities proper. An urban agglomeration is often based on physical characteristics of an area, such as density, while a metropolitan area usually considers socio-economic characteristics as well, such as per cent of non-agricultural labour force. Although there are important differences between the concepts of urban agglomeration and metropolitan areas, these differences are generally much smaller than those between either of these two concepts and city proper. Moreover, within a country a consistent concept is used over time.

⁵ Donald J. Bogue and Philip M. Hauser, "Population distribution, urbanism and internal migration", United Nations World Population Conference, working paper No. 473, Belgrade, 1965, p. 16.

⁶ *Ibid.*; see also Kingsley Davis, "The urbanization of the human population", *Scientific American*, No. 213 (1965), pp. 41-53.

⁷ Eduardo Arriaga, "Components of city growth in selected Latin American countries", *Milbank Memorial Fund Quarterly*, vol. 46, No. 2, part 1, 1968, pp. 237-252; see also Fernando Gatica, "La Urbanización en Améri-

ica Latina: 1950-1970: Patrones y Areas Críticas", *Redistribución espacial de la población en América Latina*, J. Alberts and M. Villa, eds., (Santiago, Latin American Demographic Centre), pp. 79-152.

⁸ For India, for example, see K. E. Vaidyanathan, "Components of urban growth in India, 1951-1961", *International Population Conference, London, 1969*, vol. 4 (Liège, International Union for the Scientific Study of Population, 1971), pp. 2941-2948; Mahendra F. Premi, "Role of migration in the urbanization process in third world countries: a case study of India", *Social Action*, No. 31 (July-September 1981), pp. 291-310.

⁹ *Patterns of Urban and Rural Population Growth* (United Nations publication, Sales No. E.79.XIII.9); see also Samuel H. Preston, "Urban growth in developing countries: a demographic reappraisal", *Population and Development Review*, No. 5 (June 1979), pp. 195-215.

¹⁰ Net migration includes the effects of reclassification (that is, change of boundaries for urban localities and reclassification of previously rural localities as urban).

¹¹ S. H. Preston, "Urban growth in developing countries: a demographic appraisal", *op. cit.*

¹² Kingsley Davis, "The theory of change and response in modern demographic history", *Population Index*, vol. 29 (October 1968), pp. 345-366; Dov Friedlander, "Demographic responses and population change", *Demography*, No. 6 (November 1969), pp. 359-381.

¹³ Nathan Keyfitz and Dimitar Philipov, "Migration and natural increase in the growth of cities", *Geographical Analysis*, vol. 13 (October 1981), pp. 287-299.

¹⁴ Nathan Keyfitz, "Do cities grow by natural increase or by migration?", *Geographical Analysis*, vol. 12 (April 1980), pp. 142-156.

¹⁵ *Ibid.*, p. 142.

¹⁶ A fourth situation exists at the time of the urban turn-round that seems to take place in several highly developed countries. At that point, there is a net urban-rural migration so that any urban growth is due to natural increase. Should the net urban-rural migration be substantial and fertility at about

replacement level, migration could again emerge as the leading factor in population change, that is, in this case that it would be the major source of urban population decline.

¹⁷ See N. Keyfitz, "Do cities grow by natural increase or by migration?", *op. cit.*

¹⁸ This situation, in fact, existed in Canada and the United States of America during the 1950s and 1960s. Although they were already highly urbanized at that time, their levels of fertility were much higher than in Europe, and natural increase thus was the major source of urban population growth.

¹⁹ Individual localities are also much more affected than all urban areas combined by such factors as opening or closing of factories, prisons, railroad stations, military bases and the like.

²⁰ Fathi Abu-Aianah, "Primate cities in the Arab world", *Population Bulletin of ECWA*, No. 19 (December 1980), pp. 29-46.

²¹ *Patterns of Urban and Rural Population Growth*, *op. cit.*

²² The special position of these metropolitan areas is well illustrated by McNulty's description of Accra and a few other large cities in Ghana. He notes that these places "act as principal nodes in the commercial, social and political organization of the country"; see Michael McNulty, "Urban structure and development: The urban system of Ghana", *The Journal of Developing Areas*, No. 3 (January 1969), p. 173.

²³ *Op. cit.*; since that study discusses the decomposition procedure in great detail, a brief summary of it will suffice here.

²⁴ A sensitivity analysis of the results based on this assumption showed that the findings would differ only a little if a different assumption concerning mortality differentials had been made. Specifically, the estimated average rate of growth from migration differs by a maximum of 6.8 per cent from values that would be obtained if the non-city mortality exceeded city mortality by anywhere from 0 to 50 per cent. The corresponding maximum error for natural increase is 4.7 per cent.

²⁵ *Patterns of Urban and Rural Population Growth*, *op. cit.*, p. 26.

²⁶ F. Gatica, *op. cit.*, p. 101.

²⁷ This estimate was kindly provided by Kyonghee Min in a personal communication.

²⁸ Although the data in the present study refer to metropolitan areas, the term "city" is frequently used for the sake of convenience.

²⁹ Although the *Patterns of Urban and Rural Population Growth* study examined urban growth in Argentina, Colombia and the Islamic Republic of Iran, the time periods selected in that study are different from those for metropolitan growth. Therefore, the present analysis is based on new estimates of urban population growth in these countries for intercensal periods that are identical to the metropolitan data.

³⁰ The present study employs the concept of metropolitan areas rather than city proper. Although differently defined from country to country, a metropolitan area consists of one or more central cities, surrounding urban areas, as well as some rural parts. The purpose of this concept is to capture the area that is a socio-economic unit dominated by the main city. It is therefore superior to the concept of city proper which, depending on where the city limits are drawn, often excludes large segments of the functional

city. For purposes of convenience, the paper uses the terms city and metropolitan area interchangeably.

³¹ In the case of South Africa, the legislative capital, Johannesburg, was selected rather than the administrative capital, Pretoria, since Johannesburg is the largest South African city.

³² *Estimates and Projections of Urban, Rural and City Populations, 1950-2025: The 1980 Assessment* (ST/ESA/SER.R/45).

³³ A comparison of the proportions of total employment in agriculture with the proportion of male employment in agriculture showed that countries rank almost identically in terms of those two variables.

³⁴ Although the four-city index is generally preferable, for some countries it was not possible to obtain data for four cities.

³⁵ It has often been noted that Brazil's urban structure is characterized by a dual primacy of Sao Paulo and Rio de Janeiro, which were of similar size during 1960-1970. Either of the two cities was over four times the size of the third largest city (Recife) during that period.

³⁶ It should be remembered that this component includes reclassifications of metropolitan boundaries, even though, for the sake of convenience, the following discussion will make reference only to migration.

³⁷ Brian Berry, *The Human Consequences of Urbanization* (London, Macmillan, 1973), chap. 4.

³⁸ Joseph Lelyveld, "Uprooted Cape Town blacks doomed to wander", *The New York Times*, 21 October 1981.

³⁹ John Western, *Outcast in Cape Town* (New York, 1981).

⁴⁰ See also Thomas W. Merrick and Douglas H. Graham, *Population and Economic Development in Brazil, 1800 to the Present* (Baltimore, Johns Hopkins Press, 1979), chap. 6; Manoel Augusto Costa, ed., *Estudos de Demografia Urbana* (Rio de Janeiro, IPEA/INPES, 1975).

⁴¹ Rabesh Mohan, "The people of Bogota: who they are, what they earn, where they live", the World Bank, working paper No. 390 (Washington, D.C., 1980).

⁴² Michael McNulty, *loc. cit.*

⁴³ Robert H. Weller, John J. Macisco, Jr. and George R. Martine, "The relative importance of the components of urban growth in Latin America", *Demography*, No. 8 (May 1971), pp. 225-252.

⁴⁴ This procedure is a more conservative estimate of the contribution of migration to population growth than if first-generation migrants were considered, because part of the intercensal natural increase is due to migrants who arrived in the city prior to the beginning of the intercensal period.

⁴⁵ This also raises the issue of how births should be classified if they belong to a couple consisting of a migrant and a city native. Presumably, one would allocate 50 per cent to the migration component, but it is unlikely that many cities have migration statistics in sufficient detail to permit such a differentiation.

⁴⁶ *Migration, Population Growth, and Employment in Metropolitan Areas of Developing Countries* (United Nations, unpublished manuscript).

⁴⁷ Savitri Garnjana-Goonchorn, "Internal migration into the Bangkok metropolitan area", *The Philippine Economic Journal*, vol. 16, Nos. 1-2, 1977, pp. 171-189.

⁴⁸ Republic of Korea, National Statistical Office, *1979 Statistical Yearbook* (Seoul, 1980).

WHAT THE AGE COMPOSITION OF MIGRANTS CAN TELL US

Luis J. Castro and Andrei Rogers***

SUMMARY

The present paper seeks to identify some of the factors that are responsible for the widespread regularities in age profiles exhibited by empirical schedules of migration.

It shows how family relationships among migrants are reflected into their aggregate age profiles. By disaggregating migrants into dependent and independent categories, the paper illuminates the ways in which the age profile of migrating populations is sensitive to relative changes in dependency levels and in rates of natural increase and mobility.

Just as population age compositions reflect particular characteristics of fertility and mortality régimes, so do observed migration age compositions reflect key aspects of family structure and migration patterns. A framework for assessing the impacts of natural increase, family dependencies, and differing migration propensities is proposed.

INTRODUCTION

A population pyramid graphically displays the age and sex distribution of a population; figure I presents such pyramids for Mexico and Sweden. The population of Mexico, with its large fraction of children and small fraction of elderly, may be called a "young" population in contrast to Sweden, which clearly exemplifies an "old" population.

The age composition of a population reflects the past history of fertility and mortality to which the population has been exposed. For example, high rates of natural increase give rise to age pyramids that taper more rapidly with age, and zero growth rates ultimately produce age pyramids that are nearly rectangular until ages 50 or 60 and that decline rapidly thereafter as death rates increase among the aged. Thus, one may conclude that the age composition of a population tells us something about past patterns of fertility and mortality. Since migrants are a subset of the population, does their age composition reflect analogous characteristics of recent patterns of fertility, mortality and migration?

Figure II sets out the national migration pyramids for Mexico and Sweden. They exhibit a fundamental common finding of countless migration studies: the age composition of migrants reflects age selectivity, with young adults and infants generally being the most mobile group in any population. Migration propensities are high among children, varying from a peak at age 1 to a low point about age 16. Beyond that age, migration increases sharply to another peak about age 22, after which it declines regularly until possibly interrupted by a retirement peak at the older ages.

The present paper seeks to identify some of the factors which could explain the widespread regularities in age profiles exhibited by empirical schedules of migration rates. We begin by briefly considering the problem of migration measurement and then go on to adopt a mathematical functional description of migration age compositions. Armed with this succinct representation of the age structure of migrants, we go on to examine how differences in family status patterns structure the age profile of migrants.

ESTABLISHING THE REGULARITIES: MIGRATION MEASUREMENT

Migration studies have in the past exhibited a curiously ambivalent position with regard to the measurement of geographical mobility. This ambivalence is particularly striking because of the contrast it poses with respect to the corresponding studies of mortality and fertility, studies that are richly endowed with detailed discussions of measurement problems. Haenszel (1967) attributes this paradox to the strong influence of Ravenstein's early contributions to migration analysis:

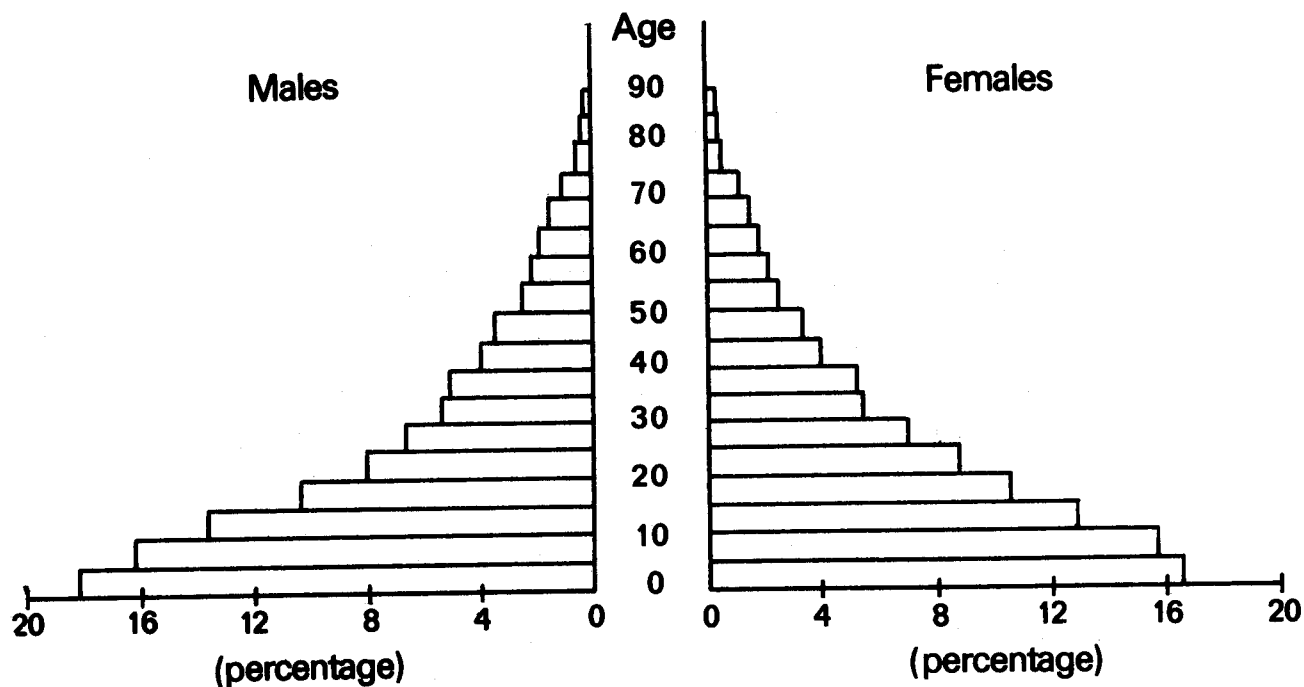
"Work on migration and population redistribution appears to have been strongly influenced by the early successes of Ravenstein in formulating 'laws of migration'. Subsequent papers have placed a premium on the development and testing of new hypotheses rather than on descriptions of facts and their collation. . . . This is in contrast to the history of vital statistics. While Graunt, more than two centuries before Ravenstein, had made several important generalizations from the study of 'bills of mortality' in London, his successors continued to concentrate on descriptions of the forces of mortality and natality by means of rates based on populations at risk" (Haenszel, 1967:260).

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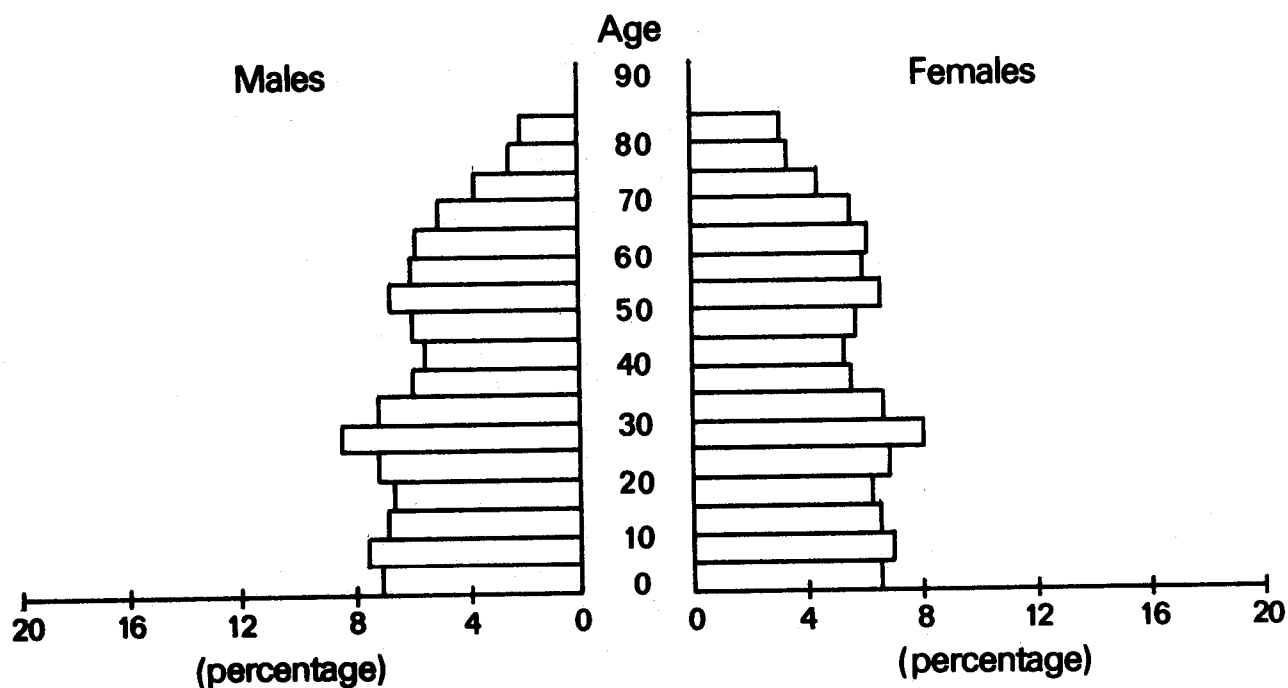
**Chairman, Human Settlements and Services, International Institute for Applied Systems Analysis, Laxenburg, Austria.

Figure I. National population age compositions: Mexico, 1970, and Sweden, 1974

Mexico, 1970



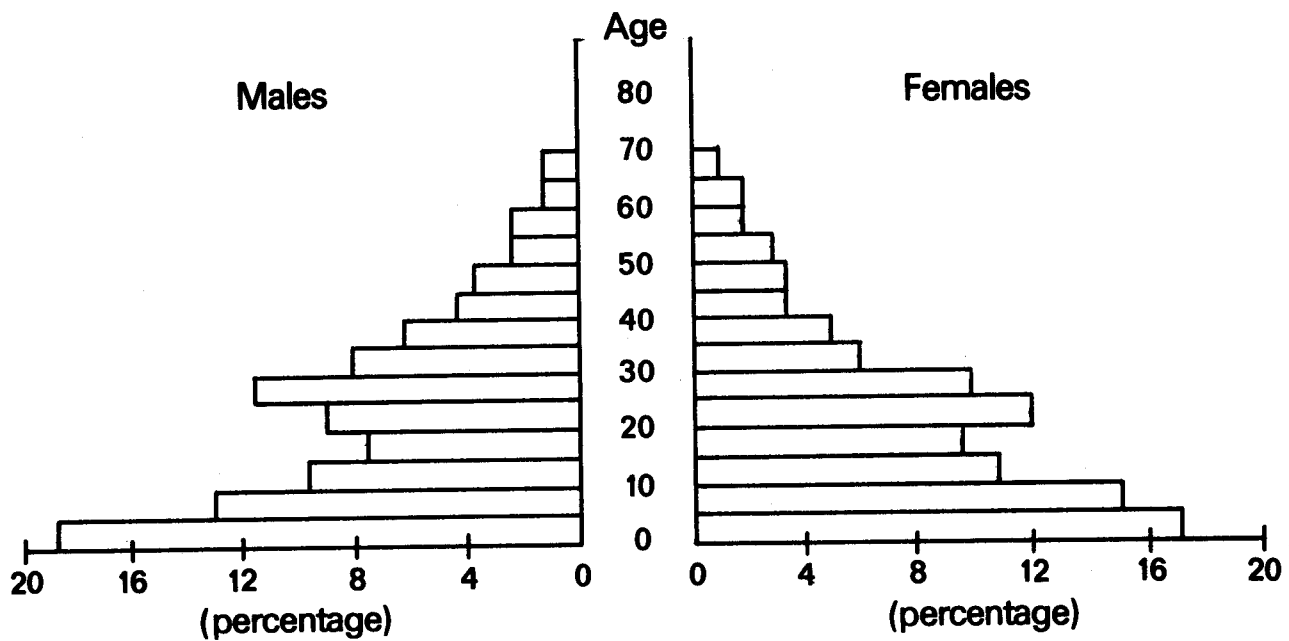
Sweden, 1974



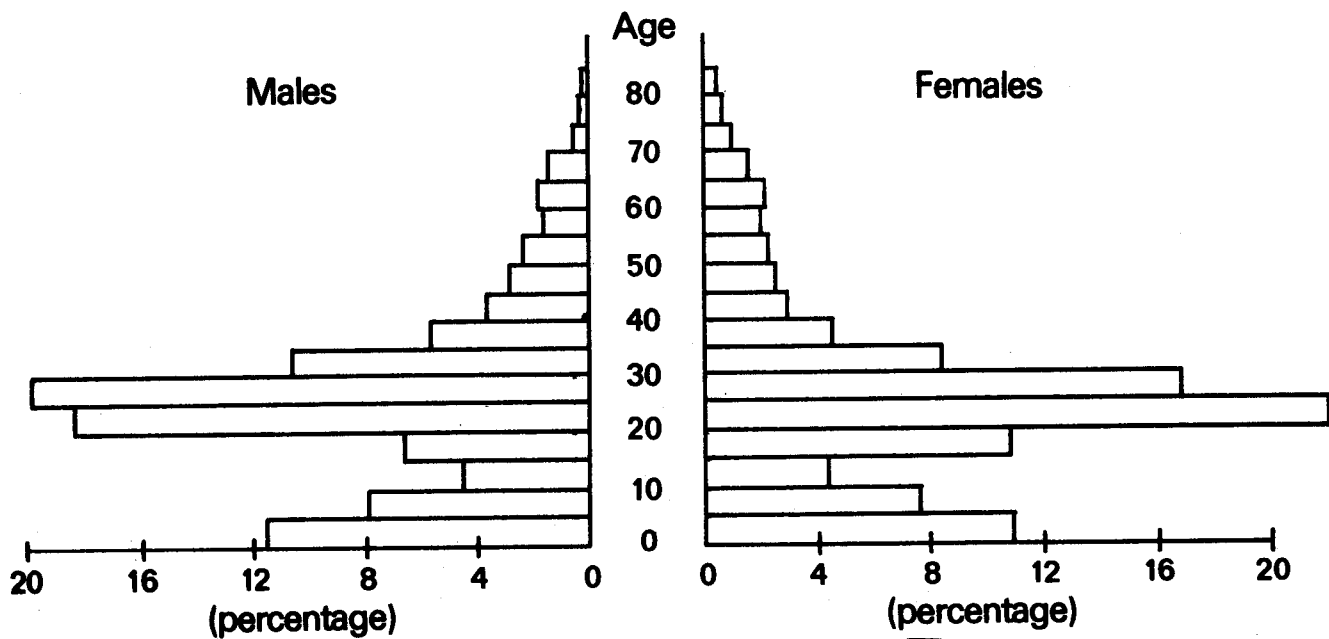
Sources: Federal Statistical Office, 1970; Andersson and Holmberg, 1980.

Figure II. National migration age compositions: Mexico, 1970, and Sweden, 1974

A. Interstate migration, Mexico, 1970



B. Interregional migration, Sweden, 1974



Sources: One per cent sample of the 1970 Mexican population census; Andersson and Holmberg, 1980.

It is natural to look to the state of mortality and fertility measurement for guidance in developing measures of migration. Like mortality, migration may be described as a process of interstate transfer; however, death can occur but once, whereas migration is a potentially repetitive event. This suggests the adoption of a fertility analogue, that is, instead of births per mother, moves per migrant; but migration's definitional dependence on spatial boundaries and on different forms of data collection introduces measurement difficulties that do not occur in the analysis of fertility.

One of the central problems in migration measurement arises as a consequence of the different sources of migration data. Most information regarding migration is obtained from population censuses or population registers that report migration data, for a given time interval, in terms of counts of migrants or of moves, respectively. Yet another source of migration data is the sample survey, which may be designed to provide information about both migrants and moves. Migration data produced by censuses are usually in the form of transitions. Population registers treat migration as an event and generate data on moves.

A mover is an individual who has made a move at least once during a given interval. A migrant, on the other hand, is an individual who at the end of a given interval no longer inhabits the same community of residence as at the start of the interval. Thus, paradoxically, a multiple mover can be a non-migrant, if after moving several times he returns to his initial place of residence before the end of the unit time interval.

Because migration occurs over time as well as across space, studies of its patterns must trace its occurrence with respect to a time interval, as well as over a system of geographical areas. In general, the longer the time interval, the larger will be the number of return movers and non-surviving migrants and, hence, the more the count of migrants will understate the number of interregional movers (and, of course, also of moves).

Most migration data collected by population censuses come from responses to four typical questions: place of birth, duration of residence, place of last residence and place of residence at a fixed prior date (United Nations, 1970). From these questions it is possible to establish the count of surviving migrants living in a region at the time of the census, disaggregated by different retrospective time intervals. The longer the time interval, the less accurate becomes the migration measure.

Because population registers focus on moves and not transitions, differences will arise between data obtained from registers and from population censuses. In the annex to the United Nations manual on *Methods of Measuring Internal Migration* (United Nations, 1970) it is stated:

"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. . . . Only with Japanese data has it so far been possible to test the correspondence between migrations, as registered during a one-year period and migrants enumerated in the census in terms of fixed-period change of residence" (United Nations, 1970:50).

TABLE 1. COMPARISON OF MIGRATION BY SEX AND TYPE BASED ON THE POPULATION REGISTER AND THE CENSUS FOR THE ONE-YEAR PERIOD BETWEEN OCTOBER 1959 AND OCTOBER 1960. JAPAN

Sex and type of migration	Register data	Census data	Ratio $\times 100$
Both sexes			
Intra-prefectural	2 966 621	1 998 171	148.47
Interprefectural	2 625 135	2 590 751	101.33
Males			
Intra-prefectural	1 488 935	1 001 745	148.63
Interprefectural	1 450 817	1 466 898	98.90
Females			
Intra-prefectural	1 477 686	996 426	148.30
Interprefectural	1 174 318	1 123 853	104.49

Source: United Nations (1970, table 42:50).

Table 1, taken from the United Nations analysis, illustrates how the ratio of register-to-census migration data is in general bigger than unity, increasing with decreasing distance, as, for example, in the case of intra- versus interprefectural migration in Japan. In general, the ratio of register-to-census migration data should tend to unity as longer distances are involved, and also as time intervals become shorter (figure III). Clearly, the ratio should be greater than unity when short distances are considered and close to unity when the time interval is short, because the probability of moving across long distances several times should be expected to be less than the probability of moving the same number of times between short distances. And, the probability of moving several times during a long interval of time should be greater than the probability of experiencing the same number of moves during a shorter period of time.

A fundamental aspect of migration is its change over time. As Ryder (1964) has pointed out for the case of fertility, period and cohort reproduction rates will differ whenever the age distribution of child-bearing varies from one cohort to another. The usefulness of a cohort approach in migration, as in fertility analysis, lies in the importance of historical experience as an explanation of current behaviour. Morrison (1970) indicates that migration is induced by transitions from one stage of the life cycle to another, and "chronic" migrants may artificially inflate the migration rates of origin areas that are heavily populated with migration-prone individuals. Both influences on period migration are readily assessed by a cohort analysis.

It is the migration of a period, however, and not that of a cohort, that determines the sudden redistribution of a national population in response to economic fluctuations, and it is information on period migration that is needed to calculate spatial population projections.

Current period migration indices do not distinguish trend from fluctuation and therefore may be distorted; current cohort migration indices are incomplete. Thus it may be useful to draw on Ryder's (1964) translation technique to change from one to the other. As Keyfitz (1977:250) observes, the cohort and period moments in Ryder's formulae can "be interpreted, not as child-bearing, but as mortality, marriage, school attendance, income, or some other attribute of individuals". Migration is clearly such an attribute.

The importance of historical experience in interpreting and understanding current migration behaviour led Peter Morrison (1970:9) to define the notion of staging as being "any linkage between a prior sequence and subsequent migration behavior". Morrison recognizes four kinds of staging: geographic, life cycle, socio-economic and experiential. Geographical staging refers to return migration and to what is conventionally understood to mean "stage migration", that is, the idea that migrants tend to move to places not very dissimilar from those they left behind. Life-cycle staging views migration as arising out of breaks in an individual's or a household's life cycle, such as entry into the labour force, marriage and retirement. Socio-economic staging sees migration sequences as being conditioned by socio-structural

factors, such as occupation, educational attainment and income level. Finally, experiential staging refers to movement experience in terms of number of previous moves and duration since the last move; it is the "parity" dimension of migration analysis.

Calculations of migration rates of increasing specificity seek to unconfound the "true" migration rates from weights that reflect the arithmetical influence of the past. This process of measuring migration

"... at different levels of specificity of occurrence and exposure yields products which draw ever finer distinctions between current behavior and the residue of past behavior reflected in the exposure distribution at any time" (Ryder 1975:10).

Such products may be weighted and aggregated to produce the "crude" rates of higher levels of aggregation. For example, the age-sex-specific migration rate is a weighted aggregation with respect to the migration "parity-duration" distribution just as the crude migration rate is a weighted aggregation with respect to the age-sex distribution.

The age profile of a schedule of migration rates reflects the influences of two age distributions: the age composition of migrants and that of the population of which they were a part (Rogers, 1976). This can be easily demonstrated by decomposing the numerator and denominator of the fraction that defines an age-specific migration rate, $M(x)$, say.

If $O(x)$ denotes the number of out-migrants of age x , leaving a region with a population of $K(x)$ at that age, then

$$M(x) = \frac{O(x)}{K(x)} = \frac{O \cdot N(x)}{K \cdot C(x)} = o \cdot \frac{N(x)}{C(x)} \quad (1)$$

where

O = total number of out-migrants

$N(x)$ = proportion of migrants aged x years at the time of migration

K = total population

$C(x)$ = proportion of total population aged x years at mid-year

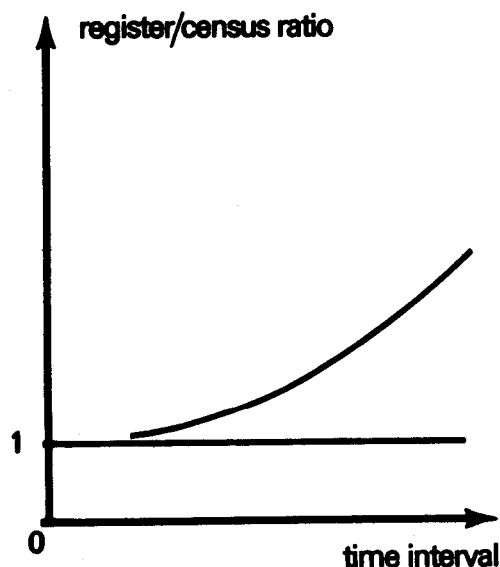
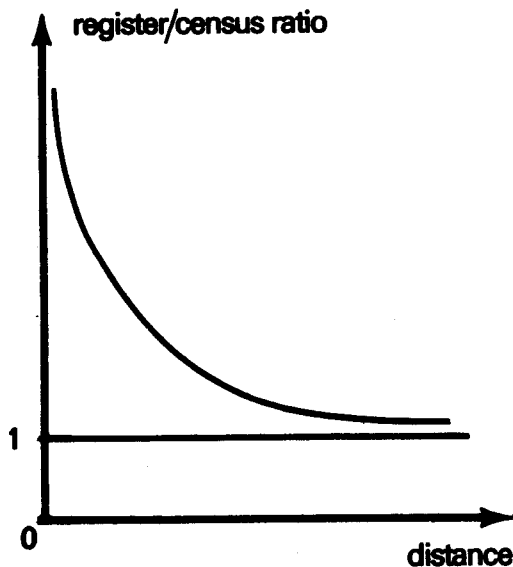
o = crude out-migration rate

We define the collection of $N(x)$ values to be the migration proportion schedule and the set of $M(x)$ values to be the migration rate schedule.

SUMMARIZING THE REGULARITIES: MODEL MIGRATION SCHEDULES

Observed age-specific migration rate schedules universally exhibit a common shape (Rogers and Castro, 1981). The same shape also characterizes the age composition of migrants, that is, migration proportion schedules. Starting with relatively high levels during the early childhood ages, migration rates or proportions decrease monotonically to a low point at age x_l , say, increase until they reach a high peak at age x_h , and then decrease once again to the ages of retirement before leaving off around some constant level, c , say. Occasionally a "post-labour force" component appears,

Figure III. Ratio of register to census migration data with respect to distance and time interval



showing either a bell-shaped curve with a retirement peak at age x , or an upward slope that increases monotonically to the last age included in the schedule, age w , say. Thus, the migration age profile may be divided into child (dependent), adult and elderly components; however, we shall confine our attention in the present paper to only the first two. But our argument is equally valid for profiles showing a retirement peak or an upward retirement slope.

The observed age distribution of migrants, $N(x)$, may be described by a function of the form:

$$N(x) = N_1(x) + N_2(x) + c \quad (2)$$

where

$$N_1(x) = a_1 e^{-\alpha_1 x}$$

for the child (dependent) component,

$$N_2(x) = a_2 e^{-\alpha_2(x - \mu_2)} - e^{-\lambda_2(x - \mu_2)}$$

for the adult (independent) component, and c is the constant term that improves the fit when migration distributions at older ages are relatively high. Figure IV illustrates the female model migration proportion schedules of the observed data presented in figure II, which by definition show an area of unity under each curve.

An alternative way of expressing equation (2) is as a weighted linear combination of the density functions representing the above three components (Castro and Rogers, 1981):

$$N(x) = \phi_1 f_1(x) + \phi_2 f_2(x) + \phi_c (1/w) \quad (3)$$

where w is the last age included in the schedule, ϕ_1 and ϕ_2 are the relative shares of the child and adult components, ϕ_c is the share of the constant term, $f_1(x)$ and $f_2(x)$ are, respectively, the single and double exponential density functions

$$f_1(x) = \alpha_1 e^{-\alpha_1 x} \quad (4)$$

$$f_2(x) = \frac{\lambda_2}{\Gamma(\alpha_2/\lambda_2)} e^{-\alpha_2(x - \mu_2)} - e^{-\lambda_2(x - \mu_2)} \quad (5)$$

and $\Gamma(\alpha_2/\lambda_2)$ represents the gamma function value of α_2/λ_2 . Note that $\phi_1 + \phi_2 + \phi_c = 1$ by definition.

Equations (2) through (5) imply that

$$a_1 = \phi_1 \alpha_1 \quad (6)$$

$$a_2 = \phi_2 \frac{\lambda_2}{\Gamma(\alpha_2/\lambda_2)} \quad (7)$$

and

$$c = \frac{\phi_c}{w} \quad (8)$$

The six parameters a_1 , α_1 , a_2 , α_2 , λ_2 and μ_2 do not seem to have demographic interpretations. Both a_1 and a_2 reflect the heights of their respective parts of the profile; α_1 and α_2 refer to the descending slopes; λ_2 reflects the ascending

TABLE 2. PRINCIPAL INDICES DEFINING OBSERVED AGE-SPECIFIC MIGRATION CHARACTERISTICS

Characteristic	Index
Proportion of children (dependants), ϕ_1	a_1/α_1
Proportion of adults ^a , ϕ_2 (labour force)	$\frac{a_2}{\lambda_2} \Gamma(\alpha_2/\lambda_2)$
Labour asymmetry, σ_2	λ_2/α_2
Labour dominance, δ_{21}	a_2/a_1
Parental-shift, β_{12}	α_1/α_2
Child-adult dependency migration ratio, D_o	$\frac{1}{\beta_{12} \delta_{21} \Gamma(1 + 1/\sigma_2)}$

^aThe reciprocal index is also of interest inasmuch as it reflects the total number of migrants per adult, $s_o = \frac{\lambda_2}{a_2 \Gamma(\alpha_2/\lambda_2)}$.

slope; and μ_2 positions the adult component on the age axis. Taken as a group, these parameters suggest a number of useful and robust measures for describing an observed migration schedule (table 2). For example, the ratio $D_o = \phi_1/\phi_2$, the child-adult dependency migration ratio, is one of several important ratios that may be used to interpret particular patterns of dependency among migrants. It assumes a central role as an indicator of family dependency structure by defining the number of dependants per adult migrant.

The child-adult dependency migration ratio varies as a function of the parameters that define the age profile of migrants. If the constant term c is close enough to zero to be ignored, as normally is the case, then $\phi_c = 0$ and

$$D_o = \frac{\phi_1}{\phi_2} = \frac{a_1 \alpha_1}{a_2 \alpha_2 \Gamma(\alpha_2/\lambda_2)}$$

Since

$$\Gamma(\alpha_2/\lambda_2) = \frac{\Gamma(1 + \alpha_2/\lambda_2)}{(\alpha_2/\lambda_2)}$$

we obtain the result

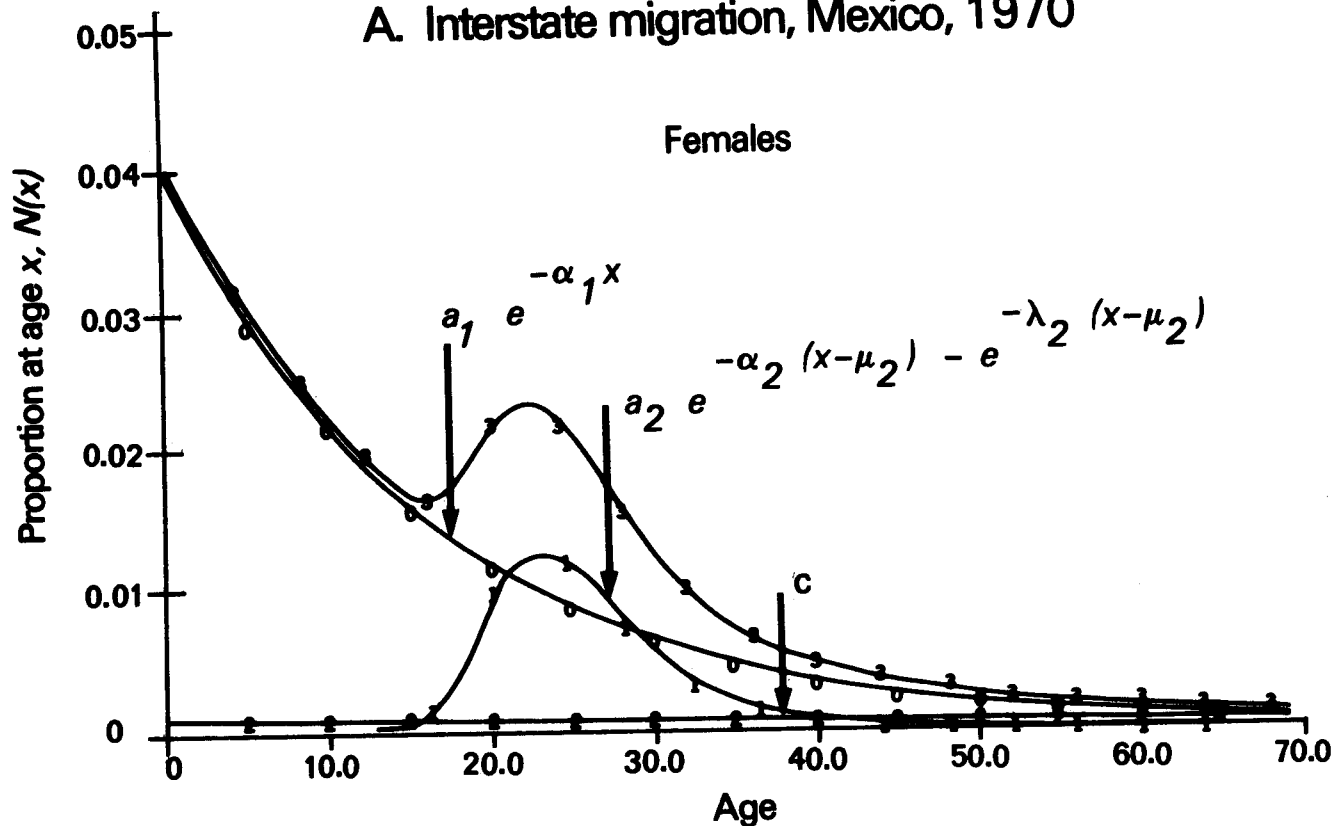
$$D_o = \frac{1}{\beta_{12} \delta_{21} \Gamma(1 + 1/\sigma_2)} \quad (9)$$

where $\delta_{21} = a_2/a_1$, $\beta_{12} = \alpha_1/\alpha_2$, $\sigma_2 = \lambda_2/\alpha_2$ are the labour dominance, parental-shift and labour asymmetry indexes defined in Rogers and Castro (1981). These three ratios and μ_2 may be used to fully characterize observed migration age profiles.

Another useful indicator of the average size of family among migrants is the value $s_o = 1/\phi_2$, which reflects the total number of migrants per adult. In a single-sex formulation, for instance, if adults are considered as heads of each migrant family (interpreting single individuals as one-person families) then the sum of the two sex-specific values of s_o closely approximates the average size of family among migrants.

Figure IV. Components of the model migration proportion schedule

A. Interstate migration, Mexico, 1970



B. Interregional migration, Sweden, 1974

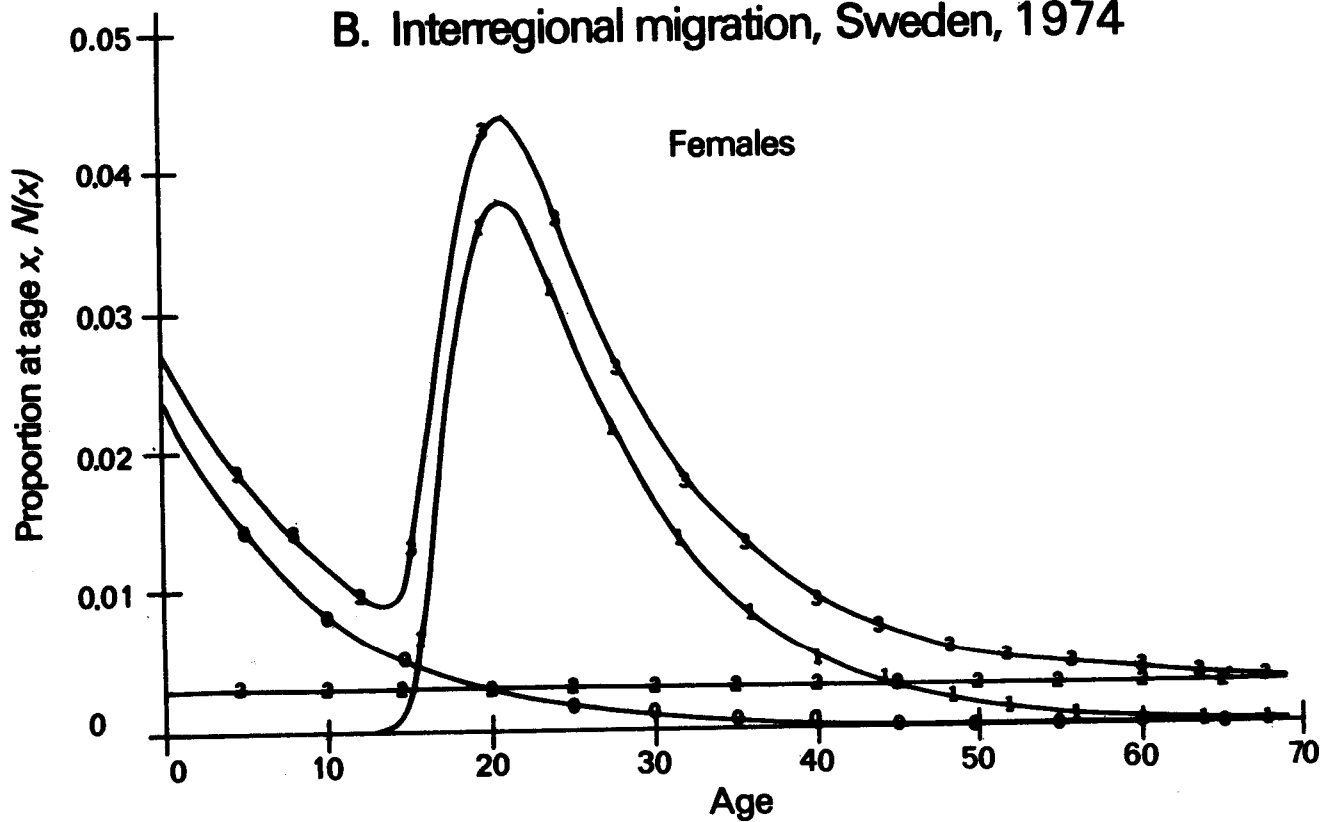


Figure V. Model migration proportion schedules for selected cities around the world and a typical national immigration flow

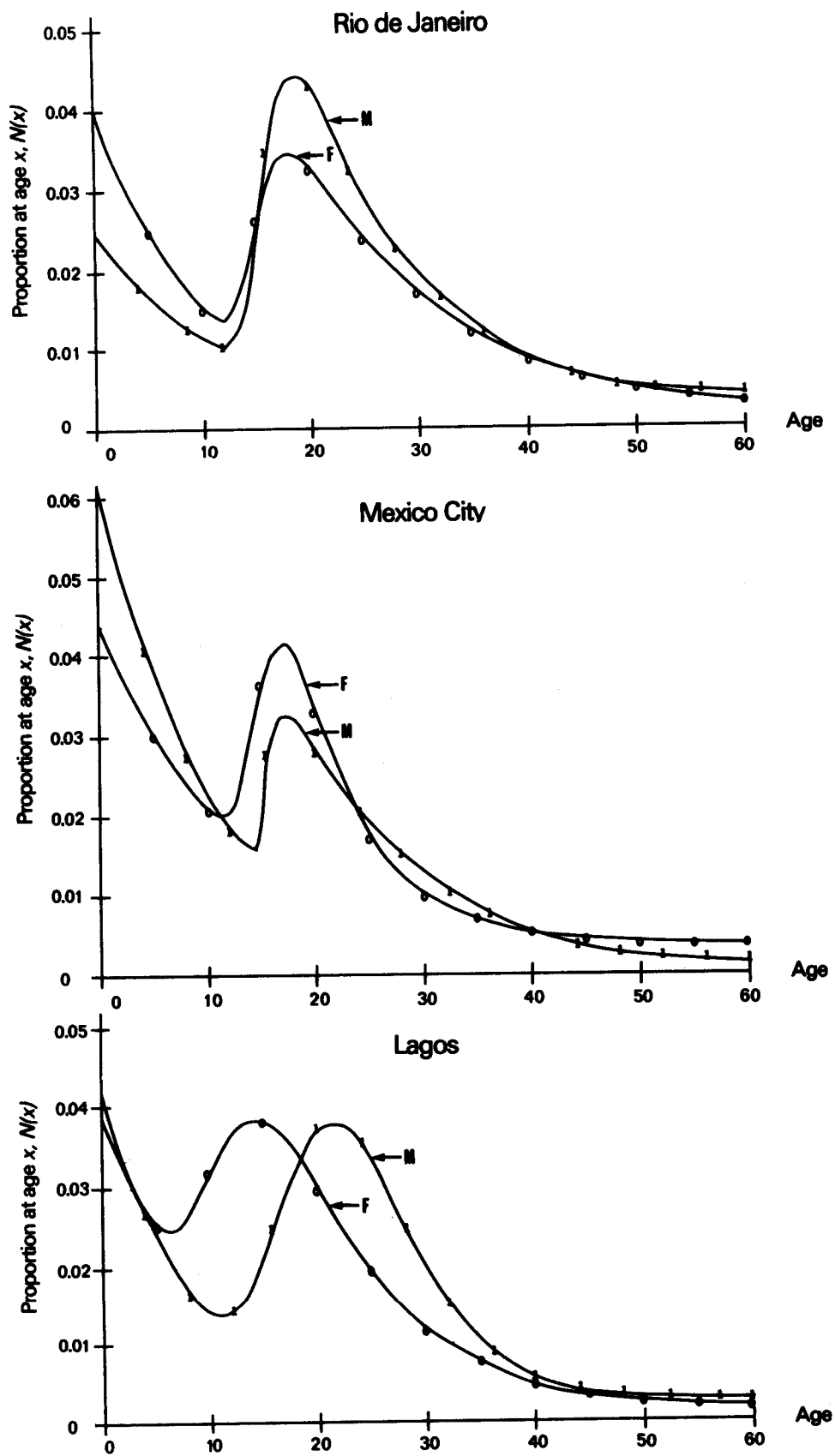
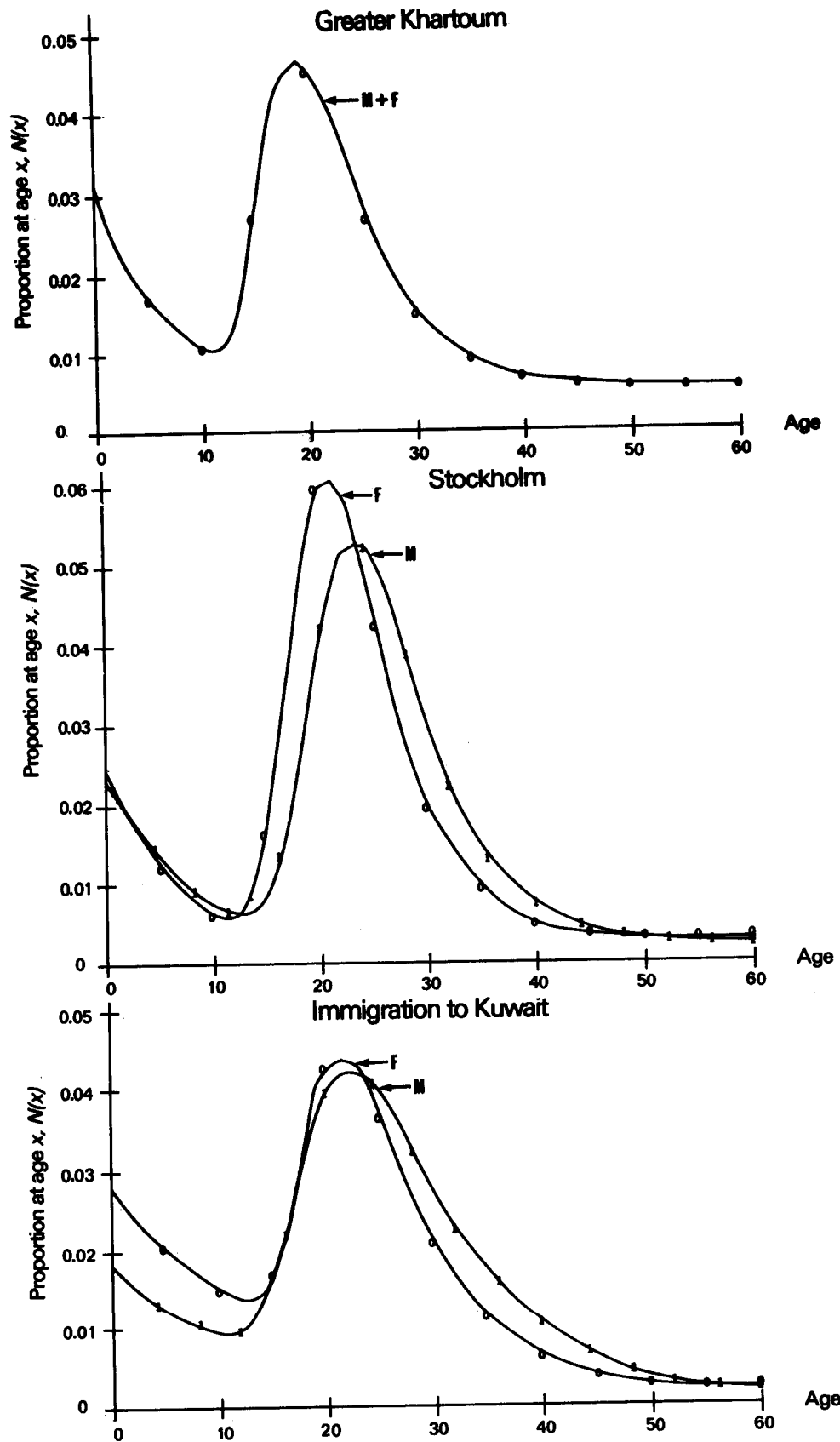


Figure V (continued)



Sources: Alberts, 1977; one per cent sample of the 1970 population census of Mexico; George and Eigbetoh, 1973; Kawabe and Farah, 1973; Andersson and Holmberg, 1980; United Nations, 1979.

TABLE 3. PARAMETERS AND VARIABLES DEFINING OBSERVED MODEL MIGRATION PROPORTION SCHEDULES FOR SELECTED CITIES AROUND THE WORLD AND A TYPICAL NATIONAL IMMIGRATION FLOW^a

Parameter or variable	Rio de Janeiro		Mexico City		Lagos		Greater Khartoum	Stockholm		Immigration to Kuwait	
	Males	Females	Males	Females	Males	Females	Total	Males	Females	Males	Females
a_1	0.025	0.041	0.065	0.048	0.042	0.038	0.031	0.025	0.023	0.018	0.027
α_1	0.075	0.092	0.101	0.081	0.099	0.065	0.099	0.116	0.095	0.056	0.047
a_2	0.051	0.037	0.027	0.028	0.062	0.048	0.054	0.088	0.096	0.086	0.084
μ_2	15.394	14.905	15.765	13.878	17.223	11.646	15.053	16.975	19.648	19.658	19.946
α_2	0.069	0.059	0.070	0.060	0.092	0.098	0.069	0.098	0.110	0.108	0.161
λ_2	0.694	0.583	1.107	1.263	0.294	0.318	0.531	0.508	0.334	0.229	0.301

NOTE: Our assumption that $c = 0$ contains the parameters to satisfy the relationship $\frac{a_1}{\alpha_1} + \frac{a_2}{\lambda_2} \cdot \Gamma(\alpha_2/\lambda_2)$.

However, our algorithm did not permit us to enter this restriction. Hence, some parameter values are "slightly biased" and in such instances the above equality is not strictly met. We are grateful to Jacques Legend for this observation.

^aThe c parameter value was set equal to zero in the non-linear parameter estimation procedure.

Figure V sets out several age profiles of internal migration flows to different cities around the world, together with a typical international migration (immigration) age distribution for males and females. These profiles were generated by model migration proportion schedules fitted to observed data, the parameters of which are included in table 3. The quantitative indices presented in table 4 confirm the regularities illustrated in figure V. For example, the migration flows to Mexico City and to Lagos differ sharply from the corresponding flows to Stockholm. The former show about double the proportion of dependants exhibited by the latter. The same table also indicates that the average size of family in the flow to Mexico City, with about $2.65 + 2.20 = 4.85$ members per migrating family, is the largest among the examples presented.

All of the migration characteristics in figure V and table 4 indicate low or high family dependency patterns. In the next section, we seek an explanation for such characteristics by linking them with the family characteristics of the population as a whole.

EXPLAINING THE REGULARITIES: FAMILY STATUS

It is widely recognized that a large fraction of total migration is accounted for by individuals whose moves are dependent on those of others. Indeed, family migration is such a well-established phenomenon that Ryder (1978) has even suggested its use as a criterion for identifying family membership: a family comprises those individuals who would migrate together.

To understand the influences that family and dependency relationships have on migration age compositions, it is useful to examine how such profiles respond to fundamental changes in dependency patterns. To illustrate this, consider a single-sex population that is divided into two groups: dependants and heads, where dependants are simply individuals who have not left home to become heads. (Included as heads are independent single individuals who may be viewed as one-person families.) Thus, the age distribution of the female population $C(x)$ may be composed by weighting the density

TABLE 4. ESTIMATED CHARACTERISTICS OF OBSERVED MODEL MIGRATION POPULATION SCHEDULES FOR SELECTED CITIES AROUND THE WORLD AND A TYPICAL NATIONAL IMMIGRATION FLOW

Characteristic	Rio de Janeiro ^a 1968-1972		Mexico City ^b 1969-1970		Lagos ^c 1967-1968		Greater Khartoum ^d 1960-1964	Stockholm ^e 1974		Immigration to Kuwait 1965-1970 ^f	
	Male	Female	Male	Female	Male	Female	Total	Male	Female	Male	Female
Proportion of dependants (percentage)	33.70	44.81	64.29	59.50	42.28	57.80	31.60	24.07	21.31	31.46	57.09
Proportion of adults (percentage)	70.14	59.54	37.67	45.55	59.90	43.88	73.77	78.06	82.17	70.54	46.27
Total number of migrants per adult	1.43	1.68	2.65	2.20	1.67	2.28	1.36	1.28	1.22	1.42	2.16
Labour asymmetry	10.03	9.83	15.74	21.01	3.20	3.24	7.73	3.04	5.18	2.12	1.87
Labour dominance	2.02	0.90	0.42	0.58	1.47	1.27	1.72	4.18	3.55	4.88	3.12
Parental shift	1.08	1.56	1.43	1.34	1.08	0.67	1.44	0.87	1.18	0.52	0.29
Child-adult migration ratio	0.48	0.75	1.71	1.31	0.71	1.32	0.43	0.31	0.26	0.45	1.23

Sources:

^aAlberts, 1977.

^bOne per cent sample of the 1970 Mexican population census.

^cGeorge and Eigbefoh, 1973.

^dKawabe and Farah, 1973.

^eAndersson and Holmberg, 1980.

^fUnited Nations, 1979.

functions of dependants and heads:

$$C(x) = \phi_{1c} f_{1c}(x) + \phi_{2c} f_{2c}(x)$$

where ϕ_{1c} and ϕ_{2c} are the proportions of dependants and heads in the total female population and $f_{1c}(x)$ and $f_{2c}(x)$ are their corresponding age distributions, respectively.

The ratio of the weights associated with the age profiles of dependants and heads defines the child-adult dependency population ratio, D_c , which is similar to the D_0 defined earlier for the migrant population:

$$D_c = \frac{\phi_{1c}}{\phi_{2c}}$$

As in the case of migration, we can also define the total number of persons per adult (head) as $s_c = 1/\phi_{2c}$. To investigate analytically some of the underlying patterns of "head formation" requires some mathematical theorizing.

Let y_0 denote the age at which an appreciable number of females first leave home to establish their own household. Since marriage is an important reason for leaving the family home, it is likely that the probability density function describing the pattern of head formation by age is similar to the one found in studies of nuptiality, that is, the double exponential function defined in equation (5). If $g(y)$ is such a function then

$$G(x) = \int_{y_0}^{\infty} g(y) dy$$

defines the proportion of females who have ever left home by age x , that is, who are heads according to our definition.

Since $f_{2c}(x)$ defines the proportion of the population of heads that are of age x , and $G(x)$ defines the proportion of the population who are heads by age x , it is evident that in a stable population growing at an intrinsic rate of growth r ,

$$f_{2c}(x) = \frac{e^{-rx} I(x) G(x)}{\int_0^{\infty} e^{-ry} I(y) G(y) dy}$$

where $I(x)$ denotes the probability of surviving from birth to age x . For similar reasons

$$f_{1c}(x) = \frac{e^{-rx} I(x) [1 - G(x)]}{\int_0^{\infty} e^{-ry} I(y) [1 - G(y)] dy}$$

Given these equations, the child-adult dependency population ratio D_c may be defined as

$$D_c = \frac{\int_0^{\infty} e^{-ry} I(y) [1 - G(y)] dy}{\int_0^{\infty} e^{-ry} I(y) G(y) dy}$$

Figure VI illustrates the above argument with hypothetical data. It presents the survivorship curve, $I(x)$, which is that of the Brass standard with $\alpha = -0.80$ and $\beta = 1.75$ with an expectation of life at birth of approximately 69 years (Brass, 1971); and the head formation curve $G(x)$ is the Coale-McNeil double exponential (Coale and McNeil, 1972) expressed by the Rodriguez and Trussell (1980) standard with mean (22 years) and variance (5 years) of age of becoming a head. Figure VII shows the resulting dependant, head and population (dependants plus heads) distributions of stable populations growing at intrinsic rates $r = 0$ and $r = 0.03$, respectively.

To derive the corresponding age compositions of migrants we introduce the probabilities $p_1(x)$ and $p_2(x)$ that a dependant and a head, respectively, migrate at age x in an interval of time. The age distribution of migrants is defined as before:

$$N(x) = \phi_1 f_1(x) + \phi_2 f_2(x)$$

where

$$f_1(x) = \frac{e^{-rx} I(x) [1 - G(x)] p_1(x)}{\int_0^{\infty} e^{-ry} I(y) [1 - G(y)] p_1(y) dy}$$

and

$$f_2(x) = \frac{e^{-rx} I(x) G(x) p_2(x)}{\int_0^{\infty} e^{-ry} I(y) G(y) p_2(y) dy}$$

The child-dependency migration ratio D_o , equivalent to equation (9), may now be defined as:

$$D_o = \frac{\int_0^{\infty} e^{-ry} I(y) [1 - G(y)] p_1(y) dy}{\int_0^{\infty} e^{-ry} I(y) G(y) p_2(y) dy}$$

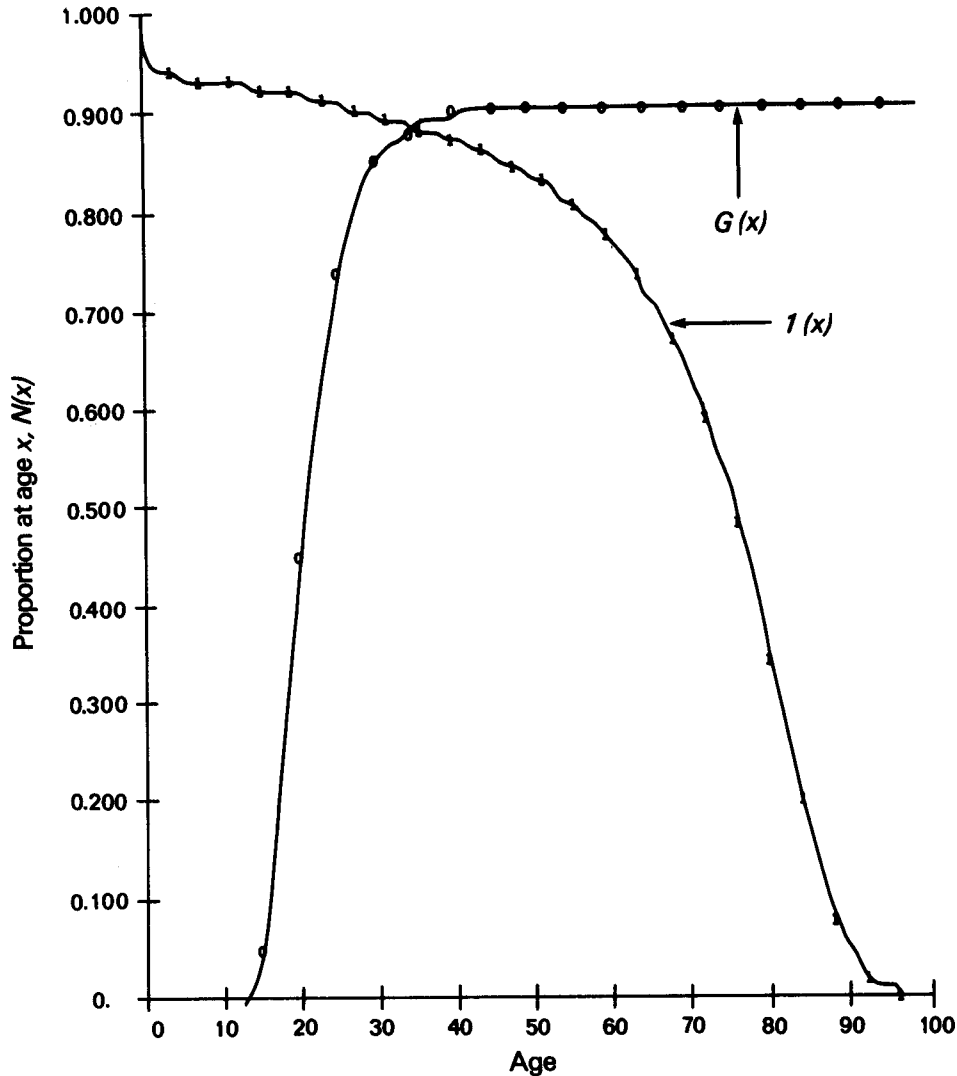
Both child-adult dependency ratios, D_c and D_o , may be analysed by using hypothetical populations once again. To specify correctly the probabilities $p_1(x)$ and $p_2(x)$ from different sources of migration data, it is necessary to identify first the number of moves a person undertakes during a unit interval. However, for our purposes we may assume that both dependants and heads follow a negative exponential propensity to migrate with respect to age, with the function's parameter reflecting the average rate of moving per unit of time. Formally, we have then

$$p_1(x) = o_1 e^{-o_1 x}$$

and

$$p_2(x - y_0) = o_2 e^{-o_2 (x - y_0)}$$

Figure VI. Proportion surviving to age x , $l(x)$, and proportion of individuals who have ever left home by age x , $G(x)$



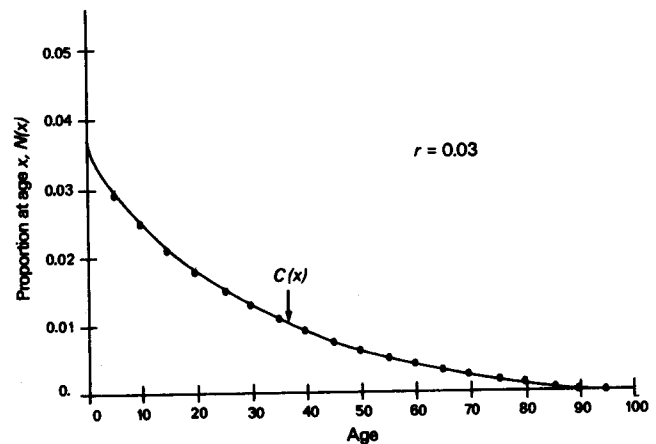
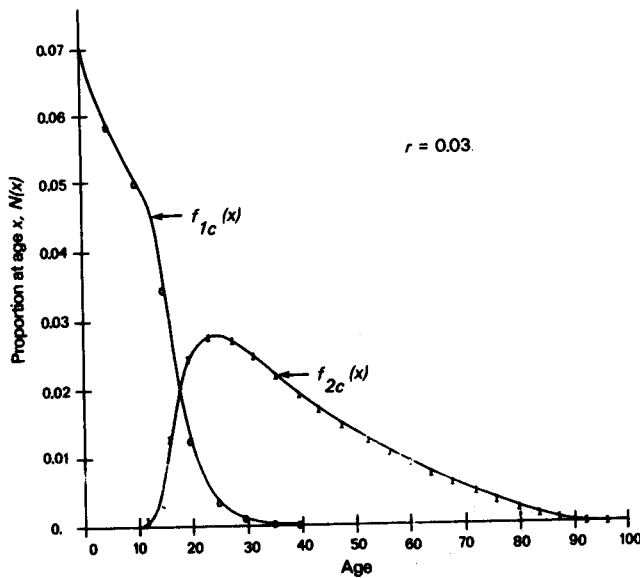
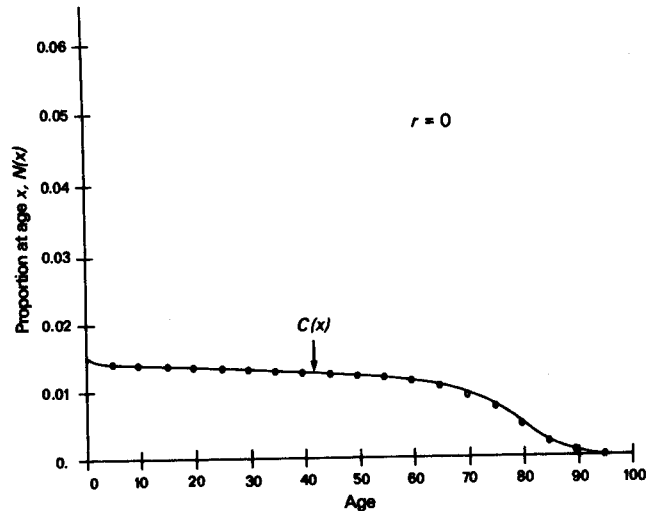
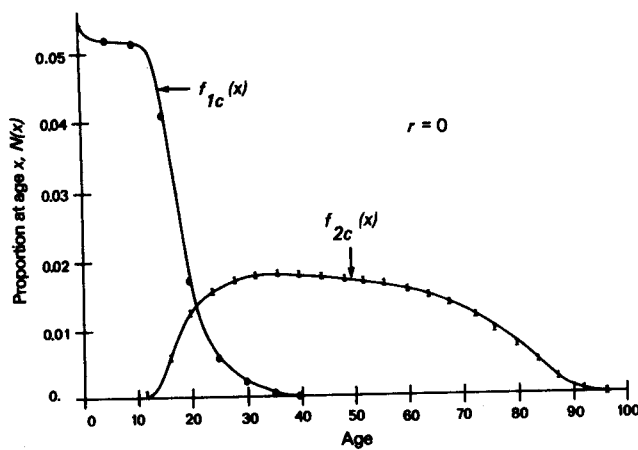
where y_0 denotes, as before, the age at which an appreciable number of females first leave home to establish their own household, and o_1 and o_2 denote the average rates of moving per unit of time of dependants and heads, respectively. One might expect that the average rate of moving per unit of time for dependants, o_1 , should not exceed o_2 , the corresponding rate for heads. In general, dependants (children) move with their parents and independent, single individuals are most likely to be found among adults.

Figure VIII presents the variation of D_0 with respect to D_c for the hypothetical populations of figure VII, under various mobility conditions as expressed by the ratio o_1/o_2 . It may be seen that the ratio D_0/D_c more closely approaches unity as the migration of heads increases.

The parameters defining the mobility conditions may be used to set out a typology of migration profiles that helps to identify how a particular family migration pattern may be

reflected in a migration age composition, and how important the migration propensities among heads and dependants are in structuring that age composition. Figures IX and X present a set of profiles classified according to two distinctly different rates of natural increase. For each of the hypothetical populations we show three alternative combinations of propensities to migrate among heads and dependants. First, figure IX sets out, for low head migration propensities ($o_2 = 0.08$), profiles showing a significant degree of family migration ($o_1 = o_2$) and also of low family dependency ($o_1 = 0.10o_2$ and $o_1 = 0.20o_2$). In a similar format, figure X presents the corresponding profiles for high head migration propensities ($o_2 = 0.16$). With the aid of these two figures we can see that patterns such as those of Stockholm indicate a relatively low family migration dependency with high head migration propensities and low population growth rates, whereas profiles such as those of Mexico City present char-

Figure VII. Proportion of dependants at age x , $f_{1c}(x)$, proportion of heads at age x , $f_{2c}(x)$, and the resulting population age composition, $C(x)$, for intrinsic rates of growth r of zero and 0.03, respectively.



acteristics that correspond to high family migration dependency and relatively high dependant and head migration propensities.

CONCLUSIONS

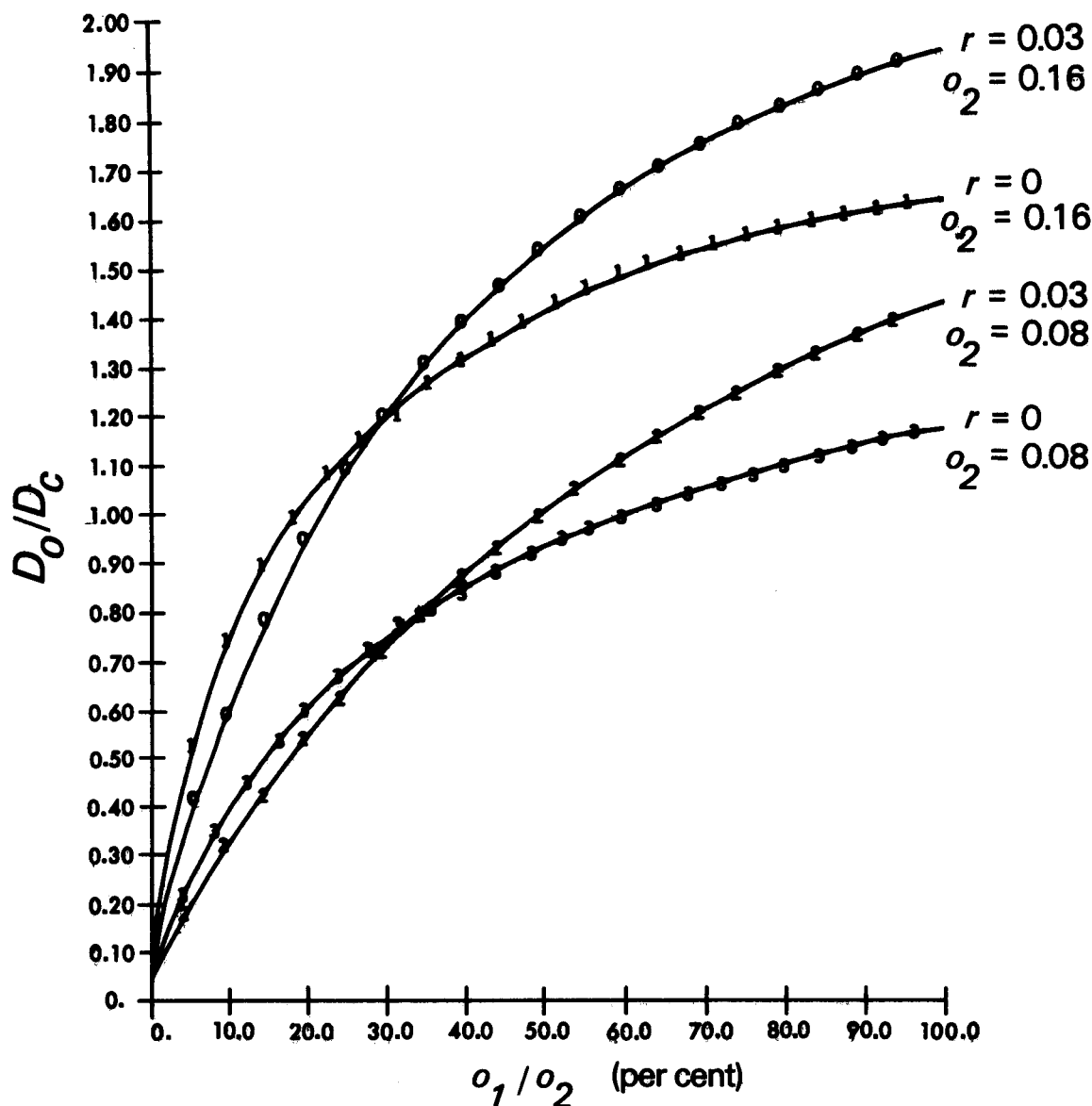
The aim of the present paper has been to show how the regularities that appear in migration age compositions can be summarized in a useful manner and to suggest what such regularities may be telling us about patterns of natural increase, family relationships and mobility levels among migrants.

A disaggregation of migrants into dependent and independent categories, and the adoption of model migration propor-

tion schedules, illuminates the ways in which the age profile of migration is sensitive to relative changes in dependency levels and in rates of natural increase and mobility. Viewing the migration process within a framework of dependent and independent movements allows one to observe that if the independent component mainly comprises single persons, then the associated dependent migration may be insignificant in terms of its relative share of the total migration. On the other hand, if migration tends to consist principally of family migration, then the share of dependent children may become a very important part of total migration.

Observed migration distributions, when analysed in the context of the family status approach, confirm the indications given by the parameters of the associated model proportion schedules. For example, high migration dependencies were

Figure VIII. Variation of child-adult dependency ratios among migrants (D_o) and the population (D_c) with respect to different levels of natural increase (r), family migration (o_1/o_2) and migration propensities of heads (o_2)



correctly indicated for Mexico City; for Stockholm they were low; and falling somewhere in between these two extremes was the case of Rio de Janeiro.

The degree of propensity to migrate among independent migrants is also evident from observed age profiles. Strongly skewed distributions in the adult ages, corresponding to high λ_2 and α_2 parameter values, indicate relatively higher migration propensities for the independent component. Profiles with high dependency levels show much more weakly skewed adult migration compositions due to lower propensities for individual moves among heads.

Just as population age compositions reflect particular characteristics of fertility and mortality régimes, so do observed migration age compositions reflect key aspects of family structure and migration patterns. Although many of the rela-

tionships set out in the present paper are still conjectural, a modest start has been made. A framework for assessing the impacts of natural increase, family dependencies and differing migration propensities has been set out.

The arguments set out in the present paper are related to a number of earlier efforts by the authors to examine regularities in age patterns of migration. For example, our focus has been on a single-sex formulation. However, it appears that differences between the age composition of migrants may be a consequence of differences in sex-dependency structures. To study these relationships, a matrix approach has been recently proposed in Castro and Rogers (1983).

Causes of migration are related to a person's age and sex. For example, migration motivated by health reasons is a phenomenon characteristic of old people, whereas educa-

Figure IX. A typology of age migration distributions for low and high population growth, family migration dependencies and low head migration propensities

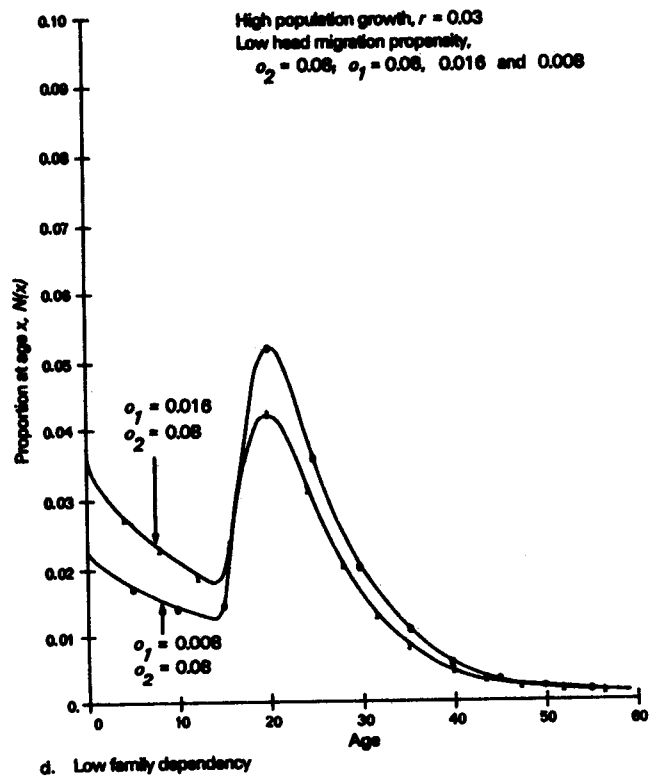
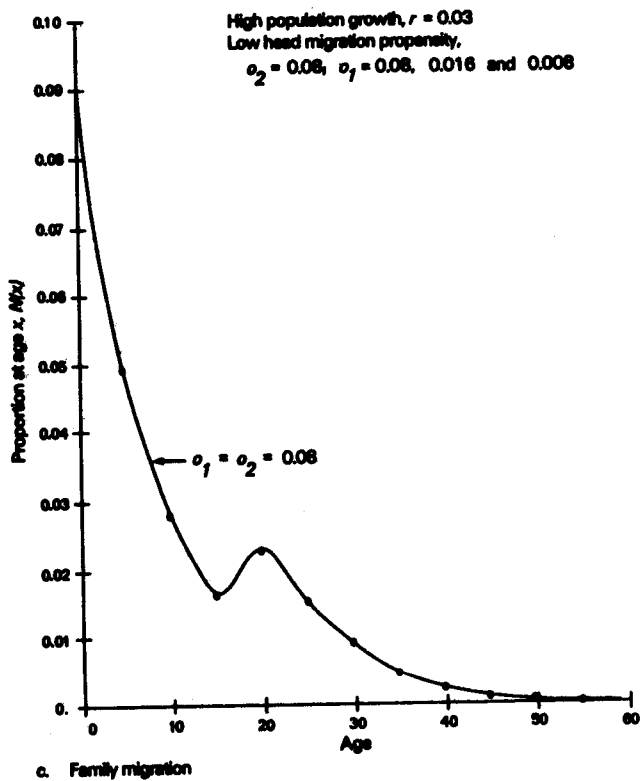
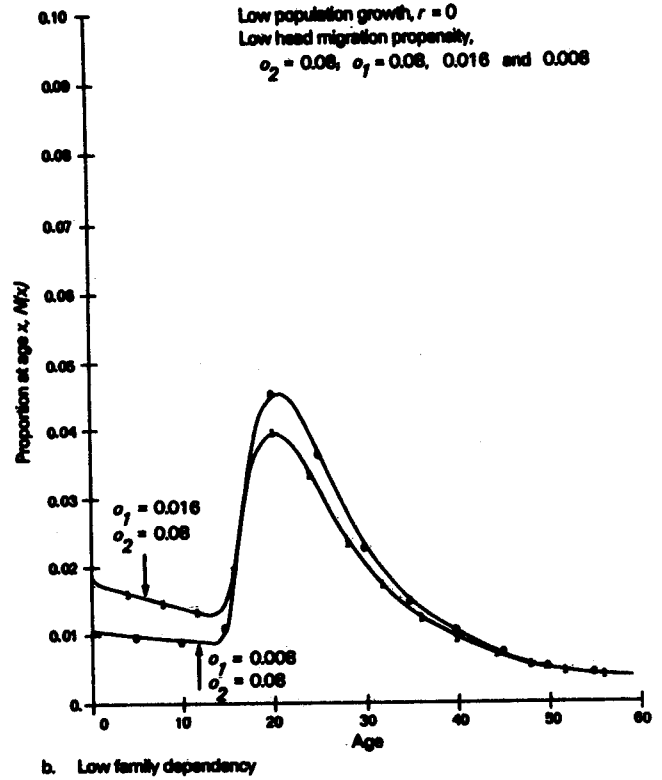
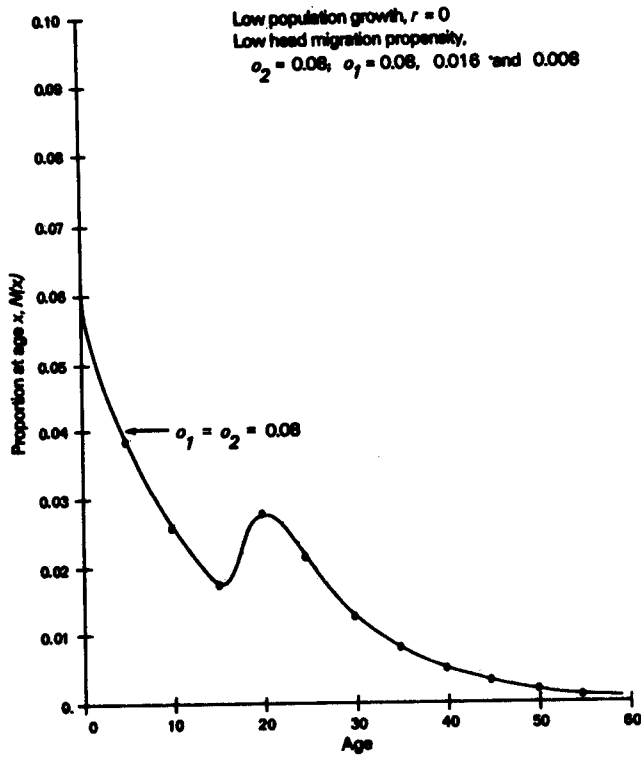
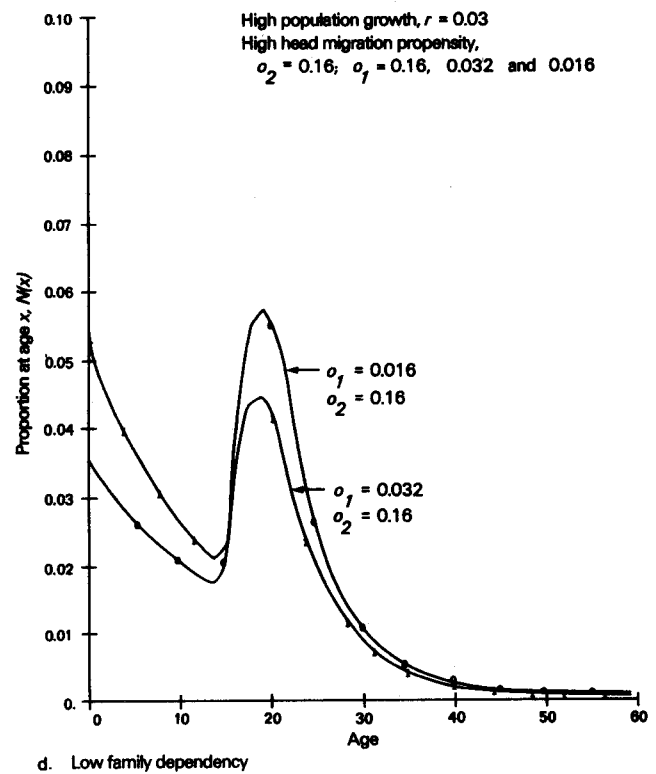
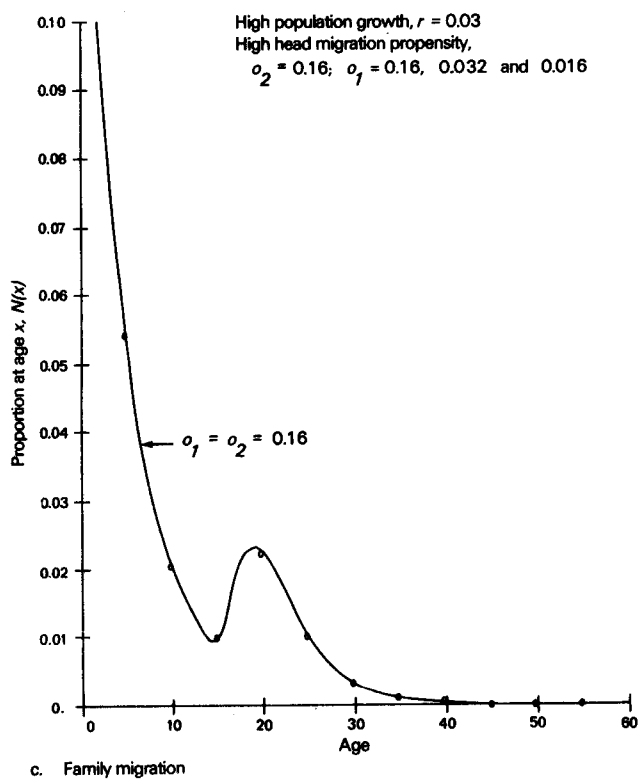
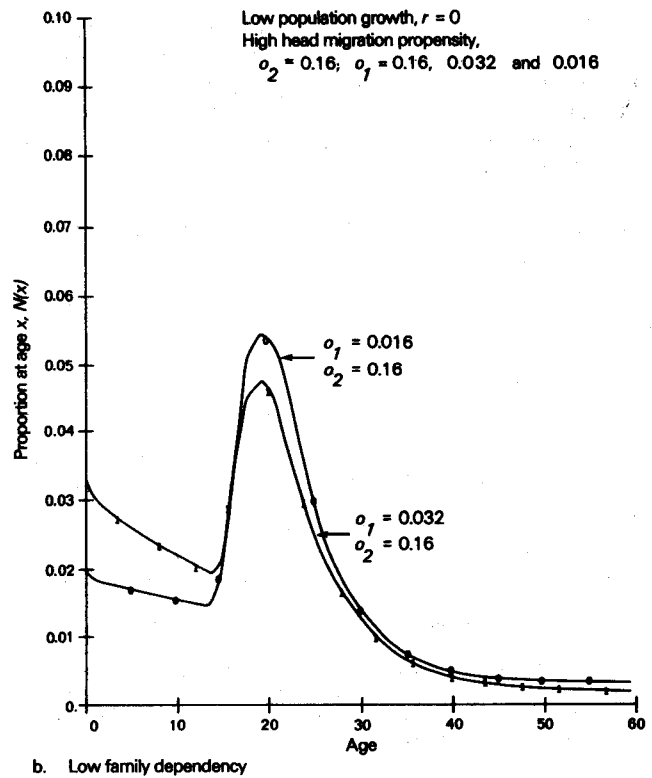
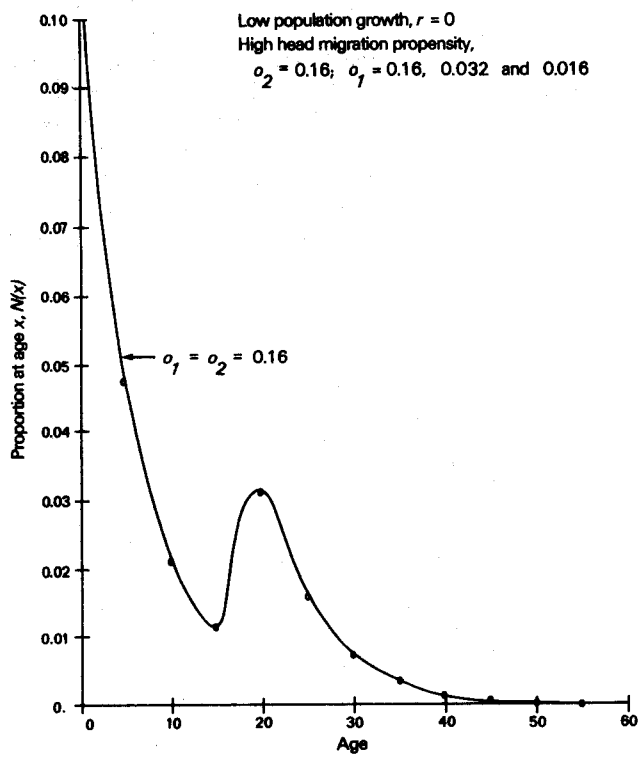


Figure X. A typology of age migration distributions for different population growth, family migration dependencies and high head migration propensities



tion-related migration is predominantly associated with young people. Thus, in order to understand better why people move, it is important to disaggregate cause-specific migration data by age and by sex. This "mortality" analogy is followed in Rogers and Castro (1981a), where it is shown that it is possible to account for some of the differences in age patterns of migration by linking them to differences in their underlying cause-specific structures.

Drawing on techniques used in the corresponding literature in fertility and mortality, Rogers and Castro (1981b) proposed procedures for adopting model migration schedules

to infer migration patterns in the absence of accurate migration data. Such model migration schedules may be used to graduate inadequate data, thereby smoothing out irregularities and ascribing to the data summary measures that can be used for comparative analysis. They also may be used to interpolate to single years of age observed reliability of empirical migration data, and indications of appropriate strategies for their correction are aided by the availability of standard families of migration schedules. Finally, such schedules may also be used to help resolve problems caused by missing data.

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THE LONG-TERM IMPACT OF WAR ON MORTALITY: OLD-AGE MORTALITY OF THE FIRST WORLD WAR SURVIVORS IN THE FEDERAL REPUBLIC OF GERMANY

*Shiro Horiuchi**

SUMMARY

For an investigation of long-term impacts of the world wars on mortality of the survivors, vital statistics in the Federal Republic of Germany from 1959 to 1974 were analysed using the age-period-cohort binary-variable regression method and the period rate of mortality change with age, which is a measure very sensitive to cohort variations. The results have revealed that the cohort of males of the Federal Republic of Germany who were adolescents (about age 15) at the end of the First World War experienced high mortality in its old age, as compared to its preceding and succeeding cohorts. This pattern has not been observed for females. Similar cohort variations have been found, though to a lesser extent, among males in some other countries, such as France and Austria, that were deeply involved in the First World War, and have begun to appear in the middle-age mortality of the Second World War survivors in the Federal Republic of Germany and Japan. The mortality patterns seem to reflect long-term impacts of malnutrition under the hardship of life during war upon vascular structures of male adolescents. The present study highlights the significance of further research on the long-term influences of catastrophic events on the health of the survivors, to which little attention has been paid.

INTRODUCTION

Mortality tends to rise during war. A number of people are killed in combat, and the hardship of life during war may also increase the number of deaths. Furthermore, warfare usually has some impact on the health and mortality of the survivors who were injured in combat or exposed to poor hygiene and malnutrition. However, little attention has been given to the long-term effects of war on mortality.

Okubo has analysed age patterns of mortality in Japan after the Second World War and has shown by graphic presentation that the male cohort that was about age 15 at the end of the War, a generation that is slightly younger than the one that suffered heavy casualties in combat, experienced relatively high mortality in middle age.¹ Such a cohort variation

has not been found for females. Okubo has speculated that the malnutrition in those days might have weakened the blood vessel structures of male adolescents. His findings lead us to the expectation that a similar cohort variation in mortality might be found among the First World War survivors, especially in the Federal Republic of Germany where people experienced significant hardships near the end of the War. The present investigation is undertaken in order to analyse cohort patterns of old-age mortality in the Federal Republic of Germany.

MATERIALS AND METHODS

Data on the mid-year population and the number of deaths by age, published by the Statistical Office of the Federal Republic of Germany, were obtained to compute the age-specific mortality rates shown in table 1. The years 1959, 1964, 1969 and 1974 were chosen in order to follow the five-year cohort born between 1899 and 1904, which seems to correspond approximately to the high-mortality male cohort in Japan, with respect to age at the end of the world wars.

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TABLE 1. AGE-SPECIFIC MORTALITY RATES FOR THE FEDERAL REPUBLIC OF GERMANY
1959, 1964, 1969 AND 1974
(Deaths per 1,000)

Age	Males				Females			
	1959	1964	1969	1974	1959	1964	1969	1974
35-39	2.44	2.39	2.46	2.36	1.68	1.53	1.50	1.23
40-44	3.35	3.54	3.68	3.61	2.34	2.32	2.30	2.07
45-49	5.40	5.49	5.88	5.66	3.53	3.47	3.66	3.32
50-54	9.29	9.17	9.62	9.21	5.33	5.12	5.42	5.12
55-59	15.95	15.97	15.82	14.64	8.20	7.90	8.03	7.20
60-64	25.19	26.75	27.84	23.94	13.61	13.09	13.37	11.56
65-69	38.84	41.07	46.35	40.72	23.98	22.22	23.56	20.09
70-74	60.08	61.43	71.13	65.19	43.16	39.23	41.49	36.35
75-79	95.85	94.08	104.42	99.78	78.64	69.49	72.80	65.28
80-84	154.67	144.35	154.83	149.92	133.67	119.05	123.79	114.92

Source: Federal Republic of Germany, Statistisches Bundesamt, 1961, 1965, 1972, 1976, *Bevoelkerung und Kultur, Reihe 7: Gesundheitswesen*, 1959, 1964, 1969, 1974 (Stuttgart, Statistisches Bundesamt).

Two methods of data analysis were employed. First, the rate of mortality change with age, defined by

$$k(x) = \frac{d \log(\mu(x))}{dx}, \quad (1)$$

where $\mu(x)$ is the mortality rate at exact age x , was estimated for ages 40, 45, . . . , 80 in each study year. Coale and Horiuchi have shown that the measure is useful for analysing age and cohort variations of mortality that are not easily detected using more conventional measures.² With five-year age group data, $k(x)$ is approximated by

$$k(x) = \frac{\log({}_5M_x / {}_5M_{x-5})}{5}, \quad (2)$$

where ${}_5M_x$ is the number of deaths divided by person-years at risk in the age interval $(x, x + 5)$.^{3,4}

Second, in order to divide mortality variations into age, period and cohort components, a dummy variable regression analysis was conducted. The age-specific death rate M_{ij} is transformed logarithmically:

$$G_{ij} = \log M_{ij}, \quad (3)$$

where $i = 1, 2, \dots, 10$ are the five-year age groups 35-39, 40-44, . . . , 80-84⁵ and $j = 1, 2, 3, 4$ are the years 1959, 1964, 1969 and 1974, respectively.⁶ Also, let $k = 1, 2, \dots, 13$ be the cohorts born in the periods 1874-1879, 1879-1884, . . . , 1934-1939. Note $k = 10 + j - i$. The model proposed is

$$\hat{G}_{ij} = \alpha + \beta_i + \gamma_j + \delta_k, \quad (4)$$

where \hat{G}_{ij} is an estimate of G_{ij} , α is a constant, and β , γ and δ are the age factor, period factor and cohort factor, respectively. This is the simplest kind of age-period-cohort model since the effects of age, period and cohort on G_{ij} are assumed to be additive.⁷

Model (4) has been used in several mortality studies. Sacher adopted the model for analysing the mortality from tuberculosis,⁸ and Barrett also employed it for studying death rates due to cancers of the cervix, bladder, breast and prostate.⁹

The analysis was conducted with the conditions $\beta_{10} = 0$, $\gamma_4 = 0$ and $\delta_{12} = \delta_{13} = 0$.¹⁰ Although the model was made estimable by setting factors for the two youngest (12th and 13th) cohorts equal to each other, strong interdependency among age, period and cohort may jeopardize the substantive interpretability of the estimated factors. In this sense, the use of the $k(x)$ analysis described above is especially helpful because the consistency of results can be examined between the $k(x)$ analysis and age-period-cohort regression.¹¹

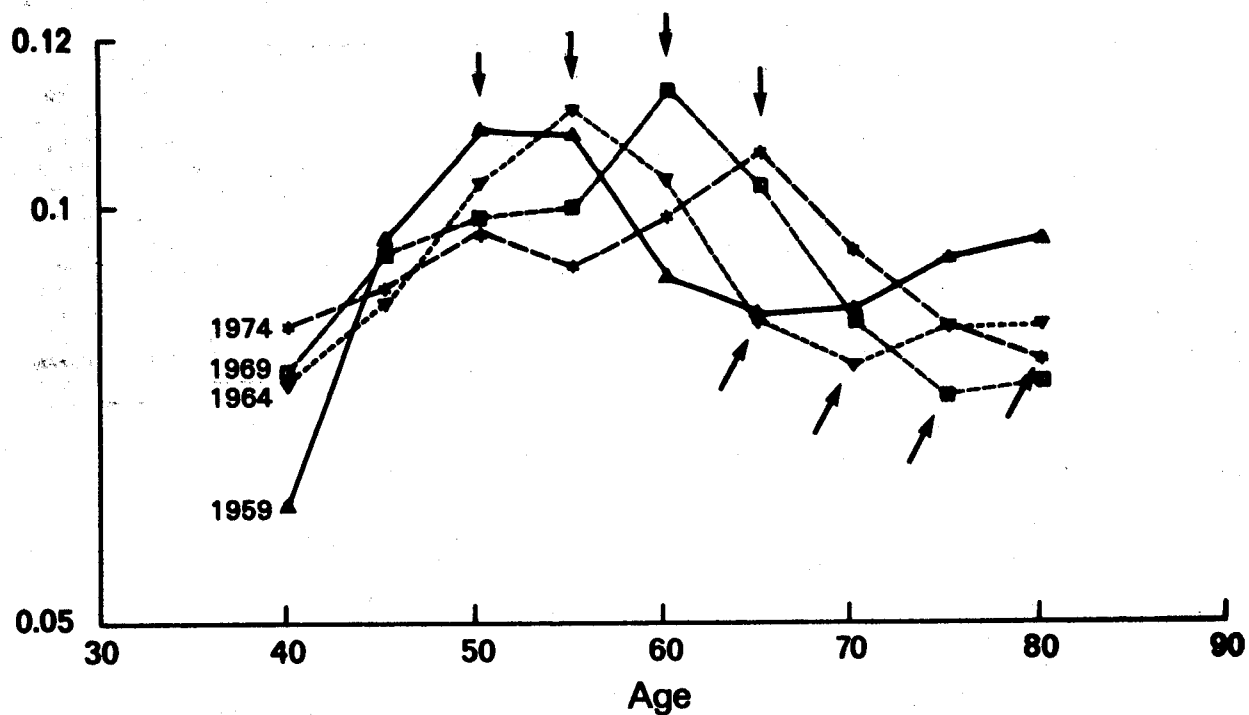
RESULTS

Figure I illustrates the age pattern of $k(x)$ for males. It is clearly seen that a dip and a peak, corresponding to births at the beginning of 1894 and 1909, respectively, shift to the right as cohorts get older. This cohort pattern suggests that a high-mortality cohort exists between the dip and the peak, for the following reason. If a low-mortality cohort is followed by a high-mortality cohort, mortality increases with age from the younger group to the older group at a relatively low rate, so that $k(x)$ tends to be small. If the order is reversed, $k(x)$ tends to be large. Therefore, if a cohort experiences a relatively higher mortality schedule than its adjacent ones, low values of $k(x)$ in older ages tend to be followed by high values of $k(x)$ in younger ages, thereby resulting in a sequence of a dip and a peak as seen in figure I. Note that the cohort located in the middle of the dip and the peak was about age 16 in 1918, the year when the War ended.¹²

Such a shift of dip and peak of $k(x)$ with cohorts is not found for females. As seen in figure II, age patterns of $k(x)$ for females are very similar for the four distinct periods, and no strong indication of cohort variation is observed.

For further investigation of cohort variations in male mortality, age-period-cohort regression analysis was conducted and R^2 was above 0.99. As presented in table 2 and illustrated in figure III, the highest cohort factor was obtained by the cohort that was born between 1899 and 1904, the one that was about age 16 in 1918. Its cohort factor is larger than those of the cohorts 10 years older and 10 years younger by 0.0832 and 0.0792, corresponding to 8.7 and 8.2 per cent higher mortality rates, respectively. As shown in figure IV, the high-mortality cohort is slightly younger than the generations of soldiers. In figure IV, the area bounded by the serrated line roughly approximates soldiers' lives lost in combat.

Figure I. Rate of mortality change with age, $k(x)$, for males, Federal Republic of Germany, 1959, 1964, 1969 and 1974



NOTE: The upward-pointing arrows and downward-pointing arrows indicate the positions of the cohorts born in 1894 and 1909, respectively.

Figure II. Rate of mortality change with age, $k(x)$, for females, Federal Republic of Germany, 1959, 1964, 1969 and 1974

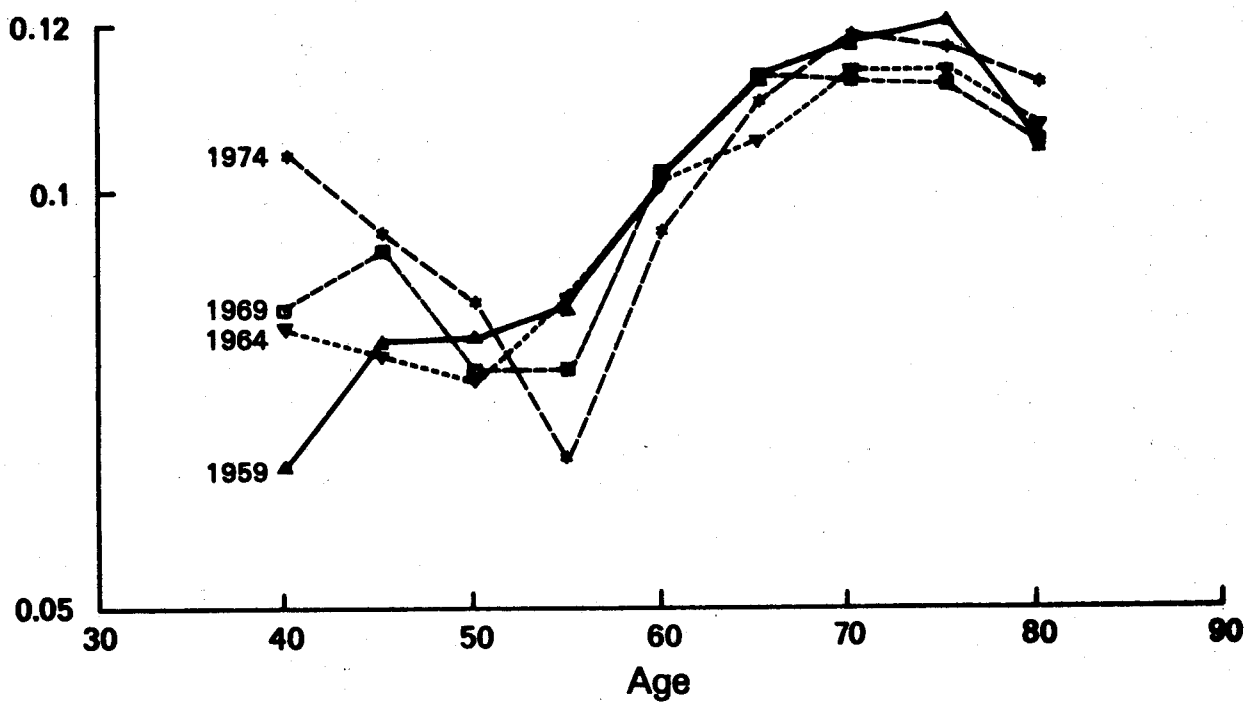


Figure III. Plot of some cohort factors (δ 's) in model (4)

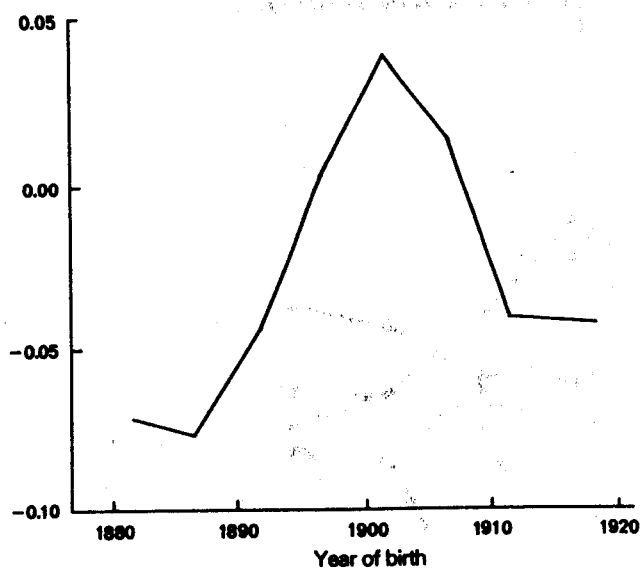
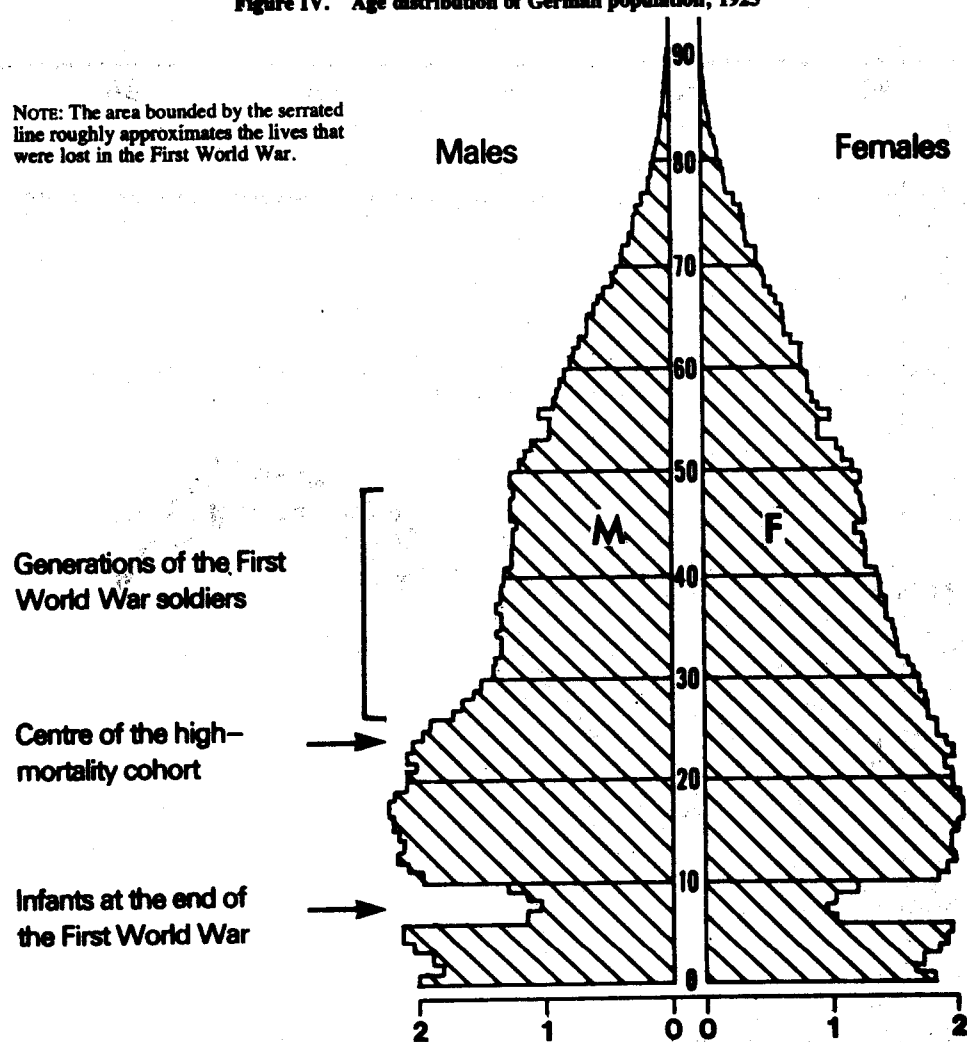


TABLE 2. ESTIMATED COEFFICIENTS OF REGRESSION ANALYSES OF THE LOG-ARITHM OF AGE-SPECIFIC MORTALITY RATE ON AGE, PERIOD AND COHORT FOR MALES IN THE FEDERAL REPUBLIC OF GERMANY

Age (B)		Period (y)		Cohort (B)	
35-39	-4.1839	1959	0.0068	1874-1879	-0.0083
40-44	-3.7892	1964	0.0151	1879-1884	-0.0714
45-49	-3.3199	1969	0.0739	1884-1889	-0.0765
50-54	-2.8166	1974	0.0000	1889-1894	-0.0448
55-59	-2.3126			1894-1899	0.0025
60-64	-1.8161			1899-1904	0.0384
65-69	-1.3395			1904-1909	0.0127
70-74	-0.8828			1909-1914	-0.0407
75-79	-0.4296			1914-1919	-0.0420
80-84	0.0000			1919-1924	-0.0022
Constant	-1.8650			1924-1929	-0.0062
				1929-1934	0.0000
				1934-1939	0.0000

Figure IV. Age distribution of German population, 1925

NOTE: The area bounded by the serrated line roughly approximates the lives that were lost in the First World War.



Source: Federal Republic of Germany, Bundesministerium für Gesundheitswesen, Das Gesundheitswesen der Bundesrepublik Deutschland, Band 1 (Stuttgart/Mainz, Verlag W. Kohlhammer, 1963), p. 47.

Patterns of age factors and period factors in table 2 appear reasonable. The age factor increases with age at the rate of 8 to 10 per cent per year of age, thus agreeing quite well with the model of geometric increase of mortality that assumes a constant rate of mortality growth.¹³ Note that the age pattern of observed death rates is less in agreement with the model, since the observed death rate increases with age at a more fluctuating rate, as shown in figure I, reflecting cohort variations.

Period factors have a high peak in 1969, suggesting that conditions in the year raised mortality by 6 to 8 per cent higher than the other years. Although the peak does not meet the expectation of declining mortality, the pattern simply mirrors periodical variations in observed death rates, since the geometric mean of age-specific death rates¹⁴ from age 35 to 84 in 1969 is also 6 to 8 per cent higher than the others.

DISCUSSION

It has been shown above that the male cohort centred at the birth years of 1901 and 1902 has experienced relatively high mortality in its old age. The evidence itself does not necessarily imply that the high mortality is related to the experience of the cohort during the First World War. However, similar patterns of mortality are observed, though to a lesser extent, among some other countries that were deeply involved in the First and Second World Wars.

Figure V(a) shows that a similar shift of dip and peak of $k(x)$ is also seen for French males, although the mid-point of cohorts between the dip and the peak seems two or three years older than its counterpart in the Federal Republic of Germany. As revealed in figures V(b) and (c), shifts of $k(x)$ patterns with cohorts are found for males in the German Democratic Republic and Austria, both of which were deeply involved in the First World War. On the other hand, similar cohort variations are difficult to find in such countries as Japan and Sweden, which did not play major roles in the First World War, as shown in figures V(d) and (e). However, it seems that the footprint of the Second World War began to appear in Japan, and the Federal Republic of Germany as well. In figure V(f), the peak-and-dip pattern is seen in $k(x)$ sequences from recent mortality data in both countries, and the cohort between the peak and the dip was about 14 at the end of the Second World War. Given this evidence, it seems quite plausible that the cohort variations in old-age mortality of males of the Federal Republic of Germany that were analysed in the last section reflect some impacts of the First World War.

Our findings may indicate that male adolescents are especially vulnerable to malnutrition experienced under the hardship of life during war, with respect to its long-term influences. The under-consumption of food seems to have been substantial. Production statistics in 1913 and 1920, for example, reflect the impact of the War on food supply. Comparing data on the production of basic food shifts, such as bread-making grains, potatoes, meat and animal fats, butter and vegetable fats, milk and so on, in those two years, Grebler has shown "that in 1920 the German people had still to be content with about 50 per cent of the supply of the most necessary articles of diet as compared with 1913".¹⁵ Rubner

estimated changes in the amount of nutrition taken by the German people during the War and concluded "that nutrition in the towns, particularly in the large towns, was not sufficient to maintain the population, and that for many under-consumption in 1914 to 1918 resulted in starvation . . .".¹⁶ The malnutrition immediately after the end of the War was also significant. The Allied food blockade of Germany continued for about five months after the Armistice of 11 November 1918. According to Bane and Lutz, "the suffering of the German children, women and men, with the exception of farmers and rich hoarders, was greater under the continued blockade than prior to the Armistice".¹⁷

Problems that remain unsolved are: (a) why the influences last a long time, (b) why adolescents tend to be affected, and (c) why males are more vulnerable than females. Some speculations about these issues are given below.

First, if malnutrition has some detrimental effects on the growth of the blood vessel structures, as suggested by Okubo,¹⁸ the influences will appear in old age, when cardiovascular diseases become the major cause of death. Figure VI shows the rate of mortality increase with age for two major causes of death in old age, cardiovascular diseases and neoplasms, for males of the Federal Republic of Germany. A shift of $k(x)$ with cohorts as seen in figure I for all causes combined can be found for cardiovascular diseases, except for data in 1964 that do not fit the shifting pattern very well. On the other hand, substantial variations of cohort origin do not appear at all for cancers.¹⁹

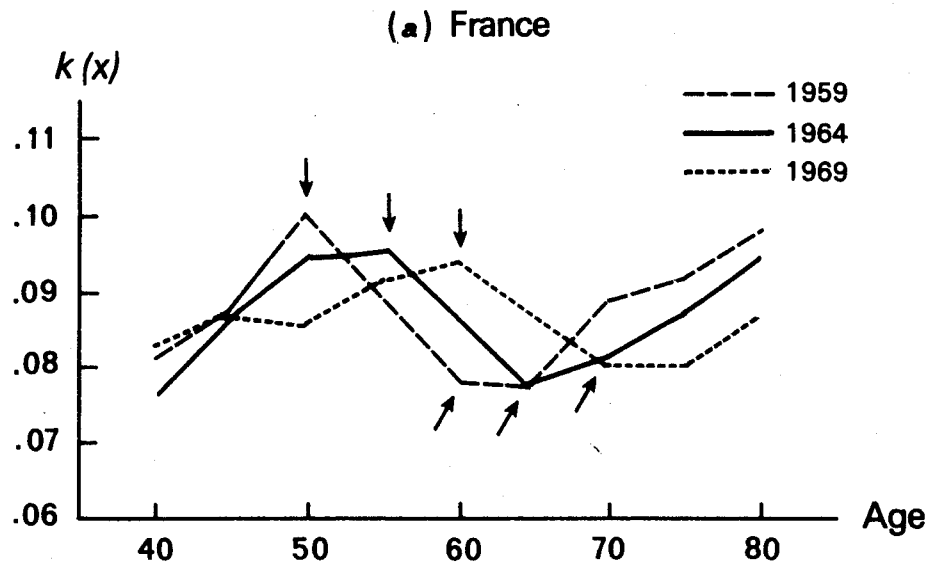
Secondly, the impact of nutritional deprivations in young childhood on the growth of the blood vessel structures may possibly be compensated to some extent by better nutrition in later years of physical growth. However, damages due to teenage undernourishment may tend to remain permanently since they are in the final stages of the major physiological development.

Thirdly, female adolescents may be less vulnerable to malnutrition because in general, females are capable of storing more fat in their bodies than males. These discussions are only tentative and further research on the cohort mortality patterns seems necessary from medical viewpoints.

On the other hand, the cohort mortality patterns found in the present paper may be explained as an instance of age misstatement. Some young males in those days, perhaps with the help of their parents, might have succeeded in understating their ages in order to avoid or defer military service during the War, and remained in the younger cohort throughout their lives, thereby keeping the reported mortality of the cohort biased upward.

The age transfer must have kept the sex ratio (male/female) of the younger cohort higher than expected after the First World War until the draft of middle-aged males near the final stage of the Second World War and loss of their lives in battle lowered the sex ratio drastically. Therefore, the age-specific sex ratio at the 1933 German census is expected to show a trace of the transfer of males to the younger cohorts. As presented in column (4) of table 3, the sex ratio decreases with age gradually but very slightly from 20 to 33, as generally expected from the usual pattern of excess male mortality, then drops beginning with age 34, that is, age 19 at the end of the Second World War, reflecting the loss of young males during the War. The sequence of sex ratios at the 1933 census

Figure V. Rate of mortality change with age, $k(x)$, for males, in selected countries



NOTE: The upward-pointing arrows and the downward-pointing arrows indicate the positions of the cohorts born in 1899 and 1909, respectively.

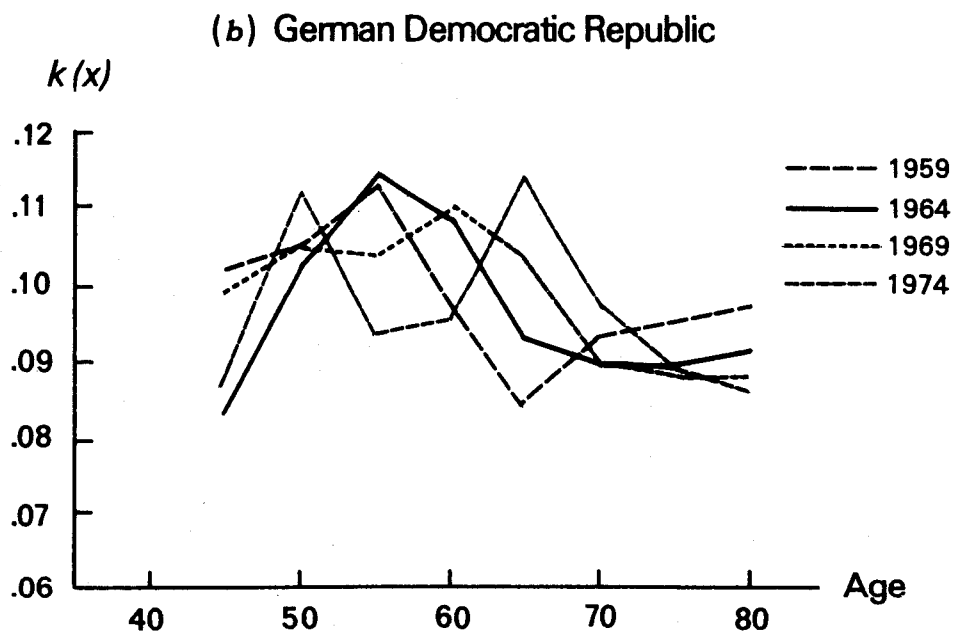
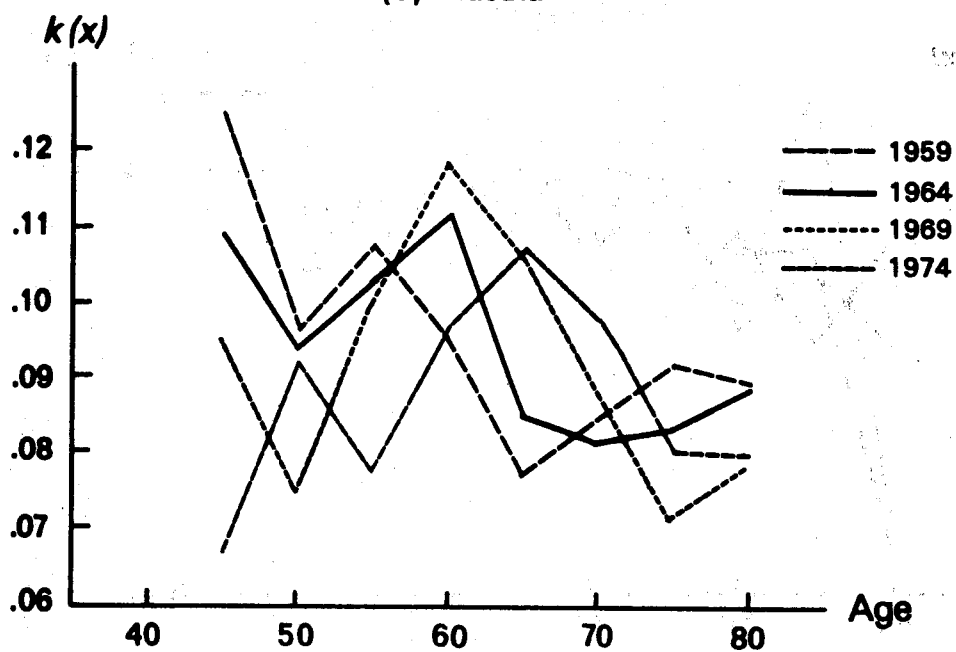


Figure V. (continued)

(c) Austria



(d) Japan

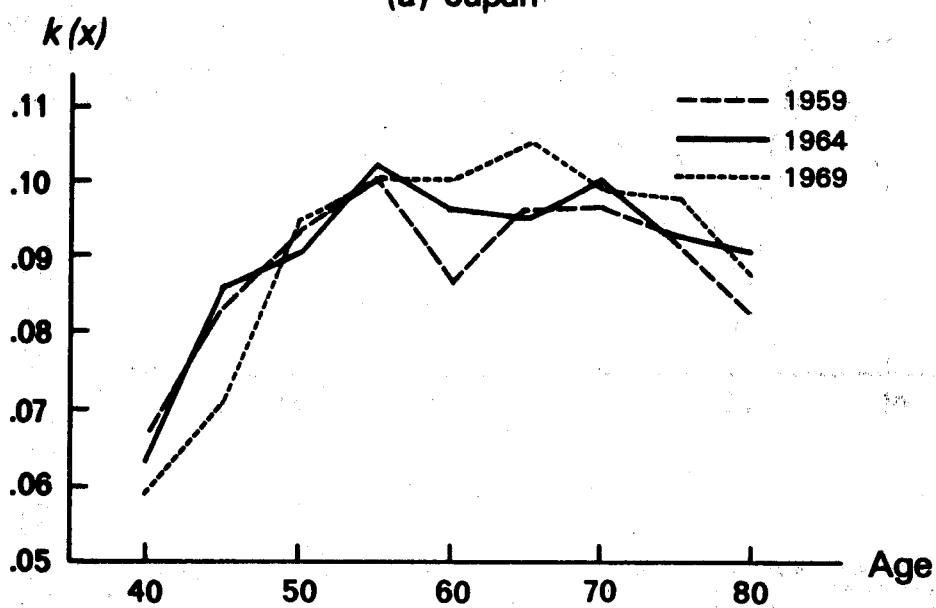
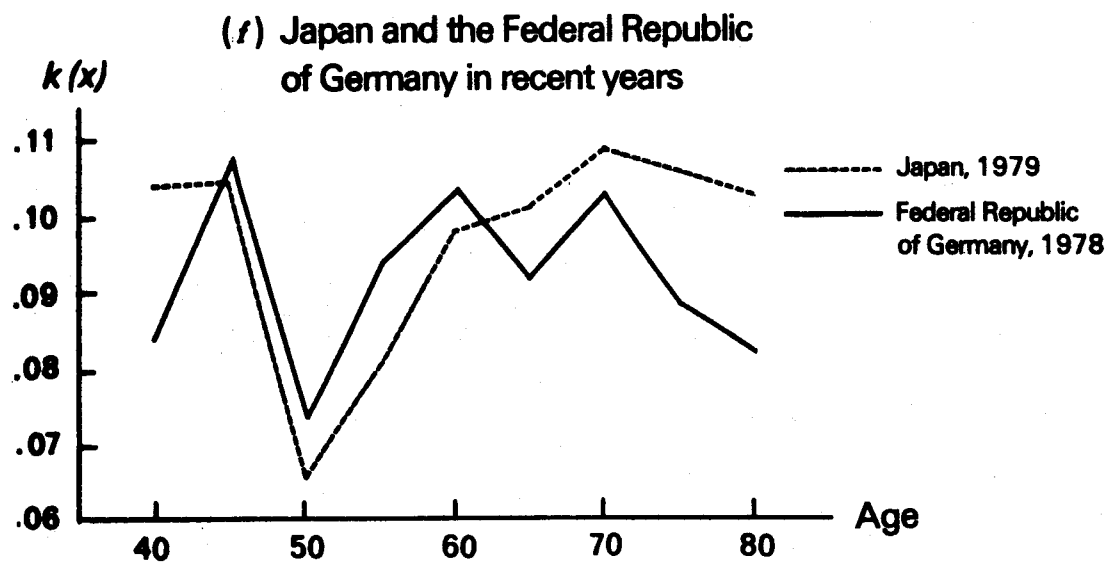
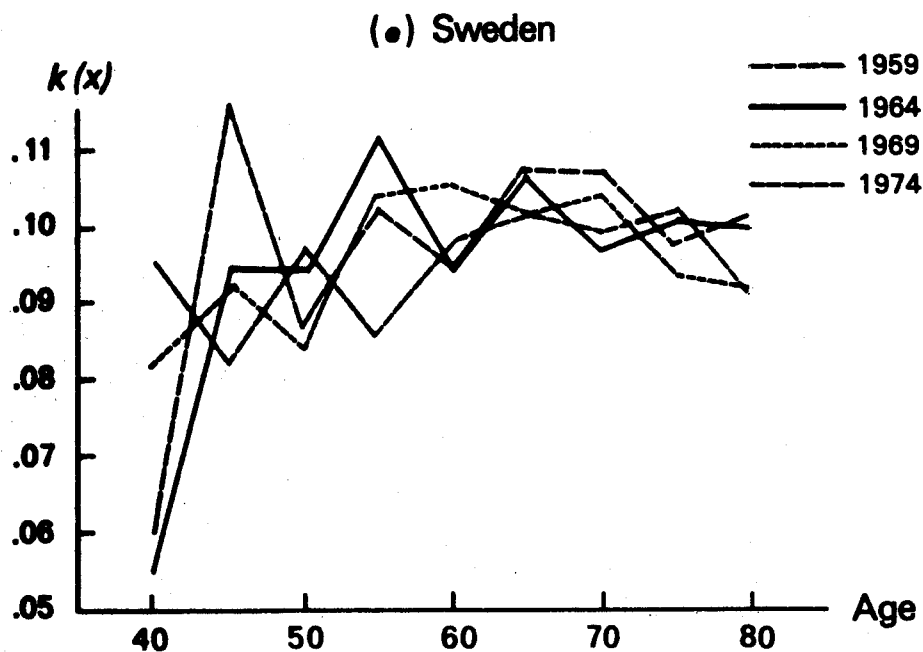


Figure V. (continued)



NOTE: Computed from the following sources: *Demographic Yearbook 1966* (United Nations publication, Sales No. 67.XIII.1); *Demographic Yearbook 1974* (United Nations publication, Sales No. E/F.75.XIII.1); *Demographic Yearbook, Special Issue: Historical Supplement* (United Nations publication, Sales No. E/F.79.XIII.8); Japan, Statistics and Information Department, Ministry of Health and Welfare, *Vital Statistics 1979, Japan* (Tokyo, Ministry of Health and Welfare, 1981); Federal Republic of Germany, *Statistisches Bundesamt, Statistisches Jahrbuch 1980 für die Bundesrepublik Deutschland* (Herausgeber, Statistisches Bundesamt, 1980).

TABLE 3. SEX RATIO AT BIRTH BY YEAR OF BIRTH AND SEX RATIO BY AGE AS OF 31 DECEMBER 1933, FOR THE FEDERAL REPUBLIC OF GERMANY

Year of birth (1)	Sex ratio at birth (2)	Age on 31 December 1933 (3)	Sex ratio on 31 December 1933 (4)
1912	1.0594	21	1.0107
1911	1.0554	22	1.0018
1910	1.0528	23	1.0031
1909	1.0531	24	0.9989
1908	1.0543	25	0.9988
1907	1.0565	26	0.9997
1906	1.0542	27	0.9947
1905	1.0565	28	0.9947
1904	1.0548	29	0.9922
1903	1.0516	30	0.9890
1902	1.0521	31	0.9944
1901	1.0547	32	0.9985
1900	1.0554	33	0.9863
1899	1.0530	34	0.9268
1898	1.0517	35	0.8766
1897	1.0528	36	0.8430
1896	1.0520	37	0.8071
1895	1.0524	38	0.7903
1894	1.0513	39	0.7757
1893	1.0539	40	0.7822

Source: Germany, Statistisches Reichsamt, 1936, *Volkszählung: Die Bevölkerung des Deutschen Reichs nach den Ergebnissen der Volkszählung 1933, Heft 2: Geschlecht, Alter und Familienstand der Bevölkerung des Deutschen Reichs* (Berlin, Paul Schmidt).

seems to reveal no strong indication of age transfer of males to cohorts about age 16 at the end of the War.²⁰

However, the birth cohorts of 1902 and 1901 that were aged 31 and 32 at the end of 1933 and thus 16 and 17 at the end of the War perturb, though only slightly, the tendency of gradual slow decline of the sex ratio with age. This may be an indication of age transfer, although the perturbation seems partly attributable to variations in sex ratio at birth. As shown in column (2) of table 3, those cohorts have slightly higher sex ratios at birth than the cohort of 1903.

Even if the relatively high sex ratios of these cohorts reflect some age transfer that really occurred, they seem too small to explain the observed size of cohort mortality variations. For instance, it can be shown by simple calculations that, if about one quarter of the cohort is in fact three years older than the age they report, then the observed death rate of the cohort is about 8 per cent higher than what it really is.²¹ Note that an 8 per cent difference in death rates is slightly smaller than what is implied by the differences in the estimated cohort factors between the high-mortality cohort of 1899-1904 and the cohorts that are 10 years younger and older than the cohort. However, no trace of such a large size of transfer of males among age groups is found in table 3.

In addition, the fact that similar mortality patterns are observed among the First World War survivors in France and the Second World War survivors in Japan and the Federal Republic of Germany seems to make the hypothesis of age misstatement even less plausible, since the difficulty in avoiding military service by understating ages may change over time and vary among countries.

Besides the above-mentioned interpretations, that is, nutritional deprivation and age transfer, at least four other hypotheses seem to provide partial accounts for the cohort mortality patterns and thus are worth considering. First, the

mortality of a certain cohort appears relatively high if the mortality of the preceding and succeeding cohorts is kept low for some reasons. It should be noted that the high-mortality cohort found in the present study is located between the generation of World War soldiers and those who were young children during the War, both of which may have experienced low mortality after the War for the following reasons. Namely, some soldiers died in combat and some young children, in particular, infants, died due to malnutrition and poor hygiene during the War, thereby making the survivors of the two generations a group of relatively strong persons who managed to survive under very difficult conditions. Cohorts between the two generations, on the other hand, may include a higher proportion of unhealthy persons, who push up the death rate for the cohorts.

This interpretation, however, has a few limitations. Although the hypothesis can differentiate the mortality of the cohort that was adolescent at the end of the War from that of the soldier generations, it does not fully explain the difference between the high-mortality cohort and the succeeding generations. If this "selection" explanation were valid, we might expect substantial cohort variations in female mortality, since malnutrition and poor hygiene are considered to strike both male and female children, as far as their short-term impacts on mortality are concerned. This expectation is not met by our data analysis results as previously shown. In addition, this interpretation does not provide a full explanation of the exact timing of the cohort variations. The cohorts between soldiers and young children spread over more than 10 years of age, as shown in figure IV, and thus the fact that the centre of the high-mortality cohorts was about age 15 and 16 at the end of the War remains unsolved.

Secondly, it may be speculated that the variations in cohort mortality are related to the post-War variations in cohort size. After many soldiers had lost their lives in the War, the survivors could enjoy the advantages of the reduced cohort size when they returned to civilian life. The cohorts several years younger, on the other hand, were significantly larger, so that they had to experience greater competition and more stress throughout their lives, resulting in higher mortality than the cohort of combat survivors. This explanation, however, does not agree very well with the fact that the larger cohorts experienced high mortality at old age even in their less competitive post-retirement life styles.

Thirdly, suppose that a particular type of weapon that has a long-term impact on health were introduced near the end of the First World War. If so, the last and youngest group of recruits who joined the armed forces after the older cohorts had lost many soldiers might have been the primary target of the weapon. The fact that poison gas was used for the first time in 1915, however, produces difficulties in finding weapons that satisfy the above condition. Moreover, this hypothesis does not seem very successful in accounting for the similarities in cohort mortality between survivors of the First World War and those of the Second World War.

Finally, it can also be speculated that cohort variations in cigarette smoking are related to the cohort mortality patterns. The habit of cigarette smoking, which, in the old days, was restricted only to small segments of societies, is considered to have spread widely early in this century. The armed

services in the First World War might have spurred the diffusion of the habit. Cigarette smoking is known to be related to various types of cancers and cardiovascular diseases²² and it often generates strong cohort variations in mortality.²³ Thus, the question may be raised whether the cohort variations in agreement with the timing of the First World War reflect some impacts of cigarette smoking.

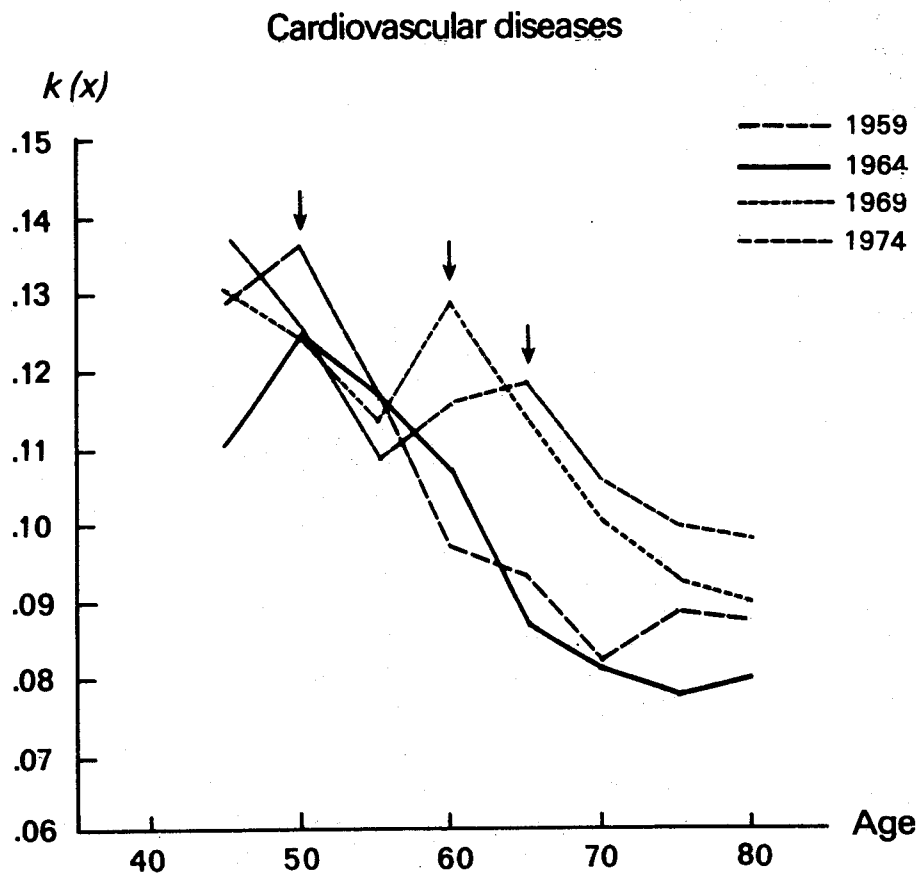
The diffusion of cigarette smoking, however, would rather cause an upturn of the cohort mortality factor than boost the death rate of a particular cohort relative to that of the preceding and succeeding generations. There seems to be no strong reason to expect only teenagers at the end of the wars to become the heaviest smokers. In addition, this interpretation, as well as the "special weapon" interpretation, seems less successful in explaining the cohort variations of the Second World War survivors than those of the First World War survivors.

Therefore, although the four interpretations described

above may agree with certain elements of the results, none of them seem to provide a full account of all the important aspects of the mortality patterns. Although it is too early to discard these different interpretations, the "malnutrition" hypothesis seems to stand more plausible than the "age-transfer" account and the other four explanations, at least for the time being.

In summary, cohort mortality variations that perhaps reflect long-term impacts of the First World War on health have been found among older males in the Federal Republic of Germany. The findings seem to shed light on the importance of a research topic to which relatively little attention been given, that is, the long-term influences of catastrophes, including famine, drought and epidemic, as well as warfare, upon the mortality of the survivors, and in particular, the effects of nutritional deprivations experienced under those conditions. The results of the present study suggest that further research on this subject should be conducted.

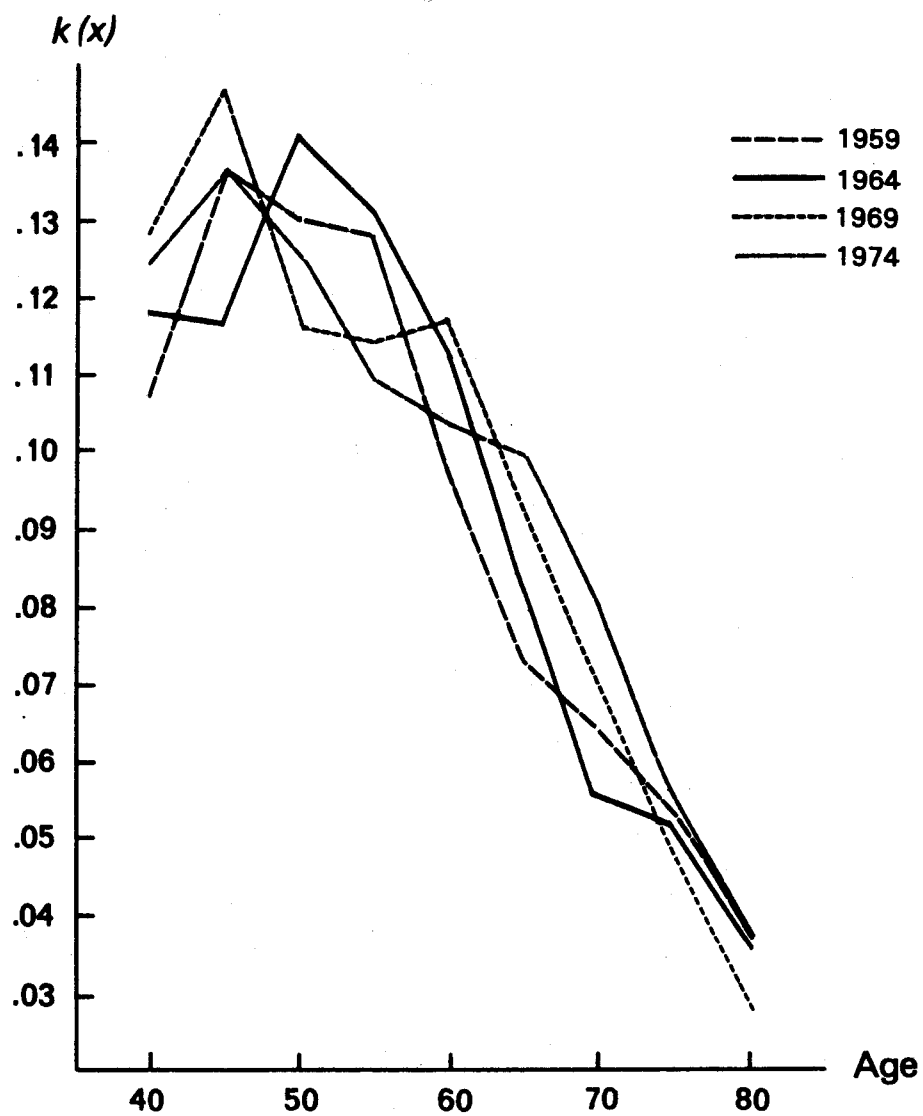
Figure VI. Rate of mortality change with age, $k(x)$, for males, Federal Republic of Germany, 1959, 1964, 1969 and 1974: cardiovascular diseases and neoplasms



NOTE: The downward-pointing arrows indicate the positions in 1959, 1969 and 1974 of the cohort born in 1909.

Figure VI. (continued)

Neoplasms



¹ Masakazu Okubo, *Increase in Mortality of Middle-Aged Males in Japan* (Tokyo, Nihon University Population Research Institute, 1981).

² Shiro Horiuchi and Ansley Coale, "Age patterns of mortality for older women: an analysis using the age-specific rate of mortality change with age", paper presented at the 1983 Annual Meeting of the Population Association of America at Pittsburgh, Pennsylvania.

³ Researchers in population studies may find that $k(x)$ is computed in the same way as the population growth rate (r) by replacing population increase over time with mortality increase with age.

⁴ Five-year age group data are quite useful for the $k(x)$ analysis, since sequences of $k(x)$'s obtained from single-year age group data tend to be more or less erratic so that some smoothing techniques need to be applied.

⁵ Death rates for ages under 35 were not included in the analysis for four reasons. First, those who were under age 35 in 1959 were born after the First World War. Secondly, the main focus of the present research is on mortality in old age. Thirdly, the number of deaths for the five-year age groups 15-19, 20-24, 25-29 and 30-34 tend to be small because of very low mortality in these ages and thus susceptible to stochastic variations. Finally, although mortality tends to increase with age above age 35, it is not necessarily the case for ages under 35. Mortality is likely to decrease with age in childhood and, in some populations, there is a local peak of death rate in young adulthood ages. Thus, in order to avoid unnecessary complexities that may result from the inclusion of these different age patterns of mortality in the analysis, the present research was confined to the age groups in which age variations of mortality appear to be dominated mainly by the physiological deterioration of the human body that proceeds with age.

⁶ There are four other alternative ways to choose a set of calendar years in five-year intervals. These years, that is, 1959, 1964, 1969 and 1974, were chosen on the basis of our preliminary analysis of data by single-year age groups in such a way that the centre of the high-mortality generation is always located at the centre of a five-year age group.

⁷ Goldstein has criticized the model on the ground that, since it is logically impossible to vary either age, period or cohort while holding constant the other two, results of data analysis using the model may be illogically conceived. (H. Goldstein, "Age, period and cohort effects—a confounded confusion", *Bulletin in Applied Statistics*, vol. 6, No. 1, 1979, pp. 19-24.) In the present research, however, age, period and cohorts can be considered as proxies for some mortality determinants that are logically separable from each other. Aging proceeds with physiological deterioration of the human body. Period factors represent health-related environmental variables, including the level of available medical technology and the accessibility to health services. Cohort factors are considered to reflect impacts of past experience on current health conditions. In fact, age factors, period factors and cohort factors are of our research interest as surrogates of impacts of aging, environment and past experience, respectively, on mortality. Since these mortality determinants can be considered to exert their influences more or less independently of each other, the use of model (4) does not seem totally inadequate for the purposes of the present study.

⁸ G. A. Sacher, "Analysis of life tables with secular terms", *The Biology of Aging*, American Institute of Biological Sciences Symposium, No. 6.253, 1960.

⁹ J. C. Barrett, "Age, time and cohort factors in mortality from cancer of the cervix", *American Journal of Hygiene*, vol. 71, 1973, pp. 253-259; "The redundant factor method and bladder cancer mortality", *Journal of Epidemiology and Community Health*, vol. 32, 1978, pp. 314-316; "A method of mortality analysis: application to breast cancer", *Revue d'Epidémiologie et de Santé Publique*, vol. 26, 1978, pp. 419-424; "Cohort mortality and prostate cancer", *Journal of Biosocial Sciences*, vol. 12, 1980, pp. 341-344.

¹⁰ Model (4) is under-identified unless some additional restrictions are imposed on it. Since the age, period and cohort factors are interrelated such that $k = 10 + j - i$, they are computationally inestimable.

A simple way to make the model estimable is to assume that two or more of the factors are equal. In the present research, however, it does not seem valid to assume any pair of age factors or period factors to be equal, since substantial variations of mortality with respect to age and period are expected on the basis of previous research findings. Mortality in middle and old ages increases steeply with age, so that no pair of age factors should be set equal. It was also decided to pose no restrictions on period factors prior to the data analysis, because developed countries are known to have experi-

enced a substantial decline of mortality after the Second World War, with some slowdown in the 1960s.

On the other hand, although cohort variations are the main subject of the present study, our focus is not necessarily on all observed cohorts. The study of Okubo (note 1) has shown that effects of the Second World War on mortality began to appear in late middle age, suggesting that the long-term impacts of warfare on the mortality of the survivors in their younger ages may be minor. The factors for the two youngest cohorts (δ_{12} and δ_{13}) that were under 45 during the study period (1959-1974) are therefore set to be equal to each other. Although this still is a strong assumption, the choice of the two factors seems more reasonable than the other alternatives.

¹¹ A few other methods for detecting cohort variations in mortality were considered. First, age-specific death rates observed in the study population can be compared to those in the model life tables. Since the model life tables show representative age patterns of mortality on the basis of existing national life tables of reliable quality, it is expected that deviations from model life tables indicate cohorts with relatively high or low mortality. The comparative analysis, however, did not satisfy the expectation because the age patterns of male adult mortality in many developed countries in the 1960s and the 1970s are systematically different from those of existing model life tables that are mostly based on national life tables before 1960 (for example, *Age and Sex Patterns of Mortality: Model Life Tables for Under-Developed Countries*, United Nations publication, Sales No. 1955.XIII.9; A. J. Coale and P. Demeny, *Regional Model Life Tables and Stable Populations*, Princeton, Princeton University Press, 1966). Death rates of older males in developed countries during the last two decades tend to be higher than those extrapolated from those of younger males on the basis of the age patterns of mortality in the model life tables, perhaps reflecting the increasing effects of smoking on old-age mortality in the recent periods (S. Preston, "An international comparison of excessive adult mortality", *Population Studies*, vol. 24, No. 2, 1970, pp. 5-21). Therefore, deviations from model life tables due to cohort variations tend to be masked by the departures due to the excessive old-age mortality for males.

Second, if cohort variations are different between males and females, the sex ratio of death rates may be unexpectedly high or low at some ages, indicating male or female cohorts of relatively high or low mortality. There is, however, a strong age pattern of sex ratio of death rates widely found in West European countries, including the Federal Republic of Germany, with a peak about age 60 to 64 (see A. D. Lopez, "The sex mortality differential in developed countries", in A. D. Lopez and L. T. Ruzicka, *Sex Differentials in Mortality: Trends, Determinants and Consequences*, Canberra, Australian National University Press, 1983, pp. 53-120; and *Levels and Trends of Mortality since 1950*, United Nations publication, Sales No. E.81.XIII.3, figure II.7). This age pattern is quite strong and dominates the sex ratio of death rates for the elderly of the Federal Republic of Germany, masking most variations of cohort origin.

¹² The cohort variation in $k(x)$ among males of the Federal Republic of Germany was initially discovered by Ansley Coale, when he and the author were conducting a study on old-age mortality at the Office of Population Research of Princeton University.

¹³ The model of geometric increase of adult mortality has been proposed by G. Gompertz and elaborated by Strehler and Mildvan, and Abernethy. See B. L. Strehler and A. S. Mildvan, "General theory of mortality and aging", *Science*, vol. 132, 1960, pp. 14-21; J. D. Abernethy, "The exponential increase in mortality rate with age attributed to wearing-out of biological components", *Journal of Theoretical Biology*, vol. 80, 1979, pp. 333-354.

¹⁴ R. Schoen, "The geometric mean of the age-specific death rates as a summary index of mortality", *Demography*, vol. 7, 1970, pp. 317-324.

¹⁵ L. Grebler and W. Winkler, *The Cost of the World War to Germany and to Austria-Hungary* (New Haven, Yale University Press, 1940), pp. 81-82.

¹⁶ F. Bumm, ed., *Deutschlands Gesundheitsverhältnisse unter dem Einfluss des Weltkrieges* (Berlin, Deutsche Verlags-Anstalt, 1928), vol. 2, p. 22.

¹⁷ Suda L. Bane and Ralph H. Lutz, eds., *The Blockade of Germany After the Armistice 1918-1919* (Stanford University Press and Oxford University Press, 1942), p.v.

¹⁸ Okubo, *op. cit.*

¹⁹ Unfortunately, the classification of causes of death changed during the study period. The change was substantial with respect to cardiovascular diseases, thereby making a further time-series analysis of cardiovascular mortality in more detail very difficult to conduct in a rigorous manner.

²⁰ The historical data shown in table 3 were kindly provided to the author by John Knodel and Neil Bennett at the Population Studies Center of the University of Michigan.

²¹ The calculation has been made under the assumption that the rate of mortality increase with age is 0.093, the median value of all $k(x)$'s in figure 1.

²² United States Public Health Service, *Smoking and Health: A Report of the Surgeon General* (Washington, D. C., Department of Health, Education

and Welfare, DHEW publication No. PHS79-50066, 1979); S. H. Preston, *Older Male Mortality and Cigarette Smoking: A Demographic Analysis* (Berkeley, University of California, Institute of International Studies, Population monograph series No. 7, 1970).

²³ Substantial cohort variations have been found both in exposure to cigarette smoking (for example, United States Public Health Service, *The Health Consequences of Smoking for Women: A Report of the Surgeon General* (Washington, D. C., Department of Health and Human Services, United States Government Printing Office, 1980 0-326-003, 1980)) and lung cancer mortality (for example, R. A. M. Case, "Cohort analysis of cancer mortality in England and Wales, 1911-1954 by site and sex", *British Journal of Preventive and Social Medicine*, vol. 10, 1956, pp. 172-199).

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