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## PREFACE

The purpose of the *Population Bulletin of the United Nations,* as stipulated by the Population Commission, is to publish population studies carried out by the United Nations, its specialized agencies and other organizations with a view to promoting scientific understanding of population questions. The studies are expected to provide a global perspective of demographic issues and to weigh the direct and indirect implications of population policy. The *Bulletin* is intended to be useful to Governments, international organizations, research and training institutions and other bodies that deal with questions relating to population and development.

The *Bulletin* is prepared by the Population Division of the Department of International Economic and Social Affairs of the United Nations Secretariat and published semi-annually in three languages—English, French and Spanish. Copies are distributed widely to users in all States Members of the United Nations.

Although the primary source of the material appearing in the *Bulletin* is the research carried out by the United Nations Secretariat, officials of governmental and non-governmental organizations and individual scholars are occasionally invited to contribute articles.

## CONTENTS

## Explanatory notes

Symbols of United Nations documents are composed of capital letters combined with figures. Mention of such a symbol indicates a reference to a United Nations document.

Reference to "dollars" ($) indicates United States dollars, unless otherwise stated.

The term "billion" signifies a thousand million.

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

A hyphen between years (e.g., 1984-1985) indicates the full period involved, including the beginning and end years; a slash (e.g., 1984/85) indicates a financial year, school year or crop year.

A point (.) is used to indicate decimals.

The following symbols have been used in the tables:

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

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

A hyphen (-) indicates that the item is not applicable.

A minus sign (-) before a number indicates a deficit or decrease, except as indicated.

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

# AGE MISREPORTING AND ITS EFFECTS ON ADULT MORTALITY ESTIMATES IN LATIN AMERICA

*Aimée R. Dechter* and Samuel H. Preston***

SUMMARY

Populations in Latin America and Hispanic populations in the United States of America are notable for having unusually low mortality at advanced ages relative to mortality levels at young ages. The pattern has been embodied in the United Nations Latin American model life-table system. This article investigates whether misreporting of ages contributes to the apparently low mortality at older ages in Latin America. It compares the size of cohorts enumerated at two censuses, after allowance for intercensal deaths, in 10 intercensal periods in four countries. It finds evidence of very pervasive overstatement of age at advanced ages. Using an empirical age-reporting matrix for Costa Rica, it estimates the bias that such misstatement produces in measured adult mortality levels in that country.

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Many Latin American countries are notable for unusually low mortality at older ages. Reported life expectancies at age 65 for females in Costa Rica (1972-1974), El Salvador (1970-1972), Uruguay (1974-1976), Ecuador (1973-1975) and Paraguay (1971-1972) equal or exceed life expectancies at age 65 in Scotland (1970-1972 and 1973-1975), Austria (1970-1974 and 1975-1976), Belgium (1968-1972), Federal Republic of Germany[1] (1970-1972 and 1974-1976), Luxembourg (1971-1973), Australia (1970-1972), New Zealand (1970-1972), Japan (1970-1974) and most of Eastern Europe at comparable periods (United Nations, 1982a). In all of these cases, the Latin American countries have significantly lower life expectancies at birth. Venezuela's female and male life expectancies at age 65 during the period 1970-1972 are higher than Belgium's during that period, yet the Belgian life expectancies at birth are 2.89 and 5.80 years higher for males and females, respectively (United Nations, 1982a).

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Peculiarly low mortality in older ages extends to people of Spanish origin living in other countries. In his study based on Hispanic surnames in Medicare files in the United States, Spencer (1984) found that elderly male Hispanic death rates were 15-30 per cent lower than those of non-Hispanic white males and elderly Hispanic female death rates were about 5-15 per cent lower than those of non-Hispanic white females. According to these records, Hispanic males aged 65 in the United States could expect to live about 1.7 years longer than non-Hispanic whites.

One explanation for both the unusually high survival rates of the older population in Latin American countries and cultures is that the surviving population in a high mortality regime may be more robust than the general population because the "fittest" have been selected into those ages as a result of the high mortality at younger ages (Manton, Poss and Wing, 1979; Manton, Stallard and Vaupel, 1986; Nam, Weatherby and Ockay, 1978). Another explanation is based on the relatively unhealthful lifestyles induced by affluence in Europe and North America. A third explanation is that ages are more seriously overstated in Latin America (Horiuchi and Coale, 1985; Coale and Kisker, 1986).

Age misstatement is expected to be more prevalent in countries where literacy rates are lower, birth records are incomplete and less reliable and birthdays are emphasized less (Ewbank, 1981; Chidambaram and Sathar, 1984). On the basis of the World Fertility Survey (WFS), Chidambaram and Sathar (1984) found that women (typically below age 50) interviewed in the Latin American and Caribbean countries were better able than women from most countries covered in WFS (except those from the Republic of Korea and the Philippines) to remember their own date of birth in terms of the western calendar. However, digit preference—in particular preferences for ages ending in five or zero—is a widely recognized problem in Latin America (Nuñez, 1984; Kamps, 1976). Rosenwaike and Preston (1984) provide evidence of age overstatement at older ages among those born in Puerto Rico and argue that this reporting error resulted in artificially low mortality rates for those ages. Davies (1975), Halsell (1976) and Leaf (1973) called attention to the extreme longevity of the population of Vilcabamba in southern Ecuador; however, Mazess and Forman (1979) found systematic age exaggeration after age 70 among the Vilcabamba population.

This article explores the extent of age misreporting at older ages in Latin America and its consequences for mortality estimates. A simple demographic accounting identity is applied to data for 10 intercensal periods in four Latin American countries and demonstrates very extensive inconsistencies which are most plausibly ascribed to age misreporting. An age-misreporting pattern consistent with the data is then identified and used to estimate the effect of age misreporting on estimated mortality levels in Costa Rica.

## Intercensal comparisons of cohort size

The change between time 0 and time $T$ in the number of persons in an open-ended cohort aged $x$ and above at time 0 can be expressed as

$$N_{x+T}(T) = {}_{T}N_{x0}(0) - \int_0^T D_{x+T}(t)dt + \int M_{x+T}(t)dt \qquad (1)$$

where $N_{x+T}(t)$ = number of persons at time $t$ in the open-ended cohort aged $x + t$ and above

$D_{x+T}(t)$ = number of deaths to persons aged $x + t$ and above at time $t$

$M_{x+t}(t)$ = difference at time $t$ between the number of in- and out-migrants among persons aged $x + t$ and above

If accurate data are used in applying this equation, the left-hand and right-hand sides must balance, since the only two ways that cohort size can change are death and migration. If a hat is used to designate reported values, the ratio of expected to actual values at time $T$ and age $x + T$ in a population closed to migration can be expressed as

$$R_{x+T}(T) = \frac{N_x(0) - \int_0^{} D_{x+t}(t)dt}{\hat{N}_{x+t}(T)}$$

Condran, Himes and Preston (1990) have used simulations of age-misreporting patterns to examine the behaviour of $R(T)$. They find that, with increasing overstatement of age as age advances,

(*a*) $R(T)$ rises above 1.00 and increases with age if age overstatement is confined to population censuses (and the same misstatement pattern applies at both censuses). $\hat{N}_x(0)$ in the numerator increases by a smaller proportion than $\hat{N}_{x+T}(T)$ in the denominator because of increased overstatement with age (and a more steeply declining age distribution as age advances). However, the presence of a negative, non-inflated $\hat{D}_{x+t}(t)$ term in the numerator, increasingly important with age, typically makes the numerator rise faster than the denominator as age increases.

(*b*) $R(T)$ falls below 1.00 and decreases with age if age overstatement is identical in deaths and in population data recorded at both censuses. In this case, both terms in the numerator are inflated by age misstatement but the denominator is inflated more rapidly since it pertains to a higher age and therefore experiences a larger proportionate net inflow from younger ages.

Their results were not sensitive to the shape of the underlying true age distribution. Experimentation with less age overstatement in deaths than in population can produce reasonably level age sequences of ratios hovering about 1.00, indicating clearly that tests of consistency rather than of accuracy are being applied. Florez-Valderamma (1983), in fact, suggests with indirect techniques that the tendency to overstate age in Chile is smaller in deaths than in populations.

These ratios have been calculated for 10 intercensal periods in four Latin American countries. The census and death registration data are structured around discrete age intervals rather than continuous cohorts, as

required in equation (1). A cohort defined by a discrete age group at a moment in time will be distributed across more than one age group over any given time interval. Furthermore, when the age interval and time interval differ by a non-integer multiple, a cohort defined at one end of the time period will be distributed across more than one age group at the other end. We identified cohorts on the basis of their age at the second census.[2] In order to perform the interpolations required to reconstruct cohorts at the first census, we have assumed that deaths and population in any year of observation are uniformly distributed within the published age and time interval. In all cases, deaths in single calendar years were used. Usually, the age interval is five years wide, but in the case of Costa Rica, 1963-1973, and Chile, 1960-1970, single-year age groups are available for both death and census data. In most other instances, we used single-year age data on population, but not on deaths. A comparison of results using the five-year and one-year age groups for deaths and population data for Chile, 1960-1970, showed that, overall, the same level and age pattern of ratios, $R(T)$, were produced in the two cases, although the ratios based on one-year data grew somewhat lower than those based on the five-year data as age advanced. At age 85+, the one-year ratios were 0.44 and 0.39 for males and females, respectively, while the five-year ratios were 0.50 and 0.46. So, using ratios based on five-year data appears to impart a conservative bias, in the direction of finding less deterioration in consistency with age.

We have also done an analysis of the sensitivity of results to other procedural assumptions. Identifying birth cohorts on the basis of their age groups in the earlier census and reconstructing them by interpolation in the following census, rather than tracing the cohorts from the later census, as we have done, produced slightly lower ratios which declined even more steeply with age. Assuming that there was a lag of six months from the time of death registration had very little effect on the ratios. Experimenting with plausible age-patterns of death registration completeness and census coverage errors in no case removed the pattern of results revealed below, although introducing these errors could have altered relative magnitudes in some instances.

## Results

Table 1 presents the results of the intercensal analyses. Except for Venezuela, the data used in table 1 are unadjusted for migration or coverage completeness in censuses and death registration. In Venezuela, we have adjusted for international migration, using the estimates of the Oficina Central de Estadística (1960-1982), assuming that net migration rates are constant with age. Primitive as the assumption may be, it produced a substantial improvement in results, in the sense that the ratios at the younger ages are moved closer to unity. The age patterns of ratios are presented graphically in figure I.

The results shown in table 1 and figure I clearly reveal, in general, a pattern of declining ratios with age. In only two of the 20 sets of ratios

TABLE 1. RATIO OF EXPECTED TO ENUMERATED POPULATION FOR OPEN-ENDED COHORTS IN VARIOUS LATIN AMERICAN POPULATIONS

| Age group at second census | 1963-1973 | | 1973-1984 | | 1950-1960 | | 1960-1970 | | 1970-1982 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | M | F | M | F | M | F | M | F | M | F |
| | *Costa Rica* | | | | | | *Chile* | | | |
| 40+ | .955 | .975 | 1.004 | 1.015 | .981 | 1.002 | .987 | 1.008 | .935 | .963 |
| 45+ | .961 | .983 | 1.017 | 1.024 | .986 | .999 | .994 | 1.013 | .935 | .960 |
| 50+ | .948 | .961 | 1.004 | 1.001 | .974 | .980 | .963 | .974 | .934 | .955 |
| 55+ | .948 | .969 | .989 | .993 | .963 | .972 | .951 | .969 | .898 | .925 |
| 60+ | .915 | .940 | .972 | .977 | .936 | .934 | .899 | .913 | .905 | .932 |
| 65+ | .881 | .915 | .953 | .958 | .911 | .924 | .872 | .903 | .870 | .901 |
| 70+ | .869 | .900 | .927 | .929 | .924 | .911 | .784 | .809 | .882 | .896 |
| 75+ | .776 | .820 | .884 | .889 | .832 | .771 | .706 | .717 | .898 | .835 |
| 80+ | .740 | .720 | .835 | .805 | .818 | .671 | .501 | .481 | .879 | .744 |
| 85+ | .619 | .582 | .732 | .690 | .821 | .513 | .442 | .390 | .975 | .447 |
| | *Venezuela* | | | | | | *Mexico* | | | |
| 40+ | 1.036 | .994 | 1.008 | 1.010 | .991 | 1.053 | 1.009 | 1.021 | .955 | .962 |
| 45+ | 1.040 | .994 | 1.023 | 1.013 | 1.004 | 1.069 | 1.016 | 1.022 | .974 | .974 |
| 50+ | 1.042 | .985 | 1.022 | .998 | .968 | 1.026 | 1.002 | .993 | .964 | .956 |
| 55+ | 1.046 | .984 | 1.017 | .992 | .965 | 1.012 | .992 | .971 | .960 | .945 |
| 60+ | 1.015 | .962 | 1.001 | .979 | .892 | .928 | .963 | .922 | .942 | .916 |
| 65+ | 1.024 | .971 | .968 | .953 | .892 | .899 | .958 | .887 | .949 | .906 |
| 70+ | .954 | .919 | .941 | .931 | .877 | .870 | 1.004 | .893 | .967 | .906 |
| 75+ | .821 | .781 | .838 | .854 | .667 | .593 | .908 | .711 | .972 | .857 |
| 80+ | .605 | .589 | .801 | .813 | .433 | .319 | .843 | .540 | 1.065 | .808 |
| 85+ | .411 | .394 | .659 | .687 | .054 | −.222[a] | .667 | .187 | .986 | .602 |

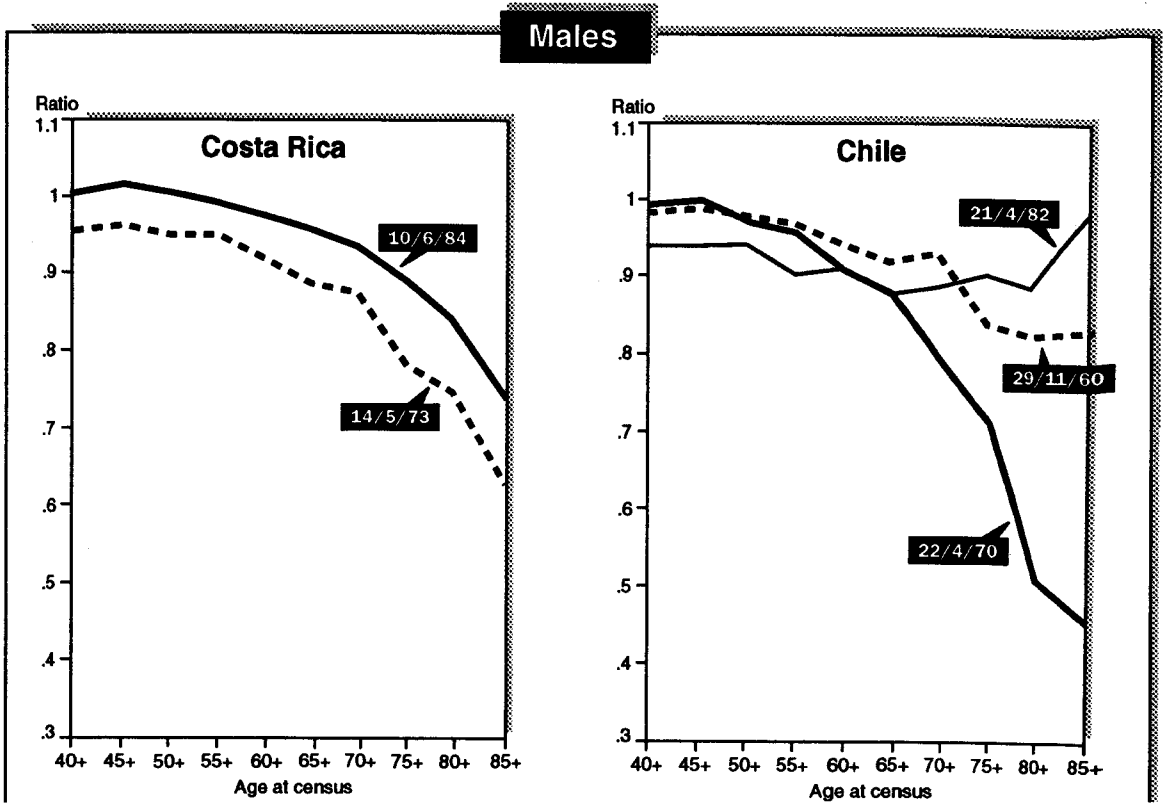
[a] More deaths were reported between 1950 and 1960 for the cohort aged 75+ in 1950 than there were members of the cohort in the 1950 census.

shown does such a pattern fail to appear: Mexican males, 1970-1980; and Chilean males, 1970-1982. Since both of these cases begin at age 40 with ratios well below unity (in fact, they are the two lowest ratios at age 40 in the table), it seems likely that results are seriously affected by some other forms of error, perhaps involving migration or differences in census coverage.

In the other 18 cases, ratios decline systematically with age to a mean value at age 85+ of 0.55 for males and 0.43 for females. A value of 0.5 means that twice as many people were found at the second census at age 85+ as were expected, based on the number at (approximately) age 75+ at the first census, together with intercensal deaths. It is reasonable to suppose that the pattern arises because large numbers of people gained more than 10 years in their reported ages between the two censuses. In fact, there seems to be no other plausible explanation. If intercensal deaths were underregistered relative to census coverage, then the ratios would be biased upwards, not downwards.

Pervasive misstatement of age among the elderly in Latin America is clearly demonstrated by these results, even though two of the countries, Costa Rica and Chile, are among the most literate and affluent of Latin

**Figure I. Ratio of expected to enumerated population**



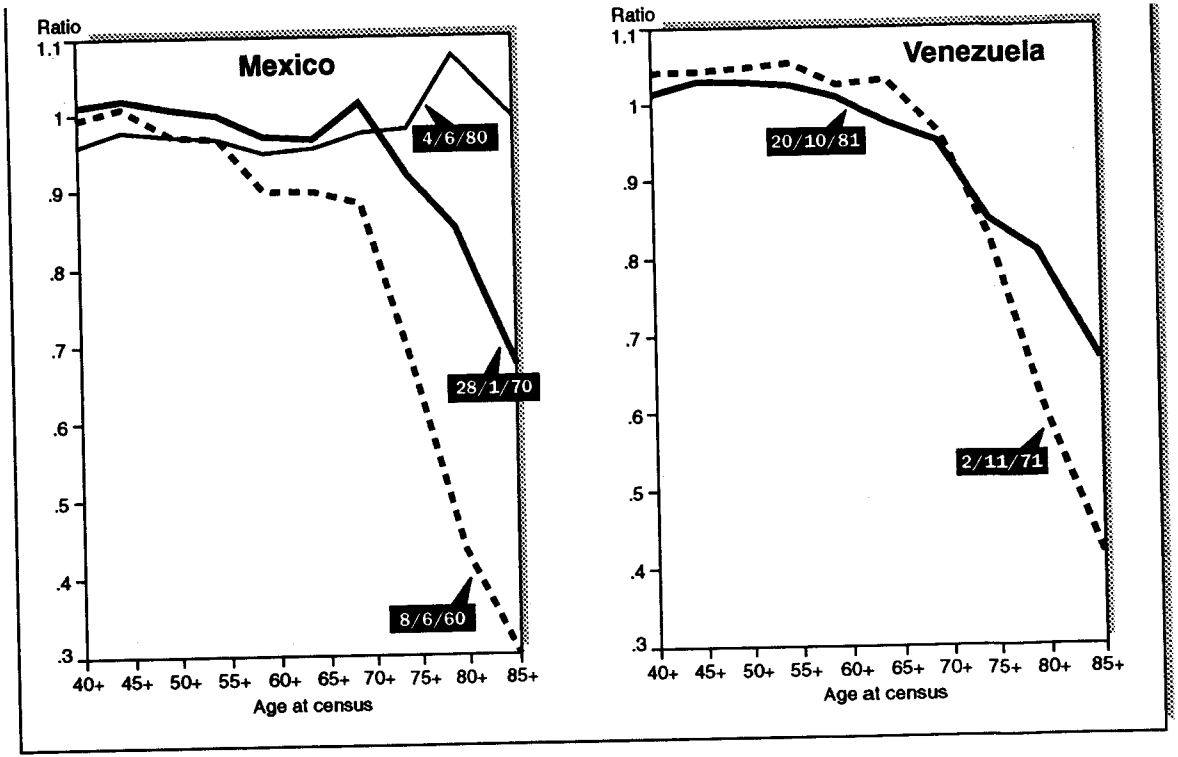
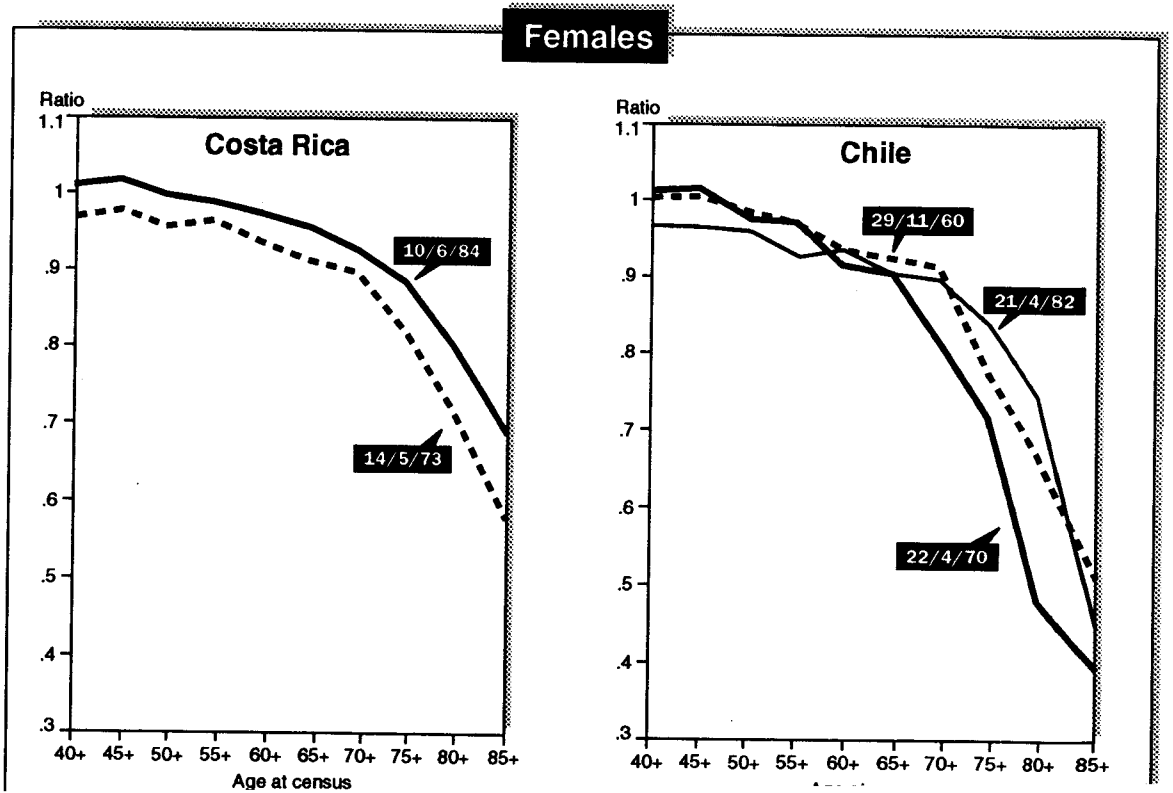
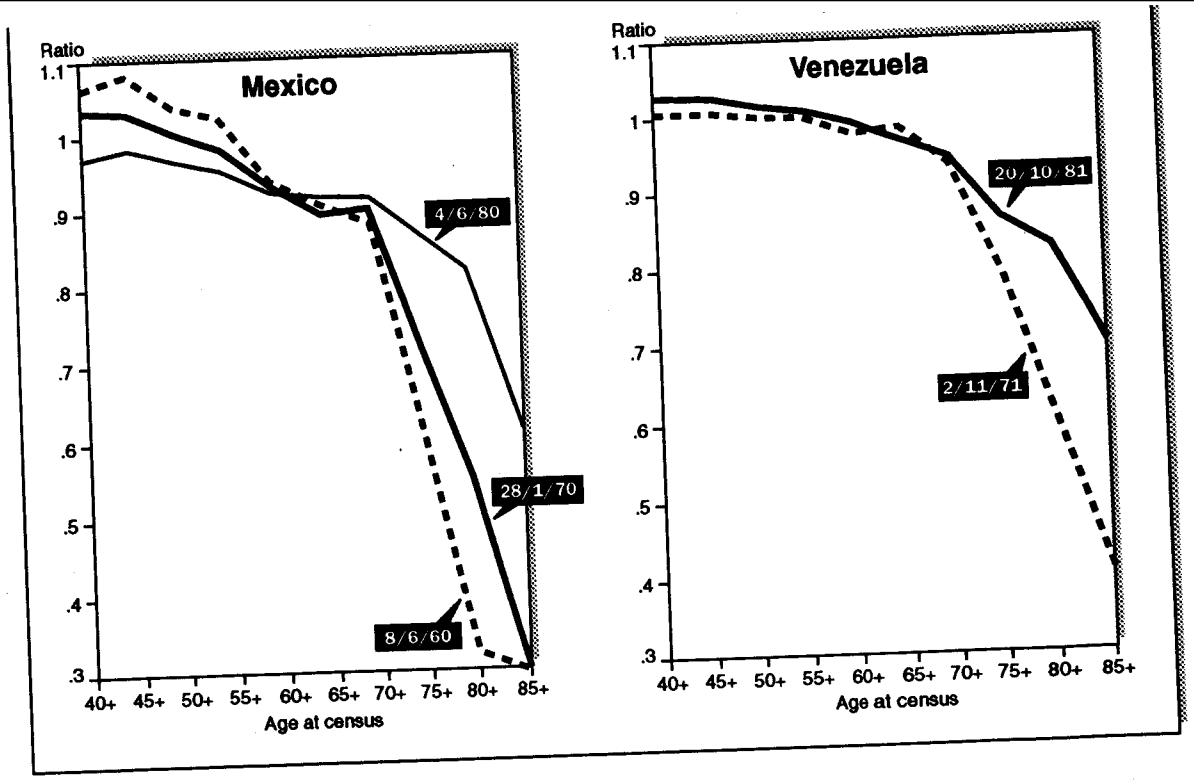

Ratio
1.1
1
.9
.8
.7
.6
.5
.4
.3
Mexico
4/6/80
28/1/70
8/6/60
40+ 45+ 50+ 55+ 60+ 65+ 70+ 75+ 80+ 85+
Age at census
Ratio
1.1
1
.9
.8
.7
.6
.5
.4
.3
Venezuela
20/10/81
2/11/71
40+ 45+ 50+ 55+ 60+ 65+ 70+ 75+ 80+ 85+
Age at census

**Figure I** *(continued)*




Mexico
Ratio
1.1
1
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40+ 45+ 50+ 55+ 60+ 65+ 70+ 75+ 80+ 85+
Age at census
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.4
.3
20/10/81
2/11/71
40+ 45+ 50+ 55+ 60+ 65+ 70+ 75+ 80+ 85+
Age at census

American populations. The age pattern of ratios declining below 1.00 suggests that age overstatement is a significant problem in both death and population enumerations. A similar pattern of ratios was earlier shown for the Puerto Rican-born population (Rosenwaike and Preston, 1984). The misreporting of age seems to be somewhat more severe among women than among men except in Venezuela, where no sex differential is suggested. This is consistent with Florez-Valderrama's indirect finding (1983), that age reporting is less accurate among women than men in Chile and Argentina. Misreporting is most severe at the highest ages, but it is not limited to those; each of the 20 sets of results shows a lower ratio at 60+ than at 40+.

The evidence of increasing age misstatement with old age is consistent with the observation that literacy rates also decline with age, since age misstatement is associated with illiteracy and low educational attainment. Rosenwaike and Preston (1984) found that among the middle- and old-age Puerto Rican population, illiterate individuals were more likely to heap their ages. The percentage literate in Chile (1970) and Costa Rica (1973) steadily declines after age 20 and falls below 70 per cent by age 80 (table 2). The sex differentials in literacy rates also provide some reason to suspect that age misreporting may be more common among women. Literacy among females in Chile (1970) and Costa Rica (1973) falls below that of males by age 25-29.

Age misreporting appears to become less serious over time. Only the 1960-1970 intercensal period in Chile shows a deterioration in the ratios at

TABLE 2. PERCENTAGE LITERATE BY SEX AND AGE

| | *Chile (1970 census)* | | *Costa Rica (1973 census)* | |
|---|---|---|---|---|
| *Age* | *M* | *F* | *M* | *F* |
| 10-14 | .932 | .942 | .943 | .955 |
| 15-19 | .960 | .964 | .954 | .962 |
| 20-24 | .946 | .945 | .940 | .944 |
| 25-29 | .932 | .927 | .919 | .917 |
| 30-34 | .916 | .902 | .884 | .883 |
| 35-39 | .906 | .887 | .856 | .845 |
| 40-44 | .888 | .867 | .849 | .833 |
| 45-49 | .866 | .839 | .846 | .831 |
| 50-54 | .858 | .828 | .826 | .812 |
| 55-59 | .833 | .809 | .810 | .791 |
| 60-64 | .801 | .765 | .771 | .759 |
| 65-69 | .777 | .739 | .778 | .756 |
| 70-74 | .764 | .727 | .771 | .752 |
| 75-79 | .736 | .708 | .753 | .733 |
| 80-84 | .689 | .664 | .722 | .678 |
| 85+ | .720 | .688 | .639 | .628 |
| TOTAL | .904 | .892 | .898 | .897 |

*Sources*: For Chile, *XIV Censo de Población y III de Vivienda, Abril 1970* (Santiago, Instituto Nacional de Estadística, 1977); for Costa Rica: *Censos Nacionales de 1973: Población* (San José, Direccíon General de Estadística y Censos, 1974).

the upper ages relative to the immediately preceding intercensal period. It is likely that advances in literacy and other aspects of social development are responsible for this improvement in age reporting among older persons.

## Adjusting for Age Misreporting and Correcting Mortality Estimates

What patterns of age misreporting might have given rise to the sets of ratios observed in table 1? To answer this question, we seek an age-reporting matrix that converts one's true age into one's reported age in such a way that age distributions become consistent from one census to the next—i.e., the age sequence of ratios becomes level at a value around unity. The search for such a matrix need not begin with purely hypothetical values. One useful study of age reporting in the Puriscal and Coronado regions of Costa Rica compared ages of people reported in the census of 1984 to their date of birth as indicated by birth certificates (Ortega and García, 1986). The age-reporting probabilities published from this study refer to both sexes combined. They are shown in table 3.

Since an age-reporting matrix is available for (part of) Costa Rica, we will focus on the aggregate demographic data for that country, using the 1973-1984 intercensal period for illustration. First, it is assumed that the age-reporting matrix applies to both deaths and population. Next, the reported age distributions of population and deaths must be converted into the estimated true age distributions, using the observed age-reporting matrix. This task is accomplished by solving a system of simultaneous equations, one system for each census year and each year of deaths. When this exercise is performed in Costa Rica, using the matrix shown in table 3, there is a marked improvement in the ratios of expected to actual population, but these ratios are still well below unity at the upper ages. For example, the ratio at age 85+ for males is 0.893 and for females, 0.781. Evidently, age misstatement in Costa Rica is a more serious problem than implied by the age-reporting matrix in the study by Ortega and Garcia. It

Table 3. Probabilities of Age Misstatement in Two Regions of Costa Rica

| *Reported age interval* | *True age interval according to certificate* | | | | | | |
|---|---|---|---|---|---|---|---|
| | *55-59* | *60-64* | *65-69* | *70-74* | *75-79* | *80-84* | *85+* |
| 55-59 | 0.933 | 0 | 0 | 0 | 0 | 0 | 0 |
| 60-64 | 0.064 | 0.922 | 0.086 | 0.027 | 0 | 0.016 | 0 |
| 65-69 | 0.002 | 0.066 | 0.819 | 0.086 | 0.018 | 0.0 | 0 |
| 70-74 | 0 | 0.004 | 0.067 | 0.824 | 0.103 | 0.049 | 0 |
| 75-79 | 0 | 0.004 | 0.027 | 0.063 | 0.762 | 0.107 | 0.010 |
| 80-84 | 0 | 0.002 | 0 | 0 | 0.094 | 0.779 | 0.063 |
| 85+ | 0 | 0 | 0.002 | 0 | 0.022 | 0.049 | 0.927 |

*Source*: A. Ortega and V. Garcia, *Estudio Experimental sobre la Mortalidad y Algunas Caracteristicas Socioeconomicas de las Personas de la Tercera Edad: Informe de la Investigación Efectuada en los Cantones, de Puriscal y Coronado, del 3 al 20 de junio de 1985*, Serie A, No. 1048 (San José, Costa Rica, CELADE).

may be that the regions examined in the inquiry are atypical of the nation as a whole or that persons who have birth certificates know their ages better than those who do not.

We found that introducing more age overstatement and slightly less age understatement into the initial age-reporting matrix produced both an improved set of intercensal cohort ratios and an age pattern of mortality more consistent with the "West" pattern of the Coale, Demeny and Vaughan (1983) life-table system. The probabilities that a person of true age $x$ to $x + 4$ reports himself or herself at ages $x + 5$ to $x + 9$ for ages above 60 were increased relative to all other reporting propensities. The exact modifications were guided by trial and error. After substantial experimentation, the transition probabilities were changed by the following amounts (and equivalent amounts were subtracted from or added to the diagonal element corresponding to the column):

INCREMENT IN THE PROBABILITY OF MISREPORTING FROM THE TRUE AGE GROUP INTO THE REPORTED AGE INTERVAL

| *True age* | *Reported age* | *Males* | *Females* |
|---|---|---|---|
| 65-69 | 70-74 | .080 | .099 |
| 70-74 | 75-79 | .093 | .102 |
| 75-79 | 70-74 | −.050 | −.050 |
| | 80-84 | .104 | .165 |
| 80-84 | 70-74 | −.030 | −.030 |
| | 85+ | .149 | .219 |

This modification in the age-reporting matrix resulted in the set of ratios of expected-to-actual population shown in table 4. Note that in order to produce the level sequence of ratios in that table, it was necessary to assume that women overstated their ages more frequently than did men. This implication is consistent with the lower ratios for women before age adjustment which were shown in table 1.

We have found patterns of age reporting that are consistent with observed intercensal changes in cohort size. These are presumably not the only patterns that might have produced such consistency. In particular, an

TABLE 4. RATIOS OF EXPECTED TO ACTUAL POPULATION IN OPEN-ENDED COHORTS AFTER APPLICATION OF ADJUSTED AGE-REPORTING MATRIX, COSTA RICA, 1984

| *Age at start of interval* | *Male ratios* | *Female ratios* |
|---|---|---|
| 40 | 1.004 | 1.015 |
| 45 | 1.017 | 1.024 |
| 50 | 1.004 | 1.001 |
| 55 | 0.989 | 0.993 |
| 60 | 1.000 | 1.005 |
| 65 | 0.962 | 0.965 |
| 70 | 0.961 | 0.986 |
| 75 | 1.055 | 1.043 |
| 80 | 0.959 | 0.937 |
| 85 | 1.001 | 1.031 |

arbitrary assumption could have been made that age reporting improved from one census to the next or was somehow different in deaths than in censuses. The initial matrix could have also been modified in some other way. But the final age-reporting matrix selected seems a reasonable first approximation to the true matrices and has the virtue of being grounded in an empirically derived matrix for Costa Rica.

What effect does this derived age-misreporting pattern have on measured mortality in Costa Rica? To answer this question, two life-tables for 1973-1984 are computed, one based on the reported population and deaths and the other based on the estimated true population and deaths after correction for age misreporting. Life expectancy estimates in these two cases are the following:

| *Age* | *Sex* | *Life expectancy before adjustment for age misreporting* | *Life expectancy after adjustment* | *Difference* |
|---|---|---|---|---|
| 40 | Males | 36.61 | 35.97 | 0.63 |
| | Females | 39.51 | 38.58 | 0.93 |
| 65 | Males | 16.27 | 15.38 | 0.89 |
| | Females | 17.96 | 16.80 | 1.16 |

Adjustment for age misstatement reduces life expectancy at age 40 by about four fifths of a year and at age 65 by about one and one-fifth years, with a larger impact on women in both cases. The change in $e_5^0$ that would correspond to the change in $e_{40}^0$ is only 4 per cent less than the impact on $e_{40}^0$, since the probability of survival from age five to age 40 in Costa Rica is about 0.96 (United Nations, 1982b, p. 296). The impact on $e_0^0$ is 90 per cent of the difference in $e_{40}^0$. Since Costa Rica has among the highest literacy rates in Latin America and its age misstatement tendencies are unusually weak among the countries shown in table 1, it is likely that adjustment for age misreporting would have a larger effect on life-expectancy estimates in Venezuela, Mexico, or Latin America in general. For example, when the final age-reporting matrix of Costa Rica was applied to the original data for Venezuela, 1971-1981, we did not succeed in producing ratios that were much improved on the original. They still lay well below unity, especially at the oldest age group, implying that greater correction for age overstatement is necessary in Venezuela than in Costa Rica. This finding suggests that the distinctively low old-age mortality in Costa Rica, compared to the typical pattern in Western Europe and the United States, is at least partially the result of age misreporting.

A note of caution should be sounded regarding sex differences in Latin American age reporting. We have found greater inconsistencies in intercensal comparisons of cohort sizes among females than among males. This is *prima facie* evidence that age misreporting is more serious among women, which is consistent with their higher levels of illiteracy and with other studies. In order to make intercensal ratios consistently near unity, we have introduced more exaggeration of age among very old women than among very old men. However, other patterns of misreporting may be responsible for the greater female inconsistencies. For example, the variance in age-reporting probabilities may be greater for females. Alterna-

tively, introducing more reporting error into censuses than into deaths moves ratios that are initially below one towards unity, as noted in the simulation results described above. The patterns of ratios, therefore, would also be consistent with *no* sex differences in age reporting of deaths combined with *greater* male exaggeration of age in censuses.

Such a pattern would be inconsistent with that suggested by Florez-Valderrama (1983). It would, however, be consistent with sex differences in orphanhood data. As in Bangladesh (Blacker, 1977) and in much of Africa (Blacker and Gapere, 1988), the proportions orphaned in Latin America at older ages are typically higher for women than for men. For example, in Peru at ages 50-64, the proportion of living mothers reported by males in the census of 1972 and in the Peru fertility survey of 1977 was 1-6 per cent higher than the proportion reported by females (Moser, 1985). One possible interpretation of these results is that the men who reported at a particular age are actually somewhat younger, on average, than the women who reported at that age. Therefore, while females show greater inconsistency in intercensal cohort comparisons in Latin America, the extent to which this result suggests greater exaggeration of age in deaths or population censuses remains an open question.

## ANNEX
## Sources of data

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## Notes

[1] With effect from 3 October 1990, the Federal Republic of Germany and the German Democratic Republic united to form one sovereign State under the designation "Germany". The data reported here were compiled prior to unification.

[2] Cohorts are selected on the basis of the age interval in the second census rather than the preceding one for several reasons. First, the density of the age distribution is less steep in the earlier census when the cohort is younger and, therefore, the distribution of the population within the age interval is closer to uniform than in the later census. Secondly, the bias imposed by inappropriately redistributing the population into cohorts according to uniform assumptions is in a more conservative direction when tracing the cohorts from the later census because $\hat{N}_x(0)$ will be inflated upward due to the negative slope of the age distribution rather than $\hat{N}_{x+t}(t)$, as would be the case when cohorts are traced forward. It should also be noted when the age distribution of deaths is positively sloped, the $\hat{D}_{x+t}(t)$ will also be biased upward because of uniform assumptions.

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# SOUTH-TO-NORTH MIGRATION SINCE 1960: THE VIEW FROM THE NORTH*

*Hania Zlotnik***

SUMMARY

Using statistics on migration flows by country of origin gathered by three of the traditional countries of immigration (Australia, Canada and the United States of America) and five European countries (Belgium, Federal Republic of Germany,[1] Netherlands, Sweden and the United Kingdom of Great Britain and Northern Ireland), this paper analyses trends in migration from developing to developed countries, the so-called "South-to-North" component of international migration. The data reveal that persons born in the developing world now constitute a majority of the immigrants admitted for resettlement by the traditional countries of immigration. In Europe, in contrast, migrants from developed countries still predominate in migrant inflows. However, during the 1980s, European countries generally gained population from the developing world, whereas they recorded only small or even negative net migration balances with respect to other developed countries. Such developments underlie the increasing concern that South-to-North migration is arousing in parts of the developed world.

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"South-to-North" migration, interpreted to mean migration from developing to developed countries, grew substantially in most receiving countries during the late 1960s and early 1970s and has either increased or remained relatively stable since then. Yet, in relative terms its importance has been increasing as the number of migrants originating in the developed world has declined. Such a trend is particularly evident among the traditional countries of immigration, where, in the late 1980s, the number of immigrants originating in developing countries generally surpassed, sometimes by wide margins, those originating in the developed world. In European countries, the balance mostly remained in favour of incoming migrants from developed countries, but the proportions originating in the

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developing world rose markedly. However, in terms of net migration, during the 1980s European countries largely gained population from developing countries, whereas they recorded only small gains or even net losses from population exchanges with the developed world.

These findings stem from the analysis of data on immigrants and emigrants gathered by developed countries, data which serve as the basis for the comparison of trends experienced by several receiving countries. Before proceeding with that comparison, however, a word of caution regarding the nature of the information available is necessary.

## THE DATA USED

Eight developed countries were found to have the data needed to assess changes in the regional composition of migration inflows through time: three of the traditional countries of immigration (namely, Australia, Canada and the United States) and five European countries (Belgium, the Federal Republic of Germany, the Netherlands, Sweden and the United Kingdom). All of these countries have published data on migrant flows classified by country of origin. However, the criteria used to identify migrants and the meaning of "origin" vary considerably from country to country.

Canada and the United States only gather data on persons admitted as permanent residents. Australia also gathers data on those persons, called "settlers", but it also publishes information on the number of former settlers departing, so that emigration may be assessed. In all three countries, data classified by country of birth have been used to identify the origin of migrants.

All the European countries considered publish information on the number of incoming and outgoing migrants, including citizens returning and emigrating. The inclusion of citizens in statistics on migration flows is a practice that is generally not followed by the three traditional countries of immigration[2] and, consequently, their statistics are basically not comparable to those gathered by the European countries. In addition, the latter generally do not use country of birth as an indicator of origin. Thus, in the statistics used here, Belgium and the Netherlands classify migrants by citizenship, whereas the Federal Republic of Germany, Sweden and the United Kingdom do so by country of previous or intended residence.

Lack of comparability also stems from the varying definitions of "immigrant" and "emigrant" used by the different countries, a topic that will not be pursued here.[3] However, as already suggested above, it is important to bear in mind the essential difference existing between the statistics of the traditional countries of immigration and those gathered by European countries, since the former refer only to persons admitted for permanent resettlement while the latter generally include most persons planning to stay in the country or out of it for a certain period (measured in terms of months in some cases). In addition, one must note that it is not clear whether and to what extent the statistics on general immigration and emigration flows available for European countries reflect the inflow of

asylum-seekers, a significant proportion of whom originates in developing countries and may eventually be granted some residence rights. To indicate the likely impact of this inflow, data on asylum-seekers classified by citizenship are discussed separately below.

In the case of the Federal Republic of Germany, it is not certain whether the normal flow statistics available include all of the so-called "ethnic German" migrants who originated in the German Democratic Republic or in other Eastern European countries and who had the right to German citizenship once they had reached Federal territory. Clearly, underrepresentation of those migrants in flow statistics would bias the composition by region of origin that is the focus of the discussion below.

Lastly, it must be noted that the classifications by country of origin used in publishing data are often less than ideal for the identification of developed vs. developing regions. When groups of countries are lumped together under labels such as "other America", "other Asia" or "Commonwealth", it is not possible to identify separately the number of persons originating in the developed countries of those regions. However, since in most cases key developed countries are identified separately, migrants classified as originating in ad hoc country groupings were generally assigned to the developing world. To the extent that some persons originating in developed countries are thus misclassified, some biases will ensue.

### THE TRADITIONAL COUNTRIES OF IMMIGRATION

The growth of the number of migrants originating in the developing world is most evident when one considers the data referring to the immigrant intake of the traditional countries of immigration (see table 1). In the United States, a country where migration originating in the developing world was already fairly important in the early 1960s (amounting to over 40 per cent of the average annual number of immigrant admissions), the number of migrants born in developing countries grew fivefold between 1960-1964 and 1985-1989. Since the total number of admissions increased only two and a half times between those two periods, the weight of migrants from developing countries rose considerably, reaching nearly 90 per cent of total admissions in 1985-1989. That is, by the late 1980s only one in every 10 immigrants admitted to the United States came from a developed country (see table 1 and figure I).

Although Australia and Canada experienced even sharper increases in the number of immigrants originating in developing countries (nearly a sevenfold increase each), their developing-country intakes had been low in relative terms during the early 1960s (amounting to 8 and 12 per cent, respectively) and, consequently, did not reach the high levels recorded by the United States in the 1980s. Thus, during 1985-1987 Canada still admitted, on average, three persons born in the developed world for every 10 landed immigrants, while in Australia almost five out of every 10 settlers admitted during 1985-1988 originated in the developed world.

TABLE 1. AVERAGE ANNUAL NUMBER OF ADMISSIONS OF PERMANENT MIGRANTS BY REGION OF ORIGIN
*(Thousands)*

| | *1960-1964* | *1965-1969* | *1970-1974* | *1975-1979* | *1980-1984* | *1985-1989* |
|---|---|---|---|---|---|---|
| Australia | | | | | | |
| Total | 115.0 | 147.2 | 141.6 | 70.6 | 94.3 | 106.8[c] |
| Developed | 106.1 | 133.0 | 113.8 | 41.8 | 57.3 | 49.5 |
| Developing | 8.9 | 14.3 | 27.8 | 28.9 | 37.0 | 57.3 |
| Percentage developing | 7.8 | 9.7 | 19.6 | 40.9 | 39.2 | 53.7 |
| Canada | | | | | | |
| Total | 88.0[a] | 182.0 | 158.9 | 130.1 | 114.1 | 111.9[b] |
| Developed | 77.2 | 143.9 | 91.4 | 57.8 | 43.2 | 32.7 |
| Developing | 10.9 | 38.0 | 67.4 | 72.3 | 70.9 | 79.2 |
| Percentage developing | 12.3 | 20.9 | 42.5 | 55.6 | 62.1 | 70.8 |
| United States | | | | | | |
| Total | 283.8 | 358.9 | 384.7 | 482.5 | 565.0 | 701.4 |
| Developed | 165.0 | 158.4 | 112.7 | 91.7 | 83.8 | 84.9 |
| Developing | 118.9 | 200.5 | 272.0 | 390.8 | 481.2 | 616.5 |
| Percentage developing | 41.9 | 55.9 | 70.7 | 81.0 | 85.2 | 87.9 |

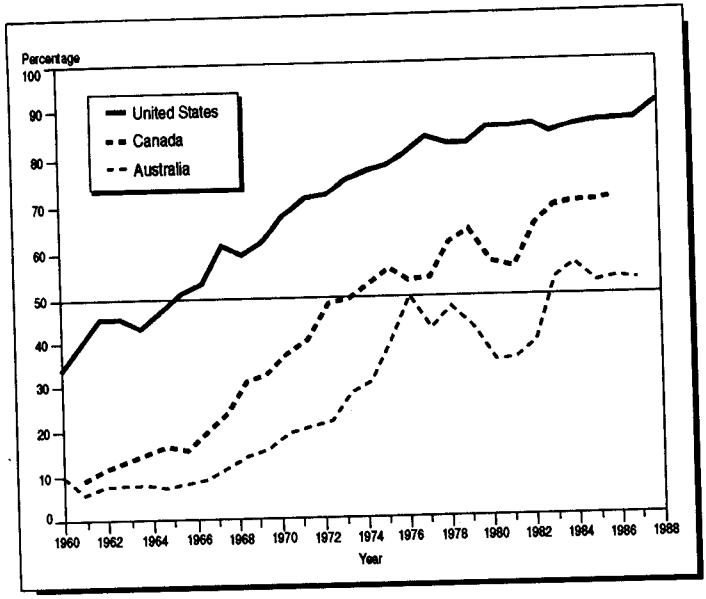
[a] 1961-1964.
[b] 1985-1987.
[c] 1985-1988.

As figure I shows, only among the immigrants admitted by the United States did the proportion of those originating in the developing world rise steadily after 1960. In Australia and Canada, a fairly steady increase was recorded until 1975-1976, when the proportion of immigrants from developing countries reached or barely surpassed the 50 per cent mark. From there on, fluctuations have been evident in both countries, although in Canada the tendency for that proportion to increase has been clearer. In all three countries, data classified by continent of origin (not shown) indicate that most of the increases detected in the proportion of immigrants from developing countries can be accounted for by the rising proportion of those originating in Asia. Indeed, the increase of Asian migration to developed countries is one of the most important developments characterizing recent migration trends worldwide.

## EUROPEAN EXPERIENCE

In comparison with the traditional countries of immigration, few of the European countries considered recorded such sharp increases in either the number or the proportion of migrants originating in the developing world (see table 2). The most drastic changes occurred in Sweden where in 1985-1988 nearly 19,000 migrants whose previous residence had been a developing country were admitted annually, a 13-fold increase over the number recorded 25 years earlier. In the Netherlands also, the number of migrants who were nationals of developing countries nearly quadrupled between the early 1960s and the late 1980s. In contrast, in both Belgium

**Figure I. Immigrants of developing country origin to Australia, Canada and the United States, 1960-1988**
*(Proportion of total)*




and the United Kingdom the number of migrants originating in developing countries remained relatively stable, and in the Federal Republic of Germany, it merely doubled.

In general, changes in either the number or the proportion of migrants originating in developing countries were not as steady in European countries as those recorded in the traditional countries of immigration. As figure II indicates, in terms of proportions, Sweden showed the most steady increases, especially after 1970. Thus, the proportion of migrants from developing countries admitted by Sweden rose from 11 to 45 per cent between 1970-1974 and 1985-1989. In the Federal Republic of Germany and the Netherlands, that proportion increased substantially during the 1970s, but when it reached the 50 per cent mark around 1980, declines set in. In both countries, the increasing share of migrants from developing countries during the 1970s may be attributed to policies favouring family reunification, a process that lost some momentum in the 1980s. Yet, on average, the proportion of migrants from the developing world remained high, amounting to 48 per cent in the Federal Republic of Germany and 38 in the Netherlands during 1980-1988.

In both Belgium and the United Kingdom the proportion of migrants from developing countries has varied within a 10-point range since 1970. Among the countries considered, Belgium was the one admitting the lowest number of migrants from the developing world during the 1980s, in

TABLE 2. AVERAGE ANNUAL NUMBER OF IMMIGRANTS TO SELECTED EUROPEAN COUNTRIES BY REGION OF ORIGIN
*(Thousands)*

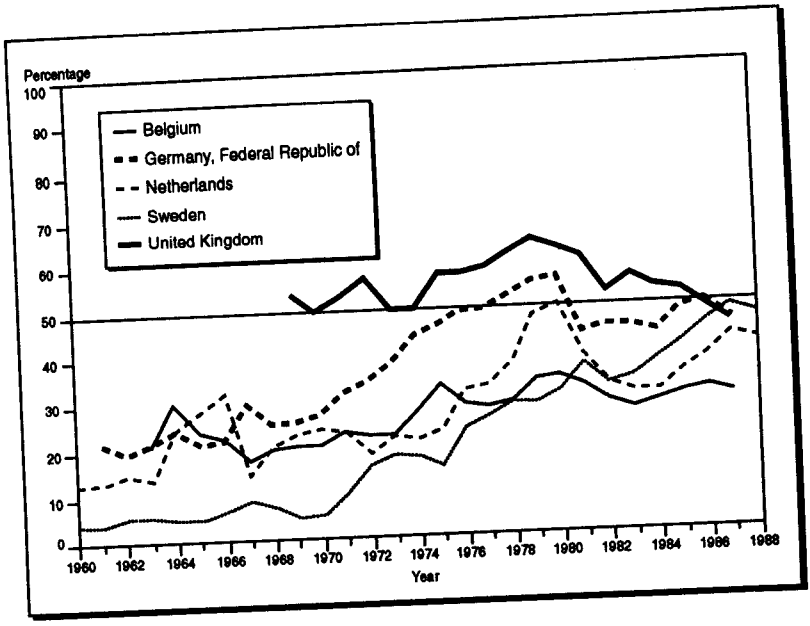
| | *1960-1964* | *1965-1969* | *1970-1974* | *1975-1979* | *1980-1984* | *1985-1988* |
|---|---|---|---|---|---|---|
| Belgium | | | | | | |
| Total | 69.1[a] | 65.6 | 64.7 | 58.3 | 47.9 | 48.6[c] |
| Developed | 54.1 | 52.1 | 50.0 | 41.1 | 33.9 | 34.4 |
| Developing | 15.0 | 13.4 | 14.6 | 17.2 | 14.0 | 14.2 |
| Percentage developing | 21.7 | 20.5 | 22.6 | 29.5 | 29.2 | 29.1 |
| Germany, Federal Republic of | | | | | | |
| Total | 576.2[b] | 706.1 | 873.1 | 527.5 | 502.2 | 554.2[c] |
| Developed | 449.4 | 535.3 | 578.2 | 262.3 | 265.9 | 288.8 |
| Developing | 126.8 | 170.9 | 294.8 | 265.2 | 236.3 | 265.4 |
| Percentage developing | 22.0 | 24.2 | 33.8 | 50.3 | 47.1 | 47.9 |
| Netherlands | | | | | | |
| Total | 57.7 | 71.0 | 89.1 | 97.6 | 79.4 | 88.5 |
| Developed | 48.4 | 53.8 | 70.3 | 64.9 | 49.7 | 54.5 |
| Developing | 9.3 | 17.2 | 18.9 | 32.7 | 29.7 | 34.0 |
| Percentage developing | 16.1 | 24.2 | 21.2 | 33.5 | 37.4 | 38.5 |
| Sweden | | | | | | |
| Total | 29.2 | 45.4 | 43.3 | 41.4 | 32.2 | 41.6 |
| Developed | 27.9 | 42.7 | 38.5 | 31.8 | 21.5 | 22.8 |
| Developing | 1.4 | 2.7 | 4.8 | 9.6 | 10.7 | 18.8 |
| Percentage developing | 4.7 | 5.9 | 11.1 | 23.2 | 33.1 | 45.3 |
| United Kingdom | | | | | | |
| Total | — | — | 205.3 | 186.6 | 186.4 | 231.3[c] |
| Developed | — | — | 99.3 | 76.7 | 82.8 | 120.0 |
| Developing | — | — | 106.0 | 109.9 | 103.6 | 111.3 |
| Percentage developing | | | 51.6 | 58.9 | 55.6 | 48.1 |

[a] 1960 and 1963-1964.
[b] 1961-1964.
[c] 1985-1987.

both absolute and relative terms. Indeed, during 1980-1988 only three out of every 10 migrants to Belgium originated in the developing world. The United Kingdom, on the other hand, tended to display fairly high proportions of migrants from developing countries (see figure II), although such proportions showed a tendency to decline during the late 1980s, reaching a low of 48 per cent in 1985-1987.

In comparing these figures it is important to bear in mind the characteristics of the data used. Because Belgium and the Netherlands produce data classified by citizenship, Belgian and Dutch returning migrants are considered to originate in the developed world irrespective of their place of previous residence. In contrast, for the other three countries, returning citizens are assigned to the developed or the developing world according to their place of previous residence. It is likely that the greater the ten-

**Figure II. Immigrants of developing country origin to selected European countries, 1960-1988**
*(Proportion of total)*




dency for citizens to migrate, the larger the bias introduced by the second approach. With its long tradition of emigration, such bias is probably greatest for the United Kingdom where a significant proportion of the migrants originating in developing countries may be British citizens returning from countries of the New Commonwealth.

Similarly, the inclusion of citizens in the data for European countries undermines their comparability with those for the traditional countries of immigration. To indicate the effects of such inclusion, the proportion of migrants originating in developing countries has been calculated for Belgium and the Netherlands only with respect to the foreign migrant intake (a step that is possible because the data are classified by citizenship). Such change of denominator leads to an increase of 7 percentage points in the proportion of migrants from developing countries recorded by Belgium in 1985-1987—from 29 to 36 per cent—and of nearly 20 points in the equivalent proportions for the Netherlands—from 38 to 58 per cent. That is, among all migrants arriving in the Netherlands, four out of every 10 are citizens of developing countries, but among foreign migrants only, those from developing countries constitute six out of every 10. The latter figure compares favourably with the 5:10 or 7:10 ratios prevalent among immigrants admitted by Australia and Canada in recent periods.

Emigration is a facet of the migration experience that is fairly well documented in the European context. Data on the number of emigrants by either citizenship or place of destination indicate that both the number and the proportion of emigrants going to the developing world have shown a tendency to increase (see table 3). However, in comparison with immigrants, the rises recorded have been more modest. In Sweden, for instance, the number of emigrants heading to the developing world tripled between the early 1960s and the late 1980s, while their proportion only doubled, rising from 7 to 14 per cent. Similar trends were recorded in Belgium and the Netherlands, where in 1985-1988 the proportion of emigrants who were citizens of developing countries reached a high of 18 per cent. In the Federal Republic of Germany, emigrants heading to developing countries reached a peak in the late 1970s at about 200,000 when they constituted about 37 per cent of all emigrants, a proportion that rose to 41

TABLE 3. AVERAGE ANNUAL NUMBER OF EMIGRANTS FROM SELECTED EUROPEAN COUNTRIES BY REGION OF ORIGIN
*(Thousands)*

| | *1960-1964* | *1965-1969* | *1970-1974* | *1975-1979* | *1980-1984* | *1985-1988* |
|---|---|---|---|---|---|---|
| Belgium | | | | | | |
| Total | 35.3[a] | 41.5 | 47.6 | 53.0 | 58.7 | 54.9[c] |
| Developed | 32.4 | 35.9 | 41.9 | 44.9 | 49.3 | 45.0 |
| Developing | 2.9 | 5.6 | 5.8 | 8.1 | 9.4 | 10.0 |
| Percentage developing | 8.2 | 13.6 | 12.1 | 15.3 | 16.0 | 18.1 |
| Germany, Federal Republic of | | | | | | |
| Total | 364.1[b] | 508.7 | 566.8 | 521.1 | 499.1 | 411.1[c] |
| Developed | 268.5 | 384.9 | 416.4 | 328.6 | 284.7 | 242.6 |
| Developing | 95.6 | 123.8 | 150.4 | 192.6 | 214.5 | 168.6 |
| Percentage developing | 26.3 | 24.3 | 26.5 | 37.0 | 43.0 | 41.0 |
| Netherlands | | | | | | |
| Total | 51.2 | 60.3 | 61.2 | 59.7 | 62.0 | 54.4 |
| Developed | 47.3 | 53.8 | 55.9 | 52.4 | 51.0 | 44.5 |
| Developing | 4.0 | 6.5 | 5.3 | 7.3 | 11.0 | 10.0 |
| Percentage developing | 7.7 | 10.8 | 8.7 | 12.3 | 17.7 | 18.3 |
| Sweden | | | | | | |
| Total | 15.2 | 19.8 | 35.7 | 23.9 | 27.4 | 22.2 |
| Developed | 14.1 | 18.0 | 32.5 | 21.2 | 23.9 | 19.0 |
| Developing | 1.1 | 1.8 | 3.2 | 2.7 | 3.5 | 3.2 |
| Percentage developing | 7.2 | 9.0 | 9.0 | 11.2 | 12.9 | 14.3 |
| United Kingdom | | | | | | |
| Total | — | — | 255.7 | 207.7 | 214.0 | 199.0[c] |
| Developed | — | — | 168.1 | 120.9 | 123.2 | 132.3 |
| Developing | — | — | 87.7 | 86.8 | 90.8 | 66.7 |
| Percentage developing | | | 34.3 | 41.8 | 42.4 | 33.5 |

[a] 1960 and 1963-1964.
[b] 1961-1964.
[c] 1985-1987.

per cent in the late 1980s. The United Kingdom also exhibited relatively high proportions of emigrants going to developing countries, fluctuating largely between 33 and 43 per cent. Indeed, as figure III shows, the Federal Republic of Germany and the United Kingdom have generally displayed higher proportions of emigrants to developing countries than the other three countries and their proportions have shown a clearer tendency to increase.

## NET MIGRATION BY REGION

The availability of information on both immigration and emigration classified by country of origin or destination (or by country of citizenship) allows the estimation of net migration by region and thus reveals the special impact that migration from developing countries has had in the European context.

Table 4 shows that, in terms of the average annual number of migrants, net migration has fluctuated considerably over time in all the European countries considered, and so has net migration by region. In general, however, since 1975 net migration from developed countries has fallen below that from developing countries and in several cases net migra-

**Figure III. Emigrants of developing country origin from selected European countries, 1960-1988**
*(Proportion of total)*

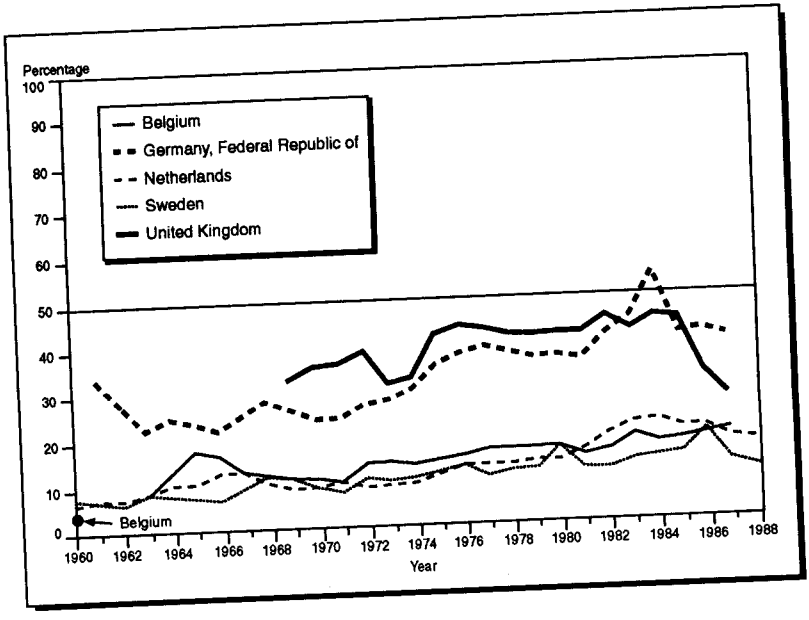


TABLE 4. AVERAGE ANNUAL NET MIGRATION TO SELECTED EUROPEAN COUNTRIES BY REGION OF ORIGIN
*(Thousands)*

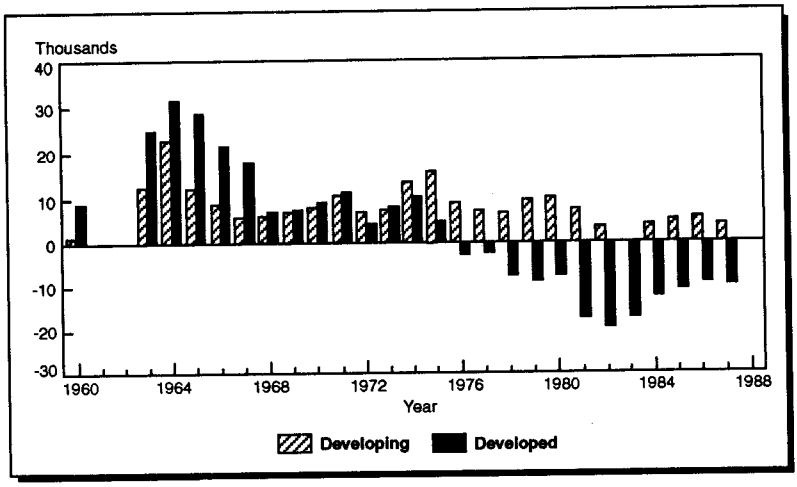
| | *1960-1964* | *1965-1969* | *1970-1974* | *1975-1979* | *1980-1984* | *1985-1988* |
|---|---|---|---|---|---|---|
| Belgium | | | | | | |
| Total | 33.8[a] | 24.1 | 17.1 | 5.3 | −10.8 | −6.4[c] |
| Developed | 21.7 | 16.3 | 8.2 | −3.8 | −15.4 | −10.6 |
| Developing | 12.1 | 7.8 | 8.9 | 9.1 | 4.5 | 4.2 |
| Germany, Federal Republic of | | | | | | |
| Total | 212.1[b] | 197.4 | 306.2 | 6.4 | 3.0 | 143.1[c] |
| Developed | 180.9 | 150.4 | 161.8 | −66.3 | −18.8 | 46.2 |
| Developing | 31.2 | 47.0 | 144.4 | 72.6 | 21.8 | 96.9 |
| Netherlands | | | | | | |
| Total | 6.5 | 10.7 | 28.0 | 37.8 | 17.5 | 34.0 |
| Developed | 1.2 | 0.0 | 14.4 | 12.5 | −1.3 | 10.0 |
| Developing | 5.4 | 10.7 | 13.5 | 25.3 | 18.8 | 24.1 |
| Sweden | | | | | | |
| Total | 14.0 | 25.6 | 7.6 | 17.5 | 4.8 | 19.4 |
| Developed | 13.7 | 24.7 | 6.1 | 10.6 | −2.3 | 3.8 |
| Developing | 0.3 | 0.9 | 1.6 | 6.9 | 7.1 | 15.7 |
| United Kingdom | | | | | | |
| Total | — | — | −50.4 | −21.1 | −27.6 | 32.3[c] |
| Developed | — | — | −68.8 | −44.2 | −40.4 | −12.3 |
| Developing | — | — | 18.4 | 23.1 | 12.8 | 44.7 |

[a] 1960 and 1963-1964.
[b] 1961-1964.
[c] 1985-1987.

tion has been positive or less negative mainly because of the positive contribution made by the component originating in the developing world. A better sense of the dominance of net migration from developing countries as compared with that originating in the developed world can be obtained from the graphs in figure IV. In Belgium, for instance, since 1976 the net migration of citizens from developed countries has been negative, while that of developing-country nationals remained positive throughout 1960-1987. In the Netherlands, the developing-country component has dominated net migration since 1975, remaining positive even when the net migration of citizens from developed countries became negative during the early 1980s. In Sweden, net migration from developing countries has shown a generally increasing trend and has been dominant since 1978. In the Federal Republic of Germany, the developing-country component has been larger than its complement since 1983, although net migration to developing countries became negative in 1975 and again in 1982-1983. Lastly, the United Kingdom presents a special case where negative net migration to developed countries has only been counterbalanced recently by the positive contribution of net migration from developing countries.

**Figure IV. Net migration**

Belgium




Federal Republic of Germany

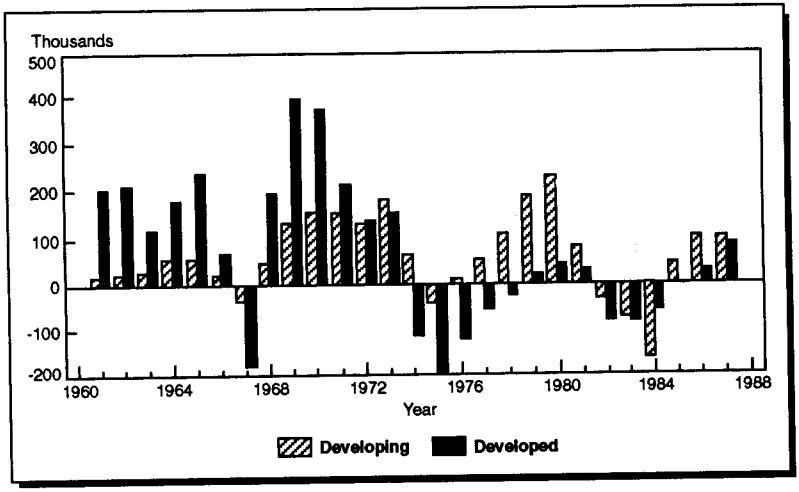
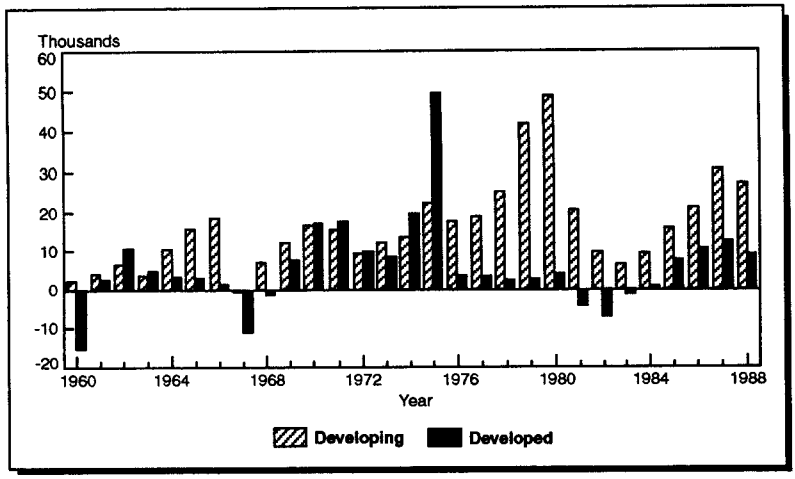


**Figure IV** *(continued)*

Netherlands




Sweden

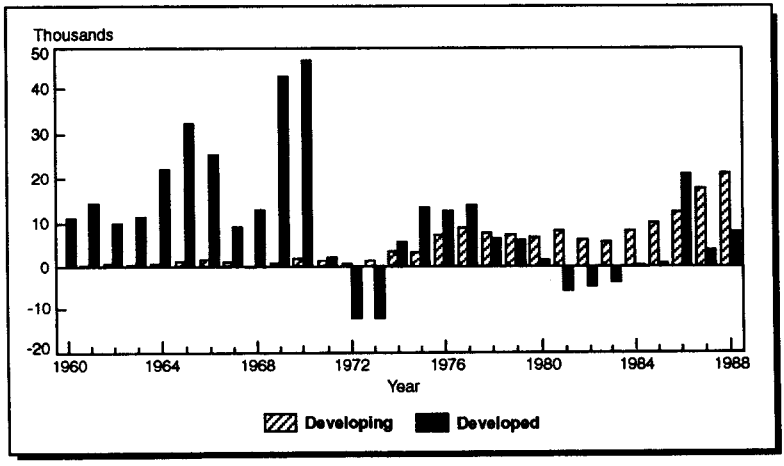
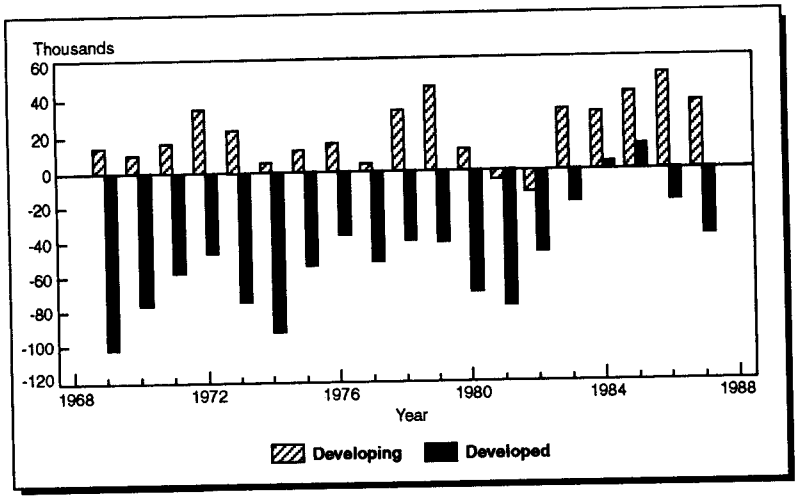


**Figure IV** *(continued)*

United Kingdom




Australia

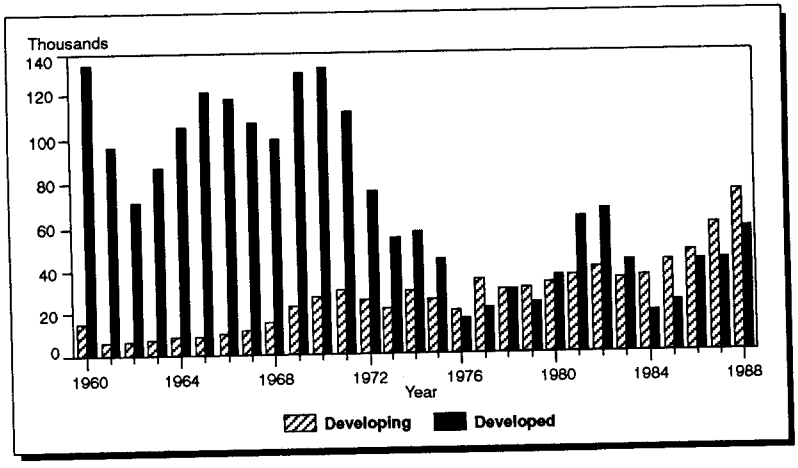


Figure IV also shows net migration to Australia by region of origin. The case of Australia is unique in showing positive net gains through settler migration during the whole period considered, gains that have been increasingly dominated by settlers originating in developing countries. That dominance first occurred in 1976, at a time of relative low net migration, and has become better established since 1984 when levels of overall net migration to Australia rose again. Yet, it must be noted that even the highest levels of net migration from developing countries recorded lately fail to match those recorded during the 1970s among migrants originating in developed countries. Indeed, the same observation is valid for countries like Belgium, the Federal Republic of Germany or Sweden where earlier migration gains were dominated by migrants from developed countries. One may speculate that the recent rise of interest and concern about "South-to-North" migration is related to the prominent role that migrants from developing countries have been playing in maintaining positive net migration balances or in reducing negative ones.

### Asylum-seekers in Europe

As already stated, it is not clear whether the normal flow statistics of European countries reflect accurately the movement of asylum-seekers, since the latter are subject to special screening and admission procedures. However, as a result of those procedures, statistics on the number of asylum-seekers by citizenship are produced. Table 5 presents the data gathered by 14 European countries for the period 1983-1989. Countries are ordered by the average annual number of requests for asylum that they received during the period.

The Federal Republic of Germany stands out as the European country receiving the largest number of asylum requests during the 1980s (an annual average of 73,000 during 1983-1989). France ranks second, with an annual average of 29,000 claims. Sweden comes third with over 18,000 asylum requests per year, and Switzerland and Austria follow with 12,000 and 11,000 yearly claims, respectively. All other European countries recorded well below 10,000 asylum requests per year, with Italy, Norway, Greece, Yugoslavia and Spain receiving, on average, less than 5,000 requests annually during 1983-1989.

Although the trends in the number of asylum requests filed every year varied considerably from one country to another, a marked tendency for that number to increase was noticed towards the end of the 1980s, especially among the countries receiving large numbers of asylum requests. Although in some cases recent increases in the number of asylum claims were associated with drops in the proportion filed by citizens of developing countries, in general that proportion remained high. Indeed, in only three of the 14 receiving countries considered did asylum-seekers from developing countries account for less than half of the total number of asylum requests filed, and in the majority of countries they accounted for over eight of every 10 asylum petitions filed during 1983-1989.

TABLE 5. NUMBER OF ASYLUM-SEEKERS REGISTERED BY SELECTED EUROPEAN COUNTRIES, 1983-1989
*(Thousands)*

| | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1983-1989 average |
|---|---|---|---|---|---|---|---|---|
| Germany, Federal Republic of | | | | | | | | |
| Total | 19.7 | 35.3 | 73.8 | 99.6 | 57.4 | 103.1 | 121.3 | 72.9 |
| Developed | 5.0 | 7.4 | 10.6 | 16.5 | 25.2 | 56.5 | 53.4 | 24.9 |
| Developing | 14.7 | 27.9 | 63.2 | 83.2 | 32.2 | 46.5 | 68.0 | 47.9 |
| Percentage developing | 74.5 | 79.1 | 85.6 | 83.5 | 56.1 | 45.1 | 56.0 | 65.8 |
| France | | | | | | | | |
| Total | 22.3 | 15.9 | 25.8 | 23.4 | 24.8 | 31.6 | 58.8 | 28.9 |
| Developed | 1.7 | 1.4 | 1.5 | 1.4 | 1.4 | 2.2 | 3.3 | 1.8 |
| Developing | 20.5 | 14.5 | 24.3 | 22.0 | 23.4 | 29.4 | 55.5 | 27.1 |
| Percentage developing | 92.2 | 91.2 | 94.3 | 94.2 | 94.3 | 93.1 | 94.5 | 93.7 |
| Sweden | | | | | | | | |
| Total | 0.0 | 12.0 | 14.5 | 14.6 | 18.1 | 19.6 | 30.4 | 18.2 |
| Developed | 0.0 | 1.0 | 2.0 | 1.7 | 1.7 | 3.2 | 10.6 | 3.4 |
| Developing | 0.0 | 11.0 | 12.4 | 12.9 | 16.4 | 16.3 | 19.8 | 14.8 |
| Percentage developing | 0.0 | 91.5 | 86.0 | 88.4 | 90.6 | 83.4 | 65.2 | 81.4 |
| Switzerland | | | | | | | | |
| Total | 7.9 | 7.4 | 9.7 | 8.5 | 10.9 | 16.7 | 24.4 | 12.2 |
| Developed | 1.3 | 0.9 | 0.7 | 0.7 | 0.6 | 1.5 | 2.4 | 1.1 |
| Developing | 6.6 | 6.5 | 9.0 | 7.9 | 10.3 | 15.2 | 22.1 | 11.1 |
| Percentage developing | 83.8 | 87.5 | 93.2 | 92.2 | 94.6 | 90.9 | 90.3 | 90.7 |

TABLE 5 (*continued*)

| | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1983-1989 average |
|---|---|---|---|---|---|---|---|---|
| Austria | | | | | | | | |
| Total | 5.9 | 7.2 | 6.7 | 8.6 | 11.4 | 15.8 | 21.9 | 11.1 |
| Developed | 5.2 | 6.5 | 6.1 | 7.9 | 10.1 | 13.9 | 15.7 | 9.3 |
| Developing | 0.7 | 0.7 | 0.6 | 0.7 | 1.3 | 1.9 | 6.2 | 1.7 |
| Percentage developing | 11.7 | 9.6 | 9.1 | 8.0 | 11.7 | 11.8 | 28.3 | 15.6 |
| Netherlands | | | | | | | | |
| Total | 2.0 | 2.6 | 5.6 | 5.9 | 13.5 | 7.5 | 13.9 | 7.3 |
| Developed | 1.1 | 0.3 | 0.0 | 0.3 | 0.5 | 1.0 | 2.3 | 0.8 |
| Developing | 1.0 | 2.3 | 5.6 | 5.6 | 13.0 | 6.5 | 11.6 | 6.5 |
| Percentage developing | 47.2 | 87.2 | 100.0 | 95.5 | 96.5 | 87.2 | 83.3 | 89.4 |
| United Kingdom | | | | | | | | |
| Total | 3.6 | 3.3 | 5.4 | 4.8 | 4.5 | 5.3 | 15.5 | 6.1 |
| Developed | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 |
| Developing | 3.3 | 3.2 | 5.3 | 4.7 | 4.4 | 5.1 | 15.3 | 5.9 |
| Percentage developing | 93.8 | 95.8 | 97.5 | 98.0 | 98.2 | 96.3 | 98.6 | 97.5 |
| Denmark | | | | | | | | |
| Total | 0.0 | 4.3 | 8.7 | 9.3 | 2.7 | 4.7 | 4.6 | 5.7 |
| Developed | 0.0 | 0.3 | 1.1 | 0.7 | 0.6 | 1.0 | 0.7 | 0.7 |
| Developing | 0.0 | 4.0 | 7.6 | 8.6 | 2.1 | 3.7 | 3.9 | 5.0 |
| Percentage developing | 0.0 | 92.7 | 87.1 | 91.9 | 78.1 | 79.5 | 83.9 | 86.9 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Belgium | | | | | | | | |
| Total | 2.9 | 3.6 | 5.3 | 7.6 | 6.0 | 5.1 | 8.1 | 5.5 |
| Developed | 0.4 | 0.4 | 0.5 | 0.5 | 1.1 | 0.8 | 1.0 | 0.7 |
| Developing | 2.5 | 3.2 | 4.8 | 7.1 | 4.9 | 4.3 | 7.1 | 4.8 |
| Percentage developing | 87.0 | 89.0 | 90.7 | 93.2 | 81.7 | 84.0 | 87.2 | 87.8 |
| Italy | | | | | | | | |
| Total | 3.0 | 4.6 | 5.4 | 6.5 | 11.0 | 1.3 | 2.2 | 4.9 |
| Developed | 1.8 | 2.6 | 4.1 | 5.3 | 10.0 | 0.1 | 0.1 | 3.4 |
| Developing | 1.2 | 1.9 | 1.4 | 1.1 | 1.0 | 1.2 | 2.2 | 1.4 |
| Percentage developing | 41.0 | 42.6 | 25.1 | 17.7 | 9.4 | 95.4 | 97.4 | 29.8 |
| Norway | | | | | | | | |
| Total | 0.0 | 0.3 | 0.8 | 2.7 | 8.6 | 6.6 | 4.4 | 3.9 |
| Developed | 0.0 | 0.0 | 0.2 | 0.4 | 1.5 | 0.7 | 1.5 | 0.7 |
| Developing | 0.0 | 0.3 | 0.6 | 2.3 | 7.1 | 5.9 | 3.0 | 3.2 |
| Percentage developing | 0.0 | 100.0 | 73.9 | 84.8 | 82.5 | 89.5 | 67.0 | 81.8 |
| Greece | | | | | | | | |
| Total | 0.4 | 0.8 | 1.4 | 4.2 | 6.9 | 8.4 | 3.0 | 3.6 |
| Developed | 0.3 | 0.5 | 0.7 | 2.0 | 2.4 | 4.1 | 0.5 | 1.5 |
| Developing | 0.2 | 0.3 | 0.7 | 2.2 | 4.5 | 4.3 | 2.5 | 2.1 |
| Percentage developing | 40.8 | 33.6 | 47.5 | 52.8 | 64.7 | 50.8 | 83.8 | 58.0 |
| Yugoslavia | | | | | | | | |
| Total | 1.8 | 2.8 | 2.0 | 2.9 | 3.1 | 4.3 | 7.1 | 3.4 |
| Developed | 1.8 | 2.7 | 1.9 | 2.6 | 2.9 | 4.0 | 7.0 | 3.3 |
| Developing | 0.0 | 0.1 | 0.1 | 0.2 | 0.2 | 0.3 | 0.2 | 0.1 |
| Percentage developing | 2.7 | 2.5 | 2.9 | 7.3 | 6.0 | 6.1 | 2.3 | 4.2 |

TABLE 5 (*continued*)

| | *1983* | *1984* | *1985* | *1986* | *1987* | *1988* | *1989* | *1983-1989 average* |
|---|---|---|---|---|---|---|---|---|
| Spain | | | | | | | | |
| Total | 1.4 | 1.2 | 2.4 | 2.3 | 2.5 | 3.3 | 2.8 | 2.3 |
| Developed | 0.1 | 0.1 | 0.2 | 0.4 | 0.4 | 1.8 | 2.0 | 0.7 |
| Developing | 1.3 | 1.1 | 2.1 | 1.9 | 2.1 | 1.5 | 0.9 | 1.6 |
| Percentage developing | 94.4 | 89.7 | 90.0 | 82.8 | 83.4 | 46.6 | 30.4 | 68.6 |
| Total | | | | | | | | |
| Total | 71.0 | 101.2 | 167.6 | 201.0 | 181.4 | 233.4 | 345.7 | 185.9 |
| Developed | 18.8 | 24.4 | 29.8 | 40.5 | 58.5 | 91.1 | 127.6 | 55.8 |
| Developing | 52.2 | 76.9 | 137.8 | 160.5 | 122.9 | 142.3 | 218.1 | 130.1 |
| Percentage developing | 73.5 | 75.9 | 82.2 | 79.8 | 67.8 | 61.0 | 63.1 | 70.0 |

*Source*: Office of the United Nations High Commissioner for Refugees, unpublished tabulations.

Only three countries, Yugoslavia, Austria and Italy, recorded relatively few asylum requests from citizens of developing countries (an average of 4, 16 and 30 per cent, respectively). However, among them, only Austria received comparatively sizeable inflows of asylum-seekers during 1983-1989. Indeed, among the countries receiving relatively large numbers of requests for asylum, only the Federal Republic of Germany recorded relatively low proportions of persons originating in the developing world, especially since 1987. As in Austria, that trend was mostly accounted for by recent increases in the number of asylum requests filed by citizens of Eastern European countries.

The growing importance of Europeans among asylum-seekers is also evident when one considers the data referring to all 14 countries together. As the total in table 5 shows, during 1983-1989 the number of asylum-seekers originating in developed countries (mostly citizens of Eastern European countries) increased sevenfold, passing from 19,000 to 128,000. Consequently, although those from developing countries quadrupled (rising from 52,000 to 218,000), their share declined. Thus, whereas in the early 1980s, seven or eight out of every 10 asylum-seekers were citizens of developing countries, by the late 1980s they accounted for only six out of every 10.

Of course, the distribution of asylum requests by area of origin may be very different from that of requests granted, especially since the evidence available suggests that recognition rates vary by region of origin (Zlotnik and Hovy, 1990). However, it is clear that, irrespective of their prospects of actually obtaining asylum, increasing numbers of persons from both the developed and the developing world are choosing the asylum option to find a safe haven in the Western world.

## South-to-North migration: a cause for concern?

The foregoing discussion has documented the growth of migration flows that originate in the developing world and are directed towards certain developed countries. Although migration from developing countries had been significant in most of the receiving countries considered before the 1970s, its growth both in absolute and relative terms dates mostly from that decade and can be attributed, at least partly, to different developments in the various developed countries. In the traditional countries of immigration, changes in the rules governing admission for permanent settlement adopted in the late 1960s by Canada and the United States (Keely, 1979 and Kubat, 1979) and in the late 1970s by Australia (United Nations, 1982) gave way to the increasing diversification of migrants by country of origin and effectively opened the door to immigrants from developing countries. In Europe, in contrast, migration from developing countries was spurred by the 1973-1974 cessation of labour recruitment that prompted migrants to stay and make their families join them. Other events, such as the end of the war in Viet Nam and the large refugee movements that ensued, allowed migrants of Indo-Chinese origin to set footholds in a

number of countries, a process that would later produce further migration waves through family reunification.

Indeed the 1980s have witnessed a rise of refugee and asylum-seeker movements directed to most developed countries but, especially, to Western Europe. The data on asylum requests filed in 14 European countries during 1983-1989 indicate that citizens from developing countries accounted for 70 per cent of all requests. During recent years, however, the number of asylum requests filed by citizens from more developed countries (mostly Eastern Europeans) increased substantially, both in absolute and relative terms.

In the European context, migration from the South has been important during most of the period since the Second World War, with European "southerners" dominating earlier flows. Thus, thousands of Greeks, Italians, Portuguese, Spaniards and Yugoslavs went north to work in the more industrialized countries of the region. Soon, however, other "southerners" followed (North Africans and Turks, in particular). Today the list of nationalities is longer, and many migrants are said to enter, stay and work in developed countries through irregular channels. Consequently, the trends that official statistics reveal may only be pale shadows of reality and the true contribution of the modern "South" may be much larger. The main source of concern for European countries attempting to control migration, particularly the growing components of it, is that the "southern" and "eastern" ones are increasing.

In the traditional countries of immigration, in contrast, concern about the origin of migration is not paramount, although the three countries considered here have moved to select immigrants more carefully in terms of needed skills. Such measures, however, are not expected to affect greatly the distribution of migrants by origin. It seems likely therefore that, given the emigration pressures existing in the developing world, migration from that region to developed countries will continue to increase.

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NOTES

[1] With effect from 3 October 1990 the Federal Republic of Germany and the German Democratic Republic united to form one sovereign State under the designation "Germany". The data reported in this article were compiled prior to the unification and refer to the Federal Republic of Germany.

[2] Only the data for Australia include Australian citizens moving as "settlers". However, an even larger number of Australian citizens leave or return to Australia as "long-term migrants", a classification that is formally more comparable to that used by European countries in gathering their own statistics on migration flows. Australian data on long-term migration by country of origin was not available to the author at the time of writing.

[3] For a further description of the data sources used, see Zlotnik and Hovy (1990).

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Population Bulletin of the United Nations, Nos. 31/32—1991

# ASSESSING THE EFFECTS OF MORTALITY REDUCTION ON POPULATION AGEING*

*Shiro Horiuchi***

SUMMARY

This article presents a new method for decomposing age distribution changes into changes in the number of births and changes in age-specific rates of mortality and migration. The method is developed on the basis of the equation for the age-specific growth rate proposed by Horiuchi and Preston (1988). Using this method, it is shown that the increase in the proportion of women in Japan during 1970-1980 is mainly due to the reduction of mortality, particularly at old ages. The results lend support to the proposed idea that the pattern of age structure changes in developed countries is now shifting from fertility-dominated to mortality-dominated ageing.

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Reduction in fertility and mortality leads to the ageing of populations. Fertility decline reduces the proportion of young children. Although the improvement of survival chances at a high mortality level may at first make the age distribution younger by reducing child mortality substantially, it will eventually contribute to population ageing by increasing the proportion of the population who reach very old ages.

Previous studies of the impact of fertility and mortality on population ageing have shown that the impact of fertility is significantly greater than that of mortality (Coale, 1956 and 1957; United Nations, 1956). The major focus of those studies seems to be on population dynamics generally observed in the course of the demographic transition: changes in fertility from an uncontrolled, high level to the neighbourhood of the replacement level (about two children per woman), and changes in the mortality level accompanying the epidemiologic transition of major causes of death from infectious and parasitic diseases to degenerative diseases.

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Most developed countries these days, however, have completed the demographic transition and entered into new phases. Emerging characteristics of nuptiality, fertility and family formation in those populations have been discussed under the label of "the second demographic transition" (van de Kaa, 1987). Concerning mortality and morbidity, those populations passed the three stages of epidemiologic transition (Omran, 1971), and entered a new, fourth stage of "delayed degenerative diseases" (Olshansky and Ault, 1986) or the "hybristic" stage, in which mortality is increasingly influenced by individual behaviour and lifestyles (Rogers and Hackenberg, 1987).

Population dynamics in the new phase are different from those during the demographic transition. Yu and Horiuchi (1987) analyse the effects of fertility and mortality changes on growth rates of different age groups and state that the importance of the effect of mortality on population ageing, relative to that of fertility, is increasing in developed countries (United Nations, 1988). They indicate the following three reasons for the rising significance of mortality.

First, the fertility decline tends to stop or slow down after reaching the neighbourhood of the replacement level, which is the total fertility rate (TFR) of about 2.1. Sometimes the decline may continue within the below-replacement zone. But even so, the decline of fertility below the replacement level is not as fast as the decline during the demographic transition, in which the TFR may fall from six or more children per woman to about two children per woman. Mortality, on the other hand, has been declining without a significant slow-down in many countries, passing through upper limits of life expectancies assumed in earlier projections (see, for example, Bourgeois-Pichat, 1978).

Secondly, significant mortality reduction in those populations can be achieved only at old ages. In general, mortality decline contributes to the growth of population of all age groups. This feature of mortality decline usually dilutes its effects on the age distribution, because the age composition remains constant if all age groups grow at the same rate. However, as death rates at young ages becomes negligibly small, room for significant mortality improvement is left only for old ages. Moreover, old-age mortality due to degenerative diseases is now on a substantial decline.

Finally, the population ageing itself strengthens mortality effects on the age structure. Although fertility effects on population growth are pronounced at young ages, mortality effects tend to be stronger at older ages. However, when the proportion of population at old ages is very small, even a large proportional growth of the age group may change the entire age distribution only slightly. An increasing proportion of the elderly population amplifies the impact of mortality reduction on the ageing of the entire age structure.

Taking into consideration the rising importance of mortality improvement to population ageing, it seems useful to distinguish four stages in a typical course of age structure changes. The first stage is characterized by stable, young age structures before the demographic transition. The con-

tinuation of uncontrolled fertility and high mortality keeps the age distribution young, which may be well-approximated by a stationary population model or a low-growth stable population model, except for perturbation due to catastrophic events such as famines and epidemics.

Then comes the stage of the increasingly younger age distribution. In a typical sequence of demographic transition, the initiation of significant mortality decline precedes that of fertility decline. The reduction from very high levels of infant and child mortality raises the population growth rate, and increases the number of young children in particular, thereby making the already young-age distribution even younger. In addition, such factors as decline in sterility, reduction in miscarriages, shortened periods of post-partum amenorrhoea and reduced widowhood raise the high fertility level further, thereby leading to the younger age structure.

The transition from the second to the third stage occurs when a significant decline of fertility starts. Falling fertility causes a continuous decrease in the proportion of young children, thereby making the age distribution older. This stage, therefore, should be called the stage of fertility-dominated population ageing. The turning point of world population growth around 1970 from the rising growth rate in the 1950s and 1960s to the falling growth rate in the 1970s, caused by the initiation of substantial fertility decline in a number of countries in Asia and Latin America, was also a turning point of age structure from the decreasing median age to the increasing median age (United Nations Secretariat, 1987).

Developed countries these days are entering into a new, fourth stage of mortality-dominated population ageing. After the completion of the demographic transition, fertility remains relatively stable, and mortality improvement, now concentrating in degenerative disease mortality at old ages, gradually becomes the major driving force of population ageing. Fertility in some populations may continue to fall further into the below-replacement zone, but the speed of decline is considerably slower than the speed in the previous stage.

On the basis of the multistage model of age structure changes described above, relationships between changes in age-specific mortality rates and the number and proportion of old women in Japan are analysed in this article. The female population in Japan, with the highest expectation of life at birth, is considered to be a front runner in the transition from the third to the fourth stage of age structure changes. A new method of assessing the impact of mortality changes at different ages on the age structure is developed for this study as an application of the age-specific growth rate equation.

## Method

Horiuchi and Preston (1988) have shown that the growth rate of population at age $a$ and time $t$, $r(a,t)$, can be decomposed into the growth rate of births, cumulated changes in age-specific death rates and cumulated

changes in the age-specific rates of net migration that the cohort experienced (see also Preston and Coale, 1982, footnote 2). Let $r_B(t)$ be the growth rate of the number of births at time $t$ and $\mu(a,t)$ and $m(a,t)$ be the instantaneous age-specific death rate and instantaneous rate of net-migration, respectively, at age $a$ and time $t$. We have

$$r(a,t) = r_B(t-a) - \int_0^a \frac{\partial \mu(x,u)}{\partial u}\,dx + \int_0^a \frac{\partial m(x,u)}{\partial u}\,dx, \qquad (1)$$

where the derivatives are assessed at $u = t - a + x$. It should be noted that equation (1) makes it possible not only to decompose the growth rate into birth effects, mortality effects and migration effects but also to decompose the total mortality effects into age-specific mortality effects and even into the age-and-cause-specific mortality effects if data on deaths by age and cause are available.

It should also be realized that the use of equation (1) for estimating the impact of mortality on population growth does not necessarily require mortality data. If migration is not significant or migration estimates are available for the cohorts to be studied, data on the size of those cohorts at their same ages will suffice. Such a data set makes it possible to derive effects of mortality changes in those age intervals. This is understood by comparing equation (1) with the following equation:

$$r(a,t) = r_B(t-a) + \int_0^a \frac{\partial}{\partial x} r(x, t-a+x)dx.$$

For estimating the effects of mortality, it is only necessary to follow the history of the study cohorts in terms of changes in age-specific growth rates. Data on the number of births in the remote past may not be required either, unless the interest is in deriving the effects on the current elderly population of improvements of child mortality that occurred a long time ago when they were very young, separately from the effects of the past increase of births. If the youngest age for which population data on the study cohorts are available is, for example, 30, then the combined effects on population growth of changes in the number of births and changes in mortality from birth to age 30 will be obtained.

Since the migration term in equation (1) can be handled in the same way as the mortality term, it is hereafter assumed that the population is closed to migration, in order to avoid unnecessary complexities. In the actual data analysis described later, the migration component is included, treating the re-annexation of Okinawa in 1972 as a special type of migration.

The absolute increase of the population aged $a$ can be decomposed by multiplying equation (1) by $N(a,t)$, the density of population size at age $a$ and time $t$. Then, by integrating it from age $a$ to age $b$, decomposition results of the age group $a$ to $b$ are obtained. An alternative way to decompose the absolute increase is to differentiate the following equation with respect to $t$:

$$N(a,t) = B(t-a) - \int_0^a D(x, t-a+x)dx,$$

where $B(t)$ is the density of births at time $t$ and $D(a,t)$ is the density of deaths at age $a$ and time $t$. However, this alternative approach does not meet the purpose of the present study, in which the focus is not on changes in the number of deaths but on changes in the risk of death.

Equation (1) leads to an expression for the growth rate of total population. Let $c(a,t)$ be $N(a,t)$ divided by the total population size at $t$. Now the growth rate of total population at $t$ is given by

$$r_T(t) = \int_{-\infty}^{t} c(t-u,t)\, r_B(u)du - \int_0^{\infty}\int_{-\infty}^{t} c(a+t-u,t)\frac{\partial \mu(a,u)}{\partial u}du\,da \quad (2)$$

The growth rate of total population is the sum of a weighted mean of past growth rates in the number of births and a weighted sum of past changes in age-specific death rates. (A more detailed discussion of equation (2) is given in annex II.)

Changes in the proportion of population aged $a$ can be decomposed by substituting equations (1) and (2) into the following equation (3):

$$\frac{\partial c(a,t)}{\partial t} = c(a,t)\,[r(a,t) - r_T(t)]. \quad (3)$$

This makes it possible to assess the direction and intensity of the effects of changes in age-specific mortality rates on the proportion of population in the given age group. A discrete version of the above formulations is used in actual data analysis (see annex I).

Another way to decompose changes in the age distribution into fertility effects and mortality effects is the method of comparative population projections (United Nations, 1956 and 1988). An advantage of the present method in comparison with the method of comparative projections is the fact that the former method makes it easy to assess the effect of mortality at different ages. Although total mortality effects can be assessed using the method of comparative population projections, it is very difficult to use it to assess age-specific mortality effects.

It is important to distinguish direct and indirect effects of mortality changes on population growth. The present method is concerned with direct mortality effects only. Mortality reduction, however, has some indirect effects. It raises the chances of survival from birth to ages of child-bearing, thereby increasing the number of births and, in turn, the number of young children. Such indirect mortality effects working through fertility are difficult to assess when the present method is adopted. Mortality effects computed by using the method of comparative population projections, on the other hand, contain both direct and indirect effects.

Another important dimension is the distinction between period-oriented approaches and cohort-oriented approaches. Although the focus of the method of comparative population projections is on mortality changes in given periods, the present method is concerned with mortality changes between cohorts. Another method for assessing the impact of changes in period mortality on the age distribution has been developed by Takahashi (1986).

## Data

Two sets of demographic estimates available in machine-readable form greatly enhance the opportunities for detailed analysis of recent demographic history in Japan. First, the demographic history of Japan from 1947 to 1984 has been reconstructed for each calendar year and each single-year age group by the Institute of Population Problems (1985). Secondly, Kobayashi and Nanjo (1988) have produced a set of annual complete life-tables from 1891 to 1986 and rearranged them by cohort.

This study follows cohorts retrospectively back to 1947, using the estimates of the Institute of Population Problems, then follows them further in the past by reverse-surviving from 1947, using the cohort life-tables by Kobayashi and Nanjo.

It should be noted, however, that such an elaborated data set is not a necessary condition for using the present method. A series of censuses 10 years apart, with five-year age groups, make possible an application, although in a less elaborated manner, of this method.

## Results

The increments of the number of women aged 60, 70 and 80 (last birthday) in each of the three decades from 1950 to 1980 are decomposed in table 1. The decomposition is based on equation (1) multiplied by $N(a,t)$. Changes in 10 years beginning on 1 January of the first year of the decade are analysed. The youngest age interval for which mortality effects are estimated is determined by the availability of population estimates of the oldest study cohort at their young ages. Migration effects are derived by dealing with the re-annexation of Okinawa in 1972 as a special kind of international migration. Other types of international migration are assumed to be negligibly small.

The old-age female population in Japan grew rapidly in the recent past. The number of women aged 60 almost doubled in three decades, from 271,413 in 1950 to 502,529 in 1980. Out of the increment of 231,116, 18 per cent is attributable to the decline in mortality at ages 50-60. Changes in mortality at ages 10-60 explain 54 per cent of the growth of the 60-year-old female population, and the rest of the increase, which is 46 per cent, is due to changes in childhood mortality under age 10 and changes in the number of births.

The population growth rate in Japan tends to be higher at older ages. The number of women aged 70 more than doubled during the same 30-year period, from 169,166 in 1950 to 386,397 in 1980. Twenty-seven per cent of the growth was produced by mortality reduction in ages 60-70 and 12 per cent by mortality reduction in ages 50-60.

The proportional growth in the number of women aged 80 is even greater. The number of 80-year old women tripled from 49,027 in 1950 to 165,409 in 1980. Forty-four per cent of the increase is explained solely by the mortality improvement from age 70 to 80, compared with 25 per cent jointly explained by the mortality reduction under age 30 and the growth in the number of births.

TABLE 1. DECOMPOSITION OF INCREASE OF WOMEN AGED 60, 70 AND 80, JAPAN, 1950-1980

| Factor | 1950-1960 | | | 1960-1970 | | | 1970-1980 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Increase | Percentage | Growth rate | Increase | Percentage | Growth rate | Increase | Percentage | Growth rate |
| | | | | | *Women aged 60* | | | | |
| Total increase | 43 863 | (100.0) | 1.5 | 122 876 | (100.0) | 3.3 | 64 377 | (100.0) | 1.4 |
| Mortality 50-60 | 17 173 | (39.2) | 0.6 | 12 569 | (10.2) | 0.4 | 11 574 | (18.0) | 0.3 |
| Mortality 40-50 | 3 911 | (8.9) | 0.1 | 15 546 | (12.7) | 0.5 | 8 952 | (13.9) | 0.2 |
| Mortality 30-40 | 4 535 | (10.3) | 0.2 | 9 114 | (7.4) | 0.3 | 14 788 | (23.0) | 0.3 |
| Mortality 20-30 | 18 | (0.0) | 0.0 | 5 870 | (4.8) | 0.2 | 9 581 | (14.9) | 0.2 |
| Mortality 10-20 | 1 430 | (3.3) | 0.1 | 1 785 | (1.5) | 0.1 | 4 117 | (6.4) | 0.1 |
| Mortality 0-10 and births | 16 796 | (38.3) | 0.6 | 77 991 | (63.5) | 2.4 | 11 263 | (17.5) | 0.2 |
| Migration (re-annexation) | — | | | — | | | 4 102 | (6.4) | 0.1 |
| | | | | | *Women aged 70* | | | | |
| Total increase | 42 072 | (100.0) | 2.2 | 48 581 | (100.0) | 2.3 | 126 578 | (100.0) | 4.0 |
| Mortality 60-70 | 22 675 | (53.9) | 1.3 | 14 443 | (29.7) | 0.7 | 22 123 | (17.5) | 0.8 |
| Mortality 50-60 | 1 697 | (4.0) | 0.1 | 13 366 | (27.5) | 0.6 | 10 358 | (8.2) | 0.4 |
| Mortality 40-50 | 2 573 | (6.1) | 0.2 | 3 044 | (6.3) | 0.1 | 12 812 | (10.1) | 0.5 |
| Mortality 30-40 | 725 | (1.7) | 0.0 | 3 530 | (7.3) | 0.2 | 7 511 | (5.9) | 0.3 |
| Mortality 20-30 | 1 397 | (3.3) | 0.1 | 14 | (0.0) | 0.0 | 4 837 | (3.8) | 0.2 |
| Mortality 0-20 and births | 13 005 | (30.9) | 0.7 | 14 185 | (29.2) | 0.7 | 65 743 | (51.9) | 2.5 |
| Migration (re-annexation) | — | | | — | | | 3 193 | (2.5) | 0.1 |
| | | | | | *Women aged 80* | | | | |
| Total increase | 33 564 | (100.0) | 5.2 | 33 996 | (100.0) | 3.4 | 48 822 | (100.0) | 3.5 |
| Mortality 70-80 | 17 014 | (50.7) | 3.0 | 13 455 | (39.6) | 1.5 | 20 770 | (42.5) | 1.7 |
| Mortality 60-70 | 402 | (1.2) | 0.1 | 11 071 | (32.6) | 1.3 | 7 971 | (16.3) | 0.7 |
| Mortality 50-60 | 1 094 | (3.3) | 0.2 | 828 | (2.4) | 0.1 | 7 377 | (15.1) | 0.6 |
| Mortality 40-50 | 166 | (0.5) | 0.0 | 1 256 | (3.7) | 0.2 | 1 680 | (3.4) | 0.1 |
| Mortality 30-40 | 901 | (2.7) | 0.2 | 354 | (1.0) | 0.0 | 1 948 | (4.0) | 0.2 |
| Mortality 0-30 and births | 13 987 | (41.7) | 2.5 | 7 031 | (20.7) | 0.8 | 7 837 | (16.1) | 0.7 |
| Migration (re-annexation) | — | | | — | | | 1 239 | (2.5) | 0.1 |

Results in table 1 indicate that the decline of adult mortality, particularly the recent improvement at old ages, has stronger impacts on the growth of the elderly female population in Japan than the growth in the number of births and the reduction of childhood mortality in the past when those old persons were born or were young children. This tendency is more pronounced for the growth of female population at older ages. These analyses, however, do not include the effects on population ageing of recent fertility decline in Japan. It is necessary, therefore, to proceed to decomposition of the increase in the proportion of all women who are old.

In table 2, changes in the proportion of women who are aged 60 or over, 70 or over, and 80 or over are decomposed into effects of old-age mortality (aged 60 and above); effects of middle-age mortality (aged 30 to 60); combined effects of young-age mortality (below age 30) and fertility (the number of births); and effects of the re-annexation of Okinawa.

TABLE 2. DECOMPOSITION OF INCREASE IN THE NUMBER AND PROPORTION OF WOMEN IN OLD AGES, JAPAN, 1970-1980

| *Factor* | *Number of women* | *Percentage* | *Proportion of women percentage* | *Percentage* |
|---|---|---|---|---|
| | | *Aged 60 or over* | | |
| (1980) | 8 448 542 | | 14.35 | |
| (1970) | 6 038 553 | | 11.52 | |
| Total increase | 2 409 989 | (100.0) | 2.83 | (100.0) |
| Mortality 60 or over | 642 233 | (26.6) | 0.96 | (34.1) |
| Mortality 30-60 | 655 495 | (27.2) | 0.91 | (32.3) |
| Mortality 0-30 and births | 1 042 034 | (43.2) | 0.93 | (32.9) |
| Migration (re-annexation) | 70 228 | (2.9) | 0.02 | (0.7) |
| | | *Aged 70 or over* | | |
| (1980) | 3 823 983 | | 6.49 | |
| (1970) | 2 515 988 | | 4.80 | |
| Total increase | 1 307 995 | (100.0) | 1.69 | (100.0) |
| Mortality 60 or over | 547 539 | (41.9) | 0.88 | (51.8) |
| Mortality 30-60 | 262 261 | (20.1) | 0.36 | (21.3) |
| Mortality 0-30 and births | 466 189 | (35.6) | 0.44 | (26.1) |
| Migration (re-annexation) | 32 006 | (2.4) | 0.01 | (0.8) |
| | | *Aged 80 or over* | | |
| (1980) | 1 010 848 | | 1.72 | |
| (1970) | 628 215 | | 1.20 | |
| Total increase | 382 633 | (100.0) | 0.52 | (100.0) |
| Mortality 60 or over | 265 896 | (69.5) | 0.44 | (84.6) |
| Mortality 30-60 | 47 226 | (12.3) | 0.06 | (11.4) |
| Mortality 0-30 and births | 60 519 | (15.8) | 0.02 | (3.0) |
| Migration (re-annexation) | 8 992 | (2.4) | 0.00 | (0.9) |

*Note*: The number and the proportion of women at the beginning of respective years are shown. Women aged 100 or over are not included in those three age groups because of difficulties in deriving reliable estimates of the size of those cohorts when they were very young.

Women aged 100 and over are not included in the denominator and numerator of the proportion, because they are very few and reliable population estimates of those cohorts at their young ages are not available. Given the lack in table 1 of clear systematic trends within the 30-year period, it is decided that the focus of this analysis is placed on changes in the 1970s.

The proportion of women aged 60 or over increased from 11.5 per cent of all women in 1970 to 14.3 per cent in 1980. Contributions to the increment, which is 2.8 per cent of the total female population, are almost equally split among the three major factors—namely, old-age mortality, middle-age mortality, and the combination of fertility and young-age mortality. The relative importance of old-age mortality, however, rises with age. More than half of the increase of the proportion of women aged 70 or over is attributable to the decreasing old-age mortality. As for women aged 80 or over, 85 per cent of the increase of its proportion is explained by the reduction in old-age mortality.

In summary, results of the present study indicate that the ageing of female population in Japan in the recent past is mainly due to the decline of mortality, particularly the improved survival chances at old ages. These mortality effects tend to be more pronounced for the increase of the proportion in older age groups. These findings seem to provide quantitative evidence of the view that populations in developed countries are now moving from the stage of fertility-dominated ageing to the stage of mortality-dominated ageing. In addition, the method adopted in this study, which has been developed as an application of the age-specific growth rate equation by Horiuchi and Preston (1988), proved to be a powerful tool for analysing changes in the age structure.

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## ANNEX I

### Decomposition of changes in age distribution

This annex describes a procedure for applying to discrete data the methodology for decomposing changes in the age distribution.

#### Basic framework

The change in the proportion of population in a given age group between two time points will be decomposed. The two time points are denoted by $t_1$ and $t_2$. The age interval is from age $a$ to $b$. The age in this annex is not the exact age but rather the age on the last birthday.

Let $N(y,t)$ be the number of persons age $y$ at time $t$. The number of persons aged $a$ to $b$, the number of persons at all ages, and the proportion of population aged $a$ to $b$ are given by:

$$G_j = \sum_{y=a}^{b} N(y, t_j)$$

$$S_j = \sum_{y=o}^{\infty} N(y, t_j)$$

and

$$P_j = G_j/S_j,$$

respectively, for time $t_j$, where $j = 1$ or 2.

In addition, let

$$g_j(y) = N(y, t_j)/G_j$$

and

$$s_j(y) = N(y, t_j)/S_j$$

for later use.

In what follows, the change in the proportion of population aged $a$ to $b$ (i.e., $P_2 - P_1$) will be decomposed into contributions of past population dynamics that occurred in different age intervals. Those age intervals are set up by selecting certain ages $x_1, x_2, \ldots$ and $x_k$ in an increasing order. The first age interval ranges from age 0 to $x_1$; the $i$-th age interval covers from age $x_{i-1}$ to $x_i$; and the $(k+1)$-*th* age interval contains age $x_k$ and over.

The decomposition will be carried out by finding a function $E_i$ of past demographic changes in the *i-th* age interval that satisfies:

$$P_2 - P_1 = \sum_{i=1}^{k+1} E_i . \tag{A.1}$$

KEY TERMS AND CONCEPTS

The basic idea underlying the discrete version of the present method of decomposition is the change in cohort size ratio, which is described below. Suppose that the number of persons aged $y$ grew between $t_1$ and $t_2$. The proportional increase is $N(y, t_2)/N(y, t_1)$, which is the ratio at the same age $y$ of two different cohorts that were born $t_2 - t_1$ years apart. The past history of the two cohorts is followed and their size during the same years of age is compared. The cohort size ratio remains constant, say, from age $x_1$ to $x_2$ if the two cohorts experience the same set of age-specific death rates and rates of net-migration. The cohort size ratio changes if the two cohorts follow different schedules of mortality and migration. Therefore, the change from age $x_1$ to $x_2$ of the ratio of the two cohorts can be considered the impact of changes in mortality and migration during the age interval upon the cohort size ratio. Note that all cohort size ratios above age $x_2$ are affected by the changes.

For example, the proportional increase from 1970 to 1980 in the number of persons aged 60 is $N(60, 1980)/N(60, 1970)$. The impact of changes in mortality and migration between ages 30 and 50 on the proportional increase at age 60 is represented by:

$$\frac{N(50, 1970)}{N(50, 1960)} - \frac{N(30, 1950)}{N(30, 1940)}.$$

Formal definitions of the cohort size ratio and its change are as follows: Suppose that there are two cohorts—one aged $y$ at $t_2$ and the other aged $y$ at $t_1$. The ratio of these two cohorts at age $x$ is given by:

$$R(x, y) = N(x, t_2 - y + x)/N(x, t_1 - y + x) \qquad \text{if } y \geqslant x$$

or

$$R(x, y) = 0 \qquad \text{if } y < x$$

The definition of the change of the cohort size ratio in the *i-th* age interval, denoted by $D_i(y)$, is more complicated, and the following three different cases need to be considered separately.

(*a*) When $i = 1$:

$$D_1(y) = R(x_1, y) - 1 \qquad \text{if } y \geqslant x$$

or

$$D_1(y) = R(y, y) - 1 \qquad \text{if } x_1 > y.$$

(*b*) When $i = 2, 3, \ldots,$ or k:

$$D_i(y) = R(x_i, y) - R(x_{i-1}, y) \qquad \text{if } y \geqslant x_i$$

$$D_i(y) = R(y, y) - R(x_{i-1}, y) \qquad \text{if } x_i > y \geqslant x_{i-1}$$

or

$$D_i(y) = 0 \qquad \text{if } x_{i-1} > y.$$

(c) When $i = k + 1$:

$$D_{k+1}(y) = R(y, y) - R(x_k, y) \qquad \text{if } y \geqslant x_k$$

or

$$D_{k+1}(y) = 0 \qquad \text{if } x_k > y.$$

## Decompositon

These definitions help to specify an appropriate expression for $E_i$. Consider the following expression:

$$E_i = (G_1/S_2)[\sum_{y=a}^{b} g_1(y)D_i(y) - \sum_{y=0}^{\infty} s_1(y)D_i(y)]$$

where $g_1(y)$ and $s_1(y)$ are as defined earlier. It will be shown that the expression for $E_i$ satisfies equation (A.1). In the above expression, $(G_1/S_2)$ is a scaling factor, the first term in the bracket represents the effects of demographic changes in the *i-th* age interval on the proportional increase in the number of persons aged $a$ to $b$, and the second term in the bracket represents the effects of demographic changes in the *i-th* age group on the proportional increase of the total population.

In order to show that the above $E_i$ satisfies (A.1), the following (A.2), (A.3) and (A.4) are needed. The proportional increase in the number of persons aged $a$ to $b$ can be decomposed as:

$$\frac{G_2}{G_1} - 1 = \sum_{y=a}^{b} \frac{N(y, t_1)}{G_1} \left[ \frac{N(y, t_2)}{N(y, t_1)} - 1 \right]$$

$$= \sum_{y=a}^{b} g_1(y)\,[R(y,y) - 1]. \qquad \text{(A.2)}$$

Similarly, the proportional increase of the total population can be decomposed as:

$$\frac{S_2}{S_1} - 1 = \sum_{y=0}^{\infty} \frac{N(y, t_1)}{S_1} \left[ \frac{N(y, t_2)}{N(y, t_1)} - 1 \right]$$

$$= \sum_{y=0}^{\infty} s_1(y)\,[R(y,y) - 1] \qquad \text{(A.3)}$$

It can also be shown that:

$$R(y,y) - 1 = \sum_{i=1}^{k+1} D_i(y) \qquad \text{(A.4)}$$

in three different cases:

(a) If $y \geqslant x_k$, then

$$R(y,y) - 1 = R(y,y) - R(x_k, y) + R(x_k, y) - R(x_{k-1}, y) + R(x_{k-1}, y)$$

$$\ldots - R(x_1, y) + R(x_1, y) - 1$$

$$= [R(y,y) - R(x_k, y)] + \sum_{i=2}^{k} [R(x_i, y) - R(x_{i-1}, y)] + [R(x_1, y) - 1]$$

$$= \sum_{i=1}^{k+1} D_i(y).$$

(*b*) Similarly, if $i = 2, 3, \ldots,$ or $k$ and $x_i > y \geqslant x_{i-1}$, then

$$R(y,y) - 1 = R(y,y) + 0 - R(x_{i-1}, y) + \sum_{j=2}^{i-1} [R(x_j, y) - R(x_{j-1}, y)] + [R(x_1, y) - 1]$$

$$= \sum_{i=1}^{k+1} D_i(y).$$

(*c*) Lastly, if $y < x_1$,

$$R(y,y) - 1 = D_1(y) = \sum_{i=1}^{k+1} D_i(y)$$

because

$$D_i(y) = 0 \text{ for } i = 2, 3, \ldots, k+1.$$

It follows from (A.2), (A.3) and (A.4) that

$$P_2 - P_1 = \frac{G_1}{S_2}\left[\left(\frac{G_2}{G_1} - 1\right) - \left(\frac{S_2}{S_1} - 1\right)\right]$$

$$= \frac{G_1}{S_2}\left[\sum_{y=a}^{b} g_1(y) \sum_{i=1}^{k+1} D_i(y) - \sum_{y=0}^{\infty} s_1(y) \sum_{i=1}^{k+1} D_i(y)\right]$$

$$= \sum_{i=1}^{k+1} \frac{G_1}{S_2}\left[\sum_{y=a}^{b} g_1(y) D_i(y) - \sum_{y=0}^{\infty} s_1(y) D_i(y)\right].$$

## ANNEX II

### Alternative expression for the population growth rate

One of the most fundamental accounting identities in demography is

$$r_T(t) = b(t) - d(t) + g(t), \tag{B.1}$$

where $r_T(t)$, $b(t)$, $d(t)$ and $g(t)$ are the growth rate of total population, the crude birth rate (CBR), the crude death rate (CDR), and the crude rate of net migration, respectively, at time $t$.

An alternative expression for the growth rate of total population is given by

$$r_T(t) = \int_0^\infty c(x,t)r(x,t)dx \tag{B.2}$$

where $c(x,t)$ is the density function of age $x$ and time $t$ that represents the proportional age distribution of population and $r(x,t)$ is the growth rate of population at age $x$ and time $t$.

As shown above, the age-specific growth rate is determined by past demographic changes as follows:

$$r(x,t) = r_B(t-x) - \int_0^x \frac{\partial \mu(a,u)}{\partial u} da + \int_0^x \frac{\partial m(a,u)}{\partial u} da, \tag{B.3}$$

where $r_B(t)$ is the growth rate of the number of birth at time $t$ and $\mu(a,u)$ and $m(a,u)$ are the death rate and rate of net migration, respectively, at age $a$ and time $u$. The derivatives in the above equation are assessed at $u = t - x + a$.

The growth rate of the number of births can be decomposed as

$$r_B(t) = r_T(t) + r_b(t) + r_f(t), \tag{B.4}$$

where $r_b(t)$ is the growth rate of the ratio of CBR to the total fertility rate (TFR) at time $t$ and $r_f(t)$ is the growth rate of the total fertility rate at time $t$. The CBR/TFR ratio represents effects on the crude birth rate of relationships between the population age structure and the age pattern of fertility (Horiuchi, 1991).

By substituting equations (B.3) and (B.4) into equation (B.2), the growth rate of total population is expressed as

$$\begin{aligned} r_T(t) = &\int_{-\infty}^t c(t-u,t)r_T(u)du + \int_{-\infty}^t c(t-u,t)r_b(u)du + \int_{-\infty}^t c(t-u,t)r_f(u)du \\ &- \int_0^\infty \int_{-\infty}^t c(a+t-u,t)\frac{\partial \mu(a,u)}{\partial u} duda \\ &+ \int_0^\infty \int_{-\infty}^t c(a+t-u,t)\frac{\partial m(a,u)}{\partial u} duda. \end{aligned} \tag{B.5}$$

The two expressions represent two different viewpoints. Equation (B.1) describes the population growth in terms of the *current* population dynamics: the size of a population grows when the number of births and in-migrants exceeds the number of deaths and out-migrants. Equation (B.5), on the other hand, describes the *current* population growth as a result of *past* changes in population size, structure, fertility, mortality and migration. It can be held, for example, that the total size of population grows if the number of children, the number of working-age adults and the number of the elderly increase together; and the growth of a particular age group may result from an increase in the number of births during the period when the cohort currently in those ages were born, a mortality decline that the cohort had experienced, a past influx of migrants into the cohort, or a combination of these factors.

In practice, it is difficult to fill out all terms of (B.5) with data, because detailed information is needed on the history of the study population for the past, say, 100 years. Nevertheless, the retrospective perspective in equation (B.2) seems to lead to a better understanding of the impact of the momentum of past demographic histories on current population growth.

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# RELATIONSHIPS BETWEEN POPULATION AND ENVIRONMENT IN RURAL AREAS OF DEVELOPING COUNTRIES

*United Nations Secretariat**

SUMMARY

In the past 10 years reports of receding forests, advancing deserts and depleted soils in the rural areas of developing countries have led to widespread concern about environmental degradation, its causes and the means to slow or reverse these trends. Among the factors suggested as contributing to environmental degradation is rapid population growth.

The present report reviews a number of studies that have attempted to assess the impact of population change on some of the environmental trends that are occurring in the rural areas of selected developing countries. It attempts to assess research findings on a single aspect of a much broader issue—namely, the impact of global demographic trends on the entire range of environmental issues facing all nations, developed and developing. The rural areas of developing countries were selected as the subject of the review because the majority of the populations of the countries reside in those areas and the impact of population variables on the environment may be more directly measured.

In order to provide a context for the findings with regard to developing countries, the report begins with a brief review of some studies that have dealt with population environment interactions at the global level. The report then describes research findings on population environment relationships in three critical ecological zones in the rural areas of the developing regions.

## FINDINGS FROM AGGREGATE DATA

Aggregate data on national population trends and trends in food imports have been used to suggest that many developing countries in which population is growing rapidly have suffered environmental damage which is so extensive and severe that they can no longer produce a suffi-

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cient volume of foodstuffs to maintain adequate levels of nutrition. In addition to citing the increasing number of developing countries that import food, such studies often cite case-studies of so-called "environmental" refugees who have been forced to abandon what had once been productive lands that had become barren due to the excessive pressure imposed by attempts to meet the demands of rapidly growing populations (Jacobson, 1989).

Such studies are generally of little use in identifying the role played by population factors, because they do not sufficiently take into account the roles played by other factors that may have little to do with population growth and yet could be largely responsible for the observed trends in food imports. One such factor might be the adoption of national agricultural policies which tend to limit the returns to foodstuff-producing smallholders. A failure to take fully into account the possible effects of other factors that might contribute to environmental degradation characterizes many analyses of population environment relationships at the national and global levels and thus limits their value in assessing the impact of demographic variables.

Some attempts to develop models that would take into account the range of variables which, along with population change, contribute to environmental degradation have been abandoned because the interrelationships are too complex to model in a manner that would be comprehensible to potential users (Slade, 1987). A number of other analysts (Kelley, 1988; MacKellar and Vining, 1987) have asserted that population growth has a significant impact on the environment, but they do not try to estimate the interrelationships or include them in their models.

Thus far, two major environmental trends—desertification and soil erosion—have not had such an adverse impact on food production as to reduce world-wide average food consumption. In the aggregate, food production has kept pace with population increase (Srinivasan, 1987). This conclusion, when considered alongside numerous reports of local-level, population-induced environmental degradation, suggests that in the study of population environment relationships, greater emphasis should be placed on the spatial distribution of desertification and soil degradation than on the overall magnitude of such degradation.

Over the past 20 years desertification has not posed a serious threat to food supplies considered at the global level, but the populations of certain regions have suffered profoundly from malnutrition due to the desertification of once productive agricultural lands. The process, but not the impact, of tropical deforestation occurs in the same spatially concentrated manner. The extinction of plant and animal species, which is often the result of tropical deforestation, also tends to occur in geographically concentrated areas. The places in which such environmental degradation is concentrated will be referred to as "critical ecological zones".

In the developing countries, critical ecological zones can be found, among other places, along the margins of tropical rain forests, along the edges of deserts and in long-settled, densely populated regions. The fol-

lowing section describes the interaction of the demographic and environmental dynamics, which is one of the factors determining the pace of environmental degradation in those zones. The discussion emphasizes migration and agricultural development, which are major mediating factors in determining the impact of population growth in these critical ecological zones.

### POPULATION/ENVIRONMENT RELATIONSHIPS IN CRITICAL ECOLOGICAL ZONES

Although this section is chiefly concerned with the role played by population factors in land degradation, it should be noted that critical ecological zones also suffer from many other environmental problems, prominent among which are unsatisfactory and declining air and water quality. Increased population densities in long-settled areas contribute to an increase in the proportion of contaminated water sources in those areas, while population growth also leads to a decline in water quality in sparsely populated regions along the margins of deserts and forests owing to the rudimentary nature of sanitary facilities in many of those areas.

Some critical ecological zones also suffer from air pollution. For example, high levels of acid rain have been observed in Central Africa. This may be related to the extensive burning taking place in the savannah regions, which in turn may be a response by shifting cultivators to population pressure (Simons, 1989).

#### *Tropical deforestation*

In recent years, many observers of conditions in tropical forests have expressed concern over the possibility of climatic change and the extinction of plant and animal species as a result of accelerated rates of tropical deforestation (Ehrlich and Ehrlich, 1990). Many have also noted that variations in rates of deforestation are statistically associated with rates of population growth, suggesting the possibility that population growth may have played a significant role in the decrease of the area covered by tropical forests.

Case-studies of deforestation in the late nineteenth and early twentieth centuries indicate that there had been extensive clearing of forests in specific locales of the developing regions, such as the Irrawaddy Delta of Myanmar (Tucker and Richards, 1983). However, comprehensive, reliable and internationally comparable base-line data for forested areas in the nineteenth century are not available. Thus, it is not possible to calculate reliable long-term measures of rates of global deforestation.

Advances in remote-sensing techniques have, however, made it possible to measure recent changes in forest cover with a high degree of accuracy. Using these techniques, the United Nations carried out the first world-wide study of tropical deforestation during the early part of the 1980s. This study measured rates of deforestation in more than 60 countries (FAO/UNEP, 1982). After allowing for differences in data quality, the report on the study estimated that the area covered by tropical forests

was declining at the rate of 0.62 per cent per annum during the study period (Lanly, 1983).

Since 1982, remote-sensing studies of deforestation have been undertaken in such developing countries as Brazil, Cameroon, Costa Rica, India, Indonesia, Myanmar, the Philippines, Thailand and Viet Nam. For six of these countries, the estimates of rates of deforestation for the mid-1980s are significantly higher than corresponding estimates for the 1970s, suggesting that there may have been an acceleration in these rates (World Resources Institute, 1990).

The studies cited above demonstrate that rates of deforestation vary significantly according to the type of forest. The rates are much higher for secondary forests (2.06 per cent per annum) than for primary forests (0.27 per cent per annum) (Sedjo and Clawson, 1983). The studies also demonstrate that deforestation is occurring more rapidly in Latin America and Asia than in Africa (Lanly, 1982). However, within each continent there are dramatic variations. Thus, the destruction of the forests of West Africa occurred rapidly, while the forests in Central Africa remained relatively intact (FAO/UNEP, 1982). These observations of variations in rates of deforestation over time and between countries have been used to investigate the causes of tropical deforestation—in particular, the role played by population factors.

The most influential theories of the causes of tropical deforestation suggest that the growth of peasant populations plays an important role in the process, but these theories differ from one another in their identification of the forces that lead peasants to destroy forests. Some theories emphasize demographic factors, while others emphasize political and economic variables. The former tend to posit that growing populations of small farmers create a scarcity of agricultural land which, in turn, leads to the expansion of agriculture into forested regions (Myers, 1984; Whitmore, 1984). A possible example of this process could be the migration of Indonesian peasants from the density populated islands of Java and Madura to the sparsely populated and heavily forested islands of Kalimantan and Sumatra.

The explanations that emphasize political and economic factors often suggest that disparities of wealth and power in the larger society cause poor peasants to seek a livelihood on the margins of society, including the rain forests of remote rural regions (Blaikie and Brookfield, 1987; Collins, 1986; Foweraker, 1981; Guppy, 1984; Ledec, 1985; Plumwood and Routley, 1982; Schmink and Wood, 1987). These analysts suggest that the unequal distribution of landholdings causes large numbers of the rural poor to lack the right to cultivate land; thus they gravitate to unclaimed land on the frontier. As the number of landless poor increases, so does the flow of migrants into communities on the fringes of the rain forest.

The latter explanation for tropical deforestation assumes that there are no secure property rights over forested lands. Often national or subnational governments assert but do not enforce their property rights to large tracts of forested land. Thus, anyone can make use of the land, although no one

has property rights to it (Bromley and Chapagain, 1984; Hazlewood, 1986; Southgate and others, 1984). In the more accessible areas, individuals and groups struggle to appropriate for themselves what is essentially a free good, establishing a claim to the land by clearing a portion of it and, thus, accelerating the rate of deforestation.

In assessing population growth relative to political and economic inequalities (in the context of the absence of an enforced system of public property rights) as an explanation for increasing rates of deforestation, recent studies (Rudel, 1989) indicate that the problem of identifying the contribution of population variables can be partially resolved by distinguishing between deforestation in different types of rain forest. Such studies suggest that the destruction of small islands of rain forest on mountain slopes in Central America or Central Africa occurs when peasants in the surrounding area "nibble" at the forests, expanding the cultivated area along the edge of the forest in small increments. Under pressure from an expanding population, they extend the area under cultivation at the expense of nearby forests.

Large blocks of rain forest present a more formidable challenge to peasant cultivators. Barriers to communication in the form of impassable rivers, difficult terrain and dense forests make it almost impossible to exploit a forested region without large, capital-intensive investments in infrastructure. When these investments open up a region for exploitation, the absence of enforced property rights may initiate a struggle to claim resources by clearing land, even in the absence of population pressure on nearby lands.

This argument suggests that in places like Central America, the Philippines, and Rwanda/Burundi, which contain relatively small islands of rain forest located within a vast sea of cleared land, variations in local rates of population increase largely explain observed variations in rates of deforestation. The same relatively strong statistical association between population increase and deforestation may also be found in regions such as West Africa, where a mosaic of cleared and forested land characterizes the landscape.

In regions bordering large blocks of rain forest, however, rapid population growth or an unequal distribution of landownership in the absence of enforced property rights would produce high rates of deforestation only if extensive investments in infrastructure were made. For example, there were high rates of deforestation in relatively capital-rich developing countries, such as Brazil, during the 1970s and low rates of deforestation in relatively capital-scarce developing countries, such as Bolivia and Zaire. In countries where there are large blocks of rain forest, a combination of capital investment, population growth and the absence of enforced property rights are required to produce rapid deforestation.

Although this argument has its clearest application in explaining variations in tropical deforestation across geographical regions, it also has important implications for variations in the rates of deforestation over time. During periods of economic austerity, a lack of new construction

projects in regions containing large tracts of rain forest is likely to reduce the rate of deforestation. If the periodic absence of economic opportunities on the frontier or in the cities reduces migration to these regions, as some have maintained (Vining, 1986), it may intensify the "nibbling" at rain forests in already settled regions. Able-bodied workers may remain in their villages and households, coping with adverse conditions by expanding, as far as possible, the area under cultivation near the villages. It should be noted, however, that this hypothesis has yet to be confirmed by empirical studies.

### *Desertification*

In contrast to the large amount of information that has accumulated about tropical deforestation during the past 10 years, information about desertification is scanty and contradictory. The extent of desertification remains open to question, as does the impact of desertification on agricultural production. According to one estimate, desertification has reduced yields on the 2 billion hectares of productive drylands (UNEP, 1987). This is two thirds of the world's drylands, which sustain 300 million people. Furthermore, two thirds of Africa's non-desert lands, along with one third of Asia's and one fifth of Latin America's non-desert lands, could suffer from desertification in the near future (World Bank, 1987).

Various agencies and experts have produced estimates of the rate of desertification. According to one such estimate, 6 million hectares become desert and an additional 21 million hectares lose their productive potential each year (Tolba, 1988). Estimates of desertification in the Sahel are framed in terms of how far the Sahara advances to the south each year. These estimates of the desert's annual advance range from 5 to 150 kilometres. However, these estimates are based on a very limited body of evidence. Remote-sensing studies and a small number of carefully done field studies suggest that the reports concerning the Sahel have not taken sufficient account of year-to-year fluctuations in vegetation and have underestimated the resiliency of vegetation on the margins of the deserts (Hellden, 1984; Olsson, 1984; Horowitz and Little, 1987; Nelson, 1990). Given these sources of uncertainty, there is need for the application of land monitoring systems in the affected (mostly Sahelian) countries which can be used to measure and map the extent of desertification both within and across countries.

Despite the ambiguity about the magnitude of the problem, the role of population increase in causing desertification seems fairly clear. That role involves the quest for fuelwood and fodder and agricultural expansion. Remote sensing and numerous observational studies have documented the land degradation and desertification which are taking place around human settlements along the margins of deserts. As people range outward from these settlements in search of fuelwood and fodder for their animals, the environmental effects of their search can be observed in satellite images of these zones. The images reveal bright, circular rings of denuded landscape surrounding most settlements.

A variety of studies indicate that the extension of rain-fed agriculture has been an important factor in the degradation of arid lands in a number of African countries. In the Sudan (Ibrahim, 1987), Niger (Painter, 1987) and Kenya (Talbot, 1986; Dietz, 1986), large numbers of peasants have moved into semi-arid regions with pastoralist populations and begun practising agriculture. The intensification of land use has denuded the landscape, and the inevitable crop failures in these arid zones have caused subsistence crises.

Studies of African agricultural development cite land scarcity resulting from population growth in densely settled, well-watered regions as the cause for the colonization of arid zones by peasant farmers (Lele and Stone, 1989; Mensching, 1988). However, very little is known about the characteristics of these migrants or the circumstances which prompted their move. They may be young, landless families, or they may be relatively prosperous families that already have sufficient land but are trying to increase the area they are able to cultivate.

The significance of the contributions made by growing populations of pastoralists to desertification is the subject of dispute. Pastoralists, such as the Masai, have increased significantly in numbers (Talbot, 1986), but evidence supporting assertions that livestock numbers have increased and pastures became degraded is difficult to obtain. Sandford (1976), for example, questioned how it was possible for livestock numbers to have increased if pastures were degrading. Questions of this kind could be resolved if better measures and data on desertification were available. The research required goes beyond the monitoring of desertification; also required are comparative historical studies of migration and land use which could be utilized to isolate the sequence of events (policy changes, population growth and migration) which may have contributed to desertification, which occurred in some areas but not others.

### *Land degradation in resource-poor zones*

The developing countries include a number of regions in which large populations of impoverished peasants eke out subsistence on small plots of land. Unlike areas experiencing desertification or tropical deforestation, resource-poor zones have been centres of agricultural production for decades. In recent years, population growth has outstripped productivity growth in some of these regions. Population growth did not induce commensurate increases in agricultural productivity, however, because the cultivators did not have sufficient resources to invest in new technologies and/or their Governments did not have the resources or institutional capacity to develop and extend the new technologies to small farmers (Muscat, 1985). Under these circumstances, land degradation generally occurs. Farmers convert the remaining patches of forest into fields and fallow their lands for shorter periods, thereby increasing the incidence of soil erosion in the region. Among regions with degraded soils are Java, the Brahmaputra/Ganges delta and the hills of Nepal in Asia, southern Malawi and

Burundi/Rwanda in Africa, and portions of the Andean highlands in South America.

While the pattern of degradation can be described, it is difficult to measure. Many problems confront those who try to measure soil erosion. Erosion occurs unevenly; a slow, steady loss of topsoil over several years may be followed by massive soil losses during one storm. If the measurements miss the storm, they may seriously underestimate soil losses. Furthermore, it is difficult to determine how broadly to extrapolate the findings derived from the study areas: to the entire valley? To the entire province?

Indirect measures hold some promise for improving estimates of land degradation. Okafor (1987), in a study of population pressure and land resource depletion in south-eastern Nigeria, suggested three such measures: farmland size per capita, fallowing frequency and an index of fragmentation in landholdings. A decline in the number of farmers selling their produce on the open market would suggest a deteriorating land base. As land productivity declines and populations increase, larger numbers of small farmers will consume all that they produce (Lele and Stone, 1989), so fewer will sell food grains. Finally, declines in productivity per hectare for major crops would suggest ongoing land degradation. These indirect measures, supplemented by case-studies, should make it possible to assess, in a preliminary way, the connections between population change and land use in the largest of the impoverished regions.

Social and natural processes often appear to be inextricably confounded as causes for soil loss. The recent controversy over the importance of natural runoff in Nepal (McNicoll, 1990), as opposed to human-induced deforestation, as a contributor to downstream flooding in India and Bangladesh is an example of the continuing uncertainty about the exact nature of the relationships in these matters. While the evidence for a connection between upland deforestation and downstream flooding in the Himalaya/Ganges Basin may not be compelling, evidence of population growth and increased flooding in north central China over six centuries provides more convincing evidence of the downstream effects of upstream deforestation (Chao, 1986).

Several historical studies of land use among the indigenous peoples of highland Bolivia have detailed how population increase and structural changes have interacted to intensify land use in the highlands. The 1954 land reform gave Bolivian peasants control over large tracts of land in the *altiplano*. The expanded access to land led to declines in the amount of fallowed land. Subsequent population increases among the landed peasants led to more intense land uses (Preston, 1969). Population increases among indigenous groups on the southern edge of the *altiplano* resulted in the extension of cropped land to lands at higher altitudes and a reduction in lands devoted to pasturing livestock (Godoy, 1984). The frequency with which peasants fallowed their land declined, and yields from potato fields began to fall, which could be considered indirect evidence of soil degradation. In other areas of the Andes, the amount of severe soil degradation has been limited because "as rural communities experience population

pressure and market penetration, they tend to change their production focus from higher to lower ecological zones" (Guillet, 1981, p. 147). In this instance, people avoided highland soil degradation by increasing tropical deforestation.

Recent studies of population and land-use change in the Andes suggest that the pattern of land degradation may have reversed in the past two decades. Studies of rural population change in Peru, Ecuador and Colombia indicate that most villages, especially villages without a road, have begun to lose population (Williams and Griffin, 1978; Rudel and Richards, 1990; Preston, 1987) as large numbers of their younger residents move to cities. The loss of population has resulted in modest changes in land use. Some landless peasants have acquired land, and some land consolidation has occurred (Preston and Taveras, 1980). If the size of landholdings and the intensity of land use are inversely related, as is usually the case, the population loss should lead to a reduction in rates of land degradation in this region.

Extreme land fragmentation characterizes southern Malawi. In this well-watered, densely populated zone of Africa, landholdings average under 1 hectare per household. To supplement their incomes from such small holdings, a large proportion of the adult males in the region engage in circular migration between their homes and places of employment in the South African mining belt. Higher yields are concentrated among the larger farmers, who have more access to fertilizers. Yields per hectare of both food and commercial crops have been declining since the 1950s. For example, the same dose of fertilizer produces smaller increments in production in the 1980s than it did during the 1950s (Lele and Stone, 1989). The land fragmentation and declining yields suggest that degraded soils are becoming more extensive in the region.

Pressures from a growing smallholder population have exacerbated problems of land fragmentation, deforestation and soil erosion in the highland regions of Rwanda and Burundi (N'diaye and Sofranko, 1990). Plots of land now average less than 1 hectare per family. As a result of the small average size of plots, large numbers of cultivators have extended the limits of cultivation to drier, lower elevation lands (Raison, 1981). Between 1966 and 1983 the amount of cultivated land doubled, increasing from 308,000 to 615,000 hectares (Tallon, 1988).

Journalistic accounts of the human uses of natural resources in the Himalayan region of Nepal paint a grim picture of environmental degradation fueled by rapid population growth (e.g., Eckholm, 1976). However, the empirical bases of this explanation of Himalayan environmental degradation appear flawed in several respects. Perhaps, of most importance, the explanation assumes a uniformity in types and causes of degradation which does not exist (Ives, 1987). For example, the explanation attributes deforestation to the collection of fuelwood. In some areas, however, it is the expansion of cropland rather than fuelwood collection which causes deforestation. In some areas, forests on private lands have actually increased in size. Furthermore, some reports have exaggerated the amount

of downstream environmental damage caused by rapid population growth and deforestation. It is probably true that upstream deforestation causes downstream flooding (for a contrary view based on a review of the literature in hydrology, see Hamilton, 1987), but at this time it is virtually impossible to calculate the amount of flooding induced by the activities of growing human populations separately from the amount of flooding that results from natural fluctuations in rainfall and runoff.

Robert Repetto reported (1986) that one third of all cultivated uplands on the island of Java, Indonesia, were eroding at rates that were 10 times the rates at which replacement soils form, thus causing a decline in soil fertility. He reported that the extension of cultivation into the uplands stemmed from continued population growth in rural Java.

The average size of landholdings in the Brahmaputra/Ganges delta declined from 1.7 to 1.0 hectares between 1960 and 1984 (Hossain, 1988). Farms are so small that many landholders have to supplement their farm income with wage labour. Although fertility rates have begun to decline, population growth is still about 2.3 per cent per year. The economic condition of the rural population deteriorated markedly during the 1970s as the real wages of agricultural workers fell. There is indirect evidence of ongoing soil erosion, in that successive nutritional surveys indicate that per capita daily energy intake declined about 16 per cent between 1962 and 1981 (Hasan and Ahmad, 1984).

There is a possibility of further intensification of agriculture in the delta. Soils are good, and a much greater proportion of the land could be irrigated and sown with high-yielding varieties of crops if funds for land improvement were made available. If the increments in income from these projects were widely distributed among farm families, farmers might retreat from the river banks and find less risky occupations.

The resource-poor areas described above are examples of a wide variety of such areas. However, the picture of people in resource-poor areas which emerges from these profiles emphasizes that in some instances people find alternative livelihoods as the land, their primary resource, degrades; in other instances, perhaps less well-documented, peasants try to halt the degradation through land improvements and intensified agriculture. The former response usually involves migration; the latter, agricultural development. The nature of these responses and their relationship are described in the following section.

### *Responses to population pressures and resource degradation*

Among other processes, migration and agricultural development condition the impact of population growth on the environment in all three of the critical zones. Twenty-five years ago, Ester Boserup (1965) outlined a pattern of agricultural development triggered by population increase. In an initial stage, farmers expand the area under cultivation. When they have exhausted the lands available for expansion, they begin to intensify their use of already cultivated land, shortening fallows, engaging in multiple-

cropping, and engineering land improvements such as irrigation systems. In effect, Boserup's model assumes that "the problem of population pressure gives rise to its own solution", a more intense use of land (Lele and Stone, 1989).

A number of factors affect the ability of cultivators to expand and intensify agriculture in response to population increases. Some populations will have a more difficult time expanding the area under cultivation than other populations because the accessibility of uncultivated arable land varies from place to place. Variations in the distribution of landholdings give rise to the same constraints. Claims to large areas of extensively cultivated land by large landholders in Latin America have closed off one avenue of expansion to smallholders (Shaw, 1989).

The history of agricultural intensification in a region is an important determinant of the response to the pressure of population growth. If cultivators have already intensified agriculture, as they have in many parts of South-East Asia, there may be few avenues of intensification open to them without a major infusion of funds from outside sources. Variations in the ability of central authorities to extend new technologies to smallholders will also affect the technological response to increasing population pressure (Bilsborrow, 1987).

Comparative historical and cross-national studies of agricultural development provide general support for Boserup's thesis of a causal link between population increase and agricultural intensification. For example, the most intense agricultural land uses in the developing world, involving large tracts of irrigated lands, occur in the most densely populated areas of the developing world, in southern and eastern Asia.

There are, however, important reasons to question the applicability of Boserup's thesis to populations in resource-poor areas in the late twentieth century. The initial studies of population increase and subsequent agricultural intensification did not specify the speed with which the change and response would occur. In the original formulation of the Boserup thesis, change occurred slowly. In Europe, for example, populations increased gradually over the course of four or five centuries, and the technologies of agricultural production changed in response to the increase in population. The responses of Chinese agriculturalists to population pressures occurred over a similar five- or six-century period.

In recent years the rate of population change in developing countries has been much more rapid. In many of these countries, particularly in sub-Saharan Africa, populations have been doubling every 20 or 30 years. Under these circumstances, the growth of population may occur so rapidly that poor farmers are not capable of adopting and perfecting the use of new techniques rapidly enough to keep up with the demand for food in the family. In this situation the farmer may turn to short-term stratagems such as extending cultivation on to marginal lands or reducing the fallowing rate without increasing agricultural inputs. In adopting these practices, the farmers increase the short-term size of the harvest but mortgage their futures by tolerating high rates of soil degradation. This "mining of the

soil" appears to be especially widespread in Africa (Pingali and Binswanger, 1987; Lele and Stone, 1989). The prevalence of soil mining suggests, contrary to Boserup's thesis, that demographically induced intensification of agriculture by farmers will not produce sufficient increments in foodstuffs to feed growing populations.

The empirical basis for this conclusion remains somewhat shaky in the case of sub-Saharan Africa, because until recently agricultural policies often gave smallholders little reason to make capital improvements in their land (Bates, 1981). In other words, the rapid increase in rural populations occurred during a period of inappropriate agricultural policy. Under these circumstances it would appear reasonable to attribute some of the soil-degrading agricultural practices and the absence of effective programmes for combating soil degradation to specific agricultural policies.

Agricultural development has a regional and a technological component. Of the six African countries studied by Lele and Stone, only one country (Kenya) exhibited a good match between the location of the agricultural population and the agricultural potential of its geographical regions. In many African countries, large portions of the agricultural population reside in regions with little agricultural potential. The mismatch between agricultural potential and population stems in part from historical patterns of disease (e.g., malaria in lower and wetter zones) and regional differences in public infrastructure investments (Lele and Stone, 1989).

Changes in land uses in critical zones appear to vary with the size of different migratory streams. Three types of migration that have land-use impacts are: circular migration, where the sending region is a resource-poor area; rural-to-rural migration, where the destination is an area undergoing desertification or deforestation; and rural-to-urban migration, where the sending region is a critical ecological zone.

Circular migration appears to increase in direct proportion to the pressure of population on the land. As landholdings become more fragmented and increases in yields fail to offset declines in the size of landholdings, small farms no longer provide a subsistence income for families, and the males begin to supplement their income by working elsewhere, in cities, mines, timber camps or on plantations (Conway, 1977).

Land use in many of the sending regions may be unaffected by labour migration. The migrant workers carry out the necessary agricultural tasks during the few months or days when they are at home. In other areas the absence of able-bodied workers has a pronounced impact on land use over a long period of time. Labour shortages in sending regions as diverse as the eastern slope of the Peruvian Andes (Hiroaka, 1985; Collins, 1988) and the southern African highlands make it more difficult to maintain land improvements, such as dykes, terraces and ditches, which prevent land degradation. More generally, the absence of labourers may reduce a community's resiliency in the face of a disaster in ways which have environmental effects. For example, when landslides damage agricultural terraces in the Himalayas, the speed with which the terraces are repaired will depend on the availability of labour in a village. The more quickly the terraces are repaired, the less erosion will occur (Ives, 1987).

Migration from densely populated agriculture zones to arid and rain-forest regions has encouraged both desertification and tropical deforestation. Although the out-migration from the sending areas is often attributed to land scarcity, research on the origins of migrants to rain-forest regions raises questions about this assertion. While most migrants come from land-poor regions, they are not always landless and do not come from the poorest families in the sending regions. Above all, they regard the move into the rain forest as an economic opportunity rather than as a move born out of desperation (Connell and others, 1976; Hardjono, 1986; Simkins and Wernstedt, 1971). This pattern suggests that population growth in long-settled areas encourages migration to ecologically fragile zones, not by creating large numbers of landless peasants but by reducing the resources close to home (e.g., land and capital) which wealthier families can exploit. Under these circumstances, prosperous farm families look for economic opportunities in agriculture in other regions. More generally, these findings suggest the importance of investigating in greater depth the forces which shape the flow of migrants from agriculturally established sending areas to ecologically marginal zones.

Out-migration offers some hope for reversing environmental degradation in ecologically degraded zones. Indications of a change in the land-holding patterns in Andean areas which are experiencing heavy out-migration suggest that land uses may become more extensive in these zones. The relative absence of land improvement schemes for combating desertification argues for programmes to spur out-migration from these zones by fostering regional development in adjacent zones with more adequate water supplies (Nelson, 1990).

## Conclusions

Two sets of conclusions can be drawn from the preceding discussion about population/environment interactions in developing countries. One set concerns the substantive trends in the human ecology of rural populations. These have clear implications for government policies to address well understood environmental problems. A second set of conclusions concerns requirements for additional information which is needed to better address less well understood environmental problems.

At present researchers are better able to count numbers of people than to measure their impact on the environment. Without improved methods of measuring both desertification and land degradation, countries and international agencies will be less able to launch a concerted effort to solve these problems.

Agricultural development has been very uneven across the developing world. The reasons are historical, political and economic, although the high cost of duplicating basic facilities in places with rapid population growth has also played a role in slow rates of development. The conse-

quence has been declining standards of living for many peasant populations, particularly in Africa, and a related acceleration in rates of land degradation in densely populated, resource-poor areas.

Population growth in these densely settled agricultural regions, coupled with urban and regional development efforts elsewhere, has increased the volume of out-migration from resource-poor areas. One stream in this migratory current, rural-to-rural migration from resource-poor areas to ecologically marginal zones, has resulted in extensive desertification and deforestation in recent years.

It has long been predicted that small proportions of the annual increments in agricultural production will come from increasing the area under cultivation. In Africa and Latin America, however, this prediction has not been borne out. Most of the recent increases in agricultural production have come from extensions of the area under cultivation. This expansion in cultivated land has had considerable environmental cost, because the newly cultivated lands were generally situated in ecologically marginal zones, on the edge of deserts or rain forests.

While the outlines of this environmentally destructive interaction between growing populations and land degradation are clear, the magnitude of the problems, their geographical distribution and their causes remain unclear. These ambiguities must be investigated analytically if Governments are to address these environmental problems in an effective way. Research which would improve our understanding of these issues is outlined below.

The database available for use in assessing the impact of rural populations on the environment in developing countries is inadequate. There has been some progress, particularly in the use of remote-sensing techniques, to measure tropical deforestation. A 1982 study by the Food and Agriculture Organization of the United Nations (FAO) measuring tropical deforestation worldwide has provided valuable baseline data, and future updates should make it possible to monitor change in rates of deforestation. A comparable effort is needed to measure desertification. Such a study would also provide valuable baseline data, and periodic updates of the original study would make it possible to measure changes in the magnitude of the problem.

The measurement of soil degradation, although equally important, presents more difficult problems. The techniques of measurement are not widely agreed upon, and soil quality must be measured through labour-intensive ground surveys which require an effective governing institution if the results are to be credible.

It is necessary to investigate in greater depth the causes and consequences of rural out-migration from densely settled areas. Among the questions that should be studied are the following: Does heavy out-migration to cities produce a change in rural land use? In particular, does the loss of population produce land consolidation and more extensive land-use patterns? What circumstances induce migration from long settled regions to ecologically marginal forests or arid lands? What role does

increased population density in long settled areas play in the decision of peasants to move to marginal lands?

These questions have important policy implications. If colonists in critical ecological zones are drawn from relatively prosperous peasant families in search of economic opportunities, then efforts to redirect regional development funds away from these zones should reduce rates of in-migration and agricultural intensification. Similarly, it might be expected that programmes of regional development in areas adjacent to the critical zones would precipitate migration out of the critical zones and relieve pressures on the land. If, however, most migration into critical zones is part of a "nibbling" process in which poor peasants integrate a new piece of land in a more arid zone into the households' nearby agricultural activities, the peasants engaging in the agricultural expansion may have so little capital and may be so wedded to a subsistence routine that they would not respond to a change in a Government's regional development priorities. Under these circumstances, family planning programmes and soil-conserving rural development efforts may be required to bring about a decline in the extent of land degradation. Interventions to reduce rapid population growth through family planning in such cases may be instrumental in preventing, or at least reducing, further environmental degradation.

In general, because rural-to-rural migration appears to lead to rapid rates of deforestation and desertification, there is need to know much more about its causes. With a better understanding of why people move to critical ecological zones, it may be possible to devise programmes that reduce the size of these migratory streams.

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# HISTORICAL POPULATION ESTIMATES FOR EGYPT: A CRITICAL REVIEW

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SUMMARY

This article attempts to piece together historical population estimates for Egypt and to assess their credibility, starting from Pharaonic times and continuing through the Greek and Roman eras and the Middle Ages. Egypt has always been a tempting ground for such an assessment, since data are available and the boundaries of the country have remained virtually unchanged for many centuries. While many doubts are raised concerning several of the estimates, the article suggests that population size in Egypt responded to societal conditions and that the demographic situation was at its worst during the Middle Ages. It improved only after the rule of the Mamluks and the Ottomans had been terminated, early in the nineteenth century.

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Egypt has a history extending over millenia during which the population continued to live within a well-defined area—namely, the Nile Valley. Unlike other ancient populations, it did not experience massive regional movements. At the Fourth IUSSP Conference (Paris, 1937), the Polish population historian Walek-Czernecki stated: "Egypt is the only large country in the old world for which our sources have transmitted figures concerning the total population. This suffices for guaranteeing her a privileged position in ancient demography. We are not obliged in this regard to resort to indirect methods which always leave a margin of uncertainty.... As far as Egypt is concerned, our task consists in critical examination of the works on the number of inhabitants. If this examination results in positive conclusions demonstrating the reliability of these works, we will have access to fundamental data which can serve as a solid basis for further research, not only on the population of the Nile valley but also on other populations of antiquity" (Walek-Czernecki, 1938, p. 7).

As will be discussed below, this statement reflects some degree of overenthusiasm, because, although there are data strong enough to suggest major changes in the long-range demographic trends in Egypt, they are not

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strong enough to offer any assurance about details. Their limitations must be recognized so that one is not led astray by conclusions that are based on them. The literature includes several works that estimate ancient Egypt's population over a long period, extending from the Pharaonic era through Arab rule in the Middle Ages. However, most of those estimates have a weak basis, and several are controversial in that, for the same period, based on different sources or procedures, they are widely different.

Two main methods were followed in estimating the population of ancient Egypt. The first was to estimate the total cultivated area and the average number of persons supported by a unit of that area. The works that followed this method did not differ significantly in their measure of the total cultivated area in an ordinary season, but they differed substantially in their estimates of the additional cultivable area made available by the high floods[1] and in the average number of persons which a unit could support.

The second method was based on land tax: the total amount and the average rate per head. Here also controversy arises—not so much over the total tax (although this has happened in some cases) but over the average rate, which usually varied among regions and social groups.

Thus, while it seems that there are more historical population estimates for Egypt than for other nations, the unreliability of the sources and the questionable nature of the estimation methods make it necessary to view the estimates with considerable caution.

## The Pharaonic era

While the rise of civilization in Egypt dates back to the fifth millenium B.C., the Pharaonic era begins with the reunification of the country about 3360 B.C. and continues until the Persian invasion in 525 B.C. During this era, except for periods of foreign invasion, the country's monarchs were called pharaohs.

It would be hard to imagine a lack of record-keeping in a civilization like Egypt's, which demonstrated its sophistication in almost every walk of life—not only through the construction of monuments with which the whole world is familiar but also through advanced technology in agriculture, chemistry, astronomy etc. and through highly efficient management of human resources.

It is well established that record-keeping existed during the reign of the Fifth Dynasty (2965-2825 B.C.) of the Old Kingdom, when the office of "Scribe of the King's records" gradually developed. During the Feudal Age (2160-1788 B.C.), every head of family was enrolled as soon as he had established an independent household, along with all the members belonging to the household, including serfs and slaves. The enrolments took place at fixed intervals of some years, and all records of land, population and tax were filed in the bureaus of the vizier (Prime Minister). In an inscription from the reign of Thutmose III (1507-1447 B.C.), an account is given of the duties of Intef, the herald of the King, "who levies the official staffs and the soldiers, who lays commands on the people to number their work

(impost) for the King, who fixes the reckoning of the country...." (El-Darwish, 1929, p. 279).

Another account of record-keeping duties is given by the senior scribe of Amenhotep III (1411-1375 B.C.), who, at the age of 80, was accorded by the King the honour of a statue in the temple of Amoun at Karnak (Luxor), on which was inscribed in hieroglyphics in his own words: "My Lord again showed favour to me: the King... put all the people subject to me and their listing under my control.... I have levied the (military) classes of my Lord, my pen reckoned the numbers of millions... I put them in classes in the place of their elders.... I taxed the houses with the numbers belonging thereto. I divided the gangs of workmen and their houses..."[2]

These accounts and others establish what one would simply presume on the basis of any knowledge of ancient Egyptian civilization—namely, the existence in those days of population and labour-force records. However, although statements such as that above of the scribe survived with the monuments on which they were inscribed or on the papyrus sheets on which they were written, the statistical records no longer exist or—more hopefully—part of them has yet to be uncovered.

Historians have tried to estimate the total population of Egypt by piecing together bits of demographically relevant information, like food production or taxes, and by making assumptions concerning conditions in ancient times relative to those in more recent times on which more information is available. By their very nature, such approaches do not lend themselves to accurate assessment, because the degree of accuracy of the inputs is usually hard to appraise.

For example, Jomard, one of the French *savants* who accompanied Napoleon's expedition to Egypt, maintained that the conditions of the soil and the population had been the same in ancient Egypt as they were in his day (early nineteenth century). "What the soil of Egypt was, it still is. The fertility of the country, the healthiness of the air, the fecundity of the women, all these things which it is not within the power of man to destroy have not changed" (Jomard, p. 104). Obviously, Jomard went too far in making easy assumptions, not only because it is clearly within the power of man to influence the soil and health conditions but also because, as El-Darwish says (pp. 274-275), there is no basis for comparing the prosperous, powerful and well-governed community that existed under the Pharaohs with the Egypt of the early nineteenth century, an "extremely backward and poverty-stricken community, living in wretched conditions of misery and disease and shackled by a disturbed rule of a degenerated sect of Mamluks".

In fact, one of Jomard's colleagues in the group of *savants* who accompanied Napoleon expressed a different point of view about the relative conditions of agriculture at the two periods: "Modern Egyptians, like their ancestors, use irrigation to cultivate their land; but the ingenious methods which the ancients brought to such a high level of perfection have lost their utility under the modern".[3]

In order to produce a quantitative estimate of population size on the basis of his assumption, Jomard computed the annual net product of the country in wheat and maize. Assuming that the cultivated area was the same in Pharaonic times as in 1800 and applying an assumed average yield for each crop, he arrived at an estimated total annual cereal product equivalent to 700.5 million kilogrammes of bread. Further assuming that the average daily consumption per person was the same in ancient Egypt as in Europe in his day—namely, half a kilogramme—and allowing for some other food products such as beans, Jomard concluded that food production in ancient Egypt was capable of feeding from 5.5 million to 6.0 million persons (p. 136).

Jomard goes on to say that if all the cultivable land in 1800—estimated to be almost double the area actually cultivated—had been utilized in ancient times, the land could have supported about 6 million persons while an amount of wheat equal to local consumption was exported (p. 138).

It is conjectural, of course, to assume similarity between cereal consumption patterns in Pharaonic Egypt and in Europe of 1800 or to assume that the area benefiting from the inundation in ancient times was nearly double the cultivated area in Jomard's day.[4] More striking is the assumption that such a huge quantity of wheat might have been exported by the Pharaohs before the Hellenic and Roman periods. Such an assumption would have no known basis. The feasibility of carrying out such a huge export operation on an irregular basis (depending on the condition of the flood) long before the Roman occupation would seem highly questionable, at least in view of the transportation problems involved. One wonders why Jomard did not accept the possibility that the whole crop was locally consumed, in which case the estimated population would be 12 million as a maximum.

To substantiate his estimate, Jomard argued that population density in ancient Egypt could not have exceeded what it was in 1800 by more than one third. Allowing an excess of 50 per cent, which gives a much higher density than in any of the most densely populated areas of Europe in his time (with the exception of the Canton of Berne), Jomard arrives at a figure of 4.2 million for the rural population in ancient Egypt.[5] To that figure he adds 1.2 million for the inhabitants of the three cities of Thebes, Memphis and Heliopolis, and another 0.5 million for the population in other urban areas, arriving at another estimate of ancient Egypt's population—a total of "between 5.5 and 5.8 million" (p. 140).

Jomard's estimates have been discussed in some detail because of the elaborate nature of his report. Other writers have provided figures without much elaboration. Cavaignac maintained that because agricultural conditions had not changed much since ancient times, 20 million hectolitres would not be an overly high estimate of the annual product of ancient times (El-Darwish, 1929, p. 275). Assuming that a person needed from three to four hectolitres annually, he calculated that the total population would be from 5 million to 6 million. Jomard also quoted (p. 143) two

estimates given by writers of his time—namely, 27 million, given by Gognet, and over 40 million for the population of the Delta alone, given by Pancton.

Almost a century later the Institute of Egypt published an elaborate study prepared by (Prince) Omar Toussoun (Toussoun, 1924). Although the document is concerned mainly with finance—particularly with taxation—the subject of population estimates is sometimes discussed. While the author refers several times to *Description de l'Egypte*, the well-known encyclopaedic publication prepared by the *savants* involved in Napoleon's expedition to Egypt at the end of the eighteenth century, and to contributions made by Jomard in various sections of that comprehensive work, he does not refer at all to the above-mentioned statement by Jomard on the population of Egypt. The possibility that this was deliberate, owing to substantial disagreement, is very likely.

Toussoun maintained (pp. 70-81) that the cultivated area of Egypt in the early 1920s—namely, 5.6 million *feddans* (4,200 square metres per *feddan*)—had existed throughout history and that to that area one should add another zone in the north of the Nile Delta which, though uninhabited in his day, must have been inhabited before, as evidenced by the ruins of cities that could not have existed without surrounding agriculture. Therefore, with a total cultivable area of 6.6 million *feddans*, Toussoun held that an estimate of 6.0 million *feddans* of cultivated area in the Pharaonic era would not only be reasonable but should perhaps be considered more likely a minimum than a maximum.

The argument becomes more conjectural when Toussoun estimates the yield. Quoting a classical Arab writer who said that in A.D. 1176 the yield per unit of wheat and barley varied between two and 20 *ardebs*,[6] he decided to use 10 as an average—or 7.1 per *feddan* as currently defined. Noting rightly that the Middle Ages were a period of decadence in Egypt and again substantiating his opinion by statements in classical Arabic texts, Toussoun concluded that the average yield in the Pharaonic era must have been considerably higher: 10 *ardebs* per *feddan*. Toussoun went on to estimate that the country's average annual yield, depending on the Nile flood, was 60 million *ardebs* of cereal.

These results were then used to estimate the total population. First, based on the cultivated area, Toussoun argued that since the population density according to the 1917 census was 2.25 persons per *feddan*, the density in Pharaonic days must have been higher, as indicated by the higher production of the country (in 1921 the cereal yield was only 26.7 million *ardebs*, compared to the 60 million estimated by Toussoun for ancient times)—perhaps about 3 per *feddan*. This density, multiplied by the estimated cultivated area of 6 million *feddans*, gives a total population of 18 million inhabitants. On the other hand, since foreign trade in cereals in ancient Pharaonic days must have been very limited because of the difficulties of transportation, the country must have had a population of at least 18 million individuals who would consume the total cereal yield of 60 million *ardebs* at the average rate of consumption in 1921, which was two

*ardebs* per person, allowing for the additional needs of livestock and the necessity of reserve storage for bad years.

In commenting on these results, Toussoun asks how ancient Egypt could have been less populated than in his day, since in ancient times the country needed a larger population in order to cultivate more land at a high level of efficiency (p. 81). He concedes that perennial irrigation, which was in effect in Lower Egypt in his day, required more labour than seasonal irrigation, but he cites the case of two provinces in Upper Egypt which were still under seasonal (basin) irrigation in his day and in which the average number of persons per *feddan* would, when applied to the whole country, give an estimated total population of 16 million. One would tend to agree with this argument if the two provinces, which suffered from economic depression and underemployment, could be considered representative.

Despite all the imponderables involved, Toussoun's estimate of 6 million *feddans* for the cultivated area in the Pharaonic era is likely to be an underestimate, because there are other areas known to have been inhabited and productive in ancient times which he did not take into consideration. One of those is a strip along the north-western coast, and another is in the oasis area stretching to the west of the Nile valley, known to have been considerably larger in ancient times. Although, again, there is no statistical basis for estimating the additional area under cultivation, it is probably safe to say that 6.5 million *feddans* would be a more realistic estimate.

On the other hand, Toussoun's estimate of the cereal yield, derived on the basis of minimum and maximum yields in a certain medieval year and raising that medieval average by 40 per cent, is not much more than a surmise. It would seem somewhat more enlightened if he used the average annual yield per *feddan* in his time (1921)—namely, 5.8 or 6.0 *ardebs* per *feddan.* On the basis of this figure and the assumption that three *ardebs* per person were needed for the annual consumption of population and livestock, one gets a total population estimate of nearly 10 million, if it is assumed that the proportion of the cultivated area allocated to cereals was about the same in ancient times as it was in Toussoun's time—namely, 82 per cent. The estimate increases to 12 million if the cereal area was 90 per cent of the total.

It goes without saying that no claim can be made about the relative accuracy of the estimate of 10 million or 12 million in a situation where the basic parameters are so hard to establish. It is not surprising under such circumstances that we have elaborate estimates ranging between 5 million and 18 million (and there are estimates that exceed 40 million). Even time is poorly defined, since the Pharaohs reigned for almost 3,000 years, during which time population size must have had its ups and downs during periods of internal struggle, war, epidemics and other calamities.

### *The Twenty-sixth Dynasty (664-525 B.C.)*

The three population figures provided by ancient writers for the Greek and Roman eras (discussed below) all referred to periods of

decadence: the first to the late fourth century B.C. when Egypt was beginning to rise from the destruction caused by the second Persian conquest; the second to the middle of the first century B.C. when the reign of the Ptolemaics was at a high level of deterioration; and the third to the middle of the first century A.D. when Roman exploitation brought about a period of serious crisis. This is why, in Walek-Czernecki's opinion, the three estimates could not be representative of the population of Pharaonic Egypt. The closest period of prosperity—namely, that of the Twenty-sixth Dynasty (664-525 B.C.), which came two and a half centuries earlier—would therefore be demographically significant. With this argument, Walek-Czernecki (1941) introduced his figures in a paper presented to the Institute of Egypt.

The estimation of population during the Twenty-sixth Dynasty is based on a comparison between the conditions during the reign of that dynasty, on the one hand, and both the Greek era (305-30 B.C.) and the modern era (A.D. 1800-1940), on the other. Both the dynastic era and the modern era, which are of approximately the same duration (140 years), were periods of recovery after decadence brought about by ruinous foreign domination. "It is therefore very likely that the population in 664 B.C. was much closer to the A.D. 1800 figure than to the figures of the fourth and first centuries B.C." (Walek-Czernecki, 1941, p. 46). (It should be noted, however, that the decadent interval preceding the latter two periods was relatively short.)

Comparing the early and the contemporary eras, Walek-Czernecki finds that, economically, socially and politically, conditions were much more demographically favourable under the Twenty-sixth Dynasty. The difference in agricultural technology between ancient and recent times should be negligible as far as its demographic impact is concerned, since ancient agriculture was managed with simple but highly efficient methods and with abundant workers. As regards the economy, ancient Egypt had at that time more land, as will be discussed below. In contrast with Egypt of the 1940s, ancient Egypt was virtually self-sufficient, with an industry based exclusively on local raw materials and with wheat kept solely for local consumption (until later in the Greco-Roman era). On the social front, it is true that there were class distinctions in ancient times, too, but the upper classes were kept under control, and balance was provided by the Pharaohs. The fact that part of the wheat product was not sold to countries across the Mediterranean at the expense of local consumption demonstrates that the kings of the Twenty-sixth Dynasty were putting the interests of their people before their own treasuries. It is also an indication that the population of the era, at least towards its end, had reached "the maximum compatible with the well-being of the masses" (Walek-Czernecki, 1941, p. 58). Although Egypt of the 1940s had access to modern health technology, mortality in 1940 was still quite high despite all the reforms carried out since early in the nineteenth century, and the birth rate had not declined. "There was no reason to suppose that during the Twenty-sixth Dyanasty mortality was higher than at the present time; the

opposite is much more likely since all the other factors influencing mortality are more favourable to the early era" (Walek-Czernecki, 1941, p. 59).

The above considerations led Walek-Czernecki to conclude that a minimum estimate of the population in 525 B.C. would be equal to the population in 1940—namely, about 16.5 million. This conclusion is reached by assuming that the total population in 664 B.C. could not have been smaller than in 1800 (2.5 million) and that the rate of growth during 664-525 B.C. was higher than during A.D. 1800-1940. In other words, the author based his argument on the following two premises:

(*a*) For the population of Egypt, going back as far as the seventh century B.C., no conditions could have been worse than those that prevailed at the end of the eighteenth century A.D.;

(*b*) The general living conditions during the reign of the Twenty-sixth Dynasty were more favourable to a larger population than those of the A.D. 1800-1940 period.

While these arguments may well be valid and the estimate may hence be acceptable, it should be realized that the argument is nowhere near a numerical exercise. It obviously cannot be ascertained that in 664 B.C. the population was equal to or more than 2.5 million (the estimate for the year 1800) nor can one take it for granted that, because conditions were better in the ancient period, the rate of population growth was bound to be higher during that period. Despite these imponderables, it should be remembered that, in essence and notwithstanding the long intervening period, the above is an exercise in comparative demography, an approach still commonly used and well recognized today.

A maximum population estimate for 525 B.C., in Walek-Czernecki's opinion, could be as high as 33 million, or double the minimum estimate. Such a high estimate would be based on accordingly higher initial figures for the population in 664 B.C. or for the average rate of growth during 664-525 B.C., neither of which is impossible. However, he saw two reasons why he should bring that maximum much further down. One was that the "extra" land exploited in the early period but no longer cultivated in modern times must have been less fertile, and hence less productive, than the land that remained under cultivation. The second reason was that the high degree of prosperity enjoyed towards the end of the Twenty-sixth Dynasty would have been difficult to realize with a population density in excess of 500 persons per square kilometre, as implied by the figures. The optimum population must therefore be sought in the vicinity of 400 persons per square kilometre, which gives a total population of 20 million to 21 million.

A word is needed now about how the cultivable land during the Twenty-sixth Dynasty was estimated. Walek-Czernecki quotes the figure of 27 million *aroures* inscribed on the temple of Edfou (first century B.C.) for the area of inundation by the Nile. He discards the value of 2,738 or 2,756 $m^2$ to the *aroure*,[7] since such a value would lead to a very high estimate of the cultivated area, and adopts—without giving a source—"the recent evaluation of the *aroure* during the Greco-Roman era of 1,970 $m^2$" (1941,

pp. 47-48), which leads to 53,000 km$^2$ for the inhabited area, which would be 63 per cent larger than in 1940. He goes on to argue that there was no reason to believe that the Edfou Temple figure for the total area was not based on the cadastres which were carried out in Ptolemaic and earlier times. It would be prudent, accordingly, to assume that this figure represented the area not at the time of establishing the temple, which was a period of great decadence, but at a more prosperous earlier period, such as the third century B.C. and earlier.

In an attempt to derive the minimum total population by a different approach, he used for the minimum cultivated area in the days of the Twenty-sixth Dynasty the area under cultivation in 1940, for which he used the figure of 12 million *aroures*.[8] This land was cultivated either by warriors, who were given lots of specified areas, or by peasants. As regards the land allocated to the warriors, he argued that the number of warriors was certainly not less than their number at the time when Herodotus visited Egypt (75 years after the end of the Dynasty), or 410,000, according to Herodotus. He also assumed the applicability of the lot size per warrior as quoted by Herodotus at the time of his visit—namely, 12 *aroures*. Walek-Czernecki thus concluded that the warriors were allocated a total of 5 million *aroures*, and that accordingly at least 7 million *aroures* were distributed among the ordinary peasants. Using for the average lot cultivated by these peasants the area of 5 *aroures*, which was the average in Ptolemaic days, he arrives at the estimate of 1.4 million families, to which the 0.4 million families of the warriors are added, to make a total of 1.8 million agricultural families. Then, using six persons as the minimum family size for a population "as prolific as the Egyptians", he reaches the minimum estimate of 11 million for the agricultural population. Since there was no doubt in his opinion that in ancient times and particularly in the days of the Twenty-sixth Dynasty the proportion of the non-agricultural population was much larger than in contemporary Egypt, he assumes a ratio of one third for the non-agricultural population, which leads to a minimum estimate of 16.5 million for the total population, or "exactly the same figure we have fixed before by a totally different method" (1941, p. 62).

It is difficult to find the second approach convincing since the assumptions are so many and at the same time so shaky. The timing of the assessment inscribed on the Edfou Temple, the area of the *aroure* at that time, the plausible density, the proportion of the non-agricultural population—each one of these has a fairly wide margin of uncertainty, and putting them together in one exercise does not narrow that margin. This is not to take away credit from Walek-Czernecki's whole exercise, in which he was clearly trying to introduce more parameters into a necessarily subjective model.

### Greek and Roman eras

Moving now to more recent times in ancient Egypt's history, one again finds conclusive information about the existence in the Greek and

Roman eras of records about individuals and their property, from which some demographic statistics can be derived. A few of these statistics have been quoted by ancient historical writers. It is to be noted, however, that this type of quotation does not prove that the official records were accurately reflected. The first such quotation was referred to by Walek-Czernecki (1938, p. 8) who mentioned a statement by Baton of Sinope (third century B.C.) in his work on the history of the Persian Empire. In Baton's statement the figures of 33,330 "villages" and 7 million inhabitants were given for the "Land of Thebes", which presumably meant the whole country, since the city itself could not include such a large number of "villages". Regardless of this confusion, Walek-Czernecki expressed the opinion that such figures should not be given much weight since "Baton is almost completely unknown".

Much more weight is given to another statement by Diodorus of Sicily, who visited Egypt in about 60 B.C. and collected statistical information from the competent authorities.[9] He gave the values of no less than 3 million for the total population of Egypt at his time (first century B.C.) and of 7 million for an earlier time to which he referred as "the old days".

There was considerable confusion among writers, arising from interpretation of linguistic terminology, as to whether Diodorus's figures refer to total population or to taxpayers—i.e., adult males. If the figures of 3 million and 7 million refer to adult men rather than to all individuals, the total population would be roughly 12 million at Diodorus's time and 28 million at an earlier time. This explains why such high figures are given in some references although the base is the same as that of the totals of 3 million and 7 million. A widely quoted writer on this point is the well-known historian Beloch, who, in the second edition of his work *Griechische Geschichte,* reversed an earlier interpretation of his and considered Diodorus's figures to be referring to taxpaying adult men.[10] This change was based on additional information contained in papyrus pertaining to the Greco-Roman eras. There is also uncertainty in the literature (Walek-Czernecki, 1938, p. 10) as to the time reference of the 7 million: was it the time of Ptolemy I (third century B.C.), who was a contemporary of the principal historical source used by Diodorus?

Over a century later, while Egypt was under Roman rule, Flavius Josephus wrote in A.D. 66 that Egypt had 7.5 million people exclusive of Alexandria, and went on to explain how he arrived at this figure: "calculated on the basis of the per capita contributions of those inhabitants". The nature of the source—namely, the tax records—leaves open the possibility that Josephus obtained the number of taxable persons from the records and then somehow derived from it the size of the total population. If this is how the estimate was derived, then the reliability of the figure is questionable since it is well established that Roman taxation in Egypt was not comprehensive, did not apply the same rate uniformly, varied from one district to another and charged lower rates in urban areas. Obviously, if the information Josephus had from the records was merely the total taxation revenue, it would be inaccurate for him to derive the total taxable population simply by dividing the total revenue by a flat taxation rate.

More controversy was added here by some writers. Johnson (1936, p. 245) rightly says that "it is evident that Josephus could make no very accurate estimate from the revenue alone", and then immediately adds the strange remark, "But if he had accurate knowledge of the revenues from Egypt, it is probable that he also had access to the records of the census, and so we may accept his estimate of the population as fairly accurate." But if Josephus had access to the census records, why would he—as he stated—use the taxation records instead?

Walek-Czernecki adds a more dramatic tone to the controversy (1938, pp. 11-12) when he says that the figure on the total number of inhabitants cannot be taken as exact unless Josephus expressed himself wrongly—i.e., had access not to the taxation record but to the general population register which in those days served as the basis for determining those subject to taxation. He then adds: "Nevertheless, if Josephus knew exactly the level of Egyptian contributions, it is probable that he also had access to the population registers. This is possible, and probable as well, since he was very well esteemed in the imperial court as a writer and was strongly interested in documents." One would have to wonder whether there is any point in using as a historical record a statement in which we think that the author expressed himself wrongly about the very basis of the argument made in that statement.

Nor does the controversy end here! A strong attack on Josephus's figure is launched by Russell, who expresses the opinion that it was derived from Diodorus's above-mentioned estimate pertaining to "an earlier time", after sidestepping Diodorus's estimate of 3 million, which was chronologically closer. Citing figures on unrelated matters given by Josephus, which seemed to be highly exaggerated, Russell (1966, pp. 69-70) concludes that "Josephus was not a man to balk at large numbers" and that "anyone who takes Josephus' figures seriously has failed to reckon with his vivid imagination". Then, in detailing how the estimate was reached, Russell goes on to say: "Josephus by adding to the seven millions the 300,000 for Alexandria, also supplied by Diodorus, got about seven millions and a half." Russell thus quickly forgot what he stated a few lines earlier—namely, that according to Josephus Egypt had 7.5 million without Alexandria.

Leaving aside this controversy and going back to Josephus's figure of 7.5 million exclusive of Alexandria and trying to add to it an estimate of the population of Alexandria, one would perhaps find an acceptable basis in a figure given by Diodorus, who stated that "during our stay in Egypt those who kept the records told us that the free inhabitants of Alexandria were more than 300,000".[11] If one assumes again that these were taxpayers, the total population of the city would then be about 1.2 million to 1.5 million, making some allowance for slaves. This assumption is supported by Diodorus's insistence that in his time Alexandria exceeded all other cities in the world in population size, which would not be true if its total population was only half a million, since at that time Rome's population exceeded 1 million by far (Walek-Czernecki, 1938, p. 12). Further assuming that this size remained more or less the same in Josephus's time,

one reaches an estimate of about 9 million for the total population of Egypt in the first century A.D..[12]

## The Arab invasion

At the time of the Arab invasion in A.D. 640, the population of Egypt was still a controversial subject in the demographic literature. The controversy is over who was taxable and how much tax was collected.

One of the main sources in the presentation below is Al-Maqrizi, a fifteenth-century chronicler whose classical work, entitled *Al-Khitat Al-Maqriziah*, was recently republished. His year of death is given as A.D. 1441. Toussoun's study also quotes several other Arab writers whose relevant statements are made use of. Arab writers seem to argue that Amr, the Arab invader, concluded peace with Moukaukis, the chief of the native Copts, on condition that each adult male Copt, except for the elderly, pay two dinars annually as a capitation tax (*giziah* in Arabic). One source adds that "after reckoning, the number was found to be eight million".[13] The figure of 8 million taxable adults certainly raises questions, since, if true, it would mean that the total population was roughly 32 million. Is there any basis for this figure of 8 million? Was it just a general impression? Was it derived from the then existing taxation records?

A special head-tax imposed upon non-Muslim adult men would be a potentially effective way of estimating the population once the rate and the revenue of the tax were known. The rate is unambiguously two dinars per person. The total revenue is unfortunately hard to determine conclusively. During the first year of the occupation, Amr, the head of the invading forces, managed to collect only 1 million dinars, compared to 20 million collected immediately before the occupation.[14] Amr's account for the drop in revenue was that a postponement was requested by the people of the *glebe* pending the ripening of their crops (Al-Maqrizi, p. 79). It is significant to note here that in reply to a query from the Khalif in this regard, Amr stated that "If during the reign of the Pharaohs the country's revenue was larger and the land more prosperous, this was because the Pharaohs, despite their atheism and tyranny, were more keen on developing their land" (Al-Maqrizi, p. 78). In the second year of the Arab rule, the total tax collected, according to seven out of nine classical Arab references quoted by Toussoun (pp. 22-23), was 12 million dinars.

The crucial issue, if these figures are to be used at all for estimating the total population, is the nature of the taxes and who paid them. The amount of 12 million dinars collected in the second year of Arab rule can perhaps be accepted since it has been quoted in so many references, although some of the writers quote their predecessors on various issues. Toussoun takes it for granted (pp. 22 and 78) that the amount was the *giziah*, collected from 6 million adult males, a conclusion that would imply the existence at that time of a total population in the vicinity of 24 million. An even much higher total would result if the figure of 8 million taxable adults, mentioned above in connection with the peace treaty, is accepted as

nearly correct. However, as can be seen from Toussoun's quotations as well as from Al-Maqrizi's text, the 12 million dinars are the total revenue from all sources. In fact, the literature makes the following points very clear:

(*a*) There were at that time two capitation taxes: the *giziah,* or the tax paid by non-Muslim male adults (excluding the elderly) in accordance with the peace treaty ratified with Moukaukis; and the poll-tax, imposed on the inhabitants of a locality as a group, with a varying rate in accordance with the condition of the Nile flood;

(*b*) There was also a land tax;

(*c*) Not all the revenue was transferred to the Khalif; some of it was retained for local administrative and other expenditure.

Al-Maqrizi not only refers to the 12 million dinars as total revenue but also uses the same word in the same sentence (p. 79) in reference to the revenue collected by Moukaukis—namely, 20 million dinars, which obviously had no *giziah* component. Even Ibn Abdel Hakam, Toussoun's main reference on this issue, refers to the 20 million dinars, to use Toussoun's French translation, as the amount "drawn from the country" (p. 12), and the same reference is made by another one of Toussoun's sources (p. 12). These details are highlighted to establish that the total population in the second year of the occupation cannot be estimated by simply dividing the 12 million dinar tax revenue by the per capita two dinars of *giziah,* as Toussoun did in his elaborate and painstaking study.

But the estimate that cannot be substantiated is the one given by Russell (1966, p. 72). Realizing that dividing the 12 million dinars by the two dinars would lead to a "fantastic" total population size of about 30 million, according to his arithmetic, he argued, giving in a footnote an article published in 1887, that "taxes seem to have been collected and reported in dirhams". Since the dinar was worth about 12 dirhams, this proposition would obviously reduce the amount to one twelfth the total and give a non-Muslim population of about 2.6 million–3 million persons before A.D. 650. One can see no justification for this assumption since all the classical Arab references referred to above give the taxes in dinars, with absolutely no ambiguity about the unit, either in the early years of the occupation or later on.

In the midst of this confusion, an approach to estimating the total population may be provided by the total amount of tax revenue collected in A.D. 657 by a new Arab ruler of Egypt, amounting to 14 million dinars, according to several (but not all) sources given by Toussoun (p. 24) (and also by Al-Maqrizi (p. 79), who was not quoted by Toussoun regarding this point). One of these sources[15] states that the increase in revenue was brought about by increasing the *giziah* by one dinar, to three per head.[16] Assuming that other taxes did not change considerably, this account would mean that the 2 million revenue increase (from 12 million to 14 million) was brought about by raising the total *giziah* by approximately one half, that the number of adult non-Muslim men was about 2 million and that the total population was roughly 8 million. This estimate fails to make any

adjustment for the number of those who had converted to Islam (and who, therefore, did not have to pay the *giziah*) or for the number of Arab migrants during the intervening period of about 14 years. No reliable information on these two variables is available.

## The Early Middle Ages

Five cadastral surveys are known to have been carried out by the Arab rulers over a period of 600 years, starting early in the eighth century. The first survey, conducted in A.D. 715, is of interest from the standpoint of demographic history because it was also reported as a population census. Ibn Abdel Hakam describes the operation as follows: "When Ibn Rifaa became ruler of Egypt, he proceeded to count its inhabitants and to consider modifying the taxes. For this purpose he sojourned six months in Upper Egypt, reaching Aswan, accompanied by a group of clerks and collaborators serving with zeal and energy. They spent three more months in Lower Egypt and surveyed more than 10,000 villages in each of which there were no less than 500 taxable males."[17] No records of this survey, demographic or cadastral, have survived. It goes without saying, however, that the reliability of any demographic conclusion drawn from it would be very questionable.

Several medieval chroniclers have quoted the amounts of land tax collected, together with either the total cultivated areas or the tax rate per unit, at several points in time, particularly when cadastres were carried out. The figures and their sources are given and discussed in detail by Toussoun (pp. 99-151). The cultivated area as given or derived can, at least theoretically, be used to estimate the total population by making assumptions about the population which the land could support. This exercise was carried out by Russell (1966, table 1, p. 74) using mainly the cultivated areas as quoted by Toussoun and making two sweeping assumptions: that the tax rate was two dinars per *feddan*, and that an average *feddan* would support one rural person plus 0.1 urban person. The exercise—namely, dividing the land tax by 2 and multiplying by 1.1—resulted in the following estimates of total population:

| *Year* | *Population* |
|---|---|
| 729 | 2.2 million |
| 800-850 | 2.4 million |
| 867 | 2.6 million |
| 874 | 2.4 million |
| 970-971 | 1.8 million |
| 1075-1100 | 1.7 million |
| 1189 | 2.4 million |

This is a hazardous exercise for several reasons. First, as shown below, several of the figures given by the chroniclers are doubtful and some can even be deemed to be wrong. Frequently the chroniclers give figures pertaining to centuries earlier than their own time, relying on statements by their predecessors. Secondly, the tax rate was not constant, but

varied with the general conditions, particularly the height of the Nile flood. It was fixed at two dinars per *feddan* when the Nile reached a specified height (Al-Maqrizi, p. 99). The tax collected also depended upon the strength of the regime. Thirdly, the assumption that the urban population was one tenth of the rural population does not seem to have much factual basis.

For instance, regarding the second survey of A.D. 729, chronicler El-Kindi states that the area cultivated or covered by the Nile water was 30 million *feddans* and that 4 million dinars were collected.[18] Al-Maqrizi, on the other hand, states (p. 75) that the total area, both cultivated and submerged, was found to be 100 million *feddans*. He then adds (p. 99) that "the total area cultivated and submerged was 30 million *feddans* other than the highland and the infertile. He [the person in charge] surveyed and organized it all and was able to collect 4 million dinars." These statements when put together may well mean that, according to this chronicler, the 100 million *feddans* comprised the total area surveyed, and the 30 million were cultivable. Commenting on these figures, Toussoun (p. 125) wonders what area the *feddan* could have been at that time.[19] He adds that if one deletes a zero from the 30 million, one would end up with an estimated cultivated area of 3 million, or 4.2 million in contemporary *feddans*, which would be logical and consistent with other estimates.

On the other hand, the cultivated land area and the tax rate utilized by Russell in deriving the estimate for the first half of the ninth century seem to be plausible. Al-Maqrizi states (p. 99) that during the reign of Khalif Al-Mamun (A.D. 813-833) the total tax reached 4.257 million dinars at the rate of two dinars per *feddan* when the Nile reached a specified height. Accordingly, the degree of validity of Russell's estimate of 2.4 million for the total population during that period depends on how valid his assumption is concerning how many persons were supported by a unit of land.

The results of the third cadastre (A.D. 867), as given by Al-Maqrizi (pp. 99-100), create the same confusion as those of the second. Again, the cultivated area is given the very high figure of 24 million *feddans*, and the tax collected was said to be as low as 800,000 dinars, owing to the ruined condition of the land. As before, Toussoun (p. 126) states how reasonable and consistent the area figure would be if a zero were deleted. Russell obliges and uses 2.4 million *feddans*, but for the land tax he uses 4.8 million dinars (i.e., 2.4 million *feddans* multiplied by 2), followed by a question mark, instead of the 800,000 dinars given by Toussoun (and Al-Maqrizi)! In the estimate of A.D. 874, three chroniclers cite a tax income of 4.3 million dinars, but say nothing about the rate, except to state that the times were prosperous. It is noteworthy that the tax revenue increased from 800,000 to 4.3 million dinars in seven years, reflecting the extent of dependence on the flood.

The estimate of 970-971 A.D. (the time when Cairo was established at its present site) was no more satisfactory. Toussoun cites a chronicler, whom he describes as serious and a contemporary of the period he was writing about, who calculated a tax income of 3.2 million dinars in the

year 970, at the rate seven dinars per *feddan*, while a few years earlier the rate was 3.5 dinars. Another chronicler is then cited, who calculated the same income (3.2 million) for 971 (Toussoun, pp. 128-129). Russell, in accordance with his adopted model, takes the 3.2 million dinars as the land tax and divides by 2 (his assumed tax rate), completely ignoring the rate of seven dinars per *feddan*, and still refers to Toussoun (pp. 128-129).

Perhaps the first table giving the numbers of localities and villages for each province in Lower and Upper Egypt, together with the tax imposed, was cited by a chronicler for the reign of El-Mosstansir Billah, who died in 1094; it is reproduced by Toussoun (pp. 130-131). The total number of villages and localities given was 2,062: 1,598 in Lower Egypt, and 464 in Upper Egypt. The total tax imposed for the whole country was 3.061 million dinars for the rural areas and 0.060 for the towns.[20] No tax rate was given, but Russell applied his standard procedure, which he applied again in the case of the estimate for the year 1189, during the reign of Saladin.

The last two cadastres of the era—those of 1298 and 1315—are clearly related. In fact they have the same land total—3,637,000 *feddans*—but differ in the rates imposed. Russell (1966, p. 76) proceeds from this basic information as follows: If one may still assume about 1 person to a *feddan* and then add 10 per cent, the total for Egypt before the plague was about 4 million people. "This might be raised a little, perhaps to 4.2 million, if one assumes that the prosperity brought more persons to the cities and raised their percentage. In any case, it is clear that Egyptian population had increased rapidly since the eleventh century and thus had risen much as had the population of Europe in the period."

With regard to the population estimates for the early Middle Ages, then, of the several estimates discussed here, some cannot be taken seriously, because the cultivated land area utilized in the estimation was not known with any reasonable degree of reliability. This leaves two estimates based on credible figures for this era—namely, those of 813-833 (first half of the ninth century) and of 1298-1315 (early fourteenth century). In both, the validity of the population estimate derived on the basis of the supporting capacity of land is still totally dependent on the estimated capacity. The corresponding estimates derived by Russell—namely, 2.4 million and 4.2 million, respectively, were arrived at by assuming that the medieval *feddan* supported 1.10 persons in the first case and 1.16 in the second. To what extent such averages are approximately true is a matter of conjecture.

At the same time, it is unquestionable that the total population of early medieval Egypt was less than it had been. Plague epidemics and famines are known to have broken out and rulers varied in the strength of their regimes. Economic and living conditions were generally very poor.[21]

## Concluding Remarks

What can one conclude from the above paragraphs, apart from the fact that historical population estimates for Egypt were very conjectural? From the midst of the confusion, whether caused by sources of informa-

tion, terminology, or interpretation of data, one can perhaps draw certain tentative conclusions.

(*a*) In ancient times, prior to the birth of Christ, Egypt's population perhaps exceeded 10 million and reached higher values in times of prosperity;

(*b*) Apart from variations connected with the condition of the Nile, the strength of the Government and the extent of calamities, the secular trend was slowly downwards from a little before the time of Christ to the seventh century A.D., when the population reached about 8 million;

(*c*) The pace of decline accelerated thereafter, with the population size reaching perhaps 2.5 million two centuries later;

(*d*) There was a subsequent recovery which raised the size to over 4 million before the plague epidemic of the fourteenth century;

(*e*) After that, the country went through five centuries of poverty, disease and chaotic rule, with the general level of the total population remaining at or near the 2.5 million level until early in the nineteenth century, after the consecutive rules of the Mamluks and the Ottomans were finally brought to an end.

(*f*) Subsequently, over a period as short as the last three quarters of the nineteenth century, the population regained the level which it had maintained prior to the Roman invasion.

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NOTES

[1] In the summer the Nile used to get substantial amounts of flood water from the mountains of Ethiopia. The height of the flood water varied from year to year. Flooding was a crucial factor in the economic life of the Egyptians. In the 1960s the annual floods were brought under control with the construction of the High Dam at Aswan in the south of the country.

[2] Some historians find in this passage a reference to the first census report on record. It is interesting to note that in the inscription the senior scribe includes the prayer that he might live for 110 years, which is about the ceiling for length of life as we know it today.

[3] M. DeChabrol, quoted in *Description de l'Egypte*, 2nd ed., vol. XVIII (Paris, C. L. F. Panckoucke, 1826), p. 316.

[4] It is doubtful that the Nile would inundate the whole area every year, but perhaps Jomard's estimate for the cultivated area was an average and perhaps he assumed that there was an efficient storage system which could save the excess crop from good years for consumption in low-flood years.

[5] Actually this figure is double Jomard's own estimate of the rural population in 1800. The 50 per cent he refers to must therefore be the ratio of the contemporary density to the ancient density (unless the ancient agricultural area is four thirds of the contemporary area—an assumption not mentioned by Jomard in his memorandum).

[6] A unit of measurement for the volume of cereals and other agricultural products, still in use at present.

[7] The latter figure was given by Herodotus, who visited Egypt in the middle of the fifth century B.C.

[8] Or 5.6 million *feddans*, using his definition of the *aroure*.

[9] Diodorus of Sicily is quoted in Greek by Walek-Czernecki (1938, p. 9) and in French by Toussoun (1924, p. 77). The text reads as follows:

"Egypt has since old times been distinguished among all known countries for being so densely populated, and in this regard it is second to none until now. In ancient times it had remarkable villages, and more than 18 thousand towns, as the Egyptian (sacred) records show. Under the reign of Ptolemy of Lagos, more than 30 thousand were counted, and this large number remains the same. The total population in the old days was seven million and is now no less than three million."

[10] K. J. Beloch, *Die Bevölkerung der griechnisch-römischen Welt* (Leipzig, 1886), pp. 501-507. In this early publication he estimated the cultivated area at 28 thousand square kilometres (6.7 million *feddans*) and the total population in A.D. 14 (the year of Augustus's death) at 5 million. The latter figure and the source are quoted in several works, including J. C. Russell, *Late Medieval Population*, vol. 48, part 3 (Philadelphia, Transactions of the American Philosophical Society, 1958), table 1, p. 7.

[11] The Greek text is given in Walek-Czernecki (1938), p. 12.

[12] In response to a letter initiated by Toussoun, Beloch stated that he would accept, on the basis of new papyrus discoveries, a total population figure not much below 10 million persons for that period (Toussoun, 1924, p. 85).

[13] Ibn Abdel Hakam, *Foutouh Masr* (Yale Oriental Series), p. 70, quoted in Toussoun (1924, p. 106). The same quotation was given in Al-Maqrizi (p. 79).

[14] Toussoun (1924, pp. 12 and 14) gives four classical sources here. Al-Maqrizi (p. 79) adds, again after quoting a source, that Amr collected 600,000 dinars from Alexandria as *giziah*: he found there 300,000 non-Muslims (males?) whom he taxed two dinars each.

[15] Ibn Iyas, *Badai El-Zouhour*, vol. 1, p. 26, quoted in Toussoun (1924, p. 24).

[16] Al-Maqrizi, giving his source, states (p. 79) that when the Khalif told Amr (the first ruler) of the increase in revenue, the latter commented that the population was hurt in the process. This account seems to suggest that the increase was attained by an unusual measure not practised before.

[17] Cited in Al-Maqrizi, p. 74.

[18] El-Kindi, *Fadail Misr*, p. 201, quoted in Toussoun (1924, p. 125).

[19] The current area of a *feddan*—namely, 4,200 $m^2$—was adopted only in 1838. Earlier, and apparently for a long time, the *feddan* was 5,939 $m^2$ (Toussoun, 1924, pp. 115-116).

[20] Cairo, Alexandria, Damietta, Tennis, Kift, Nakadeh and El-Hibsh.

[21] For instance, E. Ashor in his "Essai sur l'alimentation des diverses classes sociales dans l'orient médiéval", *Annales*, vol. 23, No. 5 (September/October 1968), pp. 1,017-1,053, demonstrated that in the eleventh century a humble working Egyptian could buy food to the value of only 1,100 calories per day. Quoted in T. H. Hallingsworth, *Historical Demography* (London, Sources of History, 1969), pp. 309-310.

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# INTERNATIONAL COOPERATION IN THE AREA OF POPULATION

*C. Stephen Baldwin**

SUMMARY

In order to assess the experience of the developing countries with international cooperation in population activities, the Sixth United Nations Population Inquiry among Governments, a survey carried out by the United Nations in 1988 on national population policies, contained a series of questions on the matter. Responses received from 79 developing countries are analysed and compared to a similar, but more limited, survey carried out in 1983. It was found that a large majority of the countries in all developing regions report that technical cooperation makes a substantial and useful contribution to progress in the field of population and that the needs for international cooperation will continue for at least another decade. Countries identify computer equipment and training as priority needs. There is some decline in reported needs for consultants and resident experts. The most commonly noted difficulties were undependable or reduced levels of funding and slowness of implementation.

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Since international technical cooperation is a major factor in the implementation of population policies for most developing countries, a series of questions on the topic were included in the Sixth United Nations Population Inquiry among Governments, a survey carried out by the United Nations in 1988. It was addressed to 170 Member and Observer States of the United Nations and covered all aspects of population policy. The questions on international technical cooperation concerned its relative contribution to the attainment of population policy goals, the anticipation of future needs and priorities, and each Government's policies and programmes.

The Inquiry was carried out by means of a detailed questionnaire, transmitted to the respective Governments through the Office of the

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Secretary-General of the United Nations in July 1987. The questionnaire was available in each of the official United Nations languages—Arabic, Chinese, English, French, Russian and Spanish. Responses were received from 108 countries, 79 developing and 29 developed. The complete list of responding countries is shown in annex I. The specific questions on experience with international technical cooperation are presented in annex II. More detailed information on the Inquiry can be found in *Results of the Sixth Population Inquiry among Governments* (United Nations, 1990).

A similar but somewhat more limited set of questions on international cooperation was asked in the *Report on the Fifth Population Inquiry among Governments* (United Nations, 1984a), which was undertaken in 1983.

There are some *caveats* applicable to the survey data. Although a refining of the questionnaire used in 1983 improved the reliability of the responses received in 1987, it must nevertheless be recalled that the 108 responses represent only 64 per cent of the 170 Member States (only 60 per cent of the 132 developing countries). And the question of response reliability remains, for describing national population policies, programmes and priorities is not at all a simple task. Much depends on who actually fills out the questionnaires and on that authority's degree of complete and pertinent knowledge. There is an unavoidable amount of uncertainty regarding the comparability of the responses across national and regional divisions. Nevertheless, the Sixth Inquiry affords a unique and valuable body of data.

## Analysis

Notwithstanding the slightly changed format for the Sixth Inquiry module on technical cooperation, it is instructive to compare Governments' views on certain matters over time, to see whether, *grosso modo*, significant overall or regional changes in perceptions occurred in the five years after the Fifth Inquiry was conducted. The analysis that follows will consider developing countries only.

Seventy-nine developing countries responded; they represent a total mid-1988 population of 3.5 billion, or 69 per cent of the world's estimated total of 5.1 billion. The affirmative response rate of the Economic Commission for Europe (ECE) was the highest (all of the region's developing countries), followed closely by the Economic Commission for Africa (ECA) (26 out of 29 countries) the Economic Commission for Latin America and the Caribbean (ECLAC) (19 of 24 countries), the Economic and Social Commission for Asia and the Pacific (ESCAP) (13 of 17 countries) and the Economic and Social Commission for Western Asia (ESCWA) (three of six countries). This pattern of response corresponded closely with that of the Fifth Inquiry.

### *Sources of past technical cooperation support*

Governments were asked whether they had received any support in the form of international cooperation to help in attaining their population

goals. Out of the 79 developing countries responding, all but 15 responded in the affirmative, and only nine in the negative. Comparable figures in 1984 were 10 and six, respectively, of the 87 developing countries that responded.

Countries were also asked to provide information about the sources of international cooperation. They were not asked to distinguish between original and secondary sources. There was a fairly even pattern of distribution in each region, suggesting multiple sources of support, with the ECA region having the highest concentration in the "4-6 or more" sources category (15 of 29 countries), followed in a near tie for second place by ECLAC and ESCAP (10 of 24, and 7 of 17, respectively, of all countries responding). Overall, 12 developing countries reported only one source of support, while 34 reported four or more.

With regard to the 199 sources that were specified, 135, or 68 per cent, were from within the United Nations system:

(*a*) United Nations Population Fund (UNFPA), 50;

(*b*) United Nations Children's Fund (UNICEF), 13;

(*c*) United Nations Development Programme (UNDP), 13;

(*d*) World Health Organization (WHO), 11;

(*e*) World Bank, 11;

(*f*) Others, 37 (International Labour Organisation (ILO), Food and Agriculture Organization of the United Nations (FAO), United Nations Educational, Scientific and Cultural Organization (UNESCO), and the Department of Technical Cooperation for Development of the United Nations Secretariat).

Thirty-seven sources, or 19 per cent, were of bilateral origin (United States Agency for International Development, Canadian International Development Agency, Danish International Development Agency, Swedish International Development Authority etc.), while 21 sources, or 11 per cent, "miscellaneous", included non-governmental organizations (International Development Research Centre, International Planned Parenthood Federation, the Futures Group, Research Triangle Institute, Pathfinder, Westinghouse, Association for Voluntary Sterilization etc). The European

TABLE 1. NUMBER OF SOURCES OF INTERNATIONAL SUPPORT REPORTED BY COUNTRIES

| *Regional commission* | *Number of sources* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | *0* | *1* | *2* | *3* | *4* | *5* | *6 or more* | *No response* | *Total* |
| ECA | 3 | 3 | 4 | 2 | 4 | 4 | 7 | 2 | 29 |
| ECLAC | 4 | 3 | 3 | 2 | 4 | 2 | 4 | 2 | 24 |
| ESCAP | 2 | 4 | 0 | 2 | 1 | 1 | 5 | 2 | 17 |
| ESCWA | 2 | 2 | 1 | 0 | 0 | 1 | 0 | 0 | 6 |
| ECE | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 3 |
| TOTAL | 11 | 12 | 10 | 6 | 9 | 8 | 17 | 6 | 79 |

*Source*: Results of the Sixth Population Inquiry among Governments (ST/ESA/SER.R/104).

Economic Commission (EEC), Organization of American States (OAS) and Organisation for Economic Co-operation and Development (OECD) were cited as sources six times (3 per cent).

*Relative contribution of technical cooperation*

Governments were asked whether technical cooperation including financial assistance had made a "very substantial", "substantial" or "minor" contribution, or "no" contribution at all to their population goal (annex II, question 903). For the ECLAC region, nine of the 20 countries responded that the contribution had been "very substantial". Eight countries in the ECA region and three countries in the ESCAP region reported "very substantial" contributions. While the ECA region registered high percentages in the combined "very substantial" and "substantial" responses, (23 of the 29 total responses received), the ESCAP and ECLAC regions registered comparatively low combined responses (11 and 16 of the responding countries, respectively), perhaps indicating the inevitable consequence of both regions' longer-established national commitment to activities in this area. Overall, the developing countries responding thus registered 70 per cent in the combined positive category and only 15 per cent in the negative category (i.e., "minor" and "no"). The remaining percentage represented non-responses.

*Difficulties encountered with past technical cooperation*

Governments were asked to indicate whether they had encountered substantial difficulties with the technical cooperation process in the past (annex II, question 904). A larger positive response was recorded by countries of the ECA and ECLAC regions (55 and 54 per cent, respectively, of those responding), while the ESCAP region was about evenly divided between negative, affirmative and non-responses, including "not applicable".

To investigate the nature and seriousness of the difficulties encountered, a series of follow-up questions was asked. A major source of problems, particularly in the ECA region, was "undependable funding/reduced level of funding". More than a quarter of all countries (22), and 31 per cent of those responding to the question, considered this a major difficulty, while 12—more than half of the countries in the ECA region that responded—found it so. Indeed, of all the developing countries only four did not consider funding to be a "minor" or a "major" difficulty.

Second in overall significance was "slowness in implementation", which 16 countries, or 23 per cent, considered a major difficulty, and twice that number (40 per cent) considered either a major or minor problem. Once again, it was the ECA region that was most sensitive to this difficulty, eight countries considering it to be major. Five countries of the ECLAC region and only two countries of the ESCAP region reported it to be a major difficulty.

No other problem area was considered as important, although 10 countries (eight in ECA, two in ECLAC) responded that "inappropriate coordination between donor agencies" was a major area of concern, and 24 considered it either minor or major. In addition, nine countries, about evenly divided between the ECA and ECLAC regions, considered "differences between donor and Government priorities" a major source of difficulty (and an almost equal number considered it no difficulty at all), while 31 countries in all regions considered it either minor or major. At a somewhat lower level of concern, five countries overall, four of them in ECA, felt strongly that the orientation of technical cooperation activities had been "too narrow", although 24 felt this posed some degree of difficulty for them. Finally, only a single country, in the ECLAC region, considered the inappropriateness of the "executing agency" to be a major difficulty. Regarding other difficulties encountered, five countries volunteered the following information: one in the ESCAP region stated that coordination activities needed to be improved among the various agencies. One ECA country made reference to inappropriate/inadequate monitoring and evaluation of funded activities, while another cited insufficient technical cooperation resources available to meet existing needs. In the ECLAC region, the slowness of the approval process and a lack of United Nations methodological manuals, were cited.

*Need for technical cooperation in the field of population*

In response to the question "Does the Government anticipate the need for international cooperation in the form of technical or financial assistance in the field of population during the next decade?" (annex II, question 913), the response from the developing countries in 1988 was overwhelmingly positive. All but four responded in the affirmative, while an even larger proportion than previously did so from ECA (28 of 29, as opposed to 25 of 30 in 1984). All 15 of the countries responding from the ESCAP region felt such a need (16 of 18 in 1984), as did 19 of 21 ECLAC countries responding (all, in 1984), and four out of five ESCWA countries (four out of four in 1984). Of three developing countries in the ECE region, all of which responded, there was a consensus that further assistance would be required.

Of perhaps the greatest interest, in response to the question on broad areas of possible population action (annex II, question 914), there was an evident shift in priorities over the intervening five-year period. For all areas except two, to be discussed below, a nearly uniform number of countries (40-44) responding gave a "high priority" ranking to the following seven areas, and with a corresponding combined "medium" and "high" range of 58-67:

(*a*) Basic data collection and processing;

(*b*) Population dynamics, including analysis and demographic research;

(*c*) Formulation, implementation and evaluation of population policies/programmes;

(*d*) Family planning programmes;

(*e*) Population communication and education;

(*f*) Special programmes, status of women, children and youth, aged;

(*g*) Population training.

In the case of the first three areas, highest priority was reported by countries of the ECA and ECLAC regions (20 and 14, 19 and 15, and 19 and 12, respectively). However, in the case of the fourth area—"family planning programmes"—a most interesting development is noted, in addition to (and, of course, accounting for) its overall rise in priority since 1984. In 1988, 21 ECA countries responding gave a "high" rating in this area, followed by nine of 16 countries responding in the ESCAP region, and eight of 19 countries responding in the ECLAC region. Three of six ESCWA countries gave a "high" rating to this area. This is in marked contrast to the 1984 findings, where slightly under a third (30 countries out of 91) considered that family planning programmes would be a high priority over the next decade (United Nations, 1984). For the ESCWA (formerly ECWA), ECA, and ECLAC (formerly ECLA) regions, the area of family planning programmes was ranked lowest in priority; in ESCWA, no "high" response was received, while only five of 15 were received from ECLAC, and 12 of 30 from ECA.

For the population communication and education area, the ECA and ECLAC regions are again mostly responsible for the overall high priority assigned. Presumably the low and medium concentrations registered in the ESCAP region reflect its longer and thus generally more established experience with these areas of technical cooperation activity.

Regarding special programmes, ECLAC and ECA again tended most to assign them high priority, while ESCAP registered significantly less interest. Again we must assume that the reason is the comparatively longer and more intensive work in these areas.

The area of population distribution/redistribution programmes is less frequently assigned high priority than any of the other areas. What is particularly striking is that the pattern of responses varies quite markedly between the economic regions. The area is assigned high priority by 15 of the 20 responding countries of the ECLAC region, thus being one of the issues that was most frequently reported to be of high priority for that region. On the other hand, for responding countries of the ECA and the ESCAP regions, the area was least likely to be assigned high priority. It may well be that this pattern of response simply reflects the very much higher overall level of urbanization that has been reached in the ECLAC region.

The area of population training was considered in the Fifth Inquiry under "population dynamics", which was deemed a sector of highest priority. Government responses to the Sixth Inquiry are only slightly less positive. Forty developing countries out of 79 responding gave the sector high priority, and 67 considered it either medium or high. Only two countries, one in the ESCAP region and the other in the ESCWA region, considered it of low priority.

As a reliability check on the above findings, the 20 developing countries (eight from the ECA region, nine from the ECLAC region, and three from the ESCAP region) which had claimed that past technical cooperation had made a very substantial contribution to the achievement of their population goals, were considered as a group apart. Their responses to the "broad area" question were compared to their responses to the component question.

As a broad area, only basic data collection and processing and, to a slightly lesser extent, population training, stood out, especially in this supplementary analysis, receiving respectively, 12 of 14 and nine of 18 high priority rankings from the relevant developing countries attaching any priority at all to these areas. Interestingly, the only other area that received responses that were at all comparable in the extent of concern shown (seven "high" out of 18 responses) was population distribution/redistribution, presumably because a large number (nearly half) of countries in the subsample are in the ECLAC region. For the rest, only population policy formulation as an area received as many as two high responses, while the other areas generally rank-ordered in the subsample as they had overall. This finding would appear to bear out the proposition that the highest degree of priority remained as it was in 1983—namely, "basic data collection, demographic analysis and associated training..." (United Nations, 1987).

With respect to the specific components of technical cooperation (annex II, question 923) the category "computer equipment, including microcomputers and demographic software" received the largest proportion of high priority ratings (52, or two thirds of the responding countries). All but one country gave it either medium or high priority, and ECA was the region where the largest proportion of countries attached high priority to receiving this assistance in this area. Two areas of less formal training of shorter duration—"in-service training" and "workshops/seminars"—were next in high priority ranking, with only three countries (two from ECE, neither developing; and one from ECLAC) assigning no priority to the former, and only one, in the ESCAP region, to the latter. Countries of the ECLAC region registered significantly greater interest in both areas; all but two assigned either medium or high priority to in-service training, and 14 of 20 responding assigned it high priority, while some four fifths gave workshops and seminars the highest ranking, and all but six countries gave them either medium or high priority. Overall, 48 countries gave a high rating to in-service training, 44 to workshops and seminars, and 20 to study tours.

The lowest overall priority was accorded resident experts—a most interesting finding, compared with data from the Fifth Inquiry which showed that "the leading components of technical cooperation required (were)... advisory services, including consultants...". Twenty-five of 69 countries that responded on this activity to the Sixth Inquiry assigned low priority to resident experts, while 17 of 62 did so for consultants. One can only speculate as to the reasons underlying what appears to be a significant change here in Governments' perceptions. The simplest explanation may

be that, to the extent that more developing countries are becoming self-reliant in trained human resources, the long- or shorter-term services of outside experts will become or will appear to be generally less important. The relative needs for resident experts (highest overall for ECA, followed by ESCAP and ECLAC, in that order) and consultants (ECLAC, followed by ECA and ESCAP) would seem to bear out the theory on developing a human resource base, alluded to above. Formal long-term training was assigned high priority by only 29 developing countries but was viewed as being of either high and medium priority by 64 countries. Thus, the overall training categories continued to enjoy the same high ranking accorded by Governments five years earlier. At that time, training was second only to advisory services.

The major exception to the general priority assigned training as a technical cooperation component was the area of study tours, for which nearly a quarter of all responses were in the low category, especially by countries in the ESCAP and ECLAC regions, while 10 of the ECA region's 26 responses gave it a high priority.

Other relatively high priorities for technical cooperation, especially in the ECLAC region, were "publications and related dissemination activities". A very great majority of all responding countries indicated that this was of either high or medium priority for them. Library supplies and equipment were of nearly equal importance in the two combined response categories and of even greater importance overall in the ECA region, while the remaining "payments" and "equipment" categories (except for computers, discussed above and vehicles), were remarkably homogeneous in terms of overall priorities assigned. Either high and medium priorities were assigned by 52 countries to "payments for printing costs", by 54 countries to "payments for operation/maintenance of equipment", by 55 countries to "payments for local personnel", and by 64 countries to "vehicles". Countries of the ECA region were significantly more interested in the vehicles category than countries in the other major developing regions. There was similarly greater interest among the ECA countries in payments for equipment operation/maintenance, local personnel and printing costs. There were 10 "other" responses in which countries indicated priority components not covered by the categories specified above. Five ESCAP countries cited contraceptives and medicines for the improvement of maternal and child health; contraceptives and sterilization subsidies; the creation of infrastructure in terms of building; population education for youth; and research and evaluation activities in population and family planning. A single ECLAC country mentioned as important the financing of basic field investigations, while in the ECA region one country added a priority dimension of training (local-level training [formal]). Another concluded that "... all of the components of technical cooperation prove to be of high priority", and a third wished for audio-visual equipment and also supplies to make oral contraceptives locally. Finally, one of three developing countries in the ECE region listed nation-wide quenquennial surveys as an area of priority.

As in the case of the priority area analysis, a subset of the 20 developing countries that had indicated that technical cooperation had contributed very substantially to the achievement of their population goals was examined to determine whether any significant variation from the overall components analysis existed. The examination did not reveal significant shifts in priority.

### *Statements of Governments*

Finally, as in the Fifth Inquiry, Governments were given the opportunity to respond to an open-ended question on any other matter they wished to raise, with special reference to "the goals and recommendations in reference to international cooperation adopted by the International Conference on Population in Mexico City, 1984" (see annex II, question 939). A total of 58 out of 108 countries responded to this question.

In quite marked contrast to the 1982 responses, there were only eight responses containing any negative comments regarding past experience with technical cooperation. Of those, five were from the ECA region, two from ESCWA, and one from ECE. (In the Fifth Inquiry, 10 countries provided critical responses in 15 substantive areas (see United Nations, 1987, p. 74)).

One response to the Sixth Inquiry criticized the unwillingness of international technical cooperation programmes to include provision for equipment maintenance in its funding, favouring rather a very limited range of activities such as education, training or research. Another raised the issue of whether short-term experts could/should be used in place of a long-term resident adviser for a particular project. Still another cited too hasty "unilateral" support-cutting decisions by "the developed countries and international communities", while one country stated that technical cooperation "interventions" of an overly specific nature, not fully integrated into the ongoing programmes of the recipient country, tended to reduce their effectiveness. One African country listed five problem areas, including divergent donor/Government priorities; divergent national/international ideas on the part of professionals; local administrative "instability", slowness and occasional lack of coordination; and international provisions of equipment that was not always suited to existing local needs. Another mentioned that its population programme was not considered a priority by international funding agencies. Finally, two countries referred to resource constraints, one stating that they had inhibited the participation of local experts in technical cooperation activities, the other citing greater development need than available resources would satisfy and occasional slowness in the disbursal of aid and/or in following up at all after "initial commitments have been made".

On the positive side, the great majority of responses consisted of an iteration of past (favourable) experiences with technical cooperation in specific population sectors such as data analysis, training, population and development etc., including the past and planned future funding patterns of

developed countries. At least three countries, one each from the ECA, ECLAC and ESCAP regions, registered specific support for activities in technical cooperation among developing countries, while several African and Latin American countries expressed great interest in the burgeoning population and development sector.

## Conclusions

As in the case of the Fifth Inquiry, where a module on technical cooperation activities in population was first introduced, a large majority of developing countries in all major regions of the world indicated that they had received international support in the achievement of their population goals. With regard to sources of that support, nearly half of the 73 countries responding indicated that the sources ranged from four to six in number, with two thirds of the total specified being from within the United Nations system.

In the ECA region especially, four fifths of the countries assigned either a "substantial" or "very substantial" role to technical cooperation's contribution to population progress. ECLAC and ESCAP reported only slightly less positive combined responses to both categories. At the same time, over half of the countries in both regions had experienced difficulties with technical cooperation, while the ESCAP countries responding were divided about half and half on the "difficulty/no difficulty" question. Major problems included undependable or reduced levels of funding, especially in the ECA region; slowness in implementation, again felt most by ECA countries responding; and, to a lesser extent, poor donor agency coordination, donor/Government differences in priorities and, for five countries overall, too narrow a technical cooperation focus. There was also a light scattering of "other difficulties" registered by five countries in response to the open-ended portion of that question.

Again, as in the case of comparable Fifth Inquiry responses, an overwhelming majority—69 of 73 developing countries that responded—indicated that they would have a continuing need, over at least another decade, for international technical cooperation. In contrast with the Fifth Inquiry, the areas of family planning programmes now joined those of basic data collection/processing, population dynamics, population policies and programmes, population communication and education, special programmes, and population training as areas of high future priority for a preponderance of developing countries, with mostly minor regional variations. Only population distribution/redistribution programmes, again as in 1983, were of a significantly lower priority, except in the ECLAC and, to a lesser extent, ECA regions.

As for preferred components of future technical cooperation, computer equipment and training programmes of shorter duration were highest in individual ranking, while in marked contrast with comparable Fifth Inquiry responses, both resident experts and consultants were considered of relatively low priority. Overall, the combined "training" categories, ranking first, received an even higher priority ranking than in the Fifth

Inquiry, where they were considered second in priority to advisory services (i.e., resident and consultant experts). With some regional variation, with ECA generally being higher, particularly regarding operation/maintenance costs for equipment, and the "older" region, ESCAP, usually being lower, the priority accorded most of the possibilities offered in the "payments" and "equipment support" categories was fairly homogeneous across the major developing country regions responding.

In response to a final open-ended question on any other matter Governments might wish to raise concerning technical cooperation in population, the great majority of responses mentioned favourable or value-free past experience. One seventh of all the responses to this question, eight in number, were negative; they were of a scattered nature and included no major substantive critical theme.

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## ANNEX I

### Countries that responded to the Sixth Population Inquiry, by regional commission

*Developing countries*

*Economic Commission for Africa*

Algeria
Angola
Botswana
Burkina Faso
Burundi
Cameroon
Cape Verde
Comoros
Egypt
Ethiopia
Gambia
Guinea-Bissau
Kenya
Liberia
Madagascar
Malawi
Mauritania
Mauritius
Morocco
Senegal
South Africa
Swaziland
Tunisia
Uganda
United Republic of Tanzania
Zambia
Zimbabwe

*Economic Commission for Latin America and the Caribbean*

Antigua and Barbuda
Argentina
Barbados
Bolivia
Brazil
Chile
Colombia
Costa Rica
Cuba
Dominican Republic
Ecuador
El Salvador
Guatemala
Guyana
Haiti
Honduras
Jamaica
Mexico
Nicaragua
Panama
Peru
Saint Lucia
Saint Vincent and the Grenadines
Venezuela

*Economic and Social Commission for Asia and the Pacific*

Bangladesh
China
Fiji
India
Indonesia
Iran (Islamic Rep. of)
Malaysia
Mongolia
Nepal
Pakistan
Philippines
Republic of Korea
Singapore
Sri Lanka
Thailand
Vanuatu
Viet Nam

*Economic and Social Commission for Western Asia*

Bahrain
Democratic Yemen[a]
Iraq
Jordan
Kuwait
United Arab Emirates

*Economic Commission for Europe*

Cyprus
Israel
Turkey

*Developed countries*

*Economic Commission for Europe*

Albania
Austria
Belgium
Bulgaria
Byelorussian Soviet Socialist Republic
Canada
Czechoslovakia
Finland
France
German Democratic Republic[b]
Germany, Federal Republic of[b]
Hungary
Italy
Luxembourg
Malta
Netherlands
Norway
Poland
Portugal
Spain
Sweden
Switzerland
Ukranian Soviet Socialist Republic
Union of Soviet Socialist Republics
United Kingdom of Great Britain and Northern Ireland
United States of America
Yugoslavia

*Economic and Social Commission for Asia and the Pacific*

Australia
Japan

[a] On 22 May 1990, Democratic Yemen and Yemen merged to form a single State. Since that date they have been represented as one Member of the United Nations with the name "Yemen". They responded to the Sixth Inquiry before they were united.

[b] Through accession of the German Democratic Republic to the Federal Republic of Germany with effect from 3 October 1990, the two German States have united to form one sovereign State. As from the date of unification, the Federal Republic of Germany acts in the United Nations under the designation "Germany". Their response to the Sixth Inquiry was prior to unification.

## ANNEX II

### Section 9. International cooperation in the area of population*

901. Has the Government received any support in the form of international cooperation for the achievement of its population goals?
1. ☐ No (Go to 913)
2. ☐ Yes

902. Please specify the sources of such support:

_____

903. In the view of the Government what has been the relative contribution of technical cooperation (including financial assistance) in achieving progress towards its goals and policies in the population area?
1. ☐ Very substantial contribution
2. ☐ Substantial contribution
3. ☐ Minor contribution
4. ☐ No contribution

904. Has the Government encountered substantial difficulties with the technical cooperation process in the past?
1. ☐ No (Go to 913)
2. ☐ Yes

905. Please specify the nature and extent of the difficulties encountered:

| | *No difficulty* | *Minor difficulty* | *Major difficulty* |
|---|---|---|---|
| 906. Undependable funding/reduced levels of funding | 1 | 2 | 3 |
| 907. Differences between donor and government priorities | 1 | 2 | 3 |
| 908. Orientation of technical cooperation too narrow | 1 | 2 | 3 |
| 909. Slowness in implementation | 1 | 2 | 3 |
| 910. Inappropriate executing agency | 1 | 2 | 3 |
| 911. Inappropriate coordination between donor agencies | 1 | 2 | 3 |
| 912. Other difficulties (please specify below) | 1 | 2 | 3 |

_____

913. Does the Government anticipate the need for international cooperation in the form of technical or financial assistance in the field of population during the next decade?
1. ☐ No (Go to 939)
2. ☐ Yes

914. Please indicate the priority the Government assigns to current and future international technical cooperation in the following broad areas of possible population programme action:

| | *Priority level* | | | |
|---|---|---|---|---|
| *Broad areas* | *None* | *Low* | *Medium* | *High* |
| 915. Basic data collection and processing | 1 | 2 | 3 | 4 |
| 916. Population dynamics, including analysis and demographic research | 1 | 2 | 3 | 4 |

*Excerpted from the Sixth United Nations Population Inquiry among Governments.

| | *Broad areas (continued)* | *Priority level* | | | |
|---|---|---|---|---|---|
| | | *None* | *Low* | *Medium* | *High* |
| 917. | Formulation, implementation and evaluation of population policies and programmes | 1 | 2 | 3 | 4 |
| 918. | Family planning programmes | 1 | 2 | 3 | 4 |
| 919. | Population communication and education | 1 | 2 | 3 | 4 |
| 920. | Special programmes, including status of women, children and youth, the aged | 1 | 2 | 3 | 4 |
| 921. | Population distribution/redistribution programmes | 1 | 2 | 3 | 4 |
| 922. | Population training | 1 | 2 | 3 | 4 |

923. Please indicate the level of priority the Government assigns to each of the following specific components of technical cooperation, now and in the medium-term future:

| | *Areas* | *Level of priority* | | | |
|---|---|---|---|---|---|
| | | *None* | *Low* | *Medium* | *High* |
| 924. | Long-term training (formal) | 1 | 2 | 3 | 4 |
| 925. | In-service training | 1 | 2 | 3 | 4 |
| 926. | Workshops/seminars | 1 | 2 | 3 | 4 |
| 927. | Publications and related dissemination activities | 1 | 2 | 3 | 4 |
| 928. | Study tours | 1 | 2 | 3 | 4 |
| 929. | Resident experts | 1 | 2 | 3 | 4 |
| 930. | Consultants | 1 | 2 | 3 | 4 |
| 931. | Library supplies and equipment | 1 | 2 | 3 | 4 |
| 932. | Computer equipment, including microcomputers and demographic software | 1 | 2 | 3 | 4 |
| 933. | Vehicles | 1 | 2 | 3 | 4 |
| 934. | Payments for local personnel | 1 | 2 | 3 | 4 |
| 935. | Payments for operation/maintenance of equipment | 1 | 2 | 3 | 4 |
| 936. | Payments for printing costs | 1 | 2 | 3 | 4 |
| 937. | Others (please specify in 938 below) | 1 | 2 | 3 | 4 |

938. _____

939. The Government is invited to provide a statement concerning any aspect of its policies, programmes or priorities, as well as its experience (including achievements and difficulties, if any, in the field of international technical cooperation) in reference to international cooperation in the field of population. In this connection the Government may wish to consider the goals and recommendations in reference to international cooperation adopted by the 1984 International Conference on Population at Mexico City.

## ERRATA*

Shiro Horiuchi, "Measurement and analysis of cohort-size variations", *Population Bulletin of the United Nations*, No. 30 (1991), pp. 106-124.

*Page 107, paragraph 4, line 13*
For developed *read* developing

*Page 116, paragraph 3, line 4*
For United Nations, 1988 and 1989 *read* United Nations, 1988 and United Nations Secretariat, 1987

*Page 118, paragraph 1, line 9*
For $f_{bf}$ *read* $r_{bf}$

*Page 119, table 3*

| | |
|---|---|
| World total, row 4, column 4 | for $-0.38$ *read* 0.38 |
| Developed countries, row 1, column 4 | for 0.47 *read* $-0.47$ |
| Developed countries, row 1, column 5 | for 0.63 *read* $-0.63$ |

*Page 120, paragraph 1, line 7*
For United Nations, 1988 *read* United Nations Secretariat, 1987

*Page 123, line 6*
For World Health Organization *read* United Nations Secretariat

*Requested by the author.

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