

VI. ESTIMATES BASED ON CENSUSES, VITAL REGISTERS AND RECORDS OF MIGRATION

1. Advantages of the use of vital statistics and migration statistics

In countries where censuses are taken periodically and where there are accurate records of births, deaths and migration, the best method of making current population estimates is obviously to add the recorded natural increase and migratory changes to the population at the last census date. If the census figures and statistics of births, deaths and migration were perfectly accurate and consistent, this method would result not merely in estimates, but in precise figures of population size.

In practice, of course, the statistics are never perfect. In many countries where censuses have attained a fairly high degree of accuracy, vital statistics are markedly defective, although there are also a few countries where vital statistics are more accurate than census enumerations. Vital statistics in some countries are so imperfect that for purposes of current estimates, extrapolation is preferable. There are few countries in which international migration is recorded fully and with sufficient accuracy for all practical purposes. The more or less serious defects of migration statistics in most countries preclude the drawing of a precise migratory balance for any given time interval. The effect of these defects on current estimates of population depends both on the importance of the gaps in the statistics and on the actual volume of migration.

In some countries where the volume of international migration is small and where vital statistics are imperfect, errors in these statistics are usually greater than the net migratory movement to and from the country. In that case, even the omission of the migration factor from the computation of current population estimates can only result in errors which are small compared to errors arising from other sources. If, in addition, the statistically recorded movements account for only a small part of all migration to or from a country, it may be considered unnecessary or even unwise to take migration into account when making current population estimates. If the migration statistics are biased — that is, if the movements in one direction (e.g., immigration) are overstated in relation to the movements in the other direction — the estimates may be more accurate if these data are ignored in making the computations. However, the complete omission of migration statistics is ordinarily not advisable since the use of these statistics will usually tend to lessen the total error in the estimate, even though only by a rather small amount.

In countries with highly accurate vital statistics, on the other hand, accurate accounting of migratory movements, even if these are rather small, is important. In many countries, where other statistics are highly accurate, errors in current estimates are ascribed chiefly, if not entirely, to defective migration statistics, and further improvement of the estimates depends chiefly on any improvement in these statistics.

2. Components of error in estimates based on censuses and vital statistics with or without migration statistics

Current estimates derived from an inaccurate census with the use of fairly accurate vital and migration statistics may be considerably in error from the date of the census onward, but the error does not increase with the passing of time. On the other hand, current estimates based on an accurate census and inaccurate vital statistics may be of high quality immediately after the census, but will deteriorate as time passes. It is true that errors can compensate one another (e.g., the census may have been an under-enumeration while vital statistics exaggerate the natural increase because of under-registration of deaths, or under-registration of births may be partly compensated by a failure to record all immigrants, etc.), but there is no assurance that they will balance. Consequently, estimates based on components that are subject to error are unreliable even though some of the errors may occasionally happen to compensate.

Since the natural increase of a population is merely the numerical difference between births and deaths, errors in the computed natural increase arise only from differences in the completeness of registration of births and deaths. If birth registration is more nearly complete than death registration, the error in the computed natural increase is positive; if death registration is the more nearly complete, the error is negative.¹ While it is widely believed that death registration is usually more nearly complete than birth registration, there is evidence that in a number of countries the

¹ This statement requires some modification. In a country with a high birth rate and a low death rate, the natural increase of the population may be understated even though the registration of deaths is less complete than that of births, because a smaller proportion of unregistered births may involve larger numbers than a larger proportion of unregistered deaths. Suppose that, during some interval, 1 million births and 400,000 deaths have occurred, resulting in a natural increase of 600,000, but that birth registration is 90 per cent complete and death registration is 80 per cent complete. Then, despite greater completeness of birth registration, only 900,000 births and 320,000 deaths have been registered, resulting in an "apparent natural increase" of 580,000, which is less than the true natural increase.

opposite is true. It is unfortunate that estimates of the completeness of birth and death registration have been made only in a few countries.

Statistics of births and deaths are tabulated in some countries according to the time of their registration, in others according to the time of their occurrence. In the long run, the statistics tabulated in these two ways must give approximately the same totals, but over short periods the results may differ considerably if the delay between the occurrence of the events and the registration is variable. In that case, tabulations according to time of registration may involve considerable errors in the calculation of natural increase during various short periods of time. In some countries, delayed registration may result in some re-registration and double counting of births and deaths.

Where migration statistics are used in making current population estimates, errors may result from a more nearly complete recording of arrivals than of departures, or vice versa. For example, if the migration statistics are derived from passport records, they may include a larger proportion of all arrivals than of all departures, since passports are in many cases not required upon departure.

Migration statistics, however, present many other problems.² In many countries such statistics are kept only to serve specific requirements in the enforcement of certain kinds of legislation. In such cases, the statistics comprise only certain types of migrants, such as those entering or leaving at specific ports or other points on the boundary, or using specific modes of transportation. They may or may not include persons intending to change their residence for a short or long duration, and may make various provisions for temporary travellers, visitors, tourists, students, etc. Special migration statistics may exist for particular categories, such as persons entering or leaving on labour contracts, or persons of military ages. The definitions used for compiling the migration statistics may not be at all suitable to indicate the changes in population that result from movements across a country's boundaries. A particularly serious problem arises where statistics of immigration are not at all comparable with statistics of emigration.

3. Methods of improving estimates using vital statistics and migration statistics

The main ways of improving current population estimates of the type discussed in this chapter are to take censuses more frequently; to improve the accuracy of census statistics, vital statistics and migration statistics; to devise more adequate means of estimating the magnitudes of the errors in these statistics, and of "correcting" them; and to obtain better information on the "corrections" required for consistency in the various series. Sampling methods have many applications in these fields. The means of identifying errors and inconsisten-

cies and of estimating the "corrections" are to be discussed in a later publication.

One important consideration in the use of vital statistics and migration statistics is their consistency with the census statistics. If statistics of births and deaths do not refer to the same territory or the same categories of the population as does the census enumeration, errors in the current population estimates may result.

To be strictly consistent with a *de facto* census definition, vital statistics should refer to the place of occurrence of each vital event, as they usually do. If the census definition is a *de jure* one, vital statistics should be employed, if available, which refer, in the case of deaths, to the place of residence of decedants, and in the case of births, to the residence of the mother or father. However, differences between the two kinds of vital statistics are usually negligible since rather few births and deaths occur in any one country to the residents of another country. Further difficulties arise from the special treatment of the military population in a census, not only in times of war, but also of peace. Deaths of military personnel and such births as occur to them may or may not find their way into civil registers.

If perfectly consistent vital statistics cannot be obtained, the data can be rendered approximately consistent with census definitions by means of estimates of the differences arising from the inconsistencies. In countries where there is a "vital statistics registration area" which does not cover the entire country, estimates have to be made for births and deaths occurring outside the registration area. Estimates are also needed where births and deaths of certain minorities, such as those of the aborigines of Australia or tribal Indians of some Latin-American countries, are not registered.

Consistency is usually a major problem in the case of migration statistics. To be fully consistent with *de facto* census figures, migration statistics should record every arrival and departure, whether permanent or only for a short duration. Migration statistics that are mainly confined to movements of persons who intend to change their residence for a considerable length of time are more nearly consistent with a *de jure* census definition. Migration statistics of the latter type, however, are often particularly unsatisfactory since it cannot always be determined whether a particular person crossing a country's boundary will turn out to be a real migrant or merely a temporary traveller. Over a long series of years, the day-to-day arrivals and departures of temporary travellers tend to balance, if the records are accurate, and the residual number represents, in fair approximation, the number of persons who have actually changed their residence. However, if there are any omissions in the records, this method may give a seriously biased measure of migration even over long periods, especially where temporary travellers are far more numerous than true migrants. In that case, in order to avoid large possible errors, it is preferable to use statistics of "migrants" proper, even if it is intended to estimate the *de facto* population.

² A detailed discussion of the inadequacies of migration statistics in many countries may be found in United Nations, *Problems of Migration Statistics*. Lake Success, November 1949.

If vital statistics or migration data are not yet available for the latest year, a provisional estimate of the increase of population during that year may be made by a short-period extrapolation, as explained in section 11 of chapter V. Similarly, if data on births, deaths and migratory movements are incomplete or not available for particular years owing to some temporary defect in the system of compiling these data, suitable figures for the missing years may be found by interpolation. For example, the missing number of births in a particular year may perhaps be assumed to equal the arithmetic average between reported births in the preceding and in the following year.

Auxiliary data may also be used to improve the estimates. In countries with a planned economy, various registration systems are in effect for specific purposes. These include registration for identity cards, labour permits, factory enrolment, residential registers, registers of school children, registers for family and old-age benefits, and various other types of registers. A co-ordination of the various separate compilations by provincial or central authorities may result in current population estimates which, though perhaps inferior to the estimates from census and vital statistics, may nevertheless serve to verify their accuracy. Particularly where a long time has elapsed since the taking of the last census, such registration data (which have already been referred to as results of "non-censal counts") may become important alternative means of estimating population.

The centralization of various registration procedures, including the registration of births, deaths and migration, can eventually result in the establishment of a continuous population register. In countries where registration is of relatively recent origin, it will usually be found difficult to establish an effective continuous population register within a short time.

4. Comparison of recorded natural increase with increase shown by successive censuses

In order to illustrate the errors which can result from the use of censuses and vital statistics over a

series of years for current population estimates, the population of several countries has been estimated for the date of the latest census for which final results are available by adding to the results of the previous census the numbers of births and subtracting the numbers of deaths reported for the intervening period. Care was taken to use data of births and deaths for the precise period, from the exact date of the penultimate census to the exact date of the last census. The resulting estimates were then compared with the final results of the latter census.

For example, in Cyprus 347,959 persons were enumerated at the census of 28 April 1931 and 450,114 at the census of 10 November 1946; the population increase recorded by these two censuses amounted to 102,155. During the same time interval, 173,478 births and 76,961 deaths were registered, so that the apparent natural increase was 96,517 — that is less by 5,638 or 5.5 per cent, than the recorded increase between the two censuses. If the population at the date of the latter census were to be estimated from the former census with addition of births and subtraction of deaths in the intervening period, the estimate would amount to 444,476, or 1.3 per cent less than the census result. This error may be attributed to one or several of the following causes: an under-registration of births, and excessive registration of deaths, under-enumeration in 1931, over-enumeration in 1946, or net emigration. Similar computations have been made for the countries shown in table II.

The computed excesses or deficiencies shown in this table may be ascribed to varying completeness of census enumeration, relative inaccuracies in statistics of births and deaths, or failure to take migration into account. In countries of immigration, such as the United States during 1940-50, part or all of the deficiencies would disappear if migration statistics for the interval are added to the balance. In certain countries, the discrepancies must be attributed to the errors in some or all of the statistics used in the computations.

A discussion of the use of such comparisons as are illustrated in table II, in ascertaining the adequacy of available statistics, is reserved for a future publication.

Table II

COMPARISON OF RECORDED NATURAL INCREASES DURING INTER-CENSAL PERIODS WITH INCREASES SHOWN BY THE CENSUSES, FOR TEN COUNTRIES^a

		<i>Apparent increases</i>			<i>Excess (+) or deficiency (-) of apparent increase according to birth and death</i>	
<i>Country</i>	<i>Census interval</i>	<i>According to censuses</i>	<i>According to recorded births and deaths</i>	<i>Numbers</i>	<i>In per cent of last census total</i>	<i>In per cent of apparent increase according to censuses</i>
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Tunisia	1936-46	622,639	377,072	- 245,567	-7.6	-39.4
Canada ^b	1931-41	1,129,869	1,245,431	+ 115,562	+ 1.0	+ 10.2
Cuba	1931-43	816,239	429,292	- 386,947	-8.1	-46.2
Dominican Republic	1935-50	641,666	706,442	+ 64,776	+ 3.1	+ 9.2
United States	1940-50	19,028,086	16,316,734	-2,711,352	-1.8	+ 14.2
Venezuela	1941-50	1,134,945	953,078	- 181,867	-3.6	-16.0
Cyprus	1931-46	102,155	96,517	- 5,638	-1.3	- 5.5
Norway	1930-46	342,756	304,449	- 38,307	-1.2	-11.2
Australia	1933-47	949,519	886,970	- 62,549	-0.8	- 6.6
Fiji	1936-46	61,259	55,005	- 6,254	-2.4	-10.2

^a Data from *Demographic Yearbook*, 1951.

^b Excluding Newfoundland.