COMPONENTS OF CITY GROWTH IN SELECTED LATIN AMERICAN COUNTRIES

EDUARDO E. ARRIAGA

Urbanization in Latin American countries during the past 20 years has been increasing faster than in other regions of the world. The degree of urbanization reached by countries such as Argentina, Brazil, Chile, Mexico, Uruguay and Venezuela is comparable to that of countries of the western European type.[1] Studies already made of urbanization in this region found that the rapid urbanization was due principally to internal migration.[2]

This article will make a detailed analysis of city growth by city size categories for those Latin American countries where availability of data allows. After a review of the information, three countries were selected: Chile, Mexico and Venezuela. Fortunately, these three countries are among the six most urbanized of the region and, in addition, they have experienced a high rate of urbanization during the last intercensal period.[2] Therefore the analysis of city growth (the principal factor contributing to urbanization[3]) will show why cities are growing so rapidly and, consequently, why urbanization is so rapid.

CITY GROWTH

The study of city growth in Chile, Mexico and Venezuela will cover the last intercensal period. Cities will be classified in six size categories[4] according to their size in the 1960 census. All cities with

TABLE I. INTERCENSAL ANNUAL NATURAL GROWTH RATES BY CITY-SIZE CATEGORIES

City-Size Category (thousands)	*Chile 1952–60**	*Mexico 1950–60**	*Venezuela 1950–61**
Total	25.3	30.3	34.8
Under 10		32.5	36.5
10 to less than 20	23.9**	25.5	36.9
20 " " " 50	26.1	28.3	37.0
50 " " " 100	24.9	27.8	33.5
100 " " " 500	27.2	28.4	37.9
500 and over	26.7	27.8	28.2

* Per thousand.
** Under 20,000.

10,000 or more inhabitants in the 1960 census will be studied through the intercensal period. The purposes of the analysis will be to determine whether internal migration has been the principal factor of city growth. First an estimate of the intercensal natural growth rate for each of the six city-size categories will be made. Then, expected population at the end of the period can be calculated by assuming that the populations in each city-size category—enumerated at the beginning of the period—grew at the estimated natural growth rate during the intercensal period. The differences between the expected and actual population enumerated at the end of the period will show whether migrants and their children born in the cities have contributed to the growth of the cities in each category. Thus, birth and death rates have to be estimated first to obtain an estimate of the natural growth rates.

Intercensal Natural Growth Rates by City-Size Category

Since none of the three countries gives the required information about mortality and fertility by city size, it was necessary to obtain death and birth rates by indirect methods (see Appendix). The intercensal natural growth rate, as shown in Table 1, was found by taking differences between the crude death and birth rates. Next, the expected population for each city-size category was calculated by using the population enumerated at the beginning of the intercensal period and the corresponding growth rate. The difference

between the calculated population and census enumerated population at the end of the period in each city-size category gave the estimated number of migrants and their natural increase in the cities.[5] These data are shown in Table 2.

The next step was to separate migrants and their city-born children in each city-size category. For this purpose, a migrant factor was developed (see Appendix) in which the estimates of the number

TABLE 2. ESTIMATION OF NET INTERNAL MIGRATION AND NATURAL GROWTH OF MIGRANTS AT THEIR DESTINATION**

City-Size Category (*thousands*)	*Population at Beginning of Intercensal Period* (*1*)	*Net Foreign Born Migration During Period* (*2*)	*Expected Population at End of Period* (*3*)	*Enumerated Population at End of Period* (*4*)	*Difference* (*4*)—(*3*) (*5*)
		CHILE			
Total	5933.0	*	7374.1	7374.1	
Under 20	3087.8	*	3796.4	3425.4	−371.0
20 to less than 50	499.4	*	626.1	687.8	61.7
50 " " " 100	386.2	*	479.1	597.3	118.2
100 " " " 500	535.9	*	6678.4	678.8	.4
500 and over	1423.6	*	1794.1	1984.8	190.6
20 and over	2845.2	*	3577.7	3948.7	371.0
		MEXICO			
Total	25791.0	*	34923.1	34923.1	
Under 10	17483.6	*	24032.8	21605.8	−2427.0
10 to less than 20	952.0	*	1220.2	1388.8	168.6
20 " " " 50	1008.5	*	1329.4	1538.8	209.4
50 " " " 100	852.9	*	1119.1	1426.4	307.3
100 " " " 500	1752.8	*	2312.6	2654.8	342.2
500 and over	3741.2	*	4909.0	6308.5	1399.5
10 and over	8307.4	*	10890.1	13317.3	2427.0
20 and over	7355.4	*	9669.9	11928.5	2258.4
		VENEZUELA			
Total	5034.9	350.8	7524.0	7524.0	
Under 20	2836.5	16.0	4108.2	3462.7	−645.5
10 to less than 20	215.0	5.8	317.3	426.5	109.2
20 " " " 50	337.3	18.9	507.9	654.7	146.7
50 " " " 100	288.1	40.2	443.2	545.0	101.8
100 " " " 500	567.5	79.2	909.4	934.0	24.6
500 and over	790.5	190.7	1238.0	1501.1	263.1
10 and over	2198.4	334.8	3415.9	4061.3	645.5
20 and over	1983.4	329.0	3098.6	3634.8	536.3

* Insignificant quantities.
** In thousands.

TABLE 3. NUMBER OF MIGRANTS IN EACH CITY-SIZE CATEGORY**

City-Size Category (thousands)	*Chile*	*Mexico*	*Venezuela*
Under 10		−2062.0	−534.6
10 to less than 20	−329.2*	143.3	90.5
20 " " " 50	54.8	177.9	121.5
50 " " " 100	104.9	261.1	84.3
100 " " " 500	.4	290.6	20.4
500 and over	169.1	1189.1	217.9
Total	329.2	2062.0	534.6
10 and over		2026.0	534.6
20 and over	329.2	1918.7	444.1

* Under 20,000.
** In thousands.

of migrants are found by multiplying the factor by the number of migrants and their descendants born in the cities.[6] The factor is:

$$\mu = \frac{P_n - P_o}{n(e^r - 1)P_n}$$

where P_o and P_n are the total population at the beginning and at the end of the intercensal period, respectively,
n is the length of the intercensal period,
r is the natural annual growth rate,
e is the base of the Naperian logarithms.

The migrant factor (μ) for each country is: .8877 for Chile, .8497 for Mexico and .8283 for Venezuela. The total migrants and their natural growth were multiplied by μ, giving the total number of migrants (see Table 3). Thus, the growth of each city-size category (Table 2, column 5 minus column 2) can be separated into the proportions due to migrants, to city population growth and to foreign-born residents in Venezuela (see Table 4).

DISCUSSION

Cities are growing very rapidly in Latin American countries and, *pari passu,* problems with transportation, sewage disposal, air pollution, water supply, cemeteries and electric power.[7] If these problems are not dealt with the city population will suffer the consequences.

In Latin American countries, mainly in those less urbanized (such as those of Central America), urbanization is occurring without any industrialization. In these areas, the supply of services required in cities will cost relatively more than if the country were industrializing at the same time.[8] On the other hand, when some of the more urbanized countries industrialize, they encounter sooner those problems related to urbanization, such as air pollution and sewage, because factories and industries locate very close to the largest cities without taking any precautions against smoke, gases or waste.

Why are cities growing so fast in Latin American countries? Principally because the population is reproducing at a high rate. Natural growth rates in certain cities, as in the case of Chile and Venezuela, are higher than in rural areas. The explanation is found in the crude birth and death rates. Crude birth rates by city-size category are not as different as age-specific fertility rates, because the female population in cities has a broader fertile age group than in rural areas. (The same happens if the number of *mothers* per inhabitant is considered.) In general, the birth rate by city-size category declines when the city-size increases, except for the intermediate category of 100 to 500 thousand, in which case, the birth rate increases in the three countries considered.[9] Estimated crude

TABLE 4. COMPONENTS OF THE CITY-GROWTH DURING THE INTERCENSAL PERIOD (PERCENT)

City-Size Categories (thousands)	*Percentage of Total Growth Due to:*		*Percentage of Total Growth Due to:*		*Percentage of Total Growth Due to:*		
	Migrants	*Natural Growth*	*Migrants*	*Natural Growth*	*Foreign Born*	*Migrants*	*Natural Growth*
Under 10	−49.1*		−33.3**			46.7†	
10 to less than 20	†	†	32.8	67.2	2.7	42.8	54.5
20 " " " 50	29.1	71.9	33.5	66.5	1.0	38.3	55.7
50 " " " 100	49.7	50.3	45.5	54.5	15.6	32.8	51.6
100 " " " 500	.3	99.7	32.2	67.8	21.6	5.6	72.8
500 and over	30.1	69.9	46.3	53.7	26.8	30.7	42.5
10 and over			41.2	58.8	18.0	28.7	53.3
20 and over	29.8	70.2	42.0	58.0	19.9	26.9	53.2

* Emigrants per hundred natural population growth in the category under 20 thousand.
** Emigrants per hundred natural population growth.
† Not available.

death rates in these countries are higher in rural than urban areas[10] because the knowledge of medical science is applied more in cities than in rural areas, and in the larger cities more often than in the smaller ones.[11] Mortality counteracts part of the effect of the differential in birth rates, and, therefore, the growth rates are not very different between rural areas and cities. The greatest difference is noted when the biggest city (generally the capital) is considered. In any case, the population growth rates in all areas are too high.

Migration from rural areas to cities, the second important factor in urbanization in the three countries considered, has been observed as following almost the same pattern. The highest net number of migrants go to the largest cities (Table 3). In Chile and Venezuela, the lowest number of net migrants is received by the middle city-size category; for Mexico, the number of net migrants increases with the city-size. If the net number of migrants is considered as a contribution to the city growth, the highest contribution is received by the biggest cities, but the smallest by the middle-sized cities (100 to 500 thousand) in the three countries (see Table 4). Unfortunately, the data presented in this paper pertain to net migration. Migration seems to take place in a series of steps according to city-size. A flow of migrants from rural areas goes to small or middle sized cities, and from these cities to the larger urban areas.[12]

Perhaps the most important fact shown here is that the growth of cities is due principally to natural growth. Births minus deaths in the cities is a higher figure than that of migrants entering the cities. This happens in any city-size category of the three countries. Of the total growth of cities 20,000 and over, 58.0 per cent in Mexico, 66.4 per cent in Venezuela (without considering international migration) and 70.2 per cent in Chile, is due to natural growth of the cities. Therefore, contrary to common opinion, migration has not been the principal cause of city growth. As Kingsley Davis pointed out, migration was the fundamental cause of urbanization at the beginning of the industrial revolution in the countries already developed, but for the countries developing at the present time, urbanization is mainly due to the natural growth of the population.[13]

CONCLUSIONS

Urbanization in Latin American countries is occurring faster than that observed in industrialized countries, past and present. The reason for that phenomenon does not seem to be that internal migration in Latin American countries is now greater than that observed at any time in the industrialized countries—it may even be smaller. The reason is that the natural growth rate in Latin American countries is at present higher than that in those industrialized countries.[14] Thus, if natural growth rates continue at the present high level, urbanization in Latin America will continue at a high rate of speed.

The situation of these Latin American countries is not very desirable: they have a rapid urbanization because of their high natural growth rate, but that is not all. They still have a high potential migration from rural areas to the cities, which is supported by the fact that the rural population continues to grow. At present only a part of the natural growth of rural population is moving to the cities (one-half in the three countries considered). What would occur if all the rural natural growth were to migrate? In countries where a high agricultural density with a low productivity per capita is already observed, it is not difficult to predict that very soon almost all natural growth from agricultural areas will migrate to the cities. A decline in rural population may occur. Therefore, urbanization for most of the Latin American countries could be faster in the future than it has been in the past. Are preparations being made in time to fill the needs that urbanization will present? If the trends remain in the future as in the past, it is not too difficult to imagine the urban problems these countries will encounter. Finally, as Davis has said, "The problem is not urbanization, not rural-urban migration, but human multiplication."[27] By facing the problem of population policy as soon as possible a solution can be found. In this paper possible solutions are not discussed; however, if one of them is population control, it will be necessary to consider whether the problem lies with the use of contraceptives and abortion, or with the number of children desired in these Latin American countries.

APPENDIX

Intercensal Natural Growth Rates

The natural growth rates were obtained by taking the difference between crude birth and death rates, which were estimated by an indirect method due to a lack of vital statistics by city-size category.

Crude birth rates: Birth rate for the entire country is available in Chile, Mexico and Venezuela; therefore, if relative differences of birth rates by city-size category in comparison to that of the whole country can be established in some way, then the birth rates for each city-size category also can be calculated. The estimation of these differences is based on census information about the number of children born to mothers aged 20 to 34.[15] That information is available (for the three countries) by state urban-rural areas. Thus, to obtain data that would represent each city-size category,[4] each state urban area was classified in one city-size category according to the mean resident city size of its urban population[16] (see Table 5).

The total number of children ever born to mothers aged 20 to 34 was found for every city-size category by adding the information from the states indicated in Table 5. They were then divided by the total population of the same areas.[17] The same ratio was calculated for the entire country. After this, the ratios of children to total population for each city-size category were divided by the ratio for the country. Assuming that these relative differences will remain the same between the birth rates of each city-size category and the birth rate for the whole country, the birth rates for each city-size category were found by multiplying the relative differences by the available country's birth rate (see Table 6).

Crude death rates: Mortality statistics are less detailed than those of fertility, but can still be used to estimate differential death rates by city-size category.

No doubt, mortality is higher in rural than in urban areas of developing countries at the present time. Also, some investigations have shown that mortality in the principal city is considerably lower than in the remaining parts of the country.[10]

The availability of information on deaths is not the same in the

TABLE 5. CLASSIFICATION OF STATE URBAN POPULATIONS

City-Size Category	*Chile*	*Mexico*	*Venezuela*
Under 10,000		Rural areas of all states	Rural areas of the country
10,000 to less than 20,000	Rural areas of all states* and state urban areas of: Atacama, Aconcagua, Maule, Arauco, Malleco, Chiloe, and Aisen	State urban areas of: Guerrero, Morelos, Oaxaca, Quintana Roo, Tlaxcala, and Zacatecas	State urban areas of: Cojedas and Yaracuy
20,000 to less than 50,000	State urban areas of: Tarapaca, Antofagasta Coquimbo, O'Higgins, Colchagua, Curico, Linares Nuble, Bio-Bio, Cautin, Valdivia, Llanquihue, and Magallanes	State urban areas of: Baja California T. Sur, Compeche, Colima, Chiapas, Hidalgo, Mexico, Michoacan, Nayarit, Queretaro, Sonora, Tabasco, and Veracruz	State urban areas of: Sucre, Anzoategui, and Bolivar
50,000 to less than 100,000	State urban areas of: Talca and Osorno	State urban areas of: Coahuila, San Luis Potosi, Simaloa, Tamaulipas, and Yucatan	State urban areas of: Tachira
100,000 to less than 500,000	State urban areas of: Valparaiso and Concepcion	State urban areas of: Aguascalientes, Baja California, Chihuahua, Durango, Guanajuato, and Puebla	State urban areas of: Lara, Zulia, and Carabobo
500,000 and over	State urban areas of: Santiago	State urban areas of: Distrito Federal, Jalisco, and Nueva Leon	State urban areas of: Distrito Federal and Miranda

* Under 20,000.

TABLE 6. BIRTH, DEATH AND NATURAL GROWTH RATES BY CITY-SIZE CATEGORY

City-Size Category (thousands)	Birth Rates			Death Rates			Natural Growth Rates		
	Chile (1)	Mexico (2)	Venezuela (3)	Chile (4)	Mexico (5)	Venezuela (6)	Chile (7) (1)-(4)	Mexico (8) (2)-(5)	Venezuela (9) (3)-(6)
Total	37.3	45.4	44.3	12.7	12.1	8.5	24.6	33.3	35.8
Under 10		48.9	49.2		13.2	11.6		35.7	37.6
10 to less than 20	37.1*	40.4	49.0	13.9*	12.4	11.0	23.2*	28.0	38.0
20 " " " 50	38.1	42.4	48.0	12.8	11.3	10.7	25.3	31.1	37.3
50 " " " 100	36.8	41.9	44.2	12.6	11.6	9.7	24.2	30.3	34.5
100 " " " 500	38.6	43.2	47.2	12.1	12.0	8.2	26.5	31.2	39.0
500 and over	36.8	40.7	35.4	10.8	10.1	6.4	26.0	30.6	29.0

* Under 20,000.

three countries. Mexico gives such information by state urban-rural areas. Chile and Venezuela give the information only by state. Thus the estimations for Chile and Venezuela were calculated in a different way from Mexico.

Because Mexican mortality registers are not complete in all states, it is assumed that the crude rural death rate for the entire country is the same as that observed in the rural areas of 16 states with the best registration: 13.3 per thousand.[18] Death rates for each city-size category were found by using the information of state urban areas and following the same procedure as in the case of the birth rates (see Table 6).

In the case of Chile, where death registers were accepted as complete, some particular states were taken as representative of urban and rural areas. For instance, the death rate of Santiago State[19]—10.8 per thousand—was accepted as pertaining to the city-size category 500,000 and over. Similarly, the death rate of the more rural states[20]—13.3 per thousand—was taken as an indication of how high rural deaths can be.[21] Then, the death rates for each of the city-size categories were estimated by considering the total death rate for the country, Santigo state's rate, the rate for the seven more rural states and other rates belonging to the state-groups shown in Table 6.

Venezuela's information was similar to that of Chile and, therefore, the same procedure was used with it. However, a difference exists between the two countries: death registers for Venezuela, as a whole, suggest an underenumeration of 13.2 per cent.[22] The death rate for the city-size category 500,000 and over was calculated by considering death information for the Distrito Federal and the state of Miranda.[23] Deaths from the Distrito Federal were accepted as complete, but those from Miranda were increased by ten per cent. The calculated death rate was 6.41 per thousand population. The death rate for the whole country (including the estimated omission) was 8.46 per thousand. An indication of the rural death rate was obtained by taking the information of Cogedes and Yaracuy states and increasing it by 14 per cent because of underenumeration.[24] Then death rates for every city-size category were estimated on the basis of the previous death rates (Table 6).

Natural growth rates: The natural growth rates were found by subtracting the crude death rates from the crude birth rates. These natural growth rates are for the year during which information was registered. They were then adjusted to make them representative of the average rate for the intercensal period. It was assumed that the calculated growth rates for each city-size category would vary in the same proportion as the calculated natural growth rate for the whole country differs from the intercensal annual geometric growth rate.[25] The final results of these growth rates are given in Table 1.

Migrant Factor

In this appendix, to deduct a factor to estimate the number of migrants from the total number of migrants and their descendents (born in the migratory place), it is necessary to make two assumptions: one concerns the natural growth rate of migrants and the other concerns the annual number of migrants arriving at the place of immigration.

The natural growth rate of migrants is assumed to be the same as that for the whole country. That is acceptable if it is taken into

account that migrants may come from any place, and that the pattern of fertility that they have is not going to change immediately when they settle in a new place,[26] if it is changed at all.

Suppose that in every one of the n periods a certain number of migrants (M_i) arrive in a specific place at the beginning of the period and that they reproduce to the period growth rate r. For the first period of time, the number of migrants and their descendents born in the place of migration (GM) will be $GM_1 = M_1e^r$ and for the n periods

$$GM = M_1e^{nr} + M_2e^{(n-1)r} + \ldots + M_ne^r \qquad (1)$$

GM, n and r can be known. The problem is to ascertain the value of M_1. To obtain a solution, it was assumed that the number of migrants arriving at a place in each period is always the same proportion of the total population of the country. (This means that the number of migrants will vary in each period, relatively in the same way as that of the total population.)

Therefore, it is possible to express the number of migrants of any period of time as a function of the migrants of the first period (M_1). In general:

$$M_i = M_1e^{(i-1)r} \qquad (2)$$

and the total number of migrants in the n periods.

$$M = \sum_{i=1}^{n} M_i = M_1 \frac{e^{nr} - 1}{e^r - 1} \qquad (3)$$

M_1 is not known, but can be determined by replacing the values of M_i in Formula 1 by the expression 2, and thus:

$$M_1 = \frac{GM}{ne^{nr}} \qquad (4)$$

Substituting M_1 (formula 4) in formula 3, it is possible to write:

$$M = \frac{GM}{ne^{nr}} \cdot \frac{e^{nr} - 1}{e^r - 1} = GM \frac{e^{nr} - 1}{(e^r - 1)ne^{nr}} = GM \cdot \mu \qquad (5)$$

In other words, total migrants during n periods of time (it can be years) are equal to the number of migrants and their descendents (GM) by a factor μ.

Because of the assumptions made, if P_o and P_n are the total population in the country at the beginning and at the end of the n period,

$$e^{nr} = \frac{P_n}{P_o}$$

thus, the migrant factor can be written as:

$$\mu = \frac{P_n - P_o}{n(e^r - 1)P_n}$$

and formula 5 can be rewritten as:

$$M = GM \frac{P_n - P_o}{n(e^r - 1)P_n} \qquad (6)$$

Some simplification can be made losing little exactness. Because r is in general small, an approximation of $e^r - 1$ is:

$$r + \frac{r^2}{2!} = \tfrac{1}{2}\, r\,(2 + r)$$

therefore, formula 6 can be transformed into:

$$M = GM \frac{2(P_n - P_o)}{n\, r(2 + r)P_n} \qquad (7)$$

This formula 7, which does not have e^r, gives practically the same results as formula 6. In general, the bias of the migrant factor is toward overestimating the number of migrants, because the natural growth rate of the migrant population is generally higher than that of the total population because of the ages of migrants.

REFERENCES

[1] Arriaga, E. E., A Methodological Note on Urbanization Indices with Applications, Proceedings of the Sydney Population Conference, August, 1967, Table 2. Also to be published in Spanish in *Estadistica,* 26, June, 1967.

[2] United Nations, Bureau of Social Affairs, Population Branch, Demographic Aspects of Urbanization in Latin America, *in* Hauser, P. M. (Editor), URBANIZATION IN LATIN AMERICA, New York, Columbia University Press, 1961, pp. 108–110; Ducoff, L. J., The Role of Migration in the Demographic Development of Latin America, *Milbank Memorial Fund Quarterly,* 43, 198–200, October, 1965, part 2; Durand, J. D. and Pelaez, C., Patterns of Urbanization in Latin America, *Milbank Memorial Fund Quarterly,* 43, 166–190, October, 1965, part 2.

[3] Other factors such as the diminution of rural population (without net immigration to urban areas) and inclusion of new cities that acquire the urban definition are not so important. The first does not occur in Latin American countries; the second, which is also due to city growth, represents around 20 per cent of the total urban population growth in the region if cities of 10,000 inhabitants and over are considered as urban.

[4] The categories will be: cities under 10,000; 10,000 to less than 20,000; 20,000 to 50,000; 50,000 to 100,000; 100,000 to 500,000; and 500,000 and over.

[5] Before the differences were taken the expected population in all categories (including rural areas) was slightly adjusted—in proportion to the population in each category—to obtain the same census total. In the case of Venezuela, because of the big international migration during the period, foreigners were treated separately. A net flow of 350.9 thousand was estimated during the period. This total was distributed by considering the total foreign-born enumerated in selected states (classified in urban-rural areas) in the 1950 and 1961 censuses. After that distribution the expected population in each city-size category at the end of the period was adjusted (proportionately) to obtain the same census total.

[6] According to the assumptions made in developing the migrant factor, the number of migrants could be overestimated.

[7] *See:* Bose, N. K., Calcutta: a Premature Metropolis, *in* CITIES, New York, Scientific American, 1965, pp. 60–61; Wolman, S., *ibid.*, pp. 60–61; Echavarria, M. and Hauser, P., Rapporteurs Report *in* Hauser, *op. cit.*, pp. 58–60.

[8] They will need equipment and goods that the country is not producing.

[9] The female population in these city-size categories present the highest proportion of females in fertile ages.

[10] This was found in other Latin American countries. *See,* for example, Gomez, M. and Jiminez, R., Tabla de vida abreviada para el area metropolitana de San José (Costa Rica) 1959–61, Centro Latinoamericano de Demografía BC.2/61, Santiago, Chile, 1962. Expectation of life for San José was 60.8. For the whole country, 55.5; Medica, V., República de Panamá. Mortalidad en la Cuidad de Panamá 1950–60, B63.1/6, Centro Latinoamericano de Demografía, Santiago, Chile, 1964. Expectation of life in Panama City 1959–61 was 70.0. For the whole country, 61.5; Camisa, Z., Tabla Abreviada de Mortalidad de la Region Pampeana de la República Argentain, 1946–48, Centro Latinoamericano de Demografía, B.64.2/3.2, Santiago, Chile, 1964. The Pampean Region is the most urbanized of this country. The expectation of life was 63.1. For the whole country, 60.8; Johnson, G., Health Conditions in Rural and Urban Areas of Developing Countries, *Population Studies,* 293–310, March, 1964. Arriaga, E., Rural-Urban Mortality in Developing Countries and an Index for Detecting Rural Underregistration, *Demography,* 4, 98–107, 1967.

[11] Urban mortality has been lower than rural mortality in these developing countries during the last decade and at the present time. That does not mean, however, that it will continue in the future. The increase of the biggest cities without adequate increase in services would eventually be a cause of mortality increase. Also, it is impossible to be blind to the continuous growth of the slums and the conditions of life in these parts of the biggest cities.

[12] *See,* Elizaga, J. C., A Study of Migration to Greater Santiago (Chile), *Demography,* 3, 352–377, 1966.

[13] Davis, K., The Urbanization of the Human Population, *in* CITIES, New York, Scientific American, 1965, pp. 10–12.

[14] Annual average natural growth rates in Latin American Countries during the decade 1950–1960 were over 25 per thousand (with the exception of Argentina). The same rates for countries of the western European type are lower than 15 per thousand (in most cases lower than ten per thousand.)

[15] The reasons this age-group was used instead of ages 15 to 50 (or 55) are: 1. the effect of internal migration on the census data is lower considering ages 20–34 than if the age group 15 to 50 is taken (the cumulative fertility of the women 35 to 50 can reflect the previous fertility pattern of the areas from which they come); 2. women in ages 20–34 contribute the highest proportion of total fertility (around 68 per cent in Chile and Venezuela, and 70 per cent in Mexico); 3. if mothers of ages 35 and over are considered, the differences in the birth rates found can be affected by births that have occurred previous to the decade under consideration; and 4. the information from young mothers (those 20 to 34 years old) is less affected by loss of memory than information from mothers ending their fertile period.

[16] The mean city-size of each urban state population was found by using a weighted average $\frac{\Sigma C_i^2}{\Sigma C_i}$ where C_i is the population of each city. In this case, each urban person is weighted by the size of the city where he lives. This average also can be interpreted as the expected value of the resident-city-size of an urban person randomly selected. (For detailed explanation *see* Arriaga, A Methodological Note on Urbanization Indices with Applications, *op. cit.* In this average all cities considered urban by the census were included because the information about children ever born by age of mother belongs to the census definition of urban population.

[17] It was divided by total population, because the rate per thousand population is sought.

[18] Arriaga, Rural-Urban Mortality in Developing Countries and an Index for Detecting Rural Underregistration, *op. cit.*

[19] The capital city is located in this state, in which 90 per cent of its population live in cities.

[20] The states taken were those which—according to the classification already made for fertility (see Table 5)—urban population could be considered as belonging to a city-size category of under 20,000. These states are: Atacama, Aconcagua, Maule, Arauco, Malleco, Chiloe and Aisen.

[21] Only as an indication, because the states considered have urban areas (cities over 20,000 inhabitants) and they cannot be considered representative of the total country's rural areas.

[22] This was found in a study made by the author. *See* Arriaga, E. E., New Life Tables for Latin American Populations in the Nineteenth and Twentieth Centuries, in press.

[23] The Metropolitan Area of Caracas is located within these two political divisions. The proportion of rural population in the Distrito Federal is very small; it is higher in Miranda state.

[24] These states were the most rural, among the 11 available, according to Table 5.

[25] For Venezuela, the intercensal geometric growth rate for the whole country was calculated, excluding in 1961, the net immigration of foreign born who arrived during the intercensal period, 350.9 thousand.

[26] Perhaps the natural growth rate of migrants is higher than for the entire country. Their fertility could be higher (they came from rural areas) and in

general, mortality at their destination is lower than in the place from which they came. In addition, most of them are of fertile age, and they can double in some cases in a few years. Therefore, if the assumed growth rate of migrants is lower than the actual, the result will be an overestimation of the number of migrants.

[27] Davis, *op. cit.*, p. 22.

ACKNOWLEDGMENTS

The author wishes to thank Professor Kingsley Davis for his advice and suggestions, and the Rockefeller Foundation for providing the grant that made this research possible.