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SEMINAR ON THE PREPARATION AND USE OF POPULATION AND HOUSING CENSUS TABULATIONS

Organized by the United Nations, through the Economic Commission for Latin America, the Statistical Office of the United Nations, the United Nations Trust Fund for Population Activities with the collaboration of the the Latin American Demographic Centre

Santiago, Chile, 14-19 August 1972

ILLUSTRATIONS OF THE ANALYSIS OF CENSUS TABULATIONS

prepared by

the Latin American Demographic Centre

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/ILLUSTRATIONS OF

ILLUSTRATIONS OF THE ANALYSIS OF CENSUS TABULATIONS

Introduction

When it was proposed that CELADE should contribute to the Seminar on the preparation and use of population and housing census tabulations organized by ECLA, the idea was evolved and put into practice in the present document, of presenting a group of illustrations of analyses based on census results.

It was not a question, it was pointed out, of preparing a document containing work expressly for the Seminar, but rather a matter of compiling studies already in existence which could be used to illustrate how demographers use the information obtained from population censuses.

This decision was made primarily for practical reasons; there were no CELADE staff with time available for going into the preparation of a document involving for this sole purpose a series of analyses based on census tabulations. This was not the only reason. It was considered that the idea of compiling work already in existence to present the points of view, styles and opinions of several different authors would have the advantage of conferring greater richness on the document, although at the price of sacrificing homogeneity or uniformity.

A problem arose when the work of preparing the compilation began: the number of possible illustrations of the use of census data existing in CELADE is exceedingly numerous, and the presentation of each, if done carefully and in detail, could be very long. In order to produce a document of a suitable length for a Seminar, a strict selection of work had to be made, and an effort made to summarize concisely the content of the illustrations selected.

The criteria used in the selection took into account the interest of each illustration, its originality in some cases and the appropriateness of presenting a varied range of topics, taking care not to have an excessive number of cases on a single topic or to neglect some topic of vital importance.

It is hardly necessary to mention that the group of examples selected does not completely satisfy those who have taken part in preparing the present document. They have frequently had, and still have, doubts on the suitability of adding or supressing a particular illustration. The necessity of finishing within the dateline for the presentation of the document meant

/that definite

that definite decisions had to be made. The result of the work of selection is summed up in the table below; this indicates under which of the four topics making up the document each of the illustrations comes. The table also indicates what the study consists of, its aim or content and the name of the author responsible for the synthesis. In nearly all cases there is some document to back up the illustration. The reader interested in extending his knowledge of the topic may refer back to the source from which the summary is taken.

/Table 1

Table 1

Topic	Illustrations	Author
Fertility	(1) Determination of fertility on the basis of the question on the number of children born alive. Advantages of the tabulation by detailed ages as compared with the tabulation by five-year age groups.	Carmen Arretx
	(2) Determination of degrees of fertility. Use of census information on children born during lifetime of the mother and children born in the year preceding the census.	Carmen Arretx
	(3) Determination of degree of fertility for inter-census periods. Use of the tabulation on the number of children born alive classified by the age of the females in the two preceding censuses.	Carmen Arretx
	(4) Differential fertility by educational attainment. Estimates prepared on the basis of census results on children born to females classified by age and educational attainment.	Carmen Arretx
Mortality	(5) Mortality tables. Illustration of the use of population census tabulations, classified by sex and age combined with data from vital statistics.	José M. Pujol
	(6) Determination of the mortality of a country using only census information: (a) children surviving and children born, classified by age of females, (b) native population classified by sex and age in two successive censuses.	Carmen Arretx

/Table 1 (concl.)

Table 1 (concl.)

Topic		Illustrations	Author
Migrations	(7)	Some characteristics of migrants.	Jorge Vidal
	(8)	Estimate of internal migration on the basis of census information. Use of the tabulation on population by sex and age classified by place of birth and register.	Carmen Arretx
	(9)	International migration. Analysis of average ages of migrants obtained from the tabulation on foreign-born population by sex and age groups.	Julio Morales
Other topics: - Spatial distribution - Nuptiality - Educational characteristics - Economic characteristics - Family - Evaluation of data	(10)	Comparison of the urban population by different definitions and distribution of the urban population by size of localities.	Jorge Vidal
	(11)	Determination of degrees of nuptiality on the basis of census information. Use of tabulations on population by marital status, sex and age.	Carmen Arretx
	(12)	Some characteristics of educational attainment. Analysis by cohort and for areas of greater or less urbanization.	Julio Morales
	(13)	Rates of participation in economic activity by (a) age and sex, (b) age and marital status of the female population and (c) age and number of children born to the female population.	Jorge Vidal
	(14)	Use of census information to estimate the under-employment of the economically active population.	Carmen Arretx
	(15)	Use of census information to determine characteristics of households.	Alejandra Pantelides
	(16)	Use of the tabulation on population by sex and detailed age to evaluate the declaration of ages.	Jorge Vidal

/FERTILITY (1)

FERTILITY (1)

DETERMINATION OF FERTILITY ON THE BASIS OF THE QUESTION ON THE NUMBER OF CHILDREN BORN ALIVE. ADVANTAGES OF THE TABULATION BY DETAILED AGES AS COMPARED WITH THE TABULATION BY FIVE-YEAR AGE GROUPS

Estimates are given on annual fertility rates prepared on the basis of census tabulations on the number of children born alive to the female population classified by (a) detailed ages and (b) five-year age groups. Data from the 1940 Census of Brazil are used 1/.

(a) Use of the tabulation by detailed ages

Using the census information on children born alive to the female population classified be detailed ages from 12 to 49 years, the average of number of children per female was calculated to the exact age x, symbolized by $\emptyset$ (x). Then, employing the procedure of Professor Mortara 2/, annual fertility rates were calculated using the expression:

$$f_{x+\frac{1}{2}} = \emptyset (x+1) - \emptyset (x)$$

where $f_{x+\frac{1}{2}}$ represents the annual fertility rate of females of x years of age. The gross reproduction rate (R') was calculated as synthetic index of these rates. Table 1 gives: the average number of children per female, the annual fertility rates and the gross reproduction rate.

(b) Use of the tabulation by five-year age groups

Taking the above information as not having been tabulated by detailed ages, the females are grouped in five-year age groups, a common practice in many censuses. In this case, the average number of children born to the female population between the ages of x and x+n can be calculated and symbolized by ${}_n h_x$. From these annual fertility rates by age groups can be calculated, using the above procedure in the following form:

1/ C. Arretx, Revisión de las estimaciones de la fecundidad de Brasil, a base de los censos de 1940, 1950, 1960 y 1970 (Revision of estimates of the fertility of Brazil on the basis of the 1940, 1950, 1960 and 1970 censuses). CELADE S/66/25, March 1970.

2/ UN ST/SOA/Series A/7, Methods of using census statistics for the calculation of life tables and their demographic measures. A. Mor New York, 1949.

/Table 1

Table 1

BRAZIL 1940: AVERAGE NUMBER OF CHILDREN BORN ALIVE UP TO THE EXACT AGE X TO 100 FEMALES, AND ANNUAL FERTILITY RATES PER 100 FEMALES OF X YEARS OF AGE

Age X	Average number of children up to the exact age x (for 100 females)	Annual fertility rates for 100 females of x years of age f(x)
14	0.0	0.6
15	0.6	1.2
16	1.8	3.5
17	5.3	7.4
18	12.7	12.8
19	25.5	16.9
20	42.4	20.5
21	62.9	23.6
22	86.5	26.2
23	112.7	28.3
24	141.0	29.9
25	170.9	31.0
26	201.9	31.6
27	233.5	31.1
28	264.6	30.5
29	295.1	29.8
30	324.9	29.0
31	353.9	28.1
32	382.0	27.1
33	409.1	26.0
34	435.1	24.8
35	459.9	23.5
36	483.4	22.1
37	505.5	20.6
38	526.1	19.1
39	545.2	17.5

/Table 1 (Concl.)

Table 1 (Concl.)

Age X	Average number of children up to the exact age x (for 100 females)	Annual fertility rates for 100 females of x years of age f(x)
40	562.7	15.9
41	578.6	14.3
42	592.9	12.6
43	605.5	10.9
44	616.4	9.2
45	625.6	7.5
46	633.1	5.7
47	638.8	3.9
48	642.7	2.1
49	644.8	0.3
50	645.1	
R'	3.15	

Source: Copied from tables 4 and 5, chapter IV of Methods of using census statistics, op.cit.

/(1) The

(1) The symbol $_{n}h_{x}$ is represented graphically, the value given it being that of the average age of the corresponding age group. This is a convention which is frequently adopted, but which does not correspond to fact. In fact, if the fertility within the age group under consideration (i.e. the average number of children born to the females population classified by detailed ages) varies lineally, the average fertility of the group corresponds to the average age of the group; as the fertility pattern moves away from its lineal form, the average age of fertility will be greater or less than the average age of the interval according to whether the fertility curve is convex or concave.

(2) Once the values of $_{n}h_{x}$ have been completed, they are joined up in a frequency polygon which generally speaking takes a regular form: an upward trend up to 30 years of age approximately and then a downward movement towards the limit of the period of fertility. Conversely, the appropriate adjustments are made in order to regularize the curve, which then gives the cumulative fertility up to ages conveniently chosen for calculating fertility rates, e.g. $\emptyset$ (15), $\emptyset$ (20) ... $\emptyset$ (50) is obtained.

(3) Then using the expression:

$$_{5}f_{x} = 1/5 \left[\emptyset (x+5) - \emptyset (x) \right]$$

the annual fertility rates are obtained for five-year age groups. The results of these calculations appear in table 2 which also includes the gross reproduction rate ($R^{\prime}$).

(c) Comparison of results

In order to aid the comparison of the results of the foregoing estimates, figure I indicates the cumulative fertility curves by age (average number of children per female) in accordance with data by detailed ages $\emptyset$ (x), and data from information by five-year age groups $_{5}h_{x}$. In the lower part of the same figure can be seen the curves of the annual fertility rates prepared on the basis of the two types of data: detailed and grouped.

The results obtained give the following:

(1) The same value is obtained for the gross reproduction rate by preparing annual fertility rates either from data by detailed ages or data by five-year age groups.

/Table 2

Table 2

BRAZIL: ESTIMATE OF ANNUAL FERTILITY RATES ON THE BASIS OF INFORMATION ON THE AVERAGE NUMBER OF CHILDREN BORN TO THE FEMALES POPULATION BY FIVE-YEARS AGE GROUPS, 1940

Ages	Average number of children per female $n^h x$ (per hundred)	Exact age x	Cumulative fertility $\emptyset(x)$ (per hundred)	Annual fertility rates for age groups $1/5[\emptyset(x+5)-\emptyset(x)]$ (per hundred)
12-14	0.12			
15-19	12.19	15	1.2	9.00
20-24	103.03	20	46.2	25.76
25-29	245.34	25	175.0	28.24
30-34	385.07	30	316.2	25.76
35-39	508.85	35	445.0	21.50
40-44	587.19	40	552.5	12.50
45-49	638.73	45	615.0	6.50
		50	647.5	R' 3.15

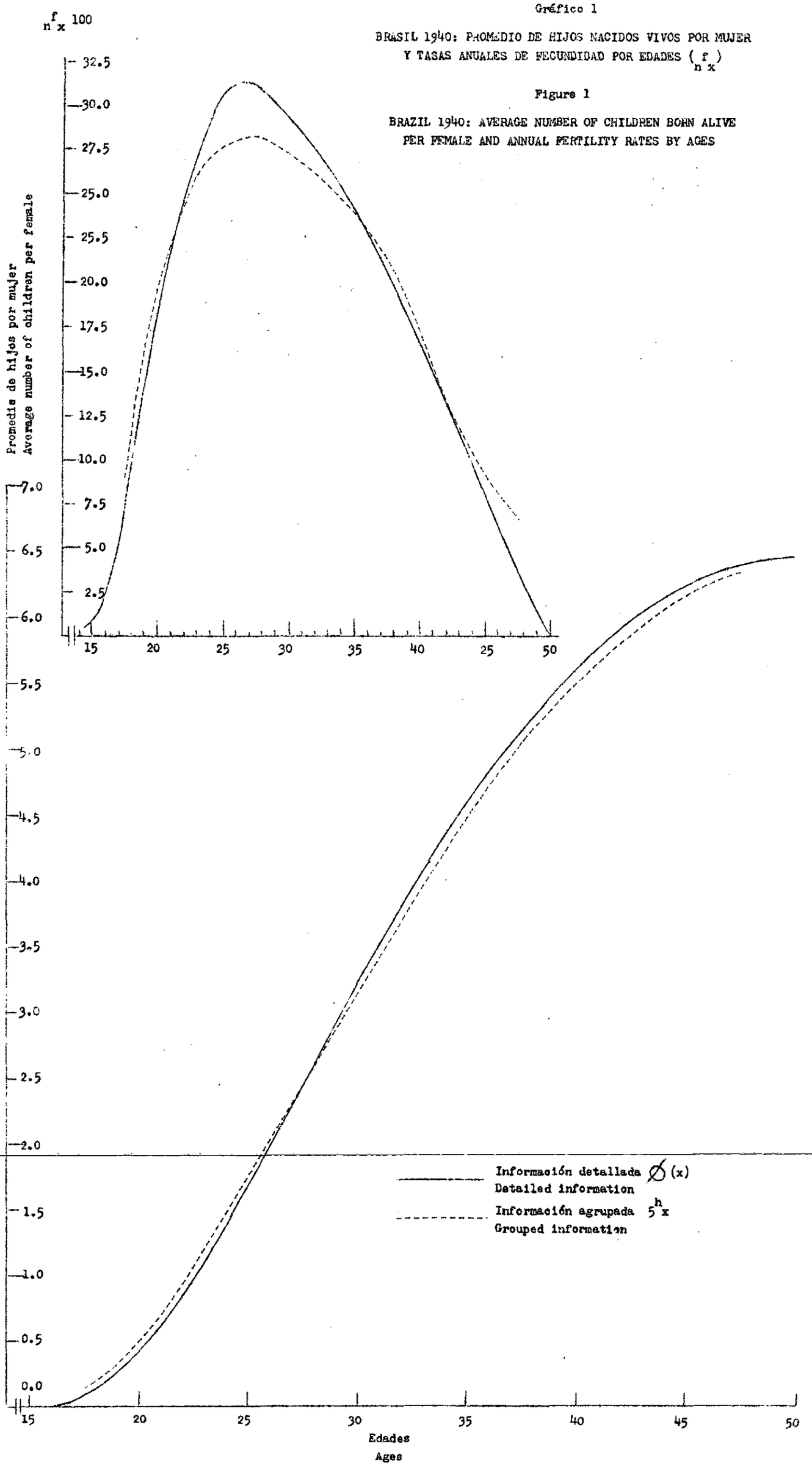
/Figure I

Gráfico 1

BRASIL 1940: PROMEDIO DE HIJOS NACIDOS VIVOS POR MUJER Y TASAS ANUALES DE FECUNDIDAD POR EDADES ($_{n}f_{x}$)

Figure 1

BRAZIL 1940: AVERAGE NUMBER OF CHILDREN BORN ALIVE PER FEMALE AND ANNUAL FERTILITY RATES BY AGES



(2) Considerable differences may be noted in annual fertility rates between 22 and 33 years of age approximately; the rates from detailed data are better (and certainly more factual) in this group than the rates derived from data tabulated by five-year age groups.

(3) The more ample data supplied by the tabulation by detailed ages enables annual fertility rates to be calculated also by detailed ages; this is of great importance for the purpose of demographic analysis and for some practical purposes too.

/FERTILITY (2)

FERTILITY (2)

DETERMINATION OF DEGREES OF FERTILITY. USE OF CENSUS INFORMATION ON CHILDREN BORN DURING LIFETIME OF THE MOTHER AND CHILDREN BORN IN THE YEAR PRECEDING THE CENSUS

C. Arretx

1. Theoretical considerations

If a country presents the following situation:

(a) fertility has remained constant with time;

(b) fertility is independent of mortality, i.e. the surviving female population in a census, of specific ages, has had a fertility experience similar to that of those of the same ages who have died;

(c) the population is closed, not affected by migration, or if it is, where the migrant female population have a fertility pattern similar to that of the non-migrant female population; the inclusion in a population census of questions on the total number of children born to the female population up to the date of the census, and on the births which took place in the year preceding the census, gives two types of data:

(i) on the number of children born (HT) during the lifetime of the mother, generally termed retrospective, and

(ii) the number of children born in a recent period e.g. during the year preceding the census, generally termed up-to-date or current.

With retrospective data, average numbers of children born per female according to age: P(x), can be calculated. This can be done by classifying the female population by detailed ages or by age-groups of any breadth, usually five-year age groups.

With up-to-date or current data, annual fertility rates are determined directly, either by detailed ages or by age groups. The sum of the annual rates from 15 years of age (when it is presumed that the period of reproduction begins) up to x years of age gives the average number of children per female at age x: F(x).

/If the

If the above conditions are fulfilled, and if there are no errors in the declaration of the number of children born, nor in the period of reference of the births in the year preceding the census, nor in the declaration of the ages of the female population, the indexes P(x) - calculated using retrospective data - and F(x) - a synthetic index of the annual fertility rates calculated with current data - should have the same value.

A comparison could, of course, be established between annual fertility rates, calculated using current data, and calculated using retrospective data. For this it would be necessary to derive the annual rates from P(x), using one of the methods in current use 1/.

Brass proposes a methodology 2/ which enables the calculation, on the basis of annual fertility rates by age estimated using current data of the average of children per female at specific ages comparable with those to which the retrospective data refer P(x).

In an analysis of both types of data, Brass establishes that they are affected by different types of error. Retrospective data, particularly with reference to the female population of over 40 years of age, are affected by omission, i.e., not all the children born are declared. The information given by young women, however (less than 30 years of age), can be accepted.

Up-to-date or current data, according to Brass, are affected by errors of situation in time, i.e., the births do not correspond exactly to the established period of reference - one year previous to the census, for example. This error does not appear to depend on age, and it is therefore presumed that the composition by age of the annual fertility rates, calculated using current data is adequate.

If (a), (b) and (c) are true, and the errors affecting the two types of data under consideration are of the type described, quotients can be established between P(x) and F(x) which vary around 1. For example,

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1/ United Nations, ST/SOA/Series A/7. Methods of using census statistics for the calculation of life tables and their demographic measures. Giorgio Mortara.

2/ Brass, W., The Demography of Tropical Africa, Princeton University Press, 1968.

if P_{20-24}/F_{20-24} is calculated, and the result is greater than one, then the declaration of briths for the preceding year covers a period of less than a year, according to the above hypotheses. If, on the other hand, the result is less than one, it might be considered that the period of reference for the births is greater than a year. In both cases, it is considered that the young female population (in this case of 20-24 years of age) does not omit to record births which have taken place up to the date of the census (retrospective data). As an adjustment factor, the expression P_{20-24}/F_{20-24} takes the current annual fertility rates.

2. Practical application 1/

With the data obtained in the Experimental Census of Guatemala on the total number of children born up to the date of the census and the children born in the year preceding the census, annual fertility rates by the age of the female population were calculated. The methodology described under point 1 was used.

The results appear in table 1.

The overall degree of fertility estimated, 6.1 children, the average per female at the end of her period of fertility, falls into line with the estimates adopted by CELADE for the preparation of population projections 2/. The estimated degree of fertility is 22 per cent greater than the overall fertility resulting from annual fertility rates, calculated using data on births during the year preceding the census. The difference occurs when the factor $P_{20-24}/F_{20-24} = 1.226$ is applied to the current annual fertility rates (column 7 of table 1); the value of this factor (more than one), according to the assumptions of the method, would show that the births declared as having taken place in the year preceding the census, cover a period of less than one year. This error may have been produced by the form in which the question is phrased in the census: How many children were born alive between January and December 1970?, which could be interpreted as a period of 10 or 11 months. Brass suggests that a means of getting round this type of error would be to ask the date of birth of the last child born to the female population.

1/ Franos A., Guatemala, Censo Experimental de 1970: Aplicación de las Técnicas del Profesor W. Brass para estimar fecundidad y mortalidad, CELADE, unpublished.

2/ CELADE, Boletín Demográfico, Year II, Nº 4.

/Table 1

Table 1

ESTIMATE OF FERTILITY ON THE BASIS OF CENSUS INFORMATION ON THE TOTAL NUMBER OF CHILDREN BORN (HT), AND CHILDREN BORN DURING THE YEAR PRECEDING THE CENSUS (HTUA)

(Guatemala, Experimental Census, 1970)

Age when census was carried out x,x+n	Order of age interval -i-	Total number of females	HT	HTUA	P_i	F_i	F_i	P_i/F_i	$f_i=P_2/F_2 \cdot f_1$
1	2	3	4	5	6	7	8	9	10
15-19	1	1 046	239	93	0.228	0.089	0.180	1 267	0.109
20-24	2	845	1 199	212	1 419	0.250	1 157	1 226	0.305
25-29	3	623	1 817	139	2 917	0.223	2 367	1 232	0.272
30-34	4	505	2 241	107	4 438	0.212	3 469	1 279	0.269
35-39	5	537	2 972	83	5 534	0.155	4 371	1 266	0.189
40-44	6	441	2 768	28	6 277	0,063	4 864	1 290	0.077
45-49	7	360	2 251	4	6 253	0,011	5 007	1 248	0.013
Overall fertility						5 015			6 120

FERTILITY (3)

DETERMINATION OF FERTILITY RATE FOR INTER-CENSAL PERIOD. USE OF TABULATION ON NUMBER OF LIVE BIRTHS TO WOMEN CLASSIFIED BY AGE, IN TWO SUCCESSIVE CENSUSES 1/

C. Arretx

1. Theoretical considerations

If data are gathered on the number of live births to the women covered by two successive censuses, measurements of fertility can be established for generations of women. In other words, it is possible to analyse the increase in the cumulative fertility (average number of children per woman) of a cohort of women between one census and the next and, on the basis of this increase, to calculate the annual fertility rates by age. Briefly, the following procedure is used:

Let $F(x)$ equal the cumulative fertility of women up to exact age x in census z, that is:

$$\emptyset^{z}(x) = F(x)$$

and let $G(x)$ equal the cumulative fertility of women up to exact age x in census $z+10$, that is:

$$\emptyset^{z+10}(x) = G(x)$$

If it is assumed that: (a) the cumulative fertility of women up to a given age is independent of the mortality rate, i.e., the survivors at age x covered by the census had the same fertility rate as the women who had died previously, and (b) the female population in the 10-year inter-censal period (z to $z+10$) was closed population, which means that the same cohort is observed at two specific moments, z and $z+10$, then $G(x+10) - F(x)$ would represent the fertility rate in the period z to $z+10$ for the cohort of women at age x in census z and at age $x+10$ in census $z+10$. The measurement of annual fertility is obtained by dividing this diference by the number of years lived during the inter-censal period which fall within the childbearing period (15 to 50 years of age). In general:

1/ C. Arretx, "Revisión de las estimaciones de la fecundidad de Brasil, a base de los censos de 1940, 1950, 1960 y 1970", CELADE S/66/25, March 1970.

/$\frac{G(x+n) - F(x)}{n}$

$$\frac{G(x+n) - F(x)}{n} = {}_nf_x = \varphi(y)$$

which represents an average annual fertility rate for the group between ages x and x+n (${}_nf_x$), and also an instantaneous fertility rate at an intermediate age between x and x+n: $\varphi(y)$, y being the intermediate age. In the above ratio, n represents the number of years lived during the inter-censal period of 10 years which fall within the child-bearing period. The next step is to establish (a) the number of years lived (n) by each cohort of women between the ages of 15 to 20 in the period z to z+10, and (b) the age (y) to which the annual fertility rate may refer.

To solve problems (a) and (b) in a simplified way, the period of fertility is assumed, as is normal, to begin at the age of 15 and to end at the age of 50.

(a) Determination of number of years lived

The number of years of exposure to the risk of conception lived in the period z to z+10 depends on the age of the women concerned. If consideration is given to age in the period z+10, then:

(i) the group of women reaching the ages of 25 and 50 in the period z+10 were 15 and 40, respectively, 10 years previously; therefore, they had all been exposed to the risk of conception during the 10 years: n = 10;

(ii) the women reaching the age of 20 in z+10 were 10 years of age in z; therefore, they had been exposed to risk for only 5 years, in the light of the assumption regarding the beginning of the fertility period: n = 5;

(iii) the women aged 15 years in z+10 had not been exposed to risk during the inter-censal period z to z+10: n = 0.

The same method is used to determine the number of years of exposure to risk lived by women aged 45 years in z.

/(b) Determination

(b) Determination of age

Once the annual fertility rates are established, the next step is to determine the age to which these rates can be ascribed, i.e., to calculate y within the interval between ages x and $x+n$ which is used in determining each rate.

The following chart shows the method used in calculating the annual rates of fertility.

To determine age y within the age interval used in establishing the annual rates of fertility, it is necessary to know the annual fertility rates by individual years of age at a given moment or, in accordance with a theoretical model, once the annual fertility rates per cohort (8 rates) are calculated they can be ascribed to ages which are determined through interpolation of these rates. The chart includes determination of age y, which is calculated on the basis of data for individual years of age obtained in the Brazil 1940 census.

Age in: z z+10	$\phi(x)$ in: z	z+10	Difference G(x+10)-F(x)	Number of years lived n	Annual fertility rate $\frac{G(x+10)-F(x)}{n} = {}_nf_x = (y_i)$	Age to which rate is ascribed according to 1940 census (y)
5-15	0	G(15)	G(15)	0		
10-20	0	G(20)	G(20)	5	${}_5f_{15} = (y_1)$	17.7
15-25	F(15)	G(25)	G(25)-F(15)	10	${}_{10}f_{15} = (y_2)$	19.9
20-30	F(20)	G(30)	G(30)-F(20)	10	${}_{10}f_{20} = (y_3)$	23.5
25-35	F(25)	G(35)	G(35)-F(25)	10	${}_{10}f_{25} = (y_4)$	30.6
30-40	F(30)	G(40)	G(40)-F(30)	10	${}_{10}f_{30} = (y_5)$	35.3
35-45	F(35)	G(45)	G(45)-F(35)	10	${}_{10}f_{35} = (y_6)$	40.1
40-50	F(40)	G(50)	G(50)-F(40)	10	${}_{10}f_{40} = (y_7)$	45.1
45-55	F(45)	G(55)	G(55)-F(45)	5	${}_5f_{45} = (y_8)$	47.1

/2. Practical

2. Practical use

The method explained above was used in determining the fertility rate in Brazil for the periods 1940-1950, 1950-1960 and 1960-1970. The census data were adjusted for the sake of consistency between the censuses, i.e., the cumulative fertility of women at age x up to census z should be lower than, or at most equal to, the fertility rate of women at age x+10 in the next census z+10. It was necessary only to correct the fertility rate of women over the age of 45.

The results are presented in table 1 and figure I.

3. Observations on the practical use of this method

(a) The method described can be used in countries where the question about live births to women is included in successive censuses.

(b) Since annual fertility rates are estimated by generation, the method does not presuppose a specific fertility trend, but takes into account any change there may have been during the period covered. Therefore it is a good method for determining the fertility rate in countries showing a declining trend, such as Brazil. It would no be legitimate in these cases to use the method devised by Professor Mortara, since it is based on the assumption that fertility remains constant over a period of 35 years.

(c) The results obtained would be all the more representative of the real situation the fewer the adjustments that would have to be made in the data and the more detailed are the ages of the women in the tabulation of data. If the data are tabulated by five-years age goups, it would be necessary to determine the cumulative fertility up to exact ages, using a graph such as that indicated in the previous example (on the use of detailed and group tabulations).

(d) The larger the number of successive censuses that included the question about the number of live births to women the greater would be the knowledge obtained regarding the trend of generation fertility, which would make it easier to estimate the future trend of this variable.

/Table 1

Table 1

BRAZIL: ANNUAL FERTILITY RATES FOR INTER-CENSAL PERIODS 1940-1950, 1950-1960 AND 1960-1970

Age at: z	z+10	Difference 1940-1950	G(x+10) - F(x) 1950-1960	1960-1970	Number of years lived n	Annual fertility rates 1940-1950	1950-1960	1960-1970
						(percentages)		
5	15	0.0	0.0	0.0	0			
10	20	46.2	45.0	42.5	5	9.24	9.00	8.50
15	25	169.4	176.7	172.0	10	16.94	17.67	17.20
20	30	266.3	267.4	268.0	10	26.63	26.74	26.80
25	35	267.8	260.0	251.3	10	26.78	26.00	25.13
30	40	201.6	204.6	187.6	10	20.16	20.46	18.77
35	45	125.1	124.0	108.0	10	12.51	12.40	10.80
40	50	58.5	52.9	44.0	10	5.85	5.29	4.40
45	55	14.4	5.0	7.2	5	2.88	1.50	1.45
					R^1 =	2.80	2.78	2.64

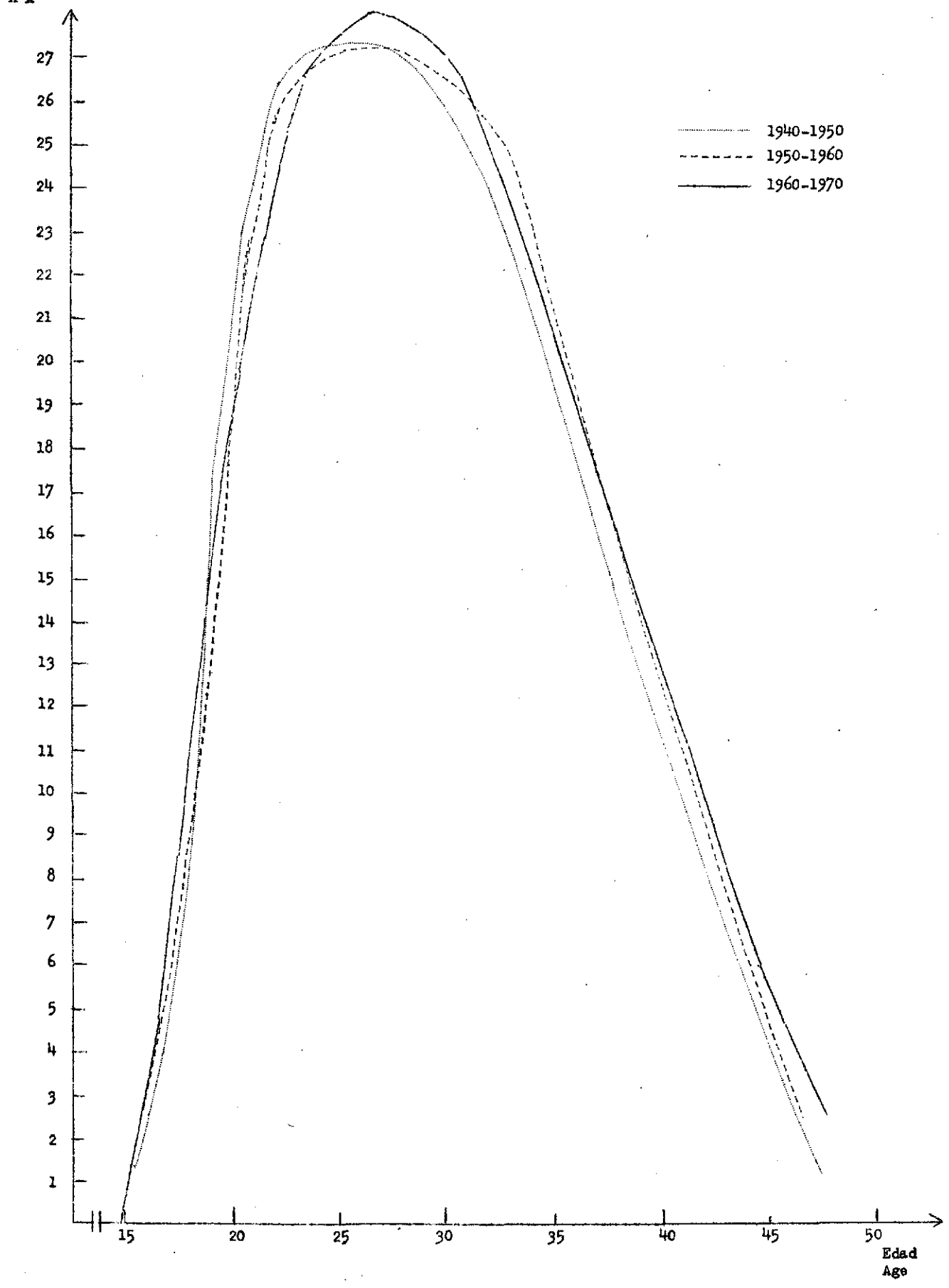
/Figure I

Gráfico 1

TASAS ANUALES DE FECUNDIDAD POR EDAD EN LOS PERIODOS INTERCENSALES 1940-195, 1950-1960 Y 1960-1970

Figure 1

$n^f_x \cdot 100$ ANNUAL FERTILITY RATES BY AGE IN INTER-CENSAL PERIODS 1940-1950, 1950-1960 AND 1960-1970



FERTILITY (4)

DIFFERENTIAL FERTILITY BY LEVEL OF EDUCATION. ESTIMATES BASED ON CENSUS RESULTS WITH REGARD TO LIVE BIRTHS TO WOMEN CLASSIFIED BY AGE AND LEVEL OF EDUCATION

C. Arretx

1. Theoretical considerations

In demographic studies fertility is considered to be a function of age and only of age. This is a simplification for practical purposes, but it is far from being realistic. The same simplification is made in connexion with mortality, when a life table is being prepared. This does not, of course, mean overlooking the fact that these variables are associated with others of a socio-economic kind.

In this example, a study is made of differential fertility by level of education, on the basis of data obtained from population censuses specially tabulated for the purpose by the CELADE Data Bank 1/. The censuses analysed included the question about the total number of live births to women up to the date of the census. These censuses also included the traditional data on educational characteristics of the population. Thus it is possible to classify the female population by age and level of education and to determine the total number of live births to the women in each of the categories established.

This is expressed by the following symbols:

N (x,e) represents the number of women at age x and educational level e

HT (x,e) represents the total number of live births to women at age x and educational level e

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1/ Data Bank.

/It seems

It seems logical that the method used to estimate fertility should be to divide the latter quantity by the former, thus:

$\frac{HT(x,e)}{N(x,e)} = h(x,e)$ which represents the average number of live births to women at age x and educational level e

The manner in which $h(x,e)$ varies can be analysed either by keeping the age constant, i.e., analysing the variation in the average number of live births to women at a specific age and different levels of education; or by keeping the level of education constant, i.e., analysing the way in which this average varies for different ages. The first type of analysis is the most appropriate for our purposes.

2. Practical use 1/

On the basis of samples of the population censuses taken about 1960 in Argentina, Chile and Paraguay, which included the question about live births to women, it was possible to prepare the tabulations for live births to women classified by age and level of education. This tabulation can be used to calculate the average number of live births to each woman, in each of the categories established. The results are shown in table 1.

Among the facts indicated by these figures, the following are the most important:

Although the countries studied have very different fertility rates - high in Paraguay, moderately high in Chile and moderately low in Argentina - there is a distinct association between the level of education and the average number of live births to each woman: the higher the level of education the lower the fertility rate, whatever the age considered.

Women who have completed a course of higher education have half or fewer than half the number of children that women with no education have.

1/ Virginia Rodríguez, "Fecundidad diferencial según nivel de instrucción", CELADE, Series C, No. 97.

/Table 1

Table 1

ARGENTINA, CHILE AND PARAGUAY: AVERAGE NUMBER OF LIVE BIRTHS TO WOMEN CLASSIFIED BY AGE GROUP AND LEVEL OF EDUCATION (CENSUS SAMPLES)

	Age group						
	15-19	20-24	25-29	30-34	35-39	40-44	45-49
Argentina a/							
None	1.17	1.90	3.02	3.22	3.92	4.38	4.49
Primary	0.80	1.30	1.81	2.24	2.49	2.75	2.77
Secondary	0.46	0.61	1.30	1.87	2.12	1.95	1.78
Higher	-	0.66	1.05	1.65	1.98	1.32	1.37
Chile							
None	0.28	1.50	2.48	3.57	4.77	5.07	5.18
Primary(first cycle)	0.17	1.05	2.02	3.42	4.51	4.31	4.35
Primary (second cycle)	0.15	0.97	1.94	2.88	3.52	3.71	3.60
Secondary-university	0.05	0.58	1.25	2.03	2.50	2.47	2.26
Paraguay							
None	0.33	1.42	2.81	3.88	4.88	5.36	5.28
Primary	0.16	0.97	2.48	3.59	4.41	4.84	4.82
Secondary	0.37	0.40	1.29	1.91	2.99	2.53	1.63
University	-	0.18	0.50	1.89	1.42	2.00	-

a/ In Argentina the women considered are not single persons, but married, widowed and separated or divorced persons.

MORTALITY (5)

ILLUSTRATION OF THE USE OF CENSUS TABULATIONS OF POPULATION CLASSIFIED BY SEX AND AGE IN COMBINATION WITH VITAL STATISTICAL DATA

J. Pujol

1. Introduction. The usefulness of mortality tables or life tables lies in the fact that they are an instrument with which it is possible to measure mortality in terms of age. The advantage of their use is that it eliminates the effect of the age distribution of the population. In other words, it is possible to measure the mortality of two or more countries, sectors or provinces with different age distributions of the population and to draw a valid comparison between them, which cannot be done if the crude death rate is used.

2. There are two types of tables, according to the detail with which they are constructed: complete and abbreviated. In the first type, the values are for each specific age, while in the second the values are given for selected ages. Various functions appear in the table, which serve to measure mortality; some of these functions depend exclusively on age, and others depend also on the age interval to which they refer. It is important to note that the abbreviated tables are not incomplete, but that they contain values for age intervals of more than one year; hence, they do not omit values, they are merely a condensed version of a complete table.

The main functions of the life table are listed and defined below:

(a) Age interval $(x, x+n)$ appears in the first column and the other functions are expressed in relation to it.

(b) Probability of death $({}_nq_x)$ is the prability of a person aged exactly x years dying before reaching the age of $x+n$.

(c) Survivors (l_x) are those persons who survive to age x, from an initial group of l_o live births (generally $l_o = 100{,}000$).

(d) Deaths $({}_nd_x)$ are those persons who die after attaining age x and before attaining age $x+n$.

/(e) Number

(e) Number of years lived between the ages of x and x+n ($_nL_x$) are the number of years lived by the cohort l_x between the exact ages of x and x+n.

(f) Number of years lived between the age x and age w(T_x), is the number of years of life left to all persons aged exactly x years; age w is that for which the number of survivors is 0.

(g) Expectation of life (e^0_x) is the number of years to be lived by each of the survivors aged exactly x years if the years to be lived by each of the components of the cohort were distributed uniformly.

3. Necessary information. Both census and vital statistical data are needed for the construction of life tables of the traditional type:

(a) Population by sex and age (age-specific for children under five and by five-year age groups for children aged five and over).

(b) Deaths by sex and age, classified with the same detail as population.

(c) Annual births by sex.

Of these data, the first come from censuses and the other two from vital statistics. Information on deaths should be made available for two or three years around the census date. Information on births should be obtained for at least five years prior to the date of the table.

This information should be made available at the national and provincial levels as well as in respect of the urban and rural sectors.

4. Use of the data. In general, a complete life table is constructed for children under five (age-specific) and a condensed table for the rest (five-year age groups).

(a) In the construction of the part of the table referring to children under five, sex- and age-specific data from population censuses are usually reconciled with vital statistical data. To this end, use is made of population data, deaths by sex and specific ages and deaths by sex, presented graphically in what is known as a Lexis diagram. In the case presented in figure I, an illustration of data for Chile around 1952, a comparison is made between registered births and births calculated as the sum of the total population and the number of deaths.

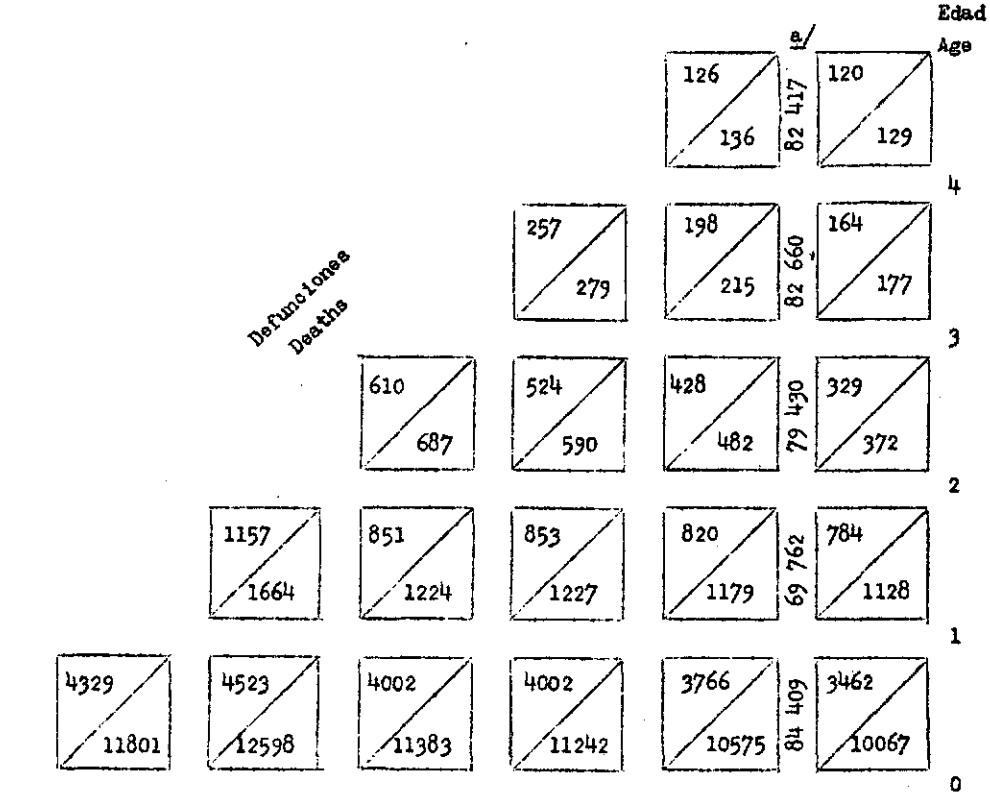
/Figure I

Gráfico 1

CHILE: DIAGRAMA DE LEXIS PARA LA POBLACION MASCULINA: GENERACIONES DE 1948-1953 CONSIDERADAS ENTRE LOS 0 Y LOS 5 AÑOS DE EDAD EL 1º DE ENERO DE 1953

Figure 1

CHILE: LEXIS DIAGRAM FOR MALE POPULATION: GENERATIONS FORM 1948-1953 OF 0 TO 5 YEARS OF AGE ON 1º JANUARY 1953



Nacimientos registrados Births registered	95 567	96 612	95 450	97 351	99 476	107 364
b/ Nacimientos calculados Births estimated	103 080	102 570	97 344	85 949	94 984	-
Nacimientos corregidos Births adjusted	102 276	103 394	102 151	104 185	106 459	114 901
Año Year	1948	1949	1950	1951	1952	1953

a/ Población calculada al 1º de enero de 1953 (en base al censo de 1952).
Estimated population on 1º January 1953 (on the basis of the 1952 census).

b/ Calculados en base al censo y defunciones.
Estimated on the basis of census and deaths.

It will be observed that there are three columns of births in this figure: the first corresponds to registered births, the second to births calculated by adding together population figures (derived from the census) and the number of deaths which appear between the two corresponding diagonals, and on the basis of these two columns it is possible to calculate a correction (usually owing to under-registration) thus obtaining a corrected figure for births.

It can be seen that the estimated number of births is greater than the registered number of births for the years 1948, 1949 and 1950, which is an indication of under-registration. Moreover, the number of births registered for 1951 and 1952 is greater than the estimated number, which is due to the poor quality of the data on population aged 1 year and under taken from the census (it will be recalled that the estimated births for 1951 and 1952 come from such population data). The corrected figures were obtained by taking an average of the under-registration for the years 1948 and 1949.

Then, taking the corrected number of births, on the one hand, and deaths (which are assumed to be of similar quality to the corrected number of births) on the other, the probability of death can be calculated.

(b) Next, the table for age five and over is constructed. As was mentioned earlier, this is done by five-year age groups.

The first requisite is for information on the population enumerated in the census by sex and age groups. Population data must be made available for a date corresponding to the middle of the period to which the data on death refer. That date does not generally coincide with the census date. It is dtherefore necessary to estimate population at the date required on the basis of census results. In the specific case used as an example here, the middle date of the period analysed was 1 January 1953 and the date of the census was 24 April 1952. It was therefore necessary to estimate the population at 1 January 1953.

The information on deaths obtained from the register is required with the same amount of detail as population data, and data for two or more years are generally taken with a view to eliminating seasonal variations.

/Table 1

Table 1 shows the population as calculated in the census of 24 April 1952, the estimated population at 1 January 1953 (children under five also appear in the Lexis figure), and the average number of deaths for 1952 and 1953. The ratio of deaths to population is also presented, that is, the central mortality rates ($_{n}m_{x}$). These rates are adjusted (last column) and the probability of death is obtained on the basis of them.

5. Table 2 is a life table of Chilean males for 1 January 1953. It can be seen that it is a cross between a complete table (for under five year-olds) and a condensed table (for population aged five and over). It is observed that of 100,000 males born (taking into account the assumption that there is no migration), 65,375 survive to the age of fifty. In the first line of the column of probability of death we find the infant mortality rate, which is a value of great importance. In the first line of the column of expectation of life we find the most important value in the table: expectation of life at birth (e^{o}_{o}), which represents the average number of years that a male child born alive in the above-mentioned period can expect to live.

6. In brief, the life table serves to measure mortality both globally and by age, and its great advantage is that it permits comparisons with other tables since it eliminates the distorting effect of age structure.

/Table 1

Table 1

CHILE: MALE POPULATION SURVEYED IN THE POPULATION CENSUS OF 24 APRIL 1952 AND PROJECTED FOR 1 JANUARY 1953; AVERAGE ANNUAL DEATHS FOR THE YEARS 1952 AND 1953; CENTRAL MORTALITY RATES, BY AGE

Age	Population at census (24-4-52)	Estimated population (1-1-53)	Average annual deaths (1952-1953)	Central mortality rates 0/oo	Adjusted central mortality rates 0/oo
0	82 935	84 409	14 018	-	-
1	68 544	69 762	1 967	-	-
2	78 043	79 430	810	-	-
3	81 217	82 660	379	-	-
4	80 978	82 417	257	-	-
5- 9	391 881	398 845	795	1.99	1.99
10-14	327 460	333 279	583	1.75	1.75
15-19	280 970	285 963	842	2.94	2.94
20-24	274 266	279 140	1 127	4.04	4.00
25-29	212 215	215 986	1 046	4.84	4.75
30-34	184 985	188 272	1 141	6.06	5.70
35-39	178 592	181 766	1 305	7.18	7.10
40-44	163 224	166 125	1 572	9.46	9.20
45-49	127 157	129 417	1 612	12.46	12.30
50-54	114 318	116 349	1 886	16.21	16.50
55-59	78 935	80 338	2 019	25.13	23.00
60-64	68 718	69 939	2 409	34.44	32.70
65-69	44 294	45 081	2 421	53.70	48.00
70-74	30 729	31 275	2 396	76.61	70.32
75-79	15 390	15 663	1 648	105.22	103.02
80-84	8 884	9 042	1 238	136.92	150.92
85-89	3 384	3 444	596	173.05	221.10
90-94	1 557	1 585	284	179.18	323.91
95-99	724	737	126	170.96	474.53
100 and over	460	468	101	215.81	695.19
Age not stated	12 698				
Total	2 912 558	2 951 392	42 578		

/Table 2

Table 2

ABBREVIATED TABLE OF MALE MORTALITY FOR CHILE, 1952-1953

x, x+n-1	$_nq_x$	l_x	$_nd_x$	$_nL_x$	T_x	e^o_x
0	0.12796	100 000	12 796	90 518	5 295 092	52.95
1	0.02182	87 204	1 903	86 081	5 204 574	59.68
2	0.00945	85 301	806	84 874	5 118 493	60.01
3	0.00452	84 495	382	84 296	5 033 619	59.57
4	0.00308	84 113	259	83 978	4 949 323	58.84
5- 9	0.00990	83 854	830	417 065	4 865 345	58.02
10-14	0.00871	83 024	723	413 143	4 448 260	53.58
15-19	0.01460	82 301	1 202	408 844	4 035 117	49.03
20-24	0.01981	81 099	1 607	401 750	3 626 273	44.71
25-29	0.02349	79 492	1 867	393 053	3 224 523	40.56
30-34	0.02812	77 625	2 183	382 982	2 831 470	36.48
35-39	0.03492	75 442	2 634	370 986	2 448 488	32.46
40-44	0.04502	72 808	3 278	356 304	2 077 502	28.53
45-49	0.05976	69 530	4 155	337 605	1 721 198	24.75
50-54	0.07939	65 375	5 190	314 545	1 383 393	21.16
55-59	0.10901	60 185	6 561	285 261	1 068 848	17.76
60-64	0.15156	53 624	8 127	248 532	783 587	14.61
65-69	0.21483	45 497	9 774	203 625	535 055	11.76
70-74	0.29926	35 723	10 690	152 019	331 430	9.28
75-79	0.40774	25 033	10 207	99 078	179 411	7.17
80-84	0.53871	14 826	7 987	52 922	80 333	5.42
85-89	0.68264	6 839	4 669	21 117	27 411	4.01
90-94	0.81926	2 170	1 778	5 489	6 294	2.90
95-99	0.91963	392	360	759	805	2.05
100 and over	1.00000	32	32	46	46	1.44

Source: Tacla O. and Pujol J.M., op. cit.

MORTALITY (6)

DETERMINATION OF THE MORTALITY RATE IN A COUNTRY EXCLUSIVELY ON THE BASIS OF CENSUS DATA: (a) NUMBER OF SURVIVING CHILDREN AND LIVE BIRTHS, BY AGE OF WOMEN; (b) POPULATION BORN IN THE COUNTRY CLASSIFIED BY SEX AND AGE IN TWO SUCCESSIVE CENSUSES

C. Arretx

Background

In many Latin American countries the data obtained from the continuous registers of births and deaths suffer from errors of omission and completeness which limit their use in determining rates of fertility and mortality. Various methods adopted to overcome these gaps in vital statistics are based on the use of population census data. They include the methods proposed by Professor Mortara 1/, who carried out a study of the demographic situation in Brazil, where there are no vital records at a national level.

Other methods 2/ 3/ devised since and used in some countries of the region have shown promising results. A method introduced by Professor W. Brass 3/ for determining the mortality rate by means of a life table prepared exclusively with census data is described below. It enables youth mortality (under 20 and over 15 years of age) to be shown separately from adult mortality.

1/ United Nations, Methods of Using Census Statistics for the Calculation of Life Tables and Other Demographic Measures, (ST/SOA/Series A/7), by Giorgio Mortara.

2/ United Nations, Manual IV. Methods of Estimated Basic Demographic Measures from Incomplete Data, (ST/SOA/Series A/42), by Ansley Coale and Paul Demeny.

3/ William Brass, The Demography of Tropical Africa (Princeton University Press, 1968).

/1. Determination

1. Determination of youth mortality

Use of data on live births and children surviving at the date of the census, according to the age of the women.

(a) Theoretical considerations

If the following factors are known:

(i) the mortality rate to which a population is subjected, i.e., the probability that a recently born person will die before reaching age x: q(x); and

(ii) the fertility rate according to the ages of the women: f(x) it is possible to calcutate the average number of children born alive to women of any age: HT, and the number still living: HS (or dead:HD). It has been found that the ratio of HS to HT depends essentially on the mortality rate and is not too affected by changes in fertility.

By combining different mortality and fertility rates a table of HS/HT ratios can be calculated, which cover a wide range of possible cases. The mortality rate of a country can be estimated on the basis of a comparison between the values observed in a census and those contained in prepared theoretical tables. For example, these types of estimates have been prepared on the basis of the results of the experimental census in Costa Rica 1/.

The method divised by Professor W. Brass goes further, being used to determine the probability of death for persons of given age. The HS/HT ratios, which are called D_i, i being the order of the age group i=1,2...10 (15-19 to 60-64 years), are converted into probability of death ages 0 and x : q(x). This conversion is based on an empirical verification of the similarity between the proportions D_i and the q(x) values at exact ages. The following table shows the probability of death which corresponds to D_i at given ages.

Through the use of multipliers, whose preparation need not be explained here, which are applied to D_i, estimates are obtained for q(x). The results are highly satisfactory, particularly for the probability of death of persons under 15 years of age (women under 45). Estimated mortality q(x) relates to both sexes.

1/ Experimental Census of Costa Rica, CELADE Series A/108.

/Age group

Age group of women	D_i	$\simeq$	$q(x)$
15-19	D_1	$\simeq$	$q(1)$
20-24	D_2	$\simeq$	$q(2)$
25-29	D_3	$\simeq$	$q(3)$
30-34	D_4	$\simeq$	$q(5)$
35-39	D_5	$\simeq$	$q(10)$
40-44	D_6	$\simeq$	$q(15)$
45-49	D_7	$\simeq$	$q(20)$
50-54	D_8	$\simeq$	$q(25)$
55-59	D_9	$\simeq$	$q(30)$
60-64	D_{10}	$\simeq$	$q(35)$

(b) Practical use 1/

Using the data on surviving children and live births gathered in the Brazil 1940 and 1950 censuses and following the methodology suggested by Professor Brass, the following results were obtained (see table 1).

With the above results it is possible to obtain other functions from a life table for ages under 20 years. They include that relating to static population, or the number of years lived between x and x+n : ${}_nL_x$, which is used in determining adult mortality in accordance with the above-mentioned procedure.

Since the probability of death obtained: $q(x)$ - or its complement $l(x)$ - relates to both sexes, it is necessary to establish a hypothesis on the mortality differential by sex, on the basis of what is observed in available life tables. Once this is done and the probability of death $l(x)$ is obtained by sex, it is possible to calculate ${}_5L_x$ through the usual methods.

1/ Arretx, C., "Revisión de las estimaciones de mortalidad intercensal utilizando nuevos procedimientos" (CELADE, in course of preparation).

/Table 1

Table 1

BRAZIL: ESTIMATED PROBABILITY OF DEATH q(x) BASED ON HS/HT RATIOS, 1940 AND 1950

Age group of women	Age at which the probability of death is estimated	HS/HT = D_i		Multipliers k_i		Probability of death q (x)		Survivors at exact age x l (x)	
		1940	1950	1940	1950	1940	1950	1940	1950
15-19	1	0.15239	0.14678	1.083	1.058	0.16504	0.15529	83 496	84 471
20-24	2	0.18488	0.16655	1.061	1.050	0.19616	0.17488	80 384	82 512
25-29	3	0.20828	0.18551	1.022	1.016	0.21286	0.18848	78 714	81 152
30-34	5	0.22537	0.20446	1.036	1.048	0.23348	0.21427	76 652	78 573
35-39	10	0.24505	0.22473	1.045	1.056	0.25608	0.23731	74 392	76 269
40-44	15	0.27057	0.24472	1.027	1.038	0.27788	0.25402	72 212	74 598
45-49	20	0.29002	0.26247	1.027	1.041	0.29785	0.27323	70 215	72 676

/In this

In this case the following results were obtained for 1950:

${}_nL_x$	Both sexes	Male	Female
${}_5L_0$	415 396	412 052	418 906
${}_5L_5$	387 105	382 865	391 575

2. Determination of adult mortality on the basis of inter-censal survival ratios

(a) Theoretical considerations

There are several methods of determining mortality rates on the basis of inter-censal survival ratios. Among the best known are those devised by Mortara 1/, Coale and Demeny 2/ and Brass 3/. The Brass method is described here as it offers some advantages over the others. It may be summarized in the following points:

Inter-censal survival ratios are established - say, for five-year age groups - and are valid for a period of 10 years : ${}_{10}{}_5P_x$.

The remaining ${}_5L_x$ are calculated on the basis of ${}_5L_0$ and ${}_5L_5$ - obtained as indicated in point 1 - and the inter-censal survival ratios:

$${}_5L_0 \quad {}_5P_0 = {}_5L_{10} \qquad {}_5L_5 \quad {}_5P_5 = {}_5L_{15}$$

$${}_5L_{10} \quad {}_5P_{10} = {}_5P_{20} \qquad {}_5L_{15} \quad {}_5P_{15} = {}_5L_{25}$$

.....

1/ United Nations, Methods of Using Census Statistics for the Calculation of Life Tables and Other Demographic Measures, (ST/SOA/Series A/7), by Giorgio Mortara.

2/ United Nations, Manual IV. Methods of Estimated Basic Demographic Measures from Incomplete Data., (ST/SOA/Series A/42), by Ansley Coale and Paul Demeny.

3/ William Brass, The Demography of Tropical Africa (Princeton University Press, 1968).

/It is

It is assumed that one-fifth of each ${}_5L_x$ value is equal to an $l(x)$ value for a given intermediate age in the ages determining the interval considered, for example:

$$1/5\ {}_5L_{10} = l(z), \text{ while } z = 12.5$$

After obtaining the $l(x)$ sequence of values, which are called observed values, they are compared with other values taken from a chosen standard life table: $l^s(x)$. This is done not by comparing the $l(x)$ values directly, but those resulting from a conversion. The conversion used is defined as follows: $\text{logit}\ (1-l(x)) = 1/2 \log_e \frac{1-l(x)}{l(x)}$

The converted values, logit $(1-l(x))$, from the observed $l(x)$ values are adjusted by means of a liner ratio to the logit $(1-l^s(x))$, from the standard table. The adjusted $l(x)$ values observed are thus defined.

(b) Practical use

With the data on native-born population, by sex and age group, in the Brazil 1940 and 1950 censuses, and following the methodology described in the previous section, it was possible to determine the mortality rate for persons over 10 years of age; that for persons under 10 was obtained as explained in point 1. The results obtained - a summarized life table - are shown in table 2.

/Table 2

Table 2

BRAZIL: SUMMARIZED LIFE TABLE FOR THE MALE POPULATION, 1940 AND 1950

x	Age n	l_x	$_nd_x$	$_nq_x$	$_nL_x$	T_x	e^o_x
0	1	1 000	148	0.148	90 084	4 214 615	42.15
1	1	852	41	0.048	82 781	4 124 531	48.41
2	3	811	32	0.039	238 500	4 041 750	49.84
5	5	779	18	0.031	385 000	3 803 250	48.82
10	5	761	16	0.021	376 500	3 418 250	44.92
15	5	745	24	0.032	366 500	3 041 750	40.83
20	5	721	33	0.046	352 250	2 675 250	37.10
25	5	688	32	0.047	336 000	2 323 000	33.76
30	5	656	34	0.052	319 500	1 987 000	30.29
35	5	622	41	0.066	300 750	1 667 500	26.81
40	5	581	49	0.084	278 250	1 366 750	23.52
45	5	532	58	0.109	251 500	1 088 500	20.46
50	5	474	65	0.137	220 750	837 000	17.66
55	5	409	72	0.176	186 500	616 250	15.07
60	5	337	76	0.226	149 500	429 750	12.75
65	5	261	67	0.257	113 750	280 250	10.74
70	5	194	78	0.402	77 500	166 500	8.58
75	5	116	56	0.483	44 000	89 000	7.67
80	∞	60	60	1.000	45 000	45 000	7.50

/MIGRATION (7)

MIGRATION (7)

SOME DIFFERENTIAL CHARACTERISTICS OF MIGRANTS

J. Vidal

General features

A knowledge of population movements within the national territory is very important, both from the strictly demographic point of view, that is, as a component of changes in the population (size composition) at points of entry and departure, and because of the practical usefulness of information on various aspects of economic and social planning, problems relating to the process of urbanization, etc.

The population census is currently the most important, if not the only available, source of information in this field, which points up the need to make good use of census results.

Various types of questions have been included in population censuses with a view to investigating internal migrations, for instance, place of birth, previous residence, with indication of the date of arrival in the place of enumeration, or residence at an established date prior to the census, usually five years previous.

Moreover, without including specific questions, it is also possible to use the results of the censuses to obtain an estimate of migration. For this purpose it is necessary to have information from two or more censuses about the sex and age distribution of the population, either for the entire country or for one or more of the major or intermediate civil divisions.

Information used

In the example given below, use is made of the results of the census conducted in Guatemala in 1964, which included a question on the place of previous residence of the population and the year of arrival of migrants. In particular, the following three aspects are analysed: (a) Percentage of migrants by area; (b) Date of occurrence of migratory movements; (c) Sex composition; and (d) Literacy. In (b), (c) and (d) a distinction is also made between areas, that is, the capital, other urban localities and rural areas. The tabulations used come from a sample of the above-mentioned census, and were calculated in CELADE.

/(a) Percentage

(a) Percentage of migrants in the total population, by areas. Table 1 was prepared on the basis of the tabulation which presents migrants (defined by place of previous residence) by type of movement, that is, whether they migrate within the major civil divisions or between such divisions, and by area.

Table 1

GUATEMALA: MIGRANTS BY PLACE OF PREVIOUS RESIDENCE, AREA AND TYPE OF MOVEMENT

Area	Percentage of migrants	Type of movement		
		Within the major civil division (per cent)	Between major civil divisions (per cent)	Total migrants
Capital	35.0	16.1	83.9	100.0
Other urban localities	21.1	39.2	60.8	100.0
Rural	16.3	45.8	54.2	100.0
Total	19.8	37.2	62.8	100.0

Source: CELADE, Operación Muestras de Censos (OMUECE). Unpublished tabulations.

From this table it can be seen that migrants account for roughly 20 per cent of the total population: 35 per cent in the capital, 21 per cent in other urban localities and only 16 per cent in rural areas. The same table also shows significant differences in the type of migration prevalent in each area. Indeed, of the total migrants registered in the capital, nearly 84 per cent came from other major civil divisions and the remaining 16 per cent from intermediate divisions of the same major division in which the capital is located.

In the rural area, on the other hand, only about 54 per cent of migrants originated in other major civil divisions, the remainder being migrants within the same division. Between these two extremes there is the proportion of migrants in urban areas, excluding the capital, 63 per cent of whom originated in other major civil divisions.

/(b) Date

(b) Date of migration. Table 2 was prepared on the basis of the tabulation which includes the time of arrival in the place of enumeration, as well as the type of migration. The figures in the table show that there are differences with respect to the time of arrival in the areas of destination between those migrants who have moved into the major civil divisions and those who have moved within those divisions. It can be seen, for instance, that the register of migration to the capital goes back longer than migration to the other areas considered in this analysis.

There is a certain similarity between the times of arrival of the migrant population in urban and rural areas, especially in the case of migration within the major civil divisions (see table 2).

It should be noted that, owing to the enumeration procedure, the figures cover only net surviving migrants, at the moment of holding the census. Surviving in the sense that they are alive at the time of the census, and not in the sense that they have not emigrated after their arrival, as is obvious.

(c) Composition by sex. As migrations differ according to sex, all tabulations on the matter should be prepared separately for the male and female sexes. On the basis of the tabulations from the sample of the Guatemala census, mentioned above, the percentage of males among migrants has been calculated according to area and type of movement. The figures are contained in table 3.

In the case of the capital and the remaining urban localities, the proportion of males (number of men for every 100 women) is significantly lower than the percentage observed in the non-migrant population of the respective areas. In the case of rural areas, it is seen that there is a greater predominance of men, compared with the non-migrant population of rural areas.

A comparison of the indices of male migrants within the major civil divisions and between those divisions shows that, here too, there are significant differences. In the urban area, excluding the capital, and in the rural area, the indices of male migrants within the respective major civil divisions are higher than the indices for migrants between those divisions. On the other hand, in the case of the capital, the index is lower for migrants between major civil divisions, which is in consonance with the generally observed fact that major cities attract more men than women.

/Table 2

Table 2

GUATEMALA: PERCENTAGE DISTRIBUTION OF MIGRANTS BY DURATION OF RESIDENCE, AREA AND TYPE OF MOVEMENT, 1964 (MIGRANTS REGISTERED AT POINT OF ENTRY)

Duration of residence (years)	Capital		Other urban		Rural	
	Within the MCD	Between MCDs	Within the MCD	Between MCDs	Within the MCD	Between MCDs
Under 1 year	4.3	7.4	12.1	16.4	12.2	16.0
1 - 4	18.4	21.9	27.3	29.3	29.7	33.2
5 - 9	18.4	20.9	17.9	17.9	18.3	20.6
10 or more	57.0	49.8	42.7	36.4	39.8	30.2
Total migrants	100.0	100.0	100.0	100.0	100.0	100.0

Source: CELADE, Operación Muestras de Censos (OMUECE). Unpublished tabulations.

Note: MCD = Major Civil Division

/Table 3

Table 3

GUATEMALA: INDEX OF MALES IN THE MIGRANT AND NON-MIGRANT POPULATION, BY TYPE OF MOVEMENT AND AREA, 1964

Area	Indices of male population			
	Non-migrants	Migrants		
		Total	Within the MCD	Between MCDs
Capital	93.4	74.1	75.7	73.8
Other urban	96.3	88.0	84.0	90.3
Rural	103.7	112.8	103.0	121.4
Total	100.1	96.6	95.4	97.3

Source: Same as for table 2.

(d) Literacy. This characteristic of the migrant population in comparison with the total population can be studied on the basis of the tabulation which cross-classfies the condition, area and literacy of the migrant. Table 4, which will be found below, was prepared for this purpose.

It will be seen that there are differences between the migrant population and the total population in the areas considered. The degree of illiteracy in the migrant population is generally less than that recorded for the total population of the respective area. The exception is Guatemala City (the capital), where the level of illiteracy among migrants is slightly higher than for the total population.

/Table 4

Table 4

GUATEMALA: PERCENTAGE OF LITERATES AND ILLITERATES IN THE TOTAL POPULATION AND IN THE MIGRANT POPULATION WITH LESS THAN FOUR YEARS' RESIDENCE IN THE PLACE OF ENUMERATION, 1964

Area	Percentage of literates		Percentage of illiterates	
	Total population	Migrants with less than 4 years' residence	Total population	Migrants with less than 4 years' residence
Capital	82.8	78.2	17.2	21.8
Other urban	55.2	71.8	44.8	28.2
Rural	23.8	33.4	76.2	66.6
Total	38.9	53.1	61.1	46.9

Source: Same as for table 2.

MIGRATION (8)

ESTIMATE OF INTERNAL MIGRATION ON THE BASIS OF CENSUS INFORMATION. USE OF TABULATION OF POPULATION BY SEX AND AGE AND BY PLACE OF BIRTH AND PLACE WHERE ENUMERATED

C. Arretx

The 1940 and 1950 censuses in Brazil included tabulations on the native-born and non-native born population by sex and age groups, classified by state of birth and state of census enumeration. These data can be used to estimate inter-state (or interregional) migration during the period between the censuses. It should be noted that the migration measured was that between the place (state) of birth and the place (state) of enumeration; any migration that might have occurred in the interim was not measured.

1. Theoretical considerations

On the basis of the census data the population of a certain state, say state X, can be classified into the following non-inclusive categories:

(a) Persons born in X and present in it at the time of the census, referred to as Native-born Non-migrants: N, although this term is not quite precise since there may have been out- and immigrations that do not show up in the census data.

(b) Persons born in X but present in another state at the time of the census, referred to as Out-migrants: E.

(c) Persons born in foreign countries and present in X at the time of the census, referred to as Foreign-born inmigrants: IE.

(d) Persons born in other states but present in X at the time of the census, referred to as Native-born immigrants: IN.

International migration by persons born in state X to or from foreign countries is taken to be of little significance, and is therefore given a zero value for the entire intercensal period.

/The evolution

The evolution of the above categories shows the size and structure of the population in state X. It is useful, therefore, to look at the changes in each of these categories during the intercensal period 1940-1950, on the basis of which reasonable hypotheses can be developed regarding the future trend in each category for use in the preparation of population projections at the state level.

In order to measure changes in each category, it is necessary to establish the level of mortality and fertility affecting them throughout the intercensal period. For practical purposes, it will be assumed that mortality and fertility levels among persons born in state X do not vary depending on whether they are migrants or non-migrants. This assumption may be roughly correct as regards mortality, but the same is not the case with fertility. Certain studies of fertility 1/ and internal migration 2/ indicate that there is a difference in the fertility of the migrant and non-migrant population (the former being less). Given, however, the poor quality of the data available and the lack of criteria for establishing differences in fertility in the various categories, it would seem reasonable to adopt a single fertility level for each of the population categories in state X.

Assuming:

(i) that the 1940 and 1950 censuses are comparable as regards coverage, declarations of age and declarations of place of birth; and

(ii) that mortality and fertility levels were as estimated for the population as a whole.

An estimate may be made of the survivors in 1950 of the 1940 population and of those born in the period 1940-1950 for each of the population categories. The number of survivors thus estimated can then be compared with the population actually enumerated in the 1950 census.

If assumptions (i) and (ii) are correct, and if increases and decreases in the population in each category are the result only of births and deaths, the estimates and the census figures for each category should be

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1/ Tabah L., Samuel R., "Resultados preliminares de una encuesta de fecundidad y de actitudes relativas a la formación de la familia en Santiago de Chile" (CELADE, Series A, Nº 26, 1960).

2/ CELADE, "Encuesta sobre migraciones en el Gran Santiago: Informe General", first part (CELADE, Series A, Nº 15, 1962).

/the same.

the same. If they are not, and taking the above assumptions as valid, the differences must be attributed to increases or decreases brought about by migratory movements in each category.

The above can be expressed symbolically, excluding the sex and age variables for purposes of simplicity, as follows:

Let N^z be the native-born non-migrant population of state X in year z

E^z the out-migrants of X in year z

IE^z the foreign-born inmigrants in X in year z

IN^z the native-born (Brazilian) inmigrants in X in year z

P the survivorship function for the period 1940-1950 showing, on the basis of the initial population, the number of survivors ten years on.

The following relationship can then be established:

(1) $N^{40} \cdot P = (N^{50})$

the second term of which, within brackets, is an estimate of the survivors in 1950 of native-born non-migrants of X, calculated on the basis of the native-born migrants of X enumerated in the 1940 census. Comparing this estimate with the number on native-born non-migrants of X actually enumerated in 1950 - N^{50} without brackets - there are three possibilities:

(i) $N^{50} < (N^{50})$

(ii) $N^{50} > (N^{50})$

(iii) $N^{50} = (N^{50})$

Taking the assumptions given above as valid, these possibilities can be interpreted as follows.

If (i) is the case, it means that native-born persons of X migrated out in the period 1940-1950, i.e., part of the non-migrants of state X in 1940 left X in the period 1940-1950.

/If (ii)

If (ii) is the case, there was an immigration of native-born of state X (returns), i.e., persons born in state X but outside the state in 1940 returned to X during the period.

If (iii) is the case, then there were no migratory movements by native-born non-migrants of state X.

Similarly, the following relations can be established with three possibilities in each case:

(2) $E^{40} \cdot P = (E^{50})$

$E^{50} \gtrless (E^{50})$

if $>$ indicates, out-migration of native-born of X between 1940 and 1950

if $<$ indicates immigration of native-born of X (return migration) over period

if $=$ indicates no migratory movements by native-born non-migrants of X over period

(3) $IE^{40} \cdot P = (IE^{50})$

$IE^{50} \gtrless (IE^{50})$

if $>$ indicates immigration of foreign-born in 1940-1950

if $<$ indicates out-migration of foreign-born present in X in 1940

if $=$ indicates no migratory movements by foreign-born enumerated in X in 1940

(4) $IN^{40} \cdot P = (IN^{50})$

$IN^{50} \gtrless (IN^{50})$

if $>$ indicates immigration of Brazilians from other states during 1940-1950

if $<$ indicates out-migration of Brazilians present in X in 1940

if $=$ indicates no migratory movements by Brazilian immigrants present in X in 1940.

/The net

The net balance of migration, i.e., the differences between the inmigrant native- and foreign-born population and the out-migrant native- and foreign-born population can be established as follows:

$$S = IN + IE - E$$

On the basis of the above relationships two alternative figures can be obtained for the volume of native-born out-migrants of state X, one from relationship (1) and the other from (2). If the census information data were correct and error-free, and if mortality and fertility experienced by each population category were at the level assumed, both figures should be the same. If they are not, then the difference implies that one or both of the assumptions adopted is incorrect. The differences obtained in the present case, as will be seen below, are insignificant and can be attributed to census errors rather than to any failing in the assumptions adopted.

2. Practical application

The above procedure was used to estimate the future population of some states in Brazil 1/ 2/. The present paper gives the estimate of internal migration by the male population during the period 1940-1950 in the state of Minas Gerais.

Table 1 shows the results of applying each of the four relationships mentioned above and gives an estimate of the net balance of migratory movements.

1/ C. Arretx, "Minas Gerais: Proyecciones de la población, 1950-1990", provisional report (CELADE S/519/59).

2/ C. Arretx, "Brasil: Estimación de la población de São Paulo para 1960" (CELADE C/47).

/Table 1

Table 1

ESTIMATED MIGRATORY MOVEMENTS BETWEEN 1940 AND 1950 IN THE STATE OF MINAS GERAIS. EFFECT CALCULATED AS OF 1950

(Male population)

Age in 1950	Out-migration using relationship (1)	Out-migration using relationship (2)	Inmigration Foreing-born (3)	Inmigration Native-born (4)	Net balance (3)+(4)-(1)	Net balance (3)+(4)-(2)
0 - 9	83 905 a/	83 905	169	15 246	-68 490	-68 490
10 - 19	73 502	82 897	173	8 046	-65 283	-74 678
20 - 29	101 206	100 888	444	5 309	-95 453	-95 135
30 - 39	59 148	43 031	414	1 522	-57 212	-41 095
40 - 49	6 084	25 497	-112	-409	-6 605	-26 018
50 - 59	21 482	7 593	-623	-1 910	-24 015	-10 126
60 - 69	4 088	4 037	-389	-1 131	-5 608	-5 557
70 and over	500	2 131	-293	-269	-1 062	-2 693
Total	349 915	349 979	-217	26 404	-323 728	-323 792

a/ Corresponds to estimates obtained from relationship (2). In this case, relationship (1) is not applicable.

INTERNATIONAL MIGRATION (9)

ANALYSIS OF THE AVERAGE AGES OF MIGRANTS OBTAINED FROM THE TABULATION ON FOREIGN-BORN POPULATION BY SEX AND AGE GROUPS

Julio Morales

It is the practice in censuses generally to make an investigation of the country or region of birth of foreign-born persons; this, with certain limitations, allows an approach to be made to the study of international migration.

This information both gives the volume of movements of persons coming from different countries in recent times, and also, using appropriate tabulations, their main economic, educational and demographic characteristics and the place where they are present or resident at the time of the census. When these tabulations are analysed, however, it should always be borne in mind that the population registered is made up of the "survivors" (in the literal sense of the term and in the sense of the remnant of non-re-emigrants) at the time of the census of earlier immigrants, with the characteristics acquired between then and now. This, thus prevents a direct comparison of this information with the data from the continuing statistics of the movement of persons between countries.

Other useful variables for the study of international migration which can be investigated using the population census are:

(a) Year of arrival in the country;

(b) Original place of settlement;

(c) Place of residence at the time of the census (by which transients can be included), and

(d) Place of residence at a fixed time previous to the census (5 years previously, for example).

The last two points are also of great interest for the study of internal migration.

/Analysis of

Analysis of the average age of migrants

It is common practice for countries to publish information on their foreign-born population, classified by sex and age groups. With these data, the average age for each sex can be calculated; in a first phase, this is a useful index for estimating the length of stay of immigrants from abroad.

The data published in the 1960 Population Census of Argentina can be used to calculate the average ages of different groups of the native population as can be seen in table 1.

Starting from the basis that the age structures at the time of migration have not changed to any great degree with the course of time, even when the intensity of migratory movements has undergone noticeable changes, and that among the native population of different origins there is no reason for outstanding structural differences it can be concluded that the great differences in the average ages of different groups of the native population seen in table 1 correspond to the different lengths of time since the main immigration flows from the different countries or regions took place.

For example, taking the fact that migration from Europe experienced a last upsurge in the years following the Second World War, and that between 1930 and 1945 approximately overseas migration was practically at a standstill, the advanced average age of European-born immigrants (54.6 years) can easily be understood. A similar situation can be found with regard to Uruguayan-born immigrants and in part Brazilian-born immigrants (53.8 and 46.5 years respectively on average). At the other end of the scale are the Bolivian-born immigrants (29.0 years), whose low average age is to be explained by the very recent inflow of Bolivian labourers to the Argentinian provinces of Jujuy and Salta, for the main part. Chilean-born and Paraguayan-born immigrants also have a low age average (32.0 and 33.3 years respectively), which suggests at least that the intense migratory flows from these countries over the last few years have been maintained.

The appreciable difference in age between those born in Argentinian territory and the foreign-born population should be emphasized. There are differences of almost 30 years, this being determined to a large extent by the density of the population of European origin. But even between the population born in Bolivia and the native Argentinian population there is an age gap of over five years, the Bolivians being the older, which goes to show that very young contingents are rare in any international migratory process.

/Table 1

Table I

ARGENTINA: AVERAGE AGES (YEARS) OF NATIVE POPULATION BY ORIGIN AND SEX

Country or region of birth	Average ages			
	Both sexes	Males	Females	Differences between males and females
Total	27.0	27.0	27.1	-0.1
Argentina	23.8	23.3	24.3	-1.0
Total foreign countries	51.9	52.3	51.4	+0.9
Europe	54.6	55.0	54.1	+0.9
Bolivia	29.0	29.2	28.8	+0.4
Brazil	46.5	47.1	45.9	+1.2
Chile	32.0	32.6	30.8	+1.8
Paraguay	33.3	33.7	32.8	+0.9
Uruguay	53.8	53.1	54.5	-1.5

Source: The native population of border countries present in the Republic of Argentina, according to the 1960 population census, Julio Morales. Series A, Nº 113, September 1971.

/It is

It is interesting to note that quite regularly among the foreign-born population - with the sole exception of those born in Uruguay - the average age of the males is higher than that of the females of the same origin. Although the differences are not great, their regular appearance requires some sort of explanation. It could well be due, in part at least, to the immigration of married couples where the age of the man is normally greater than that of the women. In boom immigration periods, it could equally be due to the presence of male advance guards as the migratory process becomes more intense. The fall in the migratory flows, however, as in the case of Uruguay, certainly involves a drop in the number of migrants of both sexes; the higher mortality rate for men, however, especially of advanced age, and the possible return of male migrants who choose to go back to their country of origin, could in concrete cases produce a greater average age for female migrants.

This analysis can be considerably improved if the average ages are calculated for different geographical areas of the country covered by the census, by using the criteria of greater or less attraction for immigrants. In the case of Argentina, for example, it may be observed that the average age of immigrants born in the border countries, with the exception of Bolivia, is noticeably higher in the provinces of less attraction than in the provinces of greater attraction, including the metropolitan areas of Buenos Aires, i.e., the immigrant contingents of the last few years seem to have tended to concentrate in the provinces of greater attraction, even Uruguayan migration, which, as already noted, was in 1960 showing very little dynamism.

SPATIAL DISTRIBUTION OF THE POPULATION (10)

COMPARISON OF DIFFERENT DEFINITIONS OF THE URBAN POPULATION AND DISTRIBUTION OF THE URBAN POPULATION BY SIZE OF COMPONENT LOCALITIES

J. Vidal

General background

Although for some purposes it is useful to know the total population of a country, for others it is more useful to know the territorial distribution of the population at the same time.

In population censuses it is usual for the information collected to be tabulated in terms of major, intermediate and even minor administrative divisions, urban and rural areas, and at times in terms of the distribution of the population according to the size (number of persons) of the localities in the country. Tabulations in terms of administrative divisions (especially major and intermediate divisions), and urban and rural areas normally cover most of the characteristics investigated in the census. On the other hand, tabulations relating to the population in localities generally take account only of the number of persons in each of them (size groups are formed for the purposes of the tabulation), without adding other characteristics of the respective populations, with the exception of sex, which is sometimes included.

These tabulations, apart from their practical utility for local administrative needs (estimates of the goods and services required by different areas, background material for economic and social planning, inter alia), constitute an important variable for the study of numerous demographic aspects which point to differences between some of these areas as regards such characteristics as fertility, mortality, migration, distribution by sex, age, etc.

Information used

For the example which follows, information has been taken from those tabulations which classify population into urban and rural categories, on the one hand, and those which present the distribution of population by size of localities, on the other. The data refer to the last two censuses conducted in Argentina, Brazil, Colombia and Guatemala, and Mexico.

/The degree

The degree of urbanization in each of these countries is analysed, using as a basis for the analysis the percentage of urban population according to the census definition and according to a uniform definition (population in localities of 20,000 inhabitants or more). The distribution of the urban population among its component localities is also studied, on the basis of this latter definition.

(a) Degree of urbanization according to the censal and uniform definitions of urban population. This study can be carried out on the basis of table 1, which was drawn up in the light of information from the tabulations mentioned above.

The figures in the table show that the countries included in it have varying levels of urbanization and that there is an increase in the respective percentages of urban population in all of them during the intercensal period studied, whichever definition of urban population is considered.

In relative terms, the amount of the increase in the percentage of urban dwellers is greater in respect of the population of localities of 20,000 inhabitants or more. In the case of Colombia, for instance, although the percentage of urban dwellers according to the census definition went up 45 per cent, the increase corresponding to the uniform definition was 59 per cent. Something similar occurs in the case of Mexico, where the corresponding increases are 20 and 31 per cent, respectively. However, it should be noted that in Argentina and Guatemala, the proportional increases in the indexes of urbanization in the intercensal period were practically identical under both definitions (censal and uniform).

The numerically lower result obtained with the uniform definition, as compared with the censal definition, is obviously due to the fact that, for all the countries included in the table, the latter definition includes localities of less than 20,000 inhabitants.

/Table 1

Table 1

URBAN AND RURAL POPULATION OF SELECTED LATIN AMERICAN COUNTRIES, ACCORDING TO THE CENSAL DEFINITION AND THE UNIFORM DEFINITION (LOCALITIES OF 20 000 INHABITANTS OR MORE), AND DISTRIBUTION OF THE URBAN POPULATION (UNIFORM DEFINITION) BY SIZE OF COMPONENT LOCALITIES

(Percentages)

Country and year	Percentage of urban population		Percentage of rural population		Percentage distribution of the urban population (uniform definition) by size of localities					
	Censal definition	Uniform definition	Censal definition	Uniform definition	Total urban population	20 000 to 49 999	50 000 to 99 999	100 000 to 499 999	500 000 to 999 999	1 million and over
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Argentina										
1947	62.5	49.1	34.5	50.9	100.0	10.7	7.8	21.0	-	60.5
1960	73.8	57.7	26.2	42.3	100.0	11.8	5.8	13.8	10.2	58.4
Colombia										
1951	36.3	23.0	63.7	77.0	100.0	18.1	15.1	39.9	26.9	-
1964	52.8	36.6	47.2	63.4	100.0	10.9	14.0	27.7	20.9	26.5
Brazil										
1950	36.2	20.2	63.8	79.8	100.0	19.1	15.4	19.4	4.9	41.2
1960	45.7	28.4	54.3	71.6	100.0	18.4	14.8	21.3	13.4	32.1
Guatemala										
1950	25.0	11.2	75.0	88.8	100.0	8.9	-	91.1	-	-
1964	34.0	15.5	66.0	84.5	100.0	13.9	-	-	86.1	-
Mexico										
1950	42.6	26.4	57.4	73.6	100.0	18.5	13.6	24.5	-	43.4
1960	50.7	34.7	49.3	65.3	100.0	16.5	13.3	19.4	19.4	39.8

Sources: Census publications and CELADE, Boletín Demográfico, Nº 9.

(b) Distribution of the urban population (uniform definition) according to the size of the component localities. When the percentage of the population resident in localities of 20,000 inhabitants or more is used as a measure of the urban population, this solves the problem of international comparability, on the one hand, and it may be considered that this measurement covers those agglomerations with effectively urban characteristics, on the other. However, this global figure obviously does not indicate the size of the agglomerations which compose the universe. Knowledge of this detail is of value for many practical and analytical purposes. The above-mentioned table includes the distribution of the urban population in localities of 20,000 inhabitants or more, by size of the localities. It is noticed immediately that there are significant differences among the countries considered. Indeed, it is seen, for instance, that 60 per cent of the urban population of Argentina is concentrated in cities of more than 1 million inhabitants, while in Brazil the figure is barely 40 per cent, which is similar to the result observed in the case of the urban population of Mexico. In countries like Colombia (1964) only slightly more than one quarter of the urban population is resident in localities of 1 million inhabitants or more.

Significant differences are also noted in the proportions of the urban population resident in localities of less than 1 million inhabitants. In this connexion, the data contained in the table give a much more complete picture of the different types of distribution of the urban population than is obtained from the over-all percentage of urban dwellers, whichever definition is used.

These figures also give an idea of the trend in this distribution during the last intercensal period. The most significant aspect in this regard seems to be the decline in the relative importance of towns of 1 million inhabitants or more and of towns of 20,000 to 50,000 inhabitants, to the advantage of intermediate-sized localities. It should be borne in mind that the changes observed in the interval between the last two censuses not only indicate the growth of the towns in the respective categories, but also the transition of some of them from one group to another, owing to the increase in their population. This point must also be considered when the evolution of the overall percentage of urban dwellers (under either of the two definitions) is examined.

NUPTIALITY (11)

DETERMINING LEVELS OF NUPTIALITY ON THE BASIS OF CENSUS INFORMATION. USE OF TABULATION ON POPULATION BY MARITAL STATUS, SEX AND AGE

C. Arretx

Background

It is necessary to study the level and structure of nuptiality in a country as these are related to other variables of an economic, demographic and social character. It is known, for example, that the rate of participation by women in economic activities is closely related to their marital status; that the pattern of nuptiality - level and structure by age - is one of the factors that influence fertility; that the internal migration is not the same as international migration in terms of marital status; etc. Consequently population censuses in general collect data on the composition of the population by marital (or conjugal) status.

In its broadest sense, the concept of nuptiality implies a change from the status of single person to that of a non-single person, and the nuptiality tables are usually based on this concept.

Given that in several Latin American countries the frequency of consensual (or de facto) unions is high - and differs in each age group - and that the level of nuptiality is on the increase - the percentage of unmarried persons in each age group is decreasing over time - estimates of nuptiality cannot be based on current marriage statistics or on the results of a single census. The former do not record consensual unions, while the latter do not show the changes occurring over time thus making it necessary to assume the level of nuptiality as constant (the method proposed by Professor Mortara uses data from one census only and hence assumes that nuptiality is constant over time 1/).

1/ G. Mortara, Métodos relativos al uso de las estadísticas censales (ST/SOA, Series A, Nº 7) chapter II.

/Intercensal nuptiality

Intercensal nuptiality can be estimated on the basis of data on the distribution of the population by marital status, sex and age collected in two successive censuses. This estimate takes account of the consensual unions recorded in the censuses - which under the concept of nuptiality employed are considered as comprising non-single persons - and also of the changes in the level and structure of nuptiality in the intercensal period.

1. Theoretical considerations

On the basis of the data collected on the marital status of the population in two successive censuses, say in years Z and Z+10, the following procedure can be used to estimate age-specific nuptiality rates, taking female nuptiality as the example.

Assuming that:

(a) The population has been closed, i.e., without migratory movements, in the intercensal period (or if there has been migration, the migrant population does not differ as regards nuptiality - which is certainly not the case);

(b) Mortality is a variable independent of the marital status of the population;

(c) Changes from single to non-single status occur between the age of 15 and 50, which is fairly close to the actual case with women; and

(d) Such changes occurred uniformly throughout the period;

it can be established that the difference between the number of single persons in the same cohort at two given times - the two censuses - represents the number of women who changed their status from single to non-single. In other words, the difference represents, under the definition used of nuptiality, the intercensal nuptiality of the cohort. Annual nuptiality can be measured by dividing this difference by the length of time lived, during the period Z to Z+10, within the period in which the change from single to non-single can occur, i.e., between 15 and 50. This can be expressed symbolically as follows:

/Let s_x^z

Let s_x^z be the proportion of single women of age x in census z

s_x^{z+10} the proportion of single women of age x in census z+10

n the length of time lived in the age group 15-50 during the intercensal period z to z+10

$$\frac{s_x^z - s_{x+10}^{z+10}}{n} = {}_nC_x = \gamma(y)$$

This represents an average annual rate of nuptiality for the age group between x and x+n (${}_nC_x$), or also an instantaneous annual nuptiality rate at an age between x and x+n, say y: $\gamma(y)$.

It is necessary to determine the length of time spent at risk by each cohort of women in the period between z and z+10, and also the age (y) to which annual nuptiality may refer.

Following a procedure similar to that described in relation to annual rates of intercensal fertility, n can be determined with the following results:

(i) Women that in z+10 were aged 25, 30, ..., 50, were aged 15, 20,..., 40, respectively. Consequently, all of them were exposed to a change of status from single to non-single over 10 years. In this case, n=10.

(ii) Women of age 20 in year z+10 were 10 years old in z, and were hence at risk for only five years, assuming that the changes in status begin at age 15. Thus n=5.

(iii) Women of age 15 in z+10 were not at risk during the intercensal period, and therefore n=0.

A similar process can be used to determine the length of exposure of women aged 45 in z.

As will be seen below, the ages to which the annual rates thus calculated correspond were determined in an approximate manner, using an arithmetical mean for the initial and final age of each cohort. For example, the rate determined on the basis of the proportion of single women that were 15 in z and 25 in z+10 was assigned to age 20 (y=20). This is a simplified and probably erroneous way of solving the problem of assigning ages, since nuptiality by age does not follow a linear progression as is

/the assumption

the assumption when calculating mean figures. It would have been very useful to have detailed data by age, so that ages could have been assigned with greater accuracy.

A synthetic index of these rates, i.e., a general nuptiality rate, can be obtained by wieghting the sum of the rates by the time each cohort has been exposed to risk during the intercensal period.

For practical purposes, it is useful to have annual nuptiality rates for the most commonly used five-year age groups (15-19, 20-24, ..., 45-49). One way of calculating these is to interpolate the rates calculated for age y, either by using analytical procedures or graphically. In the illustrations given below, the interpolation has been effected by means of a graph, mainly owing to the poor quality of the data and the type of tabulation (by age groups) available. The annual nuptiality rates were plotted on the ordinate axis and the ages (y) chosen on the abscissa. The points were then joined with a smooth curve making it possible to read ordinates at the mean point of the standard five-year age groups. In the examples shown, the corresponding histograms have been drawn in as well as the curves.

2. Practical application

With the help of the procedure outlined above, annual nuptiality rates have been determined for the Latin American countries that had sufficient data from two successive censuses. The results for Chile and Panama are shown below and are compared with the annual nuptiality rates estimated on the basis of annual marriage registers (see table 1 and figures I and II).

In comparing the rates estimated on the basis of data from the two sources it should be borne in mind that the sources are not strictly comparable. The estimates based on census data cover nuptiality only among single women and do not include second marriages. The marriage statistics used cover all the marriages celebrated in a year without distinguishing the prior marital status of the bride. Consequently, the rates calculated on the basis of census information can be expected to be lower than those based on marriage statistics, especially in the higher age groups (probably from 35 onwards) where the nuptiality of widows (and of separated or divorced persons) may be a more important factor than in the lower age groups.

/Table 1

Table 1

ANNUAL NUPTIALITY RATES ESTIMATED ON THE BASIS OF CENSUS DATA AND MARRIAGE REGISTERS

Age group	Chile Rates based on:		Panama Rates based on:	
	Census 1950-1960	M. registers 1960	Census 1950-1960	M. registers 1960
15-19	0.0528	0.0420	0.0852	0.0192
20-24	0.0576	0.0599	0.0470	0.0246
25-29	0.0386	0.0337	0.0200	0.0159
30-34	0.0172	0.0184	0.0082	0.0090
35-39	0.0089	0.0112	0.0044	0.0075
40-44	0.0042	0.0081	0.0035	0.0066
45-49	0.0013	0.0061	0.0015	0.0067
General nuptiality rate	0.9030	0.8970	0.8490	0.4475

/Figure I

Gráfico 1

CHILE: TASAS DE NUPCIALIDAD 1950-1960

Figure 1

CHILE: NUPTIALITY RATES 1950-1960

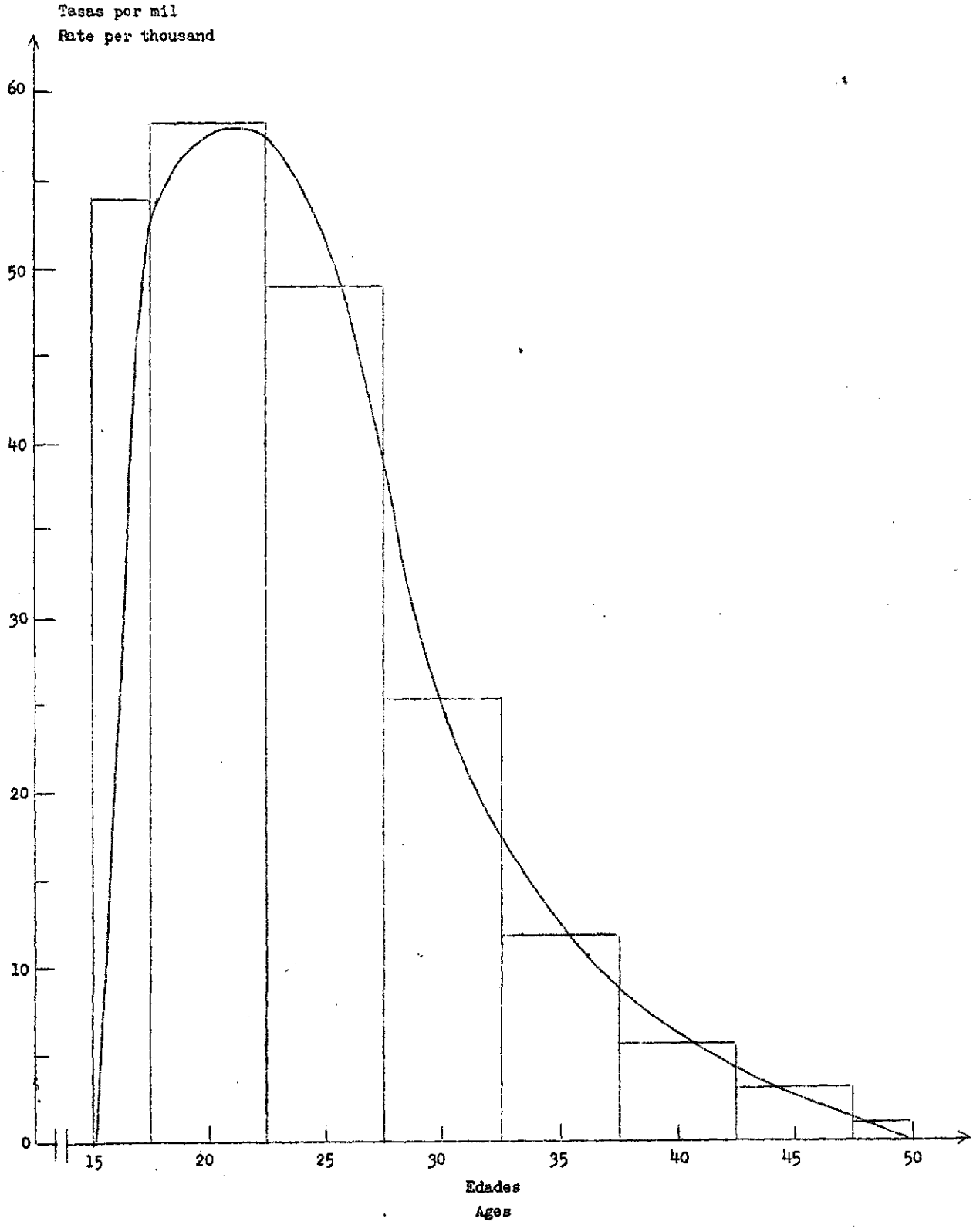
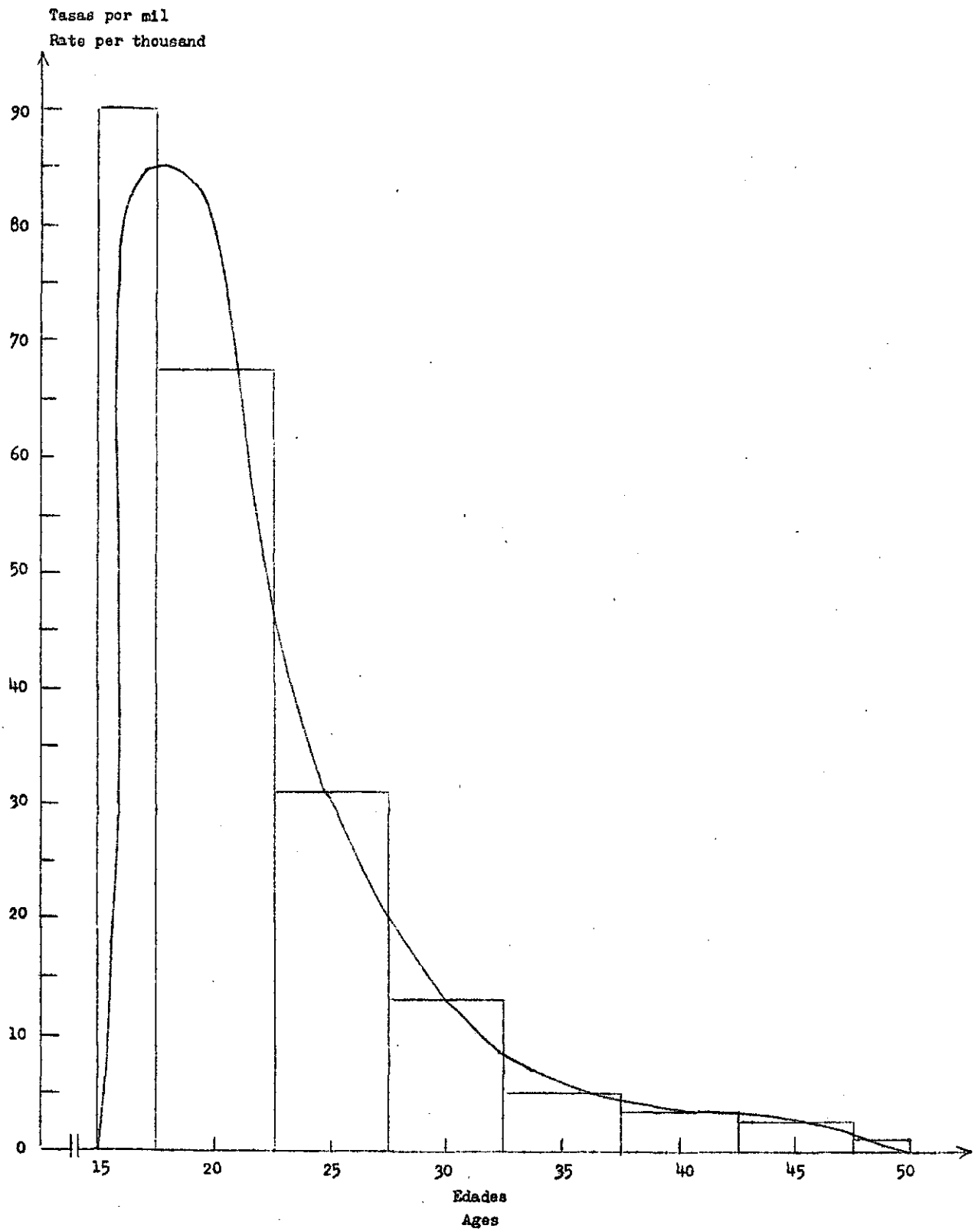


Gráfico 2

PANAMA: TASAS DE NUPCIALIDAD 1950-1960

Figure 2

PANAMA: NUPTIALITY RATES 1950-1960



It is found, however, that the rates estimated from census data are higher than those estimated on the basis of marriage registers, especially in Panama.

It can be accepted that the general level of nuptiality in Chile is the same whether estimated on the basis of census data or marriage records. This does not necessarily imply that the sources are completely accurate, but rather that there are numerical compensations. For example, it may be considered that (i) registration of marriages is relatively satisfactory; and (ii) that the frequency of consensual unions is relatively low. Hence the inclusion of second (third, fourth, etc.) marriages in registers probably offsets the frequency of consensual unions.

This kind of compensation process does not occur in the case of Panama. Even supposing that the marriage registers were complete and covered all marriages (first, second, etc.), this would not offset the high frequency of consensual unions. It can be deduced from the general levels of nuptiality calculated from the two sources that 60 per cent of nuptiality seems to correspond to consensual unions, although the actual percentage varies in each age group. In the 15-19 group, for example, the rate estimated from census data is 4.5 times higher than that estimated from marriage registers.

For purposes of population studies, what is of interest is the level and structure of general nuptiality and not simply legal nuptiality, and thus the results obtained using census data are more useful.

The procedure outlined can be extended if the data collected are more accurate (clearer declarations of marital status) and tabulations cover the 15-50 age group in detail by sex and age.

EDUCATIONAL CHARACTERISTICS (12)

SOME CHARACTERISTICS OF THE LEVEL OF EDUCATION. ANALYSIS BY COHORT AND BY AREA OF GREATEST AND LEAST DEGREE OF URBANIZATION

J. Morales

1. Background

The information that population censuses offer regarding the level of education of the population is very useful in a number of ways. On the one hand, it provides vital background for education planning and for economic and social development planning as a whole. On the other, the demographic variables - fertility, mortality and migration - are linked to the population's level of education; that is to say, these variables should be distinguished according to level of education.

2. Use of the information

A typical example of the analytical possibilities of this information, taken from the 1960 and 1970 Chilean census tabulations showing the population aged 15 and over by level of education, age and sex, is given below. Naturally, the figures in table 1 constitute a revised extract of the complete tabulation.

The improvement in the situation between the two dates is immediately apparent: there is a pronounced reduction in the number of persons with no education or irregular schooling which occurs - though to a lesser degree - even at the primary level; on the other hand, proportionally speaking, the number of persons with secondary education increases by more than a third and those with university education by exactly 100 per cent, from 1.9 to 3.8 per cent.

These changes ought to be particularly noticeable among the younger age groups, since the older generations are not greatly affected by the educational system. This shows up very clearly in the second two columns of table 1 which compare the situation of young cohort (aged 20 to 24) in 1970 with that of the population aged 60 and over in the same year. The difference between these two cohorts is of course far more striking than appears in the overall picture for 1960 and 1970.

/Table 1

Table 1

CHILE: PERCENTAGE DISTRIBUTION BY LEVEL OF EDUCATION OF THE POPULATION AGED 15 AND OVER, 1960 AND 1970, AND SELECTED COHORTS IN 1970

Level of education	Total		Selected cohorts in 1970	
	1960	1970	20-24-year-old cohort	60-year-old-and-over cohort
Total	100.0	100.0	100.0	100.0
Preschool and none	17.3	10.2	4.4	26.2
Primary (6 years)	56.2	52.6	49.4	52.6
Secondary (Secondary, industrial, etc.)	24.6	1.9	3.8	6.8
Higher (university)	1.9	3.8	6.8	2.6

Source: Census publications of the Statistical and Census Office of Chile.

/An important

An important conclusion can be drawn from this analysis: even if the installed capacity of the Chilean educational system did not improve in the near future, the average level of education of the population would continue to rise for some time and to a considerable extent, owing to the replacement of the older, less educated cohorts by new cohorts that have been able to benefit from better educational facilities.

It must, however, be borne in mind that the distribution of the 60-and-over age group by level of education is not directly and strictly comparable with that of the 20-24 year-old cohort, since the former may have altered slightly as a result not only of adult schooling but also of mortality and perhaps even of differential international migration which affects age-groups differently according to their level of education.

It is therefore interesting to note that, with the reservation expressed in the previous paragraph, the information deriving from a single census can show how the level of education of the population has evolved. All that is needed is to study the individual situation of the various cohorts covered by the same survey. The relevant tabulation should set the age (in five-year age groups) against the level of education. The analysis can be improved by being further broken down according to sex and to residence in urban or rural area.

Average number of years of education completed: If the census includes a question concerning the level of education and the last year of studies completed and if this information is properly tabulated, the average number of years of schooling completed by each group can be calculated for the various categories of people and for given geographic civil divisions. Thus, educational differentials can be determined according to specific geographic areas, types of economic activity, occupational groups, fertility, etc.

The following example shows how the level of education differs according to the degree of concentration of the population in the more highly urbanized civil divisions.

/COLOMBIA: AVERAGE

COLOMBIA: AVERAGE NUMBER OF YEARS OF EDUCATION COMPLETED BY THE POPULATION AGED BETWEEN 15 AND 59 AND PROPORTION OF THE TOTAL POPULATION LIVING IN DEPARTMENTAL CAPITALS, IN THOSE DEPARTMENTS WHERE THIS PROPORTION IS HIGHEST AND LOWEST, 1964.

Department	Percentage of population in departmental capital	Average number of years of education
With the highest proportion of the population living in the departmental capital		
Bogotá (Special District)	97,9	5,0
Atlántico	90,9	3,8
Cauca Valley	70,4	3,4
With the lowest proportion of the population living in the departmental capital		
Cauca	23,2	2,2
Chocó	23,4	1,4
Bogotá	23,8	2,2

Source: Seminar on the use of demographic studies and data in planning, Santiago, August 1971, Doc. ST/ECLA/Conf.41/L.6

These figures indicate that, in Colombia, there is a very pronounced correlation between the level of education and the degree of concentration of the population in the departmental capitals, which also happen to be the most highly urbanized towns.

Moreover, taking the average number of years of schooling of the population living in and outside each departmental capital separately, it will be found that, with the sole exception of the Special District of Bogotá, the level of education in the departmental capital is always higher than that in the other geopraphic civil divisions. The lowest figure for departmental capitals is in the department of Córdoba, with 3 years of completed schooling and the highest for the remaining areas is in the Cauca Valley, with 2.2 years. The exception of Bogotá can be explained by the fact that the population living in outlying villages comes under the cultural umbrella of the country's capital.

/ECONOMIC CHARACTERISTICS (13)

ECONOMIC CHARACTERISTICS (13)

RATES OF PARTICIPATION IN ECONOMIC ACTIVITY BY (a) SEX AND AGE; (b) AGE, MARITAL STATUS OF FEMALE POPULATION AND (c) AGE AND NUMBER OF LIVE BIRTHS TO THE FEMALE POPULATION

J. Vidal

1. Background data

From both the demographic and other standpoints, it is interesting to determine several points in relation to the participation of the population in the country's economic activities, and the demographic, economic and social characteristics of this population sub-group.

The examples presented in this section show the relation between the degree of participation of the population in economic activities and other demographic variables, such as sex, age, marital status and fertility of the female population.

(a) Rates of participation by sex and age. This analysis requires a tabulation presenting the active population by sex and age; on the basis of these data, combined with figures for the total population (active and inactive) of both sexes and the various ages, it is possible to determine the rates considered here (percentage of active population of the specified sex and age group).

By way of example, data were taken from the Chilean 1960 and 1970 censuses and are shown in table 1 and figure I.

The first fact that emerges from a study of the table is the wide difference between male and female participation in economic activities. At the national level, an average of over 90 per cent of the male population of 20 to 60 years of age participates in productive activities, while the proportion for women is approximately 25 per cent (see figure I).

These figures also clearly show that the degree of participation in economic activities of both the female and the male population varies according to age. A difference is also noted between the participation recorded in a highly developed urban area such as Greater Santiago and the national average.

/Table 1

Table 1

CHILE: RATES OF ACTIVITY OF MALE AND FEMALE POPULATION IN THE WHOLE COUNTRY ACCORDING TO 1960 AND 1970 CENSUSES, AND IN THE GREATER SANTIAGO AREA IN 1970

(Percentages)

Age group	Females			Males		
	Total		Greater Santiago	Total		Greater Santiago
	1960	1970	1970	1960	1970	1970
12-14	3.9	1.9	2.2	11.8	4.5	2.7
15-19	23.5	16.6	21.7	61.7	43.6	35.7
20-24	32.4	32.3	41.7	91.6	84.8	80.6
25-29	27.9	28.8	38.2	97.0	96.4	95.5
30-39	23.2	24.4	34.2	97.3	97.4	97.7
40-49	21.8	22.3	31.9	94.6	95.0	94.5
50-59	18.3	16.9	23.1	86.2	85.2	83.8
60-69	10.0	9.5	12.2	61.1	65.4	62.2
70 and over		4.5	4.7		31.8	27.0
Total	20.9	19.6	27.1	77.5	73.0	70.0

Source: 1960 Census and sample of 1970 Census.

/Figure I

Gráfico 1

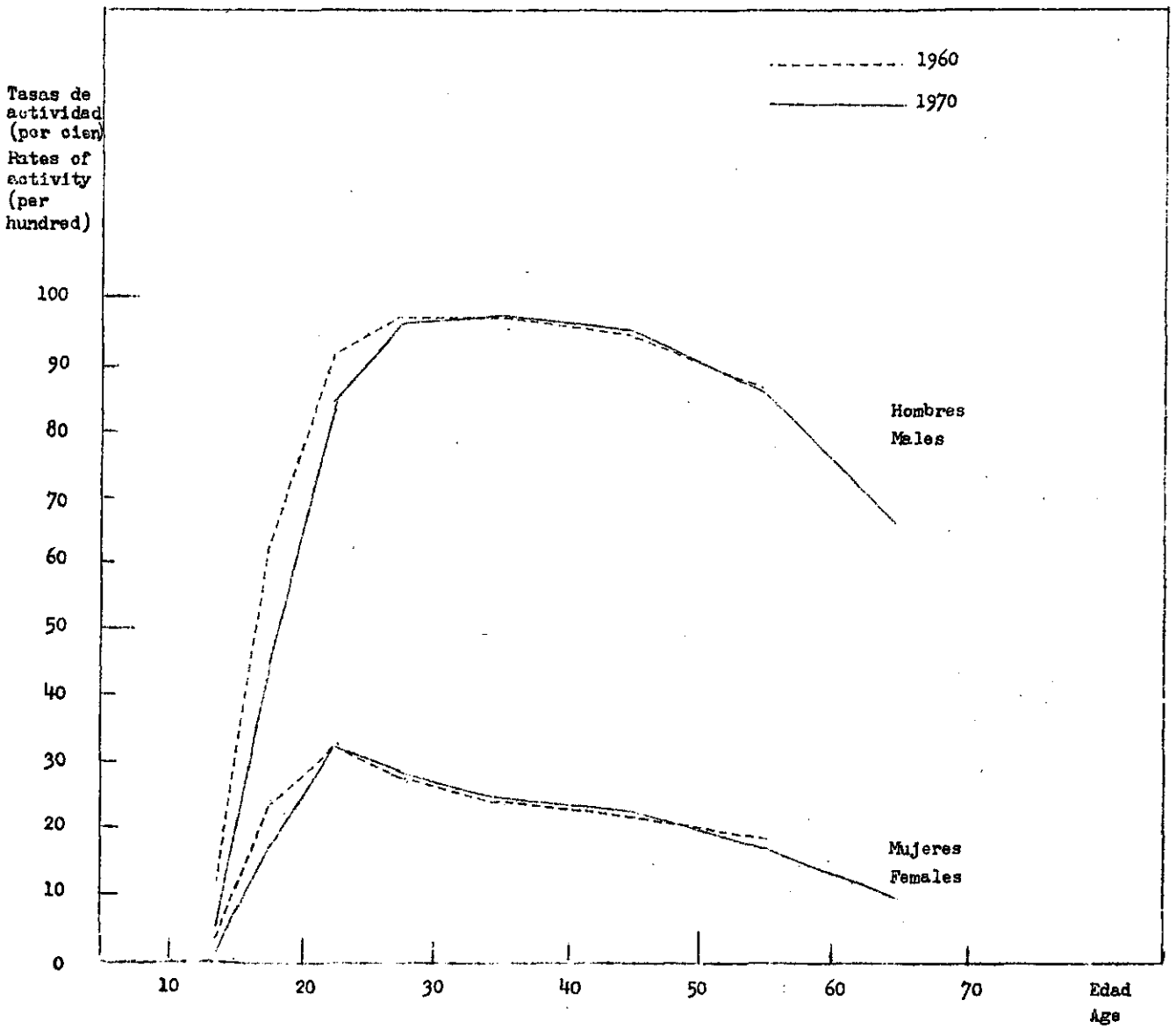
CHILE: TASAS DE ACTIVIDAD POR EDAD Y SEXO, 1960 Y 1970

(Por cien habitantes)

Figure 1

CHILE: RATES OF ACTIVITY BY AGE AND SEX, 1960 AND 1970

(Per hundred inhabitants)



It is also noted that, except in the case of persons under 15 years of age, there are no major differences between the rates of male activity in the whole country and in Greater Santiago in 1970, while in the case of the female population there are marked differences at all ages, the rates of participation being much higher in Greater Santiago.

Between 1960 and 1970 the rates of activity of the male population and females under 20 years of age declined sharply, which is probably due to increased school attendance. This is also observable when the rates of male activity in the whole country are compared with those in the Greater Santiago area, no doubt owing to differences in school attendance between the two areas. The rates for the highest age groups in Greater Santiago are lower than those for the whole country in the case of the male population (1970), which may indicate that a larger proportion of urban workers are covered by some social security system.

(b) Rates of activity of the female population by age and marital status. The figures in table 1 show, on the one hand, the smaller participation of the female population in economic activities and, on the other hand, the greater variation in its participation from one area to another (total for the whole country and in Greater Santiago). It is known, in fact, that the female participation is determined by various factors which have little or no effect on the participation of males; these include cultural factors, marital status, number of children, level of education, and the development of certain activities which require female labour (commerce, services, etc.).

The 1970 census in Chile (preliminary sample figures) included a tabulation in which the active female population is cross-classified by age and marital status.

By means of this tabulation it is possible to study the relation between the marital status and the participation of women in economic activity. This is borne out by the figures in table 2, which also show the difference between rates of participation in the whole country and in the Greater Santiago area.

The table shows that the single female population has an average participation which in the central age bracket (20 to 50 years) represents over 50 per cent of the population at those ages. The participation of females who are married or living in consensual union is never above 15 per cent. In contrast, the group of widows and separated persons has a greater participation, which is slightly below that of single persons.

/Table 2

Table 2

CHILE: RATES OF ACTIVITY OF THE FEMALE POPULATION BY MARITAL STATUS IN THE WHOLE COUNTRY AND IN THE GREATER SANTIAGO AREA, 1970

(Per 100 women)

Age	Marital status					
	Single		Married and in consensual union		Widows and separated persons	
	Total	Greater Santiago	Total	Greater Santiago	Total	Greater Santiago
12-14	1.9	2.2	-	-	-	-
15-19	17.6	22.8	6.2	10.0	28.2	31.3
20-24	47.6	59.1	12.0	17.4	45.4	49.5
25-29	58.4	74.1	14.8	20.2	49.6	60.6
30-39	58.1	77.9	14.5	20.4	54.2	66.6
40-49	51.4	67.8	13.5	19.6	43.5	55.8
50-59	37.5	48.4	9.7	13.1	24.4	31.1
60-69	19.7	24.0	5.2	8.9	10.7	11.3
70 and over	7.8	10.3	2.0	2.4	4.0	3.9
Total	26.7	36.5	12.4	17.8	22.9	29.7

Source: Preliminary sample figures.

/If the

If the rates of participation in the whole country are compared with those for the Greater Santiago area it will be seen at once that the latter are systematically higher, whatever the marital status. The rates for the single population, for example, indicate that in several age groups three-quarters of the population participates in economic activities in the Greater Santiago area. In the group of widows and separated persons the rates are also high in Greater Santiago. Proportionally, however, the biggest differences between the two areas are found in the married population group.

(c) Rates of female participation in economic activity by age and number of children born alive. The fertility rate also affects the degree of participation of the female population in economic activities. Generally speaking, the two variables are inversely proportional, as can be seen from table 3, which is based on the results of the 1960 census in Chile, thanks to the fact that a tabulation prepared for this census combined the ages of and number of children born alive to the female population participating in economic activities.

These figures corroborate the fact that the rates of activity decline systematically as the number of live births increases. In overall terms, i.e., without considering age, 27.5 per cent of the women with no children participate in economic activities, compared with 16.3 and 10.5 per cent of the women with 2 or 3 children and 4 or 5 children, respectively. The differences in participation in the various age groups are more marked than in the total figures, as is clearly shown in the table.

If the rates of activity were considered in relation to the number of children under a certain age (10 years, for example) instead of the total number of children, the relation between fertility and participation in economic activity would probably be even closer.

/Table 3

Table 3

CHILE: RATES OF ACTIVITY OF WOMEN AGED 15 YEARS AND OVER BY AGE AND NUMBER OF CHILDREN BORN ALIVE, 1960

(Per 100 women)

Age	Total	No children	1 child	2-3 children	4-5 children	6 or more children
15-19	23.5	24.4	17.6	6.7	-	-
20-24	32.4	44.6	25.2	8.9	4.1	-
25-34	25.9	46.9	35.1	17.0	8.1	5
35-44	22.4	39.1	33.7	22.1	14.0	7.8
45-54	20.4	32.1	27.2	19.9	14.5	9.8
55-64	15.3	23.5	19.3	13.6	10.8	8.2
65 and over	7.9	11.7	8.5	6.9	5.9	5.0
Total	20.9	27.5	27.0	16.3	10.5	7.5

Source: Figures taken from CELADE publication, Series E/9.

ECONOMIC CHARACTERISTICS (14)

USE OF CENSUS INFORMATION TO ESTIMATE UNDEREMPLOYMENT IN THE ECONOMICALLY ACTIVE POPULATION

C. Arretx

1. Theoretical considerations

The under-utilization of labour is an important problem in the economic and social system of the Latin American countries, and the efficient absorption of labour is usually included among the targets of development plans.

It is therefore necessary to identify - albeit approximately - the size of the Economically Active Population (EAP) which participates in the production of goods and services, but does so during shorter than normal working days, or with a level of productivity much lower than the average for the EAP as a whole, and whose income is, in consequence, lower than the average for the EAP as a whole. While it is not pretended that these are the sole and best economic criteria characterizing underemployment, they may be considered as useful elements for identifying that section of the economically active population which may be suspected of being underemployed. This group will be called the "Underemployed" from now on, in the awareness that an operational rather than a formal definition is being used.

Apart from these characteristics, which may be considered as purely economic, the underemployed have other socio-demographic and cultural characteristics, which may be expected to be derived from the economic characteristics or to be associated with them. It may be thought, for instance, that in a low-income family some of the members become economically active at an early age and hence with insufficient education, and that they work for low salaries, while others may be advanced in years and not work a full working day. Many other examples like this one could be found to illustrate the socio-demographic characteristics of the underemployed. All of them would have certain elements in common: low levels of education, marginal ages of economic activity - under 15 or over 65 - low-paid positions, such as family workers, jobs involving low income or discontinuous working hours. Population censuses, through the traditional subjects that they

/investigate,provide

investigate, provide valuable information on these characteristics of the EAP, which can be used in the estimation of underemployment. It is necessary to reach agreement on the attributes of the EAP which are relevant to the identification of the underemployed sector, and also on the limits within which it is reasonable to expect such attributes to be present within that group.

Once agreement has been reached on the attributes, it is necessary to design a tabulation which will enable the group of underemployed to be distinguished. So far, population censuses have not presented tabulations of this kind, and the first attempt made in CELADE was carried out on the basis of a tabulation specially designed for this purpose with 1960 censal samples.

2. Practical application 1/

(a) Attributes considered

In the first test the attributes listed below were chosen, after analysing certain relatively scarce data, and on the understanding that in future studies empirical grounds will have to be found to justify this selection or grounds for taking other criteria into account.

The chosen attributes are:

(i) Educational attainment. There is a connexion between the educational attainment of the EAP and productivity. It is observed that higher levels of education are associated with greater productivity. It is, therefore, to be expected that the EAP with low levels of education should have, on average, low productivity. It is necessary to define what is meant by low levels of education, and to that end, it is necessary to analyse, in each country, the average number of years of education of the population and the extent to which that average has varied in time. For the purposes of this first attempt to measure underemployment, using census information, an average of four years

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1/ C. Arretx, "La información y los estudios demográficos en América Latina", Seminar on the use of demographic studies and data in planning, (ST/ECLA/Conf.41/L.9).

/or less

or less of schooling has been taken as the limit of what is meant by low level of education, considering the average for the Latin American countries as a whole. The EAP is thus classified in two sub-groups: those with a low level of education (four years or less of study) and those with a higher educational level (more than four years of education).

(ii) Age. The EAP aged between 15 and 70 is that sector of the population most likely to be making an effective contribution to the production of goods and services, while those aged under 15 and over 70 would be doing so on account of circumstances that might progressively disappear as the countries develop. On the one hand, persons under 15 would be absorbed in the educational system, which would imply postponement of their incorporation in the labour market; on the other, persons aged over 70 would be affiliated to social security systems. Obviously, a large proportion of the EAP in these marginal age groups participates effectively in economic activities, so that it would not be realistic to include the whole of this group among the underemployed. Those in the group with a low educational level will be considered as underemployed, and those with higher levels of education will be analysed with respect to their occupation and occupational status, in the same way as the first sub-group aged between 15 and 70 is analysed.

(iii) Occupational status. Some types of occupation are largely carried out by underemployed, e.g., own-account workers and unpaid family workers. Not all persons in these categories are underemployed, and it is reasonable to expect that those among them with a low level of education would be so, while among those with higher education, persons doing specific jobs that identify them as a low-income recipients would be classed as underemployed: travelling salesmen, farmers, workers in personal service, etc.

The identification of the underemployed in other categories presents greater difficulties. Thus, for instance, among wage- and salary-earners, there is great diversity and no rigid criteria can be established. It has been considered that many wage- and salary-earners employed in personal service are underemployed; they include those performing personal services in private households.

(iv) Occupation. With regard to occupation, it is generally recognized that some occupations are typified by low income levels, and that others are of this type by virtue of the occupational status and

/level of

level of education of those engaged in them. Thus, for instance, farmers who work on their own account, shop workers employed as family workers, shop salesmen who work on their own account, etc.

If the EAP is classified by two or more of these attributes, exclusive classes may be formed which in total cover the entire range of underemployed within the EAP.

Table 1 presents a classification of the economically active population, in two age groups, by educational attainment, occupational status and specific occupations, which permits the identification of the underemployed (underlined) in each class.

This classification gives rise to the following tabulation:

Economically active population by sex, age, educational attainment, selected occupations, and occupational status.

Classification: S, X, E, O (C).

In which S: males, females
X: (under 15) + (70 and over), 15-70 years.
E: 4 years or less of education, more than 4 years of education.
O: Farmers, personal services, salesmen, craftsmen and workmen; other workers in services. Other occupations.
C: Own-account workers, wage- and salary-earners, unpaid family workers, other categories.

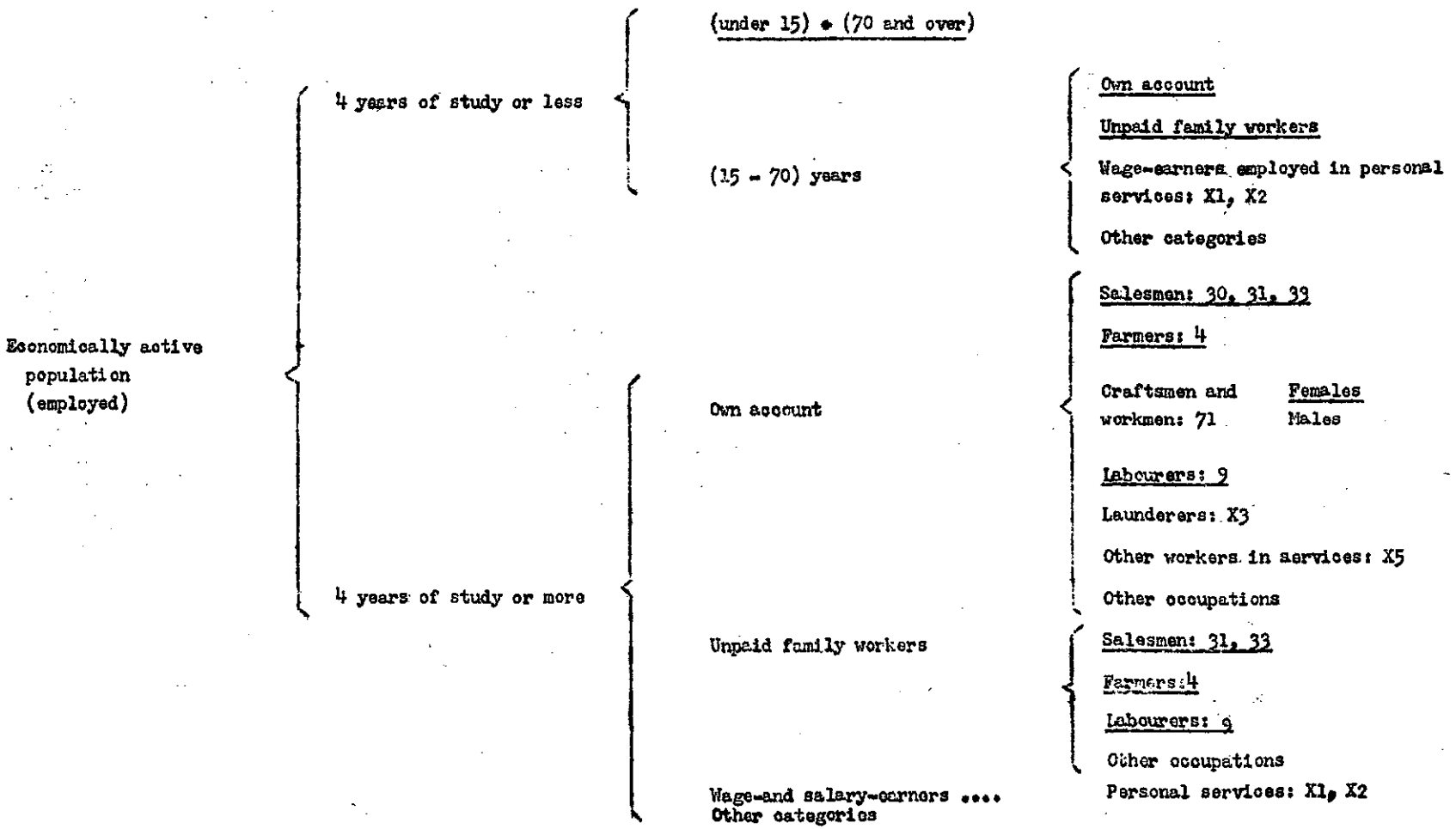
(b) Results

Using the above criteria, an estimate was made of underemployment in the EAP, on the basis of samples from the censuses of eight countries: Costa Rica, Chile, El Salvador, Ecuador, Guatemala, Honduras, Panama and the Dominican Republic. These countries were selected simply because the necessary data on them were available. Table 2 shows the percentage of underemployed within the EAP in each country and in the eight countries as a whole. The same table also shows the composition of underemployment by four groups (exclusive): (1) Underemployed aged under 15 and over 70, whose educational attainment is four years or less of schooling; (2) Underemployed in the category of own-account workers, not included in (1); (3) Underemployed in the category of family workers, not included in (1); (4) Underemployed wage- and salary-earners, not included in (1).

/Table 1

Table 1

CLASSIFICATION OF THE ECONOMICALLY ACTIVE POPULATION BY EDUCATIONAL ATTAINMENT, MAJOR AGE GROUPS, OCCUPATIONAL CATEGORIES AND OCCUPATIONS



Note: The underlined categories refer to underemployed.

/Table 2

Table 2

UNDEREMPLOYMENT IN THE ECONOMICALLY ACTIVE POPULATION OF SELECTED LATIN AMERICAN COUNTRIES

(Percentage of total and by sex; distribution in four groups)

Country	Total			Four years of study or less (under 15 and over 70)			Underemployment among own-account workers			Underemployment among unpaid family workers			Underemployment among wage- and slary-earners		
	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women
Total	41.6	38.9	51.9	4.1	4.4	3.0	25.0	27.0	17.2	6.2	7.1	2.7	6.3	0.4	29.0
Chile	24.7	16.9	52.2	1.7	1.8	1.5	14.0	13.5	15.8	0.9	1.0	0.5	8.1	0.6	34.4
Costa Rica	33.4	31.2	44.3	4.2	4.6	2.4	15.1	16.8	6.9	8.3	9.7	1.7	5.8	0.1	33.3
Ecuador	51.9	48.5	67.2	6.2	6.1	6.8	36.6	36.7	35.6	5.1	5.1	5.1	4.0	0.6	19.7
El Salvador	41.2	36.8	62.5	7.9	8.4	5.5	21.2	20.9	23.4	6.3	7.3	1.3	5.8	0.2	32.3
Guatemala	41.5	40.0	52.2	1.7	1.7	1.7	25.7	27.5	13.7	9.9	10.6	4.4	4.2	0.2	32.4
Honduras	60.4	59.8	64.8	9.0	9.4	6.5	35.7	37.9	20.4	11.1	12.3	3.5	4.7	0.2	34.4
Panamá	47.2	49.5	38.7	3.3	3.7	1.8	29.2	34.4	9.9	9.5	11.2	3.6	5.2	0.2	23.4
Dominican Republic	58.2	57.9	61.0	5.1	5.2	4.4	38.5	40.6	20.2	11.0	11.9	3.9	3.6	0.2	32.5

/The estimate

The estimate of underemployment obtained in all the eight countries considered is consistent with the estimate prepared by ILPES 1/ using economic criteria: the similarity of the results does not imply that both estimates refer to the same group. There may be qualitative differences between the underemployed as defined in one case and in another. At the present time, no elements of judgement are available to compare the two estimates; however, studies such as this one will facilitate the estimation of underemployment and, consequently, the formulation of adequate employment policies.

1/ "Elementos para la elaboración de una política de desarrollo con integración para América Latina". Document prepared by ILPES, CELADE, 1968.

FAMILY (15)

I. USE OF CENSUS DATA IN DETERMINING THE CHARACTERISTICS OF HOUSEHOLDS

A. Pantelides

The household or census family is a very important analytical unit from several different points of view:

(a) It is practically universal.

(b) It is the only institution which covers the great majority of the members of the society, with the sole exception of those who live in collective households.

(c) In the majority of known societies, it is in the household that socialization mainly takes place, especially at the crucial ages for the formation of basic attitudes.

(d) Operates as consumer unit for the majority of goods and services (consumer durables, housing, social security, etc.). In some societies, or in specific areas within them, it also operates as a unit of production.

(e) If the type of analysis proposed below is studied in depth, the possibility - not only of importance from the demographic point of view - emerges of improving the projections of the number of households of different characteristics simply from the structure by age, sex, marital status, etc., of the heads of households in the basic population and its tendency to change.

(f) From a practical point of view, it is the only group for which data on the basis of censuses can be used without any need of adding questions to those normally included, by the simple expedient of preparing special tabulations.

(g) From a more theoretical angle, with appropriate data available, it might perhaps be possible to show that different households have different demographic patterns, if the household is taken to be a primary group which transmits social norms to its components, in different ways depending on its own characteristics features.

/II. TYPE

II. TYPE OF ANALYSIS PROPOSED

If the quantitative relation between the type of society (characterized by socio-economic and/or demographic indicators) and the distribution of households and heads of households is known; and if the relation between the characteristics of the heads of households and those of the households themselves is known, given some of the characteristics of a society, the structure by households of this society can be predicted statistically speaking. Conversely, a better knowledge of this society can be obtained, taking the characteristics of its households as an indicator.

The proposed analysis of the data is therefore based on the following suppositions:

1. The distribution of households by type (nuclear, extended, composite), structure and size will be different in different societies.

2. The distribution of the heads of households by variables such as sex, age, marital status, occupation, etc., will be different in different societies.

3. Heads of households with different characteristics will form part of households which are also different in terms of type, structure and size.

III. NECESSARY TABULATIONS

The analysis of the family unit and the characteristics of the heads of households using census data has been difficult until now because of the limited number of tabulations which have been prepared; in addition, these tabulations do not always sufficiently satisfy the needs of the researcher.

For recent experimental censuses 1/ for which CELADE has been responsible, special tabulations were prepared with a view to testing their use for analysis. The results of these analyses were presented in the documents:

1/ Experimental Census of Costa Rica, carried out in the Canton of Grecia, Alajuela Province, in 1968; Experimental Census of Belén, carried out in the Department of Belén, in Catamrca Province, Argentina in 1969.

/"Costa Rica:

"Costa Rica: Informe del Censo Experimental", (CELADE, Series A No. 108) and Pantelides, Edith, "El hogar como unidad de análisis de los datos censales: Importancia y Posibilidades", (CELADE, gone to press).

The use of these documents has demonstrated the importance of the following combinations of variables:

1. Characteristics of the household, by variables connected with the head of household.

Among the characteristics of the household considered were its type (nuclear, extended, composite), structure (spouse, children, other relatives, others not related) and size (number of members).

The main variables connected with the head of household which should be combined with the three mentioned above are: age, sex, marital status, type of activity, occupation, industry, occupational category, educational attainment and migratory status.

2. It was also considered important to study the inter-relations between the type, structure and size of the household.

In many cases a control by other variables which may have some influence on the relationships identified will be necessary. The most important would appear to be: area of residence (urban-rural), and for the first group of combinations proposed, the sex and age of the head of household.

IV. EXAMPLE

An example of one of the proposed forms of analysis follows. Use was made of data from the Experimental Census of Belén, and it is clear that the results cannot be automatically extrapolated for other areas, although they may be very similar to those studied.

The analysis of the structure of the household by the occupation of the head of household gave the results which can be observed in the following table.

DEPARTMENT OF BELEN, (1969). AVERAGE NUMBER OF MEMBERS PER HOUSEHOLD, BY RELATIONSHIP WITH AND OCCUPATION OF HEAD OF HOUSEHOLD

Occupation of head of household	Members of household (average)					
	Total	Head	Spouse	Children	Other relatives	Other not related
Non-manual (cases)	5.1	1.0 (178)	0.8	2.3	0.4	0.6
Manual (cases)	5.0	1.0 (830)	0.6	2.5	0.7	0.2
Workers in agriculture, cattle-raising, forestry, and similar (cases)	5.4	1.0 (238)	0.8	2.7	0.7	0.2
Workers in mining, quarrying and similar (cases)	-	- (1)	-	-	-	-
Transport drivers (cases)	6.2	1.0 (35)	0.9	3.3	0.6	0.4
Artesanal-type workers and spinning factory operatives (cases)	4.5	1.0 (404)	0.3	2.2	0.7	0.3
Other artesanal-type workers and operatives (cases)	5.1	1.0 (42)	0.9	2.5	0.5	0.2
Labourers and day-labourers in personal service; unskilled manual workers and not-declared (cases)	5.3	1.0 (110)	0.6	2.8	0.7	0.2

Source: Experimental Census of Belén, Table VII-6.

/Households where

Households where the head is an artesanal-type worker or spinning-factory operative have a size and structure very different from the rest. This difference becomes obvious in the lower average number of children and the extraordinarily low number of spouses per head of household in this category which alone covers 40 per cent of the households in Belén where the head of household has made a declaration of occupation.

The explanation should be sought in the type of economic organization of the area and its repercussions on the structure of the population. In fact, the economy of Belén is extremely traditional and is based on two types of activity: extensive agriculture and cattle-raising, and artesanal-type work in spinning and weaving. This artesanal-type industry operates as a home-based activity and is mainly in the hands of the female population. Data collected previously now acquire a meaning: 52 per cent of the female population of Belén is economically active. But in order to explain the particular structure of the households of artesanal-type workers and spinning-factory operatives, other figures from the data collected should be added: of the total number of heads of households, 32 per cent are females; of the total number of female heads of households, 73 per cent are economically active.

The panorama thus becomes more coherent; households where the head is an artesanal-type worker or a spinning-factory operative are probably in their majority households with a female head. In addition, these women are in their majority unmarried, widows or separated, or are temporarily alone owing to the migration of the men - spouse and children - (another characteristic of Belén) for reasons of work. Since the census is factual these women appear as heads of households. This explains the small number of spouses and the relatively small number of children in these households.

Taking another line, it can be observed that the female population has a relatively greater tendency to be heads of extended or composite rather than nuclear households. If this analysis were pursued further using a tabulation of the types of household by the occupation and sex of the head (not available), other clues might probably possibly be found to the interpretation of this peculiar family organization, typical only of a social group.

V. CONCLUSIONS

The foregoing is only one example of this type of analysis and the possibilities it offers. However, with the expansion of the tabulations available as proposed above, this area is considerably extended. For example, it is possible to relate household characteristics to the characteristics of the social and economic organization as a whole, bring out the existence of peculiar family organizations determine statistically the relative importance of the different types and sizes of household, etc.

This makes the data more useful not only to sociologists, demographers and planners but also to persons studying the psychosocial and anthropological aspects.

/EVALUATION (16)

EVALUATION (16)

USE OF TABULATION ON POPULATION BY SEX AND INDIVIDUAL YEARS OF AGE FOR APPRAISAL OF STATEMENTS OF AGE

J. Vidal

Background

Practically all the data collected in censuses is subject in greater or lesser degree to different types of errors. In general, the results of direct appraisal - post-enumeration surveys - are not good enough to correct these errors, so that indirect methods of appraisal are necessary. These include the appraisal of statements of age. It may be observed that the distribution of the population by individual years of age in population censuses presents many irregularities: there appear to be many more persons of certain ages covered by the enumeration than of the adjacent ages. This is accounted for, in most cases, by the tendency to declare ages preferably ending in certain digits, for example 0 and 5.

Through the methods of appraising statements of age it is possible to determine which digits are the most preferred and which are the most disliked, which makes it easier to correct these errors.

The following example illustrates the use of one of these methods: the Myers index 1/. The results are shown in table 1.

Theoretical considerations

The construction of this index is based on the principle that since there are 10 digits in which the ages of the whole population can terminate, it should follow that 10 per cent of the population should state ages terminating in each of these digits. The index is made up by adding together the deviations of the values for each digit from the expected value (10 per cent) irrespective of the sign. An intermediate step introduced in this calculation is designed to eliminate the effect of the decrease in the number of persons of one age in favour of another.

1/ United Nations, Methods of Appraisal of Quality of Basic Data for Population Estimates (ST/SOA/Series A/23).

/Table 1

Table 1

CHILE: MYERS' INDEX AND PREFERENCES FOR EACH DIGIT, BY SEX, IN THE 1930, 1940, 1952, 1960 AND 1970 CENSUSES

Digit	Male population					Female population				
	1930	1940	1952	1960	1970	1930	1940	1952	1960	1970
0	17.3	14.7	13.2	13.5	12.3	21.4	16.9	15.5	15.0	13.4
1	6.6	7.3	8.0	7.8	7.7	5.5	6.4	7.2	7.1	7.3
2	9.7	10.3	11.9	10.4	10.7	9.2	9.9	11.1	10.1	10.5
3	8.3	8.6	9.0	9.4	9.7	7.7	8.1	8.4	8.9	9.2
4	8.5	9.3	9.2	9.6	9.7	8.2	8.9	8.8	9.3	9.7
5	12.7	11.2	10.1	10.7	10.9	10.5	12.2	11.1	11.2	11.2
6	9.2	9.8	9.8	9.7	9.5	9.2	9.6	9.8	9.6	9.6
7	8.1	8.4	9.4	8.9	9.2	7.9	8.0	8.5	8.7	8.9
8	11.6	11.7	11.2	11.2	10.9	12.6	11.9	11.5	11.4	10.9
9	8.2	8.7	8.2	8.9	9.5	7.8	8.1	8.1	8.7	9.4
Myers' index	23.2	15.8	12.8	11.4	9.5	29.0	22.0	18.4	15.4	12.2

Source: H. Gutiérrez, CELADE, Series C, Nº 89 (1930-1960).
S. Zubicueta, CELADE, unpublished (1970).

Note: The expected value for each digit is 10. A higher value indicates preference for this digit, a lower value indicates dislike.

/The lower

The lower the value of the index obtained the smaller will be the distortion due to preferences for digits and, therefore, the better will be the quality of the data on this characteristic. In the extreme case where there may be no preferences, the value 0 will be obtained (that is, all ages were correctly stated).

Practical use

Table 1, which was prepared on the basis of the tabulations presenting the population classified by individual years of age and sex in Chilean censuses from 1930 to 1970, in addition to Myers' index contains data which make it possible to determine which digits are preferred and which are disliked.

The first point that emerges in this table is the decline in the index during the period covered by the censuses considered. This decline occurs in the same proportion in both males and females.

It has also been found that the indexes for females are always higher than those for males, that is, the women's statements of age in censuses are more inaccurate.

Lastly, it may be observed that for either sex the digits most preferred are 0 and 5.

As mentioned above, this method is useful in detecting errors due to preferences for digits; other methods should be used to correct these errors.