Chapter VII

SUPPLEMENTARY ESTIMATION OF SEX-AGE COMPOSITION FOR PROJECTED TOTALS OF URBAN AND RURAL POPULATION

A. PRELIMINARY CONSIDERATIONS

Use of supplementary methods

245. Several methods of projecting urban and rural totals have been illustrated in previous chapters. In this chapter, mechanical methods are described for deriving sex-age detail to be used with the projected urban and rural totals. In these methods, an observed age structure in the past or present is adjusted to agree with the projected urban and rural totals calculated by methods previously described. It will have to be recognized that such a procedure is "mechanical" in the sense that it is not responsive to the influence which particular factors may exert on urban and rural age structures.

246. All the methods of projection described in chapters IV to VI lead to projected totals only, whether for the urban and rural population, cities or size classes of communities. The estimated compositions of these totals by sex-age groups are nevertheless of much importance because of their economic and social implications, for they determine to a large extent the available labour force, the formation of households or families and needs arising in the areas of education, employment, housing and so forth. It is therefore useful to estimate in some detail the respective population structures, provided this can be done at least with a tolerable degree of approximation.

247. The demographic causes of variations in urban and rural population structures are complex. They include urban-rural differences in fertility level and trend, to a minor degree also the mortality differences, volumes and time trends in rural-to-urban migration, as well as urban-to-rural return migration, and the sex-age composition of these migratory streams, itself also susceptible to variation in the course of time. These strictly demographic causes are further conditioned by economic, social and cultural background factors, often difficult to identify, and themselves also apt to change as time progresses. Because of the combined effect of these several factors and their accumulation with time, the action of each particular factor cannot easily be identified by analytic means.

248. Where it is possible, or reasonable, to calculate urban and rural population projections with the cohort-component method, the attempt should be made. In that method, the particular demographic factors resulting in the varied sex-age structures are specifically taken into account. It is then also possible to calculate the comparative results which would follow if one or several of the underlying demographic conditions were modified. Such methods are considered in chapter IX. Chapter VIII considers certain other methods yielding directly projections of urban and rural population by groups of sex and age, though in their case the analysis of underlying factors is not so complete.

249. For the use of the mechanical methods described in the present chapter, it will have to be assumed that the factors causing a disparity between urban and rural population structures undergo little change. This could be approximately the case where the relative difference between urban and rural fertility levels remains fairly constant, migratory movements do not fluctuate much, and especially where the greater part of the migrants' residence in urban areas is of a rather temporary character. For in that case the urban population comprises what one may call a "floating population" consisting of a pool of mostly young persons, many of them soon departing to be replaced by other young persons who are again of the same age range. Where migrants tend to take up permanent urban residence, time variations in sex-age structure can be introduced as they advance in age, volumes of migration having fluctuated in the past.

250. As surveyed in chapter II, two prevailing modes of urbanization can be recognized. In Africa and South Asia the rural-to-urban migrants are mostly young men and their duration of urban residence is often rather short. In Latin America, Northern America, Oceania and Western Europe, young women are more numerous than young men among the migrants, and there is the apparent tendency of many migrants to take up permanent urban residence as witnessed by relatively high degrees of urbanization even at advanced ages. Intermediate, or mixed, conditions can be found in some other parts of Europe, in the Soviet Union and apparently also in East Asia. In view of such diversity of actual conditions, the use of the mechanical estimating methods proposed in this chapter may be more satisfactory in some countries than in others.

Adjustment of defective age data for urban and rural projections

251. Since the accuracy of age records is questionable in many censuses—and these data are needed for the supplementary estimates discussed here— it is appropriate to review briefly how the raw census data on sex-age composition of the urban and rural populations might sometimes have to be adjusted. Methods of detecting

inaccuracies in age data and of making rough adjustments with regard to national total populations have already been dealt with in other manuals.[64] It is known that in many censuses significant proportions of small children, notably in the 0 to 4-year age group, are omitted; and furthermore that owing to preferences for particular final digits in age statements, excessive numbers tend to be reported in some age groups and deficient numbers in other age groups.

252. As regards the first defect, namely the under-enumeration of small children, it can usually be assumed that the enumeration of children aged 5 to 9 years is substantially more accurate and that (unless there is information to the contrary) the fertility of women of child-bearing ages may have been about the same in both the recent five-year periods, that when children aged 5 to 9 years were born, and that when those aged 0 to 4 years were born. To correct the 0 to 4 group with reference to the 5 to 9 group, the following steps are then necessary. Numbers of children aged 5 to 9 years are reverse-survived to the period of five to ten years prior to the census, namely when they were born, so as to obtain an estimate of numbers of births in that period.[65] Numbers of women of ages where they might nave been their mothers, e.g. ages 15 to 44 years, are reverse-survived for the middle of that period of births. The ratio of numbers of births to numbers of women, of that period, provides a rough measure of fertility. Assuming that in the most recent five-year period fertility has been the same, numbers of women reverse-survived to the middle of the more recent period can be multiplied by that same measure in order to obtain an estimate of births which occurred within the most recent five years. By forward survival, this number of births can finally be converted into numbers of children (boys and girls) aged 0 to 4 years at the date of the census.

253. As regards the second defect, namely inaccuracy of age statements, an adjustment can be made by applying a smoothing formula to the age data by five-year groups. The particular formula which was suggested in *Manual III*[66] was

$$\Sigma = {}^1/_{16}\,(-S_{-2} + 4\,S_{-1} + 10\,S + 4\,S_1 - S_2),$$

where Σ is the adjusted number of persons in one five-year group, to be computed; S is the reported number of persons in the same five-year group; S_{-2} and S_{-1} are reported numbers in the two preceding five-year groups; and S_1 and S_2 are reported numbers in the two subsequent five-year groups.

254. It must be pointed out, however, that this latter adjustment is not recommended for direct application to sex-age data of the urban and rural population, each taken separately. Since rural-to-urban migration is most intensive in late adolescence or early adulthood, true irregularities of urban and rural age composition are reflected even in the most accurate data: relative bulges at ages 15 to 19 or 20 to 24 in the urban population, and relative deficits at the same ages in the rural population. The effect of applying a smoothing formula directly to the urban and rural populations, each taken separately, would be to diminish considerably those irregularities which are normally to be expected; the consequence may very well be that the smoothed data are even less accurate than the defective data without adjustment. Smoothing of data in the national total population (i.e. the urban and rural populations combined) nevertheless remains justifiable because international migration only seldom produces any marked irregularities in national age structure, and sharp fluctuations in past birth rates (another possible cause of irregularity in age structure) are ordinarily not very likely.

255. Accordingly, to correct age data of the urban and rural population, the adjustments should first be made in the national total population. The relative amounts by which each sex-age group has been adjusted in the national total can then be allocated proportionately in the same sex-age groups of the urban and rural population.[67]

256. After adjustments have been made for incomplete child enumeration and for inaccuracies of age statement, it is advisable to prorate both the adjusted urban and rural populations so as to make them coincide with the original census totals. Given the fact that census totals usually have a certain publicity, it is desirable that the population projections remain consistent with them, so as to avoid possible confusions in the comparison of the results of projections with the basic census data.

B. METHOD OF DIFFERENCE ELIMINATION

Explanation of the method

257. The difference elimination procedure described here is an application of a general matrix solution for adjusting the information in the cells of a matrix in such a way that it conforms to an independent set of horizontal and vertical totals. In the application described here two kinds of information are utilized: (*a*) *base period data* for the sex-age composition of the urban and rural population arranged in matrix form; and (*b*) *projections* of independent totals of population by sex and age (the horizontal totals) and urban and rural population (the vertical totals). From these, a new matrix of projected sex-age composition of the urban and rural population is calculated, which balances both horizontally and vertically, with the projected totals.

258. The method is perhaps best illustrated in a simplified and fictitious example, with a matrix distin-

[64] *Manual II: Methods of Appraisal of Quality of Basic Data for Population Estimates* (United Nations publication, Sales No. 56.XIII.2); and *Manual III: Methods for Population Projections by Sex and Age* (United Nations publication, Sales No. 56.XIII.3).

[65] In forward survival, numbers in each age group are multiplied with the corresponding survival ratios. In reverse-survival, the numbers are divided by the corresponding ratios, thus "bringing to life" those who have died in the interim. With the appropriate ratios, numbers aged 5-9 at a given date can be reverse-survived to numbers aged 0-4 five years previously, and the latter to numbers born within the period of five to ten years ago. For details of procedure, see *Manual III, op. cit.*

[66] *Ibid.*, p. 12.

[67] The implied assumption is, of course, that inaccuracy of age statement has the same proportionate effects in both the urban and rural population, though it can sometimes be expected that ages are reported with somewhat greater accuracy in the urban (usually more literate) population than in the rural population.

TABLE 20. FICTITIOUS EXAMPLE TO ILLUSTRATE THE METHOD OF DIFFERENCE ELIMINATION

Panel A (base period data)

Age	*Urban*	*Rural*	*Total*
0–14.....	100	250	350
15–44.....	150	300	450
45+.....	50	150	200
TOTAL	300	700	1,000

Panel B (projected totals)

Age	*Urban*	*Rural*	*Total*
0–14.....	...	...	500
15–44.....	...	...	600
45+.....	...	...	200
TOTAL	550	750	1,300

Panel C (horizontal prorating)

Age	*Urban*	*Rural*	*Total*
0–14.....	143	357	500
15–44.....	200	400	600
45+.....	50	150	200
TOTAL	393	907	1,300

Panel D (vertical prorating)

Age	*Urban*	*Rural*	*Total*
0–14.....	200	295	495
15–44.....	280	331	611
45+.....	70	124	194
TOTAL	550	750	1,300

Panel E (horizontal prorating)

Age	*Urban*	*Rural*	*Total*
0–14.....	202	298	500
15–44.....	275	325	600
45+.....	72	128	200
TOTAL	549	751	1,300

Panel F (arbitrary adjustment)

Age	*Urban*	*Rural*	*Total*
0–14.....	202	298	500
15–44.....	276	324	600
45+.....	72	128	200
TOTAL	550	750	1,300

guishing only a few group cells. Reference may be made to table 20, in which panel *A* represents the base data, and panel B, the results of the projections (total population by age, and urban and rural totals).

259. As a first step (panel *C*), the figures in each row of panel *A* are prorated in the ratio of the marginal total of panel *B* to the marginal total of panel *A*. Thus, 100 times 500/350 is 143, and so forth. But, when added up vertically, the results in panel *C* do not agree with the vertical totals of panel *B*.

260. As a next step (panel *D*), the figures in each column of panel *C* are prorated in the ratio of marginal totals of panel *B* to marginal totals of panel *C*. For instance, 143 times 550/393 is 200, and so forth. But, when added up horizontally, the results again show some discrepancies from the horizontal totals of panel *B*.

261. The procedure is repeated twice or three times, by prorating alternatingly in the horizontal and vertical directions. In each prorating, the cells of the last matrix are multiplied by a ratio obtained by dividing the marginal totals of the projection in panel *B* by the marginal totals of the last matrix. At each successive step the remaining discrepancies are smaller, and soon they become negligible. When only a few insignificant discrepancies remain—as already happens in the example in panel *E*—these can simply be adjusted by hand. In the end, a matrix is obtained whose marginal totals, both horizontal and vertical, agree perfectly with those of the projections (panel *F* in the example).

262. How often the procedure has to be repeated will depend on the number of significant digits in the figures. In actual practice, three horizontal and three vertical proratings usually suffice. If small discrepancies from the predetermined totals can be tolerated, it is not necessary to carry the procedure to its end.

263. The method is similar to, and yields similar results as, another method which has long been used by the Registrar General's office of England and Wales.[68] The present method is preferred here because it is easier to manipulate on worksheets. Differences in the results of the two methods are virtually negligible.

264. The mathematical properties of the Registrar General's method have been studied,[69] and it can be presumed that the present method has the same properties, at least to a high degree of approximation. For instance, the same results are obtained irrespective of whether the first prorating was done horizontally or vertically. Also, the results are the same whether the method is used repeatedly (e.g. first prorating from data for a date *A* to totals for a date B, and then prorating from the results for date *B* to totals for a date *C*), or directly (prorating at once from date *A* to date *C*).

Application to a projection

265. The method of difference elimination is now applied to a projection of Iran's urban and rural population by a global method, and a projection of Iran's total population by sex-age groups. Original data on

[68] In that method, the increments (gains or losses in each group cell) of each row or column are prorated, each time, in the proportion of the initial data (panel *A*).

[69] D. F. Friedlander, "A technique for estimating a contingency table, given the marginal totals and some supplementary data", *Journal of the Royal Statistical Society* (London), series A (general), vol. 124, part 3, 1961, pp. 412-420. In this method, the modification of the initial data to the final results, measured in terms of the sum of chi-square, is minimized.

TABLE 21A. APPLICATION OF THE METHOD OF DIFFERENCE ELIMINATION TO A PROJECTION OF URBAN AND RURAL POPULATION, AND OF TOTAL POPULATION BY SEX-AGE GROUPS (EXAMPLE OF IRAN): DATA

Sex and age	Census, November 1966			Projection to 1975
	Total	Urban	Rural	
Males				
0–4	2,301	805	1,496	*3,096*
5–9	2,160	776	1,384	*2,464*
10–14	1,609	676	933	*2,114*
15–19	1,068	501	567	*1,790*
20–24	777	398	379	*1,531*
25–29	789	327	462	*1,196*
30–34	864	335	529	*911*
35–39	763	295	468	*750*
40–44	760	280	480	*649*
45–49	483	192	291	*553*
50–54	362	144	218	*467*
55–59	216	80	136	*384*
60–64	342	129	213	*301*
65+	504	178	326	*523*
Females				
0–4	2,142	762	1,380	*3,007*
5–9	1,988	722	1,266	*2,402*
10–14	1,438	612	826	*2,064*
15–19	1,055	452	603	*1,746*
20–24	887	375	512	*1,494*
25–29	848	324	524	*1,166*
30–34	803	301	502	*886*
35–39	670	272	398	*730*
40–44	578	212	366	*634*
45–49	365	154	211	*542*
50–54	382	160	222	*462*
55–59	201	83	118	*385*
60–64	326	126	200	*312*
65+	463	169	294	*592*
ORIGINAL TOTALS, 1966	25,144	9,840	15,304	
PROJECTED TOTALS, 1975		*14,707*	*18,444* [a]	*33,151* [a]

[a] Originally 33,152,000 and 18,445,000. Adjustment by 1,000 was made to make totals agree with the sum of rounded figures for sex-age groups,

the urban and rural population, detailed by sex-age groups, are available from the census taken in November 1966. The method of difference elimination is used to obtain similarly detailed results for 1975. The entire calculation can be carried out on one large worksheet. For reasons of space it is illustrated here in three successive segments (tables 21a, 21b, and 21c).

266. The census age data suffer from large inaccuracies. Probably the enumeration of small children was incomplete, since nearly the same number of children were reported at ages 0 to 4 and 5 to 9. Probably there was also a large heaping on ages such as 30, 40, 50 or 60, as indicated by the irregular progression of numbers in successive age groups. [70] For the purpose of the projection of the total population by sex-age groups, however, the age data were smoothed and a correction was made for the underenumeration of small children. [71]

267. The method of difference elimination can be applied directly to the raw data: since the total population used for reference is smoothed, the prorating procedures have the effect of similarly smoothing the age distributions of the urban and rural populations. In fact, direct smoothing of the original urban and rural age data is inadvisable: there are genuine irregularities in urban and rural sex-age compositions, mainly owing to the age-specific incidence of migration, and these would be caused to vanish if a smoothing formula were applied

[70] Methods of examining the accuracy of census statistics by age have been described in *Manual II: Methods of Appraisal of Quality of Basic Data for Population Estimates* (United Nations publication, Sales No. 1956.XIII.2).

[71] By means of methods described in *Manual III: Methods of Population Projections by Sex and Age* (United Nations publication, Sales No. 1956.XIII.3).

TABLE 21B. APPLICATION OF THE METHOD OF DIFFERENCE ELIMINATION TO A PROJECTION OF URBAN AND RURAL POPULATION, AND OF THE TOTAL POPULATION BY SEX-AGE GROUPS (EXAMPLE OF IRAN): FIRST (HORIZONTAL) AND SECOND (VERTICAL) PRORATING

Sex and age	Horizontal results		Vertical results		Projection to 1975
	Urban	Rural	Urban	Rural	
Males					
0–4	1,083	2,013	1,217	1,851	*3,096*
5–9	885	1,579	994	1,452	*2,464*
10–14	888	1,226	997	1,127	*2,114*
15–19	840	950	944	874	*1,790*
20–24	784	747	881	687	*1,531*
25–29	496	700	557	644	*1,196*
30–34	353	558	397	513	*911*
35–39	290	460	326	423	*750*
40–44	239	410	268	377	*649*
45–49	220	333	247	306	*553*
50–54	186	281	209	258	*467*
55–59	142	242	160	223	*384*
60–64	114	187	128	172	*301*
65+	185	338	208	311	*523*
Females					
0–4	1,070	1,937	1,202	1,781	*3,007*
5–9	872	1,530	979	1,407	*2,402*
10–14	878	1,186	986	1,091	*2,064*
15–19	748	998	840	918	*1,746*
20–24	632	862	710	793	*1,494*
25–29	446	720	501	662	*1,166*
30–34	332	554	373	509	*886*
35–39	296	434	332	399	*730*
40–44	233	401	262	369	*634*
45–49	229	313	257	288	*542*
50–54	194	268	218	246	*462*
55–59	159	226	179	208	*385*
60–64	121	191	136	176	*312*
65+	178	414	200	381	*592*
CALCULATED TOTALS, 1975	13,093	20,058	14,708 [a]	18,446 [a]	
PROJECTED TOTALS, 1975	*14,707*	*18,444*	*14,707*	*18,444*	*33,151*

[a] Discrepancy from projected total due to accidents of rounding,

directly. In this respect, the method of difference elimination offers a distinct advantage. [72]

268. Since the method has already been illustrated in a fictitious example, the procedure involved in tables 21a, 21b and 21c needs no further comment. After two horizontal and two vertical proratings, the results come so close to the predetermined totals that only very slight adjustments remain to be made, requiring no further calculation.

Further uses of this method

269. The method of difference elimination can be useful for many other purposes where cell frequencies are needed to agree with a twofold classification. One such use is to estimate, if there are some data for another date and the marginal totals for the given date, numbers of the population by sex and age and by marital status. [73] Another use is to estimate age distributions for numerous regions of a country, if there are sex-age totals for another date. The method is likewise useful when three or more categories of the population are considered, e.g. the population in different size classes of localities, or the urban and rural populations in each of several regions of a country. One further use of the method is its applicability in the establishment of sex-age estimates for an "urban" population defined differently than in the census.

270. To provide an example and at the same time a test, the case of Japan is taken. Here, the 1960 census

[72] The assumption implicit in this use of the method is that errors of age statement are of equal direction and intensity in the urban and rural populations. If—as may often be—urban age statements are more accurate than the rural, the consequence is an overadjustment of the urban data and an insufficient adjustment of the rural data. These residual errors, however, would usually have only secondary importance.

[73] As illustrated by Friedlander, *op. cit.*

TABLE 21C. APPLICATION OF THE METHOD OF DIFFERENCE ELIMINATION TO A PROJECTION OF URBAN AND RURAL POPULATION, AND OF THE TOTAL POPULATION BY SEX-AGE GROUPS (EXAMPLE OF IRAN): THIRD (HORIZONTAL) PRORATING AND FINAL RESULTS

Sex and age	Horizontal results		Final results [a]		Projection to 1975
	Urban	Rural	Urban	Rural	
Males					
0–4	1,228	1,868	1,231	1,865	*3,096*
5–9	1,001	1,463	1,004	1,460	*2,464*
10–14	992	1,122	994	1,120	*2,114*
15–19	907	883	909	881	*1,790*
20–24	861	670	863	668	*1,531*
25–29	555	641	556	640	*1,196*
30–34	397	514	398	513	*911*
35–39	326	424	327	423	*750*
40–44	270	379	271	378	*649*
45–49	247	306	248	305	*553*
50–54	209	258	210	257	*467*
55–59	160	224	160	224	*384*
60–64	128	173	128	173	*301*
65+	210	313	211	312	*523*
Females					
0–4	1,212	1,795	1,215	1,792	*3,007*
5–9	986	1,416	988	1,414	*2,402*
10–14	980	1,084	982	1,082	*2,064*
15–19	834	912	836	910	*1,746*
20–24	706	788	708	786	*1,494*
25–29	502	664	503	663	*1,166*
30–34	375	511	376	510	*886*
35–39	332	398	333	397	*730*
40–44	263	371	264	370	*634*
45–49	256	286	257	285	*542*
50–54	217	245	218	244	*462*
55–59	178	207	178	207	*385*
60–64	136	176	136	176	*312*
65+	204	388	203	389	*592*
CALCULATED TOTALS, 1975	14,672	18,479	14,707	18,444	*33,151*
PROJECTED TOTALS, 1975	*14,707*	*18,444*	*14,707*	*18,444*	*33,151*

[a] Results of one further (vertical) prorating, not shown here, and final adjustments by hand.

defined as "urban" the population of administrative municipal districts (*shi*), some of them territorially very extensive and including much population which, because of lower densities of settlement, might otherwise be regarded as rural. At the same time, the census determined the population of urban clusters as defined by population size (at least 5,000 inhabitants) and density (at least 4,000 persons per square kilometre within each respective enumeration district), under the term "densely inhabited districts". Thus, the "urban" and "rural" population amounted in 1960 to 59,239,000 and 34,108,000 inhabitants, respectively, the definition of "urban" being rather extensive in that case; and the population within and outside "densely inhabited districts", a rather narrow definition of the "urban" population, amounted to 40,807,000 and 52,540,000 inhabitants, respectively.

271. As shown in table 22, the method of difference elimination leads to a fairly good estimate of the sex-age composition of the "urban" population when defined differently. The errors of estimate are comparatively small. In the particular instance numbers of children and older persons have been somewhat over-estimated for densely inhabited districts, while young adults have been somewhat underestimated. [74] If the sex-age composition of densely inhabited districts had not been ascertained in the census, the estimate could have served as a rough substitute.

272. The method of difference elimination, finally, can be of some help in countries where the sex-age compo-

[74] Under the more intensely "urban" conditions within the narrower confines of densely inhabited districts, migrants of early adult age are more heavily represented than they are in municipal districts which include some population that in other respects perhaps may be classifiable as "rural".

TABLE 22. ESTIMATE OF SEX-AGE COMPOSITION OF D.I.D. (DENSELY INHABITED DISTRICTS) POPULATION FROM DATA ON SEX-AGE COMPOSITION OF "URBAN" AND "RURAL" POPULATION AS DEFINED ADMINISTRATIVELY, JAPAN, 1960, USING THE METHOD OF DIFFERENCE ELIMINATION

Sex and age	*Municipal population (census data)*	*Estimated D.I.D. population* [a]	*D.I.D. population (census data)*	*Error of estimate*
Males				
0–4	2,435	1,635	1,615	+20
5–9	2,708	1,766	1,710	+56
10–14	3,337	2,220	2,168	+52
15–19	3,286	2,394	2,433	−39
20–24	2,959	2,195	2,264	−69
25–29	2,824	2,033	2,070	−37
30–34	2,466	1,723	1,743	−20
35–39	1,774	1,226	1,243	−17
40–44	1,461	1,006	1,007	−1
45–49	1,433	987	995	−8
50–54	1,281	870	873	−3
55–59	1,103	743	737	+6
60–64	856	567	549	+18
65–69	585	330	363	+17
70–74	386	246	228	+18
75–79	205	128	119	+9
80–84	84	52	42	+10
85 and over	26	16	12	+4
Females				
0–4	2,325	1,555	1,535	+20
5–9	2,609	1,705	1,653	+52
10–14	3,226	2,145	2,112	+33
15–19	3,155	2,267	2,293	−26
20–24	2,891	2,081	2,133	−52
25–29	2,809	2,006	2,060	−54
30–34	2,455	1,716	1,756	−40
35–39	2,107	1,456	1,488	−32
40–44	1,758	1,212	1,229	−17
45–49	1,607	1,095	1,098	−3
50–54	1,339	910	910	0
55–59	1,137	764	750	+14
60–64	890	590	582	+8
65–69	660	434	420	+14
70–74	496	322	301	+21
75–79	319	204	186	+18
80–84	173	111	92	+19
85 and over	74	47	40	+7
TOTAL	59,239	40,807	40,807	0

[a] Calculated from "urban" (municipality) and "rural" (other areas) population census data by method of difference elimination.

sitions of the urban and rural population have not yet been ascertained. Data for another country where some of the conditions might be similar can then be used and prorated to the summary data available for the particular country.

273. For instance, the sex-age composition of the total population of Sierra Leone, but not of its urban and rural population, has been obtained in the 1963 census. Relevant data exist, however, in the 1960 census of Ghana for an urban population of 1,551,360 and a rural population of 5,179,460. Both sets of data, those for Ghana and Sierra Leone, however, are heavily affected by age misstatement. But in the case of Sierra Leone a smooth population model has been substituted, and estimates and projections have been made with that model. This makes it possible to prorate the data for Ghana directly to smoothed data for Sierra Leone. In the given example, the data for Ghana are brought into line with Sierra Leone's national sex-age composition as estimated for 1960. For that year, Sierra Leone's urban population is estimated as 250,000, and the rural population as 1,886,000.

TABLE 23. APPLICATION OF THE METHOD OF DIFFERENCE ELIMINATION TO OBTAIN AN ESTIMATE OF THE SEX-AGE COMPOSITION OF THE URBAN AND RURAL POPULATION OF SIERRA LEONE IN 1960 FROM THE URBAN AND RURAL SEX-AGE COMPOSITION OBTAINED IN THE CENSUS OF GHANA IN 1960

Sex and age	Sierra Leone (estimate)	Ghana (census)		Sierra Leone, final adjustment	
		Urban	Rural	Urban	Rural
Males					
0–4	*184,000*	137,460	501,930	19,400	164,600
5–9	*145,000*	97,790	415,940	13,300	131,700
10–14	*125,000*	74,800	282,910	17,900	107,100
15–19	*108,000*	77,190	200,000	15,400	92,600
20–24	*93,000*	88,210	180,130	16,200	76,800
25–29	*80,000*	87,560	193,030	11,500	68,500
30–34	*68,000*	65,190	177,480	9,300	58,700
35–39	*58,000*	48,290	147,650	7,100	50,900
40–44	*49,000*	37,460	129,240	5,400	43,600
45–49	*40,000*	26,440	97,140	4,200	35,800
50–54	*33,000*	19,090	78,170	3,200	29,800
55–59	*26,000*	11,650	48,630	2,000	24,000
60–64	*20,000*	10,240	53,450	1,500	18,500
65+	*31,000*	17,760	95,440	2,300	28,700
Females					
0–4	*182,000*	139,590	514,860	19,000	163,000
5–9	*145,000*	111,510	394,400	15,700	129,300
10–14	*124,000*	83,920	241,030	16,200	107,800
15–19	*108,000*	71,100	192,850	14,800	93,200
20–24	*94,000*	81,850	236,770	12,200	81,800
25–29	*81,000*	68,410	239,780	8,900	72,100
30–34	*69,000*	53,670	193,110	7,400	61,600
35–39	*59,000*	36,340	140,750	5,900	53,100
40–44	*50,000*	28,150	116,930	4,700	45,300
45–49	*42,000*	19,730	75,560	4,200	37,800
50–54	*35,000*	16,840	65,610	3,500	31,500
55–59	*29,000*	9,670	39,470	2,800	26,200
60–64	*23,000*	10,920	44,430	2,200	20,800
65+	*38,000*	20,530	78,770	3,800	34,200
TOTAL, GHANA		1,551,360	5,175,460		
TOTAL, SIERRA LEONE	*2,136,000*			250,000	1,886,000

274. Table 23 shows the original data for Ghana, the marginal totals for Sierra Leone, and the results obtained after two horizontal and vertical proratings, rounded to the nearest hundred. In the absence of the pertinent information, these results may perhaps constitute an acceptable estimate of the sex-age composition of the urban and rural population in Sierra Leone, despite the roughness of the original data for either country, and the likelihood that conditions affecting urbanization are not quite the same in both countries.

Additional considerations

275. Several advantages in the use of the method of difference elimination have been noted. It is applicable not only in the projection of the urban and rural population, but also in the calibration of urban and rural sex-age data to smoothed data of the total population, and in the estimation of sex-age composition for "urban" and "rural" populations defined differently than at the census, or even belonging to another country. The question remains whether, in a projection, the adjustments obtained by this method are plausible in terms of the dynamics of the growth components.

276. The differences between urban and rural sex-age structures stem mainly from urban-rural differences in fertility and from net rural-urban migration. As compared with the rural, the urban population pyramid has usually a somewhat narrower base (because of lower urban fertility), and "bulges" about the ages at which most migrants arrive in the cities and towns. The method of difference elimination preserves these peculiarities in the urban and rural population structures, in so far as they remain compatible with projected changes in the sex-age composition of the total population. In other words, implicit in such projections are the rough assump-

tions that the urban-rural fertility difference will remain unchanged, and that migration, both in its relative magnitude and in its composition by sex and age groups, will continue to have similar effects as in the past.

277. It can be demonstrated that quite similar results are often obtained whether the urban and rural populations are projected globally and the age composition estimated with the present method, or whether the urban and rural populations are each projected with the cohort-survival method. For in the latter method it will usually also have to be assumed that fertility differences between urban and rural areas tend to persist, and that the relative volume and composition of the migratory stream, with its dominance of young adults, will remain similar to that for which a relevant estimate can be made, i.e. according to past experience. The method of difference elimination simulates the combined effects of those fertility differences and sex-age compositions at the base date, without analysing and applying them in any specific detail. Therefore, there may sometimes be little difference in the results of both types of projections, except that the global projection leaves the analytic detail unspecified.

278. Under more special circumstances, where the inherent conditions are expected to undergo some change or where past fluctuations are implicit in the initial age structure, the global method with difference elimination can become less adequate. For instance, a fertility decline might be foreseen for urban areas, but not yet for rural areas, with consequent widening in the urban-rural difference. Or the tempo of urbanisation, especially its migratory component, might be expected to accelerate or to slow down with consequent intensification or diminution of the effects of migration upon the urban and rural age structures. Where such considerations are important a cohort-survival projection is of course preferable.

A shorter method

279. The method of difference elimination discussed in the foregoing may sometimes appear more cumbersome than is warranted by the approximate nature of the forecasts. A shorter method is therefore also to be recommended in which, however, the differences in age group totals are not entirely eliminated. Among the many uses which have been made of the shorter method one may cite a demographic study undertaken jointly by the United Nations and the Government of the Philippines. [75]

280. The base data for the projection were those obtained in household surveys around 1957, including separate data by sex and age for the urban and rural population. The total population was projected by groups of sex and age for five-yearly intervals up to 1977. Percentages of rural population were projected in a trend parallel to a projected trend in the percentage of labour force engaged in agriculture. The expected future sizes of urban and rural population were then derived from the projection of total population, applying these percentages.

281. To obtain sex and age detail for future urban and rural population, the following steps were taken. First, the percentage distributions by sex-age groups in 1957 were calculated separately for the total, urban and rural population. Next, ratios were computed for the percentages in the urban and rural population by sex and age, relative to the percentages in the total population. These steps are illustrated in table 24.

282. These ratios were then maintained, as "correction factors" so to speak, to adjust any projected percentage sex and age distributions of the total population so as to yield corresponding distributions for the urban and rural populations, respectively. [76] The projected total population had the following percentages in different sex-age groups (table 25). Multiplication of the percentages in table 25 by the urban and rural "correction factors" of the last two columns of table 24, led to the following percentage sex and age distributions for the projected urban and rural population (table 26). These, in turn, were then applied to projected actual numbers of urban and rural population so as to obtain the absolute numbers to be estimated. [77]

C. ESTIMATING SEX-AGE GROUPS WITH THE USE OF THE LOGISTIC TABLE

282. Levels or degrees of urbanization can be measured separately for each sex-age group of the national popution, in terms of urban residence ratios specific by sex and age (see chapter II, second section). For reasons discussed in chapter III, third section, it is useful to transform these sex-age-specific percentage levels to a logistic scale. For, as argued, the flexibility of a percentage is under varied constraints, depending on whether the percentage is at an intermediate or extreme level. Here again the particular parameters entering into the calculation of a logistic curve are immaterial, hence the simple curve tabulated in annex I can serve as reference also for the purpose of estimating sex-age composition.

283. Table 27 shows urban percentages of the population of Iran in 1966, specific by groups of sex and age. Thus, children were urbanized to an extent of 35 to 36 per cent, while at adult ages the percentage fluctuated about 40, reaching peaks among adolescents and young adults, and also among women about the age of 50. Comparatively high percentages of urbanization appear among males aged 15 to 19 and those aged 20 to 24. It is not unlikely that many young men of rural origin spend their period of military service at urban duty stations.

[75] *Population Growth and Manpower in the Philippines*, a joint study by the United Nations and the Government of the Philippines (United Nations publication, Sales No. 61.XIII.2).

[76] The majority of the initial population was still rural, hence the rural correction factors differ less from unity than the urban correction factors. With time, an increasing proportion of the population will be urban, but the present method makes no provision for the effect of shift in weights on the correction factors.

[77] With this procedure, the totals of urban and rural population within each sex-age group do not exactly agree with the projected total population, although the discrepancies are generally trivial. The sum of the urban and rural population may therefore be accepted as a modified projection of total population, or an adjustment may be made in the urban and rural figures.

TABLE 24. SEX-AGE DISTRIBUTIONS OF THE TOTAL POPULATION OF THE PHILIPPINES AND OF URBAN AND RURAL POPULATION, 1957 (DATA FROM 1956 AND 1957 PSSH ROUNDS, REFERRING TO PRIVATE HOUSEHOLD POPULATION)

Sex and age (years) (1)	*Per cent distribution by sex and age*			*Ratio, col. 3 ÷ col. 2* [a]	*Ratio, col. 4 ÷ col. 2* [b]
	Total population (2)	*Urban population* (3)	*Rural population* (4)	(5)	(6)
Both sexes, all ages	*100.00*	*100.00*	*100.00*	*1.000*	*1.000*
Males					
0–4	9.32	8.94	9.53	.959	1.023
5–9	7.29	6.91	7.50	.948	1.029
10–14	6.58	6.36	6.70	.967	1.018
15–19	5.12	5.17	5.08	1.010	.992
20–24	4.10	4.19	4.05	1.022	.988
25–34	5.89	6.10	5.78	1.036	.981
35–44	4.80	4.79	4.81	.998	1.002
45–54	3.39	3.43	3.36	1.012	.991
55–64	1.85	1.70	1.94	.919	1.049
65 and over	1.57	1.34	1.70	.854	1.083
Females					
0–4	8.97	8.79	9.07	.980	1.011
5–9	7.04	6.76	7.18	.960	1.020
10–14	6.26	6.07	6.36	.970	1.016
15–19	5.32	6.01	4.93	1.130	.927
20–24	4.47	4.91	4.23	1.098	.946
25–34	6.51	6.98	6.26	1.072	.962
35–44	4.98	4.97	4.98	.998	1.000
45–54	3.28	3.30	3.27	1.006	.997
55–64	1.73	1.73	1.73	1.000	1.000
65 and over	1.54	1.55	1.54	1.006	1.000

[a] This will be considered as the urban "correction factor".

[b] This will be considered as the rural "correction factor".

TABLE 25. PERCENTAGE SEX-AGE COMPOSITION OF THE TOTAL POPULATION OF THE PHILIPPINES AS PROJECTED FROM 1957 TO 1977

Sex and age (years)	*1957*	*1962*	*1967*	*1972*	*1977*
Males					
0–4	9.32	9.46	9.57	9.59	9.58
5–9	7.29	7.48	7.60	7.70	7.74
10–14	6.58	6.17	6.21	6.36	6.43
15–19	5.12	5.57	5.19	5.27	5.31
20–24	4.10	4.28	4.63	4.30	4.36
25–34	5.89	6.08	6.37	6.74	6.70
35–44	4.80	4.27	4.00	4.11	4.29
45–54	3.39	3.38	3.12	2.77	2.60
55–64	1.85	1.89	2.00	2.00	1.85
65 and over	1.57	1.38	1.25	1.23	1.27
Females					
0–4	8.97	9.22	9.32	9.34	9.31
5–9	7.04	7.22	7.41	7.51	7.55
10–14	6.26	5.95	6.07	6.21	6.27
15–19	5.32	5.29	4.99	5.07	5.18
20–24	4.47	4.45	4.40	4.14	4.21
25–34	6.51	6.66	6.75	6.67	6.41
35–44	4.98	4.62	4.42	4.51	4.56
45–54	3.28	3.43	3.31	3.06	2.93
55–64	1.73	1.81	2.03	2.11	2.05
65 and over	1.54	1.40	1.28	1.29	1.40

TABLE 26. PROJECTION OF SEX-AGE DISTRIBUTION OF URBAN AND RURAL POPULATION OF THE PHILIPPINES, 1957-1977
(Percentage)

Sex and age (years)	1957		1962		1967		1972		1977	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Both sexes, all ages ...	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*
Males										
0–4	8.94	9.53	9.07	9.67	9.18	9.78	9.20	9.80	9.19	9.79
5–9	6.91	7.50	7.09	7.69	7.21	7.81	7.30	7.92	7.34	7.96
10–14	6.36	6.70	5.97	6.28	6.09	6.40	6.15	6.47	6.22	6.54
15–19	5.17	5.08	5.62	5.53	5.25	5.16	5.33	5.24	5.37	5.28
20–24	4.19	4.05	4.37	4.23	4.73	4.57	4.40	4.25	4.46	4.31
25–34	6.10	5.78	6.29	5.97	6.59	6.25	6.98	6.61	6.93	6.57
35–44	4.79	4.81	4.26	4.28	4.00	4.01	4.11	4.11	4.29	4.29
45–54	3.43	3.36	3.42	3.35	3.16	3.09	2.80	2.74	2.63	2.58
55–64	1.70	1.94	1.73	1.98	1.83	2.10	1.84	2.10	1.70	1.94
65 and over	1.34	1.70	1.17	1.49	1.06	1.35	1.05	1.33	1.08	1.37
Females										
0–4	8.79	9.07	9.04	9.32	9.14	9.42	9.16	9.44	9.13	9.41
5–9	6.76	7.18	6.93	7.38	7.12	7.57	7.22	7.67	7.25	7.71
10–14	6.07	6.36	5.76	6.05	5.88	6.17	6.02	6.31	6.08	6.37
15–19	6.01	4.93	5.98	4.92	5.64	4.64	5.74	4.72	5.85	4.81
20–24	4.91	4.23	4.89	4.21	4.83	4.16	4.55	3.92	4.63	3.98
25–34	6.98	6.26	7.14	6.40	7.23	6.49	7.15	6.41	6.87	6.16
35–44	4.97	4.98	4.61	4.62	4.41	4.42	4.50	4.51	4.55	4.56
45–54	3.30	3.27	3.44	3.42	3.33	3.30	3.08	3.05	2.95	2.92
55–64	1.72	1.73	1.81	1.81	1.29	2.03	2.12	2.11	2.05	2.05
65 and over	1.55	1.54	1.41	1.40	1.29	1.28	1.30	1.29	1.41	1.40

TABLE 27. CALCULATION OF SEX-AGE SPECIFIC URBAN RESIDENCE RATIOS, AND OF CORRESPONDING LOGISTIC LEVELS, FROM 1966 CENSUS DATA FOR IRAN

Sex and age	Population		Per cent urban	Logistic level	Same, smoothed
	Total	Urban			
Both sexes	*25,144*	*9,840*	*39.1*	*−44*	*−44*
Males	*12,998*	*5,116*	*39.4*	*−43*	...
0–4	2,301	805	35.0	−62	−60
5–9	2,160	776	35.9	−58	−58
10–14.....	1,609	676	42.0	−32	−32
15–19.....	1,068	501	46.9	−12	−12
20–24.....	777	398	51.2	+5	+5
25–29.....	789	327	41.4	−34	−25
30–34.....	864	335	38.8	−46	−42
35–39.....	763	295	38.7	−46	−49
40–44.....	760	280	36.8	−54	−47
45–49.....	483	192	39.8	−41	−45
50–54.....	362	144	39.8	−41	−45
55–59.....	216	80	37.0	−53	−48
60–64.....	342	129	37.7	−50	−55
65 and over	504	178	35.3	−61	−61
Females	*12,146*	*4,724*	*38.9*	*−45*	...
0–4	2,142	762	35.6	−59	−60
5–9	1,988	722	36.3	−56	−58
10–14.....	1,438	612	42.6	−30	−30
15–19.....	1,055	452	42.8	−29	−29
20–24.....	887	375	42.3	−31	−31
25–29.....	848	324	38.2	−48	−43
30–34.....	803	301	37.5	−51	−46
35–39.....	670	272	40.6	−38	−48
40–44.....	578	212	36.7	−55	−41
45–49.....	365	154	42.8	−29	−39
50–54.....	382	160	41.9	−33	−32
55–59.....	201	83	41.3	−35	−38
60–64.....	326	126	38.7	−46	−45
65 and over	463	169	36.5	−55	−55

TABLE 28. PROJECTION OF LOGISTIC LEVEL, URBAN RESIDENCE RATIOS AND ACTUAL NUMBERS OF URBAN POPULATION TO 1975, IN CONFORMITY WITH PROJECTED POPULATION OF IRAN BY SEX-AGE GROUPS, AND URBAN TOTAL

Sex and age	Logistic level		Per cent urban	Population, 1975		
	1966	1975	1975	Total	Urban	Urban, prorated
Both sexes	−44	−22	44.6	*33,151*	*14,949*	*14,707*
Males	...	...	...	*16,729*	*7,647*	*7,524*
0–4	−60	−38	40.6	3,096	1,257	1,237
5–9	−58	−36	41.1	2,464	1,013	997
10–14	−32	−10	47.5	2,114	1,004	988
15–19	−12	+10	52.5	1,790	940	925
20–24	+5	+27	56.7	1,531	868	854
25–29	−25	−3	49.3	1,196	590	580
30–34	−42	−20	45.0	911	410	403
35–39	−49	−27	43.3	750	325	320
40–44	−47	−25	43.8	649	284	279
45–49	−45	−23	44.3	553	245	241
50–54	−45	−23	44.3	467	207	204
55–59	−48	−26	43.5	384	167	164
60–64	−55	−33	41.8	301	126	124
65 and over	−61	−39	40.4	523	211	208
Females	...	...	...	*16,422*	*7,302*	*7,183*
0–4	−60	−38	40.6	3,007	1,221	1,201
5–9	−58	−36	41.1	2,402	987	971
10–14	−30	−8	48.0	2,064	991	975
15–19	−29	−7	48.3	1,746	843	829
20–24	−31	−9	47.8	1,494	714	702
25–29	−43	−21	44.8	1,166	522	514
30–34	−46	−24	44.0	886	390	384
35–39	−48	−26	43.5	730	318	313
40–44	−41	−19	45.3	634	287	282
45–49	−39	−17	45.7	542	248	244
50–54	−32	−10	47.5	462	219	215
55–59	−38	−16	46.0	385	177	174
60–64	−45	−23	44.3	312	138	136
65 and over	−55	−33	41.8	592	247	243

284. With reference to the table in annex I, these specific urban residence ratios can be transformed to the logistic levels also shown in table 27. Some incongruities emerge at middle and advanced adult ages, and these are most pronounced among women where the logistic level fluctuates from −51 at ages 30 to 34 to −38 at ages 35 to 39, back to −55 at ages 40 to 44, and again to −29 at ages 45 to 49. It is unlikely that in actual fact women of adjacent five-year age groups would be urbanized to such an unequal extent. Most likely, these fluctuations are due to unequal accuracy in age statements for urban women as compared with those for rural women. To counteract this effect, the logistic levels were smoothed for age groups between 25 and 64 years of age, using a three-term moving average. Another slight modification, also in the last column of table 27, was made by introducing the arbitrary assumption that at ages 0 to 4 and 5 to 9 boys and girls may be urbanized to the same extent. [78]

285. These smoothed logistic levels of urbanization were entered in the first column of table 28. In a previous projection of urban and rural totals, the percentage urban in Iran was estimated to rise from 39.1 per cent at the 1966 census to 44.6 per cent in 1975. By reference to the logistic table in annex I it can be seen that this corresponds to a rise along the logistic curve of 22 points (from a value of −44 to −22). For purposes of the projection it will be assumed that the *increase* in logistic level of each sex-age group was the same as the *increase* in logistic level previously projected for the total population, i.e. 22 points as shown in the second column of table 28. The corresponding percentage levels (as read from the logistic table in annex I) are shown in the third column. These percentages are then applied to the projection of the total population to 1975, already calculated by sex-age groups. The results add up to an urban population of 14,949,000, which is more than the figure of 14,707,000 already projected. In the last column, therefore, the figures for each sex-age group are prorated so as to coincide with the latter total. (The rural population, by sex and age, can then be obtained

[78] This adjustment is debatable. In Latin America, for instance, small girls are more often taken by their migrant mothers to the towns, whereas small boys are more often left in the countryside, as can be borne out by analysis of census data.

TABLE 29. CALCULATION OF SEX-AGE SPECIFIC URBAN RESIDENCE RATIOS AND OF CORRESPONDING LOGISTIC LEVELS FROM 1950 CENSUS DATA FOR BRAZIL

Sex and age	Population		Per cent urban	Logistic level
	Total	Urban		
Both sexes	*51,946*	*18,684*	*35.97*	*−57.7*
Males	*25,886*	*8,971*	*34.66*	*−63.4*
0–4	4,276	1,273	30.05	−84.5
5–9	3,561	1,026	28.81	−90.5
10–14	3,165	976	30.84	−80.8
15–19	2,645	922	34.86	−62.5
20–24	2,384	901	37.79	−49.8
25–29	2,030	779	38.37	−47.4
30–39	3,146	1,225	38.94	−45.0
40–49	2,246	892	39.72	−41.7
50–59	1,361	543	39.90	−40.9
60–69	729	288	39.51	−42.6
70 and over [a]	383	146	38.12	−48.4
Females	*26,060*	*9,713*	*37.27*	*−52.1*
0–4	4,135	1,256	30.37	−83.0
5–9	3,455	1,027	29.73	−86.0
10–14	3,144	1,047	33.30	−69.5
15–19	2,858	1,093	38.24	−47.9
20–24	2,607	1,069	41.00	−36.4
25–29	2,102	877	41.72	−33.4
30–39	3,140	1,342	42.74	−29.2
40–49	2,119	936	44.17	−23.4
50–59	1,290	589	45.66	−17.3
60–69	723	347	47.99	−8.0
70 and over [a]	487	230	47.23	−11.1

[a] Includes persons of unknown age.

by subtracting estimated numbers in sex-age groups of the urban population from those already projected for the total population.)

286. The reader may wish to compare these results with the ones which had been obtained in the preceding chapter, in table 21c, by means of the method of difference elimination. It will be noted that the results do not differ greatly. Part of the difference in results may be attributable to the smoothing of the logistic levels, as done in table 28. At any rate, census age statements have been rather inaccurate, hence the estimates are rather uncertain, and it would be futile to argue which of the two sets of results are likely to be the more accurate ones. It will be noted that less calculating work is involved when the logistic table is used than in the method of difference elimination.

287. To give an idea of the possible errors of such a calculation, tables 29 and 30 present the results of the same type of procedure for Brazil. The calculation for 1960 proceeds from the census of 1950 and results are compared with corresponding data of the 1960 census. For the calculation it is assumed that only the sex-age composition of the total population is known for 1960, as well as the totals of urban and rural population. Since the age declarations are probably somewhat more accurate in Brazil than in Iran, percentages have been calculated with an additional decimal, and logistic levels have been interpolated to the nearest tenth of each interval in the table in annex I, but no smoothing was done among those levels.

288. The comparison of the projection with the 1960 census result is carried out in the last three columns of table 30. For males and females alike, the following observations can be made. The projection results in an underestimation of the population aged 0 to 14 years, an over-estimation of numbers aged 15 to 29 years, an underestimation of the population aged 30 to 39 years, an over-estimation at ages 40 to 69 and a nearly correct estimation at ages 70 and over. Evidently the comparative urbanization levels did not, in actual fact, remain the same between the two censuses, 1950 and 1960.

289. The underestimation in projected numbers of children suggests that the relative fertility level of the urban population (as compared with the rural population) was higher in the 1950-1960 period than in a period preceding 1950. The over-estimation in projected numbers of young adults, aged 15 to 29, suggests that the intensity of rural-to-urban migration was less during 1950-1960 than during years preceding 1950. The alternation between over-estimates and underestimates, as we proceed through the entire range of ages, may even suggest that the intensity of urbanization trends could have fluctuated cyclically over extended periods of the past. Of course, the effects of variations in fertility differences and migration trends cannot be disentangled in such an analysis, and alternative interpretations are pos-

TABLE 30. PROJECTION OF LOGISTIC LEVEL, URBAN RESIDENCE RATIO, AND ACTUAL NUMBERS OF URBAN POPULATION IN 1960, AND COMPARISON WITH 1960 CENSUS DATA FOR BRAZIL

Sex and age	Logistic level 1960	Per cent urban 1960	Population, 1960			
			Total as per census	Urban projected	Urban as per census	Error in projection
Both sexes	*−14.6*	*46.36*	*70,033*	*32,467*	*32,469*	*−2*
Males	...	...	*35,010*	*15,677*	*15,620*	*+57*
0–4	−41.4	39.80	5,712	2,273	2,370	−97
5–9	−47.4	38.37	5,159	1,980	2,108	−128
10–14	−37.7	40.69	4,287	1,744	1,784	−40
15–19	−19.4	45.17	3,446	1,557	1,447	+110
20–24	−6.7	48.33	2,964	1,433	1,354	+79
25–29	−4.3	48.93	2,522	1,234	1,214	+20
30–39	−1.9	49.53	4,210	2,085	2,104	−19
40–49	+1.4	50.40	3,052	1,538	1,458	+80
50–59	+2.2	50.55	1,951	986	952	+34
60–69	+0.5	50.12	1,124	563	543	+20
70 and over [a]	−5.3	48.68	583	284	286	−2
Females	...	...	*35,023*	*16,790*	*16,849*	*−59*
0–4	−39.9	40.16	5,484	2,202	2,329	−127
5–9	−42.9	39.44	5,002	1,973	2,118	−145
10–14	−25.6	43.63	4,287	1,870	1,907	−37
15–19	−4.8	48.80	3,697	1,804	1,724	+80
20–24	+6.7	51.67	3,197	1,652	1,596	+56
25–29	+9.7	52.27	2,687	1,404	1,395	+9
30–39	+13.9	53.47	4,210	2,251	2,277	−26
40–49	+19.7	54.91	2,907	1,596	1,527	+69
50–59	+25.8	56.41	1,835	1,035	1,000	+35
60–69	+35.1	58.69	1,061	623	596	+27
70 and over [a]	+32.0	57.93	656	380	380	0

[a] Includes persons of unknown age.

sible: both urban fertility and migration may have fluctuated in the course of time.

290. As was noted in chapter II, the mode of urbanization in Latin America is characterized by higher urbanization levels of women as compared with men, and rising urbanization levels with advancing age. Accordingly, one may assume that in Brazil a large proportion of rural-to-urban migrants settle in the urban areas indefinitely. If sex-age specific urban residence ratios are affected by fluctuations from past trends, it is probable that the same fluctuations will reappear at ages ten years more advanced at each of the successive decennial censuses. In so far as this may have to be expected, the mechanical methods proposed in both parts of the present chapter have only limited validity. The case of Brazil will be further investigated in the next chapter.

291. The improved estimation of sex and age groups in a projected urban and rural population depends, however, on additional statistical information. In the absence of sufficient information, it would be difficult to make better estimates than those possible with the procedures of both parts of the present chapter.