Chapter V

UNITED NATIONS METHOD OF URBAN AND RURAL POPULATION PROJECTIONS

156. As already explained, the United Nations method of measuring the tempo of urbanization and projecting it is based on the difference between urban and rural population growth and its logistic transformation. For an appreciation of possible magnitudes in this measure—URGD for short—reference is made to table 11, presenting estimates of urbanization level in twenty-four regions of the world for 1960-1970,[55] now being revised on the basis of new data.

157. It will be noted that levels of urbanization in 1960 were distinctly higher in more developed regions, ranging from 44 to 80 per cent, than in less developed regions, where the range was from 2 to 46 per cent. Rates of population growth were distinctly lower in more

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[55] Monthly Bulletin of Statistics, November 1971 (United Nations publication), special tables B-II and B-III.

TABLE 11. LEVELS OF URBANIZATION, 1960 AND 1970, RATES OF GROWTH IN URBAN AND RURAL POPULATION, 1960-1970, AND DIFFERENCES BETWEEN THESE RATES, IN NINE MORE DEVELOPED AND FIFTEEN LESS DEVELOPED REGIONS OF THE WORLD

Region	Percentage urban population		Annual rates of growth, 1960-1970 (per cent)		
	1960	1970	Urban	Rural	Difference
More developed regions [a]	*61.0*	*67.5*	*2.2*	*−0.6*	*2.8*
Australia and New Zealand	79.9	83.4	2.4	0.0	2.4
Northern Europe	72.3	76.2	1.2	−0.9	2.1
Temperate South America [b]	71.1	78.3	2.7	−1.1	3.8
Northern America	69.7	74.3	2.0	−0.3	2.3
Western Europe	68.8	74.4	1.8	−1.0	2.8
Soviet Union	49.5	57.1	2.7	−0.4	3.1
Eastern Europe	48.8	54.0	1.8	−0.3	2.1
Southern Europe	45.0	50.8	2.1	−0.2	2.3
Japan [c]	44.3	58.9	3.1	−0.8	3.9
Less developed regions [a]	*24.6*	*29.6*	*4.7*	*1.8*	*2.9*
Tropical South America [d]	45.8	55.5	5.0	1.0	4.0
Middle America	44.9	51.4	4.8	2.1	2.7
Southern Africa	41.7	45.6	3.2	1.6	1.6
Caribbean	36.7	41.6	3.6	1.5	2.1
Other East Asia [e]	32.9	42.7	5.3	1.2	4.1
South West Asia	31.5	37.4	4.5	1.9	2.6
Northern Africa	29.9	34.9	4.4	2.1	2.3
China	18.1	25.5	4.9	1.0	3.9
South East Asia	17.5	21.0	3.7	2.3	1.4
Middle South Asia	16.9	18.9	3.8	2.4	1.4
Polynesia and Micronesia	15.8	20.1	5.4	2.7	2.7
Western Africa	15.3	19.9	5.4	1.9	3.5
Middle Africa	11.5	16.5	5.7	1.4	4.3
Eastern Africa	7.5	10.1	5.6	2.1	3.5
Melanesia	2.3	3.1	5.5	2.8	2.7

SOURCE: Monthly Bulletin of Statistics, November 1971 (United Nations publication). A few regions have been regrouped as indicated in foot-notes.

[a] Unweighted average.

[b] Not including Paraguay.

[c] "Urban" population defined as that of densely inhabited districts; including former Ryukyu Islands.

[d] Including Paraguay.

[e] Republic of Korea. Democratic People's Republic of Korea. Hong Kong. Mongolia and Macao.

developed than in less developed regions. Thus, urban population grew at rates between 1.2 and 3.1 per cent in the first group, and between 3.6 and 5.7 per cent in the second group of regions. In more developed regions, the rural population declined (or did not change much, as in Australia and New Zealand), while in less developed regions, rural population grew at rates between 1.0 and 2.8 per cent per year, and this range is similar to the rates of growth of urban population in the more developed regions.

158. Despite these differences in urbanization level and growth rates, however, the differences between urban and rural growth rates in more developed and less developed regions are of the same order of magnitude. In the first group of regions, URGD ranges from 2.1 to 3.9 per cent, and in the second group, from 1.4 to 4.3 per cent. The unweighted average in both groups is nearly the same, 2.8 and 2.9 respectively. One can say that regardless of levels of development, levels of urbanization or the tempo of population growth, URGDs between about 2.0 and 4.0 are now typical throughout the world. Where there is no other detailed knowledge, projections may be made with reference to these observed ranges.

159. For the combined world population, the URGD is smaller as a result of distortions affecting the weighted averages. In 1960-1970, the more developed regions still included a majority of the world's urban population, but in these regions rates of population growth were comparatively moderate; the great majority of the world's rural population is in less developed regions where population growth is rapid. During 1960-1970, according to the estimates, the world's urban population grew from 986 to 1,358 million, and the world's rural population from 1,995 to 2,277 million, representing an urban rate of 3.3 per cent, a rural growth rate of 1.3 per cent and an URGD of only 2.0 per cent per year. This represents a slight acceleration when compared with world-wide estimates for the nineteenth and the earlier part of the twentieth century.

160. Davis and Hertz have estimated the world's population, and the world's urban population (defined as localities with at least 5,000 inhabitants) in 1800 and 1900.[56] According to them, the urban population grew in that century from 27 million to 219 million, and the remaining, or rural, population from 879 to 1,389 million. Average growth rates of the nineteenth century therefore amount to 2.1 per cent for the urban population, and 0.5 per cent for the rural population, leaving an URGD of 1.6 per cent. In view of the distorting effects already mentioned in the combined world figures for 1960-1970, URGD in individual countries or regions may for the most part have been higher.

161. Linking the estimates of Davis and Hertz for 1900 with our present estimates for 1960, we arrive at an average 1900-1960 urban growth rate of 2.5 per cent, a rural growth rate of 0.8 per cent and an URGD of 1.7 per cent, only slightly more than the world estimate for

[56] See M. Hauser, ed., *Urbanization in Asia and the Far East*, Proceedings of the Joint United Nations/UNESCO Seminar (in co-operation with the ILO) on Urbanization in the ECAFE Region, Bangkok, 8-18 August 1956, Tensions and Technology Series No. 7 (Calcutta, 1957), pp. 56-57.

1800-1900. The long continuation of urbanization with nearly the same momentum (as measured by URGD) is impressive, and it can be concluded that long-run urbanization trends have great inertia. Within shorter time periods, however, this process can fluctuate.

162. A long period of short-time changes can be observed in the decennial census data of the United States (see table 12). A break in the series occurs between 1940 and 1950, as the urban population was then redefined to take into account some of the more recent developments resulting mainly from suburbanization; the difference between the two rates, urban and rural, therefore is perhaps too low in 1930-1940 (redefinition having become due) and perhaps too high in 1940-1950 (an overdue redefinition having at last been adopted). There are also reasons to doubt the accuracy of the 1870 census, taken after the Civil War.

TABLE 12. RATES OF GROWTH IN URBAN POPULATION, IN RURAL POPULATION, AND DIFFERENCES BETWEEN THE TWO RATES, IN THE UNITED STATES, 1800-1960 (PER CENT PER YEAR)

Period	Annual growth rate		Difference between the two rates
	Urban	Rural	
Decades			
1800–1810	5.0	3.0	2.0
1810–1820	2.8	1.9	0.9
1820–1830	5.0	2.8	2.2
1830–1840	5.1	2.6	2.5
1840–1850	6.8	2.6	4.2
1850–1860	5.8	2.5	3.3
1860–1870 [a]	4.8	1.3	3.5
1870–1880 [a]	3.6	2.3	1.3
1880–1890	4.6	1.3	3.3
1890–1900	3.2	1.2	2.0
1900–1910	3.4	0.7	2.7
1910–1920	2.6	0.4	2.2
1920–1930	2.4	0.4	2.0
1930–1940 [b]	0.7	0.6	0.1
1940–1950 [c]	2.6	−0.5	3.1
1950–1960	2.7	0.0	2.7
40-year periods			
1800–1840	4.5	2.6	1.9
1840–1880	5.2	2.2	3.0
1880–1920	3.5	0.9	2.6
1920–1960 [c]	2.1	0.1	2.0

[a] Probable undernumeration of rural population in 1870,
[b] Period of economic depression,
[c] Including change-over to a new definition of urban population which had become necessary by 1950.

163. Over the entire 160-year period here considered, the difference between urban and rural rates of increase averages 2.4 per cent per year, including both favourable periods and others which were unfavourable to rapid urban growth. The average URGD was as high as 3.0 per cent during 1840-1880. It is noteworthy that during 1920-1960, a period when the level of urbanization was high, the difference between the two rates was no less than it had been during 1800-1840, a time when urbanization was still at a very low level.

164. It is evident that considerable fluctuations can occur in individual decades. Nevertheless, even at widely different urbanization levels, the span between urban and rural rates of population growth can be quite similar. Where no adverse conditions retard the tempo of urbanization, both across the world and in the long time perspective, a 2.5 or 3.0 per cent excess of urban over rural growth rates appears to be fairly normal, while growth differences between 2.0 and 4.0 per cent need not be regarded as unusual.

165. These general observations, however, do not dispense with the need to arrive at an independent judgement as regards the situation in each particular country, considering the probable or possible influence of varying economic and social conditions or policies. It is an advantage, and not a defect, of the method that varied assumptions of growth differences can be drawn up quite freely.

FORMULA FOR ITERATIVE CALCULATION

166. The urban and rural population growth rates, and the difference between them, can be calculated either as instantaneous (exponential) or annual (compound interest) rates. Accordingly, there are two alternative modes of application of the growth-difference method for projections of urban and rural population. In either instance it is assumed that a projection of the national total population already exists. Often that projection may be available by five-year time intervals only.

167. If five-year time intervals only are required for the urban and rural projection, then the recommended method may very well be that of instantaneous rates of growth, for direct use can then be made of the logistic curve tabulated in annex I. But if projections of urban and rural population are desired for a series of individual calendar years, there may sometimes be an advantage in the use of annual rates, applied by a simple formula year by year. But then it is also necessary to refer to a projection of total population by individual calendar years. If that initial projection proceeds by five-year intervals only, a series of year-by-year interpolations is also needed.

168. The formula for the year-by-year projection of urban and rural population in relation to an existing projection of total population, employing annual rates of growth, can be derived as follows.
Let T, U and R be the total, urban and rural population for the year t, T', U' and R' the same populations for the year $t+1$, u and r the urban and rural rates of increase, and d the difference between them; then the following relationships obtain:

$T = U + R$, and $T' = U' + R'$,
$U' = U(1+u) = U(1+r+d)$, and $R' = R(1+r)$,
whence
$T' = U(1+r+d) + R(1+r) = (U+R)(1+r) + Ud =$
$\qquad T(1+r) + Ud$,
so that
$\qquad T' - Ud = T(1+r)$.
Therefore,

$$\frac{U'}{U} = 1+u = (1+r) + d = \frac{T'-Ud}{T} + d,$$

and the final formula is

$$U' = \left(\frac{T'+dR}{T}\right)U.$$

The rural population is then obtained by subtraction of U' from T'. The computation can be repeated for each single year of the projection period.

YEAR-TO-YEAR INTERPOLATION OF A FIVE-YEARLY PROJECTION

169. There should be little problem in the interpolation of a projection of the total population by individual calendar years. The easiest method is perhaps the graphic one, where the projected population, at five-yearly intervals, is plotted, and the points are connected free-hand or with the use of French curves to obtain a smooth transition among gradually changing growth rates for the intervening individual years.

170. The use of a simple mathematical interpolation can also be recommended. The population of Iran, for instance, has been projected for five-yearly intervals with these results:

Year	Population (in thousands)
1965	24,549
1970	28,358
1975	33,152
1980	38,769
1985	45,050

A series of this type can usually be simply interpolated with the use of first and second differences, as shown in table 13. The detailed procedure is lengthy to explain in a text, but will be quite evident as described in the foot-notes to the table. This procedure is known as the "central difference method".

APPLICATIONS OF THE METHOD (BY ANNUAL RATES)

171. For Iran, an urban population of 9,172,000 has been estimated for 1965. Urbanization has been proceeding speedily in Iran, hence the URGD may perhaps be put at 3.0 per cent on a medium assumption. Alternative projections may put it as low as 2.0 and as high as 4.0 per cent. In applying the formula

$U' = \left(\frac{T'+dR}{T}\right)U$, we obtain the following three series

implying a high, medium or low tempo of urbanization, respectively. [57]

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[57] To illustrate the first step of computation assuming the "high" tempo, we have the following quantities: $T = 24,549$, $T' = 25,225$, $U = 9,172$, $R = 15,377$ (i.e. 24,549 minus 9,172) and $d = 0.04$ (high assumption).

Substituting in the formula $U' = \left(\frac{T'+dR}{T}\right)U$ we have

$$U' = \frac{25,225 + 0.04 \cdot 15,377}{24,549} \cdot 9,172 = 9,654.$$

Subtracting U' from T', we obtain
$\qquad R' = 25,225 - 9,654 = 15,571$;
likewise for each successive year of the projection and for alternative assumptions.

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Year (1)	Data (2)	Mean first difference (3)	Mean second difference (4)	Second difference interpolated (5)	First difference interpolated (6)	First trial, results (7)	Adjustments, interpolated (8)	Results, adjusted (9)
1965	24,549		(45) [c]			24,549		24,549
1966				44	675	25,224	1	25,225
1967				43	719	25,943	2	25,945
1968		762 [a]		42	762	26,705	2	26,707
1969				41	804	27,509	3	27,512
(1970)				40	845	(28,354) [d]	4 [e]	
1970	28,358		39 [b]			28,358		28,358
1971				38	884	29,242	1	29,243
1972				37	922	30,164	2	30,166
1973		959		36	959	31,123	2	31,125
1974				35	995	32,118	3	32,121
(1975)				34	1,030	(33,148) [d]	4	
1975	33,152		33			33,152		33,152
1976				32	1,060	34,212	1	34,213
1977				31	1,092	35,304	3	35,307
1978		1,123		30	1,123	36,427	4	36,431
1979				29	1,153	37,580	5	37,585
(1980)				28	1,182	(38,762) [d]	7	
1980	38,769		27			38,769		38,769
1981				26	1,205	39,974	1	39,975
1982				25	1,231	41,205	2	41,207
1983		1,256		24	1,256	42,461	4	42,465
1984				23	1,280	43,741	5	43,746
(1985)				22	1,303	(45,044) [d]	6	
1985	45,050		(21) [c]			45,050		45,050

[a] Equals 1/5 of (28,358 − 24,549). Other first differences are calculated in the same manner.

[b] Equals 1/5 of (959 − 762). Other second differences are calculated in the same manner.

[c] Extrapolated, in these instances equal 39 + (39-33), and 27 + (27-33).

[d] Trial results.

[e] Difference between trial result (in parenthesis) and original data (in italics), 28,358 − 28,354 in this instance.

URBAN AND RURAL POPULATION OF IRAN, 1965-1985, ACCORDING TO A PROJECTION OF TOTAL POPULATION AND THREE ASSUMED TEMPOS OF URBANIZATION

Year	Projected total	"High" tempo (4 per cent)		"Medium" tempo (3 per cent)		"Low" tempo (2 per cent)	
		Urban	Rural	Urban	Rural	Urban	Rural
1965	24,549	9,172	15,377	9,172	15,377	9,172	15,377
1966	25,225	9,654	15,571	9,597	15,628	9,540	15,685
1967	25,945	10,168	15,777	10,049	15,896	9,931	16,014
1968	26,707	10,714	15,993	10,529	16,178	10,345	16,362
1969	27,512	11,294	16,218	11,038	16,474	10,784	16,728
1970	28,358	11,908	16,450	11,576	16,782	11,247	17,111
1971	29,243	12,556	16,687	12,143	17,100	11,734	17,509
1972	30,166	13,239	16,927	12,739	17,427	12,245	17,921
1973	31,125	13,957	17,170	13,365	17,760	12,780	18,345
1974	32,121	14,712	17,409	14,021	18,100	13,340	18,781
1975	33,152	15,503	17,649	14,708	18,444	13,924	19,228
1976	34,213	16,329	17,884	15,424	18,789	14,531	19,983
1977	35,307	17,193	18,114	16,171	19,136	15,166	20,141
1978	36,431	18,093	18,338	16,949	19,482	15,822	20,609
1979	37,585	19,031	18,554	17,758	19,827	16,502	21,083
1980	38,769	20,006	18,763	18,598	20,171	17,207	21,562
1981	39,975	21,016	18,959	19,467	20,508	17,933	22,042
1982	41,207	22,062	19,145	20,366	20,841	18,683	22,524
1983	42,465	23,144	19,321	21,297	21,168	19,457	23,008
1984	43,746	24,263	19,483	22,258	21,488	20,255	23,491
1985	45,050	25,418	19,632	23,250	21,800	21,076	23,974

172. In accordance with these projections, the following percentage levels of urban population would be attained at future dates:

Year	"High" tempo	"Medium" tempo	"Low" tempo
1965	37.4	37.4	37.4
1970	42.0	40.8	39.7
1975	46.8	44.4	42.0
1980	51.6	48.0	44.4
1985	56.4	51.6	46.8

A noteworthy observation can here be made. At the low tempo (URGD = 2 per cent), a level of urbanization (46.8) is obtained after 20 years, which at the high tempo (URGD = 4 per cent) is obtained after 10 years. At the medium tempo (URGD = 3 per cent), the level of urbanization after 20 years (51.6) is that attained at the high tempo (URGD = 4 per cent) after 15 years.

these figures. A more detailed knowledge of relevant circumstances in Iran, however, might give cause to modify such a tentative judgment.

175. One might wonder whether the same method also leads to acceptable results when the level of urbanization is either very low or very high. It has therefore also been applied to the urban and rural populations of the United Republic of Tanzania and those of Canada. Again, URGD has been assumed as 4 per cent for the "high", 3 per cent for the "medium", and 2 per cent for the "low" projection. The calculations were also carried out from interpolated figures by individual calendar year. For brevity, the results are shown for five-year intervals only.

176. In the case of the United Republic of Tanzania (low level of urbanization), a relatively wide divergence in projected urban populations is obtained, depending on the assumed URGD. Relative to its size, the rural popu-

	Average annual rate of growth								
	"High" tempo			"Medium" tempo			"Low" tempo		
Years	Urban	Rural	URGD	Urban	Rural	URGD	Urban	Rural	URGD
1965–1970	5.4	1.4	4.0	4.8	1.8	3.0	4.2	2.2	2.0
1970–1975	5.4	1.4	4.0	4.9	1.9	3.0	4.4	2.4	2.0
1975–1980	5.2	1.2	4.0	4.9	1.9	3.0	4.3	2.3	2.0
1980–1985	4.9	0.9	4.0	4.6	1.6	3.0	4.1	2.1	2.0

Evidently, the time taken to attain a given level of urbanization is inversely proportional to the tempo in URGD.[58]

173. On each of the three assumptions, the quinquennial gains in percentage levels would be by nearly equal amounts in each five-year period. Accordingly, the simple method might have yielded fairly similar results. As indicated by the results for the "medium" tempo, the use of a constant rate of growth in the rural population might also have yielded satisfactory results. Results will differ to a greater extent from those of the simpler methods when the level of urbanization is either very low or very high, not intermediate as in the example given.

174. As a further check on the consistency of these projections, one may also consider average annual rates of growth (per cent) in urban and rural population, respectively, resulting from the projections, as shown above. There is nothing inherently implausible in

lation is projected within narrower limits, being more closely dependent on the projection of the total population. The following levels of urbanization are obtained (per cent of total):

Year	"High" tempo	"Medium" tempo	"Low" tempo
1965	5.8	5.8	5.8
1970	6.9	6.6	6.4
1975	8.3	7.6	6.9
1980	9.9	8.7	7.6
1985	11.7	9.9	8.3

It can be seen that the level of urbanization rises by increasing amounts. This is reasonable where urbanization is still in a phase of increasing momentum. As shown on the next page both the urban and rural populations increase at accelerating rates, but the acceleration is moderate. One might have obtained similar results by assuming rates of growth in the urban population, such as 5.0, 6.0 and 7.0 per cent per year, respectively, as was already done in chapter IV.

[58] The findings are slightly inexact when made on the basis of annual rates. With exponential rates these findings would be mathematically precise.

URBAN AND RURAL POPULATION OF THE UNITED REPUBLIC OF TANZANIA, 1965-1985, IN FIVE-YEAR INTERVALS OF TIME, ACCORDING TO A PROJECTION OF TOTAL POPULATION AND THREE ASSUMED TEMPOS OF URBANIZATION (URGD)

Year	Projected total	"High" tempo (4 per cent)		"Medium" tempo (3 per cent)		"Low" tempo) (2 per cent)	
		Urban	Rural	Urban	Rural	Urban	Rural
1965	11,674	677	10,997	677	10,997	677	10,997
1970	13,236	919	12,317	879	12,357	841	12,395
1975	15,150	1,255	13,895	1,150	14,000	1,053	14,097
1980	17,475	1,723	15,752	1,514	15,961	1,328	16,147
1985	20,287	2,372	17,915	2,003	18,284	1,684	18,603

| | Average annual rate of growth | | | | | | | | |
| | "High" tempo | | | "Medium" tempo | | | "Low" tempo | | |
Years	Urban	Rural	URGD	Urban	Rural	URGD	Urban	Rural	URGD
1965–1970........	6.3	2.3	4.0	5.4	2.4	3.0	4.4	2.4	2.0
1970–1975........	6.4	2.4	4.0	5.5	2.5	3.0	4.6	2.6	2.0
1975–1980........	6.5	2.5	4.0	5.7	2.7	3.0	4.8	2.8	2.0
1980–1985........	6.6	2.6	4.0	5.8	2.8	3.0	4.9	2.9	2.0

177. In the case of Canada (high level of urbanization), the relative divergence of results is most marked in the projected rural population, as shown below.

178. In these projections, the rise in the percentage level of urbanization gradually slows down, as can be noted in the following figures:

Year	"High" tempo	"Medium" tempo	"Low" tempo
1965	73.0	73.0	73.0
1970	76.7	75.8	74.9
1975	80.0	78.4	76.7
1980	83.0	80.8	78.4
1985	85.7	83.0	80.0

This slowing-down in the rise of level is necessary at high levels so that an absurd result of 100 per cent or more will never be attained.

179. The average annual increases or decreases in urban and rural population are as shown on the next page. It can be noted that the urban population increases at diminishing rates and the rural population decreases at increasing rates, except in the "low" tempo where the rural population also increases at a diminishing rate. The sensitivity of the rural population to the assumptions selected is evident, since the projection of the urban population depends ever more closely on the projection of the total population. [59]

180. As can be seen, the URGD method has the merit of equal applicability under a wide range of conditions and is therefore suitable for international comparisons.

[59] The meaning to be attached to the rural trend may also have to be judged in the light of the changing features of the "rural population". There is probably a tendency towards suburbanization in areas of residence sometimes defined as "rural", depending on local administrative circumstances.

The method may be equally useful in the projection of urban and rural populations among provinces or regions of the same country, assuming that provincial or regional projections of total population already exist.

181. The method raises, however, an important problem. In the foregoing examples, a URGD of 4 per cent was assumed as a "high", 3 per cent as an intermediate, and 2 per cent as a "low" assumption. These three tempos can be related to world-wide average observations. In the particular countries in question, however, developments may be of a kind deviating more widely from those average circumstances. Assumptions must then be drawn up independently, in the light of detailed knowledge concerning each particular country. Past trends noted in the same country provide an important background for reference.

182. When applying the same method to a wide variety of examples, one arrives invariably at the following experience:

(a) With any given URGD, the percentage level of urbanization rises in the manner of a logistic curve, with a continuous acceleration at the low levels, a point of inflection about 50 per cent and a continuous slow-down thereafter;

(b) These rises in percentage level are independent of the rate of growth in total population; and

(c) The time taken to attain a particular urbanization level, starting from the same initial level, will be inversely proportionate to the URGD.

183. With the use of annual rates of growth, these features are obtained to a high degree of approximation; with the use of instantaneous (exponential) rates, the observations are precise because, as already explained in chapter III, the curve in the level of urbanization is then an exact logistic.

URBAN AND RURAL POPULATION OF CANADA, 1965-1985, IN FIVE-YEAR INTERVALS OF TIME, ACCORDING TO A PROJECTION OF TOTAL POPULATION AND THREE ASSUMED TEMPOS OF URBANIZATION

Year	Projected total	"High" tempo (4 per cent)		"Medium" tempo (3 per cent)		"Low" tempo (2 per cent)	
		Urban	Rural	Urban	Rural	Urban	Rural
1965................	19,644	14,333	5,311	14,333	5,311	14,333	5,311
1970................	21,426	16,432	4,994	16,238	5,188	16,041	5,385
1975................	23,284	18,642	4,642	18,258	5,026	17,853	5,431
1980................	25,299	21,012	4,287	20,448	4,851	19,834	5,465
1985................	27,348	23,432	3,916	22,708	4,640	21,884	5,464

Years	"High" tempo			"Medium" tempo			"Low" tempo		
	Urban	Rural	URGD	Urban	Rural	URGD	Urban	Rural	URGD
1965–1970...........	2.8	−1.2	4.0	2.5	−0.5	3.0	2.3	0.3	2.0
1970–1975...........	2.6	−1.4	4.0	2.4	−0.6	3.0	2.2	0.2	2.0
1975–1980...........	2.6	−1.4	4.0	2.3	−0.7	3.0	2.1	0.1	2.0
1980–1985...........	2.2	−1.8	4.0	2.1	−0.9	3.0	2.0	0.0	2.0

Same method, using exponential rates

184. A table of the logistic curve, $100\dfrac{U_t}{T_t} = \dfrac{100e^{dt}}{1 + e^{dt}}$, is tabulated in annex I. A computation formula for the URGD method, using exponential rates, is therefore not needed. All pertinent calculations can be carried out very simply by reference to that table. The table is arranged in two columns, one identified as $100dt$ (a combination of time and the urban-rural growth rate difference), and the other as $100\dfrac{U_t}{T_t}$ (the percentage level of urbanization).

185. It should be noted that the first column of that table represents a fictitious time scale, measured from the point where the urbanization level is exactly 50 per cent, with negative values where urbanization is lower and positive values where it is higher. The intervals in that time scale are exact calendar years if URGD is exactly 1.0 per cent ($d=0.01$). If the URGD is some multiple of 1.0 per cent, the intervals in the fictitious time scale are corresponding fractions of calendar years. For instance, if the URGD is exactly 2.0 per cent ($d=0.02$), the intervals are half-years, hence exactly two successive intervals represent an interval of one year in actual time.

186. The URGD, of course, is not always an exact integral multiple of 1.0, and it may include further decimals. Interpolations will then have to be made in the fictitious time scale to obtain the corresponding points on the scale of actual time.

187. The fictitious time scale, for instance, is about −219.7 at the point where the urbanization level is 10 per cent, and about +219.7 where it is 90 per cent. Thus, about 439.4 years would have to elapse for a 10 per cent urbanized population to become 90 per cent urbanized, if URGD is at a constant 1.0 per cent. Only a quarter of that time, about 110 years, would be needed if URGD were at a constant 4.0 per cent. Assuming that an actual population has progressed from 10 per cent to 90 per cent urban in the space of, say, 250 years, the URGD needed to reach this effect is 439.4 divided by 250, which is about 1.76 per cent. The relationship between actual time, urbanization levels and URGD, represented by the table in annex II, is thus illustrated.

188. The table thus facilitates two types of procedure. Given the urbanization levels at two dates in the past, e.g. as observed in the results of two successive censuses, the URGD for that time interval can be calculated directly: it is the ratio between the time interval between the actual dates of the past (e.g. the interval between the two censuses) and the interval in the fictitious time scale of the table. For instance, the population of Colombia was 29.1 per cent urban at the census of 5 August 1938, and 38.0 per cent urban at the census of 9 May 1951, i.e. after an actual time interval of 12.68 years; in the table, an urbanization level of 29.1 per cent corresponds to the fictitious data of −89, and a level of 38.0 to the fictitious date of −49, a fictitious time interval of 40 years; dividing 40 by 12.68 we obtain 3.15, and this is the value of URGD for Colombia during 1938-1951.

189. Given URGD, on the other hand, we can readily project the urbanization levels. For instance, the urbanization level of Colombia in mid-year 1960 has been estimated as 47.8 per cent. Let it be assumed that during 1960-1970 URGD was at the same level as during 1938-1951, namely 3.15. Ten years later, in mid-year 1970, the urbanization level should have progressed by 31.5 years (10 times 3.15) in the fictitious time scale of the table. The level of 47.8 per cent (Colombia, in 1960) corresponds to the year −9 in the table. Ten years later, i.e. progressing by 31.5 years in the table, we arrive at the year 22.5 in the table. At that point in the table, the urbanization level is 55.6 per cent (by interpolation), and this, according to assumption, might have been the urbanization level of Colombia in 1970.

190. The table thus makes it possible to project urbanization levels directly and to calculate urban and rural populations according to those levels from a projection of the total population. This is a considerable simplification of the procedure.

191. As an illustration, we may take the case of Canada and assume, for this purpose, that URGD = 2.5. The annual rises in urbanization level will then correspond to rises noted every 2.5 intervals in the table (where URGD = 1.0).

192. According to the available estimates, 72.96 per cent of the population of Canada was urban in 1965, a level which occurs in the table (with an interpolation) at the point 99.25. The future levels, year by year, will be those occurring in the table at the points 101.75, 104.25, and so forth, each time advancing by 2.5 intervals. The following urbanization levels will then be attained.

193. Applying now these urbanization levels to available population estimates for the years 1965-1969 and to a projection of the total population from 1970 up to 1985, which was interpolated for individual calendar years, we obtain the following results.

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Calendar year	Point in the table	Percentage
1965	99.25	72.96
1966	101.75	73.45
1967	104.25	73.93
1968	106.75	74.41
1969	109.25	74.88
1970	111.75	75.35
1971	114.25	75.81
1972	116.75	76.27
1973	119.25	76.72
1974	121.75	77.16
1975	124.25	77.60
1976	126.75	78.03
1977	129.25	78.46
1978	131.75	78.88
1979	134.25	79.29
1980	136.75	79.70
1981	139.25	80.10
1982	141.75	80.49
1983	144.25	80.88
1984	146.75	81.27
1985	149.25	81.65

Year	Total population	Percentage urban	Urban	Rural
1965	19,644	72.96	14,333	5,311
1966	20,050	73.45	14,727	5,323
1967	20,441	73.93	15,112	5,329
1968	20,772	74.41	15,456	5,316
1969	21,089	74.88	15,791	5,298
1970	21,426	75.35	16,144	5,282
1971	21,786	75.81	16,516	5,270
1972	22,151	76.27	16,895	5,256
1973	22,522	76.72	17,279	5,243
1974	22,899	77.16	17,669	5,230
1975	23,284	77.60	18,068	5,216
1976	23,675	78.03	18,474	5,201
1977	24,073	78.46	18,888	5,185
1978	24,477	78.88	19,307	5,170
1979	24,886	79.29	19,732	5,154
1980	25,299	79.70	20,163	5,136
1981	25,714	80.10	20,597	5,117
1982	26,128	80.49	21,030	5,098
1983	26,541	80.88	21,466	5,075
1984	26,948	81.27	21,901	5,047
1985	27,348	81.65	22,330	5,018

FLEXIBLE ASSUMPTIONS

194. Under certain conditions it may be reasonable to assume, instead of a constant URGD, that the URGD will change in the course of time. This may be the case where there is a development plan intended to shift the balance of future developments between urban and rural areas. If rural developments are emphasized, the URGD may decline with time. If the stress is on urban or industrial developments, the URGD may increase. [60] Assumptions of URGD may then be drawn up accordingly. The table in annex I is well suited for the derivation of a population projection in which URGD undergoes a change.

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[60] But URGD may decrease if there occurs much settlement of suburban places which remain under a "rural" type of local administration.

195. In our example of the United Republic of Tanzania, for instance, let us assume that the Government entertains plans for a continuously accelerating industrialization. In this connexion, perhaps a flexible URGD should be assumed, rising continuously with time. For the sake of the example, let it be assumed that the URGD is initially 2.5 and that it may rise to the level of 4.5 in the course of twenty years. It would then rise by 0.1 each year. Since the urbanization level of the United Republic of Tanzania in the year 1965 is estimated as 5.8 per cent, which occurs in the table near the point −279, the following future urbanization levels can be estimated.

Calendar year	URGD	Point in table	Percentage urban
1965	...	−279.00	5.79
1966	2.55	−276.45	5.92
1967	2.65	−273.80	6.11
1968	2.75	−271.05	6.24
1969	2.85	−268.20	6.40
1970	2.95	−265.25	6.59
1971	3.05	−262.20	6.77
1972	3.15	−259.05	6.97
1973	3.25	−255.80	7.19
1974	3.35	−252.45	7.42
1975	3.45	−249.00	7.66
1976	3.55	−245.45	7.91
1977	3.65	−241.80	8.18
1978	3.75	−238.05	8.47
1979	3.85	−234.20	8.77
1980	3.95	−230.25	9.10
1981	4.05	−226.20	9.43
1982	4.15	−222.05	9.79
1983	4.25	−217.80	10.17
1984	4.35	−213.45	10.58
1985	4.45	−209.00	11.01

196. Applying now these urbanization levels to a projection of the total population interpolated by individual years, we obtain the following results.

Year	Total population	Percentage urban	Urban	Rural
1965	11,674	5.79	676	10,998
1966	11,966	5.92	708	11,251
1967	12,267	6.11	750	11,517
1968	12,578	6.24	785	11,793
1969	12,900	6.40	826	12,074
1970	13,236	6.59	872	12,364
1971	13,585	6.77	920	12,665
1972	13,951	6.97	972	12,979
1973	14,333	7.19	1,031	13,302
1974	14,733	7.42	1,093	13,640
1975	15,150	7.66	1,160	13,990
1976	15,584	7.91	1,233	14,351
1977	16,034	8.18	1,312	14,722
1978	16,500	8.47	1,398	15,102
1979	16,980	8.77	1,489	15,491
1980	17,475	9.10	1,590	15,885
1981	17,985	9.43	1,696	16,289
1982	18,514	9.79	1,813	16,701
1983	19,066	10.17	1,939	17,127
1984	19,653	10.58	2,079	17,574
1985	20,287	11.01	2,234	18,053

197. To vary the example, let us suppose that the Canadian Government, concerned over an expected decline in rural population, engages in a large programme of rural rehabilitation and development. If this should be the case, the URGD can be assumed to diminish. Let us assume that it declines from 3.0 in 1965 to 1.5 in 1980, and then remains at that level. The following percentage levels of urbanization can then be read from the table in annex II.

Calendar year	URGD	Point in the table	Percentage urban
1965	...	99.25	72.96
1966	2.95	102.20	73.54
1967	2.85	105.05	74.09
1968	2.75	107.80	74.61
1969	2.65	110.45	75.11
1970	2.55	113.00	75.58
1971	2.45	115.45	76.03
1972	2.35	117.80	76.46
1973	2.25	120.05	76.86
1974	2.15	122.20	77.24
1975	2.05	124.25	77.60
1976	1.95	126.20	77.94
1977	1.85	128.05	78.25
1978	1.75	129.80	78.55
1979	1.65	131.45	78.83
1980	1.55	133.00	79.08
1981	1.50	134.50	79.33
1982	1.50	136.00	79.58
1983	1.50	137.50	79.82
1984	1.50	139.00	80.06
1985	1.50	140.50	80.29

198. In relation to the interpolated projection of the total population, this leads to the following results.

199. In the above example, the assumptions suffice to produce a stabilization in the rural population by 1974. By 1981 the 1965 size of the rural population would be recuperated. Such a calculation need not be carried out as a forecast, but rather to provide a rough model which

Year	Total population	Percentage urban	Urban	Rural
1965	19,644	72.96	14,332	5,312
1966	20,050	73.54	14,745	5,305
1967	20,441	74.09	15,145	5,296
1968	20,772	74.61	15,498	5,274
1969	21,089	75.11	15,840	5,249
1970	21,426	75.58	16,194	5,232
1971	21,786	76.03	16,564	5,222
1972	22,151	76.46	16,937	5,214
1973	22,522	76.86	17,310	5,212
1974	22,899	77.24	17,687	5,212
1975	23,284	77.60	18,068	5,216
1976	23,675	77.94	18,452	5,223
1977	24,073	78.25	18,837	5,236
1978	24,477	78.55	19,227	5,250
1979	24,886	78.83	19,618	5,268
1980	25,299	79.08	20,006	5,293
1981	25,714	79.33	20,399	5,315
1982	26,128	79.58	20,793	5,335
1983	26,541	79.82	21,185	5,356
1984	26,948	80.06	21,575	5,373
1985	27,348	80.29	21,958	5,390

can serve to guide policy. The fictitious rural rehabilitation and development programme would have to be on a sufficient scale to reduce the URGD at least to 2.0, and preferably to 1.5, as assumed in the above. The approximate implication would be a halving in the average annual rural-to-urban transfers (net migration and reclassifications). Estimates can then be made of the expenditures required to achieve such an effect. In practice, however, the meaning of such a model will also depend very much on the definition of the "rural" population, whose living conditions in an advanced country can become qualitatively similar to those of the urban population, except for densities of settlement. In fact, in the absence of administrative change, an increasing proportion of the population may come to inhabit suburbs which are technically classified as "rural".